ATTACHMENT TO LICENSE AMENDMENT NO. 9

FACILITY OPERATING LICENSE NO. TR-3

DOCKET NO. 50-30

Revised Appendix A Technical Specifications in their entirety.

APPENDIX A

TECHNICAL SPECIFICATIONS

FOR THE

LICENSE NO. TR-3

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PLUM BROOK STATION

SANDUSKY, OHIO

DOCKET NO. 50-30

JANUARY 1997

Table of Contents

1. Introduction

Where applicable, these Technical Specifications follow the format of the American National Standard ANSI/ANS-15.1-1982.

1.1 Scope

These Technical Specifications apply to all portions of the Plum Brook Reactor Facility (PBRF), with the exception of the Mock-Up Reactor (MUR) which is separately licensed. The PBRF contains a non-operable test reactor, its support facilities, and its inventory of radioactive materials generated as a result of previous operations. The reactor was shut down in 1973 after 98,000 megawatt days of operation. Figure 1, attached, presents a Plot Plan of the PBRF.

The radioactive inventory, with the exception of distributed radioactive material existing as contamination within process systems and laboratories, is stored in four locations. These are located inside of the Containment Vessel, in the Reactor Building Canal G, in the Hot Laboratory, and in the Waste Handling Building. The PBRF contains no fuel and no special nuclear material.

1.2 Application

These Technical Specifications govern the condition of the National Aeronautics and Space Administration's PBRF in the Possession-Only status. The PBRF is described in the Design Manual and Hazard Analysis submitted for the original PBRF license and now contained in Docket No. 50-30. The PBRF systems which are radioactive, contaminated, or required to maintain a protected safe storage condition, are covered in these Technical Specifications. These systems are listed in the Table of Contents for these Technical Specifications under the Requirements Section (Items 2.2 thru 2.14).

1.3 Definitions

1.3.1 General

Authorized Entry - Entry to the PBRF which is sanctioned by the PBRF Engineer or his designee, for those persons having a legitimate need to enter and who have knowledge of the conditions, hazards, and procedures at the facility, or who are accompanied by an authorized person with this knowledge.

Clean - The condition of an area wherein contamination levels do not exceed 20 dpm alpha/100 cm^2 and 1000 dpm beta-gamma/100 cm^2 transferable; 500 dpm alpha and 1500 dpm beta-gamma fixed.

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

Non-operable - 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 interval, 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).

1.3.2 Radioactive Materials

Contaminated Material - 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 may also be contaminated.

1.3.3 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^2 and 10,000 dpm beta-gamma/100 cm^2 transferable; 2,500 dpm alpha/100 cm^2 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^2 and 1,000 dpm beta-gamma/100 cm^2 transferable; 500 dpm alpha and 1,500 dpm 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 Control of access to the PBRF Site

Applicability - This specification applies to protection of the PBRF Site by control of access.

Objective - The objective is to prevent unauthorized entry.

Specification:

Access to the PBRF shall be controlled by means of two fences with locked gates. The outer fence surrcunds the Plum Brook Station; the inner fence surrounds the PBRF. In addition, access to all buildings within the PBRF is controlled by means of locked entrance doors.

Bases:

Access to the PBRF is limited by two physical barriers (fences) each with locked gates. Access to keys for the gates in the outer fence surrounding the Plum Brook Station is controlled by the Plum Brook Station Management Office. Access to keys for the gates in the inner fence surrounding the PBRF is controlled by the PBRF Engineer and is limited to authorized personnel.

2.2 Reactor Tank (RT)

Applicability - This specification applies to the contaminated and radioactive material which makes up the reactor tank, and the contents within.

Objective - The objective is to safely store the irradiated materials and control radiation levels.

Specification:

a. The reactor tank, which is surrounded by a thick concrete biological shield, shall be drained and maintained in a dry condition. All tank nozzles and penetrations which could stream radiation shall have shields fixed in place.

b. The three shrapnel shields (20 tons each) shall be positioned above the reactor tank.

c. Radiation levels at accessible reactor tank surfaces shall be less than 100 mrem/hr.

d. All openings shall be closed, except those openings required for a dry gas purge through an absolute filter to the stack.

e. The sub-pile room door shall be closed and locked except for authorized entry.

Bases:

High radiation levels inside the RT, and streaming through RT penetrations, are contained by the shielding methods described.

a. Past experience with protected safe storage at PBRF has demonstrated that shielding described in this section is adequate to permit classifying of all accessible quadrant areas around the reactor tank as magenta-yellow zones.

b. The reactor tank top is covered with three shrapnel shields for radiation shielding.

c. Additional shields are tack welded in place where needed to reduce radiation levels to below 100 mrem/hr in all accessible areas.

d. In addition, during the past years of protected safe storage, airborne contamination has never exceed maximum permissible concentration in unrestricted areas. Since 1993, airborne contamination has never exceed the Derived Air Concentrations (DAC) in unrestricted areas. Therefore, additional protection against airborne radioactivity is not required outside the tank.

e. Access to sub-pile room is per approved written procedures.

2.3 Containment Vessel (CV)

Applicability - This specification applies to protected safe storage of the reactor and contents inside the CV.

Objective - The objective is to control personnel access to the CV and prevent entry of water which could be a vehicle to spread contaminated material.

Specification:

a. The CV shall be provided with two primary openings designed to breathe the CV to atmosphere through absolute filters.

b. One of the two existing personnel doors shall be used for controlled personnel access. This door shall be locked to prevent unauthorized entry. The other door shall be operable only from the inside as an emergency exit.

c. The truck door shall be closed and dogged in place except during temporary controlled periods to accommodate transfer of equipment which is too large to fit through the personnel door.

d. All original liquid-containing process lines penetrating the CV shall be drained and blank-flanged or capped to prevent liquid from entering the CV. The blank flange or cap shall be secured against unauthorized opening. All other process penetrations shall be closed with locked or welded valves, or capped to prevent unauthorized opening from the outside.

Bases:

Specification 2.3(a) provides authorized personnel an inhabitable atmosphere in the CV, eliminating the need for air packs or other respiratory equipment. Specifications 2.3(b) and (c) limit entry to authorized personnel and Specification 2.3(d) eliminates all outside sources of water entry which could spread contamination from the CV. The only other source of water is from moisture condensation. A dry, protected, safe storage, with access control, is provided by these specifications.

2.4 Primary Cooling Water System and Primary Pump House (PPH)

Applicability - This specification applies to protection and safe storage of the primary cooling water system outside the CV. This includes piping to the primary pump house, primary pumps, heat exchanger and deionizers.

Objective - The objective is to isolate the RT from the PPH, control access and prevent spread of contaminated materials.

Specification:

a. The primary cooling water supply and return headers shall be blank-flanged to isolate the reactor tank from the Primary Pump House (PPH). Lines between the blank flanges and the PPH shall be drained.

b. The PPH roof hatch plugs shall be in piace. The roof hatch plugs and personnel doors of the PPH shall be locked except for authorized entry.

Bases:

These specifications provide a dry primary cooling water system outside the CV and prevent unauthorized access to the system in the PPH.

2.5 Alarm System

Applicability - This specification applies to the alarms listed below as a, b, and c.

Objective - The objective is to receive a warning of off-normal conditions.

Specification:

An alarm system shall be operating to provide local alarms at the PBRF and a summary alarm at the Plum Brook Station Communication Center. The individual alarms at the PBRF include:

a. CV Entry
b. Loss of Power
c. Sump Alarm

The alarm response is provided in Section 2.17.

Bases:

This specification provides a warning system to alert the Communication Center of an off normal condition. These off-normal alarms are as follows:

a. Entry Alarm will indicate entry to the CV;

b. Loss of Power Alarm will indicate a loss of electrical power at the PBRF;

c. Sump Alarm will indicate a high level in one of the PBRF cold sump areas.

2.6 Quadrant and Canal System

Applicability - This specification applies to the Quadrant and Canal System for protected safe storage, except for Canal H which is covered under the R-93 license.

Objective - The objective is to provide a safe storage area for contaminated and radioactive materials.

Specification:

a. The quadrants and canals are clean, drained, and shall be kept dry.

b. The deionizer system was flushed and drained and shall be isolated by valves and flanges. The deionizer shall not contain ion exchange material.

c. The quadrants and canals within the CV are Magenta-Yellow Zones. Small localized fenced areas within the quadrants are Magenta Zones because of the field from the reactor core.

Bases:

These specifications provide for a secure and dry Quadrant and Canal System through the following:

a. The Quadrant and Canal systems are visually inspected for any accumulation of water under written approved procedures;

b. The Quadrant and Canal systems are surrounded by fence and locked gates to prevent unauthorized access;

c. Since there is no water in the Quadrant and Canal systems, there is no longer a need for a purification system.

2.7 Radiochemistry Laboratory

Applicability - This specification applies to the chemical fume hoods of the Radiochemistry Laboratory.

Objective - The objective is to prevent unauthorized personnel access and uncontrolled entrance of water to these areas.

Specification:

The chemical fume hood doors shall be welded closed to prevent opening and hoods shall be kept dry.

Bases:

Contamination spread is minimized by access prevention. Periodic inspection and surface smears assure control of contamination. The outside of the hoods are not contaminated.

2.8 Hot Drain System

Applicability - This specification applies to the protected safe storage of the Hot Drain System throughout the PBRF.

Objective - The objective is to prevent spread of radioactive materials remaining in the hot drains.

Specifications:

The Hot Drain System shall remain "non-operable" as defined in Section 1.3.1.

a. All accessible (white zone) external surfaces shall be clean.

b. All floor drains and other flow paths supplying a hot sump shall be plugged or sealed.

c. The hot drain pump motors shall be de-energized from the power bus at the motor control centers.

Bases:

These specifications provide for a static, relatively clean, Hot Drain System through the following:

a. Decontamination of external surfaces will remove loose radioactive material;

b. Plugging access to the Hot Drain System prevents inadvertent entry of water into the system; and

c. Draining the hot drains and maintaining them dry eliminates the need for the hot drain pumping system.

2.9 Hot Laboratory and Hot Dry Storage

Applicability - These specifications apply to protected safe storage in the Hot Laboratory including the Hot Dry Storage.

Objective - The objective is to prevent unauthorized entry to contaminated or radioactive material storage areas.

Specifications:

Hot cell doors and the 80-ton access door to the Hot Dry Storage area shall be locked. Access doors to the Hot Laboratory shall be locked.

Bases:

Authorized access with procedural control prevents personnel exposure and spread of contamination.

2.10 Hot Pipe Tunnel (HPT)

Applicability - This specification applies to the protected safe storage of the Hot Pipe Tunnel.

Objective - This objective is to prevent personnel access and entrance of water to this area.

Specification:

a. The Hot Pipe Tunnel entrances at each end of the tunnel shall be padlocked closed.

b. The tunnel shall be kept dry.

Bases:

These specifications provide for control of the Hot Pipe Tunnel through the following:

a. Authorized access with written procedural controls prevents personnel exposure and

b. Inspection of the tunnel per authorized written procedures assures that it is kept dry.

2.11 Waste Handling Building (WHB)

Applicability - This specification applies to protected safe storage of the Waste Handling Building.

Objective - The objective is to prevent unauthorized entry to the Waste Handling Building.

Specifications:

a. Access doors leading to the Waste Handling Building shall be locked closed.

b. Access doors to the evaporator room and waste packaging room shall be locked closed.

Bases:

These specifications provide for control of radioactive materials and contamination in the Waste Handling Building because authorized access through written procedural control limits personnel exposures. This applies to all areas described in Specification 2.11 Sections a and b.

2.12 Emergency Retention Basin (ERB)

Applicability - This specification applies to the protected safe storage of the ERB.

Objective - This objective is to minimize the accumulation of water in the ERB and to prevent the release of a potential source of contaminated liquid to the environment.

Specification:

a. The ERB drain line shall remain open to prevent rain water accumulation in the basin.

b. Any accumulated water shall be sampled quarterly to verify that limits of 10 CFR Part 20, Appendix B, Table II, "Radioactivity in Effluents to Unrestricted Areas," are not exceeded.

c. The pumps shall be removed from the supply line.

Bases:

Water samples per authorized written procedures assure that ERB water discharges have not exceed the limits of 10 CFR Part 20, Appendix B Table II, "Radioactivity in Effluents to Unrestricted Areas."

2.13 Hot Retention Area (HRA)

Applicability - This specification applies to protected safe storage of the HRA.

Objective - The objective is to control access and prevent release of contamination from this source.

Specification:

a. The HRA tanks, which are flushed and partially decontaminated, shall be kept dry.

b. All HRA entrances or access plugs are welded closed, except that one entrance to the annulus and the tunnel area shall be locked to allow only authorized entry.

Bases:

These specifications provide for authorized access and preclude inadvertent exposure of personnel. These specifications also mitigate against liquid accumulation and release of potentially contaminated liquid.

2.14 Contaminated Air Systems (CAS)

Applicability - This specification applies to protected safe storage of the contaminated Air Systems (CAS) which includes the Stack.

Objective - The objective is to provide controlled access into relatively clean CAS.

Specification:

a. These systems shall include the 5-foot diameter, 100-foot-high stack and all contaminated air ventilating systems except those presently serving the reactor tank, CV and HRA.

b. The fan motors shall be de-energized from the power bus at the motor control centers.

c. All manual and automatic operated valves shall be disabled in a fixed closed position.

d. The CAS which were vacuumed, partially decontaminated and purged, shall be kept dry with absolute filters removed.

Bases:

The CAS has been vacuumed to remove loose contamination, was purged, and is maintained in a dry condition for use, if required. The CAS can, with minor repairs be placed in operation, when and if required. Past monitoring under the above conditions verifies the absence of airborne radioactivity. The above program will continue to maintain the CAS in a low radiation condition.

2.15 Designated Radioactive Storage Areas Within PBRF

Applicability - This specification applies to the monitoring and surveillance of the radioactive storage areas within the PBRF.

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

Specification:

a. Radioactive material associated with the PBRF, with the exception of distributed radioactive material existing as contamination within process systems and laboratories, shall be stored in four areas:

1. The Containment Vessel
2. The Reactor Building Canal G
3. The Hot Laboratory which includes the Hot Cells and the Hot Dry Storage Area
4. The Waste Handling Building

b. Storage areas shall be posted as Radiological Control Zones, defined in Section 1.3. Radiological monitoring of these areas shall be by approved written procedures described in Section 2.20(f).

Bases:

The specifications identify the areas used for radioactive material storage and define the control for these radiological control zones.

2.16 Access to Radiological Control Zones

Applicability - These specifications apply to surveillance of radiological control zones at the PBRF.

Objective - The Objective is to provide surveillance systems for these zones.

Specifications:

a. Magenta zones shall be posted. Access to magenta zones shall require continuous radiation monitoring by health physics personnel, use of safe work permit, and use of personnel dosimetry.

b. Magenta-yellow zones shall be posted. Access to magenta-yellow zones shall require health physics monitoring, and control and use of personnel dosimetry.

c. White zones - Access to white zones shall be by authorized personnel, without health physics personnel monitoring.

Bases:

Written procedural control, implementation of ALARA, and conformance to 10 CFR 20 standards assure satisfactory surveillance of the radiation control zones at the PBRF.

2.17 Alarm Response

Applicability - This specification applies to alarm response.

Objective - The objective is to control access to the CV, monitor facility electrical power, and control ground water infiltration.

Specification:

All alarms shall annunciate in the Communication Center (CC). The CC is continuously staffed. Response to alarms shall include visual inspection to determine the cause. Response shall be within one hour of annunciation. The following conditions shall initiate alarms:

a. CV Door Open

b. Loss of Facility Electrical Power

c. Hot Retention Area Sump High Ground Water

Alarms shall be continuously operable except during maintenance. If alarms are to be replaced, the alarm system may be inoperable for periods not to exceed 24 hours.

Bases:

This specification ensures a response for abnormal conditions during the protected safe storage condition.

2.18 Facility Radiological Monitoring

Applicability - This specification applies to routine radiological surveys at the PBRF.

Objective - The objective is to determine that radioactivity is confined to radiological control zones.

Specification:

Routine radiological surveys shall be performed quarterly by trained health physics personnel using survey and counting equipment commensurate with sound health physics practices.

Bases:

This specification ensures that radioactive levels are maintained consistent with 10 CFR 10 limits and with ALARA.

2.19 Procedures

Applicability - This specification applies to approved written procedures that help administer the protected safe storage condition.

Objective - The objective is to list the types of procedures required for protected safe storage conditions.

Specifications:

Detailed written and approved procedures shall be in effect covering the following areas:

a. Response to alarms

b. Entrance to the PBRF, PBRF building, Containment Vessel, and radiological control areas

c. Facility and environmental radiological monitoring and surveillance

d. Facility changes

e. Response to emergencies that may arise from fire, floods, and tornadoes

f. Training program for the PBRF Manager and Alternate

g. Maintenance programs

These procedures shall be approved by the PBRF Safety Committee

Bases:

This specification ensures protected safe storage procedures are provided.

2.20 Inspection, Tests, and Surveys

Applicability - This specification applies to a program of inspections, tests, and surveys during protected safe storage.

Specification:

Inspections, tests, and respective frequencies shall be performed as follows:

		Frequency
a.	PBS Fence Integrity Inspection	Quarterly

b.	PBRF Fence Integrity Inspection	Monthly
c.	Building and CV Locks Inspection	Monthly
d.	Building and CV General Condition Inspection	Monthly
e.	Alarm Tests	Quarterly
f.	Facility Radiologica Surveys	Quarterly
g.	Environmental Radiological Surveys	Quarterly
h.	Absolute Filters Inspections	Annually
I.	CV Integrity Test	Annually

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

Bases:

These inspections, tests, and surveys provide a reasonable assurance that radioactivity is controlled and personnel exposure is minimized.

3. Administrative Controls

3.1 Organization

The Plum Brook Reactor Facility 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 PBRF in a condition that poses no hazard to the general public or to the environment. Figure 2 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 facility.

The Directorate shall provide the resources to maintain the PBRF in protected safe storage.

3.1.2 Internal Audit

An annual internal audit shall be performed at the PBRF. The audit shall be performed by an audit committee chaired by a NASA employee. The remainder of the committee members may be NASA personnel or NASA contractor personnel, not directly associated with the facility, who have nuclear experience. Special attention shall be given to compliance with procedures, the NRC licenses, regulations, and recordkeeping. The auditor shall submit a report on each audit for the Executive Safety Board. Reported discrepancies shall be resolved by the PBRF Engineer. The Plum Brook Reactor Facility Safety Committee shall revie and insure the proper disposition of each discrepancy.

3.1.3 Radiation Safety Officer (RSO)

The RSO shall be responsible for organization, administration, and direction of the radiological control and monitoring program, as required by these Technical Specifications, and 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 bachelors 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 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 established a system of Safety Committees to conduct detailed third party reviews of specified Center operations.

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. The purpose of the reviews is to assure that operations, written procedures, facility changes, and future plans comply with NRC licenses and regulations, do not involve unreviewed safety questions, and provide protection to the public, on-site 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 maintenance, proposed changes, new and revised procedures, facility changes, 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 a 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 not less than three members, whichever is greater. In specific instances, the PSC may designate the Chairman to act in its stead, and the Chairman 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 PBRF. The Chief, PBMO, is responsible for administering a program to ensure that proper operations, control, and safeguards are maintained for the Station. This includes a key control system. Keys for the PBRF 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 PBRF. Implementation is by authorization letter issued to the key distributor. The PBMO shall provide for the services of Plant Security, Inspection, Health Physics, and Maintenance as necessary at the PBRF.

3.1.7 PBRF Engineer (Reactor Manager)

The PBRF Engineer shall be responsible for the daily management and shall 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 for familiarization with the duties of the Reactor Manager.

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

3.3.1 Annual Report

An annual report describing the status of the facility, the results of environmental and facility radiation surveys, and evaluation of the performance of security and surveillance measures, personnel exposures to radiation, and any abnormal occurrences during the previous calendar year shall be submitted to the Director of Nuclear Reactor Regulation, ATTN: Document Control Desk, with a copy to the Regional Administrator, Region III, prior to March 31 of each calendar year.

3.3.2 Reportable Occurrences

Reportable occurrences shall be reported as expeditiously as possible by telephone and confirmed by telegraph, mailgram, or facsimile transmission to the Administrator of NRC Region III, or his representative, no later than the first work day following the event. A written follow-up report describing the reportable occurrence including causes, probable consequences, corrective actions, and measures to prevent recurrence shall be submitted within 14 days. Information provided shall contain narrative materials for a complete explanation of circumstances surrounding the event. The following events shall be reported:

a. Discovery of significant, unexplained increase in radiation or contamination levels within or around the reactor facility or fuel storage area.

b. Abnormal degradation discovered in protective barriers for the reactor facility or fuel storage area which would compromise the physical security established for protective storage of the reactor.

3.3.3 Storage Reports

Special reports which may be required by the Nuclear Regulatory Commission shall be submitted to the Director of Nuclear Reactor Regulation, ATTN: Document Control Desk, with a copy to the Administrator, Region III, within the time period specified for each such report.

3.4 Records

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

a. Radiological survey results of the PBRF and environment.

b. Equipment maintenance records (EMRs) of non-routine maintenance operations involving substitution or replacement of vital components.

c. The end condition statements, the procedures used to place the facility in the possession-only condition, and the procedure completion reports shall reflect the facility condition in possession-only status.

d. Any change which alters the end condition of Safe Protective Storage to any building, structure, system, equipment, or grounds shall be documented by a facility change record.

4. References

(1) Code of Federal Regulations, Title 10, "Energy", Government Printing Office, Washington, DC

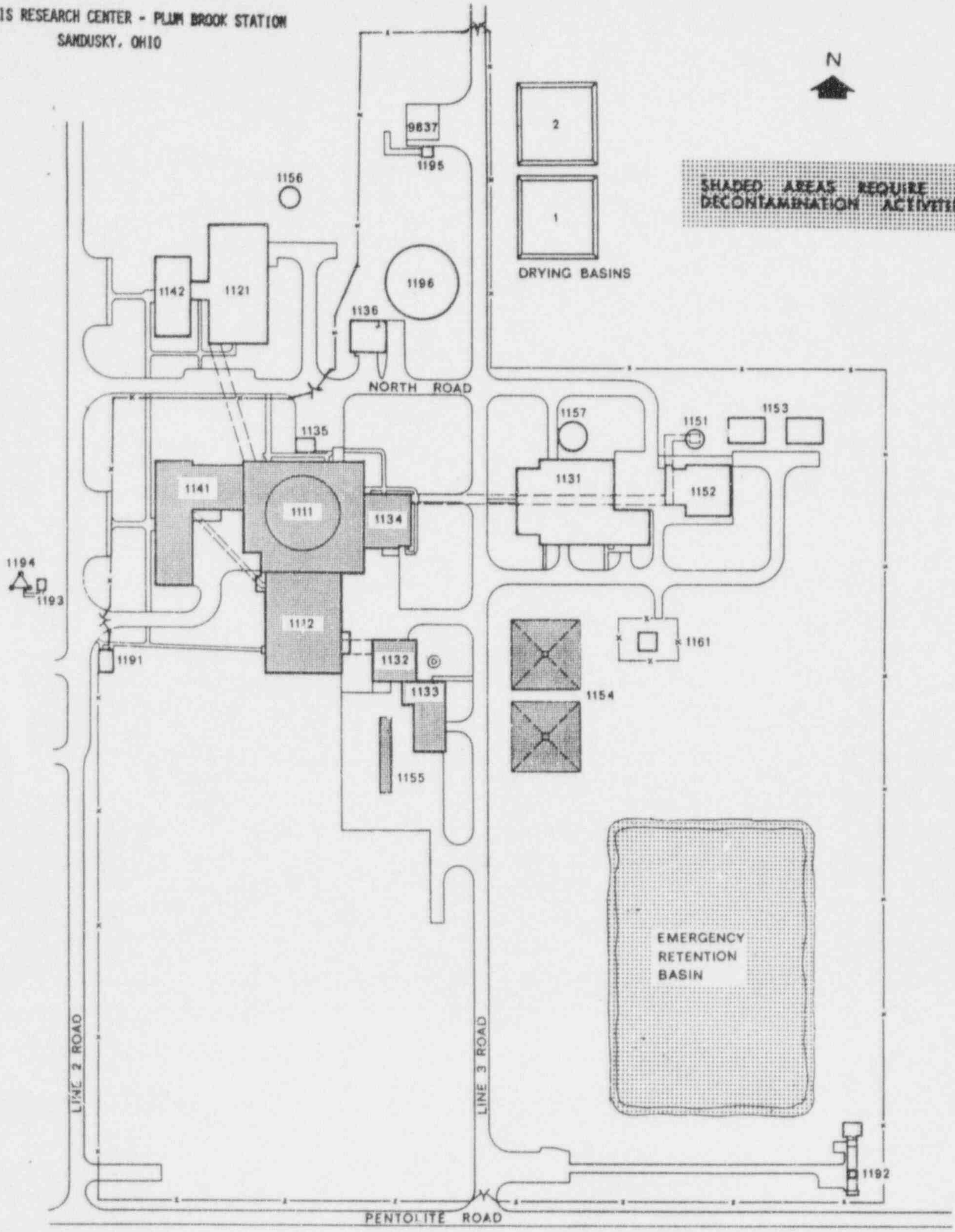
(2) American National Standard for the Development of Technical Specifications for Research Reactors, ANSI/ANS 15.1-1982, American Nuclear Society, LaGrange Park, Illinois.

Attachments:

Figure 1 PBRF Plot Plan

Figure 2 Generic Organization Chart

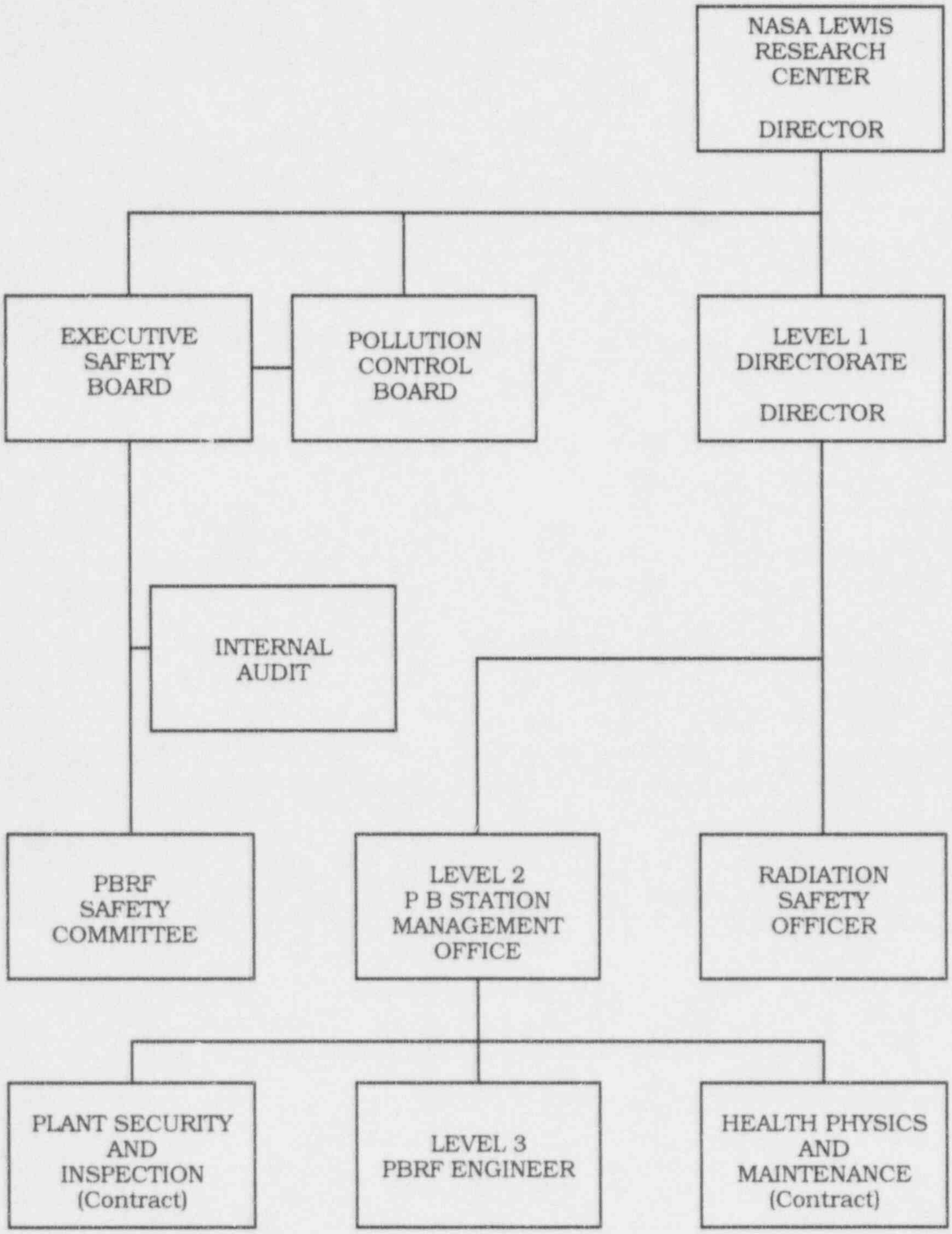
NASA LEWIS RESEARCH CENTER - PLUM BROOK STATION
SANDUSKY, OHIO



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	1195	REACTOR GAS STORAGE STRUCTURE
1151	REACTOR WATER TOWER (F)	9837	GHE FARM AT REACTOR
1152	REACTOR COOLING TOWER		
1153	REACTOR SLUDGE BASINS		

Figure 1 - Plot Plan of Plum Brook Reactor Facility.

GENERIC ORGANIZATION CHART



RESPONSIBILITIES:

LEVEL 1 - Compliance
LEVEL 2 - Surveillance and Maintenance
LEVEL 3 - Day-to-Day Oversite

FIGURE 2

BASES AND SAFETY ANALYSES

FOR

PLUM BROOK REACTOR FACILITY

PROTECTED SAFE STORAGE CONDITION

ATTACHMENT 1

TO SUPPORT REQUEST FOR AMENDMENT TO

LICENSE NO. TR-3

DOCKET NO. 50-30

TABLE OF CONTENTS

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 Reactor Facility (PBRF). 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^2 and 10,000 dpm beta-gamma/100 cm^2 transferable; 2,500 dpm alpha 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 Plum Brook Reactor Facility contains a non-operable test reactor and its inventory of radioactive materials generated as a result of previous operations. All reactor fuel and special nuclear material, as well as most waste byproduct material were removed from the facility.

3. LOCATION

The Plum Brook Station (PBS), a federal reservation of 6,400 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 buildings inside the PBRF fence are locked except during authorized entrance. These controls will deter unauthorized entry. Penetration of these controls will not be a radiological hazard to casual intruders since accessible areas outside and inside the buildings are white zones.

4. REACTOR TANK (RT)

4.1 End Condition and Bases

The Reactor Tank, located in the Containment Vessel, is surrounded by thick concrete walls. The tank contains the irradiated core structure and components. Penetrations into the RT are closed but are not necessarily gas tight. The RT is drained, defueled and covered by the shrapnel shields. The control rods and drives have been removed. Piping connected to the RT where practical is separated and blank-flanged close to the RT to reduce the effective volume of the RT. The RT is purged with dry nitrogen through an absolute filter to the stack. The purge is used to reduce corrosion of components inside the tank.

4.2 Safety Analysis

The potential hazards associated with the reactor tank end condition are direct radiation, release of contamination with the nitrogen purge and loss of nitrogen purge flow. The high radiation level inside the RT, streaming through unshielded RT penetrations, would constitute an immediate and direct hazard to personnel. Shielding protects against this hazard. Three shrapnel shields are installed over the reactor tank and limit the radiation level outside the shield to 2.5 mRem/hr. The holes for the top most shrapnel shield lifting eyes are welded shut to prevent unauthorized shrapnel shield removal. All beam holes, through holes and instrument holes are shielded to reduce radiation levels at accessible areas in the quadrants to less than 100 mRem/hr. The radiation levels at the outer surface of the concrete biological shield surrounding the reactor tank and at accessible areas within the quadrants are less than 100 mRem/hr. Additional shields necessary to attain this value at penetrations are tack welded in place. Radiation survey confirms that shielding is adequate for all quadrant accessible areas classified as magenta-yellow zones. By exercising the control required for a magenta-yellow zone, the hazards due to direct radiation are minimal.

It may be possible for the nitrogen purge to become a vehicle to release radio-contaminants into the purge piping and possible release into the environment. Particulate material inside the 9-foot diameter reactor tank is not likely to be

disturbed by the low flow (less then 10scfh) gas purge. Even if disturbed and picked up by the gas, these particles would be removed by the absolute filter before the gas vents to the stack. Typical maximum measured airborne particulate concentrations for tritium are 2.4×10^{-8} μ ci/ml, well below the Derived Air Concentration (DAC) for occupational worker limit of 2.0×10^{-5} μ ci/ml. Thus particulate contamination of the nitrogen purge gas is not considered a hazard.

Found during our Engineering Study effort to date (Section 19), tritium (H3) is a constituent in the nitrogen purge gas. The tritium originates from beryllium metal in the reactor core box which contains trapped tritium gas as a result of previous neutron activation. Tritium is capable of slowly migrating out of the beryllium molecular lattice. As this occurs, tritium diffuses into the purge gas and is released to the environment from the top of a 100-foot high vent stack. A preliminary evaluation of the existing tritium data concludes that with atmospheric dilution, stack release of tritium does not exceed MPC for an unrestricted area. The tritium monitoring at the stack is included during the normal facility monitoring.

Prolonged loss of nitrogen purge could permit air to enter the RT. This could result in the formation of nitrogen/oxygen compounds by radiolytic reactions. Some of the reaction products are corrosive and toxic. The corrosion action of the nitrogen/oxygen compounds could cause structural damage and potentially release corrosion products into the purge gas exhaust. The toxic properties of nitrogen/oxygen compounds are important only if personnel are exposed to them and this situation is not considered likely. To prevent buildup of nitrogen/oxygen compounds, the RT purge flow is monitored for loss of flow. Because the corrosion rate would be slow, loss of nitrogen purge and replacement of the nitrogen with air would result in no significant attack on structural components even after several hours of exposure. Except for special tests or maintenance, nitrogen purge will be reestablished under procedural control within 24 hours. The continuing need for nitrogen purge of the RT is periodically reviewed.

The degree of hazards associated with the RT end condition is acceptable.

5. CONTAINMENT VESSEL

5.1 End Condition and Bases

All readily accessible areas of the Containment Vessel (CV) are decontaminated to a white zone. Two primary openings allow the CV to breathe through absolute filters to the atmosphere. Personnel openings into the CV are closed to the outside except for one door which is locked and monitored by an intrusion alarm. The truck door is closed and dogged in place. This door may be opened on a temporary controlled basis to accommodate transfer of equipment too large to fit through the personnel door. All liquid process lines which penetrate the CV are drained and blank flanged or capped. The quadrants, canals and sumps are drained and the sumps are non-operable. Solid radioactive equipment and components are stored in the quadrants or hot caves.

These CV end conditions are designed to prevent unauthorized entry and to prevent contamination spread by water. Restricting CV entry to one locked and alarm monitored door precludes unauthorized access to the CV. Isolation of liquid process lines from the CV eliminates a source of water. CV flooding by other means, e.g., weather or ground water, is not considered possible due to the complete continuity of the CV structure.

The CV is served by a failing cathodic protection system. Ultrasonic measurements of the metal wall below ground show essentially no change in the 3/4-inch metal wall thickness over the past 22 years. CV sample metal coupons were installed in ground water of the deep wells. These coupons were monitored and the measured results were related to a probable CV corrosion rate. Results of ultrasonic measurements and coupon corrosion rates indicate that corrosion is within acceptable levels. The need for continuing a cathodic protection system is periodically reviewed. The Cathodic Protection may be terminated after review and conclusion by the PBRF Safety Committee that no unreviewed safety question exists under the provisions of Section 50.59, 10 CFR, part 50.

5.2 Safety Analysis

For the CV in a protected safe storage condition, two hazards are considered credible. They are radiological hazard and an industrial type accident. The CV contains radioactive equipment and components stored in the quadrants, the canal and hot caves. 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 emits no significant gaseous decay radioisotopes and the solid contamination does not become air-borne. Personnel entering the CV are subject to potential industrial accidents such as falls, sudden illness, etc. Each type of the credible accident, radiological and industrial, is covered separately.

5.2.1 Radiological Hazard

All radioactive or contaminated materials stored in the quadrants, canal or hot caves were shielded or decontaminated to activity levels not exceeding a magenta-yellow zone. No significant radioactive gas release has been detected from any of the stored material. Material stored in the quadrants and canal have unshielded direct radiation levels less than 600 mRem/hr. and further the material is shielded so the accessible radiation levels do not exceed 100 mRem/hr. Hot Caves containing contaminated material are locked or welded closed. Unauthorized entry into a magenta-yellow zone is prevented by fences built around these areas. Fences are provided around the quadrants, the canal and at the entry to the subpile room. Direct radiation levels at the fences are less than 2.5 mRem/hr. and are within limits for a white zone. Maximum airborne radiation levels are typically in the range of 1% DAC for beta-gamma, and less than detectable for alpha radiation.

5.2.2 Industrial Accidents

Entry into the CV is controlled by written procedure. Authorized entry begins by telephone notification to the Communication Center of intent to enter and approximate duration. Opening the door activates the door alarm system. The alarm deactivates when the CV door is closed, locked and acknowledge button reset. The oxygen level inside the CV is

regularly monitored. Typical readings are at or above 20.7% oxygen. Fences and railings around the quadrants and canal prevent accidental falls into these reservoirs. Commercial power failure inside the CV activate emergency battery powered lights to provide safe visibility. These practices minimize the risk of an industrial-type accident to an acceptably low level. Authorized entry ends by leaving the CV, closing and locking the CV door, telephone notification to the Communication Center and alarm acknowledgment at the Reactor Security Control Building. If a tour does not end within a reasonable time, the Communication Center initiates a search to check the situation. It is concluded that the degree of hazard associated with the CV end condition is acceptable.

6. PRIMARY COOLING WATER SYSTEM AND PRIMARY PUMP HOUSE

6.1 End Condition and Bases

The primary cooling water system was flushed, drained and purged with air. A portion of the system noted in the Reactor Tank Section 4 is separated and blank flanged close to the RT. All valve operators which penetrate into the accessible areas of the Primary Pump House (PPH) are nonoperable. All motor driven devices are disconnected from their power sources. Personnel entryways into the PPH are locked. The PPH roof hatch plugs, which provide the only personnel access to the shielded rooms, are locked in place and sealed against water entry. All PPH accessible area outside the shielded rooms are decontaminated to a white zone level.

6.2 Safety Analysis

The hazards associated with the end conditions are personnel exposure and spread of contamination. Entry into the shielded PPH rooms may bring personnel into a magenta-yellow and perhaps a magenta zone where they would be subjected to both direct radiation and transferable contamination. Seepage of water into the shielded rooms through the roof hatch plugs due to weather will only spread transferable contamination within the shielded room.

As noted above, all accessible areas outside the shielded rooms are a white zone. This ensures that personnel on routine entrance of the PPH will not be exposed to transferable contamination. Further, because of the shielding walls, direct radiation from the shielded room is reduced to white zone levels in accessible areas.

The shielded rooms of the PPH are established as magenta or magenta-yellow zones, as appropriate. The rooms are posted and the roof hatch plugs locked in place. Also, the crane hoists which are used to lift the roof hatch plugs are deactivated. Thus, unauthorized entry is prevented.

Weather seals for each of the roof hatch plugs keep rain water from entering the shielded rooms. These seals are periodically inspected to ensure their integrity. In addition, periodic remote inspections for water are made in the shielded rooms. If water is discovered in the rooms, the water will be sampled and disposed of under health physics' control.

It is concluded that the degree of hazard associated with Primary Cooling Water System and Primary Pump House end conditions is acceptable.

7. ALARM SYSTEMS

7.1 End Condition and Bases

All alarms are designed fail safe, i.e., any monitored abnormal condition including loss of electrical power will indicate an alarm condition. The alarms connect to a summary alarm panel at the Plum Brook Station Communication Center which is continuously manned to provide response to an alarm within one hour.

7.2 Safety Analysis

Alarm system failure could prevent monitoring of off-normal conditions with no indication when monitoring stopped. The most significant undetected event would be unauthorized entry into the CV. An intruder could spread contamination as well as become overexposed to radiation. Alarm system failure is detected by using fail safe design. Off-normal conditions, including

power and system failure, activate an alarm at the Plum Brook Station Communication Center.

It is concluded that the degree of hazard associated with the Alarm Systems end conditions is acceptable.

8. ELECTRICAL SYSTEMS

8.1 End Condition and Bases

All facility electrical needs are provided by a commercial power system. After loss of electrical power to the facility, loads automatically reenergize upon restoration of power.

8.2 Safety Analysis

Commercial power has demonstrated high reliability at the PBRF. During the past 22 years, only two occurrences led to an outage greater than two hours. The loss of electrical energy will affect the motor-driven sump pumps and facility lighting. In the event of a power loss, some flooding may occur. However, an emergency generator is available to supply power to the reactor building sump motors. The response time to energize the generator is typically under 20 minutes which is considerably less than the two hours required to overflow the well pits. The water flow into the sump pits does not vary significantly throughout the year, so flooding is not likely. Hazards associated with flooding are covered in Section 18.2.

Facility lighting is used primarily by inspection and maintenance personnel after their entrance into the facility. Loss of lighting during these visits could be hazardous, particularly in the containment vessel with no natural lighting source. To prevent a hazardous situation, strategically located battery power emergency lights actuate automatically upon loss of electrical power. These units provide ample lighting for personnel to safely find their way from the buildings.

It is concluded that the degree of hazard associated with the Electrical systems end conditions is acceptable.

9. QUADRANT AND CANAL SYSTEM

9.1 End Condition and Bases

The quadrant and canal systems are located in the CV, Reactor Building and the Hot Laboratory. The quadrants and canals (QC) were cleaned, flushed, drained and are dry. The deionizer tanks and the filter housing were flushed and left dry. Resins and filter elements were removed and disposed of as contaminated waste. Radioactive materials are stored in the quadrants. Some material, such as spent fuel storage baskets, underwater cutoff saw, supporting tools, and hardware are stored in Canal G. All QC are magenta-yellow zones. Ladders and other means of access to the QC floors are removed or barricaded. Additional fence and railing were provided around the QC. These end conditions for the QC were chosen to protect personnel and provide a suitable storage location for radioactive or contaminated hardware. Access to these materials is readily controlled.

9.2 Safety Analysis

The hazards associated with the end conditions for the QC are radiological and industrial. The radiological hazard is direct radiation exposure or contact with transferable contamination. Industrial hazards are those typical for security tours of an industrial establishment during non-work hours. Each type of the hazard, radiological and industrial, is covered separately.

9.2.1 Radiological

Personnel could be subjected to both direct radiation and transferable contamination from materials stored in the QC. As noted previously, the QC are magenta-yellow zones. As such they are posted and entrance is controlled. Personnel are excluded from such zones by railing or fencing. Airborne contamination is not considered to be a problem because none of the stored radioactive materials has significant gaseous decay radio-isotopes and solid contamination is not expected to become airborne. See Section 5 on Containment Vessel for further discussion on radiological control. It is equally applicable for this section.

The QC clean-up deionizer tanks and filter housing have all resins and filter elements removed, the interior surfaces were flushed and left dry. The exterior surfaces are decontaminated to white zone level while the interior surfaces, from a transferable contamination standpoint, are considered a magenta zone. The interior surfaces of these units are inaccessible to personnel. The outside of the tanks and filter housing are posted as areas containing radioactive material. Further, the building (Fan House) where these units are located is locked and under key control for authorized entry. These steps reduce the potential of contamination by the QC cleanup units.

9.2.2 Industrial Accidents

The Section 5 on Containment Vessel describes the industrial hazards considered and the precautions taken. This Section should be referred to for consideration of the QC inside the containment vessel.

Entry into the Reactor Building and canals is controlled by established procedures. The only apparent accident situation associated with the canals are falls. This event is unlikely because of the fencing or railing located around the canals as demonstrated during the past 22 years. Battery-powered emergency lights ensure adequate lighting is available. The entries are monitored by approved procedures governing entry of persons into PBRF (Buddy System).

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

10. RADIOCHEMISTRY LABORATORY

10.1 End Condition and Bases

All chemicals, consumable supplies and unnecessary equipment were removed. The fume hood systems were vacuumed and cleaned as well as practical. The filters were removed and fan power was disconnected. Doors on the fume hoods were made secure to prevent opening. The hoods are maintained in a dry condition and are posted.

10.2 Safety Analysis

The exhaust hoods in the Radiochemistry Laboratory contain some residual contamination from use during previous reactor operation. The contamination adheres to the inside floor, walls and ducting of the exhaust hood system. The hazard associated with the end conditions is the spread of contamination. Contamination spread is minimized by access prevention. The exhaust hood doors can not be opened to expose any contamination.

It is concluded that the degree of hazard associated with the Radiochemistry Laboratory end condition is acceptable.

11. HOT DRAIN SYSTEM

11.1 End Condition and Bases

The hot drain system and all floor drains were flushed, drained and sealed against water. The sumps were flushed, cleaned to a practical extent, and sealed. The sump pump motors are disconnected at the motor control center circuit breakers and are tagged out. The end conditions were selected to prevent the hot drains and sumps from spreading contamination.

11.2 Safety Analysis

Spread of radioactive contamination and direct radiation are the only credible hazards associated with the hot drain system. If water could enter the hot drain system, become contaminated and then flow into a cold sump, subsequent spreading of the contaminated water could result. The cold sumps are active sumps that discharge into the PBRF drainage system and flow off-site into Plum Brook. By sealing the hot sumps and hot drains, spread of contamination is prevented. The seals will be periodically checked. Exposure to direct radiation is prevented by the use of fenced and locked radiation control zones.

It is concluded that the degree of hazard associated with the hot drains end condition is acceptable.

12. HOT LABORATORY

12.1 End Condition and Bases

The seven hot cells were decontaminated to a practical level and contaminated hot lab equipment and tools are stored in these cells. The hot cell doors are locked closed. Other areas containing residual contamination are enclosed by fences or barriers and are posted. The Hot Dry Storage area contains radioactive and contaminated materials from previous reactor operations. The 80 ton access door to the Hot Handling room entrance to the Dry Storage area is locked closed.

12.2 Safety Analysis

Hazards associated with the end conditions are personnel exposure and spread of contamination. Personnel exposure is prevented by the biological shielding design of the Hot Laboratory and limited access through lock and key. Limited access with procedural control prevents contamination spread by personnel. Contamination spread by water has been no problem as verified by inspections over the past 22 years.

It is concluded that the degree of hazard associated with the Hot Laboratory end condition is acceptable.

13. HOT PIPE TUNNEL

13.1 End Condition and Bases

The Hot Pipe Tunnel was decontaminated to a level as low as reasonably achievable and is kept dry. Water which cannot be prevented from leaking into the contaminated area of this underground tunnel will be prevented from escaping.

13.2 Safety Analysis

Process piping inside the HPT contains some residual contamination from use during previous reactor operation. Dams and collectors are installed to prevent migration of water into and out of the contaminated area. The hazard

associated with the HPT is spread of contamination. Twenty-two years experience shows the end conditions to be effective in minimizing spread of contamination by restricting access into the closed systems, controlling access into the HPT and eliminating water sources.

It is concluded the degree of hazard associated with the HPT end condition is acceptable.

14. WASTE HANDLING BUILDING

14.1 End Condition and Bases

The Waste Handling Building was decontaminated to a practical level. This building contains radioactive materials and equipment from previous reactor operations. Areas containing residual contamination are enclosed by fences or barriers and are posted. Doors leading to the evaporator room and waste packaging room shall be locked closed. Access doors to the Waste Handling Building shall also be locked closed.

14.2 Safety Analysis

Hazards associated with the end conditions are personnel exposure and spread of contamination. Personnel exposure is prevented by posted fences and barriers. The direct radiation at these fences and barriers is less than 2.5 mRem/hr. which is equivalent to the limits of a white zone. Contamination spread by water has been no problem as verified by inspections over the past twenty-two years.

It is concluded that the degree of hazard associated with the Waste Handling Building is acceptable.

15. EMERGENCY RETENTION BASIN

15.1 End Condition and Bases

The Emergency Retention Basis (ERB) was drained and the drain line leading to the ditch remains open to prevent accumulation of rain water. The bottom of the earthen ERB contains areas with soil having trace quantities of contaminated material, however, typical maximum measured runoff activity levels are 7.1×10^{-8} μci/ml for beta-gamma, and less than detectable for alpha radiation. The supply line is blanked shut and the supply pumps were removed.

15.2 Safety Analysis

The hazard associated with the ERB end condition is release of contaminated water or soil if the drain plugged permitting accumulated water to damage the basin earth walls by excessive water. This hazard is very unlikely since the ERB contains eight-foot-high walls and the only water source to the basin is falling rain water. Normal yearly rainfall does not exceed 48 inches, therefore, the basin could hold over a year's water supply with no threat of damage.

Any large accumulation of water would be discovered on routine periodic inspections and would be corrected. Even if a break occurred, any residue would settle and accumulate in an adjacent field inside the PBRF fenced area.

It is concluded that the degree of hazard associated with the ERB end conditions is acceptable.

16. HOT RETENTION AREA (HRA)

16.1 End Condition and Bases

Each of the tanks are flushed, drained, cleaned to a practical extent and left dry. HRA transfer pumps are nonoperable. All personnel accesses to the area, except one to the annulus and one to the tunnel area, are closed against weather and welded against unauthorized entry. The authorized entries are locked to permit authorized inspections. All ventilation louvers which open to the atmosphere are closed. The exhaust vent to the stack breathes through an absolute filter.

All external surfaces of the Hot Retention Area are decontaminated to white zone level. The HRA ground water sump pump is activated by high water level. The sump is monitored for high water level.

16.2 Safety Analysis

The hazard for the HRA under the end condition are spread of contamination resulting from entry into the HRA and major damage to the tanks and associated components by floating of the tanks. Each of these events will be covered separately below.

16.2.1 Spread of Contamination

The tanks are to be maintained empty and all isolation valves in the lines to the tanks are closed and sealed. Airborne contamination from the tank interior is also unlikely because of the relatively clean surfaces and the absence of any significant decay products which are gaseous. The only credible way for contamination to spread from the HRA is by an intruder. All other ways for contamination to spread are unlikely. If rain entered the weather covers, the quantity of liquid would be small based on previous experience, and readily removed under radiological control after discovery during routine inspection.

Access to the PBRF requires the passage through the Plum Brook Station and PBRF fences. To enter the HRA, the intruder must disable a lock and climb down into the pipe chase. Since the pipe chase is a magenta-yellow zone, it is possible for transferable contamination to be removed by the intruder.

The events described above, while credible, are highly unlikely. Passage of a intruder across two locked or manned fences in both directions without observation is possible; however, selection of the HRA for entrance by the intruder is unlikely. The facility is not only innocuous in appearance but does not contain items of significant value. Even if the intruder should enter the HRA, become contaminated, and leave, the amount of transferable contamination carried on the intruder would not be significant in terms of personnel exposure hazard or widescale spread of the contamination. Thus, it is concluded that unauthorized entry into the HRA is very unlikely and if the event should occur, the magnitude of the contamination problem would be insignificant.

16.2.2 Floating of Tanks

The HRA tanks are housed underground, in a large concrete vault. Footer drains around the vault lead to a ground water sump which maintains the ground water level below the tank bottoms. In the event this sump pump failed and the ground water level rose sufficiently high to float the tanks, it is conceivable the tanks could erupt through the roof of the vault. This would result in major damage to the facility, however, the relatively low level of contamination is of little concern. A high water level alarm provides early warning for prompt action to reduce this occurrence.

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

17. CONTAMINATED AIR SYSTEMS

17.1 End Condition and Bases

The Contaminated Air system was shutdown after being vacuumed, washed, and purged clean through absolute filters. The roughing filters, prefilters and high efficiency absolute filters were removed. Fan motors are disconnected. Air controls are deenergized and vented to atmosphere. All valves and dampers are fixed in a closed position and where applicable the piping and duct inlet and outlet openings are blocked. This arrangement restricts air movement within the piping. The main entry ways to the vent stack were welded closed. The stack drain line to the hot drain system was disconnected to preserve hot drain isolation and the hot drain lines were capped.

Compared to the operating mode, the Contaminated Air System end conditions provide a reduced level of contaminants in the vent lines and areas they service which vent to the stack. This was accomplished by high velocity air purging with manual cleaning to minimize contaminants in accessible areas.

17.2 Safety Analysis

The only possible hazard is a release to the stack of contaminants in the system. This occurrence would spread contamination to the environment. The impact of this event is a function of the kind and quantity of contaminants released. A systematic cleanup was performed to remove contaminants from the Contaminated Air System. Air sample monitoring of selected areas including the PBRF stack produces typical maximum measured activity levels of less than detectable for alpha and beta-gamma sources. It is concluded that the degree of hazard associated with the Contaminated Air Systems end condition is acceptable.

18. SAFETY ANALYSIS FOR EMERGENCIES

18.1 Tornadoes and Severe Storms

Tornadoes and severe storms are covered in Section 6.3.1 of the Final Hazards Summary, NASA Plum Brook Reactor Facility, Part I. Statements made therein, which are not related to reactor operations, are still applicable.

A tornado is not expected to cause physical damage to the reactor tank or the Primary Pump House. The reactor tank is located below ground level inside the containment vessel. The Primary Pump House is constructed of reinforced concrete. All magenta zones are contained within heavy process equipment of substantial steel or concrete structures and therefore their containment should not be compromised by a tornado. Several magenta-yellow zones exist in the Reactor Building and auxiliary buildings where damage is possible. However, the inventory of radioactive materials capable of release is much smaller than when the reactor facility was in operation. Tornado damage of the buildings is not expected to release significant amounts of radioactivity.

Severe storms could cause flooding, power failure, or lightning damage. A power failure could be tolerated. Lightning damage could not cause release of radioactive materials, but could cause a fire. Both fires and flooding are covered in separate sections.

The hazards associated with tornadoes and severe storms are acceptable since the radioactive inventory and the potential for spread of contamination are lower than during reactor operation.

18.2 Flooding

Flooding could cause the release of radioactivity, if flood water washed away radioactive materials contained within the facility. Examples of magenta-

yellow zones having surface contamination are: (1) the hot sumps and hot drains, (2) the Primary Pump House, (3) Containment Vessel, (4) the quadrants and canals where radioactive and contaminated materials are stored, (5) the Hot Retention Area, and (6) other magenta-yellow zones in the facility.

As discussed in Section 8, the floor hot drains leading to hot sumps and the hot sumps are sealed against water. Thus, entrainment and spread of contaminants by water is not credible. Periodic inspection is used to ensure seal effectiveness.

As discussed in Section 5, the Pump House roof hatch plugs have weather seals which are maintained. If a seal should fail, some water could enter the rooms but would be trapped there until cleaned up under health physics control. Again, spread of contaminants is not credible.

As discussed in Section 3, the process liquid lines were isolated from the CV. Further, the CV is a continuous steel shell protected by ground water pumps outside the CV. Even if water entered the CV, spread of contamination outside the CV is not credible.

There is a possibility that some water (such as from a window break) could enter a canal in the Reactor Building. However, it is not credible that a canal would be filled, since the canals are 25 feet deep. Thus, any water entering would be contained until cleaned up under health physics control.

As stated in Section 14, entrance of water through or around the HRA weather covers into the pipe chase is unlikely. Even if it occurred, the quantity of liquid would be manageable and it would be cleaned up under health physics control. There are several other areas in the PBRF which are magenta-yellow zones. Flood water could conceivably wash contaminants from these areas to cold

sumps. Examples of these are the lowest level of the Reactor Building (RB), the basement of the Waste Handling Building (WHB), and the Hot Pipe Tunnel (HPT).

History shows that water from a very heavy storm once entered the -15 foot level of the RB. It flowed to the lowest level of the building to a cold sump. No spread of contamination occurred. To preclude this event from recurring the following actions were taken:

a. The locations where surface water entered the RB were identified. These were a pipe trench, an air intake, and the RB sills. The trench and air intake were closed, a dam was built to isolate surface water from the RB wall and the trench was modified to provide better drainage from the RB.
b. Procedures require an inspection tour of PBRF after every heavy storm. Action was also taken to protect the WHB against water. During the aforementioned storm, small quantities of flood water entered the WHB. Areas where the surface water entered are dammed and covered. Dams are also constructed at the evaporator and waste packaging rooms where white zone levels are exceeded. The dams prevent uncontaminated water from entering the rooms and contaminated water from leaving the rooms. Any water found in the rooms will be cleaned up under health physics control.

   The Hot Pipe Tunnel area was decontaminated to the greatest practical extent. The decontamination did not achieve a white zone level, so a dam was built across the HPT at the Fan House (FH) interface. Even under the severest weather only small seepage of water has entered the HPT. The dam effectively blocks water from spreading into the FH (HPT slopes to FH). Periodic inspection at the dam is made for water buildup. If water needs to be removed, this will be accomplished under health physics controls.

The hazards associated with flooding are acceptable.

18.3 Earthquakes

Earthquakes are covered in Section 6.3.3 of the Final Hazards Summary. Because of the low probability of a strong earthquake and the nature of the radioactive materials stored in the Reactor Facility (no liquids or gases), the risk associated with release of radioactive materials due to an earthquake is acceptable.

18.4 Fire

Likely sources of fire are open flames, electrical wiring, lightning, and sparks from grass fires in the local area. Procedures prohibit smoking at the PBRF. Combustibles were removed as much as is practical from areas where radioactive materials are stored. A fire in any magenta zone is not deemed credible because of the lack of combustible materials.

The only significant amount of combustible material in the area of contaminated material is the PBRF building roofs. If the tar or urethane material of the roof caught fire, structural damage to the building might occur. Also, the urethane insulation of the CV dome might catch on fire and do structural damage to the CV. Neither type of fire would release a significant amount of radiation because the radioactive material is stored at the bottom of quadrants and canals and is contained in or on the surface of solid materials, generally metallic. It is not credible that a significant part of the radioactive material could be vaporized and carried away.

The overall fire hazard is much less than when the reactor was operating. In the event of a fire, the fire fighters are directed by trained personnel according to station procedures which take into account the possible release of radioactivity.

The hazards associated with fire are acceptable.

18.5 Sabotage

Hazards due to sabotage are difficult to guard against. However, with the Facility in a protected safe storage condition, the motivation for sabotage is decreased by the absence of any nuclear fuel. For a saboteur to gain access to radioactivity, he would be required to break through the NASA Plum Brook Station perimeter fence, the reactor site fence, and into one of the PBRF buildings, unobserved by the station armed security patrol.

Since the plant is not operating, neither sabotage nor action by a subversive employee could result in a significant safety hazard. This is because none of the radioactive material would be readily transportable in large quantities. The high-radiation-level material in the reactor tank and the hot laboratory could not be removed in a short period of time and there does not seem to be adequate motivation for such action. The welded shields and shrapnel shields of the reactor tank serve as protection for this material. The presence of security and lack of motivation renders the risks associated with sabotage acceptable.

18.6 Bombing

The only bombing considerations will be for bombs of a non-nuclear type. The most serious situation would occur if the reactor tank was demolished and its contents scattered. The debris could be scattered over a large area but would remain within the Plum Brook Station perimeter fence. Since the reactor tank contains solid material, a radiation survey of the Station should allow the recovery of most of the material. A radiation hazard to the public would not exist since it is not credible that any material, other than an extremely small amount of airborne activity, would leave the station as the result of bombing.

19. ENGINEERING STUDIES AND EQUIPMENT TRANSFER

New information is constantly required to document existing conditions at reactor facilities. The PBRF is no exception. Information will be obtained by measurements, surveys, borings, tests, and other methods as necessary. This may involve:

a. Gaining temporary access to controlled areas.
b. Minor disassembly to obtain access into some equipment or subsystems.
c. Temporary shield removal for accurate measurements.
d. Temporary change to pertinent existing end conditions.

Items determined by survey to be non-contaminated and not required for protected safe storage may be released for reuse in accordance with approved procedures. Some specialty items such as hot windows, manipulators, or experiments handling equipment known to be contaminated, will upon request, be cleaned to a practical extent and may be transferred to another licensee, in accordance with 10 CFR Part 30.

These activities will be procedurally controlled and will require review and approval of the PBRF engineer and the PBRF Safety Committee to assure that the activity may be accomplished safely, is within the PBRF license requirements and involves no unreviewed safety question.

20. ENVIRONMENTAL IMPACT

The PBRF contains a nonoperable reactor with no fuel, no special nuclear material, no free by-product gaseous or liquid radioactive material. Major radioactive items

are stored at four locations; in the Containment Vessel, the Reactor Building, the Hot Laboratory and in the Waste Handling Building. As shown in the safety analysis, these items are confined and protected from unauthorized personnel and water entry. The confinement prevents personnel access to the radioactive material and the protection restricts the spread of contamination. This condition will not significantly affect the environment.

An Environmental Report for the Plum Brook Reactor Dismantling was prepared in February 1980. From this, an NRC-prepared environmental impact appraisal was made available for public inspection at the commission's Public Document Room at 1717 H. Street, N. W., Washington, DC. The Commission concluded an environmental impact statement is not warranted because of a finding of no significant environmental impact attributable to the proposed action. A condition of possess-but-not-operate protected safe storage will have less environmental affect than dismantling. Consequently, there will remain no significant environmental impact attributable to this proposed action.