PennState

Lora G. Weiss, Ph.D.
Senior Vice President for Research
The Pennsylvania State University
304 Old Main
University Park, PA 16802-1504

814-865-6332
Fax: 814-863-9659
LGW1@psu.edu
www.psu.edu/research

US NRC
ATTN: Document Control Desk
Washington, DC 20555-0001

16 December 2019

SUBJECT: RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING REACTOR BAY VENTILATION SYSTEM UPGRADE AT THE PENN STATE BREAZEALE REACTOR (EPID L-2019-LLA-0089)

To Whom It May Concern:

On March 28, 2019, Pennsylvania State University submitted a License Amendment Request (LAR) to modify to the Breazeale Nuclear Reactor (R-2) facility SAR and Technical Specifications in order to upgrade the reactor bay exhaust system. On October 30, 2019, the NRC sent a Request for Additional Information to Penn State regarding this LAR.

The response to the two questions included in the RAI is attached. A clean and mark-up version of SAR Ch. 6 and a clean and mark-up version of the affected TS pages are also included. The SAR Ch.6 mark-up includes only the change made to address the RAI; other changes in SAR Ch. 6 included with the original LAR are not marked in this copy.

Note that in addition to the response to the questions in the RAI, the facility also requests an additional editorial change to the Technical Specifications Section 6.1 in order to update the title of the Level 1 administrator.

This response and the proposed changes to the Technical Specifications and SAR were approved by the PSU Reactor Safeguards Committee via electronic vote on 12/11/2019. Questions regarding this information should be directed to Dr. Jeffrey Geuther, Associate Director for Operations. I certify under penalty of perjury that this information is true and correct.

Sincerely,

Lora Weiss, Ph.D.
Senior Vice President for Research

Executed on 12-16-2019

A020
NRR

State of Pennsylvania
County of Centre
Signed before me on December 16, 2019

By: Lora G. Weiss, Senior Vice President for Research
The Pennsylvania State University

Diane K. Keshvari
Signature of notarial officer

Stamp
Commonwealth of Pennsylvania - Notary Seal
DIANE K. KESHVARI, Notary Public
Centre County
My Commission Expires July 26, 2023
Commission Number 1234053

My commission expires: July 26, 2023

Attachments: RAI response
SAR Ch.6, clean and markup copies
TS affected pages, clean and markup copies

Cc (electronic): Xiaosong Yin, NRC
Greg Casto, NRC
Nageswara Karipenini, NRC

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RAI-1

The confinement dampers in the RBHVES are closed when the emergency evacuation alarm is activated. The terms "evacuation system," "emergency evacuation system," and "evacuation alarm system" referred to in the "Evaluation of the Proposed Change" in the initial LAR reference the same system, but it is most relevant to note that the activation of the emergency evacuation alarm directly results in the closing of the confinement dampers. The facility has reviewed SAR, Ch. 6 and SAR, Ch. 9 as revised and submitted in the original LAR. The revised SAR chapters do not use the term "emergency evacuation system" or "evacuation system." There is one instance of the term "evacuation alarm system." This term is not defined in the SAR.

In order to improve clarity, the facility puts forward the following revision to the referenced section in the "Evaluation of the Proposed Change." In this revision the terms "evacuation alarm" and "evacuation alarm system" are used in place of "evacuation system" and "emergency evacuation system." The use of "evacuation alarm" and "evacuation alarm system" avoids ambiguity with the acronym "EES," which refers to a separate "Emergency Exhaust System." Furthermore, the term "evacuation alarm system" on p. VI-2 of the revised SAR has been replaced with "evacuation alarm" since "evacuation alarm system" was not defined in the SAR. This is the only change to SAR Ch. 6 beyond the changes submitted in the 3/28/19 LAR. No additional changes to SAR Ch. 9 are required.

Original wording of the Evaluation of the Proposed Change:

> "A relief damper is present in the RBHVES system to provide duct work protection from the dynamic load caused by the rapid closure of the confinement isolation dampers. To simplify the reliability of the interface between the RBHVES control system and the **emergency evacuation system**, the only communication is through a set of auxiliary contacts on a multiplier relay in **the emergency evacuation system**. When the **evacuation system** is actuated, an **evacuation system** relay opens contacts that interrupt the control power from the RBHVES system to the confinement damper actuators. Without power the dampers fail to the closed position. The RBHVES trips the exhaust supply and recirculation fans and opens the relief damper.
>
> The RBHVES serves no safety function during an airborne release. When the **evacuation alarm system** is activated, any operating RBHVES fans are shut down, associated motor-driven confinement isolation dampers shut in approximately five seconds, and the EES system starts. (The FES, if operating, also automatically shuts down during an evacuation). Note that the EES system is not affected by the changes discussed in this LAR. The penetrations and ductwork added by RBHVES are similar in size to the existing roof fan penetrations that communicate directly with outside air. With the ventilation fans operating as designed, the ductwork becomes part of the confinement, as defined in TS. During an evacuation, the control air path is isolated from the remainder of the confinement by design. The failure of the system to isolate is bounded by the maximum

hypothetical accident (MHA) in the SAR, which assumed that effluents were released at ground level with no filter."

Revised wording:

"A relief damper is present in the RBHVES system to provide duct work protection from the dynamic load caused by the rapid closure of the confinement isolation dampers. To simplify the reliability of the interface between the RBHVES control system and the evacuation alarm, the only communication is through a set of auxiliary contacts on a multiplier relay in the evacuation alarm system. When the evacuation alarm is actuated, a relay opens contacts that interrupt the control power from the RBHVES system to the confinement damper actuators. Without power the dampers fail to the closed position. The RBHVES trips the exhaust, supply, and recirculation fans and opens the relief damper.

The RBHVES serves no safety function during an airborne release. When the evacuation alarm is activated, any operating RBHVES fans are shut down, associated motor-driven confinement isolation dampers shut in approximately five seconds, and the EES system starts. (The FES, if operating, also automatically shuts down during an evacuation). Note that the EES system is not affected by the changes discussed in this LAR. The penetrations and ductwork added by RBHVES are similar in size to the existing roof fan penetrations that communicate directly with outside air. With the ventilation fans operating as designed, the ductwork becomes part of the confinement, as defined in TS. During an evacuation, the control air path is isolated from the remainder of the confinement by design. The failure of the system to isolate is bounded by the maximum hypothetical accident (MHA) in the SAR, which assumed that effluents were released at ground level with no filter."

RAI-2

The facility agrees that the possibility exists that negative differential pressure may be lost for a short period of time without changing the state of the RBHVES indicator lamp. TS 3.5.a has been revised to include a statement exempting short-term losses of negative differential pressure that are not long enough to extinguish the indicator lamp (i.e., 5 minutes or less). The 1 hour time for correcting a loss of negative differential pressure has been reduced to 30 minutes upon discovery, since the reactor operator can easily manually trip the RBHVES from the control room, causing the facility exhaust system (a component of the RBHVES that currently serves as the primary exhaust system for the facility) to turn ON. The revised TS 3.5 included herein is amended from Revision 39, which was a one page drop-in revision to the TS that affected only TS 3.5. The original LAR revision to the Technical Specifications used Revision 38, which was the most recent electronic version of the full TS. The facility has confirmed that the control room copy of Technical Specifications in Revision 39, the current version.

Responses to the specific sub-parts of RAI-2 are as follows.

1) TS 3.5.a is intended to apply to all losses of negative pressure, not only those due to exhaust fans. The RBHVES system includes a 5 minute delay which would impede the differential pressure indicator lamp from changing state due to short-term losses of negative differential pressure. The allowed operating time of 30 minutes following discovery of a loss of differential pressure is justified in that the operations team can quickly determine whether an easily-remedied condition such as a propped-open door is causing the loss of pressure. If the problem is not easily diagnosed or fixed, the operator can manually trip the RBHVES, which turns off the system EXCEPT the facility exhaust system (FES), which currently functions as the primary reactor bay exhaust system and will be a sub-system of the RBHVES. When the RBHVES is tripped by the operator, the FES immediately turns ON, restoring negative pressure. The negative DP indicator lamp is located in plain sight of the operator and its status is logged hourly per procedure.
2) Since the installation of the RBHVES system in 2012, the negative pressure indicator lamp has never changed state due to entry / egress. By procedure, doors are not to be propped open while the reactor is operating.
3) See the attached revision to TS 3.5. The revision includes a 30 minute allowed operating time following the discovery of loss of negative DP. This allowed operating time is sufficient for the watch team to verify that there are no abnormal penetrations into the reactor confinement bay and to manually turn FES fans ON to restore negative differential pressure. The revised TS 3.5 also clarifies that the reactor may be operated during DP losses of insufficient duration to change the state of the RBHVES differential pressure indicator lamp.
4) The revised TS 3.5 enclosed with this RAI response is based on the TS amendment of record. The control room copy was verified to be the correct revision.
5) The revised TS 3.5 pages included in this RAI response are numbered "26.a" and "26.b" to allow for a "drop-in" revision to the current TS of record. The attached TS revision is submitted as a replacement to the revision sent with the originally LAR submittal and includes only affected pages.

Updated Table of Changes to the Technical Specifications

Following the changes to the LAR put forth in this RAI response, the Technical Specification Change Summary Table sent with the original LAR is amended as follows:

#	Affected Section of TS	Description	Justification
~~1~~	~~All~~	~~Editorial - page numbers in TOC and footers may be changed.~~	~~Changes to the Technical Specifications have affected the length of some sections.~~
2	3.1.1.b basis	Changed SAR reference to Ch. 13, Section B	The listed reference (Ch. 13 Sec. C) was incorrect.

3	3.5 title	The title was changed to "Engineered Safety Features – Ventilation Systems"	This title is more generic and refers to the previously-installed exhaust systems as well as the new Reactor Bay Heating Ventilation and Exhaust System.
4	~~3.5.a~~ ~~3.5.a (basis)~~ ~~3.5.b (basis)~~	~~The requirement for one reactor facility exhaust fan to be operating whenever the reactor is not secured was replaced by a specification related to bay differential pressure.~~	~~The intent of the specification is to ensure that reactor bay differential pressure is negative. The revised TS recognize that the FES are not the only component of the upgraded exhaust system, and negative differential pressure may be attained with or without the FES. The basis section was updated to reflect this change and to include the basis for a 1 hr window to restore negative DP upon discovery of no negative DP. The basis for 3.5.b was updated to clarify which exhaust systems were credited with performing certain functions.~~
4	3.5.a 3.5.a (basis)	The requirement for one reactor facility exhaust fan to be operating whenever the reactor is not secured was replaced by a specification related to bay differential pressure. An AOT of 30 minutes upon discovery of loss of negative differential pressure was added, along with allowance for operating during short periods of time when pressure is lost without extinguishing the low DP indicator lamp.	The intent of the specification is to ensure that reactor bay differential pressure is negative. The revised TS recognize that the FES are not the only component of the upgraded exhaust system, and negative differential pressure may be attained with or without the FES. The basis section was updated to reflect this change and to include the basis for a 30 minute window to restore negative DP upon discovery of no negative DP. The indicator light used to indicate loss of negative differential pressure to the operators does not change state unless the loss of pressure is longer than five minutes; the revised TS include a clause allowing operation during these brief losses of negative pressure. The basis was updated to clarify which exhaust systems were credited with performing certain functions.

5	~~3.5.c~~ ~~3.5.c (basis)~~ 3.5.b 3.5.b (basis)	The specification was amended to require fuel handling to cease in a safe manner upon discover of lost reactor bay exhaust / EES operability.	The previous requirement, that the FES must be operating and EES must be operable, would cause immediate non-compliance if the exhaust system were to trip off during fuel handling. Additionally, the phrasing of the specification was made more generic to refer to the new RBHVES, not necessarily the FES. The basis for 3.5.c was updated to document the reason for the new phrasing.
6	3.6.1 3.6.1.b (basis)	Changed name of "Beamhole Laboratory Monitor" to "Neutron Beam Laboratory Monitor"	This was done to be consistent with commonly-used terminology at the facility.
7	4.5	Title change from "Facility Exhaust and Emergency Exhaust Systems" to "Ventilation Systems"	This was done to make the section more generic and to refer to the new RBHVES in addition to extant systems.
8	4.5	References to the facility exhaust system were replaced with references to the "reactor bay heating ventilation and exhaust" system	The FES is being upgraded to the RBHVES; the section was reworded to refer to the new system. This includes the monthly test requirement in TS 4.5.b.
9	4.5.c	A requirement was added to calibrate the differential pressure monitors annually, not to exceed 15 months.	The operation of the upgraded exhaust system is monitored by observing the status of an indicator lamp which is extinguished if any one of three DP transducers reads low negative differential pressure. Since these transducers are required to perform a safety function they must be calibrated.
10	4.6.1	Changed several instances of "Beamhole Laboratory Monitor" to "Neutron Beam Laboratory Monitor"	This was done to be consistent with commonly-used terminology at the facility.
11	5.5.b	Changed "facility exhaust system" to "reactor bay heating ventilation and exhaust system"	Refer to the RBHVES instead of the FES.
12	5.5.b	Added clarification that "secured" means "fans deenergized and exhaust dampers closed" when referring to RBHVES.	This was done to clarify the meaning of "secured," which is used in other contexts elsewhere in the TS, e.g., when referring to "reactor secured" or "secured experiments."

13	5.5 Basis	Added clarification that SAR MHA is analyzed as a ground release	This was done to avoid confusion regarding the fact that the EES / FES stack height is an ALARA feature and is not credited in the accident analysis.
14	6.1.1 6.1 - Organizational Chart	The title of the Level 1 administrator has been updated from "Vice President for Research / Dean of the Graduate School" to "Senior Vice President for Research" to reflect title changes at PSU.	The actual position referred to in TS is not changed.

6.0 ENGINEERED SAFETY FEATURES

6.1 Summary Description

The building is constructed of concrete blocks, bricks, insulated steel and aluminum panels, structural steel, and re-enforced concrete and is in general, fireproof in nature. The reactor bay serves as a confinement designed to limit the exchange of effluents with the external environment through controlled or defined pathways. During normal operations, the reactor bay is kept at a negative pressure with respect to the atmosphere by the operation of one or more of four separate exhaust fans and associated confinement penetrations. Three fans are associated with the Reactor Bay Heating Ventilation air conditioning and Exhaust System (RBHVES) and the other is the Emergency Exhaust System (EES) fan. When the evacuation alarm is actuated, the EES fan starts (if not previously running) and all other fans are shutdown and the penetrations are closed (via dampers), whereby a negative pressure is maintained on the reactor bay and the effluent is exhausted through filters to a stack that exhausts at least 24 feet (7.3 m) above ground level. The reactor bay meets the TS definition 1.1.8, "Confinement means an enclosure on the overall facility which controls the movement of air into and out through a controlled path".

6.2 Detailed Descriptions

6.2.1 Confinement

The ~70,000 feet^3 (1900 m^3) minimum volume reactor bay is maintained at a negative pressure with respect to the remainder of the building by one or more of four separate exhaust fans (**see Figure 6-1**). Depending on operational configuration, fresh air to the reactor bay is supplied by leaks around doors and penetrations and by the supply air fan. Normal heating, cooling, ventilation, and negative pressure of the reactor bay is maintained by the RBHVES. A filtered emergency exhaust system (EES) is also available.

The RBHVES functions are to supply fresh tempered makeup air and to control air flow through the reactor bay to minimize worker radiation exposure and to release the reactor bay air in a controlled manner (~3500 feet^3/min or 9.9×10^4 ℓ/min) where dilution and diffusion of the effluent occurs before it comes into contact with the public. Argon-41 is the only radioactive gas of significance released during the normal operation of the reactor, and is the result of the action of thermal neutrons on air in the reactor pool water and in experimental apparatus. See section 11.1.1.1 for typical Argon-41 annual releases and section 11.1.5 for a discussion of personnel exposures.

The RBHVES contains an exhaust fan and stack that exhausts at reactor bay roof level, a makeup fan with enthalpy wheel, a recirculation fan and associated control dampers. Confinement penetration dampers close to isolate the system on system shutdown or power failure. During normal operation the balance of fresh makeup air and exhaust air maintains a slight negative pressure in the reactor bay. Two additional roof fans with gravity back-draft dampers are available as backup and to improve heating and cooling efficiency during certain weather conditions. The RBHVES serves no safety function during an airborne release.

When the evacuation alarm is activated, any operating RBHVES fans are shutdown, associated confinement isolation dampers shut, and the EES system starts. The EES creates sufficient negative pressure in the reactor bay so that any movement of radioactive material from the bay would be through the system filters. Air enters the EES through a screened opening in the east wall of the reactor bay about ~14 feet (~4 m) above the bay floor (see Figure 6-2 EES System). The air then passes through a pre-filter, absolute filter, and carbon filter that are mounted in a housing on the roof of the east extension of the reactor bay. The exhaust fan (~3100 $feet^3$/min or ~9.1×10^4 ℓ/min with motor operated damper completely open and clean filters) is also mounted there. Flow can be reduced through the system by adjusting the motorized damper (located at the fan suction) open position. Filtered air exhausts into an 18 inch (46 cm) diameter PVC pipe and stack. The stack travels up the east outside wall of the reactor building and exhausts at a point above the reactor bay roof (~34 feet above reactor bay floor level).

The most likely source of significant radioactivity would be failure of fuel element cladding. The EES is normally on standby in the automatic mode. Activation of the system occurs whenever the building evacuation alarm is initiated. The system can also be activated manually from the control panel in the Cobalt-60 facility entrance lobby.
The EES control panel in the Cobalt-60 facility entrance lobby shows the operational status of the EES system. The control panel consists of four differential pressure gauges, three of which show pressure drops across each of the filters. The fourth pressure gauge shows the velocity pressure in the stack. Also located on the control panel are two pilot lights; one indicates that the system is energized, the other indicates flow in the system (by means of a flow switch). A switch that allows the system to be manually activated is also on the panel. Manual start of the EES does not affect the RBHVES system operation.

The EES three stage filter system is housed in a dust-tight containment. The purpose of the low-cost pre-filter is to filter atmospheric dust that would be deposited in the more expensive absolute filter. Thus, the lifetime of the absolute filter is extended. The high-efficiency absolute filter is needed to remove particulate radiation and has a removal efficiency of 99.9% for .3 micron-sized particles and 99.99% for one micron-sized particles. The carbon filter has a high efficiency for removing fission gases, most importantly the radioiodine.

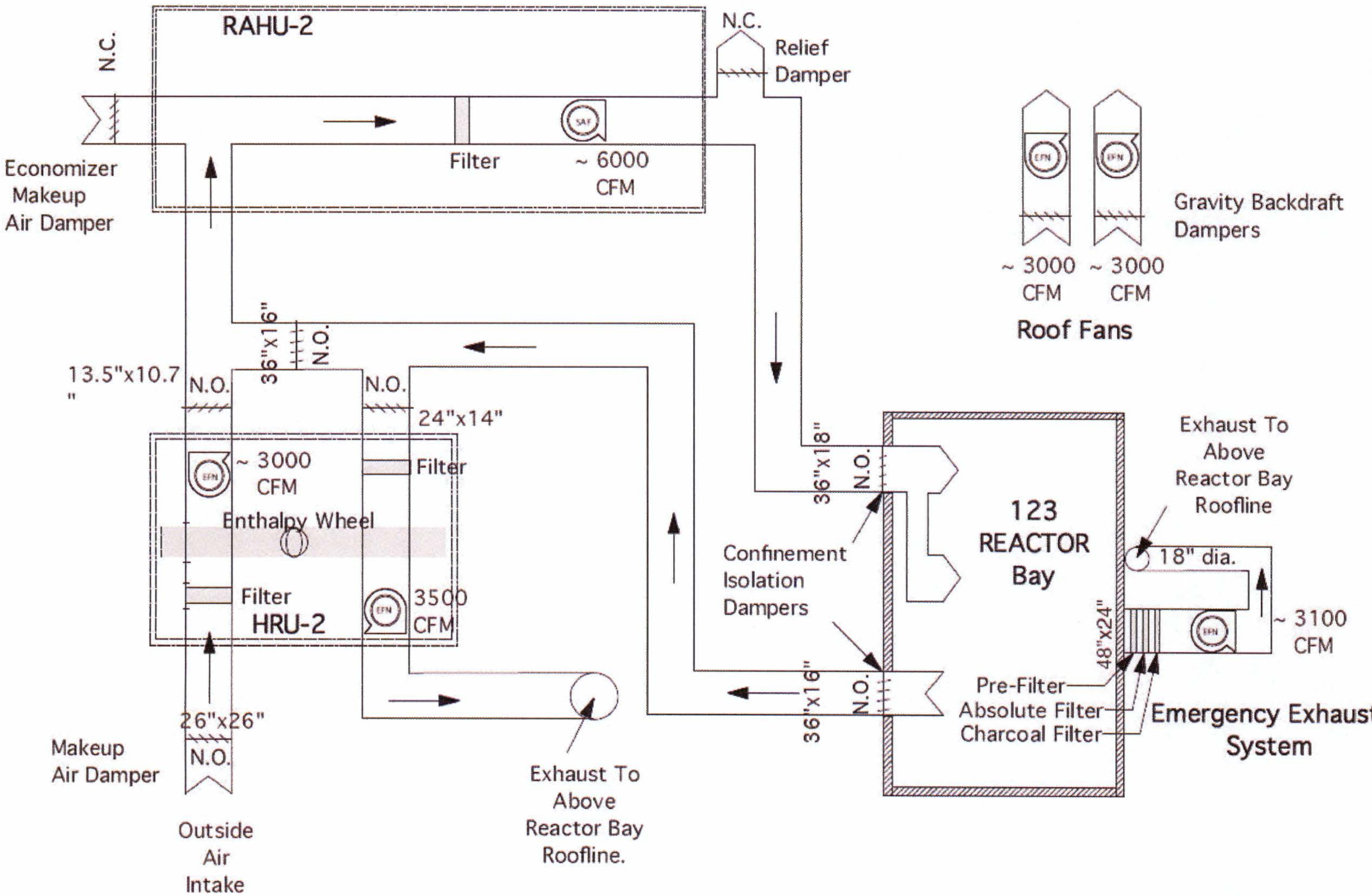

Figure 6-1 Reactor Bay HVAC and Emergency Exhaust Systems

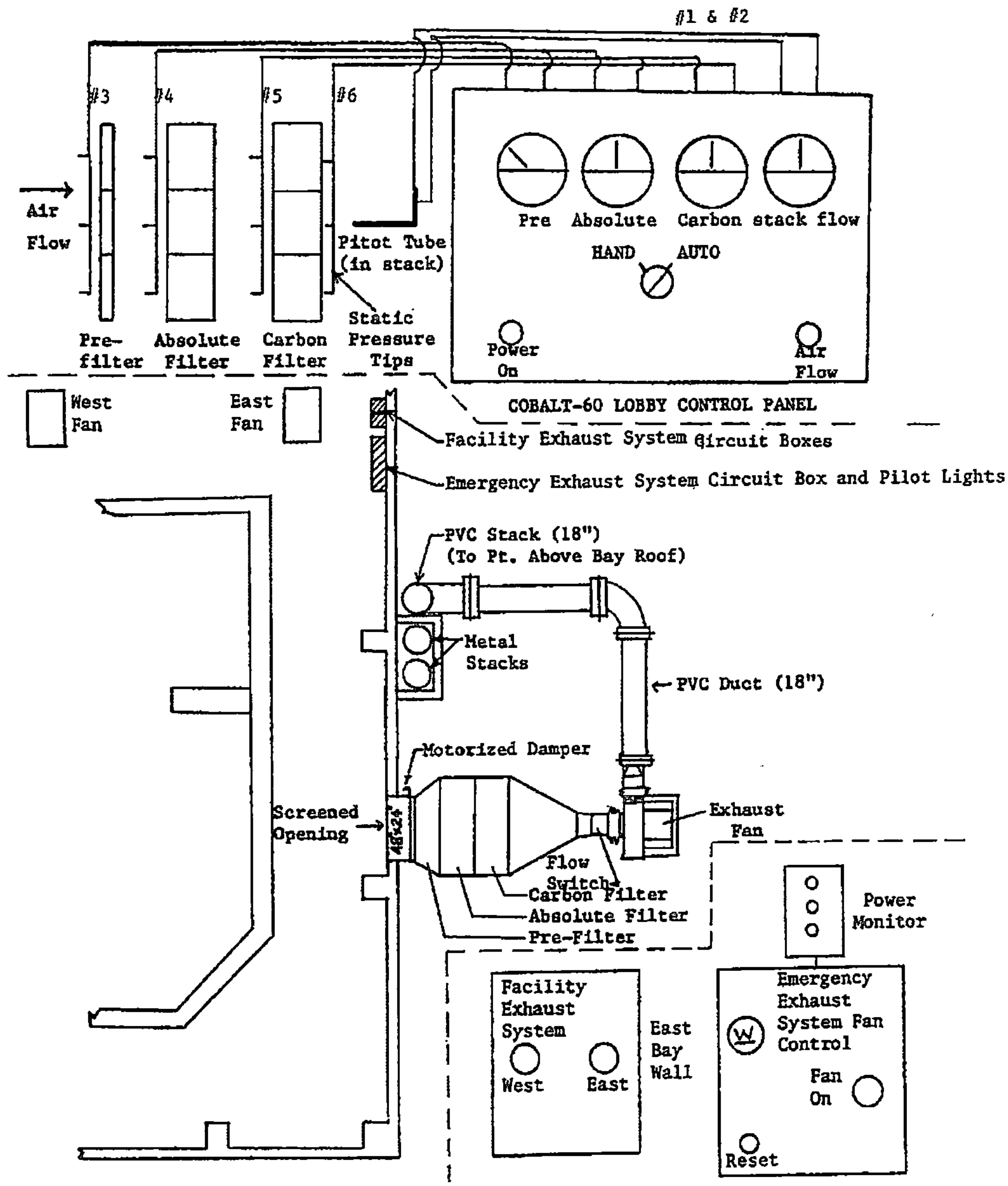

Figure 6-2 Emergency Exhaust System

Static tips are located upstream of the pre-filter, between the pre-filter and the absolute filter, between the absolute filter and the carbon filter, and downstream of the carbon filter. These static tips are connected to three of the differential pressure gauges by copper tubing. A stainless pitot tube mounted in the stack is connected to the fourth differential pressure gauge. As the EES is operated, both the efficiency and the pressure drop across the filters increase due to loading. The filters should be changed when the initial pressure drop (normal operating range for clean filters) has approximately doubled (removal range for spent filters), which is well before the maximum design pressure drop (flag setting) across the filter is exceeded (see **Table 6-1**). Periodic checks of the filter criteria are provided by a PSBR standard operating procedure.

Table 6-1
EES Filter Criteria

	Normal Operating Range (inches H_2O)	Removal Range (inches H_2O)	Flag Setting (inches H_2O)
Pre-filter	.07	.14 - .24	0.42
Absolute Filter	.7	1.4 – 1.5	1.65
Carbon Filter	.6	1.0 – 1.1	1.15
Stack	.2		0.52

The switch on the control panel has two operational modes, auto and hand. It is not possible to disable the system with this switch. Operating the system using the hand mode has no effect on the reactor's operation or any other system.

A Power Monitor box (reactor bay east wall) has three red neon lights that are lit when there is three-phase AC power available to the system. In the auto mode, when an evacuation is initiated, an indicator on the emergency exhaust system fan control box (reactor bay east wall) is lit when the emergency exhaust fan is energized.

Once the EES is energized, it takes ten to fifteen seconds for the EES flow to increase enough to activate the stack flow switch that turns on the red power-on light on the Cobalt-60 lobby control panel. Shortly thereafter, the air flow will stabilize at its normal rate (and the pressure drop gauges will stabilize). A console message "Emerg Ventilation Flow On" (also actuated by the flow switch in the stack) is the positive indication to the reactor operator that the emergency exhaust system is energized and has flow. DCC-X (reactor console digital control computer discussed in Chapter 7) also disables the RBHVES if the EES was activated by DCC-X; manually activating the EES does not disable the RBHVES.

The TS describe the requirements for the confinement and for RBHVES and EES system operability and periodic surveillance during reactor operation and fuel movement:

- TS 3.4 describes the ventilation and air passages requirements to meet the definition of confinement operability.
- TS 3.5 describes requirements for exhaust fan and EES operability when the reactor is operating or irradiated fuel or fueled experiments are being moved.
- TS 4.4 describes the surveillance requirements for verification of confinement status (reactor doors and penetrations).
- TS 4.5 indicates the surveillance frequencies to ensure the proper operation of the RBHVES and the EES in controlling the releases of radioactive material to the uncontrolled environment.
- TS 5.5a describes the confinement as designed to restrict leakage and describes the minimum volume.
- TS 5.5b describes the RBHVES and EES systems, and operability during normal and alarm conditions.

Section 13.1, Accident Analysis, gives a summary of projected radiological exposures from the MHA. This information indicates that even if the EES fails to operate during the MHA, doses to the public are still within 10 CFR 20 limits.

6.2.2 Containment

Not applicable for PSBR.

6.2.3 Emergency Core Cooling System

Not applicable for PSBR.

6.0 ENGINEERED SAFETY FEATURES

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When the evacuation alarm ~~system~~ is activated, any operating RBHVES fans are shutdown, associated confinement isolation dampers shut, and the EES system starts. The EES creates sufficient negative pressure in the reactor bay so that any movement of radioactive material from the bay would be through the system filters. Air enters the EES through a screened opening in the east wall of the reactor bay about ~14 feet (~4 m) above the bay floor (see Figure 6-2 EES System). The air then passes through a pre-filter, absolute filter, and carbon filter that are mounted in a housing on the roof of the east extension of the reactor bay. The exhaust fan (~3100 feet^3/min or ~9.1 x 10^4 ℓ/min with motor operated damper completely open and clean filters) is also mounted there. Flow can be reduced through the system by adjusting the motorized damper (located at the fan suction) open position. Filtered air exhausts into an 18 inch (46 cm) diameter PVC pipe and stack. The stack travels up the east outside wall of the reactor building and exhausts at a point above the reactor bay roof (~34 feet above reactor bay floor level).

The most likely source of significant radioactivity would be failure of fuel element cladding. The EES is normally on standby in the automatic mode. Activation of the system occurs whenever the building evacuation alarm is initiated. The system can also be activated manually from the control panel in the Cobalt-60 facility entrance lobby.
The EES control panel in the Cobalt-60 facility entrance lobby shows the operational status of the EES system. The control panel consists of four differential pressure gauges, three of which show pressure drops across each of the filters. The fourth pressure gauge shows the velocity pressure in the stack. Also located on the control panel are two pilot lights; one indicates that the system is energized, the other indicates flow in the system (by means of a flow switch). A switch that allows the system to be manually activated is also on the panel. Manual start of the EES does not affect the RBHVES system operation.

The EES three stage filter system is housed in a dust-tight containment. The purpose of the low-cost pre-filter is to filter atmospheric dust that would be deposited in the more expensive absolute filter. Thus, the lifetime of the absolute filter is extended. The high-efficiency absolute filter is needed to remove particulate radiation and has a removal efficiency of 99.9% for .3 micron-sized particles and 99.99% for one micron-sized particles. The carbon filter has a high efficiency for removing fission gases, most importantly the radioiodine.

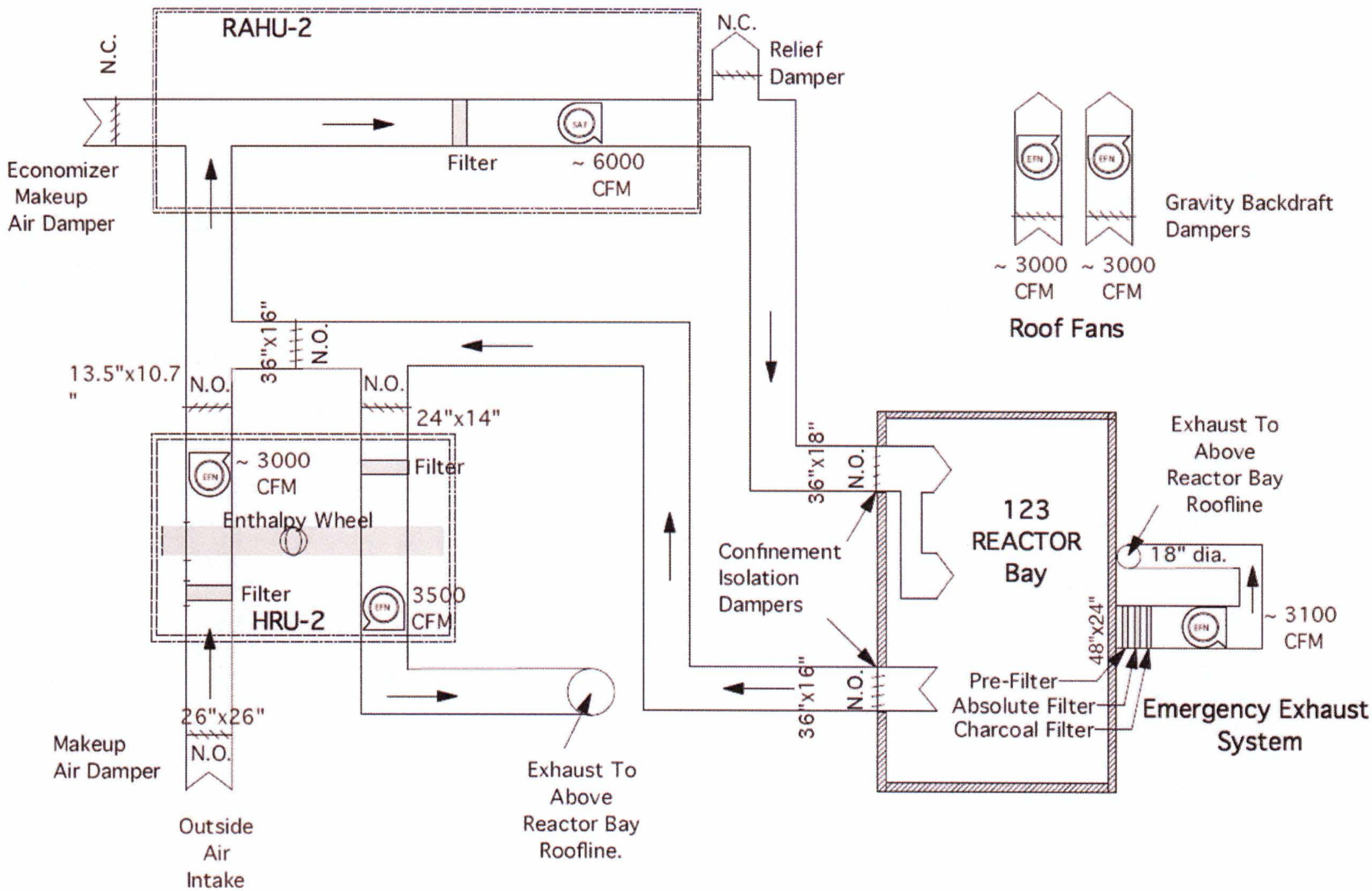

Figure 6-1 Reactor Bay HVAC and Emergency Exhaust Systems

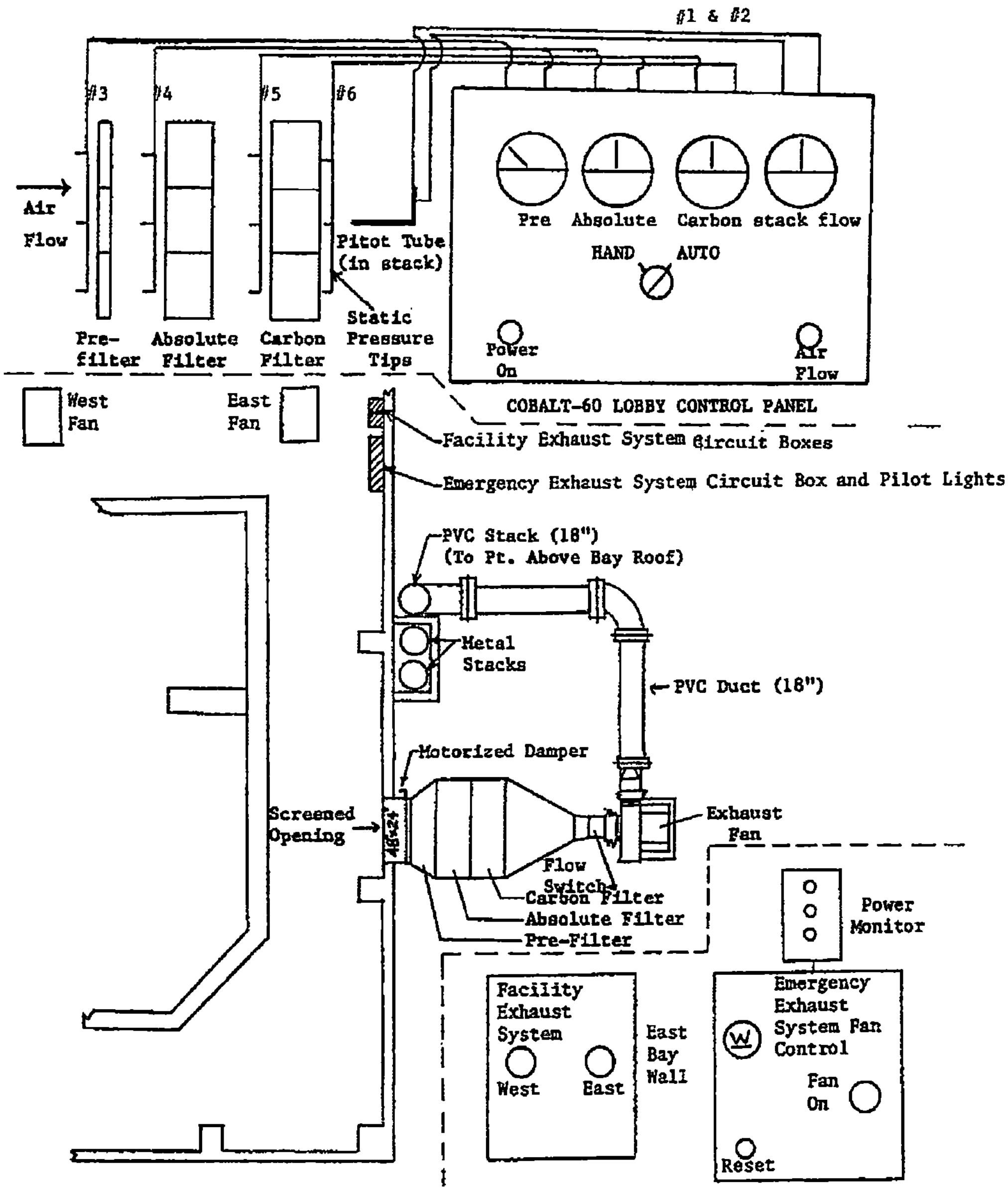

Figure 6-2 Emergency Exhaust System

Static tips are located upstream of the pre-filter, between the pre-filter and the absolute filter, between the absolute filter and the carbon filter, and downstream of the carbon filter. These static tips are connected to three of the differential pressure gauges by copper tubing. A stainless pitot tube mounted in the stack is connected to the fourth differential pressure gauge. As the EES is operated, both the efficiency and the pressure drop across the filters increase due to loading. The filters should be changed when the initial pressure drop (normal operating range for clean filters) has approximately doubled (removal range for spent filters), which is well before the maximum design pressure drop (flag setting) across the filter is exceeded (see **Table 6-1**). Periodic checks of the filter criteria are provided by a PSBR standard operating procedure.

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The switch on the control panel has two operational modes, auto and hand. It is not possible to disable the system with this switch. Operating the system using the hand mode has no effect on the reactor's operation or any other system.

A Power Monitor box (reactor bay east wall) has three red neon lights that are lit when there is three-phase AC power available to the system. In the auto mode, when an evacuation is initiated, an indicator on the emergency exhaust system fan control box (reactor bay east wall) is lit when the emergency exhaust fan is energized.

Once the EES is energized, it takes ten to fifteen seconds for the EES flow to increase enough to activate the stack flow switch that turns on the red power-on light on the Cobalt-60 lobby control panel. Shortly thereafter, the air flow will stabilize at its normal rate (and the pressure drop gauges will stabilize). A console message "Emerg Ventilation Flow On" (also actuated by the flow switch in the stack) is the positive indication to the reactor operator that the emergency exhaust system is energized and has flow. DCC-X (reactor console digital control computer discussed in Chapter 7) also disables the RBHVES if the EES was activated by DCC-X; manually activating the EES does not disable the RBHVES.

The TS describe the requirements for the confinement and for RBHVES and EES system operability and periodic surveillance during reactor operation and fuel movement:

- TS 3.4 describes the ventilation and air passages requirements to meet the definition of confinement operability.
- TS 3.5 describes requirements for exhaust fan and EES operability when the reactor is operating or irradiated fuel or fueled experiments are being moved.
- TS 4.4 describes the surveillance requirements for verification of confinement status (reactor doors and penetrations).
- TS 4.5 indicates the surveillance frequencies to ensure the proper operation of the RBHVES and the EES in controlling the releases of radioactive material to the uncontrolled environment.
- TS 5.5a describes the confinement as designed to restrict leakage and describes the minimum volume.
- TS 5.5b describes the RBHVES and EES systems, and operability during normal and alarm conditions.

Section 13.1, Accident Analysis, gives a summary of projected radiological exposures from the MHA. This information indicates that even if the EES fails to operate during the MHA, doses to the public are still within 10 CFR 20 limits.

6.2.2 Containment

Not applicable for PSBR.

6.2.3 Emergency Core Cooling System

Not applicable for PSBR.

3.0 LIMITING CONDITIONS FOR OPERATION

The limiting conditions for operation as set forth in this section are applicable only when the reactor is operating. They need not be met when the reactor is shutdown unless specified otherwise.

3.1 Reactor Core Parameters

3.1.1 Non-Pulse Mode Operation

Applicability

These specifications apply to the power generated during manual control mode, automatic control mode, and square wave mode operations.

Objective

The objective is to limit the source term and energy production to that used in the Safety Analysis Report.

Specifications

a. The reactor may be operated at steady state power levels of 1 MW (thermal) or less.

b. The maximum power level SHALL be no greater than 1.1 MW (thermal).

c. The steady state fuel temperature SHALL be a maximum of 650°C as measured with an instrumented fuel element if it is located in a core position representative of MEPD in that loading. If it is not practical to locate the instrumented fuel in such a position, the steady state fuel temperature SHALL be calculated by a ratio based on the calculated linear relationship between the normalized power at the monitored position as compared to normalized power at the core position representative of the MEPD in that loading. In this case, the measured steady state fuel temperature SHALL be limited such that the calculated steady state fuel temperature at the core position representative of the MEPD in that loading SHALL NOT exceed 650°C.

Basis

a. Thermal and hydraulic calculations and operational experience indicate that a compact TRIGA reactor core can be safely operated up to power levels of at least 1.15 MW (thermal) with natural convective cooling.

b. Operation at 1.1 MW (thermal) is within the bounds established by the SAR for steady state operations. See Chapter 13, Section B of the SAR.

c. Limiting the maximum steady state measured fuel temperature of any position to 650°C places an upper bound on the fission product release fraction to that used in the analysis of a Maximum Hypothetical Accident (MHA). See Safety Analysis Report, Chapter 13.

3.5 Engineered Safety Features - Ventilation Systems

Applicability

This specification applies to the operation of the reactor bay heating ventilation and exhaust system (RBHVES) and the emergency exhaust system (EES).

Objective

The objective is to mitigate the consequences of the release of airborne radioactive materials resulting from reactor operation.

Specification

a. EXCEPT for conditions 3.5.a(i) and 3.5.a(ii), the reactor SHALL NOT be operated unless reactor bay differential pressure is negative.
   (i) Following discovery of loss of negative differential pressure, the reactor may be operated for up to 30 minutes while negative differential pressure is restored.
   (ii) The reactor may continue to operate during brief changes to bay pressure that are not long enough to extinguish the RBHVES differential pressure indicator lamp.

b. If irradiated fuel or a fueled experiment with significant fission product inventory is being moved outside containers, systems or storage areas, at least one reactor bay exhaust fan SHALL be operating and the emergency exhaust system SHALL be operable.

   Upon discovery of no operating reactor bay exhaust fans OR discovery of an inoperable emergency exhaust system, immediately place the fuel or fueled experiment in a safe storage location and cease further movements until compliance with 3.5.b is restored.

Basis

During normal operation, the concentration of airborne radioactivity in unrestricted areas is below effluent release limits as described in the Safety Analysis Report, Chapter 13. The operation of any of the reactor bay exhaust fans, either the reactor bay heating ventilation and exhaust system or emergency exhaust system, will maintain this condition and provide confinement as defined by TS 1.1.8. If all exhaust from the reactor bay is temporarily lost, the thirty minute limit to restore exhaust gives the operators sufficient time to investigate and respond by checking for penetrations into the confinement bay and energizing fans. Reactor bay area radiation and/or particulate radiation monitors will continue to assure than an unrecognized hazardous condition does not develop. The RBHVES differential pressure indicator lamp is in plain view of the reactor operator in the control room. Due to integration time constants built into the RBHVES control software, brief (<5 minute) losses of differential pressure will not change the state of the indicator lamp.

In the event of a substantial release of airborne radioactivity, an air radiation monitor and/or an area radiation monitor will sound a building evacuation alarm

which will alert personnel and automatically cause the reactor bay heating ventilation and exhaust system to shut down. The emergency exhaust system will start and the exhausted air will be passed through the emergency exhaust system filters before release. This reduces the radiation within the building. The filters will remove $\approx$ 90% all of the particulate fission products that escape to the atmosphere. The emergency exhaust system activates only during an evacuation whereupon all personnel are required to evacuate the building (TS 3.6.2). If there is an evacuation while the emergency exhaust system is out of service for maintenance or repair, personnel evacuation is not prevented.

In the unlikely event an accident occurs during emergency exhaust system maintenance or repair, the public dose will be equivalent to or less than that calculated in the Safety Analysis Report, Chapter 13.

During irradiated fuel or fueled experiment movement, the likelihood of an event releasing fission products is increased. Therefore the continuous operation of a reactor bay exhaust fan and the availability of an operable filtered exhaust is prudent. If the system fails or is discovered to be inoperable during movement activities, the fuel or fueled experiment must be immediately placed in a safe storage location. No additional movements may be conducted until the limiting condition for operation is satisfied.

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3.6 Radiation Monitoring System

3.6.1 Radiation Monitoring Information

Applicability

This specification applies to the radiation monitoring information which must be available to the reactor operator during reactor operation.

Objective

The objective is to ensure that sufficient radiation monitoring information is available to the operator to ensure personnel radiation safety during reactor operation.

Specification

The reactor SHALL NOT be operated unless the radiation monitoring channels listed in Table 3 are operating.

Table 3
Radiation Monitoring Channels

Radiation Monitoring Channels	Function	Number
Area Radiation Monitor	Monitor radiation levels in the reactor bay.	**1**
Continuous Air (Radiation) Monitor	Monitor radioactive particulates in the reactor bay air.	**1**
Neutron Beam Laboratory Monitor	Monitor radiation in the Beamhole Laboratory (required only when the laboratory is in use.)	**1**

Basis

a. The radiation monitors provide information to operating personnel of any impending or existing danger from radiation so that there will be sufficient time to evacuate the facility and to take the necessary steps to control the spread of radioactivity to the surroundings.

b. The area radiation monitor in the Neutron Beam Laboratory provides information to the user and to the reactor operator when this laboratory is in use.

4.5 Ventilation Systems

Applicability

These specifications apply to the reactor bay heating ventilation and exhaust system and emergency exhaust system.

Objective

The objective is to ensure the proper operation of the reactor bay heating ventilation and exhaust system and emergency exhaust system in controlling releases of radioactive material to the uncontrolled environment.

Specifications

a. It SHALL be verified monthly, not to exceed 6 weeks, whenever operation is scheduled, that the emergency exhaust system is operable with correct pressure drops across the filters (as specified in procedures).

b. It SHALL be verified monthly, not to exceed 6 weeks, whenever operation is scheduled, that the reactor bay heating ventilation and exhaust system is secured when the emergency exhaust system activates during an evacuation alarm (See TS 3.6.2 and TS 5.5).

c. Reactor bay differential pressure monitors SHALL be calibrated annually, not to exceed 15 months.

Basis

Experience, based on periodic checks performed over years of operation, has demonstrated that a test of the exhaust systems on a monthly basis, not to exceed 6 weeks, is sufficient to ensure the proper operation of the systems. This provides reasonable assurance on the control of the release of radioactive material. Annual calibration of the differential pressure sensors will ensure the accurate assessment of reactor bay negative pressure as required by TS 3.5.

4.6 Radiation Monitoring System and Effluents

4.6.1 Radiation Monitoring System and Evacuation Alarm

Applicability

This specification applies to surveillance requirements for the area radiation monitor, the Neutron Beam Laboratory radiation monitor, the air radiation monitor, and the evacuation alarm.

Objective

The objective is to ensure that the radiation monitors and evacuation alarm are operable and to verify the appropriate alarm settings.

Specification

The area radiation monitor, the Neutron Beam Laboratory radiation monitor, the continuous air (radiation) monitor, and the evacuation alarm system SHALL be channel tested monthly not to exceed 6 weeks. They SHALL be verified to be operable by a channel check daily when the reactor is to be operated, and SHALL be calibrated annually, not to exceed 15 months.

Basis

Experience has shown this frequency of verification of the radiation monitor set points and operability and the evacuation alarm operability is adequate to correct for any variation in the system due to a change of operating characteristics. Annual channel calibration ensures that units are within the specifications defined by procedures.

4.6.2 Argon-41

Applicability

This specification applies to surveillance of the Argon-41 produced during reactor operation.

Objective

To ensure that the production of Argon-41 does not exceed the limits specified by 10 CFR Part 20.

Specification

The production of Argon-41 SHALL be measured and/or calculated for each new experiment or experimental facility that is estimated to produce a dose greater than 1 mrem at the exclusion boundary.

Basis

One (1) mrem dose per experiment or experimental facility represents 1% of the maximum 10 CFR Part 20 annual dose. It is considered prudent to analyze the Argon-41 production for any experiment or experimental facility that exceeds 1% of the annual limit.

4.6.3 ALARA

Applicability

This specification applies to the surveillance of all reactor operations that could result in occupational exposures to radiation or the release of radioactive effluents to the environs.

Objective

The objective is to provide surveillance of all operations that could lead to occupational exposures to radiation or the release of radioactive effluents to the environs.

5.5 Reactor Bay and Exhaust Systems

Specifications

a. The reactor SHALL be housed in a room (reactor bay) designed to restrict leakage. The minimum free volume (total bay volume minus occupied volume) in the reactor bay SHALL be 1900 m^3.

b. The reactor bay SHALL be equipped with two exhaust systems. Under normal operating conditions, the reactor bay heating ventilation and exhaust system exhausts unfiltered reactor bay air to the environment releasing it at a point at least 24 feet above ground level. Upon initiation of a building evacuation alarm, the previously mentioned system is automatically secured (fans deenergized and exhaust dampers closed) and an emergency exhaust system automatically starts. The emergency exhaust system is also designed to discharge reactor bay air at a point at least 24 feet above ground level.

Basis

The value of 1900 m^3 for reactor bay free volume is assumed in the SAR 13.1.1 Maximum Hypothetical Accident and is used in the calculation of the radionuclide concentrations for the analysis.

The SAR analysis 13.1.1 Maximum Hypothetical Accident does not take credit for any filtration present in the emergency exhaust system. Although analyzed as a ground release, the height above the ground of the release helps to ensure adequate mixing prior to possible public exposure.

5.6 Reactor Pool Water Systems

Specification

The reactor core SHALL be cooled by natural convective water flow.

Basis

Thermal and hydraulic calculations and operational experience indicate that a compact TRIGA reactor core can be safely operated up to power levels of at least 1.15 MW (thermal) with natural convective cooling.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

6.1.1 Structure

The University Senior Vice President for Research (level 1) has the responsibility for the reactor facility license. The management of the facility is the responsibility of the Director (level 2), who reports to the Senior Vice President for Research, Dean of the Graduate School through the office of the Dean of the College of Engineering. Administrative and fiscal responsibility is within the office of the Dean.

The minimum qualifications for the position of Director of the PSBR are an advanced degree in science or engineering, and 2 years experience in reactor operation. Five years of experience directing reactor operations may be substituted for an advanced degree.

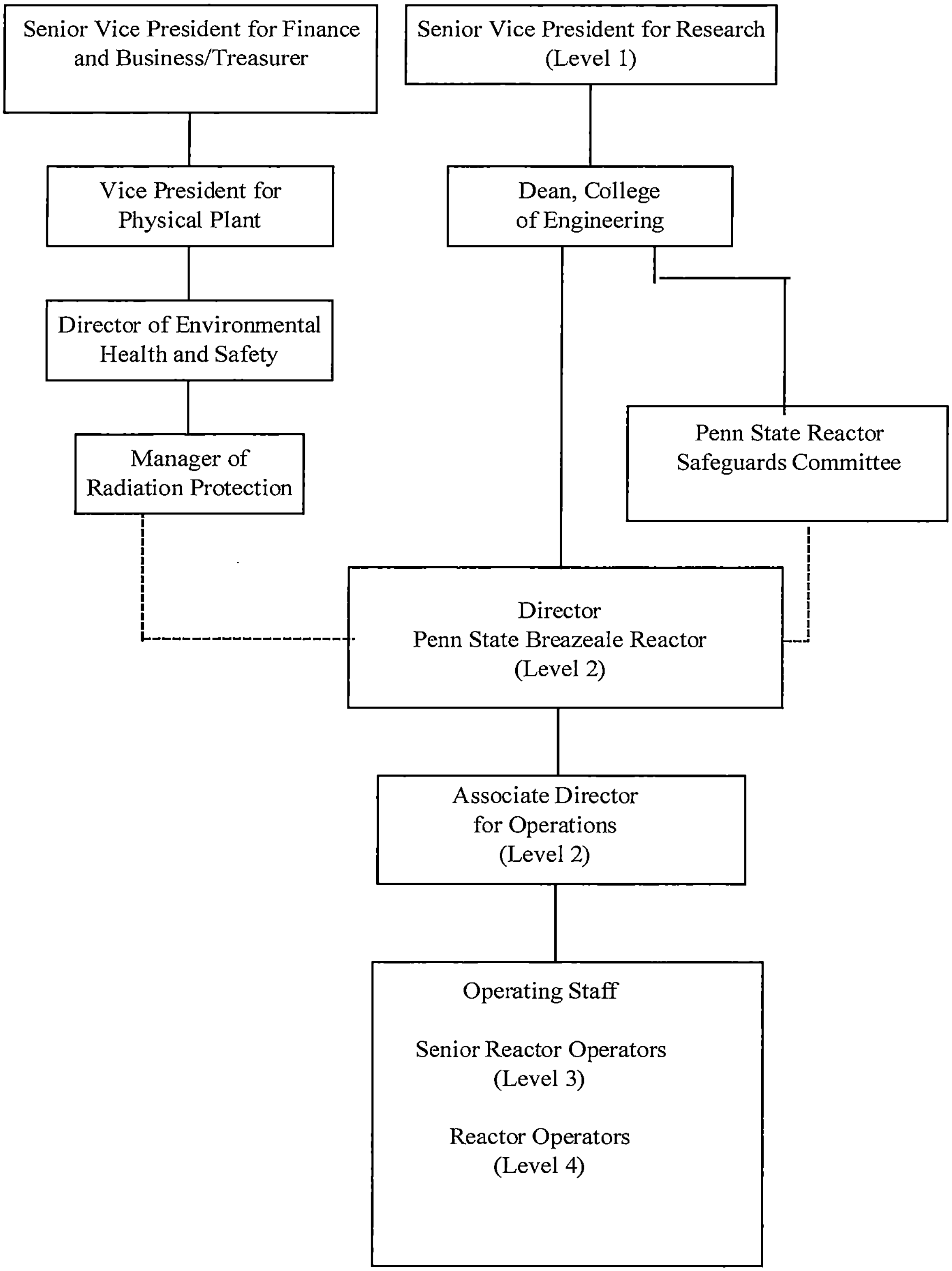
The Manager of Radiation Protection reports through the Director of Environmental Health and Safety, the assistant Vice President for Safety and Environmental Services, and to the Senior Vice President for Finance and Business/Treasurer. The qualifications for the Manager of Radiation Protection position are the equivalent of a graduate degree in radiation protection, 3 to 5 years experience with a broad byproduct material license, and certification by The American Board of Health Physics or eligibility for certification.

6.1.2 Responsibility

Responsibility for the safe operation of the reactor facility SHALL be within the chain of command shown in the organization chart. Individuals at the various management levels, in addition to having responsibility for the policies and operation of the reactor facility, SHALL be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adhering to all requirements of the operating license and technical specifications.

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

ORGANIZATION CHART



3.0 LIMITING CONDITIONS FOR OPERATION

The limiting conditions for operation as set forth in this section are applicable only when the reactor is operating. They need not be met when the reactor is shutdown unless specified otherwise.

3.1 Reactor Core Parameters

3.1.1 Non-Pulse Mode Operation

Applicability

These specifications apply to the power generated during manual control mode, automatic control mode, and square wave mode operations.

Objective

The objective is to limit the source term and energy production to that used in the Safety Analysis Report.

Specifications

a. The reactor may be operated at steady state power levels of 1 MW (thermal) or less.

b. The maximum power level SHALL be no greater than 1.1 MW (thermal).

c. The steady state fuel temperature SHALL be a maximum of 650°C as measured with an instrumented fuel element if it is located in a core position representative of MEPD in that loading. If it is not practical to locate the instrumented fuel in such a position, the steady state fuel temperature SHALL be calculated by a ratio based on the calculated linear relationship between the normalized power at the monitored position as compared to normalized power at the core position representative of the MEPD in that loading. In this case, the measured steady state fuel temperature SHALL be limited such that the calculated steady state fuel temperature at the core position representative of the MEPD in that loading SHALL NOT exceed 650°C.

Basis

a. Thermal and hydraulic calculations and operational experience indicate that a compact TRIGA reactor core can be safely operated up to power levels of at least 1.15 MW (thermal) with natural convective cooling.

b. Operation at 1.1 MW (thermal) is within the bounds established by the SAR for steady state operations. See Chapter 13, Section B~~C~~ of the SAR.

c. Limiting the maximum steady state measured fuel temperature of any position to 650°C places an upper bound on the fission product release

3.5 Engineered Safety Features - Facility Exhaust System and Emergency Exhaust SystemVentilation Systems

Applicability

This specification applies to the operation of the facility exhaust systemreactor bay heating ventilation and exhaust system (RBHVES) and the emergency exhaust system (EES).

Objective

The objective is to mitigate the consequences of the release of airborne radioactive materials resulting from reactor operation.

Specification

a. EXCEPT for conditions 3.5.a(i) and 3.5.a(ii), the reactor SHALL NOT be operated unless reactor bay differential pressure is negative.
   (i) Following discovery of loss of negative differential pressure, the reactor may be operated for up to 30 minutes while negative differential pressure is restored.
   (ii) The reactor may continue to operate during brief changes to bay pressure that are not long enough to extinguish the RBHVES differential pressure indicator lamp.

a. If the reactor is operating, at least one facility exhaust fan SHALL be operating and, except for periods of time less than 48 hours during maintenance or repair, the emergency exhaust system SHALL be operable.

b. If irradiated fuel or a fueled experiment with significant fission product inventory is being moved outside containers, systems or storage areas, at least one facilityreactor bay exhaust fan SHALL be operating and the emergency exhaust system SHALL be operable.

   Upon discovery of no operating reactor bay exhaust fans OR discovery of an inoperable emergency exhaust system, immediately place the fuel or fueled experiment in a safe storage location and cease further movements until compliance with 3.5.b is restored.

Basis

During normal operation, the concentration of airborne radioactivity in unrestricted areas is below effluent release limits as described in the Safety Analysis Report, Chapter 13. In the event of a substantial release of airborne radioactivity, an air radiation monitor and/or an area radiation monitor will sound a building evacuation alarm which will automatically cause the facility exhaust system to close and the exhausted air to be passed through the emergency exhaust system filters before release. This reduces the radiation within the building. The filters will remove ≈ 90% all of the particulate fission products that escape to the atmosphere.

The emergency exhaust system activates only during an evacuation whereupon all personnel are required to evacuate the building (TS 3.6.2). If there is an evacuation

~~while the emergency exhaust system is out of service for maintenance or repair, personnel evacuation is not prevented.~~

~~In the unlikely event an accident occurs during emergency exhaust system maintenance or repair, the public dose will be equivalent to or less than that calculated in the Safety Analysis Report, Chapter 13.~~
During normal operation, the concentration of airborne radioactivity in unrestricted areas is below effluent release limits as described in the Safety Analysis Report, Chapter 13. The operation of any of the reactor bay exhaust fans, either the reactor bay heating ventilation and exhaust system or emergency exhaust system, will maintain this condition and provide confinement as defined by TS 1.1.8. If all exhaust from the reactor bay is temporarily lost, the thirty minute limit to restore exhaust gives the operators sufficient time to investigate and respond by checking for penetrations into the confinement bay and energizing fans. Reactor bay area radiation and/or particulate radiation monitors will continue to assure than an unrecognized hazardous condition does not develop. The RBHVES differential pressure indicator lamp is in plain view of the reactor operator in the control room. Due to integration time constants built into the RBHVES control software, brief (<5 minute) losses of differential pressure will not change the state of the indicator lamp.

In the event of a substantial release of airborne radioactivity, an air radiation monitor and/or an area radiation monitor will sound a building evacuation alarm which will alert personnel and automatically cause the reactor bay heating ventilation and exhaust system to shut down. The emergency exhaust system will start and the exhausted air will be passed through the emergency exhaust system filters before release. This reduces the radiation within the building. The filters will remove $\approx$ 90% all of the particulate fission products that escape to the atmosphere.
The emergency exhaust system activates only during an evacuation whereupon all personnel are required to evacuate the building (TS 3.6.2). If there is an evacuation while the emergency exhaust system is out of service for maintenance or repair, personnel evacuation is not prevented.

In the unlikely event an accident occurs during emergency exhaust system maintenance or repair, the public dose will be equivalent to or less than that calculated in the Safety Analysis Report, Chapter 13.

During irradiated fuel or fueled experiment movement, the likelihood of an event releasing fission products is increased. Therefore the continuous operation of a reactor bay exhaust fan and the availability of an operable filtered exhaust is prudent. If the system fails or is discovered to be inoperable during movement activities, the fuel or fueled experiment must be immediately placed in a safe storage location. No additional movements may be conducted until the limiting condition for operation is satisfied.

3.6 Radiation Monitoring System

3.6.1 Radiation Monitoring Information

Applicability

This specification applies to the radiation monitoring information which must be available to the reactor operator during reactor operation.

Objective

The objective is to ensure that sufficient radiation monitoring information is available to the operator to ensure personnel radiation safety during reactor operation.

Specification

The reactor SHALL NOT be operated unless the radiation monitoring channels listed in Table 3 are operating.

Table 3
Radiation Monitoring Channels

Radiation Monitoring Channels	Function	Number
Area Radiation Monitor	Monitor radiation levels in the reactor bay.	**1**
Continuous Air (Radiation) Monitor	Monitor radioactive particulates in the reactor bay air.	**1**
Neutron Beam~~Beamhole~~ Laboratory Monitor	Monitor radiation in the Beamhole Laboratory (required only when the laboratory is in use.)	**1**

Basis

a. The radiation monitors provide information to operating personnel of any impending or existing danger from radiation so that there will be sufficient time to evacuate the facility and to take the necessary steps to control the spread of radioactivity to the surroundings.

b. The area radiation monitor in the ~~Beamhole~~Neutron Beam Laboratory provides information to the user and to the reactor operator when this laboratory is in use.

~~information to the user and to the reactor operator when this laboratory is in use.~~

4.5 ~~Facility Exhaust System and Emergency Exhaust System~~Ventilation Systems

Applicability

These specifications apply to the ~~facility exhaust~~reactor bay heating ventilation and exhaust system and emergency exhaust system.

Objective

The objective is to ensure the proper operation of the ~~facility~~reactor bay heating ventilation and exhaust system and emergency exhaust system in controlling releases of radioactive material to the uncontrolled environment.

Specifications

a. It SHALL be verified monthly, not to exceed 6 weeks, whenever operation is scheduled, that the emergency exhaust system is operable with correct pressure drops across the filters (as specified in procedures).

b. It SHALL be verified monthly, not to exceed 6 weeks, whenever operation is scheduled, that the reactor bay heating ventilation and~~facility~~ exhaust system is secured when the emergency exhaust system activates during an evacuation alarm (See TS 3.6.2 and TS 5.5).

c. Reactor bay differential pressure monitors SHALL be calibrated annually, not to exceed 15 months.

Basis

Experience, based on periodic checks performed over years of operation, has demonstrated that a test of the exhaust systems on a monthly basis, not to exceed 6 weeks, is sufficient to ensure the proper operation of the systems. This provides reasonable assurance on the control of the release of radioactive material. Annual calibration of the differential pressure sensors will ensure the accurate assessment of reactor bay negative pressure as required by TS 3.5.

4.6 Radiation Monitoring System and Effluents

4.6.1 Radiation Monitoring System and Evacuation Alarm

Applicability

This specification applies to surveillance requirements for the area radiation monitor, the ~~Beamhole~~Neutron Beam Laboratory radiation monitor, the air radiation monitor, and the evacuation alarm.

Objective

The objective is to ensure that the radiation monitors and evacuation alarm are operable and to verify the appropriate alarm settings.

Specification

The area radiation monitor, the ~~Beamhole~~Neutron Beam Laboratory radiation monitor, the
continuous air (radiation) monitor, and the evacuation alarm system SHALL be channel tested monthly not to exceed 6 weeks. They SHALL be verified to be operable by a channel check daily when the reactor is to be operated, and SHALL be calibrated annually, not to exceed 15 months.

Basis

Experience has shown this frequency of verification of the radiation monitor set points and operability and the evacuation alarm operability is adequate to correct for any variation in the system due to a change of operating characteristics. Annual channel calibration ensures that units are within the specifications defined by procedures.

4.6.2 Argon-41

Applicability

This specification applies to surveillance of the Argon-41 produced during reactor operation.

Objective

To ensure that the production of Argon-41 does not exceed the limits specified by 10 CFR Part 20.

Specification

The production of Argon-41 SHALL be measured and/or calculated for each new experiment or experimental facility that is estimated to produce a dose greater than 1 mrem at the exclusion boundary.

Basis

One (1) mrem dose per experiment or experimental facility represents 1% of the maximum 10 CFR Part 20 annual dose. It is considered prudent to analyze the Argon-41 production for any experiment or experimental facility that exceeds 1% of the annual limit.

4.6.3 ALARA

Applicability

This specification applies to the surveillance of all reactor operations that could result in occupational exposures to radiation or the release of radioactive effluents to the environs.

Objective

5.5 Reactor Bay and Exhaust Systems

Specifications

a. The reactor SHALL be housed in a room (reactor bay) designed to restrict leakage. The minimum free volume (total bay volume minus occupied volume) in the reactor bay SHALL be 1900 m^3.

b. The reactor bay SHALL be equipped with two exhaust systems. Under normal operating conditions, the ~~facility~~reactor bay heating ventilation and exhaust system exhausts unfiltered reactor bay air to the environment releasing it at a point at least 24 feet above ground level. Upon initiation of a building evacuation alarm, the previously mentioned system is automatically secured (fans deenergized and exhaust dampers closed) and an emergency exhaust system automatically starts. The emergency exhaust system is also designed to discharge reactor bay air at a point at least 24 feet above ground level.

Basis

The value of 1900 m^3 for reactor bay free volume is assumed in the SAR 13.1.1 Maximum Hypothetical Accident and is used in the calculation of the radionuclide concentrations for the analysis.

The SAR analysis 13.1.1 Maximum Hypothetical Accident does not take credit for any filtration present in the emergency exhaust system. ~~The~~ Although analyzed as a ground release, the height above the ground of the release helps to ensure adequate mixing prior to possible public exposure.

5.6 Reactor Pool Water Systems

Specification

The reactor core SHALL be cooled by natural convective water flow.

Basis

Thermal and hydraulic calculations and operational experience indicate that a compact TRIGA reactor core can be safely operated up to power levels of at least 1.15 MW (thermal) with natural convective cooling.

6.0 ADMINISTRATIVE CONTROLS

6.1 Organization

6.1.1 Structure

The University Senior Vice President for ~~Research Dean of th~~Research ~~e Graduate School~~ (level 1) has the responsibility for the reactor facility license. The management of the facility is the responsibility of the Director (level 2), who reports to the Senior Vice President for Research, Dean of the Graduate School through the office of the Dean of the College of Engineering. Administrative and fiscal responsibility is within the office of the Dean.

The minimum qualifications for the position of Director of the PSBR are an advanced degree in science or engineering, and 2 years experience in reactor operation. Five years of experience directing reactor operations may be substituted for an advanced degree.

The Manager of Radiation Protection reports through the Director of Environmental Health and Safety, the assistant Vice President for Safety and Environmental Services, and to the Senior Vice President for Finance and Business/Treasurer. The qualifications for the Manager of Radiation Protection position are the equivalent of a graduate degree in radiation protection, 3 to 5 years experience with a broad byproduct material license, and certification by The American Board of Health Physics or eligibility for certification.

6.1.2 Responsibility

Responsibility for the safe operation of the reactor facility SHALL be within the chain of command shown in the organization chart. Individuals at the various management levels, in addition to having responsibility for the policies and operation of the reactor facility, SHALL be responsible for safeguarding the public and facility personnel from undue radiation exposures and for adhering to all requirements of the operating license and technical specifications.

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

ORGANIZATION CHART