**University at Buffalo**
*The State University of New York*

**Environment, Health & Safety Services**

November 16, 2004

Document Control Desk
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Buffalo Materials Research Center
Environment, Health and Safety
State University of New York at Buffalo
220 Winspear Avenue
Buffalo, New York 14215-1034

Reference: Docket 50-57
License R-77

Dear Sir or Madam:

The State University of New York at Buffalo is submitting the following Oath and Affirmation in accordance with Title 10, Code of Federal Regulations, regarding the submission of the request for amendment to the Technical Specifications of the subject license. The original submission of the request, dated April 27, 2004, did not include the required Oath and Affirmation.

The original request letter, *Request for Amendment, Appendix A, Technical Specifications, Buffalo Materials Research Center* and *Amendment 26 to the Technical Specifications* are attached. The Oath and Affirmation applies to the content of the entire submittal, dated April 27, 2004.

I verify under penalty of perjury that the foregoing is true and correct.

Executed on November 16, 2004.

David R. Vasbinder, Director, BMRC

On this 16th day of November, 2004, before me, the subscriber, personally appeared David R. Vasbinder, to me personally known to be the person described in and who executed the foregoing release and he duly acknowledged to me that he executed the same

Anne P. Westmorland
Notary Public

ANNE P. WESTMORLAND 4784632
NOTARY PUBLIC, State of New York
Qualified in Niagara County
My Commission Expires March 30, 2007

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Dear Sir or Madam:

The State University of New York at Buffalo (hereafter the University) requests amendment to the Technical Specifications of the subject license. The requested changes are detailed in the attached document, "Request for Amendment, Appendix A, Technical Specifications, Buffalo Materials Research Center", and include deletion of the facility 50 meter high exhaust system, and its associated instrumentation, modification of fuel storage requirements, minor modification of required surveillances, and minor administrative changes. The requested changes have been approved by the Reactor Decommissioning Safety Committee.

The BMRC reactor has been shut down since 1994, and the current Technical Specifications authorize "possession only" of the reactor. The University has been unable thus far to ship the BMRC fuel assemblies to a DOE facility. However, we currently expect that we will be able to ship the fuel by the Fall of 2004. With almost ten years of decay, there has been a significant reduction in the fuel radioactivity levels since shutdown in 1994.

The BMRC stack exhaust system was installed within the nearby campus heating plant, which provides steam to heat the various buildings on campus. The heating plant is currently undergoing major renovations. During the course of the renovation project it was necessary to tear down the stack and the fan system located within the heating plant. The stack exhaust system is only required by technical specifications to be operating during fuel handling operations.

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The stack exhaust system was designed to provide controlled release of radioactive gases from reactor irradiation facilities and in the event of significant accidents, when the reactor was running, or after a minimal decay period. Analyses, as described in the amendment request, have demonstrated that the "Building Air" system that exhausts through the room of the reactor containment building is adequate to protect the public with respect to the greatly diminished fuel radioactivity levels.

In order to meet our target shipping date in the Fall of 2004, we are requesting that the NRC endeavor to review and approve this request for amendment as soon as possible. At this time the DOE has stated its intention to inspect the fuel before shipment. Fuel handling operations would be necessary to conduct such inspections. Please contact myself, Mark Adams or Harry Miller if you have questions or require additional information.

Sincerely,

David R. Vasbinder, Director, BMRC

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# Request for Amendment
# Appendix A
# Technical Specifications
# Buffalo Materials Research Center

**Reference: License R-77**
**Docket: 50-57**

1. <u>Background:</u>

The BMRC reactor has been shutdown since 1994. "Possession Only" Technical Specifications were issued February 13, 1997. The university has experienced a lengthy waiting period, to return the reactor fuel to the DOE. Shipment of the fuel is now expected to occur during the fall of 2004.

As originally constructed, air was exhausted from the reactor containment building by two fan systems. A 50-meter high "Stack Exhaust" system was used to exhaust air from fume hoods and irradiation facilities. A second exhaust system referred to as the "Building Air" system exhausts the general breathing air in the reactor building and certain low-level fume hoods. A six-inch diameter emergency exhaust duct was tied into the stack system, in the event of a significant reactor accident, to provide containment pressure control and controlled (slow) venting of potential airborne contaminants.

As part of a major renovation of the campus steam heating plant, the Stack Exhaust system was dismantled. Current Technical Specifications only require operation of the stack exhaust during fuel handling operations.

The university has re-evaluated the potential airborne releases from fuel cladding failure events, in light of the nominal ten-year fuel decay period, and has determined that a stack exhaust system is no longer required to provide adequate protection of the public and plant workers.

The university is therefore requesting amendment of the technical specifications to delete the stack and six-inch exhaust systems.

The current technical specifications allow for the storage of irradiated fuel within the reactor tank, hot cell, or similar "alternate storage" facilities. It is specifically required that any alternative storage facilities be vented to the stack exhaust (as is the Hot Cell). The university has analyzed the potential consequences of cladding failure within the containment building, and determined that it is no longer necessary to vent fuel storage facilities to the stack. Modification of the technical specifications is therefore also requested to delete the requirements that fuel storage facilities be vented to the stack.

In addition, minor modifications of other sections of the technical specifications are requested as further outlined below

## 2. Existing Systems and Specifications

### 2.1. Original Ventilation System

The original ventilation system design consisted of the following primary components:

- **"AC 1" Supply** – providing conditioned make up air to the containment building. Located within the subbasement this system drives air into the containment through an 18-inch penetration, and distributes it though ducts to various locations within the containment building
- **Fume Hood Supply** –providing additional make up air in proximity to fume hoods within containment. This system also penetrates containment through an 18-inch duct, and distributes the air through various ducts.
- **Building Air Exhaust** – exhausting general breathing air from the containment and certain low level fume hoods. This 36-inch duct exits through the containment roof. All exhaust air was HEPA filtered.
- **Stack Exhaust** – Drawing air from reactor irradiation facilities and fume hoods, this duct exits the containment through an 18-inch penetration in the subbasement. This exhaust system utilized two fans operating in series; one located in the subbasement, the other within the campus heating plant. The exhaust duct traveled underground from BMRC to the heating plant, and then upwards to a height of 50 meters, within the heating plant masonry chimney.
- **Pratt Dampers** – these hydraulic activated pancake dampers are located in the AC1, Fume Hood Supply, Building Air, and Stack Exhaust ducts. The Building Air Pratt Damper is located within containment shortly before the duct penetrates the roof. The remaining dampers are located within the subbasement, just after the ducts exit containment. In the event of an emergency the dampers may be closed thus sealing off the containment building. In the event of a damper closure, the ventilation fans, with the exception of the fan located in the campus heating plant shut down.

  Currently specifications require that the dampers trip automatically in the event of coincident high radiation alarms on the bridge area radiation monitor and the building air gaseous activity monitor.

- **Emergency Bypass** – this 6-inch diameter system was used to control pressure in the containment in the event of an emergency. When the Pratt dampers close, and seal the primary ducts, this small duct remains open, with flow controlled by a modulating damper. The fan in the heating plant continues to operate, drawing the majority of its air from a large diameter bypass damper and duct located in the heating plant. A relatively small amount of air is drawn thru the six-inch bypass line from containment. This keeps the air pressure in containment negative. The flow rate is limited by the "leakage" rate of the containment building, which is typically less than 10 CFM. The six-inch line is equipped with HEPA and activated charcoal filters.

- **Pressure Relief Valve** – a pressure relief valve is installed in the six-inch bypass duct to prevent structural damage to the containment in the event of a large pressure excursion (such as from fire or steam explosion). This relief valve is located in the duct just as it exits the containment wall.

- **Irradiated Fuel Storage** – currently irradiated fuel may be stored in the reactor tank, the hot cell, or "alternative facilities" subject to a series of specific requirements. One such requirement for alternative storage facilities is that it be vented to the stack exhaust system (as is the hot cell)

Appendix I provides schematic diagrams of the original ventilation system.

Most of the ventilation system remains operational; however the above ground segments of the stack exhaust and the fan located within the heating plant have already been dismantled.

### 2.2. Existing Exhaust Monitoring Systems

Both the Building Air and Stack exhaust systems were equipped with radioactivity monitoring systems. A small side stream of air was drawn from the duct, passed thru a fixed position filter, and then through a gaseous activity sampling tank, before return into the duct. Rate meters and GM tubes were employed to measure the radioactivity accumulated on the fixed filter, and within the gas sampling tank.

### 2.3. Selected Surveillance Requirements

Current surveillance requirements include:

- Gross Beta Analysis of the reactor tank water weekly
- Gamma spectroscopic analysis of the reactor tank water three times per year.

The intent of these specifications is to detect failure of the fuel or excessive corrosion of activated materials within the reactor tank

## 3. Proposed Changes to Systems and Specifications

### 3.1. Proposed Changes in the Ventilation System

The stack exhaust system will be eliminated. The remaining exhaust fan will be permanently removed from service. The duct will be sealed shut outboard of the Pratt damper, and the Pratt Damper will be closed. All fans that provide air to this duct will be electrically disabled or disconnected from the ducts exiting containment.

In addition the six inch emergency bypass duct will be removed from service. The duct will be sealed shut immediately outboard of the pressure relief valve.

The supply air systems will not be modified. It is anticipated that only the AC1 supply system will be routinely operated. This system will provide adequate makeup

air, and the additional capacity of the fume hood supply system will not typically be needed.

### 3.2. Proposed Changes in the Radiation Monitoring Systems

The particulate and gaseous radiation monitoring instruments for the stack exhaust will be removed from service. The remaining effluent monitors will remain in service.

### 3.3. Proposed Changes Pratt Damper System

Under the proposed specifications the automatic triggering system requirement is deleted, but it is required that a qualified individual be present to manually trigger the dampers during fuel handling operations.

### 3.4. Proposed Changes Irradiated Fuel Storage Facilities

The requirement that the Hot Cell or "alternative" storage facilities be ventilated to the stack exhaust system has been eliminated.

### 3.5. Proposed Changes Pool Water Surveillance Requirements

Under the proposed specifications the requirement for Gross Beta analysis of the pool water has been changed to quarterly, and the Gamma Spectroscopic requirement has been changed to semi-annual.

### 3.6. Proposed Change in Organization

Minor revisions have been made in the section 11.1 of the Technical Specifications which prescribes the organizational structure and minimum staffing requirements for the Facility. The role of the Director of Environment Health and Safety has been clarified to be an administrative oversight role, while the role of the Director has been clarified to include direct responsibility for all aspects of facility safety and compliance.

## 4. Justification for Changes

### 4.1. Elimination of the Stack Exhaust Systems

#### 4.1.1. Effluent Release Limit

The current Technical Specifications allow for releases from the stack exhaust in excess of the limits imposed by 10 CFR 20, taking into account prevailing meteorological conditions and dilution from the 50 meter high release point. With the stack eliminated, all effluents will be through the building air system, and the building air effluent limit will therefore apply.

The Technical Specifications require that the yearly averaged release concentration from the building air duct be less than the effluent limit imposed by 10 CFR 20 (Appendix B, Table (2)) No change in this specification has been requested.

Activities conducted within the containment do not typically produce significant airborne radioactivity, however such activities could potentially occur in the future. Since the exhaust air is HEPA filtered, a minimum of a 1000 fold reduction in the concentration or airborne particulates would occur. Gaseous airborne radioactivity could be generated by certain activities such as cutting or welding on contaminated materials. Such situations would need to be evaluated on a case by case basis, taking into consideration both worker exposures and potential releases. The current release limit restricts releases to the limit imposed by 10 CFR 20, without consideration of dilution from the exhaust release point to ground level, or occupancy factors.

### 4.2. Impact on Fuel Storage and Handling Operations

Currently all irradiated fuel is stored within the reactor tank. One or more fuel elements could experience a loss of cladding integrity as a result of corrosion failure, or mechanical events such as being dropped, or having a heavy object dropped upon it. This could release any gaseous activity in the cladding/fuel gap (krypton 85) and could release some particulate fuel debris (multiple isotopes). There is little likelihood for significant airborne particulates because of the mechanism for cladding failure and the potential "scrubbing effect" of the tank water.

In order to remove the reactor fuel from the facility it will be transferred from the reactor tank into a shipping cask. It is expected, that one or more "shuttle" casks will be used to transfer the fuel from the tank into the shipping cask. This is required since size and floor loading constraints will likely prohibit loading fuel directly into a shipping cask. Fuel will be loaded into a basket within the shuttle cask under water. The shuttle cask is then transferred in air to the shipping cask, and the fuel is lowered into the shipping cask.

If irradiated fuel were to be stored in the hot cell or an alternative storage facility that is not vented to the stack, the potential for exposure of the staff or public from the release of the krypton-85 inventory would not be increased or diminished in comparison to storage in the reactor tank. Such storage would be subject to review by the Reactor Decommissioning Safety Committee, and HEPA filtration could be utilized to reduce potential airborne particulate contaminants.

### 4.3. Potential Kr-85 Releases from Fuel Assemblies.

The Krypton 85 inventory of the fuel was estimated using the ORIGEN computer code.

In the event of a release of Kr-85 from a fuel element (pin) the radioactive gas will diffuse into containment. Since the gas is inert, it will mix with air within

containment and eventually exhaust through the building air duct. A worst case fuel pin would contain approximately 1.06 curies of Kr-85, and an average pin would contain about 0.9 curies. Not all of this activity would be diffused into the cladding-pellet gap. Because it is chemically inert, exposure to krypton 85 results from direct "immersion" in the contaminated air. Skin exposure from the krypton-85 will be approximately 100 times the penetrating exposure.

Without an exact mechanism for failure of the fuel pin(s) it is difficult to model the timing and pattern of diffusion of the Kr-85 gas within containment, and the concentration at the point of release. Using very conservative models however it is demonstrated that such releases will not expose the facility staff or members of the public to unreasonably high levels of radiation.

The actual exposures to members of the public and the staff are bounded by two extreme cases:

#### 4.3.1. Rapid release

Under this scenario the krypton gas rapidly diffuses out through the exhaust system with minimal residency time within containment and minimal dilution. This would potentially create the highest exposure to a member of the public. Calculations were performed assuming that the krypton is released over a three minute period, and that a member of the public is directly below the emission point at ground level for the full three minutes. A conservative dilution factor of ten was assumed. The average effluent concentration (without dilution) was calculated for the release period, and averaged over 24 hours, 30 days, and one year. The skin and penetrating exposures to a member of the public was also estimated (diluted by a factor of 10). The worst case scenario was estimated to be the complete and immediate release of the krypton from seven high burnup fuel assemblies (the number of assemblies that will be loaded into a fuel basket at one time)

#### 4.3.2. Confined release (within containment)

Under this scenario essentially all of the krypton gas is held within containment, and diffuses initially into a fraction of the containment volume, and eventually into the entire volume. This would result in the maximum potential exposure to workers within the facility. For this scenario the exposure to a worker was estimated assuming the worker spends a cumulative time of three minutes securing from fuel failure operations and exiting the containment building.

Highly conservative estimations of the releases and exposures from the two bounding cases were performed and summarized in Appendix II. Failure of a single pin, a single fuel assembly, and the simultaneous failure of 7 high burnup fuel assemblies were analyzed.

#### 4.3.3. Conclusions

Using highly conservative methods it was determined that for the complete simultaneous failure of 7 high burnup fuel assemblies:

- Maximum estimated penetrating exposure to a member of the public would be approximately 6.3 mrem.
- Maximum estimated skin exposure to a member of the public would be approximately 630 mrem.
- The maximum release concentration averaged over 24 hours was determined to be 1.1 E-03 micro curies per cc
- The estimated worst case worker penetrating exposure was estimated to be 250 mrem
- The estimated worst case worker skin exposure was estimated to be 25 rem

Using highly conservative methods it was determined that for the complete failure of a single high burn up fuel assembly:

- Maximum estimated penetrating exposure to a member of the public would be approximately 0.9 mrem.
- Maximum estimated skin exposure to a member of the public would be approximately 90 mrem.
- The maximum release concentration averaged over 24 hours was determined to be 1.6 E-04 micro curies per cc
- The estimated worst case worker penetrating exposure was estimated to be 36 mrem
- The estimated worst case worker skin exposure was estimated to be 3.6 rem

Using highly conservative methods it was determined that for the complete failure of a single high burn up fuel pin:

- Maximum estimated penetrating exposure to a member of the public would be approximately 0.036 mrem.
- Maximum estimated skin exposure to a member of the public would be approximately 3.6 mrem.
- The maximum release concentration averaged over 24 hours was determined to be 6.5 E-06 micro curies per cc
- The estimated worst case worker penetrating exposure was estimated to be 1.4 mrem
- The estimated worst case worker skin exposure was estimated to be 145 mrem

The worst case occupational exposures as summarized above (complete failure of seven fuel assemblies) would be approximately 5% of the annual occupational limit established by 10 CFR 20 for deep dose, and approximately 50% of the annual limit for shallow dose. In consideration of this, and the low probability of this event occurring, one may conclude that it is reasonable to eliminate the stack exhaust system.

The corresponding worst case public exposure (penetrating) of 6.3 millirem is substantially lower than the 100 millirem per year limit established by 10CFR20. In addition this potential exposure is significantly lower than the postulated public exposures resulting from the design basis accident (criticality accident resulting in partial fuel melt and cladding failure) which was accepted by the NRC when the reactor was licensed for operation at 2 megawatts.

### 4.4. Elimination of the six inch bypass system:

The intent of the bypass duct was to control pressure in the containment under damper scram conditions, and to allow for slow venting of airborne contaminants. This was required because of the much larger inventories of gaseous radioactivity within the fuel, in particular radioactive iodine.

All iodine has by now decayed away, and the only substantive gaseous isotope is the krypton 85. As demonstrated above venting on the krypton through the building air system will not create unacceptable exposures to the public or staff.

It is however important to continue to protect the building from over-pressurization or under-pressurization events such as may occur in a fire. This is provided by leaving the existing relief valve in place. The relief valve will continue to function in the same manner, since it will be inboard of the location where the duct has been sealed off.

### 4.5. Elimination of the Stack Monitoring System

Since the stack exhaust system will be removed, there will be no need for the associated monitoring system.

### 4.6. Elimination of Requirement to Vent Fuel Storage Facilities to the Stack System

The calculations described above has demonstrated that the krypton releases resulting from fuel failure, may be appropriately vented through the building air system, irrespective of whether the fuel was stored in the pool, hot cell, or other facilities within containment. If appropriate, HEPA filtration can be used for fuel storage in the Hot Cell or alternative facilities which would provide protection equivalent to or superior to pool storage (from the standpoint of worker protection). All effluents through the building air system are already HEPA filtered to protect the environment.

### 4.7. Reduction in Pool Water Surveillance Requirements

The reactor has now been shutdown for more than nine years. Appendix III provides a summary of the results of the gross beta and gamma spectroscopic analyses. This data demonstrates the stability of the data, and justifies performing the analyses on a less frequent basis.

## 4.8. Elimination of Pratt Damper Automatic Triggering

When the reactor was operational, it was often left unattended (in a secured condition), with a relatively high inventory of fission and activation products (in particular iodine). This for example would occur when the reactor was shutdown for the weekend. It was therefore appropriate to support a system that would automatically trigger the Pratt dampers under simultaneous conditions of high area radiation and high levels of gaseous effluent.

Unless fuel handling operations or other operations involving the manipulation of heavy objects in proximity to the reactor tank are underway, there is an extremely low probability that fuel cladding integrity will be compromised with the exception of corrosion failure. A corrosion based fuel failure would likely result in the slow release of the krypton from a single, or perhaps a few fuel pins. The calculations described above demonstrate that such a failure, would have very minor radiological consequences, and therefore the automatic damper triggers are no longer needed.

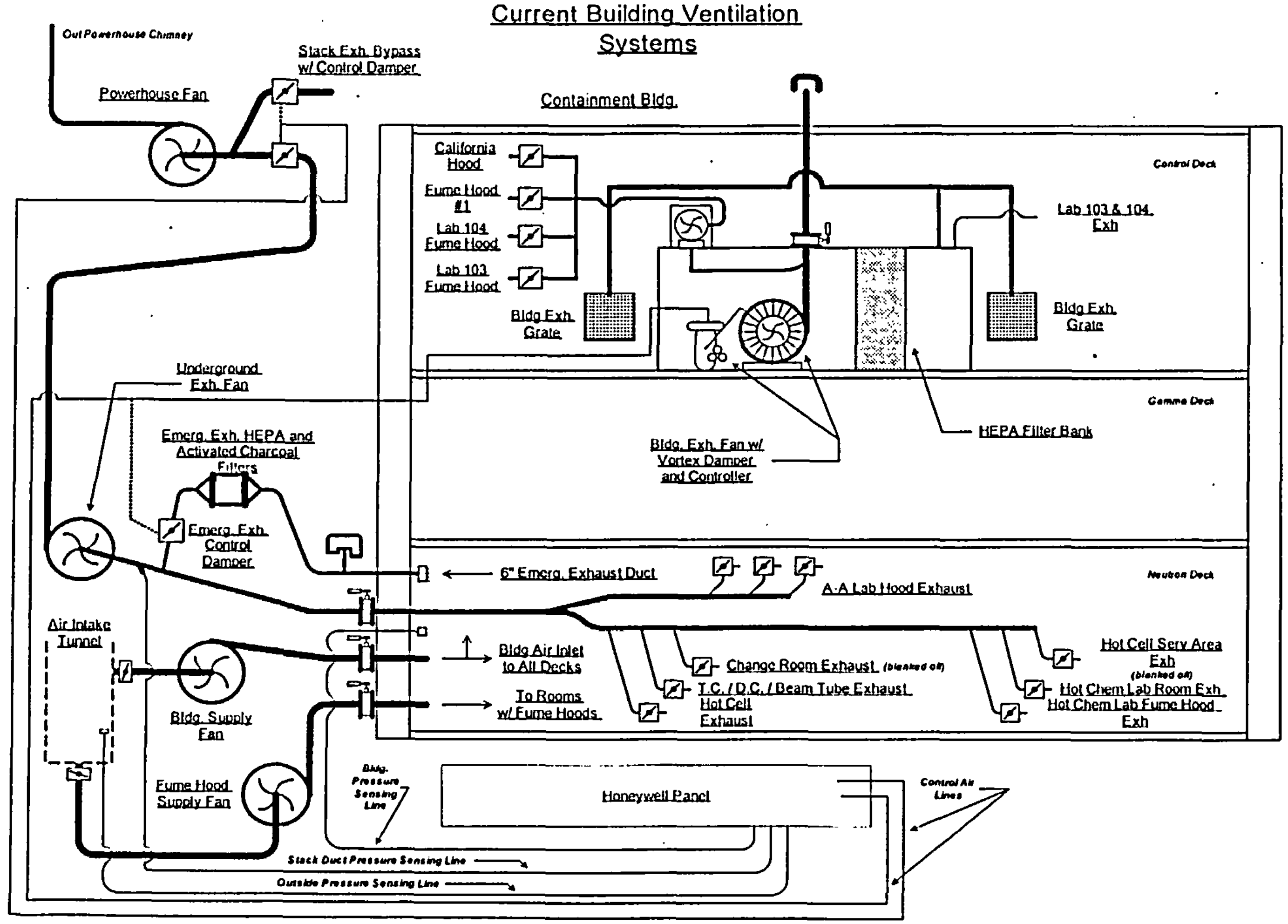
At the same time the effort required to continue to maintain the automatic triggering capability is substantial (in light of the age of the electronics). The precedent already exists in the current technical specifications to allow for manual activation during fuel handling operations. The proposed technical specifications clarify these requirements.

## 4.9. Justification for Administrative Changes

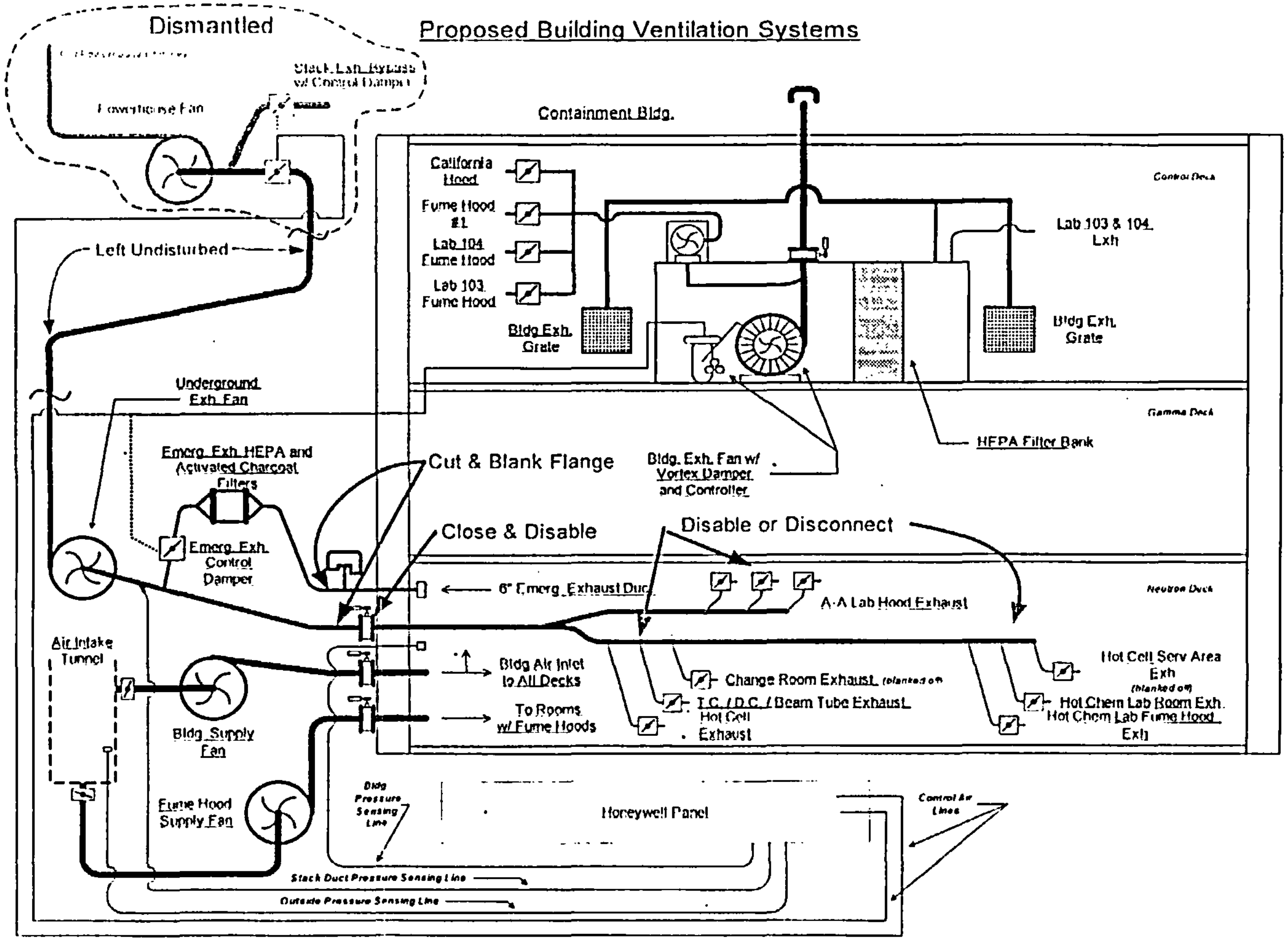
The proposed changes reflect the best allocation of resources and expertise to effectively manage the facility and ensure safety, and a name change for the campus safety department. The current Director of EH&S is an experienced administrator and safety professional, however he does not have historic direct involvement in the operation of the reactor facility. The current Director of BMRC however, has a long history of direct hands on experience specific to the operational and safety aspects of the facility.

# Appendix I
# Ventilation System Diagrams

## Current Building Ventilation Systems



# Proposed Building Ventilation Systems



# Appendix II
# Summary of Release and Exposure Calculations

# Case 1 – Rapid Release

**Assumptions:**

- Building Air exhaust rate of 4000 CFM
- All krypton released to the environment in 3 minutes
- All of the krypton 85 has diffused into the cladding/pellet gap (a very conservative assumption)

**Quantities Released: (estimated using ORIGEN Code)**

- 0.87 curies – "average" single pin failure
- 1.06 curies – worst case single pin failure
- 21.7 curies – average fuel assembly (25 pins)
- 26.4 curies – worst case fuel assembly (25 pins)
- 152 curies – (7) average fuel assemblies
- 185 curies – (7) worst case fuel assemblies

**Estimation Methods:**

- Release concentration – divide quantity released by total flow over 3 minute period, to determine average release concentration
- Assume no additional releases and constant flow to estimate average concentrations over 24 hours, 30 days, and one year
- Limiting case exposure to member of the public – assume that person is present for full three minute duration of release, and there is dilution factor of 10 at ground level
- Exposure rate – conversion factor of 1.74 E3 (mrem/hour)/(micro curie/cc) for penetrating exposure, and 1.74E5 for skin exposures (reference Federal Guidance Report No. 11 – Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion and Ingestion (USEPA)

**Summary Results**

Effluent Concentrations

- For single pin failure - effluent concentration when averaged over less than 30 days will be less than 10 CFR annual limit (7E-07)
- For single assembly failure – effluent concentration when averaged over a year will be less than 10 CFR annual limit
- For simultaneous failure of 7 worst case assemblies – nominal 4 fold dilution required to meet annual 10 CFR concentration limit

Maximum Credible Exposure to Public (or staff)

- For single pin failure – 0.5 mr/hr resulting in 0.03 mr penetrating exposure

- For single pin failure – 54 mr/hr resulting in 2.7 mr skin exposure

- For single assembly failure – 13.5 mr/hr resulting in 0.68 mr penetrating exposure
- For single assembly failure – 1.35 r/hr resulting in 68 mr skin exposure

- For simultaneous failure of 7 worst case assemblies –95mr/hr resulting in 5 mr penetrating exposure
- For simultaneous failure of 7 worst case assemblies –9.5 r/hr resulting in 470 mr skin exposure

# Case 2 – Confined Release (within containment)

**Assumptions:**

- All of the krypton 85 has diffused into the cladding/pellet gap (a very conservative assumption)
- All krypton released instantaneously into the containment building
- Worker stands in direct path of the release

**Quantities Released: (estimated using ORIGEN Code)**

- 0.87 curies – "average" single pin failure
- 1.06 curies – worst case single pin failure
- 21.7 curies – average fuel assembly (25 pins)
- 26.4 curies – worst case fuel assembly (25 pins)
- 152 curies – (7) average fuel assemblies
- 185 curies – (7) worst case fuel assemblies

**Dose Estimation Methods:**

- Concentration based dose rate established for varying fractions of containment volume (0.1%, 0.5%, 1%, 2%......100%)
- Calculate exposure from 0.1 minutes at 0.1% dose rate, 0.15 minutes at 0.5 %, 0.5 minute at 1%, 1.0 minutes at 2%, and 1.0 minutes at 5%

**Summary Results**

**Worker Exposures:**

- Total exposure from "average" single pin failure = 1.2 mrem penetrating and 120 mrem skin

- Total exposure from worst case single pin failure = 1.45 mrem penetrating and 145 mrem skin

- Total exposure from average fuel assembly (25 pins) = 30 mrem penetrating and 3 rem skin

- Total exposure from worst case fuel assembly (25 pins) = 36 mrem penetrating and 3.6 R skin

- Total exposure from (7) average fuel assemblies = 210 mrem penetrating and 21 R skin

- Total Exposure from (7) worst case fuel assemblies = 250 mrem penetrating and 25 R skin

**Exposure rates when fully diffused into containment volume:**

- "average" single pin failure – 0.29 mr/hr penetrating and 29 mr/hr skin
- worst case single pin failure – 0.35 mr/hr penetrating and 35 mr/hr skin
- average fuel assembly (25 pins) – 7.2 mr/hr penetrating and 720 mr/hr skin
- worst case fuel assembly (25 pins) – 8.7 mr/hr penetrating and 870 mr/hr skin
- (7) average fuel assemblies 50 mr/hr penetrating and 5 r/hr skin

  - (7) worst case fuel assemblies 61 mr/hr penetrating and 6.1 r/hr skin

# Appendix III:

# Summary of Pool Water Gross Beta and Gamma Spectroscopic Analyses

Primary Water Activity:

Summary of Gross Beta Measurements for the Period 5/24/2002 through February 13, 2004:

- Average calculated activity: 6.03 E-8 uCi/ml
- Average calculated MDA: 1.21 E-7 uCI/ml
- High value, calculated activity: 2.94 E-7 uCi/ml
- Activity Above MDA: 14.4% (13 of 90 calculations)

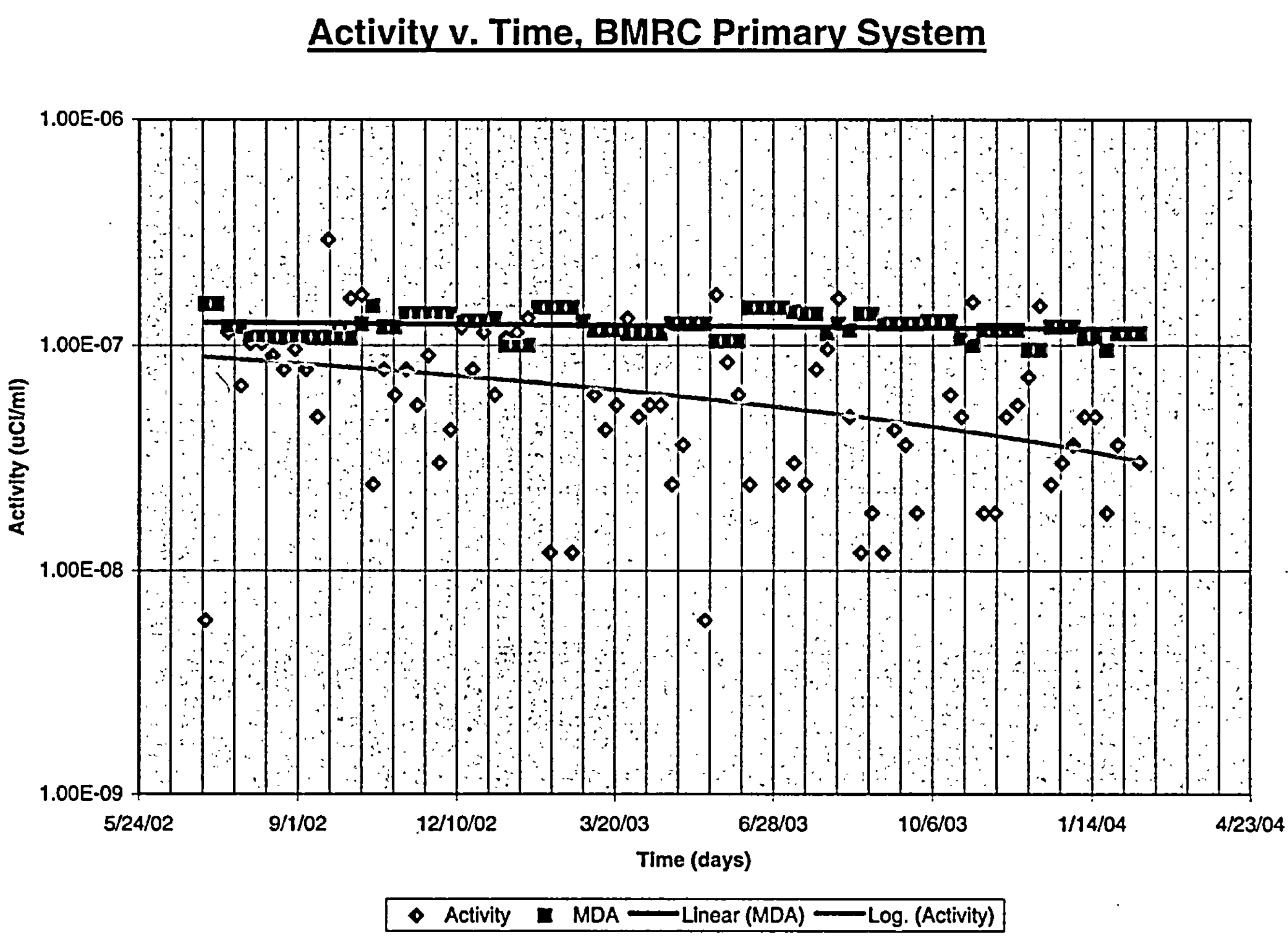
Results of Gamma Spectroscopy Measurements for the Period 2002-2003:

For 500 ml samples counted for 60 minutes:

| Sample # | Results (uCi/ml) | MDA (uCi/ml) |
|---|---|---|
| 2003-3 | No nuclides detected | Co-60: 1.17E-7; Cs-137: 7.99E-8 |
| 2003-2 | No nuclides detected | Co-60: 1.22E-7; Cs-137: 8.45E-8 |
| 2003-1 | No nuclides detected | Co-60: 7.45E-8; Cs-137: 9.86E-8. |
| 2002-3 | 1.24E-7 Co-60 | Cs-137: 8.27E-8 |
| 2002-2 | 1.35E-7 Co-60 | Cs-137: 7.66E-8 |
| 2002-1 | No nuclides detected | Co-60: 1.13E-7; Cs-137: 8.05E-8 |

**Graphical Representation of Primary System Activity for the period 5/24/2002 to 2/13/2004:**

- **MDA Trend using linear least squares analysis**
- **Activity Trend using logarithmic least squares analysis**



# Buffalo Materials Research Center

# State University of New York at Buffalo

# License R-77
# Docket 50-57

# Technical Specifications

(Possession Only)

Appendix A

*NEW DATE*

**Table of Contents**

## 1.0 Definitions

**Certified Fuel Handler:** An individual who is authorized to supervise or perform fuel handling pursuant to an NRC approved program.

**Channel Calibration:** A channel calibration is an adjustment of the channel so that its output corresponds, with acceptable accuracy, to known values of the parameter that the channel measures. Calibration shall encompass the entire channel, including equipment actuation, alarm, or trip and shall include a channel test.

**Channel Check:** A channel check is a qualitative verification of acceptable performance by observation of channel behavior. This verification should include comparison of the channel with other independent channels or systems measuring the same variable, where this capability exists.

**Channel Test:** A channel test is the introduction of a signal into the channel to verify that it is operating.

**Cold Fuel:** Cold fuel is any combination of fuel elements which may be stored within the fuel storage vault(s), in such a manner as to create a radiation level of not more than 5 mRem per hour at any accessible outer boundary of the vault.

**Control Blade:** A neutron absorbing blade with negative reactivity worth.

**Experimental Facility:** An experimental facility is any structure or device associated with the reactor that is intended to guide, orient, position, manipulate, or otherwise facilitate a multiplicity of experiments of similar character.

**Fuel Assembly:** A grouping of 25 Pulstar fuel pins in the standard Zircalloy box and aluminum structures.

**Fuel Canister:** A canister (typically aluminum or stainless steel) which is used to store fuel pins.

**Fuel Element:** A single Pulstar fuel pin.

**Fuel Handling:** The manipulation, movement, or transfer of irradiated reactor fuel within or between fuel storage facilities.

**Measured Value:** The measured value of a process variable is the value of the variable as indicated by a measuring channel.

**Measuring Channel:** A measuring channel is the combination of sensor, amplifiers, and output devices that are used for the purpose of measuring the value of a process variable.

**Operable:** Operable means that a component or system is capable of performing its intended function in its normal manner.

**Operating:** Operating means that a component or system is performing its intended function in its normal manner.

**Permanent Experimental Facility:** Those experimental facilities that would require considerable effort and planning to remove or alter such as the thermal column.

**Potentially Radioactive Liquid Effluents:** Those liquid effluents from the facility including from sinks, sumps, floor drains, etc., which have a reasonable potential to

contain radioactivity at a level in excess of 0.01% of the effluent limit prescribed by 10 CFR 20.

**Removal of a Control Blade:** Means to disconnect and physically remove a control blade assembly (blade, shroud, and extension) from its gridplate position.

**Reportable Occurrence:** A reportable occurrence is any of the conditions described in Section 12.1 of these specifications.

**True Value:** The true value of a process variable is its actual value at any instant.

## 2.0 Possession Only Limits

### 2.1 Authorized Activities

1) The BMRC reactor is licensed for "Possession Only" and no operation of the reactor is allowed.

### 2.2 Fuel Quantity Limit

1) The storage of irradiated reactor fuel within the reactor tank or within an alternative storage facilities pursuant to Section 10.3.3, shall be limited to the fuel that was present within the tank on June 30, 1994, and no additional fuel elements may be introduced into the reactor tank or irradiated fuel storage facilities. This limit will prevent the introduction of additional cold clean fuel into the tank.

2) At no time may more than 15 fuel assemblies be stored on the reactor gridplate. This limit will prevent criticality even if all control blades are completely withdrawn. The theoretical minimum number of cold clean fuel assemblies required for criticality is seventeen. The average burnup of the existing fuel assemblies is more than 13,000 MWD/Tonne.

## 3.0 Plant Instrumentation Systems

### 3.1 Reactor Tank Instrumentation for Fuel Storage

*Applicability These specifications shall not apply if there is no fuel in the reactor tank.*

*Specification 3.1.3 (suction valve interlock) shall not apply if the reactor tank water primary circulation pump is permanently disabled or electrically disconnected.*

Specifications The following plant instrumentation systems shall be maintained.

1) High and Low Water level annunciators.

2) Reactor Tank temperature indicator.

3) Primary pump suction valve interlock.

In the event that these systems are temporarily out of service (such as for repair) compensating actions such as periodic monitoring, or additional administrative controls may be substituted.

Basis

1) Specification 3.1.1 (High and Low Water Level annunciation) will warn staff members that the reactor tank water level is higher or lower than normal.

2) Specification 3.1.2 (Pool Temperature monitor) enables the staff to monitor the temperature of the reactor tank water.

3) Specification 3.1.3 (Suction Valve Closed) disables the primary pump so that it may not be started while the core outlet isolation valve is closed. Starting the pump with this valve closed could damage the N-16 delay tank.

## 3.2 Radiation Effluent *Monitor Requirements*

Applicability These specifications apply to the permanently mounted radiation *monitor in the building air exhaust system, which is* equipped with remote read-out in the reactor control room.

Objective The objective of these specifications is to set a minimum level of performance for the *effluent* radiation monitoring system.

Specifications

1) Effluents from the containment building, exhausted through the Building Exhaust System (containment roof), will be continuously monitored for gaseous radioactivity by the Building Gas *Monitor whenever the exhaust fan is operating and:*

   *i. irradiated reactor fuel is being handled within the facility*

   *or*

   *ii. Activities are being conducted within the containment building that may potentially create airborne gaseous activity in excess of 10% of the release concentration limit established by 10 CFR 20 when averaged over a 24 hour period.*

2) *Effluents from the containment building, exhausted through the Building Exhaust System (containment roof), will be continuously monitored for particulate radioactivity by the Building Particulate Monitor whenever the exhaust fan is operating and:*

   *i. irradiated reactor fuel is being handled within the facility*

   *or*

   *ii. Activities are being conducted within the containment building that may potentially create airborne particulate activity in excess of 10% of the release concentration limit established by 10 CFR 20 when averaged over a 24 hour period.*

3) *If operation of the monitors is required, the output of the monitors shall be recorded on a strip chart, a data logger, videographic recorder, or equivalent, or logged at intervals of not more than every 15 minutes*

4) The setpoints for the Building Gas Monitor *and the Building Particulate Monitor* shall be specified in writing by the Operating Committee

*Basis*

1) *Operation of the Building Gas and Building Particulate Monitors ensures that any substantive releases of gaseous or particulate radioactivity* will be detected.

2) Specification *3.2.4* will ensure that the alarm set point is clearly stated, cannot be changed without management review, and can be maintained at the lowest possible level commensurate with facility conditions and operational requirements.

## 3.3. Radiation Area *Monitor Requirements*

Specifications

1) Reactor Fuel shall not be handled in the reactor tank, unless the Reactor *Bridge* Monitor is operating. For purposes of this specification any fuel handling in the Hot Cell which includes insertion of fuel into the pass-through tube shall be considered "in the reactor tank."

2) The Set Point for the Reactor Bridge Monitor shall be specified in writing by the Operating Committee and may not exceed 75 mR/hr.

3) In the event of failure of the Bridge Monitor a portable unit shall be substituted and shall be frequently monitored, and a qualified individual shall be *identified who shall be capable of initiating a* manual damper scram *within sixty (60) seconds.*

Basis

1) The Bridge Radiation Monitor will provide redundant warning to the reactor operators in the event of low pool water level, and will warn operators of unusually high radiation levels should they occur during fuel handling operations.

2) Specification 3.3.2 will ensure that the alarm set point is clearly stated, cannot be changed without management review, and can be maintained at the lowest possible level commensurate with facility conditions and operational requirements.

3) Specification 3.3.3 will ensure that radiation levels will be adequately monitored if the Bridge Monitor is not operational.

## 4.0 Engineered Safety Systems

Applicability These specifications apply to the facility containment vessel and ventilation systems.

Objectives The objective of these specifications is to control *potential releases* of airborne radioactivity *from the facility.*

Specifications *Irradiated* reactor fuel shall not be handled in the reactor tank, Hot Cell, or in alternative facilities pursuant to Section 10.3.3 unless:

1) The Truck door is closed and sealed, and at least one of the doors for each airlock is closed and sealed. All other penetrations such as piping and electrical shall also be sealed.

2) The Building Air exhaust fan located within the Control Deck fan room is operating.

3) The air pressure within the reactor containment is negative relative to the outside air pressure.

4) The dampers (Pratt dampers) within the containment ventilation ducts are *either closed or* capable of closing in 5 seconds or *less after receipt of a manual damper closure signal and a qualified individual is present who shall be capable of initiating a manual damper scram within sixty (60) seconds.*

Basis

1) Specification 4.0.1 ensures that containment penetrations other than the ventilation ducts are closed, preventing the unmonitored and uncontrolled release of airborne radioactivity.

2) Specification 4.0.2 *ensures that fan is* operating to maintain the containment at negative pressure.

3) Specification *4.0.3. Ensures* that all containment leakage is inward.

4) Specification *4.0.4* ensures operability of the containment isolation systems in the event of fuel cladding compromise.

## 5.0 Reactor Tank Water Conditions

Applicability These specifications apply to the purity of the reactor tank water whenever fuel is stored within the tank. These specifications also apply to water which is in contact with fuel stored within alternative storage facilities pursuant to section 10.3.

Objectives The objectives of these specifications are to limit corrosion of the reactor fuel and other in-tank materials.

Specifications

1) The pH of the reactor tank water shall be maintained between 5.0 and 7.5.

2) The Resistivity of the reactor tank water shall be maintained at an average of not less than 200,000 ohm-centimeters. For purposes of interpreting compliance with this specification, the minimum level must be met when averaged over any 30-day period.

Basis Specifications 5.0.1 and 5.0.2 will prevent excessive corrosive attack of the fuel cladding and hardware, control blades, and other activated in-tank components. It also provides adequate clarity of the shielding water so that fuel may be visually monitored. Limits are imposed on the average values because the time weighted values will determine corrosion rates and short term deviations will not create a safety hazard.

## 6.0 Airborne Effluents

Applicability These specifications apply to the levels of radioactivity discharged to the environment through the building air exhaust *system.*

Objective The objective of these specifications is to ensure that persons outside of the facility are not exposed to concentrations of airborne radioactivity in excess of the limits established by 10 CFR 20.

Specifications

### 6.1 Building Air Effluent Radiation Limit

1) The concentration of radioactivity in the Building Air Exhaust, at the point of release (containment roof), shall not exceed the effluent limit established in 10 CFR 20, when averaged over the calendar year.

Basis Specification 6.1 ensures that the concentration of radioactivity in the air which exits through the containment roof is below the NRC limit.

## 7.0 Liquid Effluents

Applicability These Specifications apply to liquid radioactive effluents to the Sanitary Sewer System.

Objectives The Objectives of these specifications are:

1) To *prevent* unmonitored discharges of radioactivity to the Sanitary Sewer.
2) To ensure that discharges to the Sanitary Sewer are within the limits prescribed by *10 CFR* 20.

Specifications

1) All potentially radioactive liquid effluents shall be collected and retained in a hold tank(s).
2) Before release to the Sanitary Sewer the contents of the tank(s) shall be mixed and a representative sample shall be drawn and analyzed for radioactive content.
3) The contents of the tank(s) shall not be released to the sanitary sewer unless the analysis demonstrates that the release shall be within the limits prescribed by 10 CFR 20.
4) For purposes of determination of the effluent discharge concentration in *7.0.3* above, the dilution by the most recently established *sewage* flow rate of the Winspear Avenue trunk may be incorporated.

## 8.0 Surveillance Requirements

Applicability These specifications apply to the surveillance requirements for reactor control systems, radiation monitoring systems, and engineered safety systems.

Objective The objective of these specifications is to prescribe the minimum surveillance activities to maintain the reactor in a safe, subcritical mode, to protect the safety of the reactor staff and the public.

Specifications

### 8.1 Plant Instrumentation Systems

1) The reactor tank low and high water level annunciators shall be tested monthly, at intervals not to exceed 6 weeks *whenever irradiated fuel is stored within the tank.*

### 8.2 Radiation Monitoring Systems

1) The Reactor Bridge Monitor and the *Building* Effluent Radiation Monitors shall be tested for operability monthly, at intervals not to exceed 6 weeks.
2) The Reactor Bridge Monitor and the *Building* Effluent Monitors shall be calibrated quarterly, at intervals not to exceed four months. For the purpose of meeting this requirement, the monitors shall be calibrated by determination of their response to appropriate reference sources.
3) Any radiation monitors associated with Fuel Storage Facilities utilized pursuant to Section 10.3, shall be calibrated before fuel is installed in the facility, and shall be Operability checked as appropriate.

*Applicability:*

*The Bridge and Effluent Monitor operability tests shall not be required if the monitor(s) are not in service, however the tests must be conducted if and when the monitors are placed back in service.*

*The Effluent Monitor calibration tests are not required if the monitor has been continuously taken out of service more than 30 days before the calibration is due, however the calibration must be conducted if and when the monitor is placed back in service.*

*Calibration of the Bridge Monitor is not required if it has been taken out of service, however the calibration must be performed if and when the monitor is placed back in service.*

## 8.3 Engineered Safety Feature (Containment) Tests

The following items shall be tested quarterly at intervals not to exceed four months:

1) *The Building Air* ventilation isolation *damper closes* in less than 5 seconds in response to manual trip.
2) The Control Systems maintain negative pressure in the building under normal conditions.

## 8.4 Other Instrumentation System Surveillance

The following additional instrumentation systems shall be calibrated or tested quarterly at intervals not to exceed four months:

1) Pool Temperature Monitor
2) Suction Valve Closed pump inhibit interlock.

These specifications shall not apply if there is no fuel in the reactor tank. Specification *8.4.2* shall not apply if the reactor tank water primary circulation pump is permanently disabled or electrically disconnected.

## 8.5 Reactor Fuel Shielding Water Monitoring

Applicability These specifications apply to the surveillance and quality of reactor tank water and are in effect so long as there is fuel in the reactor tank. These specifications similarly apply to any other on site fuel storage facilities for which water is in contact with the Reactor Fuel.

Objective The objective of these specifications is to ensure that water quality is measured frequently enough to prevent excessive corrosion of the system components and to detect higher than normal levels of radioactivity in the system water.

Specifications

1) System water *pH and* conductivity *shall be measured* weekly, at intervals not to exceed 10 days.
2) *System water gross Beta activity shall be measured quarterly, at intervals not to exceed 100 days.*

3) Gamma Spectroscopy of the system water shall be conducted *two times per year at intervals not to exceed seven months.*

4) Records shall be maintained of all pool water additions.

Basis

Specification 8.5.1 ensures that poor water quality would be detected in a timely manner.

Specification 8.5.2 *and 8.5.3* ensures that fuel leakage or excessive corrosion may be detected.

Specification 8.5.3 provides a means to monitor for excessive water addition rates, which could be indicative of system leakage.

# 9.0 Plant Design Features

## 9.1 Site Description

*The site of the BMRC reactor is the South East corner of the South campus of the* State University of New York at Buffalo.

The South campus lies in a triangle bounded by Bailey Avenue, running almost due north and south, Winspear Avenue, running roughly east and west, and Main St., running north of Winspear Avenue. The nearest buildings are Acheson Hall, Howe Building, the McKay steam plant, and Clark Gym. A large Veterans Affairs Medical Center is situated approximately 2000 ft east of the BMRC. The nearest residential area is South of the reactor on the North Side of Winspear Avenue.

The reactor restricted access area consists of the containment building and the attached laboratory and office wing.

## 9.2 Containment Building

The containment building is a flat roofed, right circular cylinder, nominally 70 ft. in diameter and 52 ft. high. The containment is constructed of normal density reinforced concrete. The walls are nominally 2 ft. thick and the roof is 4 inches thick and supported by steel and concrete beams. The bottom floor is nominally 3.5 ft. thick and the entire building rests in bedrock. The total free volume of the building is approximately 186,000 cubic feet.

The building is equipped with two personnel airlocks and a single barrier "truck door". All electrical and piping penetrations are sealed. Drain lines which penetrate the containment wall are provided with 24 inch dip legs to maintain pressure seal.

## 9.3 Ventilation Systems

Under normal conditions, the containment building is ventilated by a single pass system. Conditioned air is supplied to the containment through a 30 inch diameter duct. A second 30 inch supply system can also be employed; however, it is not necessary under most conditions.

Air from the general (occupied) areas of the containment, and certain low activity fume hoods, is exhausted through a 36 inch duct which penetrates the containment roof (commonly referred to as the "Building Air" system). The Building Air exhaust

system is HEPA filtered and includes a vortex control damper on the suction side which is used to control the negative pressure in the containment building.

*When the reactor was in operation air from the remaining fume hoods and reactor irradiation facilities was exhausted thru a "Stack Exhaust" system that exited containment thru the sub-basement and exhausted through a 167 foot high stack. This system has now been abandoned and all fans that fed air into this exhaust system have been disabled and/or disconnected from the duct. In addition a six (6) inch diameter "emergency bypass" exhaust duct equipped with HEPA and activated charcoal filters, used to be capable of maintaining the containment at a slightly negative pressure, under emergency conditions (such as the reactor design basis accident). This duct also included a pressure relief valve to protect the containment from structural damage in the event of a major pressure excursion.*

*The two 30 inch supply ducts, and the 36 inch exhaust duct are equipped with "Pratt" hydraulic isolation dampers which can be manually triggered if high airborne radioactivity is detected. The damper in the former stack exhaust system is maintained in the closed position, and the duct has been blanked off. The 6 inch emergency exhaust duct has been capped outboard of the pressure relief valve, and the activated charcoal filter is no longer required.*

*When the isolation dampers are closed the building air exhaust and fans that feed into it shut down, as do the two 30 inch supply fans. This will place the containment in an approximately neutral pressure condition. As a consequence there will be minimal escape of contaminated air from the facility.*

## 9.4 Reactor Tank

The reactor tank is constructed of concrete with an aluminum liner. It is nominally 29 feet deep and will hold approximately 13,700 gallons of shielding water. When the reactor was in operation, the cooling system also included an N-16 delay tank, a heat exchanger and circulating pump. The heat exchanger was permanently removed in 1994 and replaced with a pipe. The balance of the original cooling system can be used to circulate the shielding water, and to provide flow for the demineralizer system. However, these components are no longer required and provide no safety functions. They may be removed without impacting upon reactor safety, as long as blocking flanges are installed outboard of the isolation valves.

Two demineralizer systems are required. One provides new "make up" water to replenish losses. The second is a "clean up" system used to maintain the quality of the water in the reactor tank. The clean up system and make up water addition system may be connected to the tank through the formerly utilized coolant circulation loop, or alternatively may be directly coupled to the reactor tank.

An emergency pool fill system is available for adding city water to the pool should this be desired, such as in the event of a gross leak in the tank. This system includes a manual valve at the top of the tank and an isolation valve in the BMRC sub-basement.

## 9.5 Reactor Fuel

Fuel Assemblies are 3.15 by 2.74 inches in cross section and 38 inches high. Each assembly contains 25 fuel elements in a 5 x 5 array. The pins are positioned by aluminum grids at each end, these grids each contain 25 holes 1/4 inch in diameter which were used for coolant passage. The lower end of the assembly includes an

aluminum nosepiece that mates with holes in the reactor grid plate. The top of the assembly contains a bail for handling purposes. The vertical box itself is constructed of .060 in thick Zircalloy.

Each fuel element is made up of a Zircalloy cladding tube (.47 in OD) with a .0185 inch thick minimum wall. Each element contains 40 sintered UO-2 fuel pellets. Welded caps form the closure of the cladding tubes. The fuel pellets are 0.42 inches in diameter and have a minimum density of 10.2 g/cc. Nominal enrichment is 6.0%. The fueled height is nominally 24 inches.

Typical initial (cold/clean) composition of a fuel assembly was:

Uranium 235 ............. 0.768 Kg

Uranium................. 12.83 Kg

Uranium Dioxide......... 14.56 Kg

Complete Fuel Assembly. 20.37 Kg

Table 1 lists the irradiated fuel assemblies which were located within the reactor tank on June 30, 1994 and their respective burnup

### 9.6 Control Blades

Gross reactivity control within the reactor core was provided by six control blades of which five were scramming and one was not. Each blade is composed of nominally 80% silver, 15% indium and 5% cadmium. The blades are 4.85 inches wide, by 0.18 inch thick, by 29 inches long and are plated with 0.003 inches of nickel.

Because the number of fuel assemblies stored on the gridplate is limited to fifteen, the control blades are not required to prevent criticality. Therefore, they may be disconnected from their drive units and there are no restrictions on their positions.

## 10.0 Fuel Storage and Transfer

### 10.1 Cold Fuel Storage

Applicability These specifications apply to the storage of cold reactor fuel (see definitions).

Objectives The objectives of these specifications are to maintain the fuel in a subcritical configuration, to deter the theft or diversion of the fuel, to detect such diversion should it occur and to prevent excessive exposures of personnel and the public from radiation arising from the fuel.

Specifications

1) Cold fuel shall be stored within the containment building, in secure vaults, constructed of nonflammable materials. Fuel shall be stored in rows of metal cylinders which have a minimum center to center spacing of five inches and the rows shall have a minimum center to center spacing of 16 inches. Each cylinder shall contain no more than 25 fuel elements. Those fuel storage vaults which were in use on June 30, 1994, shall continue to be exempted from the criticality alarm requirements of 10 CFR 70.24.

2) Alternatively cold fuel which has been packaged for shipment in accordance with NRC and DOT requirements may be stored within a locked room within the BMRC containment building, provided that appropriate administrative controls are instituted to prevent the introduction of the fission plate, or isotopic neutron sources within one meter of the packages.

## 10.2 Storage of the BMRC Fission Plate

Applicability These specifications apply to the storage of the BMRC fission plate.

Objective The objectives of these specifications are to prevent the unsafe neutron coupling of the fission plate with other fissile materials, to deter the theft or diversion of the fission plate, to detect such diversion should it occur, and to prevent excessive exposures of personnel and the public from radiation arising from the fission plate

Specifications

1) The Fission Plate may be stored within the fuel vault(s), a locked cask within the containment building, or within the dry chamber or thermal column. A minimum distance of 16 inches shall be maintained between the fission plate and any other fissile material.

2) Alternatively, the fission plate may be stored within a shipping container, within the containment building, in accordance with NRC and DOT regulations provided that appropriate administrative controls are instituted to prevent the introduction of other fissile materials, or isotopic neutron sources, within one meter of the package.

## 10.3 Irradiated Fuel Storage and Transfer

Applicability These specifications apply to the storage and transfer of the irradiated fuel, which shall be limited to that fuel which was present within the reactor tank on June 30, 1994.

Objectives The objectives of these specifications are to maintain the fuel in a subcritical configuration, to deter the theft or diversion of the fuel, to detect such diversion should it occur and to prevent excessive exposures of personnel and the public from radiation arising from the fuel.

Specifications

1) Irradiated reactor fuel shall be stored within the reactor tank, the Hot Cell, or within alternative fuel storage facilities in accordance with Section 10.3.3. All fuel elements will be stored within the standard PULSTAR fuel assembly hardware, or within closed canisters of similar dimension, which may contain no more than 27 elements each. If canisters contain more than 25 fuel elements, (the number of fuel elements in a standard fuel assembly) the Reactor Decommissioning Safety Committee must approve the container design, loading, storage and handling procedures.

### 10.3.1 Storage within the Reactor Tank

1) Up to 15 fuel assemblies may be stored on the grid plate in alternate rows. Unused grid plate locations will be plugged to prevent storage of more than 15 assemblies.

2) Within the reactor tank, fuel may be stored in the existing pool storage racks. The storage racks are in linear array with a minimum center to center spacing of five inches.

3) Additional fuel storage racks may be installed within the reactor tank so long as they provide equivalent subcriticality margin, mechanical strength and seismic performance.

4) During fuel transfer or loading operations, up to two assemblies may be placed in interim storage racks or holding devices on the pool shelf or Hot Cell pass through tube.

**10.3.2 Storage within the Hot Cell**

1) Irradiated fuel may be stored within the Hot Cell subject to following requirements:

2) Calculated or demonstrated Keff of the storage array must be less than or equal to 0.85 for the flooded condition.

3) Transfer of the fuel into and out of the Hot Cell must be in accordance with detailed written procedures, approved by the Operating Committee.

4) If more than 374 fuel elements are located within the Hot Cell, it must be equipped with a neutron sensing criticality alarm. (note: 375 fuel elements is equivalent to 15 fuel assemblies)

5) In order to prepare fuel for shipment to a disposal facility, fuel may be manipulated in the Hot Cell such as to load fuel elements into shipping/storage canisters. Written procedures shall ensure that criticality margins are maintained

6) *during such manipulations.*

**10.3.3 Storage within Alternative Facilities**

Irradiated fuel may be stored within alternative facilities within the containment building subject to the following requirements.

1) Calculated or demonstrated $K_{eff}$ of the storage array must be less than or equal to 0.85 for the flooded condition.

2) Transfer of the fuel into and out of the Storage Facility (from the Hot Cell or Reactor Tank) must be in accordance with detailed written procedures, approved by the Operating Committee.

3) If more than 374 fuel elements (375 fuel elements are equivalent to 15 fuel assemblies) are located within the storage facility, it must be equipped with a neutron sensing criticality alarm.

4) Shielding must be adequate to reduce the radiation level such that the radiation levels at the outer boundary of the Storage Facility will not create a High Radiation Area as defined by 10 CFR 20.

5) Use of the storage facility must be approved by the Reactor Decommissioning Safety Committee.

### 10.3.4 Transfer of Fuel between Fuel Storage Facilities

In addition to the requirements of sections 3.2, 3.3 and 4.0, the following additional requirements must be met when fuel is being transferred between fuel storage facilities (Pool, Hot Cell, or Alternate facilities)

1) The airlocks and truck door are sealed.
2) The containment pressure is negative with respect to outside atmosphere.
3) Hydraulic pressure is available to close the ventilation isolation dampers.
4) Fuel storage canisters, transfer casks, or baskets, shall be:
   - DOT certified packaging

Or

   - Equipped with bales, handles or lifting lugs and or cables or similar lifting gear which is capable or supporting at least twice the weight of the load in air. In addition appropriate safety margins will be used in designing such equipment.

And

   - Shall be designed so that fuel elements or assemblies will not spill out in the event the load is dropped.

5) The transfers must be conducted in accordance with a Radiation Work Permit approved by the Radiation Safety Officer.
6) A criticality alarm(s) shall be operating in appropriate location(s), if greater than 374 fuel elements are located in the transfer container, unless the container is DOT certified packaging.
7) Items (1), (2), and (3) above do not apply when handling fuel which is contained in sealed DOT approved canisters or containers.

### 10.3.5 Fuel handling within the reactor tank

In addition to the requirements of sections 3.2, 3.3 and 4.0, whenever fuel is handled in the reactor tank the following requirements shall apply:

1) The airlocks and truck door are sealed.
2) The containment pressure is negative with respect to outside atmosphere.
3) Hydraulic pressure is available to close the ventilation isolation dampers.
4) If fuel assemblies are being placed into a geometric configuration which has not been previously loaded, a neutron count rate monitor shall be operating and monitored.
5) The neutron count rate monitor is not required when fuel assemblies are being loaded into or transferred between the standard fuel racks which were originally installed in the reactor tank, or similar racks installed pursuant to 10.3.1 (2), which utilize an identical geometry. This would include the transfer of fuel assemblies from the grid plate to the fuel racks.

## 11.0 Administration

### 11.1 Organizational Structure

1) The organizational structure shall be as illustrated in Figure I.
2) The *Director of Environment, Health and Safety* bears responsibility for administrative oversight of the BMRC safety and operational programs.
3) The BMRC Director bears direct safety responsibility for the Facility including all safety reviews, licensing, audits, training, surveillances, operations, testing and experiments conducted at BMRC.
4) The Radiation Safety Officer bears direct responsibility for all aspects of radiological safety at BMRC and is empowered to stop, or modify any activity for purposes of ensuring the radiological safety of the staff and the public.
5) The BMRC Operations Manager is responsible for all activities related to safe storage and handling of the reactor fuel, maintenance and testing of plant safety systems and other engineered safety systems, the training and supervision of licensed operators and Certified Fuel Handlers.

### 11.2 Minimum Staffing Requirements

As long as irradiated fuel is stored within BMRC, the University staff shall include at minimum:

1) The Director of *Environment, Health and Safety*
2) The BMRC Director
3) The BMRC Operations Manager
4) The Radiation Safety Officer
5) At least one licensed Sr. Reactor Operator or Certified Fuel Handler.

*For purposes of meeting the requirements of 11.2:*

1) A single individual may serve as both the BMRC Director and Director of *Environment, Health and Safety,* or a single individual may serve as both BMRC Director and BMRC Operations Manager.
2) The Operations Manager may be the Senior Reactor Operator or Certified Fuel Handler, provided there is at least one additionally licensed Reactor Operator or Certified Fuel Handler on staff.
3) Staff members may perform collateral duties in other areas of the University or be part time employees.

### 11.3 On-Call Staffing Requirements

As long as irradiated fuel is stored within BMRC, the University shall meet the following "on-call" requirements.

1) The Operating Committee will maintain a roster of personnel who are trained in appropriate aspects of facility operation and health physics.
2) At least one individual from this roster will remain within a 50-mile radius of the facility at all times and be reachable by phone, pager or radio.

## 11.4 Operational Requirements

1) All fuel handling must supervised or performed by a licensed Sr. Reactor Operator or Certified Fuel Handler. Non-licensed personnel may assist in the conduct of the manipulations, but must receive training commensurate with their level and nature of participation.

2) All licensed Operators or Certified Fuel Handlers shall participate in the BMRC Requalification program or CFH recertification respectively, as a condition of their continued assignment to operator or Certified Fuel Handler duties. The Requalification program shall be commensurate and consistent with the current scope and nature of operational activities on site.

## 11.5 Review Functions

### 11.5.1 Reactor Decommissioning Safety Committee

1) A Reactor Decommissioning Safety Committee (RDSC) shall exist for the purpose of reviewing matters related to the health and safety of the public and the staff, in accordance with the Constitution and Bylaws of the committee.

2) The RDSC shall report to the Associate Vice President for Facilities who shall appoint the members and Chair.

3) The RDSC shall include at least eight members including as ex-officio members the BMRC Operations Manager, BMRC Director, the Radiation Safety Officer, and the Director of *Environment, Health and Safety.* The BMRC Director and Operations Manager shall be non-voting members.

4) The RDSC shall meet at least twice per year.

5) A quorum of the RDSC shall consist of at least six members, and all questions before the Committee must be approved by a simple majority of the voting members present, but by not less than four voting members.

6) Minutes of all meetings will be maintained on file and distributed to all members.

7) The RDSC shall review and approve the following:

   A) The substantive aspects of short and long term action plans relative to the reactor decommissioning, reactor plant maintenance and monitoring, except for those which may be reviewed and approved by the Operating Committee.

   B) Reportable Occurrences related to health and safety, and corrective actions.

   C) Notices of Violation related to health and safety and corrective actions.

   D) Applications for amendment to NRC licenses.

   E) Changes in Procedures or facilities implemented in accordance with 10 CFR 50.59, in Post Audit, after Operating Committee approval.

### 11.5.2 Operating Committee

1) An Operating Committee shall exist as a sub-group of the RDSC.

2) The Operating Committee shall consist of the ex-officio members of the RDSC plus additional members appointed pursuant to the by-laws.

3) The Operating Committee shall meet as often as required and minutes shall be kept of all formal meetings.

4) The Operating Committee is authorized to act for the RDSC regarding routine occurrences, and approvals for which the safety implications are minor, are well understood, and are within the scope of past practice. This would include but not be limited to:

   A) Applications for license or Plan amendments such as to update names, equipment lists, procedures etc.

   B) Operating Procedures, Emergency Procedures, Health Physics Procedures, or Maintenance Procedures.

   C) Changes in procedures, equipment of facilities pursuant to 10 CFR 50.59.

   D) Audit Reports.

### 11.5.3 Audits and Reviews

1) An independent audit shall be conducted annually of BMRC decommissioning, maintenance, operations, and surveillance activities. The auditor(s) shall have appropriate experience and education. The audit may be broken into modules, using the same or separate auditors. A written report(s) shall be provided to the BMRC Director, and shall be reviewed by the Reactor Decommissioning Safety Committee. The audit shall include at minimum a review of:

   - Operational records for compliance with internal rules, procedures, policies, regulatory compliance, and license compliance.
   - Adequacy of Procedures.
   - Plant equipment Performance and surveillance requirements.
   - Records of release and discharges of radioactivity to the environment.

2) Radiation Safety and ALARA Review shall be conducted pursuant to 10 CFR 20 requirements.

## 12.0 Actions To Be Taken In Event of a Reportable Occurrence

A reportable occurrence shall be any of the following:

1) Release of fission products from a leaking fuel element.

2) An uncontrolled or unplanned release of radioactive materials from the restricted area of the facility which when averaged over any 24 hour period exceeds the applicable limits established by 10 CFR 20 or Technical Specifications, whichever is greater.

3) An uncontrolled or unplanned release of radioactive materials that result in concentrations of airborne radioactive materials within any portion of the restricted area which results in measured or calculated exposures to personnel in excess of 40 DAC-hours.

4) Declaration of an Emergency pursuant to the BMRC Emergency Plan.

5) An observed inadequacy in the implementation of administrative or procedural controls that caused or threatens to cause the existence or development of an immediately dangerous or otherwise significant unsafe condition in connection with the operation of the facility.

In the event of a reportable occurrence, as defined above, the following shall occur:

1) Immediate steps shall be taken to correct the situation and to mitigate the consequences of the occurrence.

2) The Operating Committee will investigate the occurrence and its causes, and will report its findings to the Reactor Decommissioning Safety Committee and to the Senior Vice President, and Associate Vice President for University Facilities.

3) A report shall be filed with the NRC which shall include an analysis of the causes of the occurrence, the effectiveness of corrective actions taken and recommendations of measures to be taken to prevent or reduce the probability or consequences of recurrence.

## 13.0 Written Procedures

### 13.1 Required Procedures

Written procedures will exist that define how and when various aspects of facility operations will be performed. These procedures may include "Operating Procedures", "Emergency Procedures" and "Maintenance and Calibration Procedures."

Written procedures shall at minimum address the following areas:

1) Fuel Handling Operations.

2) Use, surveillance, and maintenance of auxiliary systems.

3) Abnormal and emergency situations.

4) Required reactor electrical and mechanical surveillance and maintenance.

5) Operation and calibration of fixed radiological monitors as required by this Technical Specification.

### 13.2 Approval, Review and Update

1) Operating Procedures and Maintenance and Calibration Procedures will be reviewed and updated as appropriate, but such review shall be no less frequent than once every two years.

2) Emergency Procedures shall be reviewed and updated in accordance with the BMRC Emergency Plan.

3) All new or revised procedures shall be approved by the Operating Committee.

### 13.3 Temporary Deviation from Written Procedures

Temporary changes to written procedures that do not change the original intent may be made with the approval of a Sr. Reactor Operator, the Operations Manager, or the BMRC Director. All such changes shall be documented.

## 14.0 Record Keeping

### 14.1 Records Which Shall be Retained for Five Years

In addition to the requirements of applicable regulations, the following records and logs shall be maintained in a manner reasonably convenient for review, and retained for at least five years:

- Operation and Maintenance Logs and records
- Records and reports related to "reportable Occurrences" as defined by section 12.
- Logs and records which document the conduct of test, checks, and measurements in compliance with surveillance requirements established by Technical Specifications
- Records of experiments performed
- Operator Requalification program records
- Facility radiation and contamination surveys
- Minutes of Operating Committee meetings
- Principal Maintenance records

### 14.2 Records Which Shall be Maintained for the Life of the Facility

The following records shall be maintained for the life of the facility:

- Records of radioactive materials discharged to the air or water (sewer)
- Radiation exposure records for all facility personnel
- Fuel inventories and transfer records
- Up-dated, corrected, and as-built facility drawings
- Minutes of Reactor Decommissioning safety Committee, (formerly the Nuclear Safety Committee) Meetings
- Off Site environmental radiation monitoring surveys

## 15.0 Reporting Requirements

### 15.1 Annual Technical Report

A report summarizing technical operations will be prepared for each calendar year. A copy of this report shall be submitted to the Director, Office of Nuclear Reactor Regulation, with a copy to the Regional Administrator (Region I) by March 31 of each year. The report shall include the following:

1) A brief narrative summary of changes in facility design or performance that relate to nuclear safety and results of surveillances tests and inspections.

2) Discussion of major maintenance operations performed during the period including the effects if any on nuclear safety and the reason for any corrective maintenance required.

3) A brief description of any changes in the facility to the extent that it changes a description of the facility in the Safety Analysis Report.

4) A brief review of changes test and experiments made or conducted pursuant to 10 CFR 50.59 including a summary of the safety evaluation of each.

5) A summary of the nature and amount of radioactive effluents discharged or released to the environment.

6) A description of environmental radiological surveys conducted outside the facility.

7) A summary of radiation exposures received by facility personnel and visitors, including details of any unusual exposures.

8) A summary of the results of radiation and contamination surveys performed within the facility.

9) Any changes in facility organization.

10) A discussion of major operations performed during the reporting period related to decontamination, dismantling or decommissioning of the facility.

## 15.2 Reportable Occurrence Reports

Notification shall be made within 24 hours by telephone or facsimile, to the NRC Operations Center and Region I, followed by a written report within 14 days to the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, ATTN: Document Control Desk, with a copy the Regional Administrator of Region I, in the event of a reportable occurrence as defined by technical specification. The written report, and to the extent practicable, the initial notification, shall:

1) Describe, analyze, and evaluate safety implications.

2) Outline the measures taken to ensure that the cause of the condition is determined.

3) Indicate the corrective action taken to prevent repetition of the occurrence, including changes to procedures.

4) Evaluate the safety implications of the incident in light of the cumulative experience obtained from the report of previous failure and malfunction of similar systems and components.

## 15.3 Safety Event Reports

A written report shall be forwarded within 30 days to the U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, ATTN: Document Control Desk, with a copy the Regional Administrator of Region I, in the event of:

1) Discovery of any substantial errors in the transient or accident analysis or in the methods used for such analysis as described in the Safety Analysis Report or in the basis for Technical Specifications.

2) Discovery of any substantial variance from performance specifications contained in the Technical Specifications or Safety Analysis Report.

3) Discovery of any condition involving a possible single failure which, for a system designed against assumed failure, could result in a loss of the capability of the system to perform its safety function.

## 15.4 Special Nuclear Materials Status Reports

Materials status reports and nuclear materials transfer reports for special nuclear material shall be made in accordance with applicable section of 10 CFR 70.

Table 1-Fuel Assemblies in Reactor Tank as of June 30, 1994

| **Assembly Number** | **Burnup** (MWD/Tonne U) |
|---|---|
| 1 | 17470.38 |
| 2 | 14606.14 |
| 3R | 12189.11 |
| 4R | 14751.23 |
| 5 | 16160.89 |
| 6 | 14918.24 |
| 7 | 18104.11 |
| 8R | 14906.87 |
| 9R | 13633.79 |
| 10 | 18917.42 |
| 11R | 16163.94 |
| 12R | 13678.76 |
| 13 | 19523.86 |
| 14 | 18875.81 |
| 15 | 19030.08 |
| 16 | 18265.14 |
| 17R | 13443.08 |
| 18R | 10555.88 |
| 19R | 10769.17 |
| 20R | 10700.76 |
| 21R | 5176.49 |
| 22R | 14929.68 |
| 23 | 16540.68 |
| 24 | 14025.08 |
| 25R | 14868.15 |
| 26R | 11690.76 |
| 27R | 15897.91 |
| 28 | 19352.25 |
| 29R | 9203.55 |
| 30R | 10329.85 |
| 31R | 1826.54 |
| 32 | 18525.83 |
| 33R | 1578.72 |
| 34R | 332.30 |
| 36R | 6620.32 |
| 37 | 15625.35 |
| 38 | 15833.18 |
| 40 | 12943.25 |
| 42 | 16904.13 |
| Can #25 | > 10000 |

Figure 1

# BMRC Organizational Structure

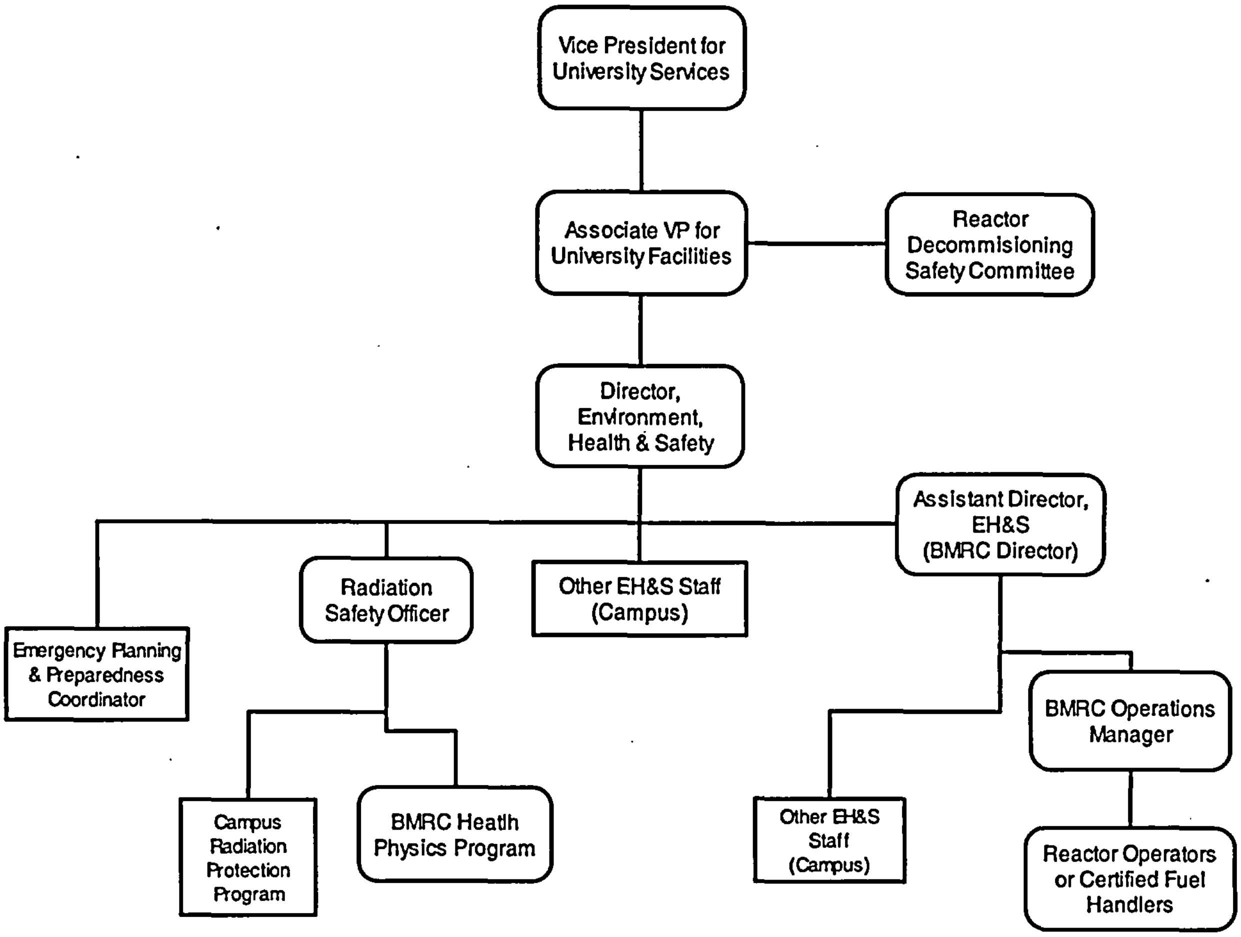



Figure 1

SUNY-Buffalo
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