

**ACTION MEMORANDUM
BROOKHAVEN GRAPHITE RESEARCH
REACTOR BELOW-GROUND DUCT PRIMARY
LINER REMOVAL ACTION**

September 29, 2003

Brookhaven National Laboratory
Brookhaven Science Associates
Under Contract No. DE-AC0-2-98CH01886 with the
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ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE

AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
BGRR	Brookhaven Graphite Research Reactor
BNL	Brookhaven National Laboratory
CERCLA	<i>Comprehensive Environmental Response, Compensation and Liability Act of 1980</i>
CFR	Code of Federal Regulations
COC	contaminants of concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
OSWER	Office of Solid Waste and Emergency Response
RCRA	<i>Resource Conservation and Recovery Act</i>
ROD	Record of Decision

I. PURPOSE

The purpose of this Action Memorandum is to document the decision by the U.S. Department of Energy (DOE) to conduct a time-critical removal action to remove the exhaust air primary liner in the below-ground ducts of the Brookhaven Graphite Research Reactor (BGRR) at Brookhaven National Laboratory (BNL). The liner is part of Area of Concern (AOC) 9, specifically 9B.

This action is being undertaken as a time-critical removal action in accordance with the Interagency Agreement among the DOE, the U.S. Environmental Protection Agency (EPA), and the New York State Department of Environmental Conservation (NYSDEC) [1]. This action will be documented in the BGRR Record of Decision (ROD). Work will be conducted in accordance with the National Contingency Plan [2].

II. SITE CONDITIONS AND BACKGROUND

A. Site Description

1. Physical Location

Brookhaven National Laboratory is located near the geographic center of Suffolk County on Long Island, New York in the Town of Brookhaven (Figure 1). The BNL site, formerly Camp Upton, was occupied by the U.S. Army during World Wars I and II, and was subsequently transferred to the Atomic Energy Commission in 1947 for use as a national laboratory. Brookhaven National Laboratory carries out basic and applied research in the fields of high-energy nuclear and solid-state physics, fundamental material and structure properties and the interaction of matter, nuclear medicine, biomedical and environmental sciences, and selected energy technologies. Major operating facilities include the Relativistic Heavy Ion Collider, the National Synchrotron Light Source and the Alternating Gradient Synchrotron. Brookhaven National Laboratory is a government-owned, contractor-operated facility of the DOE, and is operated and managed by Brookhaven Science Associates under contract to DOE.

The present site contains 5,265 acres, of which 75 percent are wooded. The remainder is developed and contains office buildings, various large research facilities, parking lots, and other facilities. The BGRR is located in the central section of the BNL property as shown in Figure 2. An elevation view of the below-ground exhaust air-cooling system, which contains the primary liner and about which this document is written, is shown in Figure 3.

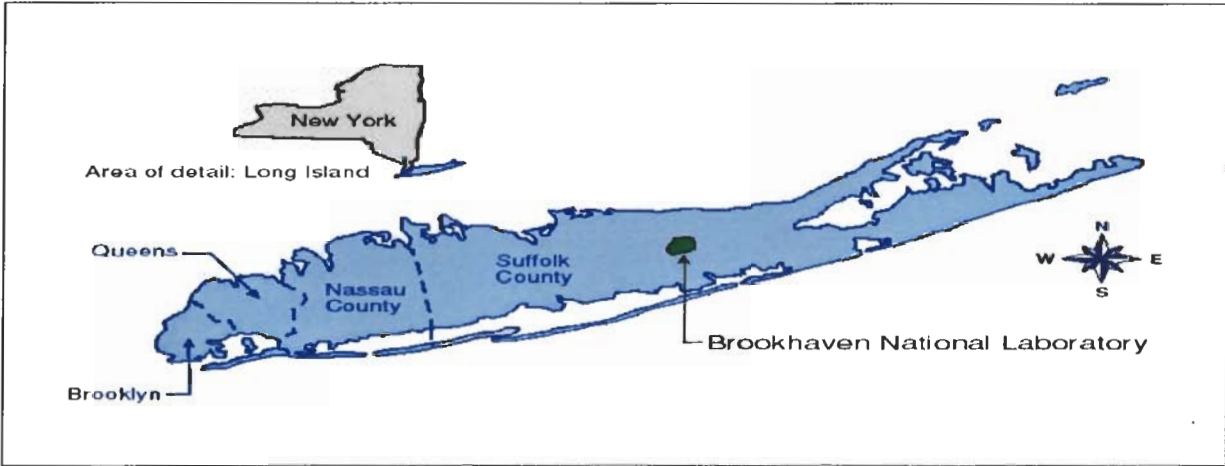


Figure 1. Location of Brookhaven National Laboratory

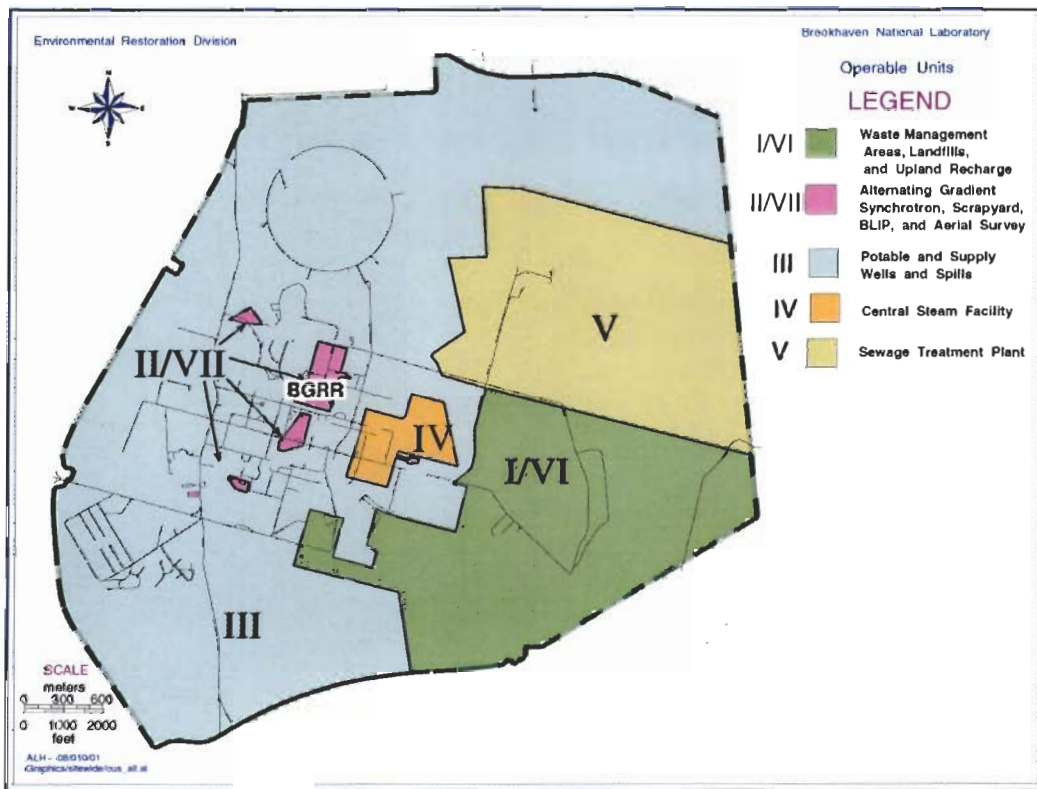


Figure 2. Location of BGRR on Brookhaven National Laboratory site

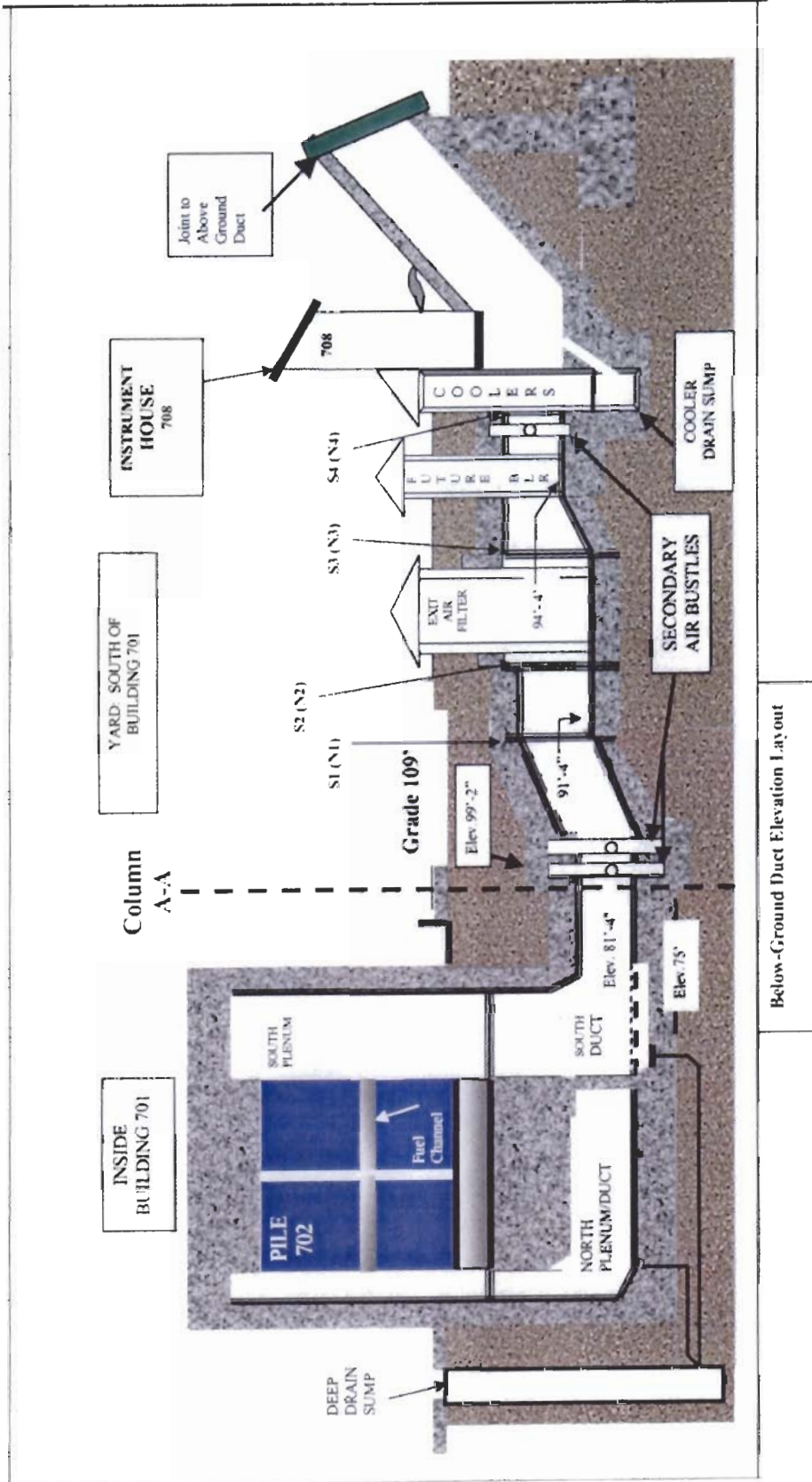


Figure 3. Below-ground Exhaust Air-cooling System (Elevation)

2. Removal Site Evaluation

The BGRR operated from 1950 until 1968. It was fueled with natural uranium from 1950 through April 1958, and with enriched uranium until final shutdown. During this period there were twenty-eight reported ruptured fuel cartridges. While normal reactor operations would have contaminated the cooling system, these fuel failures caused the majority of the contamination of the cooling system and its components, including the primary liner.

The primary liner is located inside the below-ground ducts. There are two ducts, north and south, each containing a primary liner. Figure 4 provides a sectional view of this arrangement.

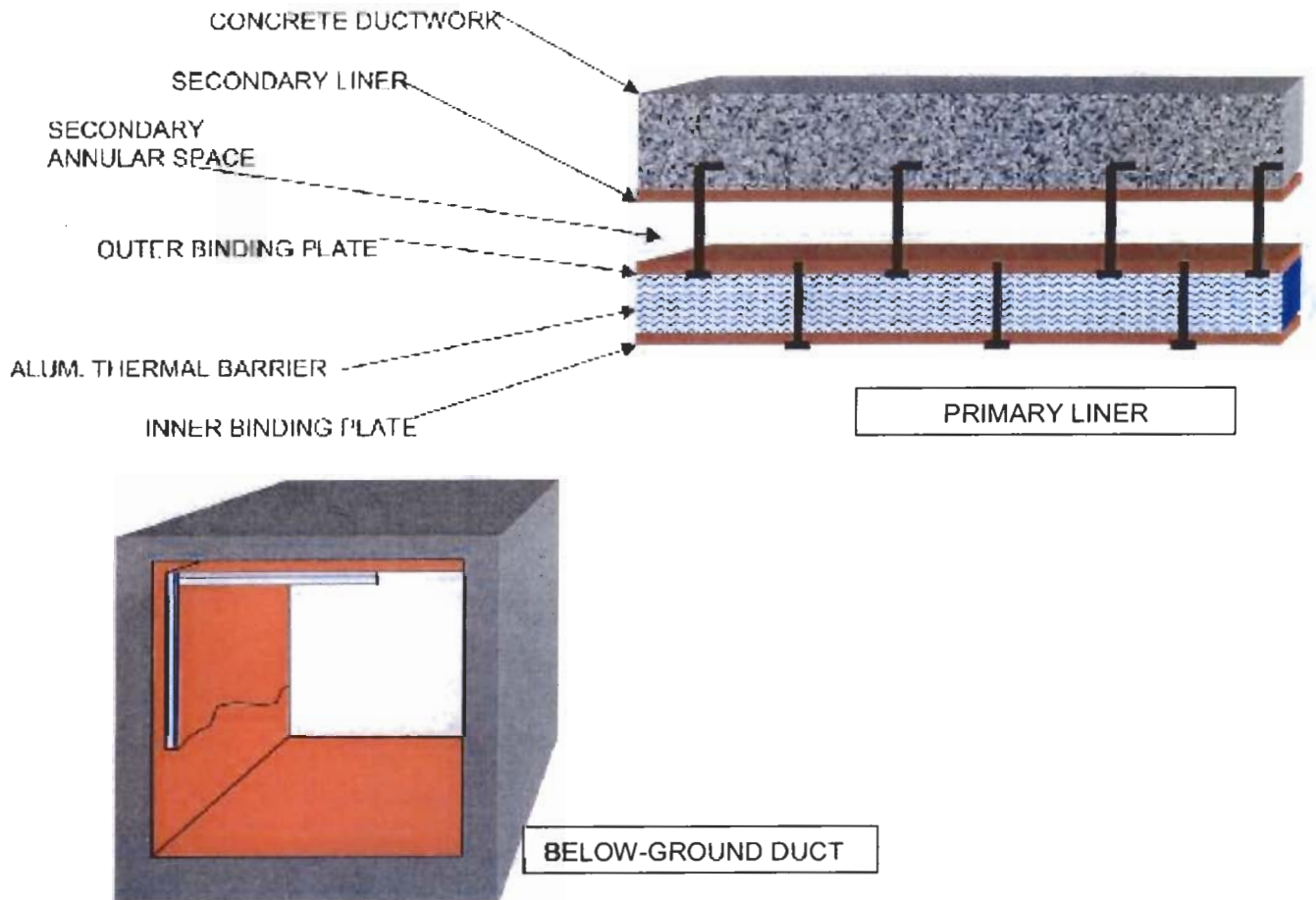


Figure 4. Below-Ground Duct and Primary Liner Construction Cross-Section

To protect the concrete of the below-ground duct from the high exhaust air temperatures during reactor operations, the duct section upstream of the air coolers had a three-part thermal liner (primary liner) and a secondary liner. (The air coolers were removed in a previous Removal Action.) The secondary liner forms the inner wall of the concrete duct and is bonded to the concrete pour with steel J-bolts. Between the primary and secondary liners is a three-inch space that forms the secondary air duct; the inner duct is the primary air duct. During reactor operations, the primary reactor cooling air flowed through the primary air duct, and secondary cooling air flowed through the three-inch secondary air duct to cool the concrete duct structure.

The primary liner was constructed of four inches of crimped aluminum sheets sandwiched between two carbon steel binding plates, the outer (rear) and the inner (front) binding plates. The outer binding plate is attached to the steel secondary liner with steel nuts and studs. The inner binding plate is likewise attached to the outer binding plate in a similar manner, with steel spacers to maintain the four-inch space for the crimped aluminum sheets. The outer binding plate is a continuous weldment of smaller plates, which is interrupted only at several expansion joints. The inner binding plate is an assembly of smaller steel plates (nominally five feet by six feet) bolted together with steel strapping to seal the seams.

The BGRR Decommissioning Project took samples from the primary liner for purposes of identifying radiological contaminants. The radionuclide-specific concentration in the liner ranged from 1.07 picoCuries per gram (uranium-235) to 31.40 nanoCuries per gram (cesium-137). The results indicated that cesium-137 and strontium-90 comprised over 98 percent of the total radioactivity. Additionally, process knowledge indicates that the liner contains no hazardous material.

The scope of work for this Removal Action is to remove the primary liner from the north and south ducts. The primary liner will be removed from the northernmost point in the reactor exhaust air plenums (where the duct transitions from vertical to horizontal) to the liners' termination at the location of the removed air coolers. In all, nearly 500 linear feet of liner will be removed from the north and south ducts.

3. Threat of Release into the Environment of a Hazardous Substance, Pollutant, or Contaminant

Characterization of the primary liner indicates that the major Contaminants of Concern (COCs) are cobalt-60, cesium-137, strontium-90, americium-241, uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239, and plutonium-240. In addition, radiological surveys inside the primary liner indicate a maximum gamma dose rate of 100 milliRem per hour. There are no known hazardous materials associated with the primary liner.

Video inspections, showing water marks at several locations inside the primary liner, and a gas-tracer leak test have demonstrated that the below-ground ducts leaked contaminated water to the surrounding soils.

Based on the above, the primary liner poses a threat of release of radiological contaminants to the environment and warrants expeditious removal from the ducts.

B. Actions to Date

1. Previous Actions

- Water in the below-ground duct was removed in 1998. Currently, the low-elevation points in the duct are monitored for any new in-leakage.
- The above-ground ducts were removed in 2001.
- The below-ground duct coolers were removed in 2002.
- Sampling and analysis, as well as a limited radiological survey, of the liner were performed during the characterization of below-ground systems in 2002.

2. Current Actions

- The below-ground ducts are monitored for water intrusion. Any water found is removed by pumping the water out at low points, such as the deep drain sump.
- The below-ground ducts are maintained under negative pressure to prevent any airborne contamination releases.
- Down-gradient groundwater is being monitored.

3. Planned Actions

- Monitoring and surveillance of the below-ground ducts will continue, including monitoring of the below-ground ducts for water intrusion.

C. National Priorities List Status

Brookhaven National Laboratory was added to the National Priorities List in 1989. An Interagency Agreement under the *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA), and applicable New York State regulations was negotiated between the DOE, EPA, and NYSDEC. The Interagency Agreement became effective in May 1992 and governs the environmental restoration program at BNL.

III. THREATS TO PUBLIC HEALTH OR WELFARE AND THE ENVIRONMENT: STATUTORY AND REGULATORY AUTHORITIES

A. Threats to Public Health or Welfare

The threats posed by the primary liner are time-critical based upon:

- Their significant radiological contamination.
- The potential for further release of radiological contamination to soil and groundwater via rainwater intrusion, which has the potential to transport contamination from the primary liner to a degraded expansion joint.

- The BNL site is located above a sole-source aquifer, as designated by EPA under the *Safe Drinking Water Act*, and groundwater is the primary source of drinking water in the area. The groundwater also is classified by New York State as Class GA under the New York Codes, Rules and Regulations (NYCRR), 6 NYCRR Part 703 [3], the best usage of which is a source of potable-water.

The appropriateness of the removal action is based on two of the eight factors listed in 40 Code of Federal Regulations (CFR) 300.415 (b) (2) [4] of the regulations implementing the National Contingency Plan.

1. Actual or potential exposure to nearby workers, populations, animals or the food chain from hazardous substances, pollutants, or contaminants, and
2. Actual or potential radiological contamination to drinking-water supplies or sensitive ecosystems.

B. Threats to the Environment

The major threat to the environment is on-site migration of radiological contaminants into surrounding soils and subsequently to groundwater.

IV. DETERMINATION OF ENDANGERMENT

If the actual or threatened releases of pollutants and contaminants from this site are not mitigated by taking the response action selected in this action memorandum, they pose a potential and substantial endangerment to the environment and risk to workers.

V. PROPOSED ACTION AND ESTIMATED COSTS

A. Proposed Action

The proposed current plan includes the following.

The three-part primary liner will be removed using remote demolition equipment that has been successfully used at several DOE and U.S. commercial nuclear facilities. The liner removal process will entail removal of the inner binding plate first, then the crimped aluminum sheets, and finally the outer binding plate. Two remote manipulators are planned for the liner removal. One will be fitted with demolition tools such as chisels or shears. The other will be fitted with a grapple or a remote-controlled circular saw attachment, depending upon the activity. The manipulator fitted with the demolition tools will shear the nuts holding the inner binding plate(s), allowing them to be removed to expose the crimped aluminum sheets. The crimped aluminum sheets will be removed using a grapple attachment. To remove the outer binding plate, a circular saw cutting attachment will be fitted to one of the manipulators. This cutting attachment will cut the plates into roughly five-foot-by-five foot sections that can be removed with a shear or chisel attachment on the second manipulator.

Once the primary liner is removed, the secondary liner will be exposed. Since this steel liner forms the concrete structure of the ducts, it will remain in place until final disposition of the BGRR facility is determined. Debris and loose contamination will be removed via vacuuming or other mechanical means.

The BGRR exhaust air primary liner will be removed from its location in the below-ground duct and disposed of in a licensed facility. This removal action is being undertaken to prevent radiological contamination from potentially being released into surrounding soils and groundwater. Performance of a time-critical removal action for this purpose is specifically referred to in the EPA's Office of Solid Waste and Emergency Response (OSWER) Interim Final Guidance on Preparing Superfund Decision Documents Directive 9355.3-02 [5].

B. Contribution to the Remedial Performance

The BGRR was identified in the Interagency Agreement as an AOC, being given the designation AOC 9. In the future, a ROD will be developed to document the final remedy selected. The proposed action addresses radiological source removal, and is therefore consistent with and contributes to the long-term objectives for AOC 9.

C. Description of Alternative Technologies

The opportunity to use the safest and most cost-effective alternative technologies lies in the physical removal and disposal of the primary liner. The BGRR Decommissioning Project plans to undertake the removal action using BNL and contractor labor resources and dispose of the liner wastes at an off-site licensed waste disposal facility. Alternative technologies considered decontamination of the liner in place and *in-situ* solidification of contaminants. Both alternatives were viable but posed greater uncertainties than for the technologies proposed in such areas as worker safety, environmental releases and local burial of low-level radioactive waste.

D. Applicable or Relevant and Appropriate Requirements

The National Contingency Plan, Section 300.430 (e)(9)(iii)(B), requires that removal attains the Federal and State Applicable and Relevant and Appropriate Requirements (ARARs) to the extent practicable. The following ARARs apply to this removal action.

1. Chemical-Specific ARARs{tc \411 ".2.1 Chemical-Specific ARARs"}

The chemical-specific ARARs that the removal action will meet are listed below:

- a. 6 NYCRR Part 212 [7], General Process Emission Sources: This State regulation will be followed to determine the need for air-emission control equipment.
- b. RCRA (40 CFR 260-268) [8]: These Federal regulations define hazardous wastes. All wastes classified as hazardous will be handled, stored, and disposed of off-site at a permitted facility in accordance with these regulations.

- c. New York State Hazardous Waste Regulations (6 NYCRR Part 370 - 373) [9]: These regulations define hazardous wastes in New York State. All wastes classified as hazardous will be handled, stored, and disposed of off-site at a permitted facility in accordance with these regulations.

2. Location-Specific ARARs{tc \l 4 "11.2.2 Location-Specific ARARs"}

No location-specific ARARs were identified.

3. {tc \l 3 ""}Action-Specific ARARs

The action-specific ARARs that this Removal Action will meet are listed below:{tc \l 411 ".2.3 Action-Specific ARARs"}

- a. 10 CFR 835 [10]: This regulation establishes the requirements for protecting workers by control and management of radiologically contaminated areas at DOE sites.
- b. RCRA (40 CFR 260-268): As described above.
- c. New York State Hazardous Waste Regulations (6 NYCRR Part 370 - 373): As described above.
- d. *Clean Air Act* (42 U.S.C Section 7401, et seq.) [11] and the National Emissions Standards for Hazardous Air Pollutants (40 CFR) [12]: regulates and limits the emissions of hazardous air pollutants, including radionuclides.
- e. 49 CFR Part 173.4 through 173.471 [13], Packaging and Transportation of Radioactive Material.

4. To-be-considered Guidance{tc \l 411 ".2.4 To Be Considered Guidance"}

In implementing this Removal Action, the following important guidance will be followed. These are guidelines that are not promulgated.

- a. NYSDEC's Division of Air Guidelines for Control of Toxic Ambient Air Contaminants, Air Guide 1 [14]: This guide will be used to assess the impacts of air emissions and to assist with evaluating the need for having air-emissions control equipment.
- b. Envirocare of Utah's Site's Waste Acceptance Guidelines Revision 3 and License (UT 2300249) Amendment 11 [15]: Radioactive and mixed waste acceptance guidelines for Envirocare.
- c. All criteria required by DOE Order 435.1 "Radioactive Waste Management" [6] shall be met during this action. Because the expected contaminants of concern are radiological for the primary liner, the waste generated is expected to be radioactive waste. As stated above, all waste will be disposed off-site in licensed waste disposal

facility. The exact disposal location will be determined based upon final waste designation.

E. Project Schedule

Major tasks include preparing planning documentation, issuing subcontracts for procurement of equipment, waste processing, transportation, and disposal, carrying out the work, and issuing a closeout report. The current BGRR working schedule calls for the removal action including all waste disposal completed by September 2004.

F. Estimated Costs

The total project cost to remove and dispose of the BGRR below-ground duct primary liner is estimated to be \$5,456,000.

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

A delayed action or no action will increase the potential for future releases of radioactive material to the environment.

VII. PUBLIC PARTICIPATION

Public participation for the primary liner Removal Action will include issuing a public notice. This will coincide with the submission of this Action Memorandum to the Administrative Record. Once this Action Memorandum has been issued, a public notice of its availability will be published in *Newsday* (regional distribution).

Additionally, project updates are provided to the BGRR Working Group, Community Advisory Council, and Brookhaven Executive Roundtable. Further BGRR-related information is available to the public from the BGRR website (<http://www.bnl.gov/bgrr>) and *cleanupupdate* newsletter.

VIII. OUTSTANDING POLICY ISSUES

The future use of the BGRR Fan House, Building 701, and adjacent areas will not be impacted by the removal of the primary liner.

IX. ENFORCEMENT

The BNL site is owned by DOE and operated by Brookhaven Science Associates. The DOE will fund the source control disposal entirely. The removal action will be conducted in accordance with CERCLA and National Contingency Plan requirements, the Interagency Agreement, and applicable New York State regulations.

X. RECOMMENDATION

This decision document recommends a time-critical removal action of the below-ground duct primary liner of the BGRR at Brookhaven National Laboratory, New York. This decision document was developed in accordance with CERCLA as amended, and is consistent with the National Contingency Plan.

XI. REFERENCES

1. Interagency Agreement between United States Environmental Protection Agency – Region II, United States Department of Energy, and New York State Department of Environmental Conservation. Federal Facility Agreement under CERCLA Section 120, Administrative Document Number II-CERCLA-FFA-00201, 1992.
2. Code of Federal Regulations, National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR 300) (U.S. Government Printing Office, Washington, D.C.).
3. New York Code, Rules and Regulations (1967), Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations, (Title 6 NYCRR Part 703) (Amended August 1999) (New York State Department of Environmental Conservation, Albany, NY).
4. Code of Federal Regulations, National Oil & Hazardous Substance Pollution Contingency Plan, Hazardous Substance Response (40 CFR 300.415 (b) (2)) (U.S. Government Printing Office, Washington, D.C.).
5. Office of Solid Waste and Emergency Response (OSWER) (Directive 9355.3-02), Interim Final Guidance on Preparing Superfund Decision Documents dated June 1, 1989 (Available from National Technical Information Service (NTIS), (Order No. PB 91-921265).
6. United States Department of Energy, (DOE Order 435.1), Radioactive Waste Management.
7. New York Code of Rules and Regulations, General Process Emissions Sources (6 NYCRR Part 212) (New York State Hazardous Waste Management Program).

8. Code of Federal Regulations, Hazardous Waste Management System (RCRA) (40 CFR Parts 260-268) (U.S. Government Printing Office, Washington, D.C.).
9. New York Code of Rules and Regulations, New York State Hazardous Waste Management Program (6 NYCRR Part 370 - 373).
10. Code of Federal Regulations, Occupational Radiation Protection (10 CFR Part 835) (U.S. Government Printing Office, Washington, D.C.).
11. *Clear Air Act* (42 U.S.C Section 7401, et seq.).
12. National Emissions Standards for Hazardous Air Pollutants (40 CFR).
13. Code of Federal Regulations (49 CFR Part 173.4) (U.S. Government Printing Office, Washington, D.C.)
14. New York State Department of Environmental Conservation, Division of Air Guidelines for Control of Toxic Ambient Air Contaminants, Air Guide 1.
15. Envirocare of Utah, Site Waste Acceptance Guidelines, Revision 3, and License (UT 2300249) Amendment 11.