

**ACTION MEMORANDUM
BROOKHAVEN GRAPHITE RESEARCH REACTOR
ABOVE GRADE DUCTING
REMOVAL ACTION**

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Prepared by
Brookhaven Science Associates
Brookhaven National Laboratory
BGRR Decommissioning Project
Upton, New York, 11973-5000

Prepared for
U. S. Department of Energy
Brookhaven Group
Upton, New York, 11973-5000

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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 Above Grade Ducting of the Brookhaven Graphite Research Reactor (BGRR) at Brookhaven National Laboratory (BNL).

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), the New York State Department of Environmental Conservation (NYSDEC), and with Suffolk County Department of Health Services. This action will be consistent with the final remedial actions that will be documented in the Brookhaven Graphite Research Reactor (BGRR) Record of Decision. Work will be conducted in accordance with the National Contingency Plan [1] (NCP, 40 CFR 300).

II. SITE CONDITIONS AND BACKGROUND

A. Site Description

1. Physical Location

Brookhaven National Laboratory is located in Upton, Suffolk County, New York, near the geographic center of Long Island (Figure 1). The site encompasses 5,300 acres, 75 percent of which is wooded. The remainder is developed and contains office buildings, various large research facilities, and parking lots. The BNL site, formerly occupied by the U.S. Army as Camp Upton during World Wars I and II, was transferred to the Atomic Energy Commission in 1947, to the Energy Research and Development Administration in 1975, and to the Department of Energy in 1977. It has been used as a National Laboratory since 1947. The BNL site is owned by the DOE and is operated by Brookhaven Science Associates (BSA).

Brookhaven National Laboratory carries out basic and applied research in the following fields: high-energy nuclear physics 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 facilities include the Brookhaven Medical Research Reactor, the National Synchrotron Light Source, the Relativistic Heavy Ion Collider (RHIC) and the Alternating Gradient Synchrotron, the High Flux Beam Reactor (HFBR), and the non-operating High Flux Beam Reactor (HFBR).

Figure 2

BGRR Site - Looking North



The Brookhaven Graphite Research Reactor (BGRR) at BNL was the first reactor built for the sole purpose of providing neutrons for research. During its years of operation from 1948 until 1969, it was one of the principal research reactors in the United States.

The BGRR was an air-cooled graphite moderated reactor. The Primary Air Cooling System utilized cooling fans that were located in a building (704) separate from the reactor building (701). Exhaust ducting constructed of reinforced concrete runs in two separate ducts below the ground from the reactor exhaust plenums to the system cooler and filters. Downstream of the filters the ducting rises above the ground and combines into one large duct, which is located on, and supported by, the Fan House (704). The individual cooling fans took suction through 48 inch diameter ducts, which penetrated the building roof and connected at the duct bottom. There is approximately 225 feet of above grade ducting (Figure 3).

During reactor operations, filtered outside cooling air was drawn across the reactor pile through this ductwork by the fans where it was cooled, filtered and eventually exited through the 100 meter tall exhaust stack.

Figure 3

Above Grade Ducting & Fan House



Figure 4

**Fan House as It Would Appear With
Above Grade Ducting Removed**



2. Removal Site Evaluation

From 1950 until 1958, the BGRR was fueled with natural uranium. During this period there were 28 reported ruptured fuel cartridges. These fuel failures led to the contamination in the cooling system and components.

In September 1999, radiological surveys were performed on the duct interior near the first above grade joint, and inside the Primary Cooling System Fans 3 and 5. These points were chosen because the number 3 fan was replaced after the fuel loading was changed from natural to enriched uranium in 1960-61, while the number 5 fan had been installed since the original construction of the BGRR in 1948. The gamma survey data taken from these locations provided a representation of the nature and extent of the contamination existing in the Primary Air Cooling System and Above Grade Ducting.

Figure 5
ASTD-ISOCS Survey Data¹

Preliminary Analysis [values subject to change following QA review]

On August 11 the ASTD ISOCS Technical Team used the ISOCS instrument to perform gamma spectrum analysis of a cement plug identified as having been obtained from the side wall of the BGRR Above Grade Duct, on the rooftop over the fan house. Also on September 2 and September 9, we performed *in situ* analysis of the interior of the ducts through three opened access portals in each of the duct sections, after the filters but before the fans. The preliminary analysis of the spectra are provided in the table below.

Surface Activity Concentration on inner surface of Above Ground Ducts (pCi/cm²)

Radionuclide	Plug Surface	North Duct	South Duct	Rooftop Duct
Am-241	37 ± 13	13 ± 2	21 ± 24	15 ± 21
Cs-137	8,500 ± 260	10,400 ± 710	24,100 ± 1,600	13,700 ± 930
Co-60	ND	ND	34.6 ± 4.4	26 ± 4.3
Na-22	ND	2.3 ± 2	2.7 ± 3.3	ND

ND = Not Detected

¹ Accelerated Site Technology Deployment-In situ Object Counting System (1999).

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

In October 1998, pieces of the concrete duct structure broke off and fell to the ground while repairs were being made in an adjacent area to prevent rainwater intrusion. Investigation revealed that the piece(s) of concrete separated from the structure in the area of the venturi mounting flanges, where there is a steel-to-concrete mating surface. Although the pieces fell into a non-radiological controlled area, the area was work controlled (construction boundaries established), and no one came in contact with the pieces. The pieces of concrete measured up to 70k dpm fixed contamination.²

As the structure ages, the potential for a catastrophic failure increases, as does the risk of a release to the environment. Although no structural analysis has been performed on the duct structure, recent visual inspections of the duct's interior walls identified extensive spalling and several through-wall cracks, with some cracks exceeding 24 inches in length. Although this is not necessarily indicative of imminent failure, it does show that the structure is degrading, thereby increasing the risks of larger pieces of the structure breaking away and releasing radioactive material to the environment.

Additionally, the aforementioned visual inspections revealed a clearly identifiable "water line" in the below grade ductwork beneath the Instrument House (708). This made it evident that water intrusion has been a long-standing problem. This further confirmed suspicions that rainwater was entering the above grade ducting through pathways such as expansion joint and venturi flanges, then running down the sloped duct and accumulating in the lower portions of the duct below the Instrument House.

B. Other Actions to Date

1. Previous Actions

Temporary repairs, utilizing sheet metal flashing and masonry sealant, were initiated in the fall of 1997. To date these repairs have eliminated most of the water intrusion. However, without major modifications, all water intrusion cannot be eliminated, especially during hard, driving rains and heavy precipitation.

2. Ongoing Action

² Occurrence Report, CH-BH-BNL-BNL-1998-0032, November 24, 1998

Periodic non-scheduled inspections of the duct exterior structure are performed pending issuance of a monitoring and surveillance procedure. Additionally, the below grade ducting is monitored weekly for water intrusion, and immediately following a rainfall that exceeds one inch in 24 hours.

3. Planned Actions

An administrative procedure, which will provide for scheduled periodic monitoring and surveillance of the Above Grade Ducting is in final review, and will be implemented immediately upon issuance. This procedure provides inspection criteria for the duct exterior structure, monitors the below grade ducting for water intrusion, and requires evaluation and action on identified structural discrepancies or 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 DOE, the 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 Above Grade Ducting are time-critical based upon its degraded structural condition which is evident in routine visual observation, and reported evidence that this degraded condition has led to releases of radioactive material to the environment. The appropriateness of the removal action is based on two of the eight factors listed in 40 CFR 300.415 (b) (2) [4] of the regulations implementing the National Contingency Plan.

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

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 6 NYCRR Part 703 [5], the best usage of which is a source of potable-water.

B. Threats to the Environment

The major threat to the environment is on-site migration of contaminants, uptake by the local fauna and flora, and contamination migration into surrounding soils.

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 due the uncharacterized physical structure.

V. PROPOSED ACTION AND ESTIMATED COSTS

A. Removal Action Objectives

The proposed action is to remove the BGRR Above Grade Ducting in its entirety from the first above ground joint. This removal action is being undertaken to prevent low-level radioisotopes being released to surface soil and subsequently migrating into surrounding soils and groundwater. Performance of an interim 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 [9].

All criteria required by DOE Order 435.1 "Radioactive Waste Management" [10] shall be met during this action. Because the expected contaminants of concern are primarily radiological, all waste generated from this Removal Action is expected to be radiological waste. However, there is a chance small volumes of hazardous or mixed waste could be generated. As stated above, all waste will be disposed of in a DOE-approved waste facility. The exact disposal location will be based on final waste designation.

B. Contribution to the Remedial Performance

The BGRR was identified in the Interagency Agreement as an *Area Of Concern* (AOC), being given the designation AOC -9. The BGRR Decommissioning Project will address AOC 9 through several removal actions under the "Policy on Decommissioning Department of Energy Facilities Under CERCLA" (dated 5/22/95) [11]. In the future, a Record of Decision will be developed to document the long-term closeout of AOC 9 based on the results of these actions undertaken as part of the BGRR Decommissioning Project. The proposed removal action addresses source removal, and therefore is consistent with and contributes to the long-term objectives of the Record of Decision for AOC 9.

C. Description of Alternative Technologies

The physical configuration and current degraded condition of the Above Grade Ducting limits alternative technologies available to mitigate the threat of future releases of radioactive material to the environment. A containment could be erected to contain the spread of contamination, but this would not prevent further degradation of the structure. Other alternatives such as sealing the structure with coating such as "gunite" are not practical because such coatings must be applied to stable and sound surface to be effective.

The opportunity to use the safest and most cost-effective alternative technologies lies in the physical removal and disposal of the structure. The BGRR Decommissioning Project plans to solicit proposals from qualified vendors for the for the removal and offsite disposal of the structure.

D. Applicable or Relevant and Appropriate Requirements

The National Contingency Plan [1] Section 300.430 (e)(9)(iii)(B) requires that the selected remedy (BGRR Decommissioning Project) attains the Federal and State ARARs or that a waiver of an ARAR is obtained. This removal action will meet the following ARAR's to the extent practicable.

Chemical-Specific ARARs

The chemical-specific ARARs that the Removal Action will meet are listed below:

1. 6 NYCRR Part 212 [12], General Process Emission Sources: This State regulation will be followed to determine the need for air-emission control equipment.
2. RCRA (40 Code of Federal Regulations parts 260-268) [13]: 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.
3. New York State Hazardous Waste Regulations (6 NYCRR Part 370 - 373) [14]: 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.

Location-Specific ARARs

No location-specific ARARs were identified.

Action-Specific ARARs

The action-specific ARAR's that this Removal Action will meet are listed below:

1. 10 Code of Federal Regulations Part 835 [15]: This regulation establishes the requirements for protecting workers by control and management of radiologically contaminated areas at DOE sites.
2. RCRA (40 Code of Federal Regulations parts 260-268): As described above.
3. New York State Hazardous Waste Regulations (6 NYCRR Part 370 - 373): As described above.
4. Clear Air Act (42 U.S.C Section 7401, et seq.) [16] and National Emissions Standards for Hazardous Air Pollutants (40 Code of Federal Regulations) [17]: This Act regulates and limits the emissions of hazardous air pollutants, including radionuclides.

To-Be-Considered Guidance

In implementing this Removal Action, the following important guidance will be considered. Guidelines that are not promulgated and are not legally binding:

1. NYSDEC's Division of Air Guidelines for Control of Toxic Ambient Air Contaminants, Air Guide 1: 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.
2. NYSDEC's Technical and Administrative Guidance Memorandum (TAGM) "Remediation Guideline for Soils Contaminated with Radioactive Materials" (#4003), September 1993 [18]: This memorandum contains State guidance for remediating radiologically contaminated soils. The State's value of 10 mRem/year above background serves as an additional goal for remediation that will be evaluated during field excavation work.
3. NYSDEC's Technical and Administrative Guidance Memorandum (TAGM): Determination of Soil Remediation Objectives and Remediation Levels (# 4046), January 1994 [19].
4. DOE's Order 5400.5 [20] and draft 10 Code of Federal Regulations 834 "Radiation Protection of the Public and the Environment" [21]: This order, and its current draft rule-making, contains the requirements and guidance for the developing radiological soil-remediation levels at DOE sites.
5. DOE Order 435.1 "Radioactive Waste Management" [10]: This order provides guidance and requirements for management and disposal of radioactive waste generated at DOE facilities.

6. U.S. EPA's Establishment of Clean-Up Levels for CERCLA Sites with Radioactive Contamination. OSWER Directive 9200.4-18, August 1997 [22]. This directive recommends an allowable exposure to radionuclides to 15mrem/year as consistent with EPA's acceptable risk range.

E. Project Schedule

Major tasks include preparing the Above Grade Duct Removal Plan, issuing sub-contracts for the specialized work, carrying out the work, disposing of the waste, and issuing a closeout report. Current planning calls for the Removal Action to be completed by September 2000, with final waste shipments completed in 2001.

F. Estimated Costs

<input type="checkbox"/> Duct Removal & Size Reduction Cutting:	\$1,449,622
<input type="checkbox"/> Waste Disposal & Shipping:	1,008,303
<input type="checkbox"/> Engineering, Characterization, Administrative:	346,447
<input type="checkbox"/> Expenditures to Date:	56,400
 Total Estimated Costs:	 \$2,860,772

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. Delaying action will also potentially increase the scope and cost of the project as the condition of the duct structure degrades.

VII. PUBLIC PARTICIPATION

Public participation for the Above Grade Ducting Removal Action includes issuing a public notice and publishing an article in the Brookhaven Bulletin. These activities 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) and in *Suffolk Life*. Simultaneously, a copy of the public notice will be sent to BNL's Environmental Restoration Division Community Relations mailing list (approximately 3,000 addresses).

VIII. OUTSTANDING POLICY ISSUES

The future use of the BGRR Fan House and adjacent areas will not be impacted by the removal of the Above Grade Ducting (Figure 4). The goal of this action is to prepare the land for residential use after 50 years of institutional control by the DOE.

IX. ENFORCEMENT

The 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 Above Grade Ducting of the BGRR at the Brookhaven National Laboratory in Upton, New York. This removal action also will include the soils that may be contaminated with hazardous- and radioactive- materials above the cleanup levels established to limit future exposure to 15 mRem/year, to meet future land-use criteria, and to protect the groundwater. This decision document was developed in accordance with CERCLA as amended, and is consistent with the National Contingency Plan.

XI. REFERENCES

1. 40 CFR 300, National Contingency Plan.
2. Occurrence Report, CH-BH-BNL-BNL-1998-0032, "Discovery of Contaminated Material Outside of a Radiologically Controlled Area", November 24, 1998.
3. Letter from Mary Logan (EPA) to G. Malosh (DOE/BHG), Subject: Brookhaven National Laboratory, BGRR (letter dated 3/23/99).
4. Final Operable Unit III Remedial Investigation Report, International Technology Corporation, March 1, 1999.
5. 40 CFR 300.415 (b) (2), National Oil & Hazardous Substance Pollution Contingency Plan.
6. New York State General Process Emissions Sources 6 NYCRR Part 703.

7. "Final Report, Radiological Risk Assessment of Operable Units 1/VI, Brookhaven National Laboratories," prepared for CDM by Afftrex Ltd. Under contract No. NYC002-5109-CS, 1996.
8. "Alternatives Report, Volume 1," prepared for BNL by CDM Federal Programs Corporation, under contract No. 739174, Document No. 5109-017-FR-BCRR, 1997.
9. "Brookhaven National Laboratory Final Feasibility Study Report Operable Unit 1 and Radiologically-Contaminated Soils," prepared for BNL by CDM Federal Programs Corporation, under contract No. 739174, Document No. 5109-020-FR-BCVJ, 1999.
10. 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.
11. United States Department of Energy, DOE Order 435 "Radioactive Waste
12. "Policy on Decommissioning Department of Energy Facilities Under CERCLA" (dated 5/22/95).
13. New York State General Process Emissions Sources, 6 NYCRR Part 212.
14. 40 CFR Parts 260-268, Hazardous Waste Management System (RCRA).
15. New York State Hazardous Waste Regulations (6 NYCRR Part 370 - 373).
16. 10 CFR Part 835, Occupational Radiation Protection.
17. Clear Air Act (42 U.S.C Section 7401, et seq.).
18. National Emissions Standards for Hazardous Air Pollutants (40 CFR).
19. NYSDEC Technical and Administrative Guidance Memorandum (TAGM), "Remediation Guideline for Soils Contaminated with Radioactive Materials" (#4003), September 1993.
20. NYSDEC Technical and Administrative Guidance Memorandum: Determination of Soil Remediation Objectives and Remediation Levels (# 4046), January 1994.
21. DOE Order 5400.5, Change 2, Radiation Protection of the Public and the Environment.
22. Draft 10 CFR Part 834, "Radiation Protection of the Public and the Environment."
23. Interagency Agreement, (EPA/DOE/NYSDEC), 1992.