



Department of Energy

Brookhaven Area Office
Building 464
P. O. Box 5000
Upton, New York 11973

JUL 24 2002

Mr. Leslie M. Hill
Brookhaven Science Associates, LLC
Brookhaven National Laboratory
Upton, NY 11973

Dear Mr. Hill:

**SUBJECT: DEPARTMENT OF ENERGY (DOE) APPROVAL OF THE
UNREVIEWED SAFETY QUESTION DETERMINATION (USQD):
BROOKHAVEN GRAPHITE RESEARCH REACTOR
DECOMMISSIONING PROJECT (BGRR-DP)**

- Reference:
- 1) Letter, from L.M. Hill, BNL to R. Desmarais, BAO, Subject: Brookhaven Graphite Research Reactor (BGRR) Unreviewed Safety Question Determination/Safety Evaluation (USQD/SE): Challenge to BGRR-ASA by Increase in Estimated Below Ground Duct (BGD) Filter Inventory, dated May 17, 2002
 - 2) Safety Evaluation Report, Brookhaven Graphite Research Reactor Decommissioning Project, dated June 13, 2002

This letter transmits approval of the subject document for project execution. The basis for this approval is contained in the enclosed Safety Evaluation Report (SER). The SER contains the technical evaluation for compliance with applicable requirements contained in the DOE Orders and Standards. The approved Auditable Safety Analysis in conjunction with the referenced USQD and the SER constitute the Safety Authorization Agreement between DOE and Brookhaven Science Associates. These documents will be placed under configuration management. All commitments and controls established in the ASA, USQD and SER will be strictly enforced.

JUL 24 2002

The BGRR DP continues to be classified as "RADIOLOGICAL". The work scope approved by this ASA is limited to surveillance, routine maintenance, and radiological/hazardous characterization.

Should you have additional questions, please contact Mark Parsons of my staff at extension 7978.

Sincerely,



Frank J. Crescenzo, Acting
Area Manager

Enclosure:
As stated

cc: Y. Collazo, PMO, CH, w/o encl.
M. Dikeakos, BAO, w/o encl.
M. Parsons, BAO, w/o encl.
G. Penny, BAO, w/o encl.
H. Taylor, BAO, w/o encl.
C. Adey, BNL, w/ encl.

DOE SAFETY EVALUATION REPORT (SER)

BROOKHAVEN GRAPHITE RESEARCH REACTOR DECOMMISSIONING PROJECT

June 13, 2002

DOE SAFETY EVALUATION REPORT (SER)

BROOKHAVEN GRAPHITE RESEARCH REACTOR DECOMMISSIONING PROJECT (BGRR-DP)

EXECUTIVE SUMMARY

This SER documents the basis for the U.S. Department of Energy (DOE) Brookhaven Area Office (BAO) approval of Brookhaven Science Associates to continue execution of the Brookhaven Graphite Research Reactor Decommissioning Project (BGRR-DP) in accordance with its safety basis documentation.

On April 24, 2002, an Occurrence Report [8] documented characterization results indicating that the filters contained in the Below Ground Ducts of the Brookhaven Graphite Research Reactor contained radionuclides in excess of the Category III Nuclear Facility threshold amounts as specified in reference [3]. All work in the vicinity of the filters was immediately halted until further notice. An Unreviewed Safety Question Determination/ Safety Evaluation [7] (USQD/SE) was performed in accordance with a DOE approved procedure [10] to evaluate the impact of the greater than Category III Nuclear Facility threshold inventory identified in the filters. This Unreviewed Safety Question Determination/Safety Evaluation (USQD/SE) concluded that filter inventories released during anticipated accident scenarios will not exceed Category III Nuclear Facility thresholds.

A Safety Evaluation Review (SER) team composed of selected subject matter experts conducted an in depth review of the USQD/SE. The SER team consisted of the DOE-BGRR Project Manager, a health physicist, a facility representative with nuclear facility oversight responsibilities, and another Project Manager with a nuclear quality assurance background. Each SME was selected based on their knowledge and experience with nuclear decommissioning operations, nuclear safety, occupational safety and health, hazardous materials operations, and radiological facility operations. Each Safety Evaluation Review team member reviewed the entire document. Team member comments have been resolved and incorporated into the USQD/SE.

The SER team concludes that the BGRR facility classification should remain as RADIOLOGICAL, and that the Auditable Safety Analysis (ASA), the USQD/SE, and this SER provide an adequate safety basis for continuation of the specific work scope identified in the ASA. This conclusion is based on the following premises:

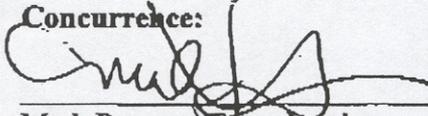
1. The form and distribution of the estimated Balance-of-Plant (BOP) radiological inventory is widely dispersed low-level contamination;
2. Reactor Pile and Biological Shield radiological inventory has been isolated (by sealing the pile faces) and characterized;

DOE SER, BGRR-DP

June 13, 2002

Concurrence and Approval Page

Concurrence:



Mark Parsons, Team Leader

6.28.02

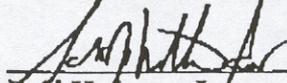
Date



Maria V. Dikeakos

6/28/02

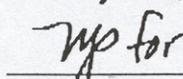
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Paul H. Jones, Jr.

6/28/02

Date

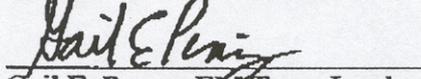


Lloyd Nelson

6.28.02

Date

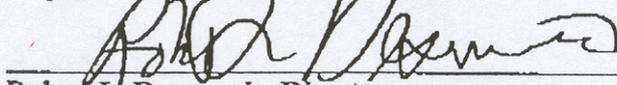
Recommended for Approval:



Gail E. Penny, EM Team Leader
Project Management Division

6/28/02

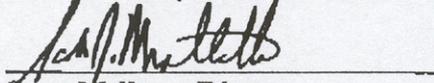
Date



Robert E. Desmarais, Director
Project Management Division

6/28/02

Date



Scott Mallette, Director
Operations Management Division

6/28/02

Date



Frank J. Crescenzo, Acting Manager
Brookhaven Area Office

6/28/02

Date

Approved for Implementation:



Marvin E. Gunn, Jr., Manager
Chicago Operations Office

7/19/02

Date

DOE SAFETY EVALUATION REPORT (SER)

BROOKHAVEN GRAPHITE RESEARCH REACTOR DECOMMISSIONING PROJECT (BGRR-DP)

EXECUTIVE SUMMARY

This SER documents the basis for the U.S. Department of Energy (DOE) Brookhaven Area Office (BAO) approval of Brookhaven Science Associates to continue execution of the Brookhaven Graphite Research Reactor Decommissioning Project (BGRR-DP) in accordance with its safety basis documentation.

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A Safety Evaluation Review (SER) team composed of selected subject matter experts conducted an in depth review of the USQD/SE. The SER team consisted of the DOE-BGRR Project Manager, a health physicist, a facility representative with nuclear facility oversight responsibilities, and another Project Manager with a nuclear quality assurance background. Each SME was selected based on their knowledge and experience with nuclear decommissioning operations, nuclear safety, occupational safety and health, hazardous materials operations, and radiological facility operations. Each Safety Evaluation Review team member reviewed the entire document. Team member comments have been resolved and incorporated into the USQD/SE.

The SER team concludes that the BGRR facility classification should remain as RADIOLOGICAL, and that the Auditable Safety Analysis (ASA), the USQD/SE, and this SER provide an adequate safety basis for continuation of the specific work scope identified in the ASA. This conclusion is based on the following premises:

1. The form and distribution of the estimated Balance-of-Plant (BOP) radiological inventory is widely dispersed low-level contamination;
2. Reactor Pile and Biological Shield radiological inventory has been isolated (by sealing the pile faces) and characterized;

3. There are minimal quantities of hazardous material located within the BGRR facility;
4. The hazards analysis for the work scope authorized in the ASA does not yield any credible events that could result in hazard severity higher than “negligible”, hazard frequency greater than ‘remote’, or risk category higher than “routine”;
5. The BGRR pile radiological inventory is not releasable for airborne dispersion based on the hazards analysis and structural integrity of the confinement systems in place;
6. To establish a conservative final hazard classification of RADIOLOGICAL, a postulated accident scenario was analyzed that resulted in the release of 50%¹ of the filter bank with the greatest radiological inventory (129% / 2 = 64.5% of Category III Nuclear Facility inventory thresholds) to determine the Total Effective Dose Equivalent (TEDE) per DOE guidelines. This analysis resulted in a TEDE of 6.45 Rem in 24-hours at 30-meters due to direct exposure, inhalation, and longer term ingestion exposure to the maximally exposed individual;
7. An adequate margin of safety can be maintained without relying on safety structures, systems and components for the work scope defined in the ASA;
8. Adequate administrative controls have been developed using a graded approach to ensure an acceptable operating envelope;
9. All controls and commitments defined in the ASA will be enforced, and;
10. Work conducted under each BGRR-DP sub-project will be analyzed through an Unresolved Safety Issue Determination (USID) process, which will be supported by detailed characterization information; detailed engineering and work packages; radiological work procedures; and a task specific Health and Safety Plan.

1.0 INTRODUCTION

1.1 Purpose

The purpose of this SER is to document the results of an independent review of the USQD/SE performed for the Brookhaven Graphite Research Reactor Decommissioning Project by a selected group of DOE-Brookhaven Area Office subject matter experts (SMEs).

The purpose of the Hazard Classification and Auditable Safety Analysis (ASA) for the BGRR-DP is to establish an acceptable operational safety envelope for the BGRR facility. The ASA defines routine work activities, analyzes the radiological Material-at-Risk (MAR), examines postulated accidents and hazards relating to the execution of the

¹ Observations of filter media crushed during sample retrieval and handling indicate that over 50% of radiological inventory of the sample was retained with the sample.

project, documents the final hazard classification (FHC), and identifies appropriate controls and commitments necessary to ensure the protection of the workers, public and the environment.

Efforts to characterize the filters for waste management purposes during April 2002 resulted in an increased estimate of the mass of filters and entrained materials from that previously used in the ASA. Filter inventories are based on three pieces of information: density of the filter media (from retrieved filter media samples), volume of filter media, and radionuclide concentrations (pCi radionuclides/gm of filter media) as determined by analytical laboratories. While concentrations of radionuclides entrained in the newer samples remained the same as previously tested specimens, the April 2002 filter media specimens were found to have a higher density than previous specimens. This increased density yielded a higher filter mass and consequently, increased radionuclide inventory. When filter inventories were discovered to be higher than the material at risk as calculated in the ASA [4], and greater than Category III Nuclear Facility inventory thresholds, a USQD/SE was prepared to analyze the effects of the additional inventory.

1.2 Review Process

This SER presents the results of the DOE Safety Evaluation Review Team review and recommends approval of the USQD/SE.

2.0 HAZARDOUS SUBSTANCES INVENTORY AND HAZARD CLASSIFICATION

2.1 BGRR BOP and Pile Inventory

The residual radiological inventory considered for the BGRR Facility hazard classification was based on analytical laboratory and in-situ measurements of contamination in the Below Ground Ducts, Canal, and Canal and Water Treatment Houses. The BOP inventory does include filter inventories as previously estimated in the ASA.

Characterization efforts and calculations (in the current ASA) indicate that BOP inventory is 63.4% of the Category III limit and that this material is not considered to be Material At Risk (MAR) under the scope of the ASA. Since the current ASA includes filter inventories as portion of the BOP inventory and filter materials are at risk for some scenarios, filter inventories should be removed from the BOP designation and not analyzed as BOP inventory in future revisions of the ASA. Filter inventories are materials at risk and will need to be analyzed as appropriate in the ASA.

MAR estimates for the pile graphite inventory were unchanged from original estimates after incorporation of actual characterization data. Control rod radiological inventories represent 4.99 % of the Category III threshold, but are not considered to be MAR.

2.2 Filter Inventory

Radionuclide inventories for the filters are determined by multiplying the calculated mass of filter media by the radionuclide concentration of the media (pCi/gm) as determined by analytical laboratory testing of retrieved filter media sections. While comparisons of radionuclide concentrations between tests performed at different times have shown the concentrations remain largely unchanged, some variation in the filter media density has been observed. This change in observed filter density directly influences the total inventory calculated for the filters and has caused an increase in filter inventory.

Safety Evaluation calculations show the filter inventory in the North and South Ducts to be 48.5% and 129%; respectively of the Category III Nuclear Facility threshold. The total filter inventory is calculated to be 177% of the Category III Nuclear Facility threshold.

3.0 HAZARDS ANALYSIS

3.1 Risk Assessment

The risk assessment of the BOP portion of the BGRR was based on a methodical review of each of the initiating events and corresponding hazards associated with the facility, as originally defined by the Preliminary Hazards Analysis (PHA). Each initiating event and its associated hazards were examined for severity, probability and risk category. Only one accident-initiating event is postulated to occur at any one time. Initiating events in the risk assessment for the BGRR filters have been pared down from the PHA event definitions. The analysis considered only two events (seismic and high winds), as others were considered incredible due to the protection afforded by the Below Ground Duct and the lack of energy sources.

Considering the administrative controls and other mitigating factors, only low industrial risks exist for the non-intrusive work scope authorized by the ASA.

3.2 Dose Assessment Summary

A review of Risk Analyses presented in the Safety Evaluation shows no significant changes that would result in changes in facility classification.

The Dose Assessment was based on the higher South Duct inventory (129% of the Category III threshold). A conservative approach assumed that 50% of this inventory was available for release and is based on observations of filter sample retention of entrained particles upon destructive removal of samples from the filter media. The

analysis assumes that the filter inventories in the North and South ducts are separate, and uses the higher inventory of the two.

3.3 Final Hazard Classification.

The SER Team concludes that the BGRR facility final hazard classification remains unchanged and is RADIOLOGICAL based on:

- a) the BOP radiological material at risk MAR = 0%, and
- b) the dose consequences of an unmitigated accident is less than 10 Rem (~ 6.45 Rem) at 30-meters over a 24-hour period to the maximally exposed individual², and
- c) applying the methodology described in DOE-EM-STD-5502-94 [2], Figure 1 therein.

3.4 SER Team Recommendation.

The SER Team recommends the final hazard classification of the BGRR Facility remain RADIOLOGICAL. Data from ongoing radiological characterization efforts shall be evaluated to assure that radiological inventories do not exceed those specified in the ASA.

4.0 CONTROL AND COMMITMENTS

4.1 Previous Commitments. Commitments specified in the SER [9] last prepared for the most recent ASA revision shall remain in effect.

4.2 BGRR Authorization Basis. The Unresolved Safety Question Determination/Safety Evaluation with DOE approvals shall be added to the BGRR Authorization Basis Manual and placed under appropriate controls as required in reference. The BGRR Auditable Safety Analysis will be revised to include the results of the USQD/SE in accordance with reference. Filter inventories should be analytically separated from BOP inventories in the ASA.

5.0 CONCLUSION

The Safety Evaluation Review Team concludes that the BGRR Facility has been properly classified as RADIOLOGICAL in accordance with the commitments identified in section 4 of this SER. Adequate controls and commitments for the work scope activities identified in the ASA have been identified and will be enforced to protect the workers, the public or the environment.

² A 10 Rem TEDE represents the Category III Nuclear Facility threshold.

Appendix A

Records and References:

1. Department of Energy, *Review and Approval of Nonreactor Nuclear Facility Safety Analysis Reports*, DOE-STD-1104-96
2. Department of Energy, *Hazard Baseline Documentation*, DOE-EM-STD-5502-94
3. Department of Energy, Change 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE-STD-1027-92
4. Hazard Classification and Auditable Safety Analysis for Brookhaven Graphite Research Reactor (BGRR) Decommissioning Project, Revision 4, dated January 10, 2002
5. BHG Administrative Procedure, BHG-OA-17, *Review/Approval of Unresolved Safety Issue Determinations*, Rev 1
6. BGRR Procedure, ERD-OPM-4.4, Rev. 1, *Safety Evaluations for Unreviewed Safety Issue Determinations*
7. Unreviewed Safety Question Determination/Safety Evaluation BGRR-USQD-02-01 Challenge to BGRR-ASA by Increase in Estimated Below Ground Duct Filter Inventory, dated May 16, 2002
8. Occurrence Report CH-BH-BNL-BNL-2002-0005, 'Determination of Increased Radiological Inventory Leading to Exceeding Radiological Facility Categorization'
9. DOE Safety Evaluation Report, Brookhaven Graphite Research Reactor, dated January 21, 2002
10. WMD-ADM-910, Unreviewed Safety Question Determination (USQD), Rev. 3