ATTACHMENT 2

APPROVAL OF USID/SE FAN 5

Environmental Management Directorate

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October 28, 1999

Mr. George J. Malosh
Brookhaven Group Manager
U.S. Department of Energy
Building 464
Upton, NY 11973

Dear Mr. Malosh:

SUBJECT: DOE-BHG Comment Resolution - Unreviewed Safety Issue Determination Safety Evaluation (USID/SE) For Pile Fan #5 Removal for Brookhaven Research Reactor Decommissioning Project (BGRR-SE-99-01)

REFERENCE: Letter from G. Malosh to M. Schlender, dated October 26, 1999

The BGRR Decommissioning Project staff has responded to the four questions listed in the attachment to the above referenced letter. This response has already been informally transmitted to the reviewer who raised them, and it is our understanding that the answers satisfy the concerns of the reviewer.

If this is not the case, or if you have any further questions or concerns, please contact me or Stephen Pulsford on ext. 2394.

Sincerely yours,

Michael Schlender

Michael Schlender
Assistant Laboratory Director
Environmental Management

Enclosure: as stated
cc (w/enc.):

J. Goodenough, DOE/CH	J. Meersman, ERD	L. Nelson, DOE/BHG
M. Holland, DOE/BHG	M. Dikeakos, DOE/BHG	S. Pulsford, BGRR
S. Mallette, DOE/BHG	S. Moss, BGRR	File WBS 1.2

CC1999-700

Department of Energy
Brookhaven Group
Building 464
P.O. Box 5000
Upton, New York 11973

OCT 26 1999

Mr. Michael Schlender
Brookhaven Science Associates, LLC
Brookhaven National Laboratory
Upton, New York 11973

Dear Mr. Schlender:

SUBJECT: APPROVAL OF UNREVIEWED SAFETY ISSUE DETERMINATION/ SAFETY EVALUATION (USID/SE) FOR PILE FAN #5 REMOVAL FOR BROOKHAVEN RESEARCH REACTOR DECOMMISSIONING PROJECT (BGRR-SE-99-01)

The Brookhaven Group (BHG) has reviewed your request to begin removal of the BGRR Pile Fan #5 Removal. BHG has determined that the actions referenced in USID/SE BGRR-SE-99-01 are appropriate with the requirements of DOE Order 5480.21, Unreviewed Safety Questions and DOE-EM-STD-5503-94, EM Health and Safety Plan Guidelines. Therefore, removal of the BGRR Pile Fan #5 is authorized contingent upon the resolution of questions attached concerning the work plan for the removal of Pile Fan #5.

If you have any questions regarding this matter, please contact Lloyd Nelson of my staff at extension 5225.

Sincerely,

George J. Malosh
Brookhaven Group Manager

Enclosure:
As stated

cc: J. Goodenough, EPG, CH
M. Holland, BHG
S. Mallette, BHG
M. Dikeakos, BHG

All comments resolved per Lloyd Nelson communication to S. Moss 10/26/99 SAM

DOE BHG comments on BGRR-SE-99-01

1) Table 1-1, "Activity Description" No. 1 states "obtain concurrence from HFBR for performing work in the motor room". Has this been done and where is the specific concurrence from Reactor Division (RD) for the work being performed in the motor room? Has RD reviewed this work package?

2) What precautions were made to isolate work being done in Building 704 from the electrical switch gear and equipment used for the HFBR?

3) Has the pile fan been drained of all oils? Are there any PCB's in the oil? If not where is the documentation this has been analyzed and/or removed? What part of the work plan addresses the removal and draining of oils from the Pile Fan?

4) The BGRR Task-Specific ES&H Plan Table 2.1.1 Chemical Hazards Listing does not have ingestion exposure checked, but Table 2-1, Chemical Hazard Information does specify ingestion as an exposure route for Sr, Cs, Pu, Am, and Uranium. These tables need to accurately reflect hazard conditions and must agree with each other.

Environmental Management Directorate

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October 7, 1999

Mr. George J. Malosh
Brookhaven Group Manager
U.S. Department of Energy
Building 464
Upton, New York 11973

SUBJECT: Unreviewed Safety Issue Determination/Safety Evaluation (USID/SE) for Pile Fan #5 Removal for BGRR Decommissioning Project

Dear Mr. Malosh:

Attached for your review and approval is the subject document (BGRR-SE-99-01, Rev. 0, dated 10/4/99), covering WBS 1.2 – Remove and Decontaminate Fan House - Phase 1. This document has already been submitted informally to the DOE Project Manager for the BGRR Decommissioning Project to expedite the review and approval process. Physical removal cannot begin until DOE approval is received.

If you have any questions regarding the contents or analysis of BGRR-SE-99-01, please do not hesitate to call Steve Moss (ext.7639) or Stephen Pulsford (ext. 2394).

Sincerely,

Michael Schlender

Michael Schlender
Assistant Laboratory Director
Environmental Management

MS:ljt
Attachments: BGRR-SE-99-01, Unreviewed Safety Issue Determination and Safety Evaluation for Pile Fan #5 Removal

cc (w/o Attachments):

M. Cowell, BU	M. Holland, DOE/BHG	S. Musolino, BGRR
F. Crescenzo, DOE/BHG	S. Layendecker, RCD	C. Newson, BGRR
R. Desmarais, DOE/BHG	S. Mallette, DOE/BHG	S. Pulsford, BGRR
M. Dikeakos, DOE/BHG	E. Martinez, DOE/BHG	T. Sheridan, DO
A. Harris, BGRR	S. Moss, BGRR	

cc (w/ Attachments):
J. Goodenough, DOE/CH
File A414

Safety Evaluation Number: **BGRR – SE – 99 – 01** **Revision Number:** 0

Prepared by: S. H. Moss **Date:** 10/04/99

Description of proposed activity: WBS 1.2, Fan Removal and Decontaminate Fan House [Phase 1]

The Fan House, Building 704 is made up of two major sections. The main section is the motor house area located on the south side of the building which includes the normal and emergency electrical power feeds to the High Flux Beam Reactor (HFBR). This section includes one primary fan motor, with some associated valve operators and instrumentation. The north and west ends of the building are segmented into nine rooms. Five of the rooms house the primary air cooling fans. Another room houses instrumentation for fan operations. One houses the primary emergency fan. One room houses the secondary air cooling fan and associated valves. The southwest room housed the emergency engine for the primary air emergency cooling fan. The fans are internally contaminated, and most of the fan rooms are also contaminated.

This will be accomplished in two phases. Phase 1 will cover only the removal of Pile Fan #5, in accordance with the Technical Work Document - Pile Fan No. 5 Removal [Ref. 11], copy attached and the Task-specific Environment, Health and Safety Plan [Ref. 10], copy attached. Phase 2 will include the rest of the fans and all remaining decontamination work. It will be covered either as a revision of this USID/SE or under a separate one.

The activities covered here include:

1) Sample and evaluate in-situ, the component pieces of the fan house scheduled for removal.
2) Fans will be removed as part of the primary air cooling system for the BGRR.
3) Each fan will be removed with its associated piping and louvers up to the downstream isolation valve.
4) A blank flange will be installed at the discharge valve to provide a second means of isolation as confinement for the HFBR.
5) All services, air, water, and steam to any of the rooms will be isolated in the motor room, and piping will be removed in the fan room.
6) The above-ground duct to each fan will be isolated from the fan by positioning the suction valve in the closed position, sealed from inside each fan room during the isolation of the fan.
7) The fans and piping will be placed in sealand containers and characterized for shipment to a metal melt facility for disposal.
8) Once the equipment is removed, any contamination remaining will be evaluated, fixed in place, or removed and isolated from the motor rooms.
9) The fire detection system will be deactivated, as required during the removal process.
10) As-left surveys and samples will be collected, analyzed and documented.
11) An activity closure report will be prepared.
12) Custody of the fan rooms and auxiliary rooms will be returned to the HFBR.

Of all the above, only as applicable to Phase 1, removal of Pile Fan #5.

Purpose:

The purpose of WBS 1.2 for the BGRR Decommissioning Project is Fan Removals and Decontamination of Fan House (Building 704). It specifically consists of: 1) removal and disposal of contaminated equipment in the fan rooms; 2) decontamination or fixing-in-place, as appropriate, contamination present in the fan rooms; 3) returning custody of the fan and auxiliary rooms to the Reactor Division / High Flux Beam Reactor.

The purpose of breaking the work up into two phases is to verify the adequacy of the planned removal process for one fan before embarking on the removal of all fans. The expedited completion of Phase 1 also facilitates the installation of a temporary stack drain system that allows for the removal of the Pile Fan Sump (covered under BGRR-SE-99-02 [Ref.13]).

References:

(1) Procedure No. BGRR-SOP-0902, "Safety Evaluations for Unreviewed Safety Issue Determinations", Rev.0 dated 7/12/99.
(2) BGRR-002, "Hazard Classification and Auditable Safety Analysis for Brookhaven Graphite Research Reactor (BGRR) Decommissioning Project", Rev. 2 dated September 8, 1999.
(3) BGRR-001, "Brookhaven Graphite Research Reactor (BGRR) Project Management Plan", Rev.0 dated May 26, 1999, as concurred with by DOE.

(4) BNL ES&H Manual Standard 1.3.3, "Safety Analysis Reports / Safety Assessment Documents", Rev.1 dated 7/28/92. [URL= https:sbms.bnl.gov/ld/ld08/ld08d081.htm]
(5) DOE-STD-1027-92, "Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports" Change Notice No. 1 dated September 1997.
(6) LA-12846-MS, "Specific Activities and DOE-STD-1027-92 Hazard Category 2 Thresholds", LANL Fact Sheet issued November 1994.
(7) LA-12981-MS, "Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 List of 757 Radionuclides", LANL Fact Sheet issued August 1995.
(8) BNL Memorandum of Agreement (MOA) between BGRR Project Office and HFBR regarding ownership and control of Fan House Building 704 and Associated Equipment, Systems and Structures, dated 12/11/98.
(9) BNL NEPA CX covering fan removals and related activities, as approved by DOE-BHG Group Manager on 5/25/99.
(10) BGRR Decommissioning Project Task-specific Environment, Health and Safety Plan (TEHASP) for Pile Fan #5 Removal Activities. (Copy included as Attachment No. 1).
(11) BGRR Decommissioning Project Technical Work Document "Pile Fan No. 5 Removal" (Copy included as Attachment No. 2).
(12) BGRR Decommissioning Project – Environment, Health and Safety Plan, Rev. 0 dated September 16, 1999.
(13) BGRR-SE-99-02, Rev. 0 dated 09/14/99 covering WBS 1.3, Pile Fan Sump, Piping and Soils Removal.
(14) BNL Memorandum dated August 18, 1999, from M. Fallier to Distribution, "Minutes of Meeting – HFBR Stack Drain and Pile Fan Sump Projects".
(15) NUREG/CR-0672, "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station", June 1980.
(16) Long Island Power Authority – Shoreham Nuclear Power Station – NRC Docket No. 50-322, "Updated Decommissioning Plan", February 1993.

SCREENING CRITERIA

Safety Function(s) of Systems Affected

1. Will the proposed activity affect the safety function(s) or failure mode(s) of the equipment/facility? Y **(N)** N/A

Because of its defunct status and defueled state, the BGRR has no current requirements for redundant systems and/or safety class or safety significant SSCs (Systems, Structures and Components). Therefore, no safety functions exist that are directly associated with current components or equipment considered part of the scope of the BGRR Decommissioning Project. Where no safety functions exist, there can be NO effect on the safety function by the proposed activity.

Pile Fan No.5 was shutdown as part of the general BGRR shutdown in 1969. It may already be considered as failed.

The proposed activity will not affect the safety function(s) of the facility [as there are none]. It will not affect the failure mode(s) of the equipment/facility, as the equipment was previously and permanently shutdown. The answer to Question 1 of Safety Function(s) of System Affected is '**NO**'.

2. Will any new failure modes be introduced by the proposed activity? **(Y)** N N/A

While BGRR-002, "Hazard Classification and Auditable Safety Analysis for the BGRR Decommissioning Project", Rev. 2 dated September 8, 1999 [Ref. 2], has not yet been approved by DOE; it is anticipated that approval will come before the Pile Fan No.5 Removal is completed.

Without the BGRR-ASA for comparison, any failure mode associated with the proposed activity constitutes a new failure mode. Guidance for the selection of appropriate failure modes to consider was taken from other decommissioning projects [Refs. 15 & 16]. The failure modes selected and associated accident analyses presented in Appendix A are; Crane Load Drop, Waste Container Drop, Contaminated Waste Bag Rupture/Fire, Oxyacetylene Explosion and Explosion of LPG Leaked from a Forklift. The Task-specific Environment, Safety and Health Safety Plan for the Pile Fan No.5 Removal [Ref. 10] and the BGRR Technical Work Document for Pile Fan No.5 Removal [Ref. 11], call for the use of flame cutting equipment. Therefore, an accident scenario based on an oxyacetylene explosion was considered. Based on the physical characteristics of the materials to be removed (metal components), Combustible Waste Fire was deemed not a credible accident scenario. Based on a review of the Task-specific Environment , Safety and Health Plan for the Pile Fan No.5 Removal [Ref. 10] and the BGRR Technical Work Document for Pile Fan No.5 Removal [Ref. 11], the work to be performed in support of the

proposed activity does not require or include the use of Contamination Control Envelope Structures or HEPA Filter Units (which could rupture as an accident scenario, if present).

In the absence of the BGRR-ASA, the proposed activity represents a new activity, with its own unique spectrum of potential failure modes. Even with the inclusion of the BGRR-ASA, the proposed activity (NEPA-CX [Ref.9] covered action) represents an activity not covered by the BGRR-ASA (per Table 1.1 – ASA Applicability Table of Section 1.4 – Scope of Work), assuming the BGRR-ASA is approved by DOE as currently drafted).

As the proposed activity is specifically defined as being outside the scope of the BGRR-ASA and consists of deconstruction and remediation activities to be performed under NEPA-CX [Ref.9], it may well introduce new failure modes not previously considered under the BGRR-ASA. The answer to Question 2 of the Safety Function(s) of System Affected is '**YES**'.

Effects on Safety

1. Could the proposed activity increase the probability of occurrence of an accident previously evaluated in the ABD? Y (N) N/A

For the Brookhaven Graphite Research Reactor Decommissioning Project, the authorization basis document is the BGRR-ASA (which is not approved by DOE). However, a DOE approved NEPA-CX exists that specifically approves the removal of the Pile Fans (including Pile Fan No.5), which, when combined with this USID/SE, as approved by DOE; fulfil the role of authorization basis documentation.

In the absence of an approved BGRR-ASA, there are no accident occurrence probabilities to be reviewed for impact by the proposed activity (as neither the BGRR-DP Health And Safety Plan [Ref. 12] nor the Task-specific Environment, Safety and Health Plan [Ref. 10] contain any accident analyses/probability of occurrences). This makes the trivial answer (prior to the approval of the BGRR-ASA) 'NO'.

However, the BGRR-ASA must still be reviewed for the potential impact of the proposed activity on the probability of occurrences for the accident scenarios contained within the BGRR-ASA. Because of the "Routine Risk" nature of the defueled BGRR (classified as a "Radiological Facility"), a rigorous probabilistic risk assessment was not required as part of the Auditable Safety Analysis. Instead, using a graded approach and the guidance offered in BNL ES&H Standard 1.3.3, {https:sbms.bnl.gov/ld/ld08/ld08d081.htm}[Ref. 4], the Risk Assessment Tables of Section 3.2 of the BGRR-ASA were developed.

Among the events analyzed in BGRR-ASA Section 3.2 – Risk Assessment are; Seismic Event, High Winds, Graphite Dust Detonation, Loss of Pile Negative Pressure System Ventilation, Loss of Pile Negative Pressure System Filtration, Crane Load Drop, Fire, Facility Worker Exposure to Toxic Material.

The proposed activity has no capability to impact the probability of occurrence of Seismic Events or High Winds (which are natural phenomena). Additionally, as the proposed activity is limited to the removal of Pile Fan No.5; it has no potential to impact the probability of events occurring at other local buildings e.g., Buildings 701 & 702. This eliminates from further consideration; Graphite Dust Detonation, Loss of Pile Negative Pressure System Ventilation, Loss of Pile Negative Pressure System Filtration, and Building 701 Crane Load Drop. The only remaining accident scenarios from the BGRR-ASA to be considered are: Risk Assessment No. 007, covering Fire; and Risk Assessment No. 008, covering Facility Workers Exposure to Toxic / Hazardous Materials.

The proposed activity involves removal of contaminated metal components. There are discrete amounts of combustible materials involved and primarily mechanical means used for separation (flame cutting is limited to minimum cut(s) necessary of clean (non-rad) metal to allow for size reduction of fan components to fit packaging for offsite transport). The accident analysis of the proposed activity in Appendix A includes three accident scenarios which already and independently address the potential for initiation of fire. These events are; Explosion of LPG Leaked from a Forklift, Oxyacetylene Explosion and Contaminated Waste Bag Rupture/Fire. The proposed activity, having its own fire probability assessment, represents no increase in the probability of fire as defined in BGRR-ASA Risk Assessment No.7. It merely reflects one of the potential initiators of the event. Theproposed activity represents no increase in the probability of occurrence of the event as defined in BGRR-ASA Risk Assessment No. 007.

Finally, as 'Potential Initiators' under Risk Assessment No. 008 covering Facility Worker Exposure to Toxic/Hazardous Materials are; natural phenomenon, operator error, or equipment failure causing breach of deactivated piping or equipment containing residual hazardous/toxic material. The only BGRR-DP facility workers are those directly involved in the

decommissioning process, including the performance of the proposed activity. Therefore, the proposed activity does not increase the probability of occurrence of this event. It merely reflects one of the potential initiators of this event. The proposed activity represents no increase in the probability of occurrence of the event as defined in BGRR-ASA Risk Assessment No. 008.

So the non-trivial answer to Question 1 of 'Effects on Safety' is also 'NO'.

The proposed activity does not increase the probability of any accident evaluated in the authorization basis document(ation).

2. Could the proposed activity increase the probability of occurrence of a malfunction of equipment, systems, or components that are Important-to-Safety? Y **(N)** N/A

As was already discussed in response to Screening Criterion No. 1 under 'Safety Function(s) of Systems Affected'; the BGRR has no current requirements for redundant systems and/or safety class or safety significant SSCs (Systems, Structures and Components) due to its defunct status and defueled state. Therefore, no safety functions exist that are directly associated with the proposed activity covered by this USID/SE. Without equipment, systems or components that are Important-to-Safety, there can be no probability of occurrence of a malfunction of equipment, systems or components that are Important-to-Safety; nor any increase in same.

The proposed activity COULD NOT increase the probability of occurrence of a malfunction of equipment, systems or components that are Important-to-Safety.

3. Could the proposed activity create the possibility of an accident of a different type than those previously evaluated in the ABD? **(Y)** N N/A

As already discussed in the response to Screening Criterion No. 2 under 'Safety Function(s) of Systems Affected', the answer to this question is 'YES'. However, the consequences of any such accident , as discussed in Appendix A are bounded under the consequences of accidents presented in the BGRR-ASA.

4. Could the proposed activity create the possibility of an equipment, system, or component malfunction of a different type than those previously evaluated in the ABD? **(Y)** N N/A

As already discussed in the response to Screening Criterion No. 2 under 'Safety Function(s) of Systems Affected', the answer to this question is 'YES'. However, the consequences of any such malfunction , as discussed in Appendix A are bounded under the consequences of accidents presented in the BGRR-ASA.

5. Does the proposed activity reduce the Margin-of-Safety as defined in the basis for any ABD? Y **(N)** N/A

In BGRR-SOP-0902 [Ref. 1], the procedure states "In the context of this procedure a Margin-of-Safety is reduced if the Safety Limit or Limiting Condition of Operation or Administrative Control as defined in the Authorization Basis Document(s) is violated". As this safety evaluation is based upon the guidance provided in the above referenced procedure, that definition of Margin-of-Safety compels the answer 'NO'.

The proposed activity DOES NOT reduce the Margin-of-Safety as defined in the BGRR-ASA because the work is being reviewed under the USI process prior to authorization and will not violate any of the Administrative Controls already contained in the BGRR-ASA as long as the work is performed as described in the task specific technical work documents [Refs. 9, 10, 11 and 12]

Authorization Basis Document(s) Changes

1. Is a change to the facility ABD(s) being made? (Y) N N/A

The BGRR-ASA refers to the performance of work outside the scope of the ASA as requiring the use of the USI process as defined in BGRR-SOP-0902 [Ref. 1]. The proposed activity covered here specifically falls under that classification (see ASA Table 1.1 – ASA Applicability Table, for NEPA-CX activity – Pile Fan Removal). The completed and approved USID/SE for the proposed activity should be considered as an addendum and amendment to the BGRR-ASA.

Therefore, it does constitute a change to the BGRR-ASA and requires the approval of the DOE Project Manager for the BGRR Decommissioning Project, prior to implementation. The answer to Question 1 under 'Authorization Basis Document(s) Changes' is 'YES'.

SAFETY EVALUATION CONCLUSION

Based on the evaluation of the evidence cited above, the issue --

_____ Does NOT constitute an Unreviewed Safety Issue.

✓ Does constitute an Unreviewed Safety Issue.

**** IF ANY OF THE ABOVE ARE <u>YES</u>, THEN A USI EXISTS. ****

Clyde T. Newson 10/5/99
BGRR Project Engineer Signature/ Date

RP Miltenberger for S. Musolino 10/5/99
BGRR Project ES&H Manager Signature/ Date

Stephen K. Fulford 10/5/99
BGRR Project Manager Signature/ Date

[illegible] 10/5/99
ERD Quality Representative Signature/ Date

APPENDIX A

ABNORMAL OPERATIONS ASSESSMENT

APPENDIX A - ABNORMAL OPERATIONS ASSESSMENT

Method of Abnormal Operations Assessment

The abnormal operations assessment of the Pile Fan No. 5 Removal was based on a methodical review of each initiating event and the severity, probability, and risk category of the corresponding hazards associated with the activity. Only one accident-initiating event is postulated to occur at one time. Guidance for the selection of appropriate failure modes to consider was taken from NUREG/CR-0672, "Technology, Safety and Costs of Decommissioning a Reference Boiling Water Reactor Power Station" [Ref. 15], and Long Island Power Authority, Shoreham Nuclear Power Station - NRC Docket No. 50-322, "Updated Decommissioning Plan" [Ref. 16]. The main failure modes to be considered include; Crane Load Drop, Waste Container Drop, Contaminated Waste Bag Rupture/Fire, Oxyacetylene Explosion and Explosion of LPG Leaked from a Forklift. The Task-specific Environmental, Health and Safety Plan (TEHASP) for the Pile Fan No. 5 Removal at the BGRR [Ref. 10] and the BGRR Technical Work Document for the Pile Fan No. 5 Removal [Ref. 11], specifically mention the use of flame cutting equipment. Based on the physical characteristics of the materials to be removed (metal components), Combustible Waste Fire was not a credible accident scenario. Based on a review of the TEHASP and the BGRR Technical Work Document for Pile Fan No. 5 Removal, the work to be performed in support of the proposed activity does not require nor include the use of Contamination Control Envelope Structures or HEPA Filter Units (which could rupture as an accident scenario, if present). The risk-assessment tables which follow represent the determination of the extent of the hazards associated with the Pile Fan No. 5 Removal, based on its current TEHASP and Technical Work Document.

BNL ES&H Standard 1.3.3, {https:sbms.bnl.gov/ld/ld08/ld08d081.htm}[Ref. 4] provides the methodology for examining the safety of facilities at the BNL. It has guidance for assessing the appropriate level of severity, probability, and risk. Table A.1-1 depicts the form used in this Safety Evaluation for Unreviewed Safety Issue Determination to perform the risk assessment. Tables A.1-2 through A.1-4 summarize the Risk Assessment Matrix found in Standard 1.3.3 and used here.

Table A.1-1

RISK ASSESSMENT FORMAT						
Severity	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV ( ) Negligible		
Probability	A ( ) Frequent	B ( ) Probable	C ( ) Occasional	D ( ) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 ( ) Routine		

Table A.1-2 summarizes the potential consequences of hazards falling into the four severity classifications established by BNL's ES&H Standard 1.3.3. Standard 1.3.3 considers the consequences for the following:

- Non-radiation release/exposure, on-site/off-site
- Radiation release/exposure, on-site/off-site
- Equipment loss
- Program downtime
- Program compromise
- Public-impact perception

Table A.1-2

HAZARD SEVERITY		
Category	**Descriptive Word**	**Potential Consequences**
I	Catastrophic	May cause death or system loss. > 100 rem Committed Effective Dose Equivalent (CEDE) on-site or > EPA Protective Action Guidelines off-site. {>$1,000,000; >4 months}
II	Critical	May cause severe injury, severe occupational illness, or major system damage. >25 rem CEDE on-site or 10 mrem off-site. {>$250,000; >3 weeks or <4 months}
III	Marginal	May cause minor injury, minor occupational illness, or minor system damage.> 5 rem annual limit on-site. {>$50,000; >4 days or <3 weeks}
IV	Negligible	Will not result in injury, occupational illness, or system damage. > 3 rem admin annual limit or 1 rem admin quarterly limit. {<$50,000; <4 days}

Table A.1-3 summarizes the probability categories established by BNL's ES&H Standard 1.3.3. They are based on the likelihood of the potential consequences occurring for a given hazard.

Table A.1-3

HAZARD PROBABILITY		
Category	**Descriptive Word**	**Potential Consequences**
A	Frequent	Likely to occur repeatedly during life cycle of system.
B	Probable	Likely to occur several times in life cycle of system.
C	Occasional	Likely to occur sometime in life cycle of system.
D	Remote	Not likely to occur in life cycle of system, but possible.
E	Extremely Remote	Probability of occurrence cannot be distinguished from zero.

Table A.1-4 summarizes the risk categories established by BNL's ES&H Standard 1.3.3. Choosing a severity and a probability for a given hazard determines its risk category. Standard 1.3.3 establishes the documentation and minimum approval required for each category.

Table A.1-4

RISK CATEGORY						
Hazard Severity	**A Frequent**	**B Probable**	**C Occasional**	**D Remote**	**E Extremely Remote**	**F Impossible**
I Catastrophic	1. High	1. High	1. High	2. Moderate	3. Low	4. Routine
II Critical	1. High	1. High	2. Moderate	3. Low	3. Low	4. Routine
III Marginal	2. Moderate	2. Moderate	3. Low	3. Low	4. Routine	4. Routine
IV Negligible	4. Routine	4. Routine	4. Routine	4. Routine	4. Routine	4. Routine

Hazard mitigation takes the form of engineered features, administrative controls, operator training, or a combination of these. Generally, the hazard's severity is not changed by mitigation, but its probability is reduced.

Risk Assessment for the facility is given on the following pages where operator's error, equipment/system failure, an accident or natural phenomenon is the initiating event. Each event is analyzed on four tables: Hazard, Risk Assessment Before Mitigation, Hazard Mitigation, and Risk Assessment After Mitigation.

The Hazard table first identifies the initiating event and lists its possible consequences and its specific hazards. A list of potential initiators is given.

The Hazard-Mitigation table lists the administrative controls, training, and engineered features that will mitigate the effects of the event. The Risk-Assessment tables contrast the risk involved due to an initiating event with and without mitigation.

Risk Assessment No. A001 covering Waste Container Drop

ACTIVITY: Pile Fan No. 5 Removal **NUMBER:** A001
HAZARD: To On-site Personnel, Equipment, Environment

Event:	Waste Container Drop
Possible Consequences & Hazards:	Damage to facility structures / equipment Release of radioactive materials/ radiation to the environment Exposure to radioactive materials through ingestion, inhalation, or dermal exposure Equipment, facility or personnel contamination Injury to worker Project delays / interruptions
Potential Initiators:	Natural phenomena, manufacturer defect, missile strike, operator error

Risk Assessment Prior to Mitigation						
Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B (X) Probable	C ( ) Occasional	D ( ) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 () Moderate	3 ( ) Low	4 (X) Routine		

Hazard Mitigation:	Limited radiological inventory at risk and available for release from entire Pile Fan No. 5 Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date. Additional limitation on fraction of entire activity's inventory available for release due to waste container drop as a result of the strength of the Strong Tight Containers, the applied polymeric barrier fixative and physical forms and distribution of inventory materials. Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan. Performance of work by trained and qualified personnel, familiar with the requirements of BNL ES&H Manual Stds; 1.3.6 - Work Planning and Control for Operations, 1.6.0 - Material Handling - Equipment & Procedures, 1.6.1 - Material handling - Operator Training & Qualification Use of Pre-job briefings and Pre-Start Checklists.

Risk Assessment Following Mitigation						
Severity:	I ( ) Catastrophic	II () Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C (X) Occasional	D ( ) Remote	E ( ) ExtrRemote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 (X) Routine		

Description - Waste Container Drop

Hazard Probability (as defined in Table A.1-3)

The waste containers to be used during the Pile Fan No. 5 Removal will be B-25 and B-12 boxes with lids (strong tight containers. They will be moved only with appropriately load rated forklifts or front end loaders. Based upon collective experiences with waste container movements, both on-site and at commercial nuclear decommissioning sites; it is conservatively assumed that the unmitigated probability of a waste container drop is higher than that of a crane load drop (which was designated 'Occasional' in the BGRR-ASA). The next higher probability frequency class is '**PROBABLE**' (likely to occur several times in the life cycle of system).

Considering the mitigation factors listed in Risk Assessment No. A001, as well as the limited life cycle remaining (time required to perform Pile Fan No. 5 Removal estimated at 14 days), the post-mitigation probability is reduced to '**OCCASIONAL**' (likely to occur sometime in the life-cycle of the system).

Hazard Severity (as defined by Table A.1-2)

Since Pile Fan No. 5 was shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to Pile Fan No. 5, caused by any Waste Container Drop. The 704 Fanhouse and Pile Fan No. 5 Working Area will be posted as a radiological control area with restrictions on access; so the potential for personnel injury or illness will be small. This is especially true considering the expertise and qualifications of the fork-lift operator(s) and assistants.

Due to the limited volume available within the waste containers, any waste container drop would be limited to only a small portion of the Pile Fan Sump inventory source term, assumed not to exceed 25%. In Appendix B - Source Term Development, the following radiological inventory was developed for the entire Pile Fan No. 5 Removal

Isotope	Inventory, [Ci]	Cat 3 Thresh, [Ci]	Fraction
Co-60	2.53E-07	2.80E+02	9.04E-10
Sr-90	1.19E-04	1.60E+01	7.45E-06
Y-90	1.19E-04	1.42E+03	8.40E-08
Cs-137	1.34E-03	6.00E+01	2.24E-05
U-233	1.70E-05	4.20E+00	4.05E-06
U-234	1.70E-05	4.20E+00	4.05E-06
U-235	2.96E-06	4.20E+00	7.05E-07
U-238	3.65E-05	4.20E+00	8.69E-06
Pu-238	2.84E-05	6.20E- 01	4.58E-05
Pu-239	1.00E-03	5.20E- 01	1.92E-03
Pu-240	1.00E-03	5.20E- 01	1.92E-03
Am-241	3.60E-04	5.20E- 01	6.93E-04
			SUM= 4.63E-03

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 25% of this Cat 3 threshold fractional sum (4.63E-03) corresponds to a maximal potential dose of less than **11.6 mRem** effective whole body; where exposure is 10 R for the release of 100% of the Hazard Category 3 threshold and calculated at 30 meters from point of release for one day of inhalation and direct exposure, while the ingestion pathway is determined over a longer period of time.

The potential consequences discussed here most closely correspond to the definition of Hazard Severity **NEGLIGIBLE** (per Table A.1-2, Hazard Severity), primarily due to the potential for
Risk Category (as defined by Table A.1-4)

Both the pre-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **PROBABLE**, and the post-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **OCCASIONAL**, define the risk category as **ROUTINE** for the activities under this USID/SE.

Risk Assessment No. A002 covering Contaminated Waste Bag Rupture/Fire

ACTIVITY: Pile Fan No. 5 Removal **NUMBER:** A002
HAZARD: To On-site Personnel, Equipment, Environment

Event:	Contaminated Waste Bag Rupture/Fire
Possible Consequences & Hazards:	Radiation exposure to on-site personnel. Release of radioactive materials/ radiation to the building and/or environment. Exposure to radioactive materials through ingestion, inhalation, and/or dermal exposure. Contamination of building, equipment and/or environment Project delays.
Potential Initiators:	Natural phenomenon, operator's error, failure of equipment.

Risk Assessment Prior to Mitigation

Severity	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability	A ( ) Frequent	B (X) Probable	C ( ) Occasional	D ( ) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 (X) Routine		

Hazard Mitigation:	Limited radiological inventory at risk and available for release from entire Pile Fan No. 5 Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date. Additional limitation on fraction of entire facility's inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials and capacity of contaminated waste storage bag. Limitations on use of combustible materials for the Pile Fan No. 5 Removal and restrictions on storing combustible material near the job-site. Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan Performance of work by trained and qualified personnel, familiar with the requirements of BNL ES&H Manual Stds; 1.3.6 - Work Planning and Control for Operations, BNL Rad Con Manual Use of Pre-job briefings and Pre-Start Checklists. Coverage of work by trained and qualified Radiological Control Technicians. Assignment of a dedicated Waste Management Representative to project, providing expertise in the minimization and disposal of contaminated waste. Area protected against direct lightning strike by proximity of Reactor stack (preferred target due to height).

Risk Assessment Following Mitigation

Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C (X) Occasional	D ( ) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 (X) Routine		

Description - Contaminated Waste Bag Rupture/Fire

Hazard Probability (as defined in Table A.1-3)

Table 11.3-3, "Summary of Maximum-Exposed Individual Radiation Doses from Postulated BWR Decommissioning Accidents" of NUREG/CR-0672 [Ref. 15], gives frequency of occurrence for some specific decommissioning related activity accidents with releases. Among the incidents listed are: Vacuum Filter Bag Rupture with frequency = Medium (with Medium defined as below 10^{-2} per year and above 10^{-5} per year, which corresponds to 'Occasional' from Table A.1-3); and Combustible Waste Fire with frequency = High (with High defined as above 10^{-2} per year, which corresponds to 'Probable' from Table A.1-3). Assuming the more conservative value as representative of the Contaminated Waste Bag Rupture/Fire, makes the unmitigated probability '**PROBABLE**' (likely to occur several times in the life cycle of the system).

Considering the mitigation factors listed in Risk Assessment No. A002, as well as the limited life cycle remaining (time required to perform Pile Fan No. 5 Removal estimated at 14 days), the post-mitigation probability is reduced to '**OCCASIONAL**' (likely to occur sometime in the life-cycle of the system).

Hazard Severity (as defined by Table A.1-2)

Since Pile Fan No. 5 was shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Pile Fan No. 5, caused by any Contaminated Waste Bag Rupture/Fire. The 704 Fanhouse and Pile Fan No. 5 Working Area will be posted as a radiological control area with restrictions on access; so the potential for personnel injury or illness will be small. This is especially true considering the small size of the accident under consideration here.

Due to the limited volume available within a contaminated waste bag, any contaminated waste bag rupture/fire would be limited to only a small portion of the Pile Fan No. 5 inventory source term, assumed not to exceed 10%. In Appendix B - Source Term Development, the following radiological inventory was developed for the entire Pile Fan No. 5 Removal

Isotope	Inventory, [Ci]	Cat 3 Thresh, [Ci]	Fraction
Co-60	2.53E-07	2.80E+02	9.04E-10
Sr-90	1.19E-04	1.60E+01	7.45E-06
Y-90	1.19E-04	1.42E+03	8.40E-08
Cs-137	1.34E-03	6.00E+01	2.24E-05
U-233	1.70E-05	4.20E+00	4.05E-06
U-234	1.70E-05	4.20E+00	4.05E-06
U-235	2.96E-06	4.20E+00	7.05E-07
U-238	3.65E-05	4.20E+00	8.69E-06
Pu-238	2.84E-05	6.20E- 01	4.58E-05
Pu-239	1.00E-03	5.20E- 01	1.92E-03
Pu-240	1.00E-03	5.20E- 01	1.92E-03
Am-241	3.60E-04	5.20E- 01	6.93E-04
			SUM= 4.63E-03

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 10% of this Cat 3 threshold fractional sum (4.63E-03) corresponds to a maximal potential dose of less than **4.7 mRem** effective whole body; where exposure is 10 R for the release of 100% of the Hazard Category 3 threshold and calculated at 30 meters from point of release for one day of inhalation and direct exposure, while the ingestion pathway is determined over a longer period of time.

The potential consequences discussed here most closely correspond to the definition of Hazard Severity '**NEGLIGIBLE**' (per Table A.1-2, Hazard Severity).

Risk Category (as defined by Table A.1-4)

Both the pre-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **PROBABLE**, and the post-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **OCCASIONAL**, define the risk category as **ROUTINE** for the activities under this USID/SE.

Risk Assessment No. A003 covering Explosion of LPG Leaked from a Forklift

ACTIVITY: Pile Fan No. 5 Removal **NUMBER:** A003
HAZARD: To On-site Personnel, Equipment, Environment

Event:	Explosion of LPG Leaked from a Front End Loader (Forklift)
Possible Consequences & Hazards:	Fire / blast wave Contamination of area, equipment and/or environment Injury to worker Release of radioactive materials/ radiation to the environment. Exposure to radioactive materials through ingestion, inhalation, and dermal exposure. Project delays / work plan interruptions
Potential Initiators:	Equipment failure, operator error, material handling vehicle failure / collision, missile strike

Risk Assessment Prior to Mitigation

Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C ( ) Occasional	D (X) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 (X) Routine		

Hazard Mitigation:	Limited radiological inventory at risk and available for release from entire Pile Fan No. 5 Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date. Additional limitation on fraction of entire facility's inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials. Limitations on use of combustible materials for the Pile Fan Sump Removal Activities and restrictions on the storage of combustible material near the job-site. Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan. Performance of work by trained and qualified personnel, familiar with the requirements of BNL ES&H Manual Stds; 1.3.6 - Work Planning and Control for Operations, 1.6.0 - Material Handling - Equipment & Procedures, 1.6.1 - Material handling - Operator Training & Qualification . Use of Pre-job briefings and Pre-Start Checklists.

Risk Assessment Following Mitigation

Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C ( ) Occasional	D ( ) Remote	E (X) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 () Low	4 (X) Routine		

Description - Explosion of LPG Leaked from a Forklift

Hazard Probability (as defined in Table A.1-3)

Table 11.3-3, "Summary of Maximum-Exposed Individual Radiation Doses from Postulated BWR Decommissioning Accidents" of NUREG/CR-0672 [Ref. 15], gives the frequency of occurrence for some specific decommissioning related activity accidents with releases. Among the incidents listed is, Explosion of LPG Leaked from a Front-end Loader with frequency = Low (with Low defined as below 10^{-5} per year). Assuming comparable frequency here makes the unmitigated probability '**REMOTE**' (not likely to occur in life cycle of system, but possible).

Considering the mitigation factors listed in Risk Assessment No. A003, as well as the limited life cycle remaining (time required to perform Pile Fan No. 5 Removal estimated at 14 days), the post-mitigation probability is reduced to '**EXTREMELY REMOTE**' (probability of occurrence cannot be distinguished from zero).

Hazard Severity (as defined by Table A.1-2)

Since Pile Fan No. 5 was shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Pile Fan No. 5, caused by any Explosion of LPG Leaked from a Front-end Loader. The 704 Fanhouse and Pile Fan No. 5 Working Area will be posted as a radiological control area with restrictions on access; so the potential for personnel injury or illness will be small. This is especially true considering the expertise and qualifications of the fork-lift operator(s) and assistants.

Due to the limited volume (hence inventory) available within any waste container being carried at the time and the limited amount of nearby dispersible material available to additionally go airborne , any release due to an explosion of LPG leaked from a front-end loader would be limited to only a portion of the Pile Fan No. 5 inventory source term, assumed not to exceed 35% (25% + 10%). In Appendix B - Source Term Development, the following radiological inventory was developed for the entire Pile Fan No. 5 Removal

Isotope	Inventory, [Ci]	Cat 3 Thresh, [Ci]	Fraction
Co-60	2.53E-07	2.80E+02	9.04E-10
Sr-90	1.19E-04	1.60E+01	7.45E-06
Y-90	1.19E-04	1.42E+03	8.40E-08
Cs-137	1.34E-03	6.00E+01	2.24E-05
U-233	1.70E-05	4.20E+00	4.05E-06
U-234	1.70E-05	4.20E+00	4.05E-06
U-235	2.96E-06	4.20E+00	7.05E-07
U-238	3.65E-05	4.20E+00	8.69E-06
Pu-238	2.84E-05	6.20E- 01	4.58E-05
Pu-239	1.00E-03	5.20E- 01	1.92E-03
Pu-240	1.00E-03	5.20E- 01	1.92E-03
Am-241	3.60E-04	5.20E- 01	6.93E-04
			SUM= 4.63E-03

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 35% of this Cat 3 threshold fractional sum (4.63E-03) corresponds to a maximal potential dose of less than **17 mRem** effective whole body; where exposure is 10 R for the release of 100% of the Hazard Category 3 threshold and calculated at 30 meters from point of release for one day of inhalation and direct exposure, while the ingestion pathway is determined over a longer period of time.

The potential consequences discussed here most closely correspond to the definition of Hazard Severity '**NEGLIGIBLE**' (per Table A.1-2, Hazard Severity).

Risk Category (as defined by Table A.1-4)

Both the pre-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **REMOTE**, and the post-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **EXTREMELY REMOTE**, define the risk category as **ROUTINE** for the activities under this USID/SE.

Risk Assessment No. A004 covering Oxyacetylene Explosion

ACTIVITY: Pile Fan No. 5 Removal **NUMBER:** A004
HAZARD: To On-site Personnel, Equipment, Environment

Event:	Oxyacetylene Explosion
Possible Consequences & Hazards:	Fire / blast wave Contamination of area, equipment and/or environment Injury to worker Release of radioactive materials/ radiation to the environment. Exposure to radioactive materials through ingestion, inhalation, and dermal exposure. Project delays / work plan interruptions
Potential Initiators:	Equipment failure, operator error, material handling vehicle failure / collision, missile strike

Risk Assessment Prior to Mitigation

Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C (X) Occasional	D ( ) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 (X) Routine		

Hazard Mitigation:	Limited radiological inventory at risk and available for release from entire Pile Fan No. 5 Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date. Additional limitation on fraction of entire facility's inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials. Limitations on use of oxyacetylene for the Pile Fan No.5 Removal and restrictions on the storage of oxyacetylene near the job-site. Use of approved Work Control Permit, Cutting and Burning Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan. Performance of work by trained and qualified personnel, familiar with the requirements of BNL ES&H Manual Stds; 1.3.6 - Work Planning and Control for Operations, 4.3.0 - Cutting and Welding . Use of Pre-job briefings and Pre-Start Checklists.

Risk Assessment Following Mitigation

Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C ( ) Occasional	D (X) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 () Low	4 (X) Routine		

Description - Oxyacetylene Explosion

Hazard Probability (as defined in Table A.1-3)

Table 11.3-3, "Summary of Maximum-Exposed Individual Radiation Doses from Postulated BWR Decommissioning Accidents" of NUREG/CR-0672 [Ref. 15], gives the frequency of occurrence for some specific decommissioning related activity accidents with releases. Among the incidents listed is, Oxyacetylene Explosion with frequency = Medium (with Medium defined as below 10^{-2} but above 10^{-5} per year). Assuming comparable frequency here makes the unmitigated probability '**OCCASIONAL**' (likely to occur sometime in life cycle of system).

Considering the mitigation factors listed in Risk Assessment No. A004, as well as the limited life cycle remaining (time required to perform Pile Fan No. 5 Removal estimated at 14 days), the post-mitigation probability is reduced to '**REMOTE**' (not likely to occur in life cycle of system, but possible).

Hazard Severity (as defined by Table A.1-2)

Since Pile Fan No. 5 was shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Pile Fan No. 5, caused by any Oxyacetylene Explosion. The 704 Fanhouse and Pile Fan No. 5 Working Area will be posted as a radiological control area with restrictions on access; so the potential for personnel injury or illness will be small. This is especially true considering the expertise and qualifications of the cutting torch operator(s) and assistants.

Due to the limited volume (hence inventory) available nearby while torch-cutting only radiologically clean portions of Pile Fan No. 5 for size reduction to facilitate off-site transfer, any release due to an oxyacetylene explosion would be limited to only a portion of the Pile Fan No. 5 inventory source term, assumed not to exceed 10%. In Appendix B - Source Term Development, the following radiological inventory was developed for the entire Pile Fan No. 5 Removal

Isotope	Inventory, [Ci]	Cat 3 Thresh, [Ci]	Fraction
Co-60	2.53E-07	2.80E+02	9.04E-10
Sr-90	1.19E-04	1.60E+01	7.45E-06
Y-90	1.19E-04	1.42E+03	8.40E-08
Cs-137	1.34E-03	6.00E+01	2.24E-05
U-233	1.70E-05	4.20E+00	4.05E-06
U-234	1.70E-05	4.20E+00	4.05E-06
U-235	2.96E-06	4.20E+00	7.05E-07
U-238	3.65E-05	4.20E+00	8.69E-06
Pu-238	2.84E-05	6.20E- 01	4.58E-05
Pu-239	1.00E-03	5.20E- 01	1.92E-03
Pu-240	1.00E-03	5.20E- 01	1.92E-03
Am-241	3.60E-04	5.20E- 01	6.93E-04
			SUM= 4.63E-03

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 10% of this Cat 3 threshold fractional sum (4.63E-03) corresponds to a maximal potential dose of less than **4.7 mRem** effective whole body; where exposure is 10 R for the release of 100% of the Hazard Category 3 threshold and calculated at 30 meters from point of release for one day of inhalation and direct exposure, while the ingestion pathway is determined over a longer period of time.

The potential consequences discussed here most closely correspond to the definition of Hazard Severity '**NEGLIGIBLE**' (per Table A.1-2, Hazard Severity).

Risk Category (as defined by Table A.1-4)

Both the pre-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **OCCASIONAL**, and the post-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **REMOTE**, define the risk category as **ROUTINE** for the activities under this USID/SE.

Risk Assessment No. A005 covering Crane Load Drop

ACTIVITY: Pile Fan No.5 Removal **NUMBER:** A005
HAZARD: To On-site Personnel, Equipment, Environment

Event:	Crane Load Drop
Possible Consequences & Hazards:	Damage to structures / equipment Injury to worker Release of radioactive materials/ radiation to the environment. Exposure to radioactive materials through ingestion, inhalation, and/or dermal exposure. Contamination of work area or equipment Project delays, work plan interruptions
Potential Initiators:	Equipment failure, operator's error, manufacturer defect, missile strike, collision

Risk Assessment Prior to Mitigation						
Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C (X) Occasional	D ( ) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 ( ) Low	4 (X) Routine		

Hazard Mitigation:	Limited radiological inventory at risk and available for release from entire Pile Fan No.5 Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date. Additional limitation on fraction of entire activity's inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials. Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan. Use of Pre-job briefings and Pre-start checklists. Performance of work by trained and qualified personnel, familiar with the requirements of BNL ES&H Manual Stds; 1.3.6 - Work Planning and Control for Operations, 1.6.0 - Material Handling - Equipment & Procedures, 1.6.1 - Material handling - Operator Training & Qualification. Regular inspection and maintenance of cranes.

Risk Assessment Following Mitigation						
Severity:	I ( ) Catastrophic	II ( ) Critical	III ( ) Marginal	IV (X) Negligible		
Probability:	A ( ) Frequent	B ( ) Probable	C ( ) Occasional	D (X) Remote	E ( ) Extr Remote	F ( ) Impossible
Risk Category:	1 ( ) High	2 ( ) Moderate	3 () Low	4 (X) Routine		

Description - Crane Load Drop

Hazard Probability (as defined in Table A.1-3)

The crane to be used for the Pile Fan No.5 Removal will be one of the two large BNL-owned and PE operated cranes (either the 75-Ton or 150-Ton crane). The heaviest lift to be made will be the removal of the 20,000 lb. Pile Fan No.5. The BNL cranes are regularly inspected for safety and maintained by Plant Engineering Division. As in the Crane Load Drop accident discussed in the BGRR-ASA Risk Assessment No. 006; the crane will only be operated by dedicated, trained and qualified crane-operators from the Riggers' Shop of the Plant Engineering Division. It was conservatively assumed in the BGRR-ASA and again here that the unmitigated probability of a Crane Load Drop was **'OCCASIONAL'** (likely to occur sometime in the life-cycle of the system).

Considering the mitigation factors listed in Risk Assessment No. A005, as well as the limited life cycle remaining (time required to perform Pile Fan Sump Removal Activities estimated at 14 days), the post-mitigation probability is reduced to **'REMOTE'** (not likely to occur in life-cycle of the system but possible).

Hazard Severity (as defined by Table A.1-2)

Since the Pile Fan No.5 was shutdown as part of the BGRR shutdown many years ago, there are no programmatic delays or repair costs associated with any damage to the Pile Fan No.5, caused by any Crane Load Drop. The 704 Fanhouse and Pile Fan No.5 Working Area will be posted as a radiological control area with restrictions on access; so the potential for personnel injury or illness will be small. This is especially true considering the expertise and qualifications of the crane operator(s) and assistants.

Any crane load drop would be limited to only a portion of the Pile Fan No.5 inventory source term. However, for the sake of conservatism, the entire source term will be assumed as releasable as a result of the event. In Appendix B - Source Term Development, the following radiological inventory was developed for the entire Pile Fan No.5 Removal.

Isotope	Inventory, [Ci]	Cat 3 Thresh, [Ci]	Fraction
Co-60	2.53E-07	2.80E+02	9.04E-10
Sr-90	1.19E-04	1.60E+01	7.45E-06
Y-90	1.19E-04	1.42E+03	8.40E-08
Cs-137	1.34E-03	6.00E+01	2.24E-05
U-233	1.70E-05	4.20E+00	4.05E-06
U-234	1.70E-05	4.20E+00	4.05E-06
U-235	2.96E-06	4.20E+00	7.05E-07
U-238	3.65E-05	4.20E+00	8.69E-06
Pu-238	2.84E-05	6.20E- 01	4.58E-05
Pu-239	1.00E-03	5.20E- 01	1.92E-03
Pu-240	1.00E-03	5.20E- 01	1.92E-03
Am-241	3.60E-04	5.20E- 01	6.93E-04
			SUM= 4.63E-03

Based upon the guidance of DOE-STD-1027-92, Attachment 1[Ref. 5], a release of the entire this Cat 3 threshold fractional sum (4.63E-03) corresponds to a maximal potential dose of less than **46.3 mRem** effective whole body; where exposure is 10 R for the release of 100% of the Hazard Category 3 threshold and calculated at 30 meters from point of release for one day of inhalation and direct exposure, while the ingestion pathway is determined over a longer period of time.

The potential consequences discussed here most closely correspond to the definition of Hazard Severity **NEGLIGIBLE** (per Table A.1-2, Hazard Severity).

Risk Category (as defined by Table A.1-4)

Both the pre-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **OCCASIONAL**, and the post-mitigation combination of Severity = **NEGLIGIBLE** with Probability = **REMOTE**, define the risk category as **ROUTINE** for the activities under this USID/SE.

Risk Assessment Summary

This section and Tables A.1-5 and A.1-6 summarize the Risk Assessment for the Pile Fan No.5 Removal given above. Five types of events are addressed under the Risk Assessment for the Pile Fan No.5 Removal in this Safety Evaluation for Unreviewed Safety Issue Determination for the activities covered:

- 001 Waste Container Drop
- 002 Contaminated Waste Bag Rupture/Fire
- 003 Explosion of LPG Leaked from a Forklift
- 004 Oxyacetylene Explosion
- 005 Crane Load Drop

These are discussed in detail as part of the Abnormal Operations Assessment above. These failure modes represent the known or anticipated types possible for the Pile Fan No.5 Removal. The specific examples represent the most severe combination of consequences and frequency deemed credible. Thus, each separate Risk Assessment Table represents an individual envelope encompassing a variety of similar or related events whose severity and probability fall within the bounds of the specific event. Each such event includes all lesser similar ones with lower overall risk (a product of the functions of severity or consequence, and probability or frequency). This combination of assorted types of events caused by any of a variety of potential initiators defines a bounding spectrum of accidents. The spectrum can cover or subtend numerous specific but unnamed incidents under their overlapping umbrellas, so long as the specific event does not exceed the envelope for the type it represents.

As summarized in the tables below, with the administrative controls and mitigating factors considered, only **ROUTINE** risks are associated with the Pile Fan No.5 Removal scope described in this USID/SE.

Table A.1-5

PRE-MITIGATION RISK CATEGORIES				
No.	**Event**	**Hazard Severity (1)**	**Hazard Frequency (1)**	**Risk (2)**
A001	Waste Container Drop	Negligible	Probable	Routine
A002	Contaminated Waste Bag Rupure/Fire	Negligible	Probable	Routine
A003	Explosion of LPG Leaked from a Forklift	Negligible	Remote	Routine
A004	Oxyacetylene Explosion	Negligible	Occasional	Routine
A005	Crane Load Drop	Negligible	Occasional	Routine

1. Severity and frequency are discussed in Section A.1-2.
2. Risk (based on severity and frequency) is defined in Table A.1-4.

Table A.1-6

POST-MITIGATION RISK CATEGORIES				
No.	**Event**	**Hazard Severity (1)**	**Hazard Frequency (1)**	**Risk (2)**
A001	Waste Container Drop	Negligible	Occasional	Routine
A002	Contaminated Waste Bag Rupture/Fire	Negligible	Occasional	Routine
A003	Explosion of LPG Leaked from a Forklift	Negligible	Extremely Remote	Routine
A004	Oxyacetylene Explosion	Negligible	Remote	Routine
A005	Crane Load Drop	Negligible	Remote	Routine

1. Severity and frequency are discussed in Section A.1-2.
2. Risk (based on severity and frequency) is defined in Table A.1-4.

The Risk Assessment concludes that all events with or without mitigation present only a Routine Risk. This analysis did not postulate any accidents or natural phenomena that could result in a credible release mechanism for any other radiological inventories than those discussed above and in Appendix B - Source Term Development. Therefore, it is the conclusion of this analysis that the Pile Fan No.5 Removal does not represent a significant risk to the public, the environment or the workers on the BGRR Decommissioning Project.

APPENDIX B

SOURCE TERM DEVELOPMENT

BGRR-SE-99-01 Source Term Inventory

as of 10/04/99

RADIO-NUCLIDE	(1) HALF LIFE [Yr]	(2) ACTIVITY CONC. [ ]	(3) TOTAL ACTIVITY [Ci]	(4) HAZ.CAT. 3 THRESHOLD [Ci]	(5) HAZ.CAT. 3 FRACTION	(1) HAZ.CAT. 2 THRESHOLD [Ci]	(6) HAZ.CAT. 2 FRACTION
003H	1.23E+01			1.60E+04	0.00E+00	2.90E+05	0.00E+00
014C	5.73E+03			4.20E+02	0.00E+00	1.38E+06	0.00E+00
055Fe	2.70E+00			5.40E+03	0.00E+00	1.11E+07	0.00E+00
060Co	5.27E+00		2.53E-07	2.80E+02	9.04E-10	1.92E+05	1.32E-12
063Ni	1.00E+02			5.40E+03	0.00E+00	4.54E+06	0.00E+00
085Kr	1.07E+01			2.00E+04	0.00E+00	2.83E+07	0.00E+00
090Sr	2.88E+01		1.19E-04	1.60E+01	7.45E-06	2.21E+04	5.40E-09
090Y	7.31E-03		1.19E-04	1.42E+03	8.40E-08	4.30E+05	2.77E-10
093Zr	1.50E+06			6.20E+01	0.00E+00	9.23E+04	0.00E+00
093Nbm				2.00E+03	0.00E+00		0.00E+00
099Tc	2.14E+05			1.70E+03	0.00E+00	3.88E+06	0.00E+00
113Cdm	9.00E+15			1.18E+01	0.00E+00	1.86E+04	0.00E+00
125Sb				1.20E+03	0.00E+00		0.00E+00
137Cs	3.02E+01		1.34E-03	6.00E+01	2.24E-05	8.65E+04	1.55E-08
137Bam				N/A	0.00E+00	N/A	0.00E+00
147Pm	2.62E+00			1.00E+03	0.00E+00	8.40E+05	0.00E+00
151Sm	9.00E+01			1.00E+03	0.00E+00	9.74E+05	0.00E+00
152Eu	1.30E+01			2.00E+02	0.00E+00	1.36E+05	0.00E+00
154Eu	8.50E+00			2.00E+02	0.00E+00	1.15E+05	0.00E+00
155Eu	4.90E+00			9.40E+02	0.00E+00	7.53E+05	0.00E+00
226Ra				1.20E+01	0.00E+00		0.00E+00
231Th				1.20E+04	0.00E+00		0.00E+00
232Th	1.41E+10			1.00E-01	0.00E+00	1.75E+01	0.00E+00
234Th				2.80E+03	0.00E+00		0.00E+00
233Pa				4.60E+03	0.00E+00		0.00E+00
234Pam				1.52E+03	0.00E+00		0.00E+00
233U	1.59E+05		1.70E-05	4.20E+00	4.05E-06	2.22E+02	0.00E+00
234U	2.45E+05		1.70E-05	4.20E+00	4.05E-06	2.22E+02	0.00E+00
235U	7.04E+08		2.96E-06	4.20E+00	7.05E-07	2.38E+02	1.24E-08
236U				4.20E+00	0.00E+00		0.00E+00
238U	4.47E+09		3.65E-05	4.20E+00	8.69E-06	2.39E+02	1.53E-07
237Np	2.14E+06			4.20E-01	0.00E+00	5.85E+01	0.00E+00
238Pu	8.77E+01		2.84E-05	6.20E-01	4.58E-05	6.17E+01	4.61E-07
239Pu	2.44E+04		1.00E-03	5.20E-01	1.92E-03	5.52E+01	1.81E-05
240Pu	6.57E+03		1.00E-03	5.20E-01	1.92E-03	5.60E+01	1.79E-05
241Pu	1.44E+01			3.20E+01	0.00E+00	2.89E+03	0.00E+00
241Am	4.33E+02		3.60E-04	5.20E-01	6.93E-04	5.48E+01	6.57E-06
242Am				8.20E+03	0.00E+00		0.00E+00
242Amm	1.52E+02			5.20E-01	0.00E+00	5.64E+01	0.00E+00
242Cm	4.46E-01			3.20E+01	0.00E+00	1.69E+03	0.00E+00
252Cf	2.64E+00			3.20E+00	0.00E+00	2.20E+02	0.00E+00
SUM					4.63E-03		4.32E-05

==========> 4.63E+01 mRem for total release

1) Values taken from LA-12846-MS, "Specific Activities and DOE-STD-1027-92 Hazard Category 2 Thresholds"

4) Values taken from LA-12981-MS, "Table of DOE-STD-1027-92 Hazard Category 3 Threshold Quantities for the ICRP-30 list of 757 Radionuclides" (except for Tritium whose value was taken from Change 1 to DOE-STD-1027-92).

5) Values developed by dividing the actual isotopic inventory by the respective Haz Cat 3 Threshold.

6) Values developed by dividing the actual isotopic inventory by the respective Haz Cat 2 Threshold.

Pile Fan Removal Contaminated Material Surface Area and Activity Estimate

(1) The metal surface area directly associated with Old Pile Fan, as estimated by E. Lilimpakis, BGRR Field Engineer = 900 sq.ft. There are 2 such fans (Nos. 4 & 5).
900 sq.ft. X 929.0304 sq.cm./sq.ft. = **8.36E+05 sq.cm.**

(2) The metal surface area directly associated with New Pile Fan, as estimated by E. Lilimpakis, BGRR Field Engineer = 1070 sq.ft. There are 3 such fans (Nos. 1, 2 & 3).
1070 sq.ft. X 929.0304 sq.cm./sq.ft. = **9.94E+05 sq.cm.**

(3) For the removal of Pile Fan No. 5, the source term is composed of three types of activity. These are; smearable surface activity, fixed surface activity and so-called 'fines' (resuspendable particulate activity). To minimize the potential for the creation of any airborne activity throughout the removal process, a polymeric barrier system will be sprayed into and onto internal surfaces of the fan prior to exposure of its internal surfaces.

(4) Average Cs-137 smearable activity on interior surface of Pile Fan No. 5 =

Side @	1.44E-03	uCi/100 sq.cm.	
Top @	7.01E-04	uCi/100 sq.cm.	
Vane @	9.21E-04	uCi/100 sq.cm.	
Insp. Plate @	3.17E-03	uCi/100 sq.cm.	
Avg Cs-137 smearable @	1.56E-03	uCi/100 sq.cm.	
Total Cs-137 smearable @	1.30E+01	uCi	= **1.30E-05 Ci**

(5) Let all excess Beta smearable activity be attributable to Sr-90 on interior of Pile Fan No. 5 =
[where 1 uCi = 2.22E+06 dpm & 1 dpm = 4.50E-07 uCi]
[and where Sr-90 is assumed to be in equilibrium with Y-90]

Side	Beta @	2.78E+03 dpm	=	1.25E-03 uCi/100 sq.cm.
	Cs-137 @			1.44E-03 uCi/100 sq.cm.
	No attributable Sr-90 activity; Sr-90 @ 0			
Top	Beta @	1.94E+03 dpm	=	8.72E-04 uCi/100 sq.cm.
	Cs-137 @			7.01E-04 uCi/100 sq.cm.
	Attributable Sr-90 activity @			8.55E-05 uCi/100 sq.cm.
Vane	Beta @	3.06E+03 dpm	=	1.38E-03 uCi/100 sq.cm.
	Cs-137 @			9.21E-04 uCi/100 sq.cm.
	Attributable Sr-90 activity @			2.29E-04 uCi/100 sq.cm.
Insp Pla	Beta @	8.27E+03 dpm	=	3.72E-03 uCi/100 sq.cm.
	Cs-137 @			3.17E-03 uCi/100 sq.cm.
	Attributable Sr-90 activity @			2.77E-04 uCi/100 sq.cm.

(6) Average Sr-90 smearable activity on interior surface of Pile Fan No. 5 =

Side @	0.00E+00	uCi/100 sq.cm.	
Top @	8.55E-05	uCi/100 sq.cm.	
Vane @	2.29E-04	uCi/100 sq.cm.	
Insp Pla @	2.77E-04	uCi/100 sq.cm.	
Average Sr-90 smearable activity =	1.48E-04	uCi/100 sq.cm.	
Total Sr-90 smearable activity =	1.23E+00	uCi	= **1.23E-06 Ci**
Total Y-90 smearable activity =	1.23E+00	uCi	= **1.23E-06 Ci**

(7) Ratio of average smearable Cs-137 activity to average smearable Sr-90 activity =

Avg Cs-137 smearable	=	1.56E-03	uCi/100 sq.cm.
Avg Sr-90 smearable	=	1.48E-04	uCi/100 sq.cm.
Ratio of Cs-137 : Sr-90	=	**10.55**	
Ratio of Cs-137 : Y-90	=	**10.55**	[Sr-90 assumed in equilibrium with Y-90]

(8) Let all Alpha smearable activity be attributable to Am-241 on interior of Pile Fan No. 5 =
(This is conservative because Am-241 has the lowest Cat. 3 threshold of all the alpha emitters found to be present in the 'Fines')

[where 1 uCi = 2.22E+06 dpm & 1 dpm = 4.50E-07 uCi]

Side	Alpha @	25.7 dpm	=	1.16E-05	uCi/100 sq.cm.
Top	Alpha @	3.2 dpm	=	1.44E-06	uCi/100 sq.cm.
Vane	Alpha @	32.1 dpm	=	1.45E-05	uCi/100 sq.cm.
Insp Pla	Alpha @	83.4 dpm	=	3.76E-05	uCi/100 sq.cm.
Average Am-241 smearable activity			=	1.63E-05	uCi/100 sq.cm.
Total Am-241 smearable activity			=	1.36E-01 uCi	= **1.36E-07 Ci**

(9) Estimated volume and mass of 'Fines' within Pile Fan No. 5 =

2 X 48" X 9" X 1/8" =	108 cu.in.	=	1769.80 cc
Density as measured (90 gm for 200 cc) =			0.45 gm/cc
Mass of 'Fines' =			**796.41 gm**

(10) Average Cs-137 activity in Pile Fan No. 5 'Fines' =

Sample 99091516-01 @	4.66E-02	uCi/gm	
Sample 99091516-02 @	3.22E-01	uCi/gm	
Sample 99091516-02R @	1.27E-01	uCi/gm	
Sample 99091516-02RR @	1.12E-01	uCi/gm	
Sample 99091516-02AB @	3.49E-02	uCi/gm	
Sample 99072105-07 @	4.41E-02	uCi/gm	
Average 'Fines' Cs-137 activity @	1.14E-01	uCi/gm	
Total 'Fines' Cs-137 activity @	9.11E+01	uCi	= **9.11E-05 Ci**

(11) Average Co-60 activity in Pile Fan No. 5 'Fines' =

Sample 99091516-01 @	3.22E-05	uCi/gm	
Sample 99091516-02 @	1.69E-04	uCi/gm	
Sample 99091516-02R @	7.05E-05	uCi/gm	
Sample 99091516-02RR @	5.36E-05	uCi/gm	
Sample 99091516-02AB @	0.00E+00	uCi/gm	
Sample 99072105-07 @	7.55E-05	uCi/gm	
Average 'Fines' Co-60 activity @	6.68E-05	uCi/gm	
Total 'Fines' Co-60 activity @	5.32E-02	uCi	= **5.32E-08 Ci**

(12) Alpha activity concentration in Pile Fan No. 5 'Fines', based on Sample 99072706-01=

Am-241 @	27.4 pCi/gm;	Pu-238 @	2.16 pCi/gm;
Pu-239/40 @	153 pCi/gm	**(assumed evenly split as both have same Cat 3 threshold)**	
U-233/34 @	2.42 pCi/gm	**(assumed evenly split as both have same Cat 3 threshold)**	
U-235 @	0.22 pCi/gm;	U-238 @	2.79 pCi/gm.

(13) Total alpha activity in Pile Fan No. 5 'Fines', based on Sample 99072706-01=

Am-241 @	2.18E+04	pCi	=	2.18E-02	uCi	=	**2.18E-08 Ci**	14.58%
Pu-238 @	1.72E+03	pCi	=	1.72E-03	uCi	=	**1.72E-09 Ci**	1.15%
Pu-239 @	6.09E+04	pCi	=	6.09E-02	uCi	=	**6.09E-08 Ci**	40.69%
Pu-240 @	6.09E+04	pCi	=	6.09E-02	uCi	=	**6.09E-08 Ci**	40.69%
U-233 @	9.64E+02	pCi	=	9.64E-04	uCi	=	**9.64E-10 Ci**	0.64%
U-234 @	9.64E+02	pCi	=	9.64E-04	uCi	=	**9.64E-10 Ci**	0.64%
U-235 @	1.75E+02	pCi	=	1.75E-04	uCi	=	**1.75E-10 Ci**	0.12%
U-238 @	2.22E+03	pCi	=	2.22E-03	uCi	=	**2.22E-09 Ci**	1.48%
Total alpha activity @	1.50E+05	pCi	=	1.50E-01	uCi	=	**1.50E-07 Ci**	100.00%

(14) Total fixed activity in Pile Fan No. 5 to be estimated per the results of the ISOCS measurements and the following adjustments. As the ISOCS measures gamma only - alpha and beta activity to be scaled from the ratios found in the smearable activity and/or the 'Fines'. As the ISOCS was used to measure the activity on the bottom of the fan, the results will be doubled to account for the entire fan. This is believed to be reasonable and conservative as the measurement included input from both the 'Fines' present and the smearable activity (which were otherwise already accounted for).

Maximum of Cs-137 =	620	uCi X 2 =	1240 uCi	=	**1.24E-03 Ci**
Maximum of Co-60 =	0.1	uCi X 2 =	0.2 uCi	=	**2.00E-07 Ci**
Maximum of Am-241 =	180	uCi X 2 =	360 uCi	=	**3.60E-04 Ci**

Attributable Sr-90, to be based upon ratio of smearable Cs-137 : Sr-90 (per Item 7 above = 10.55)

Maximum of Sr-90 = 1.24E-03 Ci/10.55=	**1.18E-04 Ci**
Maximum of Y-90 = Sr-90 = 1.24E-03 Ci/10.55=	**1.18E-04 Ci**

Attributable alpha emitters to be based on their respective ratios to Am-241 in the 'Fines' (Item 13).

Maximum of Pu-238=3.60E-04/14.58*1.15 =	**2.84E-05 Ci**
Maximum of Pu-239=3.60E-04/14.58*40.69 =	**1.00E-03 Ci**
Maximum of Pu-240=3.60E-04/14.58*40.69 =	**1.00E-03 Ci**
Maximum of U-233=3.60E-04/14.58*0.64 =	**1.70E-05 Ci**
Maximum of U-234=3.60E-04/14.58*0.64 =	**1.70E-05 Ci**
Maximum of U-235=3.60E-04/14.58*0.12 =	**2.96E-06 Ci**
Maximum of U-238=3.60E-04/14.58*1.48 =	**3.65E-05 Ci**

Bldg 704 Fan(s) & Fanhouse Sampling & Analysis

ASL #	DATE	TIME	MAT'L	ALPHA [uCi/mL]	BETA [uCi/mL]	TRITIUM [uCi/mL]	MDL - uCi/mL Alpha	Beta	Tritium	GAMMA Nuclide	ACTIVITY [uCi/gm]	1-SIGMA % Error
99072105-01	7/20/99	1600 hrs	Smear	5 In/Side	Alpha @	25.7 dpm	Beta @	2781.5 dpm	*	Cs-137	1.44E-03	uCi/smear
99072105-02	7/20/99	1600 hrs	Smear	5 In/Top	Alpha @	3.2 dpm	Beta @	1935.7 dpm	*	Cs-137	7.01E-04	uCi/smear
99072105-03	7/20/99	1600 hrs	Smear	5 vanes	Alpha @	32.1 dpm	Beta @	3059.8 dpm	*	Cs-137	9.21E-04	uCi/smear
99072105-04	7/20/99	1600 hrs	Smear	5 ins/plat	Alpha @	83.4 dpm	Beta @	8265.2 dpm	*	Cs-137	3.17E-03	uCi/smear
99072105-05	7/20/99	1600 hrs	Air	1 out G/A	Alpha @	----uCi/cc	Beta @	----uCi/cc		----------	----------	----------
99072105-06	7/20/99	1600 hrs	Air	2 ins G/A	Alpha @	5.23E-13 uCi/cc;Beta @ 1.43E-10 uCi/cc**				Cs-137	1.54E-10	uCi/cc
99072105-07	7/20/99	1600 hrs	Dirt	5 I/s crud						Co-60	7.55E-05	7.71
										Cs-137	4.41E-02	11.33
										Am-241	1.39E-04	30.97
99072706-01	7/27/99		#5 Fines	Am-241	27.4 pCi/gm							
				Pu-238	2.16 pCi/gm							
				Pu-239/40	153 pCi/gm							
				U-233/34	2.42 pCi/gm							
				U-235	0.22 pCi/gm							
				U-238	2.79 pCi/gm							
99091516-01	09/15/99	1550 hrs	#5 Heavy							Co-60	3.22E-05	8.44
										Cs-137	4.66E-02	8.04
99091516-02	09/15/99	1550 hrs	#5 Fines							Co-60	1.69E-04	14.04
										Cs-137	3.22E-01	8.78
99091516-02R	09/15/99	1550 hrs	#5 Fines							Co-60	7.05E-05	13.98
										Cs-137	1.27E-01	8.45
										Am-241	7.60E-04	38.96
99091516-02RR	09/15/99	1550 hrs	#5 Fines							Co-60	5.36E-05	14.13
										Cs-137	1.12E-01	8.78
										Am-241	7.90E-04	49.61

**** MDL - Alpha @2.06E-12 uCi/cc ; Beta @ 1.59E-11 uCi/cc**

*** MDL - Alpha @ 23.6 dpm ; Beta @ 19.9 dpm**

Bldg 704 Fan(s) & Fanhouse Sampling & Analysis

ASL #	DATE	TIME	MAT'L	ALPHA [uCi/mL]	BETA [uCi/mL]	TRITIUM [uCi/mL]	MDL - uCi/mL Alpha	Beta	Tritium	GAMMA Nuclide	ACTIVITY [uCi/gm]	1-SIGMA % Error
99091516-02AB	09/15/99	1550 hrs	#5 Fines							Cs-137	3.49E-02	9.20
ASTD-FH50129A	07/08/99	Fan Housing Bottom (From NE to SW)								Cs-137	620 uCi	Upper Est
											78 uCi	Lower Est
ASTD-FH50229A	07/08/99	Fan Housing Bottom (From NW to SE)								Cs-137	590 uCi	Upper Est
											75 uCi	Lower Est
										Am-241	< 180 uCi	Lower Est
										Co-60	< 0.1 uCi	Lower Est

BROOKHAVEN GRAPHITE RESEARCH REACTOR (BGRR) DECOMMISSIONING PROJECT

Task-Specific Environment, Health and Safety Plan For Pile Fans Removal from Building 704

Prepared by:	Ram Singh Singa	10-7-99 Date
Concurred:	H. C. Bachner BGRR Construction Manager	10-8-99 Date
Concurred:	QB Harris QA Representative	10/8/99 Date
Concurred:	Stephen V. Mussolino ES&H Manager	10/7/99 Date
Approved:	Stephen K. Pulsford BGRR Project Manager	10/8/99 Date

BOOKHAVEN NATIONAL LABORATORY
BROOKHAVEN SCIENCE ASSOCIATES
Under Contract No. DE-AC02-98CH01886 with the
U. S. DEPARTMENT OF ENERGY

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ACRONYMS AND INITIALISMS

AOC	Area of Concern
BGRR-D	Brookhaven Graphite Research Reactor – Decommissioning Project
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CX	Categorical Exclusion
DAC	Derived Air Concentration
DOE	Department of Energy
EPA	Environmental Protection Agency
ES&H	Environment, Safety, and Health
FID	flame ionization detector
FS	facility support
PID	photoionization detector
HASP	BGRR Project Environmental, Health and Safety Plan
HAZWOPER	hazardous waste operation emergency response
HFBR	High Flux Beam Reactor
IDLH	immediately dangerous to life and health
LEL	lower exposure limit
LLW	low level waste
NEPA	National Environmental Protection Act
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
OSHA	Occupational Safety and Health Administration
PBS	Polymeric Barrier Spray
PCB	polychlorinated biphenyl
PEL	permissible exposure limit
PPE	personal protective equipment
QAPP	quality assurance project plan
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RWP	radiological work permit
RWT	Rad Worker Training
SARA	Superfund Amendments and Reauthorization Act
SBMS	Standards Based Management System
S&H	safety and health
SVO	Suction Valve Operator
TEHASP	Task-specific Environmental, Health and Safety Plan
TWA	time weighted average
WAC	Waste Acceptance Criteria
WP	work permit

1.0 GENERAL INFORMATION

This Task-Specific Environment, Health and Safety Plan (TEHASP) is based on overall BGRR Environment, Safety and Health (ES&H) plan (HASP). It addresses ES&H issues related to the removal activities of Pile Fans in building 704 at the Brookhaven Graphite Research Reactor Decommissioning Project (BGRR-D), Brookhaven National Laboratory (BNL), Upton, NY. Reference the BGRR Project Management Plan for general site maps and the task-specific site map for work task locations. More detailed information regarding the subject activities can be found in the Technical Work Document Pile Fan No. 5 Removal dated September 20, 1999. This is an NEPA-CX activity that has been approved by DOE and Brookhaven Science Associates. In addition to the task-specific requirements contained in this plan, general requirements are given in the BGRR-D HASP. The HASP includes the requirements of BNL Standards Based Management Systems (SBMS), 29 CFR 1910.120 (b), BNL ES&H Standards, BNL RadCon Manual, BNL other institutionalized procedures, including work controlling documents such as Work Permits and Radiological Work Permits. This TEHASP must be used in conjunction with the applicable Work Permits and the BGRR-D HASP.

All appropriate BNL and BGRR ES&H personnel should be familiar with the applicable information and requirements contained in the BGRR-D HASP, TEHASP, and the Quality Assurance Project Plan (QAPP).

1.1 IDENTIFICATION

Site name: Brookhaven National Laboratory
Site location: Upton, NY
Client: Brookhaven National Laboratory, owned by the United States Department of Energy (DOE) and operated under contract by Brookhaven Science Associates

1.2 DESCRIPTION OF ACTIVITIES

This TEHASP covers the general work categories checked below.

- ☐ Preliminary Assessment
- ☐ Initial Investigation Walk-over
- ☐ Remedial Investigation
- ☐ Remedial Design
- ☐ Operations and Maintenance
- ☐ Supplemental Assessment
- ☐ Feasibility Study
- ☐ Initial Investigation Sampling
- ☒ Remedial/Removal Action
- ☒ Site Restoration

Table 1-1, Activity Description, outlines the scope of major activities to be performed as part of the identified work categories which are provided as background. The actual technical work plan will be published as a separate controlled document. The activities listed may be performed concurrently. General support activities or similar remediation, site restoration and removal activities for the Pile Fans are covered by this TEHASP.

Table 1-1
Activity Description
(Level of respiratory protection may change for each task within an activity. The FS personnel shall specify the proper PPE for each task.)

No.	Activity Description
1	**Mobilization**: • Obtain concurrence from High Flux Beam Reactor (HFBR) for performing work in the motor room. • Contact Plant Engineering for personnel and equipment support. • Assemble personnel and other equipment required on site. • Install temporary facilities (e.g., decontamination facilities, storage, and lay-down areas). • Conduct Pre-job Briefing with all personnel before the start of work. After the job briefing, a walkthrough may be necessary if the attendees have any questions.
2	**Work Site Preparation**: • Prepare work area around the affected Pile Fan in Building 704 Fan House so that all unnecessary equipment is removed. • Identify all energies and ensure that they are controlled per BNL ES&H Standard 1.5.2 "Lockout/Tagout." All lock keys, if any, have been assigned and documented. • Delineate the work boundaries as necessary. • Install traffic control measures of both motor vehicles and unsolicited visitors (onlookers). Place adequate signs, barricades, and/or flagmen where and when necessary to provide protection where work is being performed on or adjacent to roadways.
3	**Disconnection and Removal of SVO and Drain Manifold** • Disconnect and remove the fan suction valve operator as a unit by unbolting and removing the disconnect linkage and base mounting bolts. • Remove manifold assembly by unbolting, breaking unions as necessary and using a cutting device to cut the 3"drain pipe. Collect any cuttings in the rad bags for proper disposal. Install a 3" threaded pipe cap on this line. Unscrew and remove the three drain pipes. • If there is a use of any mobile crane, it shall be operated to comply with manufacturer's specifications and limitations, and BNL site safety requirements. Rated load capacities, boom angles, recommended operating speeds, and special hazard warnings/instructions shall be posted on all equipment and visible from the operators' cab. • Put all removed materials, such as SVO, in proper containers for disposal and exercise good housekeeping practices.

No.	Activity Description
4	**Removal of Fan Volute and Discharge Bellows/Flange**[1] • Assemble scaffold or other platform area to the height of volute suction bellows. The scaffold shall be inspected by a competent person before its use. • A fall protection system shall be implemented • Secure and isolate the valve fan suction on the top bellow in closed position. • Carefully punch four (4) holes, one at a time, of approximately ¼ " diameter in the bellows so that no internal particulate get airborne externally.[1] • Inject PBS inside the bellows and volute assembly uniformly with a minimal force so that no internal airborne particulate are dispersed outside the bellows. This step of fixation will be repeated after minimum of 8 hours lapse after the first application is made. .Manufacturer of this product recommends to wait for 1to 8 hours for proper encapsulation. This process will minimize airborne particulate generation externally.[1] • Remove flange bolts, except two, from the lower inlet volute joint. Place a glove bag around this joint to control any contamination and the final removal of two bolts.[1] • Using a Chain Fall assembly, lift the volute flange from the fan inlet and insert a sheet metal plate on the fan inlet. Lower the volute assembly over the inserted sheet metal plate. (A C-clamp type spreader may be used to spread both sides of flanges and to insert two sheet metal opening covers which will be secured by bending over the retaining tabs).[1] • Place a plastic bag type system around the inlet bellows to collect any materials. Slowly saw cut the bellow around near top end of the inlet flange. Use Rad vacuum to minimize the spread of contamination and cuttings going into the plastic bag type system. • Cover the open end of the flange with Herculite type material. • Using BNL ES&H standard 1.6.0 "Material Handling: Equipment and Procedures", and lift the volute assembly using overhead monorail with approved pre-engineered rigging materials. The monorail has been load tested. • Place the volute assembly in an approved waste box. • Contaminated materials shall be loaded into designated waste boxes. • Decontaminate the equipment as necessary at the end of each day.

[1] This activity is for discharge bellows task.

No.	Activity Description
5	**Preparation for Removal of a Pile Fan** • Conduct a Rad survey in this work area to find the extent of contamination in the motor room near the motor shaft. • Place a plastic-bag-like containment system over the opening in the motor room to control the spread of contamination, if any. • As discussed in activity 1 regarding the location of motor shaft and coupling, remove motor coupling, if necessary, and the split cover plate from the "motor room" by unbolting. Motor shaft will be left intact until it is brought to the main fan house. • Remove the inboard and outboard fan shaft upper bearing blocks. • Remove the bolts holding the outboard fan pedestal to the concrete block and remove the outboard pedestal. • Using BNL approved rigging plan and approved pre-engineered equipment, stabilize the fan housing with two slings on each side in "A-frame type" configuration using chain fall assembly and other pre-engineered hoisting materials. This should maintain the center of gravity and avoid tilting to one side. • With the use of hydraulic jacks, break loose the connection between concrete and the fan while keeping the center of gravity of the fan at the optimal position. • Using load-tested chain fall assembly, slowly lift the fan assembly so that it is just clear of the concrete supports. • Decontaminate the equipment as necessary at the end of each day.
6	**Lifting of the Fan and placement in open-top container** • As the fan is lifted, install wooden cribbing beneath the lower fan housing. • Remove the three (3) drain nipples and elbows from the bottom of the fan casing and install threaded pipe plugs. • Carefully lift the fan housing, slowly rotate the fan assembly into a position to access the inboard fan shaft. After the shaft is cut (activity #7), place the fan assembly in an open top type container that meets the requirements for storage, disposal, and transportation. • Decontaminate the equipment per RadCon Manual, Table 2-2. • This assembly may be shrink wrapped, if necessary.

No.	Activity Description
7	**Flame cutting the Fan shaft** • A burn permit shall be procured before any burning activity. • Prepare the area in accordance with burn permit. • Assign a fire watch with a fire extinguisher. The fire watch shall remain in the area until the cutting task is completed. • Cut the fan shaft. Let this piece cool down and then place in a proper container that meets the requirements for storage, disposal and transportation.
8	**Containerization of Removed Materials** • Place all removed equipment and materials in their proper approved waste containers. Label and mark as necessary per requirements. • Remove the inboard bearing block/pedestal. • Install a cover plate on the opening, created by shaft removal, in the motor room and on the opening on the discharge bellow flange.
9	**Demobilization** • Remove personnel, equipment and any generated waste from Fan area. • Remove and dismantle any temporary structures and utilities. • Clear area and remove any obstruction that could cause any trip or fall during its future use. • Decontaminate and release any equipment per RadCon Manual. • Conduct general site cleanup and perform a final radiological survey.

Decontamination is a Hazardous Waste Operation and Emergency Response (HAZWOPER) activity covered under 29 CFR 1910.120, which includes removal of radiological and chemical contamination.

If additional contaminated materials are identified for removal in any of the areas, those tasks may be performed without revision of this plan as long as the contaminants and concentrations are comparable to those described in Section 2.0.

1.3 SITE INFORMATION

1.3.1 Site Type

The following pertinent site attributes are checked below.

☐ Active	☐ Civilian	☐ Landfill
☒ Inactive	☒ Federal Government	☐ Residential
☒ Secured	☐ State Government	☐ Agricultural
☐ Unsecured	☐ Military	☐ Industrial
☐ Security Unknown	☐ Commercial	☐ Other:

1.3.2 Site Owner

United States Department of Energy

1.3.3 Site Description

A general description of the BGRR Decommissioning Project site can be found in Section 1.0 of the BGRR Project Management Plan. Fan house building 704 was equipped with five (5) primary motors and fans which were the motive force for the cooling-air to the BGRR pile. It also houses the secondary air fan, emergency fan and switches across the systems. Air ducting from the Pile is located on the roof of the structure with the equipment inside the building. The fans discharged under the building into duct work which exhausted cooling air into the base of the stack. The interior of this section of duct work has various levels of fixed and removable contamination, as do the fan rooms within the building. Due to the presence of electrical switch gear and equipment within this building which is owned by the High Flux Beam Reactor (HFBR), a formal Memorandum of Agreement (MOA) has been developed and signed by representatives of BGRR Decommissioning Project and Reactor Division. This MOA defines the protocols for cleanup activities by BGRR within the building. Access to this building is controlled by restricted key distribution and locked entry door. Contamination Areas have been posted in building 704.

The work covered under this TEHASP will be performed in the areas connected to Pile Fans. More detailed descriptions of the work areas are provided below and in the technical work plan document. Photos for Pile Fan No. 5 showing the activities are attached with this TEHASP and photos of other pile fans will be included in a revision to this plan as the work starts for those activities. This work is a specific AOC 9 under an Interagency Agreement among DOE, EPA, and New York State Department of Environmental Conservation (NYSDEC).

Contaminants identified in the Pile Fan housing indicate the presence of low-level radioactive waste, e.g., Cobalt-60, Strontium-90, Cesium-137, Plutonium-238/239/240, Americium-241, and gross alpha and beta activity. No known chemical contamination, except lead and asbestos, of

any health concerns has been characterized and is expected during these activities; however, all safety and health precautions shall be taken from any potential exposures.

1.3.4 Site Regulatory Status (check all applicable Items)

Jurisdiction	Regulation		
CERCLA/SARA	☒ EPA	☒ State of New York	☒ NPL site
OSHA	☒ 29 CFR 1910	☒ 29 CFR 1926	☒ State of New York
RCRA	☒ State of New York	☒ EPA	
Solid Waste	☒ State of New York	☒ DOE Order 435.1	☒ EPA
RAD Control	☒ DOE Order 5400.5	☒ 10 CFR 835	☒ DOE Order5700.6C

2.0 HAZARD ANALYSIS

2.1 TYPES OF HAZARDS

2.1.1 Chemical Hazards Listing

- ☒ Flammable
- ☐ Water Reactive
- ☐ Corrosive
- ☒ Toxic inorganic chemicals
- ☐ Ingestion exposure
- ☐ Explosive
- ☐ Oxidizer
- ☒ Inhalation exposure
- ☐ Toxic organic chemicals
- ☒ OSHA 1910.1000 substance
- ☐ Highly Reactive
- ☒ Contact exposure
- ☒ Carcinogen
- ☐ Mutagen
- ☒ OSHA specific hazard standards: lead, asbestos

2.1.2 Physical Hazards and General Safety and Health Hazard Listing

- ☒ Noise
- ☐ Cold
- ☒ Heavy lifting (rigging)
- ☐ Utilities, underground
- ☐ Excavations/trenches
- ☒ Hot Work (cutting)
- ☒ Electrical connections
- ☐ Confined space
- ☒ Asbestos
- ☐ Explosives
- ☒ Heat
- ☒ Traffic
- ☒ Heavy equipment
- ☒ Utilities, overhead
- ☒ Overhead hazards
- ☒ Pinch points
- ☒ Flying debris
- ☒ Scaffolding
- ☐ Intense sunlight
- ☐ Remote area
- ☐ High Pressure Systems
- ☒ Ladders
- ☐ Cave-ins
- ☒ Fire
- ☒ Slips, trips, falls
- ☒ Powered Tools
- ☒ Fall Protection

2.1.3 Biological Hazards

- ☐ Insects
- ☐ Pathogenic Microorganisms
- ☐ Poisonous Plants
- ☐ Dangerous animals
- ☐ Bloodborne agents
- ☐ Other:

2.2 KNOWN AND/OR SUSPECTED HAZARDOUS MATERIALS ONSITE

2.2.1 Chemical Hazards

No chemical hazard has been identified. However chemicals such as heavy metals, asbestos gasket, lead paint is presumed to be present. (Table 2-1).

2.2.2 Chemical Hazard Assessment

No chemical of concern has been found during the characterization phase. Characterization for chemical contents has not been completed at the time of development of this document.

Chemical hazards are not anticipated for any of the activities, except flame cutting, as these operations do not involve working with chemical contamination. In addition, any activities within contaminated areas as described in other activities, except 7, are not expected to result in chemical exposure to workers.

The use of non-toxic PBS presents no health hazard. It minimizes the generation of airborne particulate in the work area.

For all planned activities covered under this TEHASP, the potential hazard associated with exposure to chemical contaminants is expected to be very low. Although very limited chemical characterization has been done, the potential chemical exposures are minimal.

- Ambient air shall be monitored for radioactivity and chemical contaminants during work activities related to handling of contaminated radiological materials. Nuisance dust will be monitored, as necessary.
- Proper Personal Protective Equipment shall be implemented to control potential exposures to metal fumes during that activity.

2.2.3 Chemical Contaminants Monitoring

Contaminants of concern are unknown organic and inorganic vapors, lead and asbestos. Lead and asbestos have been found in other buildings connected with this system.

Monitoring for chemical contaminants shall be conducted in accordance with Table 6-1. The ES&H Coordinator shall ensure that the proper level of PPE is used. If there is any change in the level of protection, this TEHASP shall be revised.

Table 2-1
Chemical Hazard Information

Chemical	Exposure Limits	Exposure Route(s) and Symptoms	Sampling Media
Asbestos	0.1 f/cc(PEL/TWA), 1.0 f/cc STEL	Exposure route: Inhalation, Ingestion Effects: causes asbestosis, inflammation of the pleura, and certain cancers of the lungs and digestive tracts.	Filter Sampling rate:2 L per min; Varies
Strontium*	BNL RadCon Manual	Exposure routes: Inhalation, Ingestion. Effects bone	Per BNL RadCon Manual
Cesium*	BNL RadCon Manual	Exposure routes: Inhalation, Ingestion Effects whole body.	Per BNL RadCon Manual
Plutonium* Americium* Uranium*	BNL RadCon Manual	Exposure routes: Inhalation, Ingestion Carcinogenic targets bone, gastrointestinal tract, kidneys, and lungs.	Per BNL RadCon Manual
Lead	0.050 mg/m^3 TWA, OSHA PEL 0.030 mg/m^3 TWA, OSHA Action Limit 100 mg/m^3 IDLH	Exposure routes: Inhalation, ingestion, and skin contact; target organs: weakness, lassitude, insomnia, facial pallor, pale eyes, anorexia, malnutrition, constipation, abdominal pain, colic, anemia, gingival lead line, tremors, paralyzed wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension.	Filter Sampling rate 2–4 L per min

* Radionuclides

2.3 RADIOLOGICAL HAZARDS, ASSESSMENT AND ANALYSIS

Radionuclides such as Americium-241, Cesium-137, Strontium-90, Radium-226, Plutonium-238/239/240 and other transuranics, gross alpha, and gross beta have been detected in samples from Pile Fan No.5 assembly. All radiological monitoring activities shall be conducted in accordance with BNL RadCon Manual and as advised by the FS personnel. This may require use of personnel or area monitoring for radiological measurements.

The Lead Radiological Control Technician (RCT), in concurrence with FS Representative, shall implement an air-monitoring program to observe the levels of airborne radiological contaminants of concern. If monitoring results indicate unacceptable levels of airborne radiological contamination; and or if new information indicates that level of contamination varies significantly from the characterization, FS personnel will upgrade or downgrade the use of personal protective equipment (PPE) after revising the RWP, as necessary. This TEHASP shall be revised by the ES&H Coordinator to address current site conditions and changes, and reflect lessons learned as the work progresses to remaining fan removals.

2.4 SAFETY HAZARD ANALYSIS

The primary physical hazards associated with the removal activities pile fan are discussed below. The BNL standards and procedures for controlling the hazards are also specified. In addition to the specific hazards discussed below, other potential construction site hazards are listed along with the applicable BNL ES&H Standards in Table 2-2.

Table 2-2
General Construction Hazards and Controlling BNL Standards/Procedures

Hazard	Controlling ES&H Core Procedures
Electrical	BNL ES&H Standard 1.5.0, "Electrical Safety"
Coveralls, Eye and Face	BNL ES&H Standard 1.16.0, "Personal Protective Equipment"
Construction	BNL ES&H Standard 1.3.1, "Construction Safety"
Material Handling/Rigging	BNL ES&H Standard 1.6.0, "Material Handling, Equipment and Operator,"and Plant Engineering Instructions "Working on Heights"
Cutting and Welding	BNL ES&H Standard 4.3.0, "Cutting and Welding"
Fires	BNL ES&H Standard 4.0.0, "Fire Safety Program"
Noise	BNL ES&H Standard 2.4.0, "Noise"
Work Planning and Control	BNL ES&H Standard 1.3.6, "Work Planning and Control for Operations"
Heat	BNL ES&H Standard 2.5.0, " Heat Stress"

2.4.1 Energized Utilities

Energized underground utilities may present electrical, burn, fire/explosion, or other hazards during movement of heavy equipment. The ES&H Coordinator with concurrence from field engineer shall assure that measures are undertaken in accordance with BNL ES&H Standards and institutional procedures to identify and avoid energized underground /aboveground utilities during its operations. Where feasible, the ES&H Coordinator shall assure that energized utilities are locked or tagged out in accordance with BNL ES&H Standard 1.5.2, "Lockout/Tagout Requirements."

2.4.2 Heavy Equipment Use

Use of heavy equipment such as crane, forklifts, hoisting/rigging equipment such as chain fall assembly, rigging hardware, and transport trucks during removal activities may present hazards such as crushing, cutting, eye and face injury, accident, and fire hazards. Heavy equipment will only be operated by individuals with documented training and experience as mandated in ES&H Standard 1.6.1, " Material Handling: Operator Training and Qualifications." All other guidelines/ instructions as institutionalized by Plant Engineering are to be incorporated in these activities. All BNL vehicle and traffic regulations will be observed. The ES&H Coordinator shall assure that heavy equipment is pre-inspected and operated in accordance with BNL requirements and OSHA regulations.

2.4 3 Working at Heights (Fall Protection)

Activities related to work on heights shall comply with OSHA 29 CFR 1926-Subpart E, "Personal Protective and Life Saving Equipment" and also follow "Fall Hazard Mitigation Guidelines," "Specifications for Fall Protection Mechanisms and Systems," institutionalized by Plant Engineering. The Field Engineer and Construction Manager shall assure that these requirements are complied with during any such work activity and only approved pre-existing mechanisms are used.

2.4.4 Heat/Cold Stress

Use of impermeable and semi-impermeable protective clothing and respiratory protection during removal of a fan assembly may significantly increase heat stress hazards. Work activities, especially, outside the BGRR buildings may create cold weather disorders depending on the weather. The ES&H Coordinator shall assure that heat stress is prevented or cold stress controlled through implementation of the procedures contained in BNL ES&H Standards 2.5.0 "Heat /Cold Stress."

2.4.5 Lead

There is a minimal potential for exposure to lead fumes while cutting the shaft. All lead handling activities shall be conducted under BNL and other applicable regulatory requirements. If it has

been determined that potential for lead exposure is there, BNL S&H Division personnel will be contacted to follow further guidelines. The ES&H Coordinator shall initiate this action.

2.4.6 Asbestos

There are some gaskets that contain asbestos. No activity has been defined in the technical work plan document which disturbs those gaskets. However if there is any activity that has to be performed which entails working with those asbestos gaskets, work shall be performed by BNL Asbestos Handlers in accordance with BNL ES&H Standards and Procedures.

2.4.7 Flame Cutting

A qualified and trained worker, such as welder, shall perform this activity. The field engineer shall make arrangements to procure burn permit from the BNL Fire Department. The trained worker shall follow guidelines as mandated by BNL ES&H Standard, 4.3.0, "Cutting and Welding."

2.4.8 General Housekeeping

Workers shall follow required housekeeping that includes keeping area, tools and equipment clean. Any non-essential equipment shall be removed from work area at the end of each day. If there is any reusable contaminated PPE, it should be decontaminated and cleaned for later uses, as necessary.

2.5 BIOLOGICAL HAZARD ASSESSMENT

No biological hazards are expected during any of the activities for removal of the pile fan, however, the following controls are recommended.

- Workers with cuts and other skin breaks shall not work in radiological control areas.
- Workers will be instructed to practice careful personal hygiene, including washing hands and face as they leave work areas, as necessary.

3.0 MEDICAL SURVEILLANCE

Medical surveillance requirements are found in the BGRR-D HASP Section 10.0, "Biological Monitoring and Medical Surveillance." In addition to standard medical surveillance requirement, workers who may be exposed to lead or any radionuclide shall receive bioassays in accordance with BNL lead and RadCon protection requirements.

4.0 TRAINING

Project training requirements are contained in the BGRR-D HASP Section 16.0, "Training/Special Requirements."

In general, workers for this activity require RWT-200 Rad Worker Training, RWT-300 Rad Worker Contamination Training, and 40 hr HAZWOPER Training. Other personnel, who are designated to operate equipment shall have completed training and are qualified to the level of proficiency consistent with their tasks. The project shall assure that all personnel working on this task are adequately trained and qualified.

Before starting work, each worker assigned to perform tasks covered under this TEHASP will receive a documented initial ES&H orientation from the project ES&H Coordinator or designee.

5.0 SITE CONTROLS

Program requirements for site controls are specified in Section 12.0 of the BGRR-D HASP. In addition to the controls specified in this document, radiological postings, including signs and barriers, shall be adhered to by all personnel. Any change of radiological postings shall be made by FS personnel. The ES&H Coordinator shall ensure the following measures are implemented:

- Traffic control and safety measures shall be implemented during work on or near roadways. Those measures shall include use of orange traffic safety vests, flagmen, when needed, and traffic signs and cones or barricades to control traffic.

5.1 WORK PERMIT AND RADIOLOGICAL WORK PERMIT

Both BNL ES&H Standard, 1.3.6, "Work Planning and Control for Operations" and BNL RadCon Manual requirements for preparation and implementation of these permits shall be used until the activities are completed. Work Permits (WP) are required for activities 3 through 8 and are approved by ES&H Coordinator; a burn permit is required for activity 7 and is issued by the Fire Department; and a RWP is required for activities 3 through 8 as directed by FS support personnel.

6.0 SAFETY AND HEALTH MONITORING

6.1 AIR MONITORING FOR CHEMICAL CONTAMINANTS

The air monitoring devices used for activities listed in Table 1-1 will be (1) a photoionization detector (PID)/ flame ionization detector (FID); (2) a multigas detection meter or single gas detection meter capable of determining percent oxygen, lower explosive limit (LEL), carbon monoxide, and hydrogen sulfide; (3) personal sampling pumps and collection filters for particulates and charcoal tubes for collection of organic vapors; (4) a respirable dust monitor.

6.2 AIR MONITORING REQUIREMENTS AND ACTION LEVELS

Table 6-1 gives the air monitoring requirements and action levels for chemical contaminants by each activity. The ES&H Coordinator shall determine the frequency of periodic monitoring for non-rad contaminants. Air monitoring procedures are specified in BGRR-D HASP Sections 8.0 and 9.0.

Table 6-1
Air Monitoring Requirements and Action Levels for Chemical Contaminants

Activity No.	Instrument or contaminant	Frequency of Monitoring	Action Levels	Response
3, 4, 5, 6, 7	LEL meter	Initial and periodic	< 10% LEL	No action
			10% < 20% LEL	Continuous monitoring
			20% LEL	Stop work, implement engineering controls
	O_2 meter		< 19.5% O_2	Stop work, implement engineering controls
			>22.5% O_2	Stop work, implement engineering controls
	CO meter		200 ppm CO ceiling (instantaneous reading)	Stop work, implement engineering controls, evacuate area
			35 ppm CO TWA	Stop work, implement engineering controls, Level B respiratory protection
	H_2S meter		1 - 10 ppm H_2S	Contact the ES&HC perform continuous monitoring
			> 10 ppm H_2S	Stop work, evacuate area
3, 4, 5, 6, 7	PID/FID	Initial and periodic	< 1 ppm	Construction/radiological attire
			1 - 50 ppm	Level D notify the ES&HC and perform colorimetric detector tube sampling, if sampling cannot be performed within 15 min, or benzene is detected go to Level C respiratory protection
			> 50 ppm	Level C respiratory protection, if benzene is identified go to Level B
3, 4, 5, 6	Respirable dust monitor (only if dusty conditions exist)	Periodic and whenever visible dust is observed in the work area. Measurement not to be integrated for period greater than 15 min	< 50 $\mu g/m^3$ At work area perimeter	No action
			>50 $\mu g/m^3$ < 150 $\mu g/m^3$ At work area perimeter	Continue work, contact ES&HC, identify source of dust and implement engineered controls
			> 150 $\mu g/m^3$ At work area perimeter	Stop work until engineering controls reduces airborne dust to below 50 $\mu g/m^3$
			> 1 mg/m^3 for > 15 minutes In breathing zone	Level C respiratory protection until engineering and/or administrative controls are implemented

CO = carbon monoxide; O_2 = oxygen; H_2S = hydrogen sulfide
Note: Activity numbers are taken from Table 1-1.

Air will be sampled if air monitoring indicates levels of airborne contaminants above the action level of one-tenth the permissible exposure limit (PEL).

Radiological monitoring shall be conducted in accordance with BNL RadCon Manual as determined by Project FS personnel. All radiological trigger levels will be implemented per BNL RadCon Manual and associated institutional radiological control procedures.

6.3 MONITORING FOR RADIOLOGICAL CONTAMINANTS

Radiological monitoring equipment may include alpha, beta, gamma, or a combination meter, such as RO-20, Eberline E-600; a frisker such as Ludlum Model 3, or 19, or 17; an exposure rate meter such as XETEX TELESCAN; and general air monitoring monitors or instruments with similar sensitivities. All radiological monitoring equipment and procedures shall be specified by the FS personnel. Thermoluminescent dosimetry (TLD) and bioassay shall be implemented for personnel monitoring.

All monitoring devices shall be calibrated in accordance with manufacturer's recommendations and BNL requirements prior to their use.

All persons leaving a Contamination Area or a Buffer Area shall perform a whole-body frisk or pass through a portal monitor such as PCM-2.

7.0 PERSONAL PROTECTIVE EQUIPMENT

Table 7-1 specifies levels of protection for the site activities covered by this plan. Radiological requirements for these activities shall supercede if advised by the Project FS personnel .

Program requirements for components of Protection Levels A, B, C, and D, and for general site PPE and attire, are specified in Sections 13.0 of the BGRR-D HASP, "Personal Protective Equipment." It is expected that most work performed under this TEHASP will be performed per radiological requirements in accordance with RadCon Manual. The welder or the trained worker may require some heat/flame resistant PPE for torch cutting purposes. The welder or the trained worker will be instructed to use the proper PPE, in accordance with BNL ES&H Standard 4.3.0,"Cutting and Welding." Use of PPE greater than Level C is not anticipated for any of the activities for this task for any known chemical contamination. Additional PPE requirements (e.g., hearing protection, safety harnesses, etc.) shall be provided addressing those concerns as they arise.

Respiratory protection shall be recommended based on the task in each activity by FS personnel.

PPE for Levels B, C, D, and construction attire personal protection is as follows. However, if the FS personnel or the RWP mandates different PPE for radiological controls, those requirements shall be implemented.

- **Level B Protection**

  - Full-face pressure demand or continuous pressure supplied air respirator
  - Regular or coated Tyvek coveralls
  - Inner polyvinyl chloride (PVC) or vinyl gloves or equivalent
  - Outer neoprene or nitrile gloves or equivalent
  - Neoprene or rubber overboots
    Safety work shoes
  - Hard hat

- **Level C Protection**

  - Full-face air purifying respirator
  - Organic vapor cartridges and/or high efficiency particular air filter
  - Regular or coated Tyvek coveralls
  - Inner PVC or vinyl gloves or equivalent
  - Outer neoprene or nitrile gloves or equivalent
  - Safety work shoes
  - Hard hat
  - Neoprene or rubber overboots

- **Level D Protection**

  - Hard hat
  - Regular or polyethylene Tyvek coveralls
  - Safety work shoes
  - Neoprene or rubber overboots or equivalent.
  - Neoprene or nitrile gloves with PVC or vinyl inner gloves or equivalent.
  - Chemical safety goggles (as specified by the ES&HC)

- **Construction Attire (C.A.)**

[Note: It may be necessary to modify construction attire to meet radiological requirements for PPE.]

  - Hard hat
  - Sturdy /substantial work shoes
  - Long pants
    Sleeved shirt
    Cotton or leather work gloves (as needed)

All PPE used during the course of this fan removal activity must meet the following applicable BNL ES&H standards. PPE requirements shall be specified in the applicable WP and RWP.

Table 7-1
Level of Personal Protective Equipment[1]

Activity	A	B	C	D	E	F	G	H	I	J	K	Level of protection[1]	Possible upgrade
1	X	X									X	C.A.	N/A
2	X	X									X	C.A.	D
3	X	X		X	X	X	X	X	X	X	X	C.A → C	C
4	X	X		X	X		X	X	X	X	X	C.A → C.	C
5	X	X		X	X		X	X	X	X	X	C.A → C.	C
6	X	X		X	X		X	X	X	X	X	C.A.→ C	C
7	X	X	X	X	X		X	X	X	X		C.A.→ C	C
8	X	X		X	X		X		X	X	X	C.A.	C
9	X	X		X	X					X	X	C.A.	C

[1]Radiologically mandated PPE as specified in the RWP for any of the activities supercedes the level of protection as listed in Table 7-1.

Key: A physical injury hazard
B overhead/underground utility hazard
C fire/explosion hazard
D noise hazard
E contact with contaminated soil hazard
F contact with contaminated water hazard
G inhalation hazard
H ingestion hazard
I skin contact hazard
J heat/cold stress hazard
K traffic hazard

Note: Activities are from Table 1-1

8.0 EMERGENCY RESPONSE

Emergency response and notification procedures are specified in BGRR-D HASP Section 18.0, "Emergency Management."

8.1 EMERGENCY CONTACTS

First Aid/Medical Assistance **2222 or 911 or 344-2222 cellular**

	Voice	Pager
Project Manager (Stephen Pulsford)	516-344-2394	554-7028
Project ES&H Manager (Steve Musolino)	516-344-4211	344-4174
Construction Manager (Hank Bachner)	516-344-8246	554-4062
ES&H Coordinator (Reggie Suga)	516-344-8248	554-4313
Facility Manager (Kevin Corbett)	516-344-2431	554-3923
DOE BGRR Project Manager (James Goodenough)	516-344-2423	
DOE Facility Representative for BGRR (Maria Dikeakos)	516-344-3950	

Preliminary MEDICAL CARE is provided through BNL Medical Department.

9.0 ENVIRONMEANTAL PROTECTION, WASTE MANAGEMENT AND POLLUTION PREVENTION

BGRR project management, DOE, and BNL are committed to safety and protection of the environment, community, and employees in the conduct of operations. In order to meet that goal, potential air emissions were assessed to determine if additional air monitoring was required to support the task before the removal of pile fans. Additional air monitoring measures are not required for this task

No liquid effluent is anticipated for this task. However, if any liquid is encountered during the pile fan removal, it shall be collected in containers, as noted below, to ensure liquids are not released to the environment.

Each fan removal activity is anticipated to generate approximately 2,000 cubic feet of LLW fan metals and 150 cubic feet of LLW debris. No liquids, hazardous or radioactive mixed waste are anticipated during this project. Generated wastes shall be managed, stored, packaged and transported in compliance with all applicable laws and regulations in addition to DOE Orders.

Each generated waste stream shall be characterized to meet requirements specified in DOE Order 435.1, the BNL SBMS Subject Area for "Radioactive Waste Management," the disposal facilities acceptance criteria and the BGRR Sampling and Analysis Plan. Waste handling, packaging and labeling activities shall be performed using existing BNL procedures including the completion of control forms and associated documentation.

Due to the volume and dimensions of the waste to be generated during fan removal activities, subcontractors shall be used when practical for waste transportation and treatment. However, existing BNL Waste Management contracts shall be used for the final disposition of the waste materials.

Waste minimization strategies shall be employed through each step of the waste management process. All waste handlers shall be briefed on waste management requirements during the pre-job safety briefing.

APPENDIX A

RECOMMENDED EQUIPMENT LIST

This is a recommended equipment list for any HAZWOPER activity. Additional PPE may be added for task specific activities.

Full facepiece respirators
GMC-H cartridges
Respirator cleaner/sanitizer
Respirator cleaning basins
Soft bristle cleaning brushes
Rinse basins
Clean storage bags, ziploc
Faceshields
Uncoated Tyvek disposal coveralls
Neoprene overboots
Nitrile outer gloves
Vinyl inner gloves
Outer cotton gloves
Leather work gloves
Goggles
Safety glasses
Ear plugs
Hard hats w/face shield assembly
Rain suits
Orange safety vests
Backbelts
Air horns
First aid kits
PID analyzer w/calibration gases
Cal gas 37 ft^3 100 ppm methane
Lab packs

Electrolyte replenishment fluid (e.g., Gatorade)
Eye wash solution
Eye wash bottles
Traffic cones (orange)
Duct tape
2-way radios
Insect repellent
Fire extinguisher - 5 lb ABC
Fire extinguisher - 20 lb ABC
Safety barrier tape
Step Off Pad
Yellow and Magenta Rope
Tygon tubing
Smoke tubes for respirator fit testing
Bloodborne pathogen waste container/signs
Lockout/Tagout equipment
Stretchers
55-gal drums (2)
10 mil plastic trash bags
12 in. × 12 in. plastic bags
Wind sock with pole
4 gas monitor (LEL, O_2, CO, H2S) w/calibration gases
Personal sampling pumps
Personal Sampling pump calibrator
Sampling filters and cassettes
Sound level meter/dosimeter with calibrator
Hazardous waste site postings signs
Eye wash bottles and replacement fluid

PHOTO NO. 1

FAN NO. 5 SUCTION VALVE OPERATOR

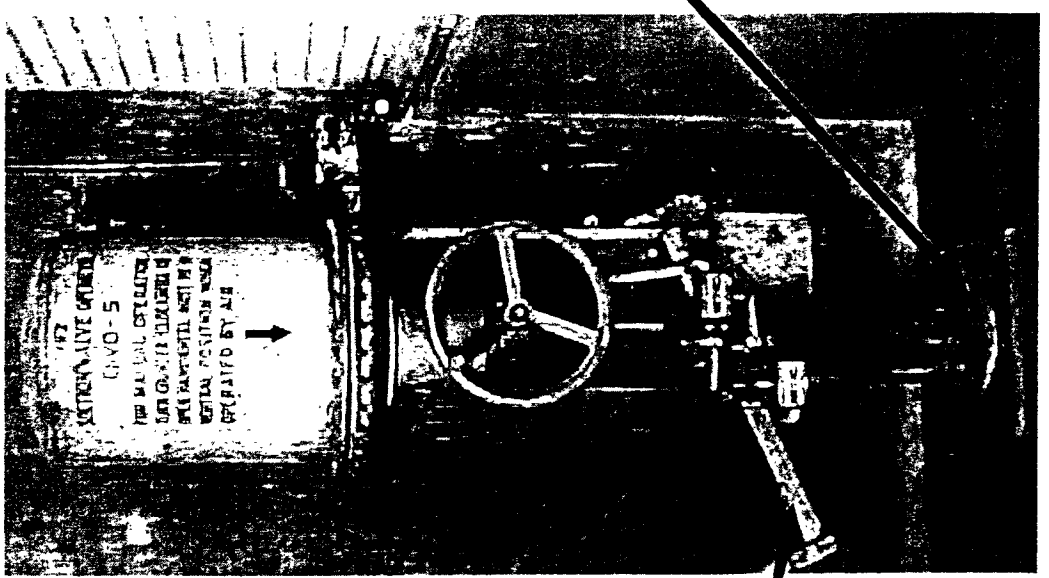


PHOTO NO. 2

FAN NO. 5 CASING DRAIN MANIFOLD

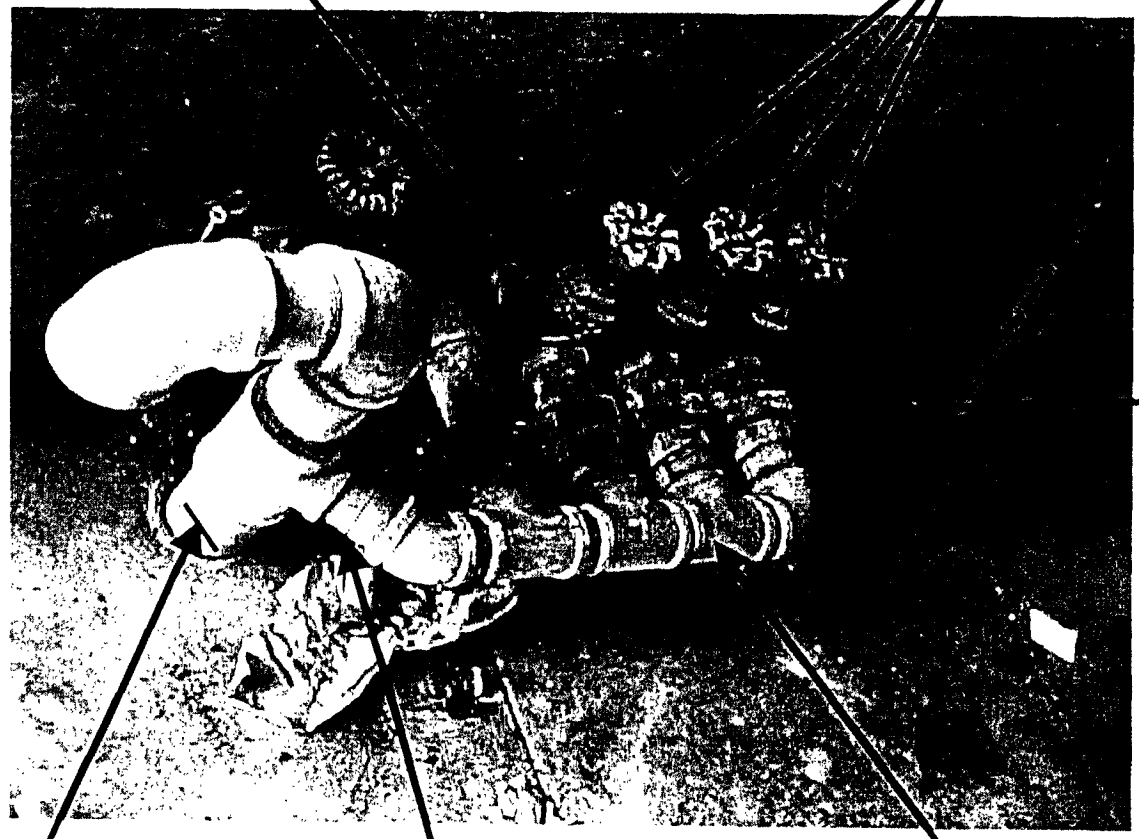


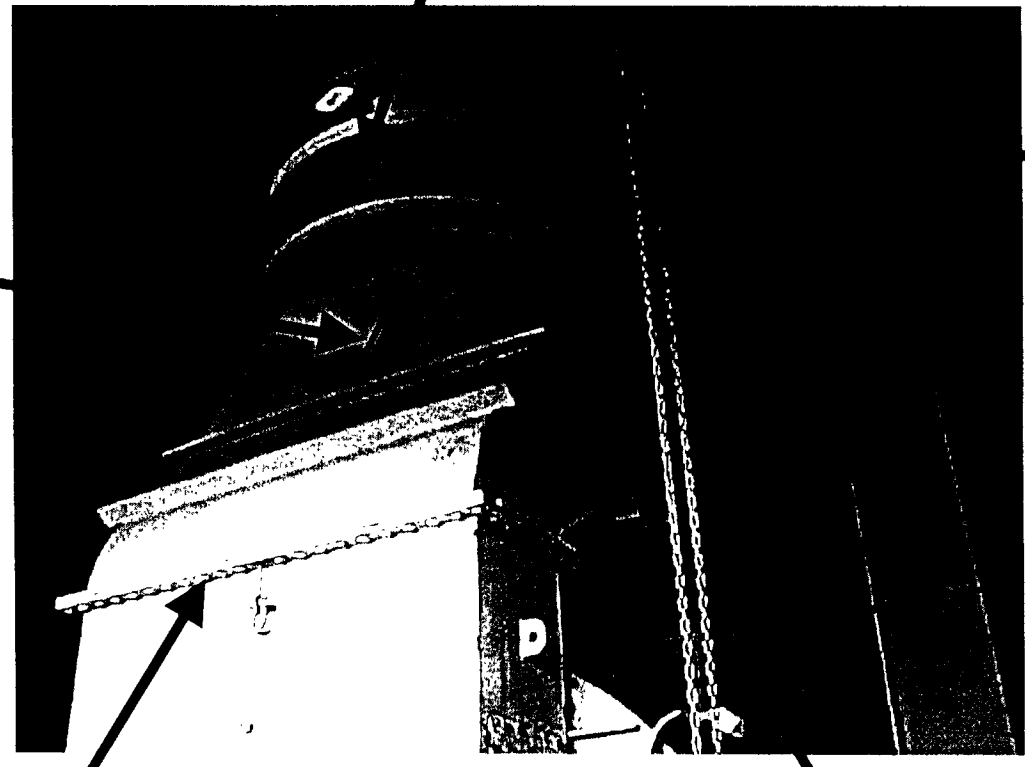
PHOTO NO. 3

SUCTION BELLOWS & VOLUTE ASSEMBLY

DRILL OR PUNCH 1/4" HOLES THRU BELLOWS TO INJECT PBS

SAWCUT OUT BELLOWS HERE TO REMOVE ASSY

REMOVE INLET VOLUTE ASSY



INSERT SHEET METAL FLANGE ISOLATION COVERS BOTH SIDES UPSTREAM & DOWNSTREAM

PHOTO NO. 4

DISCHARGE BELLOWS & FLANGE

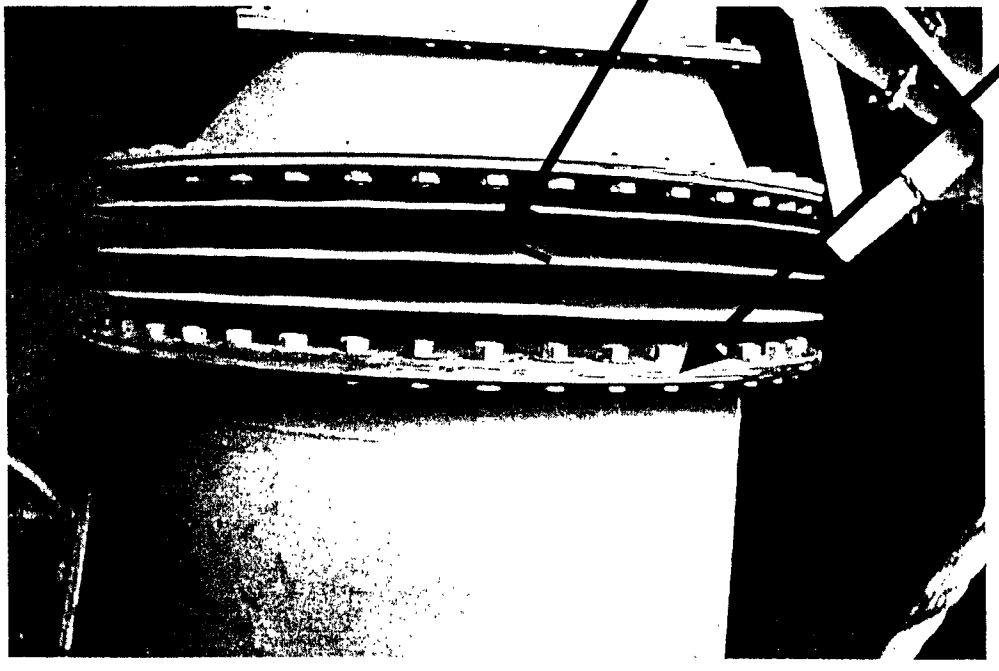
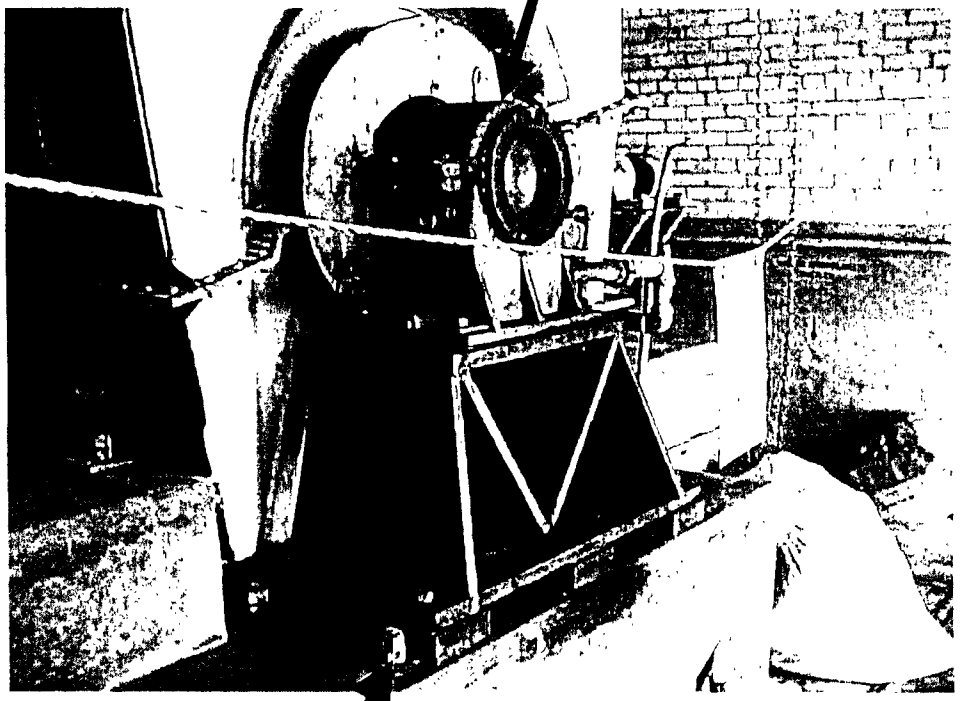


PHOTO NO. 5

OUTBOARD BEARING PEDEATAL

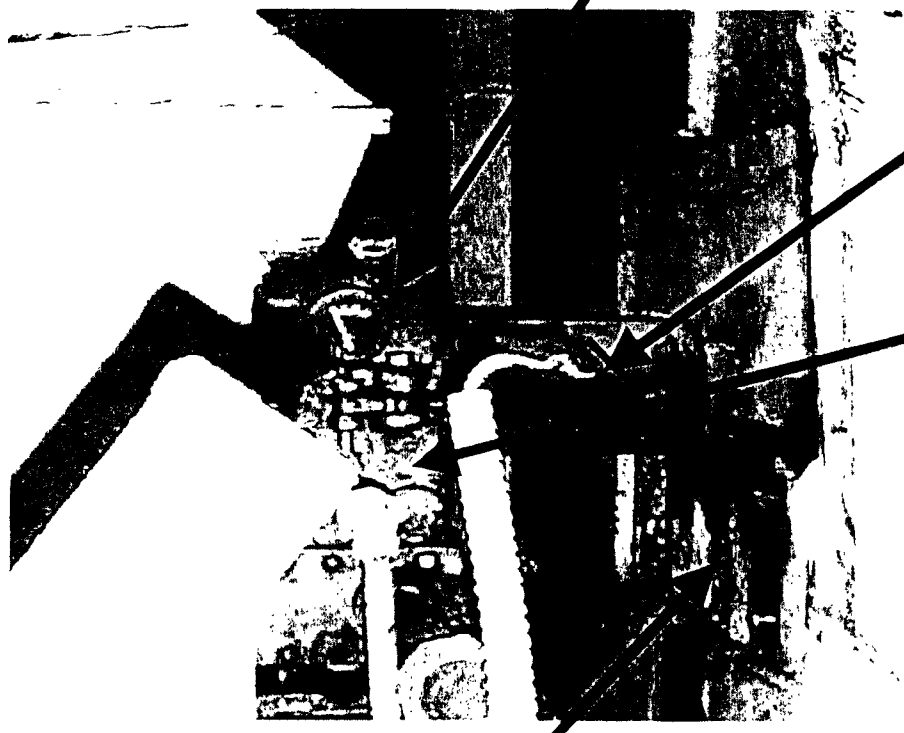
REMOVE UPPER HALF OF PILLOW BLOCK



REMOVE FASTENERS FROM OUTBOARD PEDESTAL
& REMOVE PEDESTAL & PILLOW BLOCK AS ONE ASSEMBLY

PHOTO NO. 6

INBOARD PEDESTAL AND SHAFT



REMOVE UPPER HALF OF PILLOW BLOCK

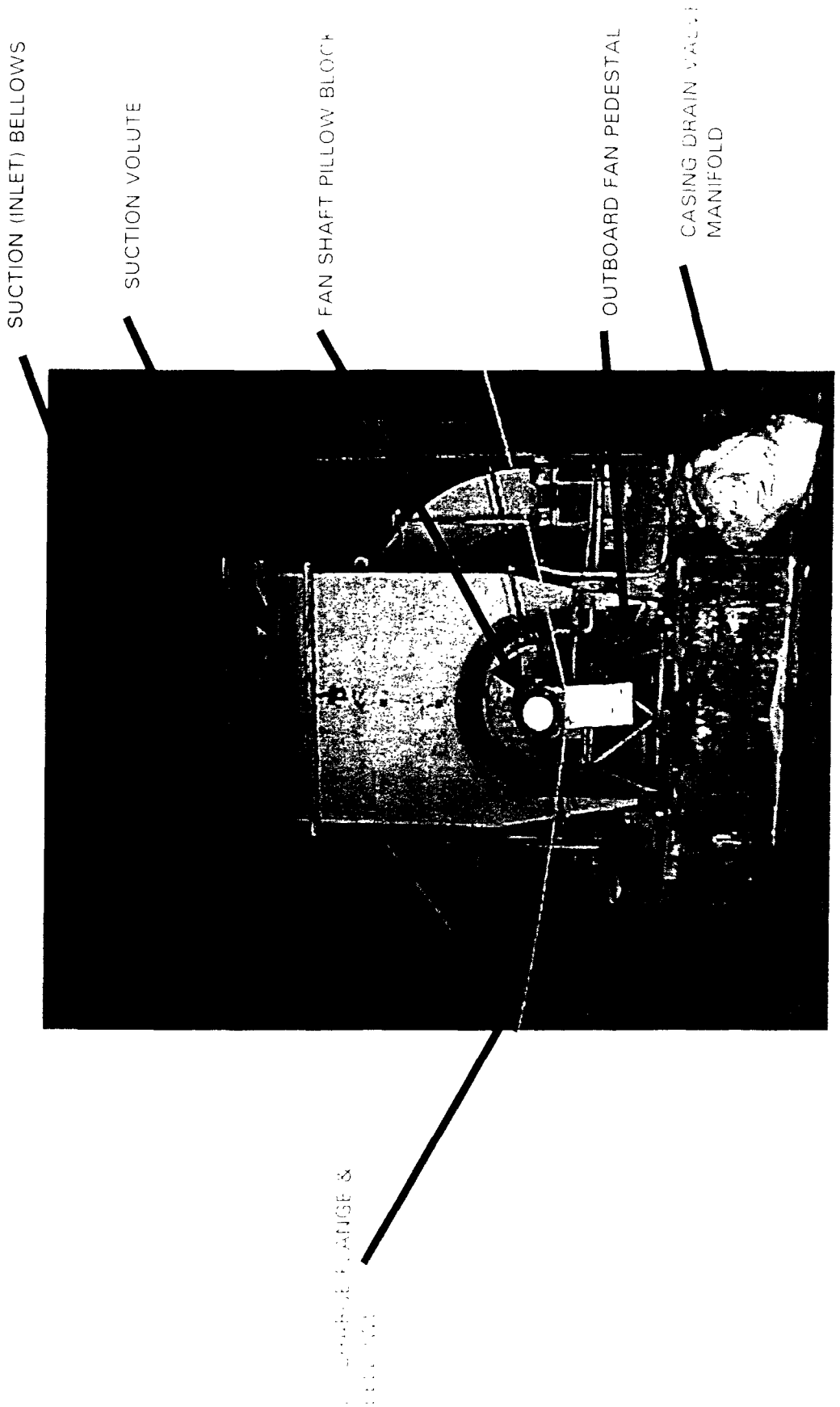
CUT SHAFT AS REQ'D

REMOVE LOWER PILLOW BLOCK & PEDESTAL AS ONE ASSEMBLY AFTER FAN HAS BEEN REMOVED

REMOVE SHAFT PENETRATION SPLIT PLATE OPPOSITE SIDE OF WALL IN MOTOR ROOM

PHOTO NO. 7

OUTBOARD VIEW - FAN NO. 5



TECHNICAL WORK DOCUMENT

PILE FAN NO. 5 REMOVAL

September 20, 1999

Prepared By:	**BGRR Field Engineer**	**Date:** 9/20/99
Reviewed By:	**BGRR Project Engineer**	**Date:** 9/20/99
Reviewed By:	**HFBR Operations**	**Date:** 9/20/99
Approved By:	**BGRR ES&H Manager**	**Date:** 9/22/99
Approved By:	**BGRR Project Manager**	**Date:** 9/22/99

TECHNICAL WORK DOCUMENT
PILE FAN NO. 5 REMOVAL

1.0 PURPOSE

1.1 To provide the detailed work instructions for the removal of the No. 5 Pile Fan.

2.0 SCOPE

2.1 This document covers work activities associated with the removal of No. 5 Pile Fan including, but not limited to, necessary preparation and setup, and removal of interferences.

3.0 RESPONSIBILITIES

3.1 The BGRR Field Engineer or designee is responsible for the proper execution of this Work Document.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 This document is a TEMPORARY procedure valid only for the specific work activities involved in the removal of No. 5 Pile fan, and may only be implemented in conjunction with an approved Work Permit and Radiation Work Permit.

4.2 The fan internal surfaces are contaminated with radionuclides such as Co-60, Cs-137, Am-241, Pu-239 and others. Before internal surfaces are exposed, Polymeric Barrier System (PBS) material shall be applied internally to minimize re-suspension of particulate activity.

4.3 The fan discharge valve is in the closed position and shall remain throughout all work activities. This valve is an HFBR confinement isolation valve.

5.0 PREREQUISITES

5.1 Sheet metal flange isolation covers for the fan inlet and outlets have been fabricated and are available on the job location.

Initial: _____ Date: _____

5.2 The Task-specific Environmental, Health and Safety Plan (TEHASP) for this work activity has been approved and reviewed by all personnel involved with these work activities.

Initial: _____ Date: _____

5.3 A Radiation Work Permit (RWP) has been issued for theses work activities.

Initial: _____ Date: _____ RWP No:_____

5.4 Verify the oil has been drained from the fan bearing assemblies.

Initial: _____ Date: _____

5.5 Obtain permission from HFBR Operations to perform work in the Fanhouse motor room.

Initial: _____ Date: _____

6.0 WORK INSTRUCTIONS

NOTE: Attachment 8.1 contains pictorial outline of the following work activities.

6.1 Disconnect and remove the fan suction valve operator in its entirety and secure the valve in the closed position.

6.2 Remove the bonnets from the (3) fan housing drain valves, break the (3) downstream unions, saw cut the 2" pipe that penetrates the floor, then remove the entire piping assembly between the unions and the sawcut.

6.3 Disconnect and remove the remaining piping downstream of the sawcut to where the 3" drain pipe penetrates the floor, and install a 3" threaded pipe cap on the 3" line.

6.4 Unscrew and remove the (3) fan drain pipes; remove any bearing cooling water lines.

6.5 Disconnect and remove the fan inlet volute as follows:

6.5.1 Punch holes (approx. 1/4" dia.) around the circumference of the bellows to allow insertion of the PBS injection nozzle.

6.5.2 Inject Polymeric Barrier Spray (PBS) into the above holes to fix internal loose contamination.

6.5.3 Remove the lower inlet volute flange bolts, leaving a minimum of (2) to stabilize joint until the glove is placed around the joint in the next step.

6.5.4 Place a glove bag around the joint, then remove the remaining flange bolts.

NOTE: Prior to commencing the following step, the sheet metal flange isolation covers should be readily accessible for immediate installation.

6.5.5 Using a c-clamp or flange spreader, or chain fall CAREFULLY spread the (2) inlet volute flanges from the fan inlet approx. 1", then immediately insert the sheet metal pipe covers to isolate the fan inlet; secure the covers by bending over the retaining tabs.

6.5.6 Setup plastic catch pockets around the circumference of the inlet bellows to collect any saw filings.

NOTE: Prior to commencing the following step a rad vacuum cleaner shall be ready to collect saw filings during the cutting operation.

6.5.7 Using a reciprocating saw or equivalent tool, cut the bellows around the circumference while using the rad vacuum cleaner nozzle to minimize the saw filings falling into the plastic catch.

6.5.8 Install a plastic cover ("Herculite" or eq.) over the open end of the inlet flange.

6.5.9 Remove the remaining portion of the bellows and the inlet volute assembly using the overhead monorail and approved rigging.

6.6 Disconnect the fan discharge bellows as follows:

6.6.1 Punch hole (approx. 1/4" dia.) around the circumference of the bellows to allow insertion of the PBS injection nozzle.

6.6.2 Inject Polymeric Barrier Spray (PBS) into the above holes to fix internal loose contamination.

6.6.3 Remove the downstream flange bolts, leaving a minimum of (4) to stabilize joint until the glove is placed around the joint in the next step.

6.6.4 Place a glove bag around the joint, then remove the remaining flange bolts.

NOTE: Prior to commencing the following step, the sheet metal flange isolation covers should be readily accessible for immediate installation.

6.6.3 Using a c-clamp or flange spreader, CAREFULLY spread the downstream bellows flange and insert sheet metal pipe covers on both sides of the spread flange (upstream & downstream). Secure the covers by bending over the retaining tabs.

6.7 Prepare the fan for lifting from its pedestal as follows:

CAUTION: **The following steps 6.7.1, 2, 3 will be performed in the motor room. A comprehensive radiological survey of the fan shaft wall penetration split cover should be performed and necessary precautions shall be taken to prevent any cross-contamination of the motor room.**

6.7.1 Disconnect/remove motor coupling.

6.7.2 Remove the fan shaft penetration split cover plate.

6.7.3 Place a plastic barrier (glove bag) over the opening in the motor room side of the wall.

6.7.4 Remove the inboard and outboard fan shaft upper bearing blocks.

6.7.5 Using approved rigging techniques, lift the fan from the pillow blocks until the fan assembly is not bearing on the lower pillow block (1" - 2").

6.7.6 Remove the fasteners holding the outboard fan pedestal to the concrete foundation (the inboard pedestal will be removed later).

6.7.7 Remove the outboard fan pedestal.

6. 8 Lift the fan until the lower housing is clear of the concrete foundation.

NOTE: The following step is performed to permit safe access to the piping nipples and elbows installed in bottom of the fan casing.

6.9 Install cribbing beneath the fan then lower fan onto cribbing.

6.10 Remove the (3) drain nipples and elbows from the bottom of the fan casing and install threaded pipe plugs.

6.11 Lift fan and remove the cribbing installed above.

6.12 Rig (i.e. rotate and move as necessary) the fan into position to access the inboard fan shaft.

NOTE: The BGRR Field Engineer will determine the exact location of the cut in the following step.

NOTE: The following step will involve the use of a flame-cutting torch.

6.10 Setup the area around the fan shaft to protect adjacent and nearby surfaces from cutting slag and splatter (i.e. fire blankets, metal collection drum) in accordance with the burning permit.

6.11 Cut the fan shaft to achieve an overall maximum shaft length of less than 7'-11" to allow the fan assembly to fit in the shipping container.

6.12 Place the fan and all removed assemblies into proper containers for removal.

6.13 Remove the inboard bearing block/pedestal.

6.14 Install a solid cover plate over plate (without shaft hole) in place of the split cover plate removed in step 6.7.2.

6.15 Clean and decontaminate the fan room to best achievable levels and survey for final documentation.

REFERENCES

7.1 DWG. C-704-3A, BLDG. NO. 704 - FLOOR PLAN & SECTIONS

7.2 DWG. M-704-1X, 1500 HP MOTOR DRIVEN COMPRESSOR - GENERAL ARRANGEMENT OF TYP. FAN CUBICLE

7.3 DWG. M-704-2A, TYPICAL FAN CELL - PARTITION & WALL DETAILS

7.0 ATTACHMENTS

8.1 Pictorial Outline of Pile Fan No. 5 Work Activities

TECHNICAL WORK DOCUMENT
PILE FAN NO. 5 REMOVAL

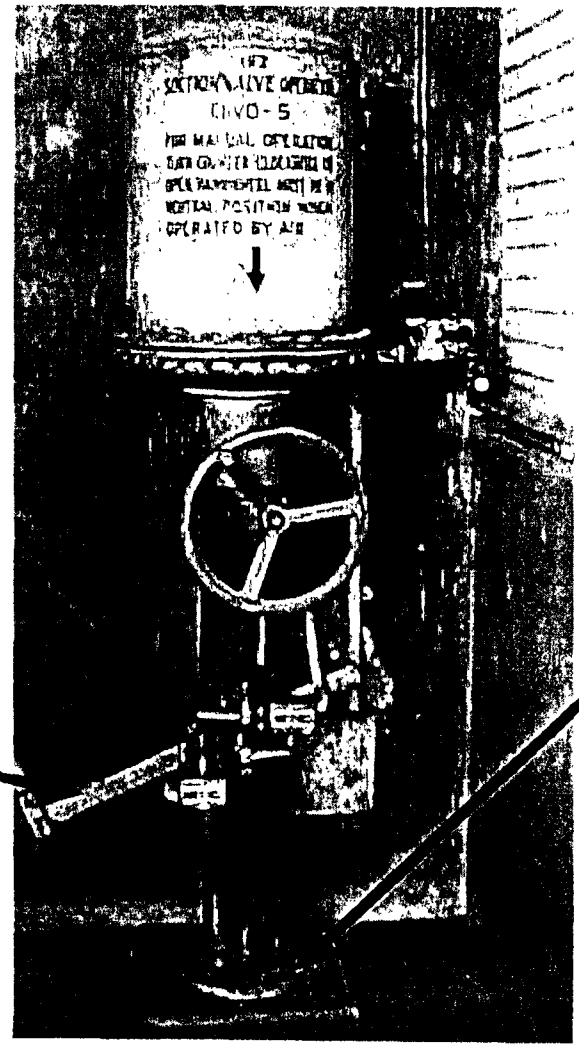
Attachment 8.1

Pictorial Outline of Pile Fan No. 5 Work Activities

1. Photo 1 - Fan No. 5 Suction Valve Operator
2. Photo 2 - Fan No. 5 Casing Drain Valve Manifold
3. Photo 3 - Suction Bellows/Volute Assembly
4. Photo 4 - Discharge Bellows & Flange
5. Photo 5 - Outboard Bearing Pedestal
6. Photo 6 - Inboard Bearing Pedestal and Shaft
7. Photo 7 - Outboard View, Fan No. 5

PHOTO NO. 1

FAN NO. 5 SUCTION VALVE OPERATOR



DISCONNECT LINKAGE FROM MOTOR OPERATOR & VALVE

UNBOLT OPERATOR & REMOVE IN ITS ENTIRETY

PHOTO NO. 2

FAN NO. 5 CASING
DRAIN MANIFOLD

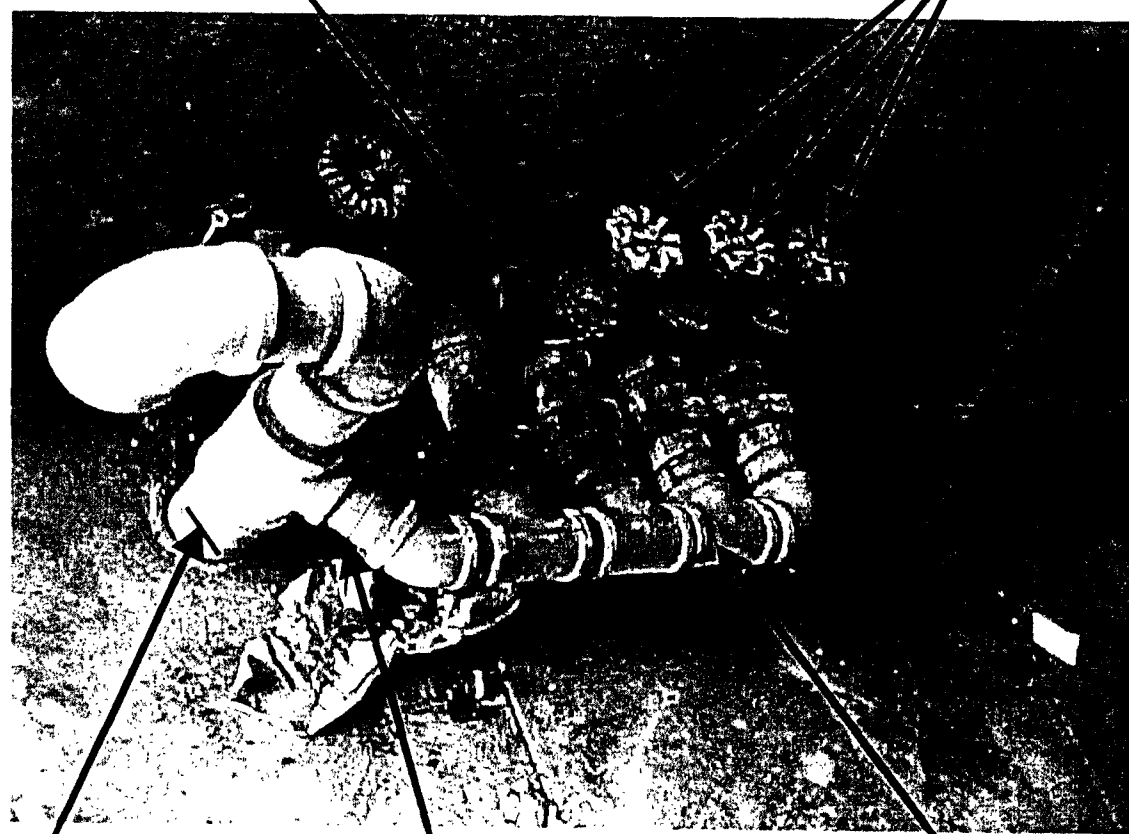
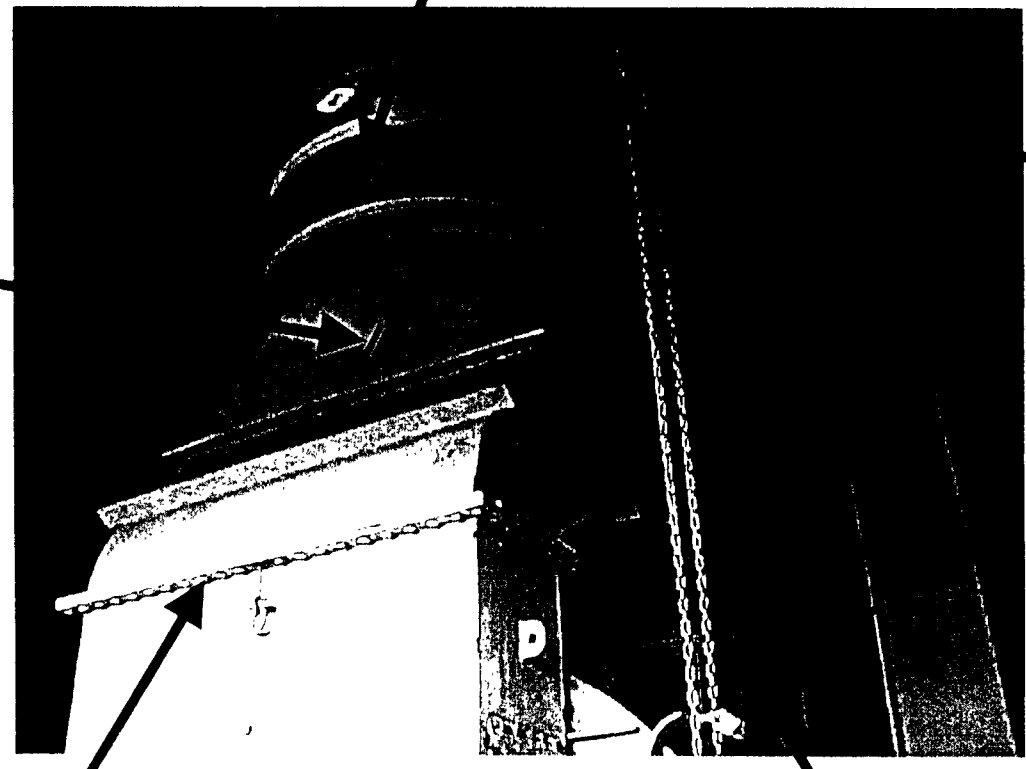


PHOTO NO. 3

SUCTION BELLOWS & VOLUTE ASSEMBLY

DRILL OR PUNCH 1/4" HOLES THRU
BELLOWS TO INJECT PBS



SAWCUT CUT BELLOWS
HERE TO REMOVE ASSY

REMOVE INLET
VOLUTE ASSY

INSERT SHEET METAL FLANGE
ISOLATION COVERS BOTH SIDES
UPSTREAM & DOWNSTREAM

PHOTO NO. 4

DISCHARGE BELLOWS & FLANGE

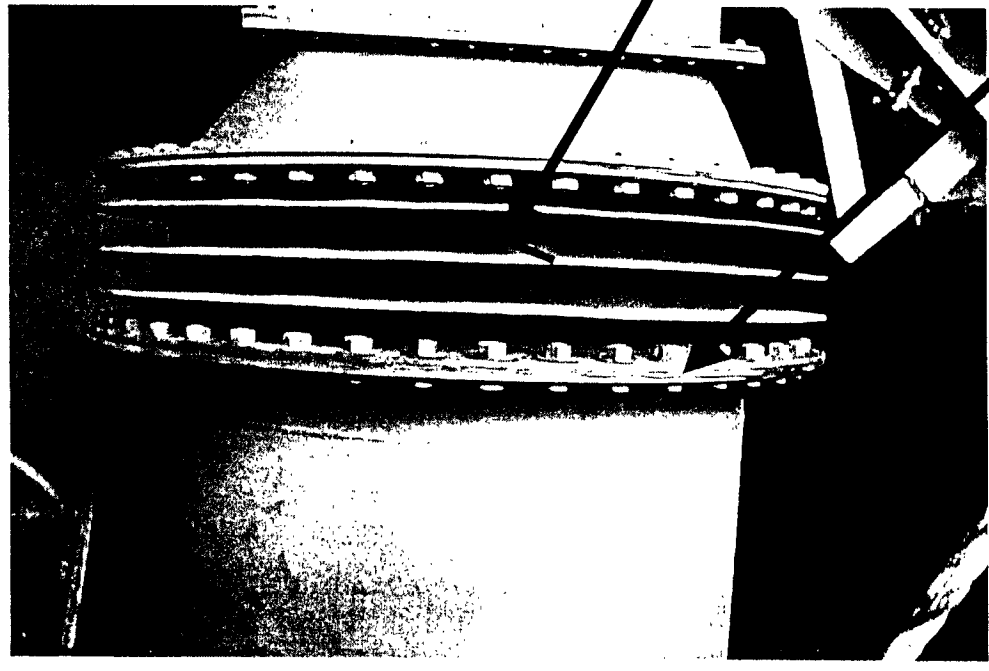


PHOTO NO. 5

OUTBOARD BEARING PEDEATAL

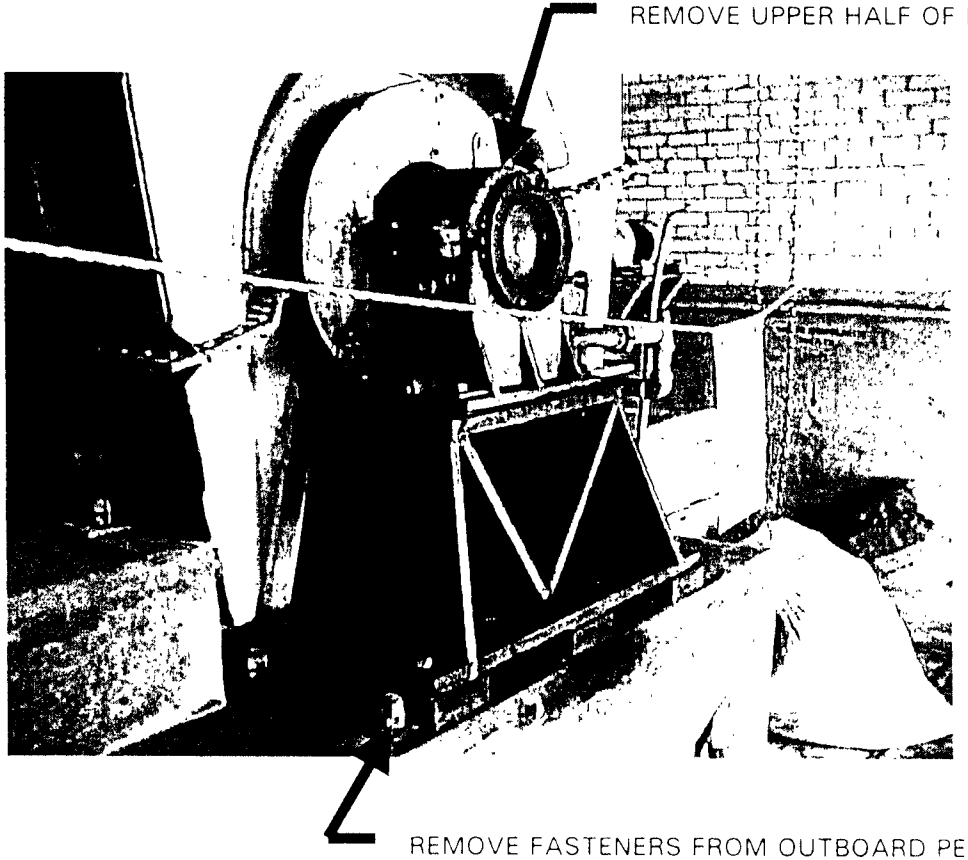


PHOTO NO. 6
INBOARD PEDESTAL AND SHAFT

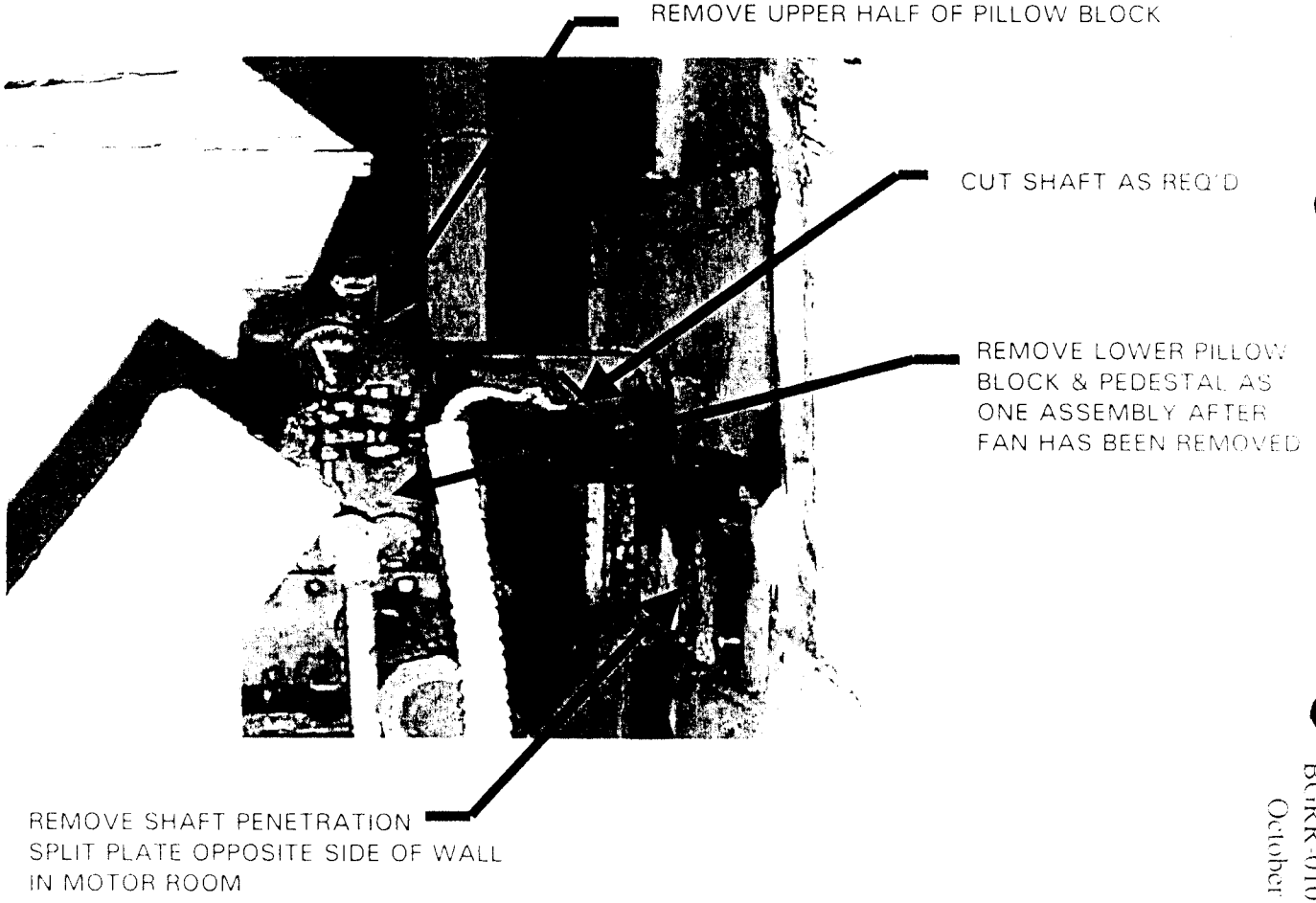
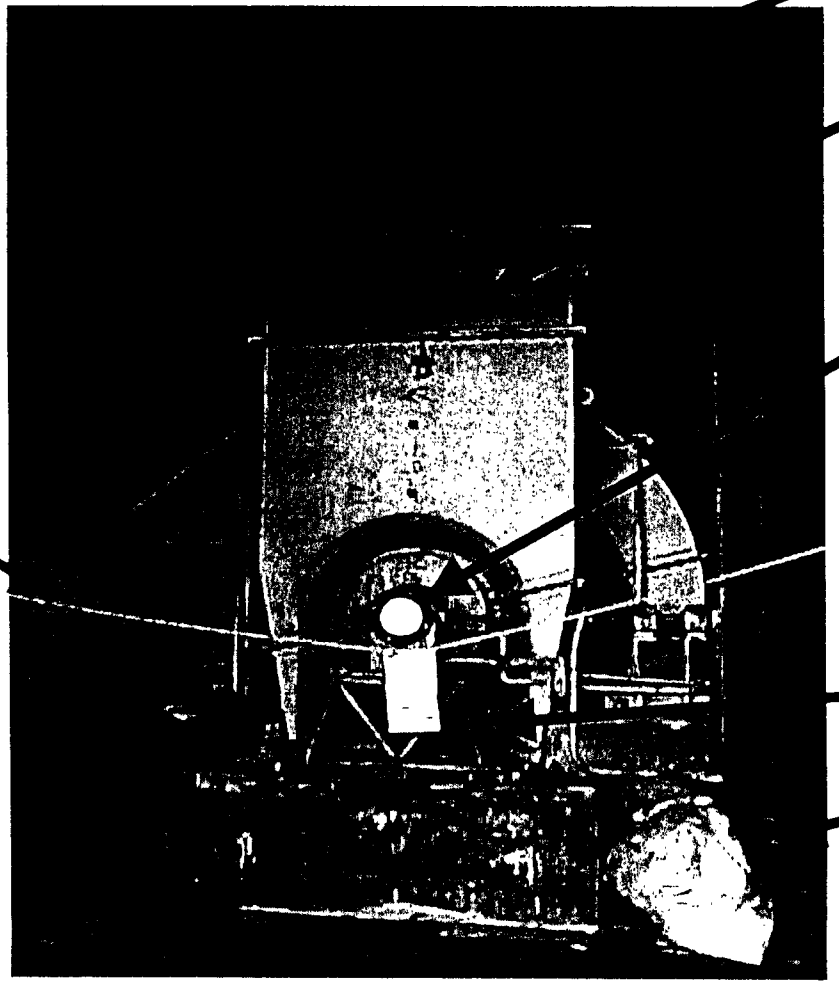


PHOTO NO. 7

OUTBOARD VIEW - FAN NO. 5



TECHNICAL WORK DOCUMENT

PILE FAN NO. 5 REMOVAL

September 20, 1999

Prepared By: _____ **Date:** 9/20/99
BGRR Field Engineer

Reviewed By: _____ **Date:** 9/20/99
BGRR Project Engineer

Reviewed By: _____ **Date:** 9/20/99
HFBR Operations

Approved By: _____ **Date:** 9/22/99
BGRR ES&H Manager

Approved By: _____ **Date:** 9/22/99
BGRR Project Manager

TECHNICAL WORK DOCUMENT
PILE FAN NO. 5 REMOVAL

1.0 PURPOSE

1.1 To provide the detailed work instructions for the removal of the No. 5 Pile Fan.

2.0 SCOPE

2.1 This document covers work activities associated with the removal of No. 5 Pile Fan including, but not limited to, necessary preparation and setup, and removal of interferences.

3.0 RESPONSIBILITIES

3.1 The BGRR Field Engineer or designee is responsible for the proper execution of this Work Document.

4.0 PRECAUTIONS AND LIMITATIONS

4.1 This document is a TEMPORARY procedure valid only for the specific work activities involved in the removal of No. 5 Pile fan, and may only be implemented in conjunction with an approved Work Permit and Radiation Work Permit.

4.2 The fan internal surfaces are contaminated with radionuclides such as Co-60, Cs-137, Am-241, Pu-239 and others. Before internal surfaces are exposed, Polymeric Barrier System (PBS) material shall be applied internally to minimize re-suspension of particulate activity.

4.3 The fan discharge valve is in the closed position and shall remain throughout all work activities. This valve is an HFBR confinement isolation valve.

5.0 PREREQUISITES

5.1 Sheet metal flange isolation covers for the fan inlet and outlets have been fabricated and are available on the job location.

Initial: _____ Date: _____

5.2 The Task-specific Environmental, Health and Safety Plan (TEHASP) for this work activity has been approved and reviewed by all personnel involved with these work activities.

Initial: _____ Date: _____

5.3 A Radiation Work Permit (RWP) has been issued for theses work activities.

Initial: _____ Date: _____ RWP No:_____

5.4 Verify the oil has been drained from the fan bearing assemblies.

Initial: _____ Date: _____

5.5 Obtain permission from HFBR Operations to perform work in the Fanhouse motor room.

Initial: _____ Date: _____

6.0 WORK INSTRUCTIONS

NOTE: Attachment 8.1 contains pictorial outline of the following work activities.

6.1 Disconnect and remove the fan suction valve operator in its entirety and secure the valve in the closed position.

6.2 Remove the bonnets from the (3) fan housing drain valves, break the (3) downstream unions, saw cut the 2" pipe that penetrates the floor, then remove the entire piping assembly between the unions and the sawcut.

6.3 Disconnect and remove the remaining piping downstream of the sawcut to where the 3" drain pipe penetrates the floor, and install a 3" threaded pipe cap on the 3" line.

6.4 Unscrew and remove the (3) fan drain pipes; remove any bearing cooling water lines.

6.5 Disconnect and remove the fan inlet volute as follows:

6.5.1 Punch holes (approx. 1/4" dia.) around the circumference of the bellows to allow insertion of the PBS injection nozzle.

6.5.2 Inject Polymeric Barrier Spray (PBS) into the above holes to fix internal loose contamination.

6.5.3 Remove the lower inlet volute flange bolts, leaving a minimum of (2) to stabilize joint until the glove is placed around the joint in the next step.

6.5.4 Place a glove bag around the joint, then remove the remaining flange bolts.

NOTE: Prior to commencing the following step, the sheet metal flange isolation covers should be readily accessible for immediate installation.

6.5.5 Using a c-clamp or flange spreader, or chain fall CAREFULLY spread the (2) inlet volute flanges from the fan inlet approx. 1", then immediately insert the sheet metal pipe covers to isolate the fan inlet; secure the covers by bending over the retaining tabs.

6.5.6 Setup plastic catch pockets around the circumference of the inlet bellows to collect any saw filings.

NOTE: Prior to commencing the following step a rad vacuum cleaner shall be ready to collect saw filings during the cutting operation.

6.5.7 Using a reciprocating saw or equivalent tool, cut the bellows around the circumference while using the rad vacuum cleaner nozzle to minimize the saw filings falling into the plastic catch.

6.5.8 Install a plastic cover ("Herculite" or eq.) over the open end of the inlet flange.

6.5.9 Remove the remaining portion of the bellows and the inlet volute assembly using the overhead monorail and approved rigging.

6.6 Disconnect the fan discharge bellows as follows:

6.6.1 Punch hole (approx. 1/4" dia.) around the circumference of the bellows to allow insertion of the PBS injection nozzle.

6.6.2 Inject Polymeric Barrier Spray (PBS) into the above holes to fix internal loose contamination.

6.6.3 Remove the downstream flange bolts, leaving a minimum of (4) to stabilize joint until the glove is placed around the joint in the next step.

6.6.4 Place a glove bag around the joint, then remove the remaining flange bolts.

NOTE: Prior to commencing the following step, the sheet metal flange isolation covers should be readily accessible for immediate installation.

6.6.3 Using a c-clamp or flange spreader, CAREFULLY spread the downstream bellows flange and insert sheet metal pipe covers on both sides of the spread flange (upstream & downstream). Secure the covers by bending over the retaining tabs.

6.7 Prepare the fan for lifting from its pedestal as follows:

CAUTION: The following steps 6.7.1, 2, 3 will be performed in the motor room. A comprehensive radiological survey of the fan shaft wall penetration split cover should be performed and necessary precautions shall be taken to prevent any cross-contamination of the motor room.

6.7.1 Disconnect/remove motor coupling.

6.7.2 Remove the fan shaft penetration split cover plate.

6.7.3 Place a plastic barrier (glove bag) over the opening in the motor room side of the wall.

6.7.4 Remove the inboard and outboard fan shaft upper bearing blocks.

6.7.5 Using approved rigging techniques, lift the fan from the pillow blocks until the fan assembly is not bearing on the lower pillow block (1" - 2").

6.7.6 Remove the fasteners holding the outboard fan pedestal to the concrete foundation (the inboard pedestal will be removed later).

6.7.7 Remove the outboard fan pedestal.

6. 8 Lift the fan until the lower housing is clear of the concrete foundation.

NOTE: The following step is performed to permit safe access to the piping nipples and elbows installed in bottom of the fan casing.

6.9 Install cribbing beneath the fan then lower fan onto cribbing.

6.10 Remove the (3) drain nipples and elbows from the bottom of the fan casing and install threaded pipe plugs.

6.11 Lift fan and remove the cribbing installed above.

6.12 Rig (i.e. rotate and move as necessary) the fan into position to access the inboard fan shaft.

NOTE: The BGRR Field Engineer will determine the exact location of the cut in the following step.

NOTE: The following step will involve the use of a flame-cutting torch.

6.10 Setup the area around the fan shaft to protect adjacent and nearby surfaces from cutting slag and splatter (i.e. fire blankets, metal collection drum) in accordance with the burning permit.

6.11 Cut the fan shaft to achieve an overall maximum shaft length of less than 7'-11" to allow the fan assembly to fit in the shipping container.

6.12 Place the fan and all removed assemblies into proper containers for removal.

6.13 Remove the inboard bearing block/pedestal.

6.14 Install a solid cover plate over plate (without shaft hole) in place of the split cover plate removed in step 6.7.2.

6.15 Clean and decontaminate the fan room to best achievable levels and survey for final documentation.

REFERENCES

7.1 DWG. C-704-3A, BLDG. NO. 704 - FLOOR PLAN & SECTIONS

7.2 DWG. M-704-1X, 1500 HP MOTOR DRIVEN COMPRESSOR - GENERAL ARRANGEMENT OF TYP. FAN CUBICLE

7.3 DWG. M-704-2A, TYPICAL FAN CELL - PARTITION & WALL DETAILS

7.0 ATTACHMENTS

8.1 Pictorial Outline of Pile Fan No. 5 Work Activities

TECHNICAL WORK DOCUMENT
PILE FAN NO. 5 REMOVAL

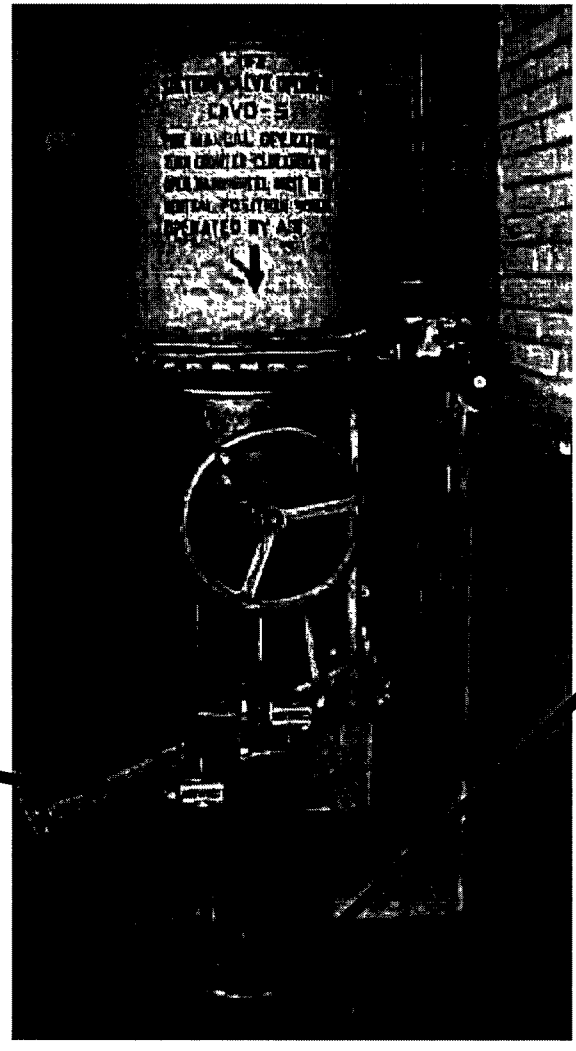
Attachment 8.1

Pictorial Outline of Pile Fan No. 5 Work Activities

1. Photo 1 - Fan No. 5 Suction Valve Operator
2. Photo 2 - Fan No. 5 Casing Drain Valve Manifold
3. Photo 3 - Suction Bellows/Volute Assembly
4. Photo 4 - Discharge Bellows & Flange
5. Photo 5 - Outboard Bearing Pedestal
6. Photo 6 - Inboard Bearing Pedestal and Shaft
7. Photo 7 - Outboard View, Fan No. 5

PHOTO NO. 1

FAN NO. 5 SUCTION VALVE OPERATOR



DISCONNECT LINKAGE FROM BOTH OPERATOR & VALVE

UNBOLT OPERATOR & REMOVE IN ITS ENTIRETY

PHOTO NO. 2

FAN NO. 5 CASING
DRAIN MANIFOLD

UNSCREW & REMOVE THE (3) DRAIN LINES AFTER REMOVAL OF THE MANIFOLD ASS'Y

REMOVE VALVE BONNETS

BREAK UNIONS

SAWCUT HERE

INSTALL THREADED CAP HERE

REMOVE MANIFOLD ASS'Y

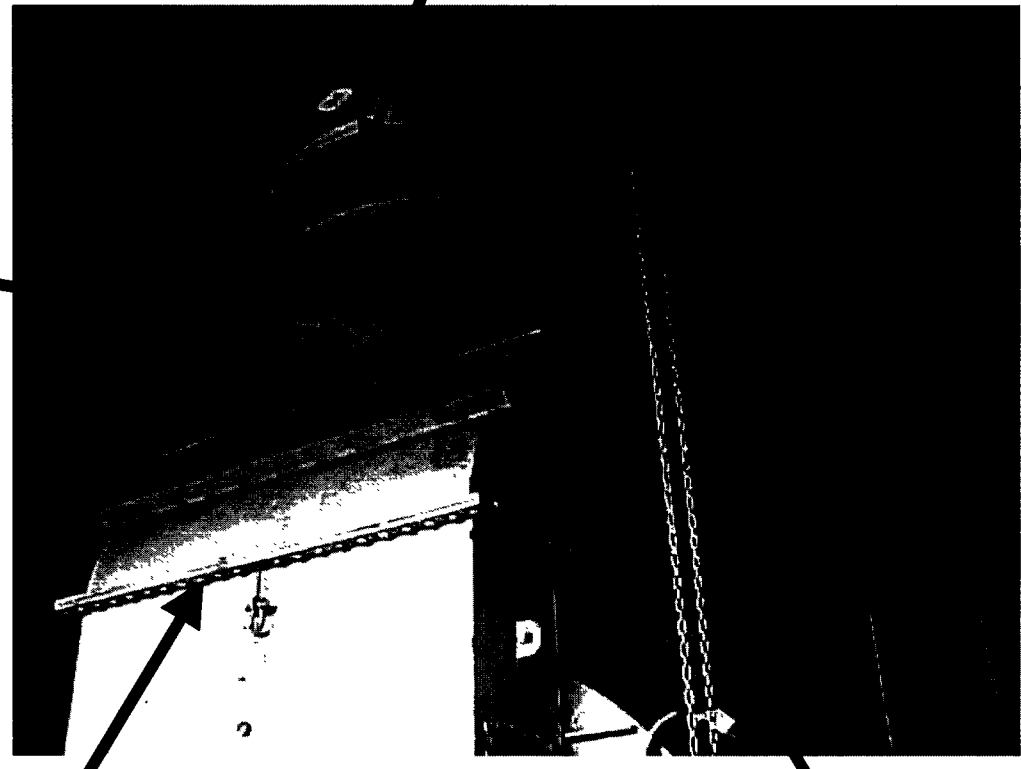
PHOTO NO. 3

SUCTION BELLOWS & VOLUTE ASSEMBLY

DRILL OR PUNCH 1/4" HOLES THRU BELLOWS TO INJECT PBS

SAWCUT CUT BELLOWS HERE TO REMOVE ASS'Y

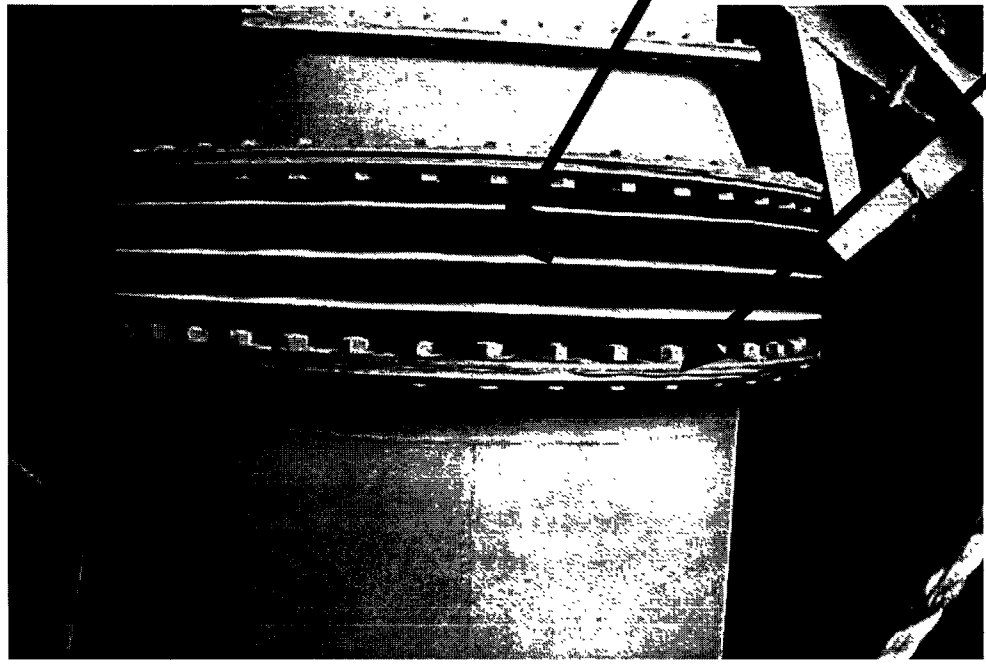
REMOVE INLET VOLUTE ASS'Y



INSERT SHEET METAL FLANGE ISOLATION COVERS BOTH SIDES UPSTREAM & DOWNSTREAM

PHOTO NO. 4

DISCHARGE BELLOWS & FLANGE

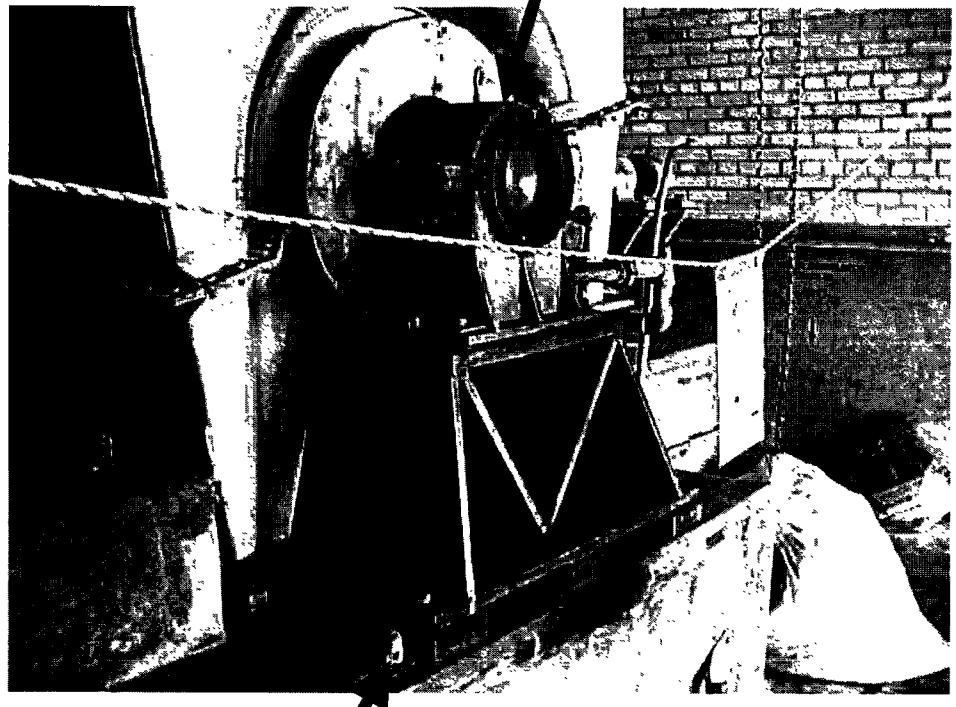


DRILL OR PUNCH 1/4" HOLES & INJECT PBS

SPREAD FLANGE HERE & INSERT SHEET METAL ISOLATION COVERS ON UPSTREAM & DOWN STREAM SIDES

PHOTO NO. 5
OUTBOARD BEARING PEDEATAL

REMOVE UPPER HALF OF PILLOW BLOCK



REMOVE FASTENERS FROM OUTBOARD PEDESTAL
& REMOVE PEDESTAL & PILLOW BLOCK AS ONE ASSEMBLY

PHOTO NO. 6
INBOARD PEDESTAL AND SHAFT

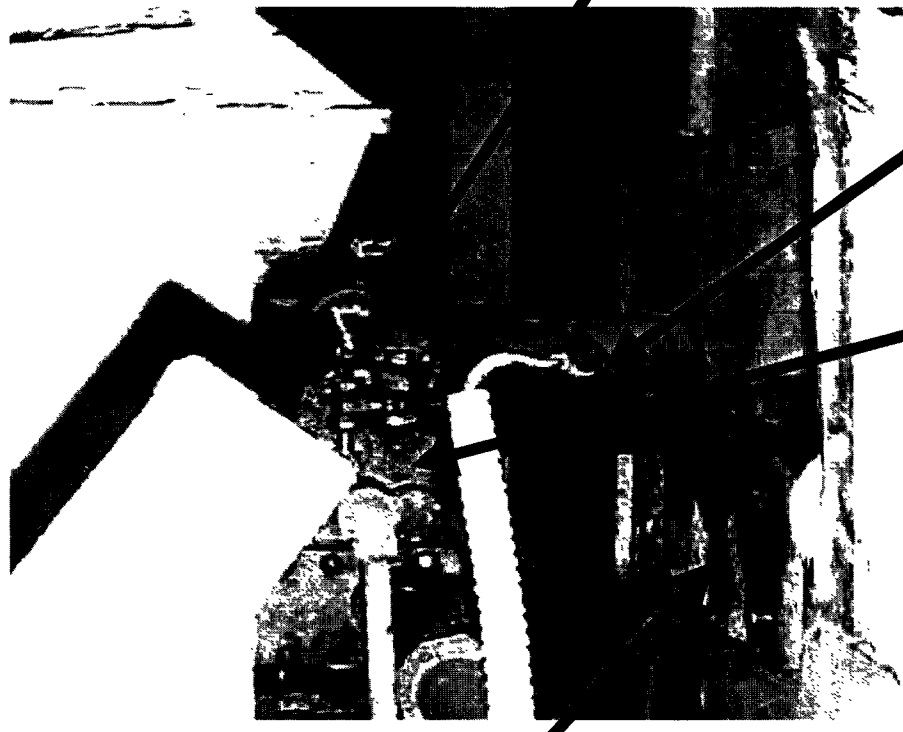
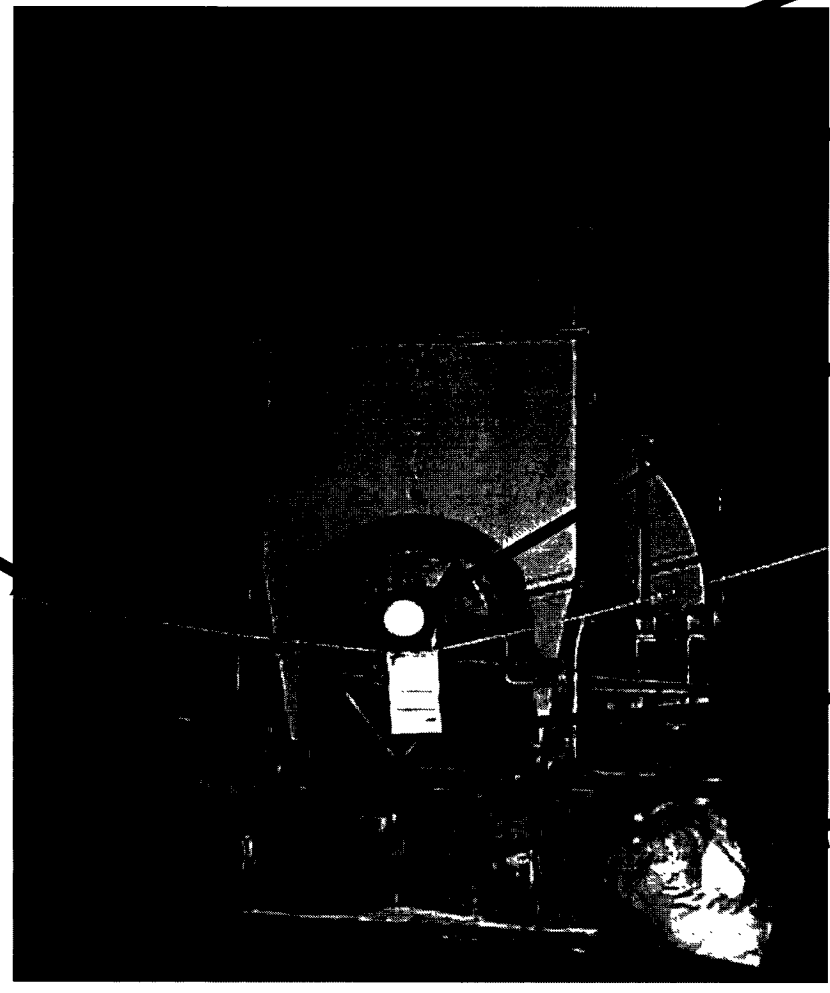


PHOTO NO. 7

OUTBOARD VIEW - FAN NO. 5