# ATTACHMENT 3

# APPROVAL OF REMAINING FANS

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

DEC 08 1999

RECEIVED
DEC - 9 1999
M. H. SCHLENDER

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 RESIDUAL PILE FANS REMOVAL FOR BROOKHAVEN RESEARCH REACTOR DECOMMISSIONING PROJECT (BGRR-SE-99-03)**

The Brookhaven Group (BHG) has reviewed your request to begin removal of the BGRR Pile Fans. BHG has determined that the actions referenced in USID/SE BGRR-SE-99-03 comply 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 Fans is authorized.

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, w/o encl.
M. Holland, BHG, w/o encl.
S. Mallette, BHG, w/o encl.
M. Dikeakos, BHG, w/o encl.

**Safety Evaluation Number:** **BGRR – SE – 99 – 03** **Revision Number:** 0

**Prepared by:** S. H. Moss SH Moss 12/8/99 **Date:** 12/03/99

**Description of proposed activity:** WBS 1.2, Fan Removal and Decontaminate Fan House [Phase 2]

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 2 will cover the removal of Primary Air Cooling Fans #1, #2, #3, #4, residual portions of Secondary Fan and isolation of residual portions of Emergency Fan (Pile Fan #5 was already addressed under BGRR-SE-99-01 [Ref. 17]), in accordance with the Technical Work Documents covering Residual Pile Fan Removals [Ref. 11], copy attached and the Task-specific Environment, Health and Safety Plan [Ref. 10], copy attached. Phase 1 was limited only to the removal of Pile Fan #5 under a separate USID/SE.

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 2, removal of all remaining Pile Fans.

**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 was 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 facilitated the installation of a temporary stack drain system that allowed for the removal of the Pile Fan Sump (covered under BGRR-SE-99-02 [Ref.13]).

The purpose of this USID/SE is to cover the completion of the work activities associated with WBS 1.2, namely, the removal of the rest of the Pile Fans and decontamination of the Fanhouse with a return of custody to the Reactor Division..

**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-014, BGRR Decommissioning Project Task-Specific Environment, Health and Safety Plan (TEHASP) for Pile Fans Removal from Building 704 (Copy included as Attachment No. 1).
(11) BGRR Decommissioning Project Technical Work Documents covering Residual Pile Fan Removals (Copies included in 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.
(17) BGRR-SE-99-01, Rev.0 dated 10/04/99 covering WBS 1.2, Fan Removal and Decontaminate Fan House [Phase 1], as approved by DOE 10/25/99.

## 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.

All Pile Fans were 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 Residual Pile Fan Removals [Ref. 10] and

the BGRR Technical Work Documents covering Residual Pile Fan Removals [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 Residual Pile Fan Removals [Ref. 10] and the BGRR Technical Work Documents covering Residual Pile Fan Removals [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 residual Pile Fans; 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. The proposed 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 documentation.

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 YES, THEN A USI EXISTS. ****

Cliphe T. Newman 12/3/99
BGRR-DP Project Engineer Signature/ Date

Stephen V. Marsh 12/3/99
BGRR-DP Manager for ESH&Q Signature/ Date

[signature] 12/3/99
BGRR-DP Project Manager Signature/ Date

Stephen V. Marsh 12/3/99
BGRR-DP Quality Representative Signature/ Date

Environmental Management Direc. .

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for the U.S. Department of Energy

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RECEIVED
DEC 9 1999
BGRR PROJECT

December 3, 1999

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

Dear Mr. Malosh:

SUBJECT: Unreviewed Safety Issue Determination/Safety Evaluation (USID/SE) for Residual Pile Fans Removal for BGRR Decommissioning Project

Dear Mr. Malosh:

Enclosed for your review and approval is the subject document (BGRR-SE-99-03, Rev. 0), dated 12/3/99), covering WBS 1.2 – Remove and Decontaminate Fan House – Phase 2. 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-99-03, please call Steve Moss (ext. 7639) or Stephen Pulsford (ext. 2394).

Sincerely,

Michael Schlender

Michael Schlender
Assistant Laboratory Director
Environmental Management

Enclosure: BGRR-SE-99-03, Rev. 0
cc (w/o enclosure):

| | | |
|---|---|---|
| M. Cowell, BU | S. Layendecker, RCD | S. Musolino, BGRR |
| F. Crescenzo, DOE/BHG | S. Mallette, DOE/BHG | C. Newson, BGRR |
| R. Desmarais, DOE/BHG | E. Martinez, DOE/BHG | S. Pulsford, BGRR |
| M. Dikeakos, DOE/BHG | J. Meersman, ERD | T. Sheridan, DO |
| M. Holland, DOE/BHG | S. Moss, BGRR | File A414 |

cc: (w/enclosure)
J. Goodenough, DOE/CH

**Safety Evaluation Number:** **BGRR – SE – 99 – 03** **Revision Number:** 0

**Prepared by:** S. H. Moss SH Moss 12/8/99 **Date:** 12/03/99

**Description of proposed activity:** WBS 1.2, Fan Removal and Decontaminate Fan House [Phase 2]

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 2 will cover the removal of Primary Air Cooling Fans #1, #2, #3, #4, residual portions of Secondary Fan and isolation of residual portions of Emergency Fan (Pile Fan #5 was already addressed under BGRR-SE-99-01 [Ref. 17]), in accordance with the Technical Work Documents covering Residual Pile Fan Removals [Ref. 11], copy attached and the Task-specific Environment, Health and Safety Plan [Ref. 10], copy attached. Phase 1 was limited only to the removal of Pile Fan #5 under a separate USID/SE.

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 2, removal of all remaining Pile Fans.

**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 was 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 facilitated the installation of a temporary stack drain system that allowed for the removal of the Pile Fan Sump (covered under BGRR-SE-99-02 [Ref.13]).

The purpose of this USID/SE is to cover the completion of the work activities associated with WBS 1.2, namely, the removal of the rest of the Pile Fans and decontamination of the Fanhouse with a return of custody to the Reactor Division..

**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-014, BGRR Decommissioning Project Task-Specific Environment, Health and Safety Plan (TEHASP) for Pile Fans Removal from Building 704 (Copy included as Attachment No. 1).
(11) BGRR Decommissioning Project Technical Work Documents covering Residual Pile Fan Removals (Copies included in 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.
(17) BGRR-SE-99-01, Rev.0 dated 10/04/99 covering WBS 1.2, Fan Removal and Decontaminate Fan House [Phase 1], as approved by DOE 10/25/99.

## 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.

All Pile Fans were 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 Residual Pile Fan Removals [Ref. 10] and

the BGRR Technical Work Documents covering Residual Pile Fan Removals [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 Residual Pile Fan Removals [Ref. 10] and the BGRR Technical Work Documents covering Residual Pile Fan Removals [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 residual Pile Fans; 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. The proposed 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 documentation.

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. ****

12/3/99
BGRR-DP Project Engineer Signature/ Date

12/3/99
BGRR-DP Manager for ESH&Q Signature/ Date

12/3/99
BGRR-DP Project Manager Signature/ Date

12/3/99
BGRR-DP 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 residual Pile Fans 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 Residual Pile Fan Removals from Building 704 [Ref. 10] and the BGRR Technical Work Documents for Residual Pile Fan Removals [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 Fans 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 residual Pile Fans 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. {Eqpt. Loss>$1,000,000; Downtime >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. {Eqpt. Loss>$250,000; Downtime >3 weeks and <4 months} |
| III | Marginal | May cause minor injury, minor occupational illness, or minor system damage.> 5 rem annual limit on-site. {Eqpt. Loss>$50,000; Downtime >4 days and <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. {Eqpt. Loss <$50,000; Downtime <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 risk 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 also 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:** Residual Pile Fans Removal **NUMBER:** A001
**HAZARD:** To On-site Personnel, Equipment, Environment

| | |
|---|---|
| **Event:** | Waste Container Drop |
| **Possible Consequences & Hazards:** | Damage to facility structures / equipment<br>Release of radioactive materials / radiation to the environment<br>Exposure to radioactive materials through ingestion, inhalation, or dermal exposure<br>Equipment, facility or personnel contamination<br>Injury to worker<br>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 Residual Pile Fans Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date.<br><br>Additional limitation on fraction of entire 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, physical forms and distribution of inventory materials, and the serial nature of the fan removals (one at a time).<br><br>Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan.<br><br>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<br><br>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 Residual Pile Fans Removal will be Sealand, B-25 and/or 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 Residual Pile Fans Removal estimated at 45 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 all the Pile Fans were shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Residual Pile Fans, caused by any Waste Container Drop.

As the 704 Fanhouse and Pile Fans Working Area will be posted as a Radiological Control Area with access restrictions in accordance with task-specific RWP(s); there will be limitations on the number, types and qualification of personnel granted entry as well as mandates on PPE required which, in general, will act to minimize the potential for personnel injury or illness as a result of work accidents or incidents. This is especially true considering the expertise and qualifications of the crane and/or heavy forklift operator(s) and assistants.

Due to the serial nature of the work (only one fan worked on at a time) and the limited volume available within the waste containers, any waste container drop would be limited to only a small portion of the Residual Pile Fans inventory source term, here assumed not to exceed 25% of at most two fans. In Appendix B - Source Term Development, the following radiological inventory was developed for Pile Fan # 4 Removal (conservatively chosen as the highest inventory fan to be removed under this USID/SE.

| Isotope | Inventory [Ci] | Cat 3 Threshold [Ci] | Cat 3 Threshold Fraction |
|---|---|---|---|
| Co-60 | 2.49E-07 | 2.80E+02 | 8.90E-10 |
| Sr-90 | 1.26E-04 | 1.60E+01 | 7.87E-06 |
| Y-90 | 1.26E-04 | 1.42E+03 | 8.87E-08 |
| Cs-137 | 1.34E-03 | 6.00E+01 | 2.23E-05 |
| U-233 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-234 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-235 | 3.08E-07 | 4.20E+00 | 7.34E-08 |
| U-238 | 3.38E-06 | 4.20E+00 | 8.05E-07 |
| Pu-238 | 2.63E-06 | 6.20E- 01 | 4.25E-06 |
| Pu-239 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Pu-240 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Am-241 | 3.60E-04 | 5.20E- 01 | 6.93E-04 |
| | | | SUM= 2.63E-03 |

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 25% of twice this Cat 3 threshold fractional sum (2.63E-03) corresponds to a maximal potential dose of less than **13.2 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. A002 covering Contaminated Waste Bag Rupture/Fire

**ACTIVITY:** Residual Pile Fans 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.<br>Release of radioactive materials / radiation to the building and/or environment.<br>Exposure to radioactive materials through ingestion, inhalation, and/or dermal exposure.<br>Contamination of building, equipment and/or environment<br>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 Residual Pile Fans Removal ( <<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date.<br>Additional limitation on fraction of entire inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials, capacity of contaminated waste storage bag and serial nature of fan removals (one at a time).<br>Limitations on use of combustible materials for the Residual Pile Fans Removal and restrictions on storing combustible material near the job-site.<br>Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan<br>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<br>Use of Pre-job briefings and Pre-Start Checklists.<br>Coverage of work by trained and qualified Radiological Control Technicians.<br>Assignment of a dedicated Waste Management Representative to project, providing expertise in the minimization and disposal of contaminated waste.<br>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 Residual Pile Fans Removal estimated at 45 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 all Pile Fans were shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Residual Pile Fans, caused by any Contaminated Waste Bag Rupture/Fire.

As the 704 Fanhouse and Pile Fans Working Area will be posted as a Radiological Control Area with access restrictions in accordance with task-specific RWP(s); there will be limitations on the number, types and qualification of personnel granted entry as well as mandates on PPE required which, in general, will act to minimize the potential for personnel injury or illness as a result of work accidents or incidents. This is especially true considering the expertise and qualifications of the crane and/or heavy forklift operator(s) and assistants.

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 one of the Residual Pile Fans inventory source term; assumed not to exceed 10% ( as was already used in the approved BGRR-SE-99-01[Ref. 17]). In Appendix B - Source Term Development, the following radiological inventory was developed for the Pile Fan #4 Removal (conservatively chosen as the highest inventory fan to be removed under this USID/SE)

| Isotope | Inventory [Ci] | Cat 3 Threshold [Ci] | Cat 3 Threshold Fraction |
|---|---|---|---|
| Co-60 | 2.49E-07 | 2.80E+02 | 8.90E-10 |
| Sr-90 | 1.26E-04 | 1.60E+01 | 7.87E-06 |
| Y-90 | 1.26E-04 | 1.42E+03 | 8.87E-08 |
| Cs-137 | 1.34E-03 | 6.00E+01 | 2.23E-05 |
| U-233 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-234 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-235 | 3.08E-07 | 4.20E+00 | 7.34E-08 |
| U-238 | 3.38E-06 | 4.20E+00 | 8.05E-07 |
| Pu-238 | 2.63E-06 | 6.20E- 01 | 4.25E-06 |
| Pu-239 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Pu-240 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Am-241 | 3.60E-04 | 5.20E- 01 | 6.93E-04 |
| | | | SUM= 2.63E-03 |

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 10% of this Cat 3 threshold fractional sum (2.63E-03) corresponds to a maximal potential dose of less than **2.7 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:** Residual Pile Fans 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<br>Contamination of area, equipment and/or environment<br>Injury to worker<br>Release of radioactive materials / radiation to the environment.<br>Exposure to radioactive materials through ingestion, inhalation, and dermal exposure.<br>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 Residual Pile Fans Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date.<br><br>Additional limitation on fraction of entire inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials, and the serial nature of the fan removals (one at a time).<br><br>Limitations on use of combustible materials for the Pile Fan Removal Activities and restrictions on the storage of combustible material near the job-site.<br><br>Use of approved Work Control Permit, Radiological Work Permit, Task-specific Technical Work Document, Task-specific Environmental, Health and Safety Plan.<br><br>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 Residual Pile Fans Removal estimated at 45 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 all Pile Fans were shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Residual Pile Fans, caused by any Explosion of LPG Leaked from a Front-end Loader.

As the 704 Fanhouse and Pile Fans Working Area will be posted as a Radiological Control Area with access restrictions in accordance with task-specific RWP(s); there will be limitations on the number, types and qualification of personnel granted entry as well as mandates on PPE required which, in general, will act to minimize the potential for personnel injury or illness as a result of work accidents or incidents. This is especially true considering the expertise and qualifications of the crane and/or heavy forklift operator(s) and assistants.

Due to the serial nature of the fan removal activities and 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 Residual Pile Fans inventory source term, assumed not to exceed 35% (25% + 10%), of at most two fans. In Appendix B - Source Term Development, the following radiological inventory was developed for the Pile Fan #4 Removal (conservatively chosen as the highest inventory fan to be removed under this USID/SE)

| Isotope | Inventory [Ci] | Cat 3 Threshold [Ci] | Cat 3 Threshold Fraction |
|---|---|---|---|
| Co-60 | 2.49E-07 | 2.80E+02 | 8.90E-10 |
| Sr-90 | 1.26E-04 | 1.60E+01 | 7.87E-06 |
| Y-90 | 1.26E-04 | 1.42E+03 | 8.87E-08 |
| Cs-137 | 1.34E-03 | 6.00E+01 | 2.23E-05 |
| U-233 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-234 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-235 | 3.08E-07 | 4.20E+00 | 7.34E-08 |
| U-238 | 3.38E-06 | 4.20E+00 | 8.05E-07 |
| Pu-238 | 2.63E-06 | 6.20E- 01 | 4.25E-06 |
| Pu-239 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Pu-240 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Am-241 | 3.60E-04 | 5.20E- 01 | 6.93E-04 |
| | | | SUM= 2.63E-03 |

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 35% of twice this Cat 3 threshold fractional sum (2.63E-03) corresponds to a maximal potential dose of less than **18.5 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:** Residual Pile Fans Removal **NUMBER:** A004
**HAZARD:** To On-site Personnel, Equipment, Environment

| | |
|---|---|
| **Event:** | Oxyacetylene Explosion |
| **Possible Consequences & Hazards:** | Fire / blast wave<br>Contamination of area, equipment and/or environment<br>Injury to worker<br>Release of radioactive materials / radiation to the environment.<br>Exposure to radioactive materials through ingestion, inhalation, and dermal exposure.<br>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 Residual Pile Fans Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date.<br><br>Additional limitation on fraction of entire inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials, and the serial nature of the fan removals (one at a time).<br><br>Limitations on use of oxyacetylene for the Pile Fans Removal Activities and restrictions on the storage of oxyacetylene near the job-site.<br><br>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.<br><br>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 Residual Pile Fans Removal estimated at 45 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 all Pile Fans were shutdown as part of the BGRR shutdown many years ago; there are no programmatic delays or repair costs associated with any damage to the Residual Pile Fans, caused by any Oxyacetylene Explosion.

As the 704 Fanhouse and Pile Fans Working Area will be posted as a Radiological Control Area with access restrictions in accordance with task-specific RWP(s); there will be limitations on the number, types and qualification of personnel granted entry as well as mandates on PPE required which, in general, will act to minimize the potential for personnel injury or illness as a result of work accidents or incidents. This is especially true considering the expertise and qualifications of the crane and/or heavy forklift operator(s) and assistants.

Due to the serial nature of the work, with only one fan's inventory being worked on at any time, and limited volume (hence inventory) available nearby while torch-cutting only radiologically clean portions of Pile Fans shafts for size reduction to facilitate off-site transfer, any release due to an oxyacetylene explosion would be limited to only a portion of the Residual Pile Fans inventory source term, assumed not to exceed 10%of the fan being cut (as per the approved BGRR-SE-99-01 [Ref. 17]). In Appendix B - Source Term Development, the following radiological inventory was developed for the Pile Fan #4 Removal (conservatively chosen as the highest inventory fan to be removed under this USID/SE)

| Isotope | Inventory [Ci] | Cat 3 Threshold [Ci] | Cat 3 Threshold Fraction |
|---|---|---|---|
| Co-60 | 2.49E-07 | 2.80E+02 | 8.90E-10 |
| Sr-90 | 1.26E-04 | 1.60E+01 | 7.87E-06 |
| Y-90 | 1.26E-04 | 1.42E+03 | 8.87E-08 |
| Cs-137 | 1.34E-03 | 6.00E+01 | 2.23E-05 |
| U-233 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-234 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-235 | 3.08E-07 | 4.20E+00 | 7.34E-08 |
| U-238 | 3.38E-06 | 4.20E+00 | 8.05E-07 |
| Pu-238 | 2.63E-06 | 6.20E- 01 | 4.25E-06 |
| Pu-239 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Pu-240 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Am-241 | 3.60E-04 | 5.20E- 01 | 6.93E-04 |
| | | | SUM= 2.63E-03 |

Based upon the guidance of DOE-STD-1027-92, Attachment 1 [Ref. 5], 10% of this Cat 3 threshold fractional sum (2.63E-03) corresponds to a maximal potential dose of less than **2.7 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:** Residual Pile Fans Removal **NUMBER:** A005
**HAZARD:** To On-site Personnel, Equipment, Environment

| | |
|---|---|
| **Event:** | Crane Load Drop |
| **Possible Consequences & Hazards:** | Damage to structures / equipment<br>Injury to worker<br>Release of radioactive materials / radiation to the environment.<br>Exposure to radioactive materials through ingestion, inhalation, and/or dermal exposure.<br>Contamination of work area or equipment<br>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 Residual Pile Fans Removal (<<Nuclear Hazard Category 3 Threshold), based on the survey and sampling analysis data collected to date.<br><br>Additional limitation on fraction of entire inventory available as a result of the applied polymeric barrier fixative, physical forms and distribution of inventory materials, and the serial nature of the fan removal work (one at a time).<br><br>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.<br><br>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 Residual Pile Fans 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(s) to be made will be the removal of the 27,000 lb. class Pile Fans. 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 Residual Pile Fans Removal Activities estimated at 45 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 all Pile Fans were shutdown as part of the BGRR shutdown many years ago, there are no programmatic delays or repair costs associated with any damage to the Residual Pile Fans, caused by any Crane Load Drop.

As the 704 Fanhouse and Pile Fans Working Area will be posted as a Radiological Control Area with access restrictions in accordance with task-specific RWP(s); there will be limitations on the number, types and qualification of personnel granted entry as well as mandates on PPE required which, in general, will act to minimize the potential for personnel injury or illness as a result of work accidents or incidents. This is especially true considering the expertise and qualifications of the crane and/or heavy forklift operator(s) and assistants.

Any crane load drop would be limited to only a portion of the Residual Pile Fans inventory source term (only one fan can fall in a crane load drop). For the sake of conservatism, the maximum individual fan source term for two fans will be assumed as releasable as a result of the event. This assumes one fan being dropped while being moved, from its packaging location into a Sealand container to its placement next to the stored fans from previous removal operations, resulting in the release of two fans inventories. This event cannot occur until at least one other fan has been removed [after BGRR-SE-99-01 is completed]. In Appendix B - Source Term Development, the following radiological inventory was developed for the Pile Fan #4 Removal (conservatively chosen as the highest inventory fan to be removed under this USID/SE)

| Isotope | Inventory [Ci] | Cat 3 Threshold [Ci] | Cat 3 Threshold Fraction |
|---|---|---|---|
| Co-60 | 2.49E-07 | 2.80E+02 | 8.90E-10 |
| Sr-90 | 1.26E-04 | 1.60E+01 | 7.87E-06 |
| Y-90 | 1.26E-04 | 1.42E+03 | 8.87E-08 |
| Cs-137 | 1.34E-03 | 6.00E+01 | 2.23E-05 |
| U-233 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-234 | 1.06E-04 | 4.20E+00 | 2.52E-05 |
| U-235 | 3.08E-07 | 4.20E+00 | 7.34E-08 |
| U-238 | 3.38E-06 | 4.20E+00 | 8.05E-07 |
| Pu-238 | 2.63E-06 | 6.20E- 01 | 4.25E-06 |
| Pu-239 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Pu-240 | 4.80E-04 | 5.20E- 01 | 9.23E-04 |
| Am-241 | 3.60E-04 | 5.20E- 01 | 6.93E-04 |
| | | | SUM= 2.63E-03 |

The following inventory was developed in USID/SE BGRR-SE-99-01 [Ref. 17] for the removal of Pile Fan #5 and represents the single most conservative fan inventory

| Isotope | Inventory [Ci] | Cat 3 Threshold [Ci] | Cat 3 Threshold 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 combined Cat 3 threshold fractional sums (7.26E-03) corresponds to a maximal potential dose of less than **72.6 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).

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 Residual Pile Fans Removal given above. Five types of events are addressed under the Risk Assessment for the Residual Pile Fans 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 Residual Pile Fans 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 Residual Pile Fans 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 Residual Pile Fans 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

## Source Term Inventory for Pile Fan No. 4 Removal

as of 11/15/99

| RADIO-NUCLIDE | (1) HALF LIFE [Yr] | ACTIVITY CONC. [ ] | TOTAL ACTIVITY [Ci] | (2) HAZ.CAT. 3 THRESHOLD [Ci] | (3) HAZ.CAT. 3 FRACTION | (1) HAZ.CAT. 2 THRESHOLD [Ci] | (4) 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 | | 2.49E-07 | 2.80E+02 | 8.90E-10 | 1.92E+05 | 1.30E-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 | | 1.26E-04 | 1.60E+01 | 7.87E-06 | 2.21E+04 | 5.70E-09 |
| 090Y | 7.31E-03 | | 1.26E-04 | 1.42E+03 | 8.87E-08 | 4.30E+05 | 2.93E-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 | 2.23E-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 | | 1.06E-04 | 4.20E+00 | 2.52E-05 | 2.22E+02 | 4.78E-07 |
| 234U | 2.45E+05 | | 1.06E-04 | 4.20E+00 | 2.52E-05 | 2.22E+02 | 4.78E-07 |
| 235U | 7.04E+08 | | 3.08E-07 | 4.20E+00 | 7.34E-08 | 2.38E+02 | 1.29E-09 |
| 236U | | | | 4.20E+00 | 0.00E+00 | | 0.00E+00 |
| 238U | 4.47E+09 | | 3.38E-06 | 4.20E+00 | 8.05E-07 | 2.39E+02 | 1.41E-08 |
| 237Np | 2.14E+06 | | | 4.20E-01 | 0.00E+00 | 5.85E+01 | 0.00E+00 |
| 238Pu | 8.77E+01 | | 2.63E-06 | 6.20E-01 | 4.25E-06 | 6.17E+01 | 4.27E-08 |
| 239Pu | 2.44E+04 | | 4.80E-04 | 5.20E-01 | 9.23E-04 | 5.52E+01 | 8.70E-06 |
| 240Pu | 6.57E+03 | | 4.80E-04 | 5.20E-01 | 9.23E-04 | 5.60E+01 | 8.57E-06 |
| 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 | | | | | 2.63E-03 | | 2.49E-05 |

=========> 2.63E+01 mRem for total release

1) Values taken from LA-12846-MS, "Specific Activities and DOE-STD-1027-92 Hazard Category 2 Thresholds".
2) 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).
3) Values developed by dividing the actual isotopic inventory by the respective Haz Cat 3 Threshold.
4) Values developed by dividing the actual isotopic inventory by the respective Haz Cat 2 Threshold.

## Source Term Inventory for Pile Fan No. 3 Removal *

as of 11/16/99

| RADIO-NUCLIDE | (1) HALF LIFE [Yr] | ACTIVITY CONC. [ ] | TOTAL ACTIVITY [Ci] | (2) HAZ.CAT. 3 THRESHOLD [Ci] | (3) HAZ.CAT. 3 FRACTION | (1) HAZ.CAT. 2 THRESHOLD [Ci] | (4) 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 | | 8.91E-06 | 2.80E+02 | 3.18E-08 | 1.92E+05 | 4.64E-11 |
| 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 | | 3.34E-04 | 1.60E+01 | 2.09E-05 | 2.21E+04 | 1.51E-08 |
| 090Y | 7.31E-03 | | 3.34E-04 | 1.42E+03 | 2.35E-07 | 4.30E+05 | 7.76E-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 | | 6.18E-04 | 6.00E+01 | 1.03E-05 | 8.65E+04 | 7.14E-09 |
| 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 | | 1.37E-05 | 2.00E+02 | 6.87E-08 | 1.36E+05 | 1.01E-10 |
| 154Eu | 8.50E+00 | | 9.32E-06 | 2.00E+02 | 4.66E-08 | 1.15E+05 | 8.10E-11 |
| 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 | | 2.18E-07 | 4.20E+00 | 5.19E-08 | 2.22E+02 | 9.81E-10 |
| 234U | 2.45E+05 | | 2.18E-07 | 4.20E+00 | 5.19E-08 | 2.22E+02 | 9.81E-10 |
| 235U | 7.04E+08 | | 0.00E+00 | 4.20E+00 | 0.00E+00 | 2.38E+02 | 0.00E+00 |
| 236U | | | | 4.20E+00 | 0.00E+00 | | 0.00E+00 |
| 238U | 4.47E+09 | | 0.00E+00 | 4.20E+00 | 0.00E+00 | 2.39E+02 | 0.00E+00 |
| 237Np | 2.14E+06 | | | 4.20E-01 | 0.00E+00 | 5.85E+01 | 0.00E+00 |
| 238Pu | 8.77E+01 | | 0.00E+00 | 6.20E-01 | 0.00E+00 | 6.17E+01 | 0.00E+00 |
| 239Pu | 2.44E+04 | | 4.61E-06 | 5.20E-01 | 8.86E-06 | 5.52E+01 | 8.35E-08 |
| 240Pu | 6.57E+03 | | 4.61E-06 | 5.20E-01 | 8.86E-06 | 5.60E+01 | 8.23E-08 |
| 241Pu | 1.44E+01 | | 9.70E-07 | 3.20E+01 | 3.03E-08 | 2.89E+03 | 3.36E-10 |
| 241Am | 4.33E+02 | | 2.91E-06 | 5.20E-01 | 5.59E-06 | 5.48E+01 | 5.31E-08 |
| 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 | | | | | 5.50E-05 | | 2.44E-07 |
| | | | | ==========> | 5.50E-01 mRem for total release | | |

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

2) 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).

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

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

* Pile Fan Nos. 1 & 2 each have the same inventory for removal as Pile Fan No. 3.

## Source Term Inventory for Residual Secondary Fan Removal

as of 12/02/99

| RADIO-NUCLIDE | HALF LIFE [Yr] (1) | ACTIVITY CONC. [ ] | TOTAL ACTIVITY [Ci] | HAZ.CAT. 3 THRESHOLD [Ci] (2) | HAZ.CAT. 3 FRACTION (3) | HAZ.CAT. 2 THRESHOLD [Ci] (1) | HAZ.CAT. 2 FRACTION (4) |
|---|---|---|---|---|---|---|---|
| 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 | | 2.34E-06 | 2.80E+02 | 8.37E-09 | 1.92E+05 | 1.22E-11 |
| 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 | | 3.94E-05 | 1.60E+01 | 2.46E-06 | 2.21E+04 | 1.78E-09 |
| 090Y | 7.31E-03 | | 3.94E-05 | 1.42E+03 | 2.78E-08 | 4.30E+05 | 9.16E-11 |
| 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 | | 1.59E-04 | 6.00E+01 | 2.64E-06 | 8.65E+04 | 1.83E-09 |
| 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 | | 2.03E-05 | 4.20E+00 | 4.83E-06 | 2.22E+02 | 9.14E-08 |
| 234U | 2.45E+05 | | 2.03E-05 | 4.20E+00 | 4.83E-06 | 2.22E+02 | 9.14E-08 |
| 235U | 7.04E+08 | | 5.91E-08 | 4.20E+00 | 1.41E-08 | 2.38E+02 | 2.48E-10 |
| 236U | | | | 4.20E+00 | 0.00E+00 | | 0.00E+00 |
| 238U | 4.47E+09 | | 6.49E-07 | 4.20E+00 | 1.55E-07 | 2.39E+02 | 2.72E-09 |
| 237Np | 2.14E+06 | | | 4.20E-01 | 0.00E+00 | 5.85E+01 | 0.00E+00 |
| 238Pu | 8.77E+01 | | 5.05E-09 | 6.20E-01 | 8.15E-09 | 6.17E+01 | 8.19E-11 |
| 239Pu | 2.44E+04 | | 9.22E-05 | 5.20E-01 | 1.77E-04 | 5.52E+01 | 1.67E-06 |
| 240Pu | 6.57E+03 | | 9.22E-05 | 5.20E-01 | 1.77E-04 | 5.60E+01 | 1.65E-06 |
| 241Pu | 1.44E+01 | | | 3.20E+01 | 0.00E+00 | 2.89E+03 | 0.00E+00 |
| 241Am | 4.33E+02 | | 6.91E-05 | 5.20E-01 | 1.33E-04 | 5.48E+01 | 1.26E-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 | | | | | 5.03E-04 | | 4.77E-06 |

==========> 5.03E+00 mRem for total release

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

2) 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).

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

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

## Pile Fan(s) 4 or 5 Removal Contaminated Material Surface Area / Activity Estimate

as of 11/15/99

(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 Fans, 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. 4 or 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 # 5 (and used also for Fan #4) =

| | | | |
|---|---|---|---|
| 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 # 5 (& # 4) =
[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 | | | |
| | No attributable Y-90 activity; Y-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. |
| | Attributable Y-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. |
| | Attributable Y-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. |
| | Attributable Y-90 activity @ | | | 2.77E-04 uCi/100 sq.cm. |

(6) Average Sr-90 & Y-90 smearable activity on interior surface of Pile Fan # 5 (& #4) =

| | | | |
|---|---|---|---|
| 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. | |
| 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 distributed on interior of Pile Fan # 5 (& # 4) with the same isotopic ratios as found in the average of the 'Fines' [Item 13]

[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 Alpha smearable activity | | | = | 1.63E-05 uCi/100 sq.cm. |
| Total Alpha smearable activity | | | = | 1.36E-01 uCi = **1.36E-07 Ci** |

| | |
|---|---|
| 3.18E-08 | Am-241 [Ci] |
| 2.31E-08 | Pu-238 [Ci] |
| 4.24E-08 | Pu-239 [Ci] |
| 4.24E-08 | Pu-240 [Ci] |
| 9.34E-09 | U-233 [Ci] |
| 9.34E-09 | U-234 [Ci] |
| 2.72E-11 | U-235 [Ci] |
| 2.99E-10 | U-238 [Ci] |

(9) Estimated volume and mass of 'Fines' within Pile Fan # 5 (& # 4) =

| | | |
|---|---|---|
| 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 # 5 (& # 4) '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 | |
| Sample 9910015-01 @ | 5.50E-02 uCi/gm | |
| Average 'Fines' Cs-137 activity @ | 1.06E-01 uCi/gm | |
| Total 'Fines' Cs-137 activity @ | 8.44E+01 uCi | = **8.44E-05 Ci** |

(11) Average Co-60 activity in Pile Fan # 5 (& # 4) '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 | |
| Sample 9910015-01 @ | 3.21E-05 uCi/gm | |
| Average 'Fines' Co-60 activity @ | 6.18E-05 uCi/gm | |
| Total 'Fines' Co-60 activity @ | 4.93E-02 uCi | = **4.93E-08 Ci** |

(12) Alpha activity concentration in Pile Fan # 5 (& # 4) 'Fines' =

Per Sample 99072706-01 [GEL Laboratory Analysis]

| | | | |
|---|---|---|---|
| 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. |

Per Sample 9910015-01 [B&W Laboratory Analysis]

| | | | |
|---|---|---|---|
| Am-241 @ | 268 pCi/gm; | Pu-238 @ ---------- pCi/gm; | |
| Pu-239/40 @ | 635 pCi/gm | **(assumed evenly split as both have same Cat 3 threshold)** | |
| U-234 @ | 171 pCi/gm | **(assumed evenly split as above)** | |
| U-235 @ < MDA | pCi/gm; | U-238 @ < MDA | pCi/gm. |

(13) Total alpha activity in Pile Fan # 5 (& # 4) 'Fines', based on average of both samples=

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Am-241 @ | 1.18E+05 pCi | = | 1.18E-01 uCi | = | **1.18E-07 Ci** | 23.41% |
| Pu-238 @ | 8.60E+02 pCi | = | 8.60E-04 uCi | = | **8.60E-10 Ci** | 0.17% |
| Pu-239 @ | 1.57E+05 pCi | = | 1.57E-01 uCi | = | **1.57E-07 Ci** | 31.22% |
| Pu-240 @ | 1.57E+05 pCi | = | 1.57E-01 uCi | = | **1.57E-07 Ci** | 31.22% |
| U-233 @ | 3.45E+04 pCi | = | 3.45E-02 uCi | = | **3.45E-08 Ci** | 6.87% |
| U-234 @ | 3.45E+04 pCi | = | 3.45E-02 uCi | = | **3.45E-08 Ci** | 6.87% |
| U-235 @ | 8.76E+01 pCi | = | 8.76E-05 uCi | = | **8.76E-11 Ci** | 0.02% |
| U-238 @ | 1.11E+03 pCi | = | 1.11E-03 uCi | = | **1.11E-09 Ci** | 0.22% |
| Total alpha activity @ | 5.03E+05 pCi | = | 5.03E-01 uCi | = | **5.03E-07 Ci** | 100.00% |

(14) Total Beta activity in Pile Fan #5 (& # 4) 'Fines', based on sample analyzed, with all beta activity reported as Sr-90, equally distributed between Sr-90 and Y-90.

Sr-90/Y-90 @ 16,900 pCi/gm (per sample 9910015-01)

| | | | |
|---|---|---|---|
| Sr-90 @ 8,450 pCi/gm X 796.41 gm = | 6.73E+00 uCi | = | **6.73E-06 Ci** |
| Y-90 @ 8,450 pCi/gm X 796.41 gm = | 6.73E+00 uCi | = | **6.73E-06 Ci** |

(15) Total fixed activity in Pile Fan # 5 (& # 4) to be estimated per the results of the ISOCS measurement 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-04/23.41*0.17 = | **2.61E-06 Ci** |
| Maximum of Pu-239=3.60E-04/23.41*31.22 = | **4.80E-04 Ci** |
| Maximum of Pu-240=3.60E-04/23.41*31.22 = | **4.80E-04 Ci** |
| Maximum of U-233=3.60E-04/23.41*6.87 = | **1.06E-04 Ci** |
| Maximum of U-234=3.60E-04/23.41*6.87 = | **1.06E-04 Ci** |
| Maximum of U-235=3.60E-04/23.41*0.02 = | **3.08E-07 Ci** |
| Maximum of U-238=3.60E-04/23.41*0.22 = | **3.38E-06 Ci** |

## Pile Fan(s) 1, 2 or 3 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 Fans, 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 # 1, 2 or 3; 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 and Co-60 smearable activity on interior surface of Pile Fan # 3 =
[Use same values as characteristic for Pile Fans # 1 & 2]

| | | | | |
|---|---|---|---|---|
| Interior 1 | Cs-137 | 3.33E-04 uCi/100 sq.cm. | Co-60 | 1.04E-05 uCi/100 sq.cm. |
| Interior 2 | Cs-137 | 7.14E-04 uCi/100 sq.cm. | Co-60 | 1.75E-05 uCi/100 sq.cm. |
| Interior 3 | Cs-137 | 5.99E-04 uCi/100 sq.cm. | Co-60 | 1.53E-05 uCi/100 sq.cm. |
| Average | Cs-137 | 5.49E-04 uCi/100 sq.cm. | Co-60 | 1.44E-05 uCi/100 sq.cm. |
| Total | Cs-137 | **5.45E-06 Ci** | Co-60 | **1.43E-07 Ci** |

5) Let all excess Beta smearable activity be attributable to Sr-90/Y-90 on interior of Pile Fan # 3 =
[Use same values as characteristic for Pile Fans # 1 & 2]
[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]

| | | | | |
|---|---|---|---|---|
| Interior 1 | Beta @ | 1.55E+03 dpm | = | 6.99E-04 uCi/100 sq.cm. |
| | Cs-137@ | | | 3.33E-04 uCi/100 sq.cm. |
| | Attributable Sr-90 activity @ | | | 1.83E-04 uCi/100 sq.cm. |
| | Attributable Y-90 activity @ | | | 1.83E-04 uCi/100 sq.cm. |
| Interior 2 | Beta @ | 3.57E+03 dpm | = | 1.61E-03 uCi/100 sq.cm. |
| | Cs-137 @ | | | 7.14E-04 uCi/100 sq.cm. |
| | Attributable Sr-90 activity @ | | | 4.47E-04 uCi/100 sq.cm. |
| | Attributable Y-90 activity @ | | | 4.47E-04 uCi/100 sq.cm. |
| Interior 3 | Beta @ | 2.35E+03 dpm | = | 1.06E-03 uCi/100 sq.cm. |
| | Cs-137 @ | | | 5.99E-04 uCi/100 sq.cm. |
| | Attributable Sr-90 activity @ | | | 2.29E-04 uCi/100 sq.cm. |
| | Attributable Y-90 activity @ | | | 2.29E-04 uCi/100 sq.cm. |

6) Average Sr-90 & Y-90 smearable activity on interior surface of Pile Fan # 3 =
[Use same values as characteristic for Pile Fans # 1 & 2]

| | | | |
|---|---|---|---|
| Interior 1 | | 1.83E-04 uCi/100 sq.cm. | |
| Interior 2 | | 4.47E-04 uCi/100 sq.cm. | |
| Interior 3 | | 2.29E-04 uCi/100 sq.cm. | |
| | Average Sr-90 smearable activity = | 2.86E-04 uCi/100 sq.cm. | |
| | Average Y-90 smearable activity = | 2.86E-04 uCi/100 sq.cm. | |
| | Total Sr-90 smearable activity = | 2.85E+00 uCi = | **2.85E-06 Ci** |
| | Total Y-90 smearable activity = | 2.85E+00 uCi = | **2.85E-06 Ci** |

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

Avg Cs-137 smearable = 5.49E-04 uCi/100 sq.cm.
Avg Sr-90 smearable = 2.86E-04 uCi/100 sq.cm.
Ratio of Cs-137 : Sr-90 = **1.92**
Ratio of Cs-137 : Y-90 = **1.92** [Sr-90 assumed in equilibrium with Y-90]

---

8) Let all Alpha smearable activity be distributed on interior of Pile Fan # 3 (& #'s 1,2) with the same isotopic ratios as found in the 'Fines' [Item 16]

[where 1 uCi = 2.22E+06 dpm & 1 dpm = 4.50E-07 uCi]
Interior 1 Alpha @ 22.9 dpm = 1.03E-05 uCi/100 sq.cm.
Interior 2 Alpha @ 42.5 dpm = 1.91E-05 uCi/100 sq.cm.
Interior 3 Alpha @ 26.1 dpm = 1.18E-05 uCi/100 sq.cm.
Average Alpha smearable activity = 1.37E-05 uCi/100 sq.cm.
Total Alpha smearable activity = 1.37E-01 uCi = **1.37E-07 Ci**

**3.75E-08 Am-241 [Ci]**
**0.00E+00 Pu-238 [Ci]**
**4.73E-08 Pu-239 [Ci]**
**4.73E-08 Pu-240 [Ci]**
**2.24E-09 U-233 [Ci]**
**2.24E-09 U-234 [Ci]**
**0.00E+00 U-235 [Ci]**
**0.00E+00 U-238 [Ci]**

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9) Estimated volume and mass of 'Fines' within Pile Fan # 3 (& #'s 1,2) = 70.00% Fan #5 Fines
While Fan #s 1,2 &3 are larger in size than Fan # 5, they do not have large flat horizontal surfaces on which to collect or accumulate 'Fines'. Neither have they operated as long as the older Fans (#4 & 5). The estimate of 70% is based on observations made by BGRR Field Engineer during sampling.
70.00% of Pile Fan #5 'Fines' equals 0.70 X 796.41 gms = **557.487 gms**

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10) Average Cs-137 activity in Pile Fan # 3 (& #'s 1,2) 'Fines' =
Sample 99091516-03 @ 1.21E-01 uCi/gm
Sample 99091516-04 @ 9.91E-02 uCi/gm
Sample 99091516-04AB @ 4.65E-02 uCi/gm
Sample 9910015-02 @ 1.22E-01 uCi/gm
Average 'Fines' Cs-137 activity @ 9.72E-02 uCi/gm
Total 'Fines' Cs-137 activity @ 5.42E+01 uCi = **5.42E-05 Ci**

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11) Average Co-60 activity in Pile Fan # 3 (& #'s 1,2) 'Fines' =
Sample 99091516-03 @ 1.65E-03 uCi/gm
Sample 99091516-04 @ 1.32E-03 uCi/gm
Sample 99091516-04AB @ 7.62E-04 uCi/gm
Sample 9910015-02 @ 1.74E-03 uCi/gm
Average 'Fines' Co-60 activity @ 1.37E-03 uCi/gm
Total 'Fines' Co-60 activity @ 7.63E-01 uCi = **7.63E-07 Ci**

---

12) Average Eu-152 activity in Pile Fan # 3 (& #'s 1,2) 'Fines' =
Sample 99091516-03 @ 8.59E-04 uCi/gm
Sample 99091516-04 @ 6.99E-04 uCi/gm
Sample 99091516-04AB @ 0.00E+00 uCi/gm
Sample 9910015-02 @ 8.33E-04 uCi/gm
Average 'Fines' Eu-152 activity @ 5.98E-04 uCi/gm
Total 'Fines' Eu-152 activity @ 3.33E-01 uCi = **3.33E-07 Ci**

---

13) Average Eu-154 activity in Pile Fan # 3 (& #'s 1,2) 'Fines' =
Sample 99091516-03 @ 2.71E-04 uCi/gm
Sample 99091516-04 @ 2.67E-04 uCi/gm
Sample 99091516-04AB @ 0.00E+00 uCi/gm
Sample 9910015-02 @ 3.14E-04 uCi/gm
Average 'Fines' Eu-154 activity @ 2.13E-04 uCi/gm
Total 'Fines' Eu-154 activity @ 1.19E-01 uCi = **1.19E-07 Ci**

---

14) Average Sr-90 activity in Pile Fan # 3 (& #'s 1,2) 'Fines', based on sample(s) analyzed.
Where not specifically identified, Sr-90 activity will be presumed to be one-half the difference between Gross Beta and the Cs-137 activity (with Y-90 being the other half). Where Sr-90 activity is specifically given, equal activities of Y-90 will be assumed.

Sample 9910015-02 @ 7.92E+04 pCi/gm
Sample 99091516-04AB @ [(1.75E-01 - 4.65E-02)/2] = 6.43E+04 pCi/gm
Average 'Fines' Sr-90 activity @ 7.17E+04 pCi/gm
Total 'Fines' Sr-90 activity @ 4.00E+07 pCi = **4.00E-05 Ci**
Average 'Fines' Y-90 activity @ 7.17E+04 pCi/gm
Total 'Fines' Y-90 activity @ 4.00E+07 pCi = **4.00E-05 Ci**

Pu-241 activity in Pile Fan # 3 (& #'s 1,2) 'Fines', based on sample analysis results and =
Sample 9910015-02 @ 1.74E+03 pCi/gm
Total 'Fines' Pu-241 activity @ 9.70E+05 pCi = **9.70E-07 Ci**

---

15) Alpha activity concentration in Pile Fan # 3 (& #'s 1,2) 'Fines', based on Sample 9910015-02=

Am-241 @ 1.34E+03 pCi/gm; Pu-238 @ ---------- pCi/gm;
Pu-239/40 @ 3.38E+03 pCi/gm **(assumed evenly split as both have same Cat 3 threshold)**
U-233/34 @ 1.60E+02 pCi/gm **(assumed evenly split as both have same Cat 3 threshold)**
U-235 @ < MDA pCi/gm; U-238 @ < MDA pCi/gm.

---

16) Total Alpha activity in Pile Fan # 3 (& #'s 1,2) 'Fines', based on Sample 9910015-02=

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Am-241 @ | 7.47E+05 | pCi | = | 7.47E-01 | uCi | = | **7.47E-07 Ci** | 27.46% |
| Pu-238 @ | 0.00E+00 | pCi | = | 0.00E+00 | uCi | = | **0.00E+00 Ci** | 0.00% |
| Pu-239 @ | 9.42E+05 | pCi | = | 9.42E-01 | uCi | = | **9.42E-07 Ci** | 34.63% |
| Pu-240 @ | 9.42E+05 | pCi | = | 9.42E-01 | uCi | = | **9.42E-07 Ci** | 34.63% |
| U-233 @ | 4.46E+04 | pCi | = | 4.46E-02 | uCi | = | **4.46E-08 Ci** | 1.64% |
| U-234 @ | 4.46E+04 | pCi | = | 4.46E-02 | uCi | = | **4.46E-08 Ci** | 1.64% |
| U-235 @ | 0.00E+00 | pCi | = | 0.00E+00 | uCi | = | **0.00E+00 Ci** | 0.00% |
| U-238 @ | 0.00E+00 | pCi | = | 0.00E+00 | uCi | = | **0.00E+00 Ci** | 0.00% |
| Total alpha activity @ | 2.72E+06 | pCi | = | 2.72E+00 | uCi | = | **2.72E-06 Ci** | 100.00% |

---

17) Total fixed activity in Pile Fan # 3 (& #'s 1,2) are estimated by the results of the ISOCS measurement 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).

Total of Cs-137 = (165 + 114) uCi X 2 = 558 uCi = **5.58E-04 Ci**
Total of Co-60 = ( 1.6 + 2.4 ) uCi X 2 = 8 uCi = **8.00E-06 Ci**
Total of Eu-152 = (2.5 + 4.2 ) uCi X 2 = 13.4 uCi = **1.34E-05 Ci**
Total of Eu-154 = (1.7 + 2.9 ) uCi X 2 = 9.2 uCi = **9.20E-06 Ci**

As the ISOCS measurements of Pile Fan #3 were unable to quantify the total Am-241 inventory due to the physical constraints of the in-situ spectrum acquision (the fan wall thickness and carbon steel composition), and the low energy of the radionuclide (Am-241) resulting in significant attentuation in the ISOCS model analysis, the amount of Am-241 present will be attributed based on the ratio of Am-241 to Cs-137 in the 'Heavy Particulate' times the amount of Cs-137 measured by the ISOCS in Pile Fan #3 itself.

Total of Am-241 = (0.073/14.2) X 558 = 2.87 uCi = **2.87E-06 Ci**

Attributable Sr-90, to be based upon ratio of smearable Cs-137 : Sr-90 (per Item 7 above = 1.92)
Total of Sr-90 = 5.58E-04 Ci/1.92 = **2.91E-04 Ci**

| | |
|---|---|
| Total of Y-90 = Sr-90 = 5.58E-04 Ci/1.92= | **2.91E-04 Ci** |

Attributable alpha emitters to be based on their respective ratios to Am-241 in the 'Fines' (Item 16).

| | |
|---|---|
| Total of Pu-238=2.87E-06 / 27.46 * 0 = | **0.00E+00 Ci** |
| Total of Pu-239=2.87E-06 / 27.46 * 34.63 = | **3.62E-06 Ci** |
| Total of Pu-240=2.87E-06 / 27.46 * 34.63 = | **3.62E-06 Ci** |
| Total of U-233=2.87E-06 / 27.46 * 1.64 = | **1.71E-07 Ci** |
| Total of U-234=2.87E-06 / 27.46 * 1.64 = | **1.71E-07 Ci** |
| Total of U-235=2.87E-06 / 27.46 * 0 = | **0.00E+00 Ci** |
| Total of U-238=2.87E-06 / 27.46 * 0 = | **0.00E+00 Ci** |

## Secondary Fan Residue Removal Contaminated Material Surface Area and Activity Estimate

1) The metal surface area directly associated with secondary fan residual component(s), as estimated by E. Lilimapakis, BGRR Field Engineer = 480 sq.ft. X 929.0304 sq.cm./sq.ft.= **4.46E+05 sq.cm.**

2) For the removal of Secondary Fan Residual Component(s); the source term is composed of only two types of activity. These are; smearable surface activity and fixed surface activity (no 'fines' associated with the residual component(s) to be removed). To minimize the potential for the creation of any air-borne activity throughout the removal process, a polymeric barrier system will be sprayed onto contaminated surfaces prior to removal activities.

3) Cs-137 and Co-60 smearable activity detected on interior surface of Secondary Fan residue =

| | | | | | |
|---|---|---|---|---|---|
| Cs-137 | 3.70E-04 uCi/100 sq.cm. | | Co-60 | 5.45E-06 uCi/100 sq.cm. | |
| Total | **Cs-137** | **1.65E-06 Ci** | | **Co-60** | **2.43E-08 Ci** |

4) Let all excess Beta smearable activity be attributable to Sr-90/Y-90 on contaminated surfaces of secondary fan component(s) [ with 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.

| | | | | |
|---|---|---|---|---|
| Beta @ | 1227.1 dpm | = | 5.52E-04 uCi/100 sq.cm. | |
| Cs-137 @ | | | 3.70E-04 uCi/100 sq.cm. | |
| Attributable Sr-90 activity @ | | | 9.11E-05 uCi/100 sq.cm. | |
| Attributable Y-90 activity @ | | | 9.11E-05 uCi/100 sq.cm. | |
| Total Sr-90 smearable activity | | | 4.06E-01 uCi | = **4.06E-07 Ci** |
| Total Y-90 smearable activity | | | 4.06E-01 uCi | = **4.06E-07 Ci** |

5) Let all Alpha smearable activity distributed on contaminated surfaces of secondary fan residual components be assumed to be of same distribution as per Pile Fan # 4.

| | | | | |
|---|---|---|---|---|
| Alpha @ | 13.0 dpm | = | 5.85E-06 uCi/100 sq.cm. | |
| Total Alpha smearable activity | | | 2.61E-02 uCi | = 2.61E-08 Ci |

| | | |
|---|---|---|
| Am-241 @ | 23.41% | 6.11E-09 Ci |
| Pu-238 @ | 0.17% | 4.43E-11 Ci |
| Pu-239 @ | 31.22% | 8.14E-09 Ci |
| Pu-240 @ | 31.22% | 8.14E-09 Ci |
| U-233 @ | 6.87% | 1.79E-09 Ci |
| U-234 @ | 6.87% | 1.79E-09 Ci |
| U-235 @ | 0.02% | 5.22E-12 Ci |
| U-238 @ | 0.22% | 5.74E-11 Ci |

6) Based on the extremely low smearable levels, the absence of particulate 'Fines', and only bkgd dose levels no ISOCS data was deemed necessary. Therefore, fixed activity will be scaled off smearable at the same ratios as was found in Pile Fan #4.

| | | | |
|---|---|---|---|
| Cs-137 Fixed/Smearable @ 1.24E-03/1.30E-05 = | 95.38 | Cs-137 | **1.57E-04 Ci** |
| Co-60 Fixed/Smearable @ 2.00E-07/<MDL ==> | " " | Co-60 | **2.32E-06 Ci** |
| Sr-90 Fixed/Smearable @ 1.18E-04/1.23E-06 = | 95.93 | Sr-90 | **3.90E-05 Ci** |
| Y-90 Fixed/Smearable @ 1.18E-04/1.23E-06 = | 95.93 | Y-90 | **3.90E-05 Ci** |
| Am-241 Fixed/Smearable @ 3.60E-04/3.18E-08 = | 11320.75 | Am-241 | **6.91E-05 Ci** |
| Pu-238 Fixed/Smearable @ 2.61E-06/2.31E-08 = | 112.99 | Pu-238 | **5.01E-09 Ci** |
| Pu-239 Fixed/Smearable @ 4.80E-04/4.24E-08 = | 11320.75 | Pu-239 | **9.22E-05 Ci** |
| Pu-240 Fixed/Smearable @ 4.80E-04/4.24E-08 = | 11320.75 | Pu-240 | **9.22E-05 Ci** |
| U-233 Fixed/Smearable @ 1.06E-04/9.34E-09 = | 11349.04 | U-233 | **2.03E-05 Ci** |
| U-234 Fixed/Smearable @ 1.06E-04/9.34E-09 = | 11349.04 | U-234 | **2.03E-05 Ci** |
| U-235 Fixed/Smearable @ 3.08E-07/2.72E-11 = | 11323.53 | U-235 | **5.91E-08 Ci** |
| U-238 Fixed/Smearable @ 3.38E-06/2.99E-10 = | 11304.35 | U-238 | **6.49E-07 Ci** |

## Bldg 704 Fan(s) & Fanhouse Sampling & Analysis

as of 12/02/99

| 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 l/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

as of 12/02/99

| 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 #5 Housing Bottom (From NE to SW) | | | | | | | | Cs-137 | 620 uCi | Upper Est |
| | | | | | | | | | | | 78 uCi | Lower Est |
| ASTD-FH50229A | 07/08/99 | Fan #5 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 |
| 99091516-03 | 09/15/99 | 1550 hrs | #3 Heavy | | | | | | | Co-60 | 1.65E-03 | 5.59 |
| | | | | | | | | | | Cs-137 | 1.21E-01 | 8.07 |
| | | | | | | | | | | Eu-152 | 8.59E-04 | 6.59 |
| | | | | | | | | | | Eu-154 | 2.71E-04 | 27.51 |
| 99091516-04 | 09/15/99 | 1550 hrs | #3 Fines | | | | | | | Co-60 | 1.32E-03 | 5.95 |
| | | | | | | | | | | Cs-137 | 9.91E-02 | 8.55 |
| | | | | | | | | | | Eu-152 | 6.99E-04 | 6.31 |
| | | | | | | | | | | Eu-154 | 2.67E-04 | 9.33 |
| | | | | | | | | | | Am-241 | 8.87E-04 | 30.55 |
| 99091516-04AB | 09/15/99 | 1550 hrs | #3 Fines | Gr. Beta = | 1.75E-01 uCi/gm | | MDL = | 2.06E-06 uCi/gm | | Co-60 | 7.62E-04 | 9.19 |
| | | | | | | | | | | Cs-137 | 4.65E-02 | 9.78 |
| | | | | | | | | | | Am-241 | 9.26E-04 | 29.37 |
| 99091714-01 | 09/14/99 | 1608 hrs | Air-#3G/A | < 0 | < MDL | N/A | 7.45E-14 | 1.8E-13 | [uCi/cc] | Cs-137 | 5.71E-13 uCi/cc | |
| 99091714-02 | 09/14/99 | 1626 hrs | Air-#3V/E | < 0 | < MDL | N/A | 7.84E-13 | 1.9E-12 | [uCi/cc] | ---------- | | |
| 99091714-03 | 09/14/99 | 1640 hrs | Air-#3I/P | < 0 | 9.63E-13 | N/A | 1.97E-13 | 4.9E-13 | [uCi/cc] | ---------- | | |
| 99091714-04 | 09/14/99 | 1700 hrs | Smear | #3 I/P-1 | Alpha @ | 22.9 dpm | Beta @ | 1551.6 dpm | * | Co-60 | 1.04E-05 uCi/smear | |
| | | | | | | | | | | Cs-137 | 3.33E-04 uCi/smear | |
| 99091714-05 | 09/14/99 | 1700 hrs | Smear | #3 I/P-2 | Alpha @ | 42.5 dpm | Beta @ | 3568.6 dpm | * | Co-60 | 1.75E-05 uCi/smear | |
| | | | | | | | | | | Cs-137 | 7.14E-04 uCi/smear | |
| 99091714-06 | 09/14/99 | 1700 hrs | Smear | #3 I/P-3 | Alpha @ | 26.1 dpm | Beta @ | 2347.0 dpm | * | Co-60 | 1.53E-05 uCi/smear | |
| | | | | | | | | | | Cs-137 | 5.99E-04 uCi/smear | |

*** MDL - Alpha @ 8.9 dpm; Beta @ 16.1 dpm.**

## Bldg 704 Fan(s) & Fanhouse Sampling & Analysis

as of 12/02/99

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 99090110-01 | 09/01/99 | 1510 hrs | Wipe | Masslin wipe w/Paint 704 Duct/S | | | | | | Cs-137 | 4.21E-03 uCi | |
| 99092711-01 | 09/27/99 | 1300 hrs | soil | Fan Cell #5 basement | | | | | | K-40 | 3.43E-06 | 9.46 |
| | | | | | | | | | | Cs-137 | 6.98E-06 | 8.40 |
| | | | | | | | | | | Tl-208 | 8.45E-08 | 21.03 |
| | | | | | | | | | | Pb-212 | 2.65E-07 | 11.93 |
| | | | | | | | | | | Bi-214 | 2.57E-07 | 11.23 |
| | | | | | | | | | | Pb-214 | 2.43E-07 | 27.69 |
| | | | | | | | | | | Ac-228 | 2.44E-07 | 13.82 |
| 99092711-02 | 09/27/99 | 1300 hrs | smear | Base#1Pi. | Alpha @ | 0.0 dpm | Beta @ | 12.9 dpm | * | Cs-137 | 5.75E-06 uCi/smear | |
| 99092711-03 | 09/27/99 | 1300 hrs | smear | Base#2Pi. | Alpha @ | 0.0 dpm | Beta @ | 32.2 dpm | * | Cs-137 | 2.16E-05 uCi/smear | |
| 99092711-04 | 09/27/99 | 1300 hrs | smear | Base#3Hr. | Alpha @ | 0.0 dpm | Beta @ | 6.4 dpm | * | ---------- | | |
| 99092711-05 | 09/27/99 | 1300 hrs | smear | Base#4Uw. | Alpha @ | 0.0 dpm | Beta @ | 0.0 dpm | * | ---------- | | |
| 99092711-06 | 09/27/99 | 1300 hrs | smear | Base#5Lw. | Alpha @ | 0.0 dpm | Beta @ | 0.0 dpm | * | ---------- | | |
| 99092711-07 | 09/27/99 | 1300 hrs | smear | Base#6Sw. | Alpha @ | 0.0 dpm | Beta @ | 0.0 dpm | * | ---------- | | |
| 99092711-08 | 09/27/99 | 1150 hrs | air | Base #5 | Alpha @ | 5.73E-12 | Beta @ | 1.1E-11 uCi/cc | | Tl-208 | 2.60E-12 uCi/cc | |
| | | | | | | | | | | Pb-212 | 5.16E-12 uCi/cc | |
| 9910015-01 | 10/05/99 | | #5 Fines | U-234 | 171 pCi/gm | | 80.2 pCi/gm | | | Co-60 | 32.1 pCi/gm | |
| | | | | U-235 | 11.4 pCi/gm | | 68.4 pCi/gm | | <MDA | Cs-137 | 55000 pCi/gm | |
| | | | | U-238 | 17.1 pCi/gm | | 61.3 pCi/gm | | <MDA | | | |
| | | | | Am-241 | 268 pCi/gm | | 52.5 pCi/gm | | | | | |
| | | | | Pu-239/40 | 635 pCi/gm | | 54.9 pCi/gm | | | | | |
| | | | | | Pu-241 | -328 pCi/gm | | 105 pCi/gm | | <MDA | | |
| | | | | | Sr-90 | 16900 pCi/gm | | 43.2 pCi/gm | | | | |
| 9910015-02 | 10/05/99 | | #3 Fines | U-234 | 160 pCi/gm | | 46.6 pCi/gm | | | Co-60 | 1740 pCi/gm | |
| | | | | U-235 | 4.32 pCi/gm | | 52 pCi/gm | | <MDA | Cs-137 | 122000 pCi/gm | |
| | | | | U-238 | 17.3 pCi/gm | | 46.6 pCi/gm | | <MDA | Eu-152 | 833 pCi/gm | |
| | | | | Am-241 | 1340 pCi/gm | | 45.1 pCi/gm | | | Eu-154 | 314 pCi/gm | |
| | | | | Pu-239/40 | 3380 pCi/gm | | 43.4 pCi/gm | | | | | |
| | | | | | Pu-241 | 1740 pCi/gm | | 115 pCi/gm | | | | |
| | | | | | Sr-90 | 79200 pCi/gm | | 42.7 pCi/gm | | | | |

*** MDL - Alpha @ 8.7 dpm; Beta @ 25.8 dpm**

**Bldg 704 Fan(s) & Fanhouse Sampling & Analysis**

as of 12/02/99

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASTD-FH30329a | 11/09/99 | Fan #3 North Face Volute (From East to West) | | | | | | | | Cs-137 | 114 | uCi |
| | | | | | | | | | | Co-60 | 1.6 | uCi |
| | | | | | | | | | | Eu-152 | 2.5 | uCi |
| | | | | | | | | | | Eu-154 | 1.7 | uCi |
| ASTD-FH30429a | 11/09/99 | Fan #3 North Face Volute (From West to East) | | | | | | | | Cs-137 | 165 | uCi |
| | | | | | | | | | | Co-60 | 2.4 | uCi |
| | | | | | | | | | | Eu-152 | 4.2 | uCi |
| | | | | | | | | | | Eu-154 | 2.9 | uCi |
| ASTD-FH3V129a | 09/16/99 | Heavy Particulate Pile Fan #3 | | | | | | | | Cs-137 | 14.2 | |
| | | | | | | | | | | Co-60 | 0.21 | |
| | | | | | | | | | | Eu-152 | 0.085 | |
| | | | | | | | | | | Eu-154 | 0.031 | |
| | | | | | | | | | | Am-241 | 0.073 | |
| ASTD-FH3V229a | 09/16/99 | Fine Particulate Pile Fan #3 | | | | | | | | Cs-137 | 1.50 | |
| | | | | | | | | | | Co-60 | 0.024 | |
| | | | | | | | | | | Eu-152 | < 0.03 | MDA |
| | | | | | | | | | | Eu-154 | < 0.02 | MDA |
| | | | | | | | | | | Am-241 | < 0.02 | MDA |
| 99112913-05 | 11/29/99 | 1120 hrs | smear | 2ndry fan | Alpha @ 13.0 dpm | | Beta @ 1227.1 dpm | | * | Co-60 | 5.45E-06 | uCi/smear |
| | | | | | | | | | | Cs-137 | 3.70E-04 | uCi/smear |

***MDL - Alpha @ 8.8 dpm; Beta @ 6.0 dpm**

# ATTACHMENT 1

## BGRR Task-Specific Environment, Safety and Health Plan

## (TEHASP) for Residual Pile Fans Removal from Building 704

BGRR-014, Rev. 0
December 3, 1999

# BROOKHAVEN GRAPHITE RESEARCH REACTOR (BGRR) DECOMMISSIONING PROJECT

## Task-Specific Environment, Health and Safety Plan For Removal of Pile Fans Nos. 4, 3, 2, 1, Secondary Fan, and Emergency Fan Duct Isolation

| | | |
|---|---|---|
| Prepared by: | [signature] | 12-3-99 Date |
| Concurred: | [signature] for HANK BACHNER<br>BGRR Construction Manager | 12/3/99 Date |
| NOTED: Con ~~Concurred~~: | [signature]<br>BGRR Project Engineer | 12/3/99 Date |
| Concurred: | [signature] for K. Corbett<br>QA Representative | 12/2/99 Date |
| Concurred: | [signature]<br>ES&H Manager | 12/2/99 Date |
| Approved: | [signature]<br>BGRR Project Manager | 12/3/99 Date |

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

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## LIST OF PHOTOS

(Refer to Technical Work Documents ERD-BGRR-TP-99-1 through ERD-BGRR-TP-99-4)

## 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 Documents for Pile Fans Removal (ERD-BGRR-TP-99-1 through ERD-BGRR-TP-99-4). 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.

Bold and underlined activities in this table denotes for the fans as listed.

| Task No. | Activity Description |
|---|---|
| 1 | **Mobilization**:<br>• Assemble personnel and other support equipment required on site for each task per TWD step 5.6. Install temporary facilities (e.g., decontamination facilities, storage, and lay-down areas).<br>• Conduct Pre-job Briefing with all personnel before the start of work. |
| 2 | **Work Site Preparation**<br>• Delineate the work boundaries and install traffic control measures of both motor vehicles and unsolicited visitors (onlookers).<br>• Identify all energies and ensure that they are locked out/tagged out per ES&H Standard 1.5.1.<br>• Construct a scaffold that meets the requirements of BNL and OSHA 1926.451. A Plant Engineering competent person must inspect this scaffold before its use. Fall-protection equipment must be used if working more than 10 feet above a lower level.<br>• Install chain fall assembly and other accessories as required. Test the assembly for its safe operation. |
| 3 | **Disconnection and Removal of different Valves, Linkages, and Piping**<br>• Disconnect and remove the linkage between damper and the operator wall per TWD step 6.1.<br>• Remove fan housing drain valves and piping per TWD step 6.2. Collect any cuttings in the rad bags for proper disposal. Avoid any skin contamination while using expandable filler.<br>• If there is any oil in either supply or return lines, collect in an approved container for proper disposal. Put all removed materials in proper containers for disposal and exercise good housekeeping practices. |

| Task No. | Activity Description |
|---|---|
| 4 | **Removal of Fan Inlet Transition Housing and Discharge Expansion Joint**<br>• Inject and apply Polymeric Barrier Spray fixative (PBS) inside the bellows and volute assembly uniformly with a minimal force so that no internal airborne particulate are dispersed outside the bellows by following steps in TWD step 5.7.<br>• Using a chain fall assembly and following BNL ES&H Standard 1.6.0 "Material Handling: Equipment and Procedures," carefully lift the fan inlet transition housing, slowly saw cut the bellows per TWD step 6.3.7-6.3.9 and remove the remaining portion of the bellows using overhead monorail with approved pre-engineered rigging materials per TWD step 6.3.<br>• Minimize the spread of contamination by using plastic-bag-type system and Rad vacuum cleaner.<br>• **Discharge Expansion Joint** is removed following TWD step 6.4<br>• Contaminated materials shall be loaded into designated waste boxes and decontamination of equipment is done per RadCon manual as necessary. |
| 5 | **Lifting and Removal of Fans and Other Accessories**<br>• Conduct a comprehensive rad survey in this work area to find the extent of contamination, if any, and take necessary precautions to prevent any cross contamination of the motor room. Place a plastic-bag-like system over the opening in the motor room to control spread of contamination, if any.<br>• Follow TWD step 6.6, and using BNL approved rigging plan and approved pre engineered equipment, stabilize the fan housing with 2 slings on each side in "A frame-type" configuration using chain fall assembly and other equivalent pre engineered hoisting materials. Lift the fan until the lower housing is clear of the concrete foundation. Remove the fan and all assemblies including the inboard and outboard bearing block/pedestal. Place in proper containers for disposal<br>• Cover the open joint flange.<br>• **For Fans Nos. 3, 2, 1, Secondary, Emergency Duct Isolation in motor room, lift the fan using hydraulic jacks and lower in the cribbing below and remove the outboard pillow block, outboard fan housing, shaft cutting, and pedestal.**<br>• Decontaminate the equipment per RadCon Manual as necessary. |
| 6 | **Lifting of the Fan for Placement in Open-Top Container**<br>• Follow TWD step 6.6, carefully lift the fan housing from fan house with a crane, and slowly rotate the fan assembly into a position to access the inboard fan shaft. Place the fan assembly in an open-top-type container.<br>• Decontaminate the equipment per RadCon Manual . |

| Task No. | Activity Description |
|---|---|
| 7 | **Removal of Motor for Fan No. 1 and Outboard Fan Housing**<br>• De-energize the fan motor and stator cooling motor.<br>• Remove fan motor and outboard fan housing following ES&H standard 1.6.0 |
| 8 | **Removal of Secondary Fan and Shaft Bearings**<br>• Stabilize the interior contamination by injecting PBS.<br>• Cut the drain pipe, inlet and outlet duct by hand saw and cap the open-ended penetrations.<br>• Lift and remove the secondary fan and shaft bearings using ES&H standard 1.6.0. |
| 9 | **Flame Cutting the Shafts**<br>• A burn permit shall be necessary before any burning activity. Prepare the area in accordance with burn permit. Assign a fire watch with a fire extinguisher.<br>• Cut the fan shaft and the **shafts in the motor room and outboard shafts for Fans Nos. 3, 2, 1, and Secondary, and discharge duct for Secondary,** and then place in a proper container. |
| 10 | **Containerization of other Removed Materials**<br>• Place all removed equipment and materials in their proper approved containers. Label and mark as necessary per requirements. |
| 11 | **Demobilization**<br>• Remove personnel, equipment, and any generated waste from Fan House<br>• Remove and dismantle any temporary structures and utilities.<br>• Clear area to the accepted radiological level. Decontaminate and release any equipment per RadCon Manual, Table 2-2.<br>• Remove any obstruction that could cause any trip or fall during its future use.<br>• Conduct general site cleanup. |

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 document. 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).

**Table 2-1**
**Chemical Hazard Information**

| Chemical | Exposure Limits | Exposure Route(s) and Symptoms | Sampling Media |
|---|---|---|---|
| Asbestos | 0.1 f/cc(PEL/TWA),<br><br>1.0 f/cc STEL | Exposure route: Inhalation, Ingestion<br><br>Effects: causes asbestosis, inflammation of the pleura, and certain cancers of the lungs and digestive tracts. | Filter<br><br>Sampling rate:2 L per min;<br><br>Varies |
| Strontium* | BNL RadCon Manual | Exposure routes: Inhalation, Ingestion.<br><br>Effects bone | Per BNL RadCon Manual |
| Cesium* | BNL RadCon Manual | Exposure routes: Inhalation, Ingestion<br><br>Effects whole body. | Per BNL RadCon Manual |
| Plutonium*<br><br>Americium*<br><br>Uranium* | BNL RadCon Manual | Exposure routes: Inhalation, Ingestion<br><br>Carcinogenic targets bone, gastrointestinal tract, kidneys, and lungs. | Per BNL RadCon Manual |
| Lead | 0.050 mg/m$^3$ TWA, OSHA PEL<br><br>0.030 mg/m$^3$ TWA, OSHA Action Limit<br><br>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<br><br>Sampling rate 2–4 L per min |

* Radionuclides

### 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.

## 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. These nuclides will be used as the planning basis for the balance of the fan removal work. 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 10 and are approved by ES&H Coordinator; a burn permit is required for activity 9 and is issued by the Fire Department; and a RWP is required for activities 3 through 10 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 $\mu g/m^3$<br>At work area perimeter | No action |
| | | | >50 $\mu g/m^3$<br>< 150 $\mu g/m^3$<br>At work area perimeter | Continue work, contact ES&HC, identify source of dust and implement engineered controls |
| | | | > 150 $\mu g/m^3$<br>At work area perimeter | Stop work until engineering controls reduces airborne dust to below 50 $\mu g/m^3$ |
| | | | > 1 $mg/m^3$ for<br>> 15 minutes<br>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; a personal Contamination Monitor Model 3 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

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

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.

**Table 7-1**
**Level of Personal Protective Equipment**

| Activity | A | B | C | D | E | F | G | H | I | J | K | Level of protection | Possible upgrade |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | X | X | | | | | | | | X | X | C.A. | N/A |
| 2 | X | 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 | C.A.→ C | C |
| 8 | X | X | | X | X | | X | X | X | X | X | C.A.→ C | C |
| 9 | X | | X | X | X | | X | X | X | X | | C.A.→ C | C |
| 10 | X | X | | X | X | | X | X | X | X | X | C.A | C |
| 11 | X | X | | | X | | | | X | X | X | C.A. | C |

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

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.

# 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 | 800 796 7363 pin 1066603 |

**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.

## 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

# ATTACHMENT 2

## BGRR Technical Work Documents

## Covering Residual Pile Fan Removals

**ERD Procedures Manual**

# TECHNICAL WORK DOCUMENT
# FAN NO. 4 REMOVAL

Text Pages 1 through 11
Attachment(s) 8.1 and 8.2

**Temporary Procedure**

Approved: _____ Date: 11/23/99
Stephen K. Pulsford, Manager
BGRR Decommissioning Project

Approved: _____ Date: 11/30/99
HFBR Operations

Preparer: **T. Jernigan**

Expiration Date: **December 31, 1999**

ERD OPM No.: **ERD-BGRR-TP-99-1**

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## 1.0 PURPOSE

1.1 To provide the detailed work instructions for the removal of the No. 4 Pile Fan.

## 2.0 SCOPE

2.1 This document covers work activities associated with the removal of No. 4 Pile Fan including, but not limited to, necessary preparation and setup, and removal of interference's.

## 3.0 RESPONSIBILITIES

3.1 The BGRR-DP Construction Manager or designee is responsible for the proper execution of this Work Document.

3.2 The BGRR-DP Project Engineer or designee is responsible for the technical content of this Work Document.

3.3 The BGRR-DP ESH&Q Manager or designee is responsible for all environmental, health and safety issues associated with the work activities delineated herein.

## 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. 4 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 of the Primary Air Cooling System are exposed, a surface fixant such as 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 so throughout all work activities. This valve is an HFBR confinement isolation valve.

4.4 Prior to performing any activities that could result in a breach of the Primary Air Cooling System, the area of the potential breach shall be prepared in accordance with the applicable RWP. Such steps where the potential for a system breach are known to exist are annotated with a **CAUTION** note preceding the step.

4.5 Sub-sections 6.1, 6.2, 6.3, 6.4 & 6.5 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.5 have been completed.

4.6 Pre-engineered scaffolding is required for this job. Scaffolding shall be erected and inspected in accordance with **BNL** and **OSHA 1926.451**.

4.7 Lifting of the major fan assembly has been determined to be a *Critical Lift* per **ESH 1.6.0, Material Handling: Equipment and Procedures.** All requirements of this procedure (e.g. Lifting Plans) shall be strictly adhered to in performance of this job.

## 5.0 PREREQUISITES

5.1 The Unreviewed Safety Issue Determination/Safety Evaluation (USID/SE) for Pile Fan No. 4 Removal has been approved.

Initial: _____ Date: _____ USID/SE No: _____

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 these 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 Fan House motor room.

Initial: _____ Date: _____

5.6 Verify all Special Materials, Tools and Equipment listed in Attachment 8.2 are available to support their respective work activities.

Initial: _____ Date: _____

5.7 Prior to removal of the fan unit, the inlet and outlet discharge flanges must be disconnected at their respective expansion joints. To minimize the spread of contamination, surface fixant such as Polymeric Barrier Spray (PBS) shall be injected into these areas utilizing a pressurized nozzle. The following methods will be used to accomplish.

5.7.1 Using self-tapping sheet metal screws, install HVAC test ports w/expandable plugs in the locations where PBS injection holes will be drilled in the next step. Holes shall be located to ensure optimum application of the fixant on the interior surfaces to prevent airborne contamination when the joint is breached.

5.7.2 Remove the expandable plug in the HVAC test port, and drill a hole through the system boundary (e.g. duct wall) in the center of the test port opening; reinstall the expandable plug to prevent spread of contamination to the exterior if the PBS is not being injected immediately.

5.7.3 Remove the expandable plug and inject the PBS moving the nozzle to achieve optimum interior coverage: reinstall plug when complete.

5.7.4 Allow the PBS to cure for the minimum time (8 hrs min.) specified on the manufacturer's label prior to breaching the system in the vicinity of the PBS application.

5.8 VERIFY that the overhead lifting monorail (beam) in the fan room has been load tested (a separate Work Permit has been initiated to perform this).

Initial: _____ Date: _____

## 6.0 WORK INSTRUCTIONS

NOTE 1: Attachment 8.1 contains pictorial outline of the following work activities.

NOTE 2: Sub-sections 6.1, 6.2, 6.3, 6.4 & 6.5 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.5 have been completed.

### 6.1 Inlet Valve & Damper Air Operator Linkages

6.1.1 VERIFY the fan inlet valve fully CLOSED.

6.1.2 SECURE the fan inlet valve in the CLOSED position.

6.1.3 DISCONNECT the linkage between the fan damper and the operator wall penetration.

6.1.4 REMOVE the linkage between fan damper and the operator wall penetration.

### 6.2 Remove Fan Housing Drain Valves and Piping

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.2.1 REMOVE the bonnets from the (3) fan housing drain valves, and the (1) fan housing discharge line drain valve.

6.2.2 At the 3" floor drain penetration, CUT the pipe that connects to tee, then BREAK the (4) unions.

6.2.3 REMOVE the entire piping assembly between the unions and the cut(s); INSTALL a 3" pipe cap on the 3" drain line penetrating the floor.

6.2.4 INJECT expandable filler foam (Hilti CF 116-14) into the remaining (4) drain lines through the unions, ensuring that the lines are filled back to the connection at the fan housing and discharge line.

6.2.5 After the foam has cured, REMOVE the (4) drain lines from the fan and discharge line and INSTALL a pipe plug in the drain connection on the fan discharge line.

6.2.6 DISCONNECT the (4) oil (supply & return) lines and INSTALL a 2" pipe plug in the oil connection on the pedestals bearing housing.

6.2.7 REMOVE the oil supply and return lines that penetrate the fan room/motor room wall and FILL the wall penetration with expandable filler foam.

## 6.3 Remove Fan Inlet Transition Housing

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.3.2 REMOVE the nuts only on the lower inlet transition housing fasteners, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing to stabilize the joint and maintain system integrity until the glove bag is placed around the joint in the next step.

NOTE:

Prior to commencing the following step, the sheet metal flange isolation covers should be readily accessible for immediate installation. Flanges shall be placed inside the glove bag when it is installed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.3 PLACE a glove bag containing the sheet metal flange covers around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.3.4 REMOVE the remaining nuts and bolts from the flanges.

6.3.5 CAREFULLY SPREAD the (2) inlet transition housing flanges from the fan inlet approx. 1", then immediately INSERT the sheet metal covers to isolate the fan inlet; SECURE the covers by bending over the retaining tabs.

6.3.6 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

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

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

6.3.9 REMOVE the remaining portion of the bellows and the inlet transition housing assembly using the overhead monorail and approved rigging.

## 6.4 Discharge Expansion Joint

NOTE:

As determined by the BGRR-DP Construction Manager/designee, the discharge expansion joint may be removed in one piece by unbolting at the flanges, or by cutting the bellows. Perform the appropriate steps that follow.

### 6.4.1 Removal of Expansion Joint by Cutting Bellows

6.4.1.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.1.2 SETUP plastic catch pockets around the circumference of the discharge 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.1.3 CUT the downstream (east) end of bellows around the circumference using a reciprocating saw or equivalent tool while using the rad vacuum cleaner nozzle to minimize the saw filings falling into the plastic catch.

6.4.1.4 INSTALL temporary plastic covers ("Herculite" or eq.) over both open ends of the bellows.

**6.4.2 Removal of Expansion Joint by Unbolting Flanges**

6.4.2.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.2.2 REMOVE the nuts only on the expansion joint flanges, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing on each flange to stabilize the joint and maintain system integrity until the glove bag is placed around the joint in the next step.

NOTE:

Prior to commencing the following step, the isolation covers should be readily accessible for immediate installation. Covers shall be placed inside the glove bag when it is installed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.2.3 PLACE a glove bag containing the sheet metal flange covers around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.4.2.4 REMOVE the remaining nuts and bolts from the flanges and REMOVE the expansion joint.

6.4.2.5 INSTALL flange isolation cover on the downstream flange at the discharge isolation valve.

6.4.2.6 COVER the fan discharge flange with plastic covering ("Herculite" or eq.).

## 6.5 Cutting Fan Shaft

NOTE:

The BGRR-DP Construction Manager/designee will determine the exact location of the cut in the following step.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP. SHAFT SHALL BE RADIOLOGICALLY CLEAN IN AREA OF CUT.**

6.5.1 SECURE in fan shaft on the fan room side of the wall to prevent the cut shaft piece from falling into the motor room after the shaft is severed.

6.5.2 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.

6.5.3 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.

**CAUTION:**

**THE FOLLOWING STEPS WILL BE PERFORMED IN THE MOTOR ROOM. A COMPREHENSIVE RADIOLOGICAL SURVEY OF THE FAN SHAFT WALL PENETRATION SPLIT COVER SHALL BE PERFORMED AND NECESSARY PRECAUTIONS SHALL BE TAKEN TO PREVENT ANY CROSS-CONTAMINATION OF THE MOTOR ROOM.**

6.5.4 REMOVE the severed portion of the fan shaft.

6.5.6 INSTALL a pre-fabricated cover over the Fan Room/Motor Room shaft hole in the split wall plate.

## 6.6 Lifting and Removal of Fan

6.6.1 VERIFY **Sub-sections 6.1 through 6.5** have been completed in their entirety.

6.6.2 VERIFY fan is rigged in accordance with lifting plans, and/or requirements of **ESH 1.6.0, Material Handling: Equipment and Procedures.**

6.6.3 LIFT the fan from the pillow blocks until the fan assembly is not bearing on the lower pillow block (1" - 2").

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

6.6.5 REMOVE the outboard fan pedestal.

6.6.6 LIFT the fan until the lower housing is clear of the concrete foundation.

NOTE:

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

6.6.7 INSTALL cribbing beneath the fan then LOWER fan onto cribbing.

6.6.8 REMOVE the (3) drain nipples and elbows from the bottom of the fan casing and INSTALL threaded pipe plugs in the fan housing.

6.6.9 LIFT fan and REMOVE the cribbing installed above.

6.6.10 PLACE the fan and all removed assemblies into proper containers for removal.

6.6.11 REMOVE the inboard bearing block/pedestal.

## 6.7 Discharge Expansion Joint Cover & Final Cleanup

NOTE:

Prior to commencing the following steps, the fabricated metal pipe cover shall be readily accessible for immediate installation when the temporary cover is removed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.7.1 If the discharge expansion joint bellows was cut (step 6.4.1, then REMOVE the temporary cover installed in Section 6.4, and IMMEDIATEDY INSTALL the fabricated metal cover over the downstream expansion joint flange using sealant and self-tapping sheet metal screws.

6.7.2 CLEAN and DECONTAMINATE the fan room to best achievable levels and survey for final documentation.

## 7.0 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

7.4 ESH 1.6.0 Material Handling: Equipment & Procedures

## 8.0 ATTACHMENTS

8.1 Pictorial Outline of Pile Fan No. 4 Work Activities

8.2 Special Material, Tools and Equipment

**Attachment 8.1**
**Page 1 of 7**

## Pictorial Outline of Pile Fan No. 4 Work Activities

### Contents

Photo 1 - HVAC Test Fitting Used As Injection Port

Photo 2 - Fan No. 4 Casing Drain Valve Manifold

Photo 3 - Suction Bellows/Volute Assembly

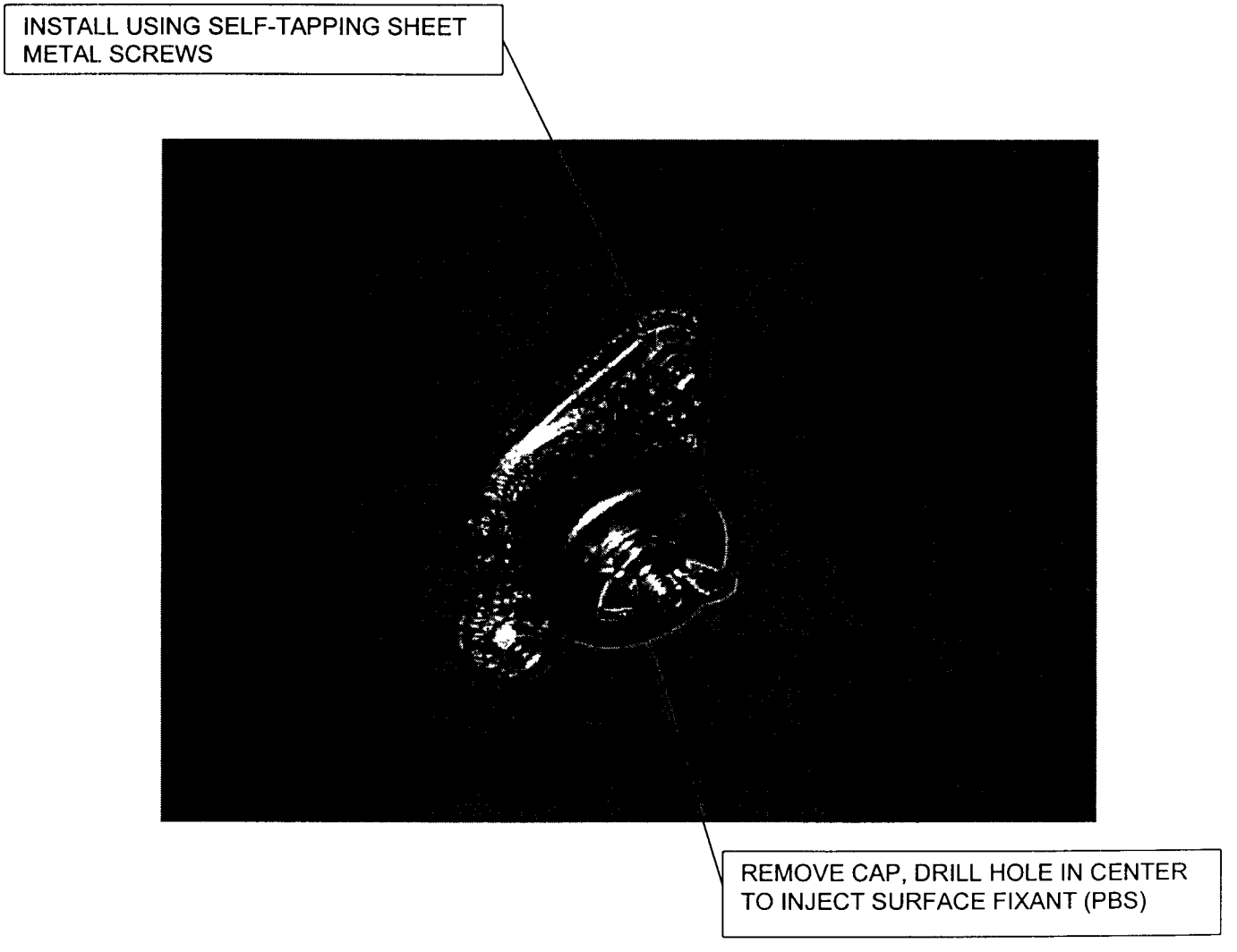
Photo 4 - Discharge Bellows & Flange

Photo 5 - Outboard Bearing Pedestal

Photo 6 - Inboard Bearing Pedestal and Shaft

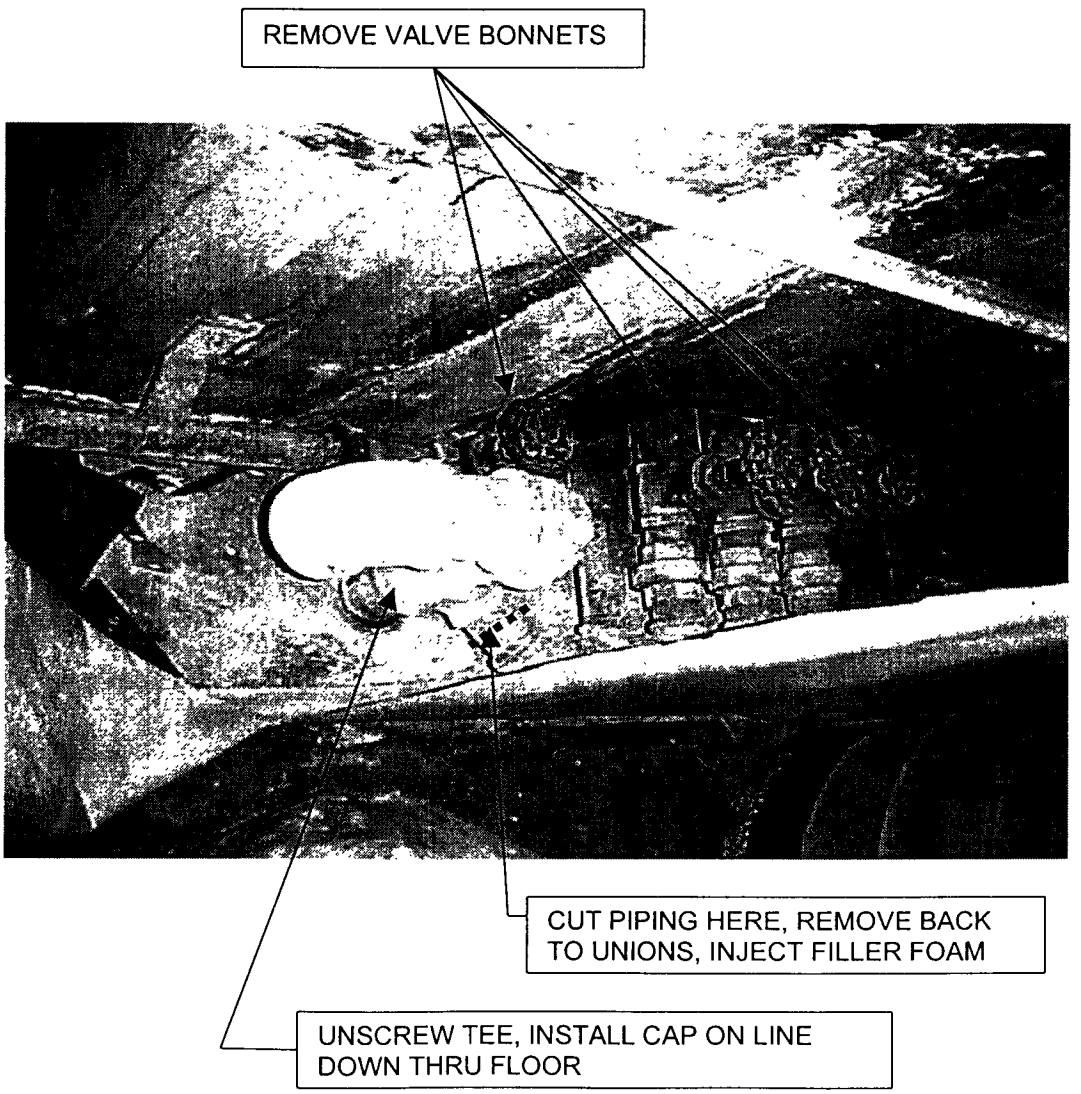
**Attachment 8.1**
**Page 2 of 7**

**Photo 1 - HVAC Test Fitting Used As Injection Port For Surface Fixant (PBS)**



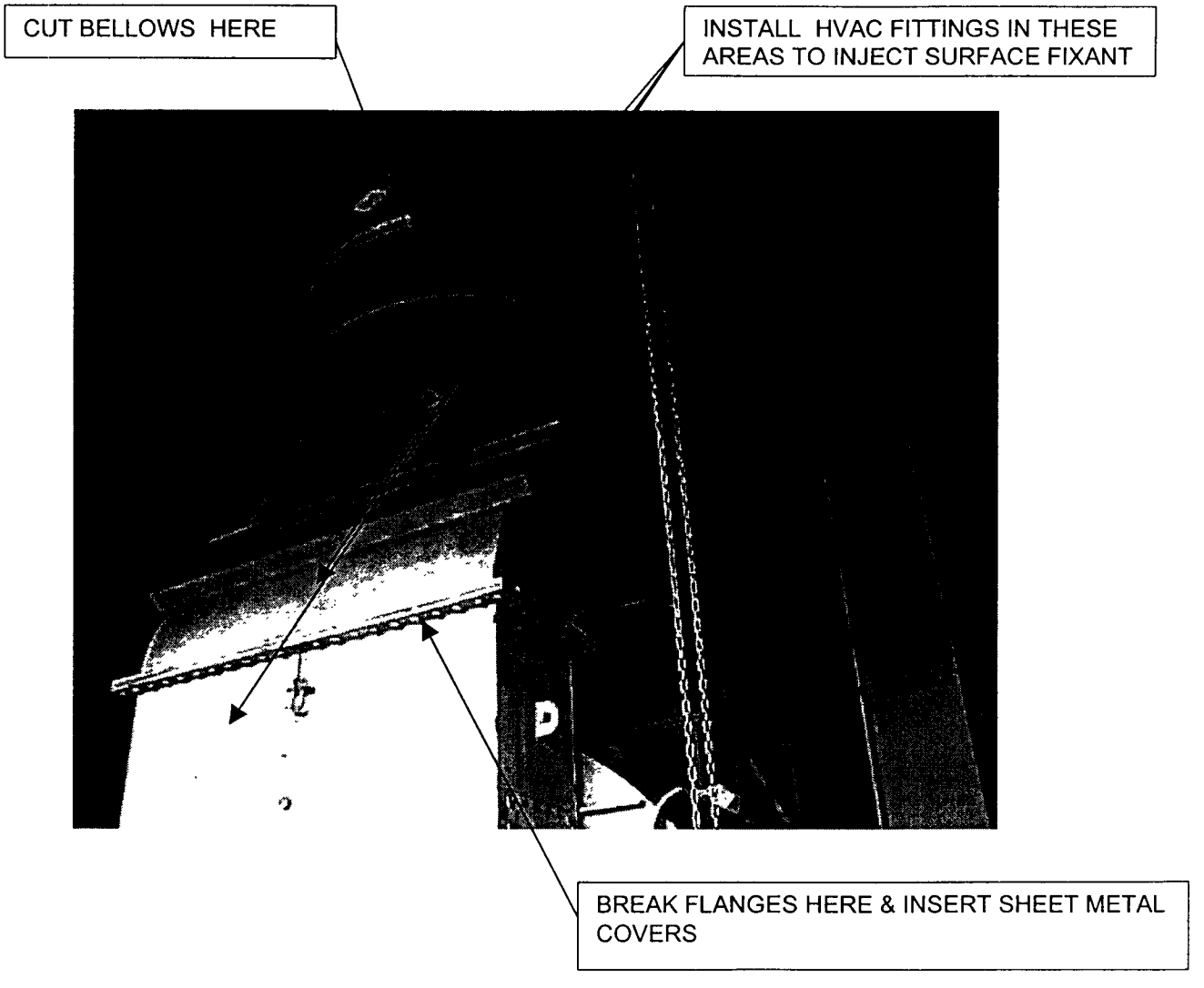
**Attachment 8.1**
**Page 3 of 7**

**Photo 2 - Fan No. 4 Casing Drain Valve Manifold**



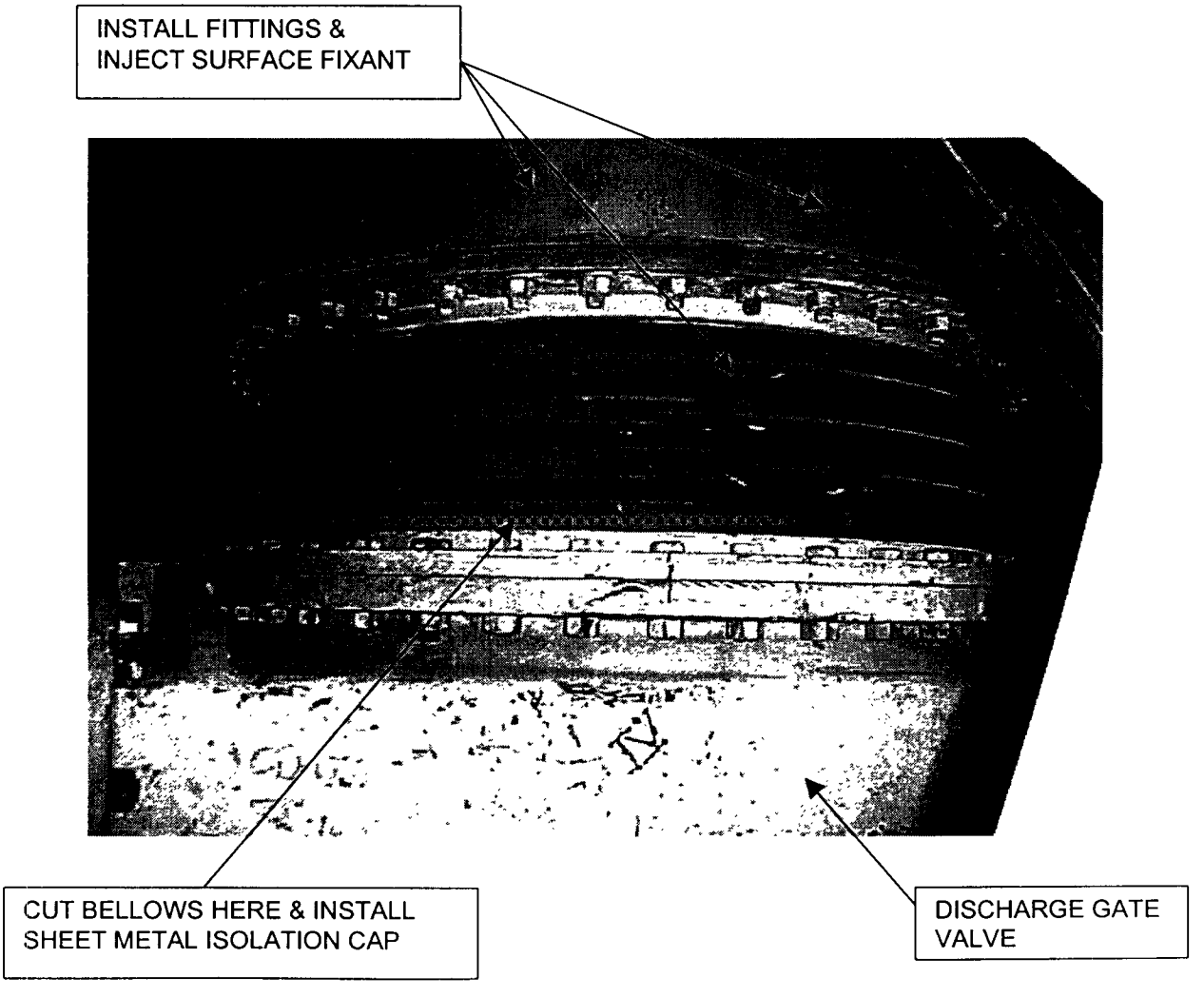
**Attachment 8.1**
**Page 4 of 7**

**Photo 3 - Suction Bellows/Volute Assembly**
**(Fan No. 5 shown, Fan. No 4 similar)**



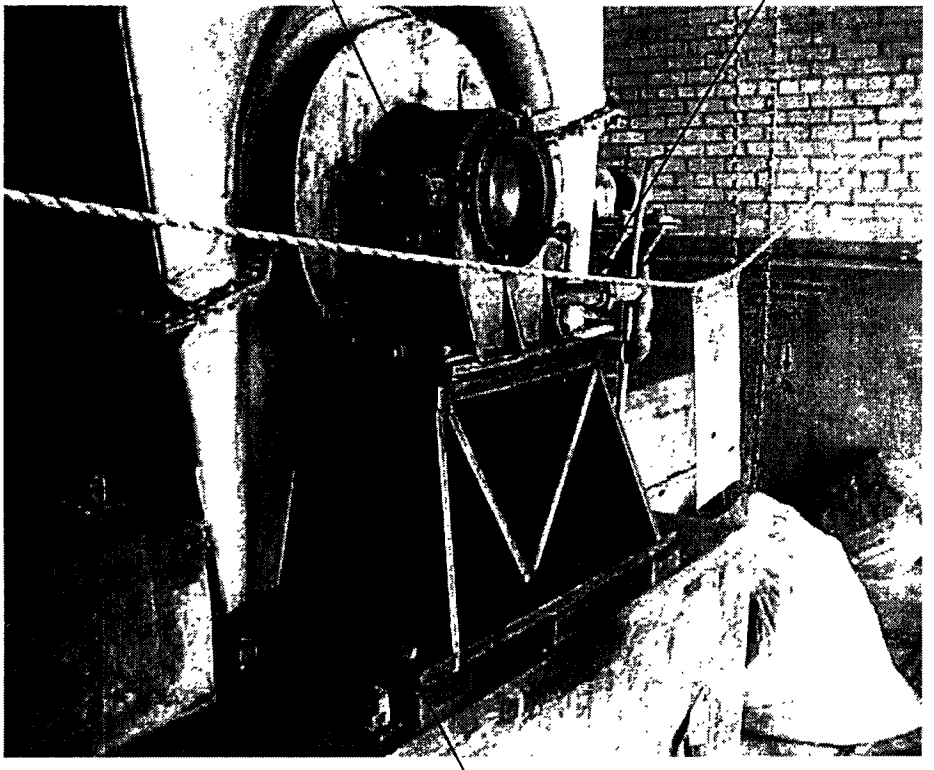
**Attachment 8.1**
**Page 5 of 7**

**Photo 4 - Discharge Bellows & Flange**



**Attachment 8.1**
**Page 6 of 7**

**Photo 5 - Outboard Bearing Pedestal**
**(Fan No. 5 shown, Fan No. 4 similar)**



**Attachment 8.1**
**Page 7 of 7**

**Photo 6 - Inboard Bearing Pedestal and Shaft**
**(Fan No. 5 shown, Fan No. 4 similar)**

# Attachment 8.2
## Special Materials, Tools and Equipment


| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| 3' THREADED PIPE CAP | 6.2.3 | 1 |
| THREADED PIPE PLUGS 2" & 1-1/2" | 6.2.5, 6.2.6, 6.6.8 | (7) 2", (1) 1-1/2" |
| 48" FLANGE ISOLATION COVER (FABRICATE) | 6.4.2 | 2 |
| FAN INLET SHEET METAL FLANGE COVER (FABRICATE) | 6.3.5 | 2 |
| POLYMERIC BARRIER SPRAY (PBS) AND INJECTION NOZZLE/PUMP | 6.3.1 6.4.1 | AS REQ'D |
| RECIPROCATING SAW | 6.3.7 | 1 |
| DRILL & BITS FOR 1/4" HOLES | 6.3.1, 6.4.1. | 1 |
| FLAME-CUTTING TORCH | 6.5.3 | 1 |
| C-CLAMPS | 6.4.4 | AS REQ'D |
| FLANGE SPREADER | 6.4.4 | AS REQ'D |
| HERCULITE | 6.3.8, 6.4.1(2), | AS REQ'D |
| SCAFFOLDING | AS REQ'D | AS REQ'D |
| COVER FOR FAN SHAFT HOLE (FABRICATE) | 6.5.6 | 1 |
| CRIBBING MATERIALS | AS REQ'D | AS REQ'D |

# Attachment 8.2
## Special Materials, Tools and Equipment


| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| RIGGING EQUIPMENT PER PLAN | AS REQ'D | AS REQ'D |
| HAND TOOLS (REVIEW FOR NEEDS) | AS REQ'D | AS REQ'D |
| 48" PIPE COVER (FABRICATE FROM 18 GA GALV. SHEET METAL OR EQ.) | 6.7.1** | 1 |
| EXPANDABLE FILLER FOAM HILTI CF 116-14 | 6.2.2, 6.2.7 | AS REQ'D |
| PIPE CUTTER (3' CAPABILITY) | 6.2.2 | 1 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**ONLY REQUIRED IF BELLOWS IS CUT AT DISHCHARGE EXPANSION JOINT

**ERD Procedures Manual**

# TECHNICAL WORK DOCUMENT
# PILE FAN NO. 3 REMOVAL

Text Pages 1 through 12
Attachment(s) 8.1 and 8.2

**Temporary Procedure**

Approved: _____ Date: 12/3/99
Stephen K. Pulsford, Manager
BGRR Decommissioning Project

Approved: _____ Date: 12/3/99
HFBR Operations

Preparer: **T. Jernigan**

Expiration Date: **January 31, 2000**

ERD OPM No.: **ERD-BGRR-TP-99-4**

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## 1.0 PURPOSE

1.1 To provide the detailed work instructions for the removal of the No. 3 Pile Fan.

## 2.0 SCOPE

2.1 This document covers work activities associated with the removal of No. 3 Pile Fan including, but not limited to, necessary preparation and setup, and removal of interference's.

## 3.0 RESPONSIBILITIES

3.1 The BGRR-DP Construction Manager or designee is responsible for the proper execution of this Work Document.

3.2 The BGRR-DP Project Engineer or designee is responsible for the technical content of this Work Document.

3.3 The BGRR-DP ESH&Q Manager or designee is responsible for all environmental, health and safety issues associated with the work activities delineated herein.

## 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. 3 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 of the Primary Air Cooling System are exposed, a surface fixant such as 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 so throughout all work activities. This valve is an HFBR confinement isolation valve.

4.4 Prior to performing any activities that could result in a breach of the Primary Air Cooling System, the area of the potential breach shall be prepared in accordance with the applicable RWP. Such steps where the potential for a system breach are known to exist are annotated with a **CAUTION** note preceding the step.

4.5 Sub-sections 6.1, 6.2, 6.3 & 6.4 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.5, 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.4 have been completed.

4.6 Pre-engineered scaffolding is required for this job. Scaffolding shall be erected and inspected in accordance with **BNL** and **OSHA 1926.451**.

4.7 Lifting of the major fan assembly has been determined to be a *Critical Lift* per **ESH 1.6.0, Material Handling: Equipment and Procedures.** All requirements of this procedure (e.g. Lifting Plans) shall be strictly adhered to in performance of this job.

## 5.0 PREREQUISITES

5.1 The Unreviewed Safety Issue Determination/Safety Evaluation (USID/SE) for Pile Fan No. 3 Removal has been approved.

Initial: _____ Date: _____ USID/SE No: _____

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 these 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 Fan House motor room.

Initial: _____ Date: _____

5.6 Verify all Special Materials, Tools and Equipment listed in Attachment 8.2 are available to support their respective work activities.

Initial: _____ Date: _____

5.7 Prior to removal of the fan unit, the inlet and outlet discharge flanges must be disconnected at their respective expansion joints. Additionally, the outboard fan inlet housing must be removed to allow the fan to be placed in a shipping container. To minimize the spread of contamination, surface fixant such as Polymeric Barrier Spray (PBS) shall be injected into these areas utilizing a pressurized nozzle. The following methods will be used to accomplish this:

5.7.1 Using self-tapping sheet metal screws, install HVAC test ports w/expandable plugs in the locations where PBS injection holes will be drilled in the next step. Holes shall be located to ensure optimum application of the fixant on the interior surfaces to prevent airborne contamination when the joint is breached.

5.7.2 Remove the expandable plug in the HVAC test port, and drill a hole through the system boundary (e.g. duct wall) in the center of the test port opening; reinstall the expandable plug to prevent spread of contamination to the exterior if the PBS is not being injected immediately.

5.7.3 Remove the expandable plug and inject the PBS moving the nozzle to achieve optimum interior coverage: reinstall plug when complete.

5.7.4 Allow the PBS to cure for the minimum time specified on the manufacturer's label (8 hrs) prior to breaching the system in the vicinity of the PBS application.

5.8 VERIFY that the overhead lifting monorail (beam) in the fan room has been load tested (a separate Work Permit has been initiated to perform this).

Initial: _____ Date: _____

## 6.0 WORK INSTRUCTIONS

NOTE 1: Attachment 8.1 contains pictorial outline of the following work activities.

NOTE 2: Sub-sections 6.1, 6.2, 6.3 and 6.4 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.5, 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.4 have been completed.

### 6.1 Inlet Valve Air Operator Linkage

6.1.1 VERIFY the fan inlet valve fully CLOSED.

6.1.2 SECURE the fan inlet valve in the CLOSED position.

6.1.3 DISCONNECT the linkage between the fan damper and the operator wall penetration.

6.1.4 REMOVE the linkage between fan damper and the operator wall penetration.

### 6.2 Remove Fan Housing Drain Valves and Piping

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.2.1 REMOVE the bonnets from the (3) fan housing drain valves, and the (1) fan housing discharge line drain valve.

6.2.2 At the 3" floor drain penetration, CUT the pipe that connects to tee, then BREAK the (4) unions.

6.2.3 REMOVE the entire piping assembly between the unions and the cut(s); INSTALL a 3" pipe cap on the 3" drain line penetrating the floor.

6.2.4 INJECT expandable filler foam (Hilti CF 116-14) into the remaining (4) drain lines through the unions, ensuring that the lines are filled completely back to the connection at the fan housing and discharge line.

6.2.5 After the foam has cured (i.e. FIRM), REMOVE the (4) drain lines from the fan and discharge line and INSTALL a pipe plug in the drain connection on the fan discharge line.

6.2.6 DISCONNECT the (4) bearing water cooling lines and INSTALL a pipe plug in the cooling water connection on the bearing pedestals.

6.2.7 REMOVE the water supply and return lines that penetrate the fan room/motor room wall (CUT lines if necessary), and FILL the wall penetration with expandable filler foam.

## 6.3 Remove Fan Inlet Transition Housing

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.3.2 REMOVE the nuts only on the lower inlet transition housing fasteners, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing to stabilize the joint and maintain system integrity until the glove is placed around the joint in the next step.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.3 PLACE a glove bag around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.3.4 REMOVE the remaining nuts and bolts from the flanges.

NOTE:

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

6.3.5 CAREFULLY SPREAD the (2) inlet transition housing 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.

6.3.6 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

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

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

6.3.9 REMOVE the remaining portion of the bellows and the inlet transition housing assembly using the overhead monorail and approved rigging.

## 6.4 Discharge Expansion Joint

NOTE:

As determined by the BGRR-DP Construction Manager/designee, the discharge expansion joint may be removed in one piece by unbolting at the flanges, or by cutting the bellows. Perform the appropriate steps that follow.

### 6.4.1 Removal of Expansion Joint by Cutting Bellows

6.4.1.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.1.2 SETUP plastic catch pockets around the circumference of the discharge 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.1.3 CUT the downstream (east) end of bellows around the circumference using a reciprocating saw or equivalent tool while using the rad vacuum cleaner nozzle to minimize the saw filings falling into the plastic catch.

6.4.1.4 INSTALL temporary plastic covers ("Herculite" or eq.) over both open ends of the bellows.

### 6.4.2 Removal of Expansion Joint by Unbolting Flanges

6.4.2.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.2.2 REMOVE the nuts only on the expansion joint flanges, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing on each flange to stabilize the joint and maintain system integrity until the glove bag is placed around the joint in the next step.

NOTE:

Prior to commencing the following step, the isolation covers should be readily accessible for immediate installation. Covers shall be placed inside the glove bag when it is installed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.2.3 PLACE a glove bag containing the sheet metal flange covers around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.4.2.4 REMOVE the remaining nuts and bolts from the flanges and REMOVE the expansion joint.

6.4.2.5 INSTALL flange isolation cover on the downstream flange at the discharge isolation valve.

6.4.2.6 COVER the fan discharge flange with plastic covering ("Herculite" or eq.).

## 6.5 Lifting of Fan & Initial Shaft Cutting

**CAUTION:**

**THE FOLLOWING STEPS WILL BE PERFORMED IN THE MOTOR ROOM. A COMPREHENSIVE RADIOLOGICAL SURVEY OF THE FAN SHAFT WALL PENETRATION SPLIT COVER SHALL BE PERFORMED AND NECESSARY PRECAUTIONS SHALL BE TAKEN TO PREVENT ANY CROSS-CONTAMINATION OF THE MOTOR ROOM.**

NOTE:

The initial lift will take the load off of the inboard pedestal bearing to allow its removal and cutting of the inboard shaft. Then the fan will be lifted to allow removal of the outboard fan housing and final shaft cutting in the following sub-section.

6.5.1 VERIFY **Sub-sections 6.1 through 6.4** have been completed in their entirety.

6.5.2 REMOVE the inboard and outboard upper pillow block housings, and all remaining fasteners securing the fan to the foundation.

6.5.3 Using hydraulic jacks, LIFT the fan until there is no weight bearing on the inboard pedestal bearing.

6.5.4 PLACE cribbing below the fan housing to support the weight of the assembly to facilitate removal of the inboard and outboard pedestal bearings, then LOWER the fan assembly onto the cribbing.

6.5.5 REMOVE the outboard pillow block and bearing pedestal in its entirety.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP. SHAFT SHALL BE RADIOLOGICALLY CLEAN IN AREA OF CUT.**

6.5.6 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.

6.5.7 CUT the inboard fan shaft as close to the fan housing as practicable to allow the fan assembly to fit in the shipping container.

6.5.8 INSTALL a fabricated cover to seal the penetration between the fan room and motor room.

## 6.6 Removal of Outboard Fan Housing, Shaft Cutting & Fan Removal

NOTE:

In the following steps, the fan assembly will first be lifted from its foundation to a height sufficient to allow removal of the outboard fan housing. This will allow the fan assembly to fit inside of the shipping container.

6.6.1 VERIFY fan is rigged in accordance with lifting plans, and/or requirements of **ESH 1.6.0, Material Handling: Equipment and Procedures.**

6.6.2 LIFT the fan until the outboard housing is clear of the pedestal foundation.

6.6.3 PLACE cribbing below the fan housing to support the weight of the assembly to facilitate removal of the outboard fan housing, then LOWER the fan assembly onto the cribbing with all of the fan

6.6.4 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.6.5 REMOVE the outboard fan housing and immediately cover both open sides of the housing with plastic covering.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP.**

6.6.6 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.

6.6.7 CUT the outboard fan shaft to achieve an overall shaft length of less than 7'-6" to allow the fan assembly to fit in the shipping container.

6.6.8 REMOVE the outboard bearing block/pedestal.

6.6.9 PLACE the fan assembly and all removed components into the proper container for shipping and/or disposal.

## 6.7 Discharge Expansion Joint Cover & Final Cleanup

NOTE:

Prior to commencing the following steps, the fabricated metal pipe cover shall be readily accessible for immediate installation when the temporary cover is removed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.7.1 If the discharge expansion joint bellows was cut (step 6.4.1, then REMOVE the temporary cover installed in Section 6.4, and IMMEDIATELY INSTALL the fabricated metal cover over the downstream expansion joint flange using sealant and self-tapping sheet metal screws.

6.7.2 CLEAN and DECONTAMINATE the fan room to best achievable levels and survey for final documentation.

## 7.0 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

7.4 ESH 1.6.0 Material Handling: Equipment & Procedures

7.5 USID/SE BGRR-SE-99-03, Removal of Residual Fans.

## 8.0 ATTACHMENTS

8.1 Pictorial Outline of Pile Fan No. 3 Work Activities

8.2 Special Material, Tools and Equipment

**Attachment 8.1**
**Page 1 of 8**

## Pictorial Outline of Pile Fan No. 3 Work Activities

### Contents

Photo 1 - HVAC Test Fitting Used As Injection Port

Photo 2 - Fan No. 3 Casing Drain Valve Manifold

Photo 3 - Suction Bellows/Volute Assembly

Photo 4 - Discharge Bellows & Flange

Photo 5 - Outboard Pedestal Bearing

Photo 6 - Inboard Pedestal Bearing

Photo 7 - Outboard Fan Housing

**Attachment 8.1**
**Page 2 of 8**

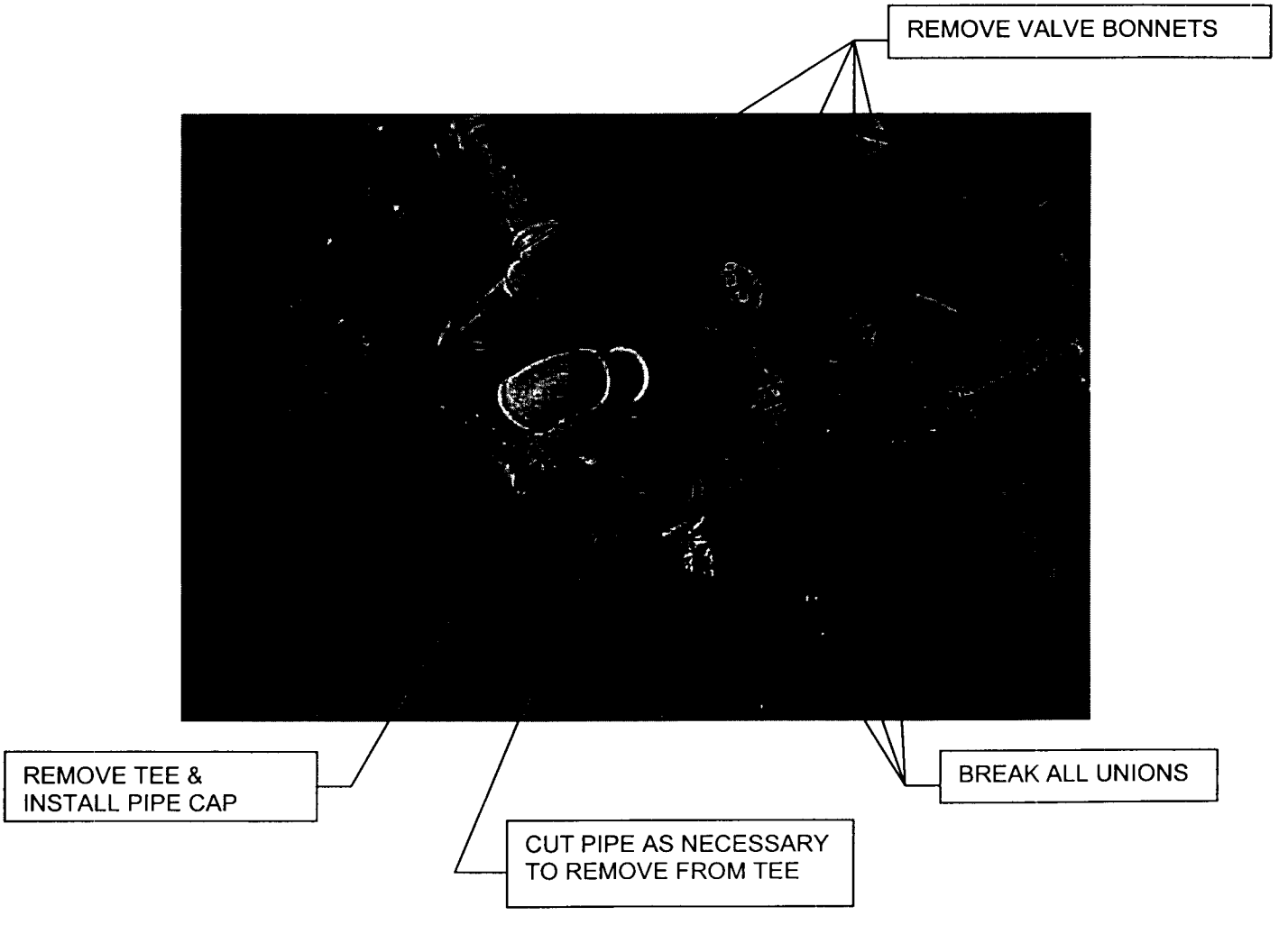
**Photo 1 - HVAC Test Fitting Used As Injection Port For Surface Fixant (PBS)**

INSTALL USING SELF-TAPPING SHEET METAL SCREWS

REMOVE CAP, DRILL HOLE IN CENTER TO INJECT SURFACE FIXANT (PBS)

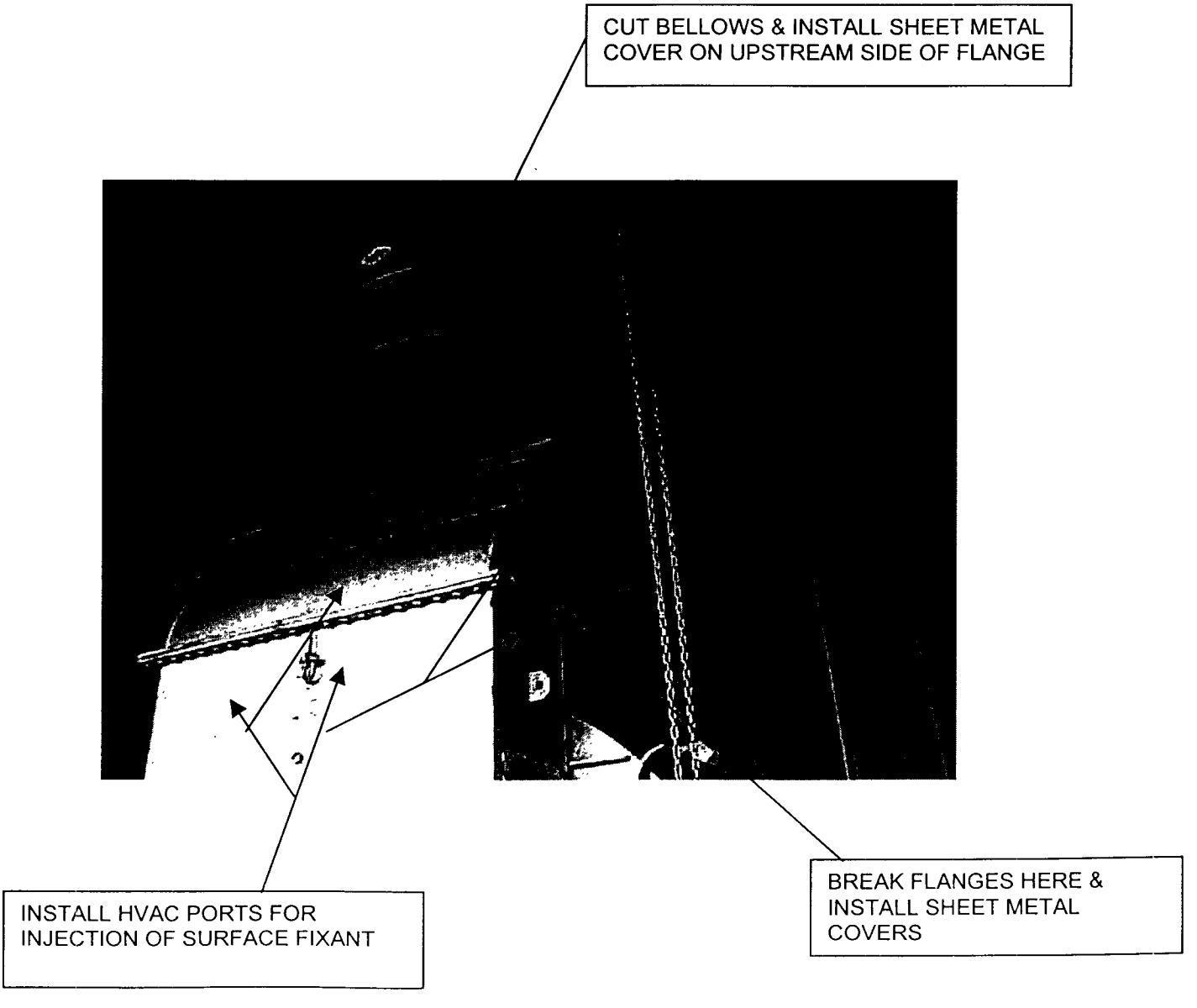
**Attachment 8.1**
**Page 3 of 8**

**Photo 2 - Fan No. 3 Casing Drain Valve Manifold**



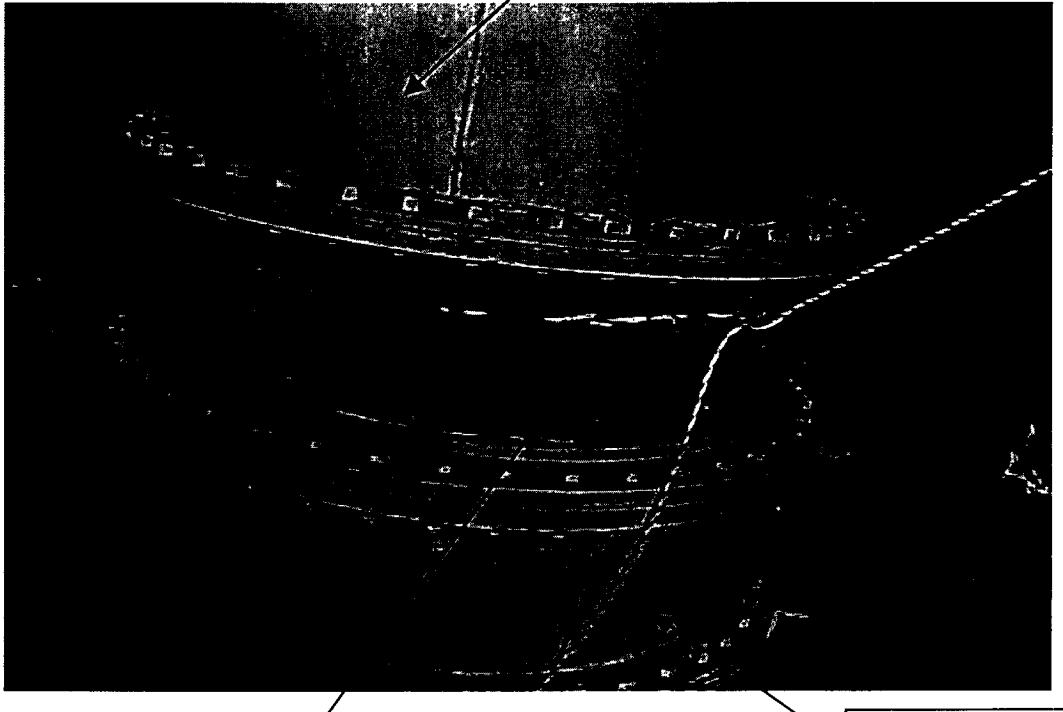
**Attachment 8.1**
**Page 4 of 8**

**Photo 3 - Suction Bellows/Volute Assembly**
**(Fan No. 5 shown, Fan No. 3 similar)**



**Attachment 8.1**
**Page 5 of 8**

**Photo 4 - Discharge Bellows & Flange**



**Attachment 8.1**
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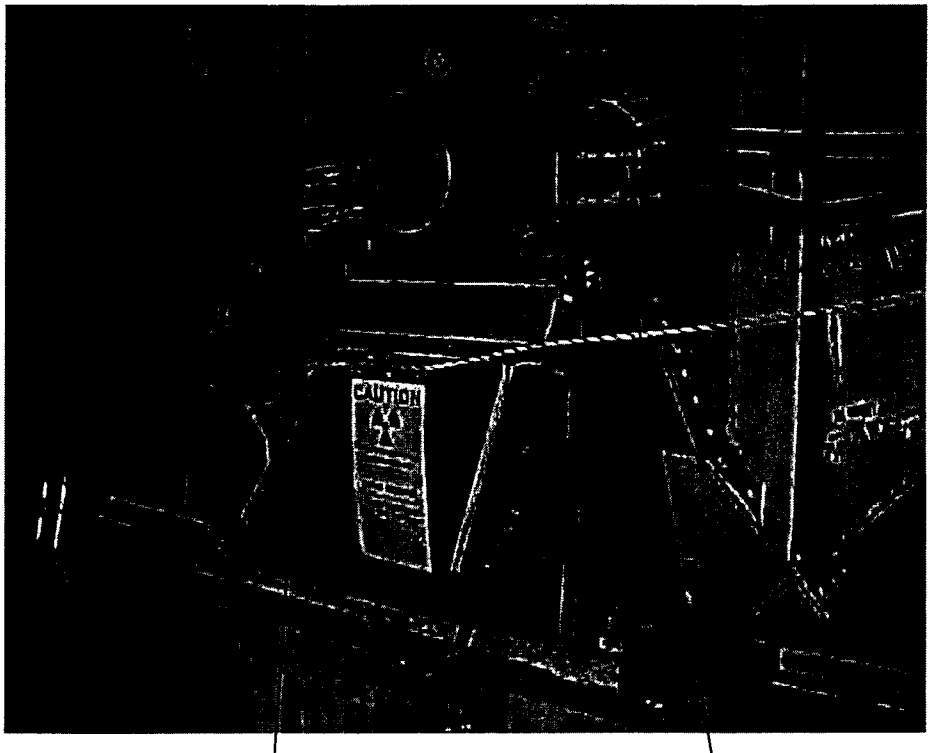
**Photo 5 - Outboard Pedestal Bearing**

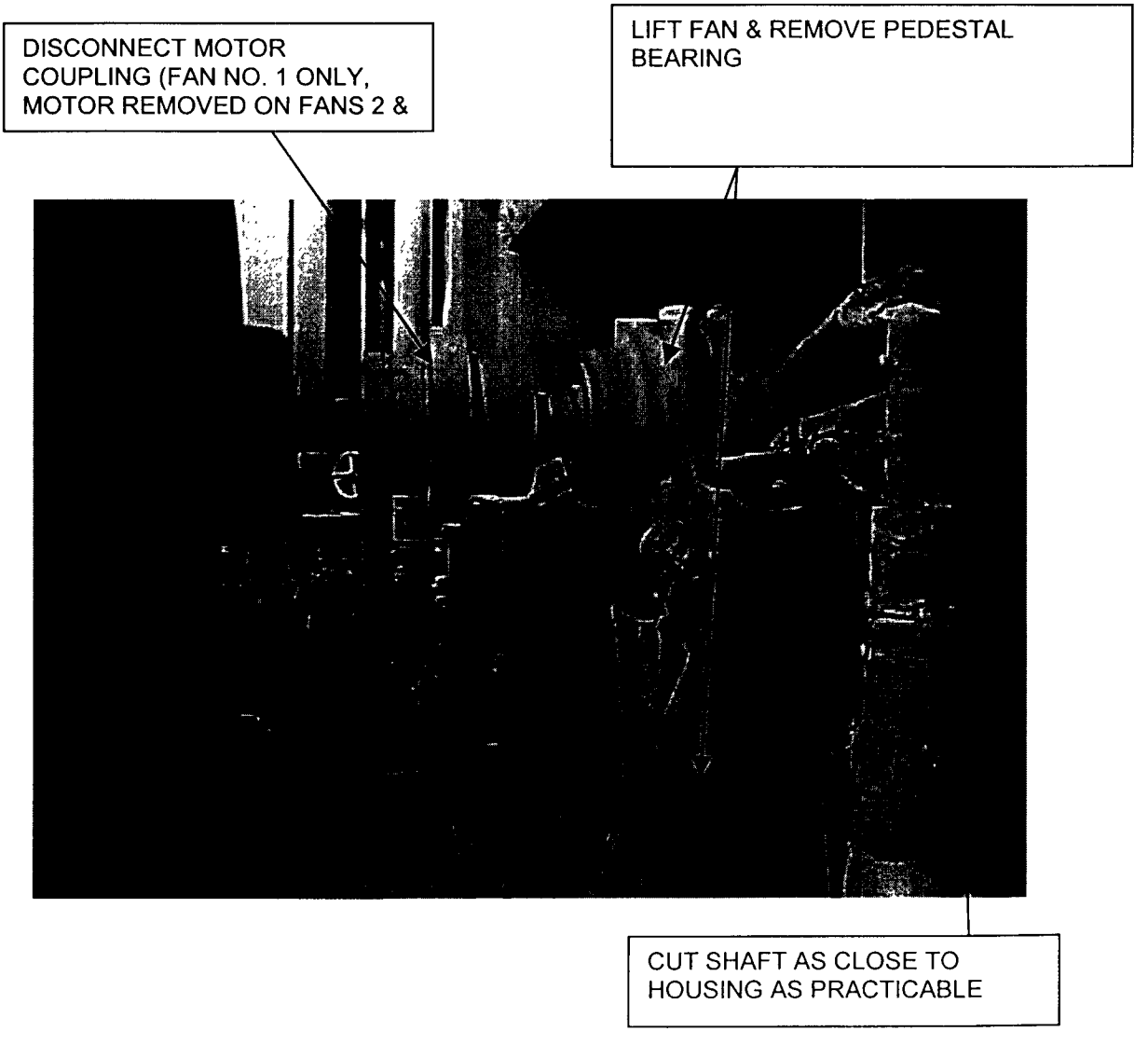



REMOVED PEDESTAL BEARING

REMOVE BEARING COOLING LINES & INSTALL PLUGS

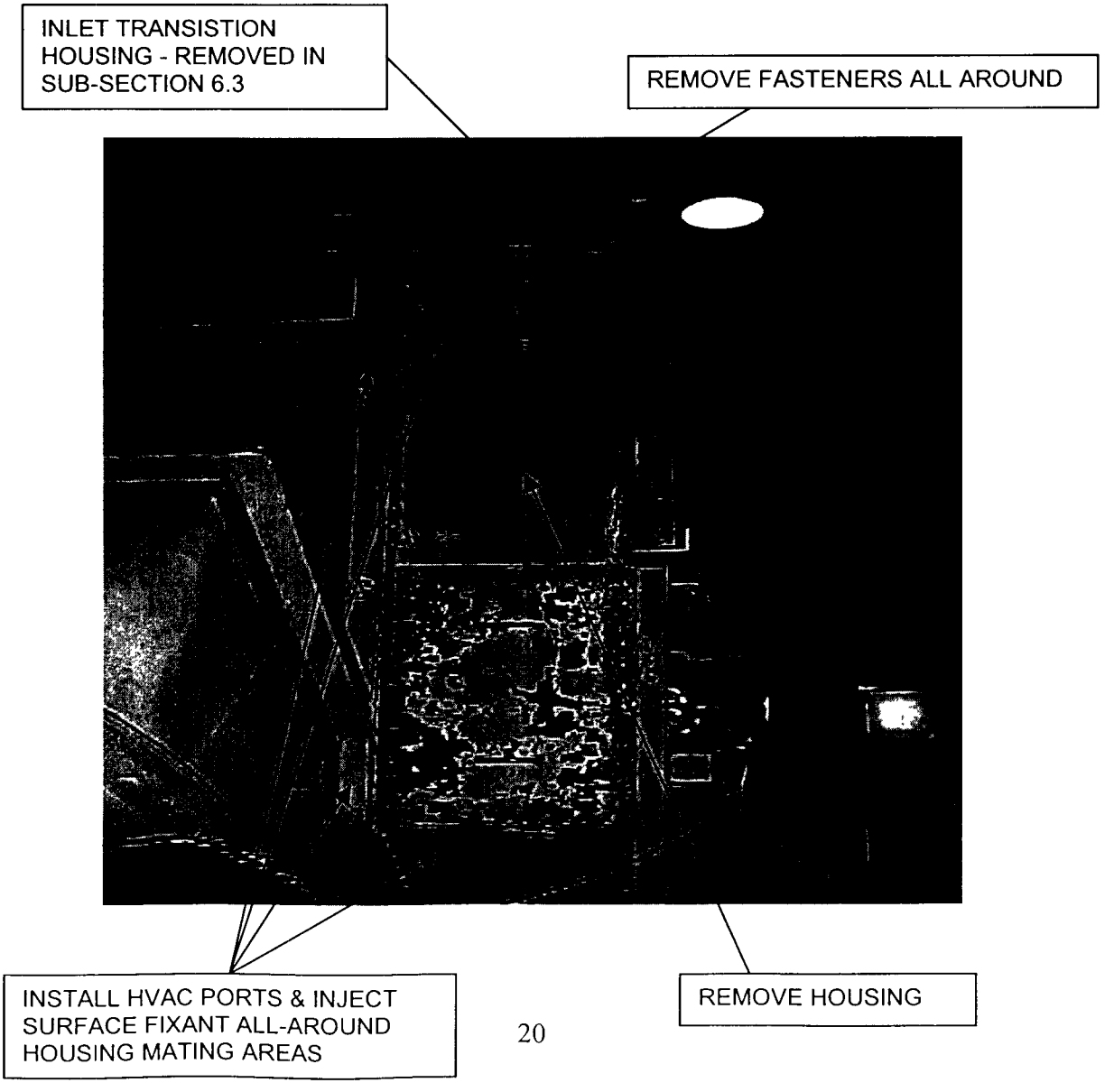
**Attachment 8.1**
**Page 7 of 8**

**Photo 6 - Inboard Pedestal Bearing**



**Attachment 8.1**
**Page 8 of 8**

**Photo 8 - Outboard Fan Housing**



# Attachment 8.2
## Special Materials, Tools and Equipment


| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| 3' THREADED PIPE CAP | 6.2.3 | 1 |
| THREADED PIPE PLUGS 2" & 1-1/2" | 6.2.5, 6.2.6, 6.6.8 | (7) 2", (1) 1-1/2" |
| 48" SHEET METAL FLANGE COVER (FABRICATE) | 6.4.4 | 2 |
| FAN INLET SHEET METAL FLANGE COVER (FABRICATE) | 6.3.5 | 2 |
| POLYMERIC BARRIER SPRAY (PBS) AND INJECTION NOZZLE/PUMP | 6.3.1 6.4.1 | AS REQ'D |
| RECIPROCATING SAW | 6.3.7 | 1 |
| DRILL & BITS FOR 1/4" HOLES | 6.3.1, 6.4.1. | 1 |
| FLAME-CUTTING TORCH | 6.5.3 | 1 |
| C-CLAMPS | 6.4.4 | AS REQ'D |
| FLANGE SPREADER | 6.4.4 | AS REQ'D |
| HERCULITE | 6.3.9 & AS REQ'D | AS REQ'D |
| SCAFFOLDING | AS REQ'D | AS REQ'D |
| COVER FOR FAN SHAFT HOLE (FABRICATE) | 6.5.8 | 1 |
| CRIBBING MATERIALS | AS REQ'D | AS REQ'D |

# Attachment 8.2
## Special Materials, Tools and Equipment
## Page 2 of 2

| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| RIGGING EQUIPMENT PER PLAN | AS REQ'D | AS REQ'D |
| HAND TOOLS (REVIEW FOR NEEDS) | AS REQ'D | AS REQ'D |
| 48" BLIND FLANGE (FABRICATE FROM 1/4" ALUM PLATE OR EQ.) | 6.7 | 1 |
| EXPANDABLE FILLER FOAM HILTI CF 116-14 | 6.2.2, 6.2.7 | AS REQ'D |
| PIPE CUTTER (3" CAPABILITY) | 6.2.2 | 1 |
| HYDRAULIC JACKS | 6.5.5 | AS REQ'D |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**ERD Procedures Manual**

# TECHNICAL WORK DOCUMENT
# PILE FAN NO. 2 REMOVAL

Text Pages 1 through 12
Attachment(s) 8.1 and 8.2

**Temporary Procedure**

Approved: _____ Date: 12/3/99
Stephen K. Pulsford, Manager
BGRR Decommissioning Project

Approved: _____ Date: 12/3/99
HFBR Operations

Preparer: **T. Jernigan**

Expiration Date: **January 31, 2000**

ERD OPM No.: **ERD-BGRR-TP-99-3**

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## 1.0 PURPOSE

1.1 To provide the detailed work instructions for the removal of the No. 2 Pile Fan.

## 2.0 SCOPE

2.1 This document covers work activities associated with the removal of No. 2 Pile Fan including, but not limited to, necessary preparation and setup, and removal of interference's.

## 3.0 RESPONSIBILITIES

3.1 The BGRR-DP Construction Manager or designee is responsible for the proper execution of this Work Document.

3.2 The BGRR-DP Project Engineer or designee is responsible for the technical content of this Work Document.

3.3 The BGRR-DP ESH&Q Manager or designee is responsible for all environmental, health and safety issues associated with the work activities delineated herein.

## 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. 2 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 of the Primary Air Cooling System are exposed, a surface fixant such as 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 so throughout all work activities. This valve is an HFBR confinement isolation valve.

4.4 Prior to performing any activities that could result in a breach of the Primary Air Cooling System, the area of the potential breach shall be prepared in accordance with the applicable RWP. Such steps where the potential for a system breach are known to exist are annotated with a **CAUTION** note preceding the step.

4.5 Sub-sections 6.1, 6.2, 6.3 & 6.4 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.5, 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.4 have been completed.

4.6 Pre-engineered scaffolding is required for this job. Scaffolding shall be erected and inspected in accordance with **BNL** and **OSHA 1926.451**.

4.7 Lifting of the major fan assembly has been determined to be a *Critical Lift* per **ESH 1.6.0, Material Handling: Equipment and Procedures.** All requirements of this procedure (e.g. Lifting Plans) shall be strictly adhered to in performance of this job.

## 5.0 PREREQUISITES

5.1 The Unreviewed Safety Issue Determination/Safety Evaluation (USID/SE) for Pile Fan No. 2 Removal has been approved.

Initial: _____ Date: _____ USID/SE No: _____

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 these 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 Fan House motor room.

Initial: _____ Date: _____

5.6 Verify all Special Materials, Tools and Equipment listed in Attachment 8.2 are available to support their respective work activities.

Initial: _____ Date: _____

5.7 Prior to removal of the fan unit, the inlet and outlet discharge flanges must be disconnected at their respective expansion joints. Additionally, the outboard fan inlet housing must be removed to allow the fan to be placed in a shipping container. To minimize the spread of contamination, surface fixant such as Polymeric Barrier Spray (PBS) shall be injected into these areas utilizing a pressurized nozzle. The following methods will be used to accomplish this:

5.7.1 Using self-tapping sheet metal screws, install HVAC test ports w/expandable plugs in the locations where PBS injection holes will be drilled in the next step. Holes shall be located to ensure optimum application of the fixant on the interior surfaces to prevent airborne contamination when the joint is breached.

5.7.2 Remove the expandable plug in the HVAC test port, and drill a hole through the system boundary (e.g. duct wall) in the center of the test port opening; reinstall the expandable plug to prevent spread of contamination to the exterior if the PBS is not being injected immediately.

5.7.3 Remove the expandable plug and inject the PBS moving the nozzle to achieve optimum interior coverage: reinstall plug when complete.

5.7.4 Allow the PBS to cure for the minimum time specified on the manufacturer's label (8 hrs) prior to breaching the system in the vicinity of the PBS application.

5.8 VERIFY that the overhead lifting monorail (beam) in the fan room has been load tested (a separate Work Permit has been initiated to perform this).

Initial: _____ Date: _____

## 6.0 WORK INSTRUCTIONS

NOTE 1: Attachment 8.1 contains pictorial outline of the following work activities.

NOTE 2: Sub-sections 6.1, 6.2, 6.3 and 6.4 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.5, 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.4 have been completed.

### 6.1 Inlet Valve Air Operator Linkage

6.1.1 VERIFY the fan inlet valve fully CLOSED.

6.1.2 SECURE the fan inlet valve in the CLOSED position.

6.1.3 DISCONNECT the linkage between the fan damper and the operator wall penetration.

6.1.4 REMOVE the linkage between fan damper and the operator wall penetration.

### 6.2 Remove Fan Housing Drain Valves and Piping

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.2.1 REMOVE the bonnets from the (3) fan housing drain valves, and the (1) fan housing discharge line drain valve.

6.2.2 At the 3" floor drain penetration, CUT the pipe that connects to tee, then BREAK the (4) unions.

6.2.3 REMOVE the entire piping assembly between the unions and the cut(s); INSTALL a 3" pipe cap on the 3" drain line penetrating the floor.

6.2.4 INJECT expandable filler foam (Hilti CF 116-14) into the remaining (4) drain lines through the unions, ensuring that the lines are filled completely back to the connection at the fan housing and discharge line.

6.2.5 After the foam has cured (i.e. FIRM), REMOVE the (4) drain lines from the fan and discharge line and INSTALL a pipe plug in the drain connection on the fan discharge line.

6.2.6 DISCONNECT the (4) bearing water cooling lines and INSTALL a pipe plug in the cooling water connection on the bearing pedestals.

6.2.7 REMOVE the water supply and return lines that penetrate the fan room/motor room wall (CUT lines if necessary), and FILL the wall penetration with expandable filler foam.

## 6.3 Remove Fan Inlet Transition Housing

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.3.2 REMOVE the nuts only on the lower inlet transition housing fasteners, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing to stabilize the joint and maintain system integrity until the glove is placed around the joint in the next step.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.3 PLACE a glove bag around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.3.4 REMOVE the remaining nuts and bolts from the flanges.

NOTE:

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

6.3.5 CAREFULLY SPREAD the (2) inlet transition housing 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.

6.3.6 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

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

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

6.3.9 REMOVE the remaining portion of the bellows and the inlet transition housing assembly using the overhead monorail and approved rigging.

## 6.4 Discharge Expansion Joint

NOTE:

As determined by the BGRR-DP Construction Manager/designee, the discharge expansion joint may be removed in one piece by unbolting at the flanges, or by cutting the bellows. Perform the appropriate steps that follow.

### 6.4.1 Removal of Expansion Joint by Cutting Bellows

6.4.1.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.1.2 SETUP plastic catch pockets around the circumference of the discharge 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.1.3 CUT the downstream (east) end of bellows around the circumference using a reciprocating saw or equivalent tool while using the rad vacuum cleaner nozzle to minimize the saw filings falling into the plastic catch.

6.4.1.4 INSTALL temporary plastic covers ("Herculite" or eq.) over both open ends of the bellows.

### 6.4.2 Removal of Expansion Joint by Unbolting Flanges

6.4.2.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.2.2 REMOVE the nuts only on the expansion joint flanges, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing on each flange to stabilize the joint and maintain system integrity until the glove bag is placed around the joint in the next step.

NOTE:

Prior to commencing the following step, the isolation covers should be readily accessible for immediate installation. Covers shall be placed inside the glove bag when it is installed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.2.3 PLACE a glove bag containing the sheet metal flange covers around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.4.2.4 REMOVE the remaining nuts and bolts from the flanges and REMOVE the expansion joint.

6.4.2.5 INSTALL flange isolation cover on the downstream flange at the discharge isolation valve.

6.4.2.6 COVER the fan discharge flange with plastic covering ("Herculite" or eq.).

## 6.5 Lifting of Fan & Initial Shaft Cutting

**CAUTION:**

**THE FOLLOWING STEPS WILL BE PERFORMED IN THE MOTOR ROOM. A COMPREHENSIVE RADIOLOGICAL SURVEY OF THE FAN SHAFT WALL PENETRATION SPLIT COVER SHALL BE PERFORMED AND NECESSARY PRECAUTIONS SHALL BE TAKEN TO PREVENT ANY CROSS-CONTAMINATION OF THE MOTOR ROOM.**

NOTE:

The initial lift will take the load off of the inboard pedestal bearing to allow its removal and cutting of the inboard shaft. Then the fan will be lifted to allow removal of the outboard fan housing and final shaft cutting in the following sub-section.

6.5.1 VERIFY **Sub-sections 6.1 through 6.4** have been completed in their entirety.

6.5.2 REMOVE the inboard and outboard upper pillow block housings, and all remaining fasteners securing the fan to the foundation.

6.5.3 Using hydraulic jacks, LIFT the fan until there is no weight bearing on the inboard pedestal bearing.

6.5.4 PLACE cribbing below the fan housing to support the weight of the assembly to facilitate removal of the inboard and outboard pedestal bearings, then LOWER the fan assembly onto the cribbing.

6.5.5 REMOVE the outboard pillow block and bearing pedestal in its entirety.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP. SHAFT SHALL BE RADIOLOGICALLY CLEAN IN AREA OF CUT.**

6.5.6 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.

6.5.7 CUT the inboard fan shaft as close to the fan housing as practicable to allow the fan assembly to fit in the shipping container.

6.5.8 INSTALL a fabricated cover to seal the penetration between the fan room and motor room.

## 6.6 Removal of Outboard Fan Housing, Shaft Cutting & Fan Removal

NOTE:

In the following steps, the fan assembly will first be lifted from its foundation to a height sufficient to allow removal of the outboard fan housing. This will allow the fan assembly to fit inside of the shipping container.

6.6.1 VERIFY fan is rigged in accordance with lifting plans, and/or requirements of **ESH 1.6.0, Material Handling: Equipment and Procedures.**

6.6.2 LIFT the fan until the outboard housing is clear of the pedestal foundation.

6.6.3 PLACE cribbing below the fan housing to support the weight of the assembly to facilitate removal of the outboard fan housing, then LOWER the fan assembly onto the cribbing with all of the fan

6.6.4 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.6.5 REMOVE the outboard fan housing and immediately cover both open sides of the housing with plastic covering.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP.**

6.6.6 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.

6.6.7 CUT the outboard fan shaft to achieve an overall shaft length of less than 7'-6" to allow the fan assembly to fit in the shipping container.

6.6.8 REMOVE the outboard bearing block/pedestal.

6.6.9 PLACE the fan assembly and all removed components into the proper container for shipping and/or disposal.

## 6.7 Discharge Expansion Joint Cover & Final Cleanup

NOTE:

Prior to commencing the following steps, the fabricated metal pipe cover shall be readily accessible for immediate installation when the temporary cover is removed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.7.1 If the discharge expansion joint bellows was cut (step 6.4.1, then REMOVE the temporary cover installed in Section 6.4, and IMMEDIATELY INSTALL the fabricated metal cover over the downstream expansion joint flange using sealant and self-tapping sheet metal screws.

6.7.2 CLEAN and DECONTAMINATE the fan room to best achievable levels and survey for final documentation.

## 7.0 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

7.4 ESH 1.6.0 Material Handling: Equipment & Procedures

7.5 USID/SE BGRR-SE-99-03, Removal of Residual Fans.

## 8.0 ATTACHMENTS

8.1 Pictorial Outline of Pile Fan No. 2 Work Activities

8.2 Special Material, Tools and Equipment

**Attachment 8.1**
**Page 1 of 8**

## Pictorial Outline of Pile Fan No. 2 Work Activities

### Contents

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Photo 2 - Fan No. 2 Casing Drain Valve Manifold

Photo 3 - Suction Bellows/Volute Assembly

Photo 4 - Discharge Bellows & Flange

Photo 5 - Outboard Pedestal Bearing

Photo 6 - Inboard Pedestal Bearing

Photo 7 - Outboard Fan Housing

**Attachment 8.1**
**Page 2 of 8**

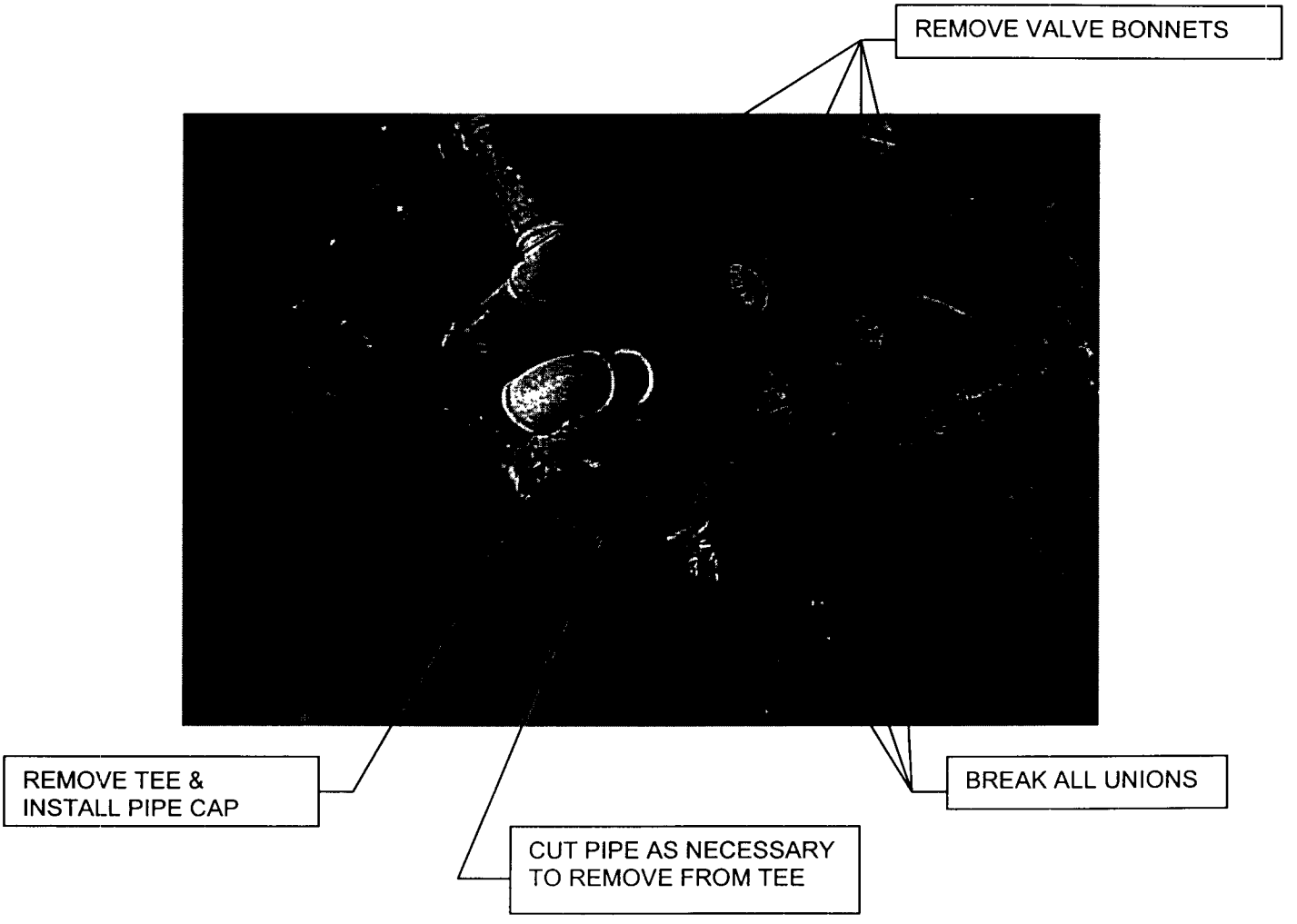
**Photo 1 - HVAC Test Fitting Used As Injection Port For Surface Fixant (PBS)**

INSTALL USING SELF-TAPPING SHEET METAL SCREWS

REMOVE CAP, DRILL HOLE IN CENTER TO INJECT SURFACE FIXANT (PBS)

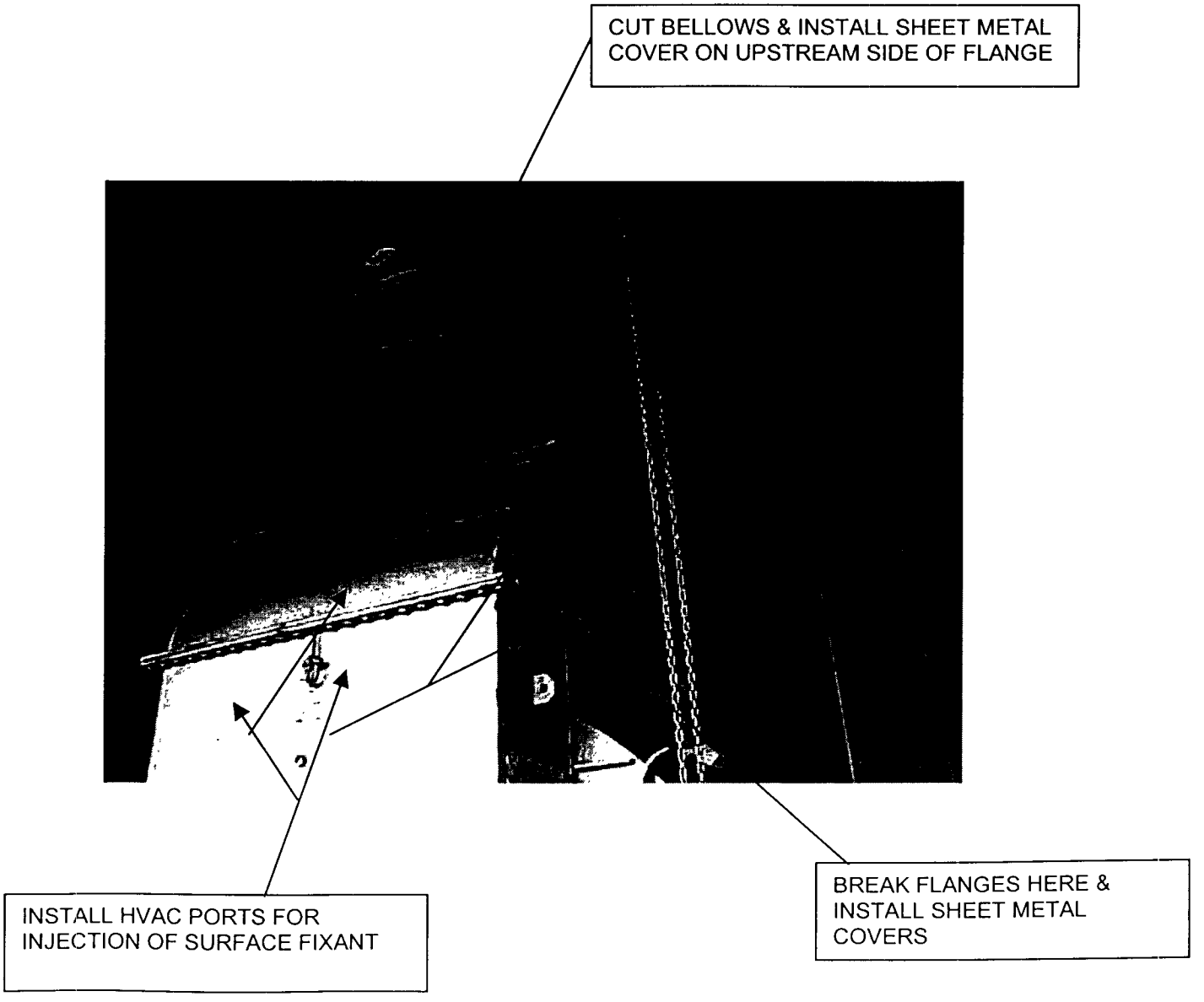
**Attachment 8.1**
**Page 3 of 8**

**Photo 2 - Fan No. 2 Casing Drain Valve Manifold**



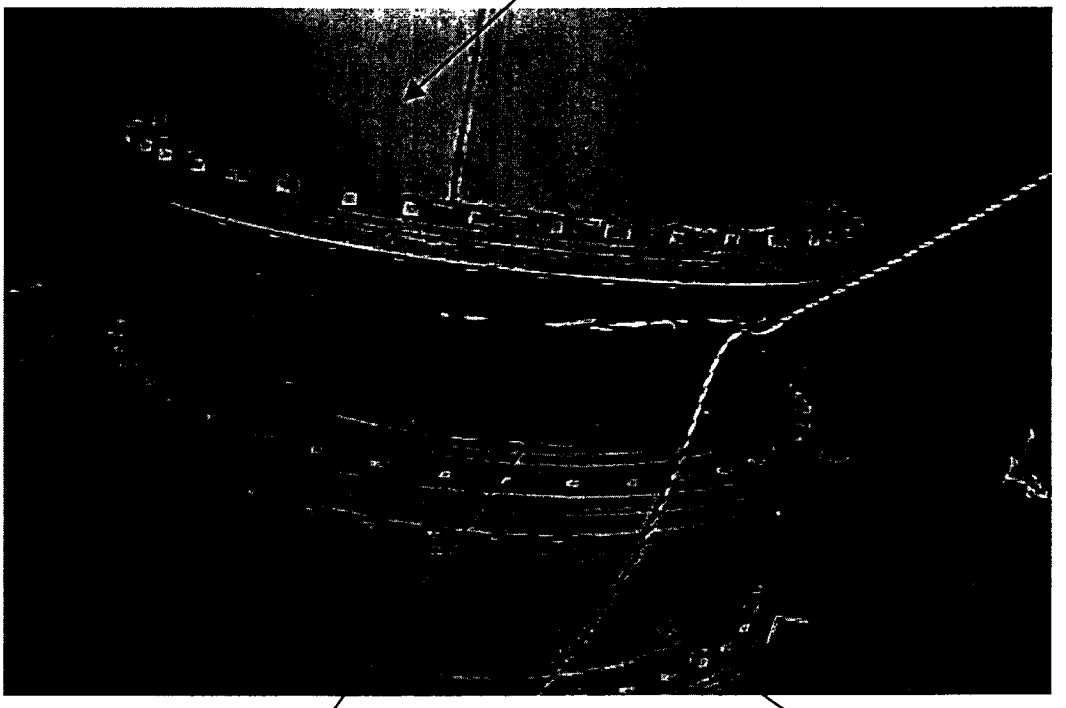
**Attachment 8.1**
**Page 4 of 8**

**Photo 3 - Suction Bellows/Volute Assembly**
**(Fan No. 5 shown, Fan No. 2 similar)**



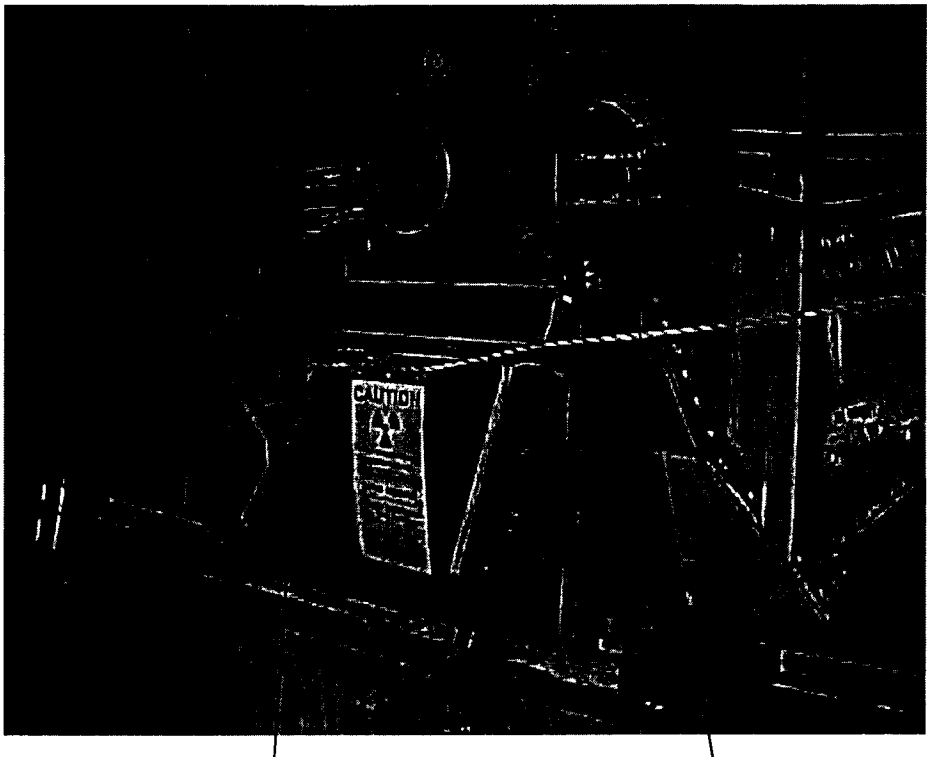
**Attachment 8.1**
**Page 5 of 8**

**Photo 4 - Discharge Bellows & Flange**



**Attachment 8.1**
**Page 6 of 8**

**Photo 5 - Outboard Pedestal Bearing**

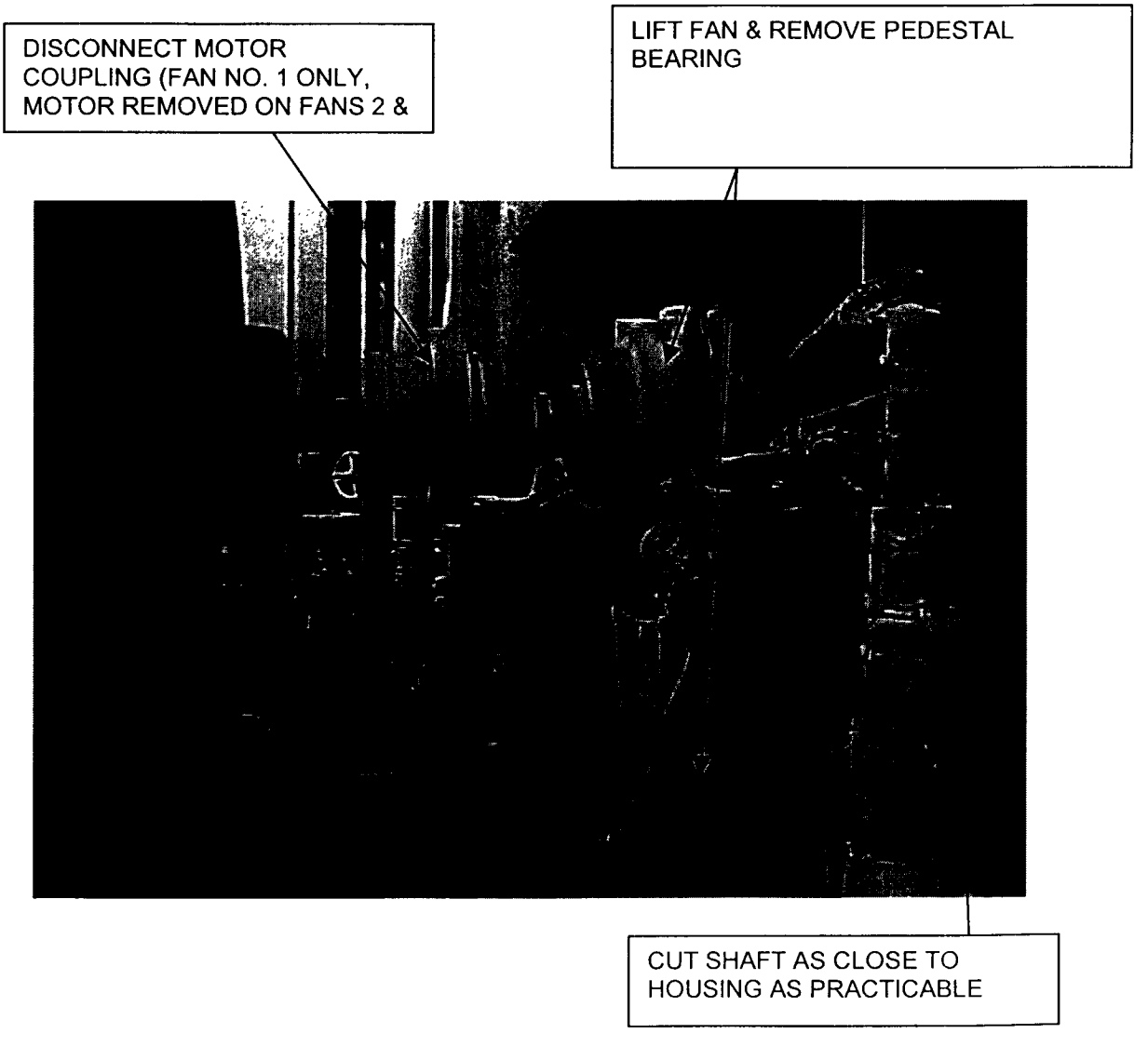



REMOVED PEDESTAL BEARING

REMOVE BEARING COOLING LINES & INSTALL PLUGS

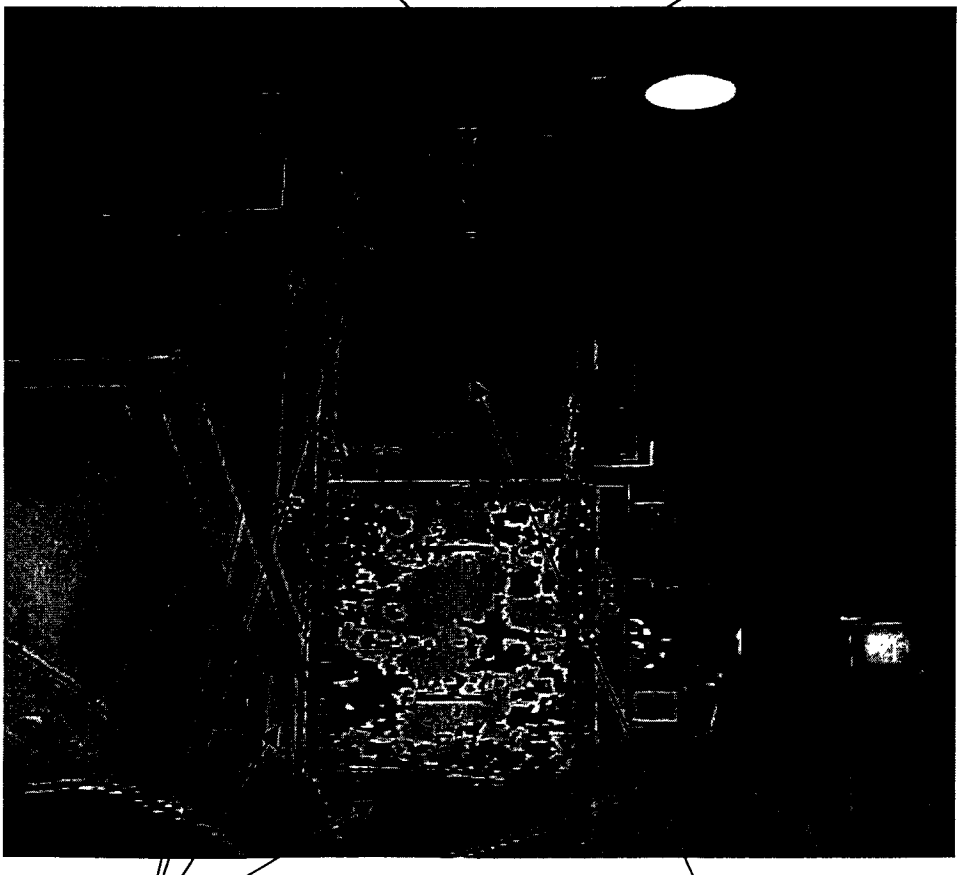
**Attachment 8.1**
**Page 7 of 8**

**Photo 6 - Inboard Pedestal Bearing**



**Attachment 8.1**
**Page 8 of 8**

**Photo 8 - Outboard Fan Housing**



# Attachment 8.2
## Special Materials, Tools and Equipment


| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| 3' THREADED PIPE CAP | 6.2.3 | 1 |
| THREADED PIPE PLUGS 2" & 1-1/2" | 6.2.5, 6.2.6, 6.6.8 | (7) 2", (1) 1-1/2" |
| 48" SHEET METAL FLANGE COVER (FABRICATE) | 6.4.4 | 2 |
| FAN INLET SHEET METAL FLANGE COVER (FABRICATE) | 6.3.5 | 2 |
| POLYMERIC BARRIER SPRAY (PBS) AND INJECTION NOZZLE/PUMP | 6.3.1 6.4.1 | AS REQ'D |
| RECIPROCATING SAW | 6.3.7 | 1 |
| DRILL & BITS FOR 1/4" HOLES | 6.3.1, 6.4.1. | 1 |
| FLAME-CUTTING TORCH | 6.5.3 | 1 |
| C-CLAMPS | 6.4.4 | AS REQ'D |
| FLANGE SPREADER | 6.4.4 | AS REQ'D |
| HERCULITE | 6.3.9 & AS REQ'D | AS REQ'D |
| SCAFFOLDING | AS REQ'D | AS REQ'D |
| COVER FOR FAN SHAFT HOLE (FABRICATE) | 6.5.8 | 1 |
| CRIBBING MATERIALS | AS REQ'D | AS REQ'D |

# Attachment 8.2
## Special Materials, Tools and Equipment


| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| RIGGING EQUIPMENT PER PLAN | AS REQ'D | AS REQ'D |
| HAND TOOLS (REVIEW FOR NEEDS) | AS REQ'D | AS REQ'D |
| 48" BLIND FLANGE (FABRICATE FROM 1/4" ALUM PLATE OR EQ.) | 6.7 | 1 |
| EXPANDABLE FILLER FOAM HILTI CF 116-14 | 6.2.2, 6.2.7 | AS REQ'D |
| PIPE CUTTER (3" CAPABILITY) | 6.2.2 | 1 |
| HYDRAULIC JACKS | 6.5.5 | AS REQ'D |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

**ERD Procedures Manual**

# TECHNICAL WORK DOCUMENT
# PILE FAN NO. 1 & SECONDARY FAN REMOVAL AND EMERGENCY FAN DUCT ISOLATION

Text Pages 1 through 15
Attachment(s) 8.1 and 8.2

**Temporary Procedure**

Approved: _____ Date: 12/3/99
Stephen K. Pulsford, Manager
BGRR Decommissioning Project

Approved: _____ Date: 12/3/99
HFBR Operations

Preparer: **T. Jernigan**

Expiration Date: **January 31, 2000**

ERD OPM No.: **ERD-BGRR-TP-99-2**

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## 1.0 PURPOSE

1.1 To provide the detailed work instructions for the removal of the No. 1 Pile Fan.

## 2.0 SCOPE

2.1 This document covers work activities associated with the removal of No. 1 Pile Fan including, but not limited to, necessary preparation and setup, and removal of interference's.

## 3.0 RESPONSIBILITIES

3.1 The BGRR-DP Construction Manager or designee is responsible for the proper execution of this Work Document.

3.2 The BGRR-DP Project Engineer or designee is responsible for the technical content of this Work Document.

3.3 The BGRR-DP ESH&Q Manager or designee is responsible for all environmental, health and safety issues associated with the work activities delineated herein.

## 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. 1 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 of the Primary Air Cooling System are exposed, a surface fixant such as 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 so throughout all work activities. This valve is an HFBR confinement isolation valve.

4.4 Prior to performing any activities that could result in a breach of the Primary Air Cooling System, the area of the potential breach shall be prepared in accordance with the applicable RWP. Such steps where the potential for a system breach are known to exist are annotated with a **CAUTION** note preceding the step.

4.5 Sub-sections 6.1, 6.2, 6.3 & 6.4 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.5, 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.5 have been completed. Sub-sections 6.8, 6.9 and 6.10 may be performed out of sequence however, steps within these sub-sections shall be performed in sequence.

4.6 Pre-engineered scaffolding is required for this job. Scaffolding shall be erected and inspected in accordance with **BNL** and **OSHA 1926.451**.

4.7 Lifting of the major fan assembly has been determined to be a *Critical Lift* per **ESH 1.6.0, Material Handling: Equipment and Procedures.** All requirements of this procedure (e.g. Lifting Plans) shall be strictly adhered to in performance of this job.

## 5.0 PREREQUISITES

5.1 The Unreviewed Safety Issue Determination/Safety Evaluation (USI/SE) for Pile Fan No. 1 Removal has been approved.

Initial: _____ Date: _____ USID/SE No: _____

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 these 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 Fan House motor room.

Initial: _____ Date: _____

5.6 Verify all Special Materials, Tools and Equipment listed in Attachment 8.2 are available to support their respective work activities.

Initial: _____ Date: _____

5.7 Prior to removal of the fan unit, the inlet and outlet discharge flanges must be disconnected at their respective expansion joints. Additionally, the outboard fan inlet housing must be removed to allow the fan to be placed in a shipping container. To minimize the spread of contamination, surface fixant such as Polymeric Barrier Spray (PBS) shall be injected into these areas utilizing a pressurized nozzle. The following methods will be used to accomplish this:

5.7.1 Using self-tapping sheet metal screws, install HVAC test ports w/expandable plugs in the locations where PBS injection holes will be drilled in the next step. Holes shall be located to ensure optimum application of the fixant on the interior surfaces to prevent airborne contamination when the joint is breached.

5.7.2 Remove the expandable plug in the HVAC test port, and drill a hole through the system boundary (e.g. duct wall) in the center of the test port opening; reinstall the expandable plug to prevent spread of contamination to the exterior if the PBS is not being injected immediately.

5.7.3 Remove the expandable plug and inject the PBS moving the nozzle to achieve optimum interior coverage: reinstall plug when complete.

5.7.4 Allow the PBS to cure for the minimum time specified on the manufacturer's label (8 hrs) prior to breaching the system in the vicinity of the PBS application.

5.8 VERIFY that the overhead lifting monorail (beam) in the fan room has been load tested (a separate Work Permit has been initiated to perform this).

Initial: _____ Date: _____

## 6.0 WORK INSTRUCTIONS

NOTE 1: Attachment 8.1 contains pictorial outline of the following work activities.

NOTE 2: Sub-sections 6.1, 6.2, 6.3 and 6.4 may be performed out of sequence as best determined by the Construction Manager/designee. However, steps within these sub-sections shall be performed in the sequence listed. Sub-sections 6.5, 6.6 and 6.7 shall be performed in sequence only after sub-sections 6.1 through 6.4 have been completed.

### 6.1 Inlet Valve Air Operator Linkage

6.1.1 VERIFY the fan inlet valve fully CLOSED.

6.1.2 SECURE the fan inlet valve in the CLOSED position.

6.1.3 DISCONNECT the linkage between the fan damper and the operator wall penetration.

6.1.4 REMOVE the linkage between fan damper and the operator wall penetration.

### 6.2 Remove Fan Housing Drain Valves and Piping

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.2.1 REMOVE the bonnets from the (3) fan housing drain valves, and the (1) fan housing discharge line drain valve.

6.2.2 At the 3" floor drain penetration, CUT the pipe that connects to tee, then BREAK the (4) unions.

6.2.3 REMOVE the entire piping assembly between the unions and the cut(s); INSTALL a 3" pipe cap on the 3" drain line penetrating the floor.

6.2.4 INJECT expandable filler foam (Hilti CF 116-14) into the remaining (4) drain lines through the unions, ensuring that the lines are filled completely back to the connection at the fan housing and discharge line.

6.2.5 After the foam has cured (i.e. FIRM), REMOVE the (4) drain lines from the fan and discharge line and INSTALL a pipe plug in the drain connection on the fan discharge line.

6.2.6 DISCONNECT the (4) bearing water cooling lines and INSTALL a pipe plug in the cooling water connection on the bearing pedestals.

6.2.7 REMOVE the water supply and return lines that penetrate the fan room/motor room wall (CUT lines if necessary), and FILL the wall penetration with expandable filler foam.

## 6.3 Remove Fan Inlet Transition Housing

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.3.2 REMOVE the nuts only on the lower inlet transition housing fasteners, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing to stabilize the joint and maintain system integrity until the glove is placed around the joint in the next step.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.3.3 PLACE a glove bag around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.3.4 REMOVE the remaining nuts and bolts from the flanges.

NOTE:

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

6.3.5 CAREFULLY SPREAD the (2) inlet transition housing 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.

6.3.6 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

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

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

6.3.9 REMOVE the remaining portion of the bellows and the inlet transition housing assembly using the overhead monorail and approved rigging.

## 6.4 Discharge Expansion Joint

NOTE:

As determined by the BGRR-DP Construction Manager/designee, the discharge expansion joint may be removed in one piece by unbolting at the flanges, or by cutting the bellows. Perform the appropriate steps that follow.

### 6.4.1 Removal of Expansion Joint by Cutting Bellows

6.4.1.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.1.2 SETUP plastic catch pockets around the circumference of the discharge 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.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.1.3 CUT the downstream (east) end of bellows around the circumference using a reciprocating saw or equivalent tool while using the rad vacuum cleaner nozzle to minimize the saw filings falling into the plastic catch.

6.4.1.4 INSTALL temporary plastic covers ("Herculite" or eq.) over both open ends of the bellows.

### 6.4.2 Removal of Expansion Joint by Unbolting Flanges

6.4.2.1 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

6.4.2.2 REMOVE the nuts only on the expansion joint flanges, leaving the bolts in place and leaving a minimum of (4) fully tightened @ 90 degree spacing on each flange to stabilize the joint and maintain system integrity until the glove bag is placed around the joint in the next step.

NOTE:

Prior to commencing the following step, the isolation covers should be readily accessible for immediate installation. Covers shall be placed inside the glove bag when it is installed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.4.2.3 PLACE a glove bag containing the sheet metal flange covers around the joint, then REMOVE the flange bolts from which the nuts were removed in the above step.

6.4.2.4 REMOVE the remaining nuts and bolts from the flanges and REMOVE the expansion joint.

6.4.2.5 INSTALL flange isolation cover on the downstream flange at the discharge isolation valve.

6.4.2.6 COVER the fan discharge flange with plastic covering ("Herculite" or eq.).

## 6.5 Lifting of Fan & Initial Shaft Cutting

**CAUTION:**

**THE FOLLOWING STEPS WILL BE PERFORMED IN THE MOTOR ROOM. A COMPREHENSIVE RADIOLOGICAL SURVEY OF THE FAN SHAFT WALL PENETRATION SPLIT COVER SHALL BE PERFORMED AND NECESSARY PRECAUTIONS SHALL BE TAKEN TO PREVENT ANY CROSS-CONTAMINATION OF THE MOTOR ROOM.**

NOTE:

The initial lift will take the load off of the inboard pedestal bearing to allow its removal and cutting of the inboard shaft. Then the fan will be lifted to allow removal of the outboard fan housing and final shaft cutting in the following sub-section.

6.5.1 VERIFY **Sub-sections 6.1 through 6.4** have been completed in their entirety.

6.5.2 REMOVE the inboard and outboard upper pillow block housings, and all remaining fasteners securing the fan to the foundation.

6.5.3 Using hydraulic jacks, LIFT the fan until there is no weight bearing on the inboard pedestal bearing.

6.5.4 PLACE cribbing below the fan housing to support the weight of the assembly to facilitate removal of the inboard and outboard pedestal bearings, then LOWER the fan assembly onto the cribbing.

6.5.5 REMOVE the outboard pillow block and bearing pedestal in its entirety.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP. SHAFT SHALL BE RADIOLOGICALLY CLEAN IN AREA OF CUT.**

6.5.6 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.

6.5.7 CUT the inboard fan shaft as close to the fan housing as practicable to allow the fan assembly to fit in the shipping container.

6.5.8 INSTALL a fabricated cover to seal the penetration between the fan room and motor room.

## 6.6 Removal of Outboard Fan Housing, Shaft Cutting & Fan Removal

NOTE:

In the following steps, the fan assembly will first be lifted from its foundation to a height sufficient to allow removal of the outboard fan housing. This will allow the fan assembly to fit inside of the shipping container.

6.6.1 VERIFY fan is rigged in accordance with lifting plans, and/or requirements of **ESH 1.6.0, Material Handling: Equipment and Procedures.**

6.6.2 LIFT the fan until the outboard housing is clear of the pedestal foundation.

6.6.3 PLACE cribbing below the fan housing to support the weight of the assembly to facilitate removal of the outboard fan housing, then LOWER the fan assembly onto the cribbing with all of the fan

6.6.4 Perform Prerequisite 5.7 to stabilize loose interior contamination.

Initial: _____ Date: _____

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.6.5 REMOVE the outboard fan housing and immediately cover both open sides of the housing with plastic covering.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP. SHAFT SHALL BE RADIOLOGICALLY CLEAN IN AREA OF CUT.**

6.6.6 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.

6.6.7 CUT the outboard fan shaft to achieve an overall shaft length of less than 7'-6" to allow the fan assembly to fit in the shipping container.

6.6.8 REMOVE the outboard bearing block/pedestal.

6.6.9 PLACE the fan assembly and all removed components into the proper container for shipping and/or disposal.

## 6.7 Discharge Expansion Joint Cover & Final Cleanup

NOTE:

Prior to commencing the following steps, the fabricated metal pipe cover shall be readily accessible for immediate installation when the temporary cover is removed.

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.7.1 If the discharge expansion joint bellows was cut (step 6.4.1, then REMOVE the temporary cover installed in Section 6.4, and IMMEDIATELY INSTALL the fabricated metal cover over the downstream expansion joint flange using sealant and self-tapping sheet metal screws.

6.7.2 CLEAN and DECONTAMINATE the fan room to best achievable levels and survey for final documentation.

## 6.8 Removal of Fan No. 1 Motor

6.8.1 VERIFY that No. 1 Fan Motor is electrically disconnected

6.8.2 VERIFY that stator cooling motor is electrically disconnected.

6.8.3 REMOVE the stator cooling ductwork in its entirety from the roof penetration to the motor connection flanges.

6.8.4 INSTALL a fabricated metal cover over the open-ended roof penetration.

6.8.5 VERIFY motor is rigged in accordance with lifting plans, and/or requirements of **ESH 1.6.0, Material Handling: Equipment and Procedures.**

6.8.6 REMOVE the No. 1 Fan Motor.

## 6.9 Isolation of Emergency Fàn Ducting

NOTE: The Emergency Fan has been previously removed.

6.9.1 INSTALL a fabricated metal cover over the existing open-ended duct at the Emergency Fan discharge flow straightener.

6.9.2 CLEAN and DECONTAMINATE the Emergency Fan room to best achievable levels and survey for final documentation.

## 6.10 Secondary Fan Removal

### 6.10.1 Removal of Drain Piping

6.10.1.1 CUT the fan drain line from the fan to the tee at the floor penetration.

6.10.1.2 INSTALL a pipe cap on the open-ended floor penetration.

### 6.10.2 Removal of Fan Ducting

6.10.2.1 Perform Prerequisite 5.7 to stabilize loose interior contamination for both the inlet and outlet duct areas.

Initial: _____ Date: _____

**CAUTION:**

**SYSTEM BREACH OCCURS IN THE FOLLOWING STEP(S). REVIEW AND ADHERE TO THE RWP.**

6.10.2.2 CUT the inlet duct in the locations shown on the appropriate photo in Attachment 8.1.

6.10.2.3 INSTALL a fabricated cover over the open end of the remaining inlet duct.

6.10.2.4 CUT the outlet duct in the locations shown on the appropriate photo in Attachment 8.1.

6.10.1.5 INSTALL a fabricated cover over the open end of the remaining outlet duct.

### 6.10.3 Removal of Fan

6.10.3.1 REMOVE all fan foundation fasteners.

**CAUTION:**

**THE FOLLOWING STEP WILL INVOLVE THE USE OF A FLAME-CUTTING TORCH. ADHERE TO ALL DIRECTIONS FOR THIS STEP IN THE RWP AND TEHASP. SHAFT SHALL BE RADIOLOGICALLY CLEAN IN AREA OF CUT.**

6.10.3.2 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.

6.10.3.3 CUT the outboard fan shaft between the fan and the closest pedestal bearing to allow removal of the fan with the bearings in place.

6.10.3.4 VERIFY fan is rigged in accordance with lifting plans, and/or requirements of **ESH 1.6.0, Material Handling: Equipment and Procedures.**

6.10.3.5 REMOVE fan and place in proper container for shipping/disposal.

### 6.10.4 Removal of Shaft Bearings & Cleanup

6.10.4.1 REMOVE the remaining fan shaft with the two pedestal bearings and INSTALL a fabricated cover over the shaft wall penetration.

6.10.4.2 CLEAN and DECONTAMINATE the Secondary Fan room to best achievable levels and survey for final documentation.

## 7.0 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

7.4 ESH 1.6.0 Material Handling: Equipment & Procedures

7.5 USID/SE BGRR-SE-99-03, Removal of Residual Fans

## 8.0 ATTACHMENTS

8.1 Pictorial Outline of Pile Fan No. 1 Work Activities

8.2 Special Material, Tools and Equipment

**Attachment 8.1**
**Page 1 of 15**

## Pictorial Outline of Pile Fan No. 1 Work Activities

### Contents

Photo 1 - HVAC Test Fitting Used As Injection Port

Photo 2 - Fan No. 1 Casing Drain Valve Manifold

Photo 3 - Suction Bellows/Volute Assembly

Photo 4 - Discharge Bellows & Flange

Photo 5 - Outboard Pedestal Bearing

Photo 6 - Inboard Pedestal Bearing

Photo 7 - Outboard Fan Housing

Photo 8 - No. 1 Fan Motor

Photo 9 - Secondary Fan Drain Piping

Photo 10 - Secondary Fan Discharge Duct

Photo 11 - Secondary Fan Discharge Transition Piece

Photo 12 - Secondary Fan Discharge Duct

Photo 13 - Secondary Fan View

Photo 14 - Secondary Fan Shaft & Bearings

**Attachment 8.1**
**Page 2 of 15**

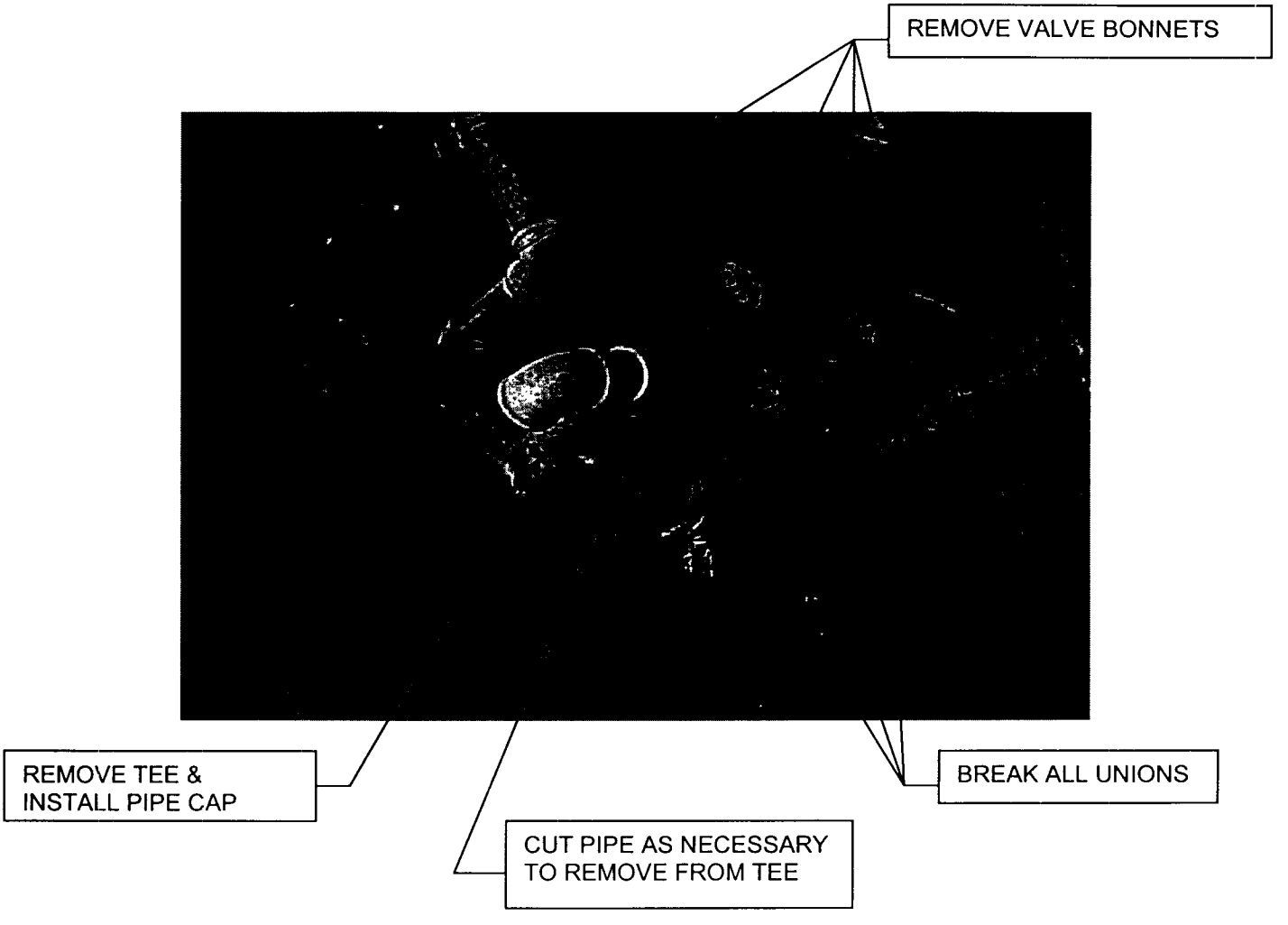
**Photo 1 - HVAC Test Fitting Used As Injection Port For Surface Fixant (PBS)**

INSTALL USING SELF-TAPPING SHEET METAL SCREWS

REMOVE CAP, DRILL HOLE IN CENTER TO INJECT SURFACE FIXANT (PBS)

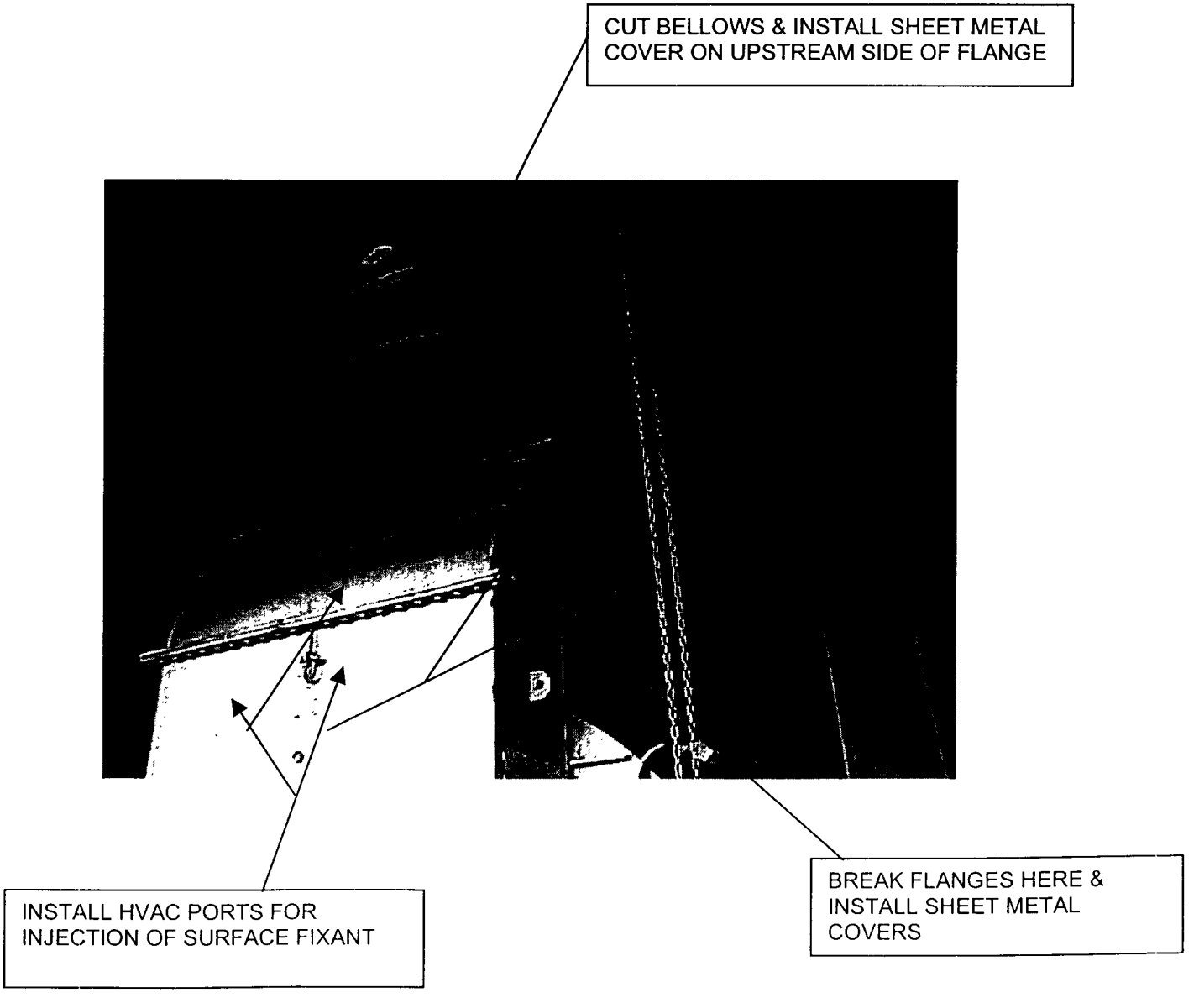
**Attachment 8.1**
**Page 3 of 15**

**Photo 2 - Fan No. 1 Casing Drain Valve Manifold**



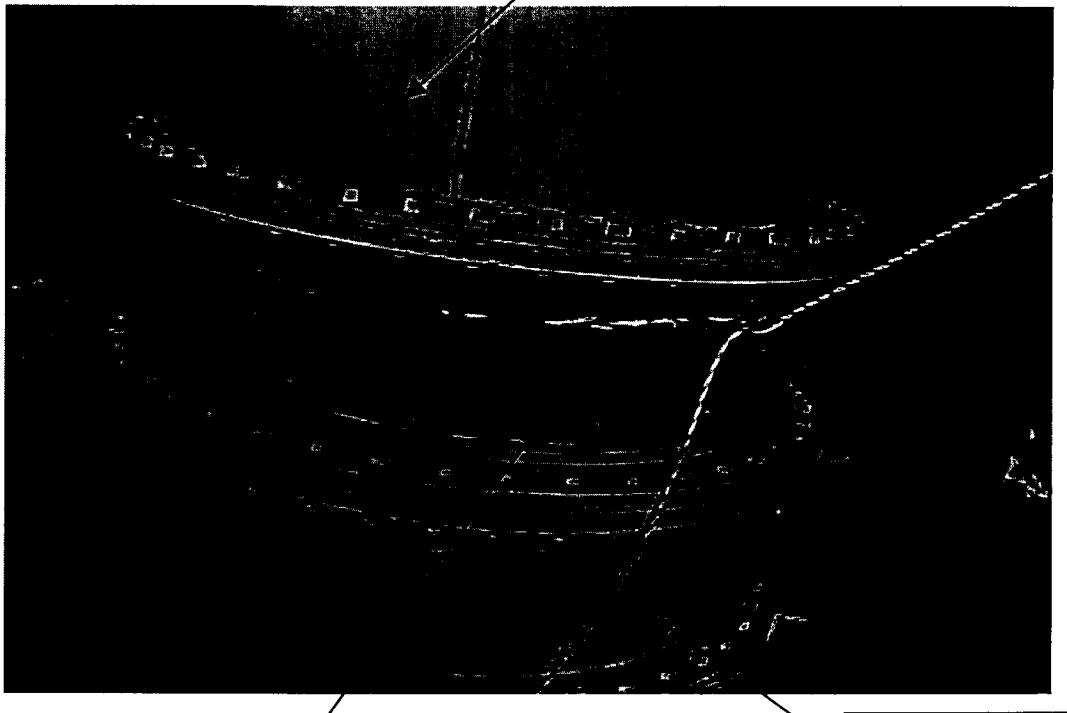
**Attachment 8.1**
**Page 4 of 15**

**Photo 3 - Suction Bellows/Volute Assembly**
**(Fan No. 5 shown, Fan No. 1 similar)**



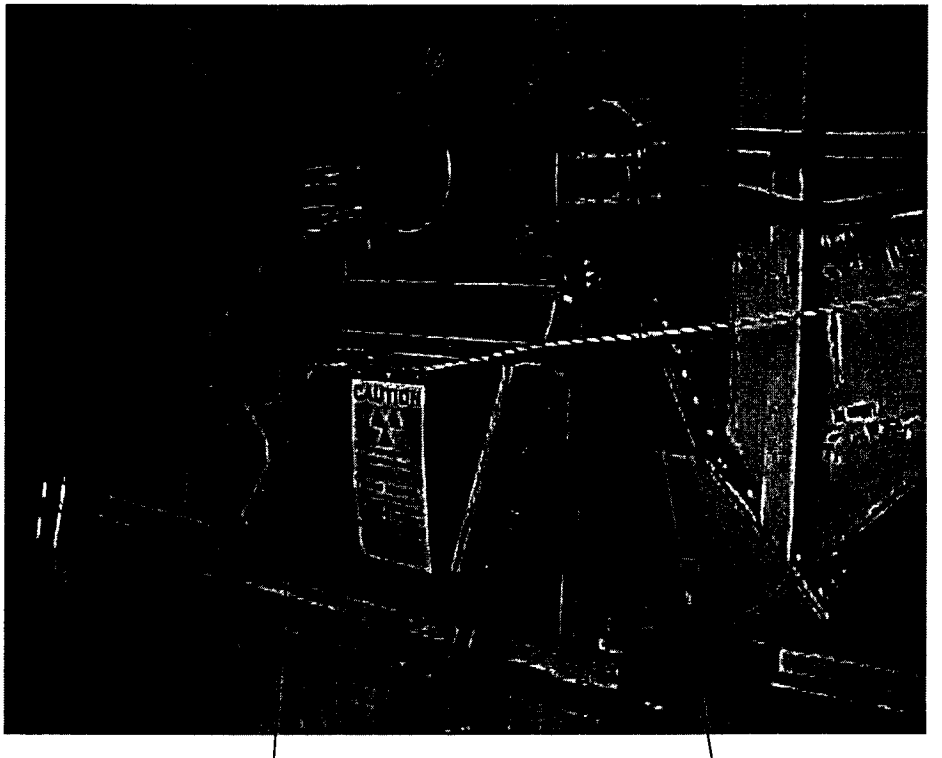
**Attachment 8.1**
**Page 5 of 15**

**Photo 4 - Discharge Bellows & Flange**



**Attachment 8.1**
**Page 6 of 15**

## Photo 5 - Outboard Pedestal Bearing



REMOVED PEDESTAL BEARING

REMOVE BEARING COOLING LINES & INSTALL PLUGS

**Attachment 8.1**
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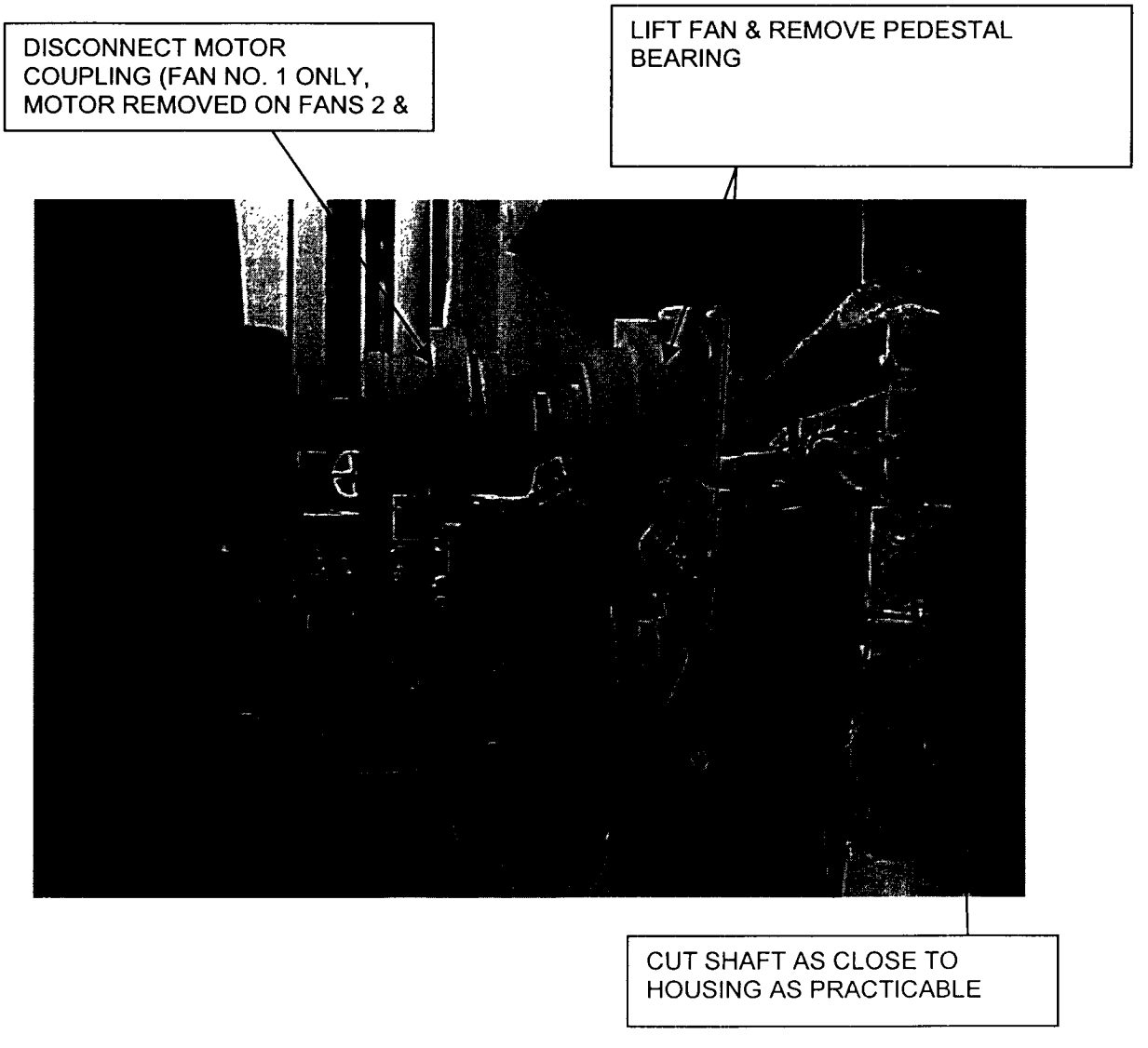
**Photo 6 - Inboard Pedestal Bearing**



**Attachment 8.1**
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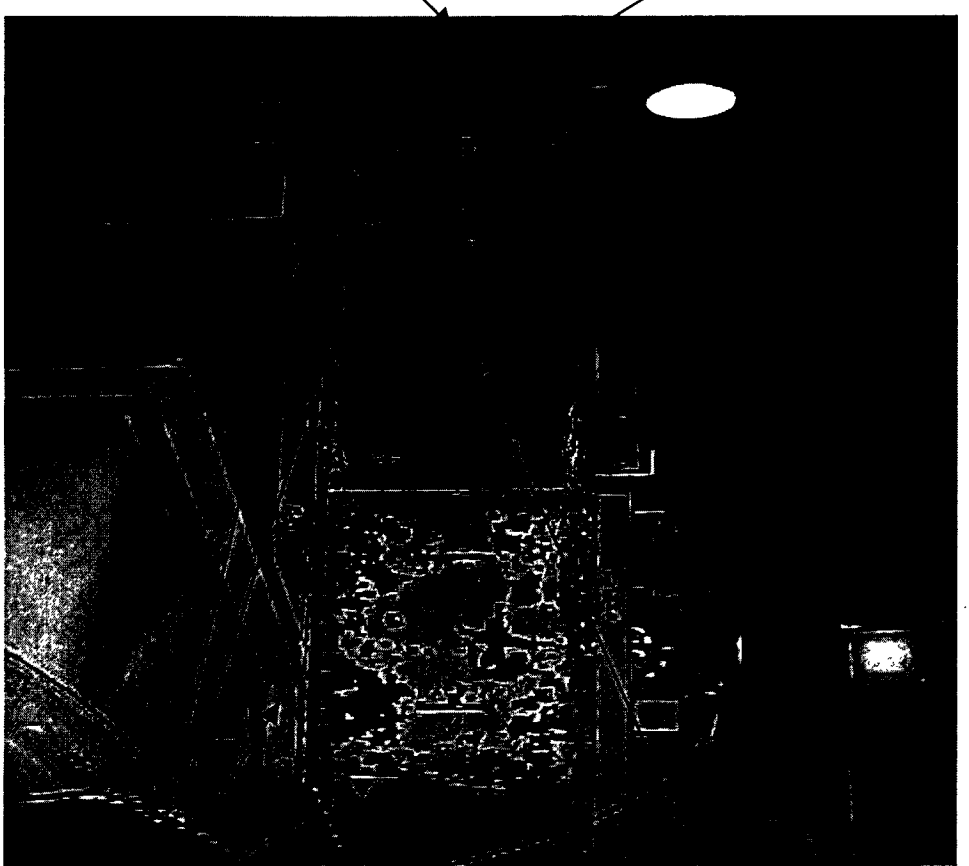
**Photo 8 - Outboard Fan Housing**



**Attachment 8.1**

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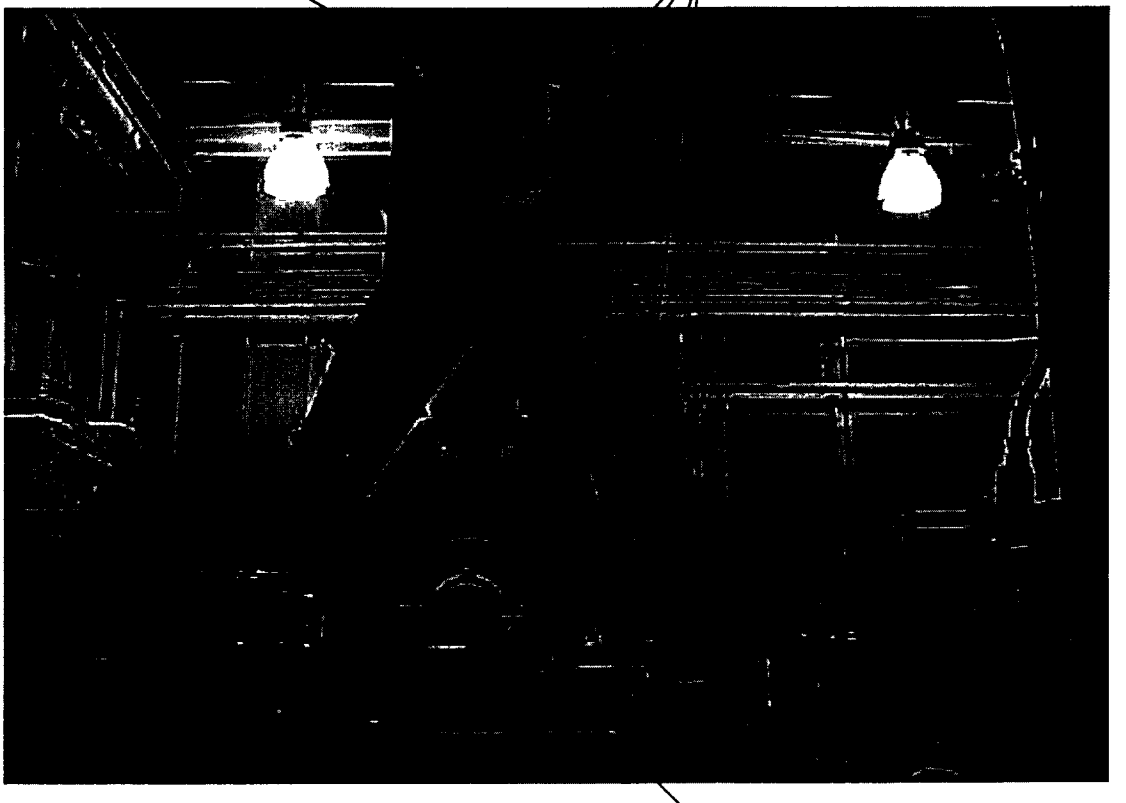
## No. 1 Fan Motor

INSTALL FABRICATED METAL COVER ON DUCT

ELECTRICALLY DISCONNECT, REMOVE STATOR COOLING FAN & ALL DUCTWORK



ELECTRICALLY DISCONNECT & REMOVE MOTOR

**Attachment 8.1**
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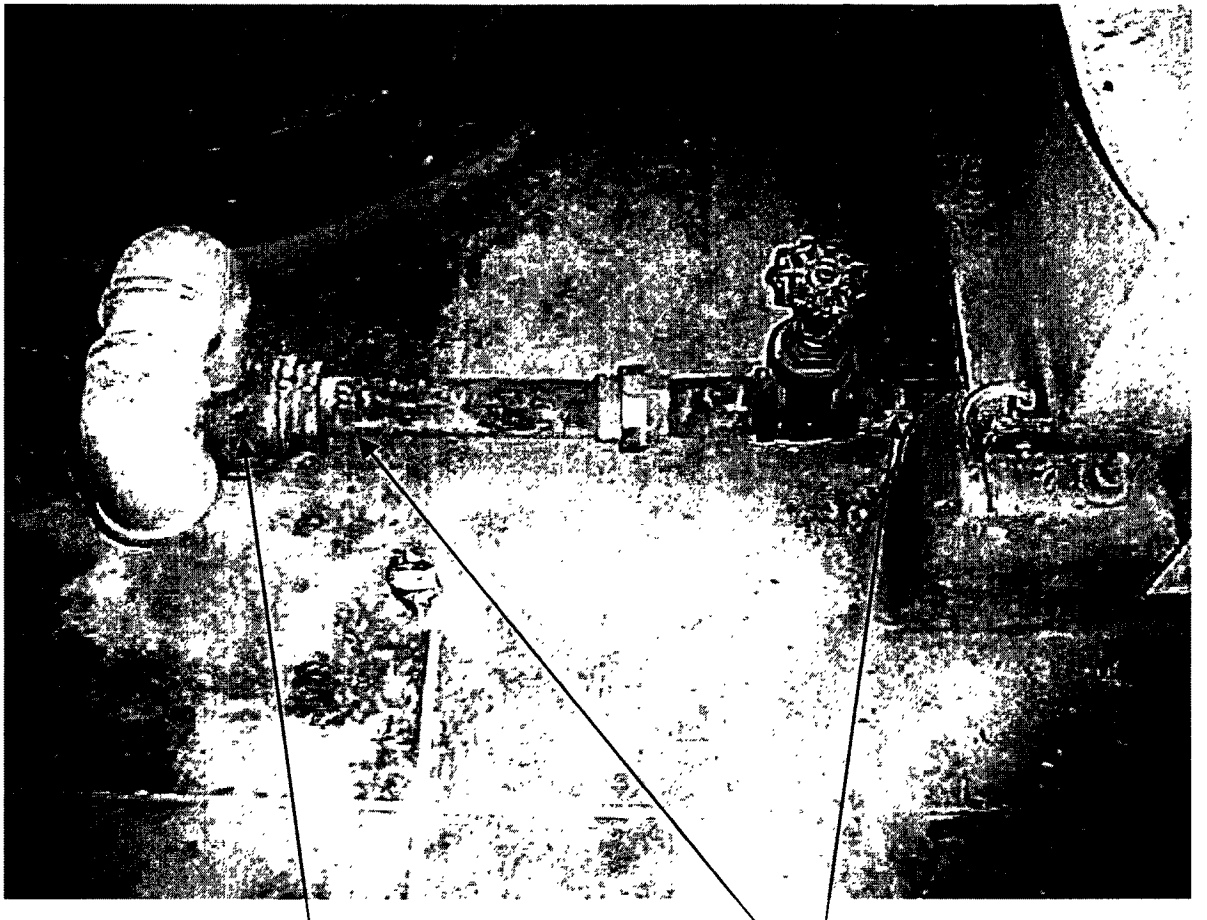
**Photo 9 - Secondary Fan Drain Piping**



REMOVE TEE & INSTALL PIPE CAP

CUT PIPE & REMOVE BACK TO FAN CONNECTION

**Attachment 8.1**
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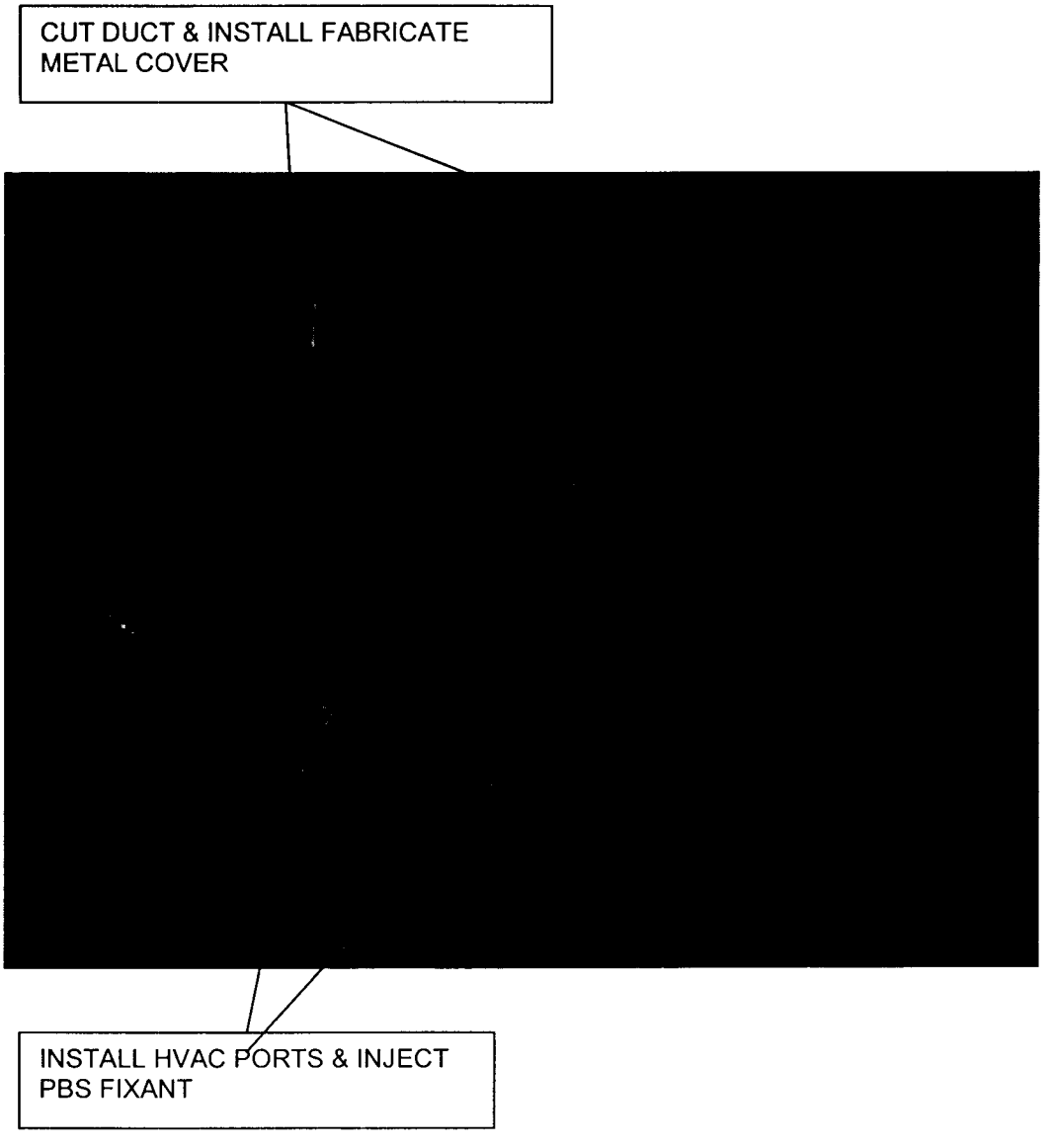
**Photo 10 - Secondary Fan Discharge Duct**



**Attachment 8.1**
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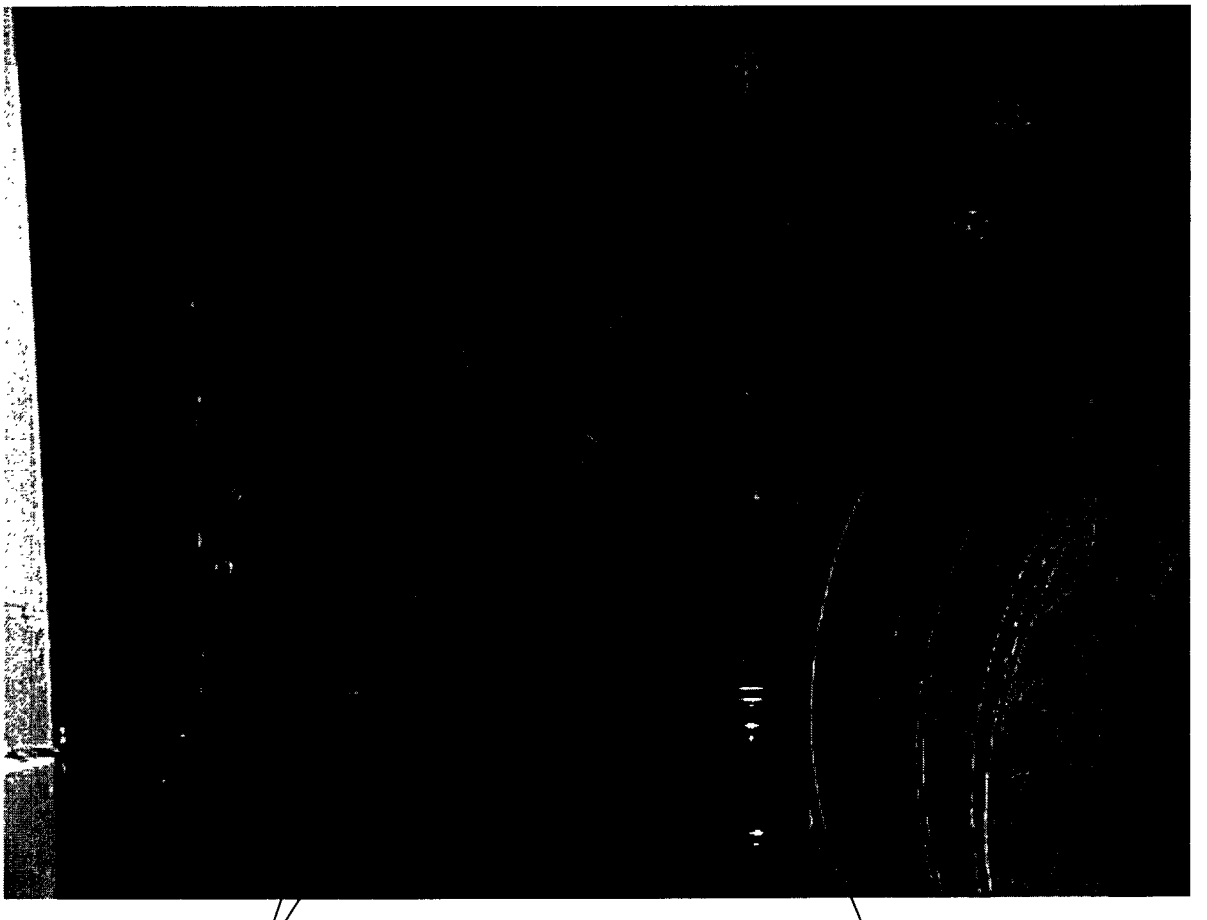
## Photo 11 - Secondary Fan Discharge Transition Piece



INSTALL HVAC PORTS & INJECT PBS FIXANT

CUT DUCT & INSTALL FABRICATED METAL COVER

**Attachment 8.1**

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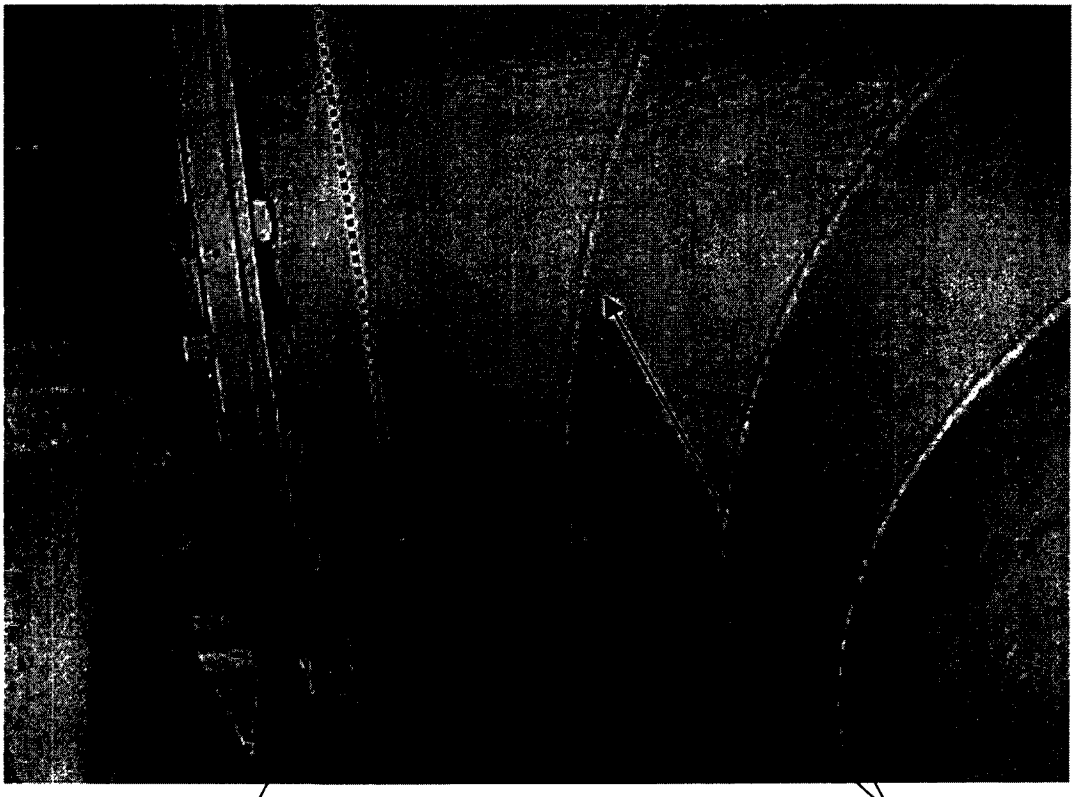
**Photo 12 - Secondary Fan Discharge Duct**



CUT DUCT & INSTALL FABRICATED METAL COVER

INSTALL HVAC PORTS & INJECT PBS FIXANT

**Attachment 8.1**
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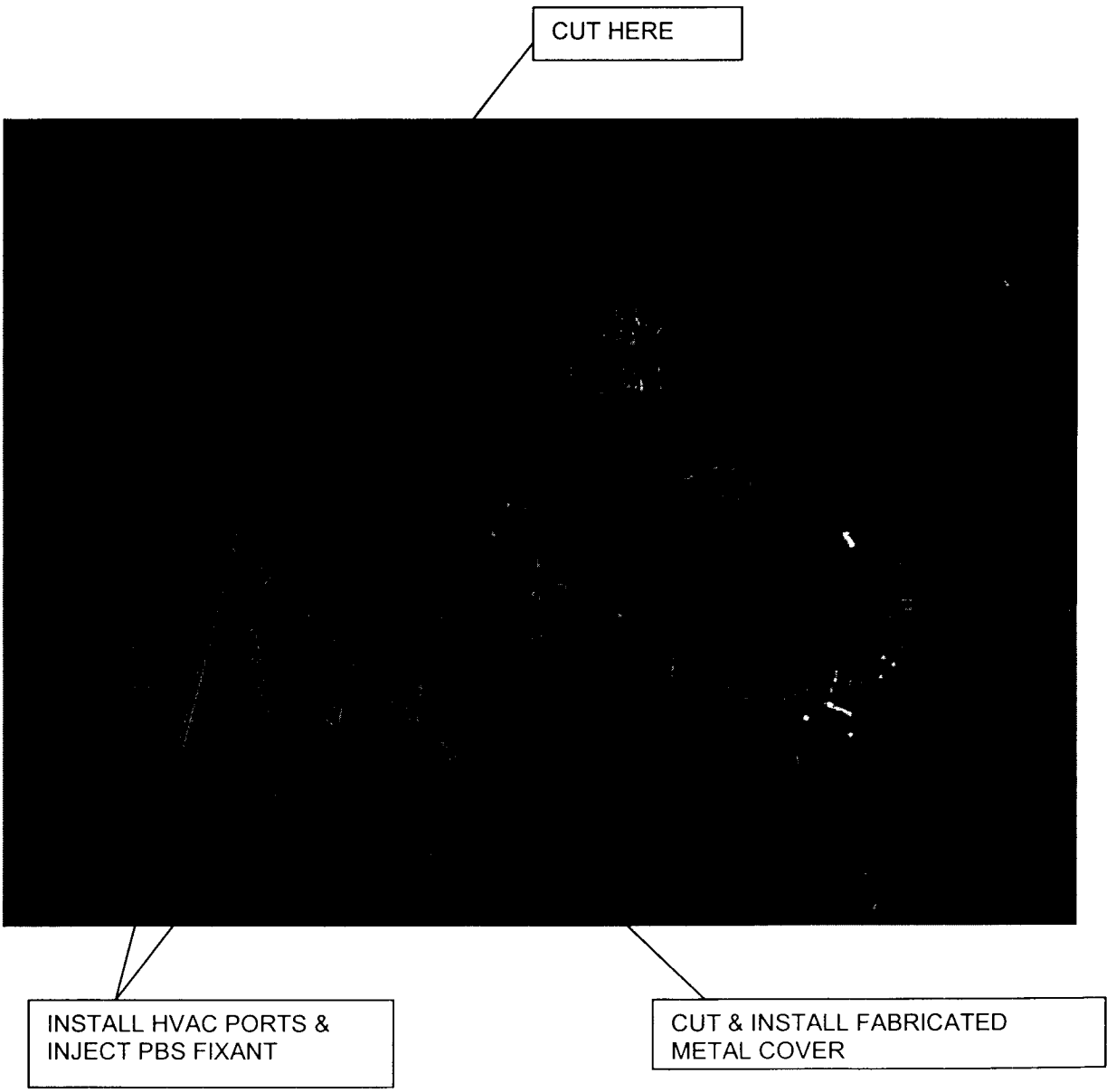
**Photo 13 - Secondary Fan View**



**Attachment 8.1**

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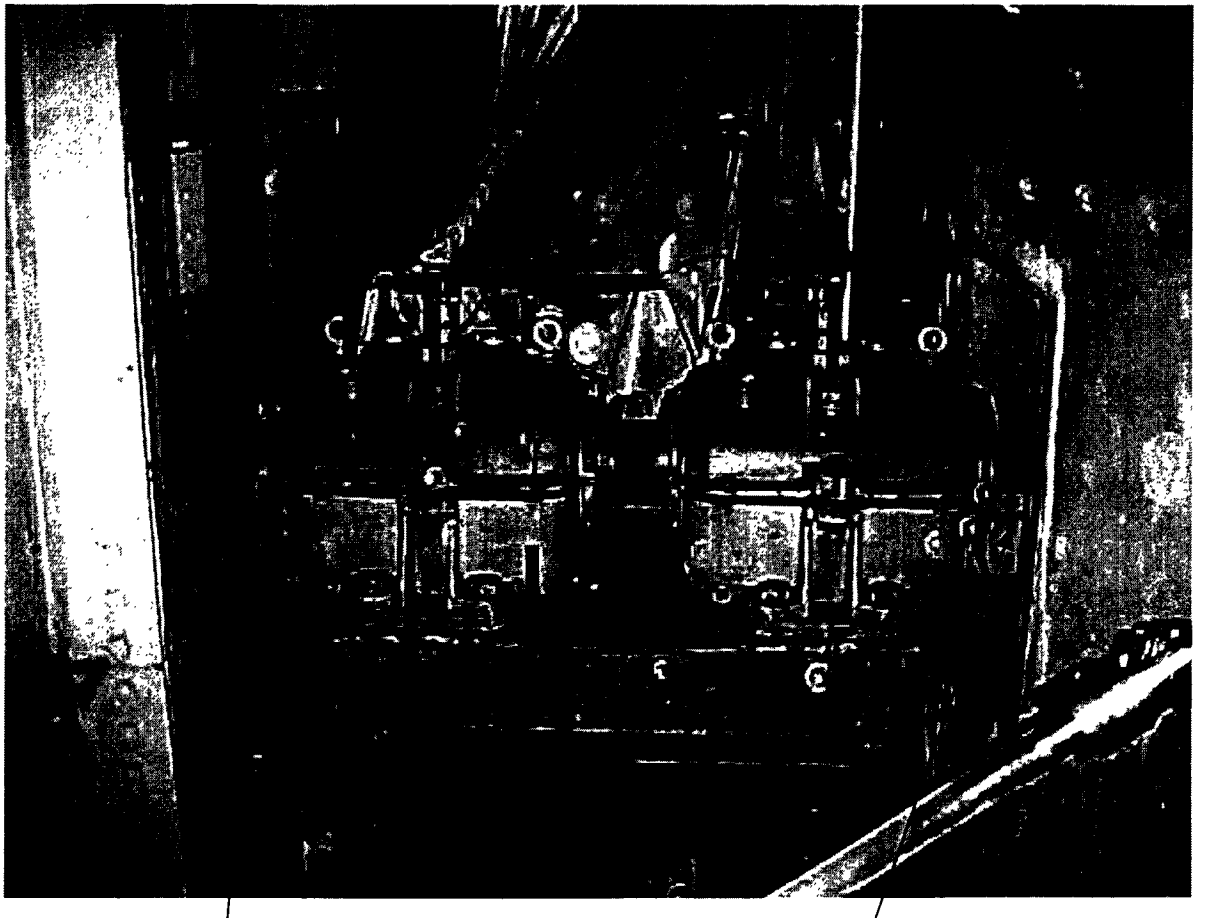
**Photo 14 - Secondary Fan Shaft & Bearings**



CUT SHAFT HERE & REMOVE SHAFT AND BEARINGS

INSTALL FABRICATED METAL COVER OVER WALL PENETRATION AFTER SHAFT IS REMOVED

# Attachment 8.2
## Special Materials, Tools and Equipment



| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| 3' THREADED PIPE CAP | 6.2.3 | 1 |
| THREADED PIPE PLUGS 2" & 1-1/2" | 6.2.5, 6.2.6, 6.6.8 | (7) 2", (1) 1-1/2" |
| 48" SHEET METAL FLANGE COVER (FABRICATE) | 6.4.4 | 2 |
| FAN INLET SHEET METAL FLANGE COVER (FABRICATE) | 6.3.5 | 2 |
| POLYMERIC BARRIER SPRAY (PBS) AND INJECTION NOZZLE/PUMP | 6.3.1 6.4.1 | AS REQ'D |
| RECIPROCATING SAW | 6.3.7 | 1 |
| DRILL & BITS FOR 1/4" HOLES | 6.3.1, 6.4.1. | 1 |
| FLAME-CUTTING TORCH | 6.5.3 | 1 |
| C-CLAMPS | 6.4.4 | AS REQ'D |
| FLANGE SPREADER | 6.4.4 | AS REQ'D |
| HERCULITE | 6.3.9 & AS REQ'D | AS REQ'D |
| SCAFFOLDING | AS REQ'D | AS REQ'D |
| COVER FOR FAN SHAFT HOLE (FABRICATE) | 6.5.8 | 1 |
| CRIBBING MATERIALS | AS REQ'D | AS REQ'D |

# Attachment 8.2
## Special Materials, Tools and Equipment



| DESCRIPTION | STEP REQUIRED FOR | QTY NEEDED |
|---|---|---|
| RIGGING EQUIPMENT PER PLAN | AS REQ'D | AS REQ'D |
| HAND TOOLS (REVIEW FOR NEEDS) | AS REQ'D | AS REQ'D |
| 48" BLIND FLANGE (FABRICATE FROM 1/4" ALUM PLATE OR EQ.) | 6.7 | 1 |
| EXPANDABLE FILLER FOAM HILTI CF 116-14 | 6.2.2, 6.2.7 | AS REQ'D |
| PIPE CUTTER (3" CAPABILITY) | 6.2.2 | 1 |
| HYDRAULIC JACKS | 6.5.5 | AS REQ'D |
| FABRICATED COVER FOR EMER. FAN DISCAHRGE DUCT | 6.9.1 | 1 |
| SECONDARY FAN DUCT METAL COVERS | 6.10.2.3/5 | 2 |
| COVER FOR SECONDARY FAN SHAFT WALL PENETRATION | 6.10.4.1 | 1 |
| | | |
| | | |
| | | |