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CORPORATION

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June 26, 2002

**VIA EXPRESS COURIER**

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Rockville, MD 20852-2738

Reference: Annual Safety and Environmental Review Panel Report for July 1, 2001 -  
June 30, 2002  
White Mesa Uranium Mill - Blanding, Utah  
International Uranium (USA) Corporation  
NRC Source Materials License No. SUA-1358  
Docket No. 40-8681

Dear Mr. Gillen:

This letter transmits International Uranium (USA) Corporation's Safety and Environmental Review Panel ("SERP") Report for the period from July 1, 2001 to June 30, 2002. This annual SERP Report is provided pursuant to License Condition 9.4 (D) of Source Materials License Number SUA-1358.

In addition to summarizing SERP evaluations, including the safety and environmental review of each such evaluation performed during the reporting period, this Report transmits change pages to the Operations Plan and/or Reclamation Plan of the approved

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Public*

Mr. Dan M. Gillen, U.S. Nuclear Regulatory Commission  
June 26, 2002  
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license application, as applicable, to reflect changes made in accordance with License Condition 9.4.

Should you have any questions regarding the information provided, please do not hesitate to contact me at (303) 389-4131.

Sincerely,



Michelle R. Rehmann  
Environmental Manager

cc: Ron E. Berg, IUSA  
T. Kenneth Miyoshi, IUSA  
David C. Frydenlund, IUSA  
Ron F. Hochstein, IUSA  
R. William von Till, U.S. Nuclear Regulatory Commission  
Tom Rice, Ute Mountain Ute Tribe  
William J. Sinclair, UDEQ

# **2001 ANNUAL REPORT**

## **White Mesa Uranium Mill Safety and Environmental Review Panel Evaluations Performed July 1, 2001 to June 30, 2002**

Prepared by:

International Uranium (USA) Corporation  
for  
White Mesa Uranium Mill  
License No. SUA-1358  
Docket No. 40-8681

June 26, 2002

Submitted to:

U.S. Nuclear Regulatory Commission  
Fuel Cycle Licensing Branch  
Office of Fuel Cycle Safety and Safeguards  
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## 1.0 INTRODUCTION

U.S. Nuclear Regulatory Commission ("NRC") Source Materials License No. SUA-1358 for the White Mesa Uranium Mill ("Mill") contains a number of performance-based license conditions. License Condition 9.4 allows International Uranium (USA) Corporation ("IUSA") to make changes in the facility, process, or procedures as presented in the approved license application or to conduct tests or experiments not presented in the application, under certain specified conditions. If, however, the specified conditions are not met, the licensee is required to file an amendment application with NRC. IUSA's Safety and Environmental Review Panel ("SERP") makes these determinations.

This Annual SERP Report for the period from July 1, 2001 to June 30, 2002 is provided pursuant to License Condition 9.4 (D) of the Mill's Source Materials License.

In addition to summarizing SERP evaluations, including the safety and environmental review of each such evaluation performed during the reporting period, this report transmits change pages to the Operations Plan and/or Reclamation Plan of the approved license application, as applicable, to reflect changes made in accordance with License Condition 9.4.

During the reporting period, five separate SERP evaluations were conducted and completed. Each SERP evaluation and review was conducted and documented in accordance with SERP procedures set forth in White Mesa Mill Standard Operating Procedure PBL-1, Rev. No. R-2.

## 2.0 DESCRIPTION AND SUMMARY OF THE SAFETY AND ENVIRONMENTAL EVALUATION OF EACH CHANGE, TEST OR EXPERIMENT

The following subsections describe and summarize the SERP evaluation of each change, test or experiment performed during the reporting period, pursuant to License Condition 9.4 of License No. SUA-1358.

In accordance with License Condition 9.4 (C), SERP membership during the reporting period consisted, at a minimum, of the following three individuals:

1. One member of the SERP had expertise in management and was responsible for managerial and financial approval changes. During this reporting period, this individual was the President or a Vice President;
2. One member had expertise in operations and/or construction and had responsibility for implementing any operational changes. During this reporting period, this person was either the President or the Mill Manager; and
3. For this reporting period, as in prior years, one member was the corporate manager of environmental health and safety, with the responsibility of assuring changes conform to radiation safety and environmental requirements.

Additional members served in selected SERPs, as appropriate, to address technical aspects such as health physics, groundwater hydrology, surface-water hydrology, specific earth sciences, and other technical disciplines or legal areas.

During the reporting period, depending upon requirements of the matter under consideration, the SERP consisted of individuals from the following list:

- Ron E. Berg – Radiation Safety Officer, White Mesa Mill
- David C. Frydenlund – Vice President and General Counsel
- Ron F. Hochstein – President and Chief Executive Officer
- William N. Deal – Manager, White Mesa Mill
- T. Kenneth Miyoshi – Manager, White Mesa Mill
- Michelle R. Rehmann – Environmental Manager
- Jo Ann S. Tischler – Chemical Engineer, Consultant

The Mill's NRC approved SERP Standard Operating Procedure ("SOP") dated June 10, 1997 identifies: (1) the membership of the SERP; (2) the general procedure to be followed in reviewing potential changes, tests, and/or experiments against the provisions of the performance-based license condition; and (3) the documentation required. The SERP followed the SOP as it performed each SERP evaluation, to ensure that each result was consistent with the following three criteria:

1. The change, test or experiment did not conflict with any requirement specifically stated in the Mill license, and did not impair IUSA's ability to meet all applicable NRC regulations (referred to hereinafter as Criterion 1).
2. There would be no degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan. (referred to hereinafter as Criterion 2)
3. The change, test or experiment was consistent with the conclusions of actions analyzed and selected in the Environmental Assessment ("EA") dated February 1997 (referred to hereinafter as Criterion 3).

## **2.1 SERP 01/02-01 – June 27, 2001**

SERP 01/02-01 was initiated with a SERP meeting on June 27, 2001 to review and make corrections to the High Thorium Content ("HTC") SOP, in response to a request by the ALARA Committee.

The HTC SOP was originally drafted for acceptance of material containing high thorium content relative to other alternate feed or mined ores, such as the W.R. Grace material. The ALARA Committee subsequently determined, and advised the SERP, that the HTC SOP shall be retained in its present draft form until and unless such time as it would be required for acceptance of the W.R. Grace material or material with similar thorium activity to the W.R. Grace material. In reconvening on July 11, the ALARA Committee considered the issue of applicability of the HTC SOP to receipt and management of the Heritage Material. The ALARA Committee discussed a proposed alternative SOP for the Heritage Material, which would contain changes relative to the HTC SOP that would be specialized for the Heritage Material. Those changes suggested by the ALARA Committee are detailed in Mill records in ALARA Committee Notes for the meetings of June 27 and July 11, 2001.

In response, as noted below under Section 2.2, the SERP reviewed and approved a separate SOP specific to the Heritage Material, which contained elements of the HTC SOP, but which was more appropriate for management of the Heritage Material.

The Heritage Material had a low thorium content relative to the W.R. Grace material, and in fact was found to have thorium content not greatly dissimilar from other alternate feed ores previously received at the Mill. Nevertheless, implementation of a specific SOP for receipt and storage of the Heritage Material was considered to be ALARA, and also provided a situation in which special unloading, ore management, and monitoring systems were practiced, and were found to have been performed in complete accordance with the SOP.

2.1.1 Description of the Change, Test, or Experiment

No change to the draft SOP has occurred to date.

2.1.2 Summary of SERP Evaluation and Conclusions

The SERP did not perform an evaluation of the HTC SOP during the reported SERP year because it had not been revised during the SERP year. As follow-up the ALARA Committee, at its meeting on June 20-21, 2002 determined that this SERP would be closed, inasmuch as IUSA does not currently anticipate the need for the HTC SOP. In the event that an HTC SOP were to become necessary, IUSA would open a new SERP, with a current tracking number, to consider the SOP.

**2.2 SERP 01/02-02 – July 11, 2001**

As noted above under Section 2.1, The proposed Heritage Alternate Feed Management SOP represented a special revision of the draft HTC SOP, which had been submitted to the NRC on December 18, 2000. The HTC SOP was prepared primarily to address materials with high levels of thorium such as are contained in the W.R. Grace Materials. While the Heritage Materials contain levels of natural thorium that are elevated relative to levels of natural uranium, the absolute levels of thorium in the Heritage Materials, based upon actual measurements upon receipt at the Mill, are much lower than the levels in the W.R. Grace Material. Therefore, the ALARA Committee and the SERP concluded that the HTC SOP was not strictly applicable to the Heritage Materials, and that a revised version of the HTC SOP, that is more appropriate for the Heritage Materials, should be developed. As a result, the Heritage SOP was developed specifically for the Heritage Material. The HTC SOP, which had been reviewed by the NRC, was used as a basis for developing the Heritage SOP. The ALARA Committee, which included SERP members, reviewed the Heritage SOP, and forwarded it for final review and approval by the SERP.

2.2.1 Description of Change, Test, or Experiment

The IUSA SERP for the Mill met via teleconference on Tuesday, July 11, 2001, in accordance with SERP SOP and the SERP Guidance to consider SERP No. 01/02-02, regarding the following item:

A. SOP for Heritage Alternate Feed Management

According to the HTC SOP, "Potential alternate feed materials undergo pre-acceptance evaluation by the IUSA ALARA Committee. Material(s) which the ALARA Committee determines require such special procedures will be designated as 'High Thorium-Content' (or, "HTC") materials."

The IUSA ALARA Committee performed a pre-acceptance evaluation of the Heritage Material, and determined that some of the approaches set forth in the HTC SOP were excessive for the Heritage material for the following reasons:

1. Activity and thorium content of the Heritage Material is much lower than the W.R. Grace Material, for which the HTC SOP was intended; and

2. The volume of Heritage Material is a small fraction of the volume of the W.R. Grace material, for which the HTC SOP was intended.

As a result, the ALARA Committee determined that the HTC SOP as drafted was not strictly applicable to the Heritage Materials. However, it was concluded that, given the elevated levels of natural thorium relative to natural uranium in the Heritage Materials, it would be appropriate to implement a modified version of the HTC SOP for the Heritage Materials. The Heritage SOP applied only to acceptance of alternate feed material from the Heritage Minerals Incorporated (HMI) site, as authorized by License Condition 10.16 contained in License Amendment 18, dated December 29, 2000.

In reviewing the HTC SOP, the SERP had noted that the HTC SOP may be amended from time to time, subject to approval by IUSA's Safety and Environmental Review Panel (SERP), as appropriate to incorporate information and results obtained from the evaluation of health physics surveys, monitoring, and controls implemented pursuant to keeping radiological exposures to employees, the public and the environment As Low As Reasonably Achievable (ALARA). Consistent with this directive by the SERP, the ALARA Committee had determined that, rather than revising the HTC SOP to provide ALARA measures relative to the Heritage Material, a separate SOP would be developed specific to the Heritage Material.

#### 2.2.2 Summary of SERP Evaluation and Conclusions

The SERP evaluations and conclusions regarding the Heritage SOP were as follows:

In evaluating the Heritage SOP relative to Criterion 1, the SERP noted that the HTC SOP was approved by the NRC, and therefore the Heritage SOP, which was customized to be appropriate to the Heritage Material, would also be acceptable. IUSA's ability to accept these types of materials (i.e., materials potentially containing thorium in greater levels than in most previously-accepted alternate feed materials) had been approved by the NRC. However, the Heritage Material did not really fit the definition of HTC as contemplated by the HTC SOP, due to lower thorium concentration and lower volume of material when compared with the W.R. Grace material. Therefore, use of the Heritage SOP for acceptance of the Heritage Material did not conflict with any requirement specifically stated in the Mill license, and it would further enhance (rather than impair) IUSA's ability to meet all applicable NRC regulations, and Criterion 1 was satisfied.

Criterion 2 was met for the following reasons. First, the intent of the SOP was to ensure that IUSA's practices for managing the Heritage Material were ALARA. This is completely consistent with IUSA's ALARA program, which is part of the Mill license. Second, the Heritage SOP did not produce any changes to the reclamation plan. Any effect of radon or thoron would be measured in the Mill's annual program for such monitoring, under the NESHAPs program. The cells currently meet a flux of 20 pCi/m<sup>2</sup>/second, and receipt of the Heritage Materials was considered in the EA and it was concluded that the material would have no impact on the ability to meet this level for reclamation. In fact, the SOP included specific language regarding tailings disposal to ensure that

there would be no impacts on the cover design. Third, all differences between the HTC SOP and the Heritage SOP were carefully considered. It was concluded that the changes to the HTC SOP reflected in the Heritage SOP appropriately dealt with the Heritage Materials and that there was no degradation in the essential health and safety or environmental commitments in the license application. As a result, the SERP determined that approval and implementation of the Heritage SOP would ensure no degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan, and therefore Criterion 2 was met.

Criterion 3 requires that the action be consistent with the actions analyzed in the EA (i.e., that the licensee is not operating in an "unanalyzed condition"). The EA concluded that the Company's ALARA program is in accordance with Reg. Guide 8.31, which describes methods to ensure that Mill operations are ALARA. The HTC SOP was reviewed by the ALARA Committee, which recommended that it be used as a basis for development of the Heritage SOP. The specific changes made to develop the Heritage SOP were reviewed by the SERP to ensure that SERP criteria were met. Measures for accepting and managing the Heritage Material that are contained in the Heritage SOP, which were discussed and approved by the SERP, were adequate to ensure that acceptance and management of Heritage Material would be consistent with the EA and would further conditions ALARA. As a result, Criterion 3 was also satisfied.

The SERP therefore concluded that:

- In accordance with the SERP SOP and Guidance, SOP PBL-6 was approved for usage at the Mill.
- Approved distribution copies of the SOP were to be managed under the Mill document control distribution system.
- Future modifications of SOP PBL-6 would be brought to the SERP for approval.
- This SOP should be reviewed by the ALARA Committee, prior to processing Heritage Material, based upon data gathered during Heritage Material receipt. Upon completion of use of this SOP, this SOP may be retired so that annual review would not be required.
- This SOP applies only to the Heritage Material, unless the ALARA Committee approves its usage for another alternate feed material.

## **2.3 SERP 01/02-03 - September 14, 2001 and October 29, 2001**

### **2.3.1 Description of Change, Test, or Experiment**

The IUSA SERP met via teleconference on Monday, October 29 to consider SERP No. 01/02-03, regarding the following six Environmental Monitoring (EM) SOPs:

- A. PBL-EP-1, Air Monitoring – Particulate Radionuclides
- B. PBL-EP-2, Stack Emission Monitoring Procedures
- C. PBL-EP-3, Surface Water Monitoring Plan
- D. PBL-EP-10, Surface Soil Monitoring
- E. PBL-EP-11, Vegetation Monitoring
- F. PBL-EP-12, Specific Conductivity, pH Meter, and Temperature Field Instrument Calibration

The ALARA Audit of 2000 had identified a need to update certain portions of the environmental protection SOPs, which were contained in the License Application. In response, the ALARA Committee placed revision of Appendix E, Environmental Monitoring SOPs as a priority item in the ALARA tracking list early in 2001.

### **2.3.2 Summary of SERP Evaluation and Conclusions**

Following the 3<sup>rd</sup> Quarter 2001 ALARA Committee meeting of August 23, a second detailed technical review of these SOPs was performed. The EM SOPs that were the subject of SERP 01/02-03 were revised on the basis of review comments received prior to August 23, and refined further following the August 23 detailed technical review. The SERP discussed the interim revisions on September 14, 2001. In addition, if reviewers determined that additional documentation was required, Technical Memoranda ("TMs") and/or peer reviews were prepared as added documentation that certain proposed technical revisions are no less protective than approaches previously contained in the LA version of these SOPs. In addition, the Corporate Manager of Environmental Health and Safety (the "CMEHS") compared the proposed revised SOPs with similar sections contained in the License Application to ensure that key elements were maintained in the revision. The CMEHS noted that these revisions to these SOPs, which are part of the Environmental Protection Manual ("EPM"), contained updates for new instruments and approaches being used in environmental monitoring, and that these updates would also address concerns identified in previous ALARA Audits.

The revisions considered by the SERP, and described by the CMEHS, were:

- Based on (1) the previous SOPs contained in the License Application copied from the NRC Public Document Room (1991 revision) and (2) draft copies of Groundwater and Surface Water quality assurance manuals (1994 revision); and
- Updated to reflect new instruments and procedures used at the Mill.

Following the discussion of specific comments (notes detailing all comments and edits are contained in the full SERP Report 01/02-03 and backup documentation retained at the Mill), and in accordance with the SERP SOP and SERP Guidance, the SERP reviewed the revised SOPs, as summarized below.

With respect to Criterion 1, the SERP noted that these SOPs were consistent with the license, in that the license requires that the Mill have SOPs to support and implement operations defined by the license and supporting documents.

In particular, the SERP noted that the Mill's NRC License Condition 9.6 requires that:

Standard operating procedures shall be established and followed for all operational process activities involving radioactive materials that are handled, processed, or stored. SOPs for operational activities shall enumerate pertinent radiation safety practices to be followed. Additionally, written procedures shall be established for non-operational activities to include in-plant and environmental monitoring, bioassay analyses, and instrument calibrations. An up-to-date copy of each written procedure shall be kept in the mill area to which it applies.

All written procedures for both operational and non-operational activities shall be reviewed and approved in writing by the radiation safety officer (RSO) before implementation and whenever a change in procedure is proposed to ensure that proper radiation protection principles are being applied. In addition, the RSO shall perform a documented review of all existing operating procedures at least annually.

License Condition 12 contains specific requirements with respect to stack sampling, surface water sampling, use of lower limits of detection, and inspections and calibration of the critical orifice assembly. The SERP found that SOPs subject to this SERP would ensure that all of these activities were performed in accordance with License Condition 12.

In addition, the February 1997 EA authorizes the licensee to "make changes in the procedures presented in the application" so long as those changes meet the three criteria detailed in the EA and in License Condition 9.4(B). The SERP noted that these changes were also necessary to ensure that SOPs are established and followed for all non-operational activities, in this case environmental monitoring protection activities; and that they were up-to-date. In performing this update, the SOPs for environmental monitoring had also been reviewed and approved by the RSO and the CMEHS to ensure that proper environmental monitoring principles were being applied. The SOPs will receive an annual review by the RSO.

For these reasons, the SERP determined that the improvements and updates in these SOPs would enhance (rather than degrade) IUSA's ability to comply with its license and NRC regulations. In addition, these updates and improvements of these SOPs were responsive to ALARA audit recommendations. Therefore, rather than impairing IUSA's ability to meet all applicable

regulations, that ability was enhanced by these SOPs. Criterion 1 was therefore considered to be satisfied.

Criterion 2 was met for the following reasons. The SOP revisions were in conformance with ALARA audit recommendations, and also incorporated other updates or enhancements to ensure that the SOPs, while being technically adequate, reflected current equipment, instruments, and practices. All reviews necessary to ensure that any change, if made, would be equally as protective as a previous approach, were included in the SERP review package. These reviews gave the SERP reasonable assurance that these revisions did not create any degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan.

Finally, the SERP evaluated the revisions relative to Criterion 3, noting that these revisions were consistent with the conclusions of actions analyzed in the EA because they included improvements to existing SOPs, and among them were revisions that were recommended by the ALARA audit. These SOPs were expected to produce no environmental impacts beyond those assessed in the EA dated February 1997, and were therefore consistent with the conclusions regarding actions analyzed in the EA. For example, as part of the SERP reviews of these SOPs, it was confirmed that the Stack Monitoring SOP was updated to reflect the current emission control equipment. The 1997 EA specifies requirements for stack effluent sampling in Section 4.6.1(b.). The Stack Monitoring SOP reviewed under this SERP met the sampling frequencies and analytical requirements, and was otherwise consistent with, the requirements stated in the 1997 EA.

The SERP conclusions regarding the Environmental Monitoring SOPs were as follows:

- In accordance with the SERP SOP and Guidance, following incorporation of the minor modifications discussed in this SERP and attached to SERP Report 01/02-03, Environmental Protection SOPs, SOP Numbers PBL-EP-1, EP-2, EP-3, EP-10, EP-11, and EP-12, Rev. No. IUSA-1, were approved for usage at the Mill.
- Copies of these Environment Protection SOPs, together with the forms to be used in performing the SOPs, were to be provided for the Mill document control distribution system.
- Future modifications of any Environmental Protection SOP would be brought to the SERP for approval.
- The ALARA Committee, meeting quarterly to consider any issues relating to SOPs, would discuss these SOPs with the Mill Radiation Staff once per year to ensure that they remain current and up to date; in addition, performance of these SOPs would be one of the subjects of the annual ALARA audit.

## **2.4 SERP 01/02-04 – May 9, 2002**

### **2.4.1 Description of Change, Test, or Experiment**

The SERP met via teleconference on Thursday, May 9, in accordance with SERP procedures in and the SERP Guidance, to consider SERP No. 01/02-04, regarding the following:

#### **A. RPP-1, Book 14 – Respiratory Protection Program**

The ALARA Committee and the RSO identified a need to update certain portions of the Radiation Protection Program (“RPP”), which was previously contained in the 1991 Mill License Application. In response, the AC placed revision of RPP as a priority item in the ALARA tracking list on February 1, 2001. During the first quarter 2002 AC meeting, the ALARA Committee directed that the RPP updates were to be completed prior to the Mill run, which was anticipated to commence by early summer of 2002.

### **2.4.2 Summary of SERP Evaluation and Conclusions**

The progression of revisions and reviews is detailed in SERP Report 01/02-04, and backup documentation which is retained on file at the Mill.

The CMEHS and the RSO noted that, throughout the revision and review process, every effort was made to ensure that any proposed revisions resulted in a Respiratory Protection Program (“RPP”) that is no less protective than the RPP previously contained in the 1991 License Application. These revisions to the RPP contained updates for new canisters and had been reviewed to ensure that the Program was consistent with 10 CFR Part 20 and NRC Regulatory Guidance. This RPP:

- Was based on the previous RPP contained in the License Application copied from the NRC Public Document Room (1991 revision); and
- Was updated to reflect updated equipment and procedures used at the Mill, as well as being reformatted to address each procedure

The entire AC had previously considered the proposed revisions, and the SERP then reviewed and discussed comments on specific pages and sections of the final draft revised RPP. Notes from each review and SERP discussion are attached to SERP Report 01/02-04.

With respect to Criterion 1, the SERP determined that this RPP revision was consistent with the license. The license requires that the Mill have SOPs to support and implement operations defined by the license and supporting documents.

In addition, the Mill's NRC License Condition 9.6 requires that:

Standard operating procedures shall be established and followed for all operational process activities involving radioactive materials that are handled, processed, or stored. SOPs for operational activities shall enumerate pertinent radiation safety practices to be followed. Additionally, written procedures shall be established for non-operational activities to include in-plant and environmental monitoring, bioassay analyses, and instrument calibrations. An up-to-date copy of each written procedure shall be kept in the mill area to which it applies.

All written procedures for both operational and non-operational activities shall be reviewed and approved in writing by the radiation safety officer (RSO) before implementation and whenever a change in procedure is proposed to ensure that proper radiation protection principles are being applied. In addition, the RSO shall perform a documented review of all existing operating procedures at least annually.

The February 1997 EA authorizes the licensee to "make changes in the procedures presented in the application" so long as those changes meet the three criteria detailed in the EA and in License Condition 9.4(B). The SERP noted that these changes were also necessary to ensure that SOPs were established and followed for all non-operational activities, in this case RPP activities; and that they were up-to-date. In performing this update, the RPP had been carefully reviewed and approved by the RSO and the CMEHS to ensure that proper respiratory protection principles were being applied. The RSO also performs annual reviews.

In view of the foregoing, the SERP found that the improvements and updates in the procedures and technologies contained in this RPP, and the addition of a policy statement, would enhance (rather than degrade) IUSA's ability to comply with its license and with NRC regulations, and therefore met Criterion 1.

In evaluating the RPP relative to Criterion 2, the SERP found that the RPP revisions were in conformance with ALARA Committee and RSO recommendations, and went further by incorporating other updates or enhancements to ensure that the procedures contained in the RPP, while being technically adequate, also reflected current equipment, instruments, and practices. Also, all reviews necessary to ensure that any change, if made, would be equally as protective as a previous approach, were performed. These reviews give the SERP reasonable assurance that these revisions did not create any degradation in the essential safety or environmental commitments in the license application, or provided by the approved reclamation plan, and that the revised RPP was consistent with the version of the RPP, which was presented in the 1991 License Application.

In considering the RPP's ability to satisfy Criterion 3, the SERP observed that the EA of February 1997 states, in Section 4.7, In-Plant Safety, that:

NRC, through 10 CFR Part 20 and license conditions, requires a radiological safety program that contains the basic elements needed to assure that exposures are kept

low, or, in any event, as low as is reasonably achievable (ALARA). Therefore, an in-plant radiation safety program including the following is required:

- Qualified management of the radiation safety program and appropriate training of personnel;
- Written radiation procedures;
- Airborne and surface contamination sampling and monitoring;
- Internal and external radiation monitoring programs;
- An approved respiratory protection program; and
- Annual ALARA audits and frequent in-house inspections.

NRC considers the program of in-plant safety, as required by Federal regulations, and the radiation safety program as defined by 10 CFR Part 20 to be sufficient to protect the worker during normal operations. The NRC evaluation of the licensee's radiation safety program is discussed more fully in the SER.

The SERP noted that, in addition to the above EA reference, the Safety Evaluation Report (SER) transmitted with the 1997 EA lists under Section 4.5.3, Respiratory Protection Program, the elements required in an RPP for the facility; RSO responsibilities; and training requirements. The SERP found that the revised RPP continued to contain all of the items described in the SER. However, while the revised RPP specified that the Mill Manager was responsible for ensuring that an RPP is established and maintained, the SER indicated that the individual responsible for this action was the Maintenance Superintendent. The President indicated that the Maintenance Superintendent position does not exist in IUSA's organization, and that the Mill Manager position was in fact a more responsible position.

The SERP found that these revisions would produce no environmental impacts beyond those assessed in the EA dated February 1997, and were expected to continue to ensure in-plant worker safety. It could therefore be concluded that the RPP was consistent with the conclusions of actions analyzed in the EA dated February 1997, and that Criterion 3 was satisfied.

The SERP conclusions and recommendations regarding the RPP were as follows:

- The RPP and associated attachments were approved for usage at the Mill.
- Attachments to the SERP report would include Reg. Guide 8.15.
- Copies of the RPP, together with previous markups showing the changes considered during the revision process, were attached to SERP Report 01/02-04 for purposes of

recording the actions of the SERP. An approved distribution copy of the RPP would be provided under separate cover for the Mill document control distribution system.

- Future modifications of the RPP would be brought to the SERP for approval.
- The AC, meeting quarterly to consider any issues relating to the RPP, would discuss the RPP with the Mill Radiation Staff once per year to ensure that it remains current and up to date; in addition, performance of the procedures in the RPP will be one of the subjects of the annual ALARA audit.
- Other SOPs would be reviewed for consistency with the RPP. This action would be added to the ALARA tracking list.
- Prior to operation of the vanadium packaging area, the use of full vs. half-face respirators would have to be reviewed to ensure protection against fumes and protection of eyes as well as respiratory protection.

## 2.5 SERP 01/02-05 – June 6, 2002

### 2.5.1 Description of Change, Test, or Experiment

The SERP met via teleconference on Thursday, June 6, 2002, to consider the following issue:

- A. Revision of Table 1 in the July 19, 2000 revision of the Sampling and Analysis Plan ("SAP") for confirmatory sampling of Ashland 1 material to address three analytes detected in IT Corporation ("IT") confirmatory sampling that were not previously included in Table 1 of the July 19, 2000 revision of the SAP ("Table 1").

### 2.5.2 Summary of SERP Evaluation and Conclusions

The SERP evaluation of this issue in light of Criterion 1 found that modifying the SAP was consistent with the license. The license requires that IUSA review analytical results to determine that no RCRA listed hazardous waste is included in material to be processed. Addition of these analytes to the SAP Table was in conformance with the license requirement that the Mill not accept RCRA listed hazardous waste, and addition of these analytes would not impair IUSA's ability to meet all applicable regulations. As a result, Criterion 1 was satisfied.

With respect to Criterion 2, the SERP determined that revision to the SAP Table 1 would be in conformance with the License Application commitment that IUSA would have a Sampling and Analysis Plan and program in place for shipments received from Ashland 1. The objective of that commitment in the License Application was to ensure that IUSA would only process materials that conform to environmental commitments made in the license amendment application. Therefore, addition of these compounds to the SAP Table 1 would not create any degradation of the essential

safety or environmental commitments in the license application, or provided by the approved reclamation plan. The SERP also evaluated safety in terms of unloading requirements and handling properties of the material based on a review by an independent chemical expert, and was advised that:

- The materials could not generate a vapor concentration sufficient to require respiratory protective equipment for vapors;
- Current worker personal protective equipment was sufficient for protection from skin exposure;
- The materials would be safely compatible with all chemicals which they will contact in the Mill; and
- The materials would not affect the tailings impoundments or the Reclamation Plan for the Mill.

Based on these considerations, Criterion 2 was considered to be met.

During the SERP evaluation with respect to Criterion 3, the SERP noted that the primary environmental impacts evaluated in the EA of February, 1997 were based on the tailings containing large volumes of organics, such as kerosene and alcohol; large volumes of acid solutions; and smaller volumes of process chemicals. The EA assumed that the Mill was designed to manage such chemicals in significantly greater quantities than these trace levels being added to the SAP, which may not even actually arrive at the Mill due to volatilization. Therefore, the theoretical presence of these compounds would have no environmental impact, and Criterion 3 would be satisfied.

The SERP conclusions and recommendations regarding revision of the SAP Table 1 were as follows:

- Three additional compounds reported in IT sampling, chloromethane, carbon tetrachloride, and 1,4 dichlorobenzene, were not RCRA listed hazardous wastes.
- The chemical engineering consultant advised IUSA that the presence of these compounds presented no additional environmental, health or safety impacts or additional handling requirements at the levels at which they were reported.
- Acceptance of materials containing these compounds, as well as those already identified in the July 19, 2000 SAP, was in conformance with the environmental commitments in License Amendment 10, in compliance with all NRC requirements applicable to the Mill, and consistent with the conclusions of the EA dated February, 1997; in other words, the three SERP Criteria were met.

- Table 1 of the SAP would be revised to include these compounds, as identified in the J. A. Tischler memorandum of May 24, 2002.
- A copy of SAP, as revised in accordance with this conclusion, would be attached to SERP Report 01/02-05.

### 3.0 SUMMARY AND CONCLUSIONS

During the reporting period, five separate SERP evaluations were conducted and completed in accordance with SERP procedures in White Mesa Mill SOP PBL-1, Rev. No. R-2, and the SERP Guidance. SERP evaluations detailed above ensured that each approved action met the criteria stated in License Condition 9.4 (B). Records of each SERP evaluation and action are documented in individual SERP Reports retained at the Mill for review and inspection, in accordance with requirements in the Mill license.

## **Attachment 1**

**Revised Environmental Protection Standard Operating Procedures  
(Replaces License Application Appendix E Sections 1-4, leave Section 5 of  
Appendix E)**

## **AIR MONITORING – PARTICULATE RADIONUCLIDES**

### **PART I AIR MONITORING PLAN**

#### **1.0 PARTICULATE RADIONUCLIDE AIR MONITORING**

Air samples for monitoring particulate radionuclides are taken at the following four locations: (See Attachment A)

- |       |  |
|-------|--|
| BHV-1 | Northeast of the Mill at the meteorological station.   |
| BHV-2 | Approximately 2.5 miles north of the Mill.   |
| BHV-4 | Approximately 400 yards south of Cell no. 4.   |
| BHV-5 | Approximately 100 yards south of the intersection of State Highway 191 and the Mill access road. |

Air samples are collected on a weekly basis. A composite of 13 weekly samples from each of the above locations is prepared to form a quarterly sample for each location.

#### **2.0 QUALITY ASSURANCE**

Quality assurance of the samples is met by collecting samples in accordance with the conditions and guidelines set forth in this SOP. (Section 6.0).

Quality assurance of the analytical results is based on the contract laboratory's quality controls such as blanks, duplicates, and standard percent recovery. The laboratory will also follow U.S. EPA Guide SW-846 and U.S. NRC Regulatory Guides 4.14 and 4.15 when analyzing the air filter samples. The laboratory is committed to meet the LLD values for radionuclides listed in these guidance documents, and will perform re-runs on all samples not meeting these limits.

#### **3.0 ANALYTICAL REQUIREMENTS**

Each quarterly sample will be analyzed for U-nat, Ra-226, Th-230 and Pb-210. Results will be expressed in picocuries per milliliter (pCi/mL).

### **PART II STANDARD OPERATING PROCEDURES**

#### **1.0 EQUIPMENT**

The equipment used in monitoring levels of particulate radionuclides consists of high volume air samplers equipped with mass flow controllers and vacuum switch controlled timers. The samplers are capable of collecting air through the sample filter at a volumetric flow rate of approximately 40 standard cubic feet per minute (scfm). The

mass flow controller varies the actual air flow rate as dictated by changing temperature, filter loading, and barometric pressure to maintain a constant standard air flow rate. The actual rate is read directly from the analog gauge located on the front panel. The timer is turned off when no vacuum exists in the system, i.e., when the motor/blower assembly is disconnected or otherwise malfunctions.

Particulates are trapped on an 8 x 10-inch glass microfiber filter such as one of the following, or equivalent:

1. Whatman EPM 1000
2. Whatman EPM 2000
3. Schleicher & Schuell #1 HV.

## **2.0 MONITORING METHODOLOGY**

The air samplers are mounted on towers approximately 2 meters above ground plane. The samplers run continuously except for calibration, mechanical or electrical failure, and maintenance down time. Target flow rate will be 32 scfm.

Air filters are replaced weekly due to particulate loadings. Maximum filter use duration will be weekly unless weather conditions prohibit safe access to one or more of the air monitoring station locations.

Each filter is stamped by the manufacturer with a unique number. The blank filters are weighed to the nearest 0.0001 gram using a Sartorius Model 2432 analytical balance or equivalent. The filters are kept in manila folders for support during transportation. The weights are then recorded on the filter folders along with the location, filter number, start date, and start time. When the filters are collected in the field, the stop date and time are entered on the folder. On return from the field, the filters are again weighed and the gross weights are recorded on the folders. Filters and folders are kept in resealable plastic bags.

Samples are collected continuously for approximately one week. The “loaded” filters are removed from the shut down samplers, folded, and placed in the folders in the plastic bags. If any part of the filter remains on the seal gasket, it is removed and added to the folder. The new filters are removed from their folders and placed on the vacuum head with the filter holder frame tightened enough to seal, but not tight enough to rupture the filters. The samplers are then turned on.

Each station’s filters are composited on a quarterly basis (13 weeks) by the environmental staff. The samples are forwarded, along with an analytical sheet and (COC) form, to the (Attachment B) to the contract laboratory in sealed plastic bags.

### **3.0 CALIBRATION**

#### **3.1 Orifice Plate**

Calibration shall be performed every two years by the EPA or by an EPA-approved method. The procedure for calibration is attached (Attachment B). Calibration equipment consists of:

1. Model GMW-6000 Primary Calibration System Roots Meter
2. Model GMW-25 Calibration Orifice Assembly

Calibration records are kept in the environmental files.

#### **3.2 Sampler**

Sampler airflow rates are checked weekly by visual observation of the analog meter, graduated in standard cubic feet per minute.

Calibration and preventive maintenance of the equipment occurs during the first Monday of each month. The preventative maintenance program calls for replacement of the motor carbon brushes. If a non-scheduled motor replacement is necessary, the sampler is re-calibrated.

An orifice plate assembly and U-tube manometer are used for monthly calibrations.

The sampler flow rate is regulated to a standard air volume that is recorded on the field calibration sheet using 20°C. (298 K) and 29.2 inches (760 mm) of mercury as standard conditions. A monthly calibration worksheet (Attachment C) is completed for each air sampling station and retained in the files.

The monthly calibration task involves the following:

1. Before visiting each monitoring location, the air temperature and barometric pressure are recorded.
2. Brushes are replaced at each BHV site monthly.
3. The motors are replaced as required. The replacement motors are usually prepared at the Mill office.
4. The new filter is placed on the vacuum head, and the orifice plate is secured on top of the filter.
5. The orifice plate is connected to the U-tube manometer and the initial inches H<sub>2</sub>O is recorded.
6. The control screw is adjusted as necessary to advance or slow the vacuum motor to reach the desired flow rate. The final flow rate must be at least 32 scfm on the analog meter and reach 75% on-stream time for the quarter to meet the required LLD for the radionuclide parameters.
7. The U-tube manometer level, in inches, is then recorded and a flow rate calculated.

## 4.0 CALCULATIONS

Using inches of water from the U-tube, refer to the following subsections to perform the calculation of flow rate. Section 4.1 provides the equation used to compute the flow rate at field conditions, and the “actual” flow rate, in cubic meters per minute. Actual flow rate must be corrected to standard flow rate using the flow rate equation in Section 4.2.

The standard flow rate is then converted to standard cubic feet with the conversion equation in Section 4.3.

### 4.1 Orifice Equation

Using the inches of water determined from the U-tube, the following equation is used to calculate the flowrate at field conditions using:

$$Q_a = a \times (\text{inches of water})^b$$

Where

$Q_a$  = Flow rate at field conditions, in cubic meters per minute ( $\text{m}^3 / \text{min}$ ).

$a$  = orifice constant

$b$  = orifice constant.

The constants  $a$  and  $b$  in the above equation are provided by the calibration laboratory for each specific calibrated orifice (Attachment D). Each orifice will have unique performance properties which relate to design and those measured performance properties are incorporated into the flow equation as specific constants. \*[The flow equation demonstrates the relationship between measured vacuum pressure in inches of water to actual flow rate utilizing this device].

### 4.2 Standard Conditions Flow Rate Equation

The flow rate at standard conditions is calculated by adjusting the field condition flow rate, calculated above, by the following equation:

$$Q_s = Q_a \times \frac{[P_a \times T_s]}{[P_s \times T_a]}$$

where

$T_s$	=	Absolute temperature at orifice calibration (298 K)
$T_a$	=	Absolute temperature at air sampler calibration ( $273^\circ\text{C} + \text{measured } ^\circ\text{C}$ )
$P_s$	=	Atmospheric pressure at orifice calibration (760 mm Hg)
$P_a$	=	Atmospheric pressure at air sampler calibration (measured mm Hg)
$Q_s$	=	Flow rate at standard conditions in cubic meters per minute ( $\text{m}^3 / \text{min}$ ).
$Q_a$	=	Flow rate at field conditions in cubic meters per minute ( $\text{m}^3 / \text{min}$ ).

#### **4.3 Correction Equation**

To convert the standard flowrate,  $Q_s$ , from cubic meters per minute to standard cubic feet per minute, use the following equation:

$$Q_{\text{Standard Cubic Feet per Minute}} = 35.341 \times Q_s$$

#### **5.0 RECORD KEEPING**

The records are kept on the filter folders, which are retained in the environmental files in the environmental office, and are also into the computer files, after the data have been reviewed. The following information will be entered in computer files (see Attachment E):

- Filter number
- Start date
- Start time
- End date
- Stop time
- Total time
- Total liters
- Loading in mg/cubic meter
- Percent on-stream
- Weekly average flow rate in cubic feet per minute

#### **6.0 QUALITY ASSURANCE**

##### **6.1 Installation and Removal of Filters**

Field methods to assure quality of air sample collection include the following:

1. Inspection of all new filters for aberrations and discarding damaged ones.
2. Maintaining seals on equipment connections.
3. Careful installation and removal of filters, retaining all abraded filter media.
4. Proper sequential handling of all filters.
5. Filters are inspected for fingerprint contamination by visual observation.

##### **6.2 Sample Duration**

Maintenance of sample duration is assured by:

1. Installation of a vacuum-actuated timer which operates the timer only when the motor is running and pulling the minimum allowable vacuum.

2. Weekly monitoring of motor brush and alternator bearing wear and proper change-out at appropriate intervals (monthly).

### **6.3 Sample Flow Rate**

Quality assurance of sample flow rate is accomplished by weekly visual checks of the analog read-out. Monthly checks of flow controller operation and documentation thereof also provide quality assurance. Samplers are checked for calibration at motor rotation intervals (monthly).

### **6.4 Calculations**

Calculations are checked on a random basis for inconsistencies, and such checks are documented.

Upon retrieval of the data analytical sheet from the contract laboratory, the date of receipt is noted, along with the date of transcribing to the sample station log sheet and the transcriber's initials. The transcription of data is reviewed by another person in the Environmental Department to minimize transposition of numerical values. Calculation and data storage is by computer program.

### **6.5 Sampler Performance**

A record of sampler operation time versus total possible duration time is maintained as a flag against excessive equipment downtime. Sampler performance is reviewed monthly.

### **6.6 Quality Control Methodology**

Blanks are weighed each week and submitted alongside the actual filters. The filters and blanks are recorded on an analytical sheet which is sent to the vendor, and this sheet is returned with the results.

Attachments for Air

Attach. A, COC & Fig. 1

## ATTACHMENT A

Period: October 08, 2001 through January 10, 2002 (4th Quarter 2001)

Page 1

Total Volume: 0.00E+00

BHV-1

BHV-1 on stream % 0.0%

Week #	Filter Number	Start Date	Stop Date	Gross Tare	Net	Stop Time	Start Time	Total Time	Total Liters	Loading, mg/m3	Per Cent On Stream	SCFM
1		08-Oct-01	15-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
2		15-Oct-01	22-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
3		22-Oct-01	29-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
4		29-Oct-01	05-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
5		05-Nov-01	13-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
6		13-Nov-01	22-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
7		22-Nov-01	28-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
8		28-Nov-01	03-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
9		03-Dec-01	14-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
10		14-Dec-01	17-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
11		17-Dec-01	24-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
12		24-Dec-01	31-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
13	Totals	94	2258.0	#DIV/0!	#DIV/0!			0	0	#DIV/0!	0.0%	36.1

Total Volume: 0.00E+00

BHV-2

BHV-2 on stream % 0.0%

Week #	Filter Number	Start Date	Stop Date	Gross Tare	Net	Stop Time	Start Time	Total Time	Total Liters	Loading, mg/m3	Per Cent On Stream	SCFM
1		08-Oct-01	15-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
2		15-Oct-01	22-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
3		22-Oct-01	29-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
4		29-Oct-01	05-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
5		05-Nov-01	13-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
6		13-Nov-01	22-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
7		22-Nov-01	28-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
8		28-Nov-01	03-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
9		03-Dec-01	14-Dec-01		0.0185			0.0	0	#DIV/0!	0.0%	36.5
10		14-Dec-01	17-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
11		17-Dec-01	24-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
12		24-Dec-01	31-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
13	Totals	94	2258.0	#DIV/0!	#DIV/0!			0	0	#DIV/0!	0.0%	36.1

Total Volume: 0.00E+00

BHV-4

BHV-4 on stream % 0.0%

Week #	Filter Number	Start Date	Stop Date	Gross Tare	Net	Stop Time	Start Time	Total Time	Total Liters	Loading, mg/m3	Per Cent On Stream	SCFM
1		08-Oct-01	15-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
2		15-Oct-01	22-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
3		22-Oct-01	29-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
4		29-Oct-01	05-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
5		05-Nov-01	12-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
6		12-Nov-01	22-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
7		22-Nov-01	28-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
8		28-Nov-01	03-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
9		03-Dec-01	14-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
10		14-Dec-01	17-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
11		17-Dec-01	24-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
12		24-Dec-01	31-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
13	Totals	92	2208.0	#DIV/0!	#DIV/0!			0	0	#DIV/0!	0.0%	36.1

Total Volume: 0.00E+00

BHV-5

BHV-5 on stream % 0.0%

Week #	Filter Number	Start Date	Stop Date	Gross Tare	Net	Stop Time	Start Time	Total Time	Total Liters	Loading, mg/m3	Per Cent On Stream	SCFM
1		08-Oct-01	15-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
2		15-Oct-01	22-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
3		22-Oct-01	29-Oct-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
4		29-Oct-01	05-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	35.4
5		05-Nov-01	12-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
6		12-Nov-01	22-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
7		22-Nov-01	28-Nov-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
8		28-Nov-01	03-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
9		03-Dec-01	14-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
10		14-Dec-01	17-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
11		17-Dec-01	24-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
12		24-Dec-01	31-Dec-01		0.0000			0.0	0	#DIV/0!	0.0%	36.5
13	Totals	92	2208.0	#DIV/0!	#DIV/0!			0	0	#DIV/0!	0.0%	36.1

## ATTACHMENT A (cont)

Period: October 08, 2001 through January 10, 2002 (4th Quarter 2001)

Page 2

BHV-6 on stream % 0.0%

BHV-6 Total Volume: 0.00E+00

Week #	Filter Number	Start Date	Stop Date	Gross	Tare	Net	Stop Time	Start Time	Total Time	Total Liters	Loading, m³/d	Per Cent On Stream	SCFM
1		08-Oct-01	15-Oct-01			0.0000			0.0	0	#DIV/0!	0.0%	35.4
2		15-Oct-01	22-Oct-01			0.0000			0.0	0	#DIV/0!	0.0%	35.4
3		22-Oct-01	29-Oct-01			0.0000			0.0	0	#DIV/0!	0.0%	35.4
4		29-Oct-01	05-Nov-01			0.0000			0.0	0	#DIV/0!	0.0%	35.4
5		05-Nov-01	12-Nov-01			0.0000			0.0	0	#DIV/0!	0.0%	35.4
6		12-Nov-01	22-Nov-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
7		22-Nov-01	28-Nov-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
8		28-Nov-01	03-Dec-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
9		03-Dec-01	14-Dec-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
10		14-Dec-01	17-Dec-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
11		17-Dec-01	24-Dec-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
12		24-Dec-01	31-Dec-01			0.0000			0.0	0	#DIV/0!	0.0%	36.5
13		31-Dec-01	08-Jan-02			0.0000			0.0	0	#DIV/0!	0.0%	36.5
Totals		92	2208.0	#DIV/0!	#DIV/0!	#DIV/0!			0	0	#DIV/0!	0.0%	36.1

\* BHV-6 installed 7/1/89

ALL BHV on stream % 0.0%

Week #	Blanks	Start Date	Stop Date	Net
1		08-Oct-01	15-Oct-01	
2		15-Oct-01	22-Oct-01	
3		22-Oct-01	29-Oct-01	
4		29-Oct-01	05-Nov-01	
5		05-Nov-01	13-Nov-01	
6		13-Nov-01	22-Nov-01	
7		22-Nov-01	28-Nov-01	
8		28-Nov-01	03-Dec-01	
9		03-Dec-01	14-Dec-01	
10		14-Dec-01	17-Dec-01	
11		17-Dec-01	24-Dec-01	
12		24-Dec-01	31-Dec-01	
13		31-Dec-01	10-Jan-02	
Totals		94	2268.0	#DIV/0!



# CHAIN OF CUSTODY

Samples Shipped to:

Sheet of		Chain of Custody/Sampling Analysis Request			
Project		Samplers' Name		Samplers' Signature	
Sample ID	Date Sample Collected	Time Sample Collected	Laboratory Analysis Requested		
Relinquished by:(Signature)		Date/Time	Received By:(Signature)		Date/Time
Relinquished by:(Signature)		Date/Time	Received By:(Signature)		Date/Time

Please return signed Chain of Custody record, cooler and blue ice ASAP.

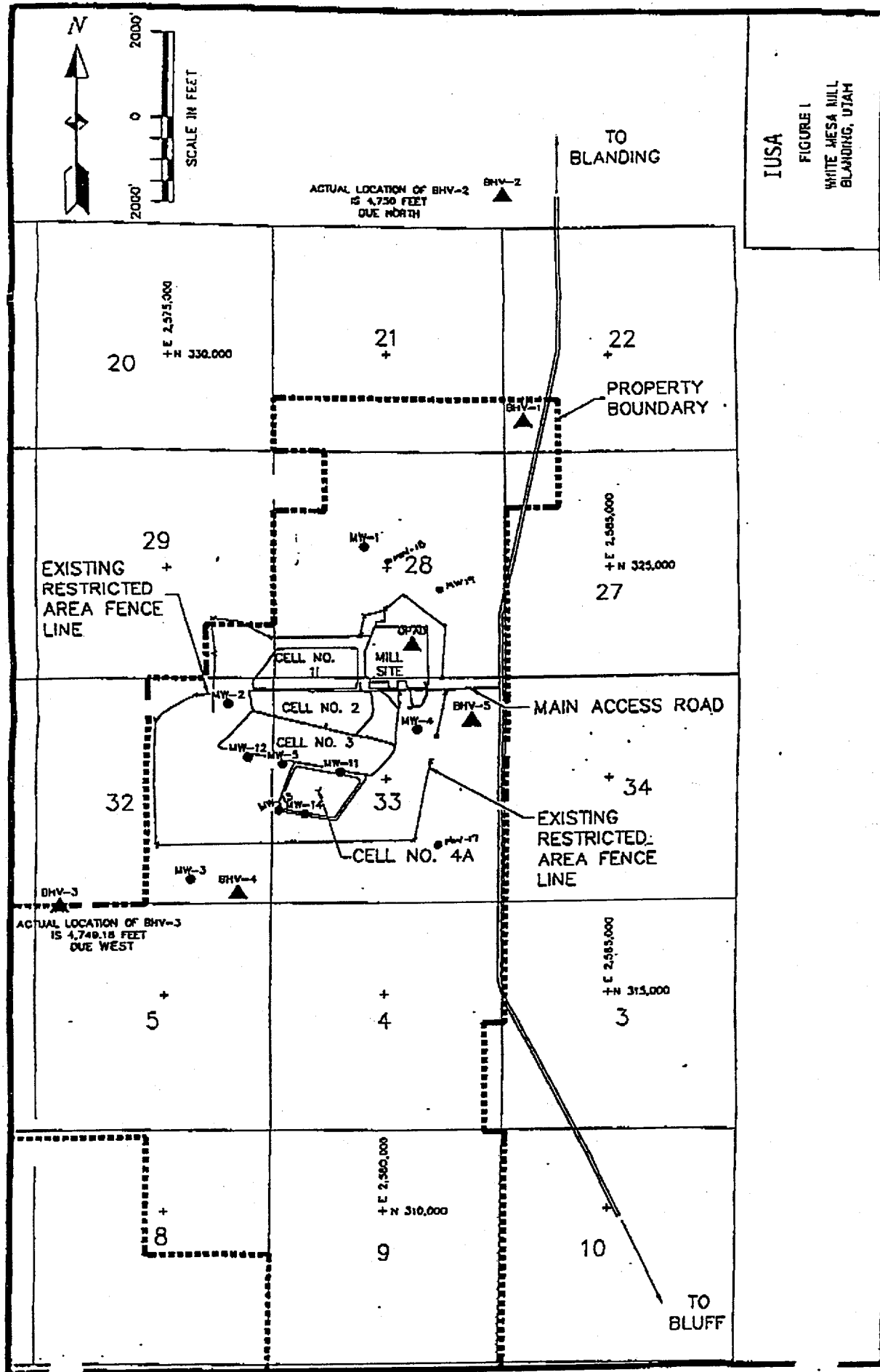


Figure 1 - Environmental Site Sampling Map

## STACK EMISSION MONITORING PROCEDURES

### WHITE MESA GAS STACK EMISSIONS

#### 1.0 INTRODUCTION

White Mesa uses scientifically approved reference methods to determine gas stack emissions release concentration for radionuclide particulates. These methods conform to principles that apply to obtaining valid samples of airborne radioactive materials, using prescribed acceptable methods and materials for gas and particulate sampling. See American Standard Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities ANSI N13.1-1969. These sampling methods are also consistent with guidance contained in the U.S. Nuclear Regulatory Commission's Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills."

#### 2.0 SAMPLING METHODOLOGIES

The sampling methods for airborne radionuclide particulates, from the yellowcake dryer and other mill effluent control stacks, are identical to methods published in the EPA's manual, Gas Stream Sampling Reference Methods for New Source Performance Standards; they are found in the EPA Manual in Appendix No. 5, "Determination of Particulate Emissions from Stationary Sources" and Appendix No. 17, "Determination of Particulate Emissions from Stationary Sources (In-Stack Filtration Method)". These appendices are attached to this SOP. Sampling is performed as per the methods, to ensure that the sampling and results are: (1) isokinetic; (2) representative; and (3) adequate for determination of the release rates and concentrations of U-Nat, Th-230, Ra-226 and Pb-210.

#### 2.1 Sampling Equipment

Sampling equipment used to collect airborne radionuclide particulates from point source emission stacks at the Mill consists of equipment manufactured by Research Appliance Company (RAC), (or other equivalent apparatuses), as follows:

1. RAC Model 201009 Model 2414 stack sampler.

2. Two each, RAC Model 201044 modular sample cases. One heater box and one glassware box.
4. One each, RAC Model 201019 umbilical cord.  
Three each, RAC Model 201013 – 100mm diameter filter holders.
5. One each, RAC Model 201005 standard pilot tube, three feet length, stainless steel/S-type probe.
6. Barometer.
7. Psychrometer.
8. Satorius Model 2432 balance or equivalent.
9. Triple beam balance.

Equipment instruction and operating manual(s) provided by the manufacturer(s) are retained at the Mill and used for specific guidance and reference.

## 2.2 Sample Collection

Gas stack samples are collected from emission control systems used in Uranium Recovery Operations at the Mill. These samples are collected from process stacks when the emission control systems are operating. They are sampled for radionuclide particulate concentrations at a frequency in accordance with Table 5-1. Sample collection methods are described in detail in EPA Method #5 and EPA Method #17, Determination of Particulate Matter Emissions From Stationary Sources. It is necessary to read and understand all procedures described in the methods and in the equipment manual. The operation of the equipment requires “hands-on” instruction from the Radiation Departmental Staff from individuals who are experienced in using sample collection equipment and applying sample collection methods. The following steps are described for stack sample collection.

1. Check equipment listed in Section 2.1 of this SOP. Consult the manufacturers equipment operations manual for details.
2. Assemble equipment as described in the operations manual for sample collection Method EPA #17.
3. Follow the calibration procedure listed in the manual. If the calibration measurements are not obtained, consult the trouble shooting section of the manual for corrective instruction. Once the collection apparatus is calibrated, proceed to the next step.
4. Weigh a new glass fiber filter, record the weight, and place in the filter holder assembly.
5. Check the sample collection system for leaks.
6. Cap ends of sample probes to prevent contamination and transport sample unit to the sample location.

7. Uncap sample end and insert 3/8-diameter sample probe into the stack in the midsection of the exhaust stream.
8. Turn sample apparatus on and observe unit operation to insure a sample is being collected and the apparatus is functioning properly.
9. Collect the stack sample for at least one hour during periods of routine process operation. Note the collection time.
10. Record the information described in the manufacture's operations manual. This information is also described in the EPA Methods for point source particulate emissions.
11. After sample collection is complete, turn off unit. Obtain sample filter from filter housing and place in a new plastic petri dish. Send to outside laboratory for radionuclide analysis in accordance with Table 5.1.

### 2.3 Sample Handling and Shipping

1. During preparation and assembly on the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin.
2. Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.
3. Before moving the sampling train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened, and cap it. Remove the umbilical cord from the last impinger, and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.
4. Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.
5. Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used, and place it in a glass sample container labeled "acetone blank."
6. Carefully remove the filter from the filter holder, and place it in its identified petri dish container. Use a pair of tweezers and/or clean

disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the PM cake is inside the fold. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish and PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

7. Send to the laboratory for radionuclide analysis.

### **3.0 RECORD KEEPING**

Records of gas stack effluent sampling events and results of analysis are retained at the Mill. The following information is recorded:

1. Stack and Run ID
2. Date and Sampler
3. Sampled Air Volume at standard conditions
4. Sampled Water Volume at standard conditions
5. Moisture Content (volume basis)
6. Stack Gas Molecular Weight (wet basis)
7. Stack Gas Velocity
8. Stack Gas Volumetric Flow Rate (dry basis, at standard conditions)
9. Particulate Concentration
10. Percent Isokinetics
11. Emission Rates for Particulates U-Nat, Th-230, Ra-226, and Pb-210.

The data are used to calculate emission rates in pounds and pico curies per hour for radionuclide particulate concentrations.

### **4.0 MONITORING LOCATION AND FREQUENCY**

Stack sampling must be performed during any quarter or semi-annual period that the stacks operate in accordance with the schedule in Table 6.1. During non-operational periods, stack sampling is not performed.

#### **4.1 YELLOWCAKE STACKS**

The exhaust stack for the drying and packaging equipment associated with the yellowcake calciner is sampled on a quarterly basis during operations. The sample ports are located on the roof of the main Mill building.

#### **4.2 Feed Stacks**

The grizzly feed stack is located on the north end of the grizzly structure. This stack is accessible from a stack platform and is sampled on a semi-annual basis if this system is operating.

### 6.3 Chemical Sample Control

Analyses on each period's sample shall include blanks for both the filters, impinger solutions, and the rinse solutions. A field log book shall be maintained listing data generated, determinations of volumes measured, and net gain weights of filters to provide a back up to summary data records. Filters are transmitted within plastic enclosed petri dishes. Handling of filters is only done using tweezers.

### 6.4 Calculations

All calculations will be retained at the Mill in both a hard copy and computer files.

The gas stack effluent concentrations (C) are calculated as follows:

$$\text{Lab Result } \mu\text{Ci (A)} / \text{Volume Sampled (V)} = \text{Effluent Concentration (C)}$$

where

$$\text{Volume Sampled (V)} = \text{Flow rate (Q)} * \text{Time of sample collection in minutes (t)}$$

and

$$\text{Lab Result } \mu\text{Ci (A)} = \text{Radioisotopic activity, in } \mu\text{Ci on air filter}$$

**EPA Method #17**  
**"Determination of Particulate Matter Emissions From**  
**Stationary Sources"**  
**40 CFR Part 60 Volume 2 App. A**

**METHOD 17--DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES**

**Note:** This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 2, Method 3, Method 5.

**1.0 Scope and Application**

**1.1 Analyte.** Particulate matter (PM). No CAS number assigned.

**Note:** Particulate matter is not an absolute quantity. It is a function of temperature and pressure. Therefore, to prevent variability in PM emission regulations and/or associated test methods, the temperature and pressure at which PM is to be measured must be carefully defined. Of the two variables (i.e., temperature and pressure), temperature has the greater effect upon the amount of PM in an effluent gas stream; in most stationary source categories, the effect of pressure appears to be negligible. In Method 5, 120 deg.C (248 deg.F) is established as a nominal reference temperature. Thus, where Method 5 is specified in an applicable subpart of the standard, PM is defined with respect to temperature. In order to maintain a collection temperature of 120 deg.C (248 deg.F), Method 5 employs a heated glass sample probe and a heated filter holder. This equipment is somewhat cumbersome and requires care in its operation. Therefore, where PM concentrations (over the normal range of temperature associated with a specified source category) are known to be independent of temperature, it is desirable to eliminate the glass probe and the heating systems, and to sample at stack temperature.

**1.2 Applicability.** This method is applicable for the determination of PM emissions, where PM concentrations are known to be independent of temperature over the normal range of temperatures characteristic of emissions from a specified source category. It is intended to be used only when specified by an applicable subpart of the standards, and only within the applicable temperature limits (if specified), or when otherwise approved by the Administrator. This method is not applicable to stacks that contain liquid droplets or are saturated with water vapor. In addition, this method shall not be used as written if the projected cross-sectional area of the probe extension-filter holder assembly covers more than 5 percent of the stack cross-sectional area (see Section 8.1.2).

**1.3 Data Quality Objectives.** Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

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**2.0 Summary of Method**

2.1 Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at stack temperature. The PM mass is determined gravimetrically after the removal of uncombined water.

**3.0 Definitions**

Same as Method 5, Section 3.0.

**4.0 Interferences. [Reserved]****5.0 Safety**

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

**6.0 Equipment and Supplies**

6.1 Sampling Train. A schematic of the sampling train used in this method is shown in Figure 17-1. The sampling train components and operation and maintenance are very similar to Method 5, which should be consulted for details.

6.1.1 Probe Nozzle, Differential Pressure Gage, Metering System, Barometer, Gas Density Determination Equipment. Same as in Method 5, Sections 6.1.1, 6.1.4, 6.1.8, 6.1.9, and 6.1.10, respectively.

6.1.2 Filter Holder. The in-stack filter holder shall be constructed of borosilicate or quartz glass, or stainless steel. If a gasket is used, it shall be made of silicone rubber, Teflon, or stainless steel. Other holder and gasket materials may be used, subject to the approval of the Administrator. The filter holder shall be designed to provide a positive seal against leakage from the outside or around the filter.

6.1.3 Probe Extension. Any suitable rigid probe extension may be used after the filter holder.

6.1.4 Pitot Tube. Same as in Method 5, Section 6.1.3.

6.1.4.1 It is recommended (1) that the pitot tube have a known baseline coefficient, determined as outlined in Section 10 of Method 2; and (2) that this known coefficient be preserved by placing the pitot tube in an interference-free arrangement with respect to the sampling nozzle, filter holder, and temperature sensor (see Figure 17-1). Note that the 1.9 cm (3/4-in.) free-space between the nozzle and pitot tube shown in Figure 17-1, is based on a 1.3 cm (1/2-in.) ID nozzle. If the sampling train is designed for sampling at higher flow rates than that described in APTD-0581, thus necessitating the use of larger sized nozzles, the free-space shall be 1.9 cm (3/4-in.) with the largest sized nozzle in place.

6.1.4.2 Source-sampling assemblies that do not meet the minimum spacing requirements of Figure 17-1 (or the equivalent of these requirements, e.g., Figure 2-4 of Method 2) may be used; however, the pitot tube coefficients of such assemblies shall be determined by calibration, using methods subject to the approval of the Administrator.

6.1.5 Condenser. It is recommended that the impinger system or alternatives described in Method 5 be used to determine the moisture content of the stack gas. Flexible tubing may be used between the probe extension and condenser. Long tubing lengths may affect the moisture determination.

6.2 Sample Recovery. Probe-liner and probe-nozzle brushes, wash bottles, glass sample storage containers, petri dishes, graduated cylinder and/or balance, plastic storage containers, funnel and rubber policeman, funnel. Same as in Method 5, Sections 6.2.1 through 6.2.8, respectively.

6.3 Sample Analysis. Glass weighing dishes, desiccator, analytical balance, balance, beakers, hygrometer, temperature sensor. Same as in Method 5, Sections 6.3.1 through 6.3.7, respectively.

**7.0 Reagents and Standards**

7.1 Sampling. Filters, silica gel, water, crushed ice, stopcock grease. Same as in Method 5, Sections 7.1.1, 7.1.2, 7.1.3, 7.1.4, and 7.1.5, respectively. Thimble glass fiber filters may also be used.

7.2 Sample Recovery. Acetone (reagent grade). Same as in Method 5, Section 7.2.

7.3 Sample Analysis. Acetone and Desiccant. Same as in Method 5, Sections 7.3.1 and 7.3.2, respectively.

**8.0 Sample Collection, Preservation, Storage, and Transport****8.1 Sampling.**

8.1.1 Pretest Preparation. Same as in Method 5, Section 8.1.1.

8.1.2 Preliminary Determinations. Same as in Method 5, Section 8.1.2, except as follows: Make a projected-area model of the probe extension-filter holder assembly, with the pitot tube face openings positioned along the centerline of the stack, as shown in Figure 17-2. Calculate the estimated cross-section blockage, as shown in Figure 17-2. If the blockage exceeds 5 percent of the duct cross sectional area, the tester has the following options exist: (1) a suitable out-of-stack filtration method may be used instead of in-stack filtration; or (2) a special in-stack arrangement, in which the sampling and velocity measurement sites are separate, may be used; for details concerning this approach, consult with the Administrator (see also Reference 1 in Section 17.0). Select a probe extension length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probe.

8.1.3 Preparation of Sampling Train. Same as in Method 5, Section 8.1.3, except the following: Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as not to allow the sample gas stream to circumvent the filter. Check filter for tears after assembly is completed. Mark the probe extension with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point. Assemble the train as in Figure 17-1, using a very light coat of silicone grease on all ground glass joints and greasing only the outer portion (see APTD-0576) to avoid possibility of contamination by the silicone grease. Place crushed ice around the impingers.

8.1.4 Leak-Check Procedures. Same as in Method 5, Section 8.1.4, except that the filter holder is inserted into the stack during the sampling train leak-check. To do this, plug the inlet to the probe nozzle with a material that will be able to withstand the stack temperature. Insert the filter holder into the stack and wait approximately 5 minutes (or longer, if necessary) to allow the system to come to equilibrium with the temperature of the stack gas stream.

8.1.5 Sampling Train Operation. The operation is the same as in Method 5. Use a data sheet such as the one shown in Figure 5-3 of Method 5, except that the filter holder temperature is not recorded.

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8.1.6 Calculation of Percent Isokinetic. Same as in Method 5, Section 12.11.

8.2 Sample Recovery.

8.2.1 Proper cleanup procedure begins as soon as the probe extension assembly is removed from the stack at the end of the sampling period. Allow the assembly to cool.

8.2.2 When the assembly can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, forcing condenser water backward.

8.2.3 Before moving the sample train to the cleanup site, disconnect the filter holder-probe nozzle assembly from the probe extension; cap the open inlet of the probe extension. Be careful not to lose any condensate, if present. Remove the umbilical cord from the condenser outlet and cap the outlet. If a flexible line is used between the first impinger (or condenser) and the probe extension, disconnect the line at the probe extension and let any condensed water or liquid drain into the impingers or condenser. Disconnect the probe extension from the condenser; cap the probe extension outlet. After wiping off the silicone grease, cap off the condenser inlet. Ground glass stoppers, plastic caps, or serum caps (whichever are appropriate) may be used to close these openings.

8.2.4 Transfer both the filter holder-probe nozzle assembly and the condenser to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

8.2.5 Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone from the wash bottle being used and place it in a glass sample container labeled "acetone blank." Inspect the train prior to and during disassembly and not any abnormal conditions. Treat the sample as discussed in Method 5, Section 8.2.

9.0 Quality Control. [Reserved]

10.0 Calibration and Standardization

The calibrations of the probe nozzle, pitot tube, metering system, temperature sensors, and barometer are the same as in Method 5, Sections 10.1 through 10.3, 10.5, and 10.6, respectively.

11.0 Analytical Procedure

Same as in Method 5, Section 11.0. Analytical data should be recorded on a form similar to that shown in Figure 5-6 of Method 5.

12.0 Data Analysis and Calculations.

Same as in Method 5, Section 12.0.

13.0 Method Performance. [Reserved]

14.0 Pollution Prevention. [Reserved]

15.0 Waste Management. [Reserved]

16.0 Alternative Procedures

Same as in Method 5, Section 16.0.

17.0 References

Same as in Method 5, Section 17.0, with the addition of the following:

1. Vollaro, R.F. Recommended Procedure for Sample Traverses in Ducts Smaller than 12 Inches in Diameter. U.S. Environmental Protection Agency, Emission Measurement Branch, Research Triangle Park, NC. November 1976.

18.0 Tables, Diagrams, Flowcharts, and Validation Data

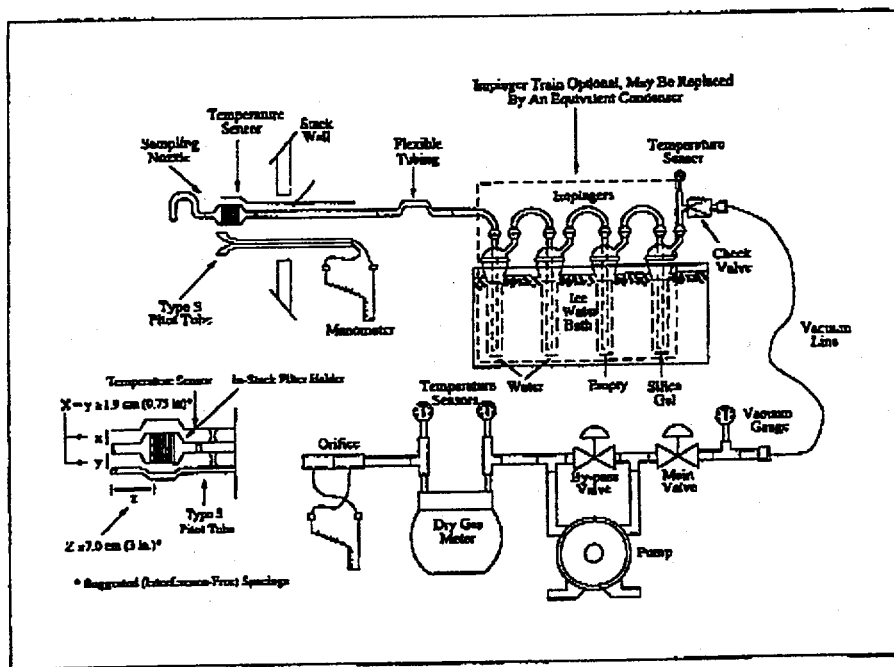


Figure 17-1. Particulate Matter Sampling Train with In-Stack Filter.

# **EPA Method #5**

## **"Determination of Particulate Matter Emissions From Stationary Sources"**

### **40 CFR Part 60 Volume 2 App. A**

#### **METHOD 5- DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES**

**Note:** This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 2, Method 3.

##### **1.0 Scope and Application**

- 1.1 **Analyte.** Particulate matter (PM). No CAS number assigned.
- 1.2 **Applicability.** This method is applicable for the determination of PM emissions from stationary sources.
- 1.3 **Data Quality Objectives.** Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

##### **2.0 Summary of Method**

Particulate matter is withdrawn isokinetically from the source and collected on a glass fiber filter maintained at a temperature of  $120 \pm 4$  °C ( $248 \pm 5$  °F) or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application. The PM mass, which includes any material that condenses at or above the filtration temperature, is determined gravimetrically after the removal of uncollected water.

##### **3.0 Definitions [Reserved]**

##### **4.0 Interferences [Reserved]**

##### **5.0 Safety**

- 5.1 **Disclaimer.** This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety

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problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to performing this test method.

### 6.0 Equipment and Supplies

6.1 Sample Collection. The following items are required for sample collection:

6.1.1 Sampling Train. A schematic of the sampling train used in this method is shown in Figure 5-1 in Section 18.0. Complete construction details are given in APTD-0581 (Reference 2 in Section 17.0); commercial models of this train are also available. For changes from APTD-0581 and for allowable modifications of the train shown in Figure 5-1, see the following subsections.

Note: The operating and maintenance procedures for the sampling train are described in APTD-0576 (Reference 3 in Section 17.0). Since correct usage is important in obtaining valid results, all users should read APTD-0576 and adopt the operating and maintenance procedures outlined in it, unless otherwise specified herein.

6.1.1.1 Probe Nozzle. Stainless steel (316) or glass with a sharp, tapered leading edge. The angle of taper shall be  $\leq 30^\circ$ , and the taper shall be on the outside to preserve a constant internal diameter. The probe nozzle shall be of the button-hook or elbow design, unless otherwise specified by the Administrator. If made of stainless steel, the nozzle shall be constructed from seamless tubing. Other materials of construction may be used, subject to the approval of the Administrator. A range of nozzle sizes suitable for isokinetic sampling should be available. Typical nozzle sizes range from 0.32 to 1.27 cm (1/8 to 1/2 in) inside diameter (ID) in increments of 0.16 cm (1/16 in). Larger nozzle sizes are also available if higher volume sampling trains are used. Each nozzle shall be calibrated, according to the procedures outlined in Section 10.1.

6.1.1.2 Probe Liner. Borosilicate or quartz glass tubing with a heating system capable of maintaining a probe gas temperature during sampling of  $120 \pm 14^\circ\text{C}$  ( $248 \pm 25^\circ\text{F}$ ), or such other temperature as specified by an applicable subpart of the standards or as approved by the Administrator for a particular application. Since the actual temperature at the outlet of the probe is not usually monitored during sampling, probes constructed according to APTD-0581 and utilizing the calibration curves of APTD-0576 (or calibrated according to the procedure outlined in APTD-0576) will be considered acceptable. Either borosilicate or quartz glass probe liners may be used for stack temperatures up to about  $480^\circ\text{C}$  ( $900^\circ\text{F}$ ); quartz glass liners shall be used for temperatures between  $480^\circ\text{C}$  and  $900^\circ\text{C}$  ( $900^\circ\text{F}$  and  $1,650^\circ\text{F}$ ). Both types of liners may be used at higher temperatures than specified for short periods of time, subject to the approval of the Administrator. The softening temperature for borosilicate glass is  $820^\circ\text{C}$  ( $1500^\circ\text{F}$ ), and for quartz glass it is  $1500^\circ\text{C}$  ( $2700^\circ\text{F}$ ). Whenever practical, every effort should be made to use borosilicate or quartz glass probe liners. Alternatively, metal liners (e.g., 316 stainless steel, Incoloy 825 or other corrosion resistant metals) made of seamless tubing may be used, subject to the approval of the Administrator.

6.1.1.3 Pitot Tube. Type S, as described in Section 6.1 of Method 2, or other device approved by the Administrator. The pitot tube shall be attached to the probe (as shown in Figure 5-1) to allow constant monitoring of the stack gas velocity. The impact (high pressure) opening plane of the pitot tube shall be even with or above the nozzle entry plane (see Method 2, Figure 2-7) during sampling. The Type S pitot tube assembly shall have a known coefficient, determined as outlined in Section 10.0 of Method 2.

6.1.1.4 Differential Pressure Gauge. Inclined manometer or equivalent device (two), as described in Section 6.2 of Method 2. One manometer shall be used for velocity head ( $\Delta p$ ) readings, and the other, for orifice differential pressure readings.

6.1.1.5 Filter Holder. Borosilicate glass, with a glass frit filter support and a silicone rubber gasket. Other materials of construction (e.g., stainless steel, Teflon, or Viton) may be used, subject to the approval of the Administrator. The holder design shall provide a positive seal against leakage from the outside or around the filter. The holder shall be attached immediately at the outlet of the probe (or cyclone, if used).

6.1.1.6 Filter Heating System. Any heating system capable of maintaining a temperature around the filter holder of  $120 \pm 14^\circ\text{C}$  ( $248 \pm 25^\circ\text{F}$ ) during sampling, or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator for a particular application.

6.1.1.7 Temperature Sensor. A temperature sensor capable of measuring temperature to within  $3^\circ\text{C}$  ( $5.4^\circ\text{F}$ ) shall be installed so that the sensing tip of the temperature sensor is in direct contact with the sample gas, and the temperature around the filter holder can be regulated and monitored during sampling.

6.1.1.8 Condenser. The following system shall be used to determine the stack gas moisture content: Four impingers connected in series with leak-free ground glass fittings or any similar leak-free noncontaminating fittings. The first, third, and fourth impingers shall be of the Greenburg-Smith design, modified by replacing the tip with a 1.3 cm (1/2 in.) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask. The second impinger shall be of the Greenburg-Smith design with the standard tip. Modifications (e.g., using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the filter holder to the condenser) may be used, subject to the approval of the Administrator. The first and second impingers shall contain known quantities of water (Section 8.3.1), the third shall be empty, and the fourth shall contain a known weight of silica gel, or equivalent desiccant. A temperature sensor, capable of measuring temperature to within  $1^\circ\text{C}$  ( $2^\circ\text{F}$ ) shall be placed at the outlet of the fourth impinger for monitoring purposes. Alternatively, any system that cools the sample gas stream and allows measurement of the water condensed and moisture leaving the condenser, each to within 1 ml or 1 g may be used, subject to the approval of the Administrator. An acceptable technique involves the measurement of condensed water either gravimetrically or volumetrically and the determination of the moisture leaving the condenser by: (1) monitoring the temperature and pressure at the exit of the condenser and using Dalton's law of partial pressures; or (2) passing the sample gas stream through a tared silica gel (or equivalent desiccant) trap with exit gases kept below  $20^\circ\text{C}$  ( $68^\circ\text{F}$ ) and determining the weight gain. If means other than silica gel are used to determine the amount of moisture leaving the condenser, it is recommended that silica gel (or equivalent) still be used between the condenser system and pump to prevent moisture condensation in the pump and metering devices and to avoid the need to make corrections for moisture in the metered volume.

Note: If a determination of the PM collected in the impingers is desired in addition to moisture content, the impinger system described above shall be used, without modification. Individual States or control agencies requiring this information shall be contacted as to the sample recovery and analysis of the impinger contents.

6.1.1.9 Metering System. Vacuum gauge, leak-free pump, temperature sensors capable of measuring temperature to within  $3^\circ\text{C}$  ( $5.4^\circ\text{F}$ ), dry gas meter (DGM) capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 5-1. Other metering systems capable of maintaining sampling rates within 10 percent of isokinetic and of determining sample volumes to within 2 percent may be used, subject to the approval of the Administrator. When the metering system is used in conjunction with a pitot tube, the system shall allow periodic checks of isokinetic rates.

6.1.1.10 Sampling trains utilizing metering systems designed for higher flow rates than that described in APTD-0581 or APTD-0576 may be used

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provided that the specifications of this method are met.

6.1.2 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in.).

Note: The barometric pressure reading may be obtained from a nearby National Weather Service station. In this case, the station value (which is the absolute barometric pressure) shall be requested and an adjustment for elevation differences between the weather station and sampling point shall be made at a rate of minus 2.5 mm Hg (0.1 in.) per 30 m (100 ft) elevation increase or plus 2.5 mm Hg (0.1 in.) per 30 m (100 ft) elevation decrease.

6.1.3 Gas Density Determination Equipment. Temperature sensor and pressure gauge, as described in Sections 6.3 and 6.4 of Method 2, and gas analyzer, if necessary, as described in Method 3. The temperature sensor shall, preferably, be permanently attached to the pitot tube or sampling probe in a fixed configuration, such that the tip of the sensor extends beyond the leading edge of the probe sheath and does not touch any metal. Alternatively, the sensor may be attached just prior to use in the field. Note, however, that if the temperature sensor is attached in the field, the sensor must be placed in an interference-free arrangement with respect to the Type S pitot tube openings (see Method 2, Figure 2-4). As a second alternative, if a difference of not more than 1 percent in the average velocity measurement is to be introduced, the temperature sensor need not be attached to the probe or pitot tube. (This alternative is subject to the approval of the Administrator.)

6.2 Sample Recovery. The following items are required for sample recovery:

6.2.1 Probe-Liner and Probe-Nozzle Brushes. Nylon bristle brushes with stainless steel wire handles. The probe brush shall have extensions (at least as long as the probe) constructed of stainless steel, Nylon, Teflon, or similarly inert material. The brushes shall be properly sized and shaped to brush out the probe liner and nozzle.

6.2.2 Wash Bottles. Two Glass wash bottles are recommended. Alternatively, polyethylene wash bottles may be used. It is recommended that acetone not be stored in polyethylene bottles for longer than a month.

6.2.3 Glass Sample Storage Containers. Chemically resistant, borosilicate glass bottles, for acetone washes, 500 ml or 1000 ml. Screw cap liners shall either be rubber-backed Teflon or shall be constructed so as to be leak-free and resistant to chemical attack by acetone. (Narrow mouth glass bottles have been found to be less prone to leakage.) Alternatively, polyethylene bottles may be used.

6.2.4 Petri Dishes. For filter samples; glass or polyethylene, unless otherwise specified by the Administrator.

6.2.5 Graduated Cylinder and/or Balance. To measure condensed water to within 1 ml or 0.5 g. Graduated cylinders shall have subdivisions no greater than 2 ml.

6.2.6 Plastic Storage Containers. Air-tight containers to store silica gel.

6.2.7 Funnel and Rubber Policeman. To aid in transfer of silica gel to container; not necessary if silica gel is weighed in the field.

6.2.8 Funnel. Glass or polyethylene, to aid in sample recovery.

6.3 Sample Analysis. The following equipment is required for sample analysis:

6.3.1 Glass Weighing Dishes.

6.3.2 Desiccator.

6.3.3 Analytical Balance. To measure to within 0.1 mg.

6.3.4 Balance. To measure to within 0.5 g.

6.3.5 Beakers. 250 ml.

6.3.6 Hygrometer. To measure the relative humidity of the laboratory environment.

6.3.7 Temperature Sensor. To measure the temperature of the laboratory environment.

## 7.0 Reagents and Standards

7.1 Sample Collection. The following reagents are required for sample collection: 7.1.1 Filters. Glass fiber filters, without organic binder, exhibiting at least 99.95 percent efficiency (<0.05 percent penetration) on 0.3 micron dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Method D 2986-71, 78, or 95a (incorporated by reference—see Sec. 60.17). Test data from the supplier's quality control program are sufficient for this purpose. In sources containing SO<sub>2</sub> or SO<sub>3</sub>, the filter material must be of a type that is unreactive to SO<sub>2</sub> or SO<sub>3</sub>. Reference 10 in Section 17.0 may be used to select the appropriate filter.

7.1.2 Silica Gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175 °C (350 °F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

7.1.3 Water. When analysis of the material caught in the impingers is required, deionized distilled water (to conform to ASTM D 1193-77 or 91 Type 3 (incorporated by reference—see Sec. 60.17)) shall be used. Run blanks prior to field use to eliminate a high blank on test samples.

7.1.4 Crushed Ice.

7.1.5 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease. This is not necessary if screw-on connectors with Teflon sleeves, or similar, are used. Alternatively, other types of stopcock grease may be used, subject to the approval of the Administrator.

7.2 Sample Recovery. Acetone, reagent grade, ≤0.001 percent residue, in glass bottles, is required. Acetone from metal containers generally has a high residue blank and should not be used. Sometimes, suppliers transfer acetone to glass bottles from metal containers; thus, acetone blanks shall be run prior to field use and only acetone with low blank values (≤0.001 percent) shall be used. In no case shall a blank value of greater than 0.001 percent of the weight of acetone used be subtracted from the sample weight.

7.3 Sample Analysis. The following reagents are required for sample analysis:

7.3.1 Acetone. Same as in Section 7.2.

7.3.2 Desiccant. Anhydrous calcium sulfate, indicating type. Alternatively, other types of desiccants may be used, subject to the approval of the Administrator.

## 8.0 Sample Collection, Preservation, Storage, and Transport

8.1 Pretest Preparation. It is suggested that sampling equipment be maintained according to the procedures described in APID-0576.

8.1.1 Place 200 to 300 g of silica gel in each of several air-tight containers. Weigh each container, including silica gel, to the nearest 0.5 g, and record this weight. As an alternative, the silica gel need not be preweighed, but may be weighed directly in its impinger or sampling holder just prior to train assembly.

8.1.2 Check filters visually against light for irregularities, flaws, or pinhole leaks. Label filters of the proper diameter on the back side near the edge using numbering machine ink. As an alternative, label the shipping containers (glass or polycarbonate petri dishes), and keep each filter in its identi-

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fied container at all times except during sampling.

8.1.3 Desiccate the filters at  $20 \pm 5.6$  °C (68-10 °F) and ambient pressure for at least 24 hours. Weigh each filter (or filter and shipping container) at intervals of at least 6 hours to a constant weight (i.e.,  $\leq 0.5$  mg change from previous weighing). Record results to the nearest 0.1 mg. During each weighing, the period for which the filter is exposed to the laboratory atmosphere shall be less than 2 minutes. Alternatively (unless otherwise specified by the Administrator), the filters may be oven dried at 105 °C (220 °F) for 2 to 3 hours, desiccated for 2 hours, and weighed. Procedures other than those described, which account for relative humidity effects, may be used, subject to the approval of the Administrator.

### 8.2 Preliminary Determinations.

8.2.1 Select the sampling site and the minimum number of sampling points according to Method 1 or as specified by the Administrator. Determine the stack pressure, temperature, and the range of velocity heads using Method 2; it is recommended that a leak check of the pitot lines (see Method 2, Section 8.1) be performed. Determine the moisture content using Approximation Method 4 or its alternatives for the purpose of making isokinetic sampling rate settings. Determine the stack gas dry molecular weight, as described in Method 2, Section 8.6; if integrated Method 3 sampling is used for molecular weight determination, the integrated bag sample shall be taken simultaneously with, and for the same total length of time as, the particulate sample run.

8.2.2 Select a nozzle size based on the range of velocity heads, such that it is not necessary to change the nozzle size in order to maintain isokinetic sampling rates. During the run, do not change the nozzle size. Ensure that the proper differential pressure gauge is chosen for the range of velocity heads encountered (see Section 8.3 of Method 2).

8.2.3 Select a suitable probe liner and probe length such that all traverse points can be sampled. For large stacks, consider sampling from opposite sides of the stack to reduce the required probe length.

8.2.4 Select a total sampling time greater than or equal to the minimum total sampling time specified in the test procedures for the specific industry such that (1) the sampling time per point is not less than 2 minutes (or some greater time interval as specified by the Administrator), and (2) the sample volume taken (corrected to standard conditions) will exceed the required minimum total gas sample volume. The latter is based on an approximate average sampling rate.

8.2.5 The sampling time at each point shall be the same. It is recommended that the number of minutes sampled at each point be an integer or an integer plus one-half minute, in order to avoid timekeeping errors.

8.2.6 In some circumstances (e.g., batch cycles) it may be necessary to sample for shorter times at the traverse points and to obtain smaller gas sample volumes. In these cases, the Administrator's approval must first be obtained.

### 8.3 Preparation of Sampling Train.

8.3.1 During preparation and assembly of the sampling train, keep all openings where contamination can occur covered until just prior to assembly or until sampling is about to begin. Place 100 ml of water in each of the first two impingers, leave the third impinger empty, and transfer approximately 200 to 300 g of preweighed silica gel from its container to the fourth impinger. More silica gel may be used, but care should be taken to ensure that it is not entrained and carried out from the impinger during sampling. Place the container in a clean place for later use in the sample recovery. Alternatively, the weight of the silica gel plus impinger may be determined to the nearest 0.5 g and recorded.

8.3.2 Using a tweezer or clean disposable surgical gloves, place a labeled (identified) and weighed filter in the filter holder. Be sure that the filter is properly centered and the gasket properly placed so as to prevent the sample gas stream from circumventing the filter. Check the filter for tears after assembly is completed.

8.3.3 When glass probe liners are used, install the selected nozzle using a Viton A O-ring when stack temperatures are less than 260 °C (500 °F) or a heat-resistant string gasket when temperatures are higher. See APTD-0576 for details. Other connecting systems using either 316 stainless steel or Teflon ferrules may be used. When metal liners are used, install the nozzle as discussed above or by a leak-free direct mechanical connection. Mark the probe with heat resistant tape or by some other method to denote the proper distance into the stack or duct for each sampling point.

8.3.4 Set up the train as shown in Figure 5-1, using (if necessary) a very light coat of silicone grease on all ground glass joints, greasing only the outer portion (see APTD-0576) to avoid the possibility of contamination by the silicone grease. Subject to the approval of the Administrator, a glass cyclone may be used between the probe and filter holder when the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack gas.

8.3.5 Place crushed ice around the impingers.

### 8.4 Leak-Check Procedures.

8.4.1 Leak Check of Metering System Shown in Figure 5-1. That portion of the sampling train from the pump to the orifice meter should be leak-checked prior to initial use and after each shipment. Leakage after the pump will result in less volume being recorded than is actually sampled. The following procedure is suggested (see Figure 5-2): Close the main valve on the meter box. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe. Disconnect and vent the low side of the orifice manometer. Close off the low side orifice tap. Pressurize the system to 13 to 18 cm (5 to 7 in.) water column by blowing into the rubber tubing. Pinch off the tubing, and observe the manometer for one minute. A loss of pressure on the manometer indicates a leak in the meter box; leaks, if present, must be corrected.

8.4.2 Pretest Leak Check. A pretest leak check of the sampling train is recommended, but not required. If the pretest leak check is conducted, the following procedure should be used.

8.4.2.1 After the sampling train has been assembled, turn on and set the filter and probe heating systems to the desired operating temperatures. Allow time for the temperatures to stabilize. If a Viton A O-ring or other leak-free connection is used in assembling the probe nozzle to the probe liner, leak-check the train at the sampling site by plugging the nozzle and pulling a 380 mm (15 in.) Hg vacuum.

Note: A lower vacuum may be used, provided that it is not exceeded during the test.

8.4.2.2 If a heat-resistant string is used, do not connect the probe to the train during the leak check. Instead, leak-check the train by first plugging the inlet to the filter holder (cyclone, if applicable) and pulling a 380 mm (15 in.) Hg vacuum (see Note in Section 8.4.2.1). Then connect the probe to the train, and leak-check at approximately 25 mm (1 in.) Hg vacuum; alternatively, the probe may be leak-checked with the rest of the sampling train, in one step, at 380 mm (15 in.) Hg vacuum. Leakage rates in excess of 4 percent of the average sampling rate or 0.00057 m<sup>3</sup>/min (0.020 cfm), whichever is less, are unacceptable.

8.4.2.3 The following leak-check instructions for the sampling train described in APTD-0576 and APTD-0581 may be helpful. Start the pump with the bypass valve fully open and the coarse adjust valve completely closed. Partially open the coarse adjust valve, and slowly close the bypass valve

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until the desired vacuum is reached. Do not reverse the direction of the bypass valve, as this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum, or end the leak check and start over.

8.4.2.4 When the leak check is completed, first slowly remove the plug from the inlet to the probe, filter holder, or cyclone (if applicable), and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and the silica gel from being entrained backward into the third impinger.

8.4.3 Leak Checks During Sample Run. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes necessary, a leak check shall be conducted immediately before the change is made. The leak check shall be done according to the procedure outlined in Section 8.4.2 above, except that it shall be done at a vacuum equal to or greater than the maximum value recorded up to that point in the test. If the leakage rate is found to be no greater than  $0.00057 \text{ m}^3/\text{min}$  ( $0.020 \text{ cfm}$ ) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction will need to be applied to the total volume of dry gas metered; if, however, a higher leakage rate is obtained, either record the leakage rate and plan to correct the sample volume as shown in Section 12.3 of this method, or void the sample run.

Note: Immediately after component changes, leak checks are optional. If such leak checks are done, the procedure outlined in Section 8.4.2 above should be used.

8.4.4 Post-Test Leak Check. A leak check of the sampling train is mandatory at the conclusion of each sampling run. The leak check shall be performed in accordance with the procedures outlined in Section 8.4.2, except that it shall be conducted at a vacuum equal to or greater than the maximum value reached during the sampling run. If the leakage rate is found to be no greater than  $0.00057 \text{ m}^3/\text{min}$  ( $0.020 \text{ cfm}$ ) or 4 percent of the average sampling rate (whichever is less), the results are acceptable, and no correction need be applied to the total volume of dry gas metered. If, however, a higher leakage rate is obtained, either record the leakage rate and correct the sample volume as shown in Section 12.3 of this method, or void the sampling run.

8.5 Sampling Train Operation. During the sampling run, maintain an isokinetic sampling rate (within 10 percent of true isokinetic unless otherwise specified by the Administrator) and a temperature around the filter of  $120 \pm 14^\circ \text{C}$  ( $248 \pm 25^\circ \text{F}$ ), or such other temperature as specified by an applicable subpart of the standards or approved by the Administrator.

8.5.1 For each run, record the data required on a data sheet such as the one shown in Figure 5-3. Be sure to record the initial DGM reading. Record the DGM readings at the beginning and end of each sampling time increment, when changes in flow rates are made, before and after each leak check, and when sampling is halted. Take other readings indicated by Figure 5-3 at least once at each sample point during each time increment and additional readings when significant changes (20 percent variation in velocity head readings) necessitate additional adjustments in flow rate. Level and zero the manometer. Because the manometer level and zero may drift due to vibrations and temperature changes, make periodic checks during the traverse.

8.5.2 Clean the portholes prior to the test run to minimize the chance of collecting deposited material. To begin sampling, verify that the filter and probe heating systems are up to temperature, remove the nozzle cap, verify that the pitot tube and probe are properly positioned. Position the nozzle at the first traverse point with the tip pointing directly into the gas stream. Immediately start the pump, and adjust the flow to isokinetic conditions. Nomographs are available which aid in the rapid adjustment of the isokinetic sampling rate without excessive computations. These nomographs are designed for use when the Type S pitot tube coefficient ( $C_p$ ) is  $0.85 \pm 0.02$ , and the stack gas equivalent density [dry molecular weight ( $M_d$ )] is equal to  $29 \pm 4$ . APID-0576 details the procedure for using the nomographs. If  $C_p$  and  $M_d$  are outside the above stated ranges, do not use the nomographs unless appropriate steps (see Reference 7 in Section 17.0) are taken to compensate for the deviations.

8.5.3 When the stack is under significant negative pressure (i.e., height of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to prevent water from backing into the filter holder. If necessary, the pump may be turned on with the coarse adjust valve closed.

8.5.4 When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

8.5.5 Traverse the stack cross-section, as required by Method 1 or as specified by the Administrator, being careful not to bump the probe nozzle into the stack walls when sampling near the walls or when removing or inserting the probe through the portholes; this minimizes the chance of extracting deposited material.

8.5.6 During the test run, make periodic adjustments to keep the temperature around the filter holder at the proper level; add more ice and, if necessary, salt to maintain a temperature of less than  $20^\circ \text{C}$  ( $68^\circ \text{F}$ ) at the condenser/silica gel outlet. Also, periodically check the level and zero of the manometer.

8.5.7 If the pressure drop across the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced in the midst of the sample run. It is recommended that another complete filter assembly be used rather than attempting to change the filter itself. Before a new filter assembly is installed, conduct a leak check (see Section 8.4.3). The total PM weight shall include the summation of the filter assembly catches.

8.5.8 A single train shall be used for the entire sample run, except in cases where simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or in cases where equipment failure necessitates a change of trains. In all other situations, the use of two or more trains will be subject to the approval of the Administrator.

Note: When two or more trains are used, separate analyses of the front-half and (if applicable) impinger catches from each train shall be performed, unless identical nozzle sizes were used on all trains, in which case, the front-half catches from the individual trains may be combined (as may the impinger catches) and one analysis of front-half catch and one analysis of impinger catch may be performed. Consult with the Administrator for details concerning the calculation of results when two or more trains are used.

8.5.9 At the end of the sample run, close the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final DGM meter reading, and conduct a post-test leak check, as outlined in Section 8.4.4. Also, leak-check the pitot lines as described in Method 2, Section 8.1. The lines must pass this leak check, in order to validate the velocity head data.

8.6 Calculation of Percent Isokinetic. Calculate percent isokinetic (see Calculations, Section 12.11) to determine whether the run was valid or another test run should be made. If there was difficulty in maintaining isokinetic rates because of source conditions, consult with the Administrator for possible variance on the isokinetic rates.

#### 8.7 Sample Recovery.

8.7.1 Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period. Allow the probe to cool.

8.7.2 When the probe can be safely handled, wipe off all external PM near the tip of the probe nozzle, and place a cap over it to prevent losing or gaining PM. Do not cap off the probe tip tightly while the sampling train is cooling down. This would create a vacuum in the filter holder, thereby draw-

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ing water from the impingers into the filter holder.

8.7.3 Before moving the sample train to the cleanup site, remove the probe from the sample train, wipe off the silicone grease, and cap the open outlet of the probe. Be careful not to lose any condensate that might be present. Wipe off the silicone grease from the filter inlet where the probe was fastened, and cap it. Remove the umbilical cord from the last impinger, and cap the impinger. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers or condenser. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.

8.7.4 Transfer the probe and filter-impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

8.7.5 Save a portion of the acetone used for cleanup as a blank. Take 200 ml of this acetone directly from the wash bottle being used, and place it in a glass sample container labeled "acetone blank."

8.7.6 Inspect the train prior to and during disassembly, and note any abnormal conditions. Treat the samples as follows:

8.7.6.1 Container No. 1. Carefully remove the filter from the filter holder, and place it in its identified petri dish container. Use a pair of tweezers and/or clean disposable surgical gloves to handle the filter. If it is necessary to fold the filter, do so such that the PM cake is inside the fold. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish any PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

8.7.6.2 Container No. 2. Taking care to see that dust on the outside of the probe or other exterior surfaces does not get into the sample, quantitatively recover PM or any condensate from the probe nozzle, probe fitting, probe liner, and front half of the filter holder by washing these components with acetone and placing the wash in a glass container. Deionized distilled water may be used instead of acetone when approved by the Administrator and shall be used when specified by the Administrator. In these cases, save a water blank, and follow the Administrator's directions on analysis. Perform the acetone rinse as follows:

8.7.6.2.1 Carefully remove the probe nozzle. Clean the inside surface by rinsing with acetone from a wash bottle and brushing with a Nylon bristle brush. Brush until the acetone rinse shows no visible particles, after which make a final rinse of the inside surface with acetone.

8.7.6.2.2 Brush and rinse the inside parts of the fitting with acetone in a similar way until no visible particles remain.

8.7.6.2.3 Rinse the probe liner with acetone by tilting and rotating the probe while squirting acetone into its upper end so that all inside surfaces will be wetted with acetone. Let the acetone drain from the lower end into the sample container. A funnel (glass or polyethylene) may be used to aid in transferring liquid washes to the container. Follow the acetone rinse with a probe brush. Hold the probe in an inclined position, squirt acetone into the upper end as the probe brush is being pushed with a twisting action through the probe; hold a sample container underneath the lower end of the probe, and catch any acetone and particulate matter that is brushed from the probe. Run the brush through the probe three times or more until no visible PM is carried out with the acetone or until none remains in the probe liner on visual inspection. With stainless steel or other metal probes, run the brush through in the above prescribed manner at least six times since metal probes have small crevices in which particulate matter can be entrapped. Rinse the brush with acetone, and quantitatively collect these washings in the sample container. After the brushing, make a final acetone rinse of the probe.

8.7.6.2.4 It is recommended that two people clean the probe to minimize sample losses. Between sampling runs, keep brushes clean and protected from contamination.

8.7.6.2.5 After ensuring that all joints have been wiped clean of silicone grease, clean the inside of the front half of the filter holder by rubbing the surfaces with a Nylon bristle brush and rinsing with acetone. Rinse each surface three times or more if needed to remove visible particulate. Make a final rinse of the brush and filter holder. Carefully rinse out the glass cyclone, also (if applicable). After all acetone washings and particulate matter have been collected in the sample container, tighten the lid on the sample container so that acetone will not leak out when it is shipped to the laboratory. Mark the height of the fluid level to allow determination of whether leakage occurred during transport. Label the container to identify clearly its contents.

8.7.6.3 Container No. 3. Note the color of the indicating silica gel to determine whether it has been completely spent, and make a notation of its condition. Transfer the silica gel from the fourth impinger to its original container, and seal. A funnel may make it easier to pour the silica gel without spilling. A rubber policeman may be used as an aid in removing the silica gel from the impinger. It is not necessary to remove the small amount of dust particles that may adhere to the impinger wall and are difficult to remove. Since the gain in weight is to be used for moisture calculations, do not use any water or other liquids to transfer the silica gel. If a balance is available in the field, follow the procedure for Container No. 3 in Section 11.2.3.

8.7.6.4 Impinger Water. Treat the impingers as follows: Make a notation of any color or film in the liquid catch. Measure the liquid that is in the first three impingers to within 1 ml by using a graduated cylinder or by weighing it to within 0.5 g by using a balance. Record the volume or weight of liquid present. This information is required to calculate the moisture content of the effluent gas. Discard the liquid after measuring and recording the volume or weight, unless analysis of the impinger catch is required (see NOTE, Section 6.1.1.8). If a different type of condenser is used, measure the amount of moisture condensed either volumetrically or gravimetrically.

8.8 Sample Transport. Whenever possible, containers should be shipped in such a way that they remain upright at all times.

## 9.0 Quality Control

## 9.1 Miscellaneous Quality Control Measures.

Section	Quality control measure	Effect
8.4, 10.1-10.6	Sampling equipment leak check and calibration.	Ensures accurate measurement of stack gas flow rate, sample volume.

9.2 Volume Metering System Checks. The following procedures are suggested to check the volume metering system calibration values at the field test site prior to sample collection. These procedures are optional.

9.2.1 Meter Orifice Check. Using the calibration data obtained during the calibration procedure described in Section 10.3, determine the  $\Delta H@$  for the metering system orifice. The  $\Delta H@$  is the orifice pressure differential in units of in.  $H_2O$  that correlates to 0.75 cfm of air at 528 °R and 29.92 in.

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Hg. The  $\Delta H\theta$  is calculated as follows:

$$\Delta H\theta = 0.0319 \Delta H \frac{T_m \theta^2}{P_{bar} Y^2 V_m^2}$$

Where:

H = Average pressure differential across the orifice meter, in. H<sub>2</sub>O.

T<sub>m</sub> = Absolute average DGM temperature, °R.

P<sub>bar</sub> = Barometric pressure, in. Hg.

θ = Total sampling time, min.

Y = DGM calibration factor, dimensionless.

V<sub>m</sub> = Volume of gas sample as measured by DGM, cfm.

0.0319 = (0.0567 in. Hg/°R) (0.75 cfm)<sup>2</sup>

9.2.1.1 Before beginning the field test (a set of three runs usually constitutes a field test), operate the metering system (i.e., pump, volume meter, and orifice) at the  $\Delta H\theta$  pressure differential for 10 minutes. Record the volume collected, the DGM temperature, and the barometric pressure. Calculate a DGM calibration check value, Y<sub>c</sub>, as follows:

$$Y_c = \frac{10}{V_m} \left[ \frac{0.0319 T_m}{P_{bar}} \right]^{\frac{1}{2}}$$

where:

Y<sub>c</sub> = DGM calibration check value, dimensionless.

10 = Run time, min.

9.2.1.2 Compare the Y<sub>c</sub> value with the dry gas meter calibration factor Y to determine that: 0.97Y < Y<sub>c</sub> < 1.03Y. If the Y<sub>c</sub> value is not within this range, the volume metering system should be investigated before beginning the test.

9.2.2 Calibrated Critical Orifice. A critical orifice, calibrated against a wet test meter or spirometer and designed to be inserted at the inlet of the sampling meter box, may be used as a check by following the procedure of Section 16.2.

## 10.0 Calibration and Standardization

Note: Maintain a laboratory log of all calibrations.

10.1 Probe Nozzle. Probe nozzles shall be calibrated before their initial use in the field. Using a micrometer, measure the ID of the nozzle to the nearest 0.025 mm (0.001 in.). Make three separate measurements using different diameters each time, and obtain the average of the measurements. The difference between the high and low numbers shall not exceed 0.1 mm (0.004 in.). When nozzles become nicked, dented, or corroded, they shall be reshaped, sharpened, and recalibrated before use. Each nozzle shall be permanently and uniquely identified.

10.2 Pitot Tube Assembly. The Type S pitot tube assembly shall be calibrated according to the procedure outlined in Section 10.1 of Method 2.

### 10.3 Metering System

10.3.1 Calibration Prior to Use. Before its initial use in the field, the metering system shall be calibrated as follows: Connect the metering system inlet to the outlet of a wet test meter that is accurate to within 1 percent. Refer to Figure 5-4. The wet test meter should have a capacity of 30 liters/rev (1 ft<sup>3</sup>/rev). A spirometer of 400 liters (14 ft<sup>3</sup>) or more capacity, or equivalent, may be used for this calibration, although a wet test meter is usually more practical. The wet test meter should be periodically calibrated with a spirometer or a liquid displacement meter to ensure the accuracy of the wet test meter. Spirometers or wet test meters of other sizes may be used, provided that the specified accuracies of the procedure are maintained. Run the metering system pump for about 15 minutes with the orifice manometer indicating a median reading as expected in field use to allow the pump to warm up and to permit the interior surface of the wet test meter to be thoroughly wetted. Then, at each of a minimum of three orifice manometer settings, pass an exact quantity of gas through the wet test meter and note the gas volume indicated by the DGM. Also note the barometric pressure and the temperatures of the wet test meter, the inlet of the DGM, and the outlet of the DGM. Select the highest and lowest orifice settings to bracket the expected field operating range of the orifice. Use a minimum volume of 0.14 m<sup>3</sup> (5 ft<sup>3</sup>) at all orifice settings. Record all the data on a form similar to Figure 5-5 and calculate Y, the DGM calibration factor, and  $\Delta H\theta$ , the orifice calibration factor, at each orifice setting as shown on Figure 5-5. Allowable tolerances for individual Y and  $\Delta H\theta$  values are given in Figure 5-5. Use the average of the Y values in the calculations in Section 12.0.

10.3.1.1 Before calibrating the metering system, it is suggested that a leak check be conducted. For metering systems having diaphragm pumps, the normal leak-check procedure will not detect leakages within the pump. For these cases the following leak-check procedure is suggested: make a 10-minute calibration run at 0.00057 m<sup>3</sup>/min (0.020 cfm). At the end of the run, take the difference of the measured wet test meter and DGM volumes. Divide the difference by 10 to get the leak rate. The leak rate should not exceed 0.00057 m<sup>3</sup>/min (0.020 cfm).

10.3.2 Calibration After Use. After each field use, the calibration of the metering system shall be checked by performing three calibration runs at a single, intermediate orifice setting (based on the previous field test), with the vacuum set at the maximum value reached during the test series. To adjust the vacuum, insert a valve between the wet test meter and the inlet of the metering system. Calculate the average value of the DGM calibration factor. If the value has changed by more than 5 percent, recalibrate the meter over the full range of orifice settings, as detailed in Section 10.3.1.

Note: Alternative procedures (e.g., rechecking the orifice meter coefficient) may be used, subject to the approval of the Administrator.

10.3.3 Acceptable Variation in Calibration. If the DGM coefficient values obtained before and after a test series differ by more than 5 percent, the test series shall either be voided, or calculations for the test series shall be performed using whichever meter coefficient value (i.e., before or after) gives the lower value of total sample volume.

10.4 Probe Heater Calibration. Use a heat source to generate air heated to selected temperatures that approximate those expected to occur in the sources to be sampled. Pass this air through the probe at a typical sample flow rate while measuring the probe inlet and outlet temperatures at various

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probe heater settings. For each air temperature generated, construct a graph of probe heating system setting versus probe outlet temperature. The procedure outlined in APTD-0576 can also be used. Probes constructed according to APTD-0581 need not be calibrated if the calibration curves in APTD-0576 are used. Also, probes with outlet temperature monitoring capabilities do not require calibration.

Note: The probe heating system shall be calibrated before its initial use in the field.

10.5 Temperature Sensors. Use the procedure in Section 10.3 of Method 2 to calibrate in-stack temperature sensors. Dial thermometers, such as are used for the DGM and condenser outlet, shall be calibrated against mercury-in-glass thermometers.

10.6 Barometer. Calibrate against a mercury barometer.

## 11.0 Analytical Procedure

11.1 Record the data required on a sheet such as the one shown in Figure 5-6.

11.2 Handle each sample container as follows:

11.2.1 Container No. 1. Leave the contents in the shipping container or transfer the filter and any loose PM from the sample container to a tared glass weighing dish. Desiccate for 24 hours in a desiccator containing anhydrous calcium sulfate. Weigh to a constant weight, and report the results to the nearest 0.1 mg. For the purposes of this section, the term "constant weight" means a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of desiccation time between weighings. Alternatively, the sample may be oven dried at 104 °C (220 °F) for 2 to 3 hours, cooled in the desiccator, and weighed to a constant weight, unless otherwise specified by the Administrator. The sample may be oven dried at 104 °C (220 °F) for 2 to 3 hours. Once the sample has cooled, weigh the sample, and use this weight as a final weight.

11.2.2 Container No. 2. Note the level of liquid in the container, and confirm on the analysis sheet whether leakage occurred during transport. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results. Measure the liquid in this container either volumetrically to  $\pm 1$  ml or gravimetrically to  $\pm 0.5$  g. Transfer the contents to a tared 250 ml beaker, and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours, and weigh to a constant weight. Report the results to the nearest 0.1 mg.

11.2.3 Container No. 3. Weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance. This step may be conducted in the field.

11.2.4 Acetone Blank Container. Measure the acetone in this container either volumetrically or gravimetrically. Transfer the acetone to a tared 250 ml beaker, and evaporate to dryness at ambient temperature and pressure. Desiccate for 24 hours, and weigh to a constant weight. Report the results to the nearest 0.1 mg.

Note: The contents of Container No. 2 as well as the acetone blank container may be evaporated at temperatures higher than ambient. If evaporation is done at an elevated temperature, the temperature must be below the boiling point of the solvent; also, to prevent "bumping," the evaporation process must be closely supervised, and the contents of the beaker must be swirled occasionally to maintain an even temperature. Use extreme care, as acetone is highly flammable and has a low flash point.

## 12.0 Data Analysis and Calculations

Carry out calculations, retaining at least one extra significant figure beyond that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used, provided that they give equivalent results.

## 12.1 Nomenclature.

$A_n$  = Cross-sectional area of nozzle,  $m^2$  ( $ft^2$ ).

$B_{wv}$  = Water vapor in the gas stream, proportion by volume.

$C_a$  = Acetone blank residue concentration, mg/mg.

$c_i$  = Concentration of particulate matter in stack gas, dry basis, corrected to standard conditions, g/dscm ( $gr/dscf$ ).

$I$  = Percent of isokinetic sampling.

$L_1$  = Individual leakage rate observed during the leak-check conducted prior to the first component change,  $m^3/min$  ( $ft^3/min$ ).

$L_a$  = Maximum acceptable leakage rate for either a pretest leak-check or for a leak-check following a component change; equal to  $0.00057 m^3/min$  ( $0.020 cfm$ ) or 4 percent of the average sampling rate, whichever is less.

$L_i$  = Individual leakage rate observed during the leak-check conducted prior to the " $i$ " component change ( $i = 1, 2, 3 \dots n$ ),  $m^3/min$  ( $cfm$ ).

$L_p$  = Leakage rate observed during the post-test leak-check,  $m^3/min$  ( $cfm$ ).

$m_a$  = Mass of residue of acetone after evaporation, mg.

$m_p$  = Total amount of particulate matter collected, mg.

$M_w$  = Molecular weight of water, 18.0 g/g-mole (18.0 lb/lb-mole).

$P_{bar}$  = Barometric pressure at the sampling site, mm Hg (in. Hg).

$P_i$  = Absolute stack gas pressure, mm Hg (in. Hg).

$P_{std}$  = Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

$R$  = Ideal gas constant,  $0.06236 ((mm\ Hg)(m^3))/((K)(g-mole))$  {  $21.85 ((in.\ Hg)(ft^3))/((^\circ R)(lb-mole))$  }.

$T_m$  = Absolute average DGM temperature (see Figure 5-3), K ( $^\circ R$ ).

$T_s$  = Absolute average stack gas temperature (see Figure 5-3), K ( $^\circ R$ ).

$T_{std}$  = Standard absolute temperature, 293 K (528  $^\circ R$ ).

$V_a$  = Volume of acetone blank, ml.

$V_{wv}$  = Volume of acetone used in wash, ml.

$V_{tc}$  = Total volume of liquid collected in impingers and silica gel (see Figure 5-6), ml.

$V_m$  = Volume of gas sample as measured by dry gas meter, dcm ( $dscf$ ).

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$V_{m(std)}$  = Volume of gas sample measured by the dry gas meter, corrected to standard conditions, dscm (dscf).

$V_{w(std)}$  = Volume of water vapor in the gas sample, corrected to standard conditions, scm (scf).

$V_s$  = Stack gas velocity, calculated by Method 2, Equation 2-7, using data obtained from Method 5, m/sec (ft/sec).

$W_a$  = Weight of residue in acetone wash, mg.

$Y$  = Dry gas meter calibration factor.

$\Delta H$  = Average pressure differential across the orifice meter (see Figure 5-4), mm H<sub>2</sub>O (in. H<sub>2</sub>O).

$\rho_a$  = Density of acetone, mg/ml (see label on bottle).

$\rho_w$  = Density of water, 0.9982 g/ml (0.002201 lb/ml).

$\theta$  = Total sampling time, min.

$\theta_1$  = Sampling time interval, from the beginning of a run until the first component change, min.

$\theta_i$  = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min.

$\theta_p$  = Sampling time interval, from the final ( $n^*$ ) component change until the end of the sampling run, min.

13.6 = Specific gravity of mercury.

60 = Sec/min.

100 = Conversion to percent.

12.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop. See data sheet (Figure 5-3).

12.3 Dry Gas Volume. Correct the sample volume measured by the dry gas meter to standard conditions (20 °C, 760 mm Hg or 68 °F, 29.92 in. Hg) by using Equation 5-1.

$$V_{m(std)} = V_m Y \frac{T_{std} \left( P_{bar} + \frac{\Delta H}{13.6} \right)}{T_m P_{std}} = K_1 V_m Y \frac{P_{bar} + \left( \frac{\Delta H}{13.6} \right)}{T_m} \quad \text{Eq. 5-1}$$

Where:

$K_1 = 0.3858$  °K/mm Hg for metric units,

$= 17.64$  °R/in. Hg for English units.

Note: Equation 5-1 can be used as written unless the leakage rate observed during any of the mandatory leak checks (i.e., the post-test leak check or leak checks conducted prior to component changes) exceeds  $L_a$ . If  $L_p$  or  $L_i$  exceeds  $L_a$ , Equation 5-1 must be modified as follows:

(a) Case I. No component changes made during sampling run. In this case, replace  $V_m$  in Equation 5-1 with the expression:

$$(V_m - (L_1 - L_a)\theta)$$

(b) Case II. One or more component changes made during the sampling run. In this case, replace  $V_m$  in Equation 5-1 by the expression:

$$\left[ V_m - (L_1 - L_a)\theta_1 \sum_{i=2}^n (L_i - L_a)\theta_i (L_p - L_a)\theta_p \right]$$

and substitute only for those leakage rates ( $L_i$  or  $L_p$ ) which exceed  $L_a$ .

12.4 Volume of Water Vapor Condensed.

$$V_{w(std)} = V_{lc} \frac{P_w RT_{std}}{M_w P_{std}} = K_2 V_{lc} \quad \text{Eq. 5-2}$$

Where:

$K_2 = 0.001333$  m<sup>3</sup>/ml for metric units,

$= 0.04706$  ft<sup>3</sup>/ml for English units.

12.5 Moisture Content.

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}} \quad \text{Eq. 5-3}$$

Note: In saturated or water droplet-laden gas streams, two calculations of the moisture content of the stack gas shall be made, one from the impinger analysis (Equation 5-3), and a second from the assumption of saturated conditions. The lower of the two values of  $B_{ws}$  shall be considered correct. The procedure for determining the moisture content based upon the assumption of saturated conditions is given in Section 4.0 of Method 4. For the purposes of this method, the average stack gas temperature from Figure 5-3 may be used to make this determination, provided that the accuracy of the in-stack temperature sensor is  $\pm 1$  °C (2 °F).

12.6 Acetone Blank Concentration.

$$C_a = \frac{m_a}{V_a \rho_a} \quad \text{Eq. 5-4}$$

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## 12.7 Acetone Wash Blank.

$$W_a = C_a V_{aw} \rho_a \quad \text{Eq. 5-5}$$

12.8 Total Particulate Weight. Determine the total particulate matter catch from the sum of the weights obtained from Containers 1 and 2 less the acetone blank (see Figure 5-6).

Note: In no case shall a blank value of greater than 0.001 percent of the weight of acetone used be subtracted from the sample weight. Refer to Section 8.5.8 to assist in calculation of results involving two or more filter assemblies or two or more sampling trains.

## 12.9 Particulate Concentration.

$$C_a = \frac{K_3 m_n}{V_{m(\text{std})}} \quad \text{Eq. 5-6}$$

Where:

$K_3 = 0.001 \text{ g/mg}$  for metric units.

$= 0.0154 \text{ gr/mg}$  for English units.

## 12.10 Conversion Factors:

From	To	Multiply by
$\text{ft}^3$	$\text{m}^3$	0.02832
$\text{gr}$	$\text{mg}$	64.80004
$\text{gr/ft}^3$	$\text{mg/m}^3$	2288.4
$\text{mg}$	$\text{g}$	0.001
$\text{gr}$	$\text{lb}$	$1.429 \times 10^{-4}$

## 12.11 Isokinetic Variation.

## 12.11.1 Calculation from Raw Data.

$$I = \frac{100 T_s \left[ K_4 V_{1c} + \frac{(V_m Y)}{T_m} (P_{\text{bar}} + \frac{\Delta H}{13.6}) \right]}{608 v_s P_s A_n} \quad \text{Eq. 5-7}$$

Where:

$K_4 = 0.003454 ((\text{mm Hg})(\text{m}^3))/((\text{ml})(^\circ\text{K}))$  for metric units.

$= 0.002669 ((\text{in. Hg})(\text{ft}^3))/((\text{ml})(^\circ\text{R}))$  for English units.

## 12.11.2 Calculation from Intermediate Values.

$$I = \frac{T_s V_{m(\text{std})} P_{\text{std}} 100}{T_{\text{std}} v_s 8 A_n P_s 60 (1 - B_{ws})} = K_5 \frac{T_s V_{m(\text{std})}}{P_s v_s A_n 8 (1 - B_{ws})} \quad \text{Eq. 5-8}$$

Where:

$K_5 = 4.320$  for metric units.

$= 0.09450$  for English units.

12.11.3 Acceptable Results. If 90 percent  $\leq I \leq 110$  percent, the results are acceptable. If the PM results are low in comparison to the standard, and "I" is over 110 percent or less than 90 percent, the Administrator may opt to accept the results. Reference 4 in Section 17.0 may be used to make acceptability judgments. If "I" is judged to be unacceptable, reject the results, and repeat the sampling run.

12.12 Stack Gas Velocity and Volumetric Flow Rate. Calculate the average stack gas velocity and volumetric flow rate, if needed, using data obtained in this method and the equations in Sections 12.3 and 12.4 of Method 2.

## 13.0 Method Performance. [Reserved]

## 14.0 Pollution Prevention. [Reserved]

## 15.0 Waste Management. [Reserved]

## 16.0 Alternative Procedures

16.1 Dry Gas Meter as a Calibration Standard. A DGM may be used as a calibration standard for volume measurements in place of the wet test meter specified in Section 10.3, provided that it is calibrated initially and recalibrated periodically as follows:

## 16.1.1 Standard Dry Gas Meter Calibration.

16.1.1.1 The DGM to be calibrated and used as a secondary reference meter should be of high quality and have an appropriately sized capacity (e.g., 3 liters/rev (0.1 ft<sup>3</sup>/rev)). A spirometer (400 liters (14 ft<sup>3</sup>) or more capacity), or equivalent, may be used for this calibration, although a wet test meter is usually more practical. The wet test meter should have a capacity of 30 liters/rev (1 ft<sup>3</sup>/rev) and capable of measuring volume to within 1.0 percent. Wet test meters should be checked against a spirometer or a liquid displacement meter to ensure the accuracy of the wet test meter. Spirometers or wet test meters of other sizes may be used, provided that the specified accuracies of the procedure are maintained.

16.1.1.2 Set up the components as shown in Figure 5-7. A spirometer, or equivalent, may be used in place of the wet test meter in the system. Run the pump for at least 5 minutes at a flow rate of about 10 liters/min (0.35 cfm) to condition the interior surface of the wet test meter. The pressure drop indicated by the manometer at the inlet side of the DGM should be minimized (no greater than 100 mm H<sub>2</sub>O (4 in. H<sub>2</sub>O)) at a flow rate of 30 liters/min (1

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cfm)). This can be accomplished by using large diameter tubing connections and straight pipe fittings.

16.1.1.3 Collect the data as shown in the example data sheet (see Figure 5-8). Make triplicate runs at each of the flow rates and at no less than five different flow rates. The range of flow rates should be between 10 and 34 liters/min (0.35 and 1.2 cfm) or over the expected operating range.

16.1.1.4 Calculate flow rate,  $Q$ , for each run using the wet test meter volume,  $V_w$ , and the run time. Calculate the DGM coefficient,  $Y_{ds}$ , for each run. These calculations are as follows:

$$Q = K_1 \frac{P_{bar} V_w}{(T_w + T_{std})\theta} \quad \text{Eq. 5-9}$$

$$Y_{ds} = \frac{V_w(T_{ds} + T_{std})P_{bar}}{V_{ds}(T_w + T_{std})\left(P_{bar} + \frac{\Delta p}{13.6}\right)} \quad \text{Eq. 5-10}$$

Where:

$K_1 = 0.3858$  °C/mm Hg for metric units = 17.64 °F/in. Hg for English units.

$V_w$  = Wet test meter volume, liter (l³).

$V_{ds}$  = Dry gas meter volume, liter (l³).

$T_{ds}$  = Average dry gas meter temperature, °C (°F).

$T_{std} = 273$  °C for metric units = 460 °F for English units.

$T_w$  = Average wet test meter temperature, °C (°F).

$P_{bar}$  = Barometric pressure, mm Hg (in. Hg).

$\Delta p$  = Dry gas meter inlet differential pressure, mm H<sub>2</sub>O (in. H<sub>2</sub>O).

$\theta$  = Run time, min.

16.1.1.5 Compare the three  $Y_{ds}$  values at each of the flow rates and determine the maximum and minimum values. The difference between the maximum and minimum values at each flow rate should be no greater than 0.030. Extra sets of triplicate runs may be made in order to complete this requirement. In addition, the meter coefficients should be between 0.95 and 1.05. If these specifications cannot be met in three sets of successive triplicate runs, the meter is not suitable as a calibration standard and should not be used as such. If these specifications are met, average the three  $Y_{ds}$  values at each flow rate resulting in no less than five average meter coefficients,  $Y_{ds}$ .

16.1.1.6 Prepare a curve of meter coefficient,  $Y_{ds}$ , versus flow rate,  $Q$ , for the DGM. This curve shall be used as a reference when the meter is used to calibrate other DGMs and to determine whether recalibration is required.

#### 16.1.2 Standard Dry Gas Meter Recalibration.

16.1.2.1 Recalibrate the standard DGM against a wet test meter or spirometer annually or after every 200 hours of operation, whichever comes first. This requirement is valid provided the standard DGM is kept in a laboratory and, if transported, cared for as any other laboratory instrument. Abuse to the standard meter may cause a change in the calibration and will require more frequent recalibrations.

16.1.2.2 As an alternative to full recalibration, a two-point calibration check may be made. Follow the same procedure and equipment arrangement as for a full recalibration, but run the meter at only two flow rates [suggested rates are 14 and 30 liters/min (0.5 and 1.0 cfm)]. Calculate the meter coefficients for these two points, and compare the values with the meter calibration curve. If the two coefficients are within 1.5 percent of the calibration curve values at the same flow rates, the meter need not be recalibrated until the next date for a recalibration check.

16.2 Critical Orifices As Calibration Standards. Critical orifices may be used as calibration standards in place of the wet test meter specified in Section 16.1, provided that they are selected, calibrated, and used as follows:

#### 16.2.1 Selection of Critical Orifices.

16.2.1.1 The procedure that follows describes the use of hypodermic needles or stainless steel needle tubings which have been found suitable for use as critical orifices. Other materials and critical orifice designs may be used provided the orifices act as true critical orifices (i.e., a critical vacuum can be obtained, as described in Section 16.2.2.2.3). Select five critical orifices that are appropriately sized to cover the range of flow rates between 10 and 34 liters/min (0.35 and 1.2 cfm) or the expected operating range. Two of the critical orifices should bracket the expected operating range. A minimum of three critical orifices will be needed to calibrate a Method 5 DGM; the other two critical orifices can serve as spares and provide better selection for bracketing the range of operating flow rates. The needle sizes and tubing lengths shown in Table 5-1 in Section 18.0 give the approximate flow rates.

16.2.1.2 These needles can be adapted to a Method 5 type sampling train as follows: Insert a serum bottle stopper, 13 by 20 mm sleeve type, into a 1/4-inch Swagelok (or equivalent) quick connect. Insert the needle into the stopper as shown in Figure 5-9.

16.2.2 Critical Orifice Calibration. The procedure described in this section uses the Method 5 meter box configuration with a DGM as described in Section 6.1.1.9 to calibrate the critical orifices. Other schemes may be used, subject to the approval of the Administrator.

16.2.2.1 Calibration of Meter Box. The critical orifices must be calibrated in the same configuration as they will be used (i.e., there should be no connections to the inlet of the orifice).

16.2.2.1.1 Before calibrating the meter box, leak check the system as follows: Fully open the coarse adjust valve, and completely close the bypass valve. Plug the inlet. Then turn on the pump, and determine whether there is any leakage. The leakage rate shall be zero (i.e., no detectable movement of the DGM dial shall be seen for 1 minute).

16.2.2.1.2 Check also for leakages in that portion of the sampling train between the pump and the orifice meter. See Section 8.4.1 for the procedure; make any corrections, if necessary. If leakage is detected, check for cracked gaskets, loose fittings, worn O-rings, etc., and make the necessary repairs.

16.2.2.1.3 After determining that the meter box is leakless, calibrate the meter box according to the procedure given in Section 10.3. Make sure that the wet test meter meets the requirements stated in Section 16.1.1.1. Check the water level in the wet test meter. Record the DGM calibration factor,

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Y.

162.2.2 Calibration of Critical Orifices. Set up the apparatus as shown in Figure 5-10.

162.2.2.1 Allow a warm-up time of 15 minutes. This step is important to equilibrate the temperature conditions through the DGM.

162.2.2.2 Leak check the system as in Section 16.2.2.1.1. The leakage rate shall be zero.

162.2.2.3 Before calibrating the critical orifice, determine its suitability and the appropriate operating vacuum as follows: Turn on the pump, fully open the coarse adjust valve, and adjust the by-pass valve to give a vacuum reading corresponding to about half of atmospheric pressure. Observe the meter box orifice manometer reading, H. Slowly increase the vacuum reading until a stable reading is obtained on the meter box orifice manometer. Record the critical vacuum for each orifice. Orifices that do not reach a critical value shall not be used.

162.2.2.4 Obtain the barometric pressure using a barometer as described in Section 6.1.2. Record the barometric pressure,  $P_{bar}$ , in mm Hg (in. Hg).

162.2.2.5 Conduct duplicate runs at a vacuum of 25 to 50 mm Hg (1 to 2 in. Hg) above the critical vacuum. The runs shall be at least 5 minutes each. The DGM volume readings shall be in increments of complete revolutions of the DGM. As a guideline, the times should not differ by more than 3.0 seconds (this includes allowance for changes in the DGM temperatures) to achieve  $\pm 0.5$  percent in  $K'$  (see Eq. 5-11). Record the information listed in Figure 5-11.

162.2.2.6 Calculate  $K'$  using Equation 5-11.

$$K' = \frac{K_1 V_m Y \left( P_{bar} + \frac{\Delta H}{13.6} \right) T_{amb}^{1/2}}{P_{bar} T_m \Theta} \quad \text{Eq. 5-11}$$

Where:

$K'$  = Critical orifice coefficient,  $[m^3 (\text{°K})^{1/2}] / [(\text{mm Hg})(\text{min})] \{ [(ft^3) (\text{°R})^{1/2}] / [(\text{in. Hg})(\text{min})] \}$ .

$T_{amb}$  = Absolute ambient temperature,  $^{\circ}\text{K}$  ( $^{\circ}\text{R}$ ).

Calculate the arithmetic mean of the  $K'$  values. The individual  $K'$  values should not differ by more than  $\pm 0.5$  percent from the mean value.

162.3 Using the Critical Orifices as Calibration Standards.

162.3.1 Record the barometric pressure.

162.3.2 Calibrate the metering system according to the procedure outlined in Section 16.2.2. Record the information listed in Figure 5-12.

162.3.3 Calculate the standard volumes of air passed through the DGM and the critical orifices, and calculate the DGM calibration factor,  $Y$ , using the equations below:

$$V_{m(std)} = \frac{K_1 V_m \left[ P_{bar} + \left( \frac{\Delta H}{13.6} \right) \right]}{T_m} \quad \text{Eq. 5-12}$$

$$V_{cr(std)} = K_1 \frac{P_{bar} \Theta}{\sqrt{T_{amb}}} \quad \text{Eq. 5-13}$$

$$Y = \frac{V_{cr(std)}}{V_{m(std)}} \quad \text{Eq. 5-14}$$

Where:

$V_{cr(std)}$  = Volume of gas sample passed through the critical orifice, corrected to standard conditions, dscf.

$K_1$  = 0.3858 K/mm Hg for metric units

= 17.64  $^{\circ}\text{R/in. Hg}$  for English units.

162.3.4 Average the DGM calibration values for each of the flow rates. The calibration factor,  $Y$ , at each of the flow rates should not differ by more than  $\pm 2$  percent from the average.

162.3.5 To determine the need for recalibrating the critical orifices, compare the DGM  $Y$  factors obtained from two adjacent orifices each time a DGM is calibrated; for example, when checking orifice 13/2.5, use orifices 12/10.2 and 13/5.1. If any critical orifice yields a DGM  $Y$  factor differing by more than 2 percent from the others, recalibrate the critical orifice according to Section 16.2.2.

#### 17.0 References.

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## 18.0 Tables, Diagrams, Flowcharts, and Validation Data

Gauge/cm	Flow rate liters/min.	Gauge/cm	Flow rate liters/min.
12/7.6	32.56	14/2.5	19.54
12/10.2	30.02	14/5.1	17.27
13/2.5	25.77	14/7.6	16.14
13/5.1	23.50	15/3.2	14.16
13/7.6	22.37	15/7.6	11.61
13/10.2	20.67	15/10.2	10.48

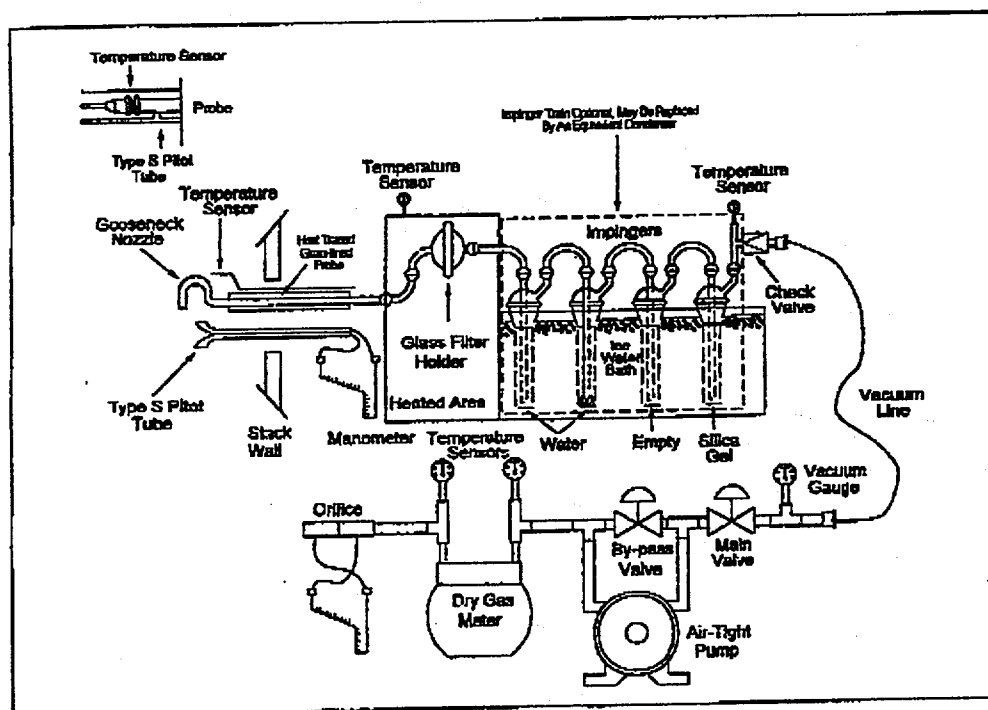
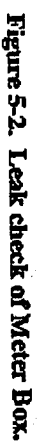


Figure 5-1. Particulate Sampling Train.



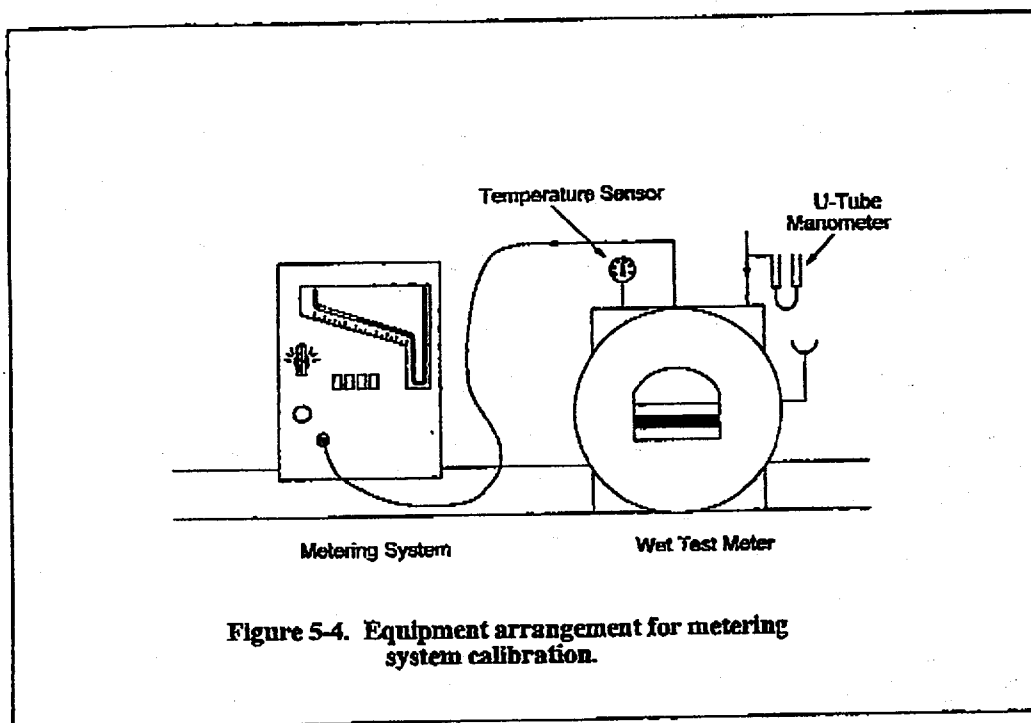
**Figure 5-2. Leak check of Meter Box.**

**Figure 5-3. Particulate Field Data.**

**Figure 5-3. Particulate Field Data.**

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Plant \_\_\_\_\_  
 Date \_\_\_\_\_  
 Run No. \_\_\_\_\_  
 Filter No. \_\_\_\_\_  
 Amount liquid lost during transport \_\_\_\_\_  
 Acetone blank volume, ml \_\_\_\_\_  
 Acetone blank concentration, mg/mg (Equation 5-4) \_\_\_\_\_  
 Acetone wash blank, mg (Equation 5-5) \_\_\_\_\_

Acetone wash blank, mg (Equation 3-3)			
Container number	Weight of particulate collected, mg		
	Final weight	Tare weight	Weight gain
1.			
2.			
Total: Less acetone blank. Weight of particulate matter.			
		Volume of liquid water collected	
		Impinger volume, ml	Silica gel weight, g
Final			g+ ml
Initial			
Liquid collected			
Total volume collected			

\* Convert weight of water to volume by dividing total weight increase by density of water (1 g/ml).

Figure 5-6. Analytical Data Sheet

$$\frac{\text{Increase, g}}{(\text{lg/ml})} = \text{Volume water, ml}$$

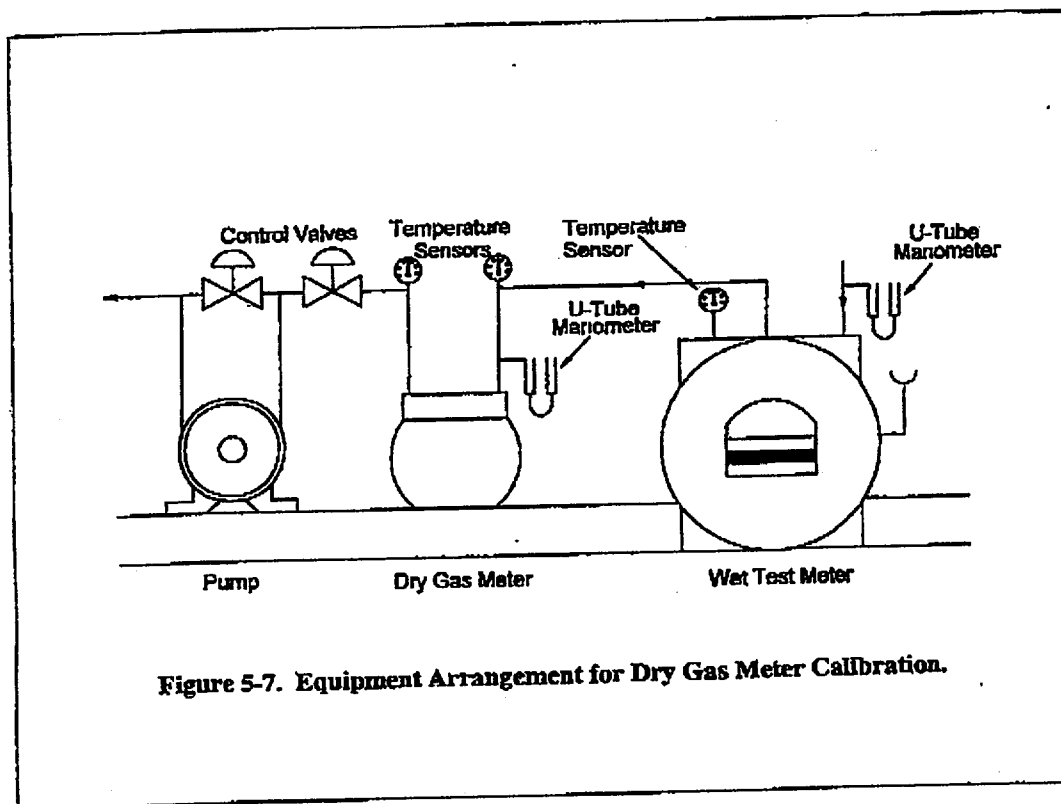


Figure 5-7. Equipment Arrangement for Dry Gas Meter Calibration.

Environmental Protection Agency

Pt. 60 App. A, Meth. 5

Date: \_\_\_\_\_  
 Dry Gas Meter Identification: \_\_\_\_\_  
 Barometric Pressure (P): \_\_\_\_\_ in. Hg

Approximate Flow Rate (Q) cfm	Spirometer (Std. Meter) Gas Volume (V <sub>s</sub> ) ft <sup>3</sup>	Dry Gas Meter Volume (V <sub>dm</sub> ) ft <sup>3</sup>	Temperatures			Dry Gas Meter Pressure (ΔP) in. H <sub>2</sub> O	Time (t) sec	Flow Rate (Q) cfm	Meter Coefficient (V <sub>ds</sub> )	Average Meter Coefficient (V <sub>av</sub> )
			Spirometer (Std. Meter) (T <sub>s</sub> ) °F	Dry Gas Meter						
				Inlet (T <sub>i</sub> ) °F	Outlet (T <sub>o</sub> ) °F					
0.40										
0.50										
0.80										
1.00										
1.20										

$$Q = K_1 \frac{P_{bar} V_s}{(T_w + T_{dm}) Q}$$

$$Y_{av} = \frac{V_s (T_{in} + T_{dm}) P_{bar}}{V_{ds} (T_{in} + T_{dm}) (P_{bar} + \Delta P / 13.6)}$$

**Figure 5-8. Example Sata Sheet for Calibration of a Standard Dry Gas Meter for Method 5 Sampling Equipment (English units).**

Pt. 60 App. A, Meth. 5

40 CFR Ch. I (7-1-01 Edition)

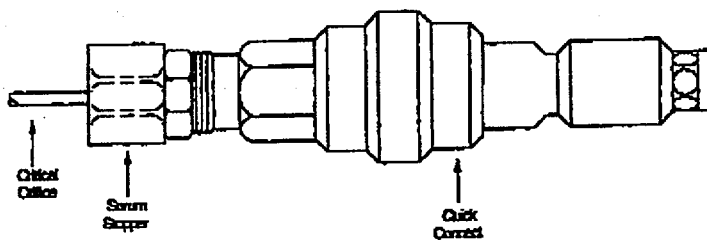


Figure 5-9. Critical Orifice Adaptation to Method 5 Metering System.

Environmental Protection Agency

Pt. 60 App. A, Meth. 5

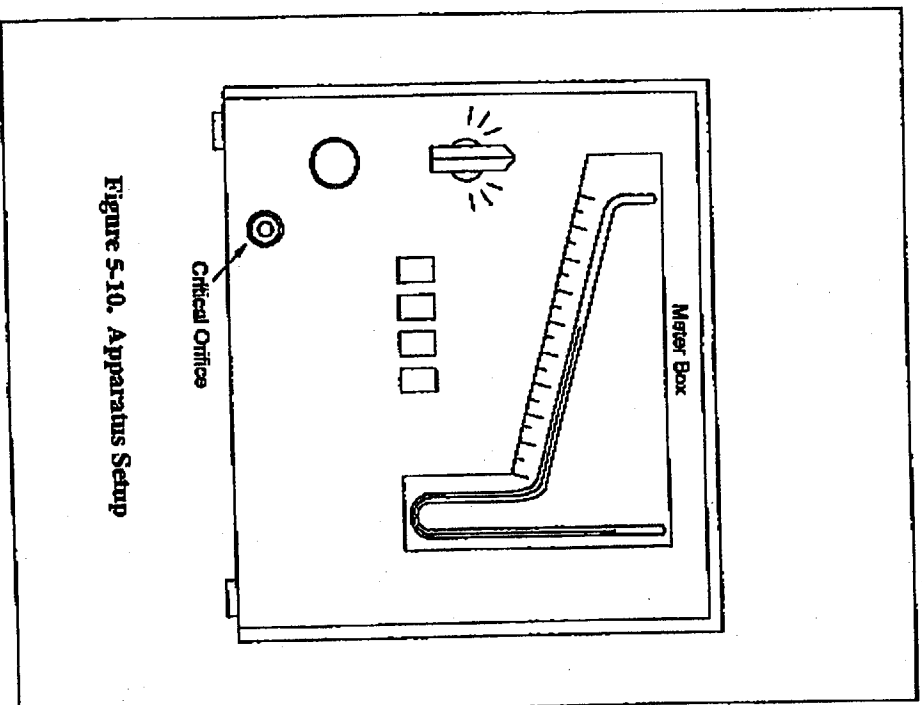


Figure 5-10. Apparatus Setup

Date \_\_\_\_\_

Train ID \_\_\_\_\_

DGM cal. factor \_\_\_\_\_

Critical orifice ID \_\_\_\_\_

Dry gas meter		Run No.	
		1	2
Final reading _____	$\text{m}^3 (\text{ft}^3)$ _____	_____	_____
Initial reading _____	$\text{m}^3 (\text{ft}^3)$ _____	_____	_____
Difference, $V_m$ _____	$\text{m}^3 (\text{ft}^3)$ _____	_____	_____
Inlet/Outlet _____	$^\circ\text{C} (^\circ\text{F})$ _____	_____	_____
Temperature _____	$^\circ\text{C} (^\circ\text{F})$ _____	_____	_____
Initial _____	mm/sec _____	_____	_____
Final _____	mm _____	_____	_____
Avg. Temperature, $t_m$ _____	mm (in.) $\text{H}_2$ _____	_____	_____
Time, $\theta$ _____	mm (in.) $\text{Hg}$ _____	_____	_____
Orifice diam. rlg. $\Delta H$ _____	mm (in.) $\text{Hg}$ _____	_____	_____
Bar. pressure, $p$ bar _____	mm (in.) $\text{Hg}$ _____	_____	_____
Ambient temperature, $t_{amb}$ _____	_____	_____	_____
Pump vacuum _____	_____	_____	_____
K' factor _____	_____	_____	_____
Average _____	_____	_____	_____

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40 CFR Ch. I (7-1-01 Edition)

Figure 5-11. Data sheet of determining K' factor.

Date \_\_\_\_\_  
 Train ID \_\_\_\_\_  
 Critical orifice ID \_\_\_\_\_  
 Critical orifice K' factor \_\_\_\_\_

Dry gas meter		Run No.	
		1	2
Final reading	m <sup>3</sup> (ft <sup>3</sup> )		
Initial reading	m <sup>3</sup> (ft <sup>3</sup> )		
Difference, V <sub>m</sub>	m <sup>3</sup> (ft <sup>3</sup> )		
Inlet/Outlet temperatures	°C (°F)	/	/
Initial	°C (°F)	/	/
Final	min/sec	/	/
Avg. Temperature, t <sub>m</sub>	min		
Time, θ			
Orifice man. rdg., ΔH	mm (in.) H <sub>2</sub>		
Bar. pressure, P <sub>bar</sub>	mm (in.) Hg		
Ambient temperature, t <sub>amb</sub>	mm (in.) Hg		
Pump vacuum	mm (in.) Hg		
V <sub>m</sub> (std)	mm (in.) Hg		
V <sub>cr</sub> (std)	m <sup>3</sup> (ft <sup>3</sup> )		
DGM cal. factor, Y	m <sup>3</sup> (ft <sup>3</sup> )		

Figure 5-12. Data Sheet for Determining DGM Y Factor

## **SURFACE WATER MONITORING PLAN AND STANDARD OPERATING PROCEDURES**

### **PART I SURFACE WATER MONITORING PLAN**

#### **1.0 MONITORING METHODOLOGY**

##### **1.1 Flow Measurement**

No flow measurements are taken at the two drainage creeks sample locations: Westwater Canyon and Cottonwood Creek.

##### **1.2 Water Quality**

Westwater Canyon and Cottonwood Creek are monitored at two locations west of and adjacent to the White Mesa Mill facility (See Figure 1). Samples are obtained annually from Westwater and quarterly from Cottonwood using grab sampling and analyzed in accordance with Table 1.

#### **2.0 QUALITY ASSURANCE**

Quality assurance for surface water monitoring includes an annual review of procedures used to measure field parameters; review of procedures for sample preservation; precautions applied to use of sample containers and equipment; and semi-annual submittal of one site split sample for analysis as a blind duplicate.

### **PART II SURFACE WATER STANDARD OPERATING PROCEDURES**

#### **1.0 EQUIPMENT**

Equipment used for monitoring surface water quality includes:

1. Beckman Model 20 pH meter and probe, or equivalent;
2. YSI Model 3000 temperature and conductivity meter and probe, or equivalent;
3. Polyethylene sample containers;
4. Sample bucket (5 gal.);

5. 142mm diameter filter holder;
6. 0.45 micron membrane filters;
7. 0.8 micron glass-fiber pre-filters; and,
8. Masterflex portable peristaltic pump, equivalent.

## **2.0 SAMPLING PROCEDURE**

A five gallon sample is obtained following rinsing of the sample bucket several times in the monitored stream. Specific conductivity, temperature and pH data is obtained in the field either as an in-stream measurement or from the water in the five gallon bucket, and recorded on the field water analysis data form (Attachment A). The bucket contents are pumped by a peristaltic pump, through a filtration unit containing a 0.45 micron membrane filter, into new polyethylene containers for a soluble, or dissolved sample. Suspended samples are not filtered.

The peristaltic pump tubing and filtration units are rinsed with distilled water prior to being utilized at each site. The equipment is pre-rinsed with a volume of the sampled stream prior to collection of the dissolved sample portion.

In the event that the sample streams contain excessive turbidity for proper filtration with the 0.45 micron filters, the samples are pre-filtered using the 0.8 micron filters on to the 0.45 micron filter.

Soluble aliquots are preserved using nitric acid to adjust the sample solution to a pH less than 2.0 and stored at approximately 4 °C.

Samples are submitted to the analytical laboratory on a quarterly basis. See Table 1 for analytical data to be requested on the surface samples.

### **2.1 Sample Labeling**

Sample containers are labeled with:

1. Project/facility
2. Date and time of sample
3. Filtered or unfiltered
4. Preservation method
5. Sampler's initials
6. Sample location

### **3.0 CALIBRATION**

Equipment used to measure field parameters will be calibrated in accordance with SOP PBL-EP-12.

### **4.0 RECORD KEEPING**

Radiological and chemical quality data is maintained in the Mill files in the Environmental Office. Records will include field and laboratory data as follows:

1. Sample location
2. Sample date
3. Field pH
4. Field temperature
5. Field conductivity
6. Total Suspended Solids Concentration
7. Total Suspended Radionuclide Concentrations
8. Dissolved Radionuclide Concentrations for U-nat, Th-230, Ra-226

### **5.0 MONITORING LOCATIONS AND FREQUENCY**

As shown on Table 1, surface water samples are collected from two locations west of the Mill property:

1. Lower Cottonwood Creek;
2. Lower Westwater Creek.

Samples are obtained four times a year on Cottonwood Creek with the semi-annual list of parameters analyzed twice, and the quarterly list analyzed twice per year. Westwater is sampled once on an annual basis and analyzed for the list of semi-annual parameters shown on Table 1.

### **6.0 ANALYSIS PROCEDURE**

The contract laboratory analytical procedures are in accordance with their respective established quality assurance and quality control programs.

Field sampling procedures are discussed in Section 2.0. Measurement of field parameters is performed using instruments which have been calibrated in accordance with SOP PBL-EP-12.

## **7.0 QUALITY ASSURANCE METHODOLOGY**

### **7.1 Field Quality**

Review of pH, temperature, and conductivity procedures performed in accordance with SOP PRL-EP-12 is done each year. Review of procedures involved with sample preservation is checked each sampling period. Sample collection bottles are not re-used and sample contents are maintained in a cooler. All filtration equipment is rinsed with distilled water prior to each site use and rinsed with the stream water prior to each site use and rinsed with the stream water prior to obtaining a dissolved content aliquot for analysis.

### **7.2 Water Quality**

On a semi-annual basis, one site sample is split in the field and submitted as a blind duplicate for analytical and sample collection quality assurance. Deviations greater than ten percent result in review of procedures.

Data is reviewed and graphed on a semiannual basis to observe abnormalities.

Table 1

Operational Phase Surface Water Monitoring ProgramMonitoring Sites  
Westwater and Cottonwood CreeksField Requirements

1. Temperature °C
2. Specific Conductivity, mhos at 25 °C
3. pH at 25 °C
4. Sample date
5. Sample ID

Vendor Laboratory RequirementsSemiannual\*

One gallon Unfiltered and raw  
 One gallon Unfiltered, raw  
 and preserved to pH <2 with  
 HNO<sub>3</sub>  
 Total dissolved solids  
 Total suspended solids  
 Gross Alpha  
 Suspended U-nat  
 Dissolved U-nat  
 Suspended Ra-226  
 Dissolved Ra-226  
 Suspended Th-230  
 Dissolved Th-230

Quarterly

One gallon Unfiltered and Raw  
 One filtered and preserved to  
 pH <2 with HNO<sub>3</sub>  
 Total dissolved solids  
 Total suspended solids

\*Semiannual sample must be taken a minimum of four months apart.

\*\*Annual Westwater Creek sample is analyzed for semi-annual parameters.  
 Radionuclides and LLDs reported in Ci/ml

Attachment A

FIELD WATER ANALYSIS SURFACE WATER  
WHITE MESA MILL

LOCATION (Circle one): Cottonwood Creek Westwater Canyon Other (describe) \_\_\_\_\_

DATE: \_\_\_\_\_

BY: \_\_\_\_\_  
(Sampler's initials)

pH BUFFER 7.0 \_\_\_\_\_

pH BUFFER 4.0 \_\_\_\_\_

SPECIFIC CONDUCTIVITY \_\_\_\_\_  $\mu$ MHOs

STEAM DEPTH: \_\_\_\_\_

pH of WATER \_\_\_\_\_

TEMP \_\_\_\_\_

COND  $\mu$ mhos \_\_\_\_\_

COND  $\mu$ mhos \_\_\_\_\_

pH Units \_\_\_\_\_

pH units \_\_\_\_\_

Temp °C \_\_\_\_\_

Temp °C \_\_\_\_\_

COND  $\mu$ mhos \_\_\_\_\_

COND  $\mu$ mhos \_\_\_\_\_

pH units \_\_\_\_\_

pH units \_\_\_\_\_

Temp °C \_\_\_\_\_

Temp °C \_\_\_\_\_

Comments:

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## **SURFACE SOIL MONITORING**

### **PART I SOIL MONITORING PLAN**

#### **1.0 SOIL MONITORING**

Surface soils are sampled at the five air monitoring sites. The sampling locations, shown in Figure 1, are as follows: BHV-1, BHV-2, BHV-3, BHV-4, and BHV-5. Soil samples are taken once per year during August or as soon as possible thereafter, but no later than September 30 of the year. In addition, a soil sample could be taken from Westwater Creek, in the place of a water sample. However, a sediment (soil) sample would only be taken at Westwater Creek if water was not available. In the event that a soil sample is collected in place of a water sample for Westwater Creek, the sample should be analyzed for the same parameters as those called for in this SOP (Radium-226 and U-nat). Refer to SOP No. PBL-EP-3 for details regarding collection of a water sample from Westwater Creek.

#### **2.0 SAMPLING AND ANALYTICAL QUALITY ASSURANCE**

The sample bags are marked for location identification and are submitted to the analytical laboratory accompanied by Chain-of-Custody forms. (Attachment A)

Analytical quality assurance for soil monitoring is based on the contract laboratory's quality controls such as blanks, duplicates, and standard percentage recovery. The laboratory is committed to meet the LLD values for radionuclides contained in U.S. NRC Regulatory Guides 4.14 and 4.15 and will perform re-runs on all samples not meeting these limits, as per EPA SW-846. Appropriate laboratory control and quality assurance data will be provided by the contract laboratory, or equivalent, including LLD information.

#### **3.0 ANALYTICAL REQUIREMENTS**

All soil samples will be analyzed, on a dry basis for the following radionuclides: Ra-226 and U-Nat. Analytical results will be reported in appropriate radiological units such as pico curies per gram or micro curies per kilogram.

### **PART II SOIL MONITORING STANDARD OPERATING PROCEDURES**

#### **1.0 SURFACE SOIL SAMPLING**

##### **1.1 Equipment**

Equipment used for soil sampling is as follows:

1. Tape measure or measuring stick calibrated to 1 foot and to one centimeter.

2. Clean trowel or shovel.
3. Clean sample containers.

## **1.2 Soil Sampling Procedure**

Soil samples are collected using a clean trowel or shovel to excavate a soil sample evenly across a one square foot area at a depth of one centimeter. The one centimeter excavation depth is maintained by using the tape measure or other suitable calibrated measuring stick. As the soil is being collected, it is placed directly into the sample container. The sample container is then identified with a label (see Section 2.1 below).

## **2.0 SAMPLING QUALITY ASSURANCE**

### **2.1 Sample Labeling**

Each sample must be labeled and all sample labels must be filled out in ink and numbered. The following information must be contained on the label:

1. Project and facility.
2. Company name
3. Date and time of sample collection.
4. Sampler's initials.
5. Sample location.
6. Requested Analytical Parameters

### **2.2 Sample Chain-of-Custody**

During sampling activities, traceability of the sample must be maintained upon sample collection until the laboratory data is issued. Information on the custody, handling, transfer, and shipment of the samples will be recorded on a Chain-of-Custody form (COC). The sampler is responsible for filling out the COC form. The COC form will be signed by the sampler when the sampler relinquishes the samples to anyone else. A COC form is to be completed for each set of samples placed in a sample shipping container and is to include the following:

1. Sampler's name.
2. Date and time of collection.

3. Sample location.
4. Sample type.
5. Analysis requested.
6. Signatures of persons releasing custody.
7. Signatures of persons accepting custody, dates, and times.

Copies of the COC forms and all custody documentation when received will be retained in appropriate files at the Mill. The original COC form remains with the samples until disposal of the samples. The samples are kept at the laboratory for a period of three months after analyses are complete. After sample disposal, the COC form will be sent to the Environmental Department along with the analyses.

### **2.3 Sample Handling and Shipping**

Samples will be placed in shipping containers and transported to the contract laboratory. COC forms will be placed inside a resealable bag and placed inside the sample shipping container.

### **2.4 Record Keeping**

All soil sample data are retained in the files and when analytical results are available the results are entered into a computer file and retained in the files. Laboratory analytical data are stored in the soil files after the data has been entered on a computer file.

## **3.0 ANALYTICAL QUALITY ASSURANCE**

### **3.1 Data Validation and Quality Control**

Laboratory analyses will be reviewed by the technical staff and any identifiable anomalies in results noted and investigated. Appropriate measures to confirm or disaffirm results will be pursued, such as laboratory conversation, analytical sample rerun, or trend analysis.

### **3.2 Quality Assurance and Data Validation**

The contract laboratory will prepare and retain a copy of all analytical and quality control documentation. The laboratory will provide hard copy information in each data package submitted in accordance with quality assurance objectives for the surface soil quality assurance project plan, that is: COC forms, cover sheets with comments, narratives, samples analyzed, reporting limits and LLD values for analytes, and analytical results of quality control samples. The data reduction and laboratory review will be documented, signed, and dated by the analyst.

### **3.3 Corrective Action**

Corrective action will be taken for any deficiencies or deviations noted in the procedures or anomalous results, such as but not limited to additional sample collection, sample re-run, laboratory inquiries, or other actions as appropriate.

Attachments for Soil

Fig 1.0  $\frac{1}{2}$  COC

<b>Chain of Custody/Sampling Analysis Request</b>					
<b>Sheet   of</b>					
<b>Project</b>	<b>Samplers' Name</b>			<b>Samplers' Signature</b>	
<b>Sample ID</b>	<b>Date Sample Collected</b>	<b>Time Sample Collected</b>	<b>Laboratory Analysis Requested</b>		
Relinquished by:(Signature)			Date/Time	Received By:(Signature) Date/Time	
Relinquished by:(Signature)			Date/Time	Received By:(Signature) Date/Time	
<b>Please return signed Chain of Custody record, cooler and blue ice ASAP.</b>					

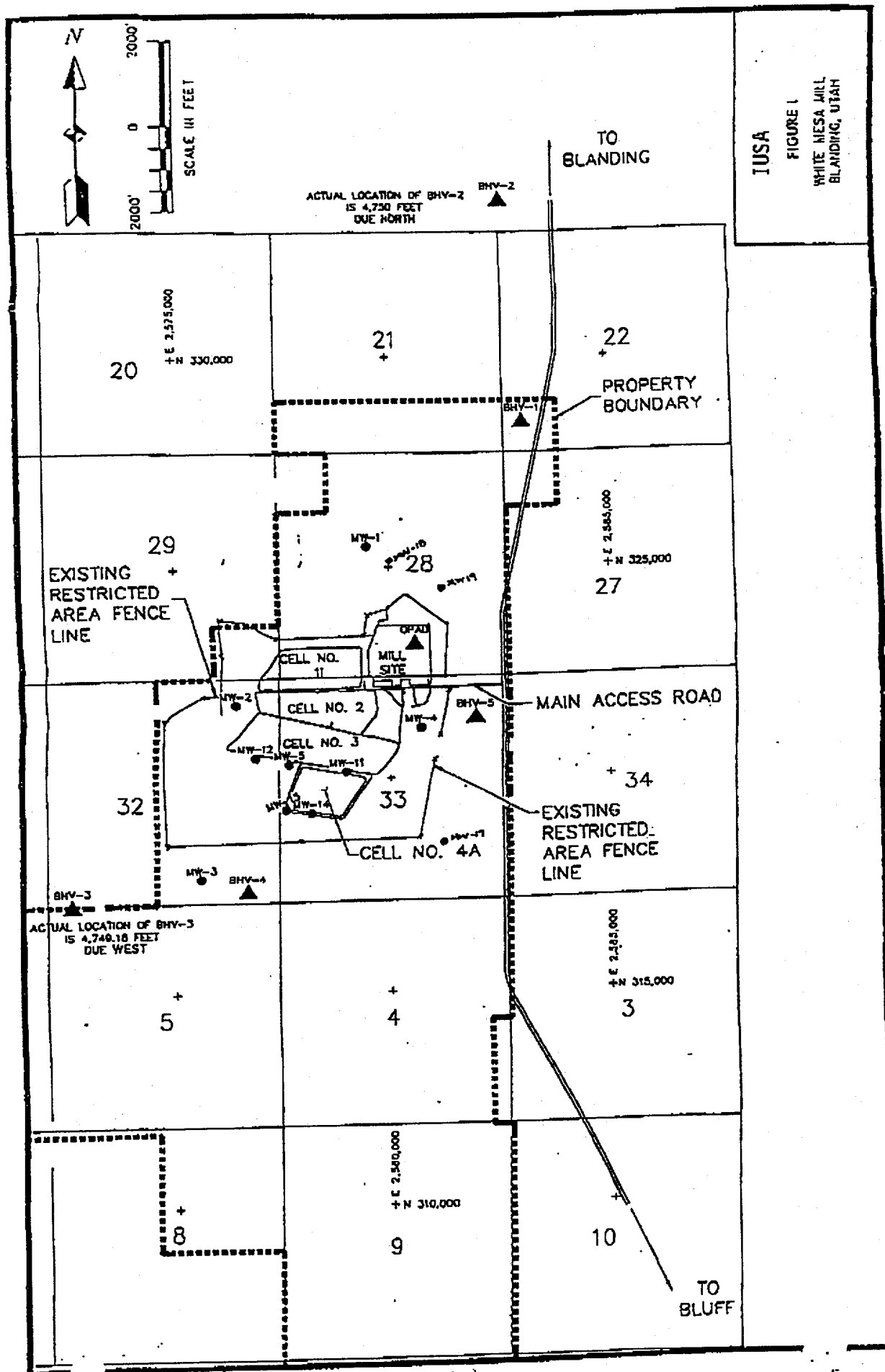


Figure 1 - Environmental Site Sampling Map

## **VEGETATION MONITORING**

### **PART I VEGETATION MONITORING PLAN**

#### **1.0 VEGETATION MONITORING PLAN**

Vegetation is sampled in early spring, late spring, and late fall at three locations around the Mill. These locations are: Northeast Area (near BHV-1), Northwest Area (½ mile west of BHV-1) and the Southwest Area (West of BHV-4 and south off Cell 3).

#### **2.0 QUALITY ASSURANCE**

Quality assurance for vegetation monitoring is based on the contract laboratory's quality controls such as duplicates, blanks, standard percent recovery, and spike percent recovery. The laboratory will also follow U.S. EPA Guide SW-846 and U.S. NRC Regulatory Guides 4.14 and 4.15 when analyzing the vegetation samples. The laboratory is committed to meet the LLD values for radionuclides addressed in these guidelines and will perform re-runs on all samples not meeting these limits.

#### **3.0 ANALYTICAL REQUIREMENTS**

Each vegetation sample will be analyzed for Ra-226 and Pb-210 radionuclide concentrations. Results will be expressed in units of picocuries per gram (pci/g) or micro curies per kilogram (µci/kg), on a wet basis.

### **PART II VEGETATION MONITORING STANDARD OPERATING PROCEDURES**

#### **1.0 VEGETATION SAMPLING**

##### **1.1 Equipment**

Equipment used for vegetation sampling is as follows:

1. Scissors
2. Large plastic sample bags

##### **1.2 Vegetation Sampling Procedure**

Vegetation samples are collected and removed at the surface with scissors at each sampling location. The vegetation sample is enclosed in a large plastic bag. Each sample will be

weighed upon return to the office and must weigh at least three kilograms in order for the laboratory to meet the required LLD values outlined in U.S. NRC Regulatory Guide 4.14. In addition, as vegetation samples are collected efforts will be made to minimize the amount of soil in the samples. The sample bag is then labeled (see Section 2.1).

## **2.0 SAMPLING QUALITY ASSURANCE**

### **2.1 Sample Labeling**

All sample labels must be filled out in waterproof ink and numbered. The date, time, sampler's initials, and the sample location will be completed at the time the sample is collected. The following information will be included on the label:

1. Project and facility.
2. Sampler's company affiliation.
3. Date and time of sample collection.
4. Sampler's initials.
5. Sample location.
6. Weight of sample.
7. Requested analytical parameters.

### **2.2 Sample Chain-of-Custody**

During sampling activities, traceability of the sample must be maintained upon sample collection until the laboratory data is issued. Information on the custody, handling, transfer, and shipment of the samples will be recorded on a Chain-of-Custody form (COC). The sampler is responsible for filling out the COC form. The COC form will be signed by the sampler when the sampler relinquishes the samples to anyone else. A COC form is to be completed for each set of samples placed in a shipping container and is to include the following:

1. Sampler's name.
2. Date and time of collection.
3. Sample location.
4. Sample type.

5. Analysis requested.
6. Signatures of persons releasing custody.
7. Signatures of persons accepting custody, dates, and times.

Copies of the COC forms and all custody documentation when received will be retained in appropriate files at the Mill. The original COC form remains with the samples until analysis of the samples. After sample analysis, the COC form will be sent to the Environmental Department along with the analyses.

### **2.3 Sample Handling and Shipping**

Sample bags will be packaged in large shipping boxes and transported to the contract laboratory. COC forms will be placed inside a sealed bag and placed inside the shipping box.

### **2.4 Record Keeping**

All vegetation sampling data will be retained in a file. When analytical data becomes available, the data is entered into a computer file and retained in the files. All laboratory analytical data is stored in the vegetation files after the data has been entered into the computer file.

## **3.0 ANALYTICAL QUALITY ASSURANCE**

### **3.1 Data Validation and QC Review**

Laboratory analyses will be reviewed by the technical staff and any identifiable anomalies in results noted and investigated. Appropriate measures to confirm or disaffirm results will be pursued, such as laboratory conversation, analytical sample rerun, or trend analysis.

### **3.2 Quality Assurance and Data Validation**

The contract laboratory will prepare a copy of and retain all analytical and QC documentation. The laboratory will provide the Mill with paper copies of the following in each data package, in accordance with QA objectives for the Surface Soil QA Project Plan:

1. COC forms
2. Cover sheets with comments
3. Narrative
4. Samples analyzed
5. Reporting limits and LLD values for analytes
6. Analytical results of QC samples

The data reduction and laboratory review will be documented, signed, and dated by the contract laboratory analyst.

### **3.3 Corrective Action**

Corrective action will be taken for any deficiencies or deviations noted in the procedures or anomalous results, such as but not limited to additional sample collection, sample re-run, laboratory inquiries, or other actions as appropriate.

Attachments for Veg.

Fig 1.0 & coc

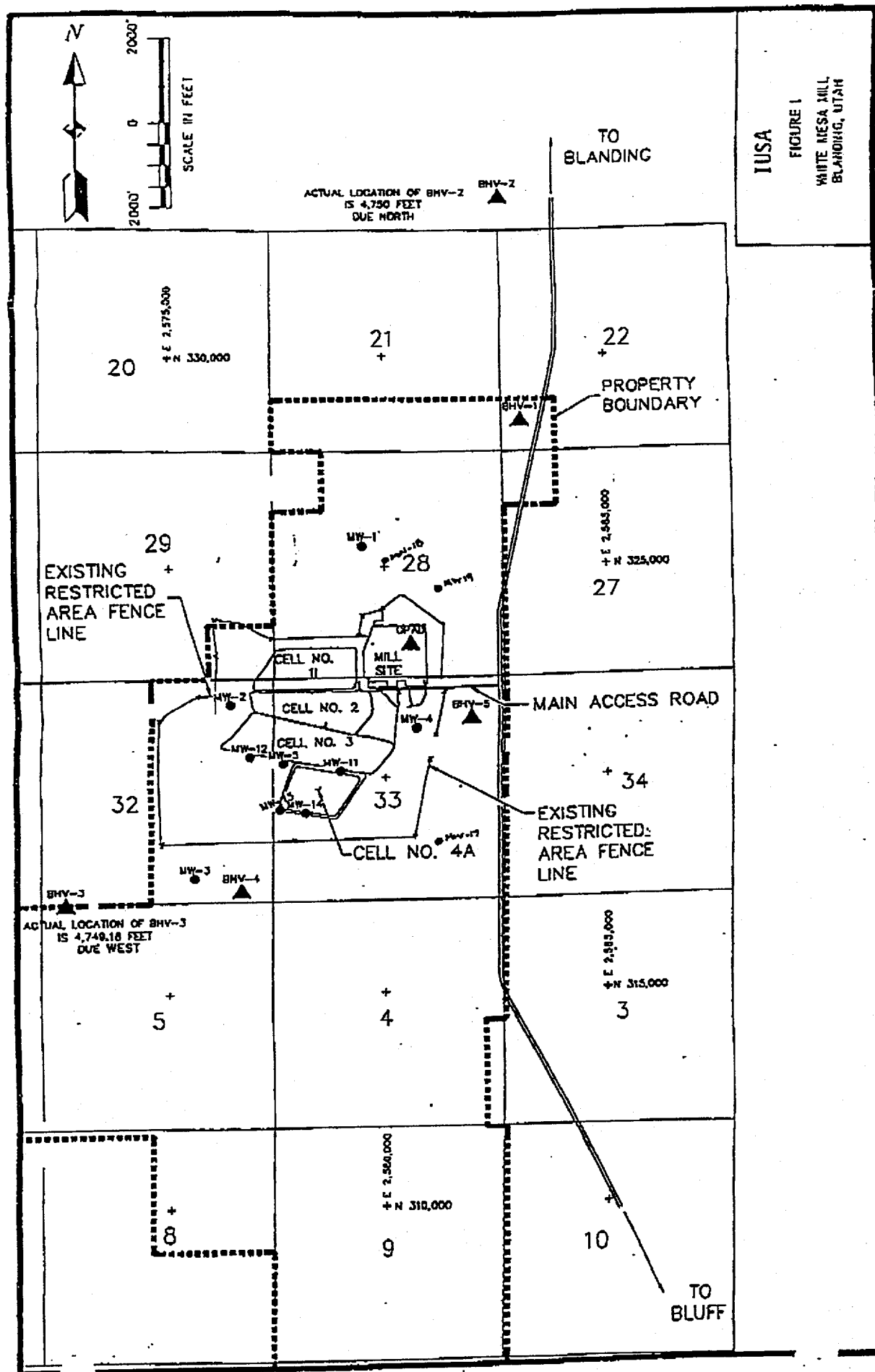


# CHAIN OF CUSTODY

Samples Shipped to:

Sheet of		Chain of Custody/Sampling Analysis Request			
Project		Samplers' Name		Samplers' Signature	
Sample ID	Date Sample Collected	Time Sample Collected	Laboratory Analysis Requested		
Relinquished by:(Signature)		Date/Time	Received By:(Signature)		Date/Time
Relinquished by:(Signature)		Date/Time	Received By:(Signature)		Date/Time

Please return signed Chain of Custody record, cooler and blue ice ASAP.



IUSA

FIGURE 1

WHITE MESA MILL,  
BLANDING, UTAH

Figure 1 - Environmental Site Sampling Map

## **SPECIFIC CONDUCTIVITY, pH METER, AND TEMPERATURE FIELD INSTRUMENT CALIBRATION STANDARD OPERATING PROCEDURES**

### **1.0 SPECIFIC CONDUCTIVITY, pH, AND TEMPERATURE FIELD INSTRUMENT CALIBRATION STANDARD OPERATING PROCEDURE**

#### **1.1 Introduction**

A critical element in the White Mesa Mill's Groundwater and Surface Water Monitoring Program is the measurement of each Monitoring Location's field parameters (i.e., pH, temperature, and conductivity). The instrument utilized at the Mill to perform these measurements is the Hydrolab Surveyor 4 with multiple parameter probe called the Minisonde. It is important that all instruments used in these measurements be calibrated and inspected prior to each use, to ensure that they are functioning properly and have no obvious, visible damage or contamination present.

#### **1.2 Equipment**

1. Hydrolab Surveyor 4 with Minisonde or equivalent
2. NBS traceable thermometer.
3. pH 7.0 and 4.0 buffer solutions.
4. Ecologic Instrument Division of Industrial Municipal Equipment Inc. stock conductivity solution of 3000 mhos or equivalent
5. Distilled water.

### **2.0 CALIBRATION OF PROBES FOR CONDUCTANCE, pH, AND TEMPERATURE**

#### **2.1 pH Probe Calibration**

The following describes the procedures for calibration of the Hydrolab Surveyor 4 / Minisonde pH probe.

1. Prior to calibration ensure that the Surveyor 4's battery is fully charged.

2. Inspect probes for visible damage and contamination.
3. Rinse the probes with distilled water prior to placing them in the sample container.
4. Fill the Minisonde's sample container with pH 7.0 buffer solution. If the Minisonde's sample container is not used and the probe is placed directly into a sample container place the probe protector over the probes prior to measurement.
5. From the Surveyor 4 main menu choose calibrate and press "Enter".
6. At the next prompt choose "Ions-1", and press "Enter".
7. Type "7" after "standard:<<".
8. Thoroughly rinse the probes and sample container with deionized water. Rinse sensors with a small amount of the pH 4.0 buffer. Fill the sample cup with the pH 4.0 buffer solution. Allow 1-3 minutes for the readings to stabilize.
9. In the Main Menu move the cursor to "Calibrate" and press "Enter."
10. Next move the cursor to "Ions" and press "Enter."
11. Place the cursor on "pH: units" and press "Enter."
12. Now type the 4.0 after "standard: <<," followed by "Enter."
13. The pH sensor is now calibrated. If further problems are encountered refer to the DataSonde4\MiniSonde manual or return instrument to the manufacturer for repair or calibration if required.

## **2.2 Temperature Probe Calibration**

The following describes the procedures for calibration of the Hydrolab Surveyor 4 / Minisonde temperature probe:

1. The Hydrolab Surveyor 4 / Minisonde temperature probe is calibrated at the factory and typically does not require any calibration for temperature. However, a check to ensure that it the probe functioning properly should be performed prior to each use.
2. Place the probe in distilled water and allow the temperature reading to stabilize (1-3 minutes), record the reading.

### **3.0 QUALITY ASSURANCE**

Following the steps outlined in procedures above and using the prescribed equipment will produce accurate and repeatable results of groundwater and surface water field parameters. HS/EA Department Manager will review technician performance periodically.

## **Attachment 2**

**Revised Radiation Protection Program and Standard Operating Procedures  
(Replaces License Application Appendix F Section 5 only)**

## **RESPIRATORY PROTECTION PROGRAM**

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    - 1.2.2 Radiation Safety Officer
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  - 3.1 Performing and documenting the Required Medical Evaluation
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## **RESPIRATORY PROTECTION PROGRAM**

### **1.0 APPLICABILITY**

The Respiratory Protection Program coordinates the

1. Air sampling sufficient to identify the potential hazard, select the proper equipment, and estimate exposures;
2. Surveys and bioassays, as appropriate, to evaluate actual intakes;
3. Testing of respirators for operability prior to each use;
4. Written procedures regarding selection, fitting, issuance, maintenance, and testing of respirators, including testing for operability immediately prior to each use; supervision and training of personnel; monitoring, including air sampling and bioassays; and record keeping; and
5. Determination by a physician prior to the initial fitting of respirators, and either every 12 months thereafter or at a greater frequency determined by a physician, that the individual user is medically fit to use the respiratory protection equipment.

### **1.1 Respiratory Protection Policy**

The Respiratory Protection Program is established for this facility as a policy of International Uranium (USA) Corporation (IUSA) to protect its employees from occupational exposure to harmful concentrations of radioactive and/or toxic materials in the air.

The following is IUSA's policy with respect to respiratory protection:

1. Process or other engineering controls will be used whenever feasible to reduce the need for use of respirators.
2. For work in areas in which respirators must be routinely used to reduce exposures, SOP's will detail use of respiratory protection. Non-routine use of respirators will be performed under Safe Work Permits. Self Contained Breathing Apparatus ("SCBA") respirators will only be used for evacuation and emergency response situations.
3. Due to the added physical stress of working while using a respirator, work periods will be alternated with rest periods.
4. Respirators will not be issued to employees unless they are to be used.

### **1.2 Responsibilities**

As noted in NRC Regulatory Guide 8.15, "it is widely recognized among safety professionals that the use of respiratory protection devices in the workplace can impose physiological and psychological stresses on workers, obstruct their vision, hinder their movements, and make effective communications difficult. These factors increase the risk

of physical injury to respirator wearers that, in many cases, far exceeds any potential risk associated with the inhalation of a small quantity of airborne radioactive material.” Therefore, the NRC recommends that process or engineering controls be used to the extent practical to control the concentration of radioactive material in air, and that the use of respiratory protection devices be contemplated only after other measures to limit intake have been considered.

In general, the Mill Manager is responsible for providing the equipment and resources necessary for the successful implementation of the Respiratory Protection Program and for facilitating the application of engineering controls to reduce the need for the use of respiratory protection devices. The Radiation Safety Officer (“RSO”) has primary responsibility for implementation and oversight of all aspects of the respiratory protection program. The Mill Manager and the RSO will coordinate efforts to use, to the extent practical, procedures and engineering controls based on sound protection principles to achieve ALARA.

#### 1.2.1 Mill Manager

The Mill Manager is responsible for ensuring that a respiratory protection program, meeting or exceeding that specified by regulation, is established and maintained for the employees under his or her jurisdiction.

#### 1.2.2 Radiation Safety Officer

The (RSO) is responsible for the implementation and direct control of the respiratory protection program. The RSO is charged with the following responsibilities:

1. Supervision of respirator selection procedures.
2. Establishment of training sessions about respiratory equipment for employees.
3. Establishment of a continuing program of cleaning and inspecting the equipment.
4. Designation of proper storage areas for respiratory equipment.
5. Establishment of issuance and accounting procedures for uses of respiratory equipment.
6. Establishment of medical screening programs and procedures for employees assigned to wear respiratory equipment.
7. Establishment of a periodic inspection schedule of those work places/conditions requiring respiratory equipment to determine exposure and/or changing situations.

8. A continuing evaluation of the above aspects to assure their continued functions and effectiveness.

### 1.2.3 Employees

Respirators are provided to employees for their personal protection and the proper use of respirators in areas in which such protection is required is a condition of their employment. Violating the established rules for respirator use may result in disciplinary action up to and including dismissal.

## 1.3 Policy Regarding Facial Hair

The proper fitting of a respiratory device is necessary to ensure that it will function adequately. Facial hair (beards, mustaches, and long sideburns) will not allow an airtight seal to be formed between the face and mask, as contaminated air will enter into the wearer's breathing zone if the proper seal is not achieved. Leakage of air into the mask will nullify the purpose of the respiratory device.

The policy of IUSA concerning facial hair is:

As a condition of employment, those employees who may at any time be required to wear a respirator as part of their employment, will not have any facial hair that will restrict the proper fitting of a respiratory device.

## 1.4 Physiological or Psychological Limitations to Respirator Use

This section describes physiological and psychological (including emotional) factors, which may limit an individual's ability to wear or work in a respirator. Any questions or problems concerning respirators or their use, such as the types described in this section, should be addressed to the RSO.

### 1.4.1 Physiological Limitations

As described below in Section 3.1, medical qualification will be required of each employee that might be using a respirator in their normal work duties. This is necessary to evaluate the individual's limitations to wearing respirator devices. A licensed physician to determine that the individual user is medically fit to use the respiratory protection equipment will perform the medical evaluation. The physician will report on any physiological factors that may limit an individual's ability to wear a respirator.

### 1.4.2 Psychological Limitations

Mental factors must also be taken into consideration when employees are required to wear respirators. Some individuals become claustrophobic when wearing a respirator. These individuals should not be required to wear respirators if the condition is severe enough to cause panic.

### 1.4.3 Other Factors

Other factors, which may cause problems in respirator sealing, must be considered when performing fit testing. These may include such factors as facial structure, scars, skin creases, or dentures.

## 2.0 PROCEDURES FOR RESPIRATOR USE

### 2.1 Supervision of the Program, Including Program Audits

The Respiratory Protection Program is administered by the RSO. Quarterly ALARA Reports from the RSO are sent to members of the ALARA Committee. The effectiveness of the Respiratory Protection Program is reviewed and exposure data evaluated during annual ALARA audits.

### 2.2 Training and Minimum Qualifications of Supervisors

A supervisor, that is, a person who has the responsibility of overseeing the work activities of one or more persons who must wear respirators, shall be given adequate training to ensure the proper use of respirators. Supervisor training shall include but shall not necessarily be limited to the following subjects:

1. Basic respiratory protection practices.
2. Nature and extent of respiratory hazards to which persons under his/her supervision may be exposed.
3. Principles and criteria of selecting respirators.
4. Training of respirator wearers.
5. Issuance of respirators.
6. Inspection of respirators.
7. Use of respirators, including monitoring their use.
8. Maintenance and storage of respirators.
9. Regulations concerning respirator use.

### 2.3 Training of Respirator Users

Each employee who may wear a respirator will be required to receive training for the proper use of the device. The following outline will be followed during the training process.

- A. Need for Respiratory Protection Equipment
- B. Mechanics of Breathing

C. Types of Respiratory Particles

1. Dust
2. Fumes
3. Mists

D. IUSA's Respiratory Company Respiratory Protection Policy Statement

E. Respiratory Hazards

1. Airborne uranium and effect
2. Radon daughters and effect
3. Chlorine and effect
4. Ammonia and effect
5. Airborne vanadium and effect
6. Acid gases and effect
7. Other effects

F. Engineering Controls

1. De-mister
2. Ventilation
3. Ventilating systems for the yellowcake dryer and packaging rooms

G. Respirator Selection

1. Type of respirators, their function, limitations
  - a) Half mask with chemical cartridges
  - b) Full-face with chemical cartridges
  - c) Supplied air respirators
  - d) Self-contained breathing apparatus
  - e) NIOSH and MSHA approved respirators only

H. Identification of Hazards

1. O<sub>2</sub> content
2. Routine hazards
3. Non-routine hazards

I. Instructions on Field Inspection of the Respirator

1. Valves
2. Body of mask
3. Straps
4. Lens
5. Air hoses

J. Fitting, Donning and Wearing Instructions and Training

Wearing instructions and training (including practice demonstrations) shall be given to each respirator wearer and shall cover the following items.

- a) Donning (including seal check), wearing, and removing the respirator.
- b) Adjusting the respirator so that its respiratory-inlet covering is properly fitted on the wearer and so that the respirator causes minimum of discomfort to the wearer.
- c) Allow the respirator wearer to wear the respirator in a safe atmosphere for an adequate period of time to ensure that the wearer is familiar with the operational characteristics of the respirator.

K. Respirator Sealing Problems

Respirators shall not be worn when conditions prevent a seal of the respirator to the wearer's face. For example:

- a) A person who has hair (beard stubble, mustache, sideburns, beard, low hairlines, or bangs) that passes between the face and the sealing surface of the face piece of the respirator shall not be permitted to wear such a respirator.
- b) A person who has facial hair (mustache or beard) which interferes with the function of a respirator valve(s) shall not be permitted to wear such a respirator.
- c) Glasses, which have temple bars, or straps, which passes between the sealing surface of a respirator's full-face piece and the wearer's face, shall not be used.
- d) A head covering which passes between the sealing surface or a respirator face piece and the wearer's face shall not be used.
- e) The wearing of glasses or goggles, a face shield, a welding helmet, or other eye and face protective device, which interferes with the seal of a respirator to the wearer, shall not be allowed.
- f) If scars, hollow temples, excessively protruding cheekbones, deep creases in facial skin, the absence of teeth or dentures, or unusual facial configurations prevent the seal of a respirator face piece to a wearer's face, the person shall not be permitted to wear the respirator.
- g) If missing teeth or dentures prevent the seal of a respirator mouthpiece in a person's mouth, the person shall not be allowed to wear a respirator equipped with a mouthpiece.
- h) If a person has a nose of a shape or size that prevents the closing of the nose by the nose clamp of a mouthpiece/nose

clamp type of respirator, the person shall not be permitted to wear this type of respirator.

**L. Maintenance, Storage, and Respirator Exchange Procedures**

1. Cleaning, sanitizing, and maintenance techniques for all types of respirators.
2. The frequency of respirator exchange (clean exchanged for used).
  - a) Heavy use
  - b) Occasional use
3. The steps that are to be taken to exchange respirators.
4. When, how, and why SCBA are used.

**M. Leaving a Hazardous Area**

1. A respirator wearer shall be permitted to leave the hazardous area for any respirator-related cause. Reasons which may cause a respirator wearer to leave a hazardous area included but are not limited to the following:
  - a) Failure of the respirator to provide adequate protection.
  - b) Malfunction of the respirator.
  - c) Detection of leakage of air contaminant into the respirator.
  - d) Increase resistance to breathing.
  - e) Severe discomfort in wearing the respirator.
  - f) Illness of the wearer including sensation of dizziness, nausea, weakness, fatigue, breathing difficulty, coughing, sneezing, vomiting, fever, or chills.
  - g) Claustrophobia, anxiety, or other psychological factors that may affect the wearer.

**N. Emergency respirator use:**

1. SCBA (self-contained breathing apparatus)
2. Emergency respirator issuance

**O. Regulations for respirator use:**

1. 10 CFR Part 20 Subpart H

## **2.4 Fit Testing**

Frequency – annually for every employee who is required to wear a respiratory protective device.

Equipment needed – MSA ventilation smoke tube, Part No. 5645 or equivalent, aspirator bulb. Steps for annual fit testing are:

1. Respirators equipped with high-efficiency filters will be used for this test (red/green filters).
2. Both ends are broken on an MSA ventilation smoke tube. One end is inserted into the tube connected to the positive pressure of a two-way aspirator bulb and the other end covered by a ½ inch length of tygon, surgical or rubber tubing. The test aerosol is generated by squeezing the aspirator bulb.
3. The test subject will don the respirator and a visual inspection of the facepiece to face seal made by the tester. An obvious leak in the facepiece to face seal shall be reason to abort the test and record the mask as unsatisfactory. Expression of discomfort created by the mask shall also be reason to abort the test.
4. The smoke will be generated in all areas surrounding the mask. The smoke is not harmful however it is sufficiently irritating that if there is a leak in the seal of the mask, it will be discovered immediately.
5. If a half-mask is being tested, the subject shall close his or her eyes prior to testing. If no leakage is detected during the test period, the subject shall perform several body movements while breathing normally. Leakage at any time shall be cause to terminate the test.
6. Any indication of detection of the smoke by the test subject during fitting indicates a failure of that respirator. If leakage is detected the facepiece to face seal shall be visually inspected for obvious leakage. If any doubt about the condition of the respirator or the filter exists, another like respirator shall be tested to assure the leakage was due to the facepiece to face seal.

## **2.5 Selecting Respirators**

Respirator selection will be determined by the type of environment in which the employee will be working. The concentration of oxygen and the type and concentration of hazardous contaminants in the work area atmosphere must be considered during the selection process.

Prior to selecting a specific type of respirator, the work environment must be thoroughly evaluated for respiratory hazards. The following questions must then be answered:

1. What are the hazards the employee will be exposed to?
2. What are the contaminants and their concentration?

3. Are there any contaminants in the workplace environment that may damage or irritate the eyes, nose, or skin?
  - a) Yes – a full-face style is recommended.
  - b) No – a half-mask style is recommended. Unless a higher protection value is needed, the half-mask is less restricting and more comfortable than the full-face design.
4. Is the oxygen concentration in the workplace atmosphere between 19.5% to 23%?
  - a) Yes – chemical cartridges *may* be used if the concentration of the contaminant is within the acceptable limits for the cartridge.
  - b) No – The workplace or area may only be entered if the O<sub>2</sub> concentration is between 19.5 and 23%. The workplace environment will be remediated (i.e., ventilated) by safety engineering controls such that the oxygen concentration falls between these limits before it may be entered.
5. Do the contaminant concentrations in the work environment exceed the limits listed for the chemical cartridge being used?
  - a) Yes – Modify the air contaminant concentration by safety engineering measures.
  - b) No – chemical cartridges may be used if oxygen concentration is between 19.5% and 23%.

#### 2.5.1 Air Purifying Respirators

Only MSHA and NIOSH approved and accepted respirators will be used. The inventory will consist of full face and half-mask units for supplied air and SCBAs.

There is only one type of air purifying respirator cartridge used for air contaminants. This is a red/green GME-H universal cartridge, which is normally effective for removing all air contaminants and atmospheric hazards, and is approved by NIOSH for use under the following conditions:

1. Organic Vapors – less than 1,000 ppm
2. Pesticides
3. Mists of Paints, Lacquers, and Enamels
4. Dust – less than 0.5 mg/m<sup>3</sup>
5. Fumes – less than 0.5 mg/m<sup>3</sup>
6. Mists – less than 0.5 mg/m<sup>3</sup>

#### 2.5.2 Supplied Air Apparatus

##### *SCBA versus supplied air respirators*

Self-contained breathing apparatus will only be used for evacuation or emergency purposes.

Supplied air respirators will be the apparatus of choice when:

1. The length of the work exceeds 20 minutes
2. There is adequate time to hook up hoses and filter boards

If at any time the atmosphere contains materials that might be corrosive to the employee or respiratory device, the area will be evacuated. The area must be ventilated until the corrosive materials fall to a safe level before work may resume.

## **2.6 Maintaining Breathing Air Quality**

The quality of air delivered to all supplied-air respirators shall meet the requirements for Grade D air for breathing air systems as defined in CGA G-7.1-1997, as cited in Regulatory Guide 8.15 under 6.5.2 "Air Quality Requirements". The ANSI/CGA G.7-1 1989 specifies the contents of Grade D breathing air as: oxygen (volume/volume) of 19.5 to 23.5%; hydrocarbon (condensed) of 5 mg/m<sup>3</sup> of air or less; carbon monoxide of 10 ppm or less; carbon dioxide of 1,000 ppm or less; and the lack of a noticeable odor.

## **2.7 Inventory and Control of Respiratory Protection Equipment**

Storage cabinets that will be used for routine respirator issuance will be located in the mill central control room, mill maintenance shop, and at the respirator cleaning facility. Only persons authorized to use respirators are to access the storage cabinets.

When an employee needs a clean respirator, he or she will obtain one from the storage locations where clean respirators are packaged and kept. After obtaining a clean respirator, the employee will enter the pertinent information on the log sheet that is kept in the cabinet with the clean respirators.

When a used respirator is exchanged for a clean unit, the dirty respirator will be placed in the receptacle provided for such use.

Employees who routinely wear a respirator for more than four hours each day or work in areas of higher exposure potential (i.e., yellowcake packaging or precipitation), will be required to exchange respirators daily.

Those employees who do not use respirators routinely will exchange them as they become ineffective in eliminating the hazardous contaminant. This determination is made by the employee by physical inspection of the respirator, by impaired breathing, (i.e. by plugging of a cartridge) or by the detection of irritant smoke or other conditions which may indicate a defective device.

## **2.8 Storage of Respiratory Protection Equipment**

Respirators shall be stored in a manner sufficient to protect the device against dust, sunlight, extreme cold, excessive moisture, or damaging chemicals.

The cleaned respirators will be stored in cabinets in the mill central control room, maintenance shop, and the safety department. The respirators will be stored in single layers with the facepieces and exhalation valves in a more or less normal position to prevent the rubber or plastic from cracking.

When respirators are not being used, they must be stored in the plastic bags in which they were issued. Dirty respirators will be placed in receptacles located in the mill central control room and at the maintenance shop. They will be gathered from these locations for cleaning and repairs.

The frequency that a dirty respirator must be exchanged for a clean one will be determined by the amount of time it is used. If the employee's use is greater than four hours per day, the exchange will be made daily. Occasional use will require a weekly exchange. Infrequent use will require monthly exchanges.

The cabinets containing emergency respirators will be located in areas that are readily accessible and in areas in which a hazard may arise. Emergency cabinets will be in the central control room, outside the SX on the north wall, on the south end of SX on the fire cabinet and in the maintenance shop. All employees should be made aware of these locations.

The cabinets will not be locked, but they will have seals attached to the hasps. The seals will prevent employees from using the respirators for routine use, but will allow emergency access. During emergencies, the seal will be broken and a respirator may be selected in a matter of seconds.

## **2.9 Maintenance, Repair, Testing, and Quality Assurance of Respiratory Protection Equipment**

Respirators and component parts shall be maintained and repaired only by persons specifically trained to perform this work. Repairs and maintenance shall be performed in accordance with the procedures detailed below.

### **2.9.1 Maintenance, Cleaning, Repair, and Testing**

Each used respirator must be disassembled before cleaning; the cartridges must be removed and discarded and any hoses or regulators must be removed and washed separately. Some of the units have elastic head straps; these should also be removed and washed separately.

The respirators will be cleaned and rinsed in a commercially available dishwasher. The radiation and safety staff will perform cleaning and washing of respirators. The respirators will be washed and then aired dried.

Each reassembled respirator must be inspected for radiation contamination before it is used. An instrument survey or a swipe test may be conducted to determine if any item is contaminated. The equipment check must indicate levels of less than 100 dpm/100 cm<sup>2</sup> of alpha radiation or 1,000 dpm/100 cm<sup>2</sup> of beta-gamma radiation to be serviceable. If

repeated washings do not decrease contamination to acceptable levels, that item must be disposed of.

Respirators shall be inspected in accordance with NRC Regulatory Guide 8.15, Revision 1, October 1999. The following conditions should be checked during any type of inspection:

#### Air Purifying Respirators

Routinely used air purifying respirators should be checked as follows before and after each use.

- A. Examine the facepiece for:
  - 1. Excessive dirt
  - 2. Cracks, tears, holes, or distortion from improper storage
  - 3. Inflexibility (stretch and massage to restore flexibility)
  - 4. Cracked or badly scratched lenses in full facepieces
  - 5. Incorrectly mounted full facepiece lens or broken, or missing mounting clips
  - 6. Cracked or broken air purifying element holder(s), badly worked threads, or missing gasket(s), if required
- B. Examine the head straps or head harness for:
  - 1. Breaks
  - 2. Loss of elasticity
  - 3. Broken or malfunctioning buckles and attachments
  - 4. Full facepieces only – excessively worn serrations on the head harness which might permit slippage
- C. Examine the exhalation valve for the following after removing its cover:
  - 1. Foreign material such as detergent residue, dust particles, or human hair under the valve seat
  - 2. Cracks, tears, or distortion in the valve material
  - 3. Improper insertion of the valve body in the facepiece
  - 4. Cracks, breaks, or chips in the valve body, particularly in the sealing surface
  - 5. Missing or defective valve cover
  - 6. Improper installation of the valve in the valve body
- D. Examine the air purifying elements for:
  - 1. Incorrect installation, loose connections, missing or worn gaskets, or cross-threading in holder
  - 2. Cracks or dents in outside case of filter, cartridge, or canister

- E. If the device has a corrugated breathing tube, examine it for:
  - 1. Broken or missing end connectors
  - 2. Missing or loose hose clamps
  - 3. Deterioration (determined by stretching the tube and looking for cracks)
- F. Examine the harness of a front or back mounted gas mask for:
  - 1. Damage or wear to the canister holder which may prevent its being held securely in place
  - 2. Broken harness straps or fastenings

### Supplied Air Respirators

The following shall be checked:

- A. If the device has a tight fitting facepiece, use the procedures outlined above for air purifying respirators.
- B. Examine the air supply for:
  - 1. Integrity and good condition of air supply lines and hoses including attachments and end fittings
  - 2. Correct operation and condition of all regulators, valves, or other air flow regulators

### 2.9.2 Quality Assurance

To prevent the use of faulty or defective respiratory equipment, the following steps will be taken:

#### A. New Equipment

All new equipment will be thoroughly inspected before it is put into service. Only MSHA/NIOSH approved equipment will be used. Parts used for repairs will be purchased only from the manufacturer of the unit being repaired or their agents.

#### B. Cleaning and Repairs

All respiratory devices will be inspected before and after cleaning and before and after repairs are made. The inspection procedures that are to be used are listed above under Section 2.9.1.

Any replacement items that will be used for repairs will be inspected prior to assembly.

C. Periodic Checks of Items in Storage

At least once during each quarter, all of the respirators that are in storage will be checked for serviceability and to make sure that they will be ready for immediate use.

**2.10 Recordkeeping**

Inspections of all respiratory devices will be conducted in accordance with the provisions contained in NRC Reg. Guide 8.15 and section 2.9.1 above, and under no circumstances shall a device that is known to be defective be used.

Freshly cleaned and inspected respirators will be placed in plastic bags and sealed.

The individual who serviced the respirator shall write the date on each bag and initial it to indicate the work has been done properly.

Respirators used for emergency use are inspected, and the inspection recorded, once per month.

**2.11 Limitations on Periods of Respirator Use and Relief from Respirator Use**

As noted above under Section 1.2, the NRC has noted that the use of respiratory protection devices in the workplace can impose physiological and psychological stresses on workers, obstruct their vision, hinder their movements, and make effective communications difficult. In consideration of this, a respirator wearer shall be permitted to leave the work area for any respirator-related cause. Reasons, which may cause a respirator wearer to leave a work area, include, but are not limited to, the following:

1. Failure of the respirator to provide adequate protection.
2. Malfunction of the respirator.
3. Detection of leakage of air contaminant into the respirator.
4. Increased resistance to breathing.
5. Severe discomfort in wearing the respirator.
6. Illness of the wearer including: sensation of dizziness, nausea, weakness, fatigue, breathing difficulty, coughing, sneezing, vomiting, fever, or chills.
7. Claustrophobia, anxiety, or other psychological factors that may affect the wearer.

## **2.12 Monitoring, Including Air Sampling and Bioassays**

### **2.12.1 Evaluation of Respiratory Hazards**

Before a respiratory protective device is used, the work area must be evaluated as to the type of hazards that may be encountered. The type of respiratory protection may be selected only after the hazard has been classified.

Most areas of the mill have been evaluated for hazards during routine work assignments. Signs will be posted in the different areas that will indicate the type of respiratory device to be used under normal conditions.

Equipment needed:

- Oxygen and Combustible Gas Detector
- MSA Model 360 or equivalent
- MSA Samplair Pump Kit (or similar) with the following detector tubes:

- Carbon Dioxide
- Carbon Monoxide
- Sulfur Dioxide
- Ammonia
- Hydrogen Sulfide
- Nitrous Oxide
- Halogen Gases (Chlorine)
- Acid fumes and mists
- Organic vapors

Many environmental designs were incorporated into the mill's construction to keep exposures to most hazards at a minimum. This environmental equipment is checked frequently to ensure that it is functioning properly.

To ensure the reliability of these controls, monthly gross alpha and radon daughters samples will be collected at numerous locations throughout the mill. Routine samples will also be collected in the vanadium precipitation and packaging areas and analyzed for airborne vanadium.

The routine samples have already identified some areas that require respirator use at all times during normal working conditions. These areas are inside the yellowcake dryer and packaging enclosures and the vanadium dryer area and the packaging area. Other areas that may require respirator use may include, but would not be limited to the sample bucking room, and the SAG mill.

Respirators need not be worn routinely during normal working conditions in other areas of the mill. At these locations, usage will be determined by the hazard level or at the employee's request. Occasionally, a condition may exist that the environmental controls

cannot handle. At that time, the appropriate respirator must be used until the workplace atmosphere is returned to normal.

Infrequently, maintenance work will have to be performed in areas that are not normally sampled or areas that may have questionable air quality. Prior to anyone entering one of these areas, the environment must be evaluated to determine what hazards exist.

A Safe Work Permit is issued for all work tasks that are anticipated to present unidentified or unusual hazardous environmental conditions. A Radiation Work Permit is issued for work in unassessed areas or for nonrecurring tasks for which engineering controls are not in place or practical. The safety department will be responsible for the evaluation of the areas before work begins.

When the oxygen concentration is listed as potentially hazardous, a portable detector will be used to determine the exact oxygen-air mixture. NIOSH defines that air which contains less than 19.5% O<sub>2</sub> is an oxygen-deficient atmosphere, and attempting to breathe such air is considered to present a hazard that would be immediately dangerous to life and health. Any area having less than 19.5% O<sub>2</sub> will not be entered until or unless the O<sub>2</sub> concentration returns to and is maintained at a level above 19.5%. If an area is identified as having an oxygen-deficient atmosphere, the oxygen levels must be remedied by engineering controls prior to entry by personnel. The use of a SCBA will only be for emergency escape or emergency response purposes.

Other atmospheric hazards will be identified and quantified by using air sampling equipment, such as the MSA Samplair Pump (or similar device) with detector tubes for the specific contaminant in question. The instructions must be carefully read for every test as each type of detector tube is handled differently.

After exposure to the atmosphere, the tubes will indicate the presence and concentration of the chemical for which that tube is designed. Chemical cartridges are good only in atmospheres in which the chemical concentration is less than the limit set by the manufacturer and the oxygen concentration is equal to or greater than 19.5%. As noted above, the company policy is not to enter an area in which the O<sub>2</sub> level is below 19.5%, but to enter such areas only in emergency situations, such as to retrieve an injured worker, and then with the use of a SCBA.

There are many other hazards that are very obvious but are often overlooked. The following are examples:

- dust concentrations have an adverse affect on breathing and/or the comfort of the individual;
- some substances may cause irritation to the eyes, nose, throat, etc., but may not be chemically toxic.

These and other such conditions should always be considered in evaluating respiratory hazards. If there is any doubt about the conditions within the work area, a respiratory device should be used. Always be conservative.

### 2.11.2 Breathing Zone Air Samples

Breathing zone samples are collected to determine the air contamination concentration an individual may be exposed to during the execution of his job. The respiratory protection factor is used to calculate the individual's exposure during the work task duration. The application of a respiratory protection factor assigned to the particular respiratory device is used to reduce an individual's exposure to an air contaminant concentration as determined by breathing zone sampling. Routine breathing zone samples are collected by the use of a small belt-mounted pump attached to a hose that is, in turn, attached to the person's clothing close to the head (or breathing zone). The sample is collected for a period of time that would be representative of one eight hour workday. They are collected in such a manner that the material collected will be representative of that being inhaled by the individual wearing the sampler.

### 2.11.3 Bioassay Program

Evaluation of the effectiveness of the respiratory protection program will be accomplished by air sampling (described above in 2.12.1) and by the Mill Bioassay Program.

Those employees who are working in areas that require the use of respirators will submit a urine specimen for analysis on a biweekly basis. Employees who use respirators during maintenance may also be required to submit specimens after maintenance ceases. The samples will be collected from individuals who have performed maintenance tasks in atmospheres that are significantly elevated in contaminant concentration or they are working in such an area for an extended period of time.

The specimens will be analyzed for uranium content.

## 3.0 PROCEDURES FOR MEDICAL EVALUATIONS AND AUDITS

### 3.1 Performing and Documenting the Required Medical Evaluation

Medical qualification will be required of each employee that might be using a respirator in their normal work duties. This is necessary to evaluate the individual's limitations to wearing respirator devices. The medical evaluation will be performed by a licensed physician to determine that the individual user is medically fit to use the respiratory protection equipment. Medical evaluation will be performed prior to the initial fitting of a respirator use and either every 12 months thereafter or periodically at a frequency to be determined by the physician.

The medical screening process will include a medical history and will be sufficient (in the opinion of the physician) to identify any person who should not use respiratory devices for medical reasons, or who should be limited to the use of specific types of respirators. The physician will report any medical restrictions the employee has that would limit an individual's ability to use a respirator. Based on the physician's recommendations, any

employee may be subject to additional or more frequent medical evaluation as deemed necessary by the physician.

### **3.2 Maintaining TEDE ALARA and Performing ALARA Evaluations of Respiratory Protection**

As stated in the Policy Statement in 1.0, IUC shall use, to the extent practical, procedures and engineering controls based on sound protection principles to achieve ALARA, and shall limit intakes by means of engineering controls or procedures, along with the use of respirators, consistent with maintaining the TEDE ALARA. When a specific ALARA evaluation is performed to justify the use or nonuse of respirators, the evaluation shall consider the elements detailed in Section 2.1 of Regulatory Guide 8.15.

## **4.0 PROCEDURES FOR RESPIRATOR APPLICATIONS**

### **4.1 Routine Respirator Use**

As noted above under 2.8, the cabinets for routine use respirators will be located in the mill central control room, maintenance shop, and the safety department.

Respirators will not be issued to employees unless they are to be used. Only employees having current authorization to use respirators are to access the storage cabinets and obtain respirators.

When respirators are not being used, they must be stored in the plastic bags in which they were issued. Dirty respirators will be placed in receptacles located in the mill central control room and at the maintenance shop. They will be gathered from these locations for cleaning and repairs.

Donning the respirator must be performed in accordance with the training provided. At least one type of user seal check must be performed immediately prior to exposure to ensure that the respirator is properly seated on the face.

The frequency that a dirty respirator must be exchanged for a clean one will be determined by the amount of time it is used. If the employee's use is greater than four hours per day, the exchange will be made daily. Occasional use will require a weekly exchange. Infrequent use will require monthly exchanges.

### **4.2 Nonroutine Respirator Use**

Nonroutine Respirator Use shall be defined as use of respirators in unassessed areas or for nonrecurring tasks for which engineering controls are not in place of practical.

### **4.3 Emergency Respirator Use**

Emergency Respirator Use shall be used for recovery of an injured person from an area where air concentrations of radioactive material may be high, the breathing quality of the

ambient air has not been assessed, or the area may become immediately dangerous to life or health (IDLH) because of the presence of nonradiological hazards.

Respirators designed for emergency use will be stored in areas that are readily accessible to all employees. Emergency cabinets will be in the central control room, outside the SX on the north wall, on the south end of SX on the fire cabinet, and in the maintenance shop.