APS User Safety Policies and Procedures

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Approvals: approval records in the APS Integrated Content Management System

Changes:
Rev. 1, 30 June 2008:
1) Clarification - Explicitly state in the Environment, Safety and Health Programs section (page 6):
Safety is a line management responsibility at Argonne:

- For XOR, the chain is from the beamline personnel, to the XSD XOR Associate Division Director, and through the XSD Division Director.
- For CATs and CDTs the chain is from the beamline personnel, to the CAT/CDT Director, and through the AES Division Director.

2) Title added to footer.

Revision history records in the APS Integrated Content Management System.

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APS User Safety Policies and Procedures

Introduction

The point of contact for changes to the User Safety section of APS User Policies and Procedures (UP&Ps) is the APS User Safety Officer. Changes can be made in response to suggestions from any stakeholder in user activities. Every user of a User Policy or Procedure is to notify the owner of any errors/corrections and is encouraged to suggest potential improvements.

Modifications to UP&Ps shall be managed according to Managing APS Facility Procedures (AP&P 3.1.05, APS document number APS_1001409). The policy and procedure owners will work with the APS Procedure Administrators to keep UP&P current in the APS Integrated Content Management System (ICMS).

The current revisions of any UP&P will be available through ICMS; anyone using a UP&P should ensure that they are using the current version.

Definitions:

CAT - Collaborative Access Team
Individuals/organizations, with management external to the APS, that have joined together to design, construct, and operate a beamline or beamlines at the APS.

CDT - Collaborative Development Team
Individuals/organizations, with management external to the APS, that have joined together to design and construct a beamline at the APS, in partnership with the APS. In operations, CDT beamlines transition into APS/XOR managed beamlines.

XOR – X-ray Operations and Research
A section of the APS X-ray Science Division that designs, builds, and operates the facility-managed beamlines.

Purpose

APS User Safety Policies and Procedures define planning and work processes, for user-related activities, that help protect the health and safety of workers, the environment, and the public. These processes ensure that safety considerations are an integral part of beamline operations and the execution of beamline-based experimentation.

Scope

These user policies and procedures cover safety requirements relevant to the operation and use of APS beamlines and beamline support facilities (e.g., LOM laboratories and user machine shops).

- Argonne environmental, safety, and health (ESH) standards apply to user operations; these policies and procedures are APS-specific implementation of the Argonne requirements.

- The APS has site-specific ESH processes that cover both non-user and user activities (e.g., facility design reviews, working on radiation shielding safety systems, configuration control work permits, issuance of radiation dosimeters, etc.). The following policies and procedures are those that focus on or are unique to user activities.

- General training requirements, common to all users, are separate from these policies and procedures.

Policies and procedure for the following topics are not included here and are defined elsewhere in other APS Policies and Procedures (AP&P):

- User Administration (AP& P 3.1.101)
- User Training (AP&P 3.1.103)
- Beamline Management and Facilities (AP&P 3.1.104)

Applicability

APS User Safety Policies and Procedures apply to the activities of beamline personnel, experimenters, and other support personnel using CAT/CDT/XOR beamlines and associated facilities (e.g., LOM labs). These apply to users that are not Argonne employees as well as Argonne employees.

Beamline Safety Programs

Environment, Safety and Health Programs

(Formerly AP&P 3.1.07, APS document number APS_1186205)

Policy

This policy applies to each partner user group that has the responsibility of operating a beamline at the APS, including Collaborative Access Teams (CAT), Collaborative Development Teams (CDT) and the APS X-ray Sciences Division's X-ray Operations and Research (XOR) group.

Each of these partner user groups is responsible for providing a safe workplace and for working in an environmentally sound manner. Each group shall manage the risks its activities pose to personnel, the environment, and APS facilities by:

- anticipating, identifying, and evaluating hazards,
- reducing recognized risks to acceptable levels, and
- ensuring activities meet applicable APS/ANL/DOE safety standards.

These activities are collectively referred to as the *beamline safety program* and the document describing these efforts is referred to as the *beamline safety plan*.

Each partner user group operating a beamline shall:

- Shall allocate the resources required to support an effective beamline safety program,
- Document its safety program, providing copies of the safety plan to the APS User Safety Officer,
- Notify the User Safety Officer of changes in the personnel assigned to carry out safety roles defined in the safety plan,
- At least once every twelve months, review the safety assignments and, as appropriate, reassign responsibilities or create new roles, and
- At least once every thirty-six months, review and, as necessary, revise the program and plan to keep them commensurate with the group's activities.

The CAT/CDT/XOR Director shall be assigned the primary responsibility for ensuring that an effective program is in place and for ensuring that the beamline safety plan accurately describes what the group intends to do and how it intends to do it. The APS recognizes the prerogative of the CAT/CDT/XOR Director to delegate the day-to-day management of responsibilities to other individuals and encourages each partner user group to do so, as delegation can help build a safety organization that will be able to more effectively formulate and implement safety policies and procedures.

Safety is a line management responsibility at Argonne:

- For XOR, the chain is from the beamline personnel, to the XSD XOR Associate Division Director, and through the XSD Division Director.
- For CATs and CDTs the chain is from the beamline personnel, to the CAT/CDT Director, and through the AES Division Director

The safety plan shall:

1. Define the key roles that must be carried out to effectively implement the safety program, listing the responsibilities associated with and naming the individual assigned to each role,
2. State that the CAT/CDT/XOR Director assumes line management responsibility for safety.
3. Identify the CAT/CDT/XOR safety representative (the safety representative is the primary point of contact with the APS on safety issues).
4. Indicate that the partner user group shall conduct its activities in a manner that conforms to the environment, safety, and health requirements of Argonne National Laboratory and the Advanced Photon Source. In part, this requires that, except as provided for by variance, the group complies with the policies and procedures made mandatory in the following ANL documents:
   - ANL Environment, Safety & Health Manual,
   - ANL Waste Handling Procedures Manual,
   - ANL Hoisting and Rigging Manual,
   - ANL Hazardous Materials Transportation Safety Manual, and
   - APS User Policies and Procedures relating to environment, safety and health
5. Affirm the partner user group's willingness to cooperate with APS, ANL, and DOE representatives engaged in oversight activities.
6. Acknowledge that the APS has the authority to order a halt to activities that the APS, or other entities with oversight responsibilities, deem unsafe or not in compliance with requirements.
7. State that the partner user group will comply with the APS User Policy and Procedures covering radiation safety shielding configuration control.
8. In the pre-MOU version of the plan, state that the partner user group will accept APS-designed safety interlocks and will allow the APS staff to install these on the beamlines and other experimental facilities as appropriate.
9. Affirm that the partner user group will carry out an experiment safety review program that conforms to the requirements set forth in the APS User Policy and Procedure covering the subject.
10. Commit the partner user group to obtaining review by, and written approval from, the AES Division Director before changing its operations, facilities, equipment, or procedures in a way that might reasonably be thought to increase the risk of significant adverse impact on APS facilities, the environment, or any person.

Beamline Facilities Reviews

(Formerly AP&P 3.1.18, APS document number APS_1180581)

Policy

To enhance the safety of beamline facility operations, each beamline, associated facilities (office areas, control areas, labs, experiment equipment with engineered safety controls, etc.), and experiment safety program will be reviewed for meeting APS/ANL safety standards on a periodic basis. The review will be conducted by the User Safety Officer (USO). The review committee will report its findings to the APS-AES Division Director. A summary of the review will be provided to the APS Deputy ALD for X-ray Science for use with the sector review.

Procedure

1 Introduction – Purpose, Scope, and Applicability

The APS has established this review process to verify that all APS beamline facilities are safe and meet APS/ANL safety standards. This procedure describes the beamline safety program assessment that is conducted on every beamline every three years.

2 Preparation - Prerequisite Actions

The USO chairs the review and appoints a review committee that includes the Critical Components System Manager (CCSM), the User Technical Interface, AES ES&H Coordinator, and others as appropriate to the beamline's program and facilities.

The USO notifies the CAT/CDT/XOR Director of the beamline review, provides guidelines for a 30–45 minute presentation by the beamline management, and requests that they arrange for the presentation and facility inspections.

3 Acceptance Criteria

The review is completed with the acceptance of the report by the APS-AES Division Director.

4 Procedure Action Steps - Performance

4.1 The beamline management provides the 30 – 45 minute summary and status report of the beamline and experiment safety program and notes changes in the beamline since the last design review.

4.2 The committee will verify that a current safety plan is in place and that it is consistent with the current scope of beamline activities.

4.3 The AES or XSD ES&H Coordinator will provide the USO with recent ES&H inspection reports and identify open safety issues.

4.4 The review committee will verify that the APS has safe operations beamline records on file and that they are consistent with the beamline as-built conditions. Typically, records reviewed include:

1. Beamline/sector layout,
2. Synchrotron and bremsstrahlung raytraces,
3. Shielding component designs (e.g., assembly drawings that show component functionality for shutters and stops and critical dimensions),
4. PSS operations records (e.g., User Requirements Document),
5. Shielding designs, and
6. Safe operations envelope (e.g., maximum beam current or minimum gap limits).

4.5 The committee will conduct the inspection of beamline and associated facilities (including LOM labs and other beamline managed areas) and review beamline sector records (safety plans, recent ES&H inspection reports, etc.).

4.6 The USO reports preliminary findings of the review panel to the beamline management for correction, comment, or prompt mitigation of identified problems. The report may include notable safety practices found on the beamline, opportunities for safety enhancements, and findings of deficiencies where the beamline operations have not met APS/ANL safety standards.

4.7 The USO prepares the final review report. The report may reflect remedial work promptly undertaken by the beamline management and brought to the Chair's attention.

4.8 The USO forwards the final report to the AES Division Director and copies the CAT/CDT/XOR Director and the APS Deputy ALD for X-ray Science.

Beamline Accident Investigations

Policy

Purpose

The primary purpose of an incident or accident investigation is to identify the hazard control systems that either failed or were lacking. By determining the direct, contributing, and root causes, CAT/CDT/XOR hopes to identify corrective actions that can help prevent similar occurrences.

Applicability & Scope

This applies to incidents and accidents occurring in CAT/CDT/XOR's facilities at the APS.

Definitions

- Accident: an unexpected event that produces personal injury, illness, or death; damage to or loss of property or vehicles; or environmental releases involving reportable quantities of radiation or hazardous materials.
- Incident: an unexpected occurrence that could result in an accident or illness if repeated—a "near miss."
- First aid: one-time treatment and subsequent observation of minor scratches, cuts, splinters, burns, etc., that do not ordinarily require medical care from a physician. (Such treatment is considered first aid even if it is provided by medical personnel.)
- Occupational illness: an abnormal physical condition or disorder caused by exposure to chemicals, radiation, or any other factors associated with the work environment.
- Reportable accident: any accident whose consequences go beyond the administration of first aid.

Responsibilities

Director

The CAT/CDT/XOR Director shall ensure that the requirements of this guideline are met. The Director shall also review all investigation reports.

First-Line Supervisors

First-line supervisors and Principal Investigators with direct responsibility for the people, equipment, or facility involved in an incident or accident shall ensure that the CAT/CDT/XOR Safety Coordinator and CAT/CDT/XOR Manager are promptly notified and shall perform the initial investigations. Supervisors are also responsible for ensuring that appropriate corrective actions are implemented.

Safety Coordinator

The CAT/CDT/XOR Safety Coordinator or the CAT/CDT/XOR Manager shall:

- Investigate incidents and accidents (unless the CAT/CDT/XOR Director assigns another individual to this role) and support the investigatory efforts of other CAT/CDT/XOR personnel;
- Promptly notify the AES ES&H Coordinator and/or the XSD ES&H Coordinator of any occupational illness or reportable accident; and
- Monitor the progress of corrective actions and advise managers when schedules are not being met.

All CAT/CDT/XOR Personnel

CAT/CDT/XOR personnel shall immediately report all injuries and illnesses through the 911 system either by calling 911 or by having a co-worker call. CAT/CDT/XOR personnel shall also report accidents and incidents to CAT/CDT/XOR line management as described below. CAT/CDT/XOR personnel, including witnesses to an incident/accident, are expected to participate in investigations as required.

Response to Accidents and Incidents

Notification

Any person who witnesses an accident or incident or who comes upon an accident or incident not known to be previously reported shall first call 911 if appropriate and then immediately notify the CAT/CDT/XOR Manager. If he/she is unavailable, notify the APS Floor Coordinator. All phone calls should be made from a safe location.

The CAT/CDT/XOR Safety Coordinator or an alternate shall notify the AES ES&H Coordinator and/or the XSD ES&H Coordinator as soon as is practical after learning of any occupational illness or reportable accident, for further guidance on investigation and reporting requirements.

On-Scene Actions

Upon arriving at the scene of a reportable accident, CAT/CDT/XOR personnel shall report to the Area Emergency Supervisor, if present, and secure the area and all related equipment and

machinery to prevent further incidents and preserve evidence that may be relevant to subsequent investigations. CAT/CDT/XOR should notify either the AES ES&H Coordinator, the XSD ES&H Coordinator, or the APS Floor Coordinator if additional assistance is needed in securing the incident/accident scene.

Investigation of Incidents and First-aid Accidents

The CAT/CDT/XOR Safety Coordinator (or alternate appointed by the CAT/CDT/XOR Director) will lead investigations of incidents and first-aid accidents. Reports shall be submitted to the CAT/CDT/XOR Director for review and concurrence. Personal accounts of an incident using the ESH-239 Form shall be submitted to APS-ESH immediately. The APS ES&H Coordinators will help conduct the investigation. Submission of required documents to ANL must occur within seven (7) days of the incident.

Investigation of occupational Illnesses and Reportable Accidents

The CAT/CDT/XOR Safety Coordinator will seek guidance from the AES ES&H Coordinator and/or the XSD ES&H Coordinator upon learning of any occurrence in these categories.

References

- The Code of Federal Regulations, Title 29, Part 1904
- Chapter 1-7 of the *ANL ESH Manual*

Response to Actions That Are Inconsistent with Beamline Safety Plans

Each CAT/CDT/XOR has the responsibility for managing the general safety of its operations in a manner that is consistent with its beamline safety plan. If the APS, or any other duly appointed entity (such as ANL-ESH, DOE, or a CAT Safety Oversight Committee) with APS safety oversight responsibilities, determines that a CAT activity is not consistent with applicable safety requirements, the APS will review the activity in question and determine an appropriate corrective action.

In particular, if a beamline safety system control, either administrative (e.g., a component that is under configuration control) or engineered (e.g., an interlock that is part of the APS Personnel Safety System), is found to have been circumvented, the person making the observation will immediately notify an APS Floor Coordinator and the CAT/CDT/XOR Director or beamline Safety Coordinator. The Floor Coordinator will take the affected beamline off-line immediately. The CAT/CDT/XOR and the APS will then review the circumstances of the violation and determine an appropriate response, commensurate with the severity and potential consequences of the violation. The review process will include discussion with the responsible organization or individuals about ways to prevent a recurrence.

Experiment Reviews

APS Beamline Experiment Safety Reviews

(Formerly AP&P 3.1.25, Revision: 2, supersedes Rev 1 (1 Sep 2006), APS document number APS_1187022)

Policy

Applicability

This section (APS Beamline Experiment Safety Reviews) applies only to beamline- and LOM-related user research activities at the APS.

Summary

Using the APS web-based system, researchers are required to define the scope of all of their experimental activities at the APS and to prepare an Experiment Safety Assessment Form (ESAF) and submit an Experiment Hazard Control Plan (EHCP).

The APS and the Beamline Management will authorize an experiment to be conducted only after the activities associated with the experiment have been defined, hazards have been identified, and adequate hazard controls have been implemented. For the purposes of this Policy and Procedure, the organization responsible for the day-to-day operations of a beamline is referred to as the *Beamline Management*.

No experimental activities may be started at the APS without: 1) approval of the EHCP by the beamline management, 2) approval of the EHCP by the APS, and 3) the verification of safeguards/training as specified in the EHCP and on the Experiment Authorization (EA) form. The approval of the experiment and the EHCP is valid until the listed end date given in the ESAF. Resubmission of the ESAF is required if the experiment is to be conducted after this time limit has elapsed. At the beginning beamline experiments an EA form must be posted at the beamline end cabinet and an EHCP must be posted at the experiment station. At the beginning of LOM laboratory only (or other non-x-ray experiments) the EHCP and EA forms must be posted in the work area. The EA and EHCP are generated automatically from the ESAF system.

The Beamline Management and the APS will be working together as partners in the review process to ensure that a safe working environment is maintained at the APS.

Responsibilities

Researchers wishing to conduct experiments at the APS are responsible for:

- Preparing an EHCP by completing an electronic ESAF on the APS web pages that:
    - Defines the scope of the experiment, disclosing all materials (samples, reagents, equipment, etc.), facilities, and processes that will be used at the APS
    - Identifies hazards associated with their activities
    - Defines the safeguards consistent with ANL/APS standards [1]
    - Lists the experimenters that will be working at the APS
    - Lists the start and end date of the experiment
- Submitting the ESAF and the EHCP to the APS far enough in advance of the experiment so that the APS can verify that the proposed controls are adequate and consistent with applicable requirements
- Identifying a member of the experiment team as an on-site spokesperson (OS) who will sign the Experiment Authorization form upon confirming the accuracy and completeness of the EHCP and that all safeguards are in place
- Completing all required training prior to the beginning of the experiment work
- Working within the scope of and in conformance with the EHCP
- Sharing opportunities for improvement on the experiment safety process with the APS and beamline personnel

Beamline Management is responsible for:

- Assisting experimenters in identification of safeguards consistent with the safe operation of beamline facilities
- Reviewing EHCPs in a timely manner
- Identifying to the APS plans that are beyond the beamline management's expertise to evaluate and for which APS/ANL support is sought
- Approving EHCPs only after determining that they appear to:
    - Identify all significant risks to personnel and the environment
    - Define a hazard control strategy capable of reducing risks to acceptable levels
    - Include adequate hazard control verification requirements

- Designating individuals who can approve EHCPs
- Verifying safeguards and all required training are in place and endorsing the EA

APS/AES is responsible for:

- Administrating the APS beamline experiment safety review program; the APS Engineering Support Division (AES) Division Director has line responsibility for the program
- Maintaining web-based systems for entering ESAFs, experiment safety reviews and for the preparation of EHCPs
- Assisting experimenters in identification of safeguards and training required by ANL or APS policy
- Appointing an APS Beamline Experiment Safety Review Board (ESRB) whose members, or designees, review and approve EHCPs (appointments are made by the AES Division Director)
- Approving EHCPs only after determining that they appear to:
    - Adequately describe the experiment
    - Identify all significant risks to personnel and the environment
    - Define a hazard control strategy satisfying ANL requirements and capable of reducing risks to acceptable levels
- Reviewing EHCPs in a timely manner
- Including adequate hazard control verification requirements
- Verifying and documenting the implementation of hazard controls where required
- Posting authorization forms and EHCPs

Procedure

1. Using the APS web-based Experiment Safety review system, a spokesperson for the research group submits information to the Beamline and the APS characterizing the experiment by completing an ESAF. Submission of this information must meet the lead-time requirements defined on the APS Experiment Safety web page. Experiments that present minimal hazards common to all beamlines should be submitted at least 7 days prior to the scheduled start of the experiment. Additional time is required for higher levels of risk and for safety protocols new to the APS. If circumstances do not allow for the full 7 days for review, the APS will consider the request for expedited review on a

case-by-case basis.

[Steps 2 and 3 can take place in any order, but both steps must be completed before an experiment is authorized.]

2. The Beamline Management (for the beamline where the experiment is to be performed) reviews the submitted EHCP for consistency with anticipated hazards associated with the experiment and consistency with beamline facilities safeguards. If acceptable, the designated representative of the beamline management approves the plan using the APS web-based experiment safety review system. Typically the beamline management will screen the plan before the APS review.

3. The APS Experiment Safety Review Board reviews the EHCP for consistency with expectations and ANL/APS standards. If acceptable, a member of the board, or designee, approves the plan using the APS web-based experiment safety review system.

4. The APS advises the submitter:

    - That the EHCP has been approved by both the Beamline and the APS, and that the experiment may run after required training is completed and specified hazard controls have been verified to be in place, or
    - What safety concerns need to be addressed and that the plan needs to be revised and resubmitted, or
    - If the proposed experiment falls outside the scope of activity the APS can safely accommodate.

    [Note: the approval is valid until the end date of the experiment as listed in the ESAF. An experiment that is to be conducted after the listed end date must be resubmitted for review and approval.]

5. The experiment OS and other personnel designated in the EHCP:

    - Verify that the EHCP accurately identifies materials, equipment, activities and users that are part of the experiment and
    - Endorses the EA form

    The beamline management and other personnel designated in the EHCP:
    - Verify that the EHCP has been reviewed and approved,
    - Verify that the specified controls, training, and safeguards are in place, and
    - Endorses the EA form

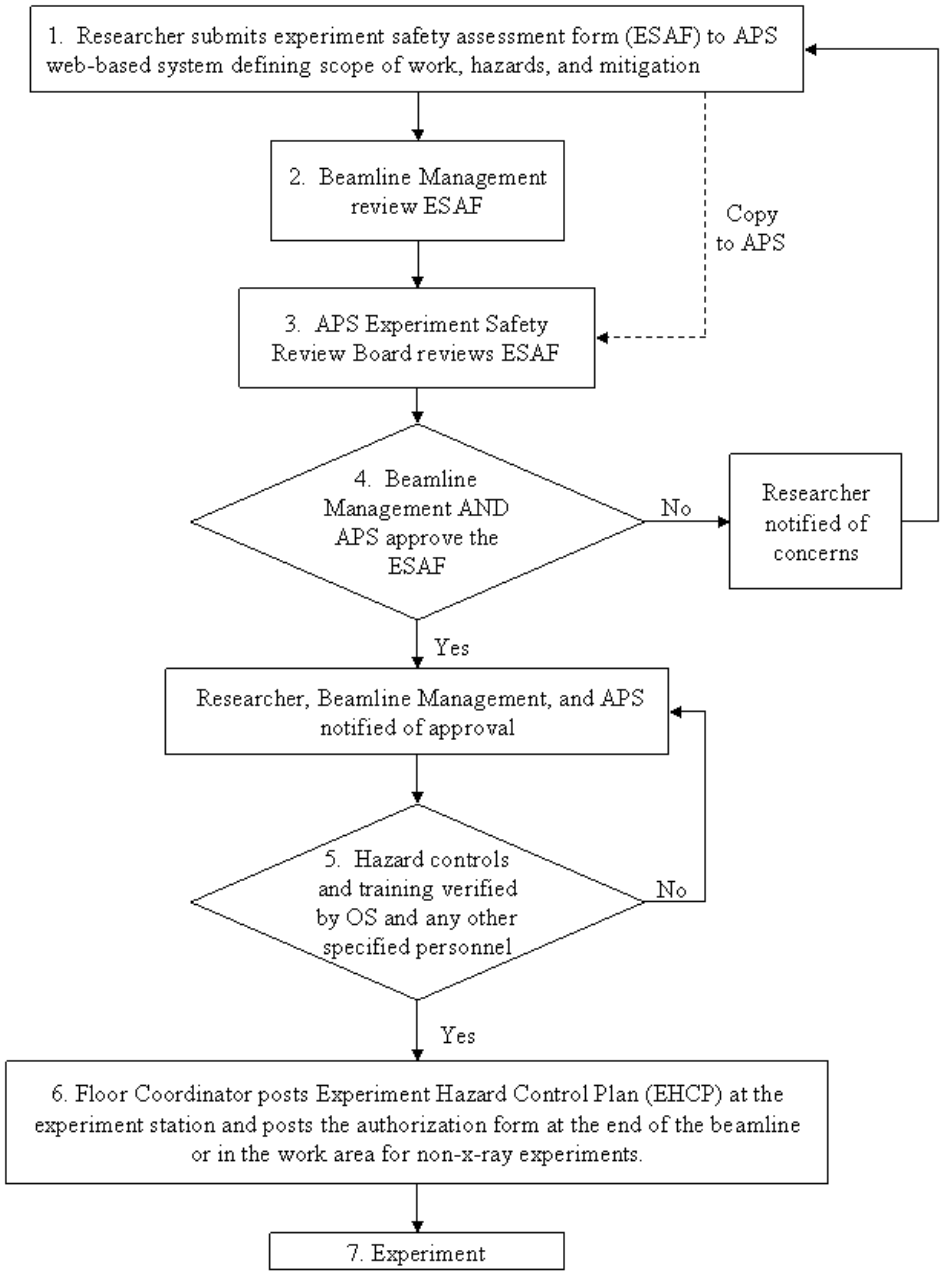
    The verification and endorsement are required before the activity that triggered the requirement can begin. If a non-hazardous sample that is consistent with the originally

defined scope of the ESAF is added to the experiment, no additional approval by the APS is needed. Addition of hazardous materials or equipment beyond the original scope of the ESAF will require approval by the APS before the experiment may begin.

6. An APS Floor Coordinator posts the endorsed experiment authorization form in the display cabinet on the main aisle at the end of the beamline and a copy of the EHCP at the experiment station or in the laboratory (for non-x-ray experiments).

7. The experimenters conduct the experiment.

APS Beamline Experiment Safety Review Process



[1] ANL-E *Environment, Safety and Health Manual* and *APS User Policies and Procedures*

Identification of User Experiment Samples

Policy

As part of the experiment safety review process, users are required to identify materials brought to the APS and the hazards associated with the materials.

All materials to be used as part of experiments at the APS shall be identified using proper scientific nomenclature. Generic names, abbreviations, and acronyms should be included to clarify the nature of the material. Names that hide or obscure the nature of the material shall not be used.

Example 1:
Sample is the liquid crystal n-hexyl-4n'-n'pentyloxybiphenyl-4-carboxylate

Not acceptable: Sample A
Not acceptable: liquid crystal sample
Not acceptable: 65OBC

Acceptable:
liquid crystal n-hexyl-4n'-n'pentyloxybiphenyl-4-carboxylate (65OBC)

Example 2:

Not acceptable: protein B

Acceptable: parainfluenza virus 5 F protein in its metastable, profusion Conformation

Example 3:

Not acceptable: Sample 121
Not acceptable: SARS

Acceptable: main protease from the coronavirus that causes Severe Acute Respiratory Syndrome (SARS)

Confidential Materials

The APS understands that in some cases users seek to keep the identity of the samples/materials nonpublic. As part of the APS experiment safety review system, the users seeking sample confidentiality can, on a sample-by-sample basis, check the

material as confidential on the Experiment Safety Assessment Form (ESAF) and the specific names of the materials will not be listed on publicly posted Experiment Authorization Form (EA) and Experiment Hazard Control Plan (EHCP). Only the ESAF reviewers and the experimenters listed on the ESAF will be able to view the names of the materials.

Nonproprietary Experiments

For nonproprietary experiments, the sample identification shall be entered into the ESAF.

Proprietary Experiments

For proprietary experiments (declared proprietary and user pays the APS for the beam time) the experimenter has two options:

1. Enter the sample identification into the ESAF (the confidentiality tools described above may be used) or

2. If the experimenter seeks to not name the materials in the ESAF, the sample identification information may be provided to the beamline management in a sealed envelope. This information must be available at the beamline while the samples are at the APS. In all circumstances the hazards associated with the material must be entered into the ESAF and an appropriate EHCP shall be developed. To fulfill its oversight responsibilities and ensure that materials and hazards have been properly identified and mitigated, the APS reserves the right to verify the information. The verification is intended only for the validation of the safety review process.

Conducting Radioactive Sample Experiments in APS Experiment Enclosures

(Formerly AP&P 3.1.26 APS document number APS_1187383)

Policy

This policy reflects the basic ANL philosophy that in non-controlled areas, such as the APS experimental floor, there should be no release of radioactivity. Any significant release would pose a health hazard to APS users and a risk to APS operations. The policy described below is meant to prevent radioactive releases and to limit the consequences of a potential release.

There exists a very comprehensive protocol for all experiments at the Advanced Photon Source (APS). The required procedures are spelled out in the APS Experiment Hazard Classes (APS ESAF Experiment Hazard Class 8.1). The following guidelines supplement the above technical documents. Investigators are advised to become familiar with these documents and the relevant sections of the Argonne Environment, Safety & Health (ESH) Manual. In this section all references to "samples" mean "radioactive samples".

All proposed experiments involving radioactive samples will be reviewed by the APS Radioactive Sample Safety Review Committee (RSSRC). The review will be on a graded basis. Hence, the experimenters are strongly advised to send in the experiment proposal in detail at least two months before the expected scheduled date of the experiment. Previously approved containment, isotopes, and weights can be submitted as late as two weeks in advance.

The following guidelines are to be followed for all experiments with radioactive materials at all the experimental hutches at APS. Although spelled out as guidelines, these are minimum requirements to be adhered to by all the experimenters. All solid samples must have at least one acceptable containment enclosure. In general, no credit shall be allowed for a sample holder as containment. This will be determined by the RSSRC after a review of the proposed experiment. Gaseous radioactive samples are prohibited. Powder and liquid radioactive samples will be allowed provided they have a minimum of two containment enclosures. If multiple samples are each individually contained within separate primary barriers, they can have a common secondary and tertiary barrier. In the case of multiple samples inside a primary containment, the sample masses for each isotope must be summed to give the total mass for each isotope within the primary. Fragile materials used as containment must be approved by the RSSRC. Upon request the experimenter must provide a physical example of the containment proposed and be available to meet with the RSSRC.

The investigator proposing to do experiments with radioactive materials at an experimental hutch must provide the following in addition to other items specified in the APS ESAF Experiment Hazard Class 8.1:

- sample matrix, weight, and dimensions

- detailed description of the sample containment
- weight of **each** radioactive isotope in the sample
- data on integrity of the sample, the sample holder, and containment under expected experiment conditions (e.g., heating, cooling, pressure, etc.)
- special training requirements, in reference to handling, accountability, transport, etc., of the samples
- exposure readings from the sample at contact and at 30 cm, with a description of the instruments used to take these readings

Work with radioactive materials involves some risk. If the material is "dispersible" the risk is certainly higher. To evaluate the maximum amount of activity of a given radioactive material that can be safely used in an experiment in a hutch, one must address the maximum risk one is willing to accept in the case of a leak or breach in a containment system. Then one must address the degree of containment necessary for that acceptable maximum risk.

For the purpose of establishing risk-based containment requirements, it is the policy of ARGONNE that the maximum a person should inhale from a breach or leak in sample containment should not exceed 2% of the annual limit of intake (ALI) for a given dispersible radionuclide. This would result in a committed effective dose equivalent of 100 mrem. Hence, the containment goal must be such that the dose commitment from a person's annual intake will always be less than 100 mrem. This is 2% of 5 rem, the US- DOE whole body stochastic limit for annual total effective dose equivalent (10CFR835). In cases of potential inhalation of multiple radionuclides, the total committed effective dose equivalent from all inhaled radionuclides should not exceed 100 mrem.

A Derived Air Concentration (DAC) is defined as that concentration of radionuclide in air which, if breathed by a Reference Man for a work-year (2000 hrs), would result in the intake of one Annual Limit of Intake (ALI). That is, the concentration of a radionuclide in air is limited by

$$\int C(t)Bdt \le ALI$$

where C(t) is the concentration of the radionuclide in air per hour at time *t*, *B* is the volume of the air breathed by worker per unit time, and the integration is carried out over a 2000 hour work-year.

In the case of a constant air concentration, the DAC is related to the ALI through

DAC (μCi/cc) = ALI (μCi)/2.4E09(cc)

based on a normal breathing rate B of 2.0E+04 cc per minute. There are no derived guides for instantaneous or short-term values of C(t).

For a given time *t* that a worker in a hutch could be exposed to a dispersed radionuclide resulting from a leaking or breached containment, one can use the ANL policy to calculate the

maximum allowed sample activity q_i of a given i^{th}. The rate of change of concentration in a hutch can be written as

$$\frac{dC}{dt} + C(\lambda_r + \lambda_v) = \frac{f_a}{V}\left(\frac{f_r}{2000}\right)q_i$$

- C is the concentration [μCi/(cc·h)] in air as a function of time,
- V is the volume of the hutch (cc),
- λ_r is the radioactive decay constant (1/h)
- λ_v is the effective air exchanges (1/h),
- q_i is the activity of the i^{th} radionuclide ((μCi),
- f_a is the fraction of material that could potentially become air borne, and
- f_r is the fraction of material that could escape a containment system in 2000 hours.

Solving the differential equation with initial conditions C=0 at t=0, one would obtain for the concentration in air C(t)

$$C(t) = \frac{f_a}{V}\left(\frac{f_r}{2000}\right)\frac{q_i}{\lambda_r + \lambda_v}\left[1 - e^{-(\lambda_r + \lambda_v)t}\right] .$$

The time-averaged concentration is given by

$$\overline{C(t)} = C_0\left[1 - \frac{1 - e^{-(\lambda_r + \lambda_v)t}}{(\lambda_r + \lambda_v)t}\right]$$

where

$$C_0 = \left(\frac{f_a}{V}\right)\left(\frac{f_v}{2000}\right)\frac{q_i}{(\lambda_r + \lambda_v)} .$$

Now, if we set

$$\overline{C(t)} = C_0\left[1 - \frac{1 - e^{-(\lambda_r + \lambda_v)t}}{(\lambda_r + \lambda_v)t}\right] = 0.2$$

for a time t that a worker in a hutch could be exposed to a dispersed radionuclide, then one can determine the maximum allowed quantity $(q_{max})_i$

$$(q_{\max})_i = \frac{0.02(DAC)V(2000)(\lambda_r + \lambda_v)}{f_a f_v \left[1 - \frac{1 - \exp\{-(\lambda_r + \lambda_v)t\}}{(\lambda_r + \lambda_v)t}\right]} \quad ,$$

where

q is the maximum allowable activity of the solid radioactive material (μCi)
V is the volume of the experiment enclosure (cc)
λ_r is the radioactive decay constant (1/h)
λ_v is the "effective "air exchanges in the enclosure (1/h)
f_a is the fraction of the material that could escape a properly operating containment system
f_r is the fraction of the material that could potentially become airborne
DAC is the Derived Air Concentration of the radioactive material in μCi/cc.
2000 is the number of hours in a work-year.

The basis and assumptions are given in detail in section 5.18 of the Argonne ES&H manual, in Veluri et al (2001), and in addition in an unpublished technical basis document in Veluri (1992).

Some simplifications to the above equation can be made without any loss of generality. For radioactive materials with $\lambda_r << \lambda_v$, the average air concentration is controlled by the effective number of air exchanges per hour. This effective number of air exchanges is obtained by multiplying the number of nominal air exchanges with a correction factor called the "mixing factor." (Constance, 1972). It should be understood that perfect mixing of air even in small enclosures is usually unattainable. The mixing factor could vary from 0.33 to 0.1 depending on the size of the enclosure. Customarily, for small enclosures 0.33 is used and for large enclosures like the hutches, 0.1 is used. At the APS hutches, it is assumed that one nominal air exchange takes place every two hours. With the most conservative mixing factor of 0.1, the effective number of air exchanges computes to 0.05 (1/h).

Similarly the product $f_a f_r$ can be simplified as F, the assumed total release fraction. The literature is replete with a number of empirical release fractions for different physical forms of radionuclides. (Brodsky, 1989, 10 CFR 30.72, 1991, NUREG- 1400, 1991). Conservative release fractions are used for experiments at APS, reflecting the need to use a sample activity as small as possible to reduce the potential dose to as low as reasonably achievable in case of leakage or breach.

At APS, 0.001 is typically used as the release fraction for solids, 0.01 for powders and 0.01 for liquids. If better release fractions are provided with some technical basis to back up, APS would be willing to use those release fractions.

In Table 1, the maximum allowed sample activity $(q_{max})_i$ calculated from Eqn(1) for a solid sample of selected radionuclides is provided.

In the case of multiple radioisotopes, the q_i for each radioisotope must obey

$$\sum_i q_i / (q_{\max})_i \leq 1.0,$$

which ensures that the committed effective dose does not exceed 100 mrem.

Nuclide Activity	Specific Solid Sample Activity * (Ci/g)	Derived Air Concentration (μCi/cc)	Maximum Allowed Solid Sample Activity (μCi)	Maximum Allowed Solid Sample Weight (g)
Th-229	2.12E-01	4.0E-13	3	1.415E-05
Th-230	2.05E-02	3.0E-12	24	1.17E-03
Th-232	1.09E-07	5.0E-13	4	3.67E+01
U-235	2.15E-06	2.0E-11	163	7.58E+01
U-238	3.35E-07	2.0E-11	163	4.87E+02
Nat-U	6.85E-07	2.0E-11	163	2.38E+02
Dep-U	3.35E-07	2.0E-11	163	4.87E+02
Np-237	6.99E-04	2.0E-12	16	2.29E-02
Pu-238	17.0	3.0E-12	24	1.41E-06
Pu-239	6.19E-02	3.0E-12	24	3.88E-04
Pu-240	2.27E-01	3.0E-12	24	1.06E-04
Pu-242	3.91E-03	3.0E-12	24	6.14E-03
Am-241	3.42	3.0E-12	24	7.02E-06
Am-243	0.198	3.0E-12	24	1.21E-04
Cm-248	4.23E-03	7.0E-13	6	1.42E-03
Cf-248	1.58E03	3.0E-11	244	1.5E-07
Cf-252	5.35E02	8.0E-12	65	1.22E-07
Bk-249	1.63E03	7.0E-10	5691	3.49E-06
Es- 253	2.51E04	6.0E-10	4878	1.9E-07
Sr-90	13.7	8.0E-09	6.5E04	4.74E-03
Tc-99	1.69E-02	3.0E-07	2.4E06	1.42E+02
Tc-99m	5.24E06	6.0E-05	8.13E07	1.55E-05

Table 1: Maximum Allowed Solid Sample Activity of Selected Radionuclides

*The Maximum Allowed Activity is evaluated for one hour duration of stay in the hutch, i.e., t=1hr, with an assumed volume of 1.0E08 cc, with an assumed effective number of air exchanges, λ_v =0.05 (1/h), and the total release fraction F=0.001. The total release fraction could be modified on a case by case basis depending on the sample matrix, the nature of the x-ray beam, (unfocused or focused), the proven integrity of the sample

holder design and any additional containment provided to the sample. For powder and liquid samples, the maximum allowed activity is reduced by a factor of 10.

References

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LOM Machine Shops

User Shop Access

(Formerly AP&P 3.1.13 APS document number APS_131331)

Policy

To reduce the risk of personal injury, adverse environmental impact, and damage to equipment, the APS has established controls for the use of the machine shops located in the APS Lab Office Modules (LOM) and user managed spaces. For the purposes of this section on user shop access the following definitions are used:

- **User Shop**: Any location where machine tools are available to CAT/CDT/XOR/User personnel including the shared, central pentagon LOM shops and CAT/CDT/XOR managed areas.
- **Shop User**: Any person who uses machine tools in a user shop.
- **Machine Tools**: Stationary, as opposed to hand-held, material forming tools.
- **Shop Coordinator**: Appointed by CAT/CDT/XOR management to represent/oversee its interest in user shop operations
- **Machine Shop Certifier**: A person knowledgeable of machine tool operation/training and appointed by the APS, to determine, via hands-on demonstration and/or written tests, if a shop user candidate has sufficient experience and skills to use the machine(s) in a proper, safe manner.

No one is allowed to use a User Shop until they have been authorized to do so according to the requirements of this policy.

There are a number of options at the APS for users to obtain machining services: a full line of machining services are available to APS Users through the ANL machine shops, the APS may be able to provide some limited machining support, and a CAT/CDT/XOR personnel may also be able to provide support.

This sections defines the APS site-specific program that is consistent ANL standards for machine shop safety, as defined in the ANL *ES&H Manual*.

Authorization to use machine shop tools will be on a tool-by-tool and shop-by shop basis.

Responsibilities

Shop Users

Shop users shall:

- Obtain the required certification and authorization before using machine tools in any user shop.
- Inspect machine tools before each use of the tool to verify that the tool has the required guarding and is operating properly.
- Inspect any hand tools and portable power tools used in a User Shop before each use to check that the condition of the tool is safe for use.
- Promptly report any unsafe condition to a Floor Coordinator.
- Not use any defective tools. Machine tools having deficiencies will be locked out and will not be returned to service until the problems have been corrected.
- Inform the Shop Coordinator, in advance, of the desire to machine toxic or hazardous material and shall not proceed until a review has been completed and authorization has been granted by the AES ES&H Coordinator.
- Shall clean up after each use of the User Shop.

Shop Coordinator

Shop Coordinators shall:

- Provide User Shop Orientation (refer to Appendix A).
- Maintain a User Shop Access List (refer to Appendix A) for the user shops they manage or share in the management of. The list will include: 1) the names of authorized users who have received the User Shop Orientation and have completed the machine-specific skills assessments and 2) the specific tools that each person has been authorized to use.
- Post User Shop Access List at the entrance to and in the user shop.
- Notify a Floor Coordinator of updates to User Shop Access List.
- Ensure that all machine tools are in a lockable area or have administrative controls to limit shop use to only authorized users.
- Conduct and record the results of monthly machine shop inspections (the LOM Shop Monthly Inspection Record or similar checklist shall be maintained, refer to Appendix A).
- Notify a Floor Coordinator in the planning stage of proposals to install machine tools (and other equipment and furnishings) in a user shop. (No equipment may be installed without an APS/ANL review and approval of equipment.)
- Inspect tools prior to their use at the CAT/CDT/XOR facilities.
- Remove any defective machine tools from service until the problems are corrected.
- If lead machining is allowed in the user shop, manage lead certification per APS/ANL procedures.

- Inform Floor Coordinator of requests to machine toxic materials in their user shop and participate in safety review.
- Assist users in clean-up procedures.

Floor Coordinator

Floor Coordinators Shall:

- Arrange for certification examinations to be administered by the Machine Shop Certifier.
- Forward notice of changes in authorized access to the APS User Administration Office if the shop access is to a shop controlled with APS-managed card readers.
- Update APS/ANL shop training records.
- When notified of an unsafe condition, ensure that the equipment is safely secured, ensure that the Shop Coordinator is notified, and arrange for a safety review.
- Coordinate lockout/tagout procedures for User Shops.
- Provide temporary badges to authorized users, as needed, to access the machine shop during off hours and weekends/holidays.
- Arrange safety reviews for machining hazardous materials.
- Perform safety checks for CAT/CDT/XOR personnel working after hours or during weekends/holidays.
- Arrange for APS/ANL review and approval of equipment that a CAT/CDT/XOR seeks to place in a User Shop.
- Coordinate installation of machine tools (and other equipment and furnishings) in a User Shop.
- Arrange for an inspection, by the AES ES&H Coordinator (or his designee), of each new machine to be added to the shop.
- Arrange for inspections of machinery to verify conformance with applicable standards.
- Ensure that APS-provided equipment meets ANL standards.
- Perform a general shop walk through as part of their monthly Life Safety Inspection.
- Arrange for maintenance on APS-provided machine tools and assist in installation, dressing, or replacement of grinding wheels.
- Assist in clean-up procedures in case of leak or spill.

CAT/CDT/XOR Director

The CAT/CDT/XOR Director shall

- Assign a Shop Coordinator and ensure that the Shop Coordinator listed in the APS Beamline HR Database is kept up to date.

Machine Shop Certifier

The Machine Shop Certifier Shall:

- Administer and evaluate hands on and/or written tests to assess if a candidate has the ability to use specific machine tools in a proper, safe manner.
- Document the assessment of candidates providing the records to a Floor Coordinator.

AES Division Director

The AES DD Shall:

- Have line management responsibility for the implementation of this policy including the designation of a Machine Shop Certifier.

Authorization of Personnel

Earning Authorization

Anyone wishing to use a user shop should have the appropriate training and experience for the tools they are seeking to use prior to requesting the access. Individuals who lack the appropriate skills and authorization will need to have their machining done for them by others.

To obtain the authorization to use specific machine tools in the user shop, the candidate must receive a Shop Coordinator-provided general orientation to the user shop and must pass machine-specific examination(s) to demonstrate that the candidate can use the specified machine tools properly and safely. The examinations are administered by the Machine Shop Certifier (or designee) and can be arranged through the Floor Coordinators.

A person who has completed only the general orientation is allowed only access to the shop for the use of clamping devices and hand tools only.

A person is considered an authorized user if they have:

- completed the general orientation,
- been certified by the Machine Shop Certifier (or designee) that they can properly use specified machine tools properly, **and**
- had their name added to the shop-specific, machine-specific User Shop Access List by the Shop Coordinator, **and** this list has been posted on the outside entryway and inside the User Shop.

If the candidate does not pass the machine specific test(s), the Shop Coordinator can refer the candidate to training classes or the APS may help to locate training classes in the vicinity of Argonne.

Shop Access

The user's APS badge will allow the authorized user access to the LOM shop. When a person is added to the User Shop Access List, the APS User Administration Office will update the database that controls the LOM card readers.

Access to other User Shop areas controlled by the CAT/CDT/XOR will be managed by the appropriate Shop Coordinator.

Loss of Authorization

User Shop Orientation and User Shop Authorized Operator Certification expire after two years.

Any APS Floor Coordinator, CAT/CDT/XOR Director, CAT/CDT/XOR Safety Officer, or Shop Coordinator of the sectors assigned to a particular user shop may suspend or revoke for cause a person's authorization to use that User Shop or the machine tools located therein. Defeating or circumventing installed guarding is, by itself, sufficient cause for revocation of a person's authorization to use a user shop. Other causes for revocation include, but are not limited to, failing to use appropriate personal protective equipment, using unsafe shop practices, continuing to use tools improperly after being shown the proper usage, failing to clean up work area before leaving the shop, failing to use proper machine-shop etiquette, and allowing an unauthorized person access to the machine tools in the user shop.

If a person's authorization to use a user shop is revoked, a Floor Coordinator will assure that the person's name is removed from all Uuser shop Access Lists at APS. Persons who continue to use a user shops after losing their User Shop Authorization Certification may lose their access privileges to the APS.

User Shop Rules

- The User Shop Rules will be posted on the wall in the user shop.
- Authorized Operators must adhere to the principles of the User Shop Rules to maintain authorization to use the user shop.
- The User Shop Orientation contains a copy of the User Shop Rules.

Procedure

1 Introduction

1.1 Purpose

To reduce the risk of personal injury, adverse environmental impact, and damage to equipment, the APS has established controls for the use of the machine shops located in the Lab Office Modules (LOM) and user-managed spaces.

1.2 Scope

This procedure defines the process by which a person seeking to use user shop machine tools can become certified (i.e., confirmed that they have the knowledge and skills to safely operate the tool) and authorized to use the tools.

1.3 Applicability

This procedure shall be followed by any person, CAT/CDT member, General User, XOR member, or other person acting as an agent of the user, seeking to use a user shop.

2 Hazardous Conditions - Precautions and Limitations

Failure to meet the requirements set forth in this policy and procedure may result in injury to personnel, damage to the environment, and/or damage to equipment.

3 Preparation - Prerequisite Actions

Persons wishing to use a user shop should already have the appropriate skills before coming to the CAT/CDT/XOR facilities. (Individuals who lack the appropriate shop skills will need to have their machining done for them by others.) The CAT/CDT/XOR Shop Coordinator will provide experienced machine tool operators with a general orientation to the user shop and a copy of the general APS machine shop rules. Completion of the shop orientation enables access to the shop for the use of clamping devices and hand tools only. To gain certification to use a particular machine tool, the testing by the Machine Shop Certifier must be arranged through a Floor Coordinator, and access to the machine tool must be arranged in advance.

4 Acceptance Criteria

Authorization requires:

- Certification by APS assigned tester, the Machine Shop Certifier and
- Authorization by CAT/CDT/XOR Shop Coordinator.

5 Procedure Action Steps - Performance

Certification Procedure

1. The candidate contacts the area Shop Coordinator to request authorization to use the shop and specific machine tools.

2. The Shop Coordinator conducts an interview to assess the candidate's need for shop access and for the use of specific machine tools.

3. If the Shop Coordinator decides that the candidate needs access to the shop, the shop Coordinator gives to the candidate the package "User Shop Orientation." The candidate reads the package and fills out the top section of the "User Shop Authorization Certification Form" (certification form).

4. The Shop Coordinator provides the candidate with an orientation to the machine shop and notes the date on the certification form.

5. For User Shop access only, no machine tool use, after completing shop orientation, the Shop Coordinator may add the candidate to the list of authorized users.

6. If the Shop Coordinator decides that the candidate needs access to specific machine tools, the Shop Coordinator indicates, on the certification form, on which machines the candidate seeks to be certified.

7. The Shop Coordinator signs and dates the certification form.

8. If machine-specific certification is required, the candidate takes the certification form to the Floor Coordinator.

9. The Floor coordinator will arrange for examinations to be administered by the Machine Shop Certifier.

10. The Machine Shop Certifier administers the test for each machine specified by the Shop Coordinator and writes down the result (passed/not passed) and the date of the test.

11. The Machine Shop Certifier signs and dates the certification form

12. The candidate takes the certification form to the Shop Coordinator.

13. The Shop Coordinator adds the candidate's name to the User Shop Access List for those machine tools for which the candidate passed the certification test and updates the User Access List in the Beamline HR Administration database.

14. The Shop Coordinator posts the updated User Shop Access List on the shop entry and in the shop.

15. The Shop Coordinator files the certification form and forwards a copy to the local Floor Coordinator.

16. The Floor Coordinator updates the user training records

17. If the authorized user has been granted access to a User Shop with an APS-managed card reader, the Floor Coordinator notifies the User Administration Office, and the User Office updates the card reader database to activate the User APS badge for the specific shop.

6 Closeout - Post Performance Activity

Daily Inspections
As appropriate to individual machines, the Shop Coordinator will ensure that a description of the guarding is attached to or posted near each machine tool. Before each use of the machine, the shop user will ensure that the guarding is in place.

Monthly Inspections
The Shop Coordinator will conduct monthly machine shop and machine tool inspections, using the LOM Shop Monthly Inspection Checklist, which incorporates machine guarding criteria.

Deficiencies
The Floor Coordinator will assist in lockout/tagout for deficient machines. Machine tools having deficiencies will not return to service until the problems have been corrected.

7 References – Source Requirements

Argonne Environment, Safety, and Health Manual

8 Appendixes

Appendix A

The orientation and record forms listed below are available through:

- the APS Facility/Safety and Training Web page
  URL: http://www.aps.anl.gov/Safety_and_Training/Safety_Guides

  and

- the searchable APS electronic document library
  URL: http://icms.aps.anl.gov/.

1. **User Shop Orientation**
1. **User Shop Authorization Certification Form**
2. **User Shop Access List**
3. **LOM Shop Monthly Inspection Record**

Machining Lead in LOM Shops

(Formerly AP&P 3.1.14 revised 2006, APS document number APS_1000047)

1. Revision 0, Policy – Responsibilities listed the training course ESH 171 Lead Hazards and Controls as required for any person seeking to machine lead.

   Revision 1, Policy – ESH 171 is not required for any person seeking to machine lead, rather it is required only if the activity/work will generate airborne levels greater than the OSHA action level of 30 µg/ m^3. This training change and the notification requirement for work above the OSHA threshold were separated as "additional responsibilities" for above threshold work.

2. LOM shop 438 has been removed from the list of shops approved for machining lead.

Policy

To provide a safe work environment at the APS, the APS has adopted the following site-specific implementation of the ANL lead handling ESH requirements.

All lead machining in LOM shops shall be done in accordance with the ANL ESH Manual requirements for controlling and monitoring lead found in ESH Manual Section 4.12 Safe Handling of Lead.

Lead machining can only take place in APS-approved areas. Not all LOM machine shops allow lead machining. **The APS approved LOM shops are listed below in the section 7.**

Any person who wishes to machine lead will do so at the discretion of the Shop Coordinator.

Responsibilities

Any person seeking to machine lead in a LOM shop must:

- Provide the Shop Coordinator with a record of completion of:

  (ESH 170 OSHA Lead Standard Orientation)
  https://www.wbt.anl.gov/CourseContent.asp?COURSENO=ESH170

- Receive authorization to machine lead from the Shop Coordinator.
- Notify the Shop Coordinator before starting each lead machining project.
- Ensure that work is done in a safe manner to prevent excessive exposure to lead and lead compounds.
- Follow ANL requirements for safe work practices and use of protective equipment.

- Ensure that all lead-bearing dust and debris are removed when work is completed.
- Consider ergonomics and weight implications when movement of lead materials is a work factor.

Additionally, if the work might produce airborne lead levels in excess of the OSHA action level (30 µg/ m^3), any person seeking to machine lead in a LOM shop must:

- Provide the Shop Coordinator with a record of completion of:

  (ESH 171 Lead Hazards and Controls)
  https://www.wbt.anl.gov/CourseContent.asp?COURSENO=ESH171

- Shall notify the Shop Coordinator and an APS ESH Coordinator.

The APS ESH Coordinator must:

- Work with any worker who has identified that there is a potential for the work producing airborne lead exposures that exceed the OSHA action level to ensure that ANL ESH requirements (e.g., informing the ANL Medical Department and ESO-IH of the work, arrange for any biological monitoring, arrange for EQO-IH exposure assessments, etc.) are met.
- Provide Shop Coordinators with the results of EQO-IH exposure assessments.

The Shop Coordinator must:

- Confirm that plans and safeguards are in place to prevent excessive exposure to lead and lead compounds.
- Oversee lead machining work for compliance with ANL requirements for safe work practices and use of protective equipment, including respirators.
- Attach a copy of OSHA lead training certification to the LOM Shop Authorized Operator Certification Form.
- Post and/or inform shop users of the results of **LOM machine shop** ESH-IH monitoring, exposure controls needed, and actions planned to correct excessive exposure conditions.
- Review the results from the monitoring to confirm that lead work is being performed in designated lead work areas and mitigate contamination as needed.
- Ensure that lead is stored, inventory and usage reported, and waste disposed of according to OSHA and EPA requirements.
- Ensure that proper labeling and posting are provided for lead-containing materials.
- Check box on the LOM Shop Authorized Operator Certification Form that states the Authorized Operator meets all requirements for machining lead.

Oversight

APS/ANL may perform unscheduled wipe sampling of affected areas to ensure that lead levels do not exceed the following clearance criterion. There are no specific OSHA standards for surface lead contamination. However, the General Industry Lead Standard [29 CFR 1910.1025 (h) (1)] and Lead Exposure in Construction Standard [29 CFR 1926.62 (h) (1)] require surfaces to be maintained as free as practicable of lead accumulation. The APS clearance criterion is 200 $\mu g/ft^2$.

If 25% of samples exceed the clearance criterion, recleaning may be required. If the average concentration is below the clearance criterion, the area is deemed to be clean. If a few samples significantly exceed the clearance criterion, spot cleaning is recommended.

In addition, APS/ANL will perform periodic wipe sampling of LOM machine shops to ensure lead levels meet the clearance criterion. LOM shops permitting lead machining will be sampled biannually (every six months with a one-month grace period), and those not permitting lead machining will be sampled annually (every 12 months with a one-month grace period).

Procedure

1 Introduction

1.1 Purpose

To provide a safe work environment at the APS, the APS has adopted the following site-specific procedure for the implementation of the ANL lead handling ESH requirements.

1.2 Scope

This procedure applies to all machining of lead in LOM shops at the APS.

The specifics of lead handling are included by reference to the APS lead handling procedure: Procedure **#1110-00120.**

1.3 Applicability

This procedure is to be followed for any machining of lead in an APS LOM shop.

2 Preparation - Prerequisite Actions

No one is allowed to use a user shop for any machining activities until they have been authorized to do so according to the requirements of APS Policies and Procedures. To earn authorization, candidates must receive an LOM Shop Orientation from the Shop Coordinator and they must pass machine-specific examinations.

PPE

The Floor Coordinator can arrange a meeting with the AES-ESH Coordinator to determine protective clothing and respirator requirements for the project.

Air Monitoring

If there is the potential that a worker might be exposed to airborne lead levels exceeding the OSHA action level (30 $\mu g/m^3$) air monitoring requirements must be determined in consultation with an APS ESH Coordinator, and any required air monitoring must be arranged prior to the start of the lead machining.

Warning Sign

If exposures are expected to exceed the PEL of 50 $\mu g/m^3$ of air, the work area must be isolated and posted prior to the starting of the machining:

WARNING

LEAD WORK AREA

POISON

NO SMOKING OR EATING

The Shop Coordinator must post signs at the entrances to all lead work areas as required by the OSHA Lead Standard.

Ventilation and Vacuum Cleaners

If a local exhaust ventilation system is used to capture welding or cutting fumes, the system shall be equipped with a tapered pickup hood. The hood must be positioned close to the source of fume generation and repositioned as necessary to maintain capture efficiency.

Portable tools including, but not limited to, grinders, needle scalers, sanders, and saws must be equipped with local exhaust ventilation accessories and attached to a HEPA-filtered exhaust system or HEPA vacuum cleaner.

All HEPA-filter equipped air handling units, including vacuum cleaners, must be inspected by EQO-IHS. HEPA-filtered units and vacuum cleaners must pass a challenge aerosol test documenting acceptable filter performance. Such tests must be performed prior to first use on site and after HEPA filter replacement.

All HEPA-filtered vacuum cleaners must be tagged with a dated test tag when tested. A HEPA-filtered vacuum cleaner must not be used if the test tag is not present or if it has been more than one year since the unit was tested. Testing can be arranged through the Floor Coordinator.

The HEPA vacuum will be labeled FOR LEAD USE ONLY. **Non-HEPA vacuums found in shops should be labeled for nontoxic or nonradioactive use. Labels are available from the AES ESH Coordinator.**

3 Acceptance Criteria

The responsible Shop Coordinator must approve any lead machining in their LOM shop.

An APS ESH Coordinator must approve monitoring and mitigation plans for machining that may exceed OSHA action levels.

4 Procedure Action Steps - Performance

[If a person is already authorized to perform lead machining in a LOM shop, skip to section 4.2.]

4.1 Authorization to machine lead

4.1.2 The CAT/CDT/XOR candidate will supply the Shop Coordinator with copies of his/herOSHA lead training certification and medical monitoring certification.

4.1.3 The Shop Coordinator will attach these forms to the LOM Shop Authorized Operator Certification Form.

4.1.4 The Shop Coordinator will check the line on the “LOM Shop Authorized Operator Certification Form” that states that the CAT/CDT/XOR candidate is now authorized to machine lead.

4.1.5 The Shop Coordinator will update the LOM Shop Access List to reflect that the new Authorized Operator can machine lead.

4.1.6 The Shop Coordinator will submit a copy of these forms to the Floor Coordinator.

4.1.7 Floor Coordinator will keep a copy on file, send a copy to the AES ESH Coordinator, and send a copy to the User Office. The User Office will update the Authorized Operator’s TMS profile.

4.2 Machining Lead

4.2.1 The person seeking to machine lead will inform the Shop Coordinator before starting each lead machining project.

4.2.2 The Shop Coordinator will review the plans and may authorize the work to proceed

4.2.3 All PPE is donned.

4.2.4 **APS Lead Handling Procedure #1110-00120 is to be used for the safe handling of lead. (SAFETY NOTE: Remove gloves prior to operating rotating machine tools. Secure lead items with clamps rather than using hands to hold in place.)**

4.2.5 Surfaces such as workbenches, floors, and equipment must be kept clean of lead accumulation. (Compressed air or dry sweeping shall not be used to clean lead-contaminated surfaces.)

4.2.6 Washing of hands and contaminated skin is needed after contact with lead and before eating, drinking, smoking, applying cosmetics, or chewing gum.

4.2.7 Wet methods and /or HEPA-filter-equipped vacuum cleaners shall be used to clean lead contaminated surfaces.

4.2.8 The Shop Coordinator and the Authorized Operator shall ensure that all lead-bearing dust and debris are removed when lead work is complete.

4.2.9 **Excess lead materials and cuttings** will be **stored** in containers labeled for lead scrap located in the LOM Shop.

4.2.10 **Lead waste must be placed in containers designated as hazardous waste and the containers need to be placed in a satellite waste accumulation area (SWAA).**

4.2.11 Chemical inventories must be updated. Materials tracked in the ANL Chemical Management System will be reported automatically. Items used but not tracked in the Chemical Management System (cutting and using lead sheet, for example) must be tracked separately by the Shop Coordinator and Authorized Operators.

5 Closeout - Post Performance Activity

The EPA requires an annual report on the amount of lead and leaded compounds manipulated by coring, drilling, cutting, and machining. This is reported by entering information on the Toxic Release Inventory form posted in each shop.

In order to comply with DOE requests, APS must show how much lead and leaded component material is machined. A log sheet with entries that track the amount of lead and leaded components machined will be available in the LOM Shop.

6 References - Source Requirements

29CFR1910.1025 OSHA Lead Standard, General Industry
29CFR1926.62 OSHA Lead Standard, Construction
ANL-East ESH manual Chapter 4.12, "Safe Handling of Lead"
APS Lead Handling Procedure #1110-00120

7 Appendix A - LOM Shops Approved for Machining Lead (5 December 2005):

1. 432 C LOM Shop
2. 433 C LOM Shop
3. 434 C LOM Shop

Electrical Safety

User Electrical Inspections

(Formerly AP&P 3.1.21 APS docuemt numberAPS_1180984)

Policy

To protect the safety of personnel and equipment, all electronic and electrical equipment at the APS shall be inspected to ensure compliance with NEC, OSHA, DOE, and ANL regulations. This requirement for inspections includes all electrical equipment brought to the APS by users. The ANL standards are found in the ANL ES&H Manual, Section 9.3.2.

All electrical equipment that is brought to the APS by APS users must be inspected by an Argonne Designated Electrical Equipment Inspector (DEEI) before the equipment can be used. The APS has personnel that have been trained to be DEEIs.

In some cases, this inspection will be quite simple, e.g., if the equipment has already been inspected by a Nationally Recognized Testing Laboratory (NRTL) and is used for its designed purpose. Other equipment will require a more thorough inspection (this may include NRTL inspected equipment if it is assembled into apparatus with other components). Additional details about the inspections (including what type of equipment has to be inspected, inspection criteria, and a list of DEEIs) may be found in the documents available at: http://www.aps.anl.gov/Safety_and_Training/Electrical_Safety/index.html.

The need for an electrical equipment inspection will be noted through the APS Experiment Safety Assessment Form (ESAF). It is the responsibility of the user and the beamline staff to contact a DEEI or the User Safety Officer and arrange for an inspection at least three (3) days in advance. Inspections will normally be performed during regular business hours. Requests with less than three days notice or for inspections not during regular business hours will be dealt with on a case-by-case basis.

If user electrical equipment is found to be deficient it may not be used at the APS. The Sector and the APS will assist the user in attempt to rectify any deficiencies in the equipment so that it may be used at the APS. Overtime costs and the cost for any APS-supplied parts for the repair will be the responsibility of the user. Users with electrical equipment that has not been inspected by a DEEI will not be allowed to proceed with their experiments and may result in the loss of the user's scheduled beamtime.

Procedure

1 Introduction – Purpose, Scope, and Applicability

The APS has established a user electrical equipment inspection process to ensure that all user electrical/electronic equipment is safe and meets APS/ANL safety standards. This procedure describes the process for making the arrangements for inspections but not the specific technical standards of the inspection.

2 Arranging for the inspection of user electrical/electronic equipment

The need for an electrical equipment inspection will be noted through the APS Experiment Safety Assessment Form (ESAF). When a user checks the Electrical Equipment, High Voltage, or Electric Furnace checkboxes on the Equipment page of the ESAF, notification will be sent to the DEEIs that an inspection will be needed.

Scheduling inspections

It is the responsibility of the user and the beamline staff to arrange with either one of the DEEIs or the User Safety Officer for the actual date and time of the inspection. This notification is to be given at least three (3) days in advance of the actual inspection date. The APS will make an effort to honor requests that are received less than three (3) days in advance but due to work assignments and scheduling conflicts may not be able to complete the inspection at the date and time requested. In this case the experiment may not be used until a DEEI is available, the inspection is completed, and the equipment is approved for use by the DEEI.

Off- hours inspections

Requests for off-hours inspections (weekday evenings and nights or weekends) will be handled on a case-by-case basis. If notification of a request for off-hours inspections is given less than three (3) days in advance of the requested date the user will be responsible for any overtime charges. DEEI coverage cannot be guaranteed on a timely basis during weekends. If an experiment is to begin on the weekend, it is strongly recommended that the user has the equipment available for inspection before the weekend.

Radiation Safety

Working on Beamline and Front-End Shielding Components

(Formerly AP&P 3.1.03 APS document number APS_1181699)

In recognition of the potentially significant hazards associated with beamline or front end radiation shielding, it is the policy of the APS that the APS Engineering Support (AES) Division is responsible for all work on beamline and front end shielding. This responsibility encompasses the labor for alignment, shielding validation, maintenance, repair, and any modification of any beamline shielding component.

If the beamline or front end component has an APS Radiation Shielding red tag, then the AES Division is responsible for any work on the component.

Users and other beamline personnel may operate engineered radiation safety shielding components. For example: users may actuate beamline shutters, and beamline personnel may open or close permanently installed manual shutters or stops, or may open or close an enclosure labyrinth or station door. The shielding systems must be used only as they were designed/intended and with APS and beamline prescribed safeguards (e.g., PSS safety interlocks and administrative controls).

There may be specific cases where the beamline management may seek to have beamline personnel assist with work on radiation shielding. Requests for this permission may be made to the AES Division Director. Beamline personnel may only work on the shielding with the written authorization of the AES Division Director for a specific scope of work.

Labor

The AES Division will provide labor for the alignment, shielding validation, maintenance, and repair of beamline shielding components at no cost to the beamline management. AES, on a case-by-case basis, may recover labor costs from the CAT/CDT/XOR.

Parts

The beamline management provides parts (or the funding for the parts) for maintaining the beamline shielding components. Due to the diversity of parts required, often unique to one component on one beamline, and the beamline management's ownership of the hardware, the beamline management is responsible for maintaining spares. AES may maintain some stock of common spare parts (e.g., pneumatic actuator seals).

AES Technical Support

The AES Division personnel shall ensure the information (specifications, drawings, procedures, etc.) is available and provide the trained personnel to ensure that the work is done properly and the shielding device is returned to service safely.

Safety

In order to maintain a high level of safety, each person and group that requests or takes part in work on beamline shielding components should be aware that there are safety implications of their requests or activities. Further, if they are aware of a potentially unsafe situation resulting from the work, then the component or system is to be secured until the questions are resolved.

No work by any party on any radiation safety shielding is allowed without a complete, approved Configuration Control Work Permit (CCWP).[1] No work shall start on the beamline or front end shielding without the CCWP specified authorizations.

If the component is a new installation or a modification of an existing design, which operates outside of the safety/performance envelope of previous design reviews, the component shall not be brought into operation until the design and use are reviewed and approved by the appropriate design review committee.

For newly installed components, the CCSM will work in concert with the Beamline Commissioning Readiness Review Team to ensure that the design/operational requirements records are in place.

References

[1] *Configuration Control Work Permit Policy and Procedure*

Management of Sealed Radioactive Calibration Sources

(Formerly APS Technical Update - No. 15, Policy for Management of Low-Activity Sealed Radioactive Calibration Sources by APS Users, reviewed October 4, 2007)

Policy

Scope

This policy describes how APS users will manage low-activity (less than 5 mCi) radioactive calibration sources that are certified* as sealed. The guidelines are based on federal regulations and Chapters 5-12 and 5-20 of the *ANL ESH Manual*. It should be noted that sources in the above category, if brought to ANL for periods of less than 60 days, are exempt from the leak-testing and site-wide inventory provisions of Chapter 5-20.

Roles and Responsibilities

1. APS users will make advance arrangements through the AES Sealed Source Custodian for all shipments of radioactive sources to and from ANL and between noncontiguous buildings on the site. ANL's Special Materials Section will manage all such shipments. Prior to shipment, Special Materials personnel will assign a control number to the shipment and will provide instructions on the proper packaging, labeling, and addressing of the shipment. Receipt and delivery of sources purchased through APS User Accounts will be managed by ANL Receiving and Health Physics personnel as described in Chapter 5-12 of the *ANL ESH Manual*. Under no circumstances may sealed radioactive sources be transported from one ANL location to another in a personal vehicle.

2. Each CAT/CDT/XOR will appoint a source custodian.

3. As soon as possible after a new source arrives at the APS, the source custodian will document it by completing a New Source Entry Form and sending a copy to the AES SSID Coordinator. Blank forms are available from the Office of the AES ES&H Coordinator. The source custodian will give the AES SSID Coordinator an inventory update every 6 months, and within 15 days after any significant change.

4. The source custodian will ensure that the sources are properly labeled, stored, and tested for integrity on a periodic basis as described in Chapter 5-20. The sources should be stored in a locked cabinet, which is used only for that purpose. The preferred location for the cabinet is in one of the LOM labs assigned to the CAT/CDT/XOR; this lab will then be designated as a controlled area.

5. The custodian will also be responsible for knowing the location of all sources at all times, authorizing users of the sources, and will ensure that all necessary records are

maintained. The Sealed Source Checkout Record form (model available from AES ESH Coordinator) will be used to track locations; any authorized user who checks out a source will enter the indicated information on this form.

6. Authorized users will ensure that sealed sources are not left unattended and unsecured while checked out, and will return them promptly after use. The source custodian may designate temporary storage locations where sealed sources can be secured while checked out. A sealed source that is in use inside a radiation enclosure for a calibration will be considered "secured" for the duration of the calibration period if all doors to the enclosure are closed and posted with appropriate signs.

7. Authorized users may move sealed sources between controlled areas within the APS facility (for example, to the Experiment Hall floor from the LOM lab where the source is stored); the user will promptly enter the new location on the Sealed Source Checkout Record.

* Per *ANL ESH Manual*, Chapter 5-20, "Accountability and Control of Sealed Radioactive Sources".

Issuance of Ionizing Radiation Dosimeters at the APS

(Formerly AP&P 3.1.29 APS document number APS_1215504)

Policy

Wearing a personal radiation thermoluminescent dosimeter (TLD) is required for access to any radiologically controlled area that is posted by the Argonne Health Physics Group as *Controlled Area, TLD required for entry*. TLDs will be regularly issued to APS personnel/users who must enter these posted areas at least once per calendar quarter (routine access). For those requiring less frequent access, a TLD may be obtained from the Main Control Room or the User Office on an as-needed basis.

While specific areas may require a TLD for access, in general, TLDs are not required for access to the majority of the APS Experiment Hall and the top of the storage ring tunnel. TLDs will be regularly issued to personnel/users who work in the Experiment Hall if they need to routinely access areas or engage in activities specifically requiring a TLD in accordance with Argonne standards.

According to Argonne ESH Manual Chapter 5, dosimeters are also required for specific activities for which there may be radiation exposure hazards (e.g., operation of an analytic x-ray generator). TLDs will be regularly issued to APS personnel/users who perform these activities at least once per calendar quarter. For those that less frequently engage in these activities, a visitor TLD may be obtained.

Any person who is likely to receive 0.1 rem/year or more from one or more sealed sources is required to wear a TLD and should request, and will be regularly issued a TLD. Typically, wearing a TLD is not required for, and will not be regularly issued for, the handling of *exempt* sealed source (i.e., a source whose activity is less than the values in 10CFR835 Appendix E).

A person who is not regularly issued a dosimeter may request automatic issuance of TLDs. The request should be made to their Division Director or the AES Division Director in the case of users that are not APS employees and should explain why the dosimetry is sought.

HazMat Transport

Transporting Hazardous Materials

(Content of this section revised 8/31/2006)

The procedures given below apply to all materials that are considered to be hazardous by the U.S. Department of Transportation (DOT). Consult your CAT/CDT/XOR Safety Coordinator or the AES ES&H Coordinator if you are not sure whether the material in question is in this category. Shipments of small quantities of some materials may qualify for an exemption from DOT requirements. Your home institution or CAT/CDT/XOR can help you determine whether your shipment qualifies.

Radioactive materials that need to be shipped to/from the APS require special handling by the ANL Special Materials Group. Contact the User Safety Officer before shipping these materials. The address to be used for radioactive materials will be provided by the ANL Special Materials Group.

Incoming Shipments

When possible, obtain hazardous chemicals from the APS stockroom. If you can't get what you need from the stockroom, keep the amount being shipped to the APS as small as possible.

Under no circumstances may you transport a nonexempt hazardous material to the APS in your own car or other personal vehicle.

To have a hazardous material shipped to your CAT/CDT/XOR's facilities at the APS, follow these steps:

1. Arrange to have all shipping duties handled by persons with appropriate hazardous materials training.
2. Provide the above individuals with all the information they need to prepare the shipment.
3. Inform your CAT/CDT/XOR Safety Coordinator of the planned shipment and arrange for any special handling the shipment may require upon arrival.
4. Advise the shipper to address the package to:

Recipient's Name
c/o Building 46, Hazardous Materials Receiving
APS/ANL
Sector No. _____
Argonne National Laboratory

9700 South Cass Ave.
Argonne, IL 60439

Also inform the shipper of any supplementary labeling information recommended by the Safety Coordinator to help ensure proper handling of the shipment upon arrival.

Outgoing Shipments

To ship a hazardous material from the the APS to an off-site location, follow these steps:

1. Give the following information to your CAT/CDT/XOR Safety Coordinator:
    - Identity of the material
    - Amount of the material
    - All associated hazards

    The Safety Coordinator will then work with ANL to prepare an ANL shipping order and obtain appropriate packaging.
2. Complete the process by working with the person designated by your CAT/CDT/XOR to be responsible for shipping arrangements.

Internal Shipments

Do not use your personal vehicle to move a hazardous material from building to building within ANL unless it qualifies for the small quantity exception in TUD-23. Your APS Floor Coordinator will help you arrange all on-site moves.

Reference

DOT Hazardous Materials Training Course **Workbook**. This link may be used as a reference and guide for shipping hazardous materials. This link is to a workbook. Reading this information DOES NOT mean that you are trained in Hazardous Materials Shipping. If you have any questions about shipping materials to/from the ANL/APS please contact your institution's shipping department or your CAT/CDT/XOR.

Transportation of Small Quantities of Hazardous Materials

(Formerly APS part of Technical Update No. 23 – this section reviewed October 4, 2007)

Policy

The ANL Transportation Safety Board has reviewed and approved the transportation of small quantities of *some* hazardous materials, by APS users to the APS if transported in full conformance with the DOT Small Quantity Exceptions regulations.

Summary:

- **No exception** from ANL policies and procedures for handling **radioactive materials** is provided.
- Materials **must** be packaged and labeled in full conformance with DOT regulations.
- Users are encouraged to minimize the transportation of HazMats to and from ANL.
- Users are encouraged, when possible, to use the shipping department resources of their home institution and to use commercial shippers.
- Users are encouraged to avail themselves of ANL-provided shipping, receiving and on-site transportation services.
- Users should be aware that there are additional requirements and restrictions that apply to the movement of HazMat materials by air and other common carriers. These requirements and restrictions are beyond the scope of this exception.

The ANL Tranportation Safety Board has approved the on-site hazardous material (HazMat) transportation by APS users, in compliance with Department of Transportation (DOT) Small Quantity Exceptions (49 CFR 173.4):

1. If transported in full conformance with DOT regulations, the entry of small quantities of nonradioactive qualifying materials at any gate. [Refer to Table below for qualifying materials and quantity limits.]
2. If transported in full conformance with DOT regulations, the transport of small quantities of nonradioactive qualifying materials in rental or other user-driven vehicles across the ANL site to the user facilities at the APS.
3. If prepared for transport in full conformance with the DOT regulations, the off-site transport of nonradioactive qualifying materials without the involvement of ANL personnel.

No exception from the existing ANL standards for handling radioactive materials was approved. All radioactive materials are to be transported to and from the APS in accordance with ANL requirements (e.g., receipt at Building 46, on-site transfers by ANL Special Materials Handling, off-site shipment by ANL Facility Mangement Services, etc.).

Materials that are synthesized at ANL and that have unknown hazards, and/or hazards not present in any of the reactants, must be reviewed and the hazards indentified by ANL-trained HazMat personnel prior to transport off the ANL site. Also, for outbound user transport of HazMats, materials with different hazard classification shall be packaged in separate packages (i.e., only one hazard classification per package).

Prior to approval, each experiment proposed for an APS beamline requires user submission of an APS Experiment Safety Assessment Form that includes an identification of the materials that are to be used in the experiment. The APS will require, and verify as part of its safety oversight, that CAT/CDTs and XOR, as they carry out their experiment safety responsibilities, verify that the DOT and ANL transportation safety requirements are being met. The APS User Safety Officer will coordinate the APS oversight. The APS will deal with noncompliance with the ANL transportation requirements as described in the published *APS User Policies and Procedures*: "Response to Actions That Are Inconsistent with Beamline Safety Plans."

The APS will continue to encourage users to minimize transportation of HazMats to and from ANL. In addition, the APS encourages its users to make appropriate use of institutional and commercial shipping services when shipping materials to ANL and recommends that users avail themselves of ANL-provided shipping, receiving and on-site transportation services. The APS will work with ANL to make standard packaging that meets the DOT requirements (49 CFR 173.4) available to the users.

The APS, with the support of ANL, will coordinate training of the APS CAT/CDTs and XOR on HazMat transportation requirements. The APS will also advise the APS users that there are additional requirements and restrictions that apply to the movement of materials by air and other common carriers. AES will rely on the ANL Training Management System to record user training and will provide training information upon request.

Table 2: Qualifying materials and quantity limits of materials that may be transported to the APS by APS users. This table applies to ground transport only.

DOT Class or Division Number	Name of Class or Division	Max. amount per container [gram solid or ml liquid]
MATERIALS THAT CAN BE TRANSPORTED BY APS USERS IN SMALL QUANTITIES ON THE ANL SITE		
Class 3	Flammable and combustible liquid	30
Division 4.1	Flammable solid	30
Division 4.2, (PG II and III)	Spontaneous combustible material	30
Division 4.3, (PG II and III)	Dangerous when wet material	30
Division 5.1	Oxidizer	30
Division 5.2	Organic peroxide	30
Division 6.1, (PG I)	Poisonous material	1
Division 6.1, (PG II and III)	Poisonous material	30
Class 8	Corrosive material	30
Class 9	Miscellaneous hazardous material	30
MATERIALS THAT CANNOT BE TRANSPORTED BY APS USERS ON ANL SITE		
Class 1	All divisions of explosives and detonating devices	0
Class 2	Flammable gas, non-flammable compressed gas, and poisonous gas	0
Division 4.2, (PG I)	Spontaneous combustible material	0
Division 4.3, (PG I)	Dangerous when wet material	0
Division 6.2	Infectious agents	0
Division 7	Radioactive material	0

* note PG = "packing group"

Who Can Handle Non-Radioactive APS User Shipments

(Formerly APS Technical Update – 28 – this section reviewed October 4, 2007**)**

DOT Hazard Classification		Options for Shipment Handling		
		ANL Shipping Department	User Transport on the ANL Site	User Arranged Carrier Pickup
Non-hazardous Material	Including dry shippers not containing DOT hazardous materials	allowed	allowed	allowed[1,2]
Hazardous Materials and Dangerous Goods	1. Small Quantities	allowed	allowed[3]	ground ship only permitted[1,2] Air/Rail/Water not permitted
	2. Bio-samples in dry shippers with frozen propane, etc.[4]	required	permitted on the ANL site only	not permitted
	3. All other Hazardous Materials	required	not permitted	not permitted

[1] Shipping papers shall be addressed as from: User Name, User's Home Institution, c/o APS Sector ___, 9700 South Cass Avenue, Argonne, IL 60439
[2] If the sender is an ANL employee or if ANL material is being sent then the shipment must be arranged through the ANL shipping department.
[3] In accordance with the small quantity exception.
[4] Air shipment allowed in accordance with the DOT requirements.

ANL Employees and ANL Materials

To ensure ANL compliance with transportation requirements and for property management tracking, if the sender is an ANL employee or if ANL materials or equipment are being sent, then the shipment must be sent through the ANL shipping department.

Non-ANL APS Users and Argonne Shipping Department

The services of the ANL shipping department are available to the APS users for transporting materials both on the ANL site and to off-site locations. A valid user account with adequate funding is required to pay for freight charges incurred on the CAT/CDT's behalf. As described below, some hazardous materials shipments must be sent through the ANL shipping department. For time-critical shipments, if contacted in a timely fashion, ANL shipping can prepare all shipping materials in advance and may be able to make special pick-up arrangements to meet the user's needs.

Non-ANL APS Users and Overnight Shipper Pickups

When it is impossible or impractical for the ANL shipping department to prepare a time-critical, nonhazardous shipment (e.g., on weekends and when it is too late in the day), non-ANL-employee users may arrange for an overnight shipper to pick up their package at the APS. For any user-arranged shipments:

- **the APS user and the APS user's home institution shall assume full responsibility for complying with the appropriate CAT/CDT/XOR, ANL, U.S. Department of Transportation (DOT), and carrier requirements,**
- **the user shall not use a preprinted U.S. DOE/Argonne National Lab airbill**, and
- the user shall **not** use an ANL account with the shipping company.

For these user-arranged shipments, the "from" portion of the airbill is to completed as follows:

User Name
User's Home Institution
c/o APS Sector ___ (a local contact's name at the APS is optional)
9700 South Cass Avenue
Argonne, IL 60439

This address will enable the carrier to directly contact the sender (rather than ANL's shipping department) to resolve any questions or problems with the shipment. The name provided should identify a person who is knowledgeable of the shipment's contents and familiar with its packaging, labeling and documentation.

Transporting Hazardous Materials on the ANL Site

All materials identified by the DOT as hazardous shall be transported on the ANL site by ANL transportation services and shall be shipped from ANL by the ANL Shipping and Receiving Department. Materials that meet the requirements (as described below) of either 1) the small-quantity exception or 2) of the cryogenically preserved nonhazardous biological samples in certain frozen refrigerants may be transported on the ANL site by users. The user needs to ensure that adequate information and time is provided to the handlers in the ANL shipping department in order that the shipment can be properly packaged and meet the user's delivery requirements.

Small Quantities of Hazardous Materials

For ground transport only users can transport on the ANL site small quantities of certain classes of hazardous materials to and from the APS in accordance with the process described in APS

Technical Update 23 (16 July 1998). Users also may arrange for a carrier to pick up these shipments, but they must be designated for "**ground transportation only**."

Dry Shippers

Dry shippers are specially designed shipping containers that keep materials at liquid nitrogen temperatures for extended periods with no free-flowing liquid and are not regulated by the DOT. Properly packaged dry shippers that do not contain hazardous materials may be treated as nonhazardous shipments. Regardless of the designation of the material being shipped, **it is the user's responsibility to ensure that the shipment does not contain any free-flowing liquid nitrogen**. **Empty dry shippers** must be at room temperature or they are subject to IATA Dangerous Goods Regulations Packing Instruction 202.

The DOT has approved the air cargo transport of dry shippers containing cryogenically preserved nonhazardous biological samples preserved in small quantities of certain frozen refrigerants, by any shipping party, to and from the APS; refer to APS Technical Update Number 25 (20 May 1999) for details. These air shipments shall be arranged by the ANL Shipping and Receiving Department. Because of the time-critical nature of many of these shipments, APS users are allowed to transport **properly** labeled and packaged shipments **on the ANL site**. To ensure the timely preparation of the shipment, the user should make advanced arrangements with the ANL shipping department, including the identification of any special shipping requirements (e.g., the user should alert the Shipping Department of the inclusion of infectious agents or other hazards associated with the shipment).

Resources

CAT/CDT/XOR representatives trained in transportation safety, the shipping department, AES User Safety Officer, and APS ESH Coordinators are all available to answer questions about shipping requirements or direct you to the appropriate resources to resolve any questions.

For additional information contact: User Technical Interface

DOT Authorized Cryo-preserved Biological Sample Air Transport

(Formerly APS Technical Update No. 25 - last reviewed October 4, 2007)

The U.S. Department of Transportation (DOT) has approved an ANL request that "authorizes the cargo air transport of small samples of biological macromolecules (e.g., proteins, enzymes, antibodies, ribosomes, non-restricted viruses, DNA, RNA, etc.) contained in deeply refrigerated flammable or non-flammable gas and packaged in a 'dry shipper' charged with liquid nitrogen." In a dry shipper, the cryogenic fluid has been immobilized in an absorbent material in the dewar. DOT regulations have previously permitted the use of dry shippers, the request approval now allows for the air transport of biological samples preserved in small quantities of propane, ethane, chlorodiflouromethane, and other refrigerant gases. A copy of the approval (number CA-199807017, second revision dated October 22, 2002), including packaging requirements, labeling requirements, and other special provisions, is attached for your reference. Note: 1) this authorization applies **only** to shipments to and from ANL, and that there may be additional requirements for transporting your shipment outside of the United States (refer to section 6c); and 2) there are additional measures that are required for transporting infectious agents, and guidance can be provided by ANL/ESH transportation safety personnel.

You must ensure that your in-bound or out-bound shipment meets all of the requirements specified in the attached DOT approval.

ANL-originated shipments

To arrange for your dry shipper to be picked up for an outbound shipment from ANL, contact ANL Site Services Material Handling personnel. The arrangements will include where and when to pick the package up and a CAT/CDT/XOR contact.

- To arrange for same day pickup and outbound shipment: contact Material Handling personnel before 10:00 A.M. and request delivery to building 46 before noon.
- If the shipment must go out on a particular day and your shipment will not be available in the morning of the day required, then no later than the day before, contact the material handling personnel to see if shipping arrangements can be made to meet your requirements. To expedite such shipments, you may be requested to FAX a copy of the completed ANL Shipping Order (ANL form ANL-126C) to the ANL shipping department at 630.252.4130 so that the shipping documents (air bills, labeling, etc.) can be prepared ahead of time by the shipping department.

The following must accompany the material to be shipped:

1. a completed ANL Shipping Order (form ANL-126), providing the off-site shipping information,
2. a completed Hazardous Material Manifest/Cargo List (form PFS-SS/MAT 001, copy attached, follow link below), providing the on-site driver with the on-site transport

directions and a manifest, which includes proper shipping name, DOT hazardous classification and UN number (for assistance contact ANL shipping at 630.252.2934),

3. MSDS, to help expedite shipping department hazards identification and verification of the material classification), and

4. per the DOT requirement, a copy of the DOT approval letter (follow link below).

Shipments to ANL

The DOT approval includes requirements that any individual that prepares hazardous materials for transportation is trained on the requirements and conditions of the approval, as well as on the general requirements of DOT regulations (refer to section 6 d of the DOT approval for specific federal regulation references). ANL encourages you to use the trained shipping personnel at your home institution and ensure that they are aware of the conditions of the DOT approval. Additional HazMat personnel training can be provided through ANL and is available from the DOT. (On-line DOT HazMat and training information can found on the DOT web-sites http://hazmat.dot.gov and http://www.text-trieve.com/tsi/.)

Be aware that you should verify that the air carrier you plan on using will accept the shipment for transport and determine whether the carrier has any the specific requirements of their own. Currently ANL has worked with FedEx, who has agreed to accept these shipments from ANL.

CAT/CDT/XOR safety personnel and the ANL shipping department (telephone 630.252.2934) can provide guidance and can answer your questions regarding the shipment of hazardous materials.

attachments: (NOTE - both attachments are PDF documents)

DOT Approval CA-199807017 - rev. 2, 22 Oct. 2002
Hazardous Material Manifest/Cargo List, form PFS-SS/MAT 001 (Rev. 4/99)

Beryllium

Procedure for the Management of Broken Beryllium Windows and Equipment Contaminated with Beryllium Oxide

(Under revision 28 May 2008)

Applicability:

This procedure may be utilized at the APS beamlines or within a laboratory setting when managing the clean-up and disposal or either broken beryllium windows or equipment contaminated with beryllium oxide (BeO).

Introduction

1.0 Introduction

Inhalation of beryllium dust and/or particles can cause chronic beryllium disease (CBD) or beryllium sensitization in exposed individuals. CBD is a chronic and sometimes fatal lung condition. Beryllium sensitization is a condition in which a person's immune system may become highly responsive or allergic to the presence of any beryllium within the body. In the case of beryllium sensitization, the concentration of beryllium may be different for each individual person. Other routes of entry that may attribute to these conditions also include ingestion and skin contact or absorption. Furthermore, both beryllium and beryllium compounds are considered to be ANL class 1 carcinogens.

In an effort to reduce any potential beryllium exposure to its workers, the APS has set a policy that no machining and/or grinding of beryllium or beryllium compounds that can produce airborne and/or surface beryllium dust is allowed within its facilities. Although intact beryllium windows are considered "finished articles" and are exempt from the requirements of the ANL Chronic Beryllium Disease Prevention Program, precautionary measures must still be adhered to in order to clean-up and dispose of broken beryllium window fragments as a result of unexpected breakage during beamline or other laboratory operations.

Several years of beryllium monitoring at the APS has shown that broken beryllium windows typically result in fragments with little detectable concentration of beryllium observed from wipe sampling by EQO-Industrial Hygiene. Furthermore, air monitoring following several window breakages have consistently shown no detectable airborne concentrations of beryllium (*ref. monitoring results on file in the Office of the APS Chemical Hygiene Officer).* Therefore, the APS has adopted the following procedure for managing broken beryllium windows based on clean-up recommendations provided by EQO-Industrial Hygiene and prior monitoring results.

1.1 Purpose

To provide APS personnel and users with a step-by-step procedure that may be utilized at the APS beamlines or within a laboratory setting when managing the clean-up and disposal of broken beryllium windows. This policy defines the personnel allowed to initiate and perform the cleanup of a broken beryllium window and the logging requirements for the event.

1.2 Scope

Several research processes at the APS have the potential to create a situation in which a beryllium window may unexpectedly break. These processes include the following:

- A broken beryllium window on an X-ray detector
- A broken beryllium window under vacuum
- A broken beryllium window into an experimental station

1.3 Applicability

The use of this procedure is applicable to beamline scientists, engineers, APS Floor Coordinators, and other APS safety personnel.

1.4 References

ESH Manual chapters 4.6, *Beryllium* & 4.5, *Chemical Carcinogens*

DOE G440.1-7A *Implementation Guide for use with 10 CFR Part 850, Chronic Beryllium Disease Prevention Program*

25 March, 2008 Memo from Steve Eagles to Tom Barkalow *Window clean-up procedure review* (APS_1258059)

1.5 Type of Procedure

Clean-up & disposal

Procedure

Designated cleanup personnel – Only a trained APS Floor Coordinator, Beamline scientist, or APS ESH Coordinator may perform the cleanup and disposal of a broken beryllium window following this procedure. This person will be designated as the Event Beryllium Coordinator (EBC) for the current event. A list of predesignated, trained EBCs will be maintained by the APS Chemical Hygiene Officer (CHO). All logging of the event will be done by the APS CHO for reporting and tracking purposes. The event may be logged into the Floor Coordinator log only to serve as a reference to the event. The AES-UES group maintains a cleanup kit for Beryllium.

Types of Beryllium incidents:

1. **A Broken Beryllium Window on an X-ray Detector** - X-ray detectors are equipped with a thin beryllium window that is mounted on the end of the detector probe by the manufacturer. Typically, the beryllium window breaks into the detector should the window rupture while under vacuum. In such instances, the level of beryllium contamination must be assessed prior to packaging and sending the detector back to the manufacturer for repair.
2. **A Broken Beryllium Window Under Vacuum** – On occasion, a beryllium window may rupture while under vacuum on the beamline due to an unanticipated overpresssurization of the vacuum system. In such instances, fragments of the beryllium window have been known to travel as far upstream as the turbo pump.
3. **A Broken Beryllium Window Into An Experimental Station** – Sometimes a beryllium window that is mounted within a flange may break during initial installation within the experimental station or during other work downstream from the window that could create the potential for beryllium window fragments to rupture into normally occupied portions of the experimental station.

CAUTION: **If any** conditions are observed where there are unknown factors present such as a visible oxide, or undetermined residue has formed on any Be window fragments that appears to be potentially friable, (can easily crumble into a dust or powder), cleanup should be delayed until the industrial hygienist can be called to the location to conduct an evaluation. Avoid disturbing this material.

- The user or beamline scientist must contact the on-duty Floor Coordinator by calling 2-0101.
- The Floor Coordinator will:
  - Immediately secure the area and post as **DANGER: Suspect Beryllium Contamination.**
  - Place a tacky-mat at the entrance to the experimental station.
  - Contact the APS Chemical Hygiene Officer (Paul Rossi 2-4192; 4-4492) and/or any APS ES&H Coordinator (Elroy Chang 2-6714; 4-1888, Jim Lang 2-7021; 4-1585 or Paul Rossi).
  - Contact EQO-Industrial Hygiene to perform wipe sampling of the detector and surrounding areas.
  - If the CHO, an APS ES&H Coordinator, or EQO-IH determine that a HEPA-filtered vacuum is needed follow the instructions for the vacuum below.
- The EBC will:
  - Don nitrile gloves, safety glasses, tyvek coat, and shoe covers
  - Pick up any noticeable beryllium fragments using small pieces of sticky tape and place into a small plastic Ziploc bag.
  - If the window was on a detector, remove contaminated detector and immediately place into a plastic bag.
  - Tape the bag and label as **DANGER: Contaminated with Beryllium. Do Not Remove Any Fragments by Blowing or Shaking. Cancer Hazard and Lung Disease Hazard.**

  - Wipe down surrounding areas with solvent wipes.
  - Place all used solvent wipes into a plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- Upon exiting the experimental station, remove all PPE and place into another plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- Place the used tacky-mat into a plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- The Floor Coordinator WILL NOT release the area unless instructed by the APS Chemical Hygiene Officer, APS ES&H Coordinator or EQO-Industrial Hygiene.
- The APS CHO will then enter the contaminated equipment information (i.e., location used, model number, serial number) into the Be window log and update the log upon notification of the final status of the equipment by the equipment owner.
- Sampling results will typically be available from EQO-Industrial Hygiene within 1-2 weeks. If the results show no detectable beryllium contamination, then all used PPE and tacky-mat may be disposed of in the regular trash and labels may be removed from any equipment identified as **DANGER: Suspect Beryllium Contamination Inside.** If sampling results show detectable beryllium contamination above the DOE threshold, then all used PPE and tacky-mat must be disposed of as chemical waste and all contaminated equipment must be relabeled as **DANGER: Contaminated with Beryllium. Do Not Remove Any Fragments by Blowing or Shaking. Cancer Hazard and Lung Disease Hazard.**
- Complete a WMO-197 Chemical Waste Requisition and dispose of the beryllium window fragments through ANL Waste Management Operations.

Notes:

<u>If Be contaminated items are to be removed from the bag for decontamination</u>:

- The EBC will immediately move the bagged items into a chemical fume hood that is rated for carcinogen use (note: the flow rate at the face of the hood must be 135 fpm +/- 15).
- The EBC will post the face of the hood as **DANGER: Cancer Hazard.**
- Note: The decontamination and/or replacement of such items while at the APS must then be handled under a separate carcinogen handling procedure.

<u>If a piece of beryllium contaminated equipment is to be shipped back to the manufacturer</u>:

- The Window Owner will:
  - Provide MSDS for beryllium and/or beryllium oxide when preparing equipment for shipment back to the manufacturer.
  - Provide either the APS Chemical Hygiene Officer or any APS ES&H Coordinator with the ANL-126C Shipping Order number and shipping address so that he/she can send an email to the ANL Shipping Department to

inform of the upcoming shipment. In some instances, he/she may also need to send a duplicate email to ANL Export Control for international shipments.
- Contact the ANL Shipping Department (2-5712 or 2-2934) to arrange for the old detector to be transported from the APS to Bldg. 46.

If preparing the contaminated items for disposal through ANL Waste Management Operations,
- The Beamline SWAA Owner will complete a WMO-197 Chemical Waste Requisition. The bagged Be waste is to be labeled and placed in the beamline SWAA to be made ready for WMO pickup.

HEPA-filtered vacuum procedure:

If the APS CHO, an APS ES&H Coordinator, or EQO Industrial Hygiene determines that a HEPA-filtered vacuum is needed for the cleanup then:
- The EBC will:
  - Obtain a HEPA-filtered vacuum and the tools that may be necessary in order to disassemble any equipment or flanges in the cleanup process.
  - Enter into the HEPA-filtered vacuum logbook the date and location that the vacuum was used for beryllium clean-up.
- A second person must use the HEPA-filtered vacuum along the areas where the equipment is being breached prior to accessing any interior surfaces,
- Once the equipment is disassembled, EQO-Industrial Hygiene will then perform wipe sampling of the interior surfaces to the extent that is physically practical.
- Any noticeable beryllium fragments may then be picked up using small pieces of sticky tape and placed into a small plastic Ziploc bag.
- Use the HEPA-filtered vacuum over the entire interior surfaces of the equipment to the extent that is physically possible.
- EQO-Industrial Hygiene will then perform final wipe sampling of the interior surfaces of the equipment that was disassembled.
- Reassemble the vacuum chamber, beam pipe, or other equipment and temporarily label as **DANGER: Suspect Beryllium Contamination Inside.**
- If a vacuum pump was disassembled and is to be reassembled.
  - if the pump is an ion pump it may be reassembled for use and tagged as **DANGER: Suspect Beryllium Contamination Inside**
  - - OR –
  - If the pump is a turbo pump or other pump capable of dispersing Beryllium it may be bagged and tagged as **DANGER: Suspect Beryllium Contamination Inside** and replaced with a new pump.
  - Note: Any decontamination efforts of a beryllium contaminated vacuum pump while at the APS must then be handled under a separate carcinogen handling procedure. If preparing the contaminated vacuum pump for disposal through ANL Waste Management Operations, complete a WMO-197 Chemical Waste Requisition.

- Upon exiting the experimental station, remove all PPE and place into a plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- Note: Leave all tools and the HEPA-filtered vacuum inside the experimental station as well.
- EQO-Industrial Hygiene will then perform final wipe samplings of the tools, HEPA-filtered vacuum, the floor and any horizontal surfaces per their discretion.

Documentation Required

- Floor Coordinator Shift Log (for reference to the event).
- APS CHO Be Window Log
- WMO-197 Chemical Waste Requisition

Training and Additional Requirements

To be designated as an Event Beryllium Coordinator:

- ESH 211, *Beryllium Awareness Training* (required)
- ESH 574, *Chemical Waste Generator* (required)
- ESH 456, *Chemical Waste Certifier* (needed for completing WMO-197 only)
- ESH 246, *Safe Handling of Carcinogens* (recommended)
- JHQ changed to reflect clean-up personnel as having the potential for low-level exposure to beryllium

PPE required for cleanup: nitrile gloves, safety glasses, tyvek coat, and shoe covers.

DOE AL – Action Level = 0.2 micrograms/m^3 of air
OSHA PEL – Permissible Exposure Limit = 2 micrograms/m^3

DOE Surface Clearance Level for equipment = 0.2 micrograms/100 cm^2 of surface

Adherence to DOE levels is required for ANL operations.

Any improvements or corrections to this procedure may be submitted here
(http://www.aps.anl.gov/Internal/Policies_and_Procedures/comment_form.php)