

XFD Safety Report for FY 1998

1. Introduction

An important element of XFD's mission is ensuring the safety of APS users, visitors, and APS/XFD personnel, and the protection of the environment. In keeping with Integrated Safety Management (ISM) Core Function 5, "provide feedback and continuous improvement," XFD is initiating periodic reporting of its safety-related activities and statistics, beginning with this summary for FY 1998.

2. Safety Training for XFD Personnel

Determining Training Requirements

The safety training requirements for most XFD personnel are determined by completing an ANL Job Hazard Questionnaire (JHQ). This document is used to identify the hazards employees encounter on the job. Approximately once each year, employees and their supervisors jointly review the JHQ to ensure that it reflects the employees' current assignments.

The data from completed JHQs are entered into ANL's Training Management System (TMS), a database that uses the JHQ responses and Division input to identify each individual's training requirements. The system produces a report, known as a Training Profile, that lists required and suggested training, dates when training was completed, and dates by which training/retraining must be completed.

XFD supervisors and managers have real-time access to the records of those they supervise through a password-protected Web-based window into the TMS. This enables them to verify that appropriate training is in place before assigning work. Employees also have access to their own records.

Computer-Based and Web-Based Training

The following courses are available as computer-based training (CBT) administered by the XFD ES&H Office:

- ESH738, General Employee Radiation Training
- ESH700, Radiological Worker Training – Level 1
- ESH702, Radiological Worker Training – Level 2
- ESH707, Accelerator Worker Radiation Safety
- DIV832, Chemical Hazards Training – Agents that Damage the Skin, Mucous Membranes and Eyes
- DIV834, Chemical Hazards Training – Corrosives, Irritants, and Sensitizers

The following courses are available via the Web:

- ESH108/382, Building Safety Orientation
- ESH108/400/401, Building Safety Orientation

- ESH223, Computer Protection
- ACIS/Tunnel Safety Courses
- Orientation for Chemical Management System Users (Nonmandatory)

Radiological Worker Training

All XFD personnel are required to complete ESH738, *General Employee Radiation Training* (GERT), and/or other courses from the following list as required by their work assignments:

- ESH700, *Radiological Worker Training – Level 1*
- ESH702, *Radiological Worker Training – Level 2*
- ESH707, *Accelerator Worker Radiation Safety*
- ESH709, *Sealed Radioactive Source Custodian*
- ESH713, *Radiological Worker Training for X-ray Users*
- APS457, *APS Experimental Facilities Division X-Ray Laboratory Training*

Most of these courses have both refresher and retraining requirements, which are met by attending courses with slightly different content and different course numbers.

Training Completed by XFD Personnel

To date, XFD personnel have attended more than 40 different safety courses and have collectively completed approximately 2,935 hours of training

Training Compliance Progress

XFD's compliance with training requirements, as calculated by TMS, has improved steadily throughout FY 1998 to 98.7% as of October 5, 1998.

3. Safety Training for Users

The responsibility for APS user safety training is shared by the APS and the CATs. This training falls into three broad categories:

“Core” training is required for all APS users and is administered by the APS User Office. As of July 30, 1998, 1,070 APS users have completed the core training program, which consists of the following elements:

APS User Orientation: This Web-based orientation, developed and updated as needed by XFD staff, is currently being delivered to newly arrived APS users via on-site computers; some preliminary experiments with remote delivery to users at their home institutions have been conducted. The general orientation course covers ANL and APS policies; general safety information such as site alarms, the use of 911, hazard communication, radiation safety, and experiment safety; and the basics of the beamline Personnel Safety System (PSS). Additional safety information is provided by the *APS User Guide* and the pocket-

sized *APS User Safety Guide*, both prepared by XFD staff; these booklets are part of the user registration package and are also posted on the Web. All incoming users sign a statement confirming that they have read and understood both the *APS User Guide* and the User Orientation and will follow the guidelines given there.

General Employee Radiation Training (GERT): The GERT training is a general APS requirement consistent with DOE policy. APS users who do not have a current GERT card from another DOE facility must pass a computer-based GERT exam. They may prepare for the exam by taking a CBT course at the APS or via the Web, or by reading a hard-copy study guide, which is part of the user registration package.

Sector-specific training is also required for all APS users; it is administered by the CATs. To facilitate this training, XFD has provided a model checklist of topics to be covered; each CAT may modify the list as necessary. The training focuses on communicating specific information needed to implement the CAT's safety plan; examples include locations of utility shutoffs, chemical storage locations and practices, and beamline-specific operation of the PSS. The CAT signs off on the checklist and sends a copy to the APS User Office to verify that each new user who will be working under its auspices has completed this training. To date, the User Office has received signed-off "sector orientation records" for 797 APS users.

Task-specific training is the third element of APS user training. The CATs identify task-specific training needs for their personnel and users in accordance with their CAT safety plans. Qualified CAT staff members may perform some of this training themselves; two examples are training users to operate the hoists in the experiment stations and orienting experienced machine tool users to the CAT's machine shop. Many other task-specific training needs are met, in whole or in part, through courses offered by ANL's ESH Division; the XFD ES&H Coordinator's office handles user enrollments in these courses. XFD supports the course selection process both by one-on-one consultation with users and by maintaining an XFD-developed computer program that matches available courses and certifications to planned activities. XFD has also worked closely with the ESH Division's Training Section (ESH-TR) to tailor courses and course requirements to APS users' needs. A recent example is the condensed DOT HazMat Worker Training course described in Section 5 below. To date, APS users who are not employed by ANL have taken a total of 33 different optional and required ESH-TR courses and have collectively completed approximately 347 hours of formal ESH-TR training.

4. Support Services Provided by the ANL ESH Division

Dosimetry

At present, permanent dosimeters are assigned to approximately 182 XFD employees and 447 APS users. (Users who plan to spend only a short time at the APS are generally given temporary dosimeters.) In CY 1997, the total cumulative dosage received by all XFD personnel and APS users was 40 mrem. (The maximum permissible dose for a single individual classified as a "non-radiation worker" is 100 mrem/yr.) For the period January-September 1998, the total cumulative dosage received by all XFD personnel and APS users was 20 mrem.

Industrial Hygiene Surveys

In March 1998, XFD personnel were surveyed for exposure to hazards associated with flame spray deposition of metals. Exposures to chromium and nickel were found to be well below

permissible limits. Noise exposures continued to be high. Affected personnel already participate in a hearing conservation program and will continue to do so.

5. Processes and Procedures

Transporting Small Quantities of Hazardous Materials

The ANL Transportation Safety Board recently approved an XFD proposal to allow APS users to bring small quantities of certain nonradioactive hazardous materials (HazMats) directly to the APS in personal or rental vehicles, when packaged and transported in accordance with U.S. Department of Transportation (DOT) "Small Quantity Exception" regulations. The transport of these materials must be pre-approved by the CAT that is hosting the user's experiment, as part of the experiment safety review process described in Section 11 below. A condensed DOT HazMat Worker Training course has been provided to representatives of all the APS CATs to enable them to provide users of their beamlines with appropriate guidance and review. (A number of XFD staff members have also taken this course.) The training included an overview of other relevant DOT requirements and a brief review of DOT enforcement activities.

Working with Radioactive Samples

Users have begun doing experiments with radioactive samples at the APS. These samples present new requirements in terms of nuclear material accountability and radiation safety. XFD Operations personnel are working closely with Health Physics personnel in ANL's ESH Division to establish guidelines and develop procedures, and with the CATs to prepare and plan for these experiments. Certain categories of radioactive samples fall into the "accountable nuclear material" category, which carries with it additional DOE-imposed requirements for sample accountability and movement. A Web-based database is being developed to provide sample accountability by tracking the arrival of samples at the APS, sample movement between beamlines, and final disposition at the completion of the experiment. Preparations are underway to construct a dedicated area at the APS for receiving sample shipments and checking the integrity of the containment. Work is also ongoing to generate detailed radioactive-sample safety envelopes (see Section 11 below), which will classify samples and activity levels into well-defined categories with corresponding, predefined safety requirements. This information will greatly reduce the amount of time required by the CATs to plan experiments with radioactive samples.

Chemical Tracking System

In August 1998, XFD completed an inventorying activity that resulted in the bar-code labeling of Division-owned chemicals and the creation of records for these chemicals in the ANL Chemical Management System, or CMS. (Formerly, XFD had maintained records in an internally administered database.) Concurrently, the APS procurement system was enhanced to provide for the automatic entry of new chemicals into CMS at the time of purchase. Plans are now being made to bring APS users into the system.

Laser Safety

ANL's Laser Safety Officer (LSO) or Deputy LSO inspects all new Class 3b and Class 4 laser installations at the Laboratory before they are put into service, specifies required hazard controls, approves Standard Operating Procedures, and verifies that all laser operators (including APS users) are properly trained. The LSO and Deputy LSO are employees of the ANL ESH Division. Each CAT that uses a laser in one of the above classes has designated a Laser Custodian to ensure that the recommended controls, procedures, and training are implemented. The XFD ES&H Coordinator has received the necessary training to serve as a Deputy LSO if the need arises.

6. XFD Operational Safety

The World Wide Web is used extensively to convey operations and safety related information to the APS staff and users. All faults in XFD systems are recorded in the Web-based Trouble Reporting System. All planned work is entered into a Work Request System for approval and scheduling. Both of these systems provide a readily available database of information for tracking and trending faults and planning future work. Equipment tracking system information is provided through the Web for quick access to specific equipment failure and repair records. APS staff can use the Web to access the names and local phone numbers of designated contacts (XFD personnel for insertion device or front-end system faults, and CAT personnel for abnormal beamline situations). Emergency shutdown procedures for all systems are available on the Web to facilitate quick response in emergency situations. The configuration management records for beamline shielding are available to Operations personnel and can be easily updated by the Floor Coordinators as shielding status is changed. The Web also provides a record of current approved operating safety envelopes for all the beamlines.

7. XFD Occupational Injury Experience

Nature of Incident	No. of Lost Work-days	No. of Restricted Workdays	Corrective Actions
1. While helping a custodial worker put trash into a dumpster, an employee slipped on a patch of ice and received a bruise.	0	0	More thorough snow removal from the area was requested.
2. A gasket failed after an employee changed a filter assembly in a high-pressure water system; the spraying water knocked him into a wall and caused a possible minor corneal abrasion.	0	0	The supervisor prepared a written procedure for the task that described the hazards and the required hazard controls.
3. An employee fabricated a makeshift tool, dropped it during use, and suffered a puncture wound in his palm while trying to catch it as it fell.	0	0	The task for which the tool had been fabricated was discontinued.

8. User Safety Experience

Observations	Corrective Actions or Comments
1. CAT personnel observed a user working with <0.5 g of uranyl acetate (<280 nCi/g) in a lab that was not a Radiological Control Area. The CAT stopped the work and ordered a survey; no contamination was found.	The CAT has implemented more stringent requirements for supplying information via the Experiment Safety Approval form and instituted additional confirmations of that information.
2. A shipping firm rejected two hydrogen sulfide cylinders (one empty, one holding about 20 g) packaged by CAT personnel for off-site shipment. The shipment was accepted after the ANL Shipping Department provided assistance.	The CAT was instructed in the proper procedures for shipping hazardous materials to/from ANL.
3. A CAT was using a class 3b laser to align a class 4 laser without proper safeguards and prior authorization by the ANL Laser Safety Officer (LSO). The CAT's work on that beamline was stopped while XFD and the LSO worked with the CAT to ensure proper setup and operation of the Class 4 laser.	Class 2 lasers are now used for alignments as recommended. This CAT's laser installation has become a model for proper implementation of safeguards and standard operating procedures.
4. A user group removed chemical waste from the APS because of a misunderstanding of waste disposal procedures.	The CAT and experimenters received additional instruction about waste handling; CAT staff members have received the necessary training to properly accumulate and certify waste for pickup.
5. A user performed an experiment with samples that contained a small quantity (<200 µg) of methylmercury. The samples were pre-encapsulated before arrival at the APS. The CAT had implemented proper hazard analysis, transport controls, personal protective equipment, signage, and standard operating procedures for the experiment.	In an independent assessment of the CAT's safety program, its management of these samples was cited as a "noteworthy practice."
6. The odor of thiophenol was detected outside a CAT's chemistry lab while a user was working with thiophenol in a hood in the lab. An industrial hygienist from the ESH Division investigated and determined that no risk was posed by the level of exposure that occurred.	The industrial hygienist gave the experimenters additional instruction about working with this and similar compounds. No similar incidents have occurred since.

9. Safety Surveys and Results

Between August 1997 and the time of this writing, XFD has conducted three self-assessments of its safety programs. In each case, a comprehensive survey of employees at all levels was used to gather the needed information. The scope and results of each self-assessment are summarized below.

XFD Integrated Safety Management Self-Assessment, August 1997: This self-assessment was designed to evaluate the degree to which XFD's activities incorporate the seven guiding principles and five core functions of ISM. Most XFD employees indicated that they are fully participating in, and seeing the benefits of, this integrated approach. The results also indicated that XFD's primary opportunity for safety improvement was in the area of supervisor participation in inspections. The Division followed up by having its managers implement the DuPont Safety Training Observation Program.

XFD Hazardous Materials Management Practices Self-Assessment, December 1997: This self-assessment looked at the degree to which XFD personnel understand and carry out assigned responsibilities and comply with ANL requirements for hazardous materials management. The results indicated a high level of awareness of and compliance with the requirements for procurement, storage, use, labeling, hazard communication, waste management, etc., and the application of good management practices. Some areas for improvement were identified, and corrective actions were implemented by XFD Group Leaders. These actions included initiating regular inspections of chemical labs and satellite waste accumulation areas and reminding Principal Investigators of the need to develop work plans and consult more closely with the Lab Safety Captains.

Gap Analysis for the Experimental Facilities Division, August 1998: This self-assessment was similar in scope to that of August 1997 (discussed above). The survey questions were designed to measure the degree to which XFD's practices met ISM criteria. Only minor gaps were identified. A corrective action plan is being formulated; it will include efforts to better communicate existing policies, guidance, and inspection results to XFD personnel.

10. Independent Assessments and Audits

During FY 1998, XFD was the subject of independent oversight activities and audits covering the following areas:

Chemical Vulnerability, January 1998: This audit was conducted by a team of representatives from ANL's ESH/QA Oversight Group (EQO) and the DOE. The activity verified determinations previously reported by XFD in conjunction with its December 1997 Hazardous Materials Management Practices Assessment (see above). No findings resulted. The report recommended the integration of Divisional inventory databases into CMS, as XFD was already planning to do.

Radiation Protection Program, March 1998: ANL's ESH Division assessed the radiation protection programs implemented by both APS Divisions. The XFD program was found to be in compliance with 10 CFR 835 and Chapter 5 of the ANL *Environment, Safety and Health Manual*.

The resulting report contained no safety-related findings or observations, and took note of five noteworthy procedures or processes.

ESH Training, April 1998: This review was conducted by representatives from DOE's Argonne Group as part of an ANL Program Review. No findings pertaining to XFD resulted; the report characterized XFD training records as "well maintained and complete" and acknowledged XFD's noteworthy practice of prohibiting certain activities unless required training had been verified.

Hoisting and Rigging Program, May-June 1998: This ANL-wide review was arranged and conducted by EQO with technical support provided by various ANL staff members. No findings or recommendations pertaining to XFD resulted.

Biosafety/Infection Control, July 1998: This review was conducted by representatives from DOE's Argonne Group as part of an ANL Program Review. No findings pertaining to XFD resulted. However, the DOE did recommend that XFD obtain evidence of training completed by APS users from other ANL Divisions. (XFD had already made arrangements for access to the TMS records of APS users who are not ANL employees.) XFD will inform the CATs that it may ask for evidence/documentation of training during experiment safety review oversight activities (see Section 12 below).

11. User Experiment Safety

The CATs have the primary responsibility for safety reviews of proposed experiments. The information needed to perform these reviews is obtained through the use of a standard APS Experiment Safety Approval Form (ESAF). In addition, some CATs have instituted more detailed experiment and safety questionnaires to be submitted with users' proposals. The forms are completed by the experimenter, who describes the materials and equipment to be used, the known hazards, and the ways in which these hazards will be mitigated. The CAT Director or designated safety coordinator reviews the information and makes recommendations as needed. The CATs may ask the XFD Experiment Safety Review Coordinator or the XFD ES&H Coordinator to advise them on mitigating potential hazards, or to participate in the review process. When the safety review is completed, the CAT Director or designee lists any required hazard mitigation measures and signs off to indicate approval of the experiment. Before the experiment may begin, an individual designated by the CAT also verifies that all required safeguards are in place and signs the form. An APS Floor Coordinator posts the form at the beamline for the duration of the experiment. An XFD committee oversees the CAT experiment safety review process to ensure compliance with ANL safety requirements and to provide additional guidance on safety-related issues. This committee meets weekly to discuss ongoing and future experiments. The XFD Experiment Safety Review Coordinator serves as the liaison between the CAT Safety Coordinators and the APS.

The numbers of users and experiments at the APS, as reported on ESAFs, greatly increased during fiscal year 1998; 540 experiments were carried out in the course of 2,012 "user visits" involving 822 different individuals.

The APS is currently implementing two methods to assist the CATs with their experiment safety review process. The first, a Web-based system for the submission and approval of ESAFs, is currently in final beta testing and is expected to be implemented in early FY 1999. When a user submits an ESAF on-line, it will be transmitted to the appropriate CAT and, concurrently, to the XFD Experiment Safety Review Coordinator, who will be able to insert comments about any safety concerns the APS may have; those comments will be automatically transmitted to the CAT

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Safety Coordinator. The XFD Experiment Safety Review Coordinator will be notified when the CAT approves the experiment. When the users are ready to begin the experiment, the ESAF will be printed out for sign-off and posting as described above.

The Web-based system also includes safety guidance for the experimenters and the CATs. The guidance is based on the materials, hazards, and equipment that the experimenter checks off on the ESAF. The system will display either the requirements for working with a particular hazard or a link to other documentation on mitigating the hazard.

The second form of assistance that is now being implemented is a standard set of APS “experiment safety envelopes,” which group proposed experiments on the basis of hazards. These envelopes have been developed in accordance with a graded approach that takes into account the severity of the hazards. Each envelope specifies a set of controls, including procedural and engineered controls, restrictions, shipping guidance, training requirements, and additional safety guidance references, that is sufficient to provide for the safe conduct of all individual experiments in that class. In addition, a set of Safety Guidelines for certain hazards is appended to the safety envelopes document. The guidelines provide more detailed information for working with individual hazards. When reviewing and approving an experiment, the CAT chooses the applicable envelope(s) and ensures that the specified controls are in place. The envelope(s) applicable to a given experiment are also listed on the ESAF that is posted at the beamline during the experiment.

The nine APS Experiment Safety Envelopes are:

1. APS Base Hazard Class
2. Cryogenic Hazards
3. High Temperatures
4. Class 3 and 4 Lasers
5. High Pressure Systems
6. Chemicals
7. Biosafety
8. Radioactivity
9. Other Hazards

The envelopes are currently being reviewed by the APS Research Directorate. The envelope descriptions will be posted on the Web and put into effect as soon as they are finalized. There will also be a link from the Web-based ESAF Safety Guide, which will list suggested envelopes for each experiment based on the hazards noted on the corresponding ESAF. The final determination of applicable safety envelopes is made by the CAT during the experiment safety review process.

12. Safety Oversight

XFD Walkthroughs

During FY 1998, XFD conducted a number of routine walkthrough inspections of spaces occupied by XFD employees and APS users. It also conducted one inspection in response to an Immediate Action Request from the ESH Division.

Ergonomics Walkthrough, September-October 1997: XFD personnel inspected office spaces as part of an ongoing self-assessment that focused on ergonomic issues. At XFD’s request, an ergonomics specialist from the ESH Division participated. The observations resulted

in substantial modifications to two XFD staff members' offices and minor modifications in other locations.

General Walkthrough, October 1997: XFD personnel conducted a general walkthrough of XFD- and CAT-occupied spaces. The walkthrough resulted in 25 observations that required follow-up; three of these remain open at the time of this writing.

General Walkthrough, February 1998: XFD personnel conducted another general walkthrough of XFD- and CAT-occupied spaces. The invited participants included a fire protection specialist and a safety specialist, both from the ESH Division. The walkthrough resulted in 13 observations that required follow-up; all have since been closed out.

General Walkthrough, July 1998: XFD personnel conducted another general walkthrough of XFD- and CAT-occupied spaces. The invited participants again included a fire protection specialist and a safety specialist from the ESH Division. The walkthrough resulted in several observations that required follow-up; all have since been closed out.

Immediate Action Request, July 1998: The ESH Division asked XFD to review the potential for localized oxygen-deficient or other hazardous atmospheres. In response, the XFD ES&H Coordinator and User Technical Interface Group Leader conducted a walkthrough of XFD- and user-occupied spaces. The only observation of note was a previously identified concern related to the use of liquid nitrogen. Owing to anticipated changes in the liquid nitrogen distribution system and the lack of any previous problems, further investigation will be deferred until the new system is put in place. However, the potential for catastrophic releases will be considered during the design of the new, centralized distribution system.

Independent CAT Safety Assessments

To take advantage of the CATs' growing experience in managing their own safety programs at the APS, XFD has initiated the formation of three Independent CAT Safety Assessment groups, within which the CATs conduct reciprocal assessments of each other's safety programs. XFD has provided a set of model assessment criteria. Each of the CATs currently in residence at the APS has named a representative to one of these groups, and the XFD Experiment Safety Review Coordinator is an ex officio member of all three groups. Each CAT is reviewed by the other CATs in its group at least annually, on a rotating basis. After a given CAT is reviewed, it receives a written report (which is copied to XFD) identifying action items and a schedule for completing these actions. The groups are also encouraged to make recommendations to the APS for enhanced safety support. Groups I and III have already started their assessment programs, and Group II will do so in early FY 1999.

The CATs' group affiliations, sector assignments (in parentheses), and assessment dates are shown below.

Group I			Group II		Group III	
BESSRC (11, 12)	2/98	1/99	IMM (8)		Bio (sector 18)	
CMC (9)	6/98	4/99	MHATT (7)		CARS (sectors 13, 14, 15)	
DND (5)	9/97	10/98	m (6)		IMCA (sector 17)	
SRI (1, 2, 3)	7/97	7/98	PNC (20)		MR (sector 10)	
			UNI (33, 34)		SBC (sector 19)	6/98

The Independent Safety Assessment model criteria include (but are not limited to) the following steps:

1. CAT safety overview presentation (CAT safety organization, communications, training, operations, safety planning, safety inspections, unique hazards, incident reports, follow-ups, lessons learned, etc.).
2. Questions by assessment team and inspection of safety-related records.
3. Walkthrough of CAT sector(s) and labs.
4. Executive session and close-out (report writing, action item identification, mitigation schedule, report to CAT of findings, recommendations to APS for safety improvements, and report distribution).

13. XFD Safety Communication Activities

Safety Communication with XFD Employees

Group Meetings: The XFD ES&H Coordinator attends all meetings of the Experimental Floor Operations Group; since the XFD Floor Coordinators belong to this group, user safety issues are always a subject of discussion there. He also participates in most of the meetings of the other XFD groups, where he discusses general and group-specific safety issues.

Division Meetings: Safety issues are discussed at most XFD Division Meetings, which are held approximately twice a year. At the most recent Division Meeting, the Division Director reviewed the findings of XFD's August 1997 Integrated Safety Management Self-Assessment.

Safety Communication with APS Users

XFD has several forums for regular safety-related communication with APS users. At the quarterly APS Research Directorate Meetings, XFD management formally presents new safety policies and guidance to the CAT Directors as a group, and discusses any generic safety concerns that are best addressed by the CATs in a "top-down" manner. At the weekly "CAT Chats," XFD management discusses safety issues directly with the CAT staff members who manage and carry out the CATs' day-to-day activities on the experiment floor. In addition, safety information is made available to the entire user community both through the quarterly publication *CAT Communicator* (which is mailed to about 1600 APS users) and via the APS Web site.