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CRITICALITY SAFETY TRAINING AT THE HOT FUEL EXAMINATION FACILITY

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The Hot Fuel Examination Facility (HFEF) Complex comprises four hot cells and out-of-cell support facilities operated by Argonne National Laboratory at the Idaho National Engineering Laboratory near Idaho Falls, Idaho. Its basic missions are to support the U.S. Breeder Reactor Program and to provide state-of-the-art facilities for development of remote handling equipment and technology. Because significant quantities of solid fissile materials, both fresh and irradiated, are handled in a variety of configurations, the HFEF criticality safety programs represent a major effort.[1]

The cornerstone of the program is training in the basic theory of criticality and in specific criticality hazard control rules that apply to HFEF. Our philosophy is that rules and regulations are better accepted by Operations personnel after there is a thorough understanding of the reasons why the rules exist. In our training more emphasis is placed on the "Why" of a rule than the rule itself. All professional staff and supervisory personnel, as well as fissile material handlers, must satisfactorily complete this training annually. To provide the training, a multimedia program using videotapes, workbooks, and live instruction has been developed and implemented.[2] Topical coverage of the basic theory of criticality is presented as outlined in Table 1. Documentation of this effort is part of the HFEF management system, and training records are subject to audit by the Argonne Criticality Hazards Control Committee and the Department of Energy.[3]

We believe that formal training is vital to combat complacency concerning criticality hazards. Unlike accidents such as falls or fires, criticality has not been in the realm of experience for most workers. Specific rules can thus be perceived as arbitrary and as hindrances to accomplishing assigned tasks. To help overcome such attitudes, we make criticality prevention a high-profile program. Videotaped presentations on basic criticality theory alternate with live lectures presented by the person responsible for criticality safety in HFEF. Even though it

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requires a significant commitment of time, we believe all personnel involved in the design of equipment, writing of procedures, and supervision need to be trained. A recent study of 421 criticality safety violations indicated that 85% were associated with faulty practices; the rest were due to mechanical failures.[4] It is our experience that mandatory training and testing actually help to reduce pressure on the individual since everyone must participate, regardless of their background. Feedback and discussion are encouraged in each training session, so the program is enriched by shared experience. This tends to reduce personal prejudices and build a common base of knowledge. In turn, communications between individuals and groups with diverse responsibilities are facilitated.

The Manager of the HFEF Complex has authorized a single professional staff-member to oversee implementation of the criticality prevention program. This individual works closely with the training coordinator and the operations manager to assure that all personnel are qualified, and that all procedures involving nuclear fuel are reviewed and approved prior to implementation. A major effort in his area of responsibility is to maintain a high degree of visibility and rapport with the fissile material handlers. This is considered essential in the implementation of our criticality training program. Feedback from the operators is important to assure the constant review of equipment and methods. To be effective, the person responsible for criticality safety must be one of the first to know of any problems on the operating floor. He must have the confidence of management, experimenters, and designers so his guidance concerning operational decisions and facility modifications will be credible. The HFEF management plan calls for a review of new or modified procedures and equipment by this person. The earlier his involvement, the smoother the process. By maintaining communication between Operating personnel and persons responsible for Safety, the probability of accidental criticality is minimized.

REFERENCES

1. A. S. Garcia, et al., "Administrative Practices for Criticality Safety at The Hot Fuel Examination Facility," Trans. Am. Nucl. Soc. 38, 365 (1981).

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3. F. L. DiLorenzo, et al., "Hot Fuel Examination Facility Operating Philosophy and Experience," Proc. 29th Conf. Remote Syst. Technol., 3 (1981).

4. R. C. Lloyd, et al., "Assessment of Criticality Safety in DOE Facilities," Pacific Northwest Laboratory Report PNL-3790 (May 1981).

TABLE 1

Basic Theory of Criticality

Objective and Introduction

Basic Nuclear Physics
- Atomic and Nuclear Structure
- Radioactivity
- Neutron Reactions

Nuclear Fission
- Nuclear Fuels
- Breeding
- Fission Products
- Neutron Production
- Energy Release
- Consequences of Accidental Criticality
  - Prompt Radiation-Shielding
  - Contamination-Containment
  - Facility Damage-Recovery Costs
- Termination of the Chain Reaction

Factors that Influence Criticality
- Critical Mass
- Facility Zones
- Shape of Fuel Masses
- Neutron Interactions of Adjacent Units
- Isotopic Enrichment
- Moderation of Neutrons
- Poison Materials
- Neutron Reflection

Criticality Control at The HFEF
- Facility Design
- Radiation Instrumentation
- Equipment and Process Design
- Fuel Handling Rules

Summary