Training for Nuclear Criticality Safety will be offered approximately once a month. Class size is limited to 18 persons. For specific dates and reservations, please telephone Tom McLaughlin or Dave Smith at FTS 843-4789 (505-667-4789). Those attending are required to have a Q-clearance since classes are conducted at Los Alamos Technical Area 18 (Pajarito Site), a secure area. No registration fee is required by employees of the Department of Energy or its contractors. Other students may be accepted on a space available basis.

Individuals attending the training class are responsible for arranging hotel reservations. The two motels in Los Alamos are the Los Alamos Inn (505-662-7211) and the Hilltop House (505-662-2441). We recommend that you make your reservations early, particularly during the summer months.

Albuquerque International Airport is the nearest major air terminal to Los Alamos. Air transportation from Albuquerque to Los Alamos is available from Ross Aviation, Inc. (See the *Official Airline Guide* for information or call 505-242-2811.) Commercial car rentals are available in Los Alamos, or Laboratory taxis (667-5307) can pick you up at the Los Alamos Airport and take you to motels or the class site. Commercial car rentals are available at the Albuquerque airport; the drive to Los Alamos takes approximately two hours.

Los Alamos is located in the Jemez Mountains, approximately 35 miles northwest of Santa Fe, the state capital. The altitude is 7,300 feet. Summer days rarely exceed 85° and the nights are cool. Winter temperatures are cold, but below-freezing daytime temperatures rarely last more than a few days. Tourist attractions in the area include Bandelier National Monument (Indian ruins and hiking trails), downhill and cross-country skiing, Santa Clara and San Ildefonso Indian Pueblos (inhabited), Laboratory and County historical museums, and the city of Santa Fe with art galleries, Indian and Spanish crafts, and fine restaurants.

LALP-82-13
April 1982 1M

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Training for Nuclear Criticality Safety

Sponsored by the
Office of Nuclear Safety

A Department of Energy Program
at Los Alamos National Laboratory
of the University of California

Criticality safety may be described as the art of avoiding an uncontrolled nuclear chain reaction. *Training for Nuclear Criticality Safety* is an intensive two-day program consisting of lectures and laboratory sessions, including active student participation in actual critical experiments. The course is held at the Critical Assemblies Facility at Los Alamos National Laboratory.

The program is directed toward supervisory and senior staff personnel and others with a strong interest in criticality. A basic background in mathematics and science is helpful, but math beyond simple algebra is avoided. Examples and common analogies are used to explain complex concepts and processes.

Lectures provide an appreciation of the fundamentals of criticality. Emphasis is placed on examples of criticality controls that are applied to process and storage systems at Los Alamos and throughout the nuclear community. Lively and instructional discussions help students recognize the actual criticality concerns and controls associated with their particular work situation, as well as appreciate the safety margins involved. Discussions of accident experiences are used to illustrate the influence of system parameters on reactivity and to demonstrate the need for trained, safety-conscious personnel.

In the laboratory sessions, a simple assembly of plastic and enriched uranium foil is stacked by hand up to a neutron multiplication of about 10, then stacking is continued by remote assembly to achieve a multiplication of about 100. A critical assembly machine, such as the plutonium-fueled "flattop" assembly, is used to demonstrate operation at, and slightly above, delayed critical. The influences of delayed neutrons and control rod movements on the time behavior of the assembly are dramatically experienced by participants.

TRAINING FOR NUCLEAR CRITICALITY SAFETY

COURSE OUTLINE

LECTURE SESSIONS

Introduction

- Safety Philosophy
- Radiation Safety versus Criticality Safety

Basic Concepts and Nomenclature

- Atoms and Neutrons, Sizes and Masses
- Neutron Cross Sections
- Fission Process
- Prompt and Delayed Neutrons

Idealized and Real Fissioning Systems

- Neutron Slowing Down
- Neutron Life Cycle
- Multiplications Factor
- Metal versus Solution Systems

Time Behavior of Fissioning Systems

- Delayed Neutron Effects
- Prompt and Delayed Critical
- Reactor Period

Minimum Critical Masses

Practical Criticality Control: Examples

- Slab Tanks
- Annular Tanks
- Poisoned Tanks
- Limited Volume Dissolvers
- Solution Storage in Six-Inch Pipes
- Storage Vaults—Interaction
- Moderation Control—Dry Oxide Processing
- Concentration Control
- Mass Limits

Standards, Guides, Computer Codes, and Other Information Sources

Accident Experience

- Case Descriptions
- Lessons Learned—General Philosophy

LABORATORY SESSIONS

Control Room and KIVA Orientation

Operating Procedures and Limits for Critical Assemblies

Hand-Stacking Experiment

Flattop Operation