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Training and Qualifications at Los  
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**Nuclear Criticality Safety Staff Training and Qualifications  
At Los Alamos National Laboratory  
by**

**S. P. Monahan and T. P. McLaughlin**

Operations involving significant quantities of fissile material have been conducted at Los Alamos National Laboratory continuously since 1943. Until the advent of the Laboratory's Nuclear Criticality Safety Committee (NCSC) in 1957, line management had sole responsibility for controlling criticality risks. Advice and guidance were obtained on an ad hoc basis and typically, but not necessarily, from staff performing critical experiments at the Los Alamos Critical Experiments Facility (LACEF) and research reactor operations at the now closed Omega West site.

From 1957 until 1961, the NCSC was the Laboratory body which promulgated policy guidance as well as some technical guidance for specific operations. During this time, operating organizations were still obtaining most of their criticality advice and controls from LACEF staff. In 1961 the Laboratory created the position of Nuclear Criticality Safety Officer (in addition to the NCSC). This position was filled by Dave Smith for the duration of the office-until 1980. Dave was a staff member in the Critical Experiments Group during this time period. With the creation of this position, Dave gradually handled more and more of the responses to requests for criticality guidance from the operating groups, calling on fellow LACEF staff members for assistance as needed.

In 1980, Laboratory management moved the Criticality Safety Officer (and one other LACEF staff member who, by that time, was also working nearly full-time on criticality safety issues) into the Health Division Office. Later that same year the Criticality Safety Group, H-6 (at that time) was created within H-Division, and staffed by these two individuals. The training and education of these individuals in the art of criticality safety was almost entirely self-reg-

ulated, depending heavily on technical interactions between each other, as well as NCSC, LACEF, operations, other facility, and broader criticality safety community personnel.

Although informal on paper, this self-mentoring program was quite rigorous in practice, relying on the professionalism of the criticality safety staff in maintaining:

1. a genuine interest in helping to accomplish the necessary tasks as efficiently and with as large a safety margin as practical,
2. familiarity with all of the fissile material operations through regular site visits and observations,
3. good rapport and open lines of communication with supervisors and fissile material handlers by demonstrating a high level of competence, helpfulness, and mutual trust, and
4. an interest in learning as a professional by taking part in community activities (society meetings and standards development) and reviews of and involvement in special projects at other facilities.

Although the Los Alamos criticality safety group has grown both in size and formality of operations since 1980, the basic philosophy that a criticality specialist must be developed through mentoring and self motivation remains the same. Formally, this philosophy has been captured in an internal policy, document "*Conduct of Business in the Nuclear Criticality Safety Group*". This governing policy outlines roles and responsibilities and recognizes the need for:

1. In-depth process knowledge in order to perform competent evaluations that consider the relevant credible process upsets, and that this process knowledge is accumulated over time by each staff member through exposure to work site operations both at Los Alamos and sister facilities,

2. a thorough foundation in neutron physics principals,
3. an understanding of handbook resources, computer codes, etc., including the associated advantages, limitations, and applicability,
4. an understanding of the meaning and intent of ANS-8 standards, and other regulations, as these provide the bases and guidance for how work is performed,
5. a willingness and desire to reach out and interact with both operations personnel and staff members within the group to obtain assistance and guidance as needed,
6. a willingness and desire to regularly visit and observe fissile material operations and to share relevant findings with process supervision, operators, and fellow NCS staff,
7. true safety professionalism, i.e., the ability to reach a generally accepted balance of risk vs. cost vs. benefit,
8. continuing growth and commitment in all of these areas,

on the part of the staff members. Fundamental to the success of this policy is the background and personality of the individual. A marked effort must be made to acquire self-motivated people with excellent communication and interpersonal skills, and a helpful, safety-conscious attitude.

The policy is no more specific than this, it does not formally require participation in external activities or courses, checklists of accomplishments, nor any other criteria that might serve as qualifications. Apprenticeship is accomplished through self-motivated interaction with seasoned professionals, not with thick, detailed procedures that would tend to hinder the development and exercising of professional judgment. The degree to which any one staff member meets the above intrinsic and somewhat intangible qualities of a criticality safety specialist is judged subjectively by the group leader, colleagues, and the individuals themselves. In this respect the pro-

profession of criticality safety is not unlike that of a medical specialist. There is no criteria nor adequate checklist of accomplishments for objectively judging the technique of a surgeon, or the expertise of a diagnostic specialist. These professionals are also mentored via residency to a point at which they are subjectively judged by their peers to have achieved the level of required proficiency.

In the past the DOE has recognized the need for senior mentorship as at least one essential element in the development of criticality safety specialists. During the mid-1980s there was an official internship program in which new criticality staff members rotated throughout the complex to gain as broad an experience base as possible. Unfortunately, the program was cancelled after rotating only two members because it was perceived as being too expensive.

More recently, and to their credit, the NRC has also recognized this need, and has on several occasions allowed members of their staff to spend a period of time with the Los Alamos and Fernald criticality safety programs. Their goal was not so much to learn procedures or the evaluation process, but rather to gain a broader perspective on the intangibles of a criticality specialist, such as interactions with operations staff leading to an understanding of credible upset conditions and the application of professional judgment.

Before leaving this point it is important to stress that detailed, specific qualifications have generally not been developed at Los Alamos. It is our belief that such criteria are of major benefit only in providing a means by which an outside entity can judge to what degree individuals have satisfied them. They provide no true means for judging the technical competence, ability, or commitment of an individual.

In summary, there are no short cuts or substitutes in the development of a

criticality safety specialist. A person must have a self-motivated personality, excellent communications skills, a thorough understanding of the principals of neutron physics, a safety-conscious and helpful attitude, a good perspective of real risk, as well as a detailed understanding of process operations and credible upsets. These are largely intangibles that can only be judged by peers and immediate supervision.