Criticality Safety Engineer Specialist Training and Qualification Program

Introduction

There is a need for a documented training and qualification program for new criticality safety engineer specialists at nuclear facilities. The need is being driven by (1) the emphasis on nuclear criticality safety, as nuclear facilities continue to undergo process modifications to support their respective missions; (2) regulatory agencies (e.g., U.S. Department of Energy, U.S. Nuclear Regulatory Commission, IAEA); and (3) the lack of a source of trained criticality safety engineer specialists from the universities.

Background

This white paper was identified by the ANS/NCSD Education Committee as important to meeting the overall mission statement, "To promote development of nuclear criticality safety expertise by providing opportunities that offer technical growth and recognition." One way to promote development of nuclear criticality safety expertise is to have a clear understanding of what is expected in a nuclear criticality safety training and qualification program.

General Discussion

Traditionally, someone had become a criticality safety engineer specialist by on-the-job training and participation in national technical societies and standards activities. Many criticality safety engineer specialists have scientific or engineering degrees (e.g., chemical, mechanical or nuclear engineering); however, there are very few universities with a program that specialize in nuclear criticality safety topics. Many chemical or mechanical engineers understand the industrial operations and processes; but have little appreciation for the physics of nuclear criticality safety. Most nuclear engineers are well grounded in reactor physics and in the operation and construction of computer codes; but have little appreciation for industrial operations and process or for the traditions and requirements of nuclear criticality safety control implementation and analysis documentation.

A nuclear criticality safety training program should be developed with the cooperative involvement of management, supervision, and nuclear criticality safety staff. The training program should include specific learning objectives, program structure, program content, and program evaluation. Adequate documentation is a key part of a training program. The final framework of the criticality safety engineer specialist training and qualification program is anticipated to be promulgated through the national consensus standard: ANSI/ANS-8.26, "Criticality Safety Engineer Training and Qualification." In the interim, it is hoped this white paper will be useful in developing said training programs.

Minimum Requirements of Nuclear Criticality Safety Training and Qualification Program:
This section includes the minimum requirements for a successful nuclear criticality safety training program. Appropriate facility management should maintain documentation of progress. Appropriate consideration should be given to previous demonstrated nuclear criticality safety work experience. The nuclear criticality safety function at a given facility shall consist of no less than two qualified criticality safety engineer specialists and one of whom must be a qualified senior criticality safety engineer.

Criticality Safety Engineer Specialist Job Tasks
Several job tasks are typically performed by criticality safety engineer specialists. Not all specialists will perform all of the tasks; however, the well-trained specialist should have some familiarity with each task and many specialists will perform several tasks. The job tasks include the following:

An Analyst performs analyses and independent technical evaluations of nuclear criticality safety; and requires knowledge of operations and processes; analysis methods/codes; hand computations; and standards and regulations.

A Facility Engineer assures implementation of nuclear criticality safety controls; and requires knowledge of facility operations; processes; personnel; nuclear criticality safety related procedural requirements; and standards and regulations.

A Methods Engineer develops, implements, and verifies computational tools; and requires knowledge of computer techniques, nuclear criticality safety physics, and standards.

A Technical Reviewer performs independent technical reviews of analyses of nuclear criticality safety; and requires knowledge of facilities and processes; analysis methods/codes; hand computations; and standard and regulations.

Criticality Safety Engineer Specialist Training and Qualification Program:
A formal criticality safety engineer specialist training and qualification program should be developed at each facility based primarily upon on-the-job training on facility-specific processes, configuration management practices, analytic tools, periodic technical classes or seminars, and participation in off-site professional development activities. It is important that the Facility Engineer training be based upon on-the-floor experience to fully understand the processes, procedures, and people to assure that nuclear criticality safety controls are properly implemented.

A very effective type of training is on-the-job facility-specific training. In an organization in which people join at random times with different backgrounds and skill levels, the most effective training is done with a more senior criticality safety engineer specialist working with the new person on a one-to-one basis. This is particularly true for learning the computational analytic tools. There is an evaluation process in peer technical reviews and management evaluation of the criticality safety engineer specialist's analyses. As part of each technical review by a senior criticality safety engineer specialist, the reviewer should evaluate the quality of the work, discuss the evaluation with the author, and document the evaluation per internal procedures. The technical reviews and resulting documented evaluations will then be available to management to assess the training.

Regularly scheduled on-site training shall be developed by a more senior criticality safety engineer specialist for newly hired or assigned personnel. The outline of the course should include the three broad areas of facility indoctrination, code use, and nuclear criticality safety fundamentals. Topics for the required training modules should include license/regulatory conditions; overall process knowledge; administrative rules and requirements; configuration management program; double contingency principle; nuclear criticality safety controls; ANSI/ANS-series 8 nuclear criticality safety standards; analytical methods; and evaluation documentation.

Professional development through participation in off-site training courses, technical seminars, and participation in national programs should be encouraged and documented. These activities may include (but not limited to) the U.S. Los Alamos National Laboratory criticality experiments courses, the University of New Mexico and University of Tennessee nuclear criticality safety courses, U.S. Oak Ridge National Laboratory computer code courses, ANS and U.S. Department of Energy nuclear criticality safety workshops. Participation in ANS annual meetings and national and international consensus standards development organizations/activities is also highly recommended.

Conclusion

There is a need for a documented training and qualification program for criticality safety engineer specialists at nuclear facilities.