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EXPERIENCE WITH PERFORMANCE BASED TRAINING OF NUCLEAR CRITICALITY SAFETY ENGINEERS

R. G. Taylor

Nuclear Criticality Safety Department
Health, Safety, Environment, and Accountability Organization

December 20, 1993

Summary for Submission to:
American Nuclear Society 1994 Annual Meeting
New Orleans, Louisiana
June 19-23, 1994

Prepared by the
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831
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Historically, new entrants to the practice of nuclear criticality safety have learned their job primarily by on-the-job training (OJT) often by association with an experienced nuclear criticality safety engineer who probably also learned their job by OJT. Typically, the new entrant learned what he/she needed to know to solve a particular problem and accumulated experience as more problems were solved. It is likely that more formalism will be required in the future. Current U. S. Department of Energy requirements for those positions which have to demonstrate qualification indicate that it should be achieved by using a systematic approach such as performance based training (PBT).[1] Assuming that PBT would be an acceptable mechanism for nuclear criticality safety engineer training in a more formal environment, a site-specific analysis of the nuclear criticality safety engineer job was performed. Based on this analysis, classes are being developed and delivered to a target audience of newer nuclear criticality safety engineers. Because current interest is in developing training for selected aspects of the nuclear criticality safety engineer job, the analysis is incompletely developed in some areas.

The nuclear criticality safety engineer job analysis indicated that the job has four major components as shown in Figure 1. Analysis is the principal activity of the nuclear criticality safety engineer and is further subdivided into three categories. Process analysis encompasses determination of the limits and conditions necessary to maintain nuclear subcriticality under normal and credible abnormal

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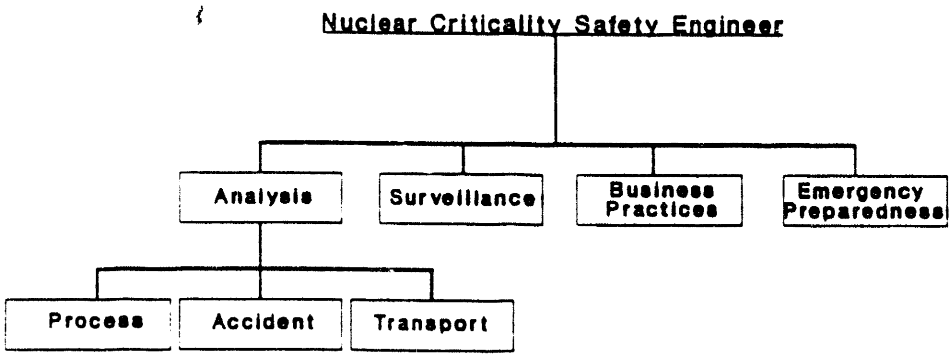
Figure 1 - Partially Developed Job Analysis for Nuclear Criticality Safety Engineer

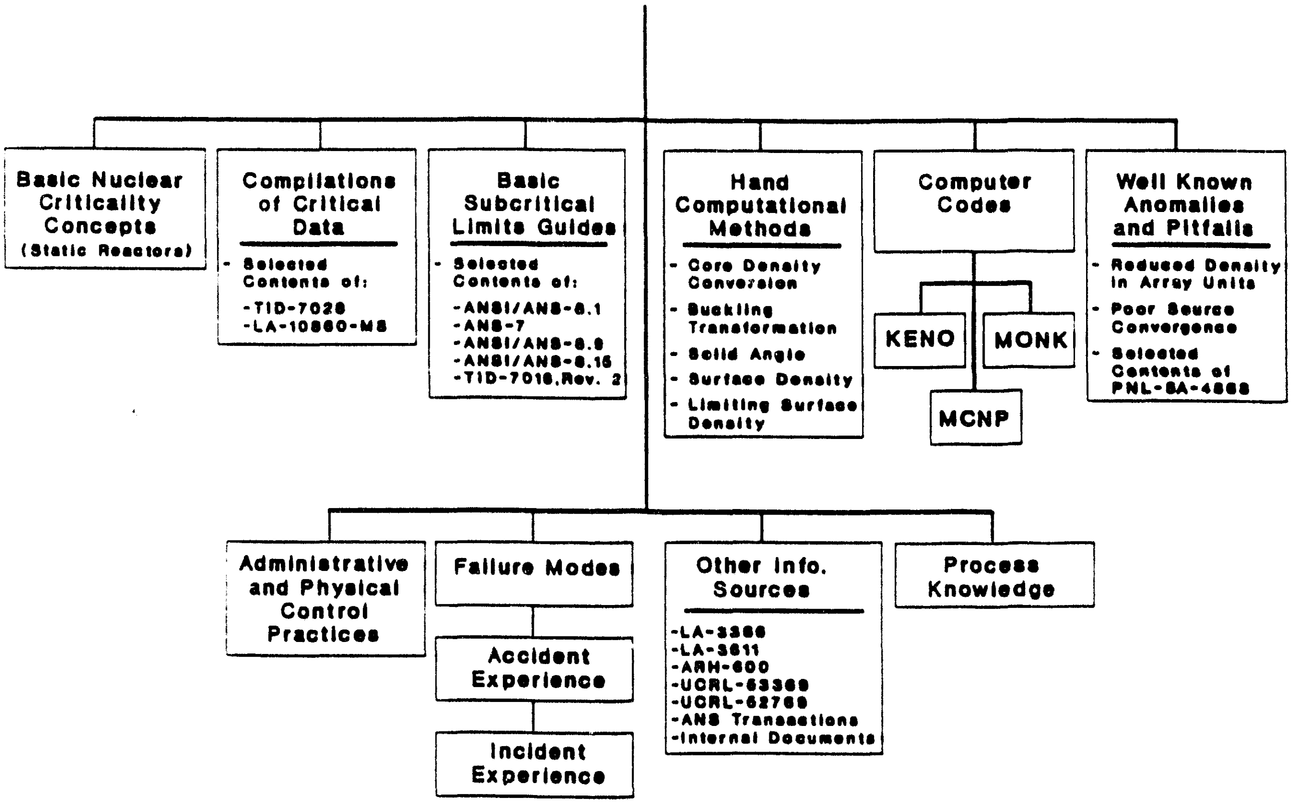


conditions for a fissile material activity. Accident analysis involves determination of the size and format of a nuclear criticality accident and transportation analysis involves the nuclear criticality safety analysis of fissile material packages in accordance with transportation regulations. Surveillance encompasses examination of fissile material activities for adherence to authorized limits and conditions. Business Practices is incompletely developed at this time, but is envisioned to include integration of analysis with facility operations and practices. Emergency Preparedness is also incompletely developed at this time, but it is envisioned to include basic information on the facility criticality accident alarm system , basic emergency responses, and selected topics from the American National Standard ANSI/ANS-8.3, *Criticality Accident Alarm System.*

Currently, the principal interest is in developing training for Process Analysis and this area is further subdivided as shown in Figure 2. The subject matter areas indicated were derived by repeatedly asking the question, "What knowledge, skills, and abilities are necessary to perform process analysis?" Some limited verification of the results was provided by brief interviews with members of the target audience. Although the results of the job analysis are probably neither complete nor exhaustive, they do indicate that nuclear criticality safety, like any other specialized field, has a set of basic information which is not readily recognized by new entrants. The subject matter areas indicated in figure 2 are viewed as an indication of the background needed to be comfortably competent performing a routine process nuclear criticality safety analysis.

All the knowledge and skills indicated in Figure 2 can be obtained by self-study; however, many of them can be imparted by suitable training classes developed using PBT principles. At this time, two classes covering Basic Nuclear Criticality Concepts, four classes covering Compilations of Critical Data, and one class addressing Basic Subcritical Limits Guides have been developed and delivered to the target audience. Response from the target audience has generally been favorable and the

Figure 2 - Nuclear Criticality Safety Engineer Process Analysis Job



features they seem to like most are an emphasis on the practical, having paper copies of the overhead transparencies in hand to make notes on during the presentation, and the working out of practical problems presented during class sessions.

Initially, it was intended that testing be done immediately after class presentation and that tests be graded and records kept. Valid concerns were raised as to the fairness of testing a subset of the nuclear criticality safety engineer staff, the risks and consequences of not passing tests, the confidentiality of student performance, and the desire to be tested privately rather than in a small class. Testing was considered desirable as a tool to point instructional direction by identifying topics which needed to be developed more fully or covered again because students were having trouble with them. To address the concerns raised, the testing protocol was changed from in-class to take-home. Completed individual tests are examined by the instructor but are not marked upon or graded. Composite results for the class are compiled and are returned to each student along with their test and an answer key all in a sealed envelope.

1. U. S. Department of Energy, *Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities*, DOE Order 5480.20, February 20, 1991.

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