NUCLEAR TECHNOLOGY EDUCATION CONSORTIUM

N13 CRITICALITY SAFETY MANAGEMENT

Summary

This module examines and explains the techniques and philosophy of criticality safety management. It will briefly review the fundamental physical processes involved in criticality, taking as its basis the classical six-factor formula for k_{eff}. The effects of heterogeneity will be considered by applying simple 'hand' calculations e.g. surface density and compared with modern Monte Carlo methods. Relevant national and international standards will be identified and their underlying philosophies discussed.

On completion, students should have obtained:

- A sound understanding of the fundamental physical mechanisms in criticality.
- Developed an understanding of the philosophy of criticality safety management.
- An appreciation of the physical and geometric parameters affecting the effective multiplication factor of both homogeneous and heterogeneous fissile systems.
- Knowledge and experience of applying simple 'hand' calculation in criticality assessment.
- An exposure to industry standard Monte Carlo methods and applied these to a sample problem.
- Reviewed relevant national and international standards and lessons learned from past criticality incidents.

Syllabus

This module consists of pre-course reading, a one-week taught component and an assessed post-course assignment.

Pre-course reading

- Revision of atomic and nuclear physics
- Review and guided analysis of past criticality incidents

Taught

- Overview of Criticality Incidents
- Radiological and physical consequences of a criticality excursion
- The Six-factor formula
- Calculation of critical masses
- Reactivity and power profiles
- The "double contingency" philosophy
- Criticality of assemblies and the effect of spacing
- Introduction to the main computational tools
- Regulatory basis of criticality safety

Post-course assignment

- Case study considering the criticality safety implications of a fuel store