

NUCLEAR TECHNOLOGY EDUCATION CONSORTIUM

N05 WATER REACTOR PERFORMANCE AND SAFETY*

Summary

Water reactors are likely to be the main source of nuclear power for the foreseeable future. This module considers such reactors with particular reference to their performance and safety and commences with an understanding of water reactor hydraulics, heat transfer and fuel design. The main codes for predicting reactor safety (RELAP, TRAC, CATHARE, TRACE) will also be described as will CFD methods, the latter in the specific context of the generic commercial code, STARCD. Hands-on experience with codes is given. Finally, accidents beyond the design basis (“*severe*” accidents) are discussed.

On completion, students should have obtained:

- A knowledge and understanding of the structure and performance of water reactors
- A knowledge of the types of accidents which might occur in water reactors and of the steps which are needed to mitigate their consequences
- A knowledge of the computational bases for establishing water reactor safety
- The ability to more confidently use reactor performance and safety codes
- Direct knowledge of CFD methods and their basis, particularly in the context of prediction of water reactor performance and safety

Syllabus

- Introduction to water reactors
- Introduction to single phase fluid flow in water reactors
- Introduction to heat transfer in water reactors
- Introduction to two-phase flow and heat transfer
- Calculation of fuel performance
- Water reactor fuel design
- Loss-of-coolant accident (LOCA) phenomena
- Critical flow
- Introduction to transient system codes
- Application of the TRACE code
- Introduction to the STARCD code and its application to water reactor systems
- Application of the STARCD code
- Clad ballooning
- Severe accidents

* It is strongly suggested the N12 module (Reactor Thermal Hydraulics) be taken before attempting N05.