

NUCLEAR TECHNOLOGY EDUCATION CONSORTIUM

N02

NUCLEAR FUEL CYCLE

Summary

The purpose of this module is to describe the nuclear fuel cycle and examine in detail, the technical, economical, safety and environmental issues involved during each stage. The module covers the entire cycle from the extraction of ore to the disposal of waste. The processes involved in reprocessing of fuel are examined and the consequences reprocessing has, in terms of reactor fuel design and waste disposal, are discussed. Each stage is described on an international scale examining global markets and capacities.

On completion, students should have obtained:

- A full understanding of all the processes involved in the front- and back-ends of the once-through fuel cycle.
- An understanding of fuel reprocessing and the advantages reprocessing can provide.
- An appreciation of the safety and environmental considerations involved in the cycle.
- An overview of the nuclear fuel cycle for both military and commercial purposes and how it has been affected by historic events.
- Knowledge of the worldwide capacities and economical markets involved in the cycle as well as an appreciation of political influence.
- Ability to perform cost of enrichment and spent fuel inventory calculations.

Syllabus

This module consists of two parts. The first is a taught part which consists of 35 lectures and includes a number of tutorial sessions. The taught part comprises:

- Overview of the fuel cycle
- Mining and milling of uranium
- Purification and conversion to UF_6
- Uranium enrichment
- Fuel fabrication
- Properties of irradiated fuel
- Irradiated fuel transport and storage
- Nuclear fuel reprocessing
- Recycling of uranium and plutonium
- Disposal of nuclear waste
- Emerging fuel technologies

The second part of the module is two fold. Students are required to choose one of three titles on which to write a short essay. This is followed by a choice of one of two calculation-based investigations. The choice for calculation-based investigations is:

- Economics of enrichment
- The effects of recycling – A mass flow analysis

This combination should provide the student with a deeper understanding of at least two areas of the nuclear fuel cycle. Resource materials and literature are provided but students should supplement this with their own literature and internet searches.