**-SQA-SCOTTISH QUALIFICATIONS AUTHORITY**

**Hanover House**
**24 Douglas Street**
**GLASGOW G2 7NG**

# NATIONAL CERTIFICATE MODULE DESCRIPTOR

**-Module Number-** **0077705** **-Session- 1987-88**

**-Superclass-** **XK**

**-Title-** **REACTOR SYSTEMS AND THE FUEL CYCLE**

**-DESCRIPTION-**

Type and purpose

A general module designed as an introduction to different methods of nuclear power generation. It is particularly relevant for operators in the atomic energy industry.

Preferred Entry Level

0077702 Atomic Energy and Radiation Control

Learning Outcomes

The student should:

1. know selected basic principles of nuclear fission;
2. know the basic components of different types of reactor systems;
3. know advantages and disadvantages of different reactor systems;
4. know the concept of a fuel cycle;
5. know different methods of preparing nuclear fuel;
6. know the procedures for reprocessing nuclear fuel.

Content/ Context

Corresponding to Learning Outcomes 1-6:

1. Fission; fusion; chain reactions; critical mass; actinides: uranium, thorium, plutonium; decay series.
2. Nuclear reactions: main features of different types; fuel moderator, cooling, control rods, shielding and containment.

3. Advantages and disadvantages of different systems: Magnox, A.G.R. PFR, water reactors, Candu, with regard to fuel, moderator, operating temperature, coolant, cladding material.

4. Fuel cycle: manufacture fuel from raw material; natural uranium; enriched uranium or U + Pu; fuel used, burn up achieved; reprocessing of fuel to separate U, Pu + waste; reuse of Pu nitrate in fuel elements.

5. Enrichment U, different fuels needed for different reactor systems and their preparation.

6. Reprocessing: separation of U, Pu and fission products. Fuel transport from reactor 'topping and tailing' of fuel assemblies, removal of outer wrappers, laser cutting of fuel pins, dissolving fuel in nitric acid, accountancy tank, mixer - settler process, solvent extraction process using TBP/OK solvent. Separation of U, Pu and fission products. Concentration of Pu feed solutions.

Suggested Learning and Teaching Approaches

In this content based module, the emphasis should be on student centred learning packages which require active participation in, eg. consulting textbook sources/UKAEA publicity material/press reports/articles in professional and scientific journals and relevant audio visual material. Computer simulation exercises would be ideal if available. The involvement of UKAEA personnel on-site would be valuable, eg. in helping the student to prepare a written report relating to one or more of the Learning Outcomes.

Assessment Procedures

Acceptable performance in the module will be satisfactory achievement of the performance criteria specified for each learning outcome.

Where cutting scores are stated these are intended to be guidance. The precise cutting score for a test will depend on the difficulty of the test and will have to be decided by the Tutor aided by the Assessor.

The following abbreviations are used below:

LO Learning Outcome
IA Instrument of Assessment
PC Performance Criteria

LO1 IA Written exercise consisting of 10 multiple choice questions, 5 short answer questions which should elicit answers of not more than 1 or 2 brief sentences and worksheets.

PC The student should:

(a) identify and describe principles of nuclear fission;

(b) complete worksheets to show fission and decay chains.

Cutting score 75%.

LO2 IA Identification test.

PC The student should identify the components of each reactor type from block diagrams.

Cutting score 75%.

LO3 IA Short project report and 5 short answer questions which should elicit answers of 1 or 2 brief sentences.

PC (a) The student should outline the advantages and disadvantages of different reactor systems with regard to fuel, moderator, operating temperature, coolant, cladding material.

(b) The project should include case history, worksheet completion and report on work environment.

Cutting score 75%.

LO4 & 5 IA Short project report and 10 multiple choice questions.

PC (a) The student should:

LO4 (i) identify and outline the concept of a fuel cycle;

LO5 (ii) identify and outline different methods of preparing nuclear fuel.

LO4 &5 (b) The project should include case history, worksheet completion and report on work environment.

Cutting score 75%.

LO6 IA The short project report and 5 short answer questions which elicit answers of not more than 1 or 2 brief sentences.

PC (a) The student should identify and outline the procedures for reprocessing nuclear fuel.

(b) The project should include case history, worksheet completion and report on work environment.

Cutting score 75%.

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