Short Courses in Nuclear Science & Technology

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SUMMARY ANSTO provides a range of short courses in nuclear science and engineering for staff in support of its own activities. Staff have expertise in a number of research and applied areas and their skills enable us to participate in the delivery of regional courses under the auspices of the International Atomic Energy Agency (IAEA). Capitalising on our skills in working safely with radiation we develop and deliver specific courses in radiation protection for industrial and academic users of radiation sources. Finally, ANSTO supports the Australian and New Zealand Association of Physicians in Nuclear Medicine with a course for registrars in nuclear medicine departments.

1. INTRODUCTION

Nuclear science and engineering short courses for staff tend to concentrate on two core areas of expertise: operation and maintenance of a reactor, and radiation protection. Other specialist expertise resides in the research programs and in the support areas for a nuclear establishment such as waste management and risk and reliability studies. Expertise from these areas is frequently drawn on by the IAEA for participation on regional training courses

2. INTERNAL STAFF TRAINING

HIFAR Training

Staff working in HIFAR are required by our regulator, the Nuclear Safety Bureau, to be accredited at specified intervals. Accreditation and re-accreditation procedures, including training courses, ensure that reactor operating staff have been trained to perform their duties and meet acceptable standards of knowledge and performance.

The HIFAR training unit system was developed as a means of achieving standardisation in constructing the various training syllabi used in the HIFAR training program. The training units themselves comprise specific areas of information pertinent to HIFAR. The application of the training units differs between courses in order to allow for the different depths of presentation required depending on the capabilities or interests of the participants and/or the level of training required.

The choice of units to be included in a given training course depends on the purpose of the course. For example, a course designed for new reactor operators would include essentially all units whereas a course designed for new active handling staff would cover reactor physics in only the broadest terms. The depth of presentation of the units would also vary with the purpose of the course. An illustration of this is training in radiation monitoring. In this example, training active handling staff to do their own radiation monitoring necessarily includes practical sessions with the actual equipment intended for use but in the case of operations engineers this subject could be treated satisfactorily with lectures alone.

Specified combinations of units are delivered at different levels to train operations engineers, reactor operators, reactor shift supervisors and active handling engineers.

A full training course intended to prepare a staff member for accreditation status may take as long as 50 days and will be supported by periods of practical training on-the-job. However, modularisation allows each topic to be treated as a stand alone short course and as such, it can be advertised within ANSTO for a much wider audience than the core participants who are HIFAR staff.

The course for operations engineers is frequently attended by other professionals needing an equivalent level of knowledge. The theoretical content provided is considered to be at the equivalent level of an undergraduate course in nuclear engineering.

Other courses may also be attended by non-HIFAR personnel from across ANSTO employed at either professional, technical or trades levels.

All courses are provided on an 'as needed' basis. Generally, individual topics or units are each of a 1/2

day duration. Where greater detail is justified, this is provided by sub-unit. The units and sub-units are grouped under eight broad subject areas. These are :

Subject 1: ANSTO/HIFAR Introduction/ General

These five units in Subject 1 are concerned with either general topics such as ANSTO personnel policies and quality assurance or specific to HIFAR such as the various roles and responsibilities of personnel employed in HIFAR operating team

Subject 2: Health and Safety

These seven units are predominantly about health and safety issues which are common to any industrial employer, eg. fire safety, manual handling and first aid. Exceptions are topics covering radiation protection, the site emergency organisation and HIFAR personnel protection equipment.

Subject 3: Nuclear Technology

All seven individual units within this subject area are of interest to this paper. They are:

Introduction to Nuclear Technology, including

- general aspects of nuclear reactor design
- reactor types and their uses
- a brief history of developments
- HIFARs nuclear engineering design.

Nuclear Physics

Reactor Theory including:

- neutron transport and moderation
- neutron multiplication and criticality
- reactor kinetics and control
- reactor fuels
- a short history of reactor accidents

Heat Transfer and Fluid Flow including:

- fundamentals of fluid flow
- fundamentals of heat transfer
- heat transfer and fluid flow in HIFAR

Radiation Detection, including:

- geiger and proportional counters and ionisation chambers
- scintillation and germanium detectors
- neutron detectors
- self-powered detectors

HIFAR Physics and Core Management, including

- HIFAR physics characteristics
- HIFAR physics measurements
- HIFAR fuel management

Radiation Shielding Design, including

- packaging and shipping of radioactive materials

Subject 4: HIFAR Plant

There are 13 units within this subject area.

Introduction to HIFAR Plant

Introduction to HIFAR Circuits, including

- D_2O circuit
- ECCS
- secondary cooling circuit
- helium circuit
- shield cooling circuit
- graphite space helium circuit
- No. 1 storage block
- demineralised water system
- collimator cooling circuit

Introduction to Site Connected Systems, including

- effluent system
- compressed air supply
- site water supply
- HIFAR fresh water system
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Introduction to Reactor Control

Introduction to Electrical Power Supply and Distribution, including:

- electrical power supply system
- Building 70 fire indication board

Introduction to Instrumentation, including:

- physical and nucleonic instrumentation
- control room instrumentation
- reactor protection system
- data acquisition system

Emergency Control Room

Introduction to HIFAR Design Modification, including:

- shield cooling problems
- HIFAR refurbishment modernisation
- HIFAR seismic upgrading

Reactor Containment Building Ventilation System, including:

- normal ventilation
- active extract ventilation
- standby active ventilation system
- control room ventilation system

Introduction to HIFAR Containment Systems, including:

- reactor containment building
- personnel air locks
- vehicle air lock
- space conditioner systems
- containment isolation system

Introduction to the HIFAR Core, including:

- HIFAR core layout
- HIFAR fuel design

Introduction to HIFAR Chemical Control, including:

- chemical control of the D_2O circuit
- chemical control of the secondary cooling circuit
- chemical control of the helium circuit
- chemical control of the graphite space helium circuit
- chemical control of miscellaneous circuits

Introduction to HIFAR Service Facilities, including:

- VGR facilities
- silicon irradiations
- NAA irradiations
- neutron beam facilities
- irradiation facilities
- vertical rigs within the RAT
- horizontal self-service rigs
- HIFAR rig engineering design

Subject 5: HIFAR Safety

These eight units are a mixture of HIFAR specific and general nuclear safety and include:

Introduction to HIFAR Safety

HIFAR Operating Requirements

The HIFAR Safety Case

Engineered Safety Provisions

Accident Control, including:

- hazards assessment
- emergency procedures
- emergency drills and exercises

Subject 6: HIFAR Operation

Again, these 13 units are a mixture of HIFAR specific and more general nuclear plant content and include:

Introduction to HIFAR Operation

Control Room Operation

Records, Reports and Approvals, including:

- operation records
- maintenance records
- operation reports and approvals

Routine Monitoring of Plant inside the reactor containment building

Monitoring of Outside Plant

Fuel and Rig Handling

Special Operations, eg. flux scanning

Neutron Beam Facility Operations

Experiences in HIFAR Operations

Irradiated Fuel Storage and Wste Disposal

Subject 7: HIFAR Services

Introduction to HIFAR Services

The Use of Neutron Beam Facilities

Radioisotope Production

NAA/DNA Irradiations

Silicon Irradiations

Previous Applications of HIFAR

Hot Cells

Subject 8: HIFAR Maintenance

Introduction to HIFAR Maintenance

Maintenance Procedures, Instructions and Records

Plant Modifications

Safety Aspects of Plant Modifications, including:

- industrial safety in plant maintenance

- radiological safety problems in plant maintenance
- reactor safety significance in plant maintenance

Radiation Protection Courses

All staff who are registered on our personnel dosimetry service must attend a one-day radiation protection course. Staff with higher level needs are invited to attend either a 3-day or a 10-day course. These more detailed courses are also open to the public on a commercial basis.

3. IAEA TRAINING COURSES

The IAEA report to the Board of Governors on Technical Co-operation Activities in 1994 shows the importance of Australia's training role in the Asia/Pacific region.

Place of study	Fellow	Visit. Scient.	Course particip	Total
Australia	20	6	64	90
China	12	4	59	75
India	36	4	42	82
Indonesia	1	0	15	16
Japan	20	8	71	99
RoK	3	8	34	45
Malaysia	11	3	55	69
N. Zealand	0	2	0	2
Pakistan	7	3	0	10
Philippines	1	0	0	1
Singapore	1	0	0	1
Sri Lanka	2	0	0	2
Thailand	8	7	41	56
Viet Nam	1	3	0	4
TOTAL	123	48	381	552

In any one year, ANSTO hosts, on average, three regional training courses. In 1994, we hosted four of the 23 regional training events, training 64 of the 403 participants in the region. This represents about 16% of international short courses in the Asia/Pacific region. The topics for these courses were typical of our training activities with the IAEA and were:

1. Research reactor utilization
2. The use of computers in nuclear medicine
3. Strategies and methodologies for applied marine radioactivity studies
4. Off-site planning and countermeasures for radiological emergencies.

This level of involvement compares favourably with other major hosts: Japan, India, China and Malaysia.

4. PUBLIC INFORMATION COURSES

Short courses, usually of one-day or less, are organised and delivered to meet public information needs. During 1994/95 for instance, members of local emergency response units, primarily the Fire Brigade, attended courses in radiation protection. High school science teachers are another group for whom special interest courses are organised.

5. COMMERCIAL COURSES

Short courses in radiation protection are scheduled at both the Lucas Heights Research Laboratories (LHRL) and in Victoria each year. Other courses are commissioned by client companies and tailored to meet their specific needs. Generally, our commercial training program is of one-day courses for radiation protection of workers using

- industrial radiation gauges
- x-ray devices
- neutron moisture and density gauges
- unsealed sources (laboratory workers)

Specially developed courses are currently being held for members of the NSW Fire Brigade HAZMAT team and a course is available for workers in the mineral sands industry.

Three-day and 10-day courses are scheduled each year and these are aimed primarily at radiation safety officers in industry.

A two week course approved by the Australian and New Zealand Association of Physicians in Nuclear Medicine (ANZAPNM) is designed to provide medical doctors and scientists with the knowledge and skills required for the effective use of radionuclides in medical diagnosis and treatment. Completion of this course is a prerequisite for those people who seek membership of the ANZAPNM.

In 1994/95 over 40 external courses were delivered , serving more than 150 public and private sector organisations

REFERENCES:

HIFAR Training Manual

International Atomic Energy Agency. 1994, *Report by the Director General: The Agency's Technical Co-Operation Activities in 1994.*