



**STANDARDS FOR
CERTIFICATION AND
RECERTIFICATION OF
RESEARCH REACTOR
OPERATOR**



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1.0 Background

A regulatory body, the Atomic Energy Licensing Board (AELB) has been established pursuant to Act 304, and has been assigned the main responsibilities for the supervision of nuclear activities and facilities. This includes responsibilities for the regulation of nuclear installations, use of radioisotopes, radioactive waste and transport safety, and a role in the national system for emergency preparedness. AELB is also empowered to issue regulations, standards and guidelines for all nuclear activities in Malaysia.

This Requirements was based on IAEA Safety Standards Series, “The Operating Organization and the Recruitment, Training And Qualification of Personnel For Research Reactors”, Draft Safety Guide DS 325 (March 2006), together with USNRC NUREG 1537, “Guidelines for Preparing And Reviewing Applications for the Licensing of Non-Power Reactors”, “10 CFR Part 55, Operators Licenses” and “GS-R-1: Legal and Governmental Infrastructure for Nuclear, Radiation and Radioactive Waste and Transport Safety”.

2.0 Objective

The objectives of the certification and recertification programme are:

- 2.1 To ensure that all research reactor operators have and maintain the minimum required competency.
- 2.2 To ensure applicable Malaysia legislative requirements are met.
- 2.3 To provide recognition of the qualifications and competence of research reactor operators.

3.0 Scope

This Standard shall apply to the Research Reactor Operator which contains:

- i. Requirements for certification and recertification; and
- ii. Provide instructions for minimum training requirements.

4.0 Definition

For the purpose of this Standard:

“Research Reactor Operator” means any individual licensed to manipulate a control of a Research Reactor

“**Regulatory Body**” means Atomic Energy Licensing Board (AELB) established under Atomic Energy Licensing Act (ACT 304)

“**Licensee**” means the holder of a license issue under Atomic Energy Licensing Act (ACT 304)

5.0 Certification of Reactor Operator

5.1 General Requirement

Only research reactor operators certified by the regulatory body shall operate the reactor.

5.2 Initial Certification

5.2.1 Education

Minimum Diploma in Engineering/Science discipline or equivalent from a recognized institution.

5.2.2 Experience

Minimum of six (6) continuous months performing duties of a reactor operator trainee under the supervision of Reactor Manager at the research reactor.

5.2.3 Training

The applicant requesting certification shall have received training from the Licensee including the topic areas in **Appendix 1**. Training of the reactor operator in accordance to the principles of a Systematic Approach Training (SAT) is the responsibility of the licensee, but it is subject to regulatory body approval. The applicant must complete the training programme prior to applying for certification.

5.3 Medical Requirement

The applicant/s shall be medically fit and no substance abuse.

5.4 Initial Certification Examinations

Prior to applying for certification the applicant/s shall pass the following examinations conducted by the regulatory body:

- i. Comprehensive written.
- ii. Facility walkthrough; and

- iii. Operating.

All of which must be approved by the regulatory body. The applicant/s is allowed to retake each examinations maximum 2 times.

5.4.1 Comprehensive written

- i. Three Papers in 90 minute each, which consist of:
 - (a) Paper 1: Reactor Physics, Thermal-hydraulics Fundamentals of Reactor Safety;
 - (b) Paper 2: Reactor Facility Specific Design, Reactor Facility Operation, and Administrative Requirement;
 - (c) Paper 3: Statutory Basis, Radiation Protection and Occupational Safety.
- ii. To be eligible for certification, the applicant/s shall obtain a grade of at least 70% on each of the papers comprising the comprehensive written examination.
- iii. The syllabus of the comprehensive written examination is stated in *Appendix 1(a)*.
- iv. The applicant is allowed to retake the written examination paper if the range score is from 55% to 69% (the applicant/s is requested to retake only the paper that they do not attain a passing grade); if the written examination score is less than 55% the applicant is allowed to retake the paper after undergoing the applicable training again.

The applicant shall take the facility walkthrough and operating examination within a year after passing the written exam.

5.4.2 Facility walkthrough (Oral and Practical examination)

- i. To be eligible for certification the applicant shall obtain a grade of at least 80% on this examination.
- ii. The syllabus of the Facility Walkthrough examination is stated in *Appendix 1(b)*.
- iii. The applicant is allowed to retake the examination once if the range score is from 65% to 79%.
- iv. If the applicant is unsuccessful on this retake examination they must complete the facility walkthrough training again.

- v. If the initial score is less than 65% - the applicant is allowed to retake the facility walkthrough examination after undergoing the facility walkthrough training again.

5.4.3 Operating

- i. To be eligible for certification the applicant shall obtain a grade of at least 80% on this examination.
- ii. The applicant is deemed to fail the test if any automatic SCRAM occurs. (excluding system malfunctions).
- iii. The syllabus of the operating examination is as stated in *Appendix I(c)*.
- iv. The applicant is allowed to retake the examination once if the range score is from 65% to 79%. If the applicant is unsuccessful on this retake examination they must complete the operating training again.
- v. If the score is less than 65% or automatic SCRAM occurs (excluding system malfunctions). – The applicant is allowed to retake the test after undergoing the training for operating examination again.

5.5 Validity of examination certification result

The examination results are valid for 6 months after the applicant has completed the final certification examination.

5.6 Extending the validity of an examination /active duty

Where a person cannot successfully complete the examination specified in section 5.4 within a year prior to certification, that period may, on application from the licensee, be extended by the regulatory body for a further period not exceeding (6 months) under the following conditions:

- i. The person's certification has been delayed by an extended shutdown of the reactor
- ii. The person's certification has been delayed due to sickness, injury or family-related responsibilities
- iii. Period of extended training

When applying for an extension, the licensee shall submit information pertaining to:

- i. The conditions referred to in 5.6
- ii. The measures taken to ensure that the person has maintained the knowledge and skills required to work competently as a reactor operator.

5.7 Documents for Certification

In order to be considered for certification, the licensee shall submit to the regulatory body:

- i. Application (letter of intent)
- ii. Medical check-up done by registered medical practitioner within a period of 6 month from the date of application.
- iii. Curriculum vitae of the applicant
- iv. A copy of relevant academic qualification.
- v. Record of training.
- vi. Certification Exam Results.

5.8 Certification Validity

The certification shall be valid for 3 years from the date it is issued.

After the period of validity, certification may be renewed by regulatory body for a period of three years. The licensee must submit the application for re-certification for regulatory body's approval at least three months before the operator's certification expires.

5.9 Transition Certification

For the period from September 1, 2007 to August 31, 2008, operator/s:

- i. with minimum 8 years operating experience at the research reactor in Malaysia and must be on active duty for at least 6 months at the date of application;
- ii. successfully completed the continuing training as Appendix 2; and
- iii. successful in interview conducted by regulatory body;

will be granted certification.

5.10 Revocation of certification

- i. If the operator is inactive for a period of more than 12 months and has not successfully completed continuing training programme including examination.
- ii. At the discretion of regulatory body after reviewing evidence of unethical behaviour.

6.0 Recertification of Reactor Operator

6.1 Training

The applicant requesting recertification shall have received training from the Licensee including the topic areas in **Appendix 2**. Training of the reactor operator in accordance to the principles of a Systematic Approach Training (SAT) is the responsibility of the licensee, but it is subject to regulatory body approval. The applicant must complete the training programme prior to applying for recertification. The applicants have to attend at least 80% of continuing training.

Duration of the training is highly dependant on the reactor facility and its operating programme.

6.2 Recertification Examinations

The applicants are required to pass the following examinations in order to be considered for recertification:

- i. Oral examination
- ii. Operating examination

The licensee shall prepare and implement the recertification examinations. The examinations must be approved by the regulatory body.

6.2.1 Oral examination

- i. Syllabus – as stated in *Appendix 2*.
- ii. Passing mark : 80%
- iii. If the individual fails to achieve a grade at least 80%, they shall be required to undergo remedial training (lecture, self-study, tutorial or on the job training as determined by reactor manager) on those areas or topics where weaknesses or deficiencies are indicated before being eligible to retake the examination.

6.2.2 Operating examination

- i. as indicated at *Appendix 1(c)*.
- ii. Passing mark : 80% without SCRAM (excluding system malfunctions)
- iii. If the individual fails to achieve a grade at least 80%, they shall be required to undergo remedial training (lecture, self-study, tutorial or on the job training as determined by Reactor Manager) on those areas or topics where weaknesses or deficiencies are indicated before being eligible to retake the examination.

6.2.3 Approval of Recertification Examination

The licensee shall provide the following information to the regulatory body as below:

- i. Person responsible for the recertification examination
- ii. Examination question
- iii. Marking scheme

6.2.4 The operator applying for recertification is in active duty

If the operator is inactive for more than 6 months but not exceeding 12 months, the applicant needs to retake the operating examination to be eligible for recertification.

(Inactive means that the operator has not performed the work for which he is certified for at least one shift in a six (6) month period).

An Operator requesting recertification that has been inactive for more than 12 months is not eligible for recertification until successfully completing the continuing training programme including the applicable examinations.

A period of active duty will take into consideration the provisions in section 6.3

6.3 Extending the validity of an examination /active duty

Where a person cannot successfully complete the examination specified in section 6.2 within a year prior to recertification, that period may, on application from the licensee, be extended by the regulatory body for a further period not exceeding (6 months) under the following conditions:

- i. The person's recertification has been delayed by an extended shutdown of the reactor

- ii. The person's recertification has been delayed due to sickness, injury or family-related responsibilities
- iii. Period of extended training

When applying for an extension, the licensee shall submit information pertaining to:

- i. The conditions referred to in 6.3
- ii. The measures taken to ensure that the person has maintained the knowledge and skills required to work competently as a reactor operator.

After the period of validity, certification may be renewed by regulatory body for a period of three years. The licensee must submit the application for recertification for regulatory body's approval at least three months before the operator's certification expires.

6.4 Application for recertification

In order to be considered for recertification by regulatory body the licensee must submit to the regulatory body:

- i. Name of operators
- ii. Period of duty – man-hour (based on operating log book and statement from reactor manager)
- iii. Evidence of successful completion of continuing training.
- iv. Recertification examination results to regulatory body for approval.
- v. Evidence of medical status.

7.0 References

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- [25] **IAEA Safety Standard Series**, “The Operating Organization And The Recruitment, Training And Qualification of Personnel For Research Reactors”, Draft Safety Guide DS 325.
- [26] **USNRC NUREG 1537**, “Guidelines for Preparing And Reviewing Applications for the Licensing of Non-Power Reactors”
- [27] **10 CFR Part 55**, “Operators Licenses”.

APPENDIX 1

1(a) Initial Training and Comprehensive Written Examination

Part A: Fundamentals Knowledge

1. Fundamental of nuclear physics
 - 1.1. Quantities, units and symbols
 - 1.2. Structure of the atom and radioactive decay
 - 1.3. Interaction of radiation with matter
2. Reactor physics
3. Energy release and thermal-hydraulics
4. Fundamentals of reactor engineering and reactor safety
5. Radiological protection
6. Occupational safety
7. Statutory bases
 - 7.1. National Regulations
 - 7.2. Radiation Protection Regulations

Part B: Facility-Specific Knowledge

1. Facility engineering
 - 1.1. Buildings and equipment
 - 1.2. Layout, operating modes and functions of the reactor equipment.
 - 1.2.1. Reactor tank and internals
 - 1.2.2. Reactor cooling system
 - 1.2.3. Reactor control
 - 1.2.4. Control rod drives
 - 1.2.5. Reactor protection system
 - 1.2.6. Reactor confinement or containment
 - 1.2.7. Instrumentation and alarm systems
 - 1.2.8. Reactor auxiliary systems
 - 1.2.9. Conventional service systems
 - 1.2.10. Cooling water systems
 - 1.2.11. Electrical systems
 - 1.3. Control room
 - 1.3.1. Control room and auxiliary control stations
 - 1.3.2. Control room engineering
 - 1.3.3. Computer systems

- 2. Facility operation
 - 2.1. Facility control
 - 2.2. Abnormal operating events
 - 2.2.1. Malfunctions of important facilities
 - 2.2.2. Abnormal operation and incidents
 - 2.2.3. Unforeseen event sequences
 - 2.3. External events
 - 2.4. Radiological protection and monitoring
 - 2.5. Environmental monitoring
 - 2.6. Chemistry
 - 2.7. Access control
- 3. Administrative requirements
 - 3.1. Conditions imposed and directives issued by Authorities
 - 3.2. Operating manual
 - 3.3. Organization of operation
 - 3.3.1. Control room and shift duty rules
 - 3.3.2. Alert plans
 - 3.3.3. Other operating rules

APPENDIX 1

1(b) Initial Training and Facility Walkthrough Examination

1. Examination by means of questioning: (Combined during walkthrough below)

Duration: max. 30 min. / person

- 1.1. Short description of the facility using plans
- 1.2. Maximum of three questions taken from the facility knowledge "Question Catalogue" particularly on the subjects of accident handling and protection related procedures (using overhead transparencies prepared beforehand when appropriate).

2. Examination by means of practice-oriented presentations

Place of examination: control room and various places in the reactor hall as appropriate. Examinees are questioned one at the time on Sect. 2.2 and 2.3.

Duration : 30 min. / person or more
(level of knowledge of the candidates)

Note : When the reactor is in operation some demonstrations may have to be simulated.

- 2.1. Explanations of selected components of the coolant circuitry and systems, the reactor protection system and the reactors instrumentation in functional context. Each item below is discussed near the appropriate panel or observation point:
 - (a) Air conditioning panel
 - (b) Fuel element temperature display panel
 - (c) Nuclear instrumentation
 - (d) Coolant circulation control panel
 - (e) Power supply circuit panel
 - (f) Fire extinguishing system
 - (g) Leak detection indication panel and emergency core cooling system
 - (h) Trip interlock panel
 - (i) Radiation protection instrumentation panel
 - (j) Test units for the coarse control-rods bank and the fast shutdown system
 - (k) Control desk
- 2.2. Power correction (from < 1 MW to exactly 1 MW) using the basis stepwise procedure.
- 2.3. Discussion of an accident scenario; application of the operating manual with

facility walkthrough as appropriate.

- 2.4. Safely operate the facility's heat removal systems, including primary coolant, emergency coolant, and decay heat removal systems, and identify the relations of the proper operation of these systems to the operation of the facility.
- 2.5. Safely operate the facility's auxiliary and emergency systems, including operation of those controls associated with facility equipment that could affect reactivity or the release of radioactive materials to the environment.
- 2.6. Demonstrate or describe the use and function of the facility's radiation monitoring systems, including fixed radiation monitors and alarms, portable survey instruments, and personnel monitoring equipment.
- 2.7. Demonstrate knowledge of significant radiation hazards, including permissible levels in excess of those authorized, and ability to perform other procedures to reduce excessive levels of radiation and to guard against personnel exposure.
- 2.8. Demonstrate knowledge of the emergency plan for the facility, including, as appropriate, the operator's or senior operator's responsibility to decide whether the plan should be executed and the duties under the plan assigned.
- 2.9. Demonstrate the knowledge and ability as appropriate to the assigned position to assume the responsibilities associated with the safe operation of the facility.
- 2.10. Demonstrate the applicant's ability to function within the control room team as appropriate to the assigned position, in such a way that the facility licensee's procedures are adhered to and that the limitations in its license and amendments are not violated.
- 2.11 The following places to be visited:
 - Reactor control room;
 - Reactor hall;
 - Reactor pool top;
 - Reactor basement & beam tubes;
 - Primary & secondary pumps, water treatment systems;
 - Cooling towers;

APPENDIX 1

1(c) Initial Training and Operating Examination ¹

Content:

The operating test, will be administered in the Reactor control room, to the extent applicable, requires the applicant to demonstrate an understanding of and the ability to perform the actions necessary to accomplish a representative sample from among the following 6 items:

1. Perform pre-start-up procedures for the facility, including operating of those controls associated with facility equipment that could affect reactivity.
2. Manipulate the console controls as required to operate the facility between shutdown and designated power levels.
3. Identify annunciates and condition-indicating signals and perform appropriate remedial actions where appropriate.
4. Identify the instrumentation systems and the significance of facility instrument readings.
5. Observe and safely control the operating behaviour characteristics of the facility.
6. Perform control manipulations required to obtain desired operating results during normal, abnormal, and emergency situations.

¹ Based on USNRC

APPENDIX 2

Continuing Training and Recertification Oral Examination

| Relevant Topics – Theoretical Part | | |
|------------------------------------|--|--|
| Fundamentals | <ul style="list-style-type: none"> • Facility related reactor physics • Thermodynamic aspects of the reactor • Operating procedures • Radiation protection aspects of the facility • Chemistry of the coolant circuit | |
| Reactor Engineering | <ul style="list-style-type: none"> • Power supply in the facility • Reactor protection system and observing of safety instructions • Instrumentation / electronic systems • Instrumentation / mechanical systems • Neutron absorbers in the reactor • Coolant system circuiting • Experience from other similar reactors • Experimental facilities • Reactor fuel • Physical and engineering principles of measurement techniques in research reactors • Recording and processing of data | |
| Regulations and Organization | <ul style="list-style-type: none"> • General safety rules at the centre, protection against external events • Organization, competent authorities, responsibilities • Authorizations, notifications, reporting • Plans for maintaining professional knowledge • Administration • Regulations related to accident prevention • Respiratory protection • Recapitulation of facility safety and radiation protection services • Changes to the reactor systems and administrative procedures; • Changes to licensing conditions and licensing document, in particular the SAR, and Operational Limits and Conditions (OLCs); • Emergency drills; • Operator's response to accidents; • Experience feedback from operation of the reactor and of other similar research reactors. In this regard, inclusion of the lessons learned from accidents | |

| | | |
|--|--|--|
| | <p>reported to the Incidents Reporting System for Research Reactors (IRSRR) should be considered;</p> <ul style="list-style-type: none"> Operational and maintenance tasks that are infrequently performed. | |
|--|--|--|

| Relevant Topics – Practical Part | | |
|--|---|--|
| Operational Practice | <ul style="list-style-type: none"> Handling and replacing of fuel elements, neutron absorbers, experiments Use of portable radiation protection instruments in the facility Employment of facility-specific electronic data processing | |
| Operational aspects of Reactor Coolant Circuitry and related systems | <ul style="list-style-type: none"> Applicable operational limits and conditions Response to postulated abnormal occurrences Response to postulated emergency conditions Recent modifications to the coolant system | |
| General Practical Topics | <ul style="list-style-type: none"> Reactor Alarm – exercise Fire alarm – exercise First Aid – course | |
| Special Topics – Theoretical Part | | |
| | <ul style="list-style-type: none"> Operating Procedures, Operations Manual Service Procedures, Inspection Manual Fault analysis, reportable occurrences | |
| Special Topics- Practical Part | | |
| | <ul style="list-style-type: none"> Self performance or partaking in periodic tests and in-service inspections in accordance with the Inspection Manual, under the supervision of the Reactor Manager or qualified Operation engineer | |

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