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TECHNICAL GUIDELINE

STANDARD FOR CERTIFICATION OF RESEARCH REACTOR OPERATOR

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TABLE OF CONTENTS

1.0 INTRODUCTION **1**
Background 1
Objective 1
Scope 2
Interpretation 2

2.0 CERTIFICATION OF RESEARCH REACTOR OPERATOR **3**
General Requirement for Certification 3
Pre-requisite Condition for Certification 3
Reactor Operator Status Upgrades 4
Training Requirements 4
Initial Training Prior to certification *5*
Medical Requirements 5
Medical Examination *5*
Documentation of Medical Examination Results *6*
Incapacitation because of disability or illness *6*

3.0 PROCEDURE OF APPLICATION **6**
General 6
Application for Examination 6
Application for Certification, Recertification or Status Upgrade 7
Application for Certification *7*
Application for Re-certification *7*
Application for Status Upgrade *7*
Required Documentation for Application *8*
Validity of Examination Results 8
Validity of Certification 9
Amendment and Revocation of Certification 10
Examination Fraud and Misconduct 10

4.0 EXAMINATION SCHEME FOR CERTIFICATION **11**
General 11
Certification of Reactor Operator (Part A) 12
Re-certification of Reactor Operator (Part B) 14
Status Upgrade for Senior Reactor Operator (Part C) 15

5.0 REFERENCES **16**

6.0 SUPERSESSION **16**

7.0 COMMENCEMENT DATE **17**

8.0 CONCLUSION **17**

9.0 DOCUMENT RECORD **17**

APPENDIX 1 ..... **19**

APPENDIX 2 ..... **20**

APPENDIX 3 ..... **21**

APPENDIX 4 ..... **26**

1.0 INTRODUCTION

Background

1.1. Research reactor demonstrate a wide variety of designs, a wide range of power levels, different modes of operation and uses, differences in siting and differences in operating organizations. These varieties of reactor characteristics require some flexibility, in particular when dealing with the staffing with competent personnel, including reactor operators. The licensee shall be primarily responsible for ensuring reactor operators are appropriately trained and re-trained, qualified and certified to perform the assigned task.

1.2. IAEA Specific Safety Requirements *Safety of Research Reactors* (No. SSR-3) Para 7.4 requires the Licensee (termed *operating organization*) to establish the functions and responsibilities for the key positions in the organization for reactor operation. Para 7.5 of (No. SSR-3) also requires the Licensee to determine the staff positions that require a licence or certificate and shall provide for adequate training in accordance with the requirements of the Department of Atomic Energy Malaysia.

1.3. This Standard is developed mainly to address the process for certification of research reactor operator, including Senior Reactor Operator. The standard presents the detail requirements prior to, and during the certification process before any certification is granted by Department of Atomic Energy Malaysia.

Objective

1.4. The objective of certification program is:

a) To ensure all research reactor operator acquire, possess and maintain the minimum required competency;

b) To ensure all applicable Malaysian legislative requirements are met; and

c) To provide recognition of the qualification and competence of research reactor operator.

Scope

1.5. This Standard shall apply to the certification of research reactor operator and senior reactor operator for any research reactor facilities in Malaysia.

1.6. This standard does not specifically address requirements for a certification of:

a) Trainee who's in the process of undergoing reactor operation training prior to certification or re-certification process;
b) Training institution, including their lecturers and professional/technical staff for the purpose of initial reactor operator training program;
c) Associates personnel with maintenance and/or test activity of the reactor, which subsequently required the reactor to be operated; and
d) Any other personnel whom is not defined as Reactor Operator or Senior Reactor Operator.

Interpretation

1.7. For the purposes of this Standard, unless the context requires otherwise:

"Active Duty" means a minimum required period of engagement in reactor-related functions, which represents at least four (4) hours per calendar quarter. Such engagement includes reactor control and reactivity manipulation activities, and maintenance activities. For Senior Reactor Operators, the term shall also include supervisory responsibilities directly associated with reactor operations;

"Certification program" means a process for certification or recertification of a Reactor Operator or Senior Reactor Operator's status upgrade defined under Section 2 of this Standard;

"Candidate" means an individual whose being nominated by the Licensee in the application for certification, re-certification or status upgrade examination;

"Committee" means Jawatankuasa Keselamatan Nuklear, where its membership is appointed by Director General of Department of Atomic Energy Malaysia;

"Licensee" means a holder of a licence issued under the Atomic Energy Licensing Act 1984;

"Research Reactor Operator" means Reactor Operator and Senior Reactor Operator;

"Reactor Operator" means certified personnel to manipulate a control of research reactor, by means of either manually-operated, automatically- operated, or combination of both;

"Senior Reactor Operator" means any certified Reactor Operator who's responsible to direct the licensed activity to be performed; and

"Reactor Manager" means designated person authorized to oversee the safe operation and utilization of the research reactor.

2.0 CERTIFICATION OF RESEARCH REACTOR OPERATOR

General Requirement for Certification

2.1. The research reactor shall only be operated by a certified Research Reactor Operator.

Pre-requisite Condition for Certification

2.2. Prior to the admission of certification process, the candidate shall fulfil the following conditions:

a) Citizenship: the candidate shall be a citizen of Malaysia;
b) Age requirements:
    i. For Reactor Operator: shall not less than 20 years old during the application for certification;
    ii. For Senior Reactor Operator: shall not less than 30 years old and not exceeding 60 years old during the application for certification; and
    iii. For re-certification of Reactor Operator: no age limit is required during the application for re-certification.
c) Minimum Diploma or Vocational in Engineering/Science discipline from a recognized institution;
d) Minimum of six (6) months performing duties as Reactor Operator Trainee under supervision of Reactor Manager at the research reactor accumulated within one (1) year period;
e) Complete the Reactor Operator Training Program, as defined under Appendix 1 of this Standard; and
f) Fulfils the medical requirements to be deemed fit for duty.

Reactor Operator Status Upgrades

2.3. The status of Reactor Operator may be upgradable to Senior Reactor Operator.

2.4. A candidate for Senior Reactor Operator shall:
a) Be a certified Reactor Operator with valid certification, during his/her application in becoming Senior Reactor Operator;
b) Possess a minimum of 7 years' experience as certified Reactor Operator;
c) Be able to direct the reactor operation during the designated shifts; and
d) Be officially designated by Licensee to be in position of Senior Reactor Operator.

Training Requirements

Initial Training Prior to certification

2.5. The candidate shall complete the reactor operator training with syllabus as define under Appendix 1 of this Standard. No restriction is imposed on the training duration prior to formal certification process.

2.6. As part of the initial training, candidate may participate in on-the-job training to demonstrate familiarity and competence for the position to which they will be assigned. An on-the-job training plan should be prepared and the achievement of learning objectives and tasks performed during the training should be recorded as part of the training record for the candidate. The initial training programme shall reflect actual conditions of the structural, system and component of the designated facility.

Medical Requirements

Medical Examination

2.7. The candidate shall be examined by Approved Registered Medical Practitioner to ensure that medical condition and general health will not detrimentally affect the performance of the assigned duties or cause operational errors which may endanger reactor operational safety.

2.8. In concluding the candidate by medical examination as “Fit for Duty” for reactor operation, the candidate shall fulfil the minimum medical requirements and criteria indicated in ANSI/ANS-15.4 (2016) or any equivalent standards available.

2.9. The candidate shall undergo regular medical examination for once in three years. This requirement shall also apply to any new application for certification, recertification or status upgrade.

Documentation of Medical Examination Results

2.10. The licensee shall document and maintain the results of medical examination and any medical records for each reactor operator and/or senior reactor operator. Such documentation shall be retained during the tenure of an individual while he/she performs the function of a Research Reactor Operator.

Incapacitation because of disability or illness

2.11. If during the validity of the certification, any Research Reactor Operator develops a temporary or permanent physical or mental condition that causes the Research Reactor Operator fail to meet Para 2.7, the Licensee shall notify Department of Atomic Energy Malaysia in writing within 30 days of learning of the diagnosis.

2.12. Special medical examination shall be administered to conclude whether the Research Reactor Operator can be cleared for resumption of reactor operation.

3.0 PROCEDURE OF APPLICATION

General

3.1. This section deals with detail procedure of application for certification of Research Reactor Operator, including the requirements for: waiver from examination; validity and extensions; and amendment and revocation of certification.

Application for Examination

3.2. The application for certification examination shall initiate with a written Letter of Examination Request to Department of Atomic Energy Malaysia, and the following information shall also be provided:

a) List of candidate for examination;
b) Medical record of candidate;
c) Evidence of completion of Reactor Operator Training Program; and
d) Evidence that the candidate has successfully performed reactor operation as a trainee, under direct supervision of Reactor Manager.

Application for Certification, Recertification or Status Upgrade

Application for Certification

3.3. The application for certification (Part A) shall be made to Department of Atomic Energy Malaysia upon completion of all examination schemes.

Application for Re-certification

3.4. The application for recertification (Part B) shall be made at least 6 months before the expiration date of existing certification.

3.5. In any cases where the application for re-certification of Reactor Operator is initiated after the expiry date of existing certification, Department of Atomic Energy Malaysia may granted additional six (6) months period to allow the re-certification process to be complete, given that the candidate demonstrate the ability to continuously maintain his/her competency as a Reactor Operator.

3.6. Without prejudice to Para 3.5, if the re-certification process could not be completed within six (6) months extended period from the existing valid certification, the existing certification is deemed revoked, and he/she shall undergo formal certification process as required under Para 3.3.

Application for Status Upgrade

3.7. The application for Reactor Operator status upgrade to Senior Reactor Operator (Part C) may be made if the condition specified in para 2.4 is met.

Required Documentation for Application

3.8. The following information shall be provided during the application, as appropriate:

a) List of candidate to be certified, re-certified or status upgraded;
b) Valid examination results;
c) Medical examination results; and
d) Licensee's designation letter for Senior Reactor Operator position (for status upgrade only).

Validity of Examination Results

3.9. The examination results shall be valid from the date of results issuance, and shall remain valid for 12 months.

3.10. The initial certification process is arranged in systematic manner to allow the whole process to be completed within twelve (12) consecutive months. Appendix 1 illustrates the generic process of the certification of Research Reactor Operator.

3.11. For the case of initial certification, where any candidate cannot successfully complete the facility walkthrough and operation examination within 12 months after passing the written examination, the validity of written examination result may be extended by the Director General of Department of Atomic Energy Malaysia for a period not exceeding 6 months only for the following conditions:

a) The reactor is in shutdown mode, where the decision for resumption of reactor operation is foreseen; and
b) Documented medical incapacity due to the candidate's sickness or injury.

3.12. When applying for an extension, the Licensee shall submit application for extension containing information pertaining to:

a) Justification for extension; and

b) Measures taken to ensure the candidate has maintained the knowledge and skills required to work competently as Reactor Operator.

3.13. Without prejudice to Para 3.11; if the certification process could not be completed within six (6) months extended period, the existing examination results is deemed invalid, and he/she shall undergo certification examination process again as required under Para 4.1.

3.14. In the event a candidate fails to initiate re-certification within 12 months of either their last active duty or the expiration of their previous certification (whichever is later), they shall be ineligible for re-certification. However, an exception may be granted if the delay was caused by one or more of the following conditions:

a) The reactor is in shutdown mode, where the decision for resumption of reactor operation is foreseen;
b) Documented medical incapacity due to the candidate's sickness or injury;
c) Pregnancy and maternity leave (strictly excluding extended childcare leave); or
d) Short courses less than six (6) months or two (2) consecutive calendar quarters.

3.15. The candidate must demonstrate his or her competency by taking any examination as determined by the Director General of Department of Atomic Energy Malaysia.

Validity of Certification

3.16. The certification granted under this Standard shall remain valid for a period of 5 years, unless:

a) Otherwise prescribed by the Director General of Department of Atomic Energy Malaysia or the recommendation for any period less than 5 years;
b) The Research Reactor Operator demonstrate temporary or permanent illness or incapacitation as prescribed in Para 2.11;
c) The Research Reactor Operator's employment is terminated from RTP; or
d) The Licensee determines that the current certified Research Reactor Operator no longer needs to maintain his/her certification.

3.17. The certification granted under these standards shall bound with the following conditions:
a) The condition under the certification shall not be re-assigned, or otherwise transferred;
b) The certification is limited to the designated facility to be operated;
c) The Research Reactor Operator is subject to, and shall observe all applicable rules and regulations;
d) The Research Reactor Operator shall be in an active duty;
e) The Research Reactor Operator shall not be a convicted felon; and
f) The Research Reactor Operator shall not be under influence of, abuses or dependency of any substances or drugs.

Amendment and Revocation of Certification

3.18. The certification and conditions of certification are subject to amendment and revision in accordance with the Act or any amendment thereto.

3.19. The certification granted may be revoked and suspended by Department of Atomic Energy Malaysia in accordance with the Act or any amendment thereto.

Examination Fraud and Misconduct

3.20. For the purposes of this Standard, examination fraud and misconduct include, but are not limited to, cheating or attempting to cheat, impersonation, the use or possession of unauthorized reference materials, unauthorized communication between candidates, plagiarism, falsification of information, and any act intended to compromise the integrity or fairness of an examination.

3.21. Any candidate or examination personnel involved in examination fraud or misconduct shall be dealt with in accordance with the applicable provisions of this Standard and any relevant regulations, directives or instructions issued by the Director General.

4.0 EXAMINATION SCHEME FOR CERTIFICATION

General

4.1. The examination scheme for Reactor Operator initial certification (Part A) shall consist of:

a) Written Examination (Part A1);
b) Facility Walkthrough Examination (Part A2); and
c) Operation Examination (Part A3)

4.2. The examination scheme for Reactor Operator re-certification (Part B) shall consist of:

a) Oral Examination (Part B1); and
b) Operation Examination (Part B2)

4.3. The examination scheme for Senior Reactor Operator’s status upgrade (Part C) shall consist of:

a) Oral Examination (Part C1); and
b) Operation Examination (Part C2)

Certification of Reactor Operator (Part A)

Written Examination (Part A1)

4.4. The written examination shall constitute of three papers which consist of the following subjects:

a) **Paper Theory 1 (Nuclear and Reactor Physics and Thermodynamics)**: Nuclear and Reactor Physics, System Thermal-hydraulics, and Research Reactor Safety;

b) **Paper Theory 2 (Fundamentals of Reactor Engineering and Reactor Safety)**: Reactor Facility Specific Design, Reactor Facility Operation, and Reactor Administrative Requirement;

c) **Paper Theory 3 (Radiation Protection)**: Statutory Basis, Radiation Protection and Occupational Safety.

4.5. Each written examination paper is arranged to be completed within 150 minutes, comprises of combination of multiple-choice type question and subjective question.

4.6. The syllabus of the written examination is stated in Appendix 2.

4.7. The minimum passing grades of each Written Examination papers shall be 70% marks to be eligible to sit for Facility Walkthrough Examination.

4.8. The candidate is allowed to retake once of the written examination paper which does not attain passing marks required under Para 4.7 if the range score obtained is from 50% to 69%. The candidate shall retake those papers within 6 months from the date of examination result issuance.

4.9. If the range score obtained is equal or less than 49%, the candidate is allowed to re-take the paper which does not attain passing marks required under Para 4.7 after undergoing the training for respective subjects again.

Facility Walkthrough Examination (Part A2)

4.10. The syllabus of the Facility Walkthrough examination is stated in Appendix 3.

4.11. The minimum passing grades of Facility Walkthrough Examination shall be 80% marks to be eligible to sit for Operation Examination.

4.12. The candidate is allowed to retake the Facility Walkthrough examination if the range score obtained is from 65% to 79%.

4.13. If the range score obtained is equal or less than 64%, the candidate is allowed to re-take the Facility Walkthrough examination again after undergoing the training for facility walkthrough.

Operation Examination (Part A3)

4.14. The syllabus of the Operation Examination is stated in Appendix 4.

4.15. The minimum passing grades of Operation Examination shall be 85% marks.

4.16. The candidate is deemed to immediately fail the Operation Examination in any of the following conditions occurs:

a) The candidate fails to follow the required reactor operation sequences as specified in the reactor operation procedures;
b) SCRAM of reactor (excluding system malfunction);
c) The candidate fails to response to alarm;
d) The reactor operation exceeding any limits specified in Operational Limits and Conditions; or
e) The candidate demonstrates an un-ethical behaviour during the conduct of reactor operation.

4.17. The candidate is allowed to retake the Operation Examination if the range score obtained is from 70% to 84%.

4.18. If the range score obtained is equal or less than 69% or any conditions stated in Para 4.16 occurs, the candidate is allowed to re-take the Operation examination again after undergoing the training for reactor operation.

Re-certification of Reactor Operator (Part B)

Oral Examination (Part B1)

4.19. The syllabus of the Oral Examination is stated in Appendix 3.

4.20. The minimum passing grades of Oral Examination shall be 80% marks to be eligible to sit for Operation Examination.

4.21. If the range score obtained is equal or less than 79%, the candidate is allowed to re-take the Oral Examination again after undergoing the remedial training on those areas or topics where weakness or deficiencies are indicated before the Candidate is allowed to retake the examination.

Operation Examination (Part B2)

4.22. The syllabus of the Operation Examination is stated in Appendix 4.

4.23. The minimum passing grades of Operation Examination shall be 85% marks.

4.24. If the range score obtained is equal or less than 84% or any conditions stated in Para 4.16 occurs, the candidate is allowed to re-take the Operation examination again after undergoing the remedial training on those areas or topics where

weakness or deficiencies are indicated before the Candidate is allowed to retake the examination.

Status Upgrade for Senior Reactor Operator (Part C)

Oral Examination (Part C1)

4.25. The syllabus of the Oral Examination is stated in Appendix 3.

4.26. The minimum passing grades of Oral Examination shall be 85% marks to be eligible to sit for Operation Examination.

4.27. If the range score obtained is equal or less than 84%, the candidate is allowed to re-take the Oral examination again after undergoing the remedial training on those areas or topics where weakness or deficiencies are indicated before the Candidate is allowed to retake the examination.

Operation Examination (Part C2)

4.28. The syllabus of the Operation Examination is stated in Appendix 4.

4.29. The minimum passing grades of Operation Examination shall be 90% marks.

4.30. If the range score obtained is equal or less than 89% or any conditions stated in Para 4.16 occurs, the candidate is allowed to re-take the Operation examination again after undergoing the remedial training on those areas or topics where weakness or deficiencies are indicated before the Candidate is allowed to retake the examination.

5.0 REFERENCES

1) International Atomic Energy Agency. *Fundamental Safety Principles*, Safety Fundamental No. SF-1 (2006)

2) International Atomic Energy Agency. *The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors*, Safety Guide No. NS-G-4.5 (2008)

3) United States Nuclear Regulatory Commission. *Operator Licenses* (10 CFR 55)

4) United States Nuclear Regulatory Commission. *Non-Power Reactor Operator Licensing Examiner Standards* (NUREG-1478 Rev.01). March 1995.

5) American Nuclear Society. *Selection and Training of Personnel for Research Reactor*. Standard No. ANSI/ANS-15.4 (2016).

6) Atomic Energy Licensing Board. *Standard for Certification and Recertification of Research Reactor Operator*, LEM/TEK/54 (version 2009)

7) Atomic Energy Licensing Board. Standard Persijilan Pegawai Perlindungan Sinaran. LEM/TEK/44 (Bahagian A-G). 2015

8) International Atomic Energy Agency. *Safety of Research Reactor* Specific Safety Requirement No. SSR-3

6.0 SUPERSESSION

This publication superseded previous issued LEM/TEK/54 Sem.1 (dated 17 January 2017).

7.0 COMMENCEMENT DATE

This document shall take effect immediately upon its issuance.

8.0 CONCLUSION

Should there be any inquiries regarding this document, applicant/licensee may contact the Department of Atomic Energy at the address provided below:

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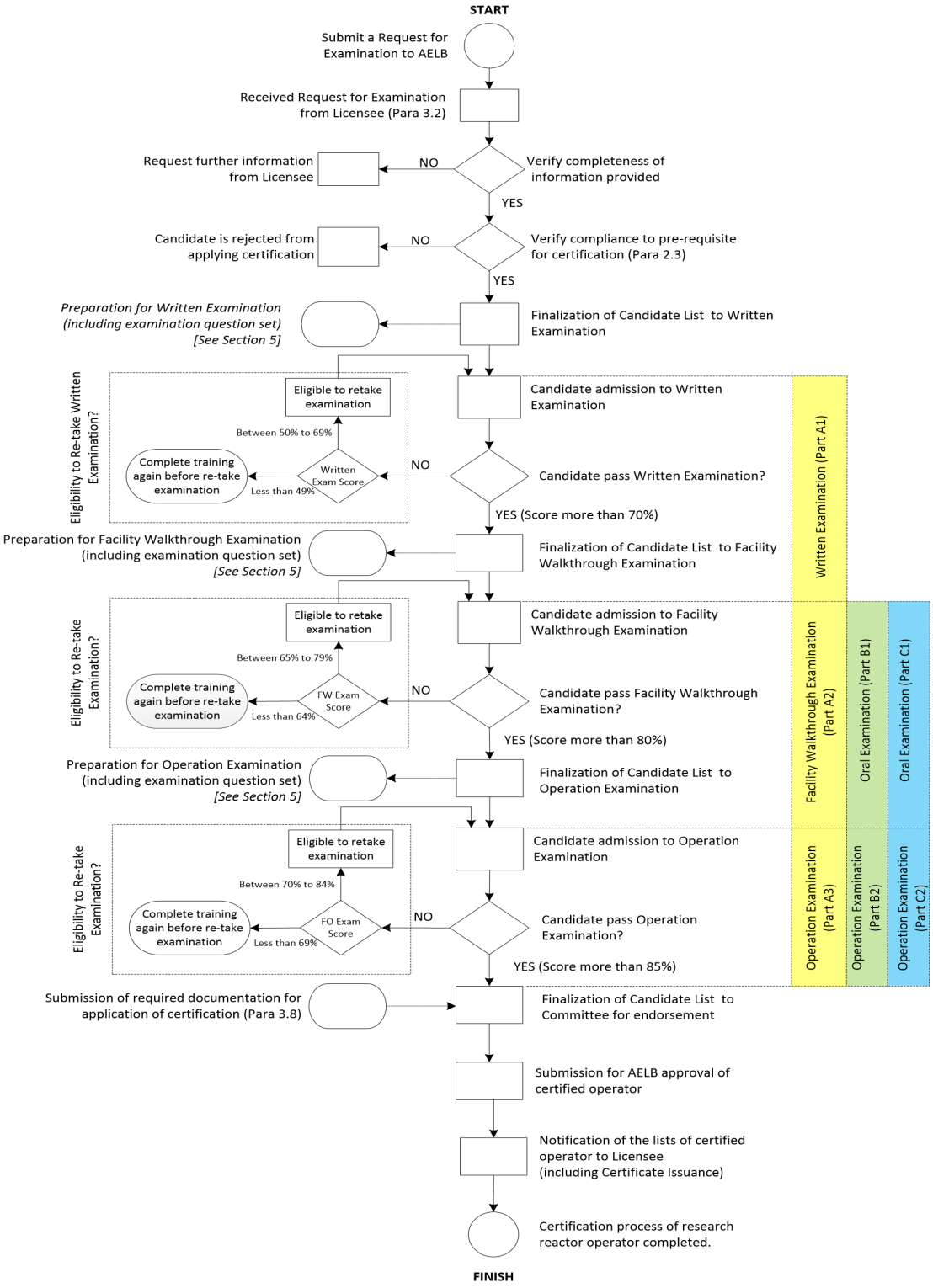
9.0 DOCUMENT RECORD

Date of Issuance	Status of Revision	Drafter
17 January 2017	1	The Committee members of Jawatankuasa Kecil Keselamatan Nuklear: En. Nik Mohd. Faiz Khairuddin - *Lembaga Perlesenan Tenaga Atom* Cik Lydia Ilaiza Saleh - *Lembaga Perlesenan Tenaga Atom* Prof. Madya Dr. Faizal Mohamed - *Universiti Kebangsaan Malaysia* Dr. Mohd. Abd. Wahab Mohd. Yusof - *Agensi Nuklear Malaysia*

		Datin Zarina Masood - *Agensi Nuklear Malaysia* Pn. Noorly Akmar Ramli - *Suruhanjaya Tenaga* En. Sham Shuhairi Nasarudin - *Jabatan Keselamatan & Kesihatan Pekerjaan* En. Mohd. Radzi. Rohaizad - *Jabatan Keselamatan & Kesihatan Pekerjaan* Pn. Sumitra Jayaseelan - *Kementerian Sains, Teknologi & Inovasi* En. Keshminder Singh a/l Ajaib Singh - *Kementerian Sains, Teknologi & Inovasi*
29 September 2026	2	1. Mohamad Aiman Adjmal bin Zuri 2. Ts. Ridha bin Roslan 3. Dr Teng Iyu Lin

APPENDIX 1

GENERIC PROCESS FOR CERTIFICATION OF RESEARCH REACTOR OPERATOR



APPENDIX 2

INITIAL TRAINING AND COMPREHENSIVE WRITTEN EXAMINATION SYLLABUS

A1.1. The initial training for Reactor Operator shall comprise of the minimum following scopes:

1. Fundamental of Nuclear and Reactor Physics
2. System Thermal-Hydraulics
3. Reactor Engineering and Safety
4. Facility Design: Mechanical and Instrumentation & Control
5. Facility Operating Procedures
6. Administrative Requirements
7. Statutory Bases
8. Radiation Protection
9. Occupational Safety

APPENDIX 3

FACILITY WALKTHROUGH AND ORAL EXAMINATION SYLLABUS

General

A2.1. The objectives of facility walkthrough and oral examination to determine if the candidate possesses and maintain adequate competencies and knowledge in the area of facility system design and operation.

A2.2. The examination is conducted in the combination of facility walk-down and oral presentation. No time limit is imposed on the duration of examination for each candidate. Considering the performance of the candidate, and to ensure optimization of examination, it is recommended that the examiner spend approximately 30 minutes per candidate.

Required Examination Competencies

A2.3. The following examination competencies shall be evaluated for each candidate:

a) **System Equipment and Components:** This area deals with presentation of system hardware and components design. It is also includes the basic flow path (explanation, free-hand drawing or tracing piping and instruments drawing), sources, power supplies, system backups, system operation to perform its intended functions and its relationship with interconnecting systems.

b) **System Instrumentation/Interlocks/Protection:** This area deals with presentation of instrumentation associated with the system, including its purposes, expected reading during normal, abnormal, and emergency situation, component protection and interlock function. Also, any automatic protection afforded by the system, set-points, coincidence and reasons for the protection is appropriately evaluated in this subject area.

c) **Procedural Knowledge/Uses:** This area deals with presentation of normal, abnormal, and emergency procedures associated with the system, including procedural pre-requisites, precautions and limitation. Any special tests, regular experimental procedures, pre-operational and post operational checklists may be included in this area. The examiner shall sample a candidate's knowledge in normal, abnormal, emergency procedures to ensure the minimum competency is achieved.

d) **Administrative and Statutory Requirements:** This area incorporates the competency of a candidate in the area of Reactor Operational Limits and Conditions, including Safety Limits (SL), Safety System Setting (SSS), Limiting Condition for Safe Operation (LSO), Surveillance Requirements (SR) and Administrative Requirements (AR). Statutory requirements, such as approved license conditions, and other administrative requirement may be evaluated in this area.

A2.4. For the purpose of this examination, the following requirements shall apply:

a) For Reactor Operator certification: **ALL** Thematic Area (TA) must be evaluated, where at least **ONE** Specific Area (SA) is selected;
b) For Reactor Operator recertification: at least **TWO** Thematic Area (TA) is evaluated, where at least **THREE** Specific Area (SA) is selected;
c) For Senior Reactor Operator Status Upgrade: Specialized topic on oral examination will be developed by the Committee on case-by-case basis.

A2.5. The subject topic of examination (including subject topic details) is tabulated in **Table A2-1**.

Table A2-1: Thematic Area for Walkthrough/Oral Examination

Thematic Area (TA)		Specific Area (SA)	
MF	*Major Reactor System*	MF1	Reactor Core (including Core construction)
		MF2	Reactor Control Rod
		MF3	Control Rod Drive
		MF4	Primary Cooling System
		MF5	Secondary Cooling System
		MF6	Nuclear Fuel Design
		MF7	Reactor Pool
AU	*Reactor Auxiliary System*	AU1	Reactor Cooling Water Control (including leak detection system)
		AU2	Compress air system
		AU3	Sampling system (including Environmental sampling and pool water sampling system)
		AU4	Fire Protection System
		AU5	Service Water System
		AU6	Equipment and Floor Drainage
		AU7	Reactor Ventilation System (including any active or passive system)
		AU8	Radioactive waste management
		AU9	Reactor water Make-up/Clean-up System
EL	*Reactor Electrical System*	EL1	Normal AC power Supply
		EL2	Emergency AC power Supply
		EL3	Normal DC power Supply
		EL4	Emergency DC power Supply
		EL5	Reactor Building Electrical power system
		EL6	Un-interrupted power supply
		EL7	Offsite power supply
		EL8	Onsite Power Supply (including any Diesel Generator)
FC		FC1	Fuel Handling and Storage

Thematic Area (TA)		Specific Area (SA)	
	Reactor Facilities	FC2	Exposure Room
		FC3	In-core Experimental Facilities
		FC4	Beam Ports
		FC5	Thermal Column
		FC6	Pneumatic Transfer System
		FC7	Liquid Waste handling and disposal
		FC8	Gaseous Waste handling and disposal
		FC9	Solid Waste handling and disposal
IC	*Nuclear and Radiation Instrumentation System*	IC1	Startup Channels
		IC2	Log N channel
		IC3	Safety Channel
		IC4	In-core/Ex-core Instrumentation
		IC5	Reactor Operation Control Panel
		IC6	Liquid Effluent Monitors
		IC7	Gaseous Effluent Monitors
		IC8	Area Radiation Monitors
TR	*Reactor Responses during Normal Operation, Transient and Emergency Situation*	TR1	Power Increase, Decrease, and Power Correction (in AUTO mode)
		TR2	Power Increase and Decrease, and Power Correction (in MANUAL mode)
		TR3	Emergency Shutdown from Full Power/Designated Power
		TR4	Normal Shutdown from Full Power/Designated Power
		TR5	Subcritical to Criticality (including Control Rod Manipulation)
		TR6	Control Rod Malfunction
		TR7	Instrumentation Malfunction
		TR8	Primary Cooling System Leak Control
		TR9	Fuel Cladding Failure

Thematic Area (TA)		Specific Area (SA)	
		TR10	Reactor Protection System (including any setpoints)
		TR11	Emergency Plan and Procedures
RG	Regulations and Organization	RG1	General Facility Safety Rules
		RG2	Organizations, Competent Authorities, Responsibilities
		RG3	Authorization, Notification and Reporting
		RG4	Modification of Reactor System and Reactor Procedures
		RG5	Licensing and Enforcement
		RG6	Modification of Licensing Documents (including SAR and OLC)
		RG7	Operator Responses During Incident/Accident

APPENDIX 4

OPERATION EXAMINATION SYLLABUS

General

A3.1. The objectives of operation examination are to:

a) determine if the candidate possesses and maintain adequate competencies to demonstrate specific action of reactor operation, which covers the demonstration of a start-up and shutdown procedures, and control manipulation; and

b) evaluate Candidate's understanding and level of knowledge on the design and operation of the reactor and its associated facilities, both internal and external to the reactor control room.

Required Examination Competencies for Reactor Operator

A3.2. All candidate of Reactor Operator (whether for initial certification or recertification) are required to accomplished the following standardize normal operational sequences[1] (without SCRAM):

a) Perform pre-operational procedures;

b) Initiate reactor start-up operation sequences;

c) Bring the reactor from sub-critical to a critical condition at designated power level by Manual mode;

d) Increase power level to a designated power level requested

   i. by Manual or Automatic mode; or

   ii. successfully performed Square-Wave mode operation;

e) Maintained the reactor at designated power for at least 15 minutes (Note: It is recommended that candidate is able to demonstrate the control of reactor at 100% licensed power level);

[1] The normal operational sequence of the reactor is designed based on the updated, approved operation procedure

f) Initiate reactor power reduction up to designated power level;
g) Perform automatic SCRAM, and removed key from reactor console; and
h) Performed post-operational procedures.

A3.3. The candidate is graded based on the following criteria:

a) Understanding and interpretation of annunciator and alarm signals:
    i. Ability to correctly understand, interpret and verify any alarm and annunciators (including, when necessary, the use of the alarm response procedure);
    ii. Ability to prioritized any alarm and annunciators; and
    iii. Ability to attend to them based on the importance and severity.
b) Diagnosis of Events and Conditions based on Signal and Instrumentation Readings:
    i. Ability to recognize off-normal trend or status; ii. Ability to correctly use reference material (prints/book/chart recording) to aid in the diagnosis and clarification of events; and
    ii. Ability to correctly diagnose reactor conditions based on control room indications.
c) Understanding of Reactor and System Responses:
    i. Ability to locate and correctly interpret relevant instruments and other indicators of reactor/system response;
    ii. Ability to demonstrate knowledge of system operation, including setpoint, interlocks and automatic actions; and
    iii. Ability to demonstrate an understanding of his/her action (or inaction) affected reactor/system condition.

d) Compliance/Use of Procedures and Operational Limits and Conditions (OLC):
    i. Ability to refer to the appropriate procedure in a timely manner; ii. Ability to recognize emergency procedure condition and carry out

appropriate action without the aid of reference or other form of assistance;

ii. Ability to comply with procedures (including precautions and limitations) in an accurate and timely manner; and

iii. Ability to recognized reactor conditions which are address in OLC.

e) Console Operations:

i. Ability to locate controls effectively and accurately; ii. Ability to manipulate controls in an accurate and timely manner; iii. Ability to act appropriately in response to an instrumentation readings; and

ii. Ability to take manual controls of automatic functions where appropriate.

f) Communications:

i. Ability to effectively communicate information on the status of the reactor/system.

Additional Required Examination Competencies for Senior Reactor Operator

A3.4. For SRO operation examination, in addition to standardize normal operational sequences of the reactor, the SRO candidate may also be assessed with situation of abnormality of the reactor, including, in the event of instrumentation failure, component failure or major transients.

A3.5. For Senior Reactor Operator status upgrade, in addition to the criteria in A3.3, the following shall also be evaluated:

a) Communications:

i. Ability to understand and judge the condition of the reactor/system based on the information available from reference material and/or reactor operator;

ii. Ability to making decision/direction for a continued safe operation;

iii. Ability to direct Reactor Operator to perform specific action based on the decision made; and

iv. Ability to communicate the status of his/her action (or in-action) to Reactor Manager and Licensee's Safety Committee.