

# STANDARD FOR CERTIFICATION OF RESEARCH REACTOR OPERATOR



ATOMIC ENERGY LICENSING BOARD  
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

Atomic Energy Licensing Board  
Ministry of Science, Technology and Innovation  
Batu 24, Jalan Dengkil, 43800 Dengkil, Selangor

Tel: 03-8922 5888

Fax: 03-8922 3685

Laman Web: <http://www.aelb.gov.my>

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## FOREWORD

Since 2009, the Atomic Energy Licensing Board (AELB) has issued the first national regulatory standards on the certification and recertification of Malaysian TRIGA Mk. II (RTP) research reactor operator (LEM/TEK/54) (hereafter called “previous standard”). These previous standards underline mandatory requirements to be fulfilled in order to be certified as reactor operator. The requirements underline is developed in 2007-2009 through a series of consultancy meeting with the national experts and contribution from the International Atomic Energy Agency (IAEA) reflecting the IAEA Member States best practices and good recommendations.

Through the experience gained from the uses of the previous standard, AELB issued the revision of LEM/TEK/54 (hereafter called “revised standard”) aimed to incorporate the accumulation of new requirements from updated IAEA and internationally accepted safety standards, as well as the lesson learnt from the recent Fukushima disaster in 2011. This revised standard introduced a streamlined requirements applied prior to, during and post certification process, including detail procedures for application of certification, certification examination scheme, standardized conduct of examination and procedures for dealing with misconduct of examination. In addition, new syllabus of examination is designed to ensure the future certified operator meet the expectation to continuously operate RTP in safely manner.

The revised standard has undergone an extensive and rigorous process in collection of information, preparation for drafting, a well-thought peer-review and approval process prior to publications. The high quality of standard published is ensured through this iterative and transparent process. The success of this publication is represent by the results of consistent hard work and tenacity of all those involved in addressing the complexity and challenges in meeting the requirements of Atomic Energy Licensing Act 1984 and its subsidiary regulations. This standard will serve as a centralized source of information for AELB and Licensee in implementing certification of research reactor operator as well as to provide guidance to assess the level of competence of the candidate reactor operator.

This is one of the many initiatives undertaken by AELB to provide an efficient and effective supervision towards safety, security and safeguards for peaceful use of atomic energy application in Malaysia. I wish to record my sincere thanks and appreciation to all of them and I am confident that their contributions will be truly appreciated by the readers for many years to come.

**HAMRAH BIN MOHD ALI**  
Director General  
Atomic Energy Licensing Board  
Ministry of Science, Technology and Innovation

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## 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 Safety Requirements *Safety of Research Reactors* (No. NS-R-4) Para 7.3 requires the Licensee (termed *operating organization*) to establish the functions and responsibilities for the key positions in the organization for reactor operation. Para 7.4 of NS-R-4 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 AELB.

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 AELB.

1.4. This publication supersedes previous issued LEM/TEK/54 (dated 4 December 2009).

### Objective

1.5. 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

1.6. This Standard shall apply to the certification of research reactor operator and senior reactor operator of PUSPATI TRIGA Mk. II research reactor (RTP).

1.7. 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

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

“AELB” means Atomic Energy Licensing Board, as defined under the Atomic Energy Licensing Act 1984;

“Active Duty” means a minimum required period of reactor control and reactivity manipulation, which represents at least 4 hours per calendar quarter;

“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 Kecil Keselamatan Nuklear, where its membership is appointed by AELB;

“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 a 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.

## **CERTIFICATION OF RESEARCH REACTOR OPERATOR**

### **General Requirement for Certification**

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

2.2. The initial certification process is arranged in systematic manner to allow the whole process to be completed within twelve (12) consecutive months. Figure 2-1 illustrates the generic process of the certification of Research Reactor Operator.

### **Pre-requisite Condition for Certification**

2.3. 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 and not exceeding 45 years old during the application for certification; and
  - ii. For Senior Reactor Operator: shall not less than 30 years old and not exceeding 55 years old during the application for certification
- c) Minimum Diploma in Engineering/Science discipline from a recognized institution;
- d) Minimum of six (6) continuous months performing duties as Reactor Operator Trainee under supervision of Reactor Manager at the research reactor;
- 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.

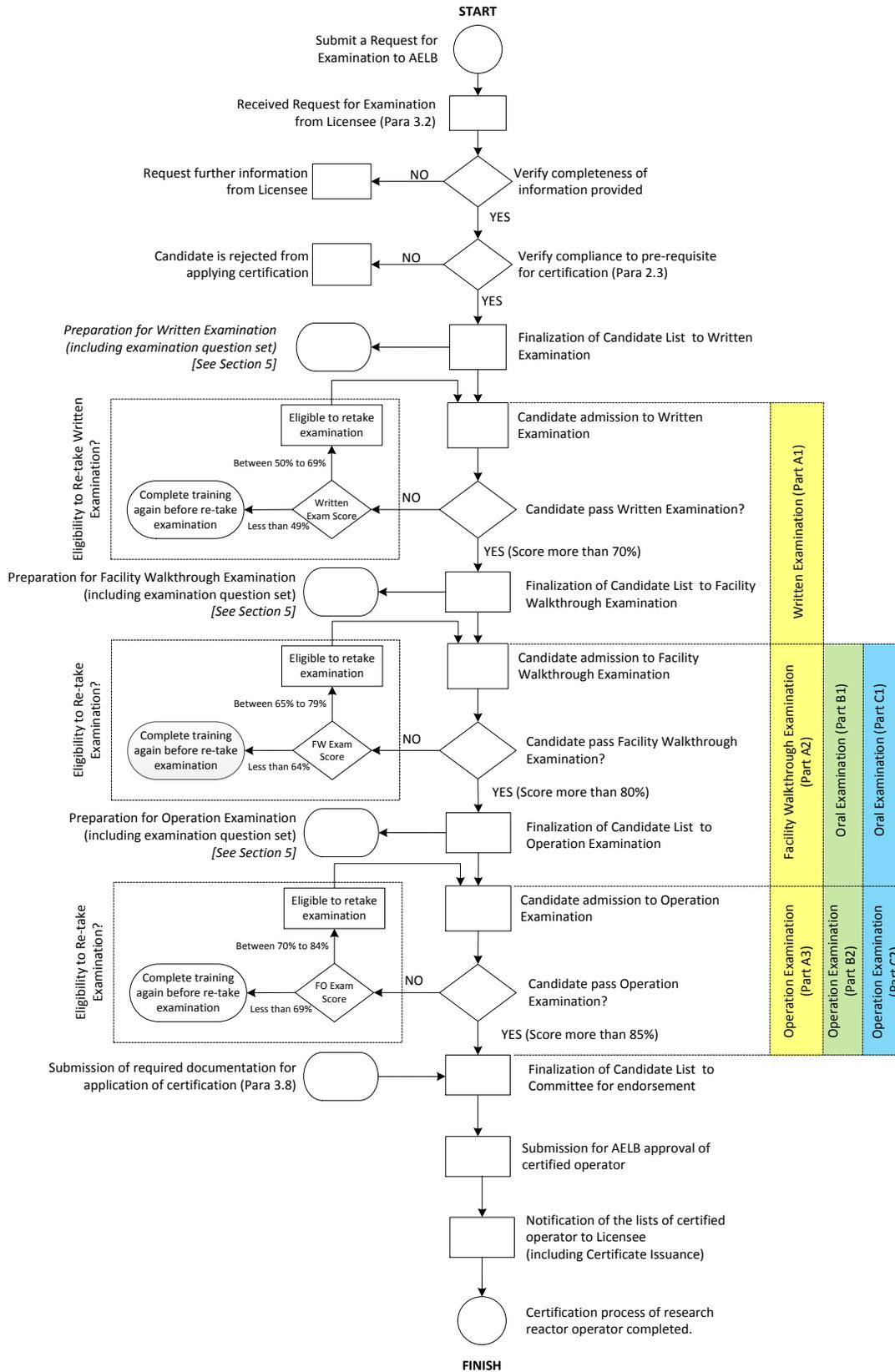


Figure 2-1: Generic Process for Certification of Research Reactor Operator

## **Training Requirements**

### *Initial Training Prior to certification*

2.4. 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.

2.5. 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*

2.6. 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.

2.7. 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.

2.8. 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*

2.9. 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*

2.10. 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 2.6, the Licensee shall notify AELB in writing within 30 days of learning of the diagnosis.

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

### **Reactor Operator Status Upgrades**

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

2.13. 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.

## PROCEDURE OF APPLICATION

### General

3.1 This sections 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 AELB, and the following information shall also be provided:

- a) List of candidate for examination;
- b) Reference Material for examination (see Section 5);
- 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 AELB 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, AELB 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 2.3(b)(ii) and 2.13 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 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 AELB 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) The delay in certification due to candidate's sickness or injury.

3.11 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.

3.12 Without prejudice to Para 3.10; 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.

### **Validity of Certification**

3.13 The certification granted under this Standard shall remain valid for a period of 3 years, unless:

- a) Otherwise prescribed by AELB or the Committee's recommendation for any period less than 3 years;
- b) The Research Reactor Operator demonstrate temporary or permanent illness or incapacitation as prescribed in Para 2.10;
- 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.

3.14 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**

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

3.16 The certification granted may be revoked and suspended by AELB in accordance with the Act or any amendment thereto.

### **Transitional Period**

3.17 The Standard for Certification and Recertification of Research Reactor Operator (LEM/TEK/54) 2007 is revoked; provided that any existing certification granted under that Standards prior to 1 February 2017 shall be remain valid until such certificate expires.

## EXAMINATION SCHEME FOR CERTIFICATION

### General

4.1 The examination scheme for Reactor Operator certification (Part A) shall consists 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 consists 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 consists of:

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

### Written Examination (Part A1)

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

- a) **Paper A1-1**: Nuclear and Reactor Physics, System Thermal-hydraulics, and Research Reactor Safety;
- b) **Paper A1-2**: Reactor Facility Specific Design, Reactor Facility Operation, and Reactor Administrative Requirement;
- c) **Paper A1-3**: Statutory Basis, Radiation Protection and Occupational Safety.

4.5 Each written examination paper is arranged to be completed within 120 minutes, comprises of combination of multiple-choice type question and subjective question.

4.6 The syllabus of the written examination is stated in Appendix 1.

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 2.

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 3.

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.

### **Oral Examination (Part B1)**

4.19 The syllabus of the Oral Examination is stated in Appendix 2.

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 3.

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.

### **Oral Examination (Part C1)**

4.25 The syllabus of the Oral Examination is stated in Appendix 2.

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 3.

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.

## **CONDUCT OF CERTIFICATION EXAMINATION**

### **General**

5.1 This section describes general procedures in conduct of certification examination specified under Section 4 of this Standard. This includes preparation, scheduling and coordinating examinations, assigning examiners and proctors, and obtaining reference material from facility.

### **Conduct of Examination**

5.2 The examination scheme set forth in this standards shall be conducted by AELB.

5.3 Notwithstanding to Para 5.2, the operation and walkthrough examination scheme set forth in this standards shall be implemented at the designated Licensee's reactor facility for which the candidate would expected to be an operator.

## Preparatory Activities for Examination

### *Examination Scheduling*

5.4 Scheduling of the examination, including preparation, administration and grading of examinations are prepared by AELB. In completing this process, negotiation with representative of the Licensee may be made on issues related to examinations dates.

### *Assignment of Parties involved in the Conduct of Certification Examination*

5.5 For the purpose of this section, Table 5-1 lists the parties involved in the conduct of the certification examination with their main responsibility.

Table 5-1: Parties involved in the conduct of certification examination

<b>Parties involved</b>	<b>Appointment</b>	<b>Main Responsibility</b>
Examiner ( <i>Pegawai Pemeriksa</i> )	Committee	a) Examine and evaluate examination (Part A1) based on the answer scheme and grading methodology as determined by the Committee
Assessor ( <i>Pegawai Penilai</i> )	Committee	a) Assess Candidate performance in examination (Part A2, A3, Part B, Part C) based on the answer scheme and grading methodology as determined by the Committee
Proctor ( <i>Pegawas Peperiksaan</i> )	AELB	a) Administer the conduct of certification examination; b) To provide necessary support to Examiner/Assessor/Examination Secretariat, where necessary

Parties involved	Appointment	Main Responsibility
		c) To provide reports of any misconduct of examination to the Committee (See <i>Section 6</i> )
Examination Secretariat ( <i>Urusetia Peperiksaan</i> )	AELB	a) Coordination of the certification examination request from Licensee (including scheduling, appointment of suitable assessor, examiner); b) To provide necessary support to Committee Secretariat, where necessary c) To announce the examination results approved by the Committee
Drafter ( <i>Penyedia Soalan Peperiksaan</i> )	N/A	a) Develop a set of questions and answer scheme as determined by the Committee b) Develop a complete list of marking scheme for each answers
Committee's Secretariat ( <i>Urusetia JKKN</i> )	N/A	a) To consolidate the draft of examination question, answers, grading scheme to the Committee for approval; b) To arrange for Committee activities for the purposes of research reactor operator certification c) To provide necessary support to Examination Secretariat, where necessary

5.6 The committee reserve the right to assign another examiner if the previous assigned examiner appears to present a conflict of interest that may jeopardize the performance, evaluation and integrity of the examination.

5.7 An examiner or assessor who failed a candidate in examination shall not be assigned to administer that Candidate's retake examination.

5.8 An examiner or assessor, AELB, or the Committee, shall not be liable or be hold responsibility for any damages, incidents or accident to the reactor and its associated structure, system and component caused by the Candidate prior to, during or post examination session, or after the Candidate has been certified or re-certified. It is presumed that the responsibility for safety of the reactor rests with the Licensee.

5.9 The examination proctors shall administer the conduct of examination in ensuring the integrity of examination. Specifically, they have the following responsibilities during the conduct of examination session:

- a) To verify the adequacy of examination area and support facility prior to examination session to ensure no aids/reference material available to candidate to allow him/her for possible cheating;
- b) Receive of sealed packages containing examination questions, and ensure the seal is maintain intact;
- c) To direct the candidate to sit at a designated seat;
- d) To verify the candidate's identity and to ensure the attendance of candidate is appropriately recorded;
- e) To ensure the candidate to bring with him/her pencils, pens, ID (identity card/passport) and non-programmable calculator **ONLY** into the examination room;
- f) To distribute the examination questions 10 minutes before the examination starts;
- g) To hinder any candidate:
  - i. whose late than 30 minutes after the examination commence to undertake the intended examinations;
  - ii. to leave examination area 30 minutes before the examination session complete;
- h) To observe the candidate for any possibility of cheating during examination session, and to record such act of possible cheating determined to be reported to the Committee;
- i) To instruct the candidate, when the examination session is over:

- i. To immediately stop writing on the examination answer sheet;
  - ii. To consolidate the examination sheet;
  - iii. To bring back his/her ID and personnel belonging when leaving the examination area;
  - iv. To leave the consolidated answer sheet; examination questions; and any used and un-used paper on the desk;
  - v. To leave the examination room in orderly manner.
- j) To collect consolidated answer sheet, un-used and used paper on the candidate desk and prepared them for submission for marking process.

#### *Pre-Examination Site Visits and Facility Review*

5.10 In some cases, it may advantageous to arrange for site visits and facility review prior to the facility walkthrough/oral/operation examinations. This site visits allow the assigned assessor to familiarize themselves with the facility and provide an opportunity to review and validate the status of reference material provided to AELB for the purpose of examination.

#### *Reference Material for Examinations*

5.11 Upon the application of Examination Request is made by the Licensee, the following information shall also be provided:

- a) Training material, existing learning objectives, lecture handouts used for training;
- b) Complete procedure index (including temporary procedures list);
- c) All administrative procedures, notices, and directives (including superseded procedures)
- d) All facility procedures, including normal operating procedures, and procedures for experiments (including superseded procedures);
- e) All emergency plan, procedures and instructions, including any abnormal or special procedures (including superseded procedures);

- f) All applicable instructions from the reactor managements that are safety related and may supersede regular procedures;
- g) Fuel handling and core loading procedures;
- h) Annunciator/alarm procedures;
- i) System operating procedures, including system required for experiments;
- j) Facility's piping and instrumentation diagram, electrical diagram, coolant flow diagrams;
- k) Facility technical handbook, including any curve or information as used by operator during normal operation; and
- l) Any precautions, limitation, and complete list of set points for the facility.

## **Administration of Examination**

### *Administration of Written Examination (Part A1)*

5.12 The following administrative principles for conduct of written examination (Part A1) is adopted:

- a) A single room must be provided for administration of the written examination. The location of this room, restroom and other supporting facilities should be such as to prevent contact with other candidate during the written examination;
- b) Minimum spacing of 1.8m (6 ft.) between candidates is required to ensure examination integrity;
- c) Candidate may bring pens, pencils, and/or non-programmable calculators into the examination room. Only black ink or dark pencils should be used for writing answers to questions; and
- d) No wall charts, models, and/or other training materials can be present in the examination room. No other equipment or reference material will be allowed unless provided by the examiner.

5.13 The following written examination instruction shall be read **VERBATIM** by proctors prior to the starts of examination session:

- a) Cheating on the examination means an automatic fail of examination and could result in more severe penalties.
- b) Restroom trips are to be limited and only one applicant at a time may leave. You must avoid all contact with anyone outside the examination room to avoid the appearance or possibility of cheating.
- c) Use black ink or dark pencil only to facilitate legible reproductions.
- d) Write your name in the blank provided in the upper right-hand corner of the examination cover sheet and each answer sheet.
- e) Write your answers on the answer sheet provided. **USE ONLY THE PAPER PROVIDED AND DO NOT WRITE ON THE BACK SIDE OF THE PAGE.**
- f) Before you turn in your examination, consecutively number each answer sheet.
- g) The point value for each question is indicated in [brackets] after the question.
- h) If the intent of a question is unclear, ask questions to the examiner only.
- i) When turning in your examination, assemble completely examination questions, examination aids and answer sheets. In addition, turn in all scrap paper.
- j) Ensure all information you wish to have evaluated as part of your answer is on your answer sheet. Scrap paper will be disposed of immediately following the examination.
- k) To pass the written examination, you must achieve a grade of 70 percent or greater in each paper.
- l) There is a time limit of two (2) hours for completion of the examination.
- m) When you have completed and turned in your examination, leave the examination area. If you are observed in this area while the examination is still in progress, your application for certification may be denied or revoked.

*Administration of Facility Walkthrough, Oral and Operation Examination*

5.14 This section addresses the administration of Facility Walkthrough, Oral and Operation Examination (Part A2, A3, Part B and Part C).

5.15 The number of persons present during an examination should be limited to ensure the integrity of the examination and to minimize distractions to the candidates. Except for the certified operators, no other member of the RTP's training or operations staff and any Candidate shall be allowed to witness Facility Walkthrough, Oral or Operation Examination.

5.16 Previous Facility Walkthrough, Oral and Operation examination shall not to be used as a reference for future candidates. The use of video recording during the administration of examinations is not authorized.

5.17 During the examination session, the assessors must not restrict the candidate operator's activities to such an extent that the candidates being evaluated are required to assume actual responsibilities of the certified operator. The candidate will be expected to assume the full responsibility of the role he/she is playing in the examination.

5.18 Other assessors may be present either to witness the examination as part of their training, or to audit the performance of the assessors administering the operating test.

5.19 The following principles for conduct of examination is adopted:

- a) An assessor shall brief the candidates prior to beginning the examination. It is recommended that this briefing be presented to all candidates who are scheduled to be examined during the same session at the same time.
- b) In any cases where the candidate withdraws from the examination, prior to or after commencement of the examination session, the Licensee shall notify the AELB in written justifying the reason of such withdrawal. In any

cases, the candidate shall be considered as failing in examination and the candidate is required to apply for rescheduling of examination.

- c) While administering the examination, the assessor should encourage the candidate to draw diagrams, flow paths, or other visual representations. This allows the candidate to better express themselves when providing an answer or explanation to the assessor.
- d) Prior to commencement of operation examination, the assessor shall determine the scenario to be performed by the candidate. Such scenario should be developed in combination of normal operation of the facility, instrumentation error, component failure and major transients.
- e) The assessor should limit discussions with the applicants during the scenario performance to both maintain realism and to avoid distracting the candidate. The questions asked by assessor during the scenario performance should be limited to those that are necessary for assessing the candidate's understanding of facility conditions and required operator actions during the scenario.
- f) If the candidate performs in a way other than expected, the assessor should note the candidate's actions (or lack of actions). These notes must provide sufficient information to allow the assessor to confidently judge Candidate performance on the knowledge and prescribed competencies, and must provide basis of his/her action for a certification decision.

## EXAMINATION FRAUD AND MISCONDUCT

### General

6.1 This section describes a procedure to deal with fraud and misconduct of any examination prescribed under this Standard.

6.2 For the purposes of this section –

“Reference Material” means any book, numerical tables, mathematical formula, paper, document, picture, mobile phone or any other electronic device;

“Plagiarism” means an act or instance of using or closely imitating the language, ideas and thought of another author without authorization, and the representation of that work is not crediting by the original author;

“Falsification” means an act to alter fraudulently, or to make false or incorrect information, with or without intent to deceive;

### Fraud and misconduct of examination

6.3 During an examination, any Candidate shall not take, or attempt to take or use any Reference Material except those authorized by the examiner, into or out of any examination room; or receive or attempt to receive or in any other manner whatsoever obtain or attempt to obtain any Reference Material in any manner from any other person while in the examination room except for such Reference Material received from the Examiners or recommended by Committee.

6.4 Any candidate shall not obtain or attempt to obtain the services of any other person to appear for the examination on his behalf or in any other manner whatsoever.

6.5 During an examination session, a Candidate shall not impersonate or attempt to impersonate another Candidate and appear for such examination on behalf of any Candidate other than himself.

6.6 A Candidate shall not via whatever means, cheat or attempt to cheat or conduct himself in a manner which can be construed as “*cheating*” or attempt to cheat in an examination, while the examination is in progress.

6.7 An examination proctors, in ensuring the examination integrity, shall not put him/herself, or any attempt to compel him/herself aiding, or attempt to aid any Candidate, via whatever means, to cheat or attempt to cheat or in any manner which can be construed as “cheating” in an examination, while the examination is in progress.

6.8 A Candidate shall not, during an examination, communicate with any other Candidate during an examination session by any means whatsoever.

6.9 Any offence committed under Para 6.3 to 6.8 shall be construed as a strict liability offence and shall be dealt with in accordance with Para 6.10-6.16.

### **Procedures to Handle Fraud and misconduct of examination**

6.10 Should there is any evidence, or suspicion by the proctors that any fraud, cheating, or falsification is occur during the examination session, he/she shall prepare a written report to the Committee within five (5) days, compiling such evidence to the claim of any fraud, cheating, or falsification.

6.11 The committee, based on the written report submitted by the proctor, shall request upon the candidate to justify his/her action of any fraud, cheating, or falsification he/she may or may not conducted.

6.12 The committee shall conduct a thorough investigation of such claims of any fraud, cheating, or falsification. The committee also reserve the rights to establish independent subcommittee to investigate any fraud, cheating, or falsification, and to report to the Committee within thirty (30) days of its findings.

6.13 The committee, based on findings of investigation, shall make its decision, whether or not any fraud, cheating, or falsification is occurring, based on the following consideration:

- a) Are any act of fraud, cheating, or falsification being occur?
- b) Are the candidate(s) having an intention to perform such act?
- c) What are the severities of such claimed act of fraud, cheating, or falsification?

6.14 The candidate, after consideration by Committee, upon conviction of his/her misconduct of examination, he/she shall be presumed to fail all the examination for certification. He/she shall not be allowed to apply for certification for one year, starting from the latest examination date which he/she attended.

6.15 If the examiners/proctors/assessors or any AELB staffs are involved in the misconduct of the examination, the AELB management reserve the right to determine the punishments based on applicable Public Services circular/directives/policies.

6.16 If any third party persons are involved in the misconduct of the examination, the AELB management reserve the right to report the case to the police for further criminal investigations.

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## REFERENCES

- 1) International Atomic Energy Agency. *Fundamental Safety Principles*, Safety Fundamental No. SF-1 (2006)
- 2) International Atomic Energy Agency. *Safety of Research Reactors*, Safety Requirements No. NS-R-4 (2005)
- 3) 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)
- 4) United States Nuclear Regulatory Commission. *Operator Licenses* (10 CFR 55)
- 5) United States Nuclear Regulatory Commission. *Non-Power Reactor Operator Licensing Examiner Standards* (NUREG-1478 Rev.01). March 1995.
- 6) American Nuclear Society. *Selection and Training of Personnel for Research Reactor*. Standard No. ANSI/ANS-15.4 (2016).
- 7) Atomic Energy Licensing Board. *Standard for Certification and Recertification of Research Reactor Operator*, LEM/TEK/54 (version 2009)
- 8) Atomic Energy Licensing Board. *Standard Persijilan Pegawai Perlindungan Sinaran*. LEM/TEK/44 (Bahagian A-G). 2015

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## **APPENDIX 1**

### **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 2

### 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	<i>Major Reactor System</i>	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	<i>Reactor Auxiliary System</i>	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	<i>Reactor Electrical System</i>	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)	
	<i>Reactor Facilities</i>	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	<i>Nuclear and Radiation Instrumentation System</i>	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	<i>Reactor Responses during Normal Operation, Transient and Emergency Situation</i>	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)	
		TR1 0	Reactor Protection System (including any setpoints)
		TR1 1	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 3

### 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<sup>1</sup> (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*);

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<sup>1</sup> 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 prioritize 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
  - iii. 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 set-point, interlocks and automatic actions; and
  - iii. Ability to demonstrate an understanding of his/her action (or in-action) 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;

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

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

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## CONTRIBUTORS FOR DRAFTING AND REVIEW

*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

*AELB Staffs:*

Cik Gan Pek Yen	- Lembaga Perlesenan Tenaga Atom
En. Abd. Aziz Sadri	- Lembaga Perlesenan Tenaga Atom
Pn. Najihah Mat Lazim	- Lembaga Perlesenan Tenaga Atom
Cik Nurul Sareeza Azidin	- Lembaga Perlesenan Tenaga Atom
En. Ridha Roslan	- Lembaga Perlesenan Tenaga Atom