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GUIDELINE FOR LICENCE APPLICATION FOR RADIOACTIVE WASTE DISPOSAL FACILITIES (BOREHOLE DISPOSAL)

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CHAPTER 1: OBJECTIVE

1. This document is prepared to provide guidance to the applicant who intent to deal with radioactive waste disposal facility (Borehole Disposal).

CHAPTER 2: SCOPE

2. This guidance material explains the procedure for the Class G license application under the provisions of Subsection 12 (1)(b) Atomic Energy Licensing Act 1984 (Act 304) dealing with activities involving radioactive waste disposal facility (Borehole Disposal).

3. This guidance material, relating to radioactive waste disposal facility (Borehole Disposal), will cover and comprises of phases as below (approval shall be obtained for each of the phases before proceed to the next phase):

(a) Siting;
(b) Construction;
(c) Operation;
(d) Wastes emplacement;
(e) Closure;
(f) Post-closure measures; and
(g) Decommissioning

CHAPTER 3: OVERVIEW OF IMPLEMENTATION OF BOREHOLE DISPOSAL CONCEPT

4. Implementation for radioactive waste disposal using the borehole disposal concept can be divided into phases as below:

Phase 1 (Pre-Operational)

(1) Site characterization

(a) The licensee shall characterize the site for the disposal borehole and document this information in the safety case at a level of detail sufficient to support a general understanding of both the characteristics of the site and how the site will evolve over time. The documentation shall include a description of the site's present condition, its probable natural evolution and possible natural events, and also of human plans and actions in the vicinity that may affect the safety of the borehole over the period of interest.

(2) Site and Inventory Specific Design

(a) The licensee shall design the borehole and the engineered barriers to take account of the site characteristics and the inventory of wastes to be disposed, and to ensure operational and post-closure safety.

(3) Construction

(a) The disposal facility shall be constructed in accordance with the design as described in the approved safety case. It shall be constructed in such a way as to preserve the safety functions of the host environment that have been shown by the safety case to be important for safety. The borehole shall be constructed so as to facilitate operation.

(b) Construction of a BDC facility could continue after the commencement of operation of part of the facility and after the emplacement of waste packages, for instance in an adjacent borehole. Such overlapping of construction and operational activities shall be planned and carried out so as to ensure safety, both in operation and after closure.

(c) Borehole construction shall not proceed until a licence has been granted. This requires the regulatory body to review, assess and approve the impact of the proposed construction on radiological safety during both the operational and the post-closure periods.

(d) Construction shall be accompanied by a planned programme of testing, commissioning and inspection (including regulatory inspection) so as to demonstrate that the facility has been constructed in accordance with the safety case.

Phase 2 (Operational)

(1) Operating the radioactive waste disposal facility (Borehole Disposal)

(a) The borehole disposal facility shall be operated in accordance with the safety case and the conditions of the licence. In particular, this shall include measures to demonstrate that the waste and backfill have been emplaced correctly and a contingency plan that addresses any issues that may arise in this area. Active control of safety has to be maintained for as long as the borehole facility remains unsealed and until final closure of the facility.

(b) Operational phase is be divided into two (2) sub-phases:

i. Pre-disposal operational activities

a. Waste acceptance criteria to be disposed in the borehole disposal facility
b. Inventory of DSRS to be disposed into borehole disposal facility
c. Collection of DSRS
d. Characterization of DSRS
e. Conditioning of DSRS
f. Containerization of conditioned DSRS
g. Transport of containerized DSRS waste package to interim storage facility
h. Interim storage

ii. Disposal operational activities

a. Transport of containerized DSRS waste packages to borehole disposal facility
b. Emplacement of containerized DSRS waste packages into the borehole
c. Closure of borehole disposal

(c) A borehole disposal facility shall be closed in accordance with the safety case and the conditions of the licence; this shall be done as soon as is practicable. Measures shall be implemented to demonstrate that this has been done correctly.

Phase 3 (Post-Closure)

(1) Decommissioning

(a) The licensee shall:

i. Prepare and submit a decommissioning plan as part of the licence application;
ii. Review the decommissioning plan during facility operation to ensure that it remains appropriate;
iii. Retain the necessary resources, expertise and knowledge for decommissioning;
iv. Create and maintain records and documentation relevant to the design, construction, operation and decommissioning; and

v. Decommission the facility in accordance with the plan as soon as is practicable.

(b) The licensee shall prepare and submit to the regulatory body a final decommissioning report. This report shall document, in particular, the end state of the facility or site.

(2) Institutional control

(a) The facility shall not be released from regulatory control, nor shall authorization be terminated, until the licensee has demonstrated that the end state in the decommissioning plan has been reached and that all regulatory requirements have been met.

(b) If a facility cannot be released for unrestricted use, appropriate controls shall be maintained to ensure the protection of human health and the environment. In this case, the licensee shall specify these controls, which shall be subject to approval by the regulatory body. Clear responsibility shall be assigned for implementing and maintaining these controls.

(c) In the case of restricted release of the facility or site from the regulatory control (e.g. de-licensing but with requirements for ongoing monitoring), appropriate controls shall be applied to provide protection of human health and the environment. In this case a responsible body shall be identified to address any issues that may arise from (for example) post-closure environmental monitoring.

CHAPTER 4: INTERPRETATION

5. In this guide, unless the context otherwise requires-

"Borehole disposal" For the purposes of this document, borehole disposal is the disposal of DSRS and other small volume wastes in a borehole that is specially located, drilled, constructed and licensed for such disposal.

"Capsule" For the purposes of this document, a capsule is a container into which one or more DSRS are placed. The capsule is closed by seal welding the lid into place so converting the DSRS into "special form radioactive material" as defined by IAEA Transport Regulations.

"Concrete buffer" For the purposes of this document, a concrete buffer is the pre-cast concrete lining on the inside of the disposal container.

"Conditioning" For the purposes of this document, conditioning is the sealing of a DSRS into a capsule. Conditioning is usually followed by interim storage.

"Containerization" For the purposes of this document, containerization is the placing of any waste (including a capsule) into a disposal container with or without a concrete buffer followed by seal welding of the lid.

"Disposal borehole" For the purposes of this document, a disposal borehole is a borehole that is specially located, drilled and constructed for the disposal of DSRS and other small volume wastes.

"Disposal container" The vessel into which the waste form is placed for eventual disposal; also the outer barrier protecting the waste from external intrusions. The waste container is a component of the waste package.

"Disposal facility" means facility to emplaced radioactive waste.

"Disposal package" The combination of capsule, concrete buffer and disposal container that allows DSRS and other small volume wastes to be disposed.

"Disposal" means the emplacement of radioactive waste in a suitable facility without the intention of retrieval.

"DSRS" A disused sealed radioactive source (DSRS) is a radioactive source that is no longer used, and is not intended to be used, for the practice for which an authorization was granted. Note: For the purpose of this document a DSRS is considered to be a form of radioactive waste.

"Emergency" A non-routine situation that necessitates prompt action, primarily to mitigate a hazard or adverse consequences for human life and health, property and the environment. Note: This includes nuclear and radiological emergencies and conventional emergencies such as fires, release of hazardous chemicals, storms or earthquakes. It includes situations for which prompt action is warranted to mitigate the effects of a perceived hazard.

"Emergency exposure situation" An emergency exposure situation is a situation of exposure that arises as a result of an accident, a malicious act or other unexpected event that requires prompt action in order to avoid or to reduce adverse consequences. Note: Exposure in an emergency can include both occupational exposure and public exposure, and can include unplanned exposures resulting directly in the emergency exposure situation and planned exposures to persons undertaking actions to mitigate the consequences of the emergency. Exposure in an emergency can be reduced only by protective actions and other emergency response actions.

"Emergency plan" A description of the objectives, policy and concept of operations for the response to an emergency and of the structure, authorities and responsibilities for a systematic, coordinated and effective response.

"Emplacement" For the purposes of this document, emplacement is the placing of disposal packages, surrounded by concrete, into the disposal borehole.

"Management" The administrative and operational activities that are involved in the manufacture, supply, receipt, possession, storage, use, transfer, import, export, transport, maintenance, recycling or disposal of radioactive sources (from reference [5]).

"Radioactive waste management" means all the activities, administrative and operational that are involved in the handling, pretreatment, treatment, conditioning, transportation storage and disposal of radioactive waste.

"Radioactive waste" means substance or article that contains or is contaminated with radionuclides at activity concentrations or activities greater than clearance levels and for which no use is foreseen.

"Radiology Impact Assessment (RIA)" means radiology impact assessment on the life that may exist in the long term impact from the activities associates to NORM processing/ radioactive waste disposal. Radiology impact assessment conducts on the human or critical human

populations (critical group) as to represent the most exposed individual, or at the highest risk effects from the activities associated to the NORM processing/ radioactive waste disposal.

"Safety Assessment" means a systematic assessment to analyze the potential radiological impact on the worker, public and the environment associated with the activities

"Safety Case (SC)" means the **collection of scientific, technical, administrative and managerial arguments and evidence in support of the safety of a disposal facility** covering the suitability of the site and the design, construction and operation of the facility, the assessment of radiation risks and assurance of the adequacy and quality of all the safety related work associated with the disposal facility [IAEA Safety Glossary 2007]

"Safety culture" The assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance.

CHAPTER 5: ABBREVIATION

6. In this guide, unless the context otherwise requires-

AELB	Atomic Energy Licensing Board
BDC	Borehole Disposal Concept
IAEA	International Atomic Energy Agency
DSRS	Disused Sealed Radioactive Source
OBTL	Person Responsible to the License
RPO	Radiation Protection Officer
eLesen	AELB online system for license application

CHAPTER 6: INTRODUCTION OF REGULATORY CONTROL FOR RADIOACTIVE WASTE DISPOSAL

7. Applicant who intends to apply for a license from the AELB shall follow and abide by the following Legislative framework:

(a) Atomic Energy Licensing Act 1984 (Act 304);
(b) Radiation Protection (Licensing) Regulations 1986;
(c) Radiation Protection (Transport) Regulations 1988;
(d) Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010; and
(e) Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011

8. Applicant who intends to carry out activities involving radioactive waste disposal facility (borehole disposal) shall submit the application through eLesen online system.

9. This guidance material describes disposal in the borehole disposal facility for **disused sealed radioactive sources Category 3 to 5 only**. The safety assessment and safety case for the disposal of the radioactive waste in the borehole disposal facility should be conducted according to IAEA recommendation. The design specification for borehole disposal facility and construction should also comply with the international guidelines/standards and best practices.

CHAPTER 7: LICENSING REQUIREMENTS FOR RADIOACTIVE WASTE DISPOSAL (BOREHOLE DISPOSAL)

10. Any person and/or licensee who intends to construct and use a radioactive waste disposal facility, in this context, utilizing the Borehole Disposal Concept, must have a class G license issued in accordance with the Radiation Protection Regulations (Licensing) 1986. The license application shall be submitted through the online license application system (eLesen).

(a) Basic requirements for license application are:

i. Organization and management
   a. Class G license application (eLesen)*
   b. Application fee RM 15.00
   c. Appointment of person responsible for the license (OBTL)
   d. Certified copy of Registration Certificate (Form 9) by SSM
   e. Registration of medical practitioner

ii. Radiation worker
   a. Appointment of RPO (Refer to Guidance for recognition of RPO)
   b. Appointment of RWMO [Refer to Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011]
   c. Registration of radiation worker (eLesen online system)

iii. Radiation Detection Devices – At least 2 units of survey meter
iv. Radiation Protection Program – Endorsed by AELB
v. Monitoring Program – Approved by AELB

*** Check-list for class G license application** can be obtained from AELB website (www.aelb.gov.my) – Attachment 1

(b) **Specific technical documents for license application** for radioactive waste disposal facility (Borehole Disposal) are:

i. **Safety Case for Siting of Radioactive Waste Disposal Facility** (Borehole Disposal)- Attachment 2

ii. **Radiological Impact Assessment (RIA) for Radioactive Waste Disposal Facility (Borehole Disposal)** - Attachment 3

iii. **Safety Case (SC) for Operation of Radioactive Waste Disposal Facility (SC)** – Attachment 4

Note:

a) The safety case shall demonstrate the level of protection of people and the environment provided and shall provide assurance to the regulatory body and other interested parties that the safety requirements will be met.

b) The safety case for a predisposal radioactive waste management facility and for a borehole disposal facility shall include a description of how all the safety aspects of the site, the design, operation, shutdown and decommissioning of the facility, and the managerial controls satisfy the regulatory requirements.

c) The safety case shall be documented at a level of detail and to a quality sufficient to demonstrate safety, to support decisions at each stage of waste management and disposal and to allow for the independent review and approval of the safety case. The documentation shall be clearly written and shall include arguments justifying the approaches taken in the safety case on the basis of information that is traceable.

d) The safety case shall address the exposure of workers and the public to ionizing radiation resulting from the licensed activities. This shall include comprehensive and systematic consideration of possible scenarios leading to exposures. The safety case shall also include considerations for reducing hazards posed to workers, members of the public and the environment.

e) The safety case shall be used to ensure that safety is provided by means of multiple safety functions. Containment and isolation of the waste shall be provided by means of a number of physical barriers of the disposal system. The performance of these physical barriers shall be achieved by means of diverse physical and chemical processes together with various operational controls. The licensee shall demonstrate the capability of the

individual barriers and controls, and that of the overall disposal system to perform as assumed in the safety case. The overall performance of the disposal system shall not be unduly dependent on a single barrier or safety function.

f) The licensee shall use the safety case to site, design, construct, operate and close the disposal borehole in such a way that safety is ensured by passive means and the post-closure safety of the facility will not depend on actions that would need to be taken after the closure.

g) The safety case shall be used by the licensee to ensure that the borehole disposal facility design and host environment provides containment of the radionuclides associated with the wastes until radioactive decay has significantly reduced the hazard posed. In addition, in the case of heat generating wastes, containment shall be provided while the wastes are producing heat energy in amounts that could adversely affect the performance of the disposal system.

iv. **Radioactive Waste Management Plan (RWMP) for Radioactive Waste Disposal Facility** - Attachment 5

v. **Emergency plan**

vi. **Security plan/ threat assessment** – (if related)

CHAPTER 8: SAFETY MANAGEMENT SYSTEM AND SAFETY CULTURE

11. The licensee shall ensure that protection and safety is efficiently integrated into the overall management system of the organization for which they are responsible.

12. The licensee shall also ensure that commitment to protection and safety at the highest levels within their organizations are demonstrated.

13. Licensees shall establish a management system, commensurate with the size and nature of the authorized activity, which ensures that:

(a) Policies and procedures are established that identify safety as being of the highest priority;
(b) Problems affecting protection and safety are promptly identified and corrected in a manner commensurate with their importance;
(c) The responsibilities of each individual for safety and compliance are clearly identified and that each individual is suitably trained and qualified;
(d) Clear lines of authority for decisions on safety are defined;
(e) Organizational arrangements and lines of communications are established that result in an appropriate flow of information on safety at and between the various levels in the organization of the licensee; and
(f) A quality assurance program is in place that provides information on the performance of the radioactive waste management programme and equipment, and establishes a regime for review of the programme. This shall ensure that all necessary records are maintained and are readily retrievable when required.

14. The licensee shall ensure that the management system is designed and implemented to enhance protection and safety by:

(a) Applying the requirements for protection and safety coherently with other requirements including requirements for operational performance, and coherently with guidelines for security;
(b) Describing the planned and systematic actions necessary to provide adequate confidence that the requirements for protection and safety are fulfilled;
(c) Ensuring that protection and safety are not compromised by other requirements;
(d) Providing for the regular assessment of performance of protection and safety and the application of lessons learned from experience; and
(e) Promoting safety culture.

15. The licensee ensure that the protection and safety elements of the management system are commensurate with the complexity of and the radiation risks associated with the activity.

16. The management system shall provide:

(a) Adequate assurance that the established requirements for safety and environmental protection are being met;
(b) Arrangements for regular audit and review by independent third parties; and
(c) Processes to report deficiencies at an appropriate level within the organization and to initiate remedial action.

17. The principal parties shall promote and maintain a safety culture by:

(a) Promoting individual and collective commitment to protection and safety at all levels of the organization;
(b) Ensuring a common understanding of the key aspects of safety culture within the organization;
(c) Providing the means by which the organization supports individuals and teams in carrying out their tasks safely and successfully, with account taken of the interactions between individuals, technology and the organization;
(d) Encouraging the participation of workers and their representatives and other relevant persons in the development and implementation of policies, rules and procedures dealing with protection and safety;
(e) Ensuring accountability of the organization and of individuals at all levels for protection and safety;
(f) Encouraging open communication with regard to protection and safety within the organization and with relevant parties, as appropriate;
(g) Encouraging a questioning and learning attitude and discouraging complacency with regard to protection and safety; and
(h) Providing means by which the organization continually seeks to develop and strengthen its safety culture.

CONCLUSION

18. For any questions, applicant / licensee can contact the AELB:

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REFERENCES

This guidance material to obtain for a license dealing with activities involving radioactive waste disposal facility (borehole disposal) is prepared based on the IAEA Safety guides as follow:

(a) IAEA Safety Standard SSG-1 (2009), Borehole Disposal Facilities for Radioactive Waste, IAEA, Vienna;

(b) IAEA TECDOC 1368 (2003), Safety Considerations in the Disposal of Disused Sealed Radioactive Sources in Borehole Facilities, IAEA, Vienna;

(c) Generic Post Closure Safety Assessment for Borehole Disposal of Disused Sealed Sources (Draft 0.8), December 2012; and

(d) IAEA TECDOC Series No. 1644, BOSS: Borehole Disposal of Disused Sealed Sources: A Technical Manual

(e) IAEA Safety Standards Series No. GSR Part 3 (2014), Radiation Protection and Safety of Radiation Sources: International Basic Safety Standard, IAEA, Vienna

(f) IAEA Safety Stan Standards Series No. GSR Part 5 (2009), Predisposal Management of Radioactive Waste, IAEA, Vienna

(g) Working Material for School of Drafting Regulation for Borehole Disposal System, INT9182/01/01 – Expert Mission "To pilot and test feasibility of model regulation for BDS within the framework of Ghana, Malaysia and the Philippines

Attachment 1

CHECKLIST OF LICENSING REQUIREMENTS FOR CLASS G LICENSE APPLICATION

Activities of Class G License Application:

(a) Storage before disposal;
(b) Disposal of radioactive materials, nuclear materials, prescribed substances or its waste; and
(c) Decommissioning of processing facility/nuclear installation/waste treatment facilities

No.	MATTER / INFORMATION	TYPE OF LICENSE APPLICATION		
		NEW	AMEND	RENEW
	GENERAL INFORMATION FOR THE LICENSE APPLICATION			
A.	**ORGANIZATION AND MANAGEMENT**			
1.	**Application (letter of intent) [The application must be made through the online service at http://elesen.aelb.gov.my]**	**/**	**/**	**/**
2.	Company's details including name, telephone number, fax number, mailing and premise address	/	/	/
3.	Person responsible for the license (OBTL) [Please attach along Form 49 endorsed by Malaysia Company Commission (SSM). If OBTL is not one of the board of directors, appointment letter must be signed by one of the company board member. (Please obtain from the AELB website at www.aelb.gov.my)] [Please provide company organization chart	/		
4.	Certified copy of Registration Certificate by SSM (Form 9)	/		
5.	Approved registered medical practitioner [Please obtain the form from AELB website at www.aelb.gov.my]	/		
B.	**RADIATION WORKERS**			
1.	For the recognition as a Radiation Protection Officer (RPO)/ Supervisor (PRPS), the application must be made through the online system by uploading: a) Copy Examination Certificate by AELB or agency recognized by AELB b) Copy of Radiation Protection Training Certificate organized by the AELB recognized agency (in last 3 years period) c) Copy of identity card and passport size photograph d) For non-Malaysian citizen, please attach copies of working permit (Immigration) and a valid passport e) Copy of medical examination record	/		

No.	MATTER / INFORMATION	TYPE OF LICENSE APPLICATION		
		NEW	AMEND	RENEW
	GENERAL INFORMATION FOR THE LICENSE APPLICATION			
	[LPTA/BM/5/Seksyen A dan B], must not exceed 6 months from the examination date			
2.	For the recognition as an operator, please attach the item in B1(c), B1(d) and B1(e).	/		
3.	Radiation operator should not working in any other company. If one is still in service with another company, the termination from previous company must first be obtained.	/		
C.	**RADIATION DETECTION DEVICE**			
1.	Copy of calibration certificate of radiation detection device from the recognized agency.	/		
2.	Purchasing Order (PO) of radiation detection device (if not available). Ensure the radiation detection device is suitable with the type of radiation.		/	/
D.	**RADIATION PROTECTION PROGRAM**			
1.	Preparation of Radiation Protection Program – Refer to LEM/TEK45 Sem.1 or any updated version	/		
2.	The Radiation Protection Program is endorsed by the AELB and is implemented by the user. (Please state the endorsement date of the program)		/	/
3.	Refer to AELB whether the Radiation Protection Program need to be amended or not.		/	/
E.	**STORAGE BEFORE DISPOSAL**			
	Design of Storage facility			
1.	Sketch position plan/ storage facility plan (Please mention the vicinity of the area – Must obtain verification from the recognized professional engineer)	/	/	
2.	Facility design and dimension (Design plan must obtain verification from the recognized professional engineer)	/	/	
3.	Procedure of accepting, handling and storing for accepted radioactive waste	/	/	
4.	Inventory of Radioactive material/waste (DSRS) to be disposed and activities (Category 3-5)	/	/	/
5.	Dose rate at the storage facility: a) External building surface (Limit: 20 mSv/year) b) At the Fence (Limit: 1 mSv/year)	/	/	/
6.	The general decommissioning plan for decommissioning and surveillance after operation (Decommissioning Plan)	/	*/	*/

No.	MATTER / INFORMATION	TYPE OF LICENSE APPLICATION		
		NEW	AMEND	RENEW
	GENERAL INFORMATION FOR THE LICENSE APPLICATION			
F.	**DISPOSAL / DISPOSAL FACILITY**			
	Pre-operational: **i. Siting/ facility design**			
1.	A description of the proposed disposal facility and activities	**/**		
2.	Statement on flood control and the method of controlling the movement of water in the existing water ways (if any	**/**	**/**	
3.	**Radiological Impact Assessment (RIA) / Safety Assessment (SA)** 2 sets of Radiological Impact Assessment (RIA) for the proposed disposal facility site. [The study must be conducted by the consultant and laboratory recognized by the AELB] Content of RIA including among others: **(the whole content of RIA – please refer to Attachment 3)** a) Site physical characteristic: geology, hydrology, meteorology, earthquake studies, flora, fauna, aquatic biota, etc b) Population distribution around the disposal site, including the future trend of population growth and the distance of population centers from the site c) The current land-use at the area surrounding the disposal site d) Impact assessment on the environment and radiology from the normal operation which includes the early analysis of expected radiation hazard	**/** /		
4.	Other supporting technical documents: a) Siting Plan (Siting of Disposal Facility) b) Safety Case at the siting phase of radioactive waste disposal facility **(please refer to Attachment 2)** c) Radioactive Waste Management Plan (RWMP) **(please refer to Attachment 5)** d) Decommissioning Plan e) Emergency Plan f) Security Plan (if related) g) Preliminary Safety Analysis Report (PSAR)	/		/
5.	Environmental Radiological Monitoring and Sampling Program (Background reading for 12 months- calendar)	/		/
6.	Project implementation plan	/		/

No.	MATTER / INFORMATION	TYPE OF LICENSE APPLICATION		
		NEW	AMEND	RENEW
	GENERAL INFORMATION FOR THE LICENSE APPLICATION			
	Pre-operational: **ii. Construction**			
1.	A general layout and detailed plan and design of the facility, including its conceptual safety design (Design Plan must be endorsed by the registered professional engineer (P.E))	/		
2.	A description of the foreseen radiation and chemical hazards to the workers and members of the public during normal operation of the proposed installation, taking into consideration the anticipated chemical and physical characteristics and radioactive contents of all the effluents to be discharged and emissions from the facility	/		
3.	A statement with respect to potential accidents and unscheduled releases of wastes and hazardous materials from the facility, and shall include: a) A Statement of conditions which could lead to accidents and unschedules releases of waste and hazardous materials b) A Statement on the probable effect of such accidents and releases to the health and safety of the workers, members of public and on the environment c) A Statement on the program for inspection and mantenance proposed to prevent the occurrence of such accidenst and releases d) A Statement on the emergency plan and preparedness program and mitigative measures to deal with such accidents and releases	/		
4.	The proposed dust control system	/		
5.	A Detailed engineering plan of water diversions and treatment facilities and detailed monitoring plans and contigency measures for the construction phase of the facility	/		
6.	Environmental Radiological Monitoring and Sampling Program (Background reading for 12 months- calendar)	/		
7.	Other supporting technical documents: a) Safety Case for the construction phase of radioactive waste disposal facility. The SC information for this phase have to be more detailed than the SC information for the siting/facility design phase b) Radioactive Waste Management Plan (RWMP) c) Decommissioning Plan (if there are changes) d) Emergency Plan (if there are changes)	/		

No.	MATTER / INFORMATION	TYPE OF LICENSE APPLICATION		
		NEW	AMEND	RENEW
	GENERAL INFORMATION FOR THE LICENSE APPLICATION			
G.	**Operational:**			
1.	Any changes in the material used or in the design, introduces during the construction of the disposal facility – if any	/	*/	
2.	Update to the radiation protection program, as follow: a) Proposed measures to control radiation exposures, including the operational radiation monitoring program designed for the workers, members of the public and the environment, together with a complete list of the supporting services and facilities b) Plan for unforeseen event in case of abnormal radiological and environmental monitoring results c) Detailed medical surveillance program d) Program for the Initial and periodic training of workers on the general safety and radiation protection e) The facilities and equipment designed to contain spillage and the procedures to followed in handling spillage of radioactive wastes f) The proposed plan and procedures to prevent lost, theft or unauthorized use of radioactive material/waste g) A description of the proposed procedures to prevent accidents and the proposed contingency plan in the event of an accident	/	*/	
3.	Environmental Radiological Monitoring Program, which includes: a) The sampling frequency and locations b) Types of equipment and analysis methods which will be used	/		
4.	Radiological Monitoring and Environmental Sampling Report (Safety Analysis Report, SAR)			/
5.	Detail plan for the closure of the disposal facility	/		/
H.	**Post-operational:**			
1.	Radiological Monitoring and Environmental Sampling Report (SAR) – 2 years			/
2.	*Safety Assessment after closure* and proposed period of institutional control (Minimum period: 30 years)			/

*if any changes occurred

Attachment 2

CONTENT OF SAFETY CASE FOR SITING OF RADIOACTIVE WASTE DISPOSAL FACILITY (BOREHOLE DISPOSAL)

No	Requirements	Remarks
1.	Executive Summary (for Siting of Disposal Facility)	Both languages
2.	Objective of Siting Process	Basic objective of the siting process is to select a suitable site for disposal and to demonstrate that this site has characteristics which, when combined with the facility design and waste package, provide adequate isolation of radionuclides from the biosphere for desire periods of time. Sites generally serve as a principal barrier, but engineering measures can enhance site performance and improve overall safety and environmental protection. To provide adequate containment and keep releases within acceptable limits, the disposal system should be developed such that the design of the facility and the type and amount of wastes intended for emplacement are in concert with the characteristics of the site and the surrounding natural media.
3.	Scope of Siting Process	Covers siting of a disposal facility for the disposal of Category 3 – 5 of disused sealed radioactive sources (DSRS)
4.	Stages of the Siting Process	One systematic siting process for a disposal facility may be considered to consist of four stages: i. Conceptual and planning stage ii. Area survey stage iii. Site characterization stage iv. Site confirmation stage
	(a) Conceptual and Planning Stage	The purpose of the conceptual and planning stage is to develop and overall plan for the site selection process, to establish the siting principles and to identify desirable site features, which can be used as a basis for the area survey stage. The human and financial resources, materials, equipment and

No	Requirements	Remarks
		time requirements should be estimated to the extent practicable, and responsibilities for the siting studies defined, the types of wastes to be disposed of should be defined and characterized, including the projected waste volumes and radionuclide contents, generic facility design concepts should be developed, the likely waste acceptance criteria should be identified and the overall performance criteria for the facility developed, available methodologies for safety analysis should be reviewed and basic methods and models selected. On the basis of these conceptual studies various desirable features, such as land area, geology and hydrogeology, could be identified as a basis for the area survey stage.
	(b) Area Survey stage	The purpose of the area survey stage is to identify one of more potential sites. This is often accomplished by the systematic screening of a region of interest, which results in the selection of potentially suitable areas. During this stage, it is necessary to take into account engineering, operational, socioeconomic and environmental constraints. The area survey stage generally involves two phases: i. Regional mapping to identify areas with potentially suitable sites; and ii. Screening to select potential sites for further evaluation.
	(c) Site Characterization Stage	The site characterization stage involves the investigation of one or more candidate sites to demonstrate that they meet safety and environmental requirements. Specific site related design bases should also be determined at this stage. It requires site specific information to establish the characteristics and the ranges of parameters of a site with respect to the location of the intended disposal facility. A preliminary safety assessment should be performed for each candidate site to determine that each one is potentially suitable for accommodating a disposal facility. At the conclusion of the site characterization stage, a preferred site or sites should be identified, taking into account the relevant

No	Requirements	Remarks
		economic, environmental, social and political considerations.
	(d) Site Confirmation Stage	The purpose of the site confirmation stage is to conduct detailed site investigations at the preferred site(s) to: i. Support or confirm the selection; and ii. Provide additional site specific information required for detailed design, safety and environmental impact assessment and licensing. Detailed specifications of the site(s) should be established to allow final detailed design. Radiological, radionuclide transport and ecological evaluations should be carried out in detail. Safety analysis data and models should be updated for the specific site(s), and a detailed safety and environmental impact analysis should be performed using all the detailed information available. A final safety and environmental impact assessment based on all the investigations and evaluations should be prepared, summarizing all the relevant data, evaluations and conclusions derived from all site characterization and confirmation activities.

No	Requirements	Remarks
5.	Management of the Siting Process	Selection of suitable sites for radioactive waste disposal facilities involves integration of site investigative studies involving a number of disciplines, including natural and earth sciences, engineering, safety analysis, health physics and social sciences. The process should start with identification of the need for a disposal facility and conclude with selection of a site that is confirmed as meeting all safety and other requirements. Plans for the siting process should take into account activities to provide the local as well as general public with appropriate information, consultation and compensation as needed.
6.	Information Collection and Management	The siting process involves collection and management of information on various site characteristics, which are needed for application of guidelines to identify suitable sites. Some of the data required at various stages of the process may be readily available from different sources; other data should be obtained through field investigation studies and laboratory tests. The siting process should be designed to provide the necessary data at various stages to facilitate a series of increasingly accurate estimates of the likelihood of compliance with the safety requirements.
7.	Quality Assurance (QA)	A quality assurance programme for all activities during siting shall be established to ensure compliance with relevant standards and guidelines.
8.	Siting Guidelines and Data needs	For each major stage of the siting process, the allocation data, the guidelines used and the results obtained should be reviewed and recorded so as to contribute to the thorough documentations of the entire process. The information should include (but not necessary limited to): i. A description of the siting process, including the objectives, legal limitations, and the procedures and guidelines to be considered at each phase of the site selection; ii. Specification of data to be used and the information required for each site characteristic at each phase of the siting process; iii. The data collected and the guidelines adopted; and

No	Requirements	Remarks
		iv. The results obtained in the evaluation of each guideline.
	(a) Geology	The geological setting at the site should contribute to the isolation of waste and the limitation of releases of radionuclides to the biosphere. It should also contribute to the stability of the disposal system and provide sufficient volume and engineering properties favourable for implementing disposal. Information to be collected should include stratigraphy, lithology and mineralogy, structural characteristics and geotechnical characteristics.
	(b) Hydrogeology	The hydrogeology setting of the site should include low groundwater flow and long flow paths in order to restrict the transport of radionuclides. The following information should be considered: i. Location, extent and interrelationship of the important hydrogeological units in the region; ii. Average flow rates and prevailing directions of the groundwater flow; iii. Information on recharge and discharge of the major hydrogeological units; and iv. Information on regional and local water tables and their seasonal fluctuations.
	(c) Geochemistry	The geochemistry of groundwater and the geological media should contribute to limiting the release of radionuclides from the disposal facility and should not significantly reduce the longevity of engineered barriers. Information necessary to estimate the potential for migration of radionuclides to the biosphere should include a description of the geochemical and hydro chemical conditions at the site, the surrounding geological and hydrogeological units, and the paths of potential groundwater flow. This information should include: i. Mineralogical and petro graphical composition of the groundwater flow system and its geochemical properties; ii. Groundwater chemistry
	(d) Tectonics and Seismicity	The site should be located in an area of flow tectonic and seismic activity such that the isolation capability of the disposal system

No	Requirements	Remarks
		will not be endangered. The design of the disposal facility should take into account tectonic stability and seismic activity of the site that could adversely affect the proposed disposal system. The following information should be analyzed at the site confirmation stage: i. Historical seismicity at the site; ii. Occurrence of quaternary faults at the site and the age of latest movement; iii. Evidence of active tectonic processes, such as volcanism; and iv. Estimate of maximum potential earthquake within the geological setting.
	(e) Surface Process	Surface process such as flooding of the disposal site, land sliding or erosion should not occur with such frequency or intensity that they could affect the ability of the disposal system to meet safety requirements. In the site characterization and confirmation stages, the following information should be collected: i. Topography of the site, showing actual drainage features; ii. Location of existing and planned surface water bodies; iii. Definition of areas of landslides and other potentially unstable slopes, and of materials of low bearing strength or high liquefaction potential; iv. Definition of areas containing poorly drained materials; v. Data on the flood history of the region; and vi. Upstream drainage areas.
	(f) Meteorology	The site area meteorology should be characterized such that the effect of unexpected extreme meteorological conditions can be adequately considered in the design and licensing of the disposal facility. In the site characterization stages, the meteorological conditions, as determined from the closest recording station(s), should be known in order to predict potential effects of extreme precipitation on the hydrological and hydrogeological systems at the site, and to evaluate the transport of airborne releases during operation of the disposal facility. The types of information should

No	Requirements	Remarks
		include: i. Wind and atmospheric dispersion characteristics; ii. Precipitation characteristics; and iii. Extreme weather phenomena.
	(g) Man-Induced Events	The site shall be located such that activities by present or future generations at or near the site will not be likely to affect the isolation capability of the disposal system. In the site characterization and confirmation stages, in order to estimate any adverse impact that off-site installations might have on the projected disposal system. The following information should be collected: i. Location of nearby hazardous installations, such as oil refineries, chemical plants, storage depots, pipelines and other facilities that could have an impact on the site operations; ii. Location of airports and important air traffic corridors and flight frequencies; and iii. Location of transportation routes with frequent movement of hazardous material.
	(h) Transportation of Waste	The site shall be located such that the access routes will allow transportation of waste with a minimal risk to the public. To evaluate existing or required access routes, the information to be collected should include: i. Description of existing routes in the vicinity of the site and analysis of their adequacy for handling waste shipments; ii. Anticipated improvements in the existing transportation network; iii. Estimates of the overall costs and risk of waste transportation; and iv. Analysis of emergency response requirements and capabilities related to transportation.
	(i) Land Use	Land use and ownership of land should be considered in connection with foreseeable development and regional planning in the area interest. The data should include:

No	Requirements	Remarks
		i. Existing land resources and uses and jurisdiction over them; and ii. Foreseeable development of land in the area of interest
	(j) Population Distribution	The site should be located such that the potential hazard of the disposal system on the current population and projected future population is acceptable. In the area survey stage, large scale maps should be prepared showing major population centres and regions with population density as a function of distance.
	(k) Protection of the Environment	The site shall be located such that the environment will be adequately protected during the entire lifetime of the facility and such that potentially adverse impacts can be mitigated to an acceptable degree, taking into account technical, economic, social and environmental factors. Near surface disposal facilities should comply with the requirement to protect the environment. Possible adverse effects which a near surface disposal system may have on the environment include: i. Disturbance of the environment due to the construction and operation of the disposal facility; ii. Impact on areas of significant public value; iii. Disturbance of public water supplies; and iv. Impact on endangered species.
9	Exclusion criteria	List of criteria used early in the siting process to eliminate areas based on consideration of go/ no go situations and are generally based on regulatory and/or plant design requirements.
10	References	(a) IAEA Safety Series No. 111-G-3.1 (Siting of Near Surface Disposal Facilities), 1994 (b) IAEA Safety Standards No. SSR-5 (Disposal of Radioactive Waste), 2011

Attachment 3

CONTENT OF RADIOLOGICAL IMPACT ASSESSEMENT (RIA) FOR RADIOACTIVE WASTE DISPOSAL FACILITY (BOREHOLE DISPOSAL)

NO	ITEM	EXPLANATION
1.	Executive Summary	Both languages
2.	General	RIA is a very important document prepared by an applicant when applying for a license to operate a plant and/or facility, which deals with radiation or radioactive materials and/or wastes. The document focuses on assessment of the radiological impact and risk caused by operation of the plant and/or facility to the members of the public, workers and the environment as to ensure that the resulting risk to these groups of population and the environment are within the permissible limits. The RIA should take into consideration all activities associated with operation of the plant and/or facility and those, which provide support for its safe operation. It should also include consideration on those activities and facilities, which are located outside the plant, but their implementation and operation may have implication on safety of the plant. The assessment should be realistic enough to reflect the actual situation in which the plant is going to be operated and the condition of the environment surrounding the plant that may be affected by operation of the plant. The assessment should start with generic inputs if detailed information and more realistic local data are not available. However, as time progresses and more local and site-specific information and data are available, the RIA should be reviewed and updated and reassessment is carried out using these information and data in order for the RIA to be more meaningful and representative of the actual situation. <u>Note:</u> This document shall be revised and updated in accordance with the requirements of the Radiation Protection (Licensing) Regulations 1986 at each licensing stages.
3.	Scope	In preparing the RIA, consideration should be given to the entire activities required to ensure normal operation of the borehole disposal facility starting

NO	ITEM	EXPLANATION
		from waste acceptance, pre-disposal storage, treatment, conditioning, capsulation, containerization and emplacement of container in the borehole. The assessment should take into consideration any abnormal situation that can/ may occur during normal operation of the borehole disposal facility. The assessment should only take into consideration the impact and the potential risk associated by radiological aspect from the operation of the facility. A point to note, the non-radiological aspects should be prepared in a separate document which should be submitted together with the RIA report to the relevant authorities[1] including the requirements of Environmental Quality Act 1974 and Occupational Safety and Health Act 1994, where appropriate.
4.	Objective of RIA	If the RIA is prepared for the first time, the objective of the RIA should be to assess the exposure and the risk to members of the public, workers and the environment resulting from normal operation of the facility and any unplanned event that can happen during its operation. For subsequent RIAs, the objective should be to reassess the exposure and the risk made in the earlier report, taking into consideration availability of the latest information and local, more realistic and site-specific data of the plant, the site and its surrounding environment, any progress that has been made on the plant design and construction and any changes of the process involved since it was last reported in the earlier RIA report.
5.	Description of the plant and the process involved	The RIA should include a description on the plant and its various processes, as detail and accurate as possible, taking into consideration availability of the latest information and data of the borehole disposal facility and the process involved. This information is important in the RIA in order to: i. Identify and establish the source term used in the assessment modeling and calculations; ii. Identify the critical target group(s) among members of the public and workers; iii. Identify the occupational and public exposure pathways through which the radionuclides identified in the source term would finally be brought to the critical target group(s); and

NO	ITEM	EXPLANATION
		iv. Develop occupational and public exposure modeling.
6.	Description of the site and its surrounding environment	The RIA should include a description on the site and its surrounding environment, as detail and accurate as possible. **Priority should be given on inclusion of the latest information and data on the site and its surrounding environment.** This information is important in the RIA in order to: i. Identify the critical target group(s) among members of the public; ii. Understand the migration and transport of radionuclides released from the site; iii. Identify the public exposure pathways through which the radionuclides identified in the source term would finally be brought to the critical target group(s) among members of the public; and iv. Develop public exposure modeling. The RIA should include detail description on characteristics of the site which is important to determine the release, migration and movement of the identified radionuclides in the environment through which they would finally reach the critical group(s) of the general population and deliver the radiation exposure. The site characteristics should include gathering and verification of data and information on the following subjects: i. Topography; ii. Demography; iii. Hydrology; iv. Geology; v. Meteorology; and vi. Present and future land use It is very important for the data and information to be collected over many years and as far behind as possible in order to know the variation and changes that have taken place over the years and the trend over long period of time besides to know in case of any extreme/ worst situation had ever happened with the site which should be taken into consideration as the worst case scenario in the assessment. It is equally important to know future planning of the areas around the site, in particular, with regard to land use, future development and population

NO	ITEM	EXPLANATION
		growth so that proper mitigation measures can be taken into consideration during the planning and design stage in order to minimize the impact caused to the public. The information also provides valuable inputs for the establishment of emergency planning, preparedness and countermeasures to cater for any eventuality that can/ may happen during operation of the plant.
7.	Current state of radiological environment	The RIA should include a description on status of background radiation and the presence of natural and man-made radioactive materials in the environment around the country and, in particular, around the site where the plant is going to be constructed and operated. There should also be a description on the presence of radiation and radioactive materials in the environment around similar plants in the country and elsewhere. These information and data are important to reflect the reality of the current situation of the areas around the plant besides they can be used to benchmark safety performance of the plant over the years.
8.	Impact assessment	This is the most important part of the RIA document. There should be a clear description given on the process involved in carrying out an impact assessment of the plant. The process should include: i. Description on methodology used for the assessment; ii. Description on input data for the assessment; iii. Radiation protection criteria; iv. Source term. (Identity, quantity, chemical and physical form of the radionuclides); v. Exposure scenarios; vi. Identification of critical groups; vii. Dosimeter assessment and impact analysis; viii. Results of the analysis; and ix. Treatment of uncertainty involved in the calculations (sensitivity

NO	ITEM	EXPLANATION
		analysis). **a) <u>Method of assessment</u>** The method used in the assessment should be clearly described in the RIA. The description may include explanation on: i. Establishment of radiation protection criteria based on relevant regulatory requirements, standards and guides issued by AELB; ii. Determination of source terms (critical radionuclides) involved in the assessment based on the description given in item 5; iii. Identification of exposure scenarios and the critical group(s) which can be derived from a description given in item 5 and 6; iv. Development/ identification of exposure model(s) to be used in the assessment; and v. Calculations of the dose received by the critical groups and compare them with the permissible limits as stipulated in the radiation protection criteria/ regulations. **b) <u>Input data for the assessment</u>** There should be a clear description given on the input data used in the assessment whether they are generic data, local data or those of site-specific. These data can be extracted or derived from the information provided in item 5 and 6. In the absence of local or site-specific data, generic data can be used but the assessment must be reviewed and updated when local or site-specific data are available. The generic data used should be taken from reliable and credible sources, such as, IAEA, ICRP, UNSCEAR, WHO etc. and they should be carefully selected such that the calculated results would always be on the conservative side. **c) <u>Radiation protection criteria</u>** There should be a clear description given on the radiation protection criteria used in the RIA. The radiation protection criteria are used as a basis for analyzing/ assessing the resulting impact caused by the operation of the borehole disposal facility to the target groups. They should be established based on the annual dose

NO	ITEM	EXPLANATION
		limits for members of the public and workers and other requirements given in the Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010. Dose constraints can also be used as one of the criteria to limit the exposure of the public. For controlling the exposure risk to the public, the AELB recommends to use the dose constraint of 0.3 mSv per year as stipulated in the Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010. **d) <u>Source term</u>** The source term is very critical for the RIA as it provides the inputs for the calculations of the radiation dose to the critical groups. It should be determined based on the type of radionuclides involved in or generated from operation of the borehole disposal facility which can be extracted or derived from the information provided in item 5. The operation of borehole disposal facility may be associated with a number of radionuclides but many of them may not be that significant to be considered for the purpose of RIA because of their short half-lives, small amount (percentage) and low activity, low radio toxicity to human beings, alpha/ beta emitters which are not relevant for certain exposure pathways and their limited movement or release over a period of time due to their chemical/ physical property and the nature of process involved which retard them from migrating out. Therefore, it is very important to know the characteristics of all radionuclides involved with respect to the process and operation of the plant and to consider only the critical ones for the purpose of the RIA. Accident may lead to a slightly different type of radionuclides released to the environment surrounding the plant than those usually anticipated during normal operation of the borehole disposal facility. This should be taken into consideration and properly addressed in the RIA. **e) <u>Exposure scenarios</u>** The exposure pathways through which the critical radionuclides would deliver radiation exposure to the critical groups should be identified and clearly described in the RIA. In most situations, radiation dose can be delivered to the critical groups through:

NO	ITEM	EXPLANATION
		i. External radiation emitted by the critical radionuclide(s) present in the areas; ii. Intake of critical radionuclide(s) through inhalation of air containing the critical radionuclides; iii. Inhalation of radon/ thoron gas; iv. Intake of the critical radionuclide(s) through ingestion of food and water contaminated with the critical radionuclides; and v. Intake of the critical radionuclide(s) through a cut in the skin. The critical pathways of the exposure can be identified and determined from the description given in item 5 and 6 after identification and confirmation of the critical groups affected by the operation of the facility. In identifying the critical pathways of exposure, consideration should be given to the situation that may occur during normal operation of the facility as well as during abnormal situation. **f) <u>Identification of critical groups</u>** The critical group is a group of persons who will be affected most by operation of a plant that deals with radiation or radioactive materials. They are most vulnerable to the radiation exposure and are expected to receive the highest dose from the operation of the plant. In some situations, there can be more than one group of the population significantly involved or affected by the operation of the plant, depending on its nature. The critical groups should be identified among workers working with the plant and the population living close to the plant and clearly described in the RIA. <u>Definition:</u> "critical group" means that group of the members of the public whose exposure is reasonably homogeneous and is typical of individuals receiving the highest dose; "critical pathway" means the route by which any radioactive material, nuclear material or prescribed substance travels to reach a critical group and causes the highest radiation dose;

NO	ITEM	EXPLANATION
		g) <u>Treatment of uncertainty (sensitivity analysis)</u> The RIA is carried out based on mathematical modelling developed by the applicant after taking into consideration all the information and input data described in items 5 and 6. Being mainly calculations in nature, it is, therefore, very much subjected to inaccuracy resulting from uncertainty in the value of the input data, inaccuracy of the model developed and used in the assessment and errors in the calculations due to rounding off of the figures etc. It is, therefore, very important for such uncertainty to be properly identified and addressed in the RIA report to ensure that all calculated results of the assessment are representative and acceptable within certain confident level.
9.	Mitigation measure	There should be a clear description given on mitigation measures to be undertaken by the applicant to control the hazard and to minimize the impact caused to members of the public and workers resulting from normal operation of the plant as well as during abnormal situations.
10.	Monitoring program	Monitoring should consist of radiological monitoring and non-radiological monitoring. For the purpose of RIA only radiological monitoring is considered. Non-radiological monitoring should be considered and prepared as a separate report submitted to the relevant authorities including the requirements of Environmental Quality Act 1974 and Occupational Safety and Health Act 1994, where appropriate. Radiological monitoring is required for the following purposes: i. To establish baseline data prior to operation of the plant, which will later be used to benchmark the radiological impact of the plant; ii. To ensure that the operational of the plant is within the acceptable level as what has been assessed and predicted by the RIA; and iii. To ensure that the operation of the plant comply the regulations and the guidelines issued by AELB. Radiological monitoring of the environment onsite and offsite the facility should be considered for both radiation and radioactive materials. It should be carried out prior to commencement of the operation of the plant (pre-operational monitoring) and continued during operational period until the facility is decommissioned. Pre-operational monitoring should be done for a period of not less than one

NO	ITEM	EXPLANATION
		year in order to have a complete picture of changes in environmental condition that may have taken place during one year period which may have influence on monitoring results. At the beginning of operation, monitoring can be done monthly, but thereafter the frequency can be reduced to other period, depending on the situation and performance of the facility with approval of AELB. Selection of monitoring locations should be made based on the information provided in item 6 i.e. weather condition (wind speed and the frequency of wind direction) and movement of underground water of the site. Monitoring for operational period should also take into consideration monitoring of workplaces (where radiation and radioactive materials are involved) and personnel (radiation workers). A detailed monitoring program should be established, taking into consideration the explanation given in the preceding paragraphs. Selection of monitoring locations, parameters for environmental monitoring, monitoring frequency and the method use for monitoring should be clearly described in the program which becomes part of the RIA. Results of pre-operational monitoring should be included in the RIA report submitted for application of a temporary operating stage license. Results of operational monitoring (environmental, workplaces and personnel monitoring), on the other hand, should be included in the final RIA report submitted for application of a full operating license.
11.	Conclusion	The RIA should include a conclusion on the findings of the assessments.
12	Reference	(a) International Atomic Energy Agency; Predisposal Management of Radioactive Waste, IAEA Safety Standards No. GSR Part 5 (2009)

Note:

[1] The non-radiological impacts shall be covered under Environmental Impact Assessment (EIA) report and any other related assessment.

Attachment 4

Content of Safety Case (SC) for Operation of Radioactive Waste Disposal Facility (Borehole Disposal)

NO.	ITEM	EXPLANATION
1.	Executive Summary	Both languages
2.	General	Disposal of radioactive waste represents the final step in its management and disposal facilities are designed, operated and closed with a view to providing the necessary degree of containment and isolation[1] to ensure safety. The principle of radioactive waste management: "*Radioactive waste must be managed in such a way as to avoid imposing an undue burden on future generations; that is, the generations that produce the waste have to seek and apply safe, practicable and environmentally acceptable solutions for its long term management*." The safety case is the collection of scientific, technical, administrative and managerial arguments and evidence in support of the safety of a disposal facility covering the suitability of the site and the design, construction and operation of the facility, the assessment of radiation risks and assurance of the adequacy and quality of all the safety related work associated with the disposal facility.
3.	Objective	The objective of this safety case is to assess, demonstrate and document the safety of radioactive waste disposal facilities after closure is identified, and guidance is provided on best practice in undertaking such assessment and presenting the safety case.
4.	Scope	This document should cover the waste stored received from different operators to be temporarily stored in the storage facility prior to the disposal.
5.	Preparation of the Safety Case	The safety case should be prepared taking into the following considerations: i. An integration of relevant information in a structured, traceable and transparent way that demonstrates an understanding of the behaviour and performance of the disposal system in the period after closure; ii. Identification of uncertainties in the behaviour and performance of the disposal system, analysis of the significance of the uncertainties, and identification of approaches for the management of significant uncertainties;

[1] *Containment denotes all methods or physical structures designed to prevent or control the release and the dispersion of radioactive substances. Isolation of the waste from the accessible biosphere substantially reduces the likelihood of inadvertent human intrusion into the waste and its consequences.*

NO.	ITEM	EXPLANATION
		iii. A demonstration of long term safety by providing reasonable assurance that the disposal facility will perform in a manner that protects human health and the environment; iv. Support to decision making in the step by step approach to development of a disposal facility; and v. Facilitation of communication between principle parties on issues relating to a disposal facility. The Safety Case shall include the following: a) Safety case context i. Purpose of the safety case ii. requirement for safety case, national policy/ strategy on disposal facilities, regulations iii. Demonstration of safety iv. Public engagement/acceptance v. Graded Approach vi. Financial consideration b) Safety Strategy i. Base line data e.g. waste inventory, projection etc., ii. Consideration of options e.g. disposal strategy method: near surface, deep geological etc., iii. Multiple safety function, iv. Demonstrability, v. Waste acceptance criteria e.g. packaging type, waste type etc., vi. QA c) Description of the disposal system. i. Master plan e.g. entry road, development plan of neighbouring area etc. ii. System features, iii. Type barriers, iv. Operating procedures of the facilities, v. Plant layout e.g. Detail design drawings etc. d) Safety Assessment i. RIA for the period after closure (at appropriate licence stage) ii. Site and engineering aspects iii. Passive safety iv. Multiple safety functions v. Robustness vi. Scientific and engineering principles vii. Quality of the site characterization viii. Operational safety aspects ix. Scenario models and calculation

NO.	ITEM	EXPLANATION
		x. Post closure Radiological impact xi. Non-radiological environmental impacts (EIA) xii. Management system e) Management of uncertainties i. Technical - design, concept, geomorphology parameter; and ii. Political f) Iteration and design optimization. g) Limits, control and conditions h) Integration of safety arguments i. Comparison with safety criteria ii. Complementary safety indicators and performance indicators iii. Multiple lines of reasoning iv. The robustness, defence in depth, system understanding & monitoring v. Additional measures to increase confidence – independent review vi. Plans for addressing unresolved issues
6.	Conclusion	The Safety Case should include a conclusion on the results of the assessments.
7.	Reference	IAEA Specific Safety Guide No. SSG-23 (2012) The Safety Case and Safety Assessment For Disposal Of Radioactive Waste, IAEA, Vienna

**Safety Assessment* - *Prediction of environmental concentrations of radionuclides and radiation doses to people from the proposed waste management practices, including demonstration that the legal requirements will be met both now and in the future as determined by the relevant regulatory authority.*

The **safety case is the **collection of scientific, technical, administrative and managerial arguments and evidence in support of the safety of a disposal facility** covering the suitability of the site and the design, construction and operation of the facility, the assessment of radiation risks and assurance of the adequacy and quality of all the safety related work associated with the disposal facility. **Safety assessment, an integral part of the safety case** is driven by a **systematic assessment of radiation hazards and is an important component** of the safety case. The latter involves quantification of radiation dose and radiation risks that may arise from the disposal facility for comparison with dose and risk criteria, and provides an understanding of the behaviour of the disposal facility under normal conditions and disturbing events, considering the time frames over which the radioactive waste remains hazardous. The **safety case and supporting safety assessment provides the basis for demonstration of safety and for licensing**, and will evolve with the development of the disposal facility and will assist and guide decisions on siting, design and operations. The **safety case will also be the main basis** on which **dialogue with interested parties will be conducted and on which confidence in the safety of the disposal facility will be developed**.*

Attachment 5

Content of Radioactive Waste Management Plan (RWMP) Of Radioactive Waste Disposal Facility (Borehole Disposal)

NO.	ITEM	EXPLANATION
1.	Executive Summary	Both languages
2.	General	This Waste Management Plan should be prepared with clear indications and explanation on waste to be generated from operation of the plant, and licensee' commitment on WHAT it plans/ proposes to do with the waste and HOW licensee is going to deal with and manage the waste during operation of the plant and post-operational period. Waste Management Plan should include (where appropriate) waste collection, storage, handling, transport, treatment, conditioning, packaging and finally disposal. This Waste Management Plan shall comply with the requirements stipulated in the Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011. Note: This document shall be revised and updated in accordance with the requirements of the Radiation Protection (Licensing) Regulations 1986 at each licensing stage.
3.	Scope	To cover the wastes: i. Received from different operators to be temporarily stored prior to disposal ii. Preparation of waste for disposal The Waste Management Plan should clearly describe the management of radiological waste.
4.	Objective of Waste Management	Should state clearly the objective of this Waste Management Plan.

NO.	ITEM	EXPLANATION
5.	Inventory of waste to be disposed in disposal facility	A description of the waste stored and to be disposed of in the disposal facility. i. Types of waste to be disposed (radiological); ii. Estimated quantity to be disposed of in the disposal facility; iii. Radionuclides involved and their activity; iv. Characteristic of the waste (physical, chemical and biological properties); and v. Category of the waste (as defined in the Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011. The characterization of the waste shall provide sufficient information for process control and to provide assurance that the waste or the waste package will meet the acceptance criteria for conditioning, containerization, storage, transport and disposal. The inventory for disposal shall predominantly consist of DSRS but small quantities of other waste may also be disposed of using the BDC (e.g. secondary wastes from leaking sources encountered in conditioning). Individual records shall include information, as appropriate, on the: i. Location, both before and after disposal; ii. Radionuclide content; iii. Radioactivity on a specified date; iv. Serial number or unique identifier; v. Chemical and physical form; vi. Conditioning and containerization, receipt, transfer and disposal; vii. Other information, as appropriate, to enable the waste to be identifiable, traceable and safely handled; viii. Trends in operating performance e.g. environmental discharges, number of incidents; and ix. Category of the waste (as defined in the Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011.
6.	Waste management strategy	The Waste Management Plan should include a description on strategy to be undertaken by licensee on <u>how</u> to minimize the impact caused by waste intended to be disposed in the borehole disposal facility.

NO.	ITEM	EXPLANATION
		The description on waste management strategy may include but not limited to the following: a) Waste segregation b) Secondary waste minimization i. Proper selection of raw materials; ii. Proper selection of the process involved; iii. Recycling of process materials; iv. Exemption of residues; [concepts: delay and decay/ dilute and disperse] v. Recycling/reuse of residues. vi. Recording system for waste discharges. c) Waste transport and handling d) Waste conditioning i. Methodology; ii. Design, material and leak testing of capsule; iii. Handling of waste capsules prior containerization iv. Control of workers and public exposure. e) Containerization i. Methodology; ii. Design, material and leak testing of containers; iii. Handling of waste packages prior disposal; iv. Control of workers and public exposer f) Waste disposal: Preliminary indication about: i. Method of disposal; ii. Selection of disposal site; iii. Conceptual design of waste repository; iv. Waste emplacement in borehole disposal facility v. Safety Assessment* of the disposal facility; vi. Post Closure program; vii. Indication about Institutional Control (IC).
7.	Waste Management System	A description of the proposed system for waste management including: i. The facilities and procedures involved in the handling ii. Treatment iii. Storage and iv. Disposal of radioactive waste

NO.	ITEM	EXPLANATION
8.	Legal requirements on waste management	The plan should include a description on how legal requirements on waste management are met: i. Appointment of Waste Management Officer; An applicant may propose to use a Radioactive Waste Management Officer in place of a qualified expert in radiation safety on the basis of the relatively low risk of the practice. ii. Record keeping of wastes generation, waste disposal and waste inventory; iii. Theoretical dose assessment and exposure to members of the public, workers and the environment based on quantity (item 4c[1]); iv. Control (Safety and security) of waste prior to disposal; v. A program for monitoring the concentration of radionuclides in the environment and assessment of radiation doses to members of the public arising from the waste management practices; vi. A schedule for reporting on the results of monitoring and assessments required by this plan; vii. Establishment of discharge limits for liquid and gaseous effluents and monitoring program to verify their compliance; viii. Establishment and implementation of Quality Assurance Program (QAP) for waste disposal; ix. Security, physical protection and control of waste; x. Return of Disused Sealed Radioactive Sources (DSRS); xi. A system of periodic assessment and review of the adequacy and effectiveness of procedures instituted under the Waste Management Plan to ensure currency and to take account of potential improvements consistent with best practicable technology; Preparation of Safety Case for waste disposal.
9.	Reference	(a) IAEA TECDOC 1660: Exposure of the public from large deposits of mineral residue; June 2011. (b) IAEA Safety Series No.111-F "The Principles of Radioactive Waste Management" (1995)

**Safety Assessment - Prediction of environmental concentrations of radionuclides and radiation doses to people from the proposed waste management practices, including demonstration that the legal requirements will be met both now and in the future as determined by the relevant regulatory authority.*

ACKNOWLEGEMENT

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