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PANDUAN TEKNIKAL

PANDUAN UNTUK MENDAPATKAN LESEN KELAS A DARIPADA LEMBAGA BAGI PENGILANGAN BAHAN YANG MENGANDUNGI ATAU BERKAITAN DENGAN BAHAN RADIOAKTIF SEMULAJADI (NORM)

LEMBAGA PERLESENAN TENAGA ATOM
KEMENTERIAN SAINS, TEKNOLOGI DAN INOVASI

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KANDUNGAN

PANDUAN UNTUK MENDAPATKAN LESEN KELAS A DARIPADA LEMBAGA BAGI PENGILANGAN BAHAN YANG MENGANDUNGI ATAU BERKAITAN DENGAN BAHAN RADIOAKTIF SEMULAJADI (NORM)

OBJEKTIF

1. Dokumen ini disediakan bertujuan untuk memberi panduan kepada pemohon yang berhasrat untuk berurusan dengan aktiviti pengilangan bahan yang mengandungi bahan radioaktif semulajadi (NORM).

SKOP

2. Panduan ini menjelaskan berkenaan prosedur permohonan lesen kelas A di bawah peruntukan Akta Perlesenan Tenaga Atom 1984 (Akta 304) bagi pengilangan bahan yang mengandungi bahan radioaktif semulajadi (NORM).

TAKRIFAN DAN SINGKATAN

3. Dalam panduan ini, melainkan jika konteksnya mengkehendaki makna yang lain-

“Berurusan” berhubungan dengan mana-mana bahan radioaktif, bahan nuklear, benda ditetapkan atau radas penyinaran, ertinya apa-apa aktiviti yang melibatkan bahan radioaktif, bahan nuklear, benda ditetapkan atau radas penyinaran yang sedemikian itu yang dikilang diperdagang, dikeluar, diproses, dibeli, dipunyai, diguna, diangkut, dipindah, dikendali, dijual, distor, diimport atau dieksport.

“Pengilangan” ertinya apa-apa aktiviti yang terlibat dalam pemekatan dan penceriaan apa-apa bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif, bahan nuclear atau benda ditetapkan.

“Pepasangan pengilangan” ertinya sesuatu pepasangan yang dibina untuk menjalankan usaha pengilangan

“peringkat pengendalian penuh” ertinya peringkat apabila pengendalian penuh sesuatu pepasangan pengilangan.

“Peringkat pengendalian sementara” ertinya peringkat apabila pengendalian terhad sesuatu pepasangan pengilangan yang dibenarkan bagi maksud pengesahan ciri-ciri pengendalian normal yang dijangka bagi pepasangan atau kemudahan itu yang diramalkan oleh maklumat rekabentuknya.

SINGKATAN

AELB	*Atomic Energy Licensing Board* (Lembaga Perlesenan tenaga Atom)
IAEA	*International Atomic Energy Agency*
NORM	*Naturally Occurring Radioactive Material*
OBTL	Orang Bertanggungjawab Terhadap Lesen
RPO	*Radiation Protection Officer* / Pegawai Perlindungan Sinaran (PPS)
eLesen	Sistem atas talian bagi permohonan lesen dengan AELB

PENGENALAN

4. Mana-mana orang yang berhasrat untuk berurusan dengan pengilangan bahan mineral yang mengandungi NORM dikehendaki:

a. Mengemukakan surat hasrat bagi permohonan penempatan tapak dengan mengemukakan maklumat berkaitan aktiviti, kaedah pemprosesan, bahan mentah yang akan digunakan, sisa yang akan dihasilkan dll;

b. Mengemukakan CoA* bahan mentah yang akan digunakan (analisa kandungan kepekatan aktiviti sekurang-kurangnya untuk radionuklid Th-232dan U-238)

[*Sekiranya keputusan analisa bagi radionuklid semulajadi seperti U-238 dan Th-232 melebihi aras pembersihan mengikut Waste Regulation 2011, maka aktiviti tersebut adalah tertakluk kepada peruntukan Akta 304]

5. Mengikut P.U (A) 149, Lesen kelas A adalah suatu lesen untuk mengilang, memperdagangkan, mengeluarkan, memproses, membeli, mempunyai, memiliki, menggunakan, memindahkan, mengendalikan, menjual atau menstor bahan radioaktif. Lesen kelas A mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam tiga (3) bahagian:

a. Bahagian penempatan tapak;
b. Bahagian pembinaan; dan
c. Bahagian pengendalian

Bahagian pengendalian lesen kelas A mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif yang mengenai sesuatu kemudahan rawatan sisa bagi bahan-bahan radioaktif hendaklah dikeluarkan dalam dua (2) peringkat, iaitu:

a. Peringkat pengendalian sementara; dan
b. Peringkat pengendalian penuh

6. Permohonan lesen boleh dibuat secara atas talian (*on-line*) melalui sistem eLesen.

KEPERLUAN PERLESENAN

7. Keperluan bagi permohonan lesen kelas A (Pengilangan) bagi mengilang Mineral Yang Mengandungi Bahan Radioaktif Semulajadi (NORM) antara lainnya adalah:

a. Keperluan asas permohonan lesen adalah:

i. Organisasi dan Pengurusan

a. Permohonan lesen kelas A (atas talian eLesen)
b. Perlantikan OBTL
c. Salinan Sijil Pendaftaran (Form 9) yang disahkan oleh SSM
d. Pendaftaran pengamal perubatan

ii. Pekerja Sinaran
a. Perlantikan RPO (Rujuk panduan pengiktirafan RPO)
b. Pendaftaran pekerja sinaran (atas talian eLesen)

iii. Alat Pengesan Sinaran - Sekurang-kurangnya 2 unit meter tinjau

iv. Program Perlindungan Sinaran - Diterimapakai oleh AELB

v. Program Pemonitoran Radiologi dan Alam Sekitar - Diterimapakai oleh AELB

b. Dokumen Sokongan lain

i. *Radiological Impact Assessment (RIA)* - **Lampiran 1**
ii. *Siting of Radioactive Waste Management Facility* - **Lampiran 2**
iii. *Safety Case for the Disposal Facility (SC)* dikemaskini mengikut peringkat iaitu penempatan tapak, pembinaan dan operasi kemudahan pelupusan bagi pelupusan sisa yang dihasilkan - **Lampiran 3**
iv. *Radioactive Waste Management Plan* (RWMP) - **Lampiran 4**
v. Pelan Pembubaran (*Decommissioning Plan*) - **Lampiran 5**
vi. Perancangan dan penempatan tapak kemudahan pelupusan sisa radioaktif (*Siting of the Disposal Facility)*- **Lampiran 6** (jika berkaitan)
vii. Pelan Kecemasan (ERP)
viii. Pelan Sekuriti/ Penilaian Ancaman – jika berkaitan

8. Senarai semak keperluan bagi permohonan lesen kelas A (Pengilangan) boleh didapati daripada laman web AELB (www.aelb.gov.my) – **Lampiran 7**

LAIN-LAIN

9. Pemohon juga tertakluk kepada apa-apa peruntukan undang-undang yang dikuatkuasa oleh pihak berkuasa berkenaan yang berkaitan.

10. Dokumen ini adalah tertakluk kepada pindaan dan arahan yang dikeluarkan oleh AELB dari semasa ke semasa.

PENUTUP

11. Sekiranya terdapat sebarang pertanyaan mengenai panduan ini, pemohon/pemegang lesen boleh berhubung dengan AELB menggunakan alamat di bawah:

Lembaga Perlesenan Tenaga Atom
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LAMPIRAN 1

CONTENT FOR THE PREPARATION OF RADIOLOGICAL IMPACT ASSESSMENT (RIA)

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 which deals with radiation or radioactive materials. The document focuses on assessment of the radiological impact and risk caused by operation of the plant 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 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 which 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. The RIA should be prepared in accordance with the guidelines stipulated in the LEM/TEK/30 sem.2 (1996) [page 13-14]. <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 plant starting from importation or transportation of the raw (feed) materials to the plant through the whole processes that take place in the plant until disposal of the wastes generated from operation of the plant. The assessment should take into consideration any abnormal situation that can/ may occur during normal operation of the plant. **It should not, however, cover the plant decommissioning and disposal (D&D), since it is**

		going to be covered under the D&D Plan which requires another RIA to be carried out specifically for the D&D operation. The assessment should take into consideration the impact and the risk caused by both radiological and non-radiological aspects of the operation of the plant. 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 plant 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 on the plant and the process involved. This information is important in the RIA in order to: a) Identify and establish the source term used in the assessment modeling and calculations; b) Identify the critical target group(s) among members of the public and workers; c) 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 d) 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: a) Identify the critical target group(s) among members of the public;

		b) Understand the migration and transport of radionuclides released from the site; c) 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 d) 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: a) Topography; b) Demography; c) Hydrology; d) Geology; e) Meteorology; and f) 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 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 made-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: a) Description on methodology used for the assessment; b) Description on input data for the assessment; c) Radiation protection criteria; d) Source term. (Identity, quantity, chemical and physical form of the radionuclides); e) Exposure scenarios; f) Identification of critical groups; g) Dosimeter assessment and impact analysis; h) Results of the analysis; and i) Treatment of uncertainty involved in the calculations (sensitivity 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 4, iii. identification of exposure scenarios and the critical group(s) which can be derived from a description given in item 4 and 5, 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 4 and 5.

		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 plant to the target groups. They should be established based on the annual dose 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 from NORM in Oil and Gas Industry, the AELB recommends to use the dose constraint of 0.3 mSv per year as stipulated in the LEM/TEK/30 Sem.2 1996 or any updated version. **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 plant which can be extracted or derived from the information provided in item 4. The plant operation 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. For certain types of plant, 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 plant. This should be taken into consideration and properly addressed in the RIA.

e) Exposure scenarios

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:

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 in the case of NORM/ TENORM;

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 4 and 5 after identification and confirmation of the critical groups affected by the operation of the plant.

In identifying the critical pathways of exposure, consideration should be given to the situation that may occur during normal operation of the plant as well as during abnormal situation.

f) Identification of critical groups

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.

Definition:

- "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;

g) Treatment of uncertainty (sensitivity analysis)

		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 4 and 5. 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: a) To establish baseline data prior to operation of the plant, which will later be used to benchmark the radiological impact of the plant; b) To ensure that the operational of the plant is within the acceptable level as what has been assessed and predicted by the RIA. c) 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 plant 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 plant ceases operation. Pre-operational monitoring should be done for a period of not less than one 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 plant with approval of AELB. Selection of monitoring locations should be made based on the information provided in item 5 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	1. International Atomic Energy Agency; Predisposal Management of Radioactive Waste, IAEA Safety Standards No. GSR Part 5 (2009) 2. International Atomic Energy Agency; Management of Radioactive Wastes from the Mining and Milling of Ores, IAEA Safety Standards Series No. WS-G-1.2 (2002)

Note:

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

LAMPIRAN 2

CONTENT FOR SITING OF RADIOACTIVE WASTE MANAGEMENT FACILITY

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 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 very low and low level wastes from NORM processing associated contaminated materials arise from decommissioning of the plants.
4	Stages of the Siting Process	One systematic siting process for a disposal facility may be considered to consist of four stages: a. Conceptual and planning stage b. Area survey stage c. Site characterization stage d. 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 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

No	Requirements	Remarks
		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: - Regional mapping to identify areas with potentially suitable sites; - 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 economic, environmental, social and political considerations.

No	Requirements	Remarks
	d. Site Confirmation Stage	The purpose of the site confirmation stage is to conduct detailed site investigations at the preferred site(s) to: - Support or confirm the selection; - 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.
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.

No	Requirements	Remarks
		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): - 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; - Specification of data to be used and the information required for each site characteristic at each phase of the siting process; - The data collected and the guidelines adopted; - 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 favorable 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, - Location, extent and interrelationship of the important hydrogeological units in the region

No	Requirements	Remarks
		- Average flow rates and prevailing directions of the groundwater flow - Information on recharge and discharge of the major hydrogeological units - 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: - Mineralogical and petro graphical composition of the groundwater flow system and its geochemical properties; - 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 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 analysed at the site confirmation stage; - Historical seismicity at the site; - Occurrence of quaternary faults at the site and the age of latest movement; - Evidence of active tectonic processes, such as volcanism; - 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.

No	Requirements	Remarks
		In the site characterization and confirmation stages, the following information should be collected: - Topography of the site, showing actual drainage features; - Location of existing and planned surface water bodies; - Definition of areas of landslides and other potentially unstable slopes, and of materials of low bearing strength or high liquefaction potential; - Definition of areas containing poorly drained materials; - Data on the flood history of the region; - 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 include: - Wind and atmospheric dispersion characteristics; - Precipitation characteristics; - 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: - Location of nearby hazardous installations, such as oil refineries, chemical plants, storage depots, pipelines and other

No	Requirements	Remarks
		facilities that could have an impact on the site operations; - Location of airports and important air traffic corridors and flight frequencies; - 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: - Description of existing routes in the vicinity of the site and analysis of their adequacy for handling waste shipments; - Anticipated improvements in the existing transportation network; - Estimates of the overall costs and risk of waste transportation; - 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: - Existing land resources and uses and jurisdiction over them; - 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.

No	Requirements	Remarks
		Possible adverse effects which a near surface disposal system may have on the environment include: - Disturbance of the environment due to the construction and operation of the disposal facility; - Impact on areas of significant public value; - Disturbance of public water supplies; - 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	1. IAEA Safety Series No. 111-G-3.1 (Siting of Near Surface Disposal Facilities), 1994 2. IAEA Safety Standards No. SSR-5 (Disposal of Radioactive Waste), 2011

LAMPIRAN 3

CONTENT FOR THE SAFETY CASE FOR DISPOSAL FACILITY

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 IAEA Fundamental Safety objective is to protect people and the environment from the harmful effects of ionizing radiation and as a principle "*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. *Preparation of this document should be made with reference to the IAEA DSS 355 (June 2011).* Note: This document may be revised and updated in accordance with the latest requirements of the IAEA standards.
3.	Objective	The objective of this safety case is to assess, demonstrate and document the safety of all types of radioactive waste generated from operation of the plant and waste arising from D&D of the plant. The most important considerations when assessing the safety of radioactive waste disposal facilities after closure are 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 generated from the operation of the plant and waste arising from D&D of the plant which include both radiological and non-radiological wastes, stored within or outside the plant premise.

[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.*

		For management of non-radiological waste, licensee shall prepare a separate section in accordance with the requirements of Environmental Quality Act 1974, where appropriate.
5.	Preparation of the Safety Case	The safety case should be prepared taking into the following considerations: a) 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. b) 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. c) 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. d) Support to decision making in the step by step approach to development of a disposal facility. e) Facilitation of communication between interested parties on issues relating to a disposal facility. The Safety Case shall include the following: 1.Safety case context a) Purpose of the safety case b) requirement for Safety Case, national policy/ strategy on disposal facilities, regulations c) Demonstration of safety d) Public engagement/ acceptence e) Graded Approach f) financial consideration 2. Safety Strategy a) Base line data eg. waste inventory, projection etc, b) Consideration of options eg. disposal strategy method: near surface, deep geological etc, c) Multiple safety function, d) Demonstrability, e) Waste acceptance criteria eg. packaging type, waste type etc, f) QA 3. Description of the disposal system. a. Master plan eg. entry road, development plan of neighbouring area etc b. system features, c. type barriers, d. operating procedures of the facilities, e. Plant layout eg. Detail design drawings etc.

		4. Safety Assessment a) RIA for the period after closure (at appropriate licence stage) b) Site and engineering aspects c) Passive safety d) Multiple safety functions e) Robustness f) Scientific and engineering principles g) Quality of the site characterization h) Operational safety aspects i) Scenario models and calculation j) Post closure Radiological impact k) Non-radiological environmental impacts (EIA) l) Management system 5. Management of uncertainties a) Technical - design, concept, geomorphology parameter; and b) Political) 6. Iteration and design optimization. 7. Limits, control and conditions 8. Integration of safety arguments a) Comparison with safety criteria b) Complementary safety indicators and performance indicators c) Multiple lines of reasoning d) The robustness, defence in depth, system understanding & monitoring e) Additional measures to increase confidence – independent review f) Plans for addressing unresolved issues
	Conclusion	The Safety Case should include a conclusion on the results of the assessments.
7.	Reference	IAEA DSS355 - The Safety Case and Safety Assessment For Disposal Of Radioactive Waste (Draft-June 2011)

**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****.*

LAMPIRAN 4

CONTENT FOR RADIOACTIVE WASTE MANAGEMENT PLAN

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 only waste to be generated during operational period of the plant (not to include waste generated from decommissioning which should be described in the Decontamination and Decommissioning Plan). The Waste Management Plan should clearly describe the management of both:- a. radiological and b. non-radiological wastes. For management of non-radiological waste, licensee shall prepare a separate section in accordance with the requirements of Environmental Quality Act 1974, where appropriate.
4.	Objective of Waste Management	Should state clearly the objective of this Waste Management Plan. It should reflect licensee' commitment on how the waste to be generated is going to be dealt with and managed by licensee to ensure its risk to members of the public, workers and the environment are within the limits during operational and post-operational period (protection of future generations). For subsequent Waste Management Plan, the objective should be to re-assess the actual waste generated to be dealt with and managed by licensee to ensure its risk to members of the public, workers and the

		environment are within the limits during operational and post-operational period (protection of future generations).
5.	Waste Generation	The Waste Management Plan should include a description of the waste to be generated during operation of the plant. The description should include at least the following: a. An outline of the processes generating waste and detail mass balance; b. Types of waste to be generated (radiological and non-radiological); c. Estimated quantity to be generated over one year and over the design period of the plant; d. Radionuclides involved and their activity; e. Characteristic of the waste (physical, chemical and biological properties) and f. 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 generated from operation of the plant over short term (operational period) and long term (post operational period). The description on waste management strategy may include but is not limited to the following: a. Waste segregation b. Waste minimization i. Proper selection of raw materials; ii. Proper selection of the process involved; iii. Recycling of process materials; iv. Exemption of residues; v. Recycling/reuse of residues. c. Waste transport and handling d. Waste storage during operational period i. Selection of storage location; ii. Design of the storage facility; iii. Control of workers and public exposure. e. Waste disposal: i. During operational period • A description of the environment into which the waste will be discharged or disposed, including the baseline radiological characteristics; • Establishment of release limits for gaseous and liquid effluents; • Installation of control/ cleaning system for gaseous and liquid discharges; • Controlled releases; • Recording system for waste discharges. ii. Post Operational Period. Preliminary indication about: • Method of disposal;

		• Selection of disposal site; • Conceptual design of waste repository; • Safety Assessment* of the disposal facility; • Post Closure program; • Indication about Institutional Control (IC).
7.	Waste Management System	A description of the proposed system for waste management including: a. The facilities and procedures involved in the handling, b. Treatment, c. Storage and d. Disposal of radioactive waste.
8.	Legal requirements on waste management	The plan should include a description on how legal requirements on waste management are met: a. Appointment of Waste Management Officer; b. Record keeping of wastes generation, waste disposal and waste inventory; c. Theoretical dose assessment and exposure to members of the public, workers and the environment based on quantity (item 4c[1]); d. Control (Safety and security) of waste prior to disposal; e. 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; f. A schedule for reporting on the results of monitoring and assessments required by this plan; g. Establishment of discharge limits for liquid and gaseous effluents and monitoring program to verify their compliance; h. Establishment and implementation of Quality Assurance Program (QAP) for waste disposal; i. Security, physical protection and control of waste; j. Return of Disused Sealed Radioactive Sources (DSRS); k. 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; l. Preparation of Safety Case for waste disposal.
9.	Reference	1) IAEA TECDOC 1660: Exposure of the public from large deposits of mineral residue; June 2011. 2) IAEA Safety Standards Series, WS-G 1.2 “Management of Radioactive Waste from the Mining and Milling of ores” (2002) 3) IAEA Safety Series No.111-F “The Principles of Radioactive Waste Management” (1995) 4) IAEA TECDOC 1712 “ Management of NORM Residues (2013)

LAMPIRAN 5

CONTENT FOR DECOMMISSIONING AND DISPOSAL (D&D) PLAN

NO	ITEM	EXPLANATION
1.	Executive Summary	Both languages
2.	General	The D&D plan should be prepared with clear indications and explanation on planned D&D to be carried out by licensee on the plant at the end of its operational life. The plan should indicate both the technical aspects of D&D and the commitment of licensee to provide adequate financial support for carrying out the D&D operation until release of the plant site and the final disposal of the D&D wastes. The plan should indicate the approach to be taken by licensee for the D&D of the plant and HOW licensee is going to deal with and manage the proposed D&D operation of the plant including cleaning up of the site. 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 D&D operation of the plant at the end of its operational life. To cover management of D&D wastes generated from the D&D operation (not to include waste generated from operation of the plant which should be described in the Waste Management Plan). The plan should consider both radiological and non-radiological aspects of the D&D including the requirements of Environmental Quality Act 1974 and Occupational Safety and Health Act 1994, where appropriate.
4.	Description of plant to be decommissioned and its site	The description should include: - a. Operation history of the plant and the waste generated, b. Its storage and c. Disposal (including any accident happened during operation of the plant and any modification carried out during operation of the plant – to be added later during application for the decommissioning license).
5.	Objective of the D&D Plan	Should state clearly what is the objective of the D&D Plan? It should reflect licensee's proposal and commitment on HOW the plant D&D is going to be carried out to ensure that D&D operation complies with the requirements of LEM/TEK/56 including safe disposal of the waste generated during post-operational period (after plant ceases operation) (protection of future generations).

		For subsequent Decommissioning Plan, the objective should be to reassess commitment on HOW the plant D&D is going to be carried out to ensure that D&D operation complies with the requirements of LEM/TEK/56 including safe disposal of the waste generated during post-operational period (after plant ceases operation) (protection of future generations)
6.	Establishment of Health and Safety program for D&D operation	To describe a preliminary health and safety program to be developed specifically for D&D operation which is different from the health and safety program developed for operation of the plant. The program should include: a. radiation protection program for D&D b. Industrial safety in carrying out D&D operation
7.	D&D strategy	There should be a description on strategy to be undertaken by licensee in carrying out the D&D of the plant and its site to minimize the impact caused to members of the public, workers and the environment. It should include but not limited to the following: a. Characterization of the plant and the site b. Estimation of volume of D&D waste to be generated c. D&D options: • Recycling of non-contaminated parts of the plant • Decontamination and recycling of contaminated parts of the plant • Dismantle and dispose of the whole plant • Cleaning up of the site to remain as industrial site • Cleaning up of the site to become public area.
8.	Waste Management and disposal (*detail description as in LEM/TEK/56 should be included in the document prepared for a Class A-Milling (Full Operation Stage) license and later Class G: Decommissioning licence*)	m. Appointment of Waste Management Officer; n. Record keeping of wastes generation and waste disposal; o. Establishment and implementation of QAP for waste disposal; d. Waste disposal (detail in the application for D&D license): ii. <u>During D&D operation</u> • Establishment of release limits for gaseous and liquid effluents; • Installation of control/cleaning system for gaseous and liquid discharges; • Controlled releases; • Recording system for waste discharges. iii. <u>Post closure period</u> • Indication about method of disposal • Selection of disposal site • Conceptual design of waste repository • Indication about Institutional control (IC)

9.	Proposed implementation of D&D	The description should include explanation on: a. Safety assessment for D&D operation b. Establishment of D&D Plan c. Establishment of decommissioning criteria i. release limits and release criteria for the plant and the site ii. cleanup criteria for the site d. Establishment of Quality Assurance Program (QAP) for D&D operation e. Emergency planning and preparedness for D&D operation
10.	Cost estimation and funding mechanism for D&D	To indicate the commitment of licensee to provide fund for D&D operation at the end of plant operation.
11.	References	a. LEM TEK 56 (2008) b. IAEA Safety Standards (GSR Part 6), Decommissioning of Facilities, DS 450 (2012) c. NUREG USNRC

LAMPIRAN 6

CONTENT FOR SITING OF RADIOACTIVE WASTE DISPOSAL FACILITY

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 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 very low and low level wastes from NORM processing associated contaminated materials arise from decommissioning of the plants.
4	Stages of the Siting Process	One systematic siting process for a disposal facility may be considered to consist of four stages: e. Conceptual and planning stage f. Area survey stage g. Site characterization stage h. Site confirmation stage
	e. 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 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.
	f. 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: - Regional mapping to identify areas with potentially suitable sites; - Screening to select potential sites for further evaluation.
	g. 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 economic, environmental, social and political considerations.

	h. Site Confirmation Stage	The purpose of the site confirmation stage is to conduct detailed site investigations at the preferred site(s) to: - Support or confirm the selection; - 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.
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): - 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; - Specification of data to be used and the information required for each site characteristic at each phase of the siting process; - The data collected and the guidelines adopted; - The results obtained in the evaluation of each guideline.
	l. 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.
	m. 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, - Location, extent and interrelationship of the important hydrogeological units in the region - Average flow rates and prevailing directions of the groundwater flow

		- Information on recharge and discharge of the major hydrogeological units - Information on regional and local water tables and their seasonal fluctuations
	n. 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: - Mineralogical and petro graphical composition of the groundwater flow system and its geochemical properties; - Groundwater chemistry
	o. 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 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 analysed at the site confirmation stage; - Historical seismicity at the site; - Occurrence of quaternary faults at the site and the age of latest movement; - Evidence of active tectonic processes, such as volcanism; - Estimate of maximum potential earthquake within the geological setting.
	p. 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:

		- Topography of the site, showing actual drainage features; - Location of existing and planned surface water bodies; - Definition of areas of landslides and other potentially unstable slopes, and of materials of low bearing strength or high liquefaction potential; - Definition of areas containing poorly drained materials; - Data on the flood history of the region; - Upstream drainage areas.
	q. 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 include: - Wind and atmospheric dispersion characteristics; - Precipitation characteristics; - Extreme weather phenomena.
	r. 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: - 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; - Location of airports and important air traffic corridors and flight frequencies;

		- Location of transportation routes with frequent movement of hazardous material.
	s. 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: - Description of existing routes in the vicinity of the site and analysis of their adequacy for handling waste shipments; - Anticipated improvements in the existing transportation network; - Estimates of the overall costs and risk of waste transportation; - Analysis of emergency response requirements and capabilities related to transportation.
	t. 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: - Existing land resources and uses and jurisdiction over them; - Foreseeable development of land in the area of interest
	u. 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.
	v. 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:

		- Disturbance of the environment due to the construction and operation of the disposal facility; - Impact on areas of significant public value; - Disturbance of public water supplies; - 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	3. IAEA Safety Series No. 111-G-3.1 (Siting of Near Surface Disposal Facilities), 1994 4. IAEA Safety Standards No. SSR-5 (Disposal of Radioactive Waste), 2011

LAMPIRAN 7

SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

Lesen Kelas A adalah mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam 3 bahagian iaitu (i) Bahagian Penempatan Tapak, (ii) Bahagian Pembinaan, (iii) Bahagian Pengendalian (Peringkat Pengendalian Sementara) dan (iv) Bahagian Pengendalian (Peringkat Pengendalian Penuh).

Bil.	Perkara/Maklumat	Peringkat Lesen					
		Penempatan tapak	Pembinaan	Pra Kendalian	Kendalian Penuh		
					Baru	Pinda	Membaharui
A.	**Organisasi & Pentadbiran:**						
1.	Surat permohonan (surat hasrat) [sila dapatkan dari laman web AELB di www.aelb.gov.my]	/	/	/	/	/	/
2.	Butir-butir syarikat iaitu nama, nombor telefon, nombor faks, alamat surat – menyurat dan alamat premis.	/				/	/
3.	Orang yang bertanggungjawab terhadap lesen (OBTL). Sertakan carta organisasi syarikat. [sila sertakan Borang 49 yang disahkan benar oleh Suruhanjaya Syarikat Malaysia (SSM). Sekiranya bukan Ahli Lembaga Pengarah surat perlantikan hendaklah ditandatangani oleh salah seorang ahli Lembaga Pengarah Syarikat [sila dapatkan dari laman web AELB di www.aelb.gov.my]	/					
4.	Salinan Sijil Pendaftaran Syarikat yang telah disahkan benar oleh SSM (Borang 9)	/					
5.	Surat perakuan pengamal perubatan berdaftar yang diluluskan. [sila dapatkan dari laman web AELB di aelb.gov.my]	/		/			
6.	Surat persetujuan daripada agensi yang diiktiraf untuk menjadi juruperunding dan menjalankan permonitoran radiologi dan alam sekitar.	/					
7.	Salinan surat perjanjian / kebenaran daripada pemilik tapak atau Pihak Berkuasa Tempatan (PBT) yang diakui sah.	/					
8.	Jadual pembatuan projek	/					
B.	**Pekerja Sinaran: (sila rujuk senarai semak pengiktirafan pengendali sinaran)**						
1.	Untuk pengiktirafan sebagai Pegawai Perlindungan Sinaran (PPS)/Penyelia, sila kemukakan: a) Salinan sijil lulus peperiksaan PPS (bidang NORM/TENORM) dari AELB atau agensi yang diiktiraf oleh AELB. b) Salinan sijil kursus perlindungan sinaran anjuran agensi yang diiktiraf oleh AELB(dalam tempoh 3 tahun terakhir) c) Borang biodata pekerja sinaran (LPTA/BPS) [sila dapatkan daripada laman web AELB di			/			

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SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

Lesen Kelas A adalah mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam 3 bahagian iaitu (i) Bahagian Penempatan Tapak, (ii) Bahagian Pembinaan, (iii) Bahagian Pengendalian (Peringkat Pengendalian Sementara) dan (iv) Bahagian Pengendalian (Peringkat Pengendalian Penuh).

Bil.	Perkara/Maklumat	Peringkat Lesen					
		Penempatan tapak	Pembinaan	Pra Kendalian	Kendalian Penuh		
					Baru	Pinda	Membaharui
	http://www.aelb.gov.my] d) Salinan kad pengenalan e) Bagi bukan warganegara, sertakan salinan permit kerja (Imigresen) dan pasport yang sah f) Salinan surat pengesahan pemeriksaan perubatan [LPTA/BM/5 Seksyen A dan B] tidak melebihi 6 bulan daripada tarikh pemeriksaan. g) Fee RM5.00 dan gambar saiz passport untuk kad pekerja sinaran)wajib untuk semua PPS,PY, dan Pengendali Radiografi Industri).						
2.	Untuk pengiktirafan pengendali (NORM/TENORM), sila kemukakan perkara B1(c) dan B1(d)			/			
3.	Pengendali sinaran hendaklah tidak bekerja di syarikat lain, urusan pemberhentian hendaklah terlebih dahulu mendapat kelulusan daripada Bhg. Penguatkuasaan.			/			
4.	Jika pihak syarikat tidak dapat menyediakan seorang PPS, seorang Juruperunding Perlindungan Sinaran (JPS) perlulah dilantik dari mana-mana agensi yang diiktiraf oleh AELB.			/			
C.	**Alat Pengesan Sinaran:**						
1.	Salinan sijil tentukuran alat pengesan sinaran daripada agensi yang diiktiraf oleh AELB.			/	/	/	/
2.	Surat pengesahan pembelian alat pengesan sinaran (sekiranya masih belum memiliki). Pastikan alat pengesan sinaran sesuai dengan jenis sinaran yang digunakan.			/			
D.	**Program Perlindungan Sinaran (RPP):**						
1.	Menyediakan Program Perlindungan Sinaran yang mengandungi sekurang-kurangnya seperti format LEM/TEK/45 Bahagian E [rujuk laman web AELB di aelb.gov.my]			/		/	
2.	Pastikan Program Perlindungan Sinaran telah diluluskan oleh AELB dan diterimapakai oleh syarikat (Nyatakan tarikh program tersebut diterimapakai) [*Sekiranya terdapat perubahan & perlu dikemaskini]				/*	/*	/*

SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

Lesen Kelas A adalah mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam 3 bahagian iaitu (i) Bahagian Penempatan Tapak, (ii) Bahagian Pembinaan, (iii) Bahagian Pengendalian (Peringkat Pengendalian Sementara) dan (iv) Bahagian Pengendalian (Peringkat Pengendalian Penuh).

Bil.	Perkara/Maklumat	Peringkat Lesen					
		Penempatan tapak	Pembinaan	Pra Kendalian	Kendalian Penuh		
					Baru	Pinda	Membaharui
3.	Rujuk AELB samada Program Perlindungan Sinaran perlu diubahsuai atau tidak.				/	/	/
E.	**Status Tindakan Perundangan:**						
1.	Sedang dalam siasatan.			/	/	/	/
2.	Tindakan perundangan.			/	/	/	/
F.	**Maklumat Peringkat Penempatan Tapak:**						
1.	Perihal pepasangan dan aktiviti yang dicadangkan.	/					
2.	Ciri fizikal tapak: geology, kajihidro, kajicuaca, kaji gempa, tumbuh-tumbuhan, haiwan dan biota akuatik (RIA)	/					
3.	Taburan penduduk di sekitar tapak, termasuk aliran masa depan pertumbuhan penduduk dan jarak pusat-pusat penduduk dari tapak.(RIA)	/					
4.	Penggunaan tanah pada masa sekarang di tapak dan di sekitar tapak. (RIA)	/					
5.	Penilaian kesan kepada alam sekitar dan radiologi daripada pengendalian normal termasuk analisis awal bahaya sinaran yang dijangka. (RIA)	/					
6.	Program permonitoran radiologi dan alam sekitar (baseline data) [laporan permonitoran radiologi dan alam sekitar bagi 12 bulan berturut-turut untuk 1 tahun kalender]	/					
7.	Perihal kemudahan penstoran bagi bahan radioaktif di tapak.	/					
8.	Penyataan mengenai kawalan banjir dan kaedah mengawal arus air di jalan-jalan air yang sedia ada (jika ada)	/					
9.	Pelan/Rancangan Pengurusan Sisa Radioaktif [*Sekiranya terdapat perubahan & perlu dikemaskini]	/		/*	/*	/*	/*
10.	Pelan Sekuriti [*Sekiranya terdapat perubahan & perlu dikemaskini]	/		/*	/*	/*	/*
G.	**Maklumat Rancangan Pembubaran:**						
1.	Perihal Pelan/Rancangan Pembubaran asasnya dan Pelan/Rancangan Pembubaran bagi pengawasan selepas pengendalian	/					
H.	**Maklumat Peringkat Pembinaan:**						
1.	Susunatur am dan pelan rekabentuk terperinci kemudahan itu, termasuk		/				

SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

Lesen Kelas A adalah mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam 3 bahagian iaitu (i) Bahagian Penempatan Tapak, (ii) Bahagian Pembinaan, (iii) Bahagian Pengendalian (Peringkat Pengendalian Sementara) dan (iv) Bahagian Pengendalian (Peringkat Pengendalian Penuh).

Bil.	Perkara/Maklumat	Peringkat Lesen					
		Penempatan tapak	Pembinaan	Pra Kendalian	Kendalian Penuh		
					Baru	Pinda	Membaharui
	rekabentuk keselamatannya yang dirancangkan. [Pelan rekabentuk hendaklah disahkan oleh jurutera professional (P.E) yang berdaftar]						
2.	Perihal bahaya sinaran dan kimia yang dijangka kepada pekerja dan orang awam semasa pengendalian normal pepasangan yang dicadangkan, dengan mengambil kira ciri-ciri kimia dan fizikal dan kandungan radioaktif yang telah diduga bagi semua effluent yang akan dilepaskan dan segala pancaran dari kemudahan itu.		/				
3.	Penyataan mengenai kemalangan yang mungkin berlaku dan hendaklah mengandungi :- a) Penyataan kemalangan yang boleh menyebabkan kemalangan dan menyebabkan perlepasan sisa dan bahan berbahaya yang tidak dirancangkan; b) Penyataan mengenai kesan kemungkinan kemalangan dan perlepasan kepada kesihatan dan keselamatan pekerja, orang awam dan alam sekitar; c) Penyataan mengenai program bagi pemeriksaan dan penyelenggaraan yang dicadangkan untuk mencegah daripada berlakunya kemalangan dan perlepasan dan d) Penyataan mengenai program bersiap sedia dan rancangan kecemasan serta langkah-langkah mitigasi untuk mengatasi kemalangan dan perlepasan.		/				
4.	Sistem mengawal habuk yang dicadangkan.		/				
5.	Perihal langkah-langkah yang dicadangkan untuk mengawal saliran tapak kilang.		/				
6.	Maklumat mengenai gred dan kuantiti bahan yang akan diproses dan jika bahan itu akan diimport kuantiti bulanan atau tahunan purata yang akan diimport.		/				
7.	Pelan kejuruteraan terperinci mengenai lencongan air dan rancangan pengawasan terperinci serta langkah-langkah luar jangka		/				

SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

Lesen Kelas A adalah mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam 3 bahagian iaitu (i) Bahagian Penempatan Tapak, (ii) Bahagian Pembinaan, (iii) Bahagian Pengendalian (Peringkat Pengendalian Sementara) dan (iv) Bahagian Pengendalian (Peringkat Pengendalian Penuh).

Bil.	Perkara/Maklumat	Peringkat Lesen					
		Penempatan tapak	Pembinaan	Pra Kendalian	Kendalian Penuh		
					Baru	Pinda	Membaharui
	bagi peringkat pembinaan kemudahan itu.						
8.	Lembaran aliran terperinci, termasuk penghitungan input (cth. Sisa radioaktif) dan output bahan (cth. *fly ash)* dan imbangan air serta perihal sistem sam, termasuk keupayaannya.		/				
9.	Semua binaan dan kelengkapan yang direkabentuk untuk mengawal mutu dan kuantiti semua efluen yang akan dilepaskan dan segala pancaran dari kemudahan.		/				
10.	Program permonitoran radiologi dan alam sekitar (baseline data)		/				
I.	**Maklumat Peringkat Pengendalian Sementara:**						
1.	Apa-apa pertukaran, pada bahan yang digunakan atau pada rekabentuk, yang dibuat semasa pepasangan itu dibina.			/			
2.	Perihal langkah-langkah yang dicadangkan untuk mengawal dedahan sinaran, termasuk program pengawasan sinaran semasa pengendalian yang direkabentuk bagi pekerja, orang awam dan alam sekitar, bersama senarai lengkap perkhidmatan dan kemudahan sokongan. (RPP)			/			
3.	Program pengawasan perubatan yang terperinci (RPP).			/			
4.	Program bagi latihan awal dan berkala untuk pekerja mengenai keselamatan am dan perlindungan sinaran (RPP)			/			
5.	Kemudahan dan kelengkapan yang direkabentuk untuk membendung pertumpahan dan prosedur yang diikuti dalam mengendalikan pertumpahan bahan radioaktif. (RPP)			/			
6.	Rancangan dan prosedur yang dicadangkan untuk mencegah kehilangan, kecurian atau penggunaan tanpa kebenaran bahan radioaktif. (RPP)			/			
7.	Rancangan bagi pengawasan semasa pengendalian terhadap mutu dan kuantiti efluen yang akan dilepaskan dan segala pancaran dari kemudahan termasuk (Program permonitoran radiologi dan alam sekitar) :			/			

SENARAI SEMAK PERMOHONAN LESEN KELAS A (MENGILANG)

Lesen Kelas A adalah mengenai pengilangan bahan-bahan yang mengandungi atau yang berkaitan dengan bahan radioaktif atau mengenai sesuatu kemudahan radioaktif hendaklah dalam 3 bahagian iaitu (i) Bahagian Penempatan Tapak, (ii) Bahagian Pembinaan, (iii) Bahagian Pengendalian (Peringkat Pengendalian Sementara) dan (iv) Bahagian Pengendalian (Peringkat Pengendalian Penuh).

Bil.	Perkara/Maklumat	Peringkat Lesen					
		Penempatan tapak	Pembinaan	Pra Kendalian	Kendalian Penuh		
					Baru	Pinda	Membaharui
	a) Kekerapan dan tempat pengambilan sampel b) Jenis kelengkapan dan kaedah analisa yang akan digunakan c) Rancangan luar jangka sekiranya terdapat keputusan abnormal (RPP)						
8.	Perihal prosedur yang dicadangkan untuk mencegah kemalangan dan rancangan luar jangka yang dicadangkan sekiranya berlaku kemalangan (RPP)			/			
9.	Keupayaan harian dan tahunan bagi kilang (*capasity*), pemerolehan kembali (*recovery*), kandungan bahan bekal kilang (*composition of mill feed, concentrate and tailings)*			/			
10.	Prosedur mengendali dan menstor bahan radioaktif (RPP)			/			
11.	Rancangan dan program penstabilan sisa (*stabilization of tailings*) dan pemulihan kawasan sisa (*rehabilization of tailings area)*			/			
12.	Program permonitoran radiologi dan alam sekitar (baseline data)			/			
J.	**Maklumat Peringkat Kendalian Penuh:**						
1.	Laporan Analisa Keselamatan (SAR) hendaklah mengandungi: a) Semua maklumat sah (*valid*) yang dikemukakan pada peringkat kendalian sementara (I1-I12) b) Semua maklumat baru dan semua pertukaran kepada pelan rekabentuk dan pengendalian yang dibuat berikutan dengan pengendalian sebenar di peringkat kendalian sementara jika ada.				/	/	
2.	Program permonitoran radiologi dan alam sekitar.				/		/
K.	**Lain-lain maklumat (jika berkenaan):**						
1.	Laporan keputusan Analisis Permonitoran Radiologi dan Alam Sekitar * Pra-kendalian bagi 12 bulan berturut-turut	/*	/*	/*	/*		/*
2.	Jadual pelaksanaan projek oleh syarikat	/	/	/			