

**ATOMIC ENERGY LICENSING (RADIOACTIVE WASTE MANAGEMENT)
REGULATIONS 2011**

PU(A) 274/2011

16 August 2011

Jil 55; No 16; 16 August 2011; Tambahan No 109; Perundangan (A)

IN exercise of the powers conferred by paragraph 68(2)(a) of the **Atomic Energy Licensing Act 1984[Act 304]**, the Minister makes the following regulations:-

PART I

PRELIMINARY

1. Citation and commencement

(1) These regulations may be cited as the **Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011**.

(2) These Regulations come into operation on 16 August 2011.

2. Application

These Regulations shall apply to all aspects of radioactive waste and waste management arising from medical, industrial and research applications and any other application which may be specified by the Board.

3. Interpretation

In these Regulations, unless the context otherwise requires:-

"clearance level" means the values established by the Board and expressed in terms of activity concentration or total activity, at or below which the source of radiation may be released from the control of the Board as specified in Second Schedule;

"container" means the place into which the radioactive waste is kept for handling, transport, storage or disposal and is a component of the waste package;

"discharge" means the direct release of effluents into the environment with subsequent dispersion;

"waste package" means the product of conditioning that includes the waste form, any containers and internal barriers such as absorbing materials and liners;

"waste inventory" means detailed records maintained by the licensee in accordance with the Fourth Schedule;

"quality assurance" means all those planned and systematic actions necessary to provide adequate confidence that a material, product, facility, structure, system, component, process or service will satisfy given requirements for quality;

"Radioactive Waste Management Officer" means a person appointed under regulation 6;

"disposal" means the emplacement of radioactive waste or the direct discharge of effluents;

"processing" means any operation that changes the characteristics of the radioactive waste, including pretreatment, treatment and conditioning;

"characterisation" means the determination of the physical, chemical and radiological properties of the waste to establish the need for further adjustment, treatment, conditioning, or its suitability for further handling, processing, storage or disposal;

"segregation" means an activity where radioactive waste are separated or are kept separate according to radiological, chemical or physical properties which will facilitate radioactive waste handling or processing;

"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;

"storage" means the placement of radioactive waste in the facility approved by the Board where isolation, environmental protection and human control are provided with the intention of retrieval of the radioactive waste;

"conditioning" means any operations that produce a waste package suitable for handling, transportation, storage or disposal;

"treatment" means a process and method of changing the characteristics of the radioactive waste through volume reduction, removal of radionuclides from the radioactive waste or change of composition with the intention to benefit safety and economy;

"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.

PART II

LICENSE TO DISPOSE

4. License to dispose

No person shall, dispose of or cause to be disposed radioactive waste unless he is the holder of a valid license issued by the Board in accordance with the **Radiation Protection (Licensing) Regulations 1986**[P.U. (A) 149/1986].

PART III

RESPONSIBILITIES OF LICENSEE

5. Responsibilities of licensee

The licensee shall be responsible for the safe management of radioactive waste and shall take all necessary steps to:-

- (a) ensure that radioactive waste is disposed within one year of its production;
- (b) ensure adequate protection of the workers, public and environment;
- (c) ensure that suitable staff, equipment, facilities, training and operating procedures are available to perform the safe radioactive waste management steps;
- (d) implement safety and environmental impact assessments;
- (e) establish and implement a quality assurance programme for the radioactive waste generated or its processing, storage and disposal;
- (f) establish and keep records of appropriate information regarding the generation, processing, storage and disposal of radioactive waste including the inventory of the radioactive waste;
- (g) provide surveillance and control as required by the Board;
- (h) collect, analyse and as appropriate, share operational experience to ensure continued safety; and
- (i) comply with any directive issued by the Board from time to time.

PART IV

RADIOACTIVE WASTE MANAGEMENT OFFICER

6. Appointment of Radioactive Waste Management Officer

(1) The licensee shall appoint:-

(a) a Radiation Protection Officer appointed under the **Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010**[*P.U. (A) 46/2010*]; or

(b) other technically qualified and competent person as approved by the Board,

as a Radioactive Waste Management Officer.

(2) The Radioactive Waste Management Officer appointed under subregulation (1) shall be recognised by the Board.

7. Responsibilities of Radioactive Waste Management Officer

The Radioactive Waste Management Officer shall be responsible for:-

- (a) ensuring that all stages of radioactive waste management are carried out in accordance with written safety procedures;
- (b) establishing and maintaining a detailed record keeping system for all stages of radioactive waste management including the inventory of stored radioactive waste;
- (c) obtaining the prior authorisation in writing from the Board for the transport of radioactive waste from the licensee's premise;
- (d) ensuring appropriate shielding, labelling, physical security and integrity of radioactive waste packages;
- (e) ensuring that discharge of effluents is carried out in accordance with the clearance levels or such authorised limits as contained in the licence issued by the Board;
- (f) ensuring that release or disposal of solid radioactive waste is made in accordance with the clearance levels or such authorised limits as are contained in the licence issued by the Board;
- (g) reporting on accidents and inappropriate radioactive waste management practices to the licensee;
- (h) ensuring an up-to-date knowledge of characteristics of discharge and disposal options; and
- (i) complying with any directive issued by the Board from time to time.

PART V

CONTROL OF RADIOACTIVE WASTE GENERATION

8. Control of radioactive waste generation

- (1) The licensee shall ensure that the generation of radioactive waste and its impact to the environment is as minimum as possible.
- (2) The licensee shall ensure that no used sealed source is dismantled.

PART VI

REUSE AND RECYCLE OF RADIOACTIVE MATERIAL

9. Reuse and recycle

The licensee shall, before declaring radioactive material including a sealed source as radioactive waste, consider whether he or any other person can make use of or recycle the radioactive material.

10. Transfer of radioactive material

- (1) In the event the licensee decides to transfer the radioactive material to any other person, the licensee shall obtain an approval from the Board prior to the transfer.

(2) The licensee shall ensure that the person to whom the radioactive material is to be transferred has a valid licence.

(3) If the licensee is unable to transfer the radioactive material to a person as identified under subregulation (1), he shall declare the radioactive material as radioactive waste or retain it as radioactive material.

(4) The licensee shall, after the declaration under subregulation (3), obtain an approval from the Board prior to sending the radioactive waste to a radioactive waste management facility which is approved by the Board.

PART VII

MANAGEMENT OF USED SEALED SOURCE

11. Return of used sealed source

Any person who proposes to obtain a sealed source containing radioactive material which has an activity greater than 100 Megabecquerel shall:-

(a) require the supplier to include a condition in the contract for purchase or in the document for acceptance of the sealed source as a gift, to receive the sealed source back within three months from the date of request for return made by the purchaser or receiver;

(b) submit a copy of relevant parts of the contract or acceptance document to the Board and obtain its written approval before entering into a contract or accepting the sealed source; and

(c) return the used sealed source within the period specified in paragraph (a).

12. Transfer to radioactive waste management facility

(1) If a licensee is unable to return the used sealed source to its supplier, the licensee shall obtain a written approval from the Board prior to sending the used sealed source to the radioactive waste management facility.

(2) The radioactive waste management facility under subregulation (1) shall be approved by the Board.

PART VIII

DISCHARGE AND DISPOSAL OF RADIOACTIVE WASTE

13. Discharge limit

(1) The licensee shall ensure that:-

(a) the discharge is not more than 1 cubic metre of radioactive waste in accordance with the clearance level as provided in the Second Schedule or such larger volumes as may be authorised in the licence, is released to the environment; and

(b) the total ratio of the discharge of mixed radionuclides must not be more than 1 in accordance to the calculation as in the Third Schedule.

(2) The licensee shall obtain an approval from the Board before releasing, discharging or disposing more than 1 cubic metre of radioactive waste to the environment.

(3) The Board may require the licensee to submit details of the proposed release, discharge or disposed under subregulation (2) before granting the approval.

(4) The licensee in releasing, discharging or disposing radioactive waste under subregulation (2) shall comply with the clearance levels in each calendar year.

14. Discharge and monitoring of radioactive waste

The licensee shall:-

(a) ensure all radioactive waste discharges are as low as reasonably achievable below the authorised limits; and

(b) monitor and record the discharges of radioactive waste with sufficient detail and accuracy to demonstrate compliance with the authorised limits and to provide estimation of the public exposure.

15. Nonradiological properties of radioactive waste

If radioactivity in the form of radioactive material or radioactive waste is to be released, discharged or disposed off to the environment, the licensee shall consider the nonradiological properties of the material and shall comply with all other laws concerning those properties.

16. Radioactive waste not suitable for release, discharge or disposal

If radioactive waste is not suitable to be released, discharged or disposed to the environment within one year of its creation or any greater time as the Board may approve, the licensee shall:-

(a) submit a proposal and obtain approval from the Board for disposal of the radioactive waste; and

(b) comply with any requirements made by the Board with regards to further treatment and disposal of the radioactive waste.

PART IX

MANAGEMENT OF RADIOACTIVE WASTE

17. Segregation of radioactive waste

(1) The licensee shall classify the radioactive waste as prescribed in the First Schedule and segregate the radioactive waste by using the basis under subregulation (2) and in accordance with such other requirements as required by the Board.

(2) Radioactive waste shall be classified based on their radiological, physical, chemical and biological properties.

18. Radioactive waste container

(1) Each radioactive waste after the segregation under subregulation 17(1), shall be kept separately in different container.

(2) Each of the container shall:-

(a) be clearly and uniquely marked with the details such as activity, types of radionuclides, half-life, physical and chemical form and nonradiological hazard;

(b) bear a radiation symbol;

(c) be robust;

(d) be compatible with the radioactive waste; and

(e) be able to be filled and emptied safely throughout the expected period in storage including the provision of adequate shielding as appropriate.

19. Record of radioactive waste container

The licensee shall keep and maintain a record for each radioactive waste container containing the following particulars:-

(a) its unique identification number and class of radioactive waste;

(b) types of radionuclides, where practicable based on an individual basis but otherwise in groups or in total;

(c) the activity of each radionuclide or group of radionuclides, the means of measurement or estimation and the date of measurement or estimation;

(d) the origin of radioactive waste such as from facility, laboratory, room and person;

(e) other actual or potential hazards including chemical, pathogenic and infectious in nature;

(f) the dose rate at 1 metre and date of measurement;

(g) result of surface contamination measurements;

(h) the quantity of radioactive waste in terms of number of units, mass and volume; and

(i) the name of the Radioactive Waste Management Officer who make the characterisation of the contents of the radioactive waste container and prepare the record.

20. Improvement of radioactive waste characteristic

The licensee shall ensure that the treatment and conditioning of radioactive waste is undertaken if necessary to improve the characteristics of radioactive waste prior to storage and to meet the requirements of the Board for storage and disposal.

21. Location of radioactive waste storage

The licensee shall ensure that radioactive waste is stored in such a way as to protect human health and the environment and in particular shall not be stored in the vicinity of corrosive, explosive or easily flammable materials and also in areas that is prone to natural disasters.

22. Storage facility

The licensee shall provide a dedicated facility or other facilities for the storage of radioactive waste which shall:-

- (a) be clearly marked;
- (b) bear a radiation symbol;
- (c) have controlled access; and
- (d) enable separation of untreated and treated radioactive waste.

23. Safe storage of radioactive waste

The licensee shall ensure that:-

- (a) the materials and construction of radioactive waste storage container shall guarantee the integrity of the radioactive waste package is maintained throughout its expected period of storage;
- (b) the types of radioactive waste such as glass or sharp items are stored in outer container with puncture proof inner linings;
- (c) where radioactive waste may corrode or disintegrate within the container or where storage is likely to be prolonged, a suitable lining is used in order to maintain the integrity of the contents throughout its expected period of storage;
- (d) the used sealed sources are stored in their immediate shielding within containers to reduce exposure and assist future handling; and
- (e) the internal and external surfaces of all containers are checked for contamination each time before the containers are used or reused.

PART X

TRANSPORT OF RADIOACTIVE WASTE

24. Transport of radioactive waste

The licensee shall ensure that any transport of radioactive waste from his premise is in accordance with the written law on transport of radioactive waste.

PART XI

QUALITY ASSURANCE

25. Quality assurance programme

- (1) Any person applying for a licence relating to the management of radioactive waste shall submit a written quality assurance programme which is commensurate with the scale of intended operations to the Board for approval.
- (2) The licensee shall demonstrate his intended means of compliance in accordance with all the requirements including the implementation of the submitted quality assurance programme concerning radioactive waste imposed on a licensee by these Regulations.
- (3) The licensee shall, upon request by the Board submit a report on the effectiveness of the quality assurance programme in respect of radioactive waste management activities to show that the licensee continues to meet all the requirements of these Regulations.

PART XII

PHYSICAL PROTECTION AND SECURITY

26. Security and protection of radioactive waste

The licensee shall take all measures to ensure the security and protection of all radioactive wastes in his possession or under his control to:-

- (a) prevent unauthorised persons gaining access to the radioactive waste storage area; and
- (b) protect the radioactive waste from theft, loss and sabotage.

27. Notification and report of theft, loss or sabotage

(1) The licensee shall, upon discovering any theft, loss or sabotage of any radioactive waste in his possession or under his control:-

- (a) notify the Board of such theft, loss or sabotage immediately after discovering the theft, loss or sabotage;
- (b) take actions to recover the radioactive waste and secure the facility if required; and
- (c) submit a complete report of the theft, loss or sabotage in writing to the Board within thirty days after the notification to the Board.

(2) The report to be submitted by the licensee under paragraph (1)(c) shall contain:-

- (a) where appropriate, a description of the radioactive waste, including its kind, quantity and its chemical and physical forms;
- (b) a description of the circumstances under which the theft, loss or sabotage occurred;
- (c) a statement of the location or possible location of the radioactive waste;

- (d) the possible radiation exposure to individuals, circumstances under which the exposures may occur, and the extent of potential hazard to members of the public;
- (e) the actions which have been taken, or will be taken, to recover the radioactive waste;
- (f) the procedures or measures which have been or will be adopted to prevent a recurrence of the theft, loss or sabotage of the radioactive waste; and
- (g) any other information as deemed necessary by the licensee or the Board.

PART XIII

RECORDS AND REPORTS

28. Submission of radioactive waste inventory form

The licensee shall submit:-

- (a) the radioactive waste inventory form not later than 1 March of the following year; and
- (b) the up-to-date inventory radioactive waste form relating to radioactive waste in his possession not less than thirty days and not more than sixty days before the licence expires,

to the Board as prescribed in the Fourth Schedule.

29. Submission of radioactive waste release, discharge or disposal records

The licensee shall submit to the Board a record of release, discharge or disposal of cleared radioactive waste as prescribed in the Fifth Schedule not later than 1 March of the following year.

30. Report on unauthorised release, discharge or disposal

If the licensee has reasonable grounds to believe that:-

- (a) more than 1 cubic metre of radioactive waste over the clearance levels have been released;
- (b) such volumes of radioactive waste larger than the authorised limits in a licence have been released;
or
- (c) radioactive waste that has been discharged or disposed to the environment is over the authorised limits,

the licensee shall notify the Board within twenty-four hours upon discovery of that incident and submit a written report on the matter and the actions taken to the Board within thirty days after the notification to the Board.

PART XIV

EMERGENCY PLANS AND PROCEDURES

31. Emergency response

The licensee shall respond to all emergencies involving radioactive waste as provided by the **Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010**[P.U. (A) 46/2010].

PART XV

CESSATION OF OPERATIONS, DECOMMISSIONING OR ABANDONMENT OF LICENSED FACILITIES

32. Cessation of operations, decommissioning or abandonment of licensed facilities

The licensee shall not cease to operate, decommission, or abandon his licensed facility that involves licensed waste management system or radioactive waste management facility except as provided by the **Atomic Energy Licensing (Basic Safety Radiation Protection) Regulations 2010**[P.U. (A) 46/2010].

FIRST SCHEDULE

RADIOACTIVE WASTE CLASSIFICATION

(Subregulation 17(1) and Fourth Schedule)

Class	Description
Cleared Waste	Materials containing levels of radionuclides at activity concentrations less than those specified in the Second Schedule.
Low Level (Short Lived)/Decay Waste	Low level radioactive waste containing short lived radionuclides only (half lives less than 100 days) that will decay to clearance levels within three years after the time of its generation.
Low and Intermediate Level Short Lived Waste (LILW-SL)	Radioactive waste which will not decay to clearance levels within three years containing beta/gamma emitting radionuclides with half-lives less than thirty years or alpha emitting radionuclides with an activity concentrations less than 400Bq/g and a total activity less than 4000 Bq in each radioactive waste package.
Low and Intermediate Level Long Lived Waste (LILW-LL)	Radioactive waste containing radionuclides with activity concentrations more than LILW-SL but which does not generate heat at above 2kW/m ³ .
High Level Waste (HLW)	Radioactive waste containing radionuclides with activity concentrations more than LILW-SL but which generates heat at above 2kW/m ³ .

SECOND SCHEDULE

RADIOACTIVE WASTE CLEARANCE LEVEL

(Regulation 3, paragraph 13(1)(a), First and Third Schedule)

Nuclide	Activity Concentration (Bq/g)	Activity (Bq)	Nuclide	Activity Concentration (Bq/g)	Activity (Bq)
H-3	1×10^6	1×10^9	Fe-52	1×10^1	1×10^6
Be-7	1×10^3	1×10^7	Fe-55	1×10^4	1×10^6
C-14	1×10^4	1×10^7	Fe-59	1×10^1	1×10^6
O-15	1×10^2	1×10^9	Co-55	1×10^1	1×10^6
F-18	1×10^1	1×10^6	Co-56	1×10^1	1×10^5

Na-22	1×10^1	1×10^6	Co-57	1×10^2	1×10^6
Na-24	1×10^1	1×10^5	Co-58	1×10^1	1×10^6
Si-31	1×10^3	1×10^6	Co-58 ^m	1×10^4	1×10^7
P-32	1×10^3	1×10^5	Co-60	1×10^1	1×10^5
P-33	1×10^5	1×10^8	Co-60 ^m	1×10^3	1×10^6
S-35	1×10^5	1×10^8	Co-61	1×10^2	1×10^6
Cl-36	1×10^4	1×10^6	Co-62 ^m	1×10^1	1×10^5
Cl-38	1×10^1	1×10^5	Ni-59	1×10^4	1×10^8
Ar-37	1×10^6	1×10^8	Ni-63	1×10^5	1×10^8
Ar-41	1×10^2	1×10^9	Ni-65	1×10^1	1×10^6
K-40	1×10^2	1×10^6	Cu-64	1×10^2	1×10^6
K-42	1×10^2	1×10^6	Zn-65	1×10^1	1×10^6
K-43	1×10^1	1×10^6	Zn-69	1×10^4	1×10^6
Ca-45	1×10^4	1×10^7	Zn-69 ^m	1×10^2	1×10^6
Ca-47	1×10^1	1×10^6	Ga-72	1×10^1	1×10^5
Sc-46	1×10^1	1×10^6	Ge-71	1×10^4	1×10^8
Sc-47	1×10^2	1×10^6	As-73	1×10^3	1×10^7
Sc-48	1×10^1	1×10^5	As-74	1×10^1	1×10^6
V-48	1×10^1	1×10^5	As-76	1×10^2	1×10^5
Cr-51	1×10^3	1×10^7	As-77	1×10^3	1×10^6
Mn-51	1×10^1	1×10^5	Se-75	1×10^2	1×10^6
Mn-52	1×10^1	1×10^5	Br-82	1×10^1	1×10^6
Mn-52 ^m	1×10^1	1×10^5	Kr-74	1×10^2	1×10^9
Mn-53	1×10^4	1×10^9	Kr-76	1×10^2	1×10^9
Mn-54	1×10^1	1×10^6	Kr-77	1×10^2	1×10^9
Mn-56	1×10^1	1×10^5	Kr-79	1×10^3	1×10^5
Kr-81	1×10^4	1×10^7	Tc-97	1×10^3	1×10^8
Kr-83 ^m	1×10^5	1×10^{12}	Tc-97 ^m	1×10^3	1×10^7

Kr-85 ^m	1×10^3	1×10^{10}	Tc-99 ^m	1×10^2	1×10^7
Kr-87	1×10^2	1×10^9	Ru-97	1×10^2	1×10^7
Kr-88	1×10^2	1×10^9	Ru-103	1×10^2	1×10^6
Rb-86	1×10^2	1×10^5	Ru-105	1×10^1	1×10^6
Sr-85	1×10^2	1×10^6	Ru-106 ^a	1×10^2	1×10^5
Sr-85 ^m	1×10^2	1×10^7	Rh-103 ^m	1×10^4	1×10^8
Sr-87 ^m	1×10^2	1×10^6	Rh-105	1×10^2	1×10^7
Sr-89	1×10^3	1×10^6	Pd-103	1×10^3	1×10^8
Sr-90 ^a	1×10^2	1×10^4	Pd-109	1×10^3	1×10^6
Sr-91	1×10^1	1×10^5	Ag-105	1×10^2	1×10^6
Sr-92	1×10^1	1×10^6	Ag-110 ^m	1×10^1	1×10^6
Y-90	1×10^3	1×10^5	Ag-111	1×10^3	1×10^6
Y-91	1×10^3	1×10^6	Cd-109	1×10^4	1×10^6
Y-91 ^m	1×10^2	1×10^6	Cd-115	1×10^2	1×10^6
Y-92	1×10^2	1×10^5	Cd-115 ^m	1×10^3	1×10^6
Y-93	1×10^2	1×10^5	In-111	1×10^2	1×10^6
Zr-93 ^a	1×10^3	1×10^7	In-113 ^m	1×10^2	1×10^6
Zr-95	1×10^1	1×10^6	In-114 ^m	1×10^2	1×10^6
Zr-97 ^a	1×10^1	1×10^5	In-115 ^m	1×10^2	1×10^6
Nb-93 ^m	1×10^4	1×10^7	Sn-113	1×10^3	1×10^7
Nb-94	1×10^1	1×10^6	Sn-125	1×10^2	1×10^5
Nb-95	1×10^1	1×10^6	Sb-122	1×10^2	1×10^4
Nb-97	1×10^1	1×10^6	Sb-124	1×10^1	1×10^6
Nb-98	1×10^1	1×10^5	Sb-125	1×10^2	1×10^6
Mo-90	1×10^1	1×10^6	Te-123 ^m	1×10^2	1×10^7
Mo-93	1×10^3	1×10^8	Te-125 ^m	1×10^3	1×10^7
Mo-99	1×10^2	1×10^6	Te-127	1×10^3	1×10^6
Mo-101	1×10^1	1×10^6	Te-127 ^m	1×10^3	1×10^7
Tc-96	1×10^1	1×10^6	Tc-129	1×10^2	1×10^6

Tc-96 ^m	1×10^3	1×10^7	Te-129 ^m	1×10^3	1×10^6
Te-131	1×10^2	1×10^5	Ce-143	1×10^2	1×10^6
Te-131 ^m	1×10^1	1×10^6	Ce-144 ^a	1×10^2	1×10^5
Te-132	1×10^2	1×10^7	Pr-142	1×10^2	1×10^5
Te-133	1×10^1	1×10^5	Pr-143	1×10^4	1×10^6
Te-133 ^m	1×10^1	1×10^5	Nd-147	1×10^2	1×10^6
Te-134	1×10^1	1×10^6	Nd-149	1×10^2	1×10^6
I-123	1×10^2	1×10^7	Pm-147	1×10^4	1×10^7
I-125	1×10^3	1×10^6	Pm-149	1×10^3	1×10^6
I-126	1×10^2	1×10^6	Sm-151	1×10^4	1×10^8
I-129	1×10^2	1×10^5	Sm-153	1×10^2	1×10^6
I-130	1×10^1	1×10^6	Eu-152	1×10^1	1×10^6
I-131	1×10^2	1×10^6	Eu-152 ^m	1×10^2	1×10^6
I-132	1×10^1	1×10^5	Eu-154	1×10^1	1×10^6
I-133	1×10^1	1×10^6	Eu-155	1×10^2	1×10^7
I-134	1×10^1	1×10^5	Gd-153	1×10^2	1×10^7
I-135	1×10^1	1×10^6	Gd-159	1×10^3	1×10^6
Xe-131 ^m	1×10^4	1×10^4	Tb-160	1×10^1	1×10^6
Xe-133	1×10^3	1×10^4	Dy-165	1×10^3	1×10^6
Xe-135	1×10^3	1×10^{10}	Dy-166	1×10^3	1×10^6
Cs-129	1×10^2	1×10^5	Ho-166	1×10^3	1×10^5
Cs-131	1×10^3	1×10^6	Er-169	1×10^4	1×10^7
Cs-132	1×10^1	1×10^5	Er-171	1×10^2	1×10^6
Cs-134 ^m	1×10^3	1×10^5	Tm-170	1×10^3	1×10^6
Cs-134	1×10^1	1×10^4	Tm-171	1×10^4	1×10^8
Cs-135	1×10^4	1×10^7	Yb-175	1×10^3	1×10^7
Cs-136	1×10^1	1×10^5	Lu-177	1×10^3	1×10^7
Cs-137 ^a	1×10^1	1×10^4	Hf-181	1×10^1	1×10^6
Cs-138	1×10^1	1×10^4	Ta-182	1×10^1	1×10^4

Ba-140 ^a	1×10^1	1×10^5	W-185	1×10^4	1×10^7
La-140	1×10^1	1×10^5	W-187	1×10^2	1×10^6
Ce-139	1×10^2	1×10^6	Re-186	1×10^3	1×10^6
Ce-141	1×10^2	1×10^7	Re-188	1×10^2	1×10^5
Os-185	1×10^1	1×10^6	Rn-222 ^a	1×10^1	1×10^8
Os-191	1×10^2	1×10^7	Ra-223 ^a	1×10^2	1×10^5
Os-191 ^m	1×10^3	1×10^7	Ra-224 ^a	1×10^1	1×10^5
Os-193	1×10^2	1×10^6	Ra-225	1×10^2	1×10^5
Ir-190	1×10^1	1×10^6	Ra-226 ^a	1×10^1	1×10^4
Ir-192	1×10^1	1×10^4	Ra-227	1×10^2	1×10^6
Ir-194	1×10^2	1×10^5	Ra-228 ^a	1×10^1	1×10^5
Pt-191	1×10^2	1×10^6	Ac-228	1×10^1	1×10^6
Pt-193 ^m	1×10^3	1×10^7	Th-226 ^a	1×10^3	1×10^7
Pt-197	1×10^3	1×10^6	Th-227	1×10^1	1×10^4
Pt-197 ^m	1×10^2	1×10^6	Th-228 ^a	1×10^0	1×10^4
Au-198	1×10^2	1×10^6	Th-229 ^a	1×10^0	1×10^3
Au-199	1×10^2	1×10^6	Th-230	1×10^0	1×10^4
Hg-197	1×10^2	1×10^7	Th-231	1×10^3	1×10^7
Hg-197 ^m	1×10^2	1×10^6	Th-nat	1×10^0	1×10^3
Hg-203	1×10^2	1×10^5	(incl. Th-232)		
Tl-200	1×10^1	1×10^6	Th-234 ^a	1×10^3	1×10^5
Tl-201	1×10^2	1×10^6	Pa-230	1×10^1	1×10^6
Tl-202	1×10^2	1×10^6	Pa-231	1×10^0	1×10^3
Tl-204	1×10^4	1×10^4	Pa-233	1×10^2	1×10^7
Pb-203	1×10^2	1×10^6	U-230 ^a	1×10^1	1×10^5
Pb-210 ^a	1×10^1	1×10^4	U-231	1×10^2	1×10^7
Pb-212 ^a	1×10^1	1×10^5	U-232 ^a	1×10^0	1×10^3
Bi-206	1×10^1	1×10^5	U-233	1×10^1	1×10^4
Bi-207	1×10^1	1×10^6	U-234	1×10^1	1×10^4
Bi-210	1×10^3	1×10^6	U-235 ^a	1×10^1	1×10^4
Bi-212 ^a	1×10^1	1×10^5	U-236	1×10^1	1×10^4

Po-205	1×10^1	1×10^6	U-238 ^a	1×10^1	1×10^4
Po-207	1×10^1	1×10^6	U-nat	1×10^0	1×10^3
Po-210	1×10^1	1×10^4	U-239	1×10^2	1×10^6
At-211	1×10^3	1×10^7	U-240	1×10^3	1×10^7
Rn-220 ^a	1×10^4	1×10^7	U-240 ^a	1×10^1	1×10^6
Np-237 ^a	1×10^0	1×10^3	Cm-244	1×10^1	1×10^4
Np-239	1×10^2	1×10^7	Cm-245	1×10^0	1×10^3
Np-240	1×10^1	1×10^6	Cm-246	1×10^0	1×10^3
Pu-234	1×10^2	1×10^7	Cm-247	1×10^0	1×10^4
Pu-235	1×10^2	1×10^7	Cm-248	1×10^0	1×10^3
Pu-236	1×10^1	1×10^4	Bk-249	1×10^3	1×10^6
Pu-237	1×10^3	1×10^7	Cf-246	1×10^3	1×10^6
Pu-238	1×10^0	1×10^4	Cf-248	1×10^1	1×10^4
Pu-239	1×10^0	1×10^4	Cf-249	1×10^0	1×10^3
Pu-240	1×10^0	1×10^3	Cf-250	1×10^1	1×10^4
Pu-241	1×10^2	1×10^5	Cf-251	1×10^0	1×10^3
Pu-242	1×10^0	1×10^4	Cf-252	1×10^1	1×10^4
Pu-243	1×10^3	1×10^7	Cf-253	1×10^2	1×10^5
Pu-244	1×10^0	1×10^4	Cf-254	1×10^0	1×10^3
Am-241	1×10^0	1×10^4	Es-253	1×10^2	1×10^5
Am-242	1×10^3	1×10^6	Es-254	1×10^1	1×10^4
Am-242 ^{ma}	1×10^0	1×10^4	Es-254 ^m	1×10^2	1×10^6
Am-243 ^a	1×10^0	1×10^3	Fm-254	1×10^4	1×10^7
Cm-242	1×10^2	1×10^5	Fm-255	1×10^3	1×10^6
Cm-243	1×10^0	1×10^4			

a Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Sr-90	Y-90
Zr-93	Nb-93 ^m

Zr-97	Nb-97
Ru-106	Rh-106
Cs-137	Ba-137 ^m
Ce-134	La-134
Ce-144	Pr-144
Ba-140	La-140
Bi-212	Tl-208 (0.36), Po-212 (0.64)
Pb-210	Bi-210, Po-210
Pb-212	Bi-212, Tl-208 (0.36), Po-212 (0.64)
Rn-220	Po-216
Rn-222	Po-218, Pb-214, Bi-214, Po-214
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-224	Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-226	Ra-222, Rn-218, Po-214
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-229	Ra-225, Ac-225, Fr-221, At-217, Bi-213, Po-213, Pb-209
Th-nat	Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
Th-234	Pa-234 ^m
U-230	Th-226, Ra-222, Rn-218, Po-214
U-232	Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208 (0.36), Po-212 (0.64)
U-235	Th-231
U-238	Th-234, Pa-234 ^m
U-nat	Th-234, Pa-234 ^m , U-234, Th-230, Ra-226, Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210

U-240	Np-240 ^m
Np-237	Pa-233
Am-242m	Am-242
Am-243	Np-239

THIRD SCHEDULE

CONCENTRATION CALCULATION FOR MIXTURE OF RADIONUCLIDE

(Paragraph 13(1)(b))

For radioactive waste containing a mixture of radionuclides the following calculation method shall be used:-

$$\sum_{i=1}^n \frac{C_i}{(\text{activity concentration})_i} \leq 1$$

Where,

C is the activity concentration (Bq/g) of the i^{th} radionuclide in the radioactive waste;

(activity concentration) is the value of activity concentration (Bq/g) for the radionuclide i as in Second Schedule; and

n is the number of radionuclides present in the radioactive waste

FOURTH SCHEDULE

ANNUAL RADIOACTIVE WASTE INVENTORY FORM

(Regulations 3 and 28)

Name of the company or agency :

Address of facility or agency :

Telephone/Fax number :

License number :

Class of the license :

Description of the waste :

Waste Form	Class of Waste based on First Schedule	Radioisotope	Half-Life	Chemical Form	Date and Initial Activity	Radiation Level at 1 Metre (mSv/hr)	Quantity of the Waste (kg or m3)	Location (Building and Room Number)	Maximum Activity (Bq) of each Radioisotope on 31 December

Prepared by Radioactive Waste Management Officer:

Verified by:

Signature:

Date:

Important: Completed form shall be submitted to the Board by 1 March each calendar year.

FIFTH SCHEDULE

RECORD OF CLEARED RADIOACTIVE WASTE DISCHARGE OR DISPOSAL FORM

(Regulation 29)

Name of the company or agency :

Address of facility or agency :

Telephone/Fax number :

License number :

Class of the license :

Description of the waste :

Waste Form	Radioisotope	Half-Life	Chemical Form (shall comply regulation 17)	Activity Concentration (Bq/g)	Quantity of the Waste (kg or m3)	Activity (Bq)	*Mode of Disposal	Date and Location

Prepared by Radioactive Waste Management Officer:

Verified by:

Signature:

Date:

*Discharge, dispose, release or return to supplier.

Important: Completed form shall be submitted to the Board by 1 March each calendar year.