



**FORMAT AND CONTENT OF RADIOACTIVE WASTE MANAGEMENT
PROGRAM FOR NUCLEAR INSTALLATIONS**

REGULATORY GUIDE

PAKISTAN NUCLEAR REGULATORY AUTHORITY

For Further Details

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FORMAT AND CONTENT OF RADIOACTIVE WASTE MANAGEMENT PROGRAM FOR NUCLEAR INSTALLATIONS

ABSTRACT

Radioactive waste generated from nuclear installations is required to be managed safely to protect the workers, public and the environment from harmful effects of ionizing radiation. Regulations 8(6) and 8(10) of PNRA Regulations for Licensing of Nuclear Installations in Pakistan - (PAK/909) (Rev.1) require the licensee to prepare and submit Radioactive Waste Management Program (RWMP) to the Authority for approval. Moreover, under the provisions of PNRA Regulations on Radioactive Waste Management - (PAK/915), the licensee is required to manage its radioactive waste in accordance with the approved RWMP. This regulatory guide provides guidance to the licensee on standard format and content of RWMP for nuclear installations.

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	OBJECTIVE	1
3.	SCOPE	1
4.	FORMAT AND CONTENT OF RWMP	1
4.1	General Instructions for Preparation of RWMP	1
4.2	Contents of RWMP	2
4.2.1	Introduction	2
4.2.2	Objective	2
4.2.3	Scope	2
4.2.4	Description of the Facility	2
4.2.5	Organization Structure	2
4.2.6	Description of Processes Generating Radioactive Waste	2
4.2.7	Acceptance Criteria	3
4.2.8	Minimization of Radioactive Waste Generation	3
4.2.9	Classification and Characterization of Radioactive Waste	4
4.2.10	Interdependences between Waste Management Steps	4
4.2.11	Radioactive Waste Processing and its Justification	4
4.2.12	Storage of Radioactive Waste	5
4.2.13	Radiation Doses from Radioactive Discharges	6
4.2.14	Monitoring and Surveillance of Waste Packages and Facility	6
4.2.15	Transfer and Transport of Radioactive Waste	6
4.2.16	Compliance with Acceptance Criteria for Radioactive Waste Storage or Disposal	7
4.2.17	Disposal of Radioactive Waste	7
4.2.18	Management of Disused Sealed Radioactive Sources (DSRS)	7
4.2.19	Trainings	7
4.2.20	Periodic Review of RWMP	7
4.2.21	Record and Reports	8
4.2.22	Program Implementing Procedures	8
4.2.23	Definition and Abbreviations	8
4.2.24	References, Codes, Standards, Tables and Annexes	8
5.	REFERENCES	9
6.	GLOSSARY	10
	ANNEXURE I	11
	ANNEXURE II	15

1. INTRODUCTION

Radioactive waste is generated during the operation and decommissioning of Nuclear Installations (NIs). This radioactive waste may be a potential hazard to human health and the environment as it emits ionizing radiation. It is, therefore, necessary to manage the radioactive waste safely. Regulations 8(6) and 8(10) of PNRA Regulations for Licensing of Nuclear Installations in Pakistan - (PAK/909) (Rev.1) require the licensee of NIs to prepare and submit its Radioactive Waste Management Program (RWMP) for approval of the Authority at the time of application for obtaining permission to introduce nuclear material in the installation; and for obtaining license for decommissioning/closure of the installation respectively. In addition, PNRA Regulations on Radioactive Waste Management - (PAK/915) also require the licensee to manage its radioactive waste in accordance with the approved RWMP. This Regulatory Guide (RG) provides guidance to the licensees on format and content for preparation of RWMP.

2. OBJECTIVE

The objective of this RG is to provide guidance to the licensees of NIs on the content and other details needed for preparation of RWMP to be submitted to PNRA under the regulations PAK/909 and PAK/915.

3. SCOPE

This RG is applicable to NIs for the preparation of RWMP in accordance with the prescribed format and content.

4. FORMAT AND CONTENT OF RWMP

Development of RWMP by the licensee is regulatory requirement, therefore, it is necessary to provide guidance to the licensee on the contents and other relevant information to enable them in preparing RWMP. This section gives the required information which an RWMP should contain. The licensee should develop its RWMP, by adopting and implementing applicable guidance provided in this RG, commensurate with the level of radiation risk associated with its facility i.e. by applying graded approach.

4.1 General Instructions for Preparation of RWMP

The licensee should follow the following instructions for preparation of RWMP:

- i. Provide clear, concise, factual and latest/updated information;
- ii. A table of contents including figures, tables, annexes, etc. along with page numbers should be included;
- iii. Definitions and abbreviations should be consistent throughout the document;

- iv. Duplication of information should be avoided. In case where necessary, reference of relevant section should be made; and
- v. Legible drawings, diagrams, layouts, maps, and tables should be added, wherever necessary, with proper reference.

4.2 Contents of RWMP

Following should be the general contents of RWMP:

4.2.1 *Introduction*

In this section, the licensee should briefly introduce the RWMP.

4.2.2 *Objective*

In this section of the program, the licensee should describe objectives to be achieved through preparation and implementation of the RWMP.

4.2.3 *Scope*

This section should describe the scope of RWMP.

4.2.4 *Description of the Facility*

This section should describe general introduction of the facility i.e. name, location and all types of radioactive waste generated and managed at the facility.

4.2.5 *Organization Structure*

This section should describe organizational structure of the licensee along with the role and responsibilities of all individuals involved in radioactive waste management. The information regarding interfaces (if any) between different divisions/groups involved in radioactive waste management should also be addressed.

4.2.6 *Description of Processes Generating Radioactive Waste*

This section should describe the generation processes of radioactive waste during different phases of NIs such as normal operation, maintenance of components and equipments, refueling outages, Anticipated Operational Occurrence (AOO) and decommissioning where applicable. Moreover, information on the establishment of methodology for estimation of waste generated from outages should be included in this section.

4.2.7 Acceptance Criteria

This section should describe the acceptance criteria, limits (regulatory and operational), conditions and precautionary measures taken for the management of radioactive waste along with the mechanism of compliance to meet these regulatory requirements. It should also contain criteria for meeting the clearance levels and discharge limits based on dose constraint to maintain doses as low as reasonably achievable. Moreover, this section should also include the information about implementation of established waste acceptance criteria.

4.2.8 Minimization of Radioactive Waste Generation

This section should describe the detail of measures to be taken for minimizing generation of the radioactive waste. It should include the information that supports waste minimization; segregation mechanism including clearance of materials at points of waste generation; the proper planning of activities and the use of adequate equipment for handling waste to control the secondary waste. This section should include the following sub sections:

4.2.8.1 Minimization of Solid Radioactive Waste

This section should describe the methods to control and minimize the generation of solid radioactive waste.

4.2.8.2 Minimization of Liquid Radioactive Waste

This section should describe the methods to control and minimize the generation of liquid radioactive waste.

4.2.8.3 Minimization of Gaseous Radioactive Waste

This section should describe the methods to control and minimize the generation of gaseous radioactive waste.

4.2.8.4 Clearance of Radioactive Waste

This section should describe the practices or methodologies being followed at the facility regarding clearance of radioactive waste from regulatory control.

4.2.8.5 Reuse and Recycle of Radioactive Material

This section should describe options adopted for reuse and recycle of radioactive material to the extent possible.

4.2.9 Classification and Characterization of Radioactive Waste

This section should describe mechanism adopted by the facility regarding the radioactive waste classification and characterization. It should include the information covering the basis for radioactive waste classification scheme, characteristics, limits, requirements, facility conditions and any other parameters considered for classification.

Moreover, the description should include radioactive waste characterization in terms of its physical, mechanical, chemical, radiological and biological properties; liquid radioactive waste characterization for processing purposes in accordance with its activity concentration and its content of chemical substances, etc.

4.2.10 Interdependences between Waste Management Steps

This section should describe the interdependences between waste management steps. It should cover all activities from the generation of radioactive waste up to its disposal, including its processing. Moreover, it should also provide the detail of each step selected and its compatibility with those of the other steps.

4.2.11 Radioactive Waste Processing and its Justification

This section should provide information regarding the processing of radioactive waste specific to the facility and justification for the adoption of particular methods. It should include the following sub-sections:

4.2.11.1 Collection and Segregation

This section should describe the mechanism being followed at the facility for collection and segregation of radioactive waste. The information should cover measures considered for collection of each type of radioactive waste; hold up tanks, reserve capacity including unplanned events; detail of radiation monitoring system and provisions for sampling.

Moreover, this section should also describe the provisions for segregation of radioactive waste by type like amount, form, volume, isotopic composition and activity concentration, etc.

4.2.11.2 Treatment of Radioactive Waste

This section should include the following sub-sections:

4.2.11.2.1 Treatment of Gaseous Radioactive Waste

This section should include description regarding the treatment of gaseous radioactive waste. The information should cover; basis of gaseous waste treatment process, capacity of the waste system including volume of radioactive gas to be treated; activity, radionuclide contained, concentrations of radionuclides, chemical composition; decay mechanism, activity concentration before discharge, process and effluent radiation monitoring system, filters used for capturing radioactive particulates and aerosols in gaseous effluents.

4.2.11.2.2 Treatment of Liquid Radioactive Waste

This section should include details of liquid radioactive waste treatment. The particulars should address basis of liquid waste treatment process, the methods of liquid radioactive waste treatment including expected annual quantities of radioactive waste (by radionuclide) produced, activity concentrations before discharges and chemical composition, etc.

4.2.11.2.3 Treatment of Solid Radioactive Waste

This section should provide detail of solid radioactive waste treatment. The information should cover expected annual quantities of solid radioactive waste generated and treated, processes selected for treatment of solid radioactive waste, basis of the treatment process, characteristics of the waste and process control mechanism.

4.2.11.3 Conditioning

This section should describe the arrangements made for the conditioning of radioactive waste at the facility. The information should include conditioning methods with its justification used by the facility, details of liquid waste or dispersible waste immobilization, the enclosure of the waste form in a container and the provision of an overpack, detail of waste packages produced by conditioning and compliance with the respective waste acceptance criteria, compatibility of the radioactive waste and container. Furthermore, information of conditioned waste container integrity during the predisposal storage period and capability of retrieval at the end of the storage period, enclosure in an overpack (if necessary), transport to and handling at a disposal facility may also be included.

4.2.12 Storage of Radioactive Waste

This section should describe the details of radioactive waste storage and measures taken to ensure isolation and environmental protection. It should also provide information

related to type of radioactive waste, its characteristics and associated hazards, the radioactive inventory and the anticipated period of storage, facility operations to ensure that the waste can be received, handled, stored and retrieved without undue occupational radiation exposure.

This section should also cover detail of provisions for regular inspections and maintenance of the radioactive waste and storage facility to ensure the continued integrity, availability of storage capacity for radioactive waste generated in normal operation, with a reserve capacity for waste generated in any incidents or accidents, waste forms and containers to be maintained over the expected duration of storage. Scheme adopted for stacking of waste packages along with the detail of tracking and identification systems of waste packages should be provided.

4.2.13 Radiation Doses from Radioactive Discharges

This section should provide the information about the methodology used for assessment of radiation doses due to discharges covering all site specific exposure pathways. It should also include the measures taken to keep radiation doses to the public as low as reasonably achievable.

4.2.14 Monitoring and Surveillance of Waste Packages and Facility

This section should describe provisions for monitoring and surveillance of radioactive waste packages and the storage facility. It should also describe arrangements provided for monitoring the radiological conditions in the waste storage facility, necessary measures for monitoring of radiation dose rates, concentrations of airborne radioactive material (e.g. dispersible), levels of both fixed and/or loose surface contamination, monitoring of chemical conditions (e.g. flammable gases, chemical properties of liquids) and non-radiological physical parameters (e.g. temperature, pressure, humidity). Furthermore, monitoring and surveillance frequency should also be provided.

4.2.15 Transfer and Transport of Radioactive Waste

This section should describe practices to be adopted for transfer of radioactive waste during its management. It should describe the dose rate limit (mSv/hr) at the surface and at one (01) meter away from any accessible surface of the waste package including the safety measures taken for minimization of exposure during the transfer of waste from one-step to another.

It should also address transport of radioactive waste (where applicable) in compliance with applicable regulatory requirements.

4.2.16 Compliance with Acceptance Criteria for Radioactive Waste Storage or Disposal

This section should describe the practical measures taken for compliance with the Waste Acceptance Criteria (WAC) for radioactive waste storage and/or disposal. This should include applicable WAC, otherwise anticipated WAC for the receipt and management of radioactive waste. Detail of procedures for determining whether acceptance criteria are met and techniques in place to identify the characteristics of the waste should be described. Moreover, the information should cover the contingency measures that are in place in the event of non-compliance of waste package with WAC.

4.2.17 Disposal of Radioactive Waste

This section should describe detail of disposal of radioactive waste including the information about the types, characteristics and associated hazards of radioactive waste. It should also provide detail about the provisions of monitoring and surveillance of radioactive waste packages and the disposal facility to ensure continued integrity and radiological conditions. This information should also include available capacity of disposal facility, scheme adopted for waste disposal along with the detail of tracking and identification systems of waste packages.

4.2.18 Management of Disused Sealed Radioactive Sources (DSRS)

This section should describe the detail about management of DSRS in the facility.

4.2.19 Trainings

This section should provide information about specific trainings of personnel involved in the waste management activities including its methodology. These trainings may include operation of all equipments (including radiation monitoring equipment) which will be used in radioactive waste management facility and in safe handling of radioactive waste during pretreatment, treatment, characterization, conditioning, radiation doses calculation methodologies and waste estimation etc.

4.2.20 Periodic Review of RWMP

A periodic review of the RWMP should be conducted to re-examine the adequacy and effectiveness of the program to achieve its objectives. The review should be conducted, whenever necessary, in the light of operating experience feedback, international practices and modification in radioactive waste management technology/equipment. The licensee should describe its commitment and the frequency for conducting periodic review of the program in this section. The RWMP should be revised, if needed, on the basis of review outcome and operating experience feedback. The revised program should be submitted to the Authority for review and approval.

4.2.21 Record and Reports

This section should describe the arrangements to ensure that record necessary for radioactive waste management is maintained, up to date and retrievable. It also provides the list of records maintained.

The licensee should ensure that the annual solid radioactive waste report and annual radiological effluent release report are prepared in accordance with the contents along with the tables as prescribed in Annexure I and Annexure II respectively.

4.2.22 Program Implementing Procedures

The licensee should provide a list of procedures necessary for the implementation of the RWMP, being followed at the nuclear installation, in the form of an Annexure, where appropriate.

4.2.23 Definition and Abbreviations

This section should include alphabetically the list of terms, corresponding definitions and abbreviations used in the RWMP.

4.2.24 References, Codes, Standards, Tables and Annexes

In this section, the licensee should include all applicable references, codes, standards, tables and annexes referred in the RWMP.

5. REFERENCES

1. Regulations on Radiation Protection - (PAK/904), Pakistan Nuclear Regulatory Authority (PNRA), Islamabad (2004).
2. Regulations for Licensing of Nuclear Installations in Pakistan - (PAK/909)(Rev.1), Pakistan Nuclear Regulatory Authority (PNRA), Islamabad (2012).
3. Regulations on the Safety of Nuclear Power Plants Operation - (PAK/913)(Rev.1), Pakistan Nuclear Regulatory Authority (PNRA), Islamabad (2004).
4. Regulations on Radioactive Waste Management - (PAK/915), Pakistan Nuclear Regulatory Authority (PNRA), Islamabad (2005).
5. Regulations on Safety of Nuclear Research Reactor(s) Operation - (PAK/923), Pakistan Nuclear Regulatory Authority (PNRA), Islamabad (2012).
6. Predisposal Management of Radioactive Waste, General Safety Requirements (GSR Part 5), International Atomic Energy Agency (IAEA), Vienna (2009).
7. Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors, Specific Safety Guide (SSG-40), International Atomic Energy Agency (IAEA), Vienna (2016).
8. Storage of Radioactive Waste, Safety Guide (WS-G-6.1), International Atomic Energy Agency (IAEA), Vienna (2006).
9. Occupational Radiation Protection, General Safety Guide (GSG-7), International Atomic Energy Agency (IAEA), Vienna (2018).
10. Regulatory Control of Radioactive Discharges to the Environment, General Safety Guide (GSG-9), International Atomic Energy Agency (IAEA), Vienna (2018).
11. Combined License Application for Nuclear Power Plants (LWR Edition), Regulatory Guide (1.206), U.S. Nuclear Regulatory Commission (US-NRC), Washington, DC (2007).

6. GLOSSARY

- a) "clearance" means the removal of radioactive materials or radioactive objects within licensed/ authorized practices from any further regulatory control by the Authority;
- b) "clearance level" means a value, established by the Authority and expressed in terms of activity concentration, at or below which a source of radiation may be released from regulatory control;
- c) "conditioning" means those operations that produce a waste package suitable for handling, transport, storage and/or disposal;
- d) "discharge" means a planned and controlled release of (usually gaseous or liquid) radioactive material to the environment;
- e) "disposal" means emplacement of waste in an appropriate facility without the intention of retrieval;
- f) "disused sealed radioactive source - (DSRS)" means a sealed source that is no longer used, and is not intended to be used, for the purpose for which an authorization was granted;
- g) "monitoring" means the measurement of dose, dose rate or activity related to the assessment or control of exposure to radiation or radioactive substances, and the interpretation of the results;
- h) "pretreatment" means any or all of the operations prior to waste treatment, such as collection, segregation, chemical adjustment and decontamination;
- i) "radioactive waste" means waste that contains, or is contaminated with, radionuclides at activity concentrations greater than clearance levels as established by the Authority;
- j) "radioactive waste management" means all administrative and operational activities involved in the handling, pretreatment, treatment, conditioning, transport, storage and disposal of radioactive waste;
- k) "segregation" means an activity where types of waste or material (radioactive or exempt) are separated or are kept separate on the basis of radiological, chemical and/or physical properties, to facilitate waste handling and/or processing;
- l) "storage" means the holding of radioactive sources, radioactive material, spent fuel or radioactive waste in a facility that provides for their/its containment, with the intention of retrieval;
- m) "treatment" means operations intended to benefit safety and/or economy by changing the characteristics of the waste;
- n) "waste acceptance criteria - (WAC)" means quantitative or qualitative criteria specified by a licensee (waste management facility) and approved by the Authority, for the waste form and waste package to be accepted by the licensee of a waste management facility;
- o) "waste characterization" means determination of the physical, mechanical, chemical, radiological and biological properties of radioactive waste to establish the need for further adjustment, treatment or conditioning, or its suitability for further handling, processing, storage or disposal;
- p) "waste form" means the waste in its physical and chemical form after treatment and/or conditioning (resulting in a solid product) prior to packaging;
- q) "waste package" means the product of conditioning that includes the waste form and any container(s) and internal barriers (e.g. absorbing materials and liners) as prepared in accordance with the requirements for handling, transport, storage and/or disposal; and
- r) "waste processing" means any operation that changes the characteristics of waste, including pretreatment, treatment and conditioning.

Content of Annual Solid Radioactive Waste Report

Executive Summary

Table of Contents

1. Introduction
2. Objective
3. Scope
4. Sources of Radioactive Waste
5. Types of Radioactive Waste along with Classification
6. Minimization of Radioactive Waste (as Compared to Previous Year)
7. Radioactive Waste Inventory
 - 7.1. Annual Radioactive Waste Generated
 - 7.2. Accumulated Radioactive Waste Stored
 - 7.3. Disused Sealed Radioactive Sources
 - 7.4. Radioactive Waste/ Sealed Radioactive Sources Cleared from Regulatory Control
 - 7.5. Radioactive Waste Recycled and Reused
8. Reasons of Radioactive Waste Over Generation
9. Radioactive Waste/ DSRS Transferred to and Received from other Facility
 - 9.1. Purpose of Transfer/Receiving
 - 9.2. Type, Quantity, Radionuclide Content and Activity of Radioactive Waste
10. Adequacy/Capacity of the Facility
11. Incidents/Accident Reported
12. Training of Personnel

The information provided in the annual solid radioactive waste report should at least contain the following tables:

Table 1: Summary of Generated Solid Waste Volume

Year	Concentrates		Spent Resins		Spent Filter Cartridges		Any other	
	Limit (m ³)	Actual (m ³)	Limit (m ³)	Actual (m ³)	Limit (m ³)	Actual (m ³)	Limit (m ³)	Actual (m ³)
xxxx								
Cumulative:								

Table 2: Treated Radioactive Waste*

Waste Type	Waste Material	Waste Class	Container Type & Volume	I.D. No. of Container	Activity at Storage (Bq)	Dose Rate at Surface and 1 Meter (mSv/hr)	Principal Radionuclides	Date of Storage	Purpose of Storage	Received from (Name of the Facility)	Any other Information
	Type X										
			Total No of Containers Produced in Reported Year= xx								
			Limit = xx								

Remarks (if any)

* The same table contents should be reproduced for each waste material

Waste Type means solid waste types, compressible, non compressible, etc.

Waste Material depends on waste type selected, e.g. sludge, concentrate, spent resin, spent ion exchange resins, etc.

Waste Class means class of radioactive waste as per Regulation on Radioactive Waste Management (PAK/915)

Container Type & Volume means short description of the container, such as 20 liter glass bottle, plastic bag (volume), SS drums (volume) etc.

ID. No container means identification number of the container

Activity of Storage means the total activity stored in the container along with the principal radionuclides present.

Purpose of Storage means decay storage, unprocessed storage, etc.

Received from means the name of the facility from which the waste has been received

Table 3: DSRs Stored in the Reported Year

Sr. No.	Radionuclide	I.D. No. of DSRs	Received From	Import Date	Import Activity (Bq)	Storage Date	Purpose of Storage	Any other Information
1.								
2.								

Table 4: Summary of Accumulated Waste Drums/Barrels/Tanks/Bags

Year	Concentrates		Spent Resins		Spent Filter Cartridges		Any other	
	Limit (No. of Drums)	Actual (No. of Drums)	Limit (No. of Drums)	Actual (No. of Drums)	Limit (No. of Drums)	Actual (No. of Drums)	Limit (No. of Drums)	Actual (No. of Drums)
XXXX								
Cumulative:								

Table 5: Accumulative Record of DSRS

Year	Radionuclide	Total No. of DSRS Stored	Total No. of DSRS Disposed off	Any other Information
XXXX				
	Cumulative:			

Table 6: Summary of Radioactive Waste Disposed Off

Waste Type	Waste Material	Waste Class	Container Type & Volume	I.D. No. of Container	Activity at Disposal (Bq)	Dose Rate at Surface and 1 m (mSv/hr)	Principal Radionuclides	Date of Disposal	Received From	Any other Information
	Type X									
Total Number of Containers Disposed in Reported Year = XX				Remarks (if any)						
Limit = XX										

Table 7: Summary of Radioactive Waste Cleared from Regulatory Control

Waste Type	Waste Material	Container Type & Volume	ID. No. of Container (if any)	Activity at the Time of Clearance (Bq)	Dose rate at the Time of Clearance (mSv/hr)	Principal Radionuclides	Date of Clearance	Place of Disposal	Any other Information
	Type X								
Total Number of Containers/Packages Cleared in Reported Year = xx		Remarks (if any)							

Waste Type means solid waste types, compressible, non compressible, etc.

Waste Material depends on waste type selected, e.g. sludge, concentrate, spent resin, spent ion exchange resins, etc.

Waste Class means class of radioactive waste as per Regulation on Radioactive Waste Management (PAK/915)

Container Type & Volume means short description of the container, such as 20 liter glass bottle, plastic bag (volume), SS drums (volume) etc.

ID. No container means identification number of the container

Activity at Disposal means the total activity of the container along with the principal radionuclides present at the time of disposal.

Received from means the name of the facility from which the waste has been received

Place of Disposal means the name of the facility or location where the cleared waste has been disposed off.

ANNEXURE II

Content of Annual Radiological Effluent Release Report

Executive Summary

Table of Contents

1. Introduction
2. Regulatory and Operational Limits
3. Meteorological Data for Dose Calculation
4. Habitat Data for Dose Calculation
5. Gaseous Effluents
 - 5.1 Summary of Gaseous Effluents
 - 5.2 Doses due to Gaseous Effluents
6. Liquid Effluents
 - 6.1 Summary of Liquid Effluents
 - 6.2 Doses due to Liquid Effluents
7. Limiting Condition for Operations (LCOs) Applied During the Year
8. Status of Process and Discharge Effluent Monitoring System/Instruments
9. Minimum Detection Limit of Effluent Monitoring Systems/Instruments
10. Deviations from Final Safety Analysis Report (FSAR) and RWMP
11. Changes in Dose Calculation Methodology
12. Changes made in Process Control Program
13. Corrections to Previous Report Revision Page
14. Training of Personnel

The information provided in the Annual Radiological Effluent Release Report should at least contain the following tables:

Table 1: Gaseous Effluents - Time Taken for Batch Releases

Description	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Number of Batches Released					
Total Time Period for Batch Release (hr)					
Average Time Period for Batch Release (hr)					

Table 2: Gaseous Effluents - Decay before Discharge

Description	Date of Start of Filling of Decay Tank	Date of Disconnectivity after Filling	Date of Start of Release of Decay Tank	Period for which Gases Remained Stored for Decay before Discharge
Decay Tank 1				
Decay Tank 2				

The above mentioned information should be provided for each decay tank

Table 3: Gaseous Effluents - Summations of all Releases

Summation of all Releases	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Uncertainty
	Fission and Activation Gases					
Total (Bq)						
Average Release Rate (Bq/s)						
% of Limit						
Similar information as mentioned above like total activity, average release rate, % of the limit etc. for all group of radionuclides should be provided.						

Table 4: Gaseous Effluent - Isotopic Summary

Radionuclide	Batch Mode (Decay Tank)	Continuous Mode	Batch Mode (RX Purging)	Refueling	Total	Average Concentrations	Concentration Limits	% of Concentrations Limits
	Bq	Bq	Bq	Bq	Bq	Bq/m ³	Bq/m ³	
Noble Gases								
Ar-41								
Xe-133								
Similar information as mentioned above should be provided for each isotope of each group of radionuclides.								

Table 5: Gaseous Effluents - Abnormal Releases

Radionuclides	Time of Release	Date of Release	Activity (Bq)	Release Rate (Bq/Sec)

Table 6: Gamma Dose due to Noble Gases

Quarterly Applicable Limit -----
Annual Applicable Limit -----

Distance (m)	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	Dose (Gy)	% of Limit	Dose (Gy)	% of limit	Dose (Gy)	% of Limit	Dose (Gy)	% of Limit	Dose	% of Limit

Table 7: Beta Dose due to Noble Gases

Quarterly Applicable Limit -----
Annual Applicable Limit -----

Distance (m)	Quarter 1		Quarter 2		Quarter 3		Quarter 4		Total	
	Dose (Gy)	% of Limit	Dose (Gy)	% of Limit	Dose (Gy)	% of Limit	Dose (Gy)	% of Limit	Dose	% of Limit

Table 8: Total Dose due to Gaseous Effluent

Description	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Whole Body Dose (mSv)					

Table 9: Liquid Effluents - Time Taken for Batch Releases

Description	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Number of Batches Released					
Total Time Period for Batch Release (hr)					
Average Time Period for Batch Release (hr)					

Table 10: Liquid Effluents - Decay before Discharge

Description	Date of Start of Filling of Decay Tank	Date of Dis-connectivity after Filling	Date of Start of Release of Decay Tank	Period for which Gases Remained Stored for Decay before Discharge
Decay Tank 1				
Decay Tank 2				
The above mentioned information should be provided for each decay tank.				

Table 11: Liquid Effluent - Summations of all Releases

Summation of all Releases	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total	Uncertainty
Fission and Activation Products						
Total Release (Bq)						
Volume of Release (m ³)						
Average Release Rate (Bq/s)						
% of Limit						
Similar information as mentioned above like total activity, average release rate, % of the limit etc for all group of radionuclides should be provided.						

Table 12: Gaseous Effluent – Isotopic Summary

Radionuclide	Batch Mode (Decay Tank) Bq	Continuous Mode Bq	Batch Mode (RX Purging) Bq	Refueling Bq	Total Bq	Average Concentrations Bq/m3	Concentration Limits Bq/m3	% of Concentrations Limits
Fission and Activation Products								
Co-60								
Similar information as mentioned above should be provided for each isotope of each group of radionuclides.								

Table 13: Doses due to Liquid Effluent

Description	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
Whole Body Dose (mSv)					
% of Limit					
Thyroid Dose (mSv)					
% of Limit					

Table 14: Dose to the Public due to all Facilities at the Site

Dose Limit	Whole Body	Thyroid	Any other Organ
Dose (mSv)			
% of Limit			



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