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1. PURPOSE

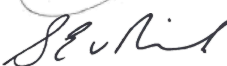
Purpose of this document is to outline and list the User Requirements Specification (URS) for an Atmospheric Radioactive Discharge Monitoring System, to be installed in the Building P1701 ventilation stack.

The URS is compiled to facilitate prospective suppliers in understanding the needs, identifying further requirements and proposing suitable equipment to facilitate atmospheric radioactive discharge monitoring.

2. SCOPE

This document addresses the user requirements related to the design, installation and testing of the Atmospheric Radioactive Discharge Monitoring System, to be installed in the Building P1701 ventilation stack and includes:

1. Statutory and regulatory requirements;
2. Functional requirements;
3. Quality requirements;
4. Electrical supply system requirements;
5. Maintenance requirements;
6. Safety and signage requirements;
7. Labelling requirements.

ACTION		NAME & EXPERTISE		SIGNATURE		DATE	
Originated		JP Rootman <i>Radiation Protection</i>				2024/03/01	
Originated		BM Nolte <i>Radiation Protection</i>				2024/03/01	
Checked		C Krös <i>Radiation Protection Specialist</i>				2024/03/01	
Checked		SE van Niekerk <i>Radiation Protection Specialist</i>				2024/03/04	
QA Approved		Z Suliman <i>QA Reviewer</i>				2024/03/05	
Approved		A Singh <i>P1701: Nuclear Facility Management Review</i>				2024/03/05	
Implementation Date:						2024/03/05	
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3. REFERENCES

This document complies with the requirements of:

SHEQ-INS-8060: Control Programme for RIMTE Equipment in the Radiological Surveillance Programme.

SHEQ-FRM-8060: RIMTE Equipment Specification

NTP-SOP-6204: P1701 Facility Specification Gaseous Radioactive Discharge Control Programme

The following documents are referenced in this document:

ES-WIN-3513: Emergency Consequence Assessment - Radiological

SHEQ-INS-8230: Management of Radioactive Discharge to the Atmosphere at the Pelindaba Site

SHEQ-INS-8240: Quantities for the Control of Radioactive Discharge to the Environment from the Pelindaba Site

IEC 60761: Equipment for continuous monitoring of radioactivity in gaseous effluents

IEC 60951: Nuclear facilities - Instrumentation systems important to safety - Radiation monitoring for accident and post-accident conditions

4. ABBREVIATIONS AND DEFINITIONS

4.1. The following abbreviations are used in this document:

CSV : Comma Separated Value

RIMTE : Radiological Inspection, Measuring and Test Equipment

4.2. The following definitions are provided to ensure a uniform understanding of this document:

Bq ¹³⁵ Xe eq	:	1 Bq noble gas activity (any Xe isotope) expressed as the equivalent of 1 Bq ¹³⁵ Xe.
Bq ¹³¹ I eq	:	1 Bq Iodine-activity (any Iodine isotope) expressed as the equivalent of 1 Bq ¹³¹ I.

5. GENERAL

NTP Radioisotopes SOC Ltd (NTP), a subsidiary of the South African Nuclear Energy Corporation SOC Ltd (NECSA), is a leading global producer and supplier of nuclear medicine and radiation-based products and services. NTP is in the process of replacing its Atmospheric Radioactive Discharge Monitoring System, installed in the Building P1701 facility ventilation stack.

The Atmospheric Radioactive Discharge Monitoring System plays an important role in the safe operation of the P1701 facility, through continuous radiological and flow measurement of stack releases, required in the calculation of radiological releases to the environment.

Due to environmental and public safety considerations, it is important that Radiological Inspection, Monitoring and Test Equipment (RIMTE) is of high and reliable quality and that installation, training, maintenance and back-up ensure an extended operating life.

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6. RESPONSIBILITIES

N/A

7. PROCESS

7.1. Atmospheric Radioactive Discharge Monitoring System Location

The monitoring system shall be installed in the Building P1701 facility ventilation stack, ~ 200 m from the facility control room. Readout of the system shall be remotely available in the control room as well as on the system in the facility stack. An Ethernet network cable is to be supplied for communication between the stack and control room.

7.2. Normal Operations: Characterising Radioactive Discharges to the Environment and System Requirements

Various nuclides, such as ^{131}I and ^{133}Xe are released to the environment during normal facility operations and/or during incidents when irradiated target plates are dissolved to produce ^{99}Mo and ^{131}I . The monitoring system shall be capable of continuously measure the noble gasses and iodine that are released through the stack. If the system is able to do spectroscopic analysis of the nuclides released, valuable information can be obtained.

According to Necsa's process to manage radioactive emissions on the Pelindaba site (SHEQ-INS-8230), the monitoring systems shall comply with the following requirements:

Table 1

Type of Discharge	Quantification units for discharge	Specified Monitoring Method/Equipment	Requirements for Measurement Sensitivity
Noble Gases	Bq ^{135}Xe equivalent	Continuous RIMTE to determine Xe-activity in air stream that will be able to alarm in the control room when the instrument reading reaches a first threshold (warning alarm) and a second threshold (emergency alarm, if applicable). Further, the measured activity discharge/discharge rate is to be displayed.	Sufficiently sensitive to measure a discharge rate of 1E8 Bq/s (^{135}Xe equivalent). As the stack flow rate is 64 000 m ³ /s, the system needs to at least measure 1500 Bq/m ³ in the airstream. <u>Reference Isotope:</u> ^{135}Xe Energy: 910 keV Beta; 249 keV Gamma

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Type of Discharge	Quantification units for discharge	Specified Monitoring Method/Equipment	Requirements for Measurement Sensitivity
Iodine	Bq ¹³¹ I eq.	Filter/absorbing media with a minimum collection efficiency of 90% for organic iodine compounds and 95% for inorganic compounds.	Analysis shall be an off-line measurement where iodine discharge shall be estimated from the off-line result. <i>Continuous monitoring using an instrument with direct read-out is not a requirement.</i> Gaseous Iodine monitoring shall be performed based on the characteristics below. <u>Reference Isotope:</u> ¹³¹I Energy: 500 keV Beta; 364 keV Gamma

The P1701 stack is classified as a high-risk stack (SHEQ-LST-8240) and therefore as a minimum shall comply with the following:

- Continuous monitoring of atmospheric discharges.
- A 'NO' and/or a 'LOW' sample flow rate alarm shall be provided and monitored in a control room.
- Monitoring system failures shall be rectified within 48 hours.

7.3. Emergencies: Monitoring Requirements During Emergencies

ES-WIN-3513 postulated a reference accident.

The release is determined to be only the airborne/volatile material (i.e. iodine and noble gases). It is assumed that 10% (5.79E13 Bq) of the Iodine and 100% (4.21E14 Bq) of the noble gases of which 1E14 Bq are from Xe135, can be released.

As continuous monitoring using an instrument with direct read-out is not a requirement for Iodine, all emergency scenarios are planned using the noble gas monitor.

If 1E14 Bq Xe-135 are released within an hour, the Xe-135 release rate will be ~1.7E12 Bq/s. If the air through the stack is release at a rate of 64 000 m3/s, stack monitor needs to be able to measure at least up to 2.7E7 Bq/m3 (For an air release rate of 48 000 m3/s the maximum range needs to be 3.5E7 Bq/m3). The design flow rate for the P1701 stack is between 48 000 m3/s and 64 000m3/s.

7.4. P1701 Atmospheric Radioactive Discharge Monitoring System

7.4.1. General Requirements

As the Atmospheric Radioactive Discharge Monitoring System in the stack is also used to manage the operational processes, the following systems are required as minimum:

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Table 2

Type of Discharge	System	Measurement Range	Standard reference
Noble Gases	Stack air is drawn through a chamber (or similar) and if possible the following Xe isotopes: Xe-133, Xe-133m, Xe-131m and Xe-135 are to be measured using a gamma spectrum. Measurement date need to be stored at least every 15 minutes. If gross counting is used, nuclides other than noble gasses needs to be filtered out from the airstream that will be counted for noble gas activity.	Noble gas concentrations of 5E2 Bq/m ³ to 5E7 Bq/m ³	Nuclear: IEC60951, IEC60761-1 and IEC60761-3
Iodine ¹³¹ I	NTP however requires an iodine estimate for operational purposes in the stack. System where stack air is drawn through a filter package and the filter package is measured using a detector.	¹³¹ I concentration of 50 Bq/m ³ to 1E5 Bq/m ³	Nuclear: IEC60761 Please note: The air stream contains more contaminants than only iodine. These contaminants may influence the iodine activity. These influences need to be recognised and pointed out/compensated for.

7.4.2. Operational Criteria

The Atmospheric Radioactive Discharge Monitoring System needs to provide for the following:

- Continuously measure and store gamma spectrums every 5 to 15 minutes.
- If spectrums are stored for noble gas releases**, the spectrums must be analysed and activities released for the different isotopes must be displayed for the previous 15 minutes. The system must be able to display the different isotopes as well as the total Xe-activity released. Users must be able to explore the spectrums stored for other isotopes that might be present in the air released.
- Ability to set Intervention and Investigation level for total Xe-activity released. If levels are exceeded, alarms must display in the control room. (Visual and Audible).

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- At the moment the stack monitoring system is not used to quantify iodine releases. Iodine activity in the stack is only used by the operators to manage the plant.
- Flow rate indication: Flow/No Flow.
- The real-time stack flow rate shall be measured and incorporated in the release calculation.
- Ability to remotely control and view the Atmospheric Radioactive Discharge Monitoring System, e.g., from the control room.
- The system shall not interfere with or disrupt the function of any existing functional equipment currently installed in the facility.

7.4.3. Regular Checks & Calibration

- The Atmospheric Radioactive Discharge Monitoring System must facilitate regular system checks and calibration.
- Procedures for such checks and calibration shall be supplied.
- Records of system checks and calibrations must preferably be stored by the monitoring system.
- Equipment and sources needed for system checks and calibrations need to be specified and be provided.

7.4.4. Maintenance & Critical Spares

- Maintenance requirements need to be specified, inclusive of first, second and third line repair requirements.
- Critical spares need to be specified, inclusive of recommended stock levels at the user and supplier.
- A maintenance manual shall be provided.

7.4.5. Data Storage and Reports

- The Atmospheric Radioactive Discharge Monitoring System shall be able to quantify activity releases per period per identified isotope (e.g., hours, day, month and year).
- The Atmospheric Radioactive Discharge Monitoring System shall be able to generate summary reports on activity discharge per identified isotope and total activity released per period (e.g., hours, day, month and year).
- Data gathered by the Atmospheric Radioactive Discharge Monitoring System shall be available on the system for at least 20 years to ensure easy withdraw of the data to facilitate comparisons, reconstructions, etc.
- The monitor system shall be able to facilitate download of discharge data at least in CSV format. The data that must be available for downloading are for example the following:
 - Date & Time and concentration (Bq/m³) as recorded.
 - Date & Time and release rate (Bq/s) as recorded.
 - Summary reports on activity (Bq) discharged per identified isotope.
 - Stack flow rates.
 - Sampling flow rates.

7.4.6. Computer hardware and software

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- The Atmospheric Radioactive Discharge Monitoring System and related software must be on the latest version of Windows/Linux.
- The software used shall be compatible with current NTP IT infrastructure.
- All software and server licences shall be specified and costed.
- All hardware shall be supplied and maintained.
- Client access for at least 3 users is required.
- Data Retention – 20 years online and 50 years archived.
- Supplier shall perform system validation.

7.4.7. **Install, Setup and Handover**

- NTP will provide resources needed to assist with the setup and installation at NTP.
- The Service Provider is responsible for installation and setup.
- The Service Provider needs to provide a schedule for installation and setup.
- The Service Provider needs to hand the Atmospheric Radioactive Discharge Monitoring System over at the end of installation, ensuring that the system can perform according to specification.
- The system shall be fully functional at the time of handover to NTP/NECSA.
- An operations manual shall be provided after installation and setup.

7.4.8. **Initial Changes to the Atmospheric Radioactive Discharge Monitoring System**

As organizations differs from one another it might be necessary to adapt the software to NTP's needs. The possibility to adapt the software, the process and the cost (hourly rate) needs to be included.

7.4.9. **Training**

Provision shall be made for training (operation and maintenance) of users of the Atmospheric Radioactive Discharge Monitoring System.

7.4.10. **Maintenance and support**

- The Service Provider's ability to support the monitoring system/s shall be highlighted.
- The Service Provider shall provide a quotation for a 5-year maintenance and support contract. The possibility to extend the contract for another 5 years shall be indicated.
- The system shall be durable, with an expected service life of no less than 10 years from the date of commissioning.

7.4.11. **Quality Management System**

- The Quality Management Systems (QMS) of the Service Provider shall be ISO9001:2015 or equivalent.
- NTP shall have the right to audit the QMS of the supplier of the Atmospheric Radioactive Discharge Monitoring System.

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- A comprehensive checklist of relevant quality requirements applicable to the Atmospheric Radioactive Discharge Monitoring System shall be compiled and submitted to NTP/NECSA for acceptance.

7.4.12. Acceptance Testing

- Factory Acceptance Testing shall be conducted and the reports made available to NTP.
- Site Acceptance Testing shall be performed to verify the operability of the Atmospheric Radioactive Discharge Monitoring System following installation and the reports made available to NTP.

7.4.13. Electricity Compatibility

The Atmospheric Radioactive Discharge Monitoring System shall be compatible with the South African national electrical grid, with particular focus on the relevant grid voltages and frequencies, and the tolerances applicable to voltages and frequencies.

7.4.14. Temperature Operating Range

The Atmospheric Radioactive Discharge Monitoring System shall be able to operate at temperatures from 5 °C to 40 °C.

7.4.15. Demarcation and Signage

- Potential hazards to personnel and equipment (including, but not limited to noise, rotating equipment, electricity), as related to the Atmospheric Radioactive Discharge Monitoring System shall be identified and appropriate demarcation, signage or other appropriate measures associated with the mitigation of such hazards, shall be implemented.
- Air terminals related to the Atmospheric Radioactive Discharge Monitoring System shall be labelled, indicating function, flow direction and minimum and maximum permissible volumetric airflow.
- All labels shall be durable and permanently affixed.

NOTE: All requirements of this document shall be strictly complied with. Non-compliance with one or more requirements listed within this document shall afford NTP/NECSA the right of refusal to accept handover of the Atmospheric Radioactive Discharge Monitoring System.

8. RECORDS

Record	Retention Period	By Whom
Tender documents	10 Years	Finance

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9. TASK HAZARD ASSESSMENT

A Task Hazard Assessment is not applicable to this User Requirement Specification document.

10. LIST OF FORMS

Form Title	Form Number	Exhibit Number
N/A		

11. REVISION HISTORY

Rev.	Date Approved	Nature of Revision	Originated by
1	2023/07/14	First Issue	JP Rootman
2	2023/09/05	Revised to include more specific measurement requirements and detection systems. Requirement to measure for particulates removed.	JP Rootman
3	See Title Page	Revised to remove the reference to compulsory isotope specific results.	JP Rootman

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