National Nuclear Regulator

REPORT

2025 REGULATORY NUCLEAR EMERGENCY EXERCISE AT NECSA PELINDABA SITE

INS-NTWP-0446

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1 EXECUTIVE SUMMARY

A Regulatory Nuclear Emergency Exercise (RNEE) was conducted at the South African Nuclear Energy Corporation (Necsa) Pelindaba site on 03 to 04 September 2025. The National Nuclear Regulator (NNR) evaluated the implementation of Necsa's and Madibeng Local Municipality's emergency plans, along with their respective emergency procedures, for both on-site and off-site response.

The specific objectives of the RNEE were set as follows:

1) Identification, classification and reporting of an emergency;
2) Notification, activation and response of the on-site and off-site emergency functionaries;
3) Effectiveness of communication arrangements between on-site and off-site organisations;
4) Implementation of urgent protective actions;
5) Implementation of early protective actions;
6) Protection of emergency workers from exposure to radioactive material;
7) Evaluation of communication to the public; and
8) Evaluation of functionary standby/shift arrangements in a prolonged emergency.

As part of the exercise preparations, the NNR developed a nuclear emergency scenario based on the specific objectives. The exercise ground rules were developed by the NNR and subsequently discussed with, and accepted by, Necsa and the intervening organisations. The exercise scenario simulated an accidental release of radioactive material from the SAFARI-1 Research Reactor, with the release occurring in two phases.

The first phase of the release of radioactivity was filtered through the stack, resulting from mechanical damage to the reactor core caused by a failed experiment container. The second phase involved an unfiltered release of radioactivity through the stack following the failure of the external power supply to the SAFARI-1 Research Reactor. The scenario required the implementation of on-site and off-site protective actions simulated for several days. The execution of these protective actions was monitored and evaluated by a team of NNR umpires at both Necsa and the Madibeng Disaster Management Centre (MDMC).

Summary of the Exercise

Several findings were identified in the form of non-compliances (deficiencies) and observations (areas of improvement), which need to be addressed.

A summary of the exercise outcomes per specific objective is provided below.

1.1.1 Identification, Classification and Reporting of an Emergency

The overall performance for this objective was assessed as satisfactory. The SAFARI-1 Research Reactor Response Team effectively identified and classified the emergency in line with established procedures and ensured timeous notification of the Emergency Control Centre (ECC). There was no non-compliance related to identification, classification and reporting of emergency at SAFARI-1 Research Reactor location and the overall performance was found to be satisfactory. However, an area for improvement in the form of observation was identified concerning the redundancy and availability of power supply systems in the Emergency Control Room for the reactor.

1.1.2 Notification, Activation and Response of the On-Site and Off-Site Emergency Functionaries

The notification of the emergency by the ECC operator to activate ECC functionaries was conducted in accordance with established procedures. However, areas for improvement were identified concerning the use of correct forms by the ECC operator during activation. Additionally, it was noted that environmental monitoring by the Field Teams (FTs) was not adequately implemented during the response.

Notification of the emergency event by Necsa to the MDMC was made in a timely manner; however, it was not conducted in accordance with the established procedure. Activation of the MDMC functionaries was carried out, with some functionaries responding physically at the Centre, while others participated virtually, particularly during the overnight response.

The overall performance of this objective was found to be partially satisfactory. Areas of improvement and deficiencies in form of observations and non-compliances were identified for both Necsa and MDMC.

1.1.3 Effectiveness of Communication Arrangements Between On-Site and Off-Site Organisations

On-site communication between the Emergency Control Centre (ECC), SAFARI-1 Research Reactor, security at gate 3, Field Teams (FTs), Ground Should Team (GST), and Field Team Leader (FTL) within the ECC was effective and conducted in accordance with established procedures. Communication between the ECC and the Media Centre (MC) was also assessed as satisfactory. Communication between ECC and MDMC was found to be satisfactory.

The overall communication arrangements were assessed as satisfactory. However, an area for improvement in the form of an observation, was identified for Necsa.

1.1.4 Implementation of Urgent Protective Actions

The on-site protective actions were implemented promptly, prior to the release of radioactivity to the environment, and were assessed as satisfactory for the protection of on-site employees. The on-site and off-site emergency decisions, the on-site emergency alarm, on-site communication, and the evacuation of all non-essential staff were promptly implemented. However, on-site employees were evacuated without the necessary steps being taken for accounting and reporting following mustering.

The implementation of urgent protective actions for the public was delayed as Necsa delayed determining the impact of the second release of radioactive material to the environment.

The overall implementation of urgent protective actions was found to be partially satisfactory. Deficiencies in the form of non-compliances were identified for Necsa.

1.1.5 Implementation of Early Protective Actions

The implementation of the early phase protective actions was demonstrated to be satisfactory. Decision-making and communication to the MDMC related to monitoring and mapping of the affected area was acceptable. The recommendation and decision to lift the food ban were made following monitoring and assessment. However, areas for improvement, in the form of observations, were identified related to the lack of a documented procedure for the termination of an emergency and the implementation of the Memorandum of Understanding (MoU).

The overall implementation of early protective actions was found to be satisfactory.

1.1.6 Protection of Emergency Workers from Exposure to Radioactive Material

During the exercise, the protection of emergency workers was observed to be acceptable for the security personnel escorting the responders, the ground shout team and the off-site responders, as considerations for ALARA, appropriate PPE, and the provision of KIO_3 tablets were made. However, areas of improvement and deficiencies in the form of non-compliances and observations were identified, as the KIO_3 tablets were also not administered to the emergency response functionaries at SAFARI-1 Research Reactor Building P-1800, adequate protection was not provided to the ECC responders, as well as the security at gate 3.

The overall protection of emergency workers was found to be partially satisfactory.

1.1.7 Evaluation of Communication to the Public

Communication to the public through Media Centre was made as required by the procedure. However, there was a delay on issuing public instructions and warning as the Ground Shout Vehicle was deployment only at 05:00.

The overall performance regarding communication to the public was found to be partially satisfactory. Areas of improvement and a deficiency in the form of observations and a non-compliance were identified and require urgent attention by Necsa and the MDMC.

1.1.8 Evaluation of Functionary Standby/Shift Arrangements in a Prolonged Emergency

Arrangement for standby/shift for operators at the SAFARI-1 Research Reactor, ECC response functionaries and MDMC was noted and satisfactory. The overall arrangements for standby rosters and shift response in urgent and early phases of an emergency were demonstrated to be satisfactory.

1.1.9 Evaluation of the Overall Response

Overall, considering the specific objectives evaluated during the exercise, Necsa and the MDMC demonstrated a satisfactory application of emergency preparedness and response actions, in line with procedural requirements. However, several areas for improvement and deficiencies in the form of observations and non-compliances were identified to enhance the overall effectiveness of emergency response implementation.

It is concluded that the Necsa Emergency Plan (SHEQ-INS-3500) remains viable for ensuring the protection of persons, property, and the environment, and its associated procedures were implemented accordingly during the exercise.

1.2 Way Forward

Necsa is required to develop a corrective action plan for the findings (non-compliances and observations) by no later than 15 December 2025. The identified corrective actions must be supported by documented root-cause analysis and preventive measures for each non-compliance and observation.

2 INSPECTION DETAILS

2.1	**Inspection Number**	INS-NTWP-0446
2.2	**Authorisation Number**	N/A
2.3	**Holder Name**	South African Nuclear Energy Corporation (Necsa)
2.4	**Hours Spent**	4 months
2.5	**Inspection Date**	03 – 04 September 2025
2.6	**Inspection Area**	Implementation of Necsa's and the Madibeng Disaster Management Centre's Nuclear Emergency Plans.
2.7	**Sources Inspected**	Processes and procedures related to the Necsa Emergency Plan (SHEQ-INS-3500) and Emergency Plan for Necsa, Madibeng and Tshwane to Control the Off-Site Impact of Necsa Emergencies (SHEQ-PLN-3500)
2.8	**Type of Inspection**	Planned and announced

2. 9 Inspectee Representatives

Personnel from:

- Necsa ECC;

- Necsa SAFARI-1 Research Reactor; and
- Various response organisations at the MDMC.

2.10 Regulatory Representatives

NNR umpires from:

- Nuclear Technology and Waste Projects (NTWP);
- Regulatory Improvement and Technical Services (RITS);
- Communication and Stakeholder Relations; and
- Corporate Support Services (CSS)

3 INTRODUCTION AND BACKGROUND

In terms of section 5 (f) of the NNR Act as amended, 1999 (Act No. 47 of 1999), the NNR is required to ensure that provisions for nuclear emergency planning are in place. Section 38 (1)(a) of the NNR Act requires a holder of nuclear authorisation to enter into an agreement with the relevant municipalities and provincial authorities to establish an emergency plan. Section 38 (2) of the Act mandates the NNR to ensure the effectiveness of the nuclear authorisation holder's approved nuclear emergency plan for the protection of persons should a nuclear accident occur.

The prescripts of the NNR Act for emergency preparedness and response are implemented through the following:

1) Requirements as per the Regulations on Safety Standards and Regulatory Practices (Regulation R.388 dated 28 April 2006);
2) Conditions of authorisation imposed on the holders of nuclear installation licences;
3) Requirements detailed in NNR Requirements Document RD-0014, Emergency Preparedness and Response Requirements for Nuclear Installations;
4) Interim Regulatory Guide on Emergency Preparedness and Response to Nuclear and Radiological Emergencies (RG-0020); and
5) Requirements detailed in NNR Position Paper PP-0015, Emergency Planning Technical Basis for New Nuclear Installations.

The effectiveness of the emergency plan and the associated emergency preparedness and response arrangements is assessed, among other means, through the conduct of regulatory nuclear emergency exercises. These exercises are designed to test the readiness of authorisation holders and intervening organisations to respond effectively to nuclear or radiological emergencies. The scope of testing includes the functionality of emergency equipment, the availability and adequacy of resources, the capability of personnel to perform assigned tasks, and the ability of individuals and response organisations to operate in a coordinated and integrated manner. Such exercises also serve to identify gaps, validate procedures, and enhance coordination among all stakeholders involved in emergency preparedness and response.

The RNEE at the Necsa Pelindaba site was conducted on 03 and 04 September 2025. The exercise evaluated the emergency preparedness and response arrangements of both on-site and off-site response organisations. Specific aspects assessed are as per specific objectives

outlined in section 6 below. To ensure evaluation of all emergency exercise response phases (i.e., Urgent and early phases) the exercise was extended and continued overnight.

The NNR prepared a simulated scenario aligned with the overall and specific objectives of the exercise, requiring full activation of Necsa's response capabilities in accordance with the evolving scenario. NNR umpires monitored and assessed the response activities at key locations, including the SAFARI-1 Research Reactor, the Emergency Control Centre (ECC), Ground Shout Team (GST) and Field Team (FT) vehicles, Necsa Gate 3, and the Madibeng Disaster Management Centre (MDMC).

4 PURPOSE

The purpose of this report is to present the outcomes of the 2025 Regulatory Nuclear Emergency Exercise (RNEE), conducted at the Necsa Pelindaba site on 03-04 September 2025.

5 DEFINITIONS AND ABBREVIATIONS

5.1 Definitions

compliance: Adherence to emergency procedures.

early response phase: The emergency response phase for which a need for taking early protective actions and other response actions can be identified until the completion of all such actions. The early response phase may last from days to weeks depending on the nature and scale of the nuclear or radiological emergency.

emergency plan: Description of the objectives, policy and concept of operations for the response to an emergency and of the structure, authorities and responsibilities for a systematic, coordinated and effective response. The emergency plan serves as the basis for the development of other plans, procedures, and checklists.

non-compliance: Non-adherence to applicable emergency plans, procedures, processes, and regulatory standards.

observation: Not non-compliance but addressing the issue is recommended as it may improve the emergency plan and/or procedure(s).

Regulatory Nuclear Emergency Exercise (RNEE): A process of evaluating the effectiveness of the authorisation holder's (on-site) and response organisation's (off-site) emergency plans, procedures and other emergency preparedness and response arrangements.

simulation: Execution of all steps in the emergency plan and procedures without actual implementation.

urgent protective action: A protective action taken in the event of a nuclear or radiological emergency which must be taken promptly (usually within hours to a day) to be effective, and the effectiveness of which will be markedly reduced if it is delayed. This includes iodine thyroid blocking, evacuation, short-term sheltering, actions to reduce inadvertent ingestion, decontamination of individuals and prevention of ingestion of food, milk or drinking water possibly with contamination.

5.2 Abbreviations

ALARA	As Low As Reasonably Achievable
ARPC	Assistant Radiation Protection Controller
DEE	Department of Electricity and Energy
EC	Emergency Controller
ECC	Emergency Control Centre
EPR	Emergency Preparedness and Response
FSO	Facility Security Officer
FT	Field Team
FTL	Field Team Leader
GST	Ground Shout Team
GSV	Ground Shout Vehicle
JOC	Joint Operations Centre
KIO_3	potassium iodate
MDMC	Madibeng Disaster Management Centre
MC	Media Centre
NDMC	National Disaster Management Centre
Necsa	South African Nuclear Energy Corporation
NNR	National Nuclear Regulator
NTWP	Nuclear Technology and Waste Projects

PPE	personal protective equipment
RNEE	Regulatory Nuclear Emergency Exercise
RPC	Radiation Protection Controller
RPO	Radiation Protection Officer

6 OBJECTIVES OF THE EXERCISE

The overall objective of the exercise was to evaluate the emergency preparedness and response capabilities of Necsa and the relevant local authorities in the event of a nuclear or radiological emergency.

The specific objectives of the RNEE were to assess the following:

1) Identification, classification and reporting of an emergency;
   a) Identify and evaluate the anomaly in facility operations;
   b) Classify the emergency; and
   c) Report the emergency to the ECC.
2) Notification, activation and response of the on-site and off-site emergency functionaries.
   a) Notification, by the ECC operator, of the emergency to:
      i) On-site emergency functionaries; and
      ii) Off-site emergency functionaries.
   b) Activation of the ECC and off-site emergency functionaries.
   c) Evaluation of the response by the ECC and off-site emergency functionaries.
3) Effectiveness of communication arrangements between all on-site and off-site organisations.
   a) Evaluation of communication between the ECC, field team, ground shout, security, media centre and Madibeng Disaster Management Centre (MDMC).
   b) Evaluation of communication between the MDMC and off-site response organisations.
   c) Evaluation of the functionality of communication equipment.
4) Implementation of urgent protective actions.
   a) Evaluation of decision-making and recommendations for evacuation, sheltering, iodine prophylaxis and food ban.
5) Implementation of early protective actions.
   a) Evaluation of decision-making and recommendations for prompt monitoring and assessment, temporary relocation and termination of emergency.

6) Protection of emergency workers from exposure to radioactive material.
   a) Evaluation of:
      i) Use of personal protective equipment (PPE) and dosimetry;
      ii) Management, control and recording of doses received; and
      iii) Long-term medical examination and psychological counselling.
7) Preparation of a press release and communication to the public.
8) Evaluation of functionary standby/shift arrangements in a prolonged emergency, i.e. availability of shift roster, change of shift and briefing of members of the new shift.

7 SCENARIO

The scenario simulated an accidental release of radioactive material from the SAFARI-1 Research Reactor (Building P-1800).

On 03 September 2025, the SAFARI-1 Research Reactor was operating at full power 20MW. The simulated scenario unfolded in two phases. The first phase involved a release resulting from mechanical damage to the reactor core caused by a failed experiment container. A Release Category 4 (RC4) source term was used to simulate the release from four heat-damaged fuel assemblies, with the radioactive material being filtered through the stack. During the exercise, the operator failed to shut down the reactor despite radiation and fission product monitors detecting core damage. Additionally, attempts to cool the core with damaged fuel elements were unsuccessful. As a safety response, the K1 ventilation system was expected to shut down automatically upon detection of radioactivity in the ventilation system, while the K9 ventilation system was expected to activate automatically.

The second release of radioactivity was unfiltered through the stack due to a failure of the external power supply to the SAFARI-1 Research Reactor. The K9 ventilation system continued to operate on battery power supplied by two Uninterrupted Power Supply (UPS) units until the emergency diesel generators (Gensets) became operational. However, both the Gensets and UPS systems failed before the release was cleared from the reactor hall. Consequently, the release category escalated from RC4 to RC5 due to the failure of the K9 system. With no alternative means available to clear the release except via convection flow through the stack, the area was initially isolated by the automatic closure of all outlet valves. These valves eventually reopened once the stored compressed air, which powered the valve actuators, was exhausted.

The release of radioactive material to the environment started from 22H00 to 01H00 for first phase, while the second phase for an unfiltered release from 03H00 to 06H00. Therefore, the exercise proceeded overnight and the next day with NNR umpires taking shifts in the ECC, Gate 3, MC and MDMC.

8 EVALUATION OF THE EXERCISE FINDINGS

The expected response from Necsa and the MDMC included, but was not limited to, notification and activation of all on-site and off-site response functionaries and organisations, implementation of urgent protective actions and early response protective actions by evacuating the on-site personnel and the public, issuing of KIO_3 tablets, food restriction, temporary relocation, communication to the public through the identified communication platforms, decontamination of individuals, and protection of emergency workers.

During the RNEE, the NNR umpires utilised structured checklists to evaluate the effectiveness of response actions and compliance with established procedures, with particular emphasis on the objectives outlined in Section 6. The findings from the exercise are categorised as non-compliances and observations. Non-compliances refer to instances where response actions contravened established procedures, whereas observations highlight identified areas for potential improvement of the response procedures.

The evaluation of the non-compliances was graded using the evaluation scheme depicted in the table below.

Inherent risk magnitude	Description of the colour coding
Intolerable	The level of risk has a very high safety and security impact
High	The level of risk has a high safety and security impact
Medium	The level of risk has a medium safety and security impact
Low	The level of risk has a very low safety and security impact

9 EXERCISE OUTCOME

The subsections below outline the exercise findings and evaluation for the respective monitored response locations.

9.1 SAFARI-1 Research Reactor Building

Evaluation of the SAFARI-1 response reviewed identification, classification of emergency, activation of SARAFI-1 Research Reactor emergency functionaries, reporting of the emergency to the ECC, communication with relevant stakeholders, protection of emergency workers, and implementation of urgent protective actions. The information below summarises the areas of compliance and specific findings.

Following the first cue to initiate the exercise at 20H00, and subsequent cues regarding radiation detection in the area monitoring system, the Reactor Operator announced the emergency via the PA system in the P-1800 building, and the Reactor Operator Supervisor together with the Building Head reported to the control room. The response functionaries demonstrated the ability to correctly identify the emergency as outlined in the scenario and effectively activated the SAFARI-1 Research Reactor emergency functionaries. Emergency functionaries reported within the required timeframes.

Both the Building Head and Assistant Building Head were activated; however, the Shift Supervisor remained the responsible person in charge of the exercise. Overall, the emergency procedures were followed, leading to correct classification of emergency and timely responses as the exercise progressed. It was noted that certain actions, such as the activation of functionaries, were pre-empted by the facility. It was further confirmed that the emergency procedures and real-time reactor parameters were available in the SAFARI-1 Research Reactor emergency control room. The mustering at P-1800 was successfully completed, with all personnel accounted for via workers' clock-in records and the visitor logbook, demonstrating effective personnel accountability.

Area(s) of non-compliance(s)

None

Observation(s)

No.	Observation
O-1.	According to the scenario, loss of off-site power occurred at 00H00. This would result in the Reactor Emergency Control Room losing power at 01H00 because it is not backed up by the emergency generators (Gensets). The response team continued operating beyond 03H00 without considering that the Reactor Emergency Control Room was not powered by the emergency backup power (Genset) and the UPS battery which the Emergency Control Room was powered on has a load carrying capacity of 1 hour, as per section 9.3.3 of RR-SAR-0009.

9.2 Emergency Control Centre (ECC)

As per the specific objectives, the evaluation in the ECC included, but not limited to, activation of the ECC functionaries, notification to the MDMC, communication with stakeholders, protection of emergency workers, declaration of emergency and decision making on protective actions, recommendation of off-site protective actions, implementation of urgent and early protective actions, and shift roster arrangements. The information below summarises the areas of compliance and specific findings.

The first notification from the SAFARI-1 Research Reactor was received at 20H00, informing the ECC of the emergency. The ECC operator immediately activated the EC and as instructed by the EC, proceeded to activate all ECC functionaries using the Interactive Voice Recorder (IVR) system as well as the shift roster available. By 21H30, the ECC was fully activated and functional with all ECC functionaries in place. Notification and Communication amongst the ECC functionaries, communication between the ECC and the off-site responders was found to be satisfactorily implemented in accordance with the procedures. The EC provided regular updates of the status of the emergency to the ECC team and the Site. The EC verified press statements prepared by the media officer in the ECC. The SAFARI-1 Research Reactor product specialist was available and consulted by the EC relating to the mitigatory activities in the SAFARI-1 Research Reactor building. The equipment in the ECC was functional, including the video wall.

Coordination of the emergency response within the ECC and the MDMC was conducted in accordance with the established arrangements. During the first release, the Field Team Leader (FTL) provided regular updates to the Radiation Protection Controller (RPC) and

Assistant Radiation Protection Controller (ARPC) team for ongoing monitoring and confirmation of the release status. Key aspects of the response were observed, including timely decision-making, implementation of on-site protective actions, and the recommendation of appropriate off-site protective actions. Actions required during the early phase of the emergency were also considered and executed accordingly. All necessary ECC equipment was available and functional in line with procedural requirements.

For the early phase, the Necsa guide was used to develop characterisation, monitoring of affected area and waste storage options. The resources required for the early phase of the response, including a list of necessary equipment and the Radiation Protection Officers (RPOs) available, were identified. The Necsa Environmental Management Group was tasked with conducting a simulated environmental sampling of different media (water, soil, milk, vegetation, etc.). Considerations were made for transition prior to termination of emergency.

Area(s) of non-compliance(s)

No.	Procedure requirement	Finding(s)	Comments
NC-1	In accordance with section 4.1 of ES-WIN-3140, When an event requiring emergency response is reported to the ECC, the ECC Operator shall complete form ES-FRM-3140 section A.	ECC operator completed an incorrect form FRM-3140 to activate the ECC response functionaries.	The ECC operator utilised a form intended for a real emergency instead of the designated exercise-specific form.
NC-2	SHEQ-INS-3500, Section 1: The EC shall be responsible for the direction of all facets of a Site or General emergency and for declaring the classification of the emergency. The EC is the only person who may authorise site muster, site evacuation, and recommend off-site protective actions and a	The declaration of a General Emergency was not adequately justified in accordance with the established procedures.	At 22H00, during the first release of filtered radioactivity into the environment, a General Emergency was declared without accompanying recommendations for off-site protective actions. As a result, the declaration was rejected by the MDMC on the basis that there was no justification for declaring a national state of disaster.

No.	Procedure requirement	Finding(s)	Comments
	stand down following a Site or General Emergency.		At 04H02, the EC requested that a recommendation be made to the MDMC for the declaration of a national state of disaster. This request was not in accordance with established procedures.
NC-3	According to section 1 of ES-WIN-3140, the actions to be performed during the different emergency classes (Unusual Event, Alert, Site, General and Off-Site Emergency) are indicated in ES-PFC-0019: Emergency Control Flow Diagram [4].	The implementation of public urgent protective actions was delayed during the exercise. • Public sheltering was not considered since the first release. • Recommendation of roadblocks to MDMC was made at 05H00. • Instructions to the public was only issued at 05H11, however, it was noted that the ground shout team arrived at the ECC for response at 21H25. • Arrangement for evacuation by Tshwane Bus Services was made at 05H00. (This is a repeat finding from 2023 RNEE from the ECC) • RPOs were deployed to MCC for public monitoring at 05H30.	It was noted that following the release of both filtered and unfiltered radioactivity to the environment, the implementation of public protective actions was delayed.
NC-4	According to section 1 of ES-WIN-3185, In case of a precautionary evacuation, accounting of personnel will be done at the building	The EC did not take necessary steps for reporting and accounting for evacuated on-site personnel.	At 21H12, an on-site evacuation was ordered and declared completed at 21H45. However, the P-1800 Building Head reported that mustering

No.	Procedure requirement	Finding(s)	Comments
	assembly point as required, before evacuating the site.		had been completed, which indicated that non-essential staff members in Building P-1800 had not been evacuated
NC-5	Section 6 of ES-WIN-3510: the RPC shall advise and assist the EC on protective actions to be taken for radiological emergencies.	The RPC team were initially not able to recognise the radiological impact of the second unfiltered release of radioactivity in the environment.	The RPC team initially indicated that the entire radioactive inventory was released during the first phase of the release to the environment; therefore, no impact to the public was expected from the second release. This was corrected following the confirmation by the FT on environmental monitoring.
NC-6	According to section 5 of ES-WIN-351: In a radiological emergency during which radioactive iodine could be released into the air, the following procedure shall be adhered to for persons that could be exposed to intakes of radioactive iodine: 5. 1 The Radiation Protection Controller (RPC) shall recommend the protective action to take iodine tablets. 5. 3 The RPC shall record the instruction to distribute Iodine tablets on ES-FRM-3501: general message form and distribute to the	RPC failed to instruct the EC for ECC, Gate 3 Security Officers and FT functionaries to take KIO_3 tablets. This is a repeat finding from 2023 RNEE from the ECC.	During the exercise, the simulated release from the SAFARI-1 Research Reactor source term inventory included radioactive iodine. As a result, response functionaries operating in the ECC and FT had a potential for exposure to radioiodine when the plume changes direction. At 04H00, the Field Team Leader (FTL) was unable to confirm whether potassium iodate (KIO_3) tablets had been administered to the Field Teams earlier during the exercise. Although Potassium Iodate tablets were available at Gate 3 Duty Room, NECSA security

No.	Procedure requirement	Finding(s)	Comments
	Field Team Leader (FTL) for action. • Emergency workers: The FTL will instruct the Field Teams (FT)		staff never received instructions to distribute the tablets or demonstrate the distribution.
NC-7	ES-WIN-3511: Duties of the Assistant Radiation Protection Controller Section 7, The ARPC shall: - Be responsible for providing dose or concentration calculations and comparing field survey data with projected data to refine/validate measurements/projections	The ARPC failed to instruct the FTL to initiate off-site monitoring by the Field Team to identify the locations and extent of the plume-affected area.	The Field Teams conducted surveys only within the Necsa site at Waypoint 16, the SAFARI-1 Research Reactor, P2400, P1900, and the ECC for the duration of the exercise. Waypoint 17 was utilised solely as a designated safe location.

Observation(s)

No.	Observation
O-2.	The initial verbal notification from the Necsa ECC operator to the MDMC Duty Operator did not include the information prescribed in Annexure 1 of MDMC-PR-3001, such as the declaration of emergency, weather conditions, incident particulars, and protective actions. It was also noted that the Necsa emergency procedure is not aligned with the requirements of MDMC-PR-3001 regarding the emergency notification content defined in Annexure 1.
O-3.	While the early phase of the emergency response was supported by a procedure document, there was no accompanying checklist outlining step-by-step actions for its implementation. The absence of such structured tools may lead to inconsistent application of early-phase tasks.
O-4.	The exercise scenario required the use of an alternate laboratory for environmental sample analysis. Although a Memorandum of Understanding (MoU) existed between Necsa and Koeberg Nuclear Power Station to facilitate such support, the attempt to engage KNPS failed. It was noted that there is no manual or procedure regarding the implementation of the MoU.
O-5.	At 06:03, the Emergency Controller (EC) initiated the transition into the early phase following the stop of the release and reassessment of protective actions. Subsequently, at 10H10, the EC intended to move to the recovery phase, however, was unsure if prior approval from the

No.	Observation
	NNR was required to proceed. It was further established that Necsa does not currently have a formal procedure outlining the criteria and process for the termination of an emergency event or transitioning between response phases. The absence of clear guidance may lead to delays or inconsistencies in decision-making during actual events.
O-6.	There was no alternative medication to KIO_3 tablets for individuals who are iodine sensitive and no clearly defined process or criteria for issuing KIO_3 tablets to individuals who are sensitive to iodine. - At 4:47, the EC called the Doctor on standby, regarding individuals with Iodine sensibility. The Doctor recommended to administer the single dose Iodine tablet to even those who are iodine sensitive and monitor the symptoms. - The basis of the recommendation did not consider pregnant or breastfeeding women, children, adults, and medical conditions of the evacuees. This is a repeat finding from 2023 RNEE raised at MDMC.

9.3 Media Centre

Evaluation of the response at Media Centre included, but not limited to, activation of the Media Centre (MC), communication to the public through media release, communication equipment, radio stations, social media, and communication with relevant stakeholders. The information below summarises the areas of compliance and specific findings.

During the exercise, the Media Centre (MC) was established at the Gate 3 building. The Centre was equipped with essential communication equipment, including laptops with 3G Wi-Fi connectivity and cell phones, and the communication team was available and prepared to support emergency response activities. Media statements were prepared in consultation with the ECC and advice of the technical advisor and were approved by EC.

The media centre demonstrated the ability to use social media as a tool to monitor and instantly communicate the facts about the emergency to the public. The communication between the ECC, MC, and the off-site Media stakeholders was found to be satisfactory. However, areas of improvements were identified.

Area(s) of non-compliance(s)

None

Observation(s)

No.	Observation
O-7.	The Necsa Media Centre procedure ES-WIN-3540 does not provide clear guidance on decisions concerning media briefings.
O-8.	The alternative Media Centre located at Necsa Gate 3 was not fully equipped and lacked several items available at the main Media Centre situated in the Visitors Centre. Only laptops, cell phones, connectivity for receiving emails, and maps were available. The Media Centre (MC) lacked television sets to monitor current developments regarding the emergency, had no telephone lines to receive queries from the public or media houses, and no KIO_3 tablets were available for the protection of the communication team.

9.4 Field Team

Evaluation of FT response included, but not limited to, communication with the FTL, protection of emergency workers, functionality of monitoring equipment, and capability of the responders to implement response actions. The information below summarises the areas of compliance and specific findings.

Following activation and deployment, the Field Team (FT) vehicle (Zulu 1) was manned at 22H15 and proceeded to conduct the necessary inspections, including testing the operability of instruments such as the Electra using a source check. The Zulu 1 vehicle was equipped with functional GPS, Breathing Apparatus (BA), EPDs, air sampler as well as KIO_3 tablets. The Field Team and the Field Team Leader communicated primarily through WhatsApp to coordinate deployments and monitor field activities.

The Field Team Leader provided guidance through the cell phones regarding the appropriate PPE to be used including overalls, safety shoes and instructions on when to wear the respiratory protection. Field Team members dose readings from their personal dosimeter (EPDs) were consistently reported to Field Team Leader. The Field Team members demonstrated strong knowledge of their duties throughout the duration of their deployment.

Area(s) of non-compliance(s)

None

Observation(s)

No.	Observation
O-9.	There was a delay in communication from the Field Team Leader (FTL) in instructing Field Team (FT) to evacuate from areas with high radiation levels during deployment at P-1900 waypoint. As a result, FTs had to make independent decisions to move to safer locations without formal direction. This indicates a weakness in the command-and-control structure during the emergency response, which could put the safety of personnel at risk.

9.5 Ground Shout

Evaluation of the GST included, but was not limited to, assessing the provision of public instructions, warnings, and relevant information; the protection of emergency workers; the functionality of communication equipment; and communication with the FTL. The information below summarises the areas of compliance.

Upon activation at 05:10, the Ground Shout Vehicle (GSV) and accompanying trailer were available at the ECC. The GSV public communication equipment was tested for functionality and there were pre-recorded tapes for different emergency situations. The GSV was equipped with an Electronic Personal Dosimeter (EPD), two Breathing Apparatus units, and a set of earplugs to protect the operator during broadcasting. KIO_3 tablets were also administered.

FTL communicated that Sector 6 was affected by the plume and instructed the GST to cover the specified area. The FTL also outlined necessary safety measures, including the use of personal protective equipment. The GST acknowledged these instructions and confirmed adherence to all safety protocols during deployment. The overall response of the GST was satisfactory.

Area(s) of non-compliance(s)

None

Observation(s)

None

9.6 Gate 3

The evaluation of the Gate 3 security officers' response included, but was not limited to, their coordination with the EC, protection of emergency workers, and the functionality of communication equipment. The information below summarises areas of compliance and outlines specific findings.

As the exercise was conducted after hours, all security responses were coordinated from Gate 3, while the other Necsa gates remained closed. At 21H10, Gate 3 was closed, and the security guards mustered in the duty room in accordance with instructions received from the ECC. As per the procedure, a 'NO ENTRY' sign was displayed at the gate, and only emergency vehicles were permitted to enter and exit the Necsa site.

The KIO_3 tablets were also available in the security Duty Room. Two-way radios were available and functioned effectively throughout the emergency exercise, maintaining continuous communication with the ECC. Gate 3 security personnel demonstrated compliance with established emergency procedures and adhered to instructions issued by the ECC and the Security Control Room, however, areas of improvement were identified.

Area(s) of non-compliance(s)

None

Observation(s)

No.	Observation
O-10.	Although the plume did not impact the area around Gate 3, there was no consideration for SSD personnel stationed at Necsa Gate 3 to wear or have PPE and EPDs readily available for use in the event of a change in wind direction. Before security personnel were exempted for the exercise, It was noted that they left the muster area to carry out their duties during the exercise, were not equipped with PPEs and EPDs.

9.7 Madibeng Disaster Management Centre (MDMC)

The evaluation of the MDMC response include but not limited to the notification and activation of JOC functionaries, decision-making processes, recommendation for declaration of national state of disaster, implementation of public protective actions, communication to the public,

protection of emergency workers, functionality of communication equipment, and the capability of responders to implement response actions.

Following receipt of the emergency notification from Necsa at 21H15, the Duty Operator at the MDMC notified and activated the Head of the Centre, along with all the required off-site response functionaries. The Duty Operation adequately followed the procedures for the activation of MDMC JOC. The Head of Centre (HOC) and functionaries responded timeously within the required timeframe. The JOC was equipped with large Necsa aerial map, telephones and screens for display. The Joint Decision-Making Team members were activated and responded virtually, with all communication adequately maintained via WhatsApp. The HOC notified the Necsa EC that the JOC was operational as required by the procedure.

The Joint Decision-Making Team demonstrated effectiveness and sound judgment by rejecting the recommendation to declare a national state of disaster, as there was no off-site impact. There was continuous communication between the MDMC and the Necsa ECC, with the HOC consistently updating JOC members on developments as information was received from the Necsa ECC. A media briefing was drafted and consulted with the Madibeng Media Officer and subsequently with Necsa, following which it was issued. The JOC team demonstrated a good safety culture by facilitating discussions to ensure alignment regarding the implementation of protective actions.

Area(s) of non-compliance(s)

No.	Procedure requirement	Finding(s)	Comments
NC-8	**MDMC-PR-3001-Section 7** On receipt of the notification the Duty Operator shall immediately confirm receipt by email confirmation to the Necsa ECC	There was no email submitted to Necsa to acknowledge the notification of emergency.	Notification was acknowledged telephonically instead of email as required. Acknowledging the notification telephonically only, limits traceability and accurate record-keeping
NC-9	**MDMC-PR-3001-Section 8.1** “When an ALERT or GENERAL EMERGENCY	The appropriate emergency classification message was not marked	Calls were made using Annexure 2, however, the classification of emergency was not marked.

No.	Procedure requirement	Finding(s)	Comments
	is declared, the Duty Operator will immediately contact those designations as listed on the Alert Notification form (Annexure 2) …" "Mark the appropriate EMERGENCY CLASSIFICATION massage with an" X" and read the appropriate massage to the functionary."	in the form (Annexure 2) as required.	
NC-10	**MDMC-PR-3001-Section 8.1** Activated functionary must sign "Annexure 4" on their arrival at MDMC (JOC)	Some functionaries did not sign Annexure 4 upon arrival.	

Observation(s)

No.	Observation
O-11.	The NNR issued a cue informing the MDMC JOC that a group of concerned members of the public had volunteered to assist with the emergency response, particularly at the Mass Care Centre. However, a joint decision was made to deny assistance from volunteers. This action was not in alignment with the provisions of the Disaster Management Act, Act 57 of 2002, which requires arrangements should be made for volunteer involvement in disaster management.

10 EVALUATION OF FINDINGS AND COMPARISON TO SPECIFIC OBJECTIVES

This section presents the evaluation and alignment of the specific objectives with the findings identified during the exercise, including both non-compliances and observations, as outlined in Section 9 above. A total of twenty-one (21) findings were identified during the 2025 Regulatory Nuclear Emergency Exercise (RNEE) at Necsa, comprising of 10 non-compliances and 11 observations.

10.1 Identification, Classification and Reporting of an Emergency

The overall performance for this objective was assessed as satisfactory. The SAFARI-1 Research Reactor Response Team effectively identified and classified the emergency in line with established procedures and ensured timeous notification of the Emergency Control Centre (ECC). There was no non-compliance related to identification, classification and reporting of emergency at SAFARI-1 Research Reactor location and the overall performance was found to be satisfactory. However, an area for improvement in the form of observation was identified concerning the redundancy and availability of power supply systems in the Emergency Control Room for the reactor.

10.2 Notification, Activation and Response of the On-Site and Off-Site Emergency Functionaries

The findings related to the specific objectives are categorised as follows:

1) NC-1 and NC-2 were raised against activation and declaration of emergency.
2) NC-08, NC-09, NC-10 and O-2 were raised against Notification and activation of emergency functionaries at MDMC.
3) NC-5, NC-7, O-1, O-6 and O-11 were raised against response to the emergency.

a) The notification of the emergency by the ECC operator to activate ECC functionaries was assessed as satisfactory and conducted in accordance with established procedures. However, areas for improvement were identified concerning the use of correct forms by the ECC operator during activation. Additionally, it was noted that environmental monitoring by the Field Teams (FTs) was not adequately implemented during the response.
b) Notification of the emergency event by Necsa to the MDMC was made in a timely manner; however, it was not conducted in accordance with the established procedure.

Activation of the MDMC functionaries was carried out, with some functionaries responding physically at the Centre, while others participated virtually, particularly during the overnight response.

The overall performance of this objective was found to be partially satisfactory. Areas of improvement in form of non-compliances and observations were identified for both Necsa and MDMC.

10.3 Effectiveness of Communication Arrangements Between On-Site and Off-Site Organisations

The findings are categorised as follows:

1) O-9 was raised against on-site communication arrangements.

a) On-site communication between the Emergency Control Centre (ECC), SAFARI-1 Research Reactor, security at gate 3, Field Teams (FTs), Ground Should Team (GST), and Field Team Leader (FTL) within the ECC was effective and conducted in accordance with established procedures. Communication between the ECC and the Media Centre (MC) was also assessed as acceptable.
b) Communication between ECC and MDMC was found to be acceptable.

The overall communication arrangements were assessed as satisfactory. However, an area for improvement in the form of observation was identified for Necsa.

10.4 Implementation of Urgent Protective Actions

The following findings were identified under implementation of urgent protective actions: NC-3, NC-4, NC-5 and NC-7.

1) The on-site protective actions were implemented promptly, prior to the release of radioactivity to the environment, and were assessed as adequate for the protection of on-site employees. The on-site and off-site emergency decisions, the on-site emergency alarm, on-site communication, and the evacuation of all non-essential staff were promptly implemented. However, on-site employees were evacuated without the necessary steps being taken for accounting and reporting following mustering.

2) The implementation of urgent protective actions for the public was delayed as Necsa delayed determining the impact of the second release of radioactive material to the environment.

The overall implementation of urgent protective actions was found to be partially satisfactory. Areas of improvement in the form of non-compliances were identified for both Necsa and MDMC.

10.5 Implementation of Early Protective Actions

The following observation were identified under implementation of early protective actions:
O-3, O-4 and O-5.

1) The implementation of the early phase protective actions was demonstrated to be satisfactory. Decision-making and communication to the MDMC related to monitoring and mapping of the affected area was satisfactory. The recommendation and decision to lift the food ban were made following monitoring and assessment. However, an area of improvement in the form of observations was identified and it is related to the undocumented procedure for termination of emergency.

The overall implementation of early protective actions was found to be satisfactory.

10.6 Protection of Emergency Workers from Exposure to Radioactive Material

The following findings were identified under protection of emergency workers:
NC-6, O-9 and O-10.

1) During the exercise, the protection of emergency workers was observed to be acceptable for the security personnel escorting the responders, the ground shout team and the off-site responders, as considerations for ALARA, appropriate PPE, and the provision of KIO_3 tablets were made. However, areas of improvement in the form of non-compliance and observations were identified, as the KIO_3 tablets were also not administered to the emergency response functionaries at SAFARI-1 Research Reactor Building P-1800, adequate protection was not provided to the ECC responders, as well as the security at gate 3.

The overall protection of emergency workers was found to be partially satisfactory.

10.7 Evaluation of Communication to the Public

The following findings were identified under communication to the public:
NC-8, O-7 and O-8.

Communication to the public through Media Centre was found to be made as required by the procedure. However, there was a delay on issuing public instructions and warning as the Ground Shout Vehicle was only deployment at 05H00 in the morning.

The overall performance regarding communication to the public was found to be partially satisfactory. Areas of improvement in the form of non-compliance and observations were identified and require urgent attention by Necsa and the MDMC.

10.8 Evaluation of Functionary Standby/Shift Arrangements in a Prolonged Emergency

Arrangement for standby/shift for operators at the SAFARI-1 Research Reactor, ECC response functionaries and MDMC was noted and satisfactory. The overall arrangements for standby rosters and shift response in urgent and early phases of an emergency were satisfactory.

11 CONCLUSION

Of the 21 findings identified during the exercise, 10 were non-compliances and were graded according to their safety significance as follows: five (5) are graded Green, two (2) are graded Yellow, three (3) are graded Orange. Therefore, the final ranking of the exercise is Yellow.

Taking into considering the specific objectives evaluated during the exercise, Necsa and the MDMC demonstrated a satisfactory application of emergency preparedness and response actions, in line with the exercise objectives and procedural requirements. However, several areas for improvement were identified to enhance the overall effectiveness of emergency response implementation. It is concluded that the Necsa Emergency Plan (SHEQ-INS-3500) remains viable for ensuring the protection of persons, property, and the environment, and its associated procedures were effectively implemented during the exercise.

Necsa is required to address the identified non-compliances and observations to ensure further improvement of the emergency response plans and procedures, and to submit a corrective action plan outlining how these findings will be addressed by no later than 15 December 2025.