Vaalputs National Radioactive Waste Disposal Facility

Public Information Document (PID)

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REVISION HISTORY

This document has been revised as follows:

Revision	Date	Nature of Revision
0	February 2020	First submission for NNR acceptance.
1	December 2020	Addressed NNR comments as per NAPP08B0046.
2	July 2021	Addressed NNR comments as per NAPP08B0062.
3	August 2021	Addressed NNR comments as per NAPP08B0066.
4	October 2021	Address NNR comments as per NAPP08B0069.
5	November 2021	Address NNR comments as per NAPP08B0070.

1 PURPOSE

The purpose of the Public Information Document (PID) is to provide members of the public with sufficient information to ensure meaningful public participation in the National Nuclear Regulator's regulatory process in terms of NRWDI's application for a nuclear installation license. The regulatory process for public participation is in accordance with Section 21 of the National Nuclear Regulator Act (Act No. 47 of 1999).

2 INTRODUCTION

Most industries produce waste, some of which is radioactive. Radioactive waste is produced, e.g., during the operational and decommissioning phases of installations associated with the operation of nuclear reactors, production and use of radioactive materials in the fields of research, medicine, industry, agriculture, commerce, education and the extraction, processing and combustion of raw materials containing naturally occurring radioactive materials, etc. Due to the hazardous nature of radioactive waste, such waste is disposed of in regulatory authorised disposal facilities specifically designed for ensuring that the waste is isolated from people and the environment (biosphere and geosphere) until such time that the radioactivity has decayed to the extent that it poses no further hazard to people and the environment. The majority of the radioactive waste volumes generated during these activities is classified as Low-level Waste (LLW)[1], while the rest can be made up of Very Low-Level Waste (VLLW), Intermediate Level Waste (ILW) and High-level Waste (HLW).

Vaalputs is the national facility for the disposal of low-level radioactive waste and situated in the Northern Cape Province. Vaalputs is currently managed and operated by the South African Nuclear Energy Corporation (Necsa). Since the inception of Vaalputs in 1986, the land was zoned for the purpose of establishing a national site

[1] LLW in this document and the Vaalputs Waste Acceptance Criteria means the same as Low and Intermediate-Level Waste (Short-lived) (LILW (SL)) as defined in the Radioactive Waste Management Policy and Strategy for the Republic of South Africa (DoE, 2005).

for disposing South Africa's low-level radioactive waste. There are no plans to re-zone the site for any other purposes.

Only LLW that comply with the Vaalputs Waste Acceptance Criteria is currently accepted for disposal at Vaalputs. Although NRWDI is mandated by virtue of Section 5(b) of the NRWDIA to implement disposal solutions for all classes of radioactive waste, the future disposal of other classes of radioactive waste (e.g., ILW and HLW) is outside the scope of the current application and will in future be dealt within the applicable legislative and regulatory frameworks.

Vaalputs was licensed by the Council for Nuclear Safety (CNS) (now known as the National Nuclear Regulator) before commencing operations in 1986. Since commencement of its operations, Vaalputs is managed and operated by the South African Nuclear Energy Corporation (Necsa) under authorisation of Nuclear License 28 (NL28) which was replaced with Nuclear Installation License NIL-28 in December 2011.

The National Radioactive Waste Disposal Institute Act (NRWDIA), (Act No. 53 of 2008) was proclaimed by the President of the Republic of South Africa in Government Gazette no. 32764 and became effective on the 1st December 2009. Promulgation of the NRWDIA resulted in the establishment of NRWDI. NRWDI's mandate is to manage radioactive waste disposal on a national basis by executing the functions as per the Section 5 of the NRWDIA. NRWDI's mandate includes the management, operation and monitoring of operational radioactive waste disposal facilities. Vaalputs is currently the only authorised operational radioactive waste disposal facility for LLW.

According to Section 3 of The National Radioactive Waste Disposal Institute Act, 2008 (NRWDIA) (Act No. 53 of 2008), NRWDI is wholly-owned by the State. NRWDI is listed as a Schedule 3A public entity in terms of the Public Finance Management Act (Act No. 1 of 1999 (as amended)). According to Sections 30 (1) (a) and 30 (9) of the NRWDIA, all Necsa's assets, rights, liabilities, licenses, authorisations, obligations and properties with regards to Vaalputs, vest in NRWDI.

2.1 History of compliance with the regulatory requirements

Vaalputs has been in operation since 1986. All operations at the disposal facility are performed in compliance with the requirements of the nuclear installation licence issued by the NNR in terms of the National Nuclear Regulator Act (Act No. 47 of 1999).

The safety performance of the disposal facility system has been assessed by means of the Post-closure Radiological Safety Assessment and the safety information was consolidated in the Vaalputs safety assessment report. The assessment results showed that the radioactive waste can be safely disposed of in the disposal trenches at Vaalputs and that the modelled data of projected radiation exposure to humans and the environment are at levels considered to be acceptable as appraised against the applicable regulatory and international safety standards.

The international principle of ALARA (As Low As Reasonably Achievable) is applied to the disposal facility operations, which would result in constantly striving for lower radiation exposure to personnel and the environment, all social and economic factors taken into account. Conventional operations comply with the requirements of the applicable regulations of the Occupational Health and Safety Act (Act No. 85 of 1993) as well as requirements of other applicable standards and regulations.

Regular audits and inspections on conventional safety, radiological safety, environmental surveillance, nuclear licence compliance and quality are conducted at the Vaalputs site. A comprehensive radiological environmental monitoring programme is integrated within the Management System for Vaalputs (see also Section 7.2) and covers a radius of up to 20 km from the disposal trenches. Monitoring results are reported to the NNR and compared to the pre-operational baseline environmental monitoring data. The annual monitoring results show that, since its inception, no environmental radiological impact could be detected as a result of the Vaalputs operations.

To accomplish the strategic goal of continuously improving, maintaining and further developing Vaalputs as a world class near surface disposal facility, much effort is applied in keeping abreast with international waste management and disposal practises as well as evolving regulatory requirements. Matters regarding Vaalputs' nuclear safety, radiation safety and nuclear incidents/accidents are communicated to local communities, surrounding farmers, local authorities, government bodies and any other interested and affected parties on a quarterly basis via the Vaalputs Public Safety Information Forum that was established in terms of the National Nuclear Regulator Act (Act No. 47 of 1999).

2.2 Similar Projects worldwide

Disposal of radioactive waste in near surface trenches is a disposal option practised in a number of countries. This option is suitable to dispose of radioactive waste that contains short-lived radionuclides of low or medium specific activity and with only very low amounts of long-lived radionuclides. The near surface disposal trenches are typically located above the groundwater table within a layer of low permeability material which has good retention characteristics for the radionuclides present in the waste. The conceptual design of the facility in terms of safety includes the defence-in-depth or multi-barrier system approach that entails a combination of climatic characteristics, geological characteristics, waste conditioning, waste packaging requirements and the disposal site characteristics.

Examples of other countries that use near surface disposal concept for radioactive waste are:

- Spain which have been operating a near surface waste disposal facility for radioactive waste for since 1992;
- Czech Republic now operates three near surface waste disposal facilities, the first facility came into operation in 1964; and
- France operates two near surface waste disposal facilities, the disposal of radioactive waste into a near surface trenches started in 1969.

3 APPLICANT'S INFORMATION

Table 1: Applicant's information

The applicant's full name	National Radioactive Waste Disposal Institute (NRWDI)
Physical Address [2]	Elias Motsoaledi Street Extension (Church Street West) R104 Pelindaba Brits Magisterial District Madibeng Municipality North West Province 0240
Company registration number/incorporation number	N/A Section 3 of The National Radioactive Waste Disposal Institute Act (NRWDIA) (No 53 of 2008) established a juristic person known as NRWDI, as wholly-owned by the State., NRWDI is listed as a Schedule 3A public entity in terms of the Public Finance Management Act (Act No. 1 of 1999 (as amended)
Date of Incorporation	1st December 2009 as per Government Gazette No 32764.
Registered Address	Elias Motsoaledi Street Extension (Church Street West) R104 Pelindaba Brits Magisterial District Madibeng Municipality North West Province 0240 **Postal address:** Private Bag X1, Pretoria, 0001 Gauteng Province Republic of South Africa
The address of the facility	**Physical address:** Vaalputs National Radioactive Waste Disposal Facility Vaalputs farm (portion 1: Geelpan, portion 2: Garing) and Bokseputs (portion 1: Stofkloof) Kamiesberg Magisterial District Northern Cape Province **Postal address:** Private Bag X7 Springbok Northern Cape Province 0240
Details of any holding or subsidiary companies	Wholly owned by the State

[2] *The NRWDI Head Office is currently located in the North West Province. The physical separation of the Head Office from the Vaalputs site in the Northern Cape Province is not regarded as a risk in terms of Management's oversight, accountability and responsibility from an operational and compliance perspective as adequate management systems, support structures and control measures have been put in place to manage risks and to provide effective oversight.*

Details of any foreign involvement or control of /nuclear installation by and foreign cooperation/government	None

4 PROJECT DESCRIPTION

The current disposal concept at Vaalputs is based on near-surface disposal consisting of trenches up to 8 metres deep located above the groundwater table. The disposal concept incorporates the Multiple Barrier System (MBS) approach and includes the Natural Barrier System (NBS) (i.e., the near field, geosphere and biosphere) and Engineered Barrier System (EBS) (i.e., the conditioned waste form, the waste container and any other engineered enhancement).

Safety assessments, which incorporate the near-field, geosphere and biosphere, have demonstrated that the disposal facility is being operated without compromising the safety of current and future generations by, amongst other:

- Providing a high level of operational and long-term safety.
- Demonstrating compliance with performance standards.
- Preventing or delaying movement of radio nuclides toward the accessible environment (i.e., biosphere and geosphere).
- Can be safely closed once all operations have ceased, given that the necessary after care measures are taken within the institutional control period.

4.1 Process Overview

The disposal concept for LLW is near-surface disposal consisting of near surface trenches (see **Figure *1***) located in the region above the groundwater table as shown in **Figure 11**. **Figure 2** shows that trenches are excavated in the surficial cover which is on average 50 m thick. The surficial cover generally consists of an overlying layer of topsoil (sand) approximately 0.5 m thick, a layer of indigenous calcrete 1 to 2 m thick and the clay material that extends down to the underlying granite layer. The sand, calcrete and clay material excavated from the trenches are kept separate in the stockpiling area and is later used to backfill and cap the trenches that have been filled with waste. **Figure 5** shows how steel waste packages are placed in a disposal trench.

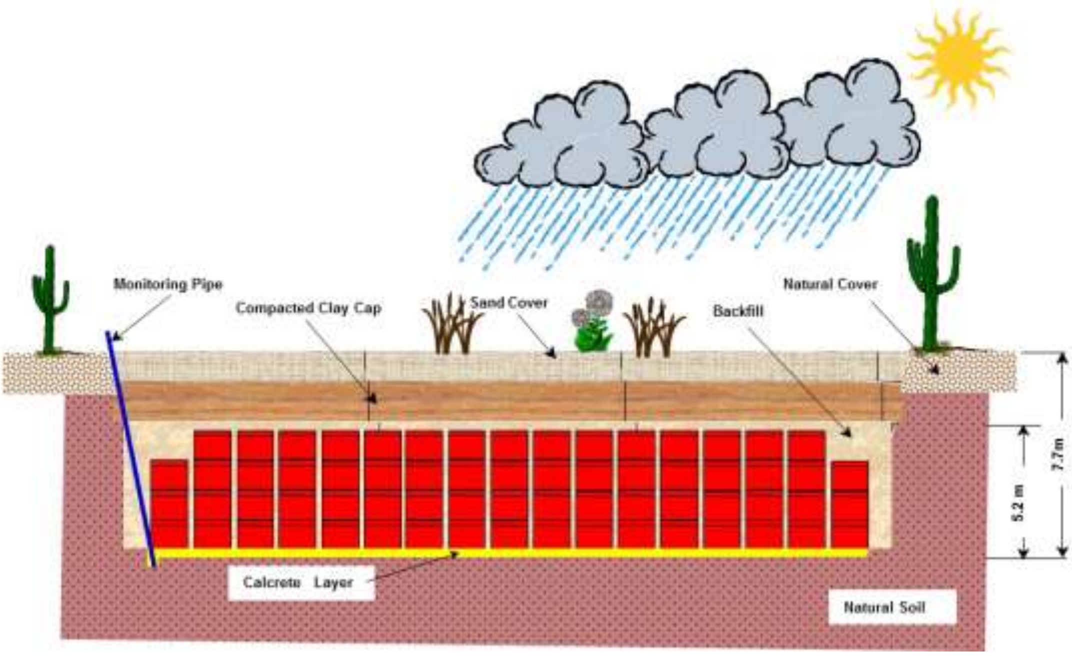

Figure 1: Graphical illustration of the Vaalputs LLW near-surface disposal concept (not to scale)

Figure 2: LLW near-surface disposal trench at Vaalputs

4.2 Description of the process

The authorised activities for Vaalputs are:

- Receipt of Low-level Waste in approved waste packages.
- Temporary Storage of waste packages in the shielded storage area in the reception hall.
- Transfer of radioactive material and contaminated equipment to other facilities authorised to receive such material and equipment.
- Disposal of Low-level Waste packages in near surface trenches.

The waste disposal process is as follows:

- Waste generators that want to dispose radioactive waste at Vaalputs, must apply to the Chief Executive Officer of NRWDI for a disposal certificate in a prescribed format as stipulated in Section 23(1) of the NRWDIA. The Chief Executive Officer shall assess the application for compliance with the radioactive waste acceptance and disposal criteria and may (subject to Board approval) either grant or refuse the application.

- Pre-shipment inspections are done at the waste generator's site on a scheduled or ad-hoc basis.
- The required documentation (data pack) is forwarded to Vaalputs and compliance with the Waste Acceptance Criteria is checked (administratively) prior to the waste packages being shipped to Vaalputs.
- If the data packs comply with the Vaalputs Waste Acceptance Criteria, the Vaalputs Manager formally approves the waste shipment.
- The waste generator ships the approved waste package shipment to Vaalputs.
- On arrival at Vaalputs (see **Figure 3**), a receiving inspection is done to ensure compliance with the Waste Acceptance Criteria (see **Figure 4**).
- If the results of the inspection show compliance with the Waste Acceptance Criteria, the waste package shipment is transported to the appropriate trench for final disposal (see **Figure 5**).
- If the results of the tests do not comply with the Waste Acceptance Criteria, a non-conformance is registered and the appropriate corrective action implemented (e.g. returning non-conforming waste packages to the waste generator).
- Waste packages are stacked in the trenches as close together as possible and the trenches are then back filled with screened clay (see **Figure 6**).
- Steel waste packages are covered within one month and concrete waste packages within two months after emplacement.
- Trenches are backfilled and capped using clay as soon as they are full (see **Figure 7**).
- Backfilling and capping operations are performed under strict radiation protection-supervision to assess and control radiation exposure to personnel.
- After a disposal trench had been backfilled and capped, it is rehabilitated (see **Figure 8**).

Figure 3: Arrival of Waste Packages at Vaalputs

Figure 4: Receiving Inspection

Figure 5: Disposal of waste packages into near surface trenches

Figure 6: Backfilling of near surface trenches after emplacement of waste packages

Figure 7: Capping of near surface disposal trench

Figure 8: Rehabilitated near surface disposal Trench

4.3 Radioactive material to be used

Vaalputs can accept LLW from any authorised nuclear installation if the LLW complies with the Vaalputs Waste Acceptance Criteria. Vaalputs currently receives solid or solidified Low-level Waste (LLW) appropriately characterised, conditioned and packaged in accordance with the Vaalputs Waste Acceptance Criteria from the two main waste generators, namely Koeberg Nuclear Power Station (KNPS) and the South African Nuclear Energy Corporation (Necsa). The KNPS waste consists essentially of compactable and non-compactable waste like redundant equipment, filters, ion-exchange resins, evaporator concentrate waste and contaminated paper gloves, plastic and coveralls in concrete and steel containers. The Necsa waste currently disposed of at Vaalputs consists of solidified Medium Active Concentrates (MAC) in steel containers and solidified NTP liquid waste in concrete containers. The current activity limits for Vaalputs are as described in the Vaalputs Waste Acceptance Criteria and shown in Table 2 below. Any proposed changes to these activity limits will require that the Waste Acceptance Criteria be informed by a safety re-assessment and approved by the NNR. Any waste package that exceeds the indicated activity limits shall not be approved for disposal.

Table 2: Activity limits

	NUCLIDE (/S)	ACTIVITY LIMITS
1	I-129 (site limit)	1.9 x 10^{11} Bq (1.9 x 10^{2} GBq)
2	Tc-99 (site limit)	1.18 x 10^{18} Bq (1.18 x 10^{9} GBq)
3	Long-lived alpha emitting nuclides	• ≤400 Bq/g average per shipment; • ≤4 000 Bq/g per waste package; • Activity evenly distributed within the waste form.
4	Long-lived beta / gamma emitting nuclides	Factor 10 higher than (3) above

	NUCLIDE (/S)	ACTIVITY LIMITS
OR	Long-lived alpha, beta and gamma emitting nuclides in excess of activity limits as specified in 3 and 4 above.	Activity concentration levels that could result in inherent intrusion dose (the intrusion dose assuming the radioactive waste is spread on the surface) below 10 mSv per annum.
6	All other nuclides	The activity per waste package shall comply with the Low Specific Activity Material (LSA) or Surface Contaminated Object (SCO) transport limits as per the IAEA Safety Standards Series No. SSR-6, Regulations for the Safe Transport of Radioactive Material, IAEA, Vienna, 2012.

The total Vaalputs disposal inventory from Koeberg and Necsa for different types of waste packages is presented in Table 3 below.

Table 3: Summary of the number of waste packages and total nuclide inventory for LLW received from KNPS and Necsa as at 31st December 2019.

Waste generator	**Waste package type**		**Total activity on 31 December 2019 (GBq)**
	Steel	**Concrete**	
Koeberg Nuclear Power Station	21 415	3 991	5.15×10^{04}
Necsa	6 154	420	1.75×10^{05}
TOTAL	**27569**	**8441**	$\mathbf{2.27 \times 10^{05}}$

4.4 Exposure to radiation

An assessment on annual dose and mortality risk to the worker and member of the public during normal operations and accident conditions was conducted for Vaalputs. The dose from external radiation to members of the public during normal operations is zero, since the public is not allowed in the facility building and trenches when waste packages are received, inspected and disposed. The dose to workers from identified risks are outlined in the sections below.

4.5 Normal occupational exposure (planned exposure)

Vaalputs workers are exposed to external radiation when carrying out the following activities:

- Conducting receiving inspections, quality checks, measuring dose rates, and taking smear samples to determine whether the waste packages conform to the Vaalputs Waste Acceptance Criteria;
- Off-loading and emplacing waste packages by crane in the trenches; and
- When backfilling and capping trenches filled with waste packages.

The NNR requires that every worker (radiation worker) at Vaalputs be subjected to routine medical examinations to ensure they are fit to work in a radiation environment. Radiation workers are further continuously monitored for radiation exposure through, e.g., the use of Electronic Pocket Dosimetry (EPD) and thermo-luminescent dosimeters (TLDs).

The regulatory dose limit for planned exposure for radiation workers is an average effective dose of 20 mSv per year over five consecutive years with a maximum effective dose of 50 mSv in any single year. In addition, the regulatory equivalent dose limit for the lens of the eye is 150 mSv per year and the equivalent dose limit for extremities (hand and feet) or skin is 500 mSv per year.

Over the past 9 years, the measured individual dose of radiation workers was 1.34 mSv/a, which is 14.9 times lower than the regulatory limit of 20 mSv/a for the average effective dose.

Dose rate measurements on concrete and steel waste packages are recorded in the shipment data packs and the Radiation Protection Officer (RPO) survey data sheets. The dose rates from the waste packages are used in the dose calculations. The activity that gives higher radiation exposure to workers is capping of waste packages in the trenches with a total modelled annual dose of 17.380 mSv/a for the capping activities. The capping is therefore done by several workers in order to spread the dose amongst the workers to ensure the doses remain within the ALARA goal of 4 mSv per year.

The worker doses at Vaalputs are within regulatory limits. Radiation exposure of workers at Vaalputs are subject to control by the Operational Radiation Protection Programme. This programme ensures that control within the annual individual dose limit is achieved. In addition, the programme also serves to ensure that all doses are kept ALARA.

4.6 Risk analysis for emergency exposure situations

Scenarios that may cause releases from the waste packages emplaced in the trenches have been identified, namely that waste packages may be dropped and rupture during crane lifting, and radioactivity released that may cause some risks to the workers. The assessment considered all types of approved waste packages received from Koeberg and Necsa and found the Necsa concrete waste packages to be the most limiting.

For the worst-case scenario (i.e., a Necsa concrete waste package drops due to a failure of lifting or rigging equipment and hit another waste package already packed in the trench) a total dose of 3.28×10^{-05} mSv/a and a total mortality risk[3] of 1.31×10^{-09} mortalities/a for workers was calculated. The exposure that would be received by a member of the public located at 1 km away from such an event was calculated to be 1.50×10^{-09} mSv/a with a corresponding mortality risk of 7.51×10^{-14} mortalities/a.

The maximum annual mortality risk limit for an individual worker is set at 5×10^{-6} fatalities per year per site while the average annual risk limit for workers is 1×10^{-5} fatalities per year per site. The mortality risk limit for members of the public is set at 5×10^{-5} fatalities per year for an individual and an average of 1×10^{-8} fatalities per year per site for a population. The dose limits are set at 20 mSv per year for workers and 1 mSv per year for members of the public.

For the worst-case scenario described above, the potential exposure risk in terms of mortalities as well as in terms of radiation exposure to workers and members of the public, were well within regulatory limits.

[3] *Mortality risk is a medical classification to evaluate the likelihood of death.*

5 SITE DEVELOPMENT STAGES AND ESTIMATED TIMESCALES

Vaalputs, being the National Radioactive Waste Disposal Facility for LLW, shall remain operational until all South Africa's LLW has been disposed of on the site. Vaalputs has adequate disposal capacity to accommodate the LLW disposal requirements for past, current as well as future authorised nuclear installations in South Africa.

Table 4 summarises the current best estimate for the site development phases for Vaalputs. The estimated operational period for Vaalputs is linked to the disposal capacity available for disposal of operational and decommissioning LLW stemming from past, current and future authorised nuclear installations.

The active institutional control period will commence after site closure and would last for up to 100 years. During this period there will still be controls on land use (site usage and occupancy). Having confirmed the passive safety of the site, the site would move into the passive institutional control period, which could last for up to 200 years past the active institutional control period. At the end of the institutional control period (300 years post-closure), a final safety assessment shall be conducted to confirm the passive state of Vaalputs to the extent that all controls applicable to a radioactive waste disposal site could be lifted and that the site could be released from regulatory control for unrestricted future use.

Table 4: Site development phases and estimated timescales

DATE	ESTIMATED TIME SCALE (years)	SITE DEVELOPMENT STAGE	MILESTONES
1983 to 1986	3	Pre-operational Period	• Site selection • Disposal concept design • Safety report • Regulatory authorisation • Disposal facility construction
1986 to 2120	134	Operational period	• Facility commissioning • Nuclear Installation License • Waste disposal operations • Monitoring and surveillance • Post-closure safety assessment • Safety Assessment Report • Closure plan

DATE	ESTIMATED TIME SCALE (years)	SITE DEVELOPMENT STAGE	MILESTONES
2121 to 2124	4	Site closure	• Final radiological survey • Detailed Safety Assessment • Site closure • Detailed decommissioning plan. • Decommissioning (Phases 1 and 2)
2125 to 2225	100	Active institutional control	Active control (e.g., post-closure monitoring, surveillance, corrective action)
2226 to 2426	200	Passive institutional control period	• Passive control (e.g., land use control, markers, records) • Decommissioning (Phase 3) • Final safety assessment
Release of land			
2427 onwards		None	No controls over site (release of land from regulatory control)

6 SITE DESCRIPTION

6.1 Site location, disposal area and facilities

Vaalputs, is located 90 km south-east of Springbok on adjoining portions of the farm Vaalputs (portion 1, Geelpan and portion 2, Garing) and Bokseputs (portion 1, Stofkloof), in the magisterial district of Kamiesberg in the Northern Cape Province and is approximately I0 000 hectares (100 km^2) in area as shown in **Figure 9**.

The current authorised disposal area is situated inside a securely fenced area on the Vaalputs site. The dimensions of this securely fenced area are 900m x 1100m. Within this securely fenced area is the currently authorised disposal area with dimensions of 700m x 500m (approximately 35 hectares). The disposal area is surrounded by a 200 meters exclusion zone.

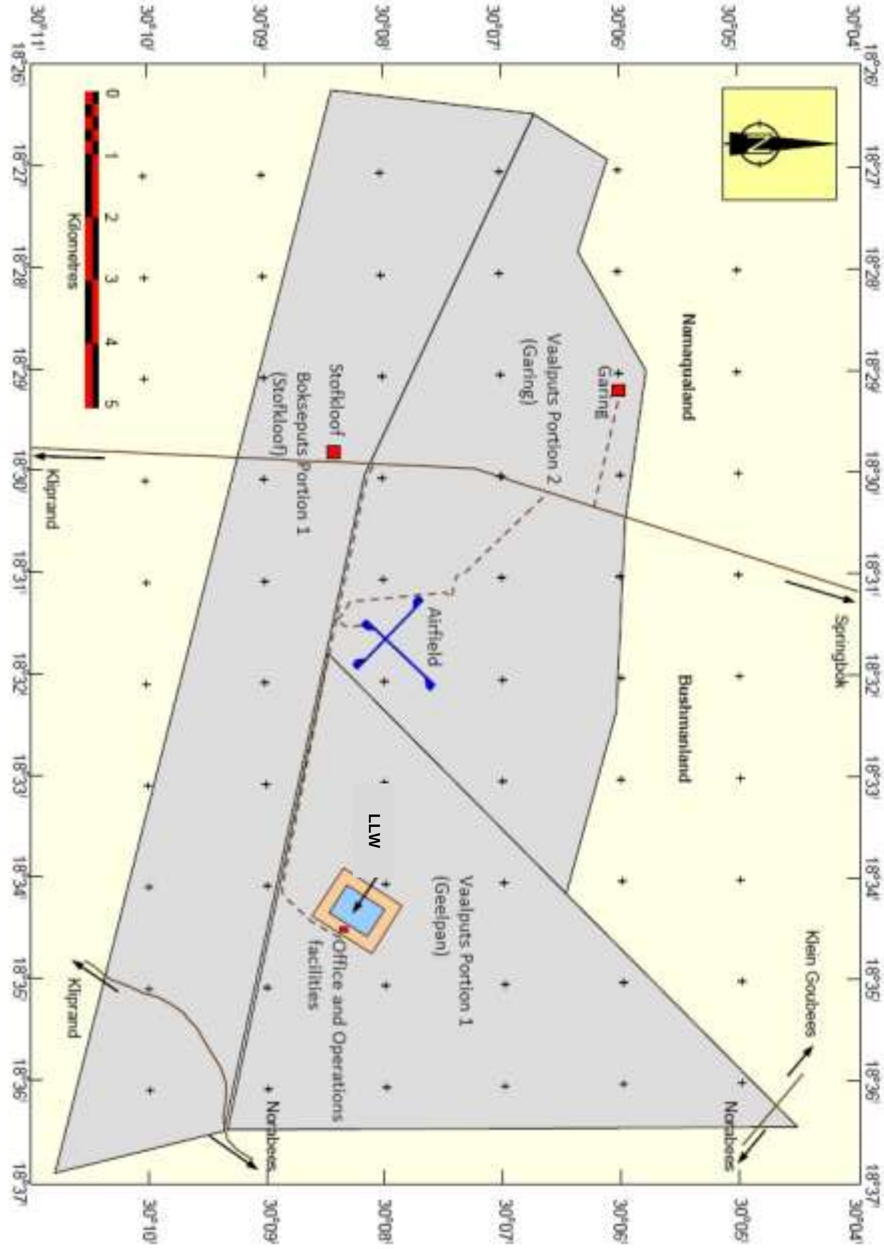

Figure 9: Site boundaries of Vaalputs

Included in the exclusion zone is a building which has an administrative area and an operational area.

- Administrative areas include drivers accommodation area, parking area, reception and display area, staff offices, records room, staff kitchen, ablutions and changing rooms, storage area, diesel storage facility, fire station, back-up generator room, pump room, water reservoir, ventilation system, electrical substation and compressor room; and

- Operational areas include waste reception area, shielded storage area, decontamination area, waste treatment area, mechanical workshop and associated storage facilities, ventilation area, laundry, laboratory, change rooms, sealed sources store, low and medium active liquid storage tanks.

6.2 Site justification

In 1978 a programme was launched to select a suitable site for the disposal of radioactive waste in South Africa. Three potential sites were selected: the central portion of the Richtersveld, the Kalahari, roughly north of Upington, and an area in Namaqualand/ Bushmanland. Based on the geosphere study and the distance from international boundaries and from Koeberg, the Vaalputs Site in Namaqualand/Bushmanland was selected. Some of the factors that contributed to Vaalputs being regarded as a suitable site were:

- Low population numbers;
- Sparse agricultural activities - the main agricultural activity around Vaalputs is sheep farming;
- Low potential for economic mineral exploitation;
- The disposal area on the Vaalputs site is locally elevated above the surrounding area, reducing flooding potential;
- Low seismic activities in and around the Vaalputs area;
- Long-term geological and geomorphological stability.

The Vaalputs site straddles the transition between summer and winter rainfall areas in South Africa which results in semi-arid to arid climate in which evaporation far exceeds precipitation. Topography around the disposal site shows little altitudinal variation not exceeding 43 m within the eastern part of the site (max. alt. 1033 m, min. alt. 990 m).

The Namaqualand / Bushmanland region is characterised by ~130 mm rainfall and ~2800 mm potential evaporation annually. Over 30 years of monitoring have shown the extreme minimum and maximum yearly rainfall to be 30 mm and 305 mm respectively and there is no distinct seasonal peak due. Rainfall occurs primarily as winter showers and autumn thunderstorms however individual storms can produce up to 100 mm of rainfall.

The ambient temperatures range from -5°C to 43°C and 30 years monitoring indicate an extreme minimum of -4.7°C and maximum of 41.5°C. The mean annual temperature is 16.7°C and shows a clear seasonal variation between summer and winter (mean max: February, 33°C; mean min: July, 2.7°C). Frost can be expected on average 20 days per year.

6.3 Natural hazards

The selection of the Vaalputs site was carried out in accordance with internationally accepted site selection criteria which also considered natural hazards that could impact on the waste disposal operations. In terms of natural hazards, the site characterisation process considered the following:

6.3.1 Seismicity

The design basis for Vaalputs is based on the worst-case seismic event of magnitude 6.3 that occurred in Ceres in 1969. Based on this magnitude, it was calculated that a seismic event as large as the Ceres event will not cause any damage to the waste packages and therefore will not result in any release of radioactivity to the biosphere or geosphere. The waste packages typically contain LLW that is solidified in a cement matrix.

6.3.2 Surface erosion

Geological studies pointed towards the long-term geomorphological stability of the region. Surface erosion from wind or water is not a feature of the site and is therefore not expected to uncover waste packages within the facility lifetime.

6.3.3 Flooding

The site lies near a triple-junction of three water sheds and contains no active surface drainage. The site is therefore unlikely to flood and there is no possibility of radioactivity contaminating surface water courses and entering man's food chain by this pathway. Also, the low rainfall combined with the high evaporation rate results in very little surface recharge of the underground water.

6.3.4 Groundwater recharge

The age of the underground water was determined by carbon dating and ranged from 2 000 to 13 000 years. Generally, no water less than 50 years old has been found below the top 4 m of soil and the water contained in the underlying clay layer formations forms an almost static regime. All these factors and the properties of the groundwater system indicate that water movement is very slow and the possibility of water transport of any radioactivity away from the disposal trenches is also be very low.

6.3.5 Ponding

Studies have shown that prolonged storms could result in some ponding in certain areas of the site due to local contour variations. It will be many years before it may be necessary to excavate trenches in the affected areas. However, the situation shall be monitored going forward and any necessary action, such as constructing a storm water drain to divert potential runoff, shall be taken timeously.

6.4 Human induced risks

The release of radioactivity that may have been caused by a human induced event was considered. In this regard, an aircraft crash scenario was assumed and analysed as summarised in Section 6.4.1 below.

For the scenarios described below, the maximum annual mortality risk limit for an individual worker is set at 5×10^{-6} fatalities per year per site while the average annual risk limit for workers is 1×10^{-5} fatalities per year per site. The mortality risk limit for members of the public is set at 5×10^{-5} fatalities per year for an individual and an average of 1 x 10^{-8} fatalities per year per site for a population. The dose limits are set at 20 mSv per year for workers and 1 mSv per year for members of the public.

6.4.1 Aircraft crash

The risk to the worker and member of the public associated with an aircraft crash into the Vaalputs trenches was determined. This scenario postulates that a fully fuelled large commercial jetliner crashes directly into the facility with enough momentum to damage and release all radioactive material from one hundred concrete waste packages on the top layer. The resulting fire that develops and is sustained briefly, releases all radioactive material (from one hundred waste packages) into the atmosphere. The analysis was done for the worst-case scenario using concrete waste packages containing the highest total activity.

Results of the modelled data have shown the following:

- The total dose that a worker can receive at a distance of 100m from the release of the radioactive material is 7 times lower than the regulatory dose limit and the maximum annual mortality risk for the worker is nine million times lower than the regulatory limit for the annual mortality risk; and

- The total dose to a member of the public at a distance of 1 km from the release of the radioactive material, is 25 times lower than the regulatory dose limit and the maximum annual mortality risk for a member of the public is five million times lower than the regulatory limit for the annual mortality risk.

6.5 Demography (population numbers and distribution)

Vaalputs site in relation to neighbouring towns and settlements is as indicated in **Figure 10** below. The population numbers and distances between the Vaalputs site and neighbouring towns and settlements, with their respective localities are summarised in Table 5 below.

Table 5: Population numbers and distances between the Vaalputs site and neighbouring towns.

Town	**Distance (km)**	**Population numbers (Census 2011)**
Okiep	95	6 306
Springbok	90	12 792
Nababeep	100	5 373
Kamieskroon	60	894
Garies	73	2 106
Rooifontein	25	330
Kamassies	25	342
Nourivier	40	459
Tweerivier	55	252
Leliefontein	45	618
Paulshoek	35	414
Kliprand	55	204
Bitterfontein	105	987

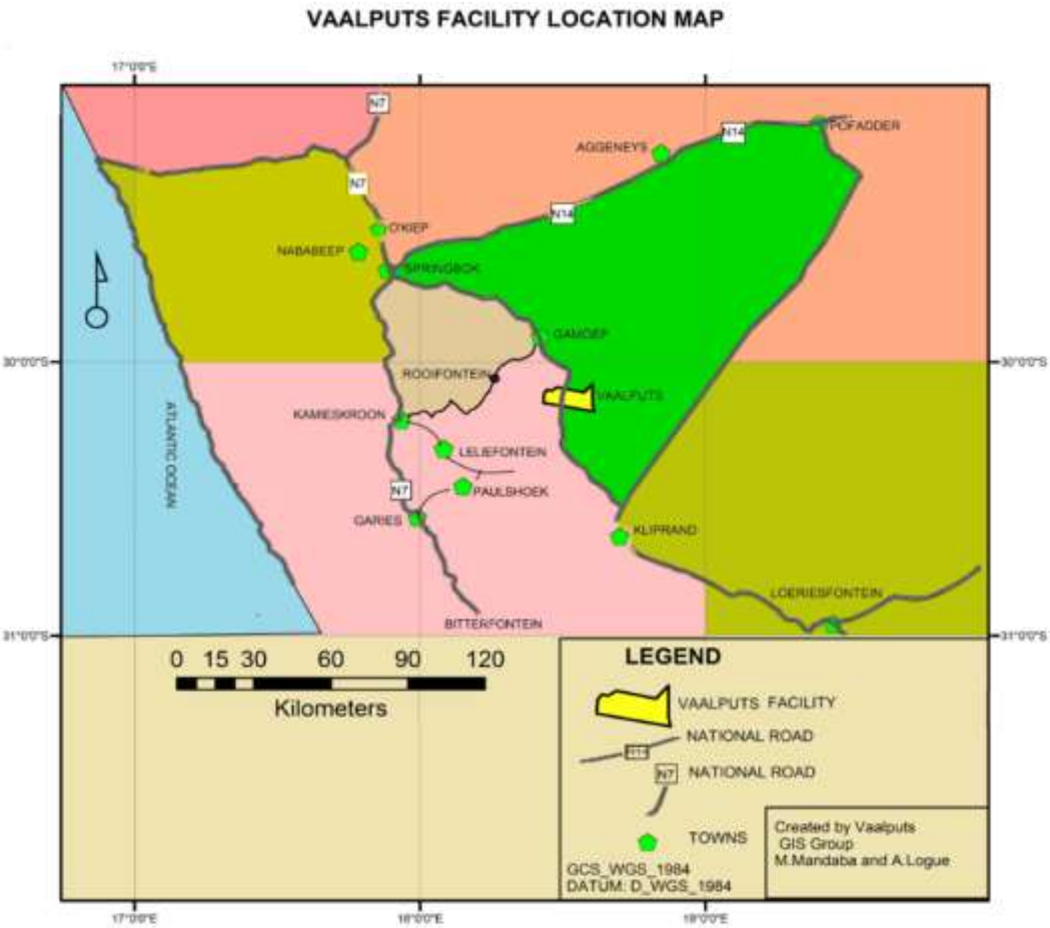

Figure 10: Vaalputs in relation to neighbouring towns and settlements

The potential of future development in the Vaalputs area is very limited due to the following:

- The rural areas around Vaalputs are sparsely populated. The population numbers in a radius of 20 km around Vaalputs varies due to about 35% of the community being migratory. Many farmers have more than one farm and they migrate between these farms according to the summer/winter seasonal rainfall.
- The major agricultural activity around Vaalputs is sheep farming. Vaalputs is situated in a transition area between convectional showers during summer and autumn in the interior and sparse winter rainfall along the west coast. During dry seasons farmers move their sheep to the wetter areas if they are able to do so. Adverse weather conditions have resulted in some farmers deserting their

farming activities altogether. Due to the area remaining essentially semi-arid, it is not expected that the agricultural activity practised will change over time.

- Apart from the development at Vaalputs there is no knowledge of other growth areas in the region. Due to the aridity of the area and low agricultural potential, the permanent population in a 20km radius around may be expected to remain sparsely populated.
- No economic mineral deposits of any type were found in the vicinity of the Vaalputs site during the site investigation and characterisation processes. It is therefore highly unlikely that any economic developments in terms of mining and other industrial activities will be undertaken in the area.

6.6 Potential radiological impact on the public and the environment

The closest towns to Vaalputs are as listed in Table 8 with a combined population of about 31077. The population densities are in accordance with the 2011 national census. The chosen location of Vaalputs with its small growth potential and lack of economically exploitable mineral deposits make it a very unlikely candidate for future socio-economic development. According to the National Radiological Protection Board of the UK, future generations are assumed to inhabit a waste disposal site as a result of loss of institutional control about 100 years after closure of the site. Even if the assumption of anarchy somewhere in the future is made, no other scenario than a sparsely populated rural area can realistically be postulated at Vaalputs.

6.7 Exposure pathways

Safety analysis and results of environmental monitoring have shown that there are no exposure pathways beyond the Vaalputs site boundaries that would result in exposure of the environment or members of the public to radiation dose or mortality risk in excess of regulatory limits.

The long-term impact of the waste disposal activities was assessed in terms of the radioactivity migrating towards the groundwater, which is then assumed to be extracted by a member of the public (neighbouring farmer) and consumed as drinking water. For this scenario as illustrated in **Figure 11** below, the dose to the most exposed individual (i.e., the neighbouring farmer) as a result of drinking this water would be less than the dose constraint of 250 µSv/a for the groundwater pathway.

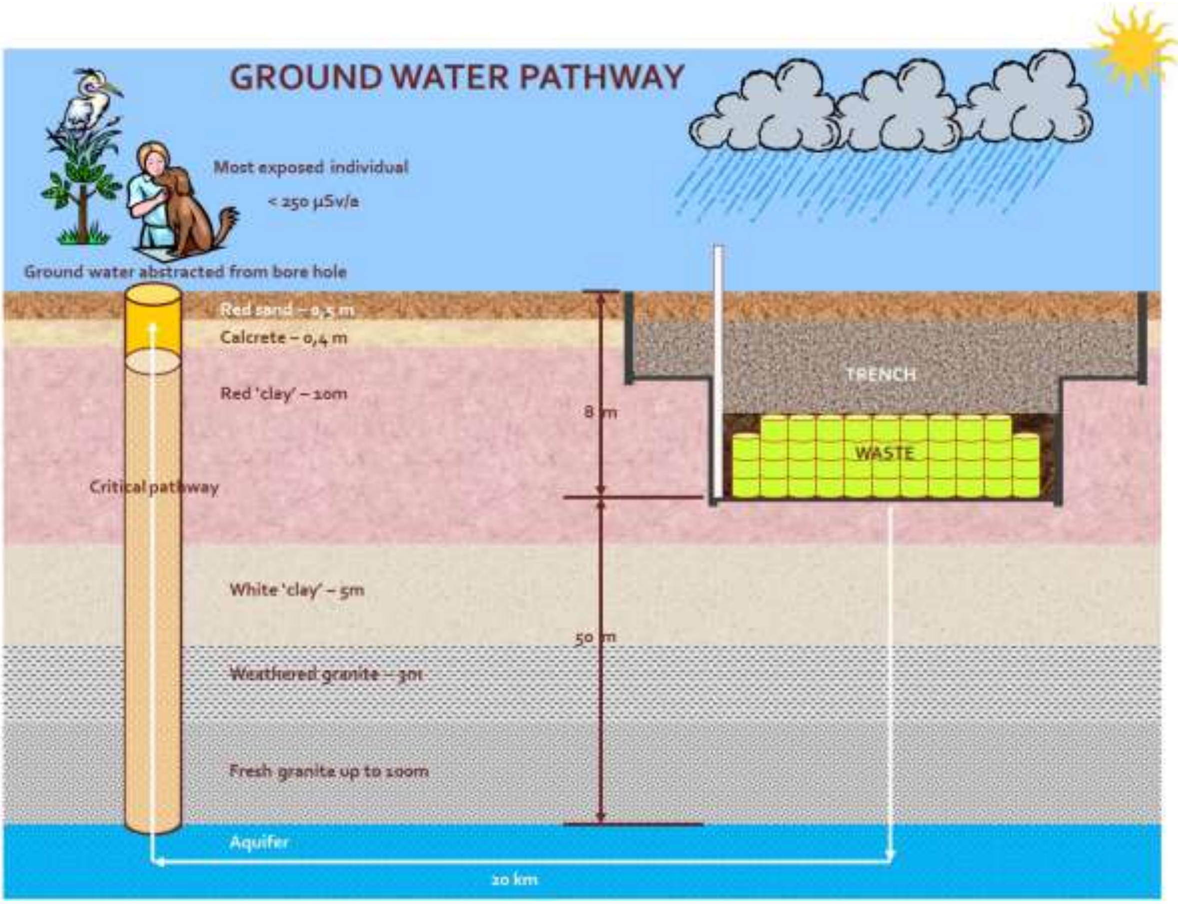

Figure 11: Graphical illustration of the groundwater pathway

7 SAFETY ASSESSMENT

7.1 Safety analysis

A Hazard and Operability (HAZOP) study was conducted, whereby the following hazards were identified to be the worst-case scenarios and as such were assessed:

(a) Worker radiation exposure due to waste disposal activities.

(b) Worker radiation exposure when waste packages are off-loaded by crane at the trenches.

(c) Falling of concrete waste package onto another concrete package during off-loading in the trenches due to failure of lifting equipment.

(d) Falling of steel waste package/s onto another steel waste package/s during off-loading in the trenches due to failure of lifting equipment.

(e) Falling of concrete waste package during off-loading in the waste treatment area due to failure of lifting equipment.

Vaalputs implements a radiation protection program to ensure that the workers are not being over exposed to radiation emanating from the waste packages. Compulsory statutory in-service inspections are performed on the lifting and rigging equipment to ensure that these are always maintained in a safe condition for operational use.

In addition to the hazards identified in the HAZOP, the annual dose and mortality risk to the worker and member of the public due to external threats to the facility such as an aircraft accident was also assessed as indicated in section 6.4.

An unmitigated release of radioactive nuclides from waste packages will not have consequences that exceed a dose of 20 mSv for a worker, or 1 mSv for a member of the public, thus Vaalputs is classified as a hazard level zero authorised nuclear installation.

7.2 Integrated management system

Vaalputs as an authorised nuclear installation implements the requirements and conditions of the Nuclear Installation License as authorised by the National Nuclear Regulator. As part of the licensing process, NRWDI submitted the required safety case that was reviewed and accepted by the Regulator. The safety case provides detail of the integrated management systems that shall be implemented to ensure the safe operation of Vaalputs and to provide assurance that NRWDI shall deploy sufficient human and financial resources to support the operations. Topics addressed in the safety case submissions that was accepted by the Regulator include: detail of the organisational structure, resources and expertise to manage a nuclear authorisation, detail of the management system for safety, health, environment, quality and security, the establishment and functioning of a Safety Committee, implementation of the Public Safety Information Forum, the radiation control and surveillance program for workplaces and the environment, detail of the radiological environmental surveillance program, a program for controlling radioactive effluents, in-service inspection and maintenance processes, emergency planning and response, the medical surveillance and control program, meteorological program, off-site transport of radioactive material, reporting and investigating events, limits on conditions for operations, Waste Acceptance Criteria, the decommissioning and after-care strategy and a safety assessment report.

Vaalputs has developed and implemented an integrated management system comprising of nuclear and conventional safety, health, environment, quality and radiation protection management systems in order to show compliance with statutory and regulatory requirements governing the site.

The IMS for Vaalputs encompasses the Quality Management System (QMS) in accordance with the requirements of ISO 9001:2015, the Environmental Management System (EMS) is in accordance with the requirements of ISO 14001:2015 and the Occupational Health and Safety Management System is in accordance with the requirements of ISO 45001:2018. Vaalputs is currently certified to the quality management standard (ISO 9001: 2015). All operations and activities are therefore controlled in accordance with the Vaalputs quality management system. A legal register listing the applicable legal safety and environmental related requirements has been established and the environmental aspects are linked to these requirements.

The Technical Officers and Radiation Protection Officers (RPO's) have independent authorities to stop-start at Vaalputs any activities in any department/section where violation of the IMS requirements, Nuclear Installation License, Occupational Health and Safety Act and all relevant environmental legislation occurs.

The QMS of authorised nuclear installations supplying waste to Vaalputs is audited on a regular basis to confirm compliance with the Vaalputs Waste Acceptance Criteria. Non-Conformance Reports (NCRs) pertaining to deviations from the Waste Acceptance Criteria are forwarded to waste generators to follow-up on or participate in corrective and close-out actions.

Responsibilities and authorities of Vaalputs personnel performing work affecting quality are documented within the procedures, works instructions, job profiles and descriptions that apply to the functions they perform.

Documented information is managed and maintained in accordance with the ISO 9001:2018 standard. The unique identification numbers, locations and inventories of all waste packages are appropriately recorded and maintained in view of the long-term frames involved in the disposal of radioactive waste.

Design and development at Vaalputs include the design of new disposal trenches and development of new disposal concepts.

No components, plant items, equipment, etc. are manufactured at Vaalputs. Should these be required they are purchased from external providers according to an approved suppliers list.

External audits and inspections are performed on a regular basis. These include corporate audits in SHEQ and other third-party audits, e.g., ISO certification bodies such as the South African Bureau of Standards (SABS). In addition, the NNR performs compliance inspections and audits on a regular basis.

The effectiveness of the IMS is continuously assessed and improved through the use of the IMS policy, IMS objectives, audit results, inspections, analysis of data, corrective and preventive action and management review meetings.

7.3 Safety management systems

This section outlines the operational programmes that are in place at Vaalputs to ensure compliance with the regulatory requirements for authorised nuclear installations as referenced in subsections 7.3.2 and 7.3.3.

7.3.1 Operational support programme

Radiation protection programme - Vaalputs has a radiation protection program in place to control the work environment to such an extent that the health risks associated with radiation are kept as low as reasonably achievable.

Medical surveillance programme– All Vaalputs personnel undergo an extensive medical assessment prior to being employed. This is to ensure that they are fit to work as radiation workers. The NNR requires that scheduled medical assessments be carried out at prescribed intervals. These intervals are defined within the medical surveillance programme for Vaalputs.

Personal safety - Various processes and procedures are in place to protect workers from harmful effects of exposure to hazards.

Process safety - Management system documents address processes, procedures and control measures for the proper care, inspection and maintenance of safety structures and components to prevent events of failure and consequential exposure of individuals to uncontrolled release of energy, physical hazards and release of hazardous substances accompanying such failures.

Radiation safety - Radiological control is exercised in accordance with the policy, procedures and requirements for Vaalputs. These include radiological control programmes for monitoring personnel, facilities, equipment and the environment, according to the requirements in the applicable SHEQ documents.

The Radiation Protection Officer conducts environmental radiation and contamination surveys on a routine basis within and around operational and non-operational trenches. Confirmatory air sampling in and around trenches is done on an ad-hoc basis. Ambient radiation dose rates using dosimeters are measured in the general trench areas.

Environmental management plan (EMP) - An EMP defining the environmental aspects, assessing the related impacts, listing objectives, targets and action plans to mitigate the significant impacts has been developed for Vaalputs and is implemented.

Safety assessments - The safety arguments and evidence in support of disposal operations undertaken by Vaalputs is documented in the Vaalputs Safety Assessment Report, which is reviewed and accepted by the NNR.

Radiological surveillance program - A dedicated operational radiological environmental surveillance program has been documented and is implemented for Vaalputs. The environmental samples are collected and analysed on a scheduled basis.

The RPO ensures that radiological hazards at Vaalputs are identified, measured, assessed and controlled in accordance with the radiation protection programme requirements.

Liquid and gaseous effluents are monitored to ensure that discharges are controlled within the limits specified by regulators.

Vaalputs monitors soil, vegetation, airborne contamination, ground water, ambient radiation, naturally occurring radioactivity in the environment, various weather-related parameters, etc., to obtain a comprehensive trail of environmental conditions. Monitoring results as per the requirements of permits and licenses are reported to the relevant regulatory authorities. Environmental sampling and monitoring are conducted as per applicable procedure.

Incident investigation - Incidents are recorded, investigated, analysed, corrected and closed-out according to written procedures.

Meteorological programme –Vaalputs has an automated weather station on site to monitor the appropriate weather parameters on a continuous basis.

Safety related structures, systems and components (SSCs) - Technical safety requirements and administrative controls all form part of items relied on for safety that function to prevent potential operational and design base accidents or mitigate their potential consequences to within safety criteria. SSCs identified in the safety assessment sections for the Vaalputs disposal facility include ventilation system, effluent systems, waste handling & lifting equipment and utility systems.

Due cognisance is given to optimise container performance and lifetime integrity by implementing rigorous quality control and engineering principals in the design, manufacturing and testing of radioactive waste containers. For example, container design takes into consideration international requirements for the transport of radioactive material (IAEA Safety Standards Series No. SSR-6, IAEA Regulations for the Safe Transport of Radioactive Material, IAEA, Vienna, 2012). Such waste packages would therefore have to withstand the applicable requirements, e.g., dropping and stacking tests. The NNR further requires that they approve all containers and packages intended to be used for transport and disposal of radioactive waste.

The waste package design and manufacture, waste nuclide measurement process, waste conditioning and waste package filling and handling processes implemented by waste generators shall be qualified in order to ensure that the processes meet all specifications and that the waste packages shall perform as required in the disposal system.

The safety limitation on disposal trench design is specified in the engineering design of trenches. The Operating Technical Specification for disposal trench design includes the following amongst others:

- Actions and acceptance criteria – inspection and measurement of the relevant trench dimensions and compared to appropriate acceptance criteria,
- Quality check records in contractor's health and safety file in Vaalputs Records

The limiting conditions for operations – the limiting condition for the Vaalputs operations are documented in the Operating Technical Specification (OTS) in order to ensure the safe operation during normal and shut down conditions of Vaalputs. The OTS prescribes the surveillance and maintenance required for ensuring compliance with the safety limits and limiting safety system settings, as well as the limitations on operations if a non-conformance is discovered.

The Vaalputs in-service inspection and maintenance process - is part of the inspection and preventive maintenance program consisting of planned periodic inspections, tests and examinations of systems, equipment and mechanical components whose failure or degradation could impact on the safety of the facility.

Emergency plan – Vaalputs has an emergency plan approved by the Regulator. The plan describes in detail the procedure to follow in case of an emergency and roles and responsibilities of personnel and stakeholders are clearly outlined in this document.

7.3.2 Compliance with safety standards

The Nuclear Sector in South Africa is governed by the Nuclear Energy Act (Act No.46 of 1999) (NEA), the National Nuclear Regulator Act (Act No. 47 of 1999) and the National Radioactive Waste Disposal Institute Act (Act No. 53 of 2008).

The governance and regulation of radioactive waste management is also subject but not limited to the provisions of the following additional acts:

- Hazardous Substances Act (Act No. 15 of 1973);
- Minerals and Petroleum Resources Development Act (Act No. 28 of 2002);
- Mine Health and Safety Act (Act No. 29 of 1996);
- National Water Act, (Act No. 36 of 1998);
- Water Services Act (Act No. 108 of 1997);
- Environment Conservation Act (Act No. 73 of 1989);
- Environment Conservation Amendment Act (Act No. 50 of 2003);
- National Environmental Management Act (Act No. 107 of 1998); and
- National Environmental Management: Integrated Coastal Management Act (Act No. 24 of 2008).

7.3.3 NNR regulations and requirements

The following regulatory documents are applicable to Vaalputs:

- R388 (2008). Regulations on Safety Standards and Regulatory Practices.
- RD-0014. Emergency Preparedness and Response Requirements for Nuclear Installations.
- RD-0016. Requirements for Licensing Submissions Involving Computer Software and Evaluation Models for Safety Calculations.
- RD-013. Requirements on Public Information Document (PID) to be produced by Applicants for New Authorisations.
- RD-0024. Requirements on Risk Assessment and Compliance with the Safety Criteria for Nuclear Installation.
- RD-0026. Decommissioning of Nuclear Facilities.
- RD-0034. Quality and Safety Management Requirements for Nuclear Installations.
- LD-1079. Requirements in Respect of Licence Change Request to the National Nuclear Regulator.
- RD-0038. Notification of Events at Facilities

7.4 Human resources

According to Section 30 (1) (b) of the NRWDIA, all the staff currently employed at Vaalputs are deemed to be employees of NRWDI. The current staff at Vaalputs have already been transferred to NRWDI and will therefore continue to manage and operate Vaalputs.

NRWDI currently has 32 positions at Head Office. Vacant positions have been approved for the future optimal functioning of NRWDI for the time when Vaalputs infrastructure, operations and personnel are fully integrated with NRWDI. The NRWDI organisational structure was approved by the Board and new positions were created to ensure that NRWDI has the required and appropriate set of skills and staff compliment to discharge its functional mandate and obligations as required for the holder of a nuclear installation license.

Technical and scientific support in terms of specific expertise to develop, maintain and oversee implementation of the integrated management system, safety case and nuclear installation license for the Vaalputs waste disposal operations is provided by the relevant support groups and includes the following:

- Nuclear licensing and permits;
- Radiation protection services;
- Safety, health and environmental management services;
- Quality management services; and
- Research and development, disposal technologies, site selection and investigation and safety case support.

Staff that are responsible for carrying out critical functions associated with radiation protection and nuclear safety and for maintaining an appropriate safety culture (e.g., Radiation Protection Specialist, Scientists and Engineers performing licensing and safety related work, etc.) will be duly authorised and appointed as Suitably Qualified and Experienced (SQEP) staff in accordance with internal processes.

While NRWDI is in the process of filling vacancies and where in-house expertise is not readily available, NRWDI will make use of external technical and scientific support service providers, both locally and internationally, as well as our strategic partners like the Council for Geoscience (CGS).

8 EMERGENCY PLANNING

The objective of an Emergency Planning is to ensure that Vaalputs is capable of implementing adequate measures to protect public health and safety in the event of a radiological emergency. The Emergency Plan is required by the regulator (NNR) as part of the conditions of the Nuclear Installation License.

The Emergency Plan and relevant procedures have been established, implemented and maintained to monitor and test, on a regular basis, the emergency preparedness and response.

8.1 Radiological emergency preparedness and response plan

This plan is concerned with the development and preparation of emergency plans to mitigate the consequences in the event of a radiological accident. Radiological emergency preparedness includes the training of all persons who will be involved in implementing the emergency plans, the acquisition of resources and facilities and the testing of emergency plans and procedures by means of drills and exercises to ensure effective response in the event of a radiological emergency.

During a radiological emergency, specialist services as well as technical and scientific skills are utilised for radiological or chemical analyses, plume modelling for early predictions, media and public liaison, etc. Every Vaalputs worker is properly trained to perform specific roles and functions during an emergency situation. Periodic, drills and exercises are carried out to test the effectiveness of the emergency planning and response.

8.2 Protective mechanisms and countermeasures

The emergency procedures for Vaalputs are in place to ensure adequate protective actions to protect the health and safety of workers, the public and the environment.

All facilities and equipment are maintained in a state of readiness to counter any emergency. Emergency facilities and equipment include the emergency control centre, communication equipment, smoke detectors, fire warning alarm system, alert and evacuation alarm system, fire station and firefighting equipment, water supply system, personal protective equipment and radiological monitoring apparatus. The emergency control organisation at Vaalputs includes a firefighting team that is trained on a regular basis.

8.3 Classification of and responses to nuclear emergencies

The classification of and the subsequent responses to nuclear emergencies are summarised as follows:

Unusual event - An abnormal occurrence that indicates an unplanned deviation from normal operations, the actual or potential consequences of which require notification of the Emergency Controller and activation of the appropriate components of the Emergency Plan.

Alert - A situation exists that could develop into a site or general emergency and therefore requires notification of all emergency personnel in order to obtain a state of readiness to respond.

Site emergency - An emergency condition exists that poses a serious radiological hazard on site but poses no serious radiological hazard beyond the public exclusion boundary.

General emergency - An emergency condition exists that poses, or potentially poses, a serious radiological hazard beyond the public exclusion boundary.

A nuclear emergency on the Vaalputs site shall not extend beyond the site borders, i.e., it shall not escalate beyond a Site Emergency as defined above.

8.4 Notification of an emergency

NNR - Emergency events shall be reported to the NNR as per NRWDI SHEQ-system requirements.

Public - Initiation of communication with local authorities and nearby residents shall be done telephonically and is exclusively and procedurally via the Emergency Controller.

9 WASTE MANAGEMENT AND DECOMMISSIONING PLAN

9.1 Vaalputs closure

An assessment of the long-term safety of the disposal site shall be conducted at the end of the operational period (see **Table 4**) to determine whether the remaining facilities and the environmental pathways shall continue to be monitored after site closure, taking into account the total nuclide inventory as well as updated safety assumptions and conditions at the time. This safety assessment shall form the basis according to which post-closure residual risks (engineering and environmental) shall be managed in the institutional control period.

Other actions to be undertaken at closure of the disposal site include:

- Final radiological survey of the disposal site and buildings;
- Environmental monitoring and comparison of results with baseline measurements;
- Assembling and archiving records;
- Phases 1 and 2 decommissioning of buildings;
- Erecting adequate security fencing and/or intrusion barriers around the site perimeter and around the disposal area;
- Placing durable markers and monuments at strategically chosen locations to demarcate the disposal facility and to acquaint possible intruders with the former use of the site for radioactive waste disposal;
- If required, construct storm water ditches to prevent rainwater from seeping towards the disposal trenches and thereby causing possible ponding conditions during heavy rainstorms; and

- Constructing a final cap over the disposal trenches, if required.

9.2 Decommissioning plan

Once waste disposal activities at Vaalputs have ceased the disposal facility shall be closed and decommissioned in a phased approach.

Initial decommissioning (Phases 1 and 2)

During these decommissioning phases the waste reception area, maintenance workshop and utility buildings shall be made passively safe to reduce post closure care and maintenance activities. The administration building including the laboratory area will be utilised to support residual work on the site such as environmental monitoring in the institutional control period and it is foreseen that these will be retained until the end of the active institutional control period.

Final decommissioning (Phase 3)

Following the active institutional control period, it is assumed that there will no longer be a need for buildings that remained on the site. These facilities, being uncontrolled radiological areas, would contain no radioactivity. It is foreseen that these buildings would then be demolished and the rubble disposed on site, according to the best practise at the time.

9.3 Anticipated radiological conditions and control requirements during decommissioning

It is expected that the ventilation and liquid waste containment and solidification systems may have become contaminated on the internal surfaces during operation, but not to the extent that it would pose a radiological hazard in terms of external radiation exposure or contamination of the facilities housing the equipment during the operational period for Vaalputs.

Future dismantling and decontamination of these items would be done according to existing radiological control procedures, the Vaalputs Nuclear Installation License requirements and other regulatory control measures as required.

9.4 Provisions for the management and disposal of radioactive waste

Most demolished structures will be essentially non-radioactive and, after decommissioning, suitable for use as landfill material or backfill material for the borrow pits.

Relatively small volumes of LLW may possibly arise from dismantling the ventilation and waste solidification systems. If these cannot be decontaminated, they shall be disposed of in the LLW trenches in line with the waste disposal practises and Waste Acceptance Criteria applicable at the time.

The expected categories, classes and quantities of radioactive waste and other materials are presented in Table 6 below:

Table 6: Categories, classes and quantities of radioactive waste and other materials that can be expected during decommissioning.

Waste description	Category	Class	Estimated quantities (m^3)
Concrete rubble and bricks from demolished buildings	Solid waste	Cleared waste	12 000
Scrap metal (pipes, door and window frames, corrugated roof sheeting, etc.)	Solid waste	Cleared waste	150
Scrap wood (doors, cupboards, etc)	Solid waste	Cleared waste	50
Other materials (lab equipment, plastic, vinyl tiles, PVC-pipes, non-hazardous chemicals, etc)	Solid waste	Cleared waste	10
Ventilation system	Solid waste	LLW	15
Liquid waste containment and solidification system	Solid waste	LLW	3

10 CONCLUSIONS

The disposal of Low-level radioactive waste in near surface trenches is a proven technology that has been implemented for more than 60 years around the globe. International experience suggests that the scientific and technological basis for safe and secure implementation of LLW disposal is available. A large body of information is currently available on proven waste disposal technologies, offering a wide spectrum of disposal solutions.

Vaalputs is duly authorised and regulated by the National Nuclear Regulator (NNR) and has been disposing of Low-level Waste in near-surface trenches for more than 33 years. During the operational period, more than 36 000 steel and concrete waste packages have been disposed of without any accidents. Over the last 9 years, the maximum individual dose of radiation workers was 1.34 mSv/a, which is 14.9 times lower than the regulatory limit of 20 mSv/a for the average effective dose. Results of environmental monitoring have shown that there has been no radiological impact on the environment or members of the public due to the waste disposal operations at Vaalputs.

As NRWDI, we are deeply committed to deliver safe, sustainable and publicly acceptable solutions for the long-term management and disposal of all radioactive waste classes. This means never compromising on safety or security, taking full account of our social and environmental responsibilities, always seeking value for money, and actively engaging with stakeholders in an open, transparent and respectful manner. NRWDI has demonstrated to the Regulator the safety case to manage and operate Vaalputs and is ready to ensure a smooth transition of Vaalputs from Necsa to NRWDI with minimum disruptions in the waste disposal activities of existing customers once the Nuclear Installation License had been issued to NRWDI.

Vaalputs will continue to communicate and share information with local communities, surrounding farmers, local authorities, government bodies and any other interested and affected parties on a quarterly basis with regard to nuclear and radiation safety matters, including but not limited to nuclear incidents/accidents.

NRWDI remains committed to fulfilling the vast expectations of South Africans to dispose of radioactive waste in a manner that meets or exceeds all applicable regulatory standards and requirements for protecting the health, safety and security of humans and the environment, now and in the future.

Our unwavering commitment is underpinned by the Bill of Rights, Section 24(b) of the Constitution of the Republic of South, which states that:

*"**Everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected for the benefit of present and future generations through reasonable legislative and other measures**".*

11 LIST OF ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
CEO	Chief Executive Officer
CGS	Council for Geoscience
EPD	Electronic Personal Dosimeter
GBq	Giga Becquerel
HR	Human Resources
HLW	High Level Waste
IAEA	International Atomic Energy Agency
ILW	Intermediate Level Waste
ISO	International Standards Organisation
KNPS	Koeberg Nuclear Power Station
LLW	Low-level Waste
LILW (SL)	Low and Intermediate Level Waste (Short Lived)
LSA	Low Specific Activity
MAC	Medium Active Concentrates
Necsa	South African Nuclear Energy Corporation
NIL	Nuclear Installation Licence
NNR	National Nuclear Regulator
NRWDIA	National Radioactive Waste Disposal Institute Act
NRWDI	National Radioactive Waste Disposal Institute
RP	Radiation Protection
RPO	Radiation Protection Officer
SABS	South African Bureau of Standards
SCO	Surface Contaminated Object
SHEQ	Safety, Health, Environmentand Quality
TLD	Thurmo Luminescent Dosimeter
VLLW	Very Low Level Waste
WAC	Waste Acceptance Criteria