Rössing Uranium Limited
Working for Namibia

Implementation of Radiation Management Plan
2015 Annual Report

The Rössing Mine

Uranium was discovered in the Namib Desert in 1928, but it was not until intensive exploration in the late 1950s that much interest was shown in the area. After discovering numerous uranium occurrences, Rio Tinto secured the rights to the low-grade Rössing deposit in 1966. Ten years later, in 1976, Rössing Uranium, Namibia's first commercial uranium mine, began operating, celebrating its 40th year of production in 2016.

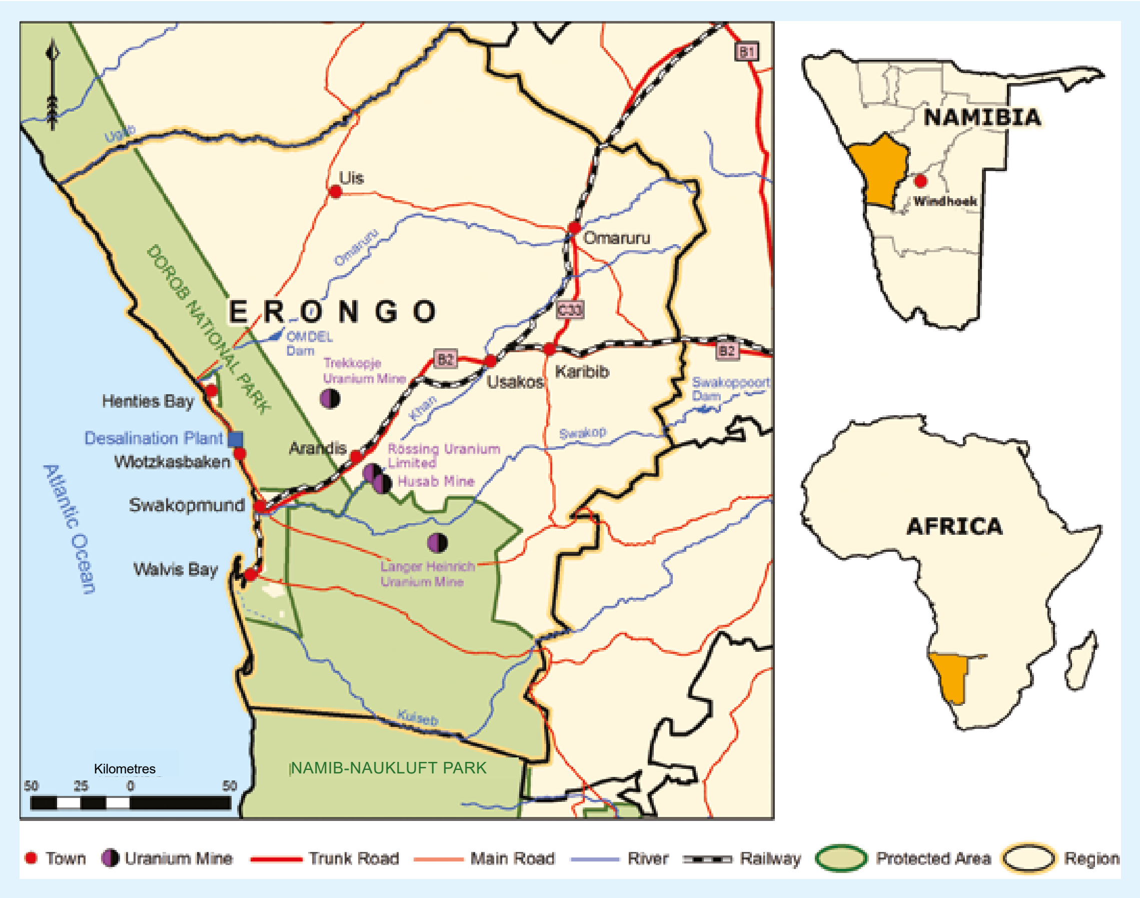
Today, Namibia has two significant uranium mines, which together provide for roughly 5 per cent of the world's uranium oxide mining output; Rössing Uranium produces about 2 per cent of the world's output. The mine has a nameplate capacity of 4,500 tonnes of uranium per year and, by the end of 2015, had supplied a total of 128,650 tonnes of uranium oxide to the world.

The mine is located 12 km from the town of Arandis, which lies 70 km inland from the coastal town of Swakopmund in Namibia's Erongo Region. Walvis Bay, Namibia's only deep-water harbour, is located 30 km south of Swakopmund.

The mining operation is located in an arid environment. Insolation at Rössing Uranium is high, and as a result, daytime ranges of temperatures are wide, especially during May and September, when the difference between minimum and maximum temperatures exceeds 20°C daily. The lowest temperatures are normally recorded during August, but frost is rare. The highest temperatures are recorded in the late summer, particularly March.

The mine site encompasses a mining licence and accessory works areas of about 180 km^2, of which 25 km^2 is used for mining, waste disposal and processing.

Mining is done by blasting, loading and hauling from the main open pit, referred to as the SJ Pit, before the uranium-bearing rock is processed to produce uranium oxide. The open pit currently measures 3 km by 1.5 km, and is 390 m deep.



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Acronyms and abbreviations

The following acronyms and abbreviations are used throughout the report:

Bq	becquerels, decays per send, unit for measuring radioactivity
CL	confidence level
g	gram
HSEC	Health, Safety, Environment and Communities
HR	Human Resources
kBq	kilo-becquerels, 1,000 Bq
LLRD	Long Lived Radioactive Dust
mBq/L	milli-becquerels per litre, 10^{-3} Bq per litre
mSv	milli-sieverts, sieverts/1,000
µSv	mico-sieverts, sieverts/1,000,000
µSv/a	µSv per annum
mSv/a	mSv per annum
mg/m^3	milligrams per cubic metre, 1/1,000th of a gram per cubic metre
µg/m^3	micrograms per cubic metre, 1/1,000,000th of a gram per cubic metre
µg/L	micrograms per litre, 10^{-6} grams per litre
NRPA	National Radiation Protection Authority
ppm	parts per million
RUL	Rössing Uranium Limited
RMP	Radiation Management Plan
RPO	Radiation Protection Officer
RSO	Radiation Safety Officer (statutory role)
SEG	Similar exposure group
SABS	South African Bureau of Standards
TLD	Thermo luminescent dosimeter
TEA Lab	Trace Element Analysis Laboratory
TSF	Tailings Storage Facility
UI	Namibia Uranium Association Uranium Institute
UOC	Uranium oxide concentrate
WHO	World Health Organization
XRF	X-ray fluorescence

1. Introduction

1.1 Background

The annual narrative report to the National Radiation Protection Authority (NRPA) about the implementation of the site Radiation Management Plan (RMP) is a requirement under the Radiation Protection Regulations[1]. This annual report is the third narrative report since the implementation of this requirement. The two previous reports (2013 and 2014) are publicly available on the Rössing website, http://www.rossing.com/reports-research2.htm.

1.2 Rössing Uranium's operations in 2015

Rössing started the year 2015 with a reduced workforce and production. In mid-2014, the conventional four-shift panel with continuous operation was transformed to a three-shift, weekdays-only operation, producing only for the fixed-term production contracts that are in place. The workforce was reduced to 850 employees in that year, down from 1,141 in 2013 and 1,528 in 2012.

On Thursday, 12 February 2015, a fire broke out in the Final Product Recovery (FPR) roasters (Figure 1), completely destroying both roasters. The fire was confined to the area of the roasters and was extinguished later that same day.

The radiological impacts of the fire to people and the environment are negligible because there was no uranium spill during the fire, and the melting and boiling points of uranium are well above the temperatures that the fire would have reached.

Environmental monitoring in the areas surrounding the FPR area has confirmed the absence of contamination to areas beyond the FPR, and subsequent urine sampling of workers engaged in firefighting has confirmed the absence of any internal contamination of affected people. After the incident, the production in the Processing Plant was continued in the absence of roasting, with the roasters repaired and back in operation three months later.

In mid-2015, a decision was made to re-introduce the fourth worker shift and to return to continuous operation, in order to increase the production efficiency. The workforce was increased to 980 until the end of the year, and the mining and processing plants returned to continuous operation in October 2015.

Figure 1: Fire breaks out at FPR in February 2015

[1] Radiation Protection and Waste Disposal Regulations: Atomic Energy And Radiation Protection Act, 2005 (Act No. 5 Of 2005)

2. Organisational arrangements

2.1 Organisational structure

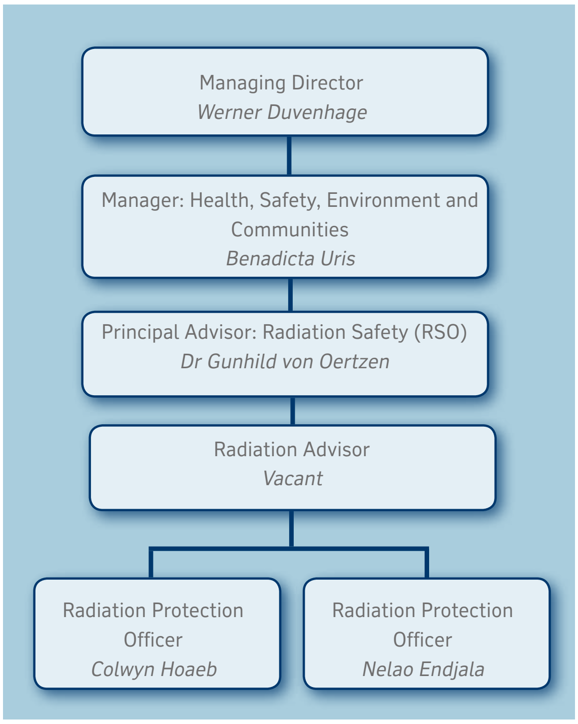
The organisational structure relating to Radiation Safety is shown in Figure 2.

The organogram changed to a structure where the Manager HSEC reports directly to the Managing Director, instead of to the General Manager Human Resources as was the case before the change.

A new position, the Advisor Radiation Safety, has been introduced and was advertised in December 2015. The role will report to the Principal Advisor Radiation Safety and will supervise the two Radiation Protection Officers.

One of the two Radiation Protection Officers was on maternity leave for six months until December 2015. The addition of the new role to the Radiation Safety Section is in part aimed at addressing staff bottlenecks such as extended leave periods of staff members.

Figure 2: Organisational structure for Radiation Safety Section, 2015



2.2 Capacity building

Building capacity in Radiation Safety remains an important deliverable. In 2015, the annual 2-day workshop for radiation safety professionals at the Namibian Uranium Institute (NUI) was held as the "Spring School for Radiation Safety Officers".

As in previous years, we have supported the NUI with the organisation and presentation of the workshop, with contributions about the implementation of the RMP at Rössing and at Langer Heinrich Uranium, about the implementation of the Strategic Environmental Management Plan (SEMP), about environmental monitoring, mine closure and seepage control.

Presenters from Rössing Uranium, Langer Heinrich Uranium, the NUI, the Desert Research Station at Gobabeb and the Namibian Geological Survey contributed to the event.

Both officers currently working in the Radiation Safety Section, Colwyn Hoaeb and Nelao Endjala, have completed modules I, II and III of the Radiation Safety Officers course, which are offered to radiation safety professionals at the NUI.

Both Radiation Protection Officers (RPOs) are undergoing on-the-job coaching for further skills development. Included in this coaching and training programme is regular exposure by acting as the site's Radiation Safety Officer, while the designated RSO is away from the office. Both RPO's were provided with on-the-job experience as acting RSO, while in constant email and phone contact with the RSO for support and information.

3. Occupational exposure protection

3.1 Changes in monitoring programme

Occupational exposure controls and monitoring programmes are continuously being reviewed and reassessed for their effectiveness.

Under the Rio Tinto performance standards for Health Safety and Environment (HSE), a ‘radiation worker’ is defined as a worker who may potentially be exposed to ionising radiation in excess of 5 mSv per annum. These workers are also often referred to as ‘designated radiation workers’.

In the past, the assessment on which workers are classified as ‘radiation workers’ was based on area monitoring in the relevant workplaces and an exposure risk assessment linked to the role description of the person. We found this system ineffective, particularly since the role descriptions and associated job exposure matrix were found to undergo significant changes in the past years. Therefore, a revision of the actual exposures measured in the different similar exposure groups (SEG) was undertaken.

Figure 3 displays the results of continuous gamma exposure monitoring using thermo luminescent dosimeters (TLD), for the years 2009 to 2015. The average recorded for each SEG is shown as a line, while the maximum recorded in each SEG is shown as a bar if this exceeded 5 mSv in any year for that SEG. As the only two SEGs where a maximum TLD dose exceeding 5 mSv was recorded between 2009 and 2015 were Recovery workers and Final Product Recovery workers, maxima are shown only for these two groups.

The graph shows that even for the groups 'FPR workers' and 'Recovery workers', where individual maxima are possible that exceed 5 mSv, the average TLD dose is well below 5 mSv and similar to that of the other groups displayed.

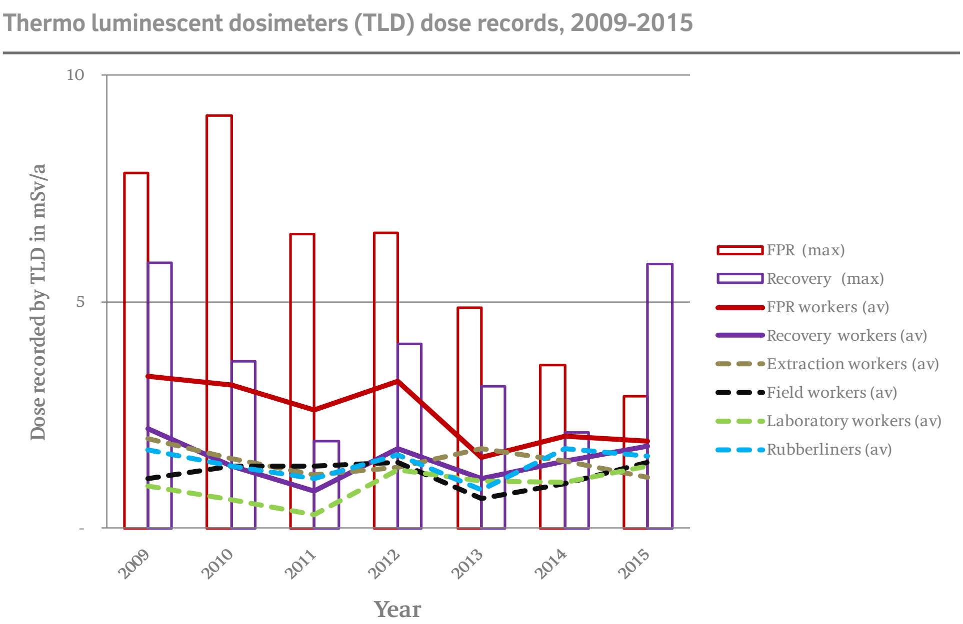
It is found that TLD records are only reliable if the dose is significantly above background. If the dose is similar to background, the value of zero is often returned for the dose, rendering the measurement meaningless.

It was therefore decided to include as ‘radiation workers’ only those workers with a potentially significant dose, ie the 'FPR workers' and 'Recovery workers'. Dose records for all other workers will go out to random sampling as is practiced for all groups whose workers are not ‘radiation workers’.

This change in monitoring method has the advantage that management of TLDs is much simplified, as all workers in the SEGs 'FPR workers' and 'Recovery workers' are ‘radiation workers’, whereas workers in all other SEGs are not.

In addition, the assignment of a group average dose to those workers whose TLD previously recorded a zero dose is no longer necessary, as now zero dose records are no longer returned for any individuals.

Figure 3: Average (lines) and maximum (bars) individual TLD dose recorded, by SEG and year



3.2 Monitoring results for 2015

As in the previous two years, mining at Rössing was characterised by low levels of production, with a correspondingly low average dose per person.

The average dose recorded by pathway and SEG is shown in Figure 4. As always, three pathways are monitored in each SEG by personal sampling, as described in detail in the Rössing RMP. The penetrating dose is recorded continuously by TLD in FPR and Recovery whose workers are designated 'radiation workers', and by electronic personal dosimeter (EPD) in all other groups. The internal dose from radon progeny is measured personally by SARAD™ DoseManPro, and the internal from the inhalation of radioactive dust is measured using the SARAD™ MyRIAM instrument. All monitoring instruments are calibrated regularly by accredited laboratories as per their manufacturer's calibration schedule.

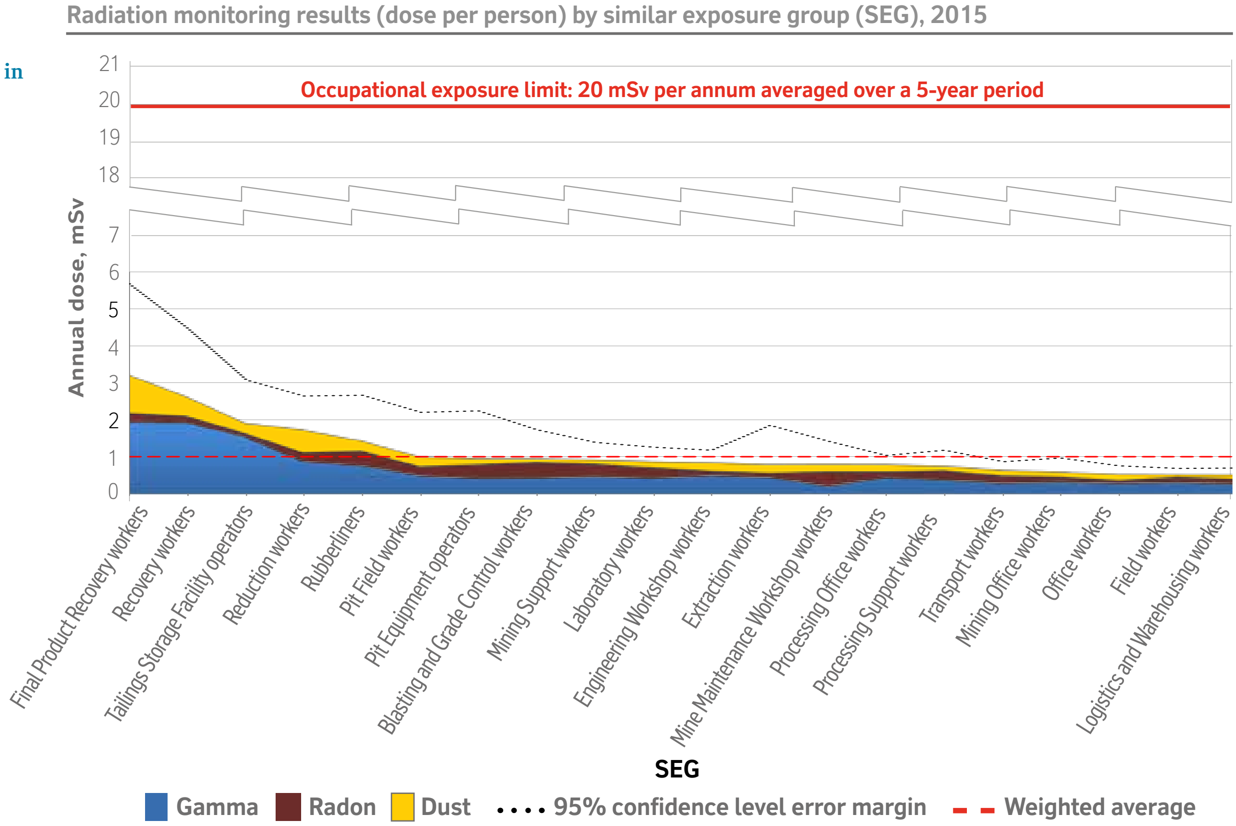
The mine-wide average dose was once again found to be 1 mSv/a. The maximum individual dose recorded for all pathways was 4.5 mSv/a in FPR, and 5.9 mSv/a in Recovery. Only two persons were recorded to have an annual dose exceeding 5 mSv/a, at 5.3 and 5.9 mSv per annum respectively.

The graph in Figure 4 also demonstrates that for most female workers, a pregnancy does not preclude them from working in their assigned role as the expected annual dose does not exceed 1 mSv/a. Exceptions are workers in FPR and Recovery. A precautionary approach is also taken for female workers in Extraction, Tailings Dam, Reduction, Rubberliners and Field Work.

After each sampling exercise (usually a week per group), each working group obtains a written report on the measured doses in their area.

In addition, the personal dose records that have been reported to the NRPA are displayed via an intranet tool to each worker via their logon details. If the workers are designated radiation workers, their urine sampling results are also displayed via this electronic tool.

Figure 4: Average doses recorded by pathway and SEG, in 2015



3.3 Designated radiation workers

As discussed in Section 3.1 above, the number of workers classified as ‘designated radiation workers’ was reduced following investigation of the actual TLD records received. After this re-classification, all workers in the SEGs 'FPR' and 'Recovery' remain designated radiation workers, a total of 46 workers at the end of the year.

The dose to penetrating radiation, as recorded by TLD, remained below 5 mSv/a for all but one of these workers. However, if all three pathways are considered, including the internal dose from radon and radioactive dust, the recorded dose of two persons exceeded 5 mSv/a, as explained in Section 3.2 above. The total average dose for FPR workers was 3.2 mSv/a, and for Recovery workers it was 2.6 mSv/a.

A total of 1,835 urine samples were submitted to the Swakopmund TEA lab in 2015. Of these, none exceeded the action or the warning levels for uranium in urine testing (40 and 20 µg of uranium per litre of urine respectively). Eighty-one samples (about 4 per cent) exceeded the detection limit of 5 µg/L.

Both the number of samples per month and the percentage of sample returning measurable uranium content decreased throughout the year, see Figure 5. A low percentage of measurable uranium content attests to effective ingestion and inhalation control in the FPR area, notably with respiratory protection devices.

Pregnancy testing of designated radiation workers is performed monthly. Between 12 (January) and 8 (December) ladies were designated radiation workers, for whom 54 pregnancy tests were performed. In addition, 35 tests were performed of female workers who are not designated radiation workers. Of all the tests performed, 4 were positive.

3.3 Radiation awareness training

Apart from awareness sessions about radiation that are offered to each section on demand or if a need for such a session has been determined, radiation awareness training forms part of the HSE training requirements for workers, compliance with which is logged electronically and followed up monthly. Each worker attends a 2-hour induction about radiation safety when he or she starts at the mine, and attends a refresher at least every 2 years thereafter.

In addition to interactive sessions, the Rössing intranet provides information in about 100 fact sheets and/or toolbox topics about radiation, which workers or leaders can access on demand.

Uranium in urine samples, 2015

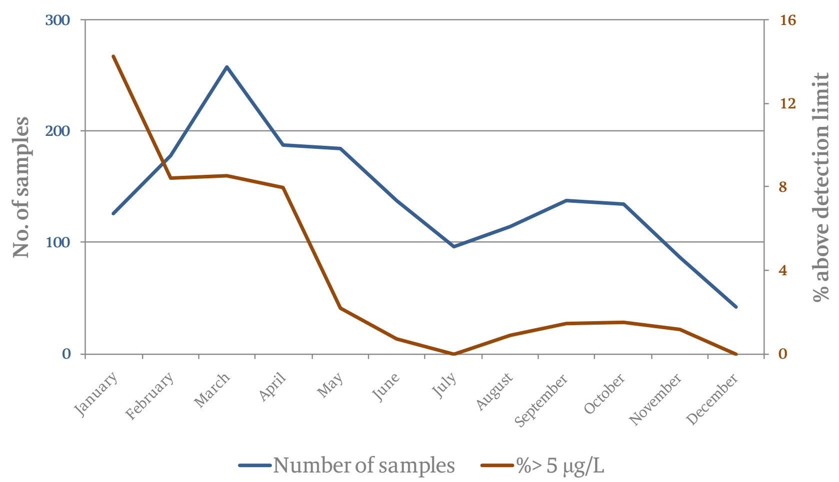


Figure 5: Uranium in urine samples in 2015, showing the percentage of samples with measurable uranium content as a red line

4. Medical exposure

Not applicable.

5. Public exposure protection

5.1 Background

The dose limit for public exposure resulting from mining activities at Rössing Uranium is 5 mSv over a defined 5-year period, or 1 mSv per year on average. This dose limit does not include background sources, be they natural or man-made.

The natural background radiation in the Erongo Region is approximately 1.8 mSv/a, while the dose to critical groups in the public is generally very low to negligible. It is therefore not possible to measure the public dose directly – it must be calculated from first principles, after determining the factors potentially contributing to this pubic dose.

This principle is illustrated in Figure 6: For each potential public exposure pathway, the critical group (ie the group that may potentially receive the largest possible public dose from this pathway) is determined. The resulting maximum ('worst case scenario') dose is then calculated for this pathway and critical group. The procedure is repeated for each pathway and critical group.

For some pathways, such as the inhalation of dust and radon progeny, the critical groups may be identical and hence the public dose for these pathways must be added to yield the total pubic dose for this critical group.

Since the public is not living in immediate vicinity of the mine and its ore body, and trains transporting uranium oxide to the port are not stationed in publicly accessible areas, the direct dose to the public from gamma radiation is negligible.

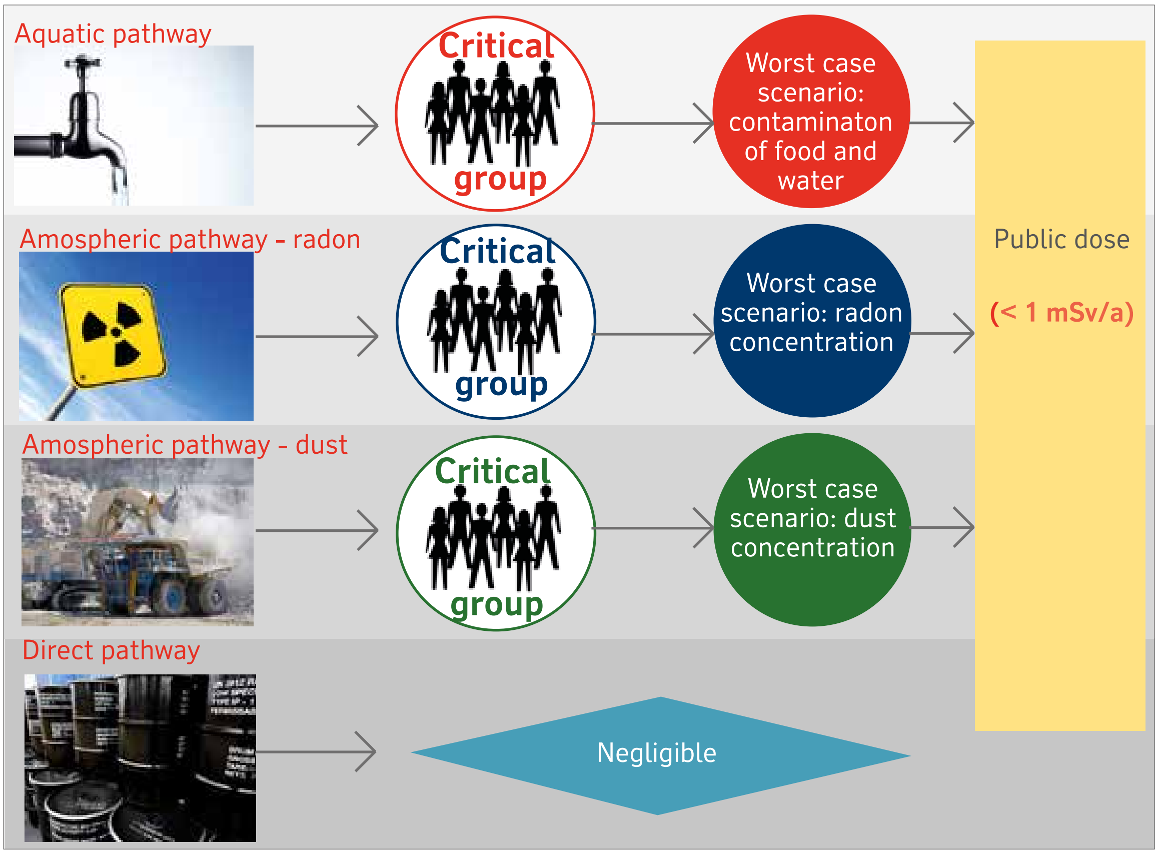
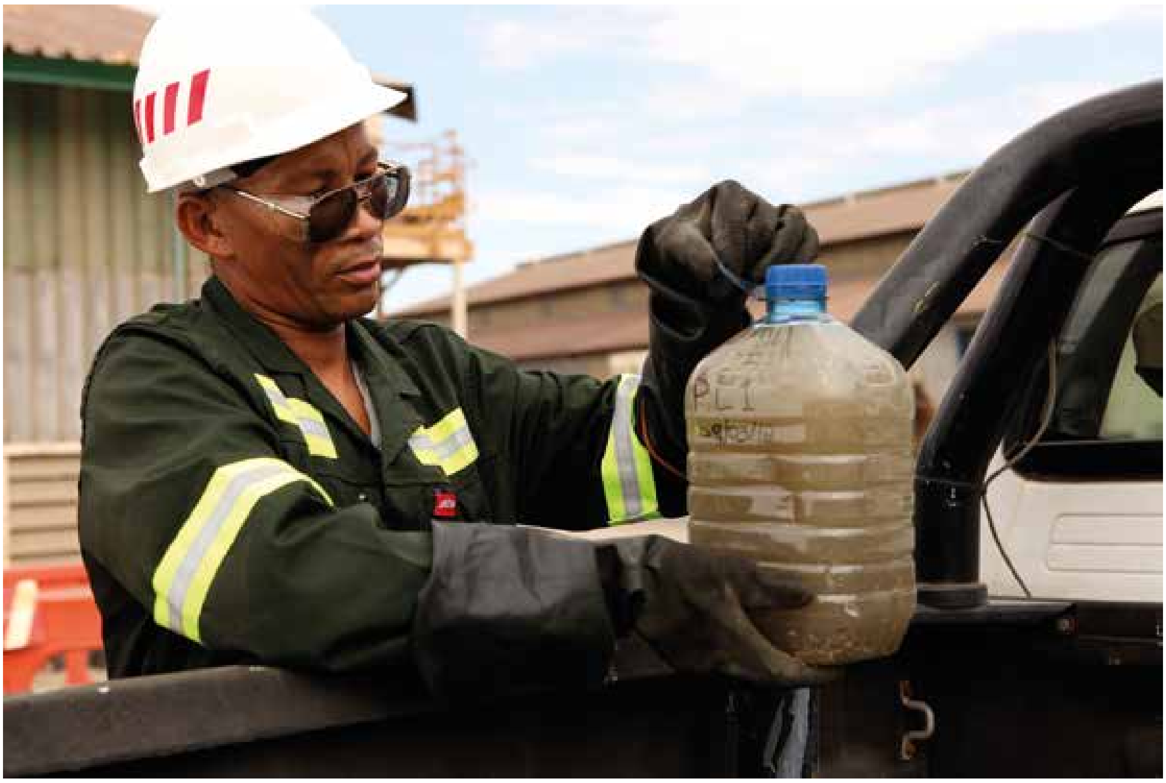


Figure 6: Schematic summary of pathways and critical groups contributing to potential public exposure doses

Figure 7: taking water samples from monitoring boreholes



5.2 Water quality

The aquatic pathway results from potential seepage of contaminated water from the Tailings Storage Facility (TSF) into the Khan River aquifer.

Seepage is prevented by means of seepage recovery systems including cut-off trenches in the waterways, seepage recovery boreholes situated around the TSF, and a seepage recovery dam downstream of the TSF. The Rössing RMP summarises these controls in more detail.

A system of monitoring boreholes surrounds the TSF and water quality is measured bi-annually. The water samples are analysed for their radionuclide content, in particular the ratio of radioactivity of the isotopes U-234 and U-238 is determined.

Alpha recoil results in a dis-equilibrium between these isotopes in naturally occurring water in aquifers, while the two isotopes in the TSF are expected to be in secular equilibrium.

The isotope ratio therefore allows a determination of the origin of water resources as either naturally occurring, or resulting from seepage from the TSF [2].

Water quality in the monitoring boreholes was measured twice in 2015. The results from the first measurement are summarised in Figure 8.

The positions of monitoring boreholes are shown on a satellite map of the mining area, colour coded according to the isotope ratio measured: a red dot indicates potential contamination from the TSF, while a green dot signifies the source of the water as naturally occurring in the environment.

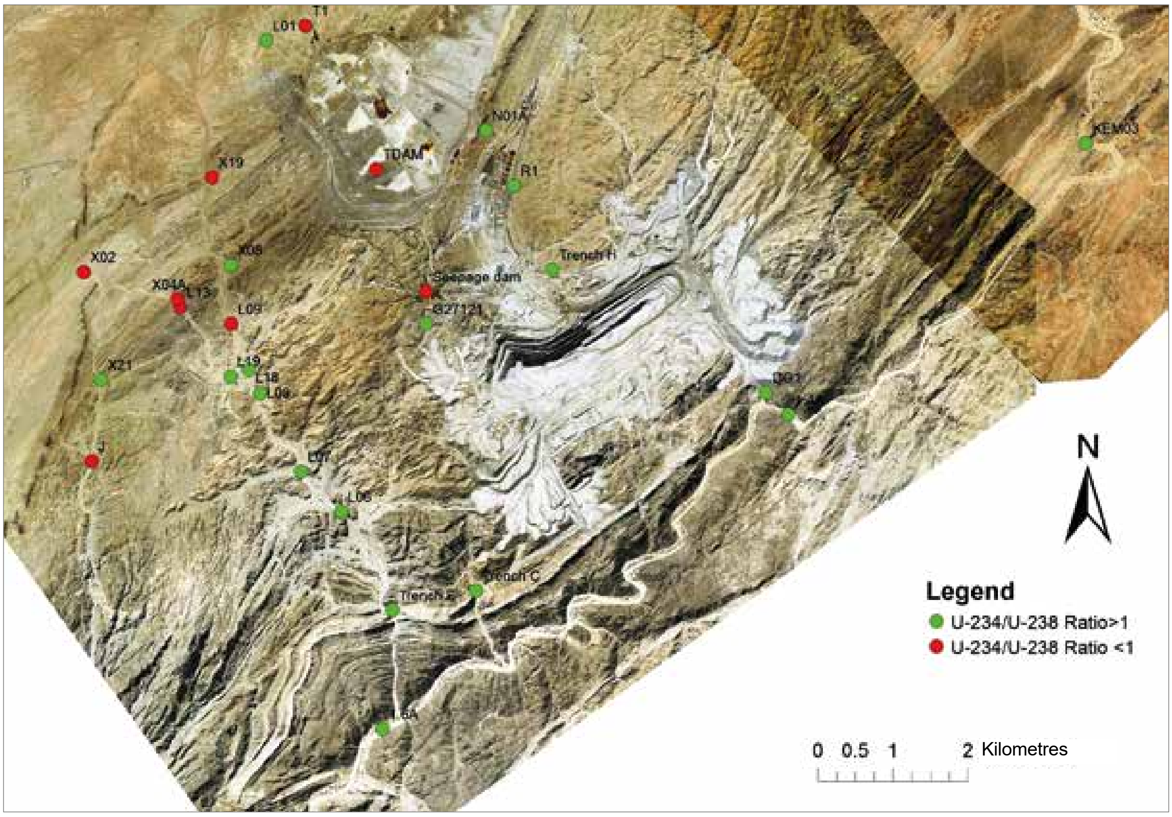
The image demonstrates that the water at all cut-off trenches, ie at Trench J, Trench C and at Trench H, is of natural origin. Hence there is no risk of seepage of contaminated water into the aquifer of the Khan River, at the bottom of the image.

The outcome from the second measurement of radionuclide ratios in 2015 has been received from NECSA more than 8 months after submission of the samples, and was found to be unreliable.

The decision has been taken that water monitoring samples will be submitted to an alternative laboratory with an improved turnaround time going forward. A suitable laboratory in Europe has already been procured for this purpose.

[2] The principles behind alpha recoil and its potentials for monitoring are explained in the RMP, and in the articles 'Water quality monitoring at Rössing Uranium mine using isotope techniques', and 'Using alpha recoil as a tool for contamination control in the Khan River aquifer'. All of these are available on the Rössing website, http://www.rossing.com/reports-research2.htm.

Figure 8: Seepage contamination plume at Rössing Uranium, January 2015



5.3. Dust monitoring

The public dose along the atmospheric pathway from the inhalation of dust can be assessed via measurements of the concentration of dust in the air breathed. The size of particles inhaled is directly linked to their potential for causing health problems.

Small particles less than 10 micrometres in diameter pose the greatest problems, because they can get deep into a person's lungs, and some may even get into the bloodstream.

Several dust monitoring stations are placed in strategic locations around the mine site, where the concentration of dust particles smaller than 10 microns is measured in hourly intervals. This dust is referred to as particulate matter smaller than 10 microns, or PM_{10} in short.

The locations of the PM_{10} stations include amongst others one at Arandis, one at the Rössing TSF and one on the Western mine boundary. The location of these monitoring stations is shown in Figure 9, along with the positions of dust fall-out monitors and multi-vertical samplers.

The hourly PM_{10} concentration measurements at Arandis in 2015 are shown in Figure 10. Apart from a few isolated concentration peaks, most of the hourly measurements display a concentration below the World Health Organization (WHO) standard of 50 $\mu g/m^3$ for the 24-hour outdoor mean PM_{10} concentration [3]. The annual average is measured to be 11 $\mu g/m^3$, exactly the same as was measured in 2014, and this is below the WHO standard for annual mean PM_{10} concentration, namely 20 $\mu g/m^3$.

The monthly average concentrations are displayed in Figure 11, along with the WHO standards for the annual and the 24-hour mean concentrations.

In order to obtain a public dose from these measurements, we refer to the analysis of the PM_{10}-portion of dust collected in Arandis that was analysed in 2014, repeated in Figure 12.

[3] World Health Organization, WHO Guidelines for Air Quality: Selected Pollutants, 2010

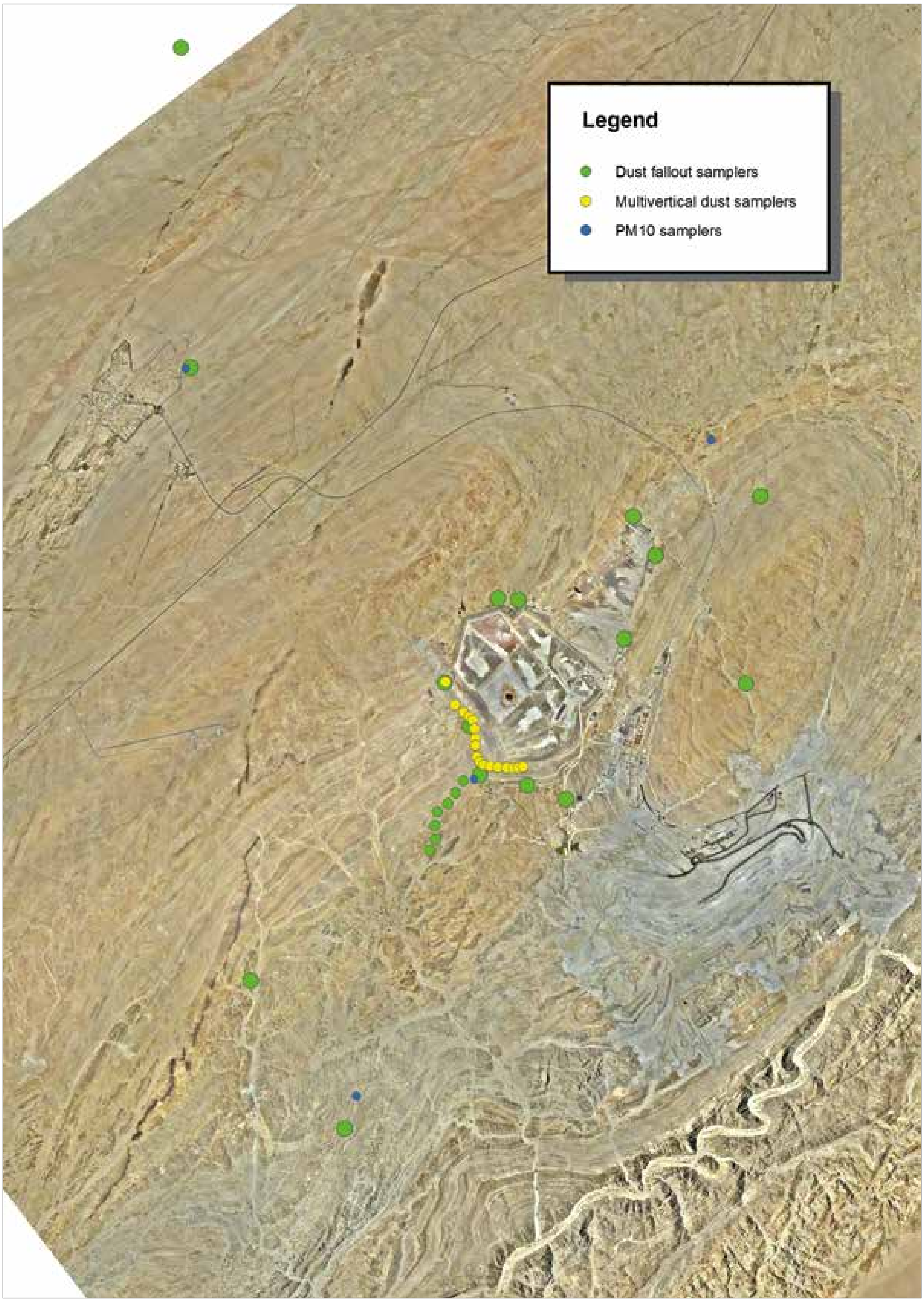


Figure 9: Air quality monitoring network at Rössing Uranium, with locations of dust fall-out samplers (green), multi-vertical dust samplers (yellow) and PM_{10} monitoring stations (blue) indicated.

Figure 10: PM_{10} concentration at Arandis, measured in intervals of 1 hour, in μg/m³

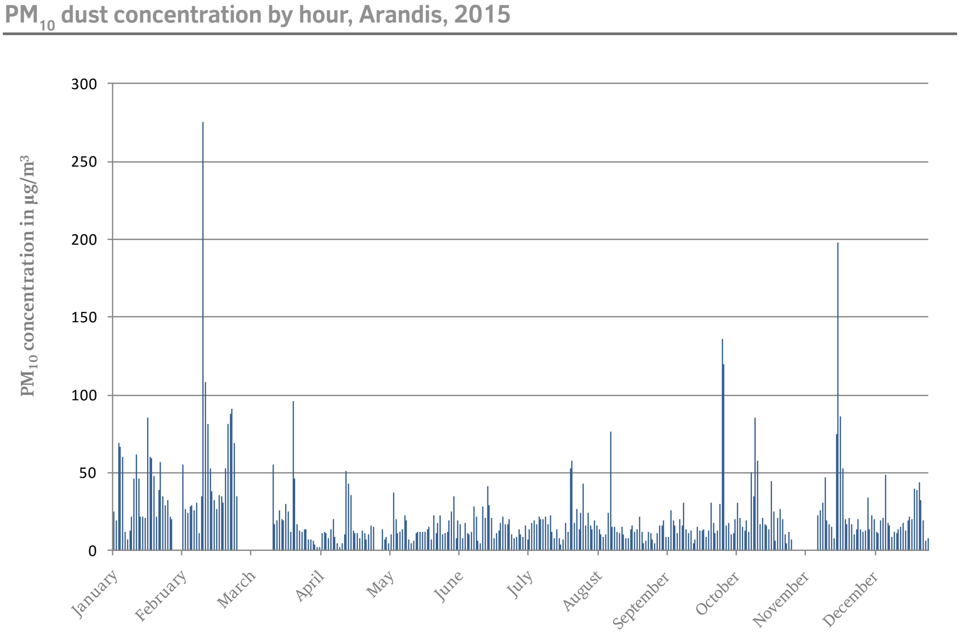


Figure 11: Monthly average PM_{10} concentrations at Arandis

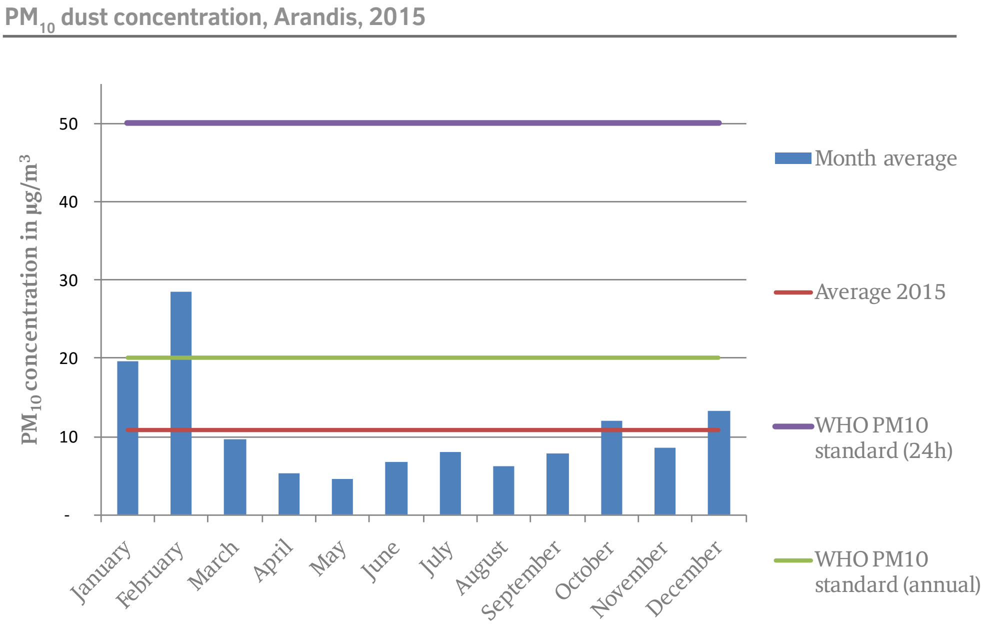


Figure 12: Analysis results from the PM_{10} portion of dust collected at Arandis

Arandis dust sample, particle size less than 10 micro-metre		
Decay chain	Nuclide	Specific activity, Bq/kg
Uranium	U-238	494
	Ra-226	756
	Pb-210	7,770
Actinium	U-235	< 34
	Ac-227	< 100
Thorium	Ra-228	220
	Th-228	200
Further radionuclides	K-40	984

Based on this dust analysis and the measured average dust concentration at Arandis of 11 µg/m^3, a public dose may be calculated, using the effective inhalation dose coefficients given in the IAEA Basic Safety Standards [4] .

The largest public dose is that calculated for adults, as the breathing rate for adults (0.9 m^3/h) is larger than that for all younger persons.

Given these conditions, the overall public dose for adults at Arandis is found to be 21 µSv/a, very small compared to the annual dose limit of 1,000 µSv/a. It must be emphasised that this dose is the overall result, which includes all sources of background radiation in the inhaled dust.

It is therefore not considered necessary to establish how much of the dust concentration measured at Arandis is of mining origin, as the resulting inhalation dose to the public is negligible.

5.4. Radon survey

As there have been no changes to the mining operations that could result in a measurable increase of the radon emitted from the site, no new radon measurements were performed in 2015.

The average radon concentration at Arandis is measured at the radon station operated by the Namibian Uranium Institute and owned by the National Radiation Protection Authority.

The station is located at the Arandis Namwater reservoir some 6 m above ground level. Between 2011 and 2014, the average radon concentration measured there was found to be 21 Bq/m^3, independently of the wind direction at this location. This means that at this location, halfway between the Rössing mine and the town of Arandis, the radon concentration is independent of contributions from mining operations and is exclusively due to background contributions.

[4] International Atomic Energy Agency, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, General Safety Requirements Part 3, No. GSR Part 3, 2014

6. Safety and security of sources

6.1. Sealed source register

Only four sealed sources are currently being used, all of them used as level measuring devices in the two primary crushers. Each crusher is equipped with two sealed sources, one respectively for the bottom and the top of the rock box of each crusher (see Figure 13).

These sources are located in locked rooms (the rock box, in which crushed rock collects before being conveyed to the coarse ore stockpile), hence access to them is restricted to personnel who are trained and authorised for confined space entry.

Of the four sealed sources in operation, one is new (Serial Number H500081140) and was installed after the old source there (SN 2770) was found to be leaking.

The sources in possession of Rössing Uranium are listed in Table 1, including those that are not being used currently. In addition, two low activity calibration sources are kept at the Radiation Safety Laboratory (Table 2).

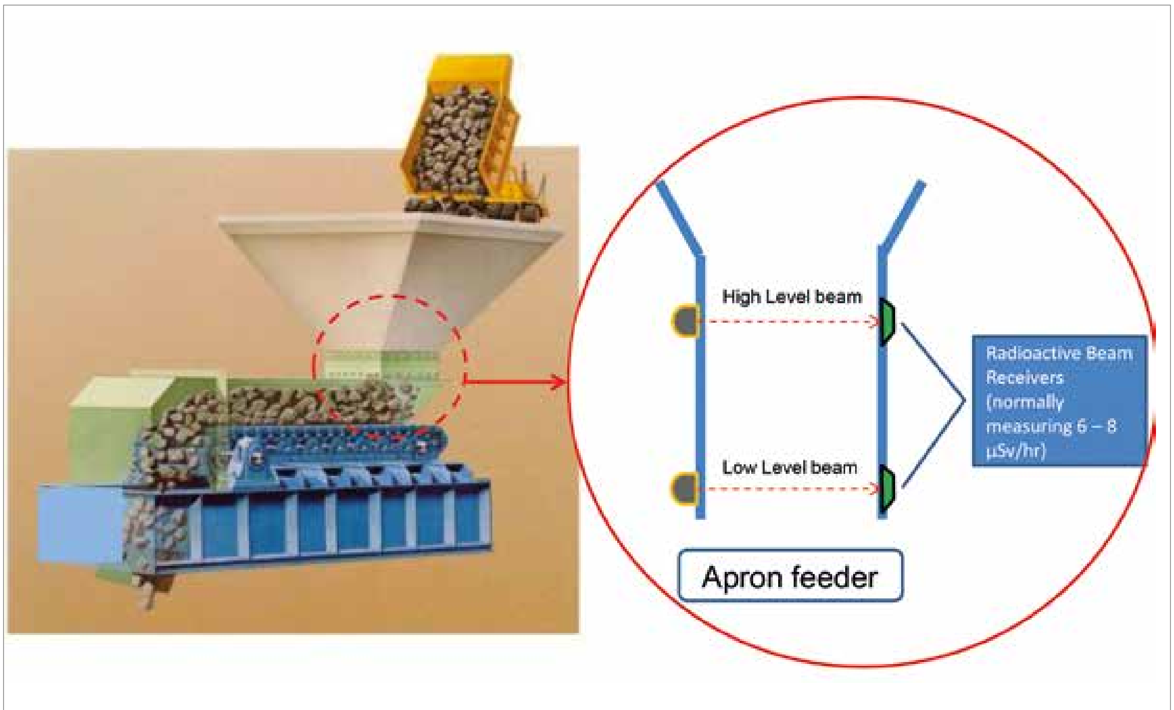


Figure 13: Schematic view of sealed sources in operation at the Primary Crusher Rock Boxes 1 and 2

Table 1: List of sealed sources at Rössing Uranium (radionuclide of all sources is Cs-137)

Serial number	Activity (GBq)	Location	Use	Comment
27255 N	44	Rock Box Primary Crusher No 1	Level	In operation
004/12	35	Rock Box Primary Crusher No 2	Level	In operation
H500081140	42	Lube Room Primary Crusher No 1	Level	In operation
005/12	34	Lube Room Primary Crusher No 2	Level	In operation
70682	0.2	Radiation Store	Level	Not in use
PA 304	0.3	Radiation Store	Density	Not in use
PA 299	0.3	Radiation Store	Density	Not in use
PA 301	0.3	Radiation Store	Density	Not in use
PA 302	0.3	Radiation Store	Density	Not in use
PA 298	0.3	Radiation Store	Density	Not in use
PA 297	0.3	Radiation Store	Density	Not in use
2770	15	Radiation Store	Level	Redundant
2771	15	Radiation Store	Level	Redundant
2772	15	Radiation Store	Level	Redundant

Table 2: List of calibration sources at Rössing Uranium

Nuclide	Type of Source	Half-life (years)	Initial activity (kBq)	Date of manufacture	Time elapsed (years)
Cs-137	Beta	30	3	2011/12/13	4
Th-230	Alpha	75380	1	2011/12/16	4

6.2. Sealed source checks

Leak tests of sources in operation are performed two-monthly, while sources not in use are only tested at six-monthly intervals. As these sources are stored in the Radiation Source Bunker, which is access restricted, no risk is posed by moving the leak test out to once in six months.

6.3. X-ray generating equipment

The Rössing Uranium chemical laboratory is making use of two analytical x-ray units, as per registration and license EPL/113/01/15, which expires in 2018.

7. Transport of radioactive material

7.1. Transport and export of uranium oxide concentrate

Under the authorisation TRM/113/01/15/ET, which authorises Rössing Uranium to transport uranium oxide to overseas converters, 978 tonnes of uranium oxide of chemical composition U_3O_8 (with a content of 830 tonnes of uranium) were exported in 2015, as summarised in Table 3.

Table 3: List of UOC shipments from Rössing Uranium in 2015

Date of consignment, 2015	Country of Final Destination	Total weight of UOC in shipment (kg)	Total weight of contained U element (kg)
20 March	CANADA	72,443.056	61,431.711
5 March	FRANCE	176,842.818	149,962.710
20 July	USA	125,657.006	106,557.141
23 August	CHINA	233,166.344	197,725.060
27 September	FRANCE	53,815.897	45,635.881
8 September	CANADA	87,488.107	74,189.915
1 November	CANADA	90,262.956	76,542.987
1 November	USA	69,223.780	58,701.765
27 November	USA	69,304.828	58,770.494
Total		978,204.792	829,517.664

7.2. Transport of other source material

Under the authorisation TRM/113/15/03/T, which authorises Rössing Uranium to transport uranium bearing ore and leach feed samples to laboratories in South Africa, three consignments to labs in South Africa were made in 2015, summarised in Table 4.

None of these consignments had a radioactivity concentration exceeding 10 Bq/g, and hence under the IAEA Transport Regulations , these materials are not regarded as radioactive for transport.

Table 4: Sample materials exported to laboratories in South Africa in 2015

Date 2015	Material exported	Mass	Total radioactivity of exported material (MBq)	Purpose of consignment	Consignee of exported material	Mode of transport
7 October	Soil samples	14 kg	< 40 kBq	Mineralogical studies	Airshed, Pretoria, South Africa	Airfreight by DHL
19 November	Core samples	2 tonnes	< 10 MBq	Mineralogical studies	SGS Laboratories, Johannesburg, South Africa	Road transport by Wesbank Transport
26 November	Return dam solution samples	3 tonnes	< 20 kBq	Leaching studies	SGS Laboratories, Johannesburg, South Africa	Road transport by Wesbank Transport

8. Emergency preparedness and response

The Rössing emergency response to uranium spills, as outlined in the procedure *JK60/PRD/009-Uranium Oxide Spillage*, was rehearsed on July 31, 2015. A representative from the NRPA, Mr Naeman Kapofi, participated in the exercise as a witness.

The drill scenario was that of a train transporting the containers of U_30_8 derailing a few metres outside the site main gate, with one of the seven containers capsized, resulting in some U_30_8 drums being damaged and uranium oxide being spilled from them.

Figure 14: Uranium spill drill: 'clean-up'

Figure 15: Contamination measurements after completion of 'clean-up'

9. Disposal of radioactive waste

9.1. Disposal of contaminated waste

Contaminated waste is deposited on the TSF, which in itself is a contaminated waste site. In 2015, a total of 6,718 tonnes of contaminated waste was deposited on the TSF.

9.2. Mineral waste

Both tailings material and waste rocks deposited without processing are regarded as mineral waste.

In 2015, we deposited 6,875,719 tonnes of tailings onto the TSF, which now holds the cumulative amount of roughly 409 million tonnes of tailings material.

We have deposited 12,522,652 tonnes of waste rock onto the Water Rock Dumps, bringing the cumulative total of waste rock material deposited to date to roughly 923 million tonnes of material.

10. Research

As part of the continuous improvement initiatives to ensure zero harm to people and to the environment, Rio Tinto operations undergo regular quality assurance audits to ensure compliance with relevant performance standards such as the ISO4001 Standard for Environmental Management, the Rio Tinto performance Standards on Health, Safety and Environment, and with legal and other requirements. In addition, strategic reviews on potential risks pertaining to potential risks pertaining to Health, Safety, Environment and Communities are performed in intervals of five years.

In the 2011 HSE review performed by Rio Tinto, a particular finding was that "Rössing has not been able to demonstrate through scientific and epidemiological studies that the current levels of radiation exposure are unlikely to cause any significant short- and long-term health impacts to its workers."

In order to address this finding, Rössing started in 2012 to organise and implement an epidemiological health study about the potential health risks to workers from working at the mine. In 2014, Rössing contracted Canadian company SENES (Specialists in Energy, Nuclear and Environmental Science) to complete a study to establish the best potential study outcome, given the available data on the Rössing workforce. The final report from SENES was received in August 2014, and a suitable research team to perform the study was then identified.

The Centre for Occupational and Environmental Health, Centre for Epidemiology, Institute of Population Health, Faculty of Medical and Human Sciences at the University of Manchester in the United Kingdom was selected to perform the study based on their extensive experience and expertise in the field of epidemiological studies, in particular given the radiological risk that is being researched.

A team from the University of Manchester visited Rössing in October 2015 to start the project. The protection of personal information during all stages of the study is of paramount importance; hence any information used for the study will be anonymised before it is shared with the research team or other external stakeholders.

The research project has been approved by the Namibian Ministry of Health and by the Namibia Cancer Registry. An independent External Advisory Committee consisting of delegates from the Namibian Union of Mineworkers, the Ministry of Health and Social Services, the Ministry of Mines and Energy, former Rössing workers and the Namibian Atomic Energy Board is providing ethical oversight for the project. The findings from the project will be presented for publication in the internationally peer reviewed scientific literature. A final report is expected in mid-2018.

A special tab has been established on the Rössing website, http://www.rossing.com/reports-research2.htm, to share more detailed information on Rössing's performance with the public. Environmental impact assessments and closure plans, environmental and biodiversity management plans and discussion of some frequently asked questions about the mine's management of health and environment are published here. Rössing's RMP and its annual reports to the NRPA are also published here for public information.

11. Conclusion

The Radiation Safety team was still severely restricted in 2015 in terms of available manpower. Periods of illness or annual leave for any members of the team result in shortcomings in terms of having at least one person available for clearances and general supervision at all times. For this reason, a new role was approved, and recruitment for the position of Radiation Safety advisor has started towards the end of 2015. The new role should significantly alleviate the workload for the entire team.

An audit by the NRPA of the RMP implementation at Rössing Uranium was held in July. No significant non-compliances were reported in the audit.

For the coming year, we have decided to focus on:

- Improving signage relevant to radiation safety and radiation clearances on the mine;
- Reducing levels of uranium dust in the Final Product Recovery area; and
- Completing the collection of all relevant data for the Rössing epidemiological health study.

Awareness about radiation risk remains a focus, and awareness sessions by suitably trained experts with all workers remain an important deliverable.

The monitoring results attest to the fact that radiation exposures at Rössing Uranium are very low indeed, and our controls are therefore a successful implementation of our vision of zero harm to people and to the environment.

We will continue making relevant information available to the public, in order to empower our communities with the knowledge to successfully put the risks relating to radiation safety into perspective.

12. Changes and revision status

First Issue	Issue date	Prepared by	
1.0	22 March 2016	G. von Oertzen	
Version number	**Revision date**	**Revised by**	**Reason for change**