

Rössing Uranium Health Study

An Overview



The Rössing Uranium 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.

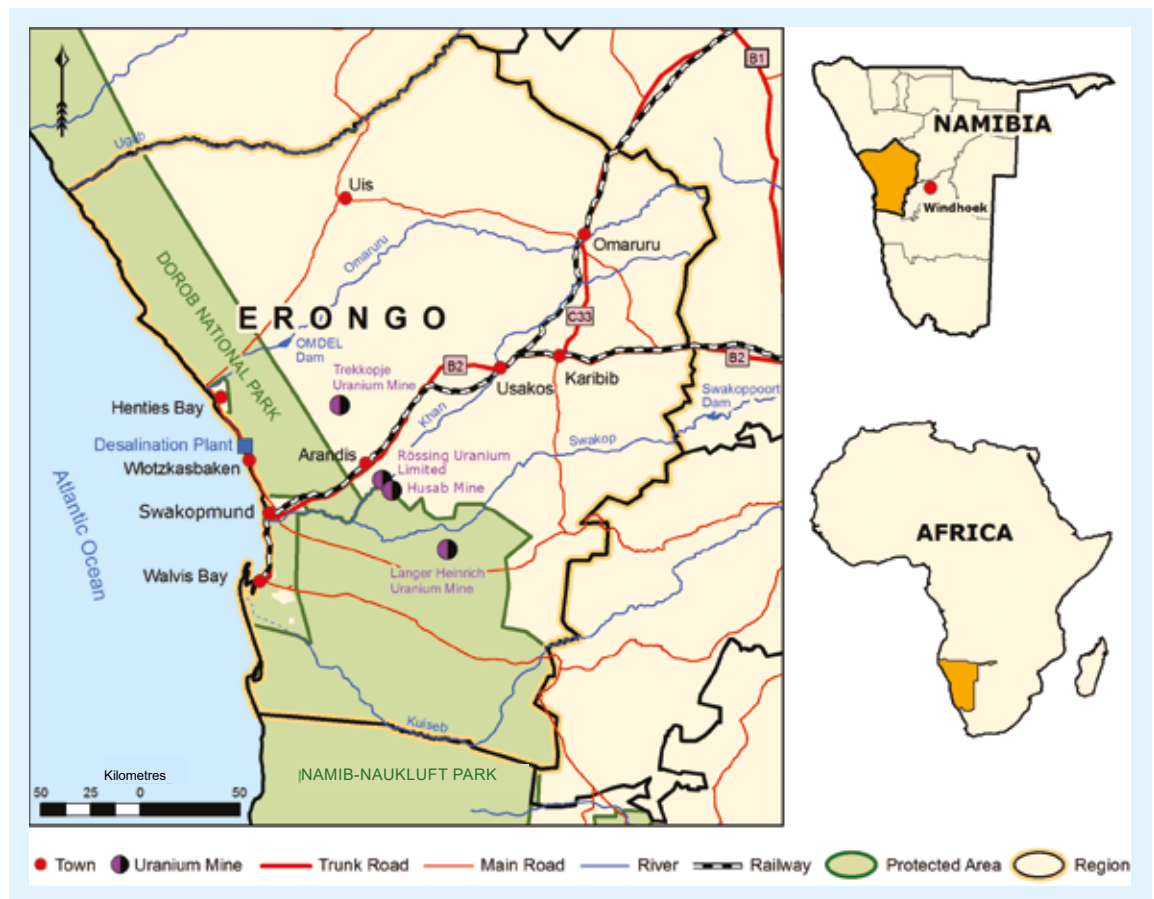
The mine is located 12 km from the town of Arandis, which lies 70 km inland from the coastal town of Swakopmund in Namibia's Erongo Region. Walvis Bay,

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 km², of which 25 km² 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.



1. Background and Purpose

Rössing Uranium started operations in 1976. In 2016 we are celebrating a milestone — 40 years of production at the mine. Over the years the well-being and safety of our employees have been our priority and we continuously place renewed focus on improving our health, safety and environmental (HSE) systems and performance.

To ensure that our safety initiatives are on the right track we have in the past attempted on several occasions to carry out a comprehensive health study that would be able to demonstrate that occupational exposures on site are not resulting in any excess health risk to workers. While several studies have been performed by external consultants, only one was published as the other studies lacked scientific rigor.

From 2011, Rössing Uranium began preparing for a scientific study designed to stand up to scrutiny. The first requirement for a successful study of this nature is a scope or project design that adequately addresses all the study parameters, such as quantity and quality of available data for the workforce, the available information on the population from which this workforce is recruited, and the study design that would produce the optimal outcome.

The scoping study was awarded to SENES (Specialists in Energy Nuclear and Environmental Sciences) in March 2014, and was completed in August 2014. SENES Consultants is a Canadian-based environmental consultancy firm.

Then the search for a suitable consultant for completing the study was undertaken and the project was awarded to the Centres for Occupational & Environmental Health (Epidemiology), and for Biostatistics, Institute of Population Health, Faculty of Medical and Human Sciences at the University of Manchester (United Kingdom) in August 2015. The choice was based on the research team's exceptional academic standing and experience with epidemiology.

We expect the project to end towards the end of 2018.

The International Commission on Radiological Protection maintains that the risk of excess cancers due to exposure of low level radiation follows a linear relationship between exposure and risk [4]. Considering the extremely low average radiation exposure doses to Rössing Uranium employees [1], [2], it is unlikely that any excess cancers have resulted as a result of the work at the mine.

The key outcome from the health study is expected to be a completed case-cohort study of worker health, with a focus on radiation-induced health effects (primarily cancer). The completed study must be scientifically peer reviewed and published in an internationally acclaimed journal, and potential concerns and contributions from key stakeholders (such as Government) will be considered and integrated where needed.

2. This is how the project will be carried out

Scoping study

The scoping study carried out by SENES suggested the following design for the planned study:

- A case cohort study design was recommended. This means that 'cases' (people who have been diagnosed with cancer) are matched with 'controls' (people who have not been diagnosed with cancer) within the same group of people.
- Both 'cases' and 'controls' are to be selected from the Rössing Uranium workforce, including all workers who have worked at the site consecutively for more than one year. For each case, five to ten controls are to be selected.
- The radiation exposure dose, obtained from historical dose records at Rössing Uranium, for controls and cases is to be compared, in order to obtain a statistical analysis of the question whether a link between radiation exposure and excess cancers exists in the workforce.

Epidemiological study

Epidemiology is the study and analysis of the patterns, causes, and effects of health and disease conditions in defined populations.

The epidemiological case cohort study can be summarised as follows:

- Perform an epidemiological case-cohort study of worker health at Rössing Uranium. The scoping study [3] presents the basis for understanding the quality and quantity of available data, and provides recommendation about the study design.
- The study is to focus on radiation exposure as principal occupational risk.
- The potential outcomes of radiation exposure to be studied are cancers that could be linked to radiation exposure or the chemical toxicity of uranium. Relevant cancer types include those of the lung, kidney, and blood-forming organs. In addition, brain cancers will be included because several of these are known to have occurred in the workforce, although no link to radiation is expected in these.

- Confounding factors, ie factors not related to occupational radiation exposure that can contribute to cancer incidence in the workforce must be considered. These would include other occupational hazards (silica dust, acid mists, asbestos, manganese and welding fumes), as well as lifestyle factors such as smoking, diet and socioeconomic background.
- The study is to be scientifically peer reviewed and published in a scientific journal.
- Relevant objectives are to be met, such as ethics review by a suitably appointed ethics committee, agreement of relevant Government stakeholders with the project scope and implementation, suitable information of all affected stakeholders such as the workforce and affected communities.

The power of epidemiological studies depends on the availability and quality of data. Both aspects (occupational hazards, ie radiation) and potential impacts (ie health outcomes) need to be available with adequate accuracy. The data-collection protocol must therefore be subjected to data quality audits by the research team.

3. Status of Study

Stage 1 of the study concerns:

1. Familiarisation of research team with mine and employees (October 2015);
2. Data collection of cohort by Rössing Uranium (started November 2015 and ongoing until present);
3. Submission of data to University of Manchester (UoM);
4. Submission of data to Namibia Cancer Registry (NCR);
5. Identification of cancer cases by NCR and submission to UoM;
6. Selection of controls by UoM;
7. Submission of controls and cases to RUL; and
8. Submission of secondary data about cases and controls by RUL to UoM.

Stage 2 concerns the statistical analysis of the data. This is expected to occur from January 2017 until mid-2017.

Stage 3 concerns:

1. Feedback to all stakeholders of outcomes of data analysis;
2. Additional analysis if needed; and
3. Preparation of scientific publication and submission to peer-reviewed scientific journal.

Stage 3 is expected to be completed by end 2018.

At present, Stage 1, point 3 has been reached.

4. References

[1] Von Oertzen G. et al, *Rössing Uranium Radiation Management Plan*, 2016

[2] Rössing Uranium, *Report to Radiation Protection Authority on Implementation of Radiation Management Plan*, 2013, 2014 and 2015, www.rossing.com

[3] SENES Consultants, *Scoping Study to Recommend Possible Health Studies of Workers Employed at the Rössing Uranium Mine*, 2014

[4] ICRP, *Low-dose Extrapolation of Radiation-related Cancer Risk*, ICRP Publication 99, Ann. ICRP 35 (4), 2005