Rössing – the great survivor

One of southern Africa's most famous mines, Rössing Uranium began operations in 1976 and was designed to produce 4 500 tonnes of uranium oxide a year. Today it produces under 3 000 tonnes a year and the uranium oxide price is a fraction of what it was 20 years ago. But Rössing is nothing if not resilient. Not only has it survived the big downturn in the uranium market but it is currently looking at an expansion which will gradually take it up to full production again and add 16 extra years to its life.

Part of the Rio Tinto Group, Rössing ranks as the world's largest open-pit uranium mine and it exploits the world's largest known granitic-hosted uranium deposit of economic importance. The ore, however, is very low grade which means that over 8 000 tonnes of ore and waste have to be mined for each tonne of uranium oxide produced. Current annual production is between 2 700 tonnes and 2 800 tonnes a year, which constitutes roughly 6 % of total world primary supply.

As a result of a surplus of supply, initially mainly from Russia, the price has been in almost continuous decline since the early 1980s, placing huge stress not only on Rössing but uranium mines around the world, many of which were forced to close in the 1990s. As Mike Leech, Rössing's General Manager Commercial, says: "When I joined the mine in 1982, the uranium oxide spot price was US$43/lb. In January 2002 it reached an all-time low of US$7,90/lb. It has subsequently recovered slightly to US$9,90/lb and the outlook is moderately optimistic, since world consumption is moving up, but clearly there is little prospect of prices ever returning to the levels of the early 1980s."

He adds that survival over the long downturn has been doubly difficult for Rössing, since it was designed as a low-grade, high-throughput mine. "We really need high tonnages to operate economically but the shrinkage of the world market has led to us cutting production over the years and we're now only working at about 60 % of capacity. Under these circumstances, we lose the economies of scale on which the mine's viability was originally based. The fact that we are currently profitable is a tribute to the excellent team we have here at the mine."

The team is currently headed by Managing Director David Salisbury (who was overseas when *African Mining* recently visited Rössing). Although Salisbury is a US citizen, 96 % of the mine's employees are Namibian citizens, as compared to 94 % in 2000. The average length of service of employees at the mine is 16 years.

The Rössing pit, which is now 3 km long, 1 km wide and more than 300 m deep.

The Demag 485E hydraulic shovel loads one of the Haulpak trucks.

Controlling costs

To get through the 90s, Rössing cut its labour force – from over 3 000 people in 1991 to about 800 now – and introduced a variety of programmes to improve productivity, cut costs and generally improve efficiency. The most recent was RB 2000 (Rössing beyond 2000) which was launched in April 1999. Says Leech: "Our minimum target was to achieve costs savings of at least N$100 million but we also said to our employees that 40 % of any savings between N$100 million and N$150 million would be given back to them in the form of a one-off bonus. We stopped counting at N$153 million worth of repeatable savings in December 2001 and concluded the programme with large cheques for employees as promised!"

Leech points out that the focus is now moving away from cost cutting and that the mine's latest programme, "Managing our Business" or MOB, is targeted more at cost efficiency. "MOB is all about accepting what we have and making it more efficient," he says. "This marks a new, and much more positive, phase for the mine and involves training all our employees in what we call 'Mission Continuous Improvement'."

Pushback ahead

Looking ahead, Leech says Rössing is reaching the point of decision regarding its so-called phase two expansion of the pit (phase one being the mine from inception to the present). "We're looking at a 300 m pushback on the southern side of the pit," he states. "Without the pushback, the mine has a life till the end of this decade. The pushback would give us an additional 16 years. The plan is based on a gradual return to full production and the annual tonnage mined would more than double to around 55 Mt, depending on the strength of the uranium market.

"Since the pushback involves about three years of stripping, we need to get a decision within the next year or so and we're planning to present the case for phase two to our shareholders in September 2003. If we get the green light, then we will have a period of significant investment ahead. The main expense would be the expansion of the mining fleet but we would also need to look at some significant upgrading of our process plant."

View from the pit observation point at Rössing looking towards the south-east. If the Phase 2 expansion goes ahead, the southern side of the pit (the area to the right here) will be pushed back.

The mining cycle

The pushback, if approved, will turn an already big operation into a giant one. The current pit, 3 km long, 1,5 km wide and more than 300 m deep, is one of the largest in southern Africa. The orebody is mined by blasting – some blasts have exceeded a million cubic metres of material although 300 000 to 500 000 m^3 is the norm – and the rock is then loaded by electric shovels into Komatsu Haulpak 730E trucks with a capacity of 180 tonnes. The trucks drive on trolley-assist on the ramps. Although the system dates back to at least the 1970s and was not pioneered by Rössing, the mine scored a "first" in 1987 when the first ever 10 % trolley assist ramp (as opposed to the 8 % gradient used previously) anywhere in the world came into operation.

Operations Manager Johan Coetzee says that Rössing is currently a truck-limited operation. "We have three in-pit shovels – a Demag 485E hydraulic shovel and two Marion 201M rope shovels – but only 11 Haulpaks, so our planning is based on maxi-

The pilot ore sorting plant with (in left background) the pre-screening plant.

Above: One of the Haulpak trucks climbs the ramp on the trolley assist system. Rössing has 4 km of trolley line and savings as a result of using the trolley assist system are estimated at N$0,35/tonne.

Right: The primary crusher station has a capacity of 60 000 tonnes a day. It is equipped with two Allis Chalmers gyratory crushers.

mising truck usage," he observes. "To assist us, we use the Wenco system which gathers information by means of mobile data terminals and GPS receivers in the trucks and shovels and relays it to a central monitoring centre."

Due to the erratic distribution of minerals in the orebody, waste and ore are often mixed together. The problem is addressed by using radiometric scanners to measure the radioactivity level of each truckload of material leaving the pit. Based on the results of the scan, which takes less than a minute, the truck proceeds either to the primary crushers or to a low-grade stockpile. The cost savings resulting from the use of the scanners are difficult to quantify but estimates vary from N$750 000 to N$1,5 million a month.

Crushing and processing

The primary crushers – Allis Chalmers 54/74 gyratories – initially reduce the uranium-bearing rock to an average size of 16 cm. It is further reduced to sand grain size through three additional crushing stages and milling (in four Marcy rod mills). Sulphuric acid is added as a leaching agent to extract the uranium from the rock, with the leaching operations being carried out in two leach tank modules. The next stages in the treatment route after leaching are sand/slime separation and thickening, the result of these processes being a clear uranium bearing ("pregnant") solution which then passes to the recovery section of the plant.

In the first stage of recovery, the pregnant solution comes into contact with beads of specially-formulated resin. The beads adsorb uranium from the solution, which is then stripped from the beads to form a more concentrated solution. This is pumped to a solvent extraction plant where it is further concentrated and the remaining impurities removed. In the next step, gaseous ammonia is added to the solution, resulting in a precipitate of "yellow cake" (ammonium diuranate). This is dried and roasted to produce Rössing's final product, uranium oxide (U_3O_8), which takes the form of a grey/black powder.

The uranium oxide is packed into 210 litre sealed

Rössing – geology and history

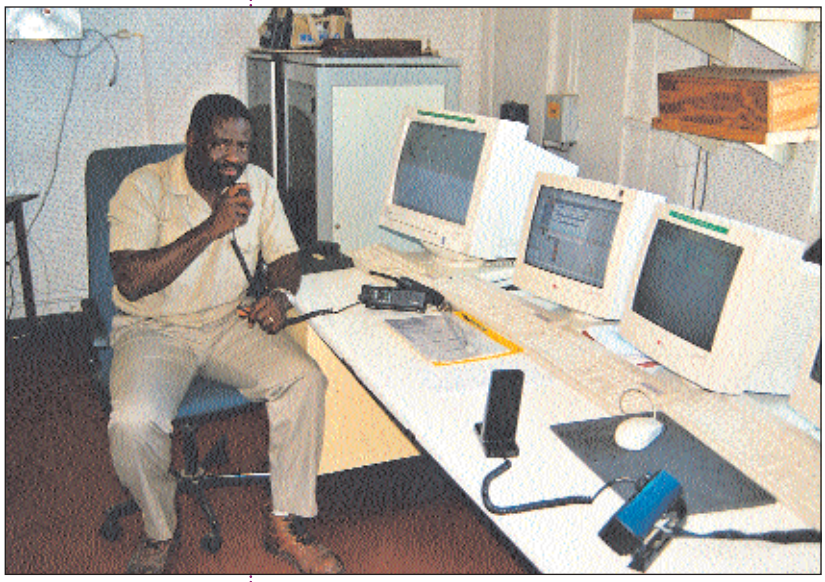
Rössing has a geological history dating back 700 million years to when the Namib Desert formed part of the sea. Very slowly, a thick succession of sediments began to accumulate on the floor of this ancient ocean. With time, geological processes led to the burial and hardening of these sediments deep within the earth's crust. At these depths extremely high pressures and temperatures caused complex folding of the sedimentary rocks. Underlying molten granite was forced upwards and became embedded in the sedimentary rocks. This intrusive granite, known locally as alaskite, contains the uranium minerals that are either microscopically small crystals of uraninite or easily seen yellow crystals of beta-uranophane. Subsequent erosion has removed much of the covering rock and exposed the Rössing deposit.

Captain Peter Louw at the entrance to an adit excavated in 1956 in the Rössing area ***(photo: Rössing Uranium)***.

Economic mineralisation occurs in two geological formations – the Rössing and Khan Formations. The Rössing Formation has a higher grade but the Khan Formation exhibits better leach performance (although it has higher comminution costs). The overall grade of the deposit is 0,034 % U_3O_8.

The presence of radioactive minerals in the Rössing area was discovered in 1928 when Captain Peter Louw and his wife Margery (who before marrying Louw was a radiographer at Guys Hospital in London) conducted an autoradiography test on a rock found about 12 km west of the Rössing deposit. In 1955 Anglo American took an interest in the Louw prospect but withdrew from the project soon thereafter and it was eventually left to Rio Tinto to carry the project forward. Rio Tinto's exploration programme starting in 1966 defined the deposit and Rössing Uranium Ltd (now owned 68,6% by Rio Tinto) was established in 1970 with the objective of bringing the orebody into production. Pre-production mining started in 1974 and the plant was commissioned in 1976, although a fire in the solvent extraction plant in 1978 meant that full commercial production was delayed until 1979.

Margery Louw died in the 1950s but Captain Louw lived long enough to see his deposit become a mine, passing away in 1978.



Pit controller Gerson Eiseb in the monitoring centre.

steel drums and railed to Walvis Bay for shipment to customers around the world in the nuclear power industry.

Radiometric sorting

A major innovation in the processing operation was introduced in 2001 with the commissioning of a pilot ore sorting plant which uses radiometric ore sorting to upgrade the feed entering the plant. "We measure the radiation rock by rock, and rocks of a grade below a set cut point are removed from the main feed stream before we go to all the expense of treating them," says Coetzee. "The system is working very well and is allowing us to screen out about a quarter of the ore which would have previously entered the plant."

In another new project, an 840 m long conveyor system is being constructed to transport tailings to the tailings dam. The ever increasing pumping height and distance as the tailings dam has grown over the years has made the current pumping system unreliable and expensive to operate and the new system, which will cost nearly N$48 million, is expected to result in substantial savings. It is due to be commissioned within the next few weeks.

The mine, of course, is a major consumer of sulphuric acid, using 180 000 tonnes annually. There is an acid plant on site which for years supplied the mine's requirements but, with the closure of the Otjihase copper mine near Windhoek (which supplied pyrite to Rössing), it was mothballed in 1999. Acid is now imported through Walvis Bay. Otjihase is once again in operation but, according to Coetzee, it is cheaper to source acid from overseas than to manufacture it on site and there seems little likelihood of the plant restarting in the immediate future.

Saving scarce water

Rössing is also a big user of water, consuming roughly 5 600 m^3 a day. Freshwater is supplied by the Central Namib Area Water Scheme based at Swakopmund, 65 km away on the coast, with the sources being wellfields in the Omaruru and Kuiseb rivers. Water is also sourced from boreholes in the bed of the Khan River near the mine, although it is very brackish and not classified as freshwater. In all, recycling accounts for 72 % of the water used at the mine while freshwater contributes 22 % and the Khan River 6 % (with most of the Khan water being used in the open pit).

With water desperately short in Namibia, particularly on the coast, Coetzee points out that Rössing has an obligation to use as little freshwater as possible. "We've probably halved our consumption since the early 1980s and even now we are achieving significant year-on-year savings. For example, our freshwater consumption rate in 2001 was 2,05 Mm^3 compared to 2,31 Mm^3 in 2000."

To reduce the freshwater demand even further, a wellfield has been constructed on the tailings dam to recover stored water which has built up over the years. The project has only recently been implement-

The coarse ore stockpile, which has a live capacity of 80 000 tonnes and a total capacity of 400 000 tonnes. Coarse ore is withdrawn from the stockpile by seven vibrating pan feeders feeding directly to a coarse ore reclaim conveyor.

Rössing breaks the barriers

Rössing now has its first female Haulpak operators. When it advertised a few months ago for pit equipment operators, the mine specified that preference would be given to female applicants. Close on 500 applications were received, with 59 coming from women, of whom 15 were finally appointed. The 15 operators, most of them pictured here, range in age from 22 to 35 and come from all parts of Namibia. Rössing is moving fast to open all jobs on the mine to women and currently has four female apprentices. Women are also being trained to operate forklifts.

Above: Looking south over the Rössing site. The secondary crushing plant is at right centre and the coarse ore stockpile in the background.

Left: Concrete supports for the tailings conveyor system with, in the distance, the mothballed acid plant.

ed but it is expected to supply 1 500 m^3/d of water for industrial use, at the same time assisting the mine's seepage control systems.

Safety and health

Rössing's efforts to achieve technical excellence appear to be matched by the attention it pays to issues such as safety and health. Says Willem van Rooyen, Manager OHSE & Risk Management: "We are a uranium mine and produce a product that is radioactive and we therefore ensure that we meet all Namibian and international standards relating to safety, exposure to radiation and protection of the environment, as well as those laid down within the Rio Tinto group itself. We are also ISO 14001 certificated. I believe our record is outstanding but we are still striving to do even better. One of our goals, for example, is to have a zero accident rate. This may seem unrealistic but there are companies around the world – Du Pont, is one – which have quite literally operated for years without any accidents."

Notwithstanding Rössing s efforts to create a safe working environment for its workers, there has been at least one relatively well-publicised case where a former employee who contracted cancer claimed compensation from Rio Tinto. However, the claim was unsuccessful and the Judge commented: "The summary of the available evidence so far will, as it seems to me, demonstrate clearly that the plaintiff's case on causation is an extremely weak one."

Van Rooyen points out that the mine has collected data on the health of its workforce over a period of 19 years and found no anomalies. "Illness and disease must, of course, occur in any workforce over time but it is clear that in the case of Rössing employees these largely relate to lifestyle and appear to have no link to occupational exposure to radiation or dust," he states.

When it comes to corporate citizenship, *African Mining's* impression is that the mine enjoys an excellent reputation within Namibia (although its parent, Rio Tinto, has frequently come under attack from activists overseas for its supposed "uncaring" attitudes). The main vehicle for its activities is the Rössing Foundation which was established in 1978 with the objective of promoting social development in Namibia and which is now one of the country's most respected NGOs.

Finally, although Rössing may still have many years of life ahead, it is already working on its closure plans and has set up a trust to fund the closure (which, in 2002 money, will cost an estimated N$280 million). Says Mike Leech: "Although Namibia's economy has diversified in the years since Rössing was first commissioned, the mine is still one of the country's bigger employers, and the town of Arandis in particular is to some extent dependent on the mine. We want to carry out closure in a very transparent way and in the coming year we will be holding open forums to explain our plans to the neighbouring communities, to outline the likely impacts and to ask for their input. The area must be able to survive the eventual closure of Rössing and we are committed to doing all in our power to ensure that this goal is achieved."

Report and photos by Arthur Tassell