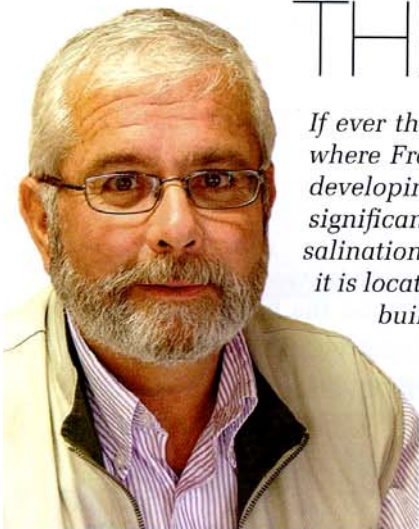


INNOVATION THE ORDER OF THE DAY AT TREKKOPJE



Alain L'Hour, Project Director, AREVA Namibia, has overall responsibility for the Trekkopje project.

If ever there was a project that could be described as innovative, it is Trekkopje in Namibia, where French nuclear giant AREVA – through its subsidiary AREVA Resources Namibia – is developing the world's first uranium mine to utilise an alkaline heap leach process. Another significant feature of the project is that AREVA is currently constructing a state-of-the-art desalination plant – Namibia's first – north of Swakopmund to supply the new mine with water, as it is located in a desert area where water resources are extremely scarce. The new mine is being built in a phased approach, with full production anticipated in 2012.

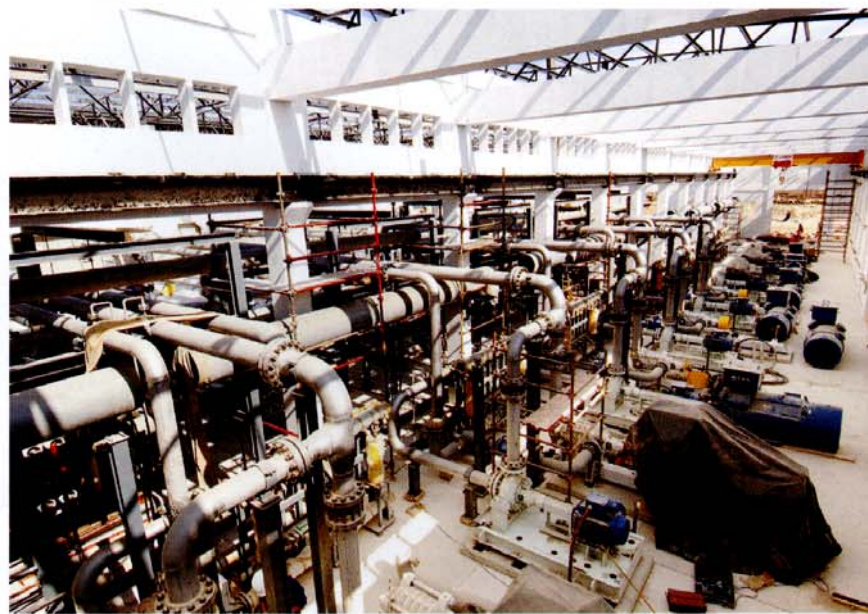
The groundwork on the Trekkopje project was carried out by UraMin Namibia which purchased the EPL from Gulf Western Trading in 2005. UraMin completed a feasibility study on the deposit in 2007 and was

bought out by AREVA the same year. AREVA has since moved fast to develop the project, launching a pilot plant in 2008 to test the alkaline heap leach process. In February 2009 it obtained its mining licence and in the following month a landmark was achieved when the pilot plant produced its first uranium. The uranium was extracted from the alkali leach solution using Nimsix IEX technology – another world 'first'.

Work on the desalination plant is well advanced and in November last year (2009) the start-up commissioning began. The function to mark this event was attended by Namibian President Hifikepunye Pohamba and Anne Lauvergeon, CEO of AREVA.

Located 70 km north-east of Swakopmund, the Trekkopje mine will exploit a very large, shallow, low grade uranium resource hosted by calcretised paleochannels with the main mineralisation covering an area of approximately 14 x 3 km. At a 40 ppm U_3O_8 cut-off, the global resource at Trekkopje is estimated at 1 130 Mt at 95 ppm – which translates into 103 000 tonnes of U_3O_8 .

Says Mine Manager Paul Day: "The full-scale mine we are planning will be a shallow open-pit, heap leaching operation with all mining taking place in a single pit. We will be using an On-Off Heap Leach



Above: Inside the desalination plant. The facility – which is probably the first in the world to have been built for a mining project – is the first large scale desalination plant in Namibia.

Left: Preparing the cells at the MIDI plant for stacking. The MIDI is the precursor to the full production (MAXI) project.

completion of the leaching cycle and the pad is then reloaded with fresh ore. In the case of Trekkopje, the spent ore will be used to backfill behind the advancing mining faces.”

Day, a mining engineer, has huge experience in Africa, having worked extensively in both South Africa, and more recently Mali in West Africa. Prior to joining AREVA, he was Mining Manager at the Sadiola gold mine in Mali (and before that worked at two other gold mines in the country, Yatela and Morila). He is responsible for managing the operational aspects of the Trekkopje project. Overall responsibility for the implementation of Trekkopje lies with Alain L'Hour, Project Director of Areva Namibia. An electrical engineer, he has been with AREVA since 1986 and has

Pad (OOHLP) design for the heap leaching as opposed to the more common single lift design, as it reduces the mine's footprint significantly and also assists the process of concurrent rehabilitation. In this method, the spent ore is removed from the pad on



The MIDI plant consist of 10 cells x 300 000 t treating -38 mm crushed ore. The stacking rate is 9 000 t/day.



Above: Aerial view of the desalination plant, which is located approximately 30 km north of Swakopmund.

Left: The seawater intake at the desalination plant during construction. The system consists of two intake pipelines approximately 1,1 km from the shoreline, and one brine disposal pipeline with a diffuser about 600 m from the shoreline. The intake pumps have been specially designed for the project, drawing from prescriptions outlined in the environmental assessment reports, and will draw water directly from ocean to plant.



been involved with project development all around the world.

The average depth of mining at Trekkopje will be just 16 m. At full production, the primary loading equipment will be 150-t class excavators working in conjunction with 100-t payload trucks for the waste and overburden and 350-t class excavators with 150-t payload trucks for the ore. Although drilling and blasting will be required, the overburden and waste above the orebody will be free dig.

“Initial crushing of the ore will be to -38 mm with agglomeration by fresh water,” Day continues. “Stacking will take place at a rate of 100 000 tonnes a

day using RAHCO racetrack technology. The ore will be washed over a 40-day period using fresh water to remove chlorides. This will be followed by an alkali leach, with the uranium being extracted from the leach solution using the Nimsix IEX technology and two-stage precipitation.” He adds that the leach pad facility will extend over an area of 3 km in length and 810 m wide, making it one of the biggest heap leach operations in the world.

Given the pioneering nature of the project, AREVA is proceeding cautiously and developing Trekkopje in phases – MINI, MIDI and MAXI, as it calls them. Phase one (MINI), which comprises two pads and the pilot plant, is already – as mentioned – in operation. Phase two (MIDI) is now well advanced. The official opening of the MIDI plant took place in July last year and stacking is in progress. This phase, which will be complete by the end of this year, consists of 10 cells at 300 000 tonnes, with the stacking rate being 9 000 tonnes/day. Phase three (MAXI) represents the full production stage of the mine. Construction of phase three is expected to start shortly and already some preliminary work has been undertaken and orders placed for long-lead items.

The full scale project will produce approximately 3 200 tonnes a year of U_3O_8 , which will make it similar to Rossing in terms of its scale (though the mining and processing methods used are very different). Production costs are expected to be less than US\$7 per tonne of ore mined. The mine will be a major employer, with the total operational workforce, including contractors’ employees, numbering 950 (98,5 % of them Namibian). At the peak of construction, the workforce will be 1 200, most of them Namibian. The mine’s life in full production will be 12 years based



Members of the Trekkopje team. They are (left to right): Justice Davhana (Long Term Planning Engineer), Malcolm Lindsay-Payne (External Affairs), Jacques de Jager (Cost Accountant), Paul Day (Mine Manager) and Mamadou Toure (Operation Planning Engineer).

on current reserves. The total capex of the project (including the work already done and the desalination plant) is projected at US\$956 million, making it one of the biggest mine developments Namibia has yet seen.

The desalination plant that forms part of the overall project is located at Wlotzkasbaken, approximately 30 km north of Swakopmund, and will obviate the need for water to be extracted from the Omdel aquifer, currently the main water resource in the Erongo Region. The first and second phases of the process entail seawater passing through ultrafiltration membranes that remove coarse debris from the water. By reverse osmosis the water is then pumped through a high pressure filter that separates the seawater into two streams – a ‘pure’ water stream and a by-product of a more concentrated saltwater (brine) stream. The brine stream is gravitationally forced back and dispersed into the ocean approximately 600 m offshore. Once completed, the plant will have the capacity to produce 20 million m³ of potable water a year.

Lime, chlorine, biodegradable anti-scalant and a range of chemicals such as hydrochloric acid, citric acid, and sodium laurel sulphate are added to the water at various stages to clean the membranes and further prevent any scaling, while preventing bacterial growth in the water. The discharge back into the ocean has about double the salt concentration as compared to the first phase intake. There are, however, 27 brine diffusers ensuring maximum mixing to reduce the environmental impact. The dispersion of the brine is designed to comply with stringent South African Marine Quality Guidelines based on the standards of the International EPA.

The water will be conveyed to the mine via a 48 km long, 800 mm diameter cast iron surface pipeline traversing the Namib Desert. Three pump stations form part of the pipeline project. The first is located adjacent to the desalination plant and the other two at intervals along the pipeline route. Each pump station will be equipped with a set of giant Mather + Platt pumps. The pumps weigh in at over 2 600 kg and each is driven by 800 kW motors.

The desalination plant has entered its final commissioning stage and tests will be carried out until mid-2010, at which point it will begin producing de-

salinated water. Apart from supplying all Trekkopje’s needs, the plant will have a surplus available for domestic and industrial users in the Erongo Region. This surplus will in fact be considerable in 2010 and much of 2011, as the plant will be in operation before Trekkopje needs its full allocation.

From an environmental point of view, Trekkopje presents no major problems. “There are no environmental issues outside of those normally associated with mining activities,” says Day. “In fact, the use of the desalination plant and the On-Off Heap Leach Pad method being used mean that Trekkopje has a smaller environmental ‘footprint’ than most of the other mines – and planned mines – in the region.”

A large number of consultants and EPC/EPCM contractors are involved with the project but key amongst them are Turgis (lead engineering consultant on utilities), Amec, Senet and Bateman Engineering (all on the MIDI plant) and TSU, Bateman Engineering and SRK (all on the MAXI plant). On the desalination plant and its related infrastructure Keyplan has been responsible for the plant design, Kuchling Consult-

The geology of Trekkopje

The Trekkopje uranium deposits are one of a number of uranium deposits located in the coastal plain of the Erongo Region of western Namibia. These deposits are hosted within surficial calcrete deposits formed in fluvial and valley-fill sediments.

The calcrete-hosted uranium deposits are the results of broad-scale surficial weathering of uraniumiferous granites and schist of Precambrian and Mesozoic age in the Namib hinterlands to the east. Uranium was dissolved as uranyl ions and transported in groundwater down the hydraulic gradient to the southwest. Deposition was focused into narrow paleostream channels in permeable shallow stream detritus at chemical (vanadium-enhanced clays) and oxidation/reduction (redox) and evaporation interfaces.

The upgrading of weak regional background uranium values by three to ten times (or more) background occurs in this unique fluvial setting of groundwater migration into suitable chemical traps. Uranium and vanadium is transported by groundwater and deposited within calcrete-cemented conglomerates, silts, and sands occupying the same drainages at an oxidising interface by an evaporation-abetted salinity increase.

ing for the pipeline design, and Delft Engineering and WSP for the seawater pump house design and seawater intake design respectively.

Civil engineering works for the MIDI plant were carried out by B&K while important contractors on the desalination plant are M&R Marine (seawater intake system), Keyplan, New Era and M&R Namibia (desalination plant construction) and Cycad (pipeline and pump station construction).

Contractors working in an operational role at Trekkopje include MCC (open-pit mining), BME (blasting) and ALS (assay services). Reagents are being supplied by Protea.

Once it is commissioned, Trekkopje will rank as Namibia's third uranium mine after Rossing and Langer Heinrich, although other projects such as Etango (Bannerman) and Rossing South (Extract Resources) are likely to follow it. The project is one of three that AREVA has in Africa – the others are in South Africa and the Central African Republic – and they all form part of AREVA's strategy of diversifying its resources to provide customers with the security of supply they expect from a leading uranium player.

The fact that AREVA has chosen to build one of its flagship mines in Namibia not only reflects the country's extraordinary endowment in terms of uranium



The Trekkopje project team pictured at AREVA Resources Namibia's Swakopmund office.

but also its status as an attractive mining destination with a stable, democratic government and – one of the most important factors – a very well developed infrastructure. From a technical point of view, Trekkopje is breaking new ground and is arguably the most interesting uranium project currently under development anywhere in the world. Certainly one can envisage it being the template for other low-grade operations both in Namibia and elsewhere. Whether it will be a profitable mine, of course, remains to be seen but AREVA's phased approach and use of sophisticated technology has reduced the risk profile drastically and should ensure its ultimate success.

Photos courtesy of AREVA Resources Namibia