Chelopech revitalized

John Chadwick visited Bulgaria's flagship underground mine where state of the art technology and experienced management are reaping rewards for all

Bulgaria has a long tradition of mining, but with little mechanization. The Chelopech copper/gold operation is the country's leader in underground mining. It has now changed over from sub-level caving (SLC) to longhole open stoping (LHOS), with cemented tailings backfill in the near future and has fully embraced trackless mining with a Sandvik fleet, developing a ramp system from surface. The mine is planning to install skip hoisting and to introduce a metal production facility on site. Productivity and recoveries are rising nicely, as is morale among the workforce. The 2005/06 safety and production performance far exceeds all previous Chelopech records.

Chelopech is an epithermal high-sulphidation gold-enargite deposit (with tennantite) in the Panagyurishte metallogenetic district and lies 75 km east of the capital Sofia. The operation was in administration incurring substantial financial losses when Dundee Precious Metals (DPM) acquired the mine in 2003. Concentrate continued to be produced at a mine production rate of 400,000 t/y in facilities in which minimum capital had been spent since privatization in December, 1993. Morale of the workforce was low due to broken promises, and lack of badly needed cash for mine/infrastructure upgrades, and the distrust of another foreign operator was perhaps the most difficult problem that DPM had to overcome. However, DPM's willingness to invest in the capital for the mine's long-term future, and integration and putting aside any 'us and them' mentality, have allowed it to win the trust of the workforce. A great deal has been achieved in three years.

DPM's ownership of Chelopech has seen success in all areas, from exploration through mining, processing and continuing advances in environmental management and sustainable development of the local communities. In 2005, 911,000 t were hoisted at a head grade of 1.5% Cu, compared with 620,000 t at 1.5% Cu in 2004, and 530,000 t at 1.6% Cu in 2003. After the proposed upgrade, the mine will be capable of hoisting well in excess of 2 Mt/y.

The Definitive Feasibility Study (DFS) for the expansion of the operations was completed in 2005 by GRD Minproc. This covers the whole project – the mine and process plant

The Chelopech copper/gold operation is Bulgaria's leader in underground mining.

upgrade, the new Metals Production Facility (MPF) and associated facilities proposed to be added or upgraded. After commissioning, the integrated Chelopech operations are expected to produce a nominal 22,000 t of copper metal and up to 137,000 oz of gold bullion per annum from mining and processing 2 Mt of ore, by flotation, pressure oxidation (POX) and SX/EW for copper, and cyanidation of the residue for gold.

The DFS estimated an initial capital requirement of $148 million, with $62 million of sustaining and deferred capital for the subsequent 12 years. The post-2007 overall operating cost is predicted to be $29.70/t processed.

Chelopech Mining EAD, the Bulgarian operating company 100% owned by DPM is drilling ten times more diamond core than previous owners did ten years ago. The success has been such that every drill metre thus far has returned 500 t of additional ore. The DFS was based on a reserve, dated December 2004, of 21.7 Mt at grades of 1.4% Cu and 3.6 g/t Au.

Before 2004, limited exploration drilling was being undertaken, really only that needed to sustain mining. But in 2004, 34,000 m were drilled on a notional 25-50 m square pattern, to depth, in known orebodies. Modelling was validated by stope sampling and mill reconciliation.

While some drilling from surface continues, the main thrust is now on underground diamond drilling to discover additional orebodies. In 2005, the mine drilled a further 25,000 m and purchased two Boart Longyear drills, an LM 55 and an LM 75 from Major Drilling and these are now the focus of the exploration programme. The target for this year is for Chelopech to drill 31,000 m of core with its own crews.

The upside potential is significant. For example a new zone (block 149) was discovered in August 2005 in which 11 holes have been drilled. Eight similar high grade targets require drilling, and a further seven conceptual targets have been identified.

Building a Toro 0010 LHD in the older of the two underground workshops.

This Voest-Alpine AM 75 roadheader is being used to mine a decline.

Changing mine infrastructure

The mine has now changed over completely to LHOS from SLC. Not only was it not possible to continue with SLC because of the surface effects, but LHOS is a more efficient method in these conditions. The old SLC was a high dilution method with which it was difficult to get any higher production.

Three block failures and one surface disturbance caused by SLC in some ore blocks were registered between 1977 and 1990. The government determined that pillars should be maintained to protect public surface infrastructure and this now prevents the use of caving methods in some blocks.

Chelopech is a good deposit to work comprising six primary disseminated sulphide orebodies hosted within silicified 'envelopes'. These orebodies are close enough to each other not to need complex infrastructure, but not so close as to cause geotechnical or production interaction. The TVM (tonnes per vertical metre) is high for each one of the orebodies. This is a commonly used unit in Australia to describe the amount of ore in a deposit; ore length is multiplied by the width and divided by the appropriate rock factor to give the TVM. Best practice Australian underground mine management and planning is widely used at Chelopech.

The complete modernization of the hoisting system and a new decline from surface will make a huge difference to underground efficiency. Chelopech is currently served by two hoisting shafts, as well as two ventilation shafts. Kapitalna is the main shaft, centrally located among the

known orebodies. It currently hoists some 900,000t/y, with another 300,000 t/y capability in the Zapad shaft, a few hundred metres to the west of Kapitalna.

The current haulage system from the ore passes is rail cars, which are hoisted in the shaft cages. This is of course a very labour intensive hoisting system with evident capacity deficiencies. Another constraint of this, with no decline, has been that all new equipment going underground has to be broken down into manageable sections to fit in the shaft.

Kapitalna is the main shaft, centrally located among the known orebodies. It currently hoists some 900,000 t/y, with another 300,000 t/y capability in the Zapad shaft, a few hundred metres to the west of Kapitalna.

Chelopech is currently mining a decline from surface, just to the east of Kapitalna shaft. A Voest-Alpine AM 75 roadheader is being used, requiring lining, extensive rock-bolting and grout injection. The decline will connect the 450 m level (height above sea level) with surface over a length of 2,300 m. Once the decline is commissioned, scheduled for June next year, Kapitalna shaft will be decommissioned for about three months while it is converted to skip hoisting (twin 14 t capacity skips), nominal capacity 2.2 Mt/y. Zapad will become just an intake shaft.

Further into the future, an underground crusher will be installed on the 100 m level and ore will then be trucked down ramps from the central area, while the bulk of production will be fed through ore passes in the western area. A conveyor system arranged in two 1:4 flights will haul ore from the 100 m level to the skip loading facility.

Backfill

The initial phase of the backfill preparation plant has tailings classification using cyclones fitted with fishtails to maximize the solids density. This dewatering technology is relatively inexpensive, is simple to operate and is essentially self regulating. It is estimated that the plant will have a 70% recovery of tailings to backfill. Though in the first two years, making up for lost time, it will use the entire tailings output. The plant will produce a reject stream (cyclone overflow) of fine, dilute slurry which will continue to report to the existing tailings management facility (TMF) from where the water will be recycled back to the plant.

A second phase for the backfill system (the addition of a belt filter) will be considered once the first is in operation, and there is a necessity to produce a better dewatered product. This dewatering technology is more expensive but will improve the quality of the product should that be necessary.

The paste produced, at 140 t/h, is to be mixed with an average of 5% cement (7% primary stopes, 3% secondary stopes) for the final fill. The paste is to be delivered underground by a pipe distribution system to the stopes.

Sandvik fleet and support

Currently, three drill jumbos (two Sandvik Tamrock Minimatics and an Axera D06) are budgeted to produce 600 m/month of development. Next year, four jumbos will be targeted to produce 800 m/ month. ANFO explosives are used throughout, for development and production.

In sulphidized rock areas, split sets alone are installed to support the back. In unsulphidized areas, mesh is used as well as the split sets. Grouted cable bolts are also installed at junctions and in weaker areas.

Currently two Sandvik Solo drills (one new) undertake the production drilling. A new Solo 7V is on order, along with three Axera D07 drill jumbos. The current LHD fleet comprises three Toro 0010s and an older 007 LHD – one more 0010 is on order. In the truck fleet are two Toro 40Bs and two 50Ds with another three Toro 50D units coming. There are also three Caterpillar 725 ADTs, each offering a haulage capacity of 23.6 t. Two of these are currently used on surface, hauling hoisted ore from Zapad shaft to the main crusher at Kapitalna. The other is part of the underground haul fleet.

The LHOS stopes are drilled out with 89 mm blastholes, taking 25 m of vertical height for one level. The complete stope will extend over three levels vertically, totalling 90 m. The average ore block is 40 m wide and 120 m long.

There are now two underground workshops, one being a new, large facility

Chelopech is updating its flotation concentrator to improve efficiency and in anticipation of feed to the new Metals Production Facility (MPF), based on Pressure Oxidation (POX), in the future.

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equipped to handle the growing mechanized fleet. Chelopech has introduced Planned Preventive Maintenance (PPM) over the past two years. Key maintenance personnel have been sent to Sandvik's training facility in South Africa as part of a training agreement ('Trans4Mine' see below).

Trans4Mine partnership

Sandvik has brought its new Trans4Mine partnership to Chelopech. This programme was developed in South Africa over the last four years. Sandvik 'implementation coaches' come in to work with mine personnel in the areas of production and machine maintenance. Chelopech has one 'coach' for each discipline. It also involves, on the gold level, training and a general review of the mechanized mining system. Everyone has key performance indicators (KPIs) to follow and achieve. Trans4Mine entails:

- Investigate – doing an audit of the mine operations and implementing an activity based measurement system
- Analyze – reviewing the audit and measurements with increased productivity as the main aim
- Identify – picking up on the bottlenecks and waste within the operation and maintenance of the equipment
- Optimize – putting to work the solutions that have been identified and the lessons learned.

Part of the thinking behind Trans4Mine is mechanized mining's need for a major change in operations front line management. Many mining operations introduce mechanized equipment but continue to operate around conventional mining processes, such that drilling, bolting, loading and tramming are viewed as separate cycles and not as fully integrated processes in the underground mining system.

The challenge of mechanized mining is to be able to plan the perfect cycle and then execute the plan. Should there be extenuating circumstances that disrupt the plan then contingency plans have to be made by front line management to use all the equipment, calling for changes in the production cycle, where the aim is still to execute all the different processes simultaneously without jeopardizing safety.

Over the past seven or eight years, chrome and platinum miners in South Africa have successfully introduced new mechanization technology to their operations and conventional practices have been successfully swept aside in favour of mechanized mining methods. To achieve their breakthrough they had to discard long-held beliefs based on conventional mining practices and apply systems engineering principles of process flow to achieve higher cycle productivity, and their success in this has been significant.

Rail cars containing ore are currently hoisted in the shaft cages. This is of course a very labour intensive haulage and hoisting system with evident capacity deficiencies.

Two Boart Longyear drills, an LM 55 and an LM 75 have a target for this year of drilling 31,000 m of core.

They have demonstrated that it is possible to break away from the conventional mindset. Trans4Mine aims to achieve this for other mines around the world. The Trans4Mine team conducts its audit on mine operations and produces a programme that maps out an action plan which, if adhered to, will elevate production levels to meet the mine's requirements safely. Mine personnel are involved from the outset and members of senior and middle management are co-opted to an action committee which drives the project and includes representatives from Sandvik's own action unit.

An important question is how much valuable production time is lost while equipment stands – a matter of availability versus utilization. It is rewarding to see how production increases when conventional mindsets are discarded and a mine reorganizes operations.

Chelopech Mining has embraced the Trans4Mine concept, and has entered into a partnership agreement with Sandvik on the back of purchasing equipment and spares

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which, during 2006, will be worth in excess of €5 million. Chelopech Mining required a partner that understood its business and the day-to-day issues that affect production, and Trans4Mine was the differentiating tool in a fiercely contested competitive pitch for the equipment business.

Mineralogy and processing

Pyrite, marcasite, and melnikovite dominate the Chelopech sulphide mineralogy and can form up to 50% by volume of the orebodies. In general terms, some 75% of the copper is in the form of arsenides and sulphosalts, with 20% as chalcopyrite and 5% as oxides. Up to 40% of the gold is locked into pyrite.

The ore mineralogy can be described as 'challenging.' However, the concentration process is relatively straightforward as a saleable copper concentrate (16.5% Cu) is produced at high pH to depress the majority of the pyrite. The concentrate contains between 5 and 6% arsenic, which significantly limits the smelters capable of treating the significant volumes of concentrate currently produced.

To overcome this significant hurdle, Chelopech is updating its flotation concentrator to improve efficiency and in anticipation of its feeding to the MPF, based on Pressure Oxidation (POX), in the future. Permitting the MPF is currently in process with a comprehensive Environmental Impact Assessment (completed to Bulgarian and EU standards) having been approved by the Supreme Environmental Council of the Ministry of Environment and Waters, twice. Final approval is awaited from the minister, who openly refuses to make a decision. These events have highlighted one of the main problems of doing business in Bulgaria – corruption motivated politically bureaucracy. This is a systemic problem currently well recognized and potentially a hindrance to Bulgaria's accession to the EU and attraction of foreign investment.

The permit problems have occurred despite DPM receiving a Class 1 Investor Certificate under the 'Encouragement of Investment Act' passed in August 2004. This should mean preferential administrative services in relation to investment projects, and reduced time to process permits, licenses and land acquisitions.

In August the company announced it had commenced "assessing alternative locations for its proposed MPF. This situation may result in a slowing down or suspension of operations at Chelopech in 2008 until facilities capable of processing the Chelopech material can be constructed and commissioned or alternative markets for the Chelopech concentrate can be found."

Nevertheless, DPM remains committed to Bulgaria, commenting that "the reduction of corporate taxes to 15% for 2005 from 19% the previous year, the completion of large scale privatizations and further municipal and public sector reforms show a commitment to improve the country's investment climate."

The design productions of the expanded concentrator and MPF are:

Concentrator	**MPF**
Annual ore throughput 2 Mt	Availability 85% (7,446 h/y)
Availability 91.3% (8,000 h/y)	Concentrate throughput 20 t/h
Throughput rate 250 t/h	Concentrate Cu grade 15.5%
Design copper head grade 1.45%	Concentrate Au grade 29.9 g/t
Design gold feed grade 3.8 g/t	
Copper concentrate weight 7.5%	
Annual production 150,000 t	

The concentrator upgrade will use much of the existing equipment, including the primary crushing area, flotation equipment, concentrate dewatering facility and services.

The primary crusher facility comprises two Sandvik Rock Processing Jawmaster 1206 jaw crushers and one Russian jaw crusher. Ore hoisted from the mine directly feeds two of these units, while the third is fed from supplementary ore stockpiles outside. During the period the shaft is being upgraded, ore trucked up via the decline will continue to be fed to the plant via the outside stockpile.

The secondary and tertiary crushing facilities will be discontinued and replaced by a grate discharge SAG mill – 8.24 m diameter (inside liners) and 4.73 m effective grinding length, powered by a 5.8 MW motor, with a ball charging arrangement, liner handler and associated equipment. Two new conveyors will transfer crushed ore from the existing transfer conveyor to the new SAG mill feed chute. The SAG mill classification circuit comprises mill discharge hopper, cyclone feed pumps and cyclone cluster. SAG mill commissioning will be completed once the shaft has been upgraded and mine production has reached the required rate. It is expected to bring benefits of lower maintenance and steel consumption, along with better handling of fines. It also will allow Chelopech to expand to 3 Mt/y at a later date, should the continuously increasing resource justify such an expansion.

To process the increased throughput, four new 100 m^3 tank cells will be installed for upgraded rougher and scavenger flotation duties. The existing flotation circuit is to be used as the new cleaning circuit.

A Metso Minerals vertical plate and frame pressure filter and ancillary equipment are being installed to complement the existing Larox Ceramec filter for concentrate dewatering. The concentrate filter cake handling system includes two screw feeders, transfer conveyor, diversion gate and emergency bunker. A system to introduce stockpiled concentrate includes a bin and transfer conveyor to direct material to the concentrate repulp tank.

The current LHD fleet comprises three Sandvik Toro 0010s and an older 007 LHD – one more 0010 is on order. In the truck fleet are two Toro 40Bs and two 50Ds with another three Toro 50D units coming.

Metals Production Facility

The MPF design is the result of an extensive testwork programme costing more than $4.5 million, with six separate pilot pressure oxidation campaigns and two locked cycle process demonstration campaigns. The majority of

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Products and Equipment

these campaigns were completed at the facilities of Dynatec's Metallurgical Technologies Division, Fort Saskatchewan, Canada. LME grade copper was produced in both campaigns, which used samples of current concentrate as well as those from future ores.

To improve POX kinetics, flotation concentrate will be reground prior to introduction to the autoclave. Regrind thickener underflow stream is pumped at 55% solids to the POX autoclave feed tank and the overflow stream will usually report to the concentrate repulp tank.

Regrind thickener underflow and underflow from the impurity removal thickeners will be pumped to the agitated POX autoclave feed tank for blending and 36 hours of storage. The total design autoclave feed rate is 50 t/h.

The oxidation autoclave is to be a five compartment, membrane and brick lined, horizontal agitated steel pressure vessel operating at 225°C and a normal pressure of 3,713 kPa. Oxygen will be supplied at a design delivery pressure of 3,850 kPa and a purity of 96% by weight.

Discharge from the autoclave goes to the counter current decantation (CCD) circuit. Solid-liquid separation of the POX discharge allows subsequent treatment of the solution phase (containing the copper, zinc and other base metal values) from the solid phase (containing the gold values). The separation is to be achieved using a five-stage CCD circuit incorporating 13 m diameter high rate thickeners. Return water from the CIL is employed as wash water. The liquor from the CCD circuit reports to the PLS storage pond. The underflow from the final stage thickener is pumped to the CIL neutralization system.

The main function of the primary neutralization circuit is to neutralize the residual acid content of the PLS solution from approximately 34 g/litre to a target value of 5 g/litre through adding limestone and removal of the resultant gypsum product.

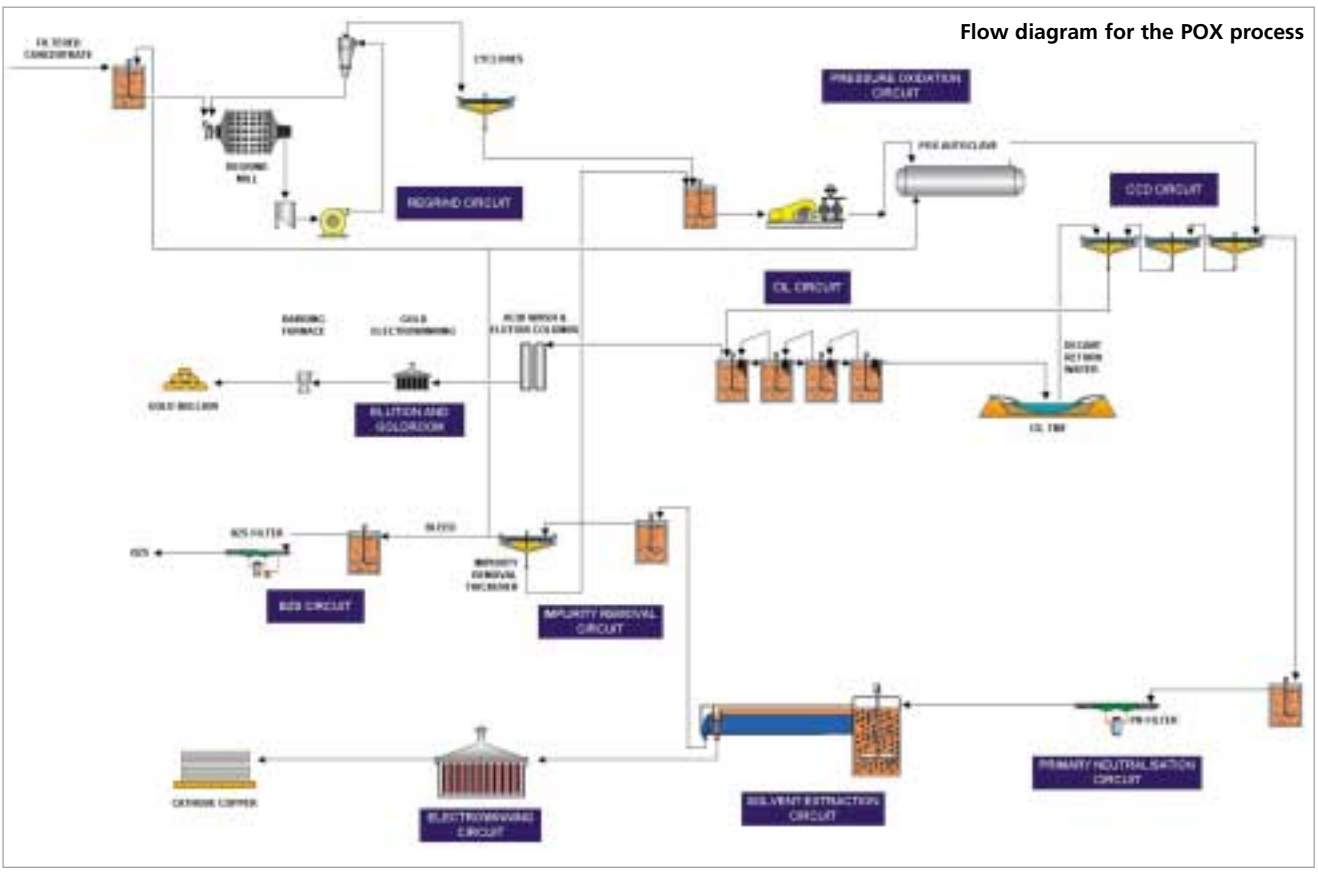
PLS solution from the clarifier reports to the SX circuit. The SX mixer settlers are configured for two stages of extraction and one stage of stripping. The aqueous phase exits the SX circuit as the raffinate stream and gravity feeds to the raffinate pond. The pond has two sections, a pre-settler with a floating boom for organic recovery and a surge pond. Organic entrainment entering the pond is retained in the pre-settler pond behind the floating boom and later recovered using the organic recovery skimmer and returned to the SX circuit. The settled raffinate stream reports to the Impurity Removal (IR) circuit.

In the Chelopech EW plant, advance electrolyte from copper SX will be fed to the copper EW circuit after removal of entrained organic. Solution temperature will be controlled to 45°C to achieve optimal conditions in electrolysis. This is achieved via heat exchange with the spent electrolyte followed by trim heating by direct steam injection. Spent electrolyte, containing 35 g/litre Cu and 180 g/litre H_2SO_4, is pumped from the circulation tank and returned to the copper SX stripping circuit. In addition, a bleed withdrawn from the electrolyte stream will control the concentration of soluble impurities such as iron, chloride and manganese.

Copper cathode will be grown continuously over a period of about seven days at a current density around 300 A/m^2.

The IR process involves two stages of neutralization to remove free acid and metallic impurities such as arsenic, zinc, iron and others from the raffinate exiting the SX plant. The IR1 section of the process comprises four agitated tanks in series. Neutralization is effected using limestone slurry and the pH is increased to about 4.4, where sulphuric acid is neutralized and the

Flow diagram for the POX process



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soluble iron is precipitated.

The IR1 feed stream contains ferrous iron that requires oxidation to the ferric state. A proportion of the discharge solids from IR1 will recycle, via a thickener, to provide seed for the precipitation reactions occurring in the neutralization tanks. The remainder recycles to the POX circuit to fix the contained arsenic and recover precipitated copper.

Overflow from the IR1 thickener is further neutralized in the Basic Zinc Sulphate (BZS) step to a pH of 8.5, yielding a potentially saleable zinc product. This product is thickened to an underflow density of some 30% solids (w/w) before being filtered and packaged for despatch.

Acid water produced from underground processes and drainage through the mine is currently neutralized and disposed with the flotation tailings. This will now be introduced to the IR2 circuit, which will recover contained metal values and allow the water to be reused in the process. The pH of the dilute slurry in IR2 is increased to 8.5 using lime slurry. The liquid stream exiting the IR circuit – neutral barren solution (NBS) – is used as quench solution for the autoclave and as make up at various points throughout the processing circuit. IR2 precipitated solids are thickened and directed to the POX circuit, as for the equivalent IR1 stream.

After pre-treatment of the ore by pressure oxidation and removal of most of the soluble copper in the CCD circuit, CCD 5 underflow slurry will transfer to the CIL circuit for gold extraction. Initially the slurry pH is increased to 10.5 with lime slurry to facilitate the subsequent cyanidation process. Gold will be extracted in a typical leach/adsorption circuit configured as one leach tank and five carbon adsorption tanks. Gold doré is recovered from the loaded carbon via a standard AARL style elution system with a 2 t batch capacity.

Tailings management

Knight Piésold undertook the feasibility level design and cost estimate for the tailings storage facility and associated works. Chelopech will operate two TMFs. The existing flotation TMF is being upgraded and raised progressively as required. It has a capacity of 50 Mt of ore equivalent. New, two celled, lined POX/CIL residue facilities will be stage constructed upstream of the flotation TMF to store the relatively high arsenic concentration tailings produced by the MPF. Although the arsenic content is in a stable form, regulations require such concentrations to be contained in a geomembrane lined dam. Residual cyanide levels in the contents of the POX/CIL TMF also demand the use of a liner. Caro's acid will be used to ensure WAD CN is less than 10 ppm.

A separate gypsum tailings stream is deposited into the flotation TMF. This is located 3 km south of the plant site. It is progressively raised using imported or borrowed low permeability fill and structural fill using a downstream raise construction method. Flotation tailings, combined with gypsum, discharge into the facility by sub-aerial deposition methods, using a combination of banks of spigots at regular intervals on the main embankment. The gypsum stream will be discharged as slurry from the northern end of the facility during times when the mine backfill plant is operating.

Underdrainage solution will be recovered from the POX/CIL tailings via an engineered collection system. This will be constructed during the first stage of both cells and will cover the lower half of the facility basin. There will be a leachate collection and recovery system (LCRS) below the geomembrane. The LCRS will collect seepage through the geomembrane or rising groundwater table and convey it to a sump, which will be monitored for water quality.

Modelling indicates that, under average conditions, and with the use of all mine water, all of the tailings facilities can be operated with 'negative' water balances, maintaining pond volumes close to the minimum levels.

People and environment

Chelopech Mining's sustainable development credentials are impressive. One of the first things DPM did when it took over the operation was to promote integration between the expatriate management (numbers kept to the essential minimum) and the local community. This is always desirable, but especially when the mine is the second largest employer in the region, after the Pirdop smelter.

Bilingual signs in both English and Bulgarian (in Cyrillic text) are just one of many ways Chelopech is integrating its multinational workforce.

A social programme has been established with local municipalities. This includes Chelopech Mining funding the main secondary level school in the region, and providing work experience opportunities for many of the students.

Much environmental cleanup has been achieved, and more will be done. Rehabilitation and revegetation of old mined out areas is well underway. Caved zones are being backfilled with previously deposited waste material to remove the unsightly acid producing piles and assist with stabilizing the caves which have opened up over the years since mining commenced.

EBRD support

The European Bank for Reconstruction and Development (EBRD) has been an important supporter. Chelopech is classic for the EBRD, just the sort of project it was set up to assist. EBRD's current funding is a $3 million senior loan in respect of environmental projects and a further $7 million senior loan for mine and mill improvement.

The EBRD notes that by 2004 Bulgaria's mining sector had "deteriorated markedly over the past decade. A large number of mines, including Chelopech, were closed due to environmental problems, poor

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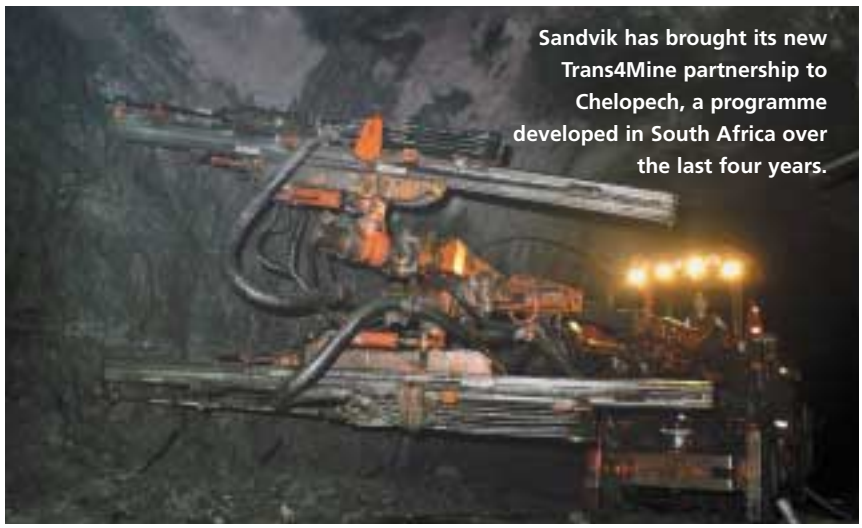
operational and financial performance and decreased domestic demand. The lack until recently of a modern regulatory framework has deterred strategic investors."

This is the bank's first mining project in Bulgaria and it sees potential country-wide benefit from the rebirth of Chelopech. Its position is that "the involvement of the bank may strengthen mining investor interest in Bulgaria and the Balkans as a whole and will demonstrate progress in the operating and regulatory environment.

"The project will benefit from the introduction of modern mining/extraction technology and improved technological common practices, thus contributing to technical and marketing know-how transfers. The project will also promote the industry's restructuring by introducing the highest efficiency and environmental standards currently available through upgrading the existing mine, mill and tailings dam facilities. Chelopech is situated in an established mining region and the proposed improvements will set new technological, environmental and health & safety standards that would be immediately relevant to other nearby operations. Energy efficiency demonstration effects are likely to be high in this project for example. As the project focuses on environmental improvements these will be easily quantifiable and monitored.

"By saving the mine from closure, the company now employs a considerable part of the working population in the area. By unbundling auxiliary services the mine has also created a number of additional jobs and prompted the establishment of several small private enterprises which are subcontracted on an on-going basis. The bank has also already been instrumental in establishing new standards of environmental monitoring and compliance and a substantial technology and know-how transfer. This is also likely to migrate through linkages with suppliers and service providers who will be asked to perform to these new and higher standards.

"A range of environmental investigations have been undertaken at Chelopech which confirm that mining operations have significantly impacted the surrounding environment since start up in 1954. Waste products from mining and tailings, generated in large quantities, represent the most significant potential environmental liability. Other issues include outstanding environmental permits, responsibility for Past Environmental Damages (PEDs,) and mine closure planning.



Sandvik has brought its new Trans4Mine partnership to Chelopech, a programme developed in South Africa over the last four years.

In late 2004, the EBRD reported, after a site visit by its Environmental Specialist in July 2004, "the existing operation has improved significantly since 2001 when the Bank considered a financing plan for the project when it was managed by a different sponsor. Extensive rehabilitation of damaged areas from past industrial activities is currently underway and the current project will result in further upgrading to tailings disposal and dam improvement.

"The underground mine has no significant problems with regard to environmental liabilities and no significant contamination or liabilities have been noted by the PEDs study or other recent environmental audits. The closure plans are well documented and meet internationally accepted standards and the operation is fully permitted to operate under the current (2001) Environmental Impact Assessment (EIA) conditions."

So, Chelopech is setting good examples in both mine and environmental management. There are two significant copper open pits near to Chelopech, Elatsite Med and Asarel Medet, in the Pirdop Valley. Also, the nearest town, Pirdop, where many Chelopech people live, is host to Cumerio Med's smelter which treats concentrates from those two open pits, and from overseas. Its annual smelting capacity is around 240,000 t of copper. The complete facility comprises a smelter, an electrolytic refinery, a sulphuric acid plant and a slag flotation plant. In the 1980s the plant was modernized and by 1987 a new Outokumpu Technology flash smelter was built, one of the largest of its kind worldwide. About 45% of Pirdop's concentrate feedstock comes from copper mines in its vicinity, 15 - 45 km from the smelter.

Prior to its ownership by Cumerio, the Pirdop smelter treated concentrate from Chelopech until an act of parliament prohibited continuation in January 1990. While there are no recorded cases of human medical problems as a result, the high arsenic content did lead to significant arsenic contamination of the area. As a result, by law, Chelopech concentrate cannot be smelted in Bulgaria. Indeed, there are very few smelters around the world that will accept it. Thus, Chelopech has to progress its POX plans for hydrometallurgical treatment of its concentrate. ***IM***