THYSSEN SCHACHTBAU GROUP

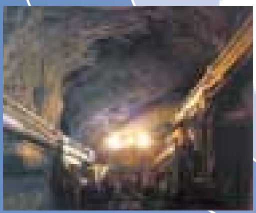
Report

2001

Thyssen Schachtbau Group

Thyssen Schachtbau Group – Your Partner!

- Mining Germany
- Mining International
- Construction Germany
- Construction International
- Production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SITUATION UPDATE

Ladies and gentlemen, business partners and associates, fellow workers

the latest issue of the Thyssen Schachtbau Report seeks to present an overall view of our current range of Group services which continue to be broad-based and built on high-quality technology.

As is customary, our report begins with a review of the year 2000 and a look ahead to 2001, together with a few words on our current position and on the future of the Thyssen Schachtbau Group.

2000: Turnover stable, operating result satisfactory. Unexpected set-back in Australia. Reorganisation on schedule.

The economic turnaround which began the previous year was successfully maintained in almost every business sector in the year 2000. With overall performance slightly up at DM 1,27 billion, the Group made (on a basis comparable to that of the previous year) an operative profit of DM 28,1 million. After taking into account high extraordinary charges associated with phasing-out of activities (mainly the necessary closure of the coal mining project in Australia, which started in 1998, and the deconsolidation of the subsidiary concerned), the Group's consolidated performance showed a negative result. Employee numbers continued to decline, due to market trends and Group reorganisation, with the total workforce now standing at 4,997 (as at 31 December).

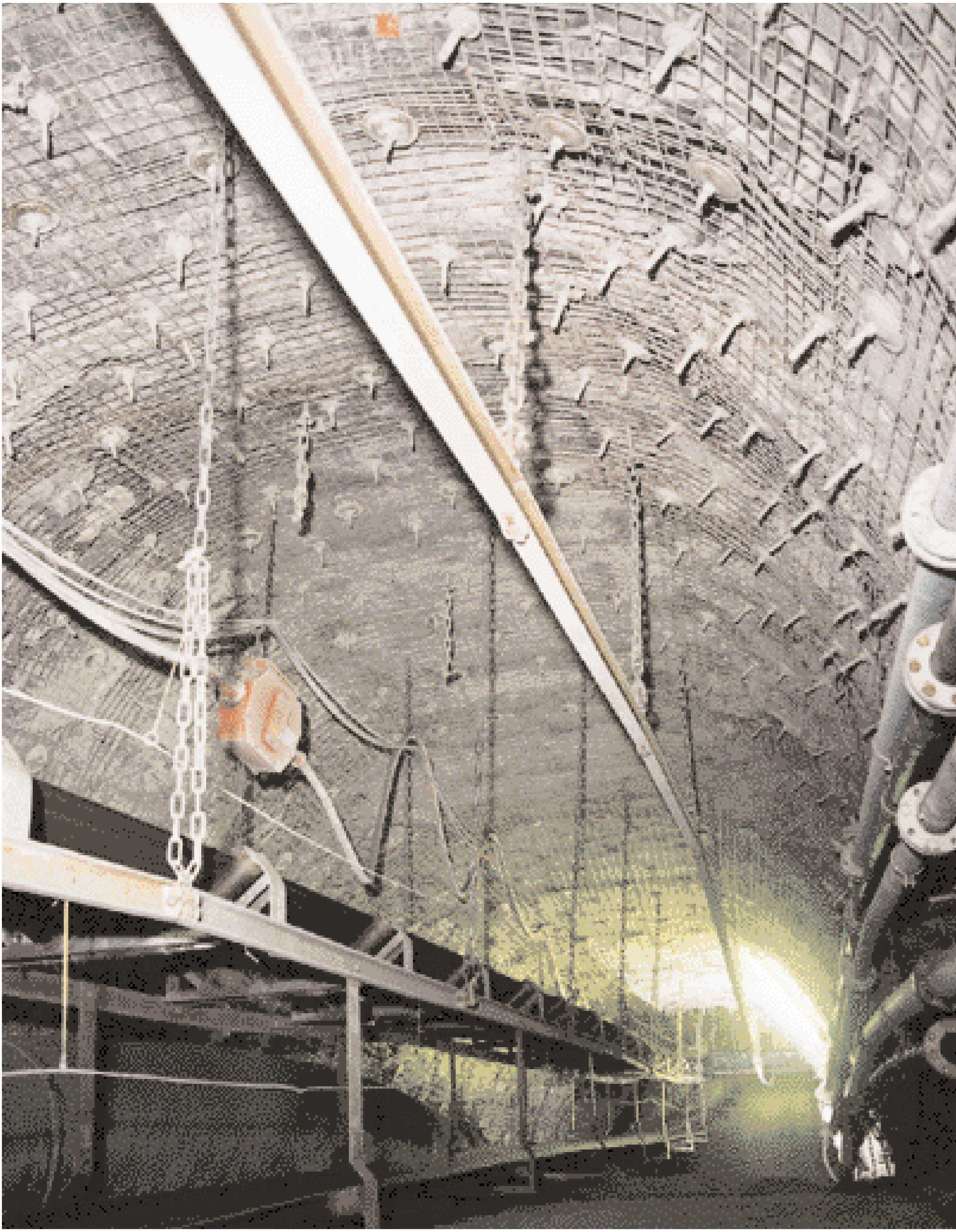
The strategic reorientation and reorganisation of Thyssen Schachtbau Group operations has been vigorously pursued. This has been achieved against the backdrop of a market which continues to be difficult due to the programme of reorganisation under way in the German coal industry, the ongoing slackness in the construction sector, and an environment of inherited liabilities from various overseas companies as a result of project closures.

2000/2001: Success in all business sectors Profit responsibility strengthened

In the *Mining Germany* sector the diminishing returns obtained from shaft sinking operations, due to the completion of the Gorleben project, were extensively compensated for by an unscheduled showing in the mining sector as a result of additional contracts from the DSK, Deutsche Steinkohle AG. The Group was successful in achieving a number of objectives, including establishing the management succession structure for the TS Mining and TS Shaft Sinking and Drilling divisions, reorganizing the technical departments (Purchasing, Logistics and Engineering) and achieving a substantial reduction in Company overheads. These two divisions have now been given much greater responsibility for their own organisation and accounts within the Thyssen Schachtbau Group, and this will make it easier for them to increase their involvement in (Group internal and Group external) consortium projects and collaborative ventures.

In the *Mining International* sector the good rates of return recorded in the Canadian and Australian ore mining sector were offset by high additional expenses incurred in other areas. These costs resulted from residual depreciation allowances from TS involvement in South American ventures and, in particular, from non-recurring expenses resulting from the termination of the Southland coal mining project in Australia.

The joint involvement in major international mining and shaft-sinking projects by Group companies in Australia, Canada, Germany and the UK yielded the first measure of success with joint venture operations in Tanzania and Ireland. As part of a targeted and



Roadheading with roofbolting in roadway no. 3580 at Niederberg colliery

coordinated collaboration venture (Thyssen Mining International) this new business approach now includes various external partner companies.
Consolidation measures have continued as scheduled for the *Construction Germany* sector. The Group's structural and civil engineering companies have been progressively merged to form TS Bau GmbH and all companies operating throughout the territory of the Federal Republic have undergone an amalgamation of their operating sites.
The aim of the ongoing rationalisation and reorganisation measures, which go hand-in-hand with system improvements in SAP networking, costing and site performance control, is to achieve a further increase in the operating results of both the Interior Installation company and the newly-formed Structural and Civil Engineering Group.
In the *Construction International* sector our companies in Austria and the UK have continued to make use of the opportunities available in their specialist markets (particularly infrastructure projects and tunnelling) and have achieved good operating results.
With new subsidiaries in Hungary, Germany and Ireland, together with greater involvement in international joint ventures (see Overseas Mining division), our overseas construction operations are gaining a stronger foothold in a number of growth markets and regions.
In the *Production* sector we have now completed the process of giving Thyssen Schachtbau engineering operations full responsibility for their own organisation and accounts. After a programme of radical reorganisation the engineering and major repairs section, which now trades as 'TS Technologie + Service', has laid the foundations for a positive contribution to company results by a successful expansion of its group external customer base.
One of our companies in this sector, whose business is to supply pulverized coal to the steel industry, has safeguarded its future income by expanding its production capacity and securing long-term contracts with major customers.

The TS Group Management Headquarters Departments also succeeded in achieving their restructuring objectives. Thyssen Schachtbau GmbH Central Services, which includes personnel, finance/accounting and EDP departments, now operate a full cost-allocation system for their intercorporate 'clients'. Staff departments have been reduced in size or transferred to the operations sector. The holding company sector has seen an amalgamation of central services, while in the finance section the treasury function has been strengthened.

A word of thanks to authors and editors

Because of the large number of articles received from the various Group business sectors, the task of selecting reports for publication has yet again been a difficult one. We should therefore like to acknowledge the dedication of all those members of TS Group companies who have submitted reports and express our thanks for their competent and informative articles. We also wish to thank our trusty team of editors for the painstaking manner in which they have dealt with the wealth of material received and yet again for the attractive presentation of this year's Report.

Our mission statement

Our business objectives are unchanged: we seek technical innovation, we seek to motivate our workforce and enhance their capabilities, and we strive to perform in an efficient and reliable manner as part of a streamlined organisation. Increasingly the needs of the marketplace and the wishes of our clients call for project-specific partnerships and long-term strategic collaborative ventures.
We will continue to provide our domestic and overseas customers with high-quality technical solutions delivered on schedule and to budget – after all, our success depends on theirs.

THYSSEN SCHACHTBAU– YOUR PARTNER TO SUCCESS

sincerely yours

Werner Lüdtke | Keith Jessup | Dr. Peter M. Rudhart

Full roofbolting at the roadhead

Roadheader drivage with the combi-support system

In order to safeguard coal production at Prosper Haniel colliery, plans were laid in the mid-1990s for the extraction of the Prosper Nord take located at a depth of some 1,000 metres between Prosper IV and Prosper V shafts.

The area in question accesses the coal seams I, H and G. The plan was to drive main seam roads to bypass the entire take in the seam H horizon and then to enter seam horizons I and G by means of rising and/or dipping stone drifts. This development concept at once called for the creation of long-term mine workings which would provide a stable framework for coal production during the planned period of extraction. In order to fulfil this requirement it was decided to use the “combination support method” for the main seam roads and gate-roads.

Combination-support method

The combination support system (type A) involves the use of standing supports combined with the installation of roofbolts, bolting mats and backfilling. The following operating method was chosen for the drivage phase: the roadway profile is cut using a roadheading machine and immediately afterwards full roofbolting is installed in combination with roll-out wire mesh as rockfall protection. Conventional steel arches are then set some 25 to 30 metres behind the machine, and the annular clearance between the supports and the roofbolted strata is sealed with backfilling concrete. The roofbolt pattern, bolting density and arch-support specifications were laid down in an expert’s report commissioned by the client. Support dimensions for special excavations, such as bridging zones, were calculated on the basis of separate reports.

Roadway drivage

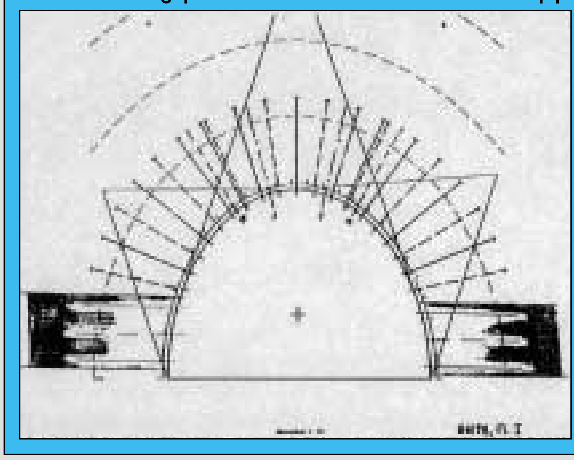
Assembly of the roadheading machine began in August 1996. Just one month later work commenced on the mechanized drivage from the inclined drift to bunker N in the main seam roadway (seam H). The drivage operation was initially undertaken using conventional heading techniques until the roadway reached seam H at a drivage length of 576 metres.

At the end of 1996 the machine was fitted with roofbolting and setting equipment and the combination-support phase was able to commence.

Technical equipment

- ❑ Voest Alpine AM 105 roadheader
- ❑ Böhler ABS roofbolter and setter
- ❑ turbofilter dust-extractor (800 m^3 capacity), auxiliary fan with cooler
- ❑ GTA support setting platform (type 1910 e)
- ❑ EKF II drag conveyor (approx. 75 metres in length)
- ❑ Hauhinco pressure booster pump
- ❑ pantechnicon including 1000 V switchgear enclosure
- ❑ monorail-mounted rail laying platform

Roofbolting pattern for combination support system



roofbolt length: A_L=2,4 mtr. resin-bonded
spacing between roofbolts: a = 1,00 mtr.
spacing between rows: r = 1,00 mtr.
number of roofbolts: N = 11,5 St / mtr.
additional roofbolts: Z as required
* = alternating (in addition to rows)

Roofbolting pattern and expert’s bolting report

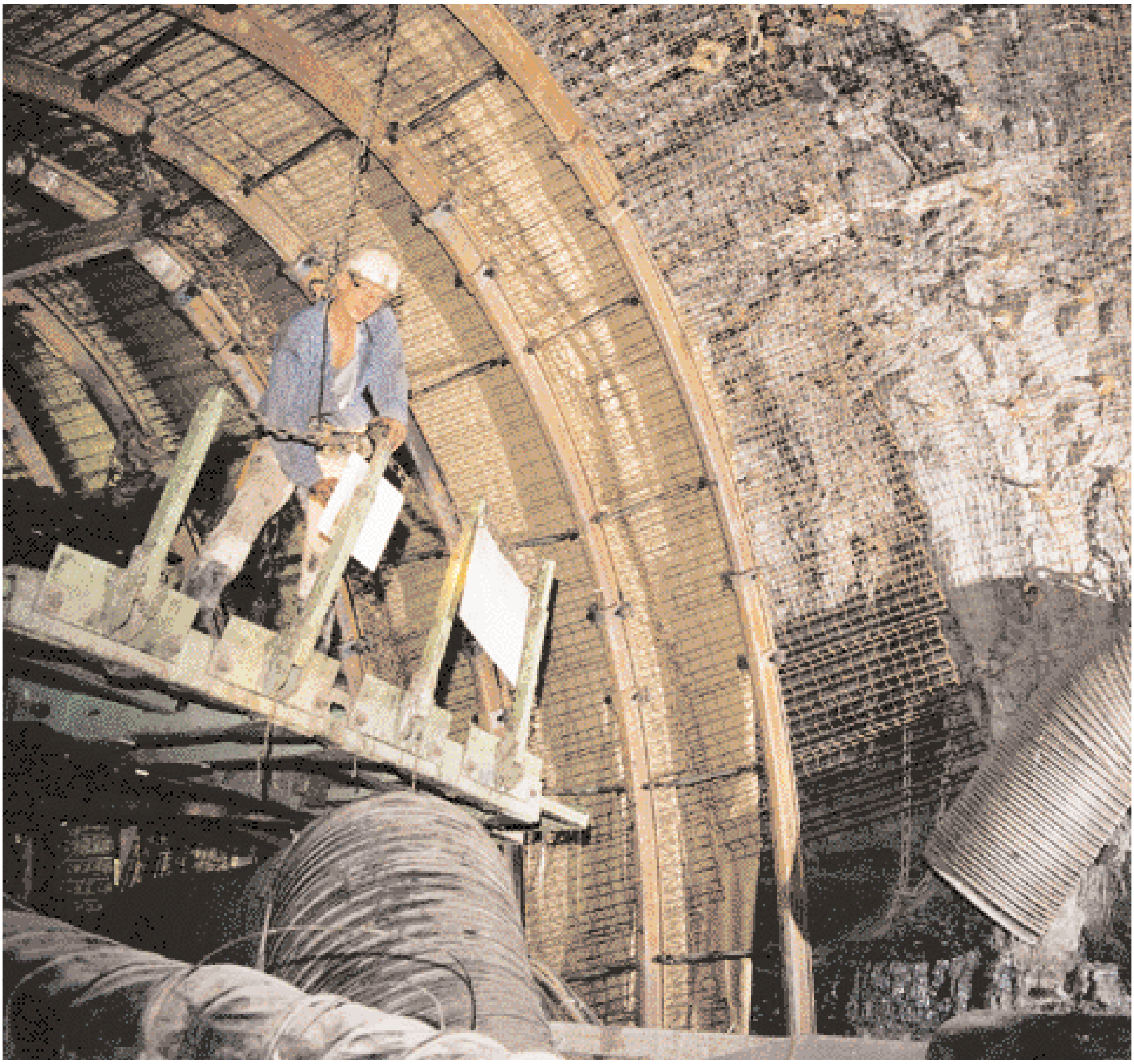
The roofbolting pattern was laid down by Department TB 3 at Deutsche Steinkohle AG and is documented in an expert’s bolting report, which was based on the following roadway parameters:

- ❑ excavated cross-section: 28.8 m^2
- ❑ support cross-section: 23.4 m^2
- ❑ clear roadway width: 6.58 m
- ❑ clear roadway height: 4.40 m
- ❑ specified concrete thickness: 0.30 m

On the basis of this fundamental set of data, precisely 11.5 rockbolts and 5 in-seam bolts were to be installed per metre of drivage. Each 2 500 mm-long roofbolt was to be resin-bonded over 2 400 mm of its length. For the roadway section in question the bolt row spacing and bolt setting interval were both specified at 1.0 metres. Auxiliary bolts were to be installed as and when required. Critical areas, such as bridging zones, were examined separately, and under certain conditions changes were made not only to the bolt row spacing and bolt setting interval but also to the type of bolts used.

Roadheading with the combination-support system

The roadway drivage described here has been using the combination-support system since January 1997. After an initial period of familiarization with the roofbolting technology, performance rates soon improved and excellent drivage results could be achieved. The rate of advance depended primarily on the two operating processes “cutting” and “roofbolting”, which were a function of the rock strength values. All the other roadheading operations were carried out in parallel, which is one of the main advantages of the combination support method.



The standing support is installed about 25 – 30 metres behind the heading face

By the end of 2000 a total of 6,892 metres of roadway had been driven using the combination system, which involved the installation of some 109,500 roofbolts. The average heading performance amounted to 7.44 metres per working day, with the best monthly result of 10.72 metres per day being achieved in December 1999.

Results and future outlook

The combined system of roofbolting in conjunction with conventional roadheader drivage methods was successfully implemented within a very short period of time and high drivage rates were achieved. The excavations still show no signs of pressure phenomena. Proof that the roadways have fulfilled planning expectations will be provided when the drivages are used for their intended purpose, namely the planned extraction of coal in the target seams.

Dipl.-Ing. Harald Korfmann

With fresh ventilation into the future

Ensdorf colliery is one of the two mines currently operated by Deutsche Steinkohle (DSK) in the Saar coalfield. The pit achieved an output of 9.8 tonnes coal disposable per man-shift in the third quarter of 2000, making it one of the most efficient collieries in the whole DSK group.

The development of coal deposits in the Primsmulde district is now essential if the colliery is to safeguard its long-term future. Accessing these new measures will also mean the sinking of a new upcast shaft.

Preliminary work for foreshaft

The proposed shaft was to have a depth of 1,260 metre. As expected, exploration drillings revealed that the "boundary fault", measuring some tens of metres, outcropped to the surface close to the shaft collar. The potential area affected by this fault run from the surface to a depth of some 75 metres. Detailed studies indicated that the foreshaft required for the wider main shaft, which was to be excavated mechanically using a shaft boring machine, should be sunk to the exceptional depth of 90 metres so that the faulted strata could be safely crossed using the conventional technique of sinking in the solid. Pre-drilling and strata injection was systematically employed in order to stem any water ingress in the foreshaft zone.

The excavation work for the fan drift and the top 10 metres of foreshaft, including the shaft collar, was under-

Gantry crane for materials hoisting and manwinding plays key role in the sinking operation

taken by construction companies using the open-cut method. The Primsmulde foreshaft consortium, comprising Thyssen Schachtbau GmbH as general coordinator for technical operations and Deilmann-Haniel GmbH as co-ordinator for commercial operations, was subsequently contracted to sink the foreshaft from the 10 metre level to a depth of 90 metres.

A new township created

After a lead-time of only four weeks the consortium began to set up the site installations on 4th October 2000. As the Primsmulde shaft was a satellite shaft, located several kilometres from the colliery's north shaft, extensive on-site facilities had to be provided for the construction teams. This meant installing washrooms and sanitary units for some 40 persons, together with offices, workshops, stores, a fuel filling station, compressed-air generating unit, fresh-water supply point, explosives store and waste box – as well as setting up the power supply installations.

The main sinking installation comprised a Liebherr mobile gantry crane, which was used for mucking out, materials hoisting and man-winding, as well as for raising and lowering the 10-tonne Liebherr R 308 hydraulic excavator. A special 3.5 cubic-metre kibble was brought in for mucking out. The manwinding cage was approved for carrying 6 persons. The sinking equipment also included two shotcrete bunkers complete with a Rombold & Gfröhrer integrated spraying system, an 18/75 kW booster fan for in-shaft ventilation and an electrically-powered emergency hoist with an emergency generator set in order to maintain winding in the event of a power failure. The shaft equipment was completed by four plumb line winches, one cable-wire winch, one blasting cable winch and various site and in-shaft lighting systems.

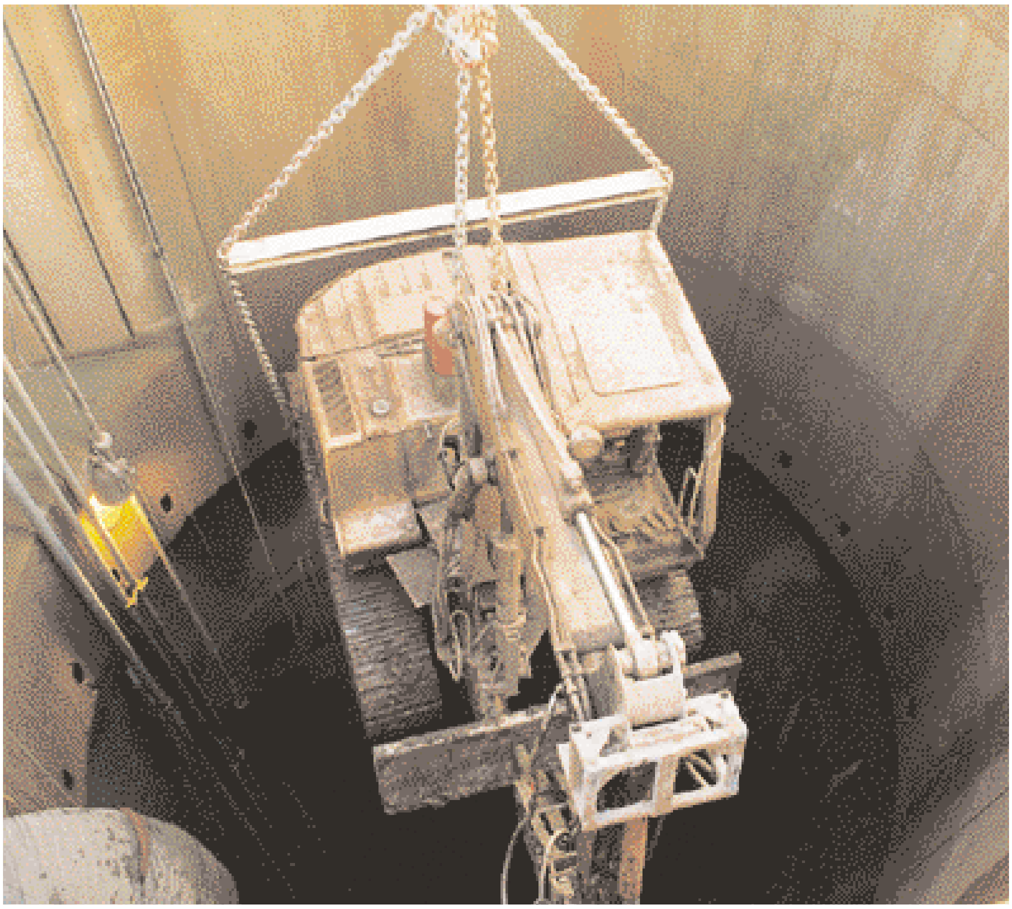
Manwinding cage transports personnel in foreshaft section

10-tonne excavator for foreshaft section can be raised and lowered at will

Sinking begins

The first preliminary drilling and strata injection operations, which were carried out from the floor of the shaft collar at a depth of 10 metres, were undertaken in parallel with the erection and assembly of the surface installations. A grout screen was created by drilling 28 boreholes to a depth of 45 metres, which were then injected with 19 tonnes of cement.

The sinking operation commenced on 23. October, three weeks after the start of the site installation work, with



Excavator being lowered to the shaft floor

Sinking commences below the shaft collar

the shaft being excavated to a diameter of 8.8 metres. The excavation work was undertaken with a diesel-hydraulic compact excavator. The provisional support measures required during the main sinking phase comprised the installation of one M24 x 2500 mm rockbolt for each two square metres of shaft wall, in conjunction with Q 188 steel reinforcing mesh and a layer of B 25-quality shotcrete sprayed to a minimum thickness of 15 cm. Right from the outset the well-trained sinking crew achieved a sinking performance of 1.10 metres per working day. As planned, no blasting was needed for the first few metres of the sinking, since the high break-out force available at the machine was sufficient on its own to excavate the shaft floor. From a depth of about 25 metres, however, blasting was required on a regular basis to free the in-situ material.

The small quantities of water trickling from the side-walls during the sinking operation were grouted directly from the shaft floor. When the 42-metre mark was reached, a second pre-drilling floor was set up, as planned, in order to create a platform for drilling four preliminary drilling and grouting holes to a depth of 97 metres. No appreciable water ingress was observed during this part of the operation.

SB VII boring machine makes its world debut

After completion of the sinking of a depth of 90 metres, a sliding formwork system is to be used to line the foreshaft section from the 80-metre level to the shaft collar with an impervious reinforced-concrete casing 40 cm in thickness. The completed foreshaft will then have an internal diameter of 7.5 metres. The 8.4 m-diameter assembly chamber for the SB VII shaft boring machine, which will subsequently be used for drilling the shaft down to mine level 20, will then be excavated between the 80-metre level and the floor of the foreshaft.

Before this operation can commence, a rotary boring rig will be used to drill the high-precision directional hole and a raise-boring system will be brought in to enlarge the advance borehole to a diameter of 1.8 metres. This raise borehole is to be drilled to a final length of 1,200 metres – a project on a scale never previously attempted anywhere in the world.

The successful outcome to this difficult shaft-construction project will again depend on the painstaking work of the planning engineers and the technical skills of the sinking crews.

Dipl.-Ing. Thomas Ahlbrecht
Heinz-Dieter Matuschak

Temporary shaft lining comprising rockbolts, steel mesh and shotcrete

New shaft extension reaches depth of 1,700 metres

Previous editions of REPORT have contained regular accounts of the shaft-deepening project under way at Ensdorf north shaft, which has been extended to its new bottom landing on level 24 at a depth of 1,712 metres. This major sinking operation has now reached another important milestone – which is reported on below.

Sinking the shaft sump – support lining installed in 13 days

After the shaft inset had been completed, work commenced on the sinking of the sump cavity to its floor depth of approximately 1,750 metres. The excavation was carried out in the solid using conventional drilling and blasting, with the work being undertaken beneath the "Mega-platform" – a four-deck stage suspended above the inset which served as a temporary overhead protection platform. A single-boom shaft boring machine was successfully used for drilling the blast holes. The debris was loaded by a 1.2 cubic-metre cactus grab and discharged at the inset level into a mobile tipper chute, which transferred it to the conveyer system. The grab winch was installed on a horizontal fully-mobile skid frame which was mounted on a suspended support frame at the pit bank.

The side-walls were temporarily supported with M24 x 2400 mm fully-resin-bonded rockbolts installed in combination with wire mesh. The permanent sump support system comprised backfilled pre-cast concrete sections. These prefabricated cast concrete blocks were systematically assembled in such a way that the gaps required for the mounting of the sump fittings were incorporated into the 37 support rings, each of which was made up of 7 individual elements. The support work on the 40 metre-deep shaft sump was completed in 13 days – with the Mega-platform used for the shaft deepening operation again lending valuable assistance. The pre-cast concrete blocks were safely picked-up and manoeuvred into their final resting position by means of a rotary-table crane which was mounted beneath the upper stage.

Shaft sump is excavated from the solid by drilling and firing and then supported by rockbolts and wire mesh

High-precision installation of 160-tonne bottom frame

The shaft-sump fittings, which were installed after completion of the sump cavity, comprised the following components (from the sump floor upwards):

- ❑ pumping platform with shaft-guide spears for the auxiliary winding system
- ❑ shaft-screen deck
- ❑ cambered-beam platform with shaft-guide spears for main winding system
- ❑ ladder-shaft running the full length of the sump chamber, which also serves as a connection between the individual platforms
- ❑ buntons for main winding system
- ❑ shaft guides and brackets for main and auxiliary winding operations.

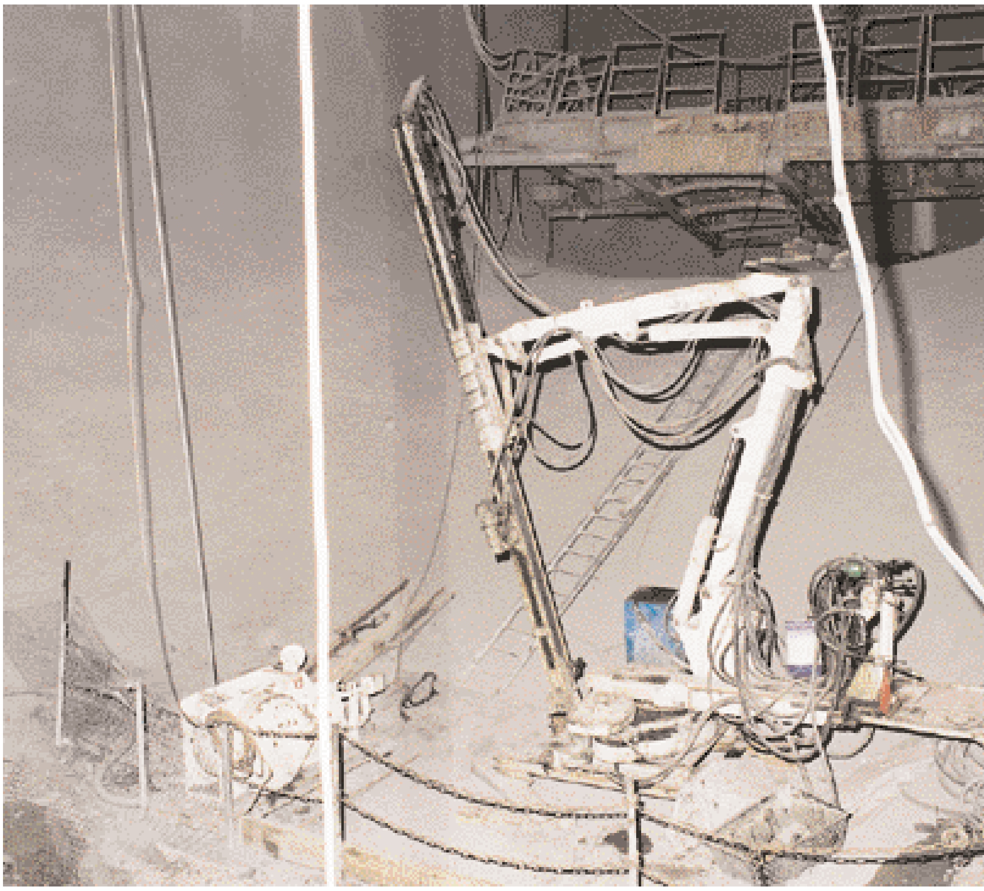
These components were installed from the top level downwards using an additional working platform which was suspended from, and which moved along with, the Mega-platform.

The substantial foundations required for the 160-tonne bottom frame were then installed, with the assembly work needed for the steelwork again being carried out from the converted working platform with the assistance of the rotary-table crane. At this point mention should made of the key role played by the colliery surveyors, whose contribution to the level of precision achieved during the entire operation proved significant.

Link-up phase commences

The bottom-frame operations were followed by the work on the overhead protection platform and the installation of the shaft guides for the main and auxiliary manwinding systems, together with the pipework – all of which were initially installed till beneath the hoisting sheave platform below shaft level 20. The installation of these paraxial components was aided by the use of clamp-on plumb lines and specially manufactured no-go gauges. All pipework was regularly tested for leaks.

The only thing left now was to connect all the shaft fittings at level 20. This meant withdrawing the sinking gear and auxiliary equipment and installing the permanent fittings. The four-deck stage itself, and then the rope-sheave platform, were dismantled piece by piece from the working platform suspended beneath the Mega-platform at level 24. A crescent-shaped stage was then used to remove the protective screen between the first and second shaft protection platforms up to level 20. The shaft guides for the auxiliary winding system were then installed in the former kibble compartment and the link-up was made for the



The shotholes are drilled by a single-boom shaft boring machine

Picture right:
Sinking debris is loaded by cactus grab into a mobile tipper chute

Final sump lining comprising backfilled pre-cast concrete blocks

160-tonne bottom frame is assembled from the Mega-platform

auxiliary winding system between the shaft surface and level 24. The rest of the protective screen above level 20 could then be removed by men working on the top of the manwinding cage.

The critical phase

The critical part of the operation began on 30th September 2000 with the extension of the shaft winding system to level 24. The screen deck, the timbers for the cambered-beam platform, the guide spears for the main winding system and the ladder-shaft were all dismantled one after the other at level 20. The missing brackets and buntons for the main winding system then had to be fitted and the shaft guides extended. On the morning of 5th October 2000 the shaft was handed over to the colliery on schedule, with Ensdorf personnel then assuming responsibility for the rest of the connection work.

The extension of winding in the north shaft down to level 24 constitutes a significant milestone for the future development of Ensdorf colliery. The successful completion of this complex operation can be attributed to the determination and commitment of all those involved, whose careful planning and excellent teamwork ensured that the overall project was able to progress in a steady and efficient manner.

Heinz-Dieter Matuschak
Dipl.-Ing. Tilo Jautze

Twin-boom drill jumbo for rotary boring of rockbolting holes

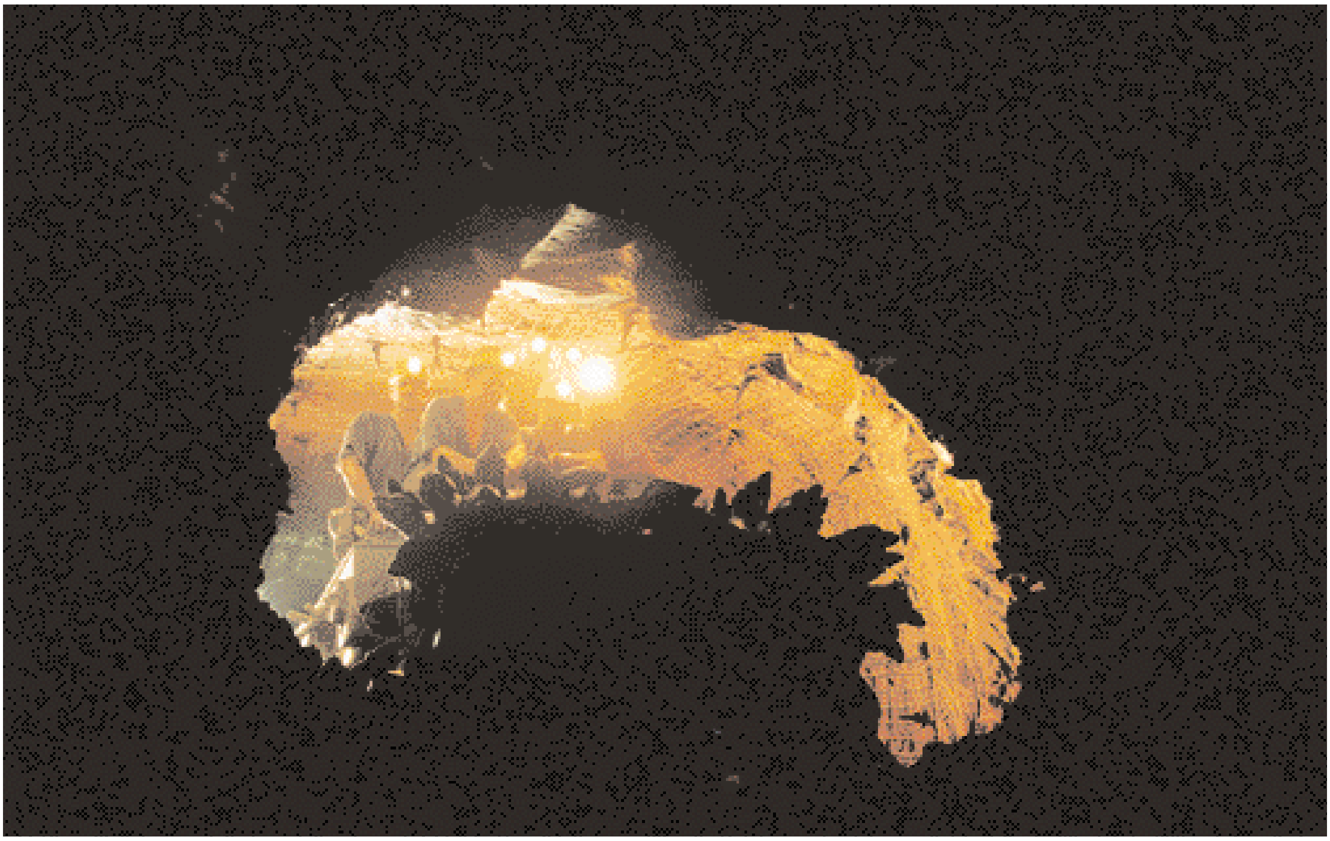
20,000 metres of drivage to develop new coal reserves

The Deutsche Steinkohle-run Niederberg colliery is located in the western part of the Ruhr coalfield and produces some 8,000 tonnes of low-volatile steam coal per day. In the late 1980s work began on the development of a new part of the take whose output would safeguard the colliery's coal production from mid-2000 to the exhaustion of the reserves in mid-2002.

High-speed manriding train cuts travelling time

The panel in question (panel 01) had already been extensively explored by reconnaissance boreholes drilled during the development of the over-lying Finefrau seam. The entry to the new panel is located about 8.5 km from no. 1 shaft and the area can be reached within 25 minutes thanks to a

special high-speed train which operates on mine level 4. The men then travel on to the seam horizon via a system of manriding belts.
Because of the distance between the mine shaft and the workings, the decision was taken to introduce the newly-constructed high-speed train system – which had not previously seen service below ground – in order that the shorter travelling times compared with conventional manriding trains would allow the drivage teams to maximize the time spent at the heading face. A total of 800 metres of roadway had to be re-excavated in order to reduce the track curvature for the high-speed system. A 180 metres-long paved passageway was also constructed through existing mine workings in order to allow easy access for those boarding and alighting from the train. The project was carried out between 1994 and 1996 by Thyssen between levels of 500 metres and a maximum depth below surface of 1,000 metres. The average seam thickness is 0.80 metres and the quantity of coal reserves being accessed is about 3 million tonnes.
The panel development work commenced in mid-1988, initially with two heading teams working simultaneously - and with longer rest periods. After a total drivage length of 680 metres, Geitling no. 1 seam was reached at the



Picture above: Roadheading crew after completing drivage break-through
Picture left: Roadhead team in roadway 4641 shortly before the roadheading machine breaks through in the counter-heading

Schachtbau's Niederberg section, who not only undertook the tunnel drivage work but were also responsible for the planning and construction of the manriding station at no. 1 shaft.

Development work begins

The area to be extracted in the new development panel measures some 1,700 metres to the strike by 2,300 metres to the dip, with a difference end of 1989 via lateral road 4 west (a double-lining support system was installed when crossing the 150 metres-wide Kamper fault) and a short inclined stone drift.
The sinking operation for bunker no. 0248, which had a capacity of 2,800 tonnes and was 42 metres in depth, was carried out from 1990 until the end of 1993 – a facility which would ensure that the flow of coal from the new panel would be segregated from the main coal clearance system.
Subsequent drivage operations comprised a cross-cut and start-pipe for the subsequent installation of an AM 105 roadheading machine, together

stone-drift 0599, which had a drivage length of 290 metres.

By early 1998 the first gate-road (no. 4670) and the first section of the western main seam road 0334 (1,800 metres in length) were both completed with roofbolt support technology (AM 85 roadheading machine with Böhler rotary boring equipment) and the link-up was made to the above-mentioned main seam road 0368. The means using a roofbolting jumbo which achieved rates of advance of between 7 and 8 metres per day. After turning the roadheading machine into main seam road 0334 the associated change of drivage direction meant that it was possible to obtain reconnaissance on the course of the Tönisberg fault, which constituted the ribside.

Additional drivages were then constructed after passing through the

Picture above: Access passage leading from shaft to high-speed manriding station

Picture right: Germany's fastest underground manriding train waits at boarding station

with a main seam road in the Finefrau horizon for the future extraction of coal from both the Finefrau seam and the Geitling no. 1 seam – a total heading distance of approximately 1,550 metres. When these roadways had been completed, lateral road 0530 was connected to the Finefrau seam level via an extension roadway, a vertical deviation and some 350 metres of stone-drift (see plan page 17).

Main seam road 0368 was excavated by an AM 105 roadheading machine between 1994 and the end of 1995; this roofbolted roadway had an excavated cross-section of 19 m^2 and was used for the exploration of the southern boundary of the take. Some eastern and western sections of the roadway later had to be abandoned due to geological faulting.

Threat of colliery closure halts work – but not for long

Work came to a halt in 1995 as the threat of closure hung over Niederberg colliery. After Deutsche Steinkohle had made a number of planning decisions, roadheading operations could be resumed in late 1996.

The same year saw a direct link-up to the bunker installation with the completion of inclined drift 0590. The return air could then be directed to the Mausegatt seam level via inclined western section of in-seam roadway 0333 (650 metres in length, TH arch profile, 21 m^2 cross-section) in the eastern part of the take was also driven during this period.

More start-off points means better performance

The completion of junction 0333/4660 meant that parallel drivage was now possible. One rising drift was excavated by an AM 85 roadheading machine at an average rate of advance of 12 metres per day, while a second dipping roadway was driven by conventional various start-off points for the next series of planned roadways.

In April 1999 DSK installed an AM 105 roadheading machine in main seam road 0334 with a view to driving roadway 4650 to a length of 1,900 metres. In November of the same year another AM 85 machine was installed in roadway 4640 and by turning the roadheader from roadway 0334 it was possible to begin driving roadway 4641.

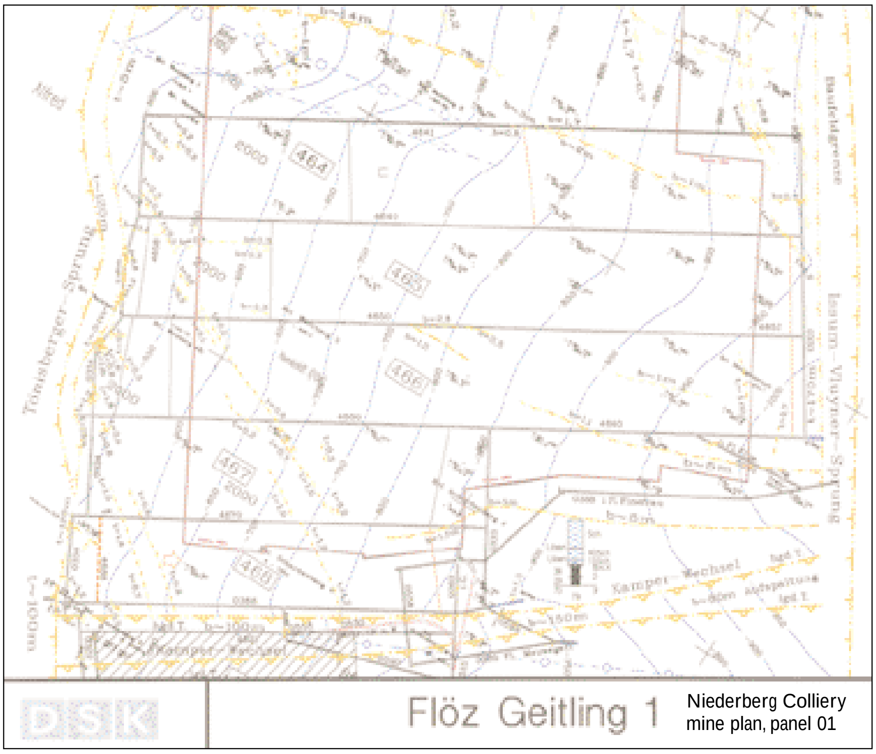
During this period development work also continued in the eastern axis of roadway system 0333 using conventional drivage methods. In December 1998, after passing the start-off point for stone-drift 0546, the second

AM 85 roadheading machine breaks through into roadway 4641 roofbolting jumbo was able to begin work on another 430-metre section of roadway. A third drilling jumbo was installed in April 1999 for the excavation of roadway 0334, and was subsequently used for driving the counter-heading to roadway 4650. In June 1999 a fourth roofbolting jumbo was brought in for the excavation of counter-heading 4640.

Preparations for coal winning

After carrying out the extensive development work needed in this panel, Thyssen Schachtbau GmbH completed a further two rise headings - as a result of which the first coal face was able to start up in April 2000.

From mid-1999 to mid-2000 a total of six heading teams were engaged simultaneously in six different roadway drivage operations. The cumulative heading performance, expressed as an average, was 60 metres per working day. To this had to be added fitting and erection work, machine assembly and conversion operations and various maintenance and transport tasks – all of which were essential if coal winning was to commence on schedule.



Niederberg Colliery mine plan, panel 01

Drivage completed under arduous conditions

The long travelling distance from the shaft combined with the high workplace density and the need for auxiliary ventilation placed a great strain on the heading teams. In spite of the relatively shallow depth, the extremely hot air and resulting high levels of humidity at the heading face, together with occasional heavy makes of water, had a very negative effect on roadhead conditions. Roofbolting was used systematically in all the drivages described above. The roofbolts were installed at row intervals of 0.33 to 0.50 metres and the 2.10 metre-long M27 or M33 fully-bonded resin-bedded bolts were installed in conjunction with fold-out mesh mats. Higher bolting densities were employed in order to provide additional reinforcement in those sections of roadway affected by exceptional geological stress. One advantage of roofbolting over conventional standing supports was that prop-free working faces could be maintained at least until the passage of the first face line.

In developing panel no. 1 in the Geitling seam Thyssen Schachtbau GmbH successfully completed more than 20,000 metres of roadway drivage, an underground coal bunker and a total of 41 junctions and crossing points.

Twin-boom rockbolting jumbo operating in roadway

Michael Lottner

A Hole with high Significance

Excavated debris is delivered by chain conveyor to the main belt on mine level 5

Development work is making speedy progress in the Lippe-Mulde district of Lohberg/Osterfeld colliery, where the intention is to extract coal from three panels in the Zollverein 2 seam.

Inclined stone drift 0363 is being constructed as the connection between these panels and the western lateral road on colliery level 5. This so-called "western triangle", which is a highly congested intersection zone, poses logistical problems for this part of the mine.

The new "turn-key" Lippe-Mulde ventilation shaft has helped enormously in remedying this situation.

The "borehole" – or more accurately the 4.2 metre-diameter, 10 metre-deep staple shaft – was constructed from a 1200-mm pilot hole using conventional drilling and blasting methods. When finally supported, the new shaft was able to accommodate two sheet-metal air ducts, a waste fall-pipe and a ladder-way.

Extensive preparations

In view of the extensive mine workings already present in this area, it was decided to undertake an endoscopic survey of the strata between the drift and colliery level 5 before commencing the sinking operation. The findings indicated that strata injection was required in order to provide preliminary rock reinforcement.

In order to be able to accommodate all the equipment needed in the lateral roadway on level 5, it was necessary to re-rip an 11-metre section of the roadway - which had originally been driven with floor enclosing segments – to create a maximum width of 6.45 metres and a roof height of 5.1 metres. Like all other construction work carried out in connection with the ventilation shaft, this operation was undertaken without interrupting the main belt conveyor or track haulage system. This was achieved by covering the belt conveyer and haulage track with a 10 metre-long protective tunnel, which also served to support the chain scraper conveyor used to deliver the debris excavated during the sinking phase on to the main belt conveyor. At the end of the operation this tunnel will be converted for use as a support for the bunker discharge conveyor.

Shaft sinking below the roadway: collar excavation extends well below the arch supports

Made-to-measure

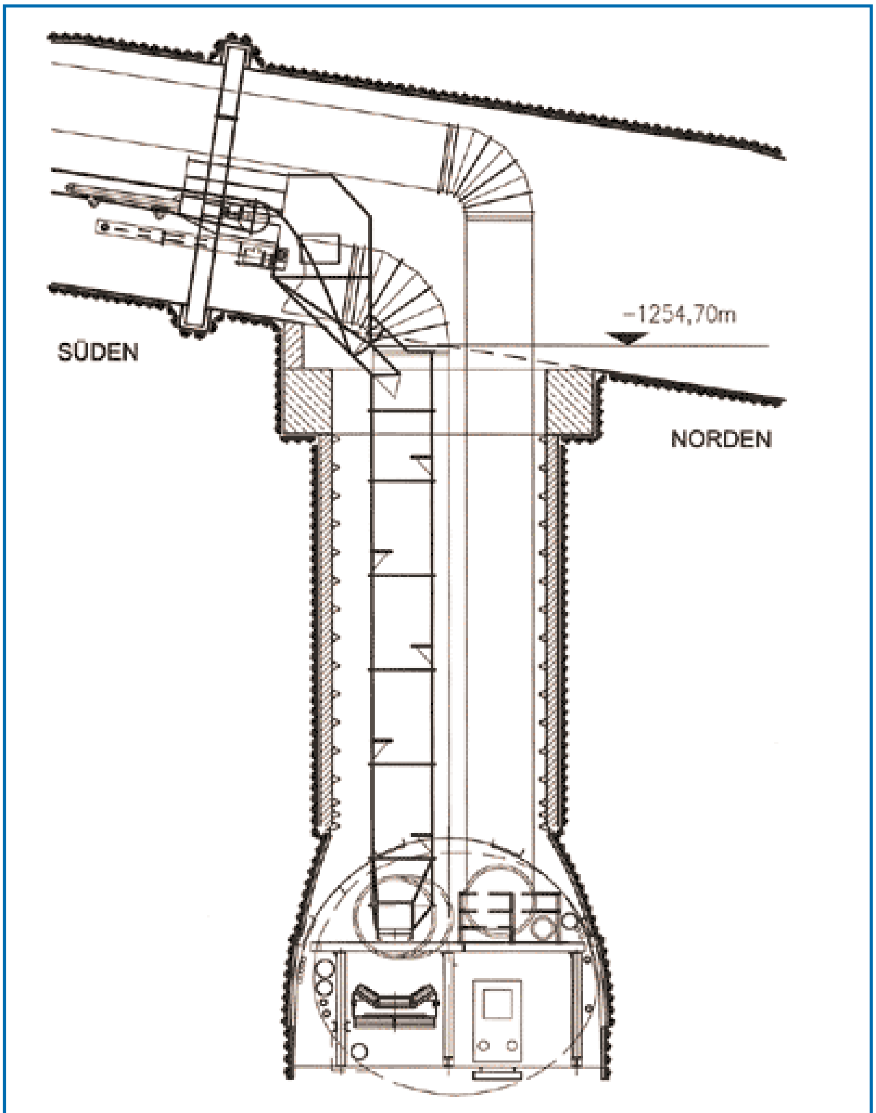
The work at the top of the ventilation shaft also continued without interruption to belt conveying or materials transport in the stone drift, which was undertaken by diesel trolley. Thyssen Schachtbau's drilling department first used a P 1.200 drilling rig to bore out the directional hole with a 216 mm chisel bit system, and then reamed out the hole – first to 450 mm and then to a diameter of 1200 mm – using the same machine operating as a raise borer. Due to the restricted space, the pilot borehole had to be directionally drilled at an angle from the upper roadway. In spite of this complication, the pre-determined break-through point in the roof of the lateral roadway on level 5 was accurate to the nearest centimetre.

The roadway arches in the upper roadway of the new ventilation shaft had to be braced on one side with a support beam before excavating the shaft collar, while the side-wall was also reinforced with rockbolts.The 3 metre-deep, 6.5 metre-wide collar could then be excavated by drilling and firing from beneath a protective canopy, after which the cavity was lined with concrete to a finished width of 4.5 metres using a formwork system. The ready-mixed concrete was delivered to level 5 in mine cars and was pumped through the pilot hole to the collar area for placement behind the shuttering.

The hole is delivered on schedule

The sinking work was carried out by drilling and firing using the pilot borehole, with 1.5-metre pulls, to an excavated diameter of 5.1 metres. After each pull the exposed surface had to be consolidated with M24 x 2400 mm rockbolts and wire mesh. During the sinking phase no strata control problems were encountered in the area stabilized by the preliminary injection measures. Difficulties only arose in the pilot-hole zone, where isolated falls of ground repeatedly prevented the clearance of the sinking debris.

Overview of the Lippe-Mulde ventilation shaft



Once the shaft had broken through into level 5, the shaft curb and ring-curb headframe could be assembled and backfilled. The 8-segment TH-profile shaft rings could then be installed at setting intervals of 600 mm, working upwards from the headframe. This work was carried out from a mobile shaft stage which was suspended on chains. The backfill material was placed in sets each comprising three shaft rings. Once the support rings had reached the collar of the shaft, the permanent shaft cover was fitted and the various shaft facilities installed, namely the 1250 mm-diameter waste fall-pipe (which was suspended in a special mounting), the two ventilation ducts and the ladderway with its ladder platforms for fall-pipe inspection and maintenance work.

The only other work to be done at the top of the shaft was to install the conveyor top-end mast for the return end of the discharging belt, and assemble the dirt intake chute and dust hood.

In spite of the complex cycle of operations and the need for different departments to coordinate their activities when carrying out the different phases of the sinking project, the ventilation shaft was successfully completed within seven months and handed over to the client on schedule.

Congestion relief

Ventilation to drivage 0363, and subsequently to the connecting tail-gates and main gates serving the first coal panel no. 472, can now be supplied from the western lateral roadway on colliery level 5 through two metal ventilation ducts (1400 and 1600 mm diameter) installed in the ventilation shaft; these in turn lead into concertina-type ducts which carry the fresh air to the heading face, thereby con-

Lohberg/Osterfeld colliery - Dinslaken-Lohberg entrance

siderably improving the climatic conditions. The new ventilation route also made it possible to dispense with the auxiliary ventilation ducts which ran along the bottom of the inclined drift.

Inclined drift 0363 was initially excavated using a belt conveyor installation which discharged on to an intermediate chain conveyor and two downstream short-length belts set up at the bottom of the incline. This conveying system, which was costly to maintain, was considerably simplified by the introduction of a waste fall-pipe with stairway inserts, which was installed in the ventilation shaft. The waste belt is now almost 100 metres shorter in length and discharges the heading debris directly into the fall-pipe. This material falls on to a bunker discharge conveyer at the bottom of the shaft, which in turn transfers it directly on to the main conveyor installation. A series of microwave sensors, which are positioned at the intake end, in the pipe and at the discharge point, monitors the flow of waste through the fall-pipe and ensures that the system remains blockage-free.

These two measures considerably relieved the congestion which had built up in the level section of roadway at the bottom of inclined drift 0363. This area continues to be used as a materials assembly point for supplying operations associated with the drift, and it also contains a concrete materials bunker. The space saved can now be employed to accommodate much-needed workshops for the diesel trolleys.

All under one roof

The entire operation to construct the Lippe-Mulde ventilation shaft was carried out under one roof as a turn-key project. From the planning stage and the supply of the special fabrications and fittings, through to the execution of the underground work, the Thyssen Schachtbau Shaft Sinking and Drilling Division, working in close coordination with colliery personnel, was able to deliver the entire contract as a complete package.

The new shaft is indeed a hole of high significance.

Dipl.-Ing. Matthias Steinweller
Dipl.-Ing. Heinrich Latos

New coal panel is a turn-key project

Niederberg colliery, which produces anthracite and low-volatile steam coal, is to merge with Friedrich-Heinrich/Rheinland mine in early 2002 to create the new West colliery. The last in-seam development projects at Niederberg involved the drivage and equipping of panels 358 and 359 in 07's district, which were to ensure coal production at the mine until mid-2002.

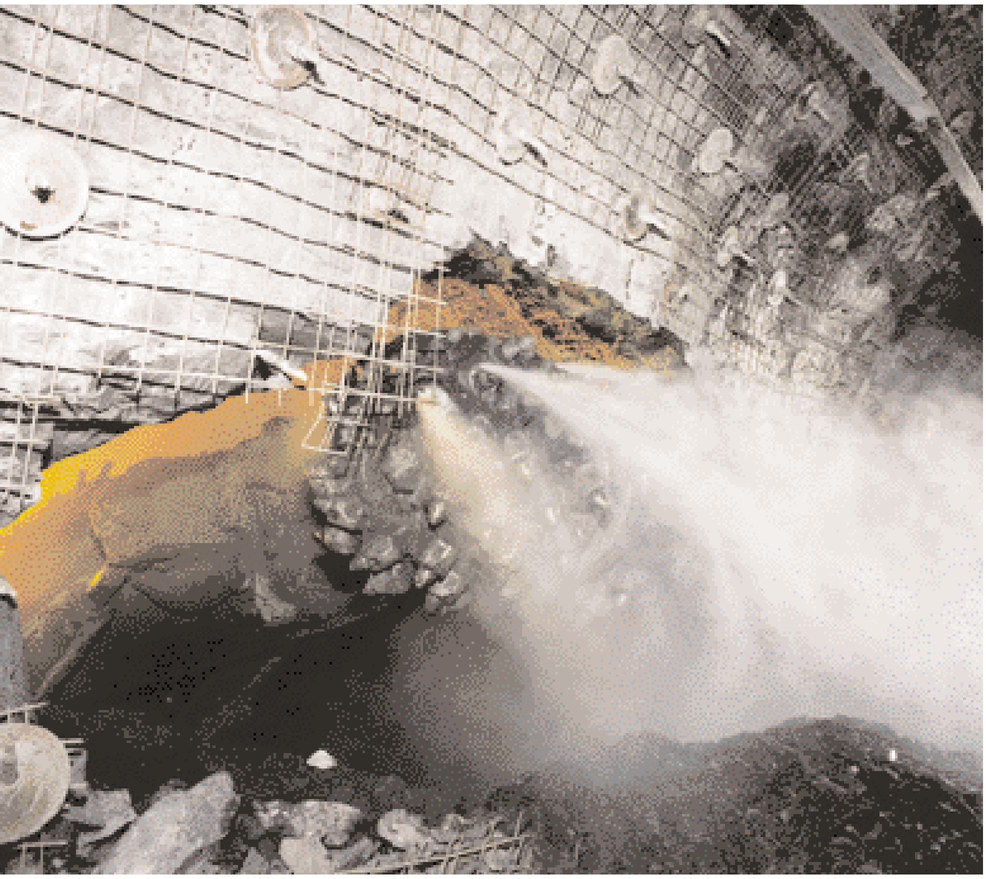
The roadways needed to access the coal panels were partly driven by Deutsche Steinkohle's own heading teams and partly by Thyssen Schachtbau. The latter was responsible for the southern section of the future tail-gate 3581, the southern main seam road, the loader gate and the inclined stone drift 0581.

With the exception of the loader gate, all drivage operations were carried out using a twin-boom roofbolting jumbo for drilling the round and setting the rockbolts and a side-tipping loader for debris clearance work. The coal-loader gate was driven using an AM 85 roadheader and the roofbolts were installed by a Böhler-equipped rockbolting and setting machine. Rockbolt supports were employed in all drivages, with rotary drilling being the preferred method for the bolting and shotfiring operations, given the favourable geology. The support system was based on M27 and M33 full-resin bolts 2.1 metres in length, which were set in rows 0.33 to 0.50 metres apart. Fold-out mesh mats were used to protect the workforce from rockfalls.

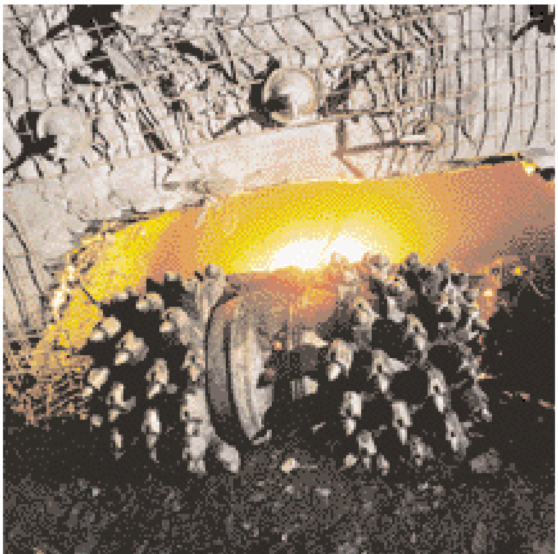
High rates of advance

Under the given operating conditions a normal heading performance of 8 metres per day was achieved using conventional drivage methods. Peak values of 60 metres per week were recorded with teams operating six days out of seven. The AM 85 roadheading machine achieved a continuous performance of 13 metres per day in the loader-gate drivage. A modified version of the Voest-Alpine KSS (combined safety system) was employed for the first time for cutter pick flushing. This system has the benefit of using low water pressures and flows, which in turn has a positive effect on heading performance.

Break-through



AM 85 roadheader in loader-gate 358 breaks through into the northern main seam road



The AM 85 takes a “well-earned break” after completing the loader-gate drivage

Contract extended

As a result of their excellent drivage record, and the experience acquired from the face installation work, Thyssen Schachtbau's Niederberg section was also awarded the contract for equipping panel no. 358.

Before this project began, however, it was apparent that the very tight deadlines involved in the subsequent excavation work could only be met by bringing forward the two drivage break-through dates and by employing additional personnel. However, the planned budget for the year 2000 could not permit the deployment of extra staff, at least not for the face installation work. This meant that only the heading teams could be deployed in 2000, while the face equipping work had to be put off until early 2001.

By employing every available means for accelerating the rate of progress, the roadheader drivage operation was successfully concluded two weeks ahead of schedule, while conventional drivage 3590 was actually completed more than 4 weeks before the planned deadline. Valuable time was therefore won for the subsequent face installation work. The most decisive factor in this respect was not the early completion of the finishing work in the drivages, but the fact that the debris loading phase had come to an end, thereby allowing work to begin on dismantling the conveyor structure. The remaining operations in main seam road 3590, such as equipment dismantling, securing the bridge zone and final roofbolting work, could therefore be postponed until February/March 2001.

Once the AM 85 roadheader had broken through in mid-November 2000, work could begin on the dismantling of the first conveyor installation, and the second followed in mid-December. This freed up a number of working crews, who were then able to turn their attentions to the face preparation and installation work. In order to prepare for the face equipping phase, which involved the installation of the face supports, face conveyor and coal plough, roofbolts were additionally installed in a 350 metre section of the main seam road. This was undertaken using fully-grouted M33 bolts 4 metres in length.

Station 0521 materials transloading point for 07's district, excavated by Thyssen Schachtbau

Belt trench excavated to create headroom for the belt transfer station

This was immediately followed by the transport and assembly operations required for the face and roadway conveyor systems, as well as for the gate-end pantechnicons which would subsequently supply the coal-face equipment. The shield supports, complete with the necessary hydraulic packs, air-conditioning systems and shifting gear, were also brought in and installed, and this was followed by the erection of a manriding conveyor in roadway 3581.

From mid-December onwards, which was the break-through date for the roofbolting jumbo, the team was able to decommission one belt after the other - working in the direction of conveying - and excavate the series of trenches required for the belt transfer stations. This meant that a portion of the dinting dirt had to be transported-out in containers. The new belt conveyors were then installed and started-up as this operation progressed. At the same time dinting work had to be undertaken in the future tail-gate and main seam roadway and the belt trenches excavated for the subsequent transfer points (see photos). The six belt conveyors, with belt widths of between 1000 and 1400 mm and an overall length of 2,300 metres, were then installed, followed by the 5 kV power supply station and all electrical installations; finally, a new mine drainage system was laid.

This operation was accompanied by the final installation of various items of equipment and facilities, including the face and roadway conveyors, shield supports, shifting gear and gate-end pantechnicons, a large timber store and the stringers required for the standing supports which would be installed after the ploughing phase.

From the beginning of January the size of the workforce was increased, so that up to 120 manshifts per day were made available 6 days a week for the different project operations.

A total of 5,500 shifts were required for the entire project, with the face installation work accounting for some 4,300 shifts and the other mining excavations (trench digging and support work) the remaining 1,200.

Assembling the face conveyor

Face trials were successfully completed in panel 358, Geitling seam 2, on 23rd February 2001, and coal ploughing subsequently began on schedule on 26th February. This meant that the project team had beaten the very tight completion deadline by 3 working days. On 6th March, that is only 7 working days later, the fully-equipped 350-metre face conveyor and shield supports were moved into place along the coal face and the northern roadhead was secured with solid timber chocks. By 10th March all the necessary standing supports had been permanently installed in the roadway used for the ploughing-in phase.

On 12th March the fully-equipped site was handed over to the coal winning department as a working coal face. Thyssen Schachtbau's Niederberg section had given an impressive demonstration of its ability to develop and equip a complete production face and to deliver it to the client on time as a turn-key facility.

Michael Lottner

Picture above:
Ready-assembled shield-support columns wait in the main seam road

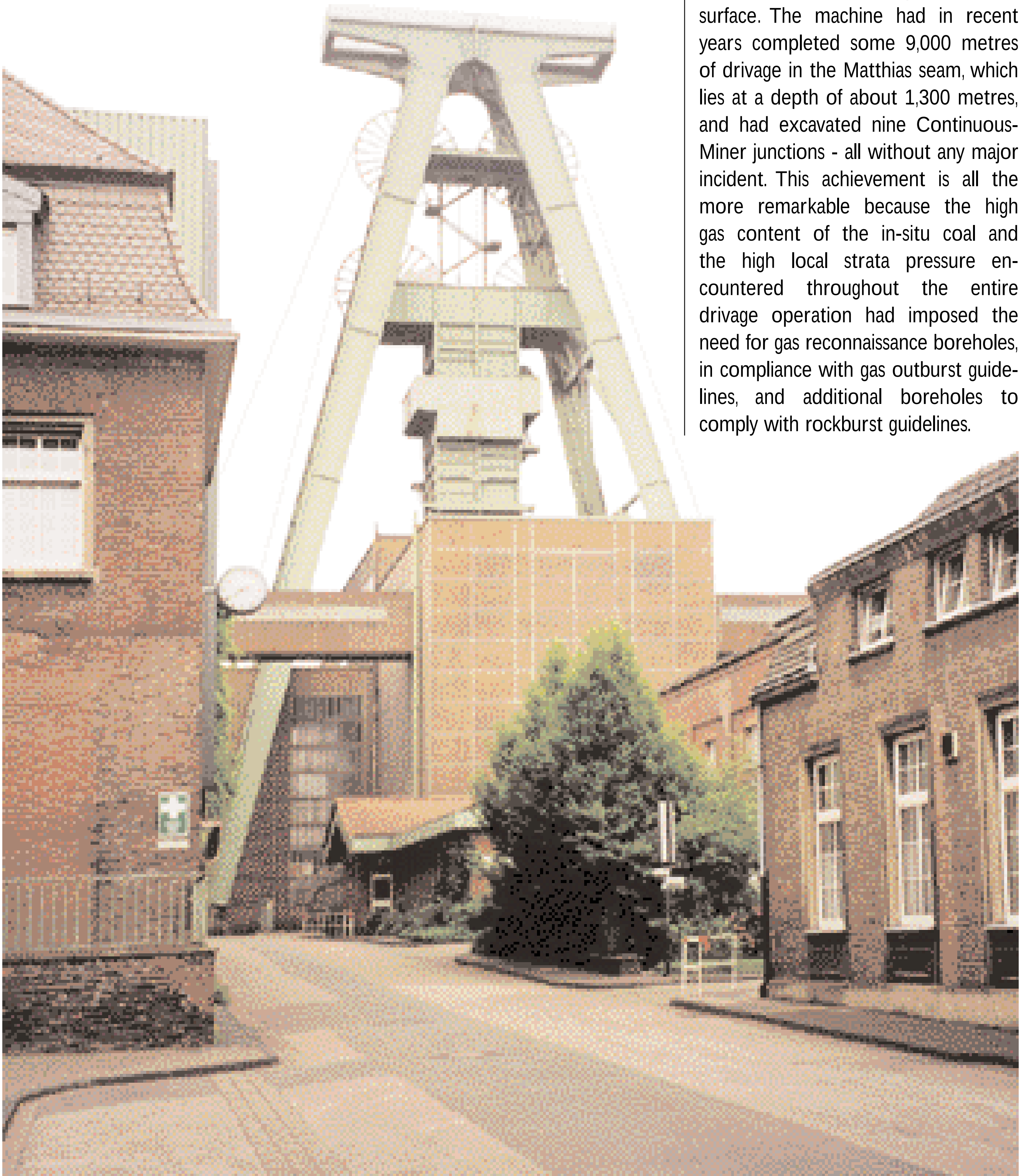
Picture left:
Face equipping – ploughing-in phase

Picutre bottom:
Heading team after break-through

Review of TS operations at Lohberg colliery

During the year 2000 Thyssen Schachtbau activities at Deutsche Steinkohle's Lohberg colliery were marked by a number of important events which reflected the changes currently taking place within the German coal industry as a whole.

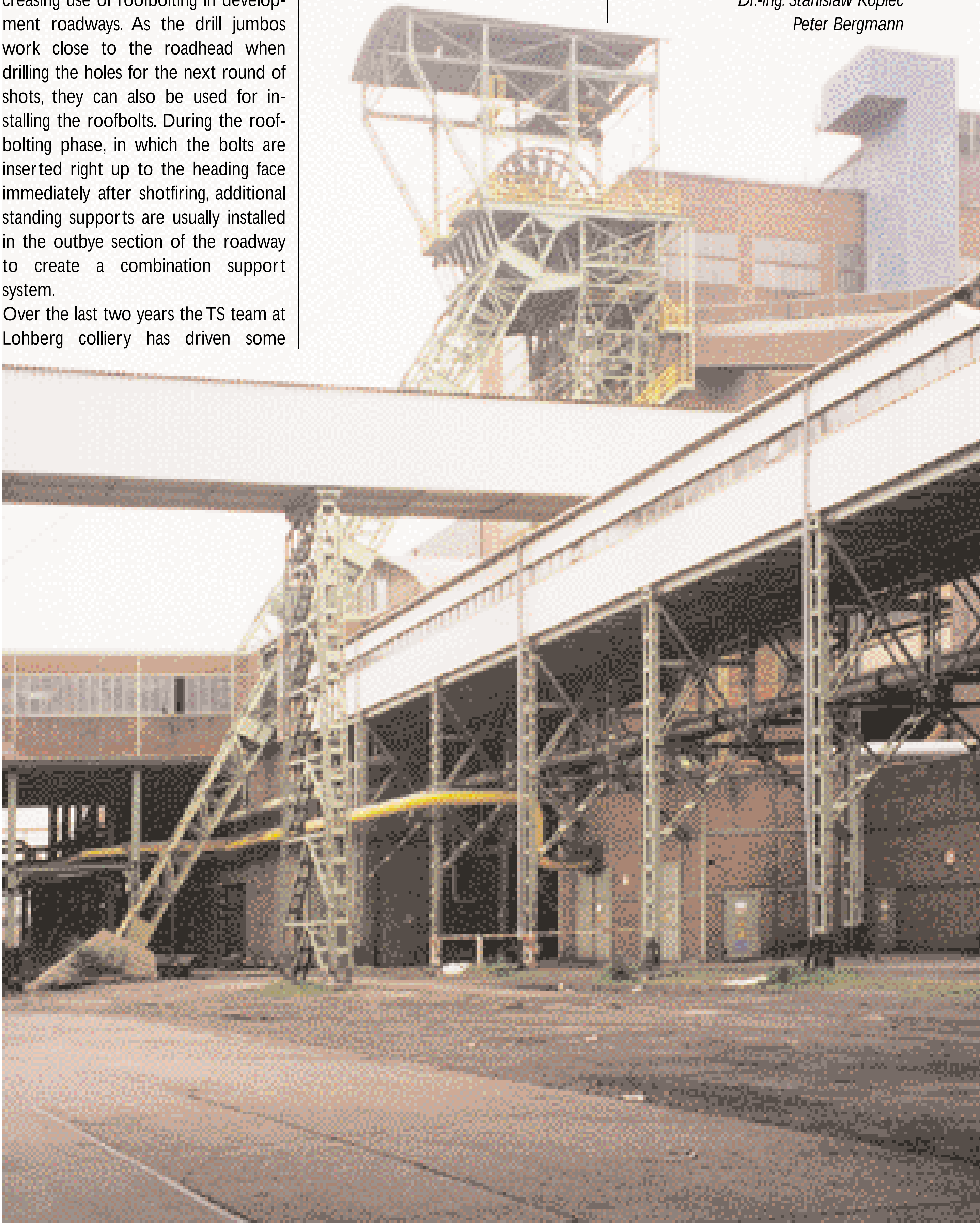
The number of shifts worked per day at the Lohberg site, expressed as an annual average, was some 20% down on the previous year, with the figure recorded standing at 90 MS/d. During the first half of the year the colliery's last operating roadheader was dismantled and transported to the surface. The machine had in recent years completed some 9,000 metres of drivage in the Matthias seam, which lies at a depth of about 1,300 metres, and had excavated nine Continuous-Miner junctions - all without any major incident. This achievement is all the more remarkable because the high gas content of the in-situ coal and the high local strata pressure encountered throughout the entire drivage operation had imposed the need for gas reconnaissance boreholes, in compliance with gas outburst guidelines, and additional boreholes to comply with rockburst guidelines.

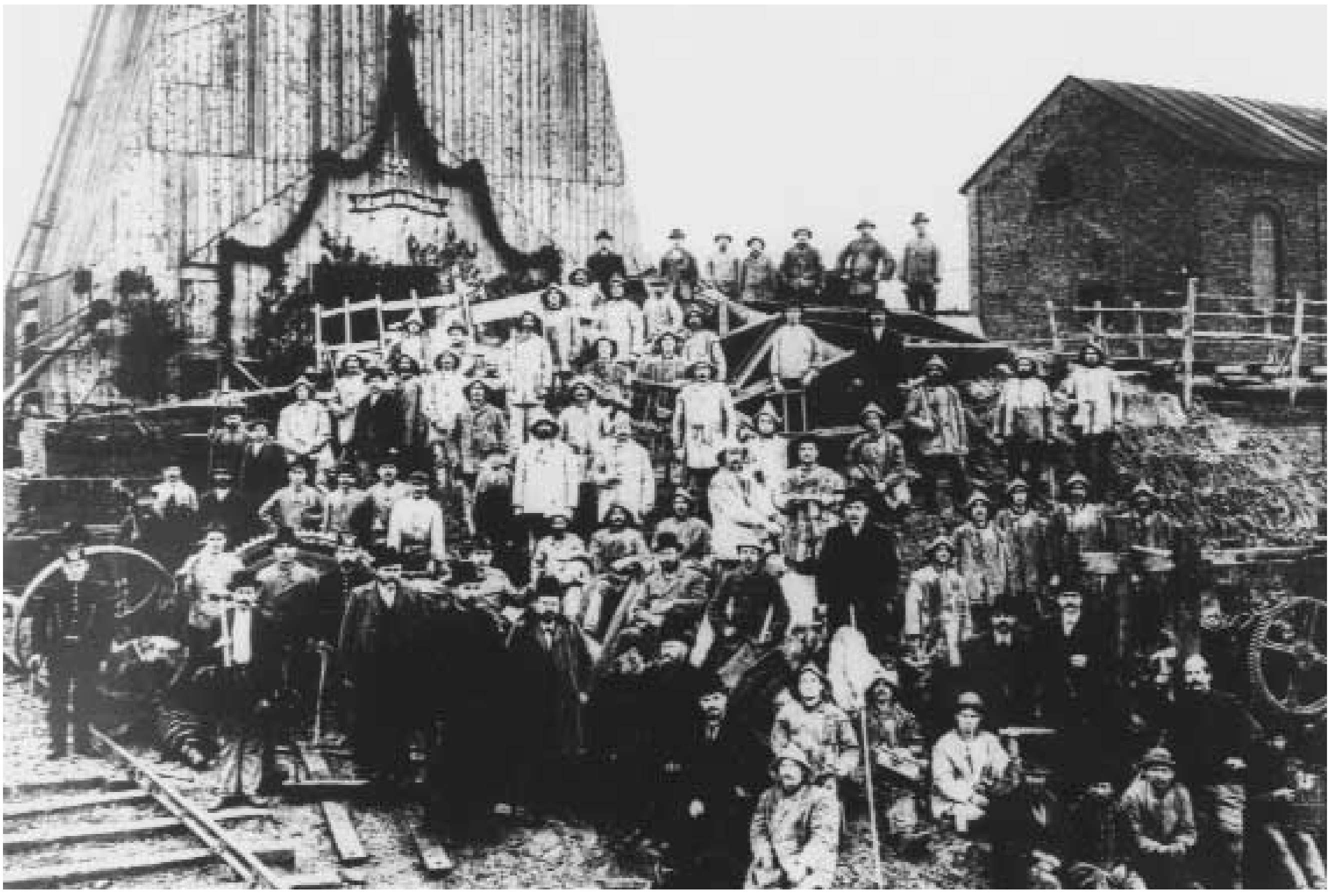


The cessation of roadheader drivage operations contrasted with the increased mechanization of conventional drivage projects based around the introduction of drill jumbos. The more frequent deployment of jumbo drills can be attributed mainly to the increasing use of roofbolting in development roadways. As the drill jumbos work close to the roadhead when drilling the holes for the next round of shots, they can also be used for installing the roofbolts. During the roofbolting phase, in which the bolts are inserted right up to the heading face immediately after shotfiring, additional standing supports are usually installed in the outbye section of the roadway to create a combination support system.

Over the last two years the TS team at Lohberg colliery has driven some 2,200 metres of roadway using this "new" roadheading technique. Each member of the heading team underwent an intensive training and refresher course so that the new operating technique could be quickly and efficiently put into practice. In spite of the new working routine, which at the outset was quite unfamiliar to most members of the workforce, safety targets were easily achieved and the recorded figure of 10 accidents was well below the pre-set target of 20 incidents per million working hours.

Dr.-Ing. Stanislaw Kopiec
Peter Bergmann





Shaft sinking crew of the shaft Deutscher Kaiser 4 / Wittfeld

130 years of shaft construction – with more than 180,000 metres of shaft sunk

180.000 metres

With the construction of the Bulyanhulu shaft in Tanzania and the Primsmulde shaft boring project in Germany, the Thyssen Schachtbau Group has now completed a total of some 183,150 metres of shaft sinking during its operating life.

This achievement marks TS out as one of the world's leading shaft construction companies.

130 years ago

The foundations for this branch of activity, which has traditionally been part of the specialist mining sector, were laid by August Thyssen as far back as 1871 when the name of the existing business was changed to "Gewerkschaft Deutscher Kaiser" – a company which united all Thyssen's coal and steel companies under one name and from which emerged the Mülheim-based Schachtbau Thyssen GmbH in 1919, which had detached itself from the main Thyssen group.

In 1871 exactly 130 years ago, the company's shaft sinking business began with the sinking of the Deutscher Kaiser I shaft in the Hamborn coalfield, which at that time was owned by August Thyssen.

The first freeze-shaft

In addition to caisson sinking, some of the earliest methods of shaft construction involved the use of boring rods to drill through unconsolidated and water-bearing strata, as well as conventional shaft sinking techniques using drilling and blasting in consolidated rock formations.

In 1905 the company began to include freeze-shaft sinking within its field of operations. The first freeze-shaft project, namely the Friedrich Thyssen V shaft at Hamborn-Marxloh, was followed in 1907 by the two freeze-shafts Lohberg I and II at Dinslaken, each of which were sunk to a freezing depth of 415 metres.

A broad portfolio of international sinking operations

The first tentative steps outside Germany were taken in 1911 with the sinking of two shafts in Belgium – an operation which marked the start of Thyssen Schachtbau's international career.

The range of services currently offered by the Thyssen Schachtbau Shaft-Sinking and Drilling Division include not only the construction of mine shafts, which can be sunk either by conventional means or using the freezing method, but also bunkers and other shaft workings, which are constructed by means of rodless shaft boring machines or by raise-boring, together with the necessary connecting galleries and insets.

More recently Thyssen Schachtbau GmbH has been involved in a number of joint projects, including the sinking of two exploration shafts in the Gorleben salt deposits which are to be used for the permanent disposal of radioactive waste, the drilling of the deepest rotary-bored staple shaft to date at the Western Deep Levels gold mine in South Africa (approx. 3,000 metres below sea level) and the construction of the world's highest shaft, which is at the Jungfernjoch in the Swiss Alps (3,571 metres above sea level). The company broke new ground for shaft deepening when it completed an innovative project at Ensdorf colliery where the existing mine shaft was extended by some 426 metres to a depth of 1,751 metres.

In sinking the 1,260 metre-deep Primsmulde mine shaft in the Saar coalfield, which is the world's deepest bored shaft, the TS Shaft Sinking and Drilling Division's shaft boring department will be setting new standards in this field.

Dipl.-Ing. Norbert Handke

Sinking of Deutscher Kaiser 1 / Hamborn

Job done! A new colliery is created

JOB DONE

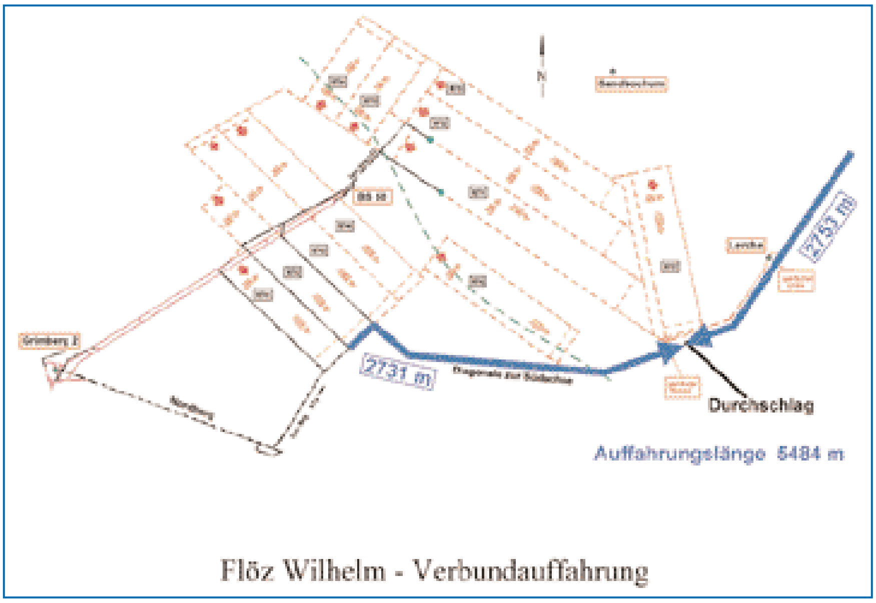
On 26th February the heading teams broke through to connect Haus Aden/Monopol with Heinrich Robert - and thereby established a new Colliery Ost.

A 3-year lead-time

In 1999 it was reported how Deutsche Steinkohle had to adapt its production levels to the demands of the free market and was therefore increasingly obliged to reduce its output. The adaptation measures needed for such a programme of change called for an intensive and lengthy planning process.

The 1999 report sought to illustrate the scale of the planning programme by taking as an example the in-seam and stone drivage operations required for the underground link-up of Haus Aden/Monopol and Heinrich Robert collieries. On 26th February 2001, exactly 3 years after the work started, this major colliery link-up project was brought to a successful conclusion - and the new Ost Mine was created.

The new connecting roadway



The long road to break-through

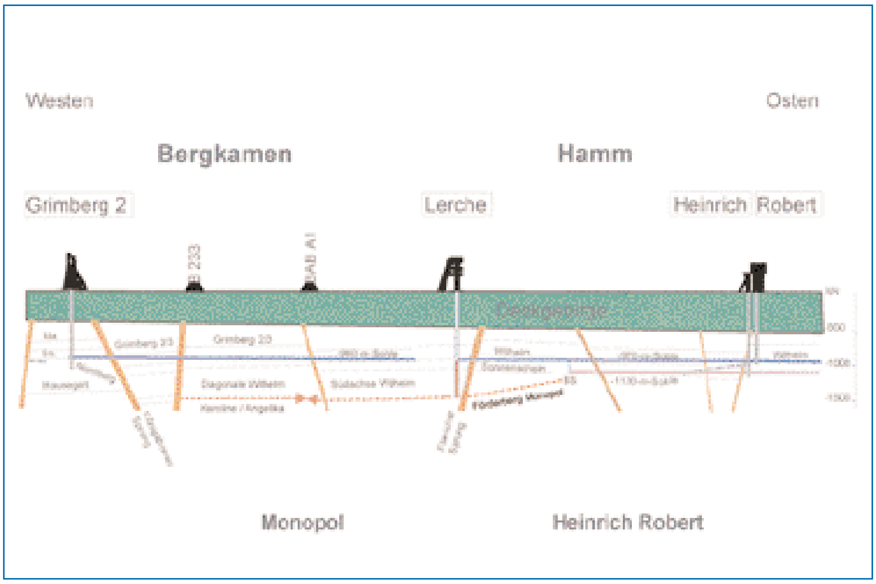
A total of 5,484 metres of new roadway had to be driven in order to achieve the merger of the two collieries. From February 1998, as part of this major tunnelling operation, Thyssen Schachtbau successfully completed some 2,753 metres of drivage working from the Heinrich Robert end.

The roadheading work was carried out by conventional means using a twin-boom drill jumbo, loader, twin-rail working platform and backfilling installation complete with an 8 cubic-metre storage hopper. The heading project included 15 special excavations, with a total length of 439 metres, and also 306 metres for the crossing of the Flierich and Rünther fault zones.

The average rate of heading advance ultimately reached 5.0 metres per working day – a creditable performance which ensured that the 3-year project remained on schedule. This achievement was subsequently recognized by colliery representatives and political figures at a colliery link-up ceremony on 26th February 2001.

The next phase

The completion of the connecting roadways is just one part of the new colliery's long-term planning programme. Work is now under way to access the coal reserves, which lie beneath Bergkamen-Overberge and Lerche, which is part of the Hamm district area.

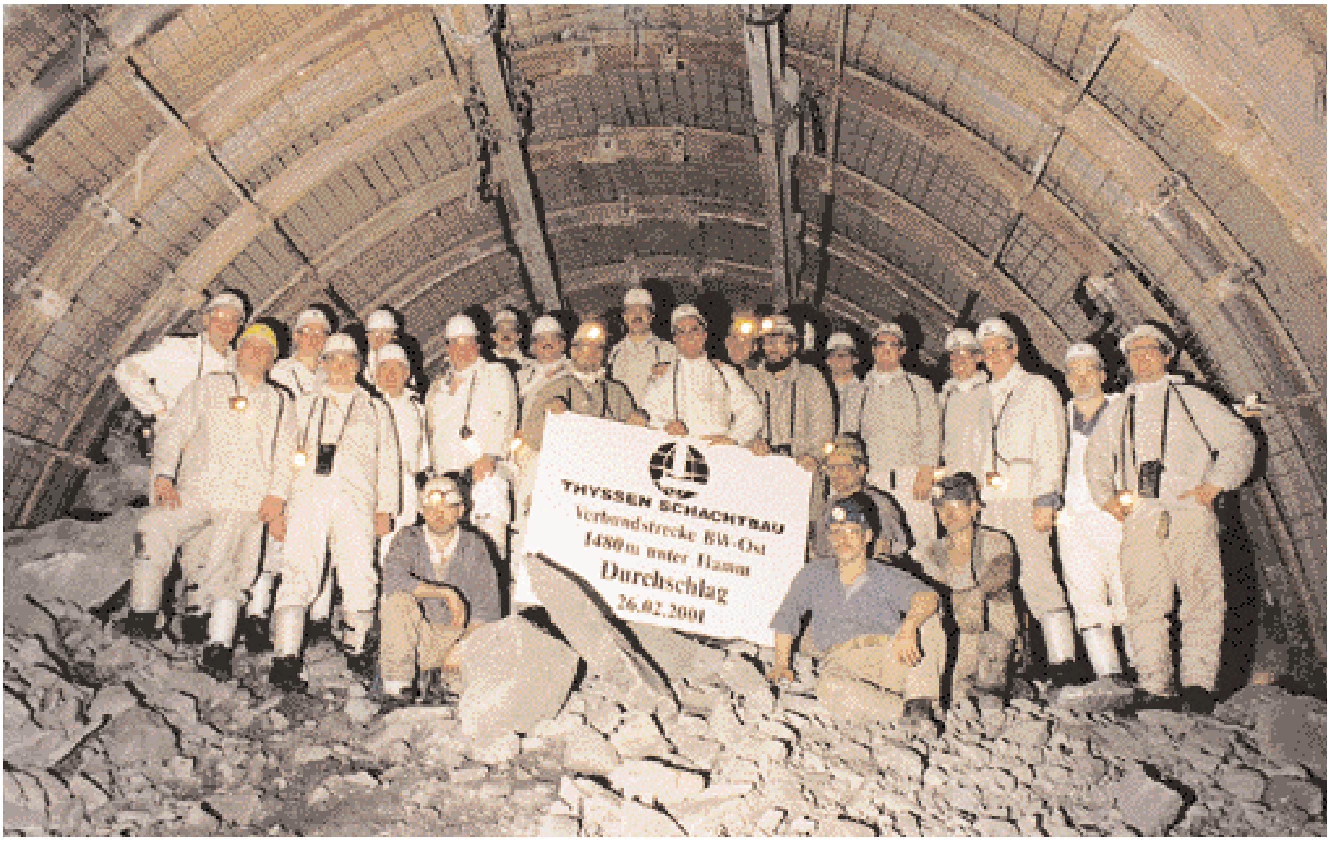


West-East cut along connecting roadway axis

The Lerche shaft, which is being deepened to 1,340-metre, will in future be used for both manwinding and materials haulage and will also serve as the intake ventilation shaft.

Thyssen Schachtbau has now been entrusted with the preparatory work for a roadway link-up with the Lerche shaft, which involves two different start-off points. This roadheading project is scheduled for completion in December 2001 and will constitute another important step towards coal-mining industry with long-term viability.

Dirk Wagener



End of an era – shaft infilling at Westfalen colliery

In June 2000 the Westfalen shaft consortium, which comprised Thyssen Schachtbau GmbH and Deilmann Haniel GmbH, was contracted by Deutsche Steinkohle AG to undertake the work of filling-in surface shafts 1, 2, 6 and 7 at Westfalen colliery.

Installing the main beams for the formwork scaffold

End of an era

The last skip was wound to the surface in shaft no. 1 on 1st July 2000, marking the end of coal winning era where production had started nearly 100 years before. Shaft nos 1 and 2 were sunk between 1909 and 1911. Shaft no.1 had a final depth of 1,087 metres, while shaft no. 2 was 1,071 metres in depth. No. 1 shaft was used as the main hoisting shaft until its closure, while no. 2 shaft was the ventilation shaft and also served for manwinding and materials haulage duties. Sinking work began on the new no. 7 manwinding and ventilation shaft at Hamm Heesen in 1976. Manwinding to a depth of 1,330 metres commenced in this new shaft in October 1983. Shaft no. 6 was primarily used as a ventilation shaft.

Shaft infilling commences

After the client had laid down the infilling deadlines for the individual shafts, the Westfalen consortium began work in June 2000. Both the precise project deadlines and the availability of the friction winder meant that strict time limits applied when shortening and extending the winding systems.
Formwork stages had to be installed in all four shafts; in shaft nos 1, 2 and 6 the installation depth was 250 metres, while in no. 7 shaft the stage was installed at a depth of 1,070 metres. As the colliery was to continue with underground salvage work until the filling operation in shaft no. 7 was completed, air pipes had to be installed in all the formwork stages in order to maintain the ventilating air supply. Furthermore these pipes had to be used for the controlled removal of CH_4 by means of the main fan in no. 6 shaft.

The infilling work commenced in no. 1 shaft and continued with no. 7 shaft, to be followed by the simultaneous filling of shaft nos 2 and 6. Before the operation could begin, the shafts had to be inspected – beginning from the rope-sheave platform in the headgear to the proposed installation level for the working platform and formwork stage – in order to check and clean the various shaft fittings (buntons, pipes, cables, ladder-ways, ladder stages and shaft lining).

Safety first

M24 x 1500 mm steel rockbolts were installed 20 metres above the stage installation level at intervals of 1 metre around the circumference of the shaft; these were to be used for the attachment of a double-layer catch net, to protect those working in the shaft, which was to be fastened both to the bolts and to the existing shaft fittings.

A mounting beam installed above this safety net was fitted with a number of attachment points for a compressed-air hoist (maximum payload 6 tonnes), which was used for position changing between buntons. Communication and signalling was provided by the existing tapping rope, the cage signalling system and a dialling telephone.

Progressive dismantling

Before the winding system could be shortened the working platforms in the open shaft section had to be installed in such a manner that they would not impede the winding operations. These platforms were constructed from steel girders covered with double-layer decking (80 mm timbers) and were attached to the shaft lining in

Shafts 1 and 2 at Westfalen colliery

View of overhead protection system

such a way that the workers were at no risk of falling down the shaft.
The cavities which were to act as abutments for the formwork stages were excavated using Long Year core drills fitted with 250 mm diameter bits. After the openings had been made in the free shaft section, the seatings were constructed using grade-B25 concrete and the stage support beams were then lowered into place.

After the winding system had been shortened the stage system was completed and finished with double-layer decking. A grating measuring 4 metres square was fitted to ensure that the ventilation flow could be maintained. Before the formwork stage was finally closed off, the existing 500 mm compressed-air line had to be detached below the timber decking. This pipe would later be used for CH4 drainage.
The first ventilation pipes could then be installed in 2-metre sections on the formwork stage, with the openings protected by gratings to prevent persons or material inadvertently falling down the shaft. A lightweight scaffold, with a working height of 14 metres and fitted with an internal stairway, was installed in order that the shaft could be fully salvaged 15 metres above the stage. This scaffold was also used for extending the ventilation

Installation of support beams for working platform

pipes, which were fitted in 8-metre sections.
The shaft fittings were dismantled from the top downwards, it being necessary to adapt the dimensions of the salvaged material to fit the available shaft conveyances. A travelling ladderway system was used by those carrying out the salvage work.

Job completed on schedule and with zero accidents

The shaft operations were completed with the dismantling of the overhead protection system and lightweight

Completed construction scaffold

Stage support beams with working platform below

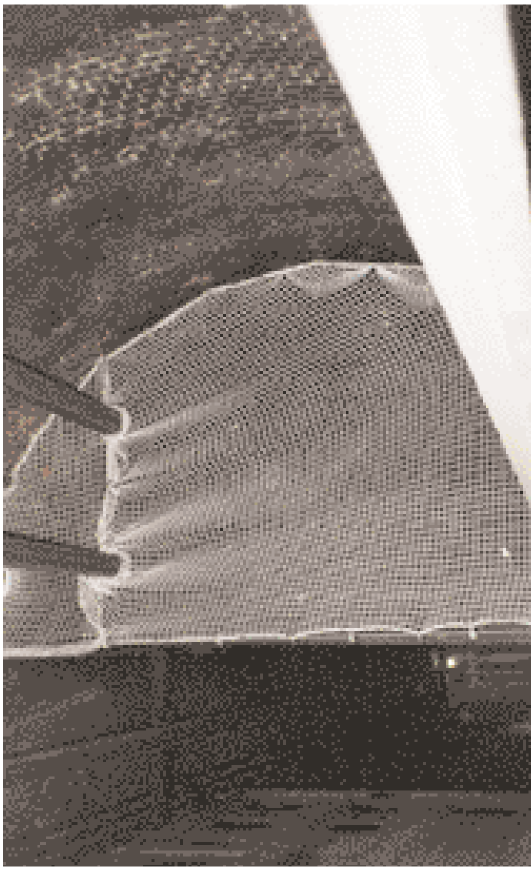
scaffold and the removal of the other items of equipment to the shaft surface.
With the shaft team working from the winding cage, the existing shaft pipe was converted for use as an inertisation line and a CH_4 and CO_2 sampling pipe (flexible measurement pipe) was installed.

Finally, the old 500-mm compressed-air pipe was detached 3 metres below the pit bank and a sliding valve was fitted for the subsequent connection of the Protego hoods- which would be used for the cold flaring of mine gas to the atmosphere.

The shaft consortium completed its work on 18th November 2000. The contract was concluded on schedule and the operation was a total success.
All those engaged in the shaft project were given regular instructions on working to correct health and safety standards. During the contract period three members of the workforce were trained as safety officials and a further ten received rescue-team training. These measures, together with the compulsory use of twin-rope harnesses when working in the shaft, certainly contributed to the impressive safety record achieved by the Westfalen consortium: during the contract period no reportable accidents occurred and there was not a single entry made in the first-aid book.

Great credit is due to all members of the workforce for their commitment and their adherence to safe working practices.

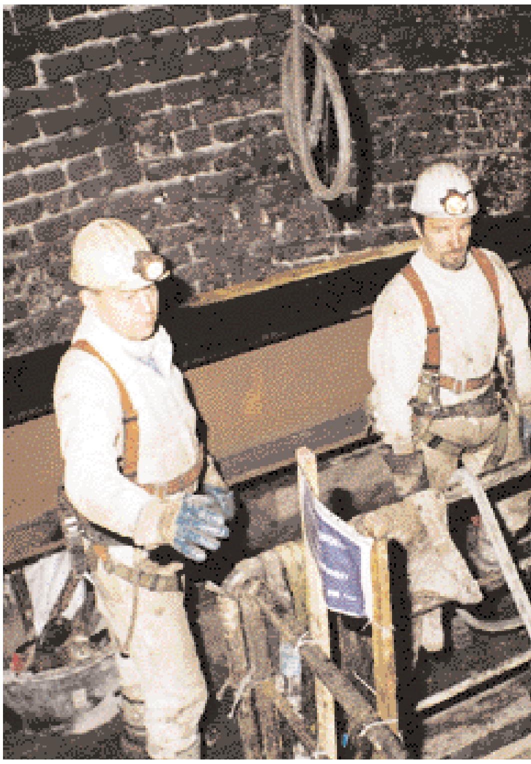
Dipl.-Ing. Veit Passmann



View of overhead protection system

Core drilling of shaft wall cavities

Installation of support beams for formwork scaffold



Work safety in operation

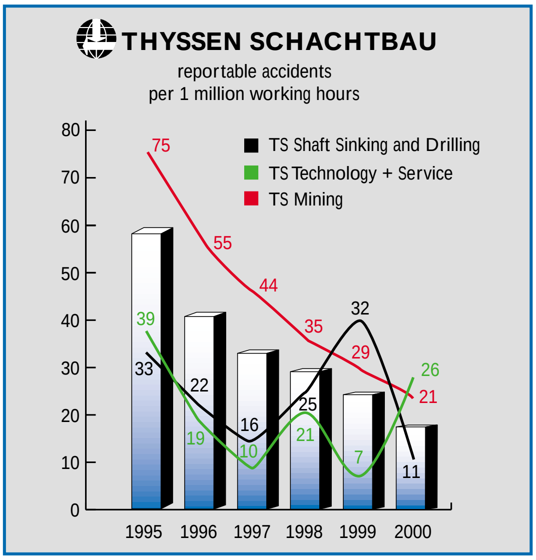
Our actions reflect our responsibilities

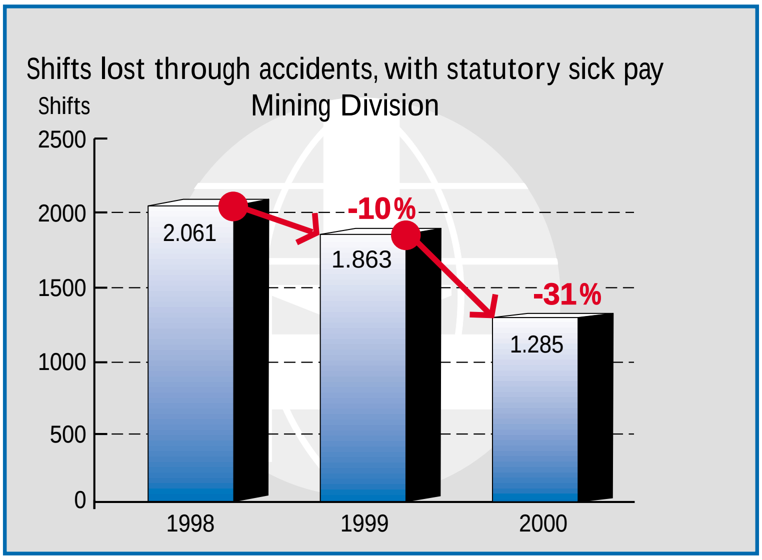
We obviously underestimated the capabilities of our workforce when we set a target of 10 % fewer accidents for the year 2000 – and by a long way. The actual accident figures for 2000 were in fact 28 % down on the previous year. With the accident rate standing at 18 reportable accidents per million working hours, the number of accidents recorded has fallen by 50 % within a space of three years – a remarkable achievement by any standards.

Photograph of BBG awards: 1. Prize winners (from left) Section Head H. Ludwig, Section Head U. Reinecke 2. (from left) Department Head (Mining) M. Haccius, Chairman of the works committee B. Grätz, Production Manager R. Reese

Fewer accidents means financial savings

The BBG (german kind of workmans compensation) annual safety award for special achievements has been rewarded for TS Mining to the Rheinland Mine Site as that one for represented TS Shaft Sinking and Drilling to the Borth Mine Site. These were the only representative of the specialist mining companies to be selected from the coal-mining sector of operations – and for Rheinland it was their third award in a row.





Successful work-safety practice has a positive economic contribution to make, in that fewer accidents means financial savings. In the mining sector the number of shifts lost through accidents at work, with statutory sick pay, has fallen by 31 % from 1,863 to 1,285. Even taking into account the fact that 10 % fewer shifts were worked in 2000 compared with the previous year, there was still a 23 % improvement in the figures for shifts lost due to accidents.

The marked improvement in the safety figures recorded by the different operating sections, in other words the success of our workforce in fulfilling their contractual obligations, can be attributed in no small measure to our continued pursuit and implementation of work-safety measures. In order to draft, implement and analyze the success of these measures we have introduced six safety initiatives in our operational divisions:

- a work-safety committee for each operational sector
- a safety guidance committee for the mining sector
- a safety deputy or mineworker, who is released from normal workplace duties, to be appointed for each working site
- a safety officer for each workplace
- a series of in-house seminars for the mining division focusing on the specific problems of each workplace
- specific access to external seminars and training aids provided by the BBG.

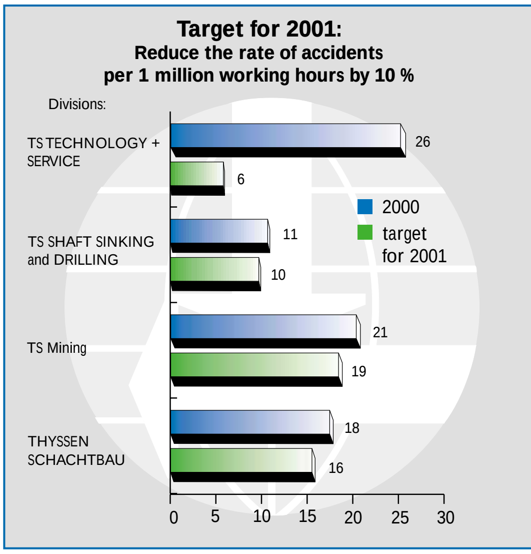
Operational Safety Measures

It would be nice to think that simply by increasing the level of operational safety measures that we introduce, the accident rate will be reduced. Of course things are not quite as simple as this, and real efforts will be needed to reach our 2001 target of a 10 % reduction in accidents compared with the previous year.

We feel that our catalogue of operational measures, which forms the framework for our safety programme, is both objective and suitable for the purpose. However, the intensity with which the different Thyssen Schachtbau divisions fulfil and implement this framework of measures can, in some individual cases, still be improved.

The decisive step for consolidating what has already been achieved, and for developing this further, must come from, and be completed by, each responsible Line Manager. The following series of questions, which are a key part of many safety talks, may serve as a useful guide to those with Line Management responsibilities:

What are my responsibilities for the safety of my fellow workers?
Am I open to questions – and do I answer these questions effectively?
Do I ask questions - and do I take in the answers?
Is the way in which I perform my work-safety actions in keeping with the safety objectives which I have set my fellow workers?



The results which have been achieved can also partly be attributed to the manner in which we have implemented our responsibility for workplace safety at the different operating sites. Further improvements can be made here, if we have the necessary resolve. The Safety Department will continue to play an active role throughout 2001 so that further progress can be made towards our ultimate objective – zero accidents.

Dipl.-Ing. Thomas Sievers

Participants from the Rheinland section attend work-safety seminar

TMCC provides oil well solution

Imperial Oil Ltd.: Well abandonment project, Cold Lake, Alberta

History of the project

In the early 1970's, Imperial Oil Ltd, experimented with multiple well drilling from one location, or pad, and utilized steam injection in order to lower the viscosity of the bitumen deposits and thus improve oil recovery or make oil extraction possible at all.

Over the years, as technology progressed, the number of wells drilled on one pad were increased from 7 to 30.

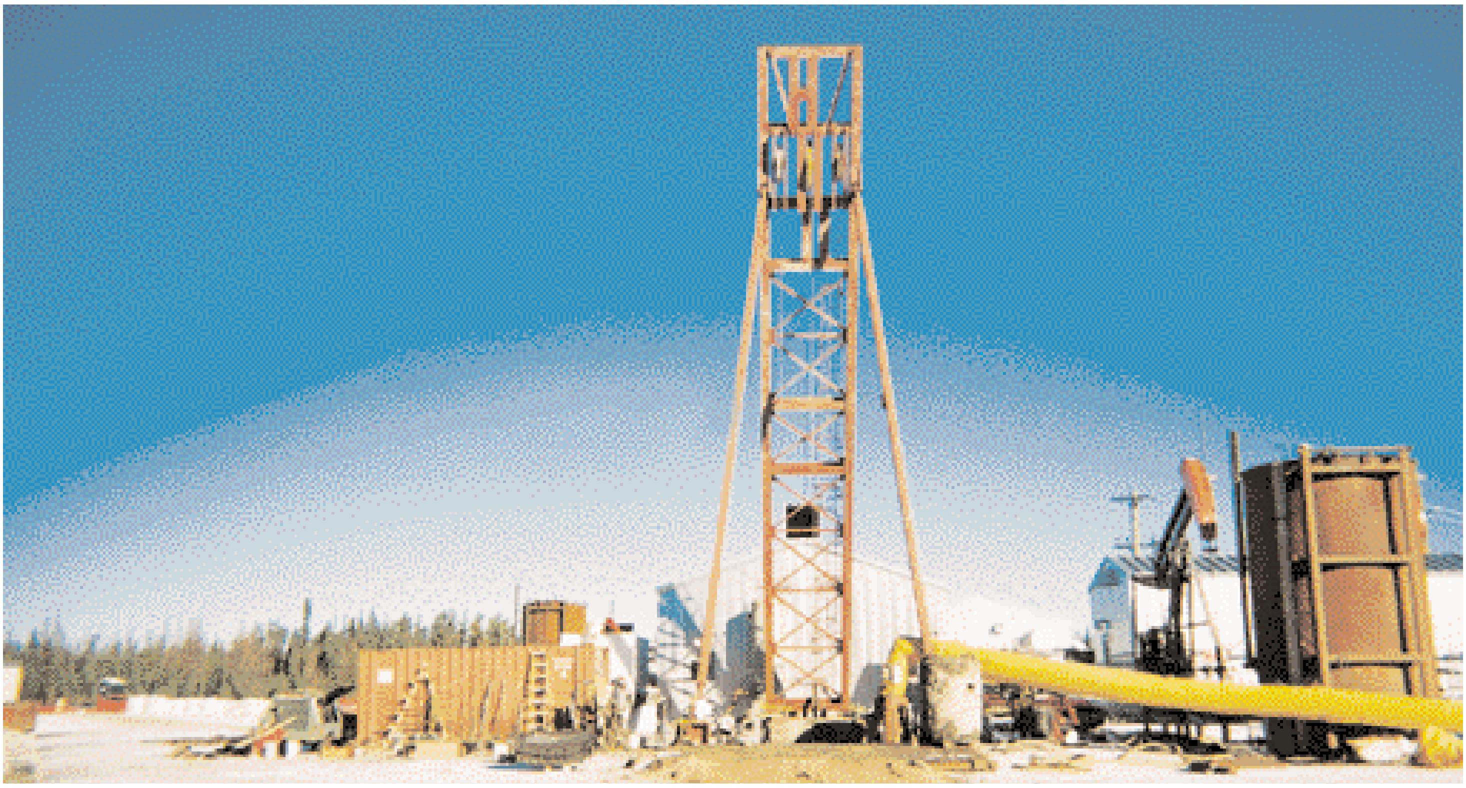
In 1999, one well on pad F01 at the Maskwa site near Cold Lake failed. In early 2000, Thyssen Mining Construction was contacted by Imperial Oil to explore the possibility of employing mining techniques to aid in the recovery of the failed well. As a result of the failure of the well F01-05, the F01pad had to be shut down. For environmental reasons, the well cannot be legally abandoned in its present condition. The casing at a depth of 77 metres must be recovered to allow re-entry below this depth for abandonment purposes.

Thyssen Mining Construction has past experience in well recovery. In the late 80's, TMCC sank a shaft around a well to access the point where a break in well casing occurred. This particular well was located in a clay formation and therefore, ground freezing techniques were not required. Imperial Oil's well no. F01-05, being located where muskeg is present, required ground freezing to make excavation possible.

With TMCC's past experience in shaft sinking and ground freezing, TMCC was hired to undertake this project.

Ground freezing

Imperial Oil employed a well drilling contractor to install 16 freeze pipes on a 7.5m diameter surrounding the well. These freeze pipe casings were installed from surface to a depth of 85 m, at 1.5 m spacing between holes,



Site arrangement with clam and pumps in the background

leaving 0.75m for ice growth between each freeze well.The freeze pipes were left at initial ground elevation for TMCC to complete freeze cellar construction.

Upon TMCC's arrival on site in late August, freeze well drilling had not yet been completed, therefore, construction of the freeze plant, compressor room and hoist building commenced. Initial concrete footings and concrete pads were poured to hasten the installation of 2-85 ton capacity freeze units. The nature of the project required oil field standards and piping quality assurance standards to be strictly adhered to. TMCC, having limited oilfield experience, found the piping installation to these standards to be both a challenging and rewarding undertaking.

Construction of the freeze cellar was initiated concurrently with the installation of the freeze plants. Four separate circuits, consisting of 4 freeze holes each, were established. The four circuits could be supplied with cold CaCl brine directly from the freeze units utilizing a supply manifold. Four supply and return lines to deliver and receive brine from the freeze plants to the freeze cellar were installed in a culvert and buried in order to gain working area. The freeze agent used was liquid Ammonia.

What is Muskeg?

In northern USA and Canada: boggy ground in an undrained or poorly-drained area of alluvial or glacial deposits, or, more specifically, in a rock syncline, which is filled with fine water-logged material, decomposed organic material, or peat moss, and is incapable of supporting large weights. The surface tends to be slightly undulating. In Alaska the term is generally employed for peaty or boggy ground irrespective of the topography.

Instrumentation

The freeze progress was monitored with the use of thermocouple temperature sensor strings located in wells adjacent to opposite sides of the shaft, 1.5 m outside of the freeze circle. To give us an accurate picture of this progress, each of the thermocouple strings had sensors located at 5 metre intervals to 85m below the surface. All thermocouple readings were - transferred to an LCD readout monitor located in the freeze plant area, which was available for instantaneous readings at any particular time. Due to design temperature restrictions on piping, a temperature of -29 degrees Celsius was the maximum temperature to which the brine could be cooled and this was achieved.

Initially, ground temperature at depth was believed to be in the neighborhood of +10 degrees Celsius, however, the actual temperature encountered was +26 degrees Celsius. This elevated ground temperature increased the freeze time from 60 to 120 days. The nature of the ground

Man winding cage transports workmen down the shaft to help grouting

conditions coupled with the heat load at depth caused the progression of freezing from the collar downward, which is opposite of a normal freezing operation. The consequence of this was that excavation of the shaft could not commence until the bottom of the shaft area was frozen in order to avoid the risk of ground water transfer into the frozen shaft. Imperial Oil ceased all steam injections in wells within a 1km radius to facilitate the freezing of this particular well by lowering the amount of heat being introduced into the reservoir.

Plant construction

With the freezing of the shaft underway, surface plant construction carried on. This consisted of 2-650cfm electric compressors, a single drum Timberland hoist, 2 stage winches and 1 Cryderman clam winch. All the electrics to run this equipment were installed simultaneously with their placement. At the completion of the equipment installation, a 10m x 30m building was erected to house the freeze/sinking plant so that they would be protected against changing weather conditions.

Shaft excavation

Excavation of the shaft commenced on December 28th of 2000 with a backhoe to a 5m depth. The shaft is excavated to 4.6 m diameter and the internal liner plate diameter is 4.3 m installed. With the thickest part of the freeze wall being at the surface – due to the high temperature gradient between surface and excavation depth – this proved to be more difficult than originally anticipated.
The next phase of excavation was recently completed on January 29, 2001 and utilized a crane and sinking bucket. A brine drilling system was in place. We drilled with sinking drills, benching our way down in 1.8 m intervals.

The failed well casing is being removed on the way down by torching means. Mucking of the blasted material is done with a Cryderman clam loading into buckets which are hoisted to the surface for dumping.
A shaft lining system was adopted as a means of shaft wall stabilization. TMCC uses both, bolted sections of liner plate and ring beams. We install them top to bottom following excavation progress and keep the lining to within 1.8 m of the bottom at all times. In intervals of approximately 7.5 meters, the annulus of the liner is sealed and then grouted not just to further aid in the stability of the liner, but also to protect from ice creep and prevent cross communication of aquifers once the well is abandoned.
The Cryderman clam is suspended from a clam winch located in the

Interior of the shaft with lining system, ring beans and Cryderman-clam

The headframe is elevated to the right position

hoistroom and tied back to the shaft ring beams to secure it while mucking. It is lowered as required to facilitate the mucking process.

A substantial collar arrangement was constructed and installed in order to support a well service rig, which will be required for well abandonment. The collar steel was designed to accommodate sinking operations including shaft collar doors, headframe foundation and material handling area. TMCC has recently completed the erection of a semi-portable headframe and commissioning of all sinking components. This phase of the shaft sinking from 30m to 77 m is underway. Normal sinking operations will be carried out until the required depth is achieved.

Site safety

Safety is of paramount importance in any efficient operation and the Cold Lake Project is no exception. Prior to commencing risk analyses were completed on all aspects of the project to develop risk management strategies for the various phases. Worker involvement and participation in all site safety meetings, inspections, JSA's and job observations have been well accepted by both the client and TMCC alike. The site objective is to be accident free to job completion and worker participation toward this goal has been exceptional.

Project completion

Upon reaching the required depth for re-accessing the well, a concrete plug will be poured at the shaft bottom. The failed well will be tied back to the shaft wall and a new casing welded to the original and extended back to the collar, stabilizing it to the shaft ring beams every 10 metres. Once back on surface, the sinking set up will be geared out and a well service rig set up over the newly installed casing. The service rig will be required to retrieve all and any down-hole equipment in the well enabling total abandonment. When the well is cleared of all down-hole equipment, the service rig will be demobilized to accommodate backfilling operations. Backfilling will consist of a clay-mix material to within 1 metre of the ground elevation. At that point, a 1 metre concrete cap will be poured on top of the backfill material in order to seal the shaft.

Conclusion

At the completion of this project, Imperial Oil will be able to resume normal operations including steaming and oil recovery on the F01 pad.

TMCC will have gained valuable experience working in the oil field and will be well placed to provide similar services for other projects.

Barry Upton

Shaft collar arrangement – guide rail and bucket suspended from the winch, clam winch and hoistroom in the background

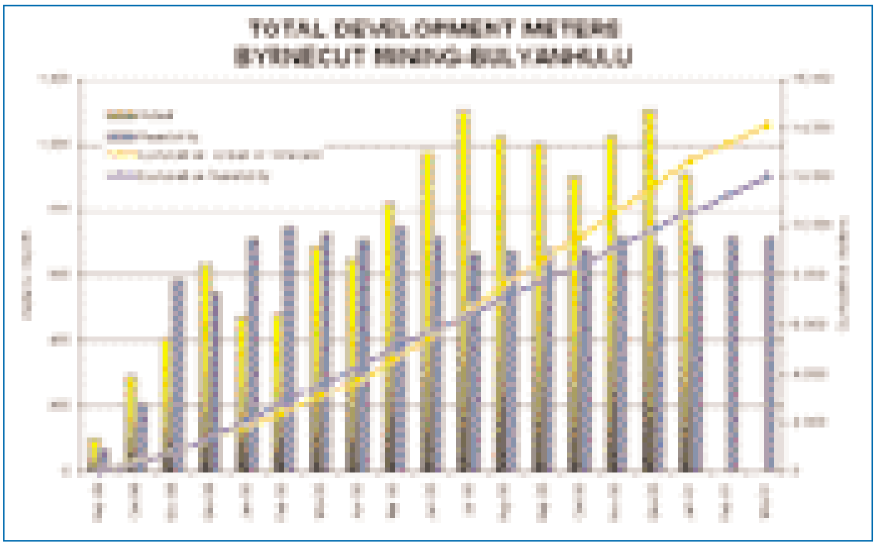
Under African Skies

Bulyanhulu

The gold deposits of Bulyanhulu, which is also known as “Buly” by local residents and mine workers, is situated in the Victorian Greenstone Belt between the East and West Rift Valleys in north west Tanzania, just three degrees south of the Equator and about 45 km south of Lake Victoria.

The tropical climate is surprisingly moderate, due to Buly’s location on a plateau some 1,200 metres above sea level. Annual rainfall averages 1,000 mm and occurs mainly during the wet season from November to May.

The mine site relies largely on air and rail transport for its supplies. The client operates an air service (two hours flying time) direct to Buly from Dar Es Salaam, the nation’s major city, five times a week. The Joint Venture operates a charter passenger service twice a week and cargo is air-freighted to the mine on an “as required” basis, from Johannesburg. Rail transport from South Africa to the mine site is often delayed by derailments; materials delivery times can vary from 8 to 12 weeks, depending on circumstances. Road transport from Dar Es Salaam takes about five days.



Mine entrance

Fast Track

Byrnecut International’s high expectations for a successful entry into the mining contracting business in Africa have been easily exceeded. The company, operating in partnership with Thyssen and RUC, has increased its rate of advance in ramps and levels by fifty percent to reach performances averaging 1000 metres per month. That amounts to more than thirteen (13) kilometres completed since work started in September 1999.

Byrnecut’s client, Kahama Mining Corporation Ltd (a subsidiary of the Canadian mining company Barrick Gold Corporation), is already planning the next phase of expansion before production has even commenced and has accepted the proposal submitted by the joint venture for a further fifteen (15) kilometres of development for the deepening of ramp workings and associated ore driving, thereby extending the drivage programme into mid- 2002.

Size of ore-body still unknown

Exploration of the ore deposit indicated that the in-situ ore reserves

Crew-members in the mine

totalled 10.5 million ounces, as opposed to the 7.5 million ounces estimated in late 1999. The ore development work carried out by Byrnecut to date has encountered continuity of mineralisation. With drilling also being used, the ore body has been extended 4 kilometres along the strike and two kilometers at depth – and it remains open.

In view of this successful outcome, a four- phase development programme has been proposed for the Buly mine. The first phase, which is being fast-tracked by Byrnecut-RUC, is currently under construction in the main zone. Subsequent phases would be developed in the east and west zones and in the ore-body at depth.

Work on the Phase One Development at Buly is moving quickly, with a 6.4-metre diameter production shaft being sunk to a depth of 500 metres by a joint venture of Thyssen and RUC. Byrnecut has already made a connection to the shaft at the 300-metre level to facilitate a rapid Phase One production start-up, once the shaft loading pocket and the upper portion of the shaft have been fitted out in early 2001.

Unfolding Potential

The success already achieved at Buly has had much to do with the attitude of Byrnecut's development crews, who have adapted themselves to the isolated location, logistical difficulties and cultural differences, and along the way earned the respect of their Tanzanian work colleagues. The success also has a lot to do with each crew's desire to set the same standards of performance and quality which they previously achieved in Australia.

The core members of the Buly crews are drawn from Byrnecut's mining contract sites across Australia. The jumbo operators, loader drivers and air-leg miners are mainly Australians and New Zealanders and most have undergone Byrnecut's comprehensive Skills Training and Safe 2000 training programmes. They are capably supported by a small contingent of South Africans whose job is to provide the temporary and permanent services needed behind the development jumbos. An equally small contingent of Australians and South Africans provide a reliable maintenance service and are achieving better than predicted mobile fleet availabilities.

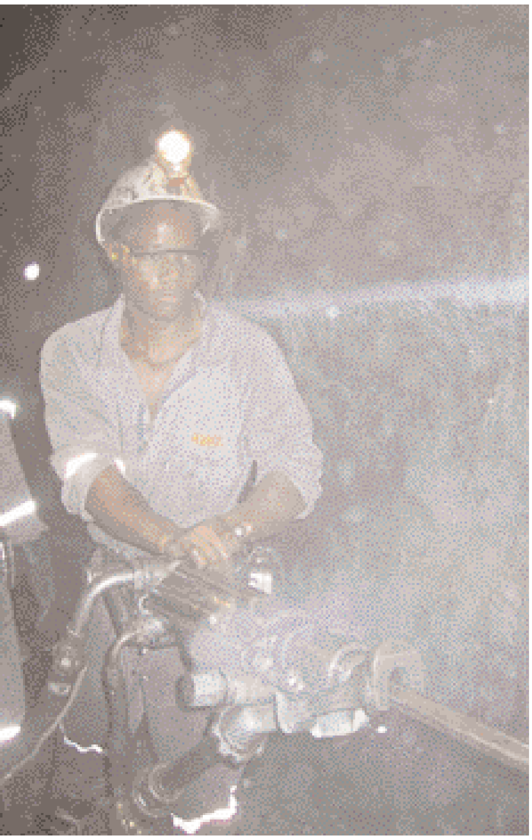
The Byrnecut International management team is committed to training prospective employees from the nearby communities. Most have little or no work experience, so Byrnecut uses a literacy and dexterity test to identify those applicants with potential skills for mechanized mining tasks. Successful recruits are given a safety induction and Byrnecut uses a modified Skills Training programme. The training modules incorporate theory and 'on the job' practical assessment and are translated into Swahili, the dominant language in the region. Progress is monitored and assessed by a Byrnecut training instructor and experienced crew members provide specialized practical instructions.

Developing Buly – in the waste

Byrnecut develops the 15%-gradient ramps, footwall drives, ore entries and special workings in the waste zone using a twin-boom Tamrock Powerclass Jumbo, which is fitted with 4.9-metre drill steel. The heading profile in the waste is usually 4.2 metres in height by 5.0 metres in width. The target advance in waste is 5 rounds cycled in 24 hours.

Practical training in the mine

Advance achieved per round is 4 metres. The charge-up crew uses a Caterpillar IT unit fitted with man-carrier basket and 250 kg pressurized ANFO Loader to charge each round. Blastholes are primed with cartridge emulsion explosives and initiated by non-electric means. Waste loading is done with one Toro 1400D equipped with an 8 cubic-metre bucket, which normally trams no less than 130 metres from face to stockpile, or direct to the EJC 430 dump trucks.
Ground support to the face precedes jumbo drilling in all headings. The backs and walls are pattern- bolted by air-leg operators and assistants who work from two Seco Boart scissor-lift platforms. Bolting density in the waste depends on the proximity to the ore body and varies from 4.7 bolts to 5.7 bolts per metre of advance.



– in the ore reef

Rapid progress is being made in the ore reef drives. Byrnecut's crews are achieving outstanding productivity rates of 18 metres per day using one single-boom Secoma Quasar Jumbo, which is equipped with a 3.7-metre drill steel. The reef is steeply dipping and has an average width of 3.5 metres, while its range varies from 2 to 6 metres. The mining profile is 3.5 metres in height and the width of the drive is taken to the geological boundaries of the ore. Mining widths vary from 2.3 to 6.0 metres. The target advance in ore is six rounds cycled in 24 hours. Advance achieved per round is 3.0 metres. Ore headings are loaded-out by three Toro 151 LHDs; tramming distances are generally no greater than 250 meters. Toro 400s also load-out the ore rounds, where mining width permits.
The loader drivers use the broken ore to construct a work-pad so that the air-leg ground support crew can reach the backs and walls for bolt installation to the face. Split-set anchor bolts are installed in a 1.2 metre by 1.2 metre staggered pattern. Mesh is occasionally installed to support the loose and friable areas, especially in the weaker parts of the reef, which are characterized by argillitic alteration.
Ore and waste (sg 2.9) is trucked along the steep 15% main ramp to the surface stockpiles using six EJC 430 Dump Trucks, which have a payload of twenty tonnes. Each truck hauls about 25,000 tonne- kilometres per month over a one-way haul of 2.7 kilometres. Operating times average out at 415 engine hours per truck per month. Haulage distances are expected to decrease once the first phase of ore and waste winding commences.
Byrnecut crews work 12-hour shifts, 13 days per fortnight. A three-crew rota system is used: two crews work 9 weeks on site while the third takes a 4-week break. Crew members generally return to their homes during these rest periods, though some take the opportunity to travel to other international destinations. Popular local retreats include the Serengeti Wild Life Park and Zanzibar.
Byrnecut invites you to watch this space for further developments in this exciting project - under African skies.

Graeme Sauer

Open-trench working in unstable overburden

McARTHUR RIVER MINE – SHAFT #3 UPDATE

Sinking towards the world richest uranium deposits

In the Report 2000, the McArthur River Shaft #3 presink and set-up was described and ended with sinking ready to go. This article summarizes the progress of the shaft to the end of 2000.

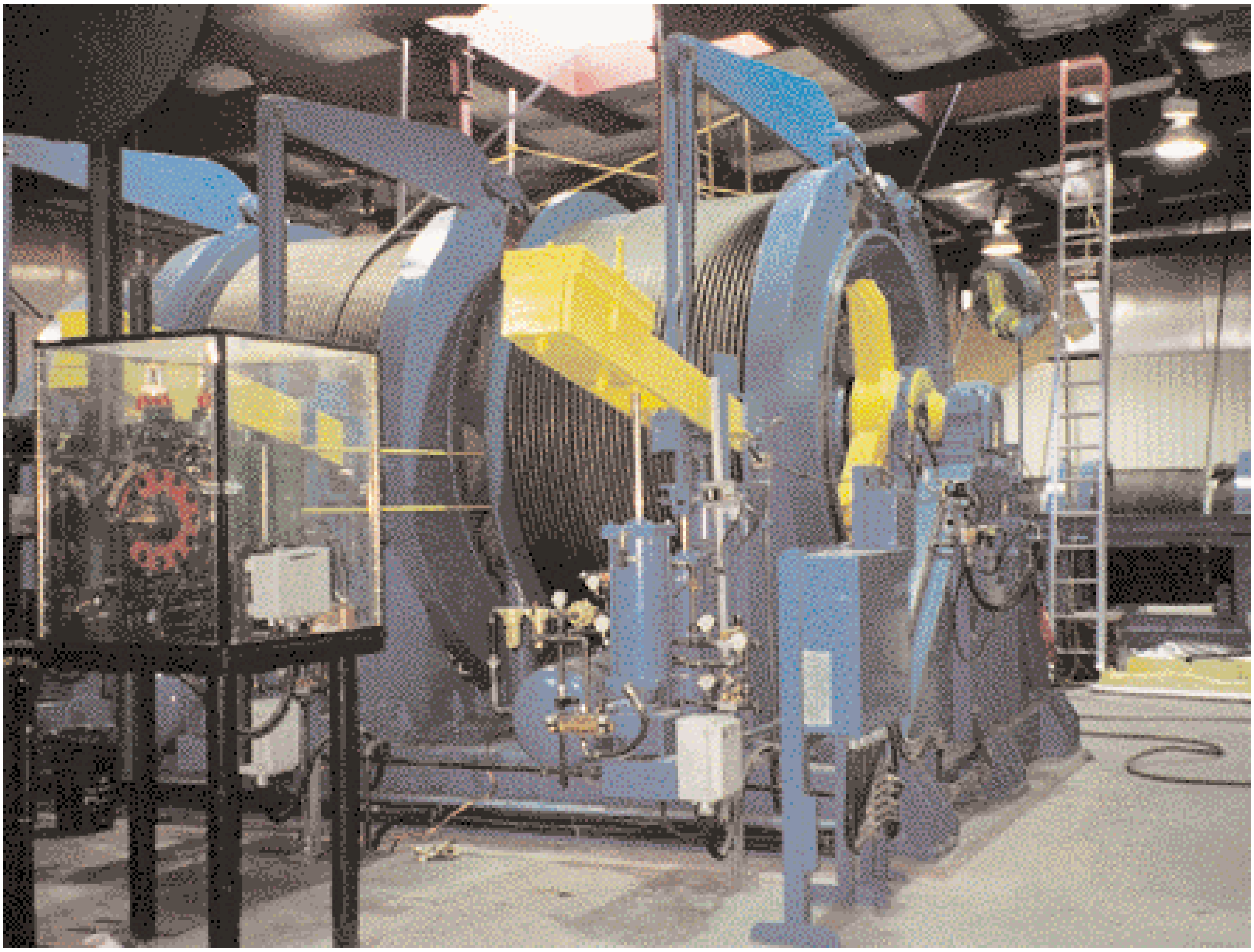
The contract, along with all work in northern Saskatchewan, is undertaken by Mudjatik Thyssen Mining ("MTM"), a joint venture between Thyssen Mining Construction of Canada Ltd. ("TMCC") and Mudjatik Enterprises ("ME"). ME is, in turn, a joint venture between a number of Aboriginal groups and communities from northern Saskatchewan.

Sinking methods

With the experience of sinking 2 similar shafts (shafts #1 and #2) and thus of the prevailing geological conditions at the McArthur River mine, MTM had the methodology for sinking well refined. The shaft diameter was 6 metres and the depth 540 metres. The geological setting was 12 metres of loose sands, 488 metres of horizontally bedded, water bearing sandstones and 40 metres of basement Gneiss. The shaft collar was completed to a depth of 25 metres and the shaft sinking infrastructure installed. The facilities consisted of:

- ❑ 30 metre high sinking headframe;
- ❑ 700 kW Lakeshore Double Drum Single Clutch Sinking Hoist;

Double Drum Sinking Hoist



- 4 – 15 kW New Era stage winches;
- 2 – 7 kW Timberland clam winches;
- 4 Sullair 100 kW compressors;
- 2 "Herman" Clam type shaft muckers;
- 1 Tamrock 2-boom shaft jumbo;
- 1 Concrete Batch plant;
- 1 – 4 Deck sinking stage and 4.6 metres of concrete form;
- 6 – 100 kW Flygt submersible pumps;
- 6 – 40 kW Flygt submersible pumps;
- 1 Grouting plant;
- Surface support of 2 Komatsu loaders and 1 Terex 25 tonne 4x6 truck.

Sinking at intervals of 3 metres

The sandstones are heavily water bearing at McArthur River and, accordingly, probe holes and grouting was required throughout the sandstones. Grout covers were drilled 55 metres to cover a 45 metres section of the shaft. Twelve covers were completed during the sinking to the basement. The covers were drilled utilizing the 2 boom jumbo also used for shaft sinking.

The sinking method employed was benching, utilizing a 2 boom jumbo mounted in the sinking stage to drill blastholes, 60 – 3.66 metre blastholes were drilled resulting in average bench advance of 3 metres. Cartridge, emulsion explosives and Magnadet detonators were used for blasting. Shaft mucking utilized 2 Herman boom type mucking units loading into 4 cubic metre buckets.

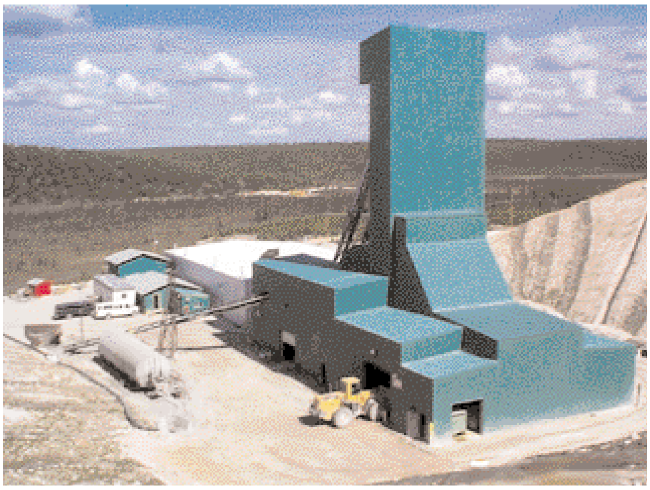
The excavation diameter was nominally 6.6 meters, allowing for a minimum wall thickness of 300 mm. The concrete lining was advanced in 4.6 metres lifts. This was done in a way that the liner was maintained at a maximum of 10 metres above the shaft bottom.

Sinking stage

Concrete was prepared in a MTM owned batch plant adjacent to the headframe and delivered underground via a 150 mm "slickline" pipe to the stage where it was distributed into the forms.

Complex water management

The contract required a pumping capability during sinking of 2,000 litres/ minute. This was achieved by the installation of pump tanks in the lining at 50 metre intervals. Initially a 40 kW submersible pump was used to pump a 50 metre head. From there onwards a 100 kW pump was used to pump the 100 m head. This process was repeated as the shaft was deepened. A 40 kW pump was used to pump from the stage to the wall tank and a 10 kW pump from the shaft bottom to the stage. At completion, the shaft water rate was 100 litres per minute. A total of 5 – 100 kW pumps were in service at shaft completion.



McArthur River ... ... Mine Project.

The crew

Shaft crews consisted of a five man mining crew supported by a deckman, hoistman, electrician and mechanic on each shift and a welder, dryman and batch plant operator on day shift. Management of the project was provided by a Project Superintendent and Shaft Captain. Administrative support was provided by the staff at the Shaft #1 Development Project. All workers worked a 12 hour shift per day on a 14 days on, 7 days off schedule.

Sinking progress

Sinking commenced on November 27, 1999 from 25 metres depth and was completed to 542 metre depth on August 17, 2000. During this period, some 101 days were expended on probing and grouting, 5 days were unavailable due to hoist breakdowns and 2 days were spent on station excavation at the 250 metre level. Sinking activities were carried out on 153.5 days for an average advance rate of 3.35 metres per day.
MTM underground mining crews broke through from the mine into Shaft #3 on January 25, 2001.

A total of 6,172 cubic metres of concrete was poured for an average wall thickness of 580 mm versus a design thickness of 300 mm.

Shaft landing at mine surface

On schedule and within budget

McArthur River Shaft #3 was completed ahead of schedule, safely and on budget. The methods, skills and techniques developed in the sinking of 3 shafts at McArthur River will ensure that MTM/TMCC will remain as one of the premiere shaft sinking contractors in North America.

Andy Fearn

Gold in Tanzania

In spite of the difficult climate and a number of infrastructural problems, excellent progress has been achieved in the development of the Bulyanhulu gold deposits in northern Tanzania, some 45 kilometres south of Lake Victoria – a project which commenced in September 1999.

Headgear with ore bunker

View of shaft site

As described in Report 2000, the mining project involved sinking a 1,090 metre-deep surface shaft, constructing 10 shaft landings and driving a 15-degree inclined drift to access the steeply-dipping ore body.

The gold deposits are owned by the Canadian mining company Barrick Gold Ltd., whose Tanzanian subsidiary Kahama Mining Corporation Ltd. is responsible for the construction and future operation of the mine.

Shaft sinking

After all the shaft-sinking equipment, namely the winding gear, shaft winder, service winches and sinking platform, had been assembled, installed and put into operation, and the permanent winder house constructed, the joint venture - which comprised the South African specialist mining company RUC Mining Contracting Company and Thyssen Schachtbau GmbH – began the shaft winding operation, with the first kibble being raised on 27th April 2000. The scale and technical design used for the sinking project was based on Tanzanian, Canadian and South African specifications and regulations.

First skipful of gold ore brought to the surface

The 6.4 metre-diametre shaft has now reached a depth of approximately 500 metres and the in-shaft hoisting fittings have been installed down to the 420 metre level. This meant that mid-shaft loading was able to commence in early April with the first skipful of ore being raised to the surface. After this date the mined ore will be brought to the surface through the sinking shaft via the 300 metre level (level 4,700) while the shaft sinking operation continues.

Inclined drivage

The roadheading operation to develop the ore body, which is being under-taken as a joint venture by RUC and Byrnecut, has made excellent progress since September 1999.

This work mainly comprises the heading of a 9,500 metre-long inclined drift, which has an average gradient of some 15°, as well as crosscuts, break-aways and level development.

The upper level development was accompanied by the excavation of some 2,000 metres of vertical shaft works between the levels, including ore passes, waste passes and ventilation boreholes, which were created using the raise-boring method.

Local infrastructure

The lack of any infrastructure in northern Tanzania poses a real challenge for the project engineers, particularly when it comes to supplying materials to the site. Most of the machinery, equipment and general construction materials have to be brought in by rail, road or air from South Africa.

Rail transport from South Africa takes between 2 and 3 months to reach the mine site. By comparison, trucks only need about 4 weeks to reach Bulyan-hulu from South Africa. However, due to the relatively poor road conditions, deliveries can only be brought in by truck during the dry season, that is to say from May to November. Essential supplies can be flown in, but this is very expensive at $4.5 per kilogramme of air freight.

The local site conditions meant that a careful and costly system had to be developed for materials planning and spare-parts warehousing. Plant and machinery have to be ordered, assembled and transported in several months before they are required. It was therefore essential for the mine site to operate an efficient provisioning system with a forward-looking reserve of spare parts and a well-stocked materials yard.

Shaft-sinking

The shaft strata, which are composed of andesitic, dioritic and basaltic formations with rock strengths of up to a maximum of 140 MPa, are excavated using conventional drilling and shot-firing methods. The sinking gear comprises an Atlas Copco quadruple-arm pneumatic-hydraulic boring machine capable of taking pulls of 3.70 metres. However, because of the local geology, the depth of advance has subsequently been reduced to about 3.0 metres.

Some of the relatively steep rock formations are intersected by fault zones filled with volcanic rock, which tend to break away in large lumps.

The sinking debris is loaded into a 4 cubic-metre kibble by cactus grab, and subsequently raised to the surface by the shaft winder.

Shaft lining

The concrete lining is installed almost simultaneously with the sinking operation under way on the floor of the shaft. The non-reinforced concrete lining, which has a minimum thickness of 23 cm, follows the sinking floor at a distance of between 15 and 20 metres. The concrete is prepared on site and transported to the shaft mouth by mobile mixing machine, where it is delivered down the fall-pipe to a baffle-plate mixing tub located on the upper deck of the sinking platform.The concrete is then pumped through hoses to its ultimate destination behind the shutter.

The concrete shutter comprises five individual rings with a total height of 5 metres.The bottom ring is fitted with a bunton box – a system normally

Shaft site with access road

Shaft-sinking personnel

employed in South African shaft sinking which allows the shaft buntons needed for the subsequent installation of the shaft guides etc. to be set in place at the same time as the permanent shaft lining is being fitted. Slotted boxes, which are bolted on to the face side of the top casing ring, allow the formwork to engage with the concrete. These boxes subsequently serve to accommodate the pipework brackets and cable holders.

Shaft landings

The landings are also excavated by conventional drilling and shotfiring in parallel with the shaft sinking operation, with the horizontal shotholes being drilled by hand using compressed-air hammer drills. An Eimco overhead shovel loader is also deployed as a back-up to the sinking grab.The floor and skip-pocket areas of the shaft landings are lined with reinforced concrete, while the roof and side-walls are finished with shotcrete.

Summary

The shaft sinking work and the construction of the ten shaft landings, together with the commissioning of the permanent shaft winder, is expected to be completed in June 2002. Given the adverse climate conditions and infrastructural problems, the project performance has been very satisfactory to date. Within seven months the project team – in addition to sinking the foreshaft – has successfully assembled, installed and commissioned all the site facilities, comprising containers, office units and sanitary installations, together with the permanent shaft equipment, including the hoisting winches, winder house and headgear structure.

These operations were mainly carried out during the rainy season, when it is not unusual for 76 mm of rain to fall in a single hour and cases of malaria occur more frequently; during the shaft sinking phase this meant that the foreshaft was completely flooded with rainwater on several occasions, as no drainage system was available. Malaria is not uncommon in the humid climate and working progress is influenced as a result.

For structural reasons part of the shaft-sinking team was recruited locally.

Foothills around Lake Victoria

Training programmes and daily safety instructions proved successful and no significant accidents have occurred during the sinking operation. Particular credit is due to the sinking crews, which comprise personnel from Tanzania, South Africa, Australia and Germany, for their excellent safety record and achievements to date.

Dipl.-Ing. Norbert Handke
Dipl.-Ing. Dietmar Schilling

Thyssen Mining – contract ore production mining at the Stillwater project Nye, Montana /USA

THYSSEN MINING

The Stillwater Complex PGM (Platinum Group Metals) – ore body extends over 26 miles and is open at depth. There is potential for over 100 years work at current mining.

Environmental concerns take high priority

The mine is located near Nye in the Beartooth Mountains 90 miles south-east of Billings, Montana. There is a 6,000 foot variance from valley at 5,000 feet to the mountain tops at over 11,000 feet . It has been mined since 1985. Each stope is accessed from above and below by levels driven at 300 feet interval vertically. Mining currently continues between the 6,900 foot and 3,200 foot levels, all are quoted from sea level. The mine is adjacent to the Yellowstone National Park, Red Lodge Ski area and the Custer National Forest. Environmental concerns are a high priority and Thyssen Mining actively complies with all local and federal requirements. The pristine Stillwater River, containing 4 types of trout, flows between the east and west sides of the mine. Black bears, deer and Bighorn sheep are common visitors to the mine site. Thyssen Mining occupies the historic and picturesque Beartooth Dude ranch as its man camp.

This report covers the introduction to production mining at the Stillwater mine and the effects of location, mining methods, physical results and client relationships are discussed.

This report is written by Andrew Saltis, Project Manager for the Stillwater – Nye Project. Mr. Saltis has been with Thyssen Mining Construction of Canada Ltd. ("Thyssen Mining") since 1995 and has been involved with the McArthur River and Cluff Lake uranium development and production mining projects in northern Saskatchewan, the Jericho Kimberlite bulk sample project in the North West Territories and is now on his second stint as the project manager at the Stillwater project in Montana. Thyssen Mining was the first mining contractor to be invited back to the Stillwater Mine in Stillwater Mining Company's ("SMC") history after the successful first project which occurred in 1998.

The contractor in production mining

The current project started life as a 10,220 foot development project beginning in September 1999, soon afterward another 5,000 feet was added in the western area of the mine. During the initial period, Thyssen Mining was asked by SMC to carry out a small amount of secondary development in order for SMC to access ore; however, after a brief cost exercise, Thyssen Mining declined to give a price as the cost to SMC would prove too prohibitive. This factor, combined with the facts that Thyssen Mining site management already had contract production mining experience and that the rising price of PGM market, brought about SMC's subsequent request to Thyssen Mining to provide a price for expanding the original project by mobilizing a production mining operation at the Nye site. Thyssen Mining's bid was successful and production mining began in February 2000.

Contract Details

The initial premise was that Thyssen Mining were to take over and mine 5 stopes already in production on the east side of the mine.
SMC personnel from those stopes would then be released to work in other stopes on the west side of the mine. The stope locations were selected for their proximity to drifts already being developed by Thyssen Mining. The stopes selected effectively required Thyssen Mining to take over full operations on the east side of the Stillwater mine and would be virtually a stand alone operation in terms of supplies, maintenance, ventilation and interaction with SMC personnel. This would ease any administration and supervision difficulties.

"Contract on trial"

The east side stopes are also different from the west side in terms of geology and physical conditions. The ore is typically more disturbed, offset with numerous faults and in softer ground conditions. Due to the very difficult geological conditions SMC was initially concerned with a contractor taking over this scenario as there was no previous history or experience of subcontract production mining for them to draw upon. Consequently, the initial contract was for only 3 months work which would minimize the risk and exposure for both parties. The contract stated that there was potential for up to 500 - 650 tons per day hauled and that road grading and stope preparation must be included. SMC would continue to provide materials to underground lay downs using the successful Normet system and would provide underground liaison personnel, geologists and engineers to enable SMC's overall mine plan to be implemented.

The camp is growing

Total manpower for this project was estimated at 48 which effectively doubled the number of Thyssen Mining personnel at the project. To accommodate this, the Beartooth man camp, that Thyssen Mining was already operating some 2 miles from the mine, had to be expanded. Extra rooms were opened up and sleeper trailers were mobilized. The man camp has a sewage limit of 90 persons, therefore this theoretically held a cap on the number of persons in the project. As time progressed, a number of personnel found accommodation in the local community and effectively a sufficient number of personnel was able to be employed as the project increased.
The increase came about in April 2000 when SMC requested Thyssen Mining begin stoping in the west side of the mine, too. The area coincided with Thyssen Mining's other development activities on the west side and appeared to be a natural fit. Taking over the stoping also increased the haulage activity, therefore Thyssen Mining also took over the rail materials and ore/waste removal operations. The total number of employees on site reached 140 and included a newly formed construction crew. The subcontract for diamond drilling was expanded at the same time with three rigs working continuously to keep up with the drifting progress of the Thyssen Mining development crews.

Photograph of the East Side Surface – the east side portal in the bottom left of the picture

The contractual changes in detail

During the operation of the first contract, SMC and Thyssen Mining became aware of some of the shortcomings of the details in the original proposal. The previous contract prices were built with minimal historical evidence and with higher risk factors. A revision of and an extension to the original contract became necessary. The new contract would amend some administration and invoicing methodologies and also utilize the costing information gleaned in the initial contract. The new contract was approved for September 2000 and was in effect until the end of December 2000. Costs for SMC fell as production increased and reduced prices were implemented.

During the operation of this second contract, it became apparent that Thyssen Mining had gained the expertise to be very proficient at this type of mining with good mining methods, cost control and safety results. In November 2000, Thyssen Mining requested from SMC that it be allowed to submit a new contract to cover 6 months of production mining in 2001 between January and June. SMC was very receptive to this bid and instructed Thyssen Mining to prepare a new proposal. The new bid retained the factors of the old proposal but streamlined the administration and invoicing process further.

Flexibility – major asset for the client

SMC accepted the third proposal and production mining continued. A three-month proposal had thus developed into seventeen months of contracted work. However, during February 2001, the mine had accumulated a 20,000 ton stockpile, stope productivity levels were at an all time high and SMC's recruitment efforts led to the request that Thyssen Mining demobilize the stoping crews. The demobilization effectively allowed SMC to reduce overall monthly costs and stockpile levels. Client trust and reliance increased, and Thyssen Mining has also gained a reputation for quality production mining in the US. With the ability to mobilize and demobilize quickly and effectively in response to client request, Thyssen Mining has shown that the use of a contractor in production mining is trouble free and a viable alternative for short term projects.

With Thyssen Mining's history of over 18 years of continuous production mining at Cluff Lake in Saskatchewan, it has also shown that long term relationships are possible too.

Production mining – geology

In exploration, diamond drill holes are drilled on 50 foot centers in a square grid pattern from each level. Thyssen Mining initially employed its own rigs and crews at Nye but moved to using a diamond-drilling subcontractor (N. Morissette Ltd.) with LM37's and a Diamec 262 to drill holes up to 650 feet long. SMC engineers carried out the planning and geology assessment of the holes. The holes were drilled at BQTK (59.9 mm hole diameter, thin wall) and initially used the KS++/4 bit for very hard rock which provided drill penetration rates acceptable to Thyssen Mining in these ground conditions.

Difficult geological conditions on the east side

The rock types were magmatic in origin being Gabbros, Dunites, Norites and Olivine, with pre-mineral dykes intruding and pegmatoidal occurrences in most units. The geology on the east side of the mine is greatly affected by the reef changing its inclination and also by numerous offset faults. Hanging wall rock can be very competent to very poor. Ore grades on the east side can generally vary from 0.3 ounce per ton to over 2 ounces per ton. Some production faces, backstopes and slashes have been estimated well over that amount. Ore can appear as visible sulphides similar to iron pyrites and also can be finely disseminated and not visible. In either case, the grade can be similar. The ore pinches and swells generally with a vertical continuity. Typically, a stope can be mined between levels at the same Easting between levels.

The west side reef is generally less affected by faults over short distances but can be overturned or more flat laying than the east side. Generally, the west side reef and footwall is more competent than the east side.

Production mining – in two basic styles

Each stope is generally operated on a two shifts per day basis with one miner and one "bull gang" member as a two-man crew. The two-man crew would drill, blast, muck and supply themselves from the entrance of the stope to the face. A production supervisor and a "nipper", i.e. an underground helper nipping material, would organize the day's duties and ensure their supply point was fully stocked. A superintendent would liaise with the client and the workforce to ensure immediate and longer-term objectives were met. This format proved so successful at the Nye site that SMC staff often spoke about Thyssen Mining as "the problem solvers" rather than problem producers.

Thyssen Mining operates up to seven stopes at any one time. Each stope is capable of producing between 20 and 200 tons per day depending on its mining methodology. Stopes at the Nye site generally consist of overhand cut and fill in two basic styles:

The first is LHD (load-haul-dump) cut and fill where access to the ore is provided by secondary ramp development off the footwall and where the reef is thick enough.

The second is a footwall access to a raise-bored hole which is bored close to the reef package. These are called captive slusher stopes or "can" stopes. They are designed whenever the reef is not wide enough for the LHD cut and fill method to be employed.

Photograph of backstopes

The access to these stopes generally is by ladder from the top, the initial cut is made from the ladder to the lowest level. The cut is opened up and a slusher installed which removes the muck via a cribbed chute to the material removal point on the next lower level. From that point onwards, the method is similar to the LHD cut and fill. After the stopes are worked out, the cavities are packed with a dirt and sand infill to serve as the floor for the next bench which is taken 10 ft higher.

Production and blasting operation

Mucking equipment includes 1.25 yard, 2 yard and 3.5 yard LHD's. Thyssen Mining maintains its own equipment fleet with supplemental rental equipment. The majority of the Thyssen Mining fleet has been in use since the original project in 1998 and has been maintained to excellent standards. Some modifications to equipment has been designed on site to improve equipment availability such as the hose bulkhead system on the drill jumbo's.

Trucking is carried out by 13 and 15 ton trucks. Some material is taken directly to the shaft via the level accesses while waste is alternatively taken to the surface portal and dumped. Great care is taken to mark ore and waste piles in stope access muck bays as dilution is finely tracked. Each area is assessed in compliance with marked piles as is each stope on dilution from agreed mining widths. Upon contact with the ore, the bottom cut is made and the ore is mined out at minimum width to the full extent of the defined area at one elevation. The walls of the stope are examined for ore content and slashed as required to ensure the full potential is realized.

Slusher stopes are designed where reef widths are under the minimum width of a 1.5 yard scoop. Stope widths can be as narrow as 3 feet where support can be given by installing wooden stulls and backboards. Material supply to these stopes is provided by small skip like devices which slide on the man way ladders for guides. Ore and waste passes down a "cribbed chute" to the material removal point on the next level below. Small grizzlies are installed on the top of these cribs to prevent any chute blockages. Scrap in ore and waste is critical, therefore it is removed as soon as the material is dumped in the stope muck bay or in the stope itself when slashing takes place.

Equipment for drilling generally is SECAN jacklegs with occasional use of a twin boom air jumbo where ground conditions and drift size permits. Cross head bits and 7/8" hex steel are the norm for jacklegs. A jackleg test bed has been designed and built by Thyssen Mining site mechanical staff which can test 42 separate functions in a leg or machine. All testing is done underground on site and replacement of parts is done purely on a reduced performance basis. The same staff also designed a jumbo boom modification which has greatly reduced hose change downtime.

West side stopes are developed as top and bottom sill cuts in preparation for sub level caving or as ramp and fill stopes. Selective blasting (split blasting) is practiced to minimize dilution and to enable larger equipment to access the stope at a later date (split blast diagram). Typical stope round dimensions are 6 – 10 feet wide, 10 feet high and 6 feet deep. This minimizes dilution in the width and ensures a jackleg can drill the height and reduces directional errors when the reef changes its azimuth. A geologist assesses each round before the next round is taken unless it is a known that the stope is on the edge of a waste gap zone.

Ground Support

Ground support is installed on a systematic basis according to 5 basic bolt densities or "support types".
Each support type increases bolting densities, however it is not just parameters such as bolts per square foot which vary but also bolt types (split sets/ dywidags / cable bolts), additional measures (mats/ mesh/ shotcrete/ spiling) and drift opening type (drift or junction).

The typical bolt types in stopes were type 2 and type 3. Occasionally the ground conditions would require higher types (typically in areas of higher grade ore or higher olivine content). Cable bolts vary between 20 and 50 feet in length depending on ground conditions and the operational plan above the current cut or level. They are cement filled with one tube and the bottom is stuffed to prevent cement fallout. They can be plated and tensioned or left unplated.

Mesh for ground cover comes as chain link rolls 5 feet x 20 feet or as 4 feet x 8 feet expanded metal panels. The panels are sandblasted to remove sharp edges. Mats are typically either 9 feet or 4 feet in length to accommodate the bolts.

When the face becomes a ballroom

Bolt patterns typically are centered around a 3 foot x 3 foot pattern or variation thereof. Bolting is always to within 3 feet of the face with walls being bolted from the back. The system works well but is dependent on supervision diligence to ensure if any increase in density is immediately installed as variations are common from round to round.

A 10 foot high face is typical on subsequent cuts as, after the first, the undercut "brow" is utilized to reduce drilling requirements. The subsequent cuts are usually offset due to dip of the reef. The "ballroom" areas in stopes are common as ore widths can vary from 2 feet to over 30 feet. Cable bolting is required after 20 feet. Ballrooms are opened by an initial drift running through the ore zone. Then, from diamond drill hole assessments and geology site visits, the size and depth of any subsequent slashing is ordered to ensure full extraction.

Rarely is ore left unextracted. This occurs when the ground conditions would put the continuation of the stope at risk. Each stope was assessed

Stope access

weekly on its ground type with each wall and the back being assigned its own bolt density requirement. A weekly planning meeting sets out the goal for the next week and also provides a forum for ideas on how to tackle the issues that the ground conditions impose. A second weekly meeting is carried out with the contract administration group to ensure information and issues are dealt with efficiently and are not mixed with operational planning matters.

Positive safety results

In terms of safety statistics, the Nye site has twice reached 100,000 hours with no lost time accidents and, at the time of writing, has reached 6 months (over 160,000 hours) with no lost time accident. Two full time safety co-ordinators are on site at any one time and, combined with safety meetings and individual safety team representatives, ensure full communications flow. The Thyssen Safety Management Plan was implemented during this project. It has been a valuable contribution to the improved safety awareness on site.

Production targets continuously surpassed

Stoping tonnages were consistent and impressive. Every monthly target was met and surpassed quite substantially on occasion sometimes by as much as 45%. Monthly output included all tons agreed by geologists. These tonnages varied between 9,000 and 11,000 tons depending upon the number of each type of stope and the production phase that each stope was encountering during that month. Twice, a Thyssen Mining stope was the number one ounce producer for the month for the whole mine. This stope was a conventional cut and fill "ballroom" stope and competed against the sub-level cave "super stopes".

Thyssen Mining has, since the beginning of the production project, maintained dilution figures less than half that of the best dilution figure for an SMC operated stope. Typical worst case dilution was 9 % with many instances of 0 %. This translates immediately into cheaper tons and improves the ability to manage ground control measures. Dilution is based on equipment usage, ore widths and mining method. Dilution in some cases can be "good dilution". This leads to cases where the maximum allowed width because of equipment constraints is diluted by ore which is outside of the allowed mining method width.

Liaison and relations with SMC was excellent with Thyssen Mining input being valued for its timeliness and quality. Thyssen Mining mined in 25 different stopes on 7 levels and, at the time of writing, had extracted 116,000 tons from these stopes in the course of 12 months.

Andrew Saltis

Jumbo Hose Bulkheads

New concert hall is a masterpiece of acoustics:

Hewn from crystal salt 700 metres below ground level

EBBG (Mining Experience Operating Company), which is a subsidiary of Glückauf Sondershausen Entwicklungs- und Sicherungsgesellschaft (GSES), was set up to market Sondershausen colliery as a tourist venue, including the notorious 'crystal tour' and other attractions such as mountain-bike runs and underground wedding ceremonies.

Excavation of the roof profile with 'acoustic terracing'

Excavation of the second and third slice (after completion of roof profile)

In May 2000 the consortium formed by Thyssen Schachtbau GmbH and TS-Bau Proterra was awarded the contract for the underground excavation of a concert hall big enough to accommodate an audience of 300. The new hall would create a new tourist attraction and at the same time enhance the national and international reputation of Sondershausen as a musical venue.

The project which subsequently unfolded some 700 metres beneath the town can be described without exaggeration as unique. One entry in the Guinness Book of Records followed another. Even the new concert hall itself is expected to be a record breaker. Visitors to the various events taking place in the hall will swell the existing number of enthusiastic visitors, who include mountain-bike fans, crystal-tour trippers and wedding guests.

Ideal geological conditions

Rock mechanics experts were satisfied with the plan to excavate such a large chamber in stable rock-salt strata; however they did recommend a non-aggressive cutting action for the roof and side-wall contours. From the Mining Inspectorate point of view, the main focus of attention was directed at the roof arch profile – a key area where safety and stability were paramount.

One of the main challenges facing the planning engineers was to create a high-quality acoustic chamber. The model-based geometric calculations carried out before the project began called not only for an arched profile but also for a special 'terracing' of the roof in order to enhance the acoustic effect. The hall was to measure 26 metres long by 18 metres wide by 10 metres in height.

In addition to the concert hall itself, other chambers were to be excavated to accommodate a foyer, cloakrooms, dining area and washrooms, together with an adjacent bowling alley.

Know-how for the acoustic terracing

The project partners opted for an AM 50 roadheader for the chamber excavation phase and ripping work, as it was considered that this machine had a non-aggressive cutting action which would comply well with the safety requirements and acoustic specifications.
In order to achieve the total chamber elevation of 10 metres, the main cavity was excavated in three horizontal slices of 3.0 to 3.5 metres in height.

Concert hall after excavation, with electricians engaged in installing the electrical installations

The creation of the arch-profile roof, with its terraced contours, proved to be a particularly complicated operation. Working in close collaboration with Glückauf Vermessung Sondershausen excavation patterns were devised for each of the 'acoustic steps', and these were then cut out by the machine using a spot and zonal laser system with continuous monitoring. Much outlay was also devoted to the change-over operations required at the conveyor and cutting head for the complex cross-cutting action which had to be performed in order to produce the terracing effect. After completion of the top slice the acoustics technician attached to the heading team was able to verify that an

Concert hall after excavation, with workmen engaged in laying the wood flooring

excellent result had been achieved. No problems were encountered during the subsequent excavation of the two lower slices, which were completed on time and to a high standard. The construction of the side-walls, with their precise angle of 4 degrees, called for a particularly high level of workmanship (Figures 3 and 4).

After undergoing a successful final inspection, the chamber was handed over to the client on 2nd January 2001.

Formal opening scheduled for May 2001

Once the engineering and fitting work has been completed, including laying floors, constructing the stage and walkways, fitting out the cloakrooms, laying cables and lighting circuits, and installing the stage equipment, the concert hall is to be formally opened in May 2001.

The construction of the new underground attraction meant excavating some 6,000 cubic metres of material from virgin drivages and trimming operations. The project was jointly funded by the Federal Land of Thuringia, the GSES and the town of Sondershausen.

Dipl.-Ing. Hans-Joachim Aland

Local bypass for the B 169 trunk road

The B 169 trunk road, which connects the areas of Cottbus and Chemnitz, links the Riesa-Seerhausen-Hof region to the A 13 in the north-east and the A 14 and A 4 in the south-west.

The Elbe bridge, which forms part of the B 169 in the Riesa conurbation, is a vital transport link in that the nearest river crossing points at Meissen and Torgau are 20 and 40 kilometres away respectively. On the left bank of the Elbe, where it flows through Riesa, is the B 169/B 182 intersection, while to the south-west there is a link-up with the B 6. In view of the very high volume of traffic using these junctions, which have never been upgraded, the route through Riesa had become something of a bottleneck and the need for a traffic-relief road was recognized as a priority within the context of the German Federal Traffic Management Plan. The Meissen Highways Department, who were responsible for issuing the contract for the road improvement scheme, opted to divide the project up into seven individual sections.

Bridges for pedestrians and cyclists over the B 169

Demolition of existing bridges on Breitscheidtstrasse

Project commencement

The bypass construction project commenced in September 1999, and was completed on 15 December 2000 with TS Bau (formerly Pape Bau-Union) being responsible for all the main contractual work required. The preparatory work involved demolishing a bridge, using explosives, knocking down a shoe factory and former petrol station and carrying out extensive site clearance operations, which required the removal of some 100,000 cubic metres of soil, the laying of 5,000 metres of drainage pipes (some to a depth of 8 metres) and the construction of a rainwater spill-over

Soundproof panel walls

Road-traffic bridge

tank alongside the river Elbe. Existing telephone, gas and water services, together with medium-voltage and high-voltage cables and street lighting circuits, were relayed or replaced as part of the road construction work.

Three soundproof barriers some 250 metres in length were constructed along the route of the new road in order to reduce the traffic noise level for the benefit of the urban residents.

Two road-traffic bridges and two additional crossings for cyclists and pedestrians, as well as retaining walls for the 7 metre-high access ramps, were constructed within a very short space of time. 3.5 km of the new carriageway was built with four-lanes.

Due to the very high traffic density, especially in the morning and evening rush-hours, the inconvenience caused by the traffic re-routing arrangements for the Bahnhofstrasse and Berliner Strasse junctions, and around the city-centre ring-road, called for a great deal of patience and understanding from commuters.

The redevelopment of the underpass for the old Elbe bridge, the construction of the new underpass and the link-up with the B 182 and B 169 are all to be finished by the project completion date of 30 June 2001. The new four-lane Elbe bridge crossing at Riesa, which is still under construction, will also be ready for traffic by this date.

Dipl.-Ing. Heike Stohr

Earth-moving operations for bridge construction work

DIG uses diverted daylight to brighten up Deutsche Bahn’s control centre in Munich

For thousands of years architects and planners working on building projects have endeavoured to use the natural laws of physics, such as light, sound, heat and cold, to put into practice the wishes of their clients.

The classical amphitheatres, for example, were masterpieces of acoustic design and these structures are in fact still used today for all kinds of events. Then there are the pyramids of Egypt, whose ability to maintain a balance between heat, cold and humidity allows them to preserve human and animal bodies, and even foodstuffs, for incredibly long periods of time.

The Deutsche Bahn construction project for the railway operations centre in Munich has also managed to extract maximum benefit from the new building. Here the installation of a “daylight deflector ceiling” meant that important requirements were met at the same time:

- ❑ the deflection of daylight,
- ❑ the absorption of ambient sound

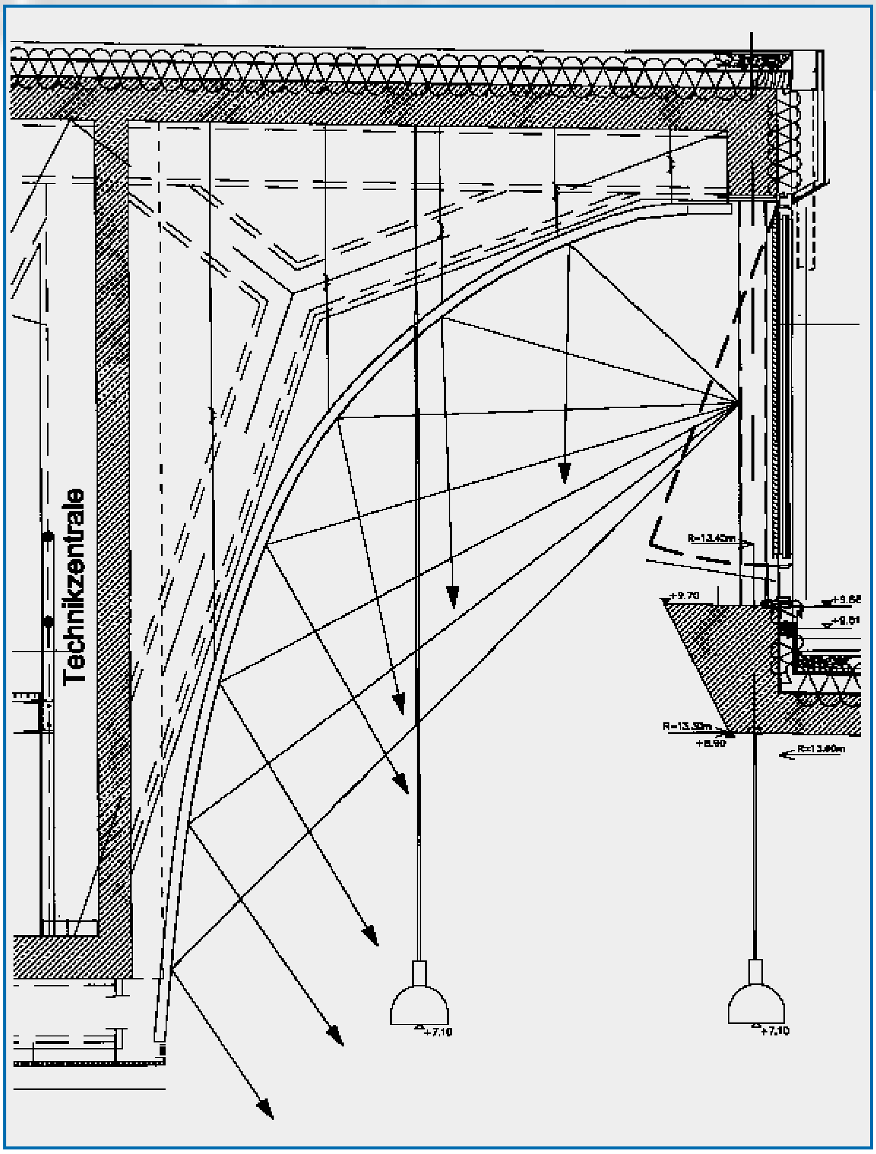
The operations centre – with 140 operators providing a 24-hour service – is responsible for controlling and monitoring all train movements in the Bavaria region. The three-storey building is circular in shape and its architecture and technical design posed complex problems for the planning and installation of a daylight deflector ceiling.

Let us now examine the project’s three basic requirements:

1,200 surface plates for the rotational hyperboloids

The core of the operations centre is a circular room with a radius of 9 metres

Figure 1: Sectional view of daylight deflector ceiling



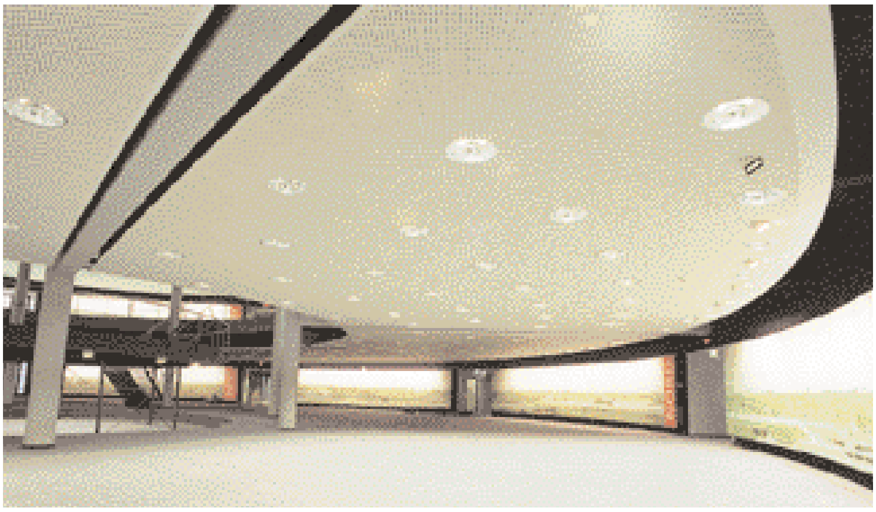


Figure 2: Perforated plasterboard panelling, sound absorption chambers with fabric covering

which houses all the technical equipment. This concrete structure was to be provided with a visually appealing internal lining. Figure 1 (left) shows the concrete wall and behind that the operational equipment. The lining system (daylight deflector ceiling) fitted in front of the wall, here depicted in section as a double line, is designed as a half rotational hyperboloid. The three-dimensional form of this lining posed a very interesting mathematical problem when it came to working out the dimensions of the inner-lining plates, and much computer time and expense was devoted to finding an appropriate solution. With the deflector ceiling designed as a complete circle with openings, the planners had to produce calculations for approximately 1,200 surface plates comprising some 150 different individual shapes.

Light deflection

To meet the functional requirements of an operations center for 140 employees comprising workplaces for up to 8 monitors the glass surfaces were kept to a minimum, with the result that only a moderate amount of daylight reached the lower rooms.

This drawback was compensated for by the geometrical layout of the lining, which used a concentrated light source to cast a fairly uniform spread of light over as wide an area as possible – rather like a car headlight. This principle is demonstrated by the light-deflection diagram shown in Figure 1. The surface plates were made from a specially-treated and structured anodized aluminium material so as to achieve a diffuse and dazzle-free light coverage without any loss in luminosity.

Sound absorption

Hard surfaces such as concrete, metal and glass are poor absorbers of sound, with the result that the building suffered not only from the undesirable hall effect but also from a high level of background noise.

In order to improve this situation the individual lining plates were provided with perforations 2 mm in diameter and set about 4 mm apart. This created a free-space surface area of approximately 20 %. An acoustic fleece material was also bonded onto the plates to provide frictional resistance to the penetrating sound waves and thereby absorb the acoustic energy.

The light deflector linings were supplemented by separate sound absorption chambers – in simple terms open shelf units inlaid with sound absorbing material – which were fitted around the walls of the room.

As the final touch – the fabric surrounding the acoustic chambers depicted local views of the Munich landscape in accordance with their location on the map – thereby giving the impression of a large area of glass.

It has to be said that complex assembly projects of this type can only be put into practice with real teamwork between the parties, namely the client, tenant and architect, on one hand, and the manufacturers and contractors, on the other.

The project once again gave DIG (Deutsche Innenbau GmbH) the opportunity to display its skills and competence as a specialist contractor for interior construction and design.

We hope that the brighter surroundings in Deutsche Bahn's operations centre will help lighting the way for all its trains to arrive safely at their destination.

Dipl.-Ing. Jörg Stieren

Project partners

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Architect/General planner:
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Underwriter:
ARGE Investa/Tercon

Contractor:
STRABAG Hoch unf Ingenieurbau
Munich branch

Light deflector ceiling supplied by:
Durlum Leuchten GmbH
An der Wiese 5
79650 Schopfheim

Figure 3: View of daylight deflector ceiling

Travelling crane is "shipped out"

It's all change at Duisburg-Schwelgern docks

Travelling cranes go walk-about

Old cranes get new home

Plans by Carbonaria GmbH for the construction of a new coking plant on the western bank of the Schwelgern dock facility meant moving two of the existing overhead travelling cranes, which were destined for new roles as freight handling installations. The new sites chosen for the cranes were on the north bank of the Schwelgern docks and at the Walsum dockyard, both of which could be accessed by water.

Transfer ramp at Walsum south dockyard

Gigantic scale

The bridge cranes are both massive structures, as shown by the following description of crane installation IV:

This steel giant, which was constructed in 1981, weighs in at 722 tonnes and measures 123 metres in length. The trolley track stands an impressive 17 metres in height.

The logistical problems associated with moving an object of this size therefore called for very careful planning.

Transfer plan

The cranes were to be moved to their new locations using a pontoon. Very precise static calculations had to be undertaken in order to ensure that the height level remained constant when transferring the installations from solid land to the specially adapted floating platform. The design alterations made to the pontoon, combined with the use of trained personnel for the water-tank pumping operations needed to maintain ballast equalization, were absolutely vital to the success of the project. Any uncontrolled settling of the pontoon would have caused sudden tilting of the payload and resulted in the failure of the operation.

A job well done

TS Bau (formerly Pape Bau-Union) began preparing for the transfer operation as early as April 2000, so as to be ready to move the cranes during late August and early September.

The first stage of the project was carried out at the cranes new location sites, where the rail-tracks, substructure and current collector ducts had to be

Crane shifting system

Constructing the transfer ramps

re-built. In all some 1,230 metres of crane tracks and 610 metres of trolley-wire ducts were assembled and installed.
Work also had to be done at the original crane sites, where a similar quantity of tracks had to be dismantled and, in some cases, disposed of.

The transfer ramps required for the move also had to be built up using some 5,000 cubic metres of earth, which had to be carefully compacted to cope with the surface pressure which would be exerted by the cranes.

Original emplacement on west bank

The transfer operation itself was undertaken by a firm of specialists. During the move the TS Bau measurement and surveying department carefully monitored the degree of settlement so as to be able to give an early warning of tilting. The care taken during this stage of the operation meant that substructure changes were kept to a maximum of 15 mm – which was easily dealt with by the project engineers.

Both bridge cranes are now performing to the complete satisfaction of

New tracks for overhead travelling crane

Formation work

their new operators – Eisenbahn und Häfen AG.

Josef Kremer
Dipl.-Ing. Andreas Pabst

Travelling cranes on tour

Plauen town centre gets face-lift

The autonomous township of Plauen, famed for its tradition of lace-making, lies on the banks of the Elster river at the heart of the Vogt region in the south-west of the Free State of Saxony.

Local transport services for the town's 71,000 inhabitants are provided by Plauen's municipal tramcar company. As part of a town-centre rebuilding project, work is now under way on the complete renovation of the central tram station, which is used daily by up to 20,000 passengers, together with the surrounding area. The operation began with the rebuilding of the "Stadtgalerie" shopping centre, a project which was funded by private investment.

Plauen's new central tram station is constructed without interruption to regular transport services

New tramcar tracks in the centre of Plauen

A contract with a difference

After the relaying and repositioning of the underground pipes and cables, TS Bau was awarded the contract to establish temporary track facilities which would allow the normal tram transport service to be maintained during the renovation work. From the public tenders which followed, the company was able to acquire orders worth a total of DM 15 million for five individual projects as part of the "Infrastructure measures for Plauen town centre". This included contracts for the renovation of the open-space areas, using high-quality natural stone paving, the relaying of some 2,500 metres of track and the construction of covered station areas, including a service building. The work also comprised the installation of a 1500 mm drainwater collector and the reconstruction of the road leading to the town centre via Hammerstrasse and Syrastrasse. The advantage of these inner-city construction projects was that they combined a number of specialist skills, namely road-building, civil engineering and rail-track laying.

New town centre to be unveiled in August 2001

Working to a tight schedule the operation commenced in July 2000 with the

Installation of balustrade walkway

Station zone with semi-finished roof structure

removal of the existing service facilities. Despite the best efforts of staff from the Federal Office of Archeology, the underground excavations produced no new insights into the town's history.
As it was necessary to keep interruptions to the tram services to a minimum, some 300 metres of twin-track had to be completely re-laid during October and November using a multiple-shift system which included week-end work. Once the new rail layout is completed, the track structure can be replaced during March 2001 and the road-building work can then commence.
The use of an innovative and advanced performance control system has meant that the construction project has been a pilot scheme in some respects. By means of a detailed "project-structure-plan" based on the SAP R/3 system the effective costs are assigned very precisely to the individual performance sectors, so that by recording performance data via the KALWIN calculation software the actual costs can be compared with calculated costs using a dedicated interface system. This means that discrepancies can be corrected at an early stage and conclusions drawn for the purpose of subsequent calculations.
The newly refurbished town centre is to be handed over to the client on 10th August 2001. Until then all those involved in the project will be working flat out to ensure that this ambitious inner-city scheme is completed on schedule and with a positive operating result.

Dipl.-Ing. Roland Stelzig
Dipl.-Ing. Jörg Romankiewicz

Working space is confined by ongoing tramcar services

New Company Joins TS Group:

ÖSTU STETTIN®
TUNNELBAU GMBH

Mülheim an der Ruhr

As part of the on-going reorganization of the Thyssen Schachtbau Group all tunneling activities in Germany have now been brought together under Östu-Stettin Tunnelbau GmbH. After a change of name from the former Östu Tunnelbau GmbH, the new company is now actively entering the German market as an affiliate of Austrian-based Östu-Stettin Hoch- und Tiefbau GmbH.

The German arm of Östu-Stettin Hoch- und Tiefbau GmbH (Leoben) has seen its new business get off to a promising start with an initial workforce of some 30 employees currently involved in the construction of the new Cologne-Frankfurt intercity express line, which is due to be completed in 2001.

The company's core business is based on techniques for the conventional construction, consolidation and support of underground cavities in a variety of cross-sections and using various different excavation methods.

- TUNNELLING
SHAFT SINKING –
MINING –
UNDERGROUND
RAILWAY –
SPECIALIZED CIVIL
UNDERGROUND
ENGINEERING

all feature in the company's wide range of activities.

The company's shaft-sinking activities are restricted to conventional projects carried out at shallow to medium depths (approx. 100 metres), and the mining sector excludes all coal-related operations, in order to respect the demarcation line between the activities of Östu-Stettin Tunnelbau GmbH and those of other companies in the Thyssen Schachtbau Group.

"The team possesses a combination of experience and youthful dynamism. Backed up by the Leoben-based parent company, the new enterprise is expected to perform well even in the fiercely-competitive German construction market."

Dr.-Ing. Helmut Ligárt

Emergency exit shafts are fitted with inner linings

In Report 2000 Leoben-based Östu-Stettin presented a report on the successful sinking of emergency exit shafts along the Cologne-Rhein/Main intercity express line. Östu-Stettin Tunnelbau GmbH has now been awarded its first contract for the installation of the inner lining in three of the Schulwald-tunnel shafts, which are between 27 and 42 metres in depth and have an internal diameter of 8 metres.

Project scope

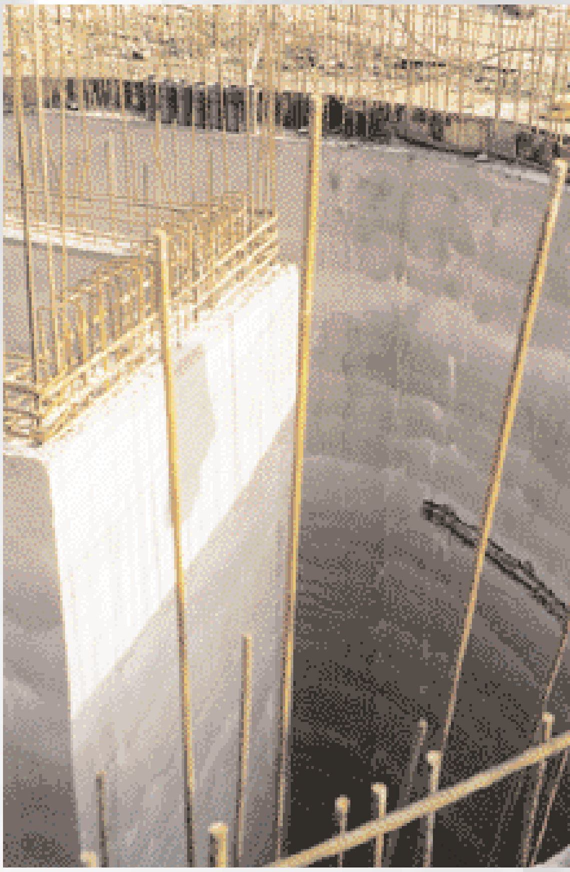
The shaft sinking work and the installation of the shotcrete lining were completed by Östu-Stettin Hoch- und Tiefbau GmbH in October 1999. After the ATAC (consortium responsible for tunnel sections A and C) had excavated the connecting adits from the main tunnel and completed the construction of the steel-concrete supporting arch and shaft floor, a specialist sub-contractor was called in to install the sealing elements, which comprised welded plastic packing strips with radial jointing rings.
The main services to be provided by Östu-Stettin Tunnelbau were as follows:

- installation of a pressure-tight steel-concrete inner lining to link up with the connecting adit to the tunnel
- installation of a rectangular, centrally-positioned lift-shaft from the bottom of the emergency shaft up to ground level
- construction of staggered landings and stairway
- supply and fitting of prefabricated stairway sections, and
- erection of a shaft-top building

Construction procedures

In close collaboration with the project consortium it was decided to construct the steel-concrete inner lining

Concrete being delivered to emergency shaft NA5 during sliding phase



After completion of the sliding concrete operation the lift-shaft stands on its own in the emergency exit shaft (in this case shaft NA2). The connecting reinforcement for one of the landings can be seen to the right

using a single-face sliding form as a cast-in-situ concrete body. The lift-shaft was then also to be cast in situ seamlessly using a double-face sliding form system. This meant that the two sliding forms would have to be dismantled on reaching the shaft surface, in order to be able to construct the upper section of the lift-shaft which projected about 4 metres above ground level.
The landings in the area of the connecting steel reinforcement, which has already been laid in sliding concrete, are constructed from the bottom upwards in a subsequent concreting phase using conventional floor slab

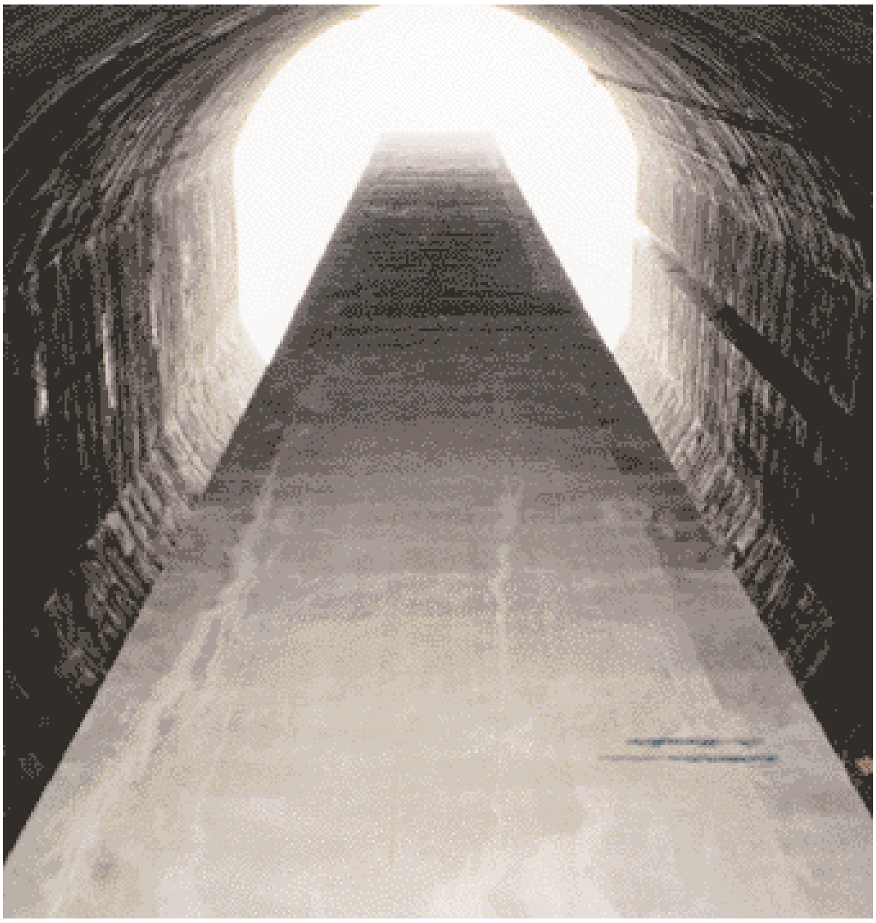
Emergency exit shaft NA4 after installation of landings, viewed from shaft bottom; the pre-fabricated stairway sections are lowered in through the surface opening in order to allow the landings to be connected together

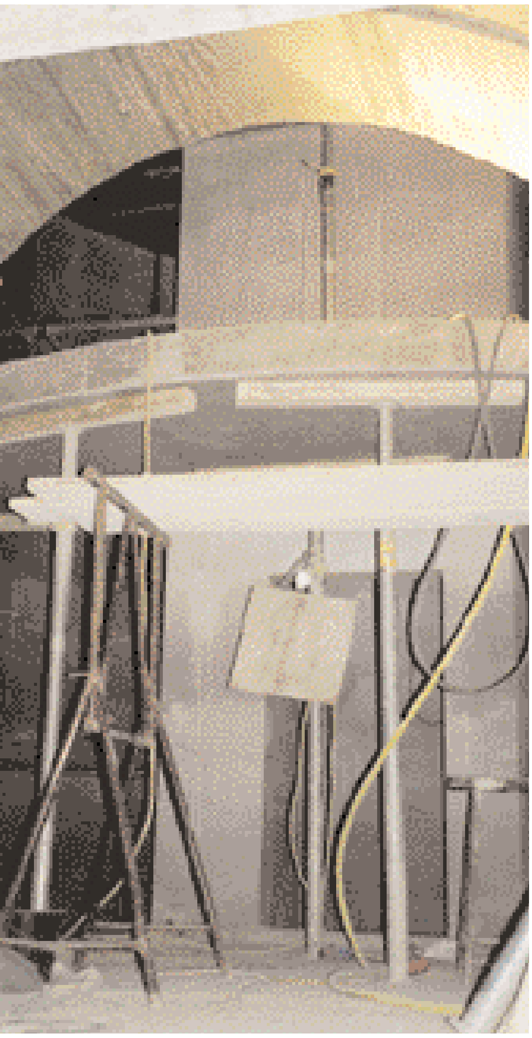
forms, which then act as abutments for the stairway sections which are brought in as pre-cast concrete units.
A site crane is used to raise the sections into their final position on elastomer bearings reinforced with steel inserts, prior to the installation of the shaft-top building, which has been designed as a steel-concrete structure.
Special attention has been paid to the planning and organisation of the sliding phases. Once the concreting operation has begun, the concrete has to be placed wet-for-wet in a constant and continuous flow so as to produce a monolothic shell. Any unscheduled cessation of the concreting operation will therefore prove extremely problematic, as it will always impair the quality of the finished product and result in a substantial increase in costs due to the need for an unbudgeted monolithic joint to be inserted. The sliding phases at all three construction sites were completed as planned and without any interruptions.

Operating equipment

The in-shaft operations were assisted by a site crane located at the shaft top. Two of the shafts were served by a Liebherr 140 HC revolving tower crane, whose design dimensions were such that the lifting hook was able to reach any point on the shaft cross-section to a depth of 40 metres below ground level, with a minimum load-carrying capacity of about 7 tonnes. A Liebherr portal crane with a loading capacity of 12.5 tonnes was already in place at the third shaft, as this installation had been used for the sinking operation.
The steel sliding form with fixed concreting stage and sub-slung curing platform, with a dead weight of some 5 tonnes and an overall weight of up to 7 tonnes (including the store of steelwork), was raised and controlled hydraulically via 10 lifting trestles in the shaft inner shell and 4 lifters at the corners of the lift-shaft. Alignment was controlled during the sliding phase by 4 optical plumb-lines installed on the shaft floor, whose readings were taken from the concreting stage. This system ensured that the tolerance specification of +/- 20 mm was safely maintained.
A special 1.5 cubic-metre skip was used for delivering the concrete. This item was fitted with a mechanized metering unit and hydraulic hose pinch-off for effective discharge control, with both systems operated electrically from the end of the filler line.
A ladder scaffolding tower accompanied the concreting team as the operation advanced and was available at all times as an emergency escape route in the event that personnel had

Cast-in-situ lift-shaft in position in the centre of the emergency exit shaft; the gap in the steel concrete of the shaft lining (right) will be used to supply water to the tunnel for fire protection purposes





Intersection between connecting adit and emergency exit shaft at NA4; the lift-shaft and landing no. 2 are clearly visible

to leave the sliding form and move back into the main tunnel. Transport to the workplace was normally provided by means of approved crane-lifted kibbles which brought the workers from the surface to the sliding form platform.

"Doka" concreting forms were used for the steel-concrete work on the landings and at the shaft-top building.

Manpower

During the sliding phase the site was manned around the clock on a 2-shift basis. The installation of the 8-10 mm-diameter steel reinforcing bars proved to be a critical part of this operation and the reinforcement column had to be laid using 6 men per shift in order to achieve optimum progress. The men worked in pairs when carrying out the various operating processes, such as crane steering, underground materials transport, concrete placement and sliding-form operation, as well as the bringing in of numerous components and the re-setting of the scaffolding tower. Each shift comprised 12 men and one supervisor.

The steel concrete work on the landings and at the shaft-top building required teams of between 4 and 5 men working on a one-shift basis.

Progress

During the sliding phase an average performance of 5.45 metres per day was achieved with a concrete placement of approximately 19 cubic metres per metre of distance. The peak performance reached over a single shift was 3.5 metres in 12 hours. The weight of reinforcing steel used, which varied as a function of the target concrete thickness, was about 110 kg per cubic metre and the average steel laying performance amounted to 0.7 tonnes per man per shift.

The landings were constructed using a cyclic working method. Each team was able to complete one landing per shift, not including the 2 – 3 days training period. The prefabricated stairway sections were laid at the rate of 8 units per shift. At the time of going to press the shaft-top building had still to be completed.

Commitment and determination

The various operations carried out at the different working sites along the new intercity express line were a testimony to the skill and determination of the Östu-Stettin Tunnelbau GmbH workforce in the performance of their first contract. The successful completion of the tunnel lining project, which was based on the correct choice of technical method, operating equipment and working cycle, has given the new company an encouraging start and has been an excellent reference for the competence of its workforce in the shaft-construction sector.

Dr.-Ing. Helmut Ligárt

On 12th December 2000 a wayside shrine was dedicated to Saint Barbara at the 3,305 metre-long Katharina Kasper tunnel in Dembach "in grateful thanks for a project free from accidents". The tunnel is part of the Cologne-Rhein/Main intercity express line.

Taking an active part in the dedication ceremony are DB project manager Dipl.-Ing. B. Belter and Sister Christeta Hess, who is Provincial Mother Superior and "tunnel godmother"

Digestion chamber with roof casing, thickener and foundation for tower block

Clarification plant gets Technology 2000 re-fit

2000

Östu-Stettin Hoch- und Tiefbau GmbH is currently engaged in the reconstruction and conversion of the Langenwang clarification plant as a contract operation for the Mürz water authority. The aim of the extension project is to comply with the new emission laws for municipal waste water and sewage systems – in this case for a treatment plant serving some 24,000 inhabitants.

The construction work, which began in August 2000, had to take account not only of the statutory requirements but also of the ecological and economic aspects of the project.

Extensive modernization

As Technology 2000 could only be put into action by extending the existing installation, additional construction work is needed to prepare for and complete the project. This involves site clearance and sludge-tank conversion work, together with the installation of a transformer station and the draining of old slurry ponds. New wells are to be constructed and permanent fencing erected, while water-level and high-pressure piping also has to be laid. The layout of the external structures is another important part of the project which had to be completed before the new clarification plant was handed over to the client.

Main installations are re-designed

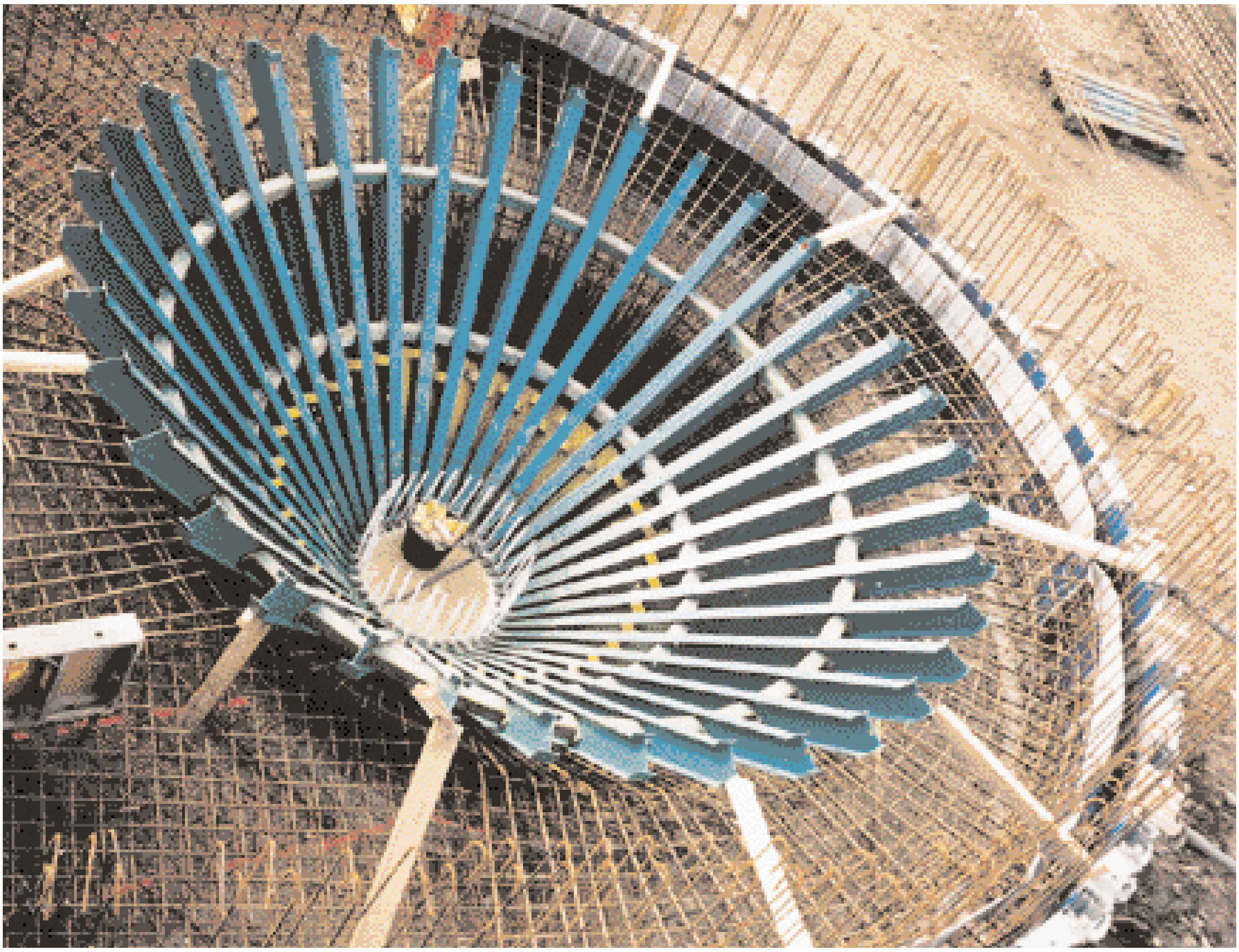
The main plant installations are being gradually reconstructed in parallel with the preparatory operations. This includes the use of state-of-the-art technology for the design of the spiral-feed pumping station as an intake for two screw feeders, providing a rated delivery capacity of 250 litres per second. The rainwater settling tank, which is a two-stage unit, is constructed from steel-concrete pipes 2000 mm in diameter and is designed for an overflow capacity of 440,000 litres.

The steel-concrete screening plant measures 13.10 x 8.60 x 6.50 metres and houses both the fines crusher and the screenings and sand washer. This unit connects with the sand trap, which is a circular cone-shaped structure crossed by a bridge.

Ground water – a local solution

The sludge pumping station is in the form of a 7-metre deep, 4-part steel-concrete shaft and its construction calls for a solid foundation. However, the proximity of the Mürz river means that the entire area is subject to a high ground-water level, with the result that extensive and controllable water pumping facilities are required, along with sheet pile-supported trench enclosures.

Funnel-shaped casing with reinforcement marks the start of the digestion chamber



Outlet from screening plant

metres and a 9 metre-deep pre-stage slurry hopper.

The two existing rainwater retention basins will in future be used as preliminary clarification tanks while the three clarification units, each measuring 30 metres in diameter, are to be converted for use as activation tanks. This conversion work will involve increasing the height of the chamber walls, removing the old coating and renovating the existing concrete.

This completes our tour of the proposed Langenwang clarification plant.

Östu-Stettin's ability for undertaking projects of this type, from both an ecological and economic viewpoint, provides local authorities with the technical advice and hands-on experience which they need in order to fulfil their statutory emission requirements in respect of waste water and sewage treatment.

Ing. Manfred Elter

An imposing backdrop

The slurry handling plant is an impressive structure and comprises two cylindrical, pre-tensioned steel-concrete containers for treating the thickened slurry. The digestion chamber, which is visible from a great distance, stands 21 metres in height and 12 metres in diameter and has a total capacity of 1,200 cubic metres.

The thickening plant, which is also 12 metres in diameter, only needs to be 9 metres in height to provide the required capacity of 400 cubic metres.

The tallest part of the installation, which is located between the two aforementioned tanks, is a 23 metre-high tower section complete with stairwell, pipe ascension shafts and access points leading to the operating areas.

The control building itself is designed as a single-storey structure and measures 17.7 x 16.4 metres.

Another important part of the installation is the reclarification tank, which is a triple-chamber rectangular unit with a holding capacity of 3 x 1,230 cubic

Digestion chamber with roof casing for thickener

New seismic system for strata exploration in the Blisadona tunnel

The Arlberg axis is one of the most important parts of the Austrian rail network. For this reason the European Union has included the Landeck to Bludenz section in its Plan for Trans-European Transport Networks, which was drawn up in 1990.

Background

Trains have to travel at very slow speeds along much of this section of the line. There is also the danger of avalanches in winter. Extensive avalanche-protection measures are in place to ensure that trains can use this section in safety, but these systems are expensive to maintain.

Adding a second track to the line between Langen am Arlberg and Klösterle will not only relieve the existing situation but will also help improve the rail service on the Arlberg section and enhance the attractiveness of the region as a whole.

The project comprises:

- the re-construction of the 2.4 kilometer-long Blisadona tunnel to the north of the existing section
- the laying of a twin-track line between the stations at Langen am Arlberg and Klösterle
- the rebuilding and modernization of Langen station, and
- the erection of substantial avalanche defences.

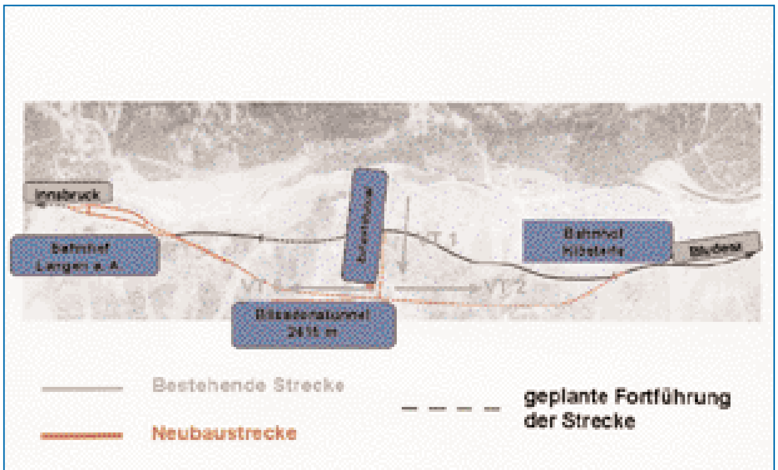
The new section of track will be designed as a 140 k.p.h. high-speed line, which will commence at the eastern end of Langen station. This work will involve the complete replacement of the existing rail tracks.
Because of the limited space available, work on the main Blisadona tunnel had to be carried out from a 430 metre-long access gallery. All the debris excavated from the tunnel was to be used for the construction of avalanche baffle works in the Grosstobel and Fuchslochtobel areas.

The construction project was to comprise a total of eleven tunnelling sections and two open-trench sections.

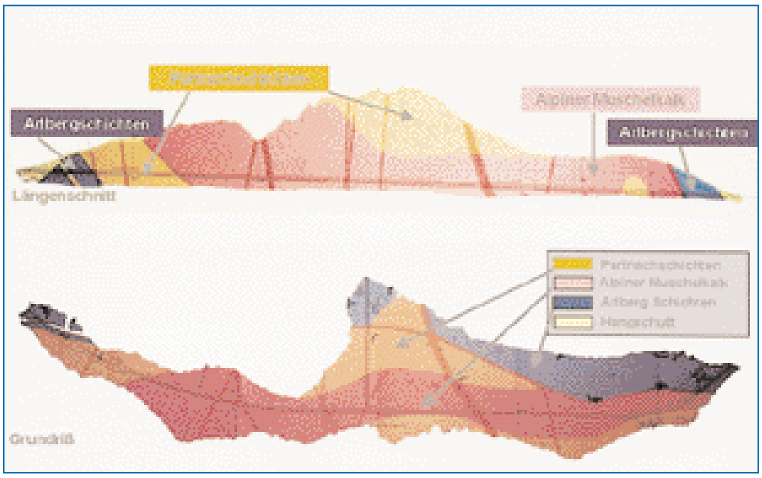
Local geology

The site lies on the southern edge of the northern Limestone Alps, which in this area are known as the Klostertal Alps. The dominant macrotectonic structure of the southern Klostertal Alps is the Spullersee syncline, which trends primarily in an east-west direction, and the tightly-compressed Klostertal anticline, which lies to the south of the Spullersee.
The rock strata are primarily composed of limestone and dolomite rock from the Alpine Muschelkalk series, together with clay shales, marls and limestones of the Partnach beds and limestone, dolomite, shales, rauhwacke limestones and dolomites from the Arlberg beds.
The strata series, which trend in an east-west direction, dip in various directions and are folded on steep axes, due to the high tectonic stress acting on the southern face of the Limestone Alps. In some places the

Project overview



Local geology – longitudinal section and horizontal projection



Excavator at the access-tunnel portal/beneath the existing rail embankment

rock is even recumbent, while the general area of the construction site is traversed by several acute-angled fault zones running almost at right angles to the general line of strike.

Construction phase and results

The Blisadona Tunnel consortium, comprising Östu-Stettin GmbH (Leoben), Beton- und Monierbau Ges.m.b.H. (Innsbruck), Universale Bau AG (Salzburg) and AST-Holzmann Bau Ges.m.b.H. (Graz), was awarded the contract for the tunnelling operation in the autumn of 1998 and the project commencement date was set for 19th October 1998. The site equipping work began in early November of that year, along with the excavation of the access tunnel (VT 1). After working through the difficult section of unconsolidated rock, the tunnelling operation encountered alternately clay shale and calcareous marl, as well as successions of the Partnach strata and thickly-laminated limestone beds. During the excavation of the access tunnel and main drive, work also commenced on the east portal, with the removal of the preliminary cut, and on the excavation of the pillar entry. Because of the altitude of the site, the work being carried out during the winter period was often interrupted by avalanche debris, with one particular flow causing considerable damage.

A lucky escape

On 19th July 1999, the day of the lucky escape, the crown section of the main drive had been excavated on the dip as far as the 230 metre point. The rising drivage in the twin-track tunnel drive had reached the 250 metre point of the crown section, with the floor section having been excavated up to the 172 metre mark. Suddenly there

Material washed out into the tunnel

was an increase in water ingress at the main drive heading face, with the usual inflow of a few litres rising to as much as 70 litres per second. The left-hand side of the roadhead comprised very consistent strata, while the right half was composed of less stable material; drainage holes were therefore drilled in this area to take the water away from the heading face and walls of the tunnel. Shortly after the change of shifts at 22.15 hours the water inflow at the roadhead increased dramatically to more than 200 litres per second, whereupon the drivage team hastily withdrew from the face of the heading. The flow of water poured out over the junction area and into the dipping tunnel of no. 2 drivage, while more water entered the dipping access tunnel and flowed out to the surface. The initial torrent of water was then followed by a moving mass of boulders and rubble, mixed with saturated small- and fine-sized material. The smaller particles were carried out through the access tunnel along with the large mass of water. The drainage channel which had been constructed at the portal entrance to the access tunnel could not cope with this large flow of mud and debris, with the result that fine-sized material poured down the hillside and into the town of Klösterle.

Both the mobile concrete mixer and the shotcreting rig, which was braced in position, were washed some 100 metres down the tunnel by the avalanche of mud and debris. The rock was strewn about the floor of the tunnel to a depth of between one and two metres from the heading face back to the junction in the rising section of the drift. Thankfully there were no injuries as a result of this incident.

The search for new safety systems

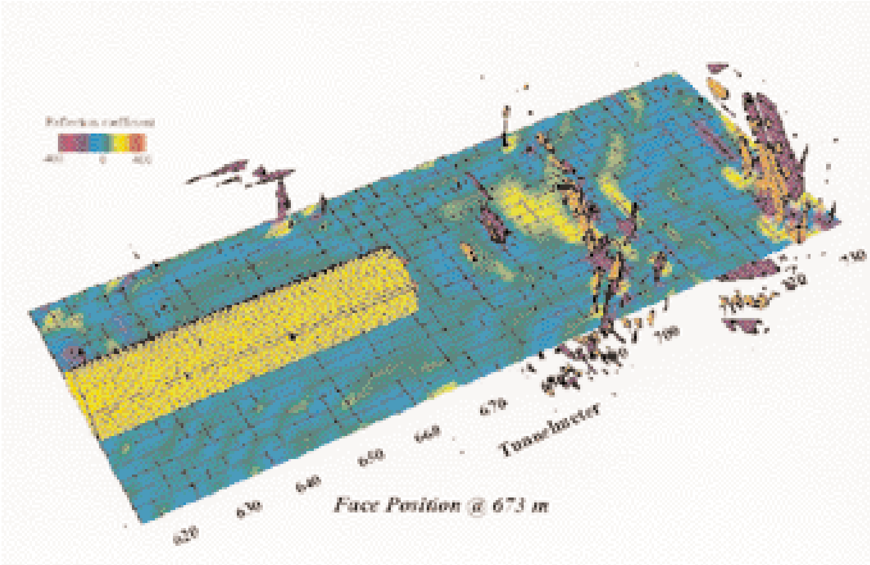
This incident triggered the search for a preliminary exploration system capable of providing a reliable indication of phenomena of this type; the new system was to be made available as quickly as possible and should not impede the tunnel drivage operation.

The various types of equipment available on the market were tested for feasibility under the aforementioned conditions and a cost comparison was undertaken. It was at this point that the project engineers happened to see a brochure from NSA Engineering Inc. (Neill/Strid/Association), who are based in Golden, Colorado. This company's NSA Tomography System (NSA-TRT) is designed to provide reconnaissance data on the strata in front of the heading face, giving a coverage length of 100 metres and an all-round cavity coverage of 25 metres.

After intensive planning and careful on-site preparations the first measurements were undertaken with the system in three of the tunnel drivages.

The results were analyzed and interpreted immediately after the measurement process. The graphic representations produced convincing pictures of the forward strata and each member of the drivage team was fascinated to know whether the findings would be borne out by the subsequent development work. Many of the hard and soft zones depicted in the

Water inflow in the crown drivage zone



Tomography with three-dimensional representation of the expected hard and soft zones

graphics were indeed encountered as the drivage advanced.

Looking into the darkness

The excellent predictive capacity of the measurements was enough to convince the tunnelling engineers that the system should be used in the remaining tunnel drivages. The measurement equipment provided usable average block lengths of 80 metres and a total of 9 measurements and 20 prediction blocks were obtained for the remaining drivages.

The NSA-TRT system, when used correctly, proved in practice to be a useful and sensible addition to the art of controlled tunnelling. Predictive systems of this kind will soon become a basic requirement for improved safety in tunnel drivage operations.

The system's greatest asset is the clarity of its three-dimensional graphics and its capacity for providing a geological section of any required part of the exploration zone. As a result, the subsequent behaviour of the strata and area of the pull can be assessed very effectively.

The drivage operation in the Blisadona tunnel has now finished. The fact that no further unforeseeable incidents occurred, in spite of a total make of water which in some cases reached 300 litres a second, can be attributed to the NSA seismic-reflection tomogram system.

The tunnel lining operation will be completed in the summer of 2001 and the electrification and track-laying work will then be commenced. The station at Langen am Arlberg is to be re-constructed during the summer of 2001 and 2002 and a full rail service is to be resumed on this section of the line from 2003.

Ing. Peter Schwab

Mobile concrete mixer entrained by the flow of mud and rock

NEW WORLD TRADE CENTRE constructed in Raab, Hungary

The activities of Ödenburg-based Stettin-Hungaria, which is one of the new subsidiary companies of Östu-Stettin Hoch- und Tiefbau (Leoben), were previously recorded in Report 1999. As already stated, the management of the new company felt compelled – in view of the promising economic developments taking place in Hungary – to seek out new markets and customers away from the company head office and immediate environment. From the outset they were determined to compete on a country-wide basis with their market competitors and successfully held their ground with well-known European operators – an impressive demonstration of Stettin-Hungaria's capabilities.

Seizing the opportunity

An opportunity arose in December 1998 with an invitation to tender for an international PHARE project to construct a new trade centre and Chamber of Commerce headquarters

Shuttering of main cornice

in Györ/Raab. The town of Raab, which is one of Hungary's fastest growing industrial centres, lies half way between Vienna and Budapest and is home to many European corporations. The contract was to be carried out with support from PHARE CBC (PHARE Regional Development Unit, Ministry of Agriculture and Regional Development) and would be strictly governed by EU regulations.
In order to be able to meet the contract specifications, which were quite demanding for any small company, Stettin-Hungaria set up a bidding syndicate with its parent company Östu-Stettin.

150 days to wait

Bids were opened at the Ministry offices in Budapest and Stettin-Hungaria won the contract as the best bidder.
However, the company had to wait 150 days for the final decision from the tendering body. The contract was finally signed on 12th August 1999 – and the project was to be completed within 365 days.
The rebuilding project comprised an area of 1,214 square metres. The basement of the building contained an underground car-park, while the ground-floor housed a conference room for 300 persons. The three upper storeys contained various offices, including the premises of the Chamber of Commerce and Austrian Consulate.

Room with a view

Visitors to the roof terrace are able to enjoy a wonderful view over the old town of Raab. One of the contract specifications which the engineering team found most challenging was to convert this roof terrace into a fully-operational "green area". The building enclosed a total of 5,370 square metres of fully air-conditioned usable space. The conference rooms were equipped with up-to-date sound and video equipment.

Finishing work for foundations

Concreting the ceiling above cellar level

Obstacles fail to delay speedy completion

The project required substantial quantities of material to be moved in and out - 8,200 cubic metres of excavated material, 4,700 cubic metres of concrete and 315 tonnes of steel. The formwork preparations were undertaken by a Hungarian subcontractor whose men had acquired experience working in Germany. As early as the second week of the project the site suffered from an increased ingress of ground-water, which called for some quick and effective decision-making. The site engineers opted for the sinking of vacuum wells, which successfully lowered the water level by some 80 cm. The construction team was then able to construct the 45 to 60 cm-thick steel-concrete raft and install the aquafin ground-water insulation. A total of 30 days were needed to lower the ground-water table. The water level currently reaches the floor of the underground car-park and the sealing measures have now proven their long-term effectiveness.

Another problem facing the project engineers was posed by the proximity to the site of one of the rapidly-expanding city's main thoroughfares. This meant that sheet piling had to be sunk to protect the excavation trench from significant levels of traffic-generated vibration.

Good planning is appreciated at the highest level

The project progressed according to schedule thanks to the dry autumn weather and relatively mild winter. In March 2000 the steel framework for the cupola was put in place in the presence of assembled VIPs. Good planning and the strict supervision of duties ensured that the project engineers had sufficient time to focus on the building's high-technology features.

A quality assurance plan was drawn up for the implementation of the project and the local offices of EMI – who are accredited providers of quality control in Hungary – were given responsibility for the site, an operation which involved continuous sampling and analysis work. The project was also regularly visited by the PHARE programme's Budapest delegation, who were always satisfied with the rate of progress.

After final inspection and approval, the client set 24th August 2000 as the date for the ceremonial opening of the building. Dignitaries present at the opening included the EU Ambassador to Hungary, Mike Lake, the city mayor and the President of the Chamber of Commerce. The company's management team and the chief project engineers appreciated the various speeches in recognition of their efforts, and were pleased to be able to hand over a building whose entrance hall acknowledged Stettin-Hungaria as the general project contractors.

Dipl.-Ing. Attila Kerekes

Visit of the PHARE delegation

Office Block Sets New Standards

The completion of a new office block with an innovative design concept has again enabled Östu-Stettin Hoch- und Tiefbau to demonstrate its specialist skills as a building contractor.

Future purpose unknown

The new office building, which is to be used by SAP Österreich, was constructed on the grounds of the former northern railway station close to the city center of Vienna. The structure is part of an ambitious inner-city redevelopment project which covers some 120,000 square metres and comprises mainly offices and other purpose-built premises, including a cinema, fitness centre and restaurants. This new "commercial mile" has developed in the last few years and is home to many well-known company names, including IBM, OMV, Bank Austria and Zürich Kosmos.

In September 1998 the building consortium of Östu-Stettin GmbH, Stragab AG and Wibeba BaugesmbH was commissioned by Projekta Ges.m.b.H. to act as general contractor for the turn-key construction of an eight-storey office block. Östu-Stettin was to be responsible for the technical control of the project.

The building was designed to comprise a usable floor space of 13,700 square metres and included a two-storey underground garage with room for 128 cars.

Maximum flexibility

At the time of tendering, and even as the construction work began, the ultimate purpose of the building was still unknown, and so maximum flexibility had to be incorporated into the internal design. Only whilst the super structure was being constructed the office block was taken over by the current occupier, SAP-Österreich, and extensive changes were made to the specifications. These new requirements resulted in a 25 % increase of the original costs.

After completing the preparatory work the construction of the outer shell of the building began in November 1998. With the building measuring some 130 metres in length, three giant construction cranes were required to cover the full extent of the site. The excavation work for the underground garage was hampered by the fact that it was located in former wetland of the river Danube, which meant that the ground-water level had to be lowered during the construction phase. Soil removal and the placement of concrete was unavoidable in this part of the site.

The entire garage structure was built in steel, with jointing strips being fitted to seal the outer walls and floor. A coating of bitumen was also spray-applied to the basement to provide additional insulation and prevent water ingress. The ground-floor and eight upper storeys, which are accessed via three stair-wells, were also constructed in steel-concrete. Very few internal walls were installed in order to allow as much flexibility as possible for the internal floor space. This meant that large span widths had to be overcome when carrying out the casing and concreting work. The floor slab work was therefore undertaken using wide-span mobile travelling tables.

Cutting-edge technology

Only as the superstructure was already being erected new specifications and "tailor-made" design of the building were being defined in collaboration with the future occupiers and specialist planning consultants. The fact that the building was to be occupied by a computer development company operating in the forefront of technology placed high demands on technical innovation and equipment design.

The client specified a building capable of incorporating spacious computer training rooms and offices whose design offered the latest in flexible and open-plan accommodation.

The top storey was to contain a number of prestigious office areas with a rooftop view over Vienna, which were to be used as seminar rooms for a maximum of 10 persons. This part of the building was also to have its own VIP kitchen and would include a large terrace with a floor space of some 180 square metres. A staff canteen and dining-room is situated on the ground floor for the use by the company's own personnel.
The outer facade of the building was constructed from suspended granite slabs which were set through the elongated window casements.

High-quality air conditioning

Special attention had to be paid to various in-house facilities such as heating, air conditioning, ventilation and electrical services and the installation of these systems called for special skills on the part of the building design team. All the seminar rooms and top-floor offices were fitted with air-conditioned ceilings which would create a draught-free and even-temperature environment. The staff offices were equipped with combination systems capable of heating and cooling the air as required.

Core features

The entire EDP cabling circuit, which is the main supply artery for any modern IT company, was designed to be sufficiently flexible to cope with the additional needs imposed by future upgrading. One of the client's main demands was that the office layout should be as open and adaptable as possible, which called for the installation of a flexible flooring system and adaptable partition walls.

Though the client had been quite precise in his target specifications, design changes had to be accommodated during the construction phase and these were successfully delivered on schedule thanks to the adaptability of the site construction team.

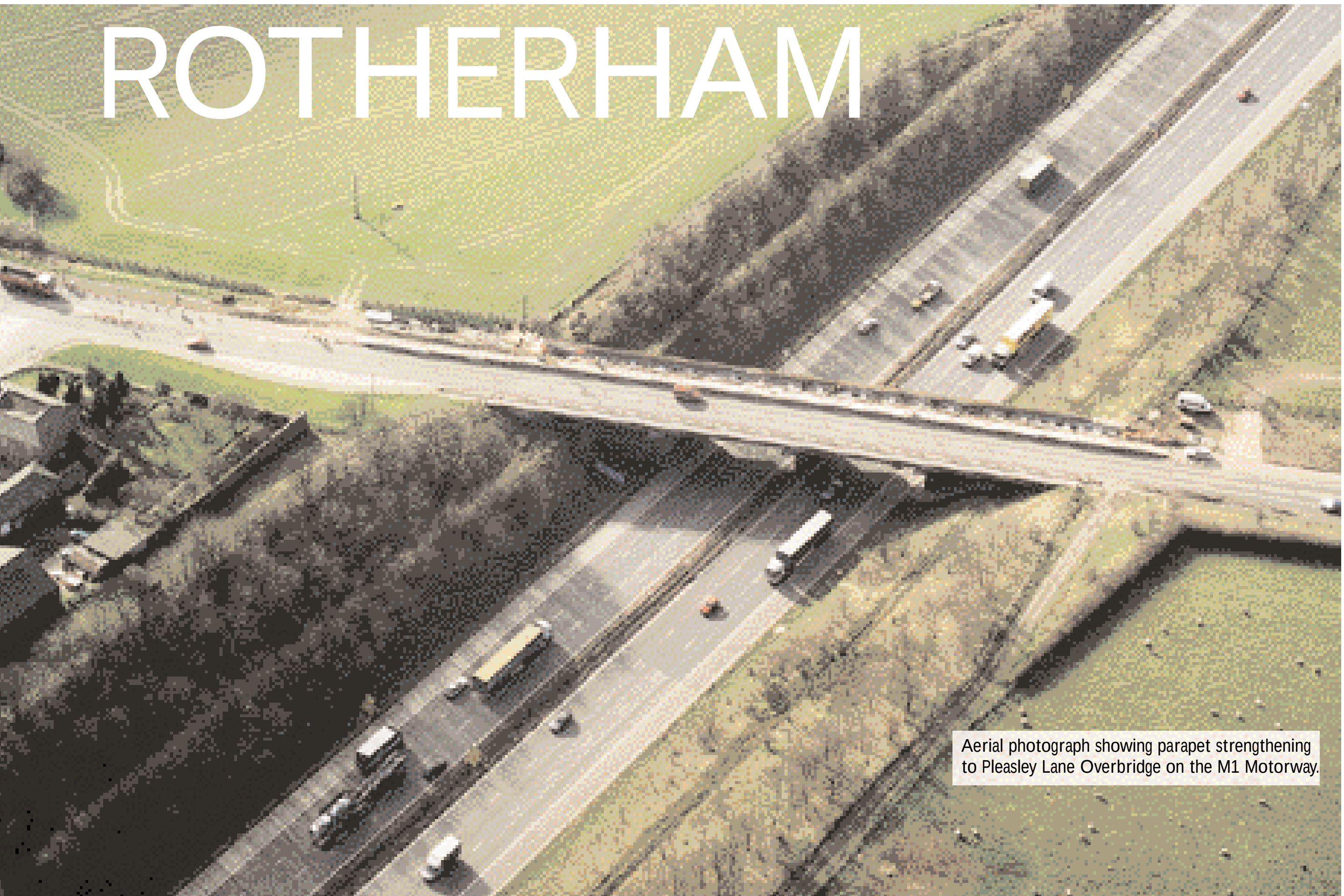
Although the overall project was affected by the many different design alterations introduced during the construction phase, which resulted from the fact that the entire block was to be occupied by a single company with quite specific operating requirements, the building was successfully handed over to the client after a total construction period of 21 months. The smooth progress and overall success of the construction project can be attributed to a large degree to the efforts of the supervisory team and site foremen and special thanks are due to them in this regard.

This difficult construction project, which involved the installation of expensive 'high-tech' equipment, again served to demonstrate Östu-Stettin's capacity for delivering on schedule.

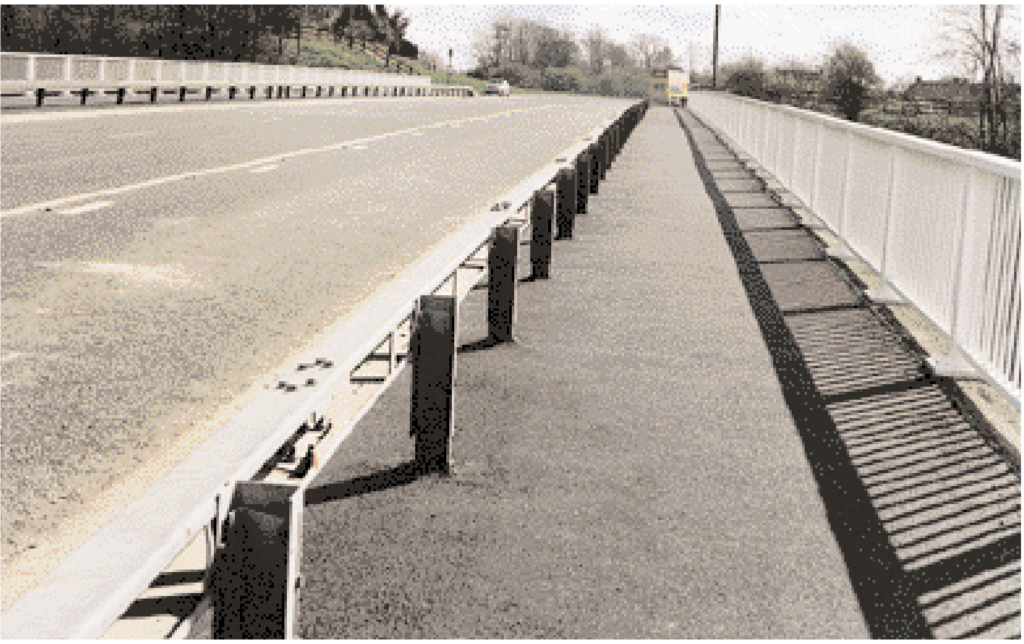
Ing. Robert Hitschmann

Aerial photograph showing resurfacing works on the M 1 Motorway under traffic management and contraflow working at the Whitehill Lane Underbridge.

JUNCTION 33 ROTHERHAM



Aerial photograph showing parapet strengthening to Pleasley Lane Overbridge on the M1 Motorway.



Photograph showing completed parapet strengthening works and resurfaced pedestrian footpath on Pleasley Lane Overbridge, M1 Motorway.

Photograph showing temporary scaffold to facilitate bridge strengthening and parapet works to Pleasley Lane Overbridge over the M 1 Motorway.

The contract for the M1 bridges consisted of the strengthening of Pleasley Road Bridge, which spans the M1 in South Yorkshire, and Whitehill Lane Bridge, which carries north- and south-bound M1 traffic over an existing A road.

The Whitehill Lane Bridge included major concrete repairs to the soffit of the bridge, which was honey-combed and badly deteriorated due to chemical attack. Hydro-demolition and sprayed concrete was used to repair the soffit. In conjunction with this work, the existing surface on the M1 was removed down to the concrete deck. The waterproofing, surfacing and joints were then replaced during various traffic management operations.

The main purpose of the contract was to comply with current loading requirements. The existing footpaths were broken out and a substantial reinforced tied-in beam was constructed to provide sufficient lateral bending and tensional resistance to stabilize the edge beams.

All the works were encapsulated to prevent debris falling onto the motorway below. The existing parapet barriers were refurbished on both bridges.

All the works required substantial traffic management and detailed planning was carried out twenty-four hours a day, seven days per week. The project was successfully completed ahead of programme.

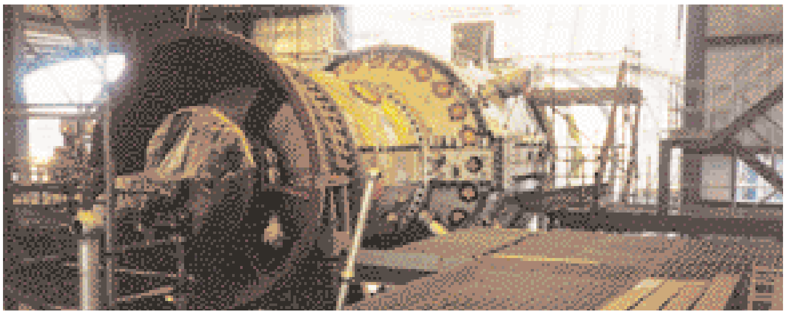
Mike Burton
Kurt Klingbeil

Photograph showing temporary scaffold to facilitate bridge strengthening works to Whitehill Lane Underbridge, M1 Motorway complete with temporary cover to pedestrian footpath.

Photograph showing parapet strengthening works on Pleasley Lane Overbridge on the M1 Motorway.

New Offices and Factory in Humberside Area

Engineering's Installation Section has gradually developed over the last few years and has outgrown its premises at Bedford Park in Scunthorpe.



Contract for Siemens in the Seabank power-station

Moving to new premises at Bessemer Way, on the Sawcliffe Industrial Estate, gives Installation the added benefits of 7,500 sq. ft of workshops equipped to supply locally-based clients, as well as those further afield in Lincoln and Humberside, with the best-value solutions to all their engineering requirements. The official opening by the Mayor of Scunthorpe, Councillor Mick Todd, took place on 23 October 2000 and Councillor Nic Dakin, Installation Section's own MD Dudley Jones and other dignitaries were in attendance. In his opening speech, Engineering Director M Myronko outlined the Section's objectives, which would form the basis for positive future developments in the installation sector.

Quality – the key to success

Our reputation has been built on our quick response to customers needs, giving a quality service at the right price. We believe that customers have a right to expect quality performance and it is on this premiss that we have built our success. We hope in this way that our business will continue to expand and that the increased range of services available from the new workshops will be of benefit to customers both old and new. Our product range now includes:

1. Electrical installation and maintenance, mainly at Corus, Scunthorpe, where we work on medium and heavy industrial 3-phase systems serving materials-handling and process equipment.

2. Work carried out for the Environment Agency, namely a 3-year contract for the testing and repair of electric fishing equipment
3. Mechanical maintenance on materials handling equipment, such as conveyors, crushers, screens, reclaimers etc.
4. Structural fabrications, such as chutes, conveyors, tanks and iron runners. We can also manufacture and install our own equipment, if this is required by the customer.

New factory

A further specialized service

Our expertise has also been demonstrated by a project completed this year in conjunction with our sister company Mining & Technical Services. This involved the drilling of additional salamander tapholes on blast furnaces at the Redcar and Scunthorpe steel works. The Redcar unit was drilled on the east, west and north sides of the furnace bottom to allow a total of some 1,300 tonnes of iron to be drained out into the torpedo vessels. This enabled Corus to achieve a quicker furnace shutdown and meant that they could undertake refurbishment within the 70 days deadline, thereby considerably reducing the period required for furnace start-up.

Salamander tap hole drilling had only been carried out twice before, once on the Queen Ann and once on the Queen Victoria furnaces at the Scunthorpe plant – both projects were undertaken by Thyssen Engineering in conjunction with Mining and Technical Services. Since completing the Redcar operation, we have carried out similar drilling work on the Queen Mary furnace at Scunthorpe. We are now considering expanding this service on a Europe-wide basis.

The Installation Section can look back on a successful 2000, particularly with regard to their increased presence at Corus' Scunthorpe steel works. This installation comprises a number of different processing units, including iron and steel making, power generation and other energy-related services. In 2000 we extended our operations to include the Corus plants at Redcar and Rotherham, together with existing works at Stocksbridge which are also targeted for expansion.

The year 2000 also saw a contract undertaken for Faist, G & H Montage and Siemens at the Peterhead Power Station, where acoustic housings and walls were erected around the gas turbine and generator set as part of a noise-reduction programme. This project subsequently resulted in a contract from Rheinhold to undertake similar work at the Seabank Power Station in Bristol and also from Marla Airport Services. In 2000 the Section was therefore awarded contracts from a total of four German-based clients.

It is hoped that the opening of our new factory will allow us to expand further into the power station sector. With three new power stations being planned for the North Lincolnshire area, T(GB) is hoping to obtain further business opportunities both for its Installation Section and for T(GB) Construction (North). The fact that both operations will be sharing the premises at Scunthorpe means that we can now work more closely together and offer added value to our extensive range of company services.

William Metcalf
Kurt Klingbeil

ELECTRIC FISHING SYSTEM

The electric fishing system consists of batteries or generators supplying a control box which sends a boosted high-voltage current to a cathode and anode arrangement. When the latter are lowered into a river between set points they induce a current and any fish swimming between the two units are stunned and float to the surface; they can then be removed from the river, checked for disease and then returned to the water unharmed.

Photograph showing block paving and feature lighting to pedestrianised area.

Effective partnering makes design a reality

Kirklees Metropolitan Council had a vision to provide a safe, attractive, quality shopping environment by way of a pedestrianised streetscape feature and engaged Thyssen Construction North to carry out the works involved under their first ever partnership agreement.

Thyssen's considerable experience of partnering was a significant factor in helping Kirklees Metropolitan Council achieve their aims.

As soon as the contract was awarded, the staff from both parties who were to be involved in the scheme attended a partnering workshop to identify the scheme's key objectives and future working relationships. Everyone entering into the partnership arrangement showed great enthusiasm for the project, which was marked by a real spirit of teamwork and cooperation – as the Project Team Charter shows.


VICTORIA LANE AND KING STREET
STREETSCAPE IMPROVEMENTS, HUDDERSFIELD
PROJECT TEAM CHARTER

We are committed to working together, in a spirit of trust, co-operation mutual agreement to achieve the following objectives:

- Minimise disruption to the Public and Businesses
- Complete the Scheme on time
- Meet or beat financial targets
- Promote a safe working environment
- A quality product without defects
- Joint, prompt and practical solution of issues

Hence ensuring a successful Project and future working relationship

Project-team-charter

Photograph showing intricate block paving to pedestrianised area.

The scheme lies at the heart of Huddersfield's main shopping area and includes well-known stores and specialist shops. The project team took great pains to minimize the general disruption caused by the works to the shopping public and deployed value engineering to mitigate escalating contract costs.

The scheme included substantial areas of high-quality block paving, street furniture and feature lighting and the work was completed ahead of programme, within budget and to everyone's satisfaction.

All those involved with the scheme agree that it was an undoubted success and are now looking forward to the next contract.

Mike Burton
Kurt Klingbeil

Photograph showing feature block paving and feature lighting to pedestrianised area. The multi-coloured band winding through the middle of the streetscape is intended to portray the effect of a stream running through the pedestrianised area.

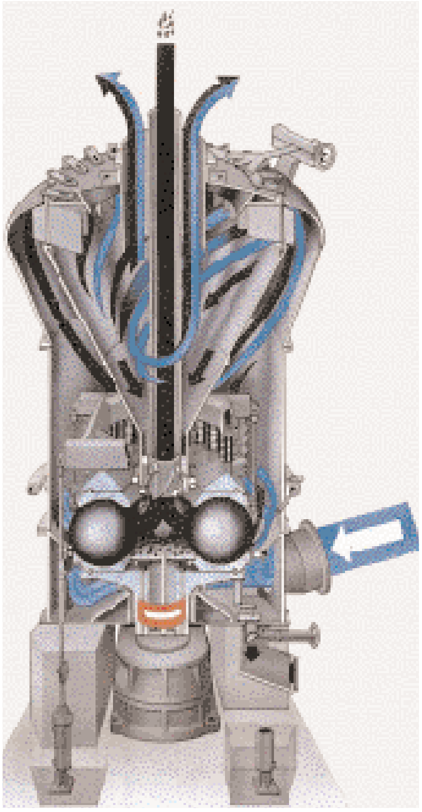
New drier-crusher contract to 2011 means increase in plant capacity

The turn of the year 2000 was marked by a new lease of life for the 13 year-old contract with Thyssen Krupp Stahl AG for the supply of pulverized coal from the company's drier-crusher plant, along with a new set of operating criteria; the renewed contract is set to run for at least 10 years until 31st December 2010.

As a result of the increasing demand for pulverized fuel from Thyssen Krupp Stahl AG, Emscher Aufbereitung GmbH is now bound by contract to further expand its production capacity. This will mean the addition of a sixth drier-crusher unit, and as with previous installations it will be constructed by Claudius Peters AG of Buxtehude. Construction is expected to take a maximum of one and a half years to complete and plant commissioning is scheduled for mid-2002.

Full production capacity will then be available and Emscher Aufbereitung GmbH will be in a position to supply the blast furnaces of Thyssen Krupp Stahl AG with up to 2 million tonnes of pulverized coal a year.

Dipl.-Oec. Eberhard Vogt



Assembly Electrical engineering

TS Technology + Service is launched

Engineering Maintenance Production

As part of a comprehensive and much-needed programme of restructuring within the Thyssen Schachtbau Group, the Mülheim-based mechanical engineering section has now taken full control of its own organization and accounts – one of the first operational departments to do so – and has adopted a more market-driven business approach.

Now trading as "TS Technology + Service", the new section has now extended its external client base and in doing so has laid the foundations for a positive business expansion.

New orientation

The new management was assigned the task of developing a new business orientation and market strategy. This meant compensating not only for losses in sales to major external clients, but also for the falling volume of orders from other Thyssen Schachtbau operating sectors (as a result of the restructuring under way in the German coal industry). Unfortunately this called first for an appropriate downsizing of operating capacity – particularly in manpower – in order to create the economic basis needed to continue business operations in this field. The adaptation measures were finally completed in the year 2000.

Project-management system introduced

In order to ensure that client orders were handled efficiently and on time, all functions (costing, production planning, design and workshop fabrication) had to be entirely re-organized. The design team was incorporated into the production planning stage and major projects were henceforth to be handled by a project manager. To enable orders to be managed as part of a continuous process, from customer inquiry and tendering through to production order processing, a software support system was implemented which would in future allow all necessary information on the manufacturing stage of the orders to be retrieved at any time during the production process.

The section's performance range and market orientation was re-designed in collaboration with an outside consultancy firm. The new image of the mechanical engineering team was conveyed to the public by a change of name to TS Technology + Service.

An idea becomes reality

TS Technology + Service sees itself as a state-of-the-art service provider. The new company can provide a full range services, from concept planning to technical implementation – including engineering, fabrication and assembly, as well as maintenance and dismantling.

All operations can be undertaken as individual jobs or as a complete package provided under one roof.

An extensive plant and machinery pool with crane capacity for unit weights of up to 75 tonnes, and a production area of some 7,600 square metres, enables the section to undertake large-and heavy-fabrication and repair jobs.

A wide range of steel fabrications, components and machinery is now produced for a variety of customers in the power-station and steelmaking sectors, as well as for the mechanical engineering and mining industries.

The company premises are easily accessible to traffic and benefit from their own railway siding.

With highly-motivated and qualified staff working at every level, and supported by certificates of competence for welded fabrications and a certified quality management system to DIN EN ISO 9001, the new company is able to guarantee high quality and maximum customer satisfaction. TS Technology + Service clients appreciate the company's flexible approach and commitment to deadlines and the technical skills of its workforce.

New business acquisition

The year 2000 also saw the setting up of a sales team for new business acquisitions. This team is now supported by a new and updated company brochure which contains an impressive catalogue of the extensive range of services provided by TS Technology + Service. The positive attitude displayed by the members of this team has became apparent in the form of a significant increase in turnover.

As a result of improved client contacts and increased customer confidence following the company restructuring measures, existing customer relations have been strengthened and a number of major new clients have been secured.

TS Technology + Service: delivering on time, guaranteeing success

Dipl.-Ing. Dipl.-Kfm. Udo van de Sand

The new ladle car already partly assembled in TS Technology + Service's assemby department

Ladle car for Thyssen Krupp Stahl AG

In November 2000 Thyssen Schachtbau Technology + Service department was awarded the contract to design, construct and supply a ladle car for Thyssen Krupp Stahl AG's number 2 oxygen steel works. Delivery is scheduled for the end of April 2001.

TKS's decision to add a second ladle car to service their number 2 vacuum plant was based on the need for greater plant availability and the requirement for an increase in productivity. Having a second ladle car available will allow the steel ladles to be transported independently to the vacuum plant and from there to be transferred to the downstream continuous-casting unit.

The contract required TS to carry out the engineering design, manufacture and assembly of the new ladle car, whose large frame dimensions made very rigorous demands on the design and practical execution of the weld fabrication work. The overview shows the progress achieved to date, including the following components:

- welded car frame
- ladle centering device
- heat screen
- cable-arm
- traveling gear and
- drive unit.

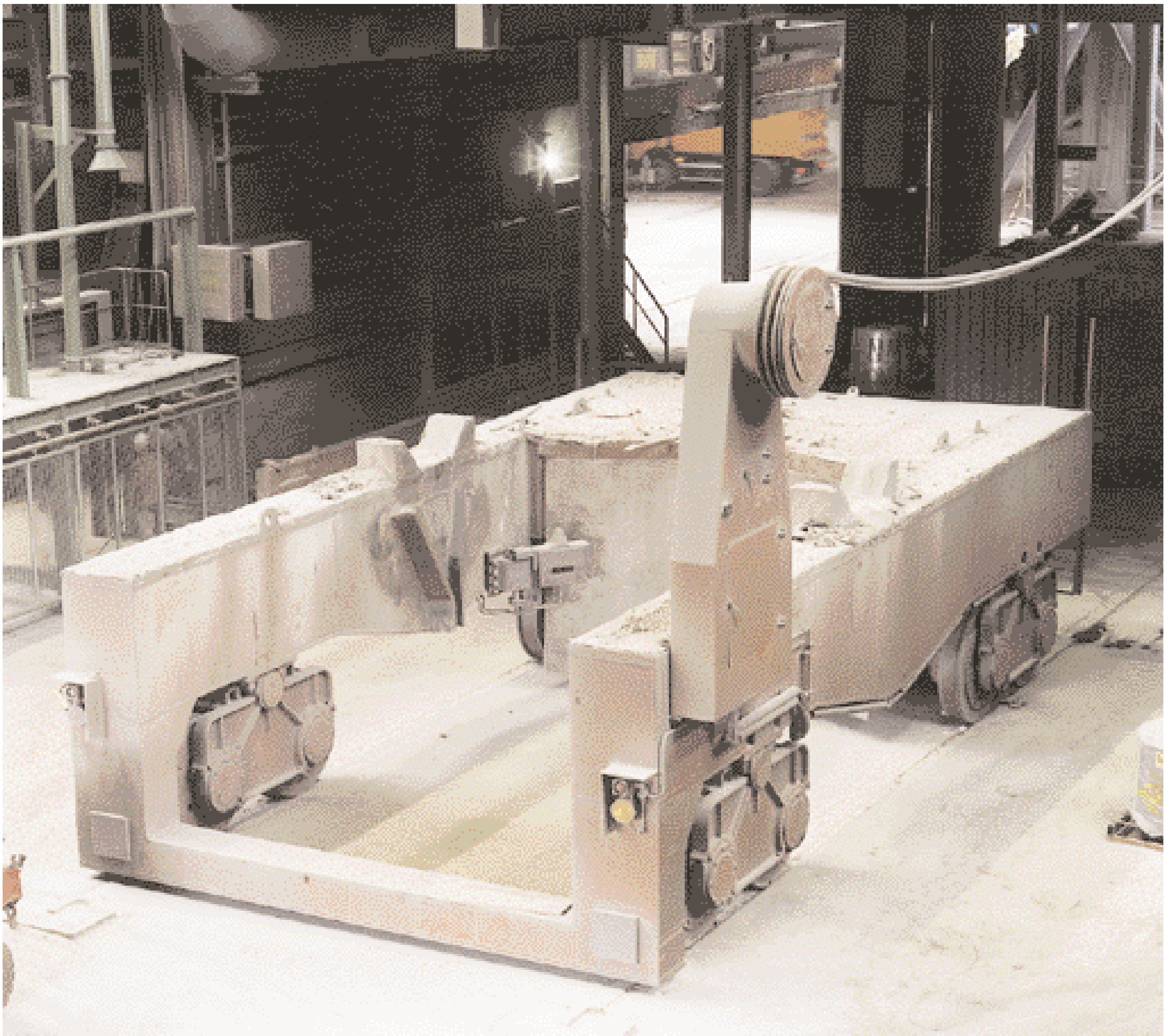
The engineering phase has already been completed in collaboration with TKS and various subcontractors, and the workshop manufacturing operations have now begun. In line with the terms of the contract, TKS have made continuous quality-control checks during the manufacturing phase.

Also the TS assembly department was presented with an interesting challenge, due to the very large and immensely heavy car components which have to be moved from place to place during the final assembly stage. The technical specifications are as follows:

- design weight approx. 100 t
- dimensions (length x width x height) 11100 x 6000 x 7300 mm
- wheel base 5200 mm
- travel speed 32 m/min
- drive power 4 x 30 kW
- load capacity 420 t.

In view of the co-operative response already obtained from Thyssen Krupp Stahl AG and the progress made to date, the Technology + Service department is confident that this project can also be completed on time and to the customer's complete satisfaction.

Dipl.-Ing. Ralf Künzl
Dipl.-Ing. Jürgen Botzki



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