THYSSEN MINING

Report

2012/13

www.thyssen-schachtbau.de

IMPRINT

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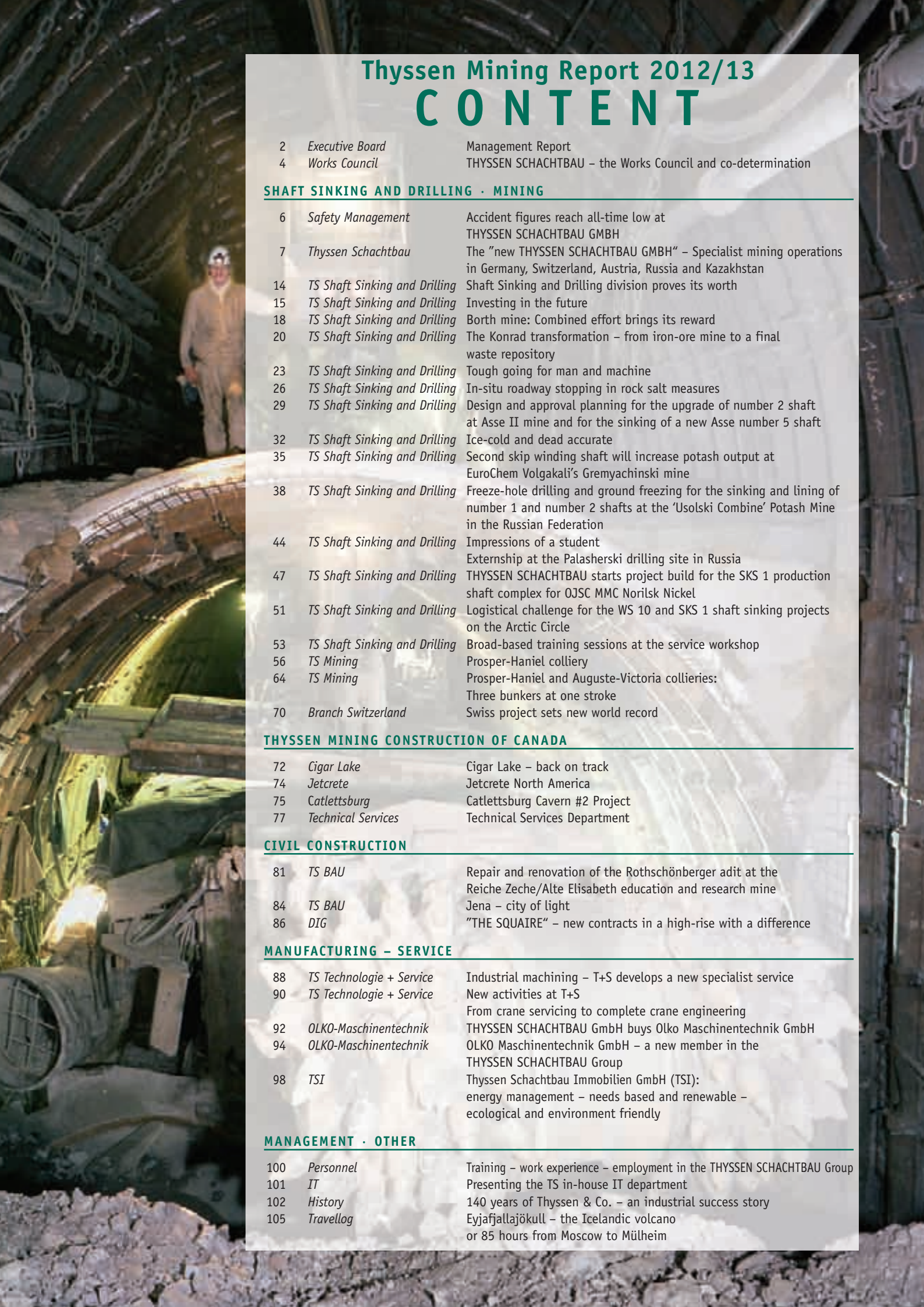
Photos:
Employees TS Group
Archive TS
Archives TS-Subsidiaries
StepMap.de

Cover Picture:
Ursula Ahlers

Printing:
Druckhaus Cramer, Greven
www.cramer.de



Thyssen Mining Report 2012/13

CONTENT

The members of the Executive Board of THYSSEN SCHACHTBAU GMBH, Dipl.-Kfm. Michael Klein (l.) and Werner Lüdtke

Ladies and gentlemen,
business partners and associates,
fellow colleagues,

this new edition of Report 2012/13 is an overview of the various and ongoing activities of the THYSSEN SCHACHTBAU group and Thyssen Mining Construction of Canada Ltd.

Both companies now employ a total workforce of about 2,800 and it has been due in no small measure to their efforts that last calendar year proved to be such a commercial success.

With a total turnover of more than € 500 million the company has continued to consolidate its market position as a highly competent and innovative partner to the mining and construction industry. This operating performance, which has been achieved in spite of the generally difficult economic situation, can be attributed to the commitment and wide-ranging capabilities of our workforce as well as to the development and improvement of our very high safety and environmental standards.

Now I would like to describe the operations of the individual companies that go to make up the TS group:

THYSSEN SCHACHTBAU Group

THYSSEN SCHACHTBAU GMBH is an internationally active specialist mining company that provides all kinds of mining-related services ranging from the planning through to the completion of turnkey shafts and underground excavations.

At a national level THYSSEN SCHACHTBAU is currently involved in work for the coal and rock-salt industries and in various projects connected with the permanent disposal of radioactive waste which have been commissioned by the DBE, the German Service Company for the Construction and Operation of Waste Repositories.

THYSSEN SCHACHTBAU is also engaged in operations outside Germany and has ongoing projects in Austria, Switzerland and Russia, where the latest construction techniques are being used to sink new mine shafts under extremely difficult geological and climatic conditions.

With the purchase of OLKO-Maschinentechnik GmbH the THYSSEN SCHACHTBAU Group has expanded by another company. OLKO is leading in the production of shaft winding equipment and building materials and will strengthen the competitive capability of the THYSSEN SCHACHTBAU Group on the market and will put us in the position of a worldwide system provider of mining.

TS GmbH – Shaft sinking and drilling division

This division has been operating at national and international level for more than a hundred years and has already completed more than 200 kilometres shafts for clients all over the world. It is now one of the world's leading providers of specialist mining services and as well as conventional shaft construction the division also specialises in cementation work, freeze sinking and fully mechanised shaft boring.

The division has recently taken on a new challenge in Russia, where several major shaft projects are now under way. The positive business development of recent years has been accompanied by a gradual expansion of the workforce.
While clients have traditionally come from the mining and extractive industries we are now beginning to win orders from power station operators who want to take advantage of the highly developed mining technology that THYSSEN SCHACHTBAU can provide. The ongoing success of the division's activities at home and abroad is based on a major programme of forward-looking investments.

TS GmbH – Mining division

The mining division is engaged in vertical and horizontal excavation projects at RAG Deutsche Steinkohle AG's German-based collieries.

This mainly comprises roadway drivages and major cavity excavations, along with a wide range of underground mining services. The availability of a technically skilled and highly trained workforce has meant that the mining division is well equipped and on a sound financial footing to meet the challenges that lie ahead.

TS GmbH – Administration department

The administration department comprises central finance and accounts, IT and manpower services, along with staff units dealing with financial control, taxation, legal matters, treasury management and health and safety issues.
The administrative section employs 40 staff and has responsibility for all Thyssen Schachtbau Group affairs.

TS BAU GMBH

TS BAU, which currently has offices at Jena (Thuringia) and Riesa (Saxony), has been in operation since the mid-1990s.
As well as structural and industrial engineering projects – which can also be delivered as turnkey installations – the TS BAU portfolio of services includes landfill site construction, roadbuilding, track-laying and civil engineering work, demolition and waste recycling, specialist mining operations, pipeline construction, trenchless pipe-laying and high-tech water-pipe and sewer-pipe renovation.
The company is now increasingly engaged in providing services to clients in the former West German states and has also expanded its portfolio to include additional landfill construction and raw-materials extraction activities.

DIG DEUTSCHE INNENBAU GMBH

For more than 40 years DIG has been setting the standard for high-quality interior fit-outs and refurbishments. The company offers consultation, design, planning and execution services for standardised drywall installations and has the capacity to undertake complex fit-outs for major projects. This includes airports, hospitals, banks, shopping malls and office buildings.
DIG is currently in overall charge of design and execution at a major internal fit-out project which is under way at Europe's largest building site – 'The Squaire' at Frankfurt international airport.

TS Technologie + Service GmbH

T + S is a forward-looking engineering company delivering individual planning and design services through to technical installation assignments on a bespoke basis.
T + S specialises in constructional steelwork, mechanical engineering, installation and assembly, building services engineering, crane and door technology, repair work and electrical engineering. With some 7,600 m² of workshop space and an array of high-performance equipment, including a crane capacity for components weighing up to 80 t, the company has what it takes to complete all kinds of large and heavy fabrications.

By maintaining close communication with clients the company is able to ensure that its products are manufactured to exact specifications and delivered on time.
The procurement of a large-capacity machining centre has recently enhanced the range of services on offer.

Emscher Aufbereitung GmbH

Emscher Aufbereitung, which is now the largest producer of pulverised coal in Europe, has been supplying products to the PCI (pulverised coal injection) market for more than fifty years. The company operates six crusher-drier units at its Duisburg plant and knows all there is to know about the technical complexities of this type of operation, which involves having to accommodate quality variations in the globally-sourced grades of coal and petroleum coke that pass through the crushing and drying process.
The company has been delivering PCI coal to ThyssenKrupp Steel AG since 1987 and is now the sole supplier to all its German-based blast furnace operations.

Thyssen Schachtbau Immobilien GmbH

The company is responsible for managing the entire property portfolio of the Thyssen Schachtbau Group in Germany. While this mainly comprises office buildings and workshop facilities it also includes houses, rental properties, building plots and industrial sites.
The company currently operates one of the region's largest photovoltaic plants at its industrial park in Mülheim an der Ruhr where a new environment-friendly energy concept is now being planned and developed.

Thyssen Mining Construction of Canada Ltd (TMCC)

Thyssen Mining Construction of Canada is one of North America's most successful specialist mining contractors and is a leading international shaft sinking company. TMCC mainly serves clients in the Canadian and US potash and uranium mining industries and the company's technical expertise has also led to involvement in international joint venture projects in Brazil and Australia.
TMCC has played a key role in introducing new technology and methods to the mining industry. The company pioneered freezing technology in North America and has used this technique to sink over a dozen shafts in the Canadian potash industry.
TMCC works closely with mining equipment manufacturers and has continued to be a major promoter of safety standards and cost efficiency in the mining sector.

Dear readers,

as this brief presentation shows, our group companies have a large portfolio that spans a wide range of services. This allows the TS group to deliver technically innovative and future-oriented solutions that meet the highest standards in terms of quality, reliability and adherence to delivery dates. Our clients and business partners are at the focal point of our operations – as is each and every member of our workforce.
On the following pages you will find more detailed descriptions of some of the Group's current projects and activities. We hope you enjoy the read.

With our very best wishes

Michael Klein Werner Lüdtke

Works Council THYSSEN SCHACHTBAU GMBH

THYSSEN SCHACHTBAU – the Works Council and co-determination

In recent years developments at THYSSEN SCHACHTBAU GMBH have been overshadowed by a decline in the coal industry and the challenges this poses.

Then in December 2010 the European Commission approved the regulation on state aid to the coal industry that allows Germany to grant aid to production until the year 2018. This provides a secure set of conditions under which the German coal industry can continue its socially-acceptable programme of restructuring. And for THYSSEN SCHACHTBAU it has provided the time needed to rebuild the company along more sustainable lines.
This means that the ultimate objective, which is to scale down the German coal industry and downsize the workforce, can still be pursued with minimal disruption and social hardship. And so far this process has been managed successfully, not least through various personal and financial sacrifices. That our chosen path was the correct one has now been confirmed by the much improved situation in which we now find ourselves. We have come through the financial crisis of 2008 very well indeed, thanks in no small measure to the booming global demand for raw materials that preceded and followed this phase. And this has also been due to the flexibility and motivation displayed by you, the workforce – and I now want to say a special word of thanks to all of you for what you have achieved.

Another plus point that has made a real contribution to the positive development of THYSSEN SCHACHTBAU as a company is the fact of having an effective co-determination policy based on real collaboration between all the social partners.

And there is real evidence of just how crucial a factor co-determination has been in Germany's success as an industrial base. Effective collaboration on the shop-floor, freedom to express different points of view and a culture of constructive debate have time and again produced workable compromises for all concerned. The co-determination policy is borne out by the fact that

Germany has one of the best industrial relations records of any country in the world. This has always given German industry a strong competitive advantage.
At this point I should like to thank my colleagues on the works council who have put in so much time and effort on behalf of the employees and the company in so many different areas right across the business.

Demographic development has meant that there is now a shortage of skilled labour and this trend is set to intensify in the years ahead. Our response to this problem can only be apprenticeships, qualifications and vocational training – for this is the prerequisite for future competitiveness. This is an all-inclusive process and the company is driving this programme forwards and providing the support that it needs.

And for THYSSEN SCHACHTBAU employees too it is important to remain part of the knowledge society, for only through lifelong learning can we continue to maintain high standards in today's rapidly changing world.

Colleagues, this success has also been built on a number of other key factors that can be summed up in four lines:
1. Participation in the improvement suggestion scheme.
2. Health and safety actions, for even one accident is one too many.
3. The THYSSEN SCHACHTBAU company pension scheme.
4. Arrangement of a group insurance contract.

I should like to take this opportunity, on behalf of myself and my colleagues on the Works Council (see photo), to thank you all for the trust you have placed in us. And I am also speaking for the team in wishing every one of you all the very best for the future – and to those who go below ground I address a heartfelt miner's greeting and good luck.

Bernd Grätz
Chairman of the Works Council

Info: The co-determination system

In Germany the co-determination system is based on the Industrial Relations Act, which was first introduced on 11 October 1952 and revised a number of times since. The works council is the most important element in the co-determination system. Its role is to represent the interests of management and employees. Legal entitlement to elect a works council applies to all companies with five permanent employees or more.
Co-determination applies to issues involving company organisation, the design of the workplace, working procedures and the working environment, and includes for example the distribution of working hours, personnel planning and guidelines on staff selection, welfare schemes, working time recording and performance monitoring. The system also deals with staff measures such as recruitment, dismissals and promotions.
Another element in the co-determination system is the supervisory board. This body consists of workers' representatives and shareholders' representatives and its role is to appoint and recall the management board, monitor the management of the business and examine the accounts. In Germany limited companies are legally required to operate co-determination if they employ more than 500 people. In this case the co-determination rules are laid down in the One-Third Employee Participation Act.
The employer side appoints representatives of the shareholders while the employee side elects works representatives and trade union representatives. A member with responsibility for personnel and social issues (Employee Relations Director) is also elected to the board of directors. This appointment cannot take-place if it is opposed by the majority of employee representatives on the supervisory board.

Accident figures reach all-time low at THYSSEN SCHACHTBAU GMBH

Following the successful introduction of the work-safety management system and the award of the SmS (system-oriented safety) seal of approval by the BG RCI (German Mining and Chemical Industry Employers' Association) to the company's Mining and Shaft sinking and Drilling divisions in 2004, the health and safety procedures that have been put in place have once again delivered a successful audit in 2011 – as they did in 2008.

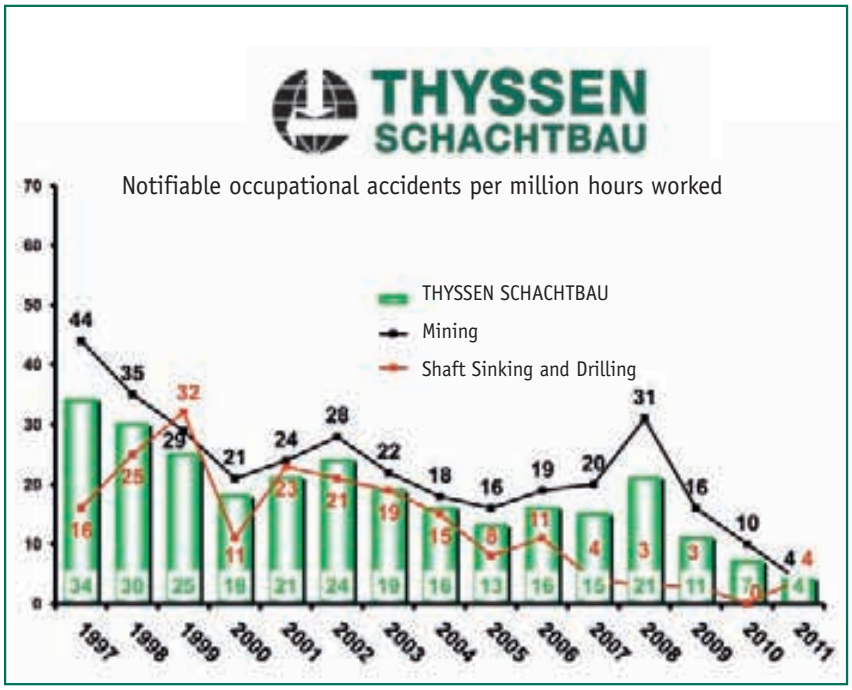
THYSSEN SCHACHTBAU GMBH can indeed be proud of the fact that it has now reported the lowest accident rate since the founding of the company. While in 1997, for example, 34 accidents were reported per million hours worked, subsequently the accidents as at 31.12.2011 could be reduced by 88 % to 4 accidents per million hours worked.

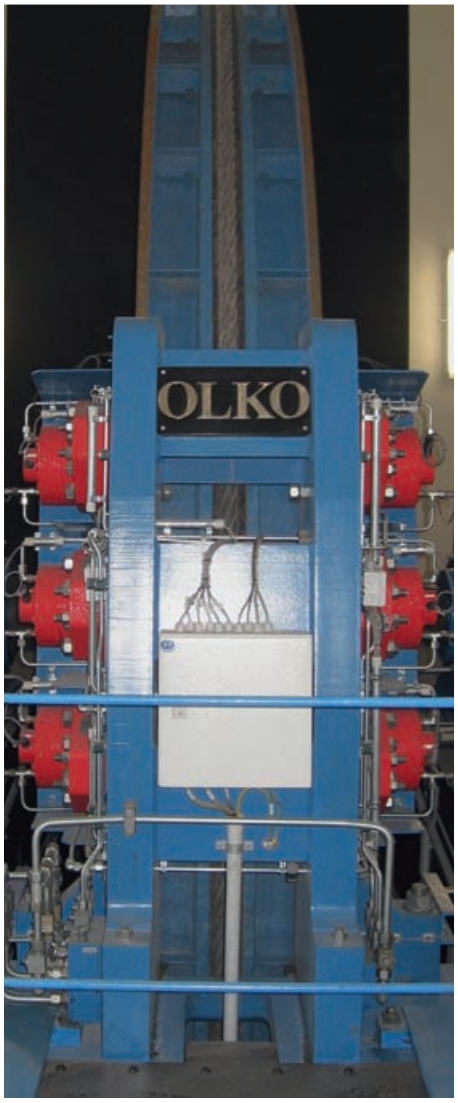
These excellent accident statistics can be attributed, on one part, to ongoing efforts to achieve the work-safety targets that are set each year for every company department and, on the other, to the systematic and unified implementation of all health and safety procedures. Despite the wide variety of working environments, many involving difficult working conditions, the work-safety management system has now been fully incorporated into the company's quality management structure. All employees – from senior management to shop-floor staff – have undergone intensive training sessions that have provided them with the qualifications needed to fulfil their health and safety remit in the performance of their respective tasks and responsibilities. A step-by-step approach has been adopted to developing individual work-based systems and putting the solutions into practice. As part of the ongoing improvement process all work-safety sequences and procedures have been further developed and refined since the introduction of the SmS scheme in 2004. Despite temporary setbacks, including a recent rise in accident rates, all departments and operating sites – along with their safety officers – have been focussing intensively on workplace safety and have devoted much time and effort to it.
And this has all paid off, as health and safety has now become firmly established in the day-to-day activities of each and every employee at THYSSEN SCHACHTBAU.

Maintaining occupational health and safety to high professional standards has become part of the corporate social responsibility at THYSSEN SCHACHTBAU and is helping to ensure the sustainability of the company.

Guido Barnfeld

Accident trends for the period 1997-2010





The "new THYSSEN SCHACHTBAU GMBH"

Specialist mining operations in Germany, Switzerland, Austria, Russia and Kazakhstan

THYSSEN MINING Group: Byrnecut Mining, Australia, THYSSEN Mining Construction of Canada (TMCC) and THYSSEN SCHACHTBAU GMBH, Germany reaches with 5,000 employees an annual turnover with round about 1 milliard Euro in 2011.

Ten years ago, in 2002, and in response to the initial impacts of the national mining crisis that was beginning to affect the coal industry, THYSSEN SCHACHTBAU set about redefining its strategic objectives as a specialist mining contractor owing to its high reliance on coal-industry projects. The company was to focus on operations in at least three countries, each involving at least three contracts for shaft sinking and drilling work. At the same time it would maintain its competitive position as a specialist contractor to the German coal industry through the systematic implementation of efficiency improvements and a programme of structural streamlining.

The plant pool was also to be renewed in line with market requirements. Looking back on what has been accomplished it is clear that this ambitious set of goals has been achieved in full – and even exceeded in many respects.

As a mining-focused company THYSSEN SCHACHTBAU has remained very much true to its roots as a shaft sinking, tunnelling and exploration drilling contractor – which go back to 1871 when August Thyssen laid the foundations of the company. In fact the first shaft sinking project commenced that very year.

THYSSEN SCHACHTBAU'S core skills are still what they were when the mining-oriented company was founded 140 years ago – and this has been a key factor in the company's success. These

achievements did not come from the diversification measures of the 1990s but rather are a result of steadfast adherence to the company's core competences, innovative development of shaft sinking, tunnelling and drilling technology and the cohesion and untiring commitment and dedication of the workforce.
Operating under a company motto that reads 'Fully committed' the firm has recorded a significant number of strategic and innovative successes over the last ten years – and a special word of thanks is due in this respect to each and every member of the THYSSEN SCHACHTBAU team.

THYSSEN SCHACHTBAU over the last fifty years: driving an innovative and results-oriented business policy!

Shaft sinking and development drivage operations have been a vital part of the business since the company was first set up in 1871. The main focus has been on colliery based stone-drifting and in-seam drivage projects, in other words developing the underground infrastructure needed to carry out coal mining operations.
The vertical and horizontal arrows in the company logo still symbolising the key role of shaft sinking and tunnelling technologies of the company.
A pool of special shaft-sinking and tunnelling machines and equipment has been built up to carry out these jobs. The company's technological progress has largely been built around a highly-skilled workforce with in-depth expertise and the ability to develop innovative ideas.

For ensuring the independent necessary design services the own technical design office was still a part of the business policy. And superlatives abound when it comes to shaft sinking and tunnelling achievements. Finished shaft diameters of six to eight metres have become the norm. Europe's deepest mine shafts are to be found in Germany; the north shaft at Ensdorf colliery, which extends 1,712 metres to pit bottom, is the deepest surface shaft of any colliery and by far the deepest shaft that THYSSEN SCHACHTBAU has sunk to date. High-performance machinery and equipment is now able to achieve average shaft-sinking rates of three metres a day, with peak performances of over four metres. These performance figures currently represent the state of the art for conventional shaft sinking.
THYSSEN SCHACHTBAU's shaft sinking and development activities over the last fifty years have mainly centred around major projects for the extraction of natural resources and the preparation of storage repositories for radioactive waste. A large number of shaft construction projects have also been successfully completed in the field of civil engineering, including ventilation shafts in the Alpine region and raise boring shafts for hydro electric power stations.
The company has maintained its leadership in freeze shaft sinking by way of a programme of innovative developments based on extensive experience acquired in the field.
The ductile iron tubbing as well as the combined lining with steel tube are essential in construction range of the company.
Deep bored shafts of over eight metres in diameter are now being sunk by THYSSEN SCHACHTBAU in Germany, Australia, the USA and South Africa. The Primsmulde shaft in Germany, which

reaches a depth of some 1,250 metres, is still the deepest bored shaft in the world and in South Africa, working 3,500 m below ground at the Western Deep Levels gold mine, the company successfully drilled through rock with a strength rating of more than 600 MPa. It also introduced and perfected the fully-mechanised technique of pilot hole-based shaft sinking.

The mine shafts that THYSSEN SCHACHTBAU drilled for the coal industry in Alabama are another first for the shaft sinking sector: the record sinking rates of over 500 metres a month of fully bored and lined shaft that were achieved in Alabama have still to be surpassed anywhere in the world.

As well as increasing the sinking rates and sinking performances efforts are now being made to reduce construction times, and hence to gain quicker access to the geological deposits, by using the permanent head-frames and headgear systems as far as possible for the initial sinking phase.

The dimensions of the winding machines have also increased to support the equipment required for the simultaneous sinking and support work and high-performance double drum winders with round strand ropes are now available for shaft sinking duties. State of the art equipment for conventional shaft sinking now includes kibbles with dirt capacities of up to 7 m^3, multiple-arm shaft boring machines and orange-peel grapples with loading capacities of 1.2 m^3.

The development of multi-deck shaft platforms from which the permanent shaft lining, in-shaft fittings and supply lines can be installed in parallel with the sinking operation has led to a significant increase in the weight of these multifunctional steel structures. The use of resin-grouted rockbolts for shaft support makes it much easier to fit the carrier brackets needed for the shaft guides and buntons. Shafts with optimised profiles now provide space not just for mineral winding operations but also for the installation of the increasing number of in-shaft pipes, power cables and supply lines that a modern mine needs for its infrastructure systems of today.

The new THYSSEN SCHACHTBAU: all tooled up for the future!

THYSSEN SCHACHTBAU , which has its head office in Mülheim an der Ruhr, now has branches in Moscow (Russia), Almaty (Kazakhstan), Sedrun (Switzerland) and Graz (Austria); the company currently has a 900-strong workforce.

Within three years 300 additional employees have been hired for shaft sinking, thus the average age of the staff is now 41 years. In combination with carefully handling of the environmental resource it is a contribution for sustainability as well.

Extensive investment in personnel and in innovative, state-of-the-art machinery ensures the firm is properly geared up to deliver technical services of the highest quality.

While shaft sinking is mostly into the depth, thus in freetime they looking for a climb up together

In 2011 the company invested in a high-performance Rhino 20007 raise boring machine from Sandvik. This will extend the range of shafts that can be drilled using the raise boring method to include structures 1,000 metres in depth and 6 m in diameter. A large number of core drilling and directional drilling machines have also been procured, including two RB 50 rotary drilling rigs (made by Prakla Bohrtechnik GmbH), five Diamec 262 and Diamec 282 type core drills (from Atlas Copco) and three Hütte HBR 201 machines. The precision drilling of freeze-holes took another step forward at the Gremyachenski project site in Russia, where drilling depths of 520 metres were successfully achieved. Geological, geotechnical and hydrogeological exploration drilling using wire-line coring and counterflush drilling techniques, which feature largely in THYSSEN SCHACHTBAU operations in Switzerland and Austria and for German-based potash company K + S Kali GmbH, have traditionally been one of the company's core competences.

For further supplement of the mechanical tunnelling equipment, the former ultra- modern road header in 100 tons category, type "Alpine Miner 105 G" from the manufacturer Sandvik is in using. The roof-bolt working stage of the road header is equipped with two drill booms.

The shaft-sinking pool has been strengthened with the purchase of sinking winches, service winches, platform hoists and cablewire winches from OLKO Maschinentechnik, which are needed for sinking shafts in excess of 2,000 m in depth. High-performance sinking grabs and multi-arm shaft boring machines have also been modified and upgraded in line with the latest operating technology.

To facilitate the sinking of the 2,050 m-deep WS 10 shaft at Norilsk, which has a finished diameter of nine metres, the THYSSEN SCHACHTBAU engineering department developed a seven-deck platform system that can be deployed in the shaft without the use of platform winches. Given the extreme depth of the shaft sinkings and platform weights of nearly 200 t the classic winch-operated platform system was not a practicable

proposition in this case because of the need to meet rope breaking strength and safety-factor requirements.
In the specific area of freeze-shaft sinking the company's plant pool was also augmented with the acquisition of mobile freeze units with a total refrigeration capacity of over ten megawatts. The latest equipment and instrument systems have now been acquired and developed, along with special software for controlling and monitoring the freeze-wall development. The calculation processes needed to measure the site-specific freeze-wall thickness and its progress were also upgraded and refined, along with the associated imaging systems.

Shaft sinking in Russia and Kazakhstan

In Russia the company is actively engaged in shaft construction projects in the Volgograd, Perm and Krasnoyarsk regions. These operations involve sinking depths in excess of 2,000 m along with freeze shafts with freeze-wall depths of as much as 520 m. THYSSEN SCHACHTBAU has now entered into partnership with the Schrobenhausen-based company Bauer AG (through their subsidiary Schachtbau Nordhausen GmbH) to set up a joint shaft sinking company in Almaty: it is hoped that the joint venture undertaking Schachtbau Kasachstan GmbH will be a successful and long-term market player in the region.

Specialist underground engineering in the heart of the Alps

The company will now be fully engaged through 2012 on shaft construction drilling, raise boring and core drilling operations in Switzerland.
The permanent joint venture company TIMDRILLING was specifically set up with Swiss partners IMPLENIA Bau AG in order to undertake these assignments.

View onto the shaft side Gremjatschinskij

Raise bore rig Wirth HG 160

In Austria the company is currently working on the construction of an 800 metre-deep, 48-degree pressure tunnel at the Reisseck II hydroelectric power station, an operation requiring an extensive programme of exploration drilling.

Specialist mining projects in Germany

In Germany the company had traditionally focused on the coal, potash and rock-salt industries and on mining projects for the underground storage of radioactive waste.
Underground mineral bunkers are a vital part of any mine's conveying system and the work involved in constructing and supporting these installations is very similar to that carried out

Raise bore machine Wirth HG 250

in shaft sinkings. Bunkers are a key component in the underground network - playing a vital role as blending points for the product streams and providing bridging capacity for production stoppages. In this way they ensure the highest possible utilisation rate for the production faces. Vertical bunkers can be designed as free-fall installations or, where degradation is to be avoided, as spiral-chute systems. Bunkers can be lined with concrete blocks and precast concrete segments or may be fitted with wear-resistant steel-fibre panels with built-in spiral chutes, according to requirements. THYSSEN SCHACHTBAU is currently constructing three coal bunkers under contract to RAG Deutsche Steinkohle.

The company is also involved in roadheader drivage and conventional drivage projects for the German coal industry and is achieving heading performances of as much as 200 m a month. Approximately eight kilometres of stone drifts and in-seam drivages are completed every year.

THYSSEN MINING Group operates global

THYSSEN MINING Group, made up of Byrnecut Mining, Australia and THYSSEN Mining Construction of Canada (TMCC), also THYSSEN SCHACHTBAU GMBH, Germany are still THYSSEN-holding, namely holding by Count Claudio Zichy-Thyssen. Count Claudio, the great-grandchild of the founder August Thyssen, is still most intimate to the venture. Mining and shaft sinking are still in focus of his business interests. Within the venture group he personifies the corporate philosophies of tradition and innovation.

Periodical visits of his specialized mining ventures are constituent part of his traditional consciousness and sustainable action.

The proud of the THYSSEN-family is transferring to the employees exactly as it will be expected from the old August Thyssen. The THYSSEN MINING Group participate on global special mine construction working for field development and mining of resources. Also in phases of economical crises the count Claudio don't raise doubts about the success and efficiency of the hard coal mining-oriented venture group. He firmly believes that the company will grow sustainable due to increasing global needs for resources that has to be developed by new shafts, tunnels, bore holes.

Technical drillings in Faido, Gotthard Basistunnel, Switzerland, for the work force TAT

DIN ISO 9001 certification and staff qualification

In order to provide effective support to the company as it fulfils its contractual obligations to customers and meets legislative requirements and the various tasks resulting therefrom THYSSEN SCHACHTBAU – Shaft sinking and Drilling department – has introduced an integrated management system covering all quality- assurance and work-safety aspects of its operations. This procedure conforms to DIN EN ISO 9001 and also meets the requirements of the 'SmS certification' (system-oriented safety), which is a health and safety initiative set up by the BG RCI (Mining and Chemical Industry Employers' Association).

In July 2011 the certification process was completed and the certificate was duly awarded by the TÜV Rheinland certification body.

During the last two years company personnel have again been intensively engaged in a vocational development programme based on professional and advanced training courses. These sessions mainly focused on shaft winding systems, shotfiring, hydraulics and automation and control technology. This staff training and qualification process is to be maintained and developed over the coming years.

"Systematic Safety at Work" re-audit

The company has remained fully committed in recent years to its workplace safety improvement targets. A total of 3 reportable accidents were recorded in 2010. This represents a continuation of the downward trend of recent years – demonstrating that an ongoing process of improvement is taking place and that THYSSEN SCHACHTBAU is now setting high standards in this area.

There is no doubt that the 'system-oriented safety' initiative introduced in 2004, which was initiated by the Mining Employers' Association, has made a significant contribution to the declining accident rate. The SmS certificate, which recognises that an undertaking meets systematic health and safety requirements based on the OHSAS 18001 standard, was again awarded to the THYSSEN SCHACHTBAU operational departments for a further three years following a successful audit in 2011. The award confirms the high safety standards that THYSSEN SCHACHTBAU has set in

recent years and demonstrates to employees and clients alike the important role that health and safety plays in the company philosophy.

THYSSEN SCHACHTBAU as "System-Provider" for Shaft Sinking and Hoisting

THYSSEN SCHACHTBAU is now able to provide the permanent hoisting systems beside the shaft sinking work „from one hand" by clearing all interfaces due to the integrate of the "OLKO-Maschinentechnik GmbH", Olfen (also see additional articles). Advantages for clients while designing, manufacturing and maintenance of shafts will be generated by synergy effects due to this combination. Investments and construction phases for mining development can be reduced significant. The permanent hoisting technology can be used more intensive and diverse for shaft sinking or shaft maintenance. This applies particular to the head frame, head sheave, hoisting engine, winches, pit frame, signal and control system, automation technology and the equipment for power supply as well.

Efficiency improvement phase completed – consolidation phase begun

The strategic process of efficiency improvement and structural streamlining that commenced in 2002 has been completed. THYSSEN SCHACHTBAU now intends to secure and consolidate what has been achieved.

The business years 2009 to 2011 saw further company expansion combined with a number of major new investment decisions. This major surge in capital investment will now be followed by period of consolidation.

The development of new organisational structures, along with the introduction of new, quality-assured processes and procedures, the induction and integration of new staff and the acceptance of new tasks and responsibilities, has meant extra effort, additional expenditure and increased operating costs – but this will all pay dividends in the future. The financial and structural investment decisions that have been made are very much targeted at the sustainability and future viability of THYSSEN SCHACHTBAU as a company.

The shaft sinking department has taken on more than 250 new staff over the last two years and the average age of the workforce is now 41. The TS recruitment policy, like its careful approach to environmental management, is therefore contributing to the company's future sustainability.

The new THYSSEN SCHACHTBAU strategy and corporate policy will help the company make the most of the opportunities arising in the market. Our expertise in a range of specialist areas not only provides real customer benefits but also maintains the tradition and consistent development that THYSSEN SCHACHTBAU has displayed over the years. We are strongly placed for the future and can look forward to all the new challenges that face us at home and abroad. And we will remain true to our motto: 'Fully committed to delivering success for our customers and clients.'

Norbert Handke
Michael Haccius


Zertifikat

Prüfungsnorm ISO 9001:2008

Zertifikat-Registrier-Nr. 01 100 110069

TÜV Rheinland Cert GmbH bescheinigt

Zertifikatsinhaber: THYSSEN SCHACHTBAU

Thyssen Schachtbau GmbH
Friedrich-Ebert-Straße 120
D - 45473 Mülheim an der Ruhr

Geltungsbereich: Teufen, Sanieren und Verwahren von Schächten; Erstellung untertägiger Grubenräume; Explorationsbohrungen über Tage und unter Tage; Herstellen von Hauptbohrungen; Planung und Projektierung von Schachtförderanlagen; Erstellen von Planungs- und Konzessionsunterlagen

Durch ein Audit, Bericht Nr. 110059, wurde der Nachweis erbracht, dass die Forderungen der ISO 9001:2008 erfüllt sind.

Das Fälligkeitsdatum für Folgeaudits ist der 06. Jul.

Gültigkeit: Dieses Zertifikat ist gültig vom 12.07.2011 bis zum 11.07.2014.

12.07.2011

IAF

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Shaft Sinking and Drilling division proves its worth

In July 2011 the THYSSEN SCHACHTBAU Shaft Sinking and Drilling division was awarded DIN EN ISO 9001 certification – further proof indeed of the high quality standards that the company sets.

In early July 2011 the THYSSEN SCHACHTBAU Shaft Sinking and Drilling division had its quality management system certified to international standard ISO 9001 by TÜV Rheinland. THYSSEN SCHACHTBAU first developed and introduced its own quality management system back in the late 1990s. The company was keen to ensure that clients would continue to receive the high quality they had become accustomed to as projects became increasingly complex and demanding and at the same time wanted to prevent existing know-how being lost during the restructuring process that was about to commence. As recent experience has repeatedly shown that clients not only want to see such a quality management system in place in-house but also expect this to comply with internationally recognised standards, the company took the decision to have the existing quality management system certified to comply with international standard DIN EN ISO 9001.

Within just a few months the existing system was revised, where necessary, and adapted to meet the requirements laid down in the standard. This also provided an opportunity to incorporate the SmS initiative (system-oriented safety), an additional health and safety certification based on international standard OHSAS 18001, which the company has been awarded on repeated occasions by the BG RCI (German Mining and Chemical Industry Employers' Association). The upshot of all this has been the creation of an 'integrated management system'.

Thanks to the commitment shown by the workforce the assessment was able to take place after just a brief 'training phase' and TÜV Rheinland was assigned the task of determining whether or not the company's quality management system met all the requirements of ISO 9001.
After an audit lasting several days, which included an inspection of working procedures at an operating site, the certificate was finally awarded with special recognition and without limitations. The certification, which is subject to annual inspection, remains valid until July 2014.

With the award of the ISO 9001 certification the Shaft Sinking and Drilling division has once again demonstrated that its performance meets the very highest standards. From proposal acquisition to tender preparation, planning and project design, and from project execution through to project hand-over, 'Shaft Sinking and Drilling' always works to the highest quality standards and strives at all times to create added value for its customers. The quality certification will now help get this message across to new clients and will have a positive impact as the company seeks to develop its market position, especially in the Alpine region and Russia.

Markus Beermann
Dr. Axel Weißenborn

The brand new Rhino 2007

Investing in the future

THYSSEN SCHACHTBAU GMBH has been involved in the raise boring sector for a number of years. More recently we have seen a growth in the demand for larger profile raise projects and for inclined borings too. This report describes how we have responded to this development.

Renewable energies

The global agreements on CO_2 reduction and the nationally agreed CO_2 targets have focused increasing attention on the exploitation of renewable energies. The expansion of this sector has meant an ongoing increase in grid load, as new grid in-feeds such a solar power and wind energy are very irregular in the manner in which they supply power directly to the consumer. One technical solution that can help balance out these supply fluctuations and store up this potential energy for use when it is needed is to build pumped storage power stations.

The pumped storage plant as a back-up system

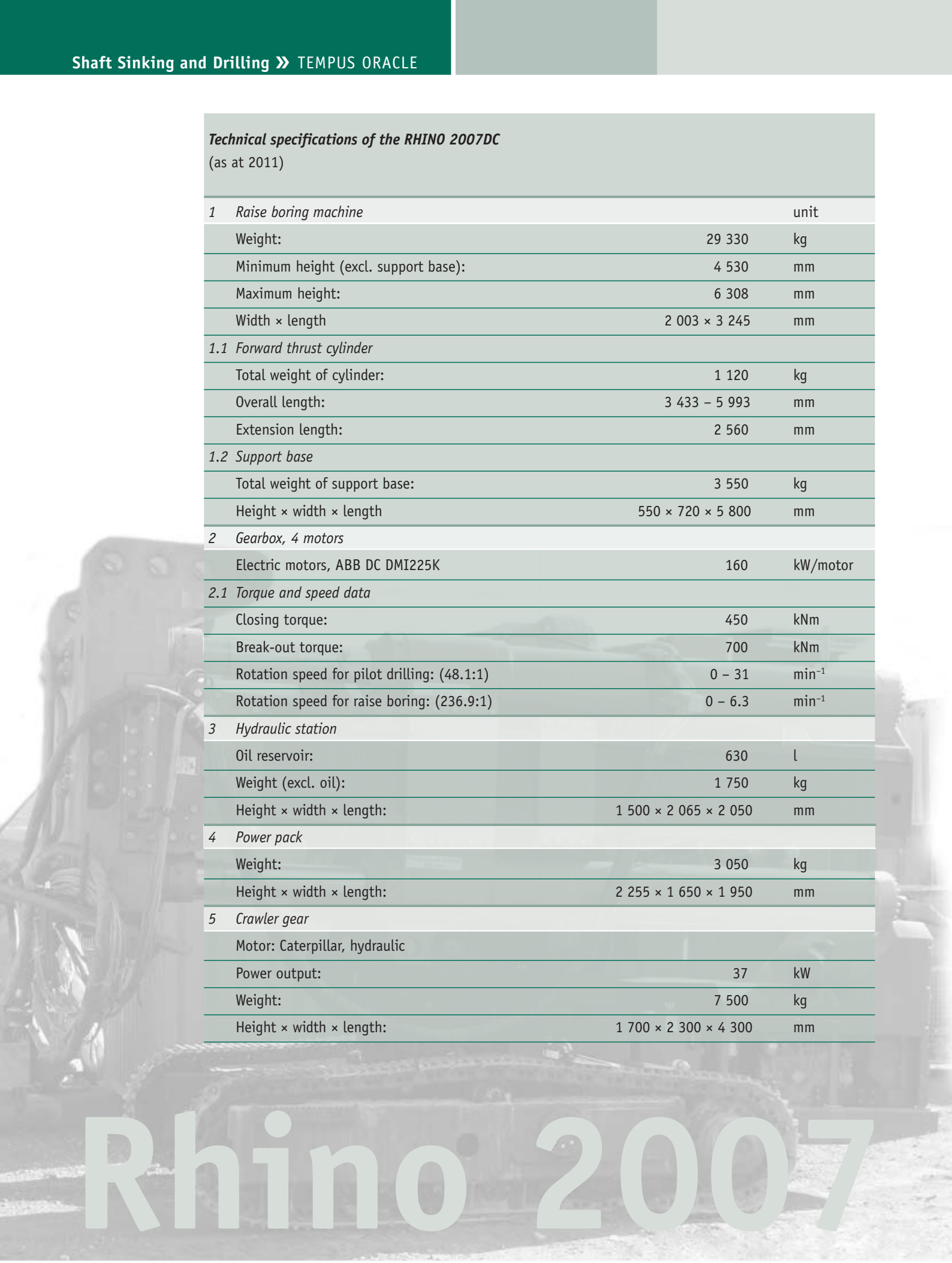
A pumped storage power station only needs a few minutes to run up to full load. If the power supply grid is affected by severe power fluctuations, for example as a result of technical problems at another power station or due to load peaks caused by increased demand from consumers, the pumped storage plant can quickly provide the balancing input that is needed to back-up and stabilise the public grid system. Furthermore, when there is an oversupply situation, and more particularly during night-time hours or when there are strong winds, the pumped storage plant is able to counteract this situation at very short notice by providing a power storage capacity. In 2011 the overall energy efficiency of pumped storage power stations was as much as 75%.

Development boost for raise boring technology

There is therefore expected to be an increased demand for underground infrastructures of the type that are required for projects of this kind, including surface shafts, staple shafts and headrace tunnels with horizontal, vertical and inclined alignments. In order to strengthen its market position and keep pace with the technical demands imposed in this sector THYSSEN SCHACHTBAU has continued to expand and renew its pool of raise boring equipment.

Technical specifications of the RHINO 2007DC
(as at 2011)

1	*Raise boring machine*		unit
	Weight:	29 330	kg
	Minimum height (excl. support base):	4 530	mm
	Maximum height:	6 308	mm
	Width × length	2 003 × 3 245	mm
1.1	*Forward thrust cylinder*		
	Total weight of cylinder:	1 120	kg
	Overall length:	3 433 – 5 993	mm
	Extension length:	2 560	mm
1.2	*Support base*		
	Total weight of support base:	3 550	kg
	Height × width × length	550 × 720 × 5 800	mm
2	*Gearbox, 4 motors*		
	Electric motors, ABB DC DMI225K	160	kW/motor
2.1	*Torque and speed data*		
	Closing torque:	450	kNm
	Break-out torque:	700	kNm
	Rotation speed for pilot drilling: (48.1:1)	0 – 31	min^{-1}
	Rotation speed for raise boring: (236.9:1)	0 – 6.3	min^{-1}
3	*Hydraulic station*		
	Oil reservoir:	630	l
	Weight (excl. oil):	1 750	kg
	Height × width × length:	1 500 × 2 065 × 2 050	mm
4	*Power pack*		
	Weight:	3 050	kg
	Height × width × length:	2 255 × 1 650 × 1 950	mm
5	*Crawler gear*		
	Motor: Caterpillar, hydraulic		
	Power output:	37	kW
	Weight:	7 500	kg
	Height × width × length:	1 700 × 2 300 × 4 300	mm



Assembling test for the Rhino 2007 on our premises in Mülheim

Raise drilling machine Rhino 2007 on crawler

The raise boring industry has seen enormous technical advances in recent years. Increasingly large and power machines are being developed and the equipment now coming on to the market boasts a high level of automation. In some cases only one person per shift is needed to operate the machine.
This equipment is now developing a performance capability that is beginning to compete with that of conventional shaft sinking technology: this means sinking depths of 1,000 m and more and shaft diameters of up to 7 m in rock with compressive strengths of up to 200 MPa.

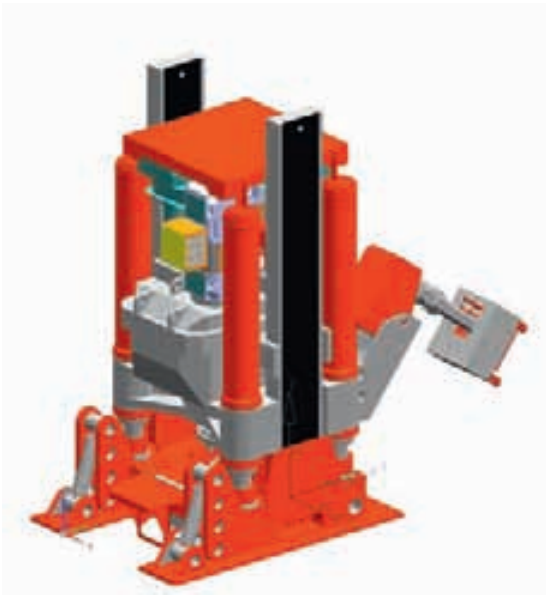
A return on investment

The results of an extensive market analysis have indicated that investing in the mid-range segment would have the best prospects of success in terms of achieving the fastest possible return on investment.

After a detailed investigation of the range of raise boring machines available on the market, together with an evaluation of various offers, the decision was eventually taken to procure the RHINO 2007 DC machine supplied by the Finnish company TRB. A key factor in making this major investment was the fact that it was a project-based purchase. The technical concept for the construction of the Reisseck II pumped storage power station provides for a total of four vertical and inclined raise boreholes with dimensions that would fall within the range of the new raise boring machine.

The current market situation gives good reasons to be optimistic that our raise boring installation will also be deployed in other projects in the foreseeable future.

Tilo Jautze
Joachim Gerbig



Rhino 2007 retracted

Rhino 2007 extended

Adjustment path to prepare the slide bars

Borth mine: Combined effort brings its reward

The Shaft Guides consortium was commissioned to dismantle the existing eight wooden rigid guides, along with their timber buntons, down to the 760 m level and to replace these with four new steel guide rails. The retrofit also included replacing the larger-profile sump guides.

Background

Before the commencement of the main operation the Shaft Sinking and Drilling Division of THYSSEN SCHACHTBAU fitted new steel buntons between the existing timber beams. This work was carried out mainly on the night shift while the shaft remained in service, so that normal winding operations were scarcely disrupted.

During renovation work in shaft number 2 esco GmbH had installed a new head frame and shaft surface building, along with a new inset frame at the 740 m level. The shaft was also to be equipped with a new winder.

The old four-compartment winding system was converted to a two-compartment arrangement (large-capacity cage and counterweight). The steel guides were procured from the Niedersachsen/Riedel mine (K+S) and comprised GHH-type and DH-type rigid guides.

Preparatory work

The Shaft Guides consortium had a maximum time-slot of eight weeks in which to complete the work in shaft number 2 at Borth mine. THYSSEN SCHACHTBAU took the role of technical leader, while Deilmann Haniel Shaft Sinking GmbH acted as the commercial manager.

The Thyssen Schachtbau engineering office worked closely with the managers on-site to develop an operating schedule for the renovation work.

The pre-used guide fittings (GHH and DH type) first had to be checked for length and verticality. An industrial tent measuring 12 m x 6 m was specially erected for this purpose. This tent was equipped with a straightening line complete with rollers, two electro-welding machines and an industrial band saw.

In order to prepare the steel guide fittings a team from the consortium first carried out a height survey of the individual steel bunton horizons. The steel guides were then cut and welded

Working platform inside the hoisting cage with generator

according to the measured horizons. This operation began some 14 days before the in-shaft refit so as to ensure a good head-start with the steel fittings when the old guides were being changed over.

Shaft work

Both shaft conveyances were specially modified for the shaft refit operation. The engineering office and on-site management team opted for an elevated platform structure built into the shaft conveyance. This platform had three working levels with extendable decks and overhead screens. Lightweight guide-rail systems with anchor points and roller carriers for hoisting gear were also installed on the working decks.

The conveyance also had an on-board diesel generator that could provide a stand-alone power supply. Each of the working platforms was supplied via an on-site electricity distribution system, as all the machines and appliances being used for the project were electric powered.

The converted cage with its counterweight was equipped with magazine capable of accommodating 8/4 individual steel guides of 9 m length, which was also used to transport the guides to the installation site. The steel guides were manoeuvred into position using an electric winch operating from the conveyance's suspension beam.

The counterweight guides were dismantled first. The wooden slats were cut into transportable pieces of about 1.5 m so that a 9 m-long steel guide could be installed. Timber-to-steel crossover pieces were incorporated into the line in order to ensure that the conveyance was running on guides at all times.

This same method was also used for replacing the cage guides. The larger-profile guides in the shaft sump (timber mountings) and in the shaft headframe were then replaced.

After the four lines had been changed over (two from the cage and two from the counterweight) work could begin on the removal of the wooden buntons and the remaining sections of shaft guides.

The completion of the in-shaft operation was marked by the installation of the new guide fittings. A clamp-on plumb line was fitted for each run of shaft guides and this was used to line up the guides and buntons.

The project was concluded with the cage and counterweight being converted back to their original functions and the installation of the roller sets.

And finally ...

The work then had to go through various approval formalities and checks by specialists and mining inspectorate officials – and the findings gave complete satisfaction all round. Borth mine was able to commence operations in number 2 shaft on time.

The site management would like to thank the client esco, the mining authorities of the Arnsberg regional administration and the experts from DMT for the excellent level of cooperation enjoyed during the operation – and also wishes to congratulate the working teams from the two partner companies for completing the project without a single accident.

Veit Passmann
Gert Winkler

Rope assembling at shaft K1

The Konrad transformation – from iron-ore mine to a final waste repository

The joint venture partnership of mining specialists THYSSEN SCHACHTBAU GMBH and Deilmann-Haniel Shaft Sinking GmbH have now received another order from the DBE (German Service Company for the Construction and Operation of Waste Repositories). In addition to the existing contract for the refit of number 1 shaft at the former iron-ore mine – as we covered in Report 2010 – the partners have now been commissioned to renovate Konrad number 2 shaft and undertake various operations in the adjacent shaft inset areas.

Activities at Konrad number 1 shaft

The dismantling work began in number 1 shaft at the turn of 2010/2011. The winding equipment needed for this operation, essentially comprising a medium-capacity winding system, emergency winder and five-deck stage, which was operated by two platform winches, was installed before the project commenced. The rope sheaves needed for winding operations were installed on the lower rope-pulley deck of the existing twin-strut headframe, itself a listed building.

In view of the important role that number 1 shaft plays in the overall infrastructure of Konrad mine it was decided that the winding compartments of the old shaft winding installation, comprising a south and a north twin-conveyance winding system, would be renovated in alternate phases.

Work commenced first in the south compartment in January 2011 and involved the removal of the ladder shaft and the cable runs that were no longer required. The other shaft fittings were left in place during this 'first ascent of the stage', as both the bunton frames (which were used for ongoing operations in the north compartment) and the vertical shaft guides in the south compartment (which were needed for operating the stage system) were still in active service.

Work could then start on cleaning the shaft walls and re-pointing the joints. The lining mainly comprised concrete blocks in combination with brickwork cribs. The renovation work on the lining was initially restricted to just two tracks in the south compartment, where the new horizontal shaft fittings would later be installed. These horizontal fixtures essentially consist of pipe brackets that will support the two lines of shaft guides for the permanent drum winding system.

Because of serious corrosion damage to the collar frame at the top of the shaft the renovation work on the lining was interrupted and the renewal of the collar frame – which had been planned in any case – brought forward. The ASK 1 consortium, which was commissioned to refit Konrad number 1 shaft, was also involved in this operation at the top of the shaft and carried

out the extensive excavation and steel-concrete work needed to create a bearing surface for the new frame.
Hydraulic concrete chainsaws and expansion grout materials were used to excavate the cavity space that had to be created around the top of the shaft. This helped produce an extremely exact excavation profile for the concrete phase that was to follow.
After completion of the renovation work on the shaft side-walls and the installation of the horizontal and vertical guides and shaft fittings in the south compartment – probably in early 2013 – the actual shaft operation being undertaken by ASK 1 will be halted so that the new drum winder 'south' can be put into operation. Shaft work in the north compartment is then scheduled to recommence in the first quarter of 2014. During this second project phase all the original shaft fittings still in place inside the shaft column will be removed, the shaft walls will be refurbished and the guide fittings, together with the bottom frames at the connections to the underground mine workings, fixed into position for the modern twin-rope Koepe winder that will come into service.

Refurbishment of Konrad number 2 shaft and connecting mine workings

The key aspects of the operation in number 2 shaft are:

- renovation of existing shaft fittings
- restoration of the brickwork
- installation of safety decks and fan drift in the shaft
- installation of inspection systems and platforms
- strengthening of the existing inset road on mine level 2
- equipping and widening of the shaft landing on mine level 2
- renovation of the landing on mine level 3
- part-drivage of a storage transport roadway close to the shaft landing
- installation of the permanent shaft fittings.

The work of equipping and widening the landing on level 2 was made even more challenging by the planning and geometrical specifications that were being imposed in addition to the existing geotechnical and geomechanical parameters. The project remit also included drawing up and/or revising the relevant approval plans and contractors' documentation for plant and equipment.
Work began in March 2010 on restoring the existing brickwork in number 2 shaft.
The shaft was cleaned from top to bottom and any defective areas of brickwork re-pointed or replaced.
Non-destructive measurements were also taken at the concrete seals around the hils sandstone.
The actual construction work requires a number of safety decks to be erected in the shaft. By dividing the shaft in this way it is possible to work on several levels simultaneously.
The work in the shaft zone at mine level 2 is being undertaken from a platform operated by hoists and safety chains. The escape route via Konrad number 2 shaft also has to be kept open for the duration of the construction phase.
The safety deck and debris platform system is designed in such a way that the emergency winder can provide continuous travel through the shaft at all times during the construction period.
Part of the work to be undertaken in number 2 shaft involves the excavation and reconstruction of the insets and shaft areas on mine levels 2 and 3.
The 'old inset roadway' has to be renovated in preparation for the new inset drivage operation.
The crown section of the new inset, which is only one metre above, will then be excavated via the renovated roadway.
The old rigid G-profile roadway supports will be removed and replaced by yielding, four-piece TH arches embedded into the floor and a 30 cm-thick layer of shotcrete as backfill. Reinforcing bolts and possibly strata injection too will be used as a temporary support measure, depending on the strata conditions.
The mobile working stage will be used to extend the shaft by some 20 metres in both directions around the inset on mine level 2. A shaft excavating machine will widen the shaft diameter on a tapering profile from 7 metres to 12 metres.
The existing shaft landing will be widened over a length of 90 metres. The 3 x 3.5 metre horseshoe shape will be extended to create a circular profile 12 metres in diameter. The old roadway axis will be sited off-centre in the new shaft landing.
As difficult geological conditions are anticipated (platy dolomite), the new landing is to be excavated in three sections in imitation of the New Austrian Tunnelling Method (crown, side-walls and floor).
The individual sections will be excavated in succession over their full length. The drivage work is to be tackled by a 'shaft excavator', a compact-sized, manoeuvrable machine that can be fitted with a range of attachments. Cutting will be the preferred excavation method, though the machine can be converted to operate as a ripper if harder strata are encountered.
Immediate support-bearing measures will be put in place as soon as the cavity has been excavated. The first support phase will comprise yielding rockbolts and a shotcrete layer. Compression joints will be incorporated into the shotcrete shell so that convergence can take place in a targeted manner.
The excavation phase will be followed by a convergence waiting period during which a monitoring system will be provided so that the client can observe any convergence movements.
As soon as the floor of the inset has been excavated work can start on driving the storage transport road.
The roadway is to be driven in two parts – the crown section and the side-walls – over a length of some 40 metres. The support system will be identical to that used in the inset and shaft.
Once any convergence movements have subsided the final support

Cleaned and grouted shaft wall

system can be set in place. The length of the yielding bolts will be adjusted accordingly, the compression joints cleared and sealed with shotcrete and, finally, the permanent layer of shotcrete sprayed into place.

Quality assurance and documentation

For the Konrad project quality control and documentation is a key aspect of the services to be performed by the consortium and to this effect the ASK partnership set up its own quality assurance and documentation department.

Each and every construction measure in which material is permanently left in the structure requires a 'control plan' to be drawn up ahead of the operation in question. Like a kind of check-list this plan serves both as a set of instructions for carrying out the work and as a record whereby all the different stages of the operation can be followed-up. The control plan contains all the approval certificates, data safety sheets and hazardous-substance assessments for the materials being used, along with the approval certificates and operating instructions for machines, and the health and safety documentation.

The control plan also provides for appropriate supporting documents (measurement logs and photographs) as proven verification of compliance with the detailed operating, installation and quality assurance instructions that have been put in place. The plan, which therefore contains all relevant information about the construction project, from the preparatory phase and execution to the completion of the work, is to be presented to the client when the project finishes. As a quality management system it therefore serves both as a set of specifications and as a verification document. When the project is finally handed over to the client the extensive body of documentation is to be filed both electronically and on paper hardcopy.

Conclusions

As well as providing specialist mining companies with an opportunity to carry out their core business activities, namely the construction and renovation of shafts and underground mine workings, the waste storage facility also presents an additional challenge as regards quality control and documentation. The ASK consortium will be working closely with all the coordinators and project managers from the DBE (German Service Company for the Construction and Operation of Waste Repositories) to ensure full compliance with the stringent requirements associated with this new underground waste storage facility.

Jürgen Dollmanski
Natascha Groll
Hubertus Kahl

Raise boring HG250 while drilling

Tough going for man and machine

In July 2008 RAG issued a call for tenders for the sinking of a new staple shaft at West colliery. The bidding consortium 'ventilation borehole F275' – comprising partners THYSSEN SCHACHTBAU GMBH and DHSS GmbH – has tendered successfully for RAG vertical development projects for a number of years and the client also entrusted this challenging engineering project to the experience and know-how of the F275 consortium.

Technical background

Ventilation borehole F275 was constructed by raise boring to a diameter of 3.66 m and a depth of 320 m. Its completion meant a new ventilation route to the two proposed new working panels 630 and 632 in the deep-lying Girondelle seam.
Given the existing shaft parameters it was decided to use a Wirth type HG 250 raise boring machine for sinking the staple shaft. In order to achieve the directional accuracy specified by the client a Micron self-adjusting rotary vertical drilling system (RVDS) was employed in conjunction with a 10 " drill string for the 12 ¼ " directional borehole. After the pilot hole had been drilled to completion the directional drilling system with its roller bits was replaced by a Sandvik 3.66 m-wide raise boring head fitted with 20 monobloc disc cutters.

Pilot drilling

The assembly and equipping work began at West colliery in November 2008, though the pilot drilling did not commence until 21.01.2009 due to a delay in completing drivage E550 for the bottom roadway.
This lower road was to be widened to create a chamber that would constitute the end-point for the staple shaft with its shaft bottom. The pilot hole had to break through as accurately as possible to the centre point of this chamber. In order to achieve this level of directional accuracy it was decided to use a self-adjusting vertical drilling system, which is capable of a drilling precision of

Assembling of the reaming head at the bottom of the blind shaft

up to 0.3% deviation from the vertical. The pilot hole was drilled using a rotary, direct flush boring technique (direct circulation method) and the drill mud – in this case clean water – was fed to the drilling unit by means of a twin piston pump.
The drilling operation started off smoothly and after seven days the pilot hole broke through to the chamber. The deviation from vertical was about 15 cm. The RVDS did not have to be changed over and completed the entire 320 m without a hitch.
The entire drill string was then removed and the RVDS with its drill bits dismantled. The drill string was then reassembled and connected to the raise boring head so that the raise boring machine with its connecting rod could be set up in the shaft bottom chamber. Once this assembly work had been completed the chamber was sealed off with a baffle wall, for safety reasons, so that the drilling debris falling down the raise hole would not pose a risk to men and machinery. A small opening was left in the right side of this screen to provide access for a chain conveyor that would gather up the material as it came piling over the top of the debris heap and transport it directly to the main belt installation.

Raise boring:

Raise boring is a technique for drilling large-diameter boreholes in solid rock. Raising means using a dry drilling process whereby an extension drilling head fitted with discs gradually cuts its way to the surface. The largest raise boring machines currently in operation can draw up to 1,500 tonnes. This class of machine can drill shafts more than 6.0 m in diameter and up to 1,000 m in depth – depending on the strength of the local rock strata. One of the prerequisites of the raise boring method is to have access at the bottom end of the hole in order to clear away the debris produced as the machine cuts its way upwards.

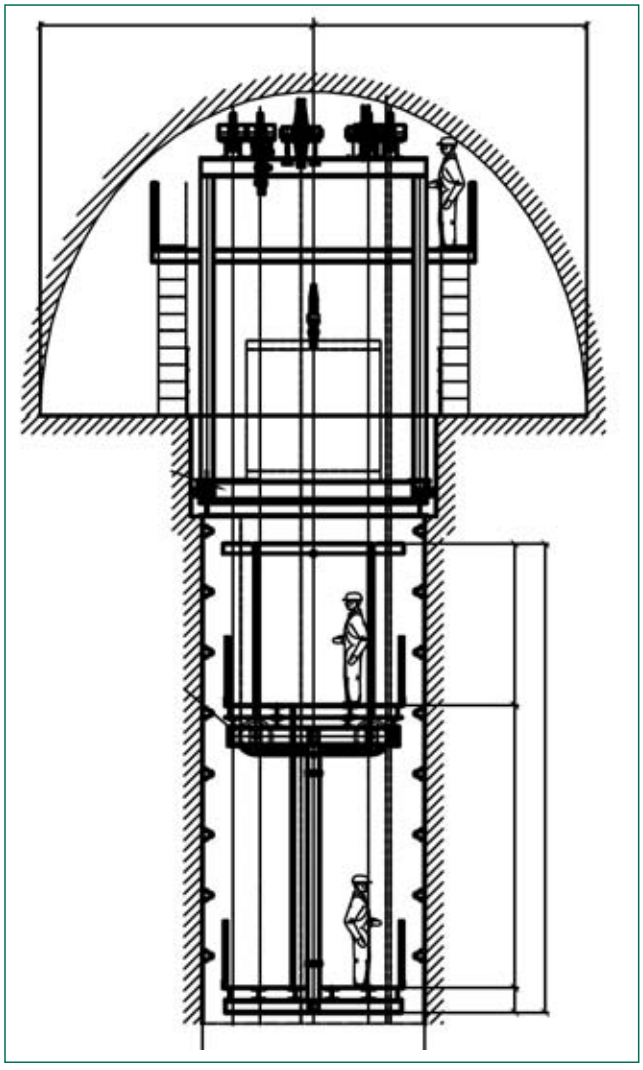
Reaming

All the preparatory work was completed by 11.02.2009 and the raise boring phase could begin. Unfortunately the drilling team realised after just a few metres that the geological conditions were far from ideal for a raise boring operation. During the first 30 m there were major rock collapses that prevented the drilling head from cutting uniformly and steadily. Add to this the fact that these large blocks of rock, some of which measured up to 0.5 m³ in size, occasionally caused damage to the drill head, which then had to be repaired.
After discussions with Sandvik it was decided that the raise boring head should have its cutter arms and disc cutters strengthened so that the normal drilling performance could be achieved even under such difficult conditions. Some of the drilling parameters, including contact pressure and rotational speed, were also adjusted to meet the challenge. As soon as these measures had been implemented the boring operation was able to continue at a quite acceptable rate of advance.
The extremely large-sized debris also posed loading problems at the foot of the shaft: the larger blocks sometimes jammed the chain conveyor and transfer point to the belt installation and had to be reduced in size. This meant frequent belt stoppages, which had a major impact on the drilling work and resulted in significant delays.
The enormous mechanical stress imposed on the drill head, combined with the frequent changes in the geological make-up of the strata – harder rock alternating with soft to very soft ground – also meant that the drill head had to be repeatedly inspected

and cleaned. The entire hole widening operation lasted until 04.06.2009.
Despite the delays imposed by the poor geomechanical conditions the operation was completed within the planned time frame thanks to the introduction of week-end working shifts.

Shaft lining

After the drilling operation had been completed on schedule the shaft support phase was able to commence as planned in June 2009. RAG also commissioned the F275 consortium to carry out this part of the overall project.
The infrastructure required to complete the support work was set up around the top of the shaft opening. This comprised a rope pulley frame, a platform winch, two hoisting winches for men and materials, an emergency travel winch and a cablewire winch.
The ventilation shaft was to be lined with a layer of shotcrete at least 5 cm thick to support the inner face of the shaft column and, additionally, to act as a levelling layer in those areas where breakouts had occurred. The frequent side-wall collapses encountered during the raise boring operations resulted in a much higher consumption of shotcrete than originally planned and formwork had to be installed in some sections before applying shotcrete to level off the larger cavities that had formed in the sides of the shaft. The shotcrete was delivered pneumatically via a drop pipe and a Schuerenberg concrete pump was used to dry spray the material into place. The material was supplied by the client in 'big bags'.
The shotcrete phase was followed-up by the installation of a three-piece yielding ring support system combined with a roll-mesh lining that was fixed directly to the shaft wall. The very cramped working conditions for the fitting and assembly team (shaft diameter 3.6 m) called for an extremely precise operating routine and perfectly coordinated logistics.



Working stage and rope pulley

Pipework

As soon as the shaft lining had been completed the operation then switched to the installation of some 15 in-shaft pipe columns. This comprised two fully-supported GRP pipes plus a total of 13 tension-proof socket connections with their mounting points at the top of the shaft. Screw couplings were also used for various pipes that would supply the new working panels with water, gas, air and calcium chloride ($CaCl_2$).

The final phase

The final piece of equipment to be installed was a small cage system that would be used for regular descents of the shaft in order, for example, to examine the condition of the pipes. This installation comprised a rope pulley frame, winch and travel cage. The cage itself ran on a tension-rope guidance system, with boarding and alighting points provided at the top and bottom of the shaft.

Conclusions

Despite all the problems and unforeseen obstacles staple shaft F275 was finally delivered on time, and fully equipped, in March 2010. The completion of F275 signalled the go-ahead for the first panel in the Girondelle seam to be started up.

Tilo Jautze
Veit Passmann
Mario Schöniger

Assembling of the measurement system and cementation technology

In-situ roadway stopping in rock salt measures

An in-situ feasibility test is to be carried out at the Morsleben radioactive waste site (ERAM) in order to verify that, as part of the care and maintenance plan for the former waste repository, salt-concrete structures can be used to create a safe and reliable stopping in horizontal mine roadways.

Background

The former Morsleben Radioactive Waste Repository is located close to the town of Morsleben in Saxony-Anhalt, close to the border with Lower Saxony. The plant is operated by the DBE (German Service Company for the Construction and Operation of Waste Repositories. The client is the German Federal Government, as represented by the BfS (Federal Office for Radiation Protection) Salzgitter. The installation, which was in operation until 1998, remains the only approved repository for radioactive waste in the whole of Germany.

The mine was used for potash production up to the early 1920s and then switched to mining rock salt until the end of the 1960s. During the Second World War parts of the mine were used as an armaments factory and inmates from the Neuengamme concentration camp were put to work there.

When salt production ended the nuclear plant operators of the then GDR acquired the site in 1970 with a view to using the mine for the storage of low- and medium-level radioactive waste. Storage trials subsequently commenced in 1978 and in 1986 the relevant GDR authorities issued a long-term operating permit. On the basis of this permit, which retained its validity after German reunification by way of a specific provision in the Unification Treaty, radioactive waste continued to be stored at the site after a brief interruption from 1994 to 1998.

A total of 6,621 radioactive sources and some 36,752 m³ of radioactive waste are now stored in the mine, with about 60% of this material having been deposited during the period 1994 to 1998. The solid waste material, which is contained in drums of 200 l to 570 l capacity, was stored on mine level 4 (at a depth of 500 m) in the former stope workings and also in specially excavated cavities. The liquid waste was first solidified with lignite filter-ash.

Preparation work inside the testing drive way and machine introduction

Project remit

The underground storage operation was discontinued in 1998 and in 2005, when it was decided that the facility would no longer be kept in service, work began on the planning of a care and maintenance phase. Investigations revealed that the underground workings exhibited stability problems due to the high excavation ratio – a legacy from the many years of active mining operations.

Many of the cavities (former stope workings) have already been filled in, with THYSSEN SCHACHTBAU already having played a major role in this operation (see Thyssen Report 2004). In 2009 the BfS submitted the documentation relating to a nuclear planning approval procedure for the closure of the ERAM facility.

As well as additional stabilisation work in those cavities and storage chambers that are still open the decommissioning plan includes the construction of stoppings at various points along the horizontal mine roadways. These will serve as important elements in the overall safety plan being developed as part of the long-term safety guarantee for the facility.

These roadway seals will separate the general mine workings from the waste storage areas and will prevent any potential nuclide transfer. In-site tests are to be carried out to confirm that such stoppings are fit for purpose (in-situ trials on a 1:1 scale under real conditions).

These in-situ tests have been the focus of a number of different studies in recent years, with much of this work – in which THYSSEN SCHACHTBAU and its subsidiary TS BAU played a major role – being undertaken in collaboration with institutes and universities, in-cluding the Freiberg University of Mining and Technology, the Institute for Deep Geological Disposal, GSF (National Research Centre for Environment and Health) Munich, the Fraunhofer Institute Dresden and the IFG Leipzig.

Many different practical tests and trial constructions of seals and stoppings were also undertaken in order to examine the functional viability of the sealing elements and these activities yielded much valuable information for follow-on projects.

In March 2010 the contract to erect structures for the ERAM facility was put out to public tender. As THYSSEN SCHACHTBAU and TS BAU had already constructed similar stoppings in other collieries the two companies set up a consortium with Schachtbau Nordhausen GmbH in order to bid for the contract.

This partnership was eventually preferred over four other bidding companies and after extensive planning and preparatory activities the actual underground work began in September 2010.

The contract

The contract provided for the construction of a 25 m-long roadway stopping. This structure was to comprise a number of different elements, namely a sealing body (M2 grade salt concrete), a contact zone, a disturbance zone in the rock salt and a plastic joint. The Morsleben operators built a stub roadway with a cross section of 20 m² specifically for this purpose.

A borehole was also drilled from another roadway, which was also specially driven for the purpose above and to the side of the target road, in order to reach the front of the stopping – which would eventually no longer be accessible. This borehole would later be used to apply pressure to the stopping in order to verify its leakage-resistance. As well as building the structure itself the contract also provided for the installation of an extensive range of measuring devices for monitoring the condition of the stopping. Before the actual structure was built a large number of injection hoses, which would later be used to carry a sealing suspension, were laid into the area to provide a means for injecting sealant if a contact joint were to open up at some future point between the body of the stopping and the surrounding salt rock or the disturbed zone/fissured zone.

Execution

The operation to construct the roadway stopping commenced on schedule in September 2010. After setting up the work-site the first operation was to erect shuttering close to the proposed roadhead. This was needed for the construction of a salt-

"Air-side" of the infal dam construction

concrete face with a precisely defined slope and surface roughness.
This was followed by the installation of the pressure chamber and control chamber. Slits were then made in the injection hoses around the circumference of the roadway profile at intervals of 0.75 m. These would be needed for the secondary-injection phase. Additional equipment was also installed for the concreting phase.

A wide range of measurement devices were also incorporated into the roadway roof, face and side-walls. All the injection hoses were then laid towards the 'fresh air side' via a cladding tube suspended in the centre of the open roadway. The cables for the measurement sensors were run through additional core drillings into a parallel heading specially driven for the purpose. This was also to serve as the central node point from where all the geotechnical measurement devices would be monitored and controlled.

The air-side shuttering was then erected and the concreting plant set up. The latter had built-in redundancy and was designed to fill the 500 m³ of void 'wet-in-wet' at the rate of 20 m³/h. The operation to fill the roadway and construct the initial stopping began on schedule the week before Christmas 2010. This phase was also completed successfully.

The first pressure tests were then carried out after a 60-day curing phase and the removal of the air-side shuttering. It became apparent that – as anticipated – a contact joint had formed between the salt concrete and the strata. This created a leakage when compressed air was applied to the structure. In February 2011 secondary injection commenced as planned into this contact joint and any disturbed zone that might be present in the salt concrete. The injection hoses laid around the circumference of the roadway were filled with a special suspension in accordance with a carefully regulated routine. The pressure and volume of the suspension was monitored by a comprehensive array of measuring instruments.

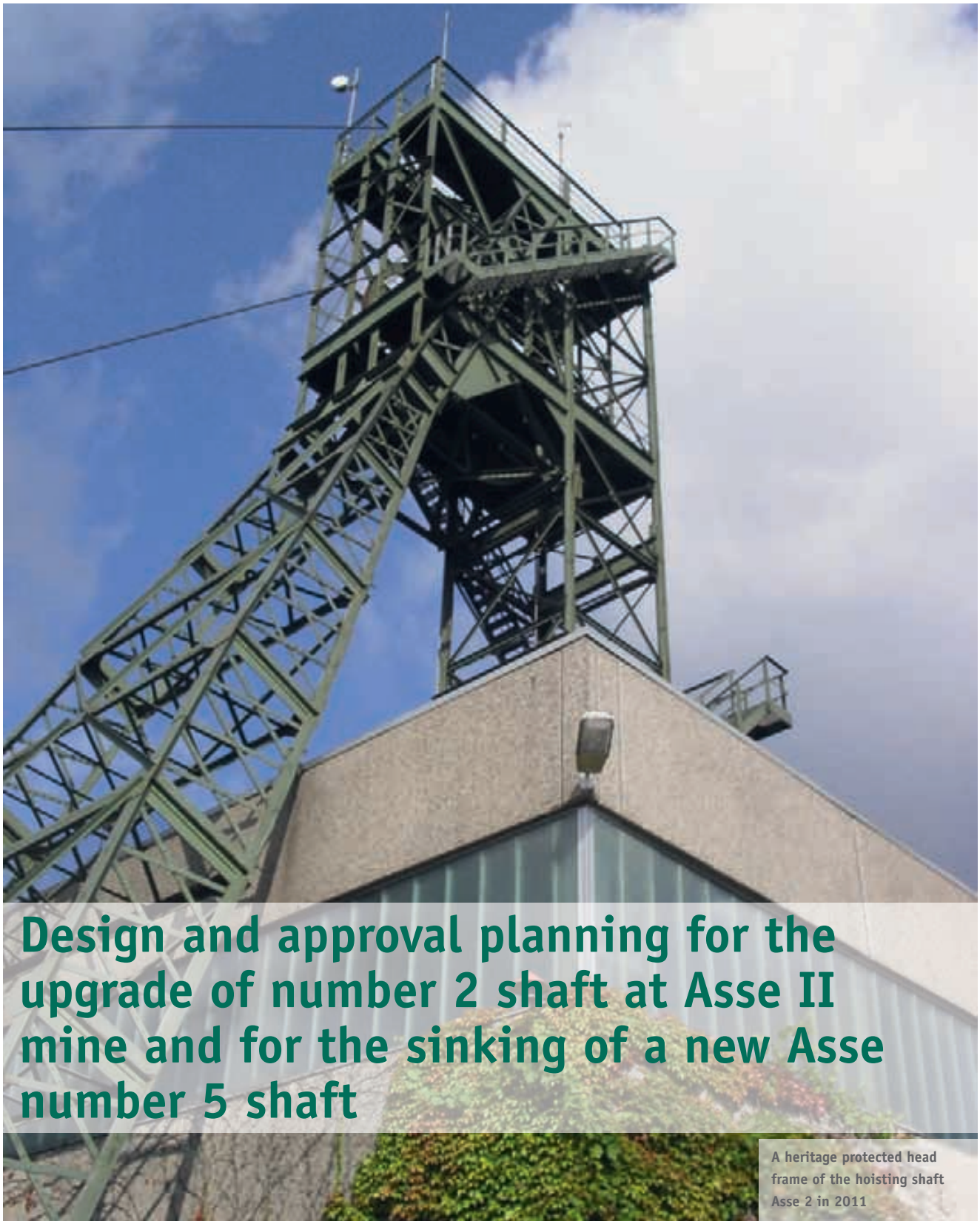
Summary

The experimental stopping constructed as a consortium venture with TS BAU GmbH and Schachtbau Nordhausen GmbH has to date fulfilled all expectations. The structure has shown that it is both theoretically and practically fit for purpose as a horizontal sealing element for underground roadways as part of the planned decommissioning of the ERAM facility. The successful completion of the stopping has given THYSSEN SCHACHTBAU another opportunity to demonstrate that its skills as a specialist mining contractor also extend to areas outside shaft sinking. This is the third such stopping to be successfully constructed in rock salt strata, following the horizontal seals already erected at the Teutschenthal and Sondershausen mines.

Tilo Jautze
Dr.-Ing. Axel Weißenborn
Frank Hansper
Olaf Einicke

Sources:
/1/ German Service Company for the Construction and Operation of Waste Repositories (DBE): Internet: http://www.dbe.de/de/betriebe/morsleben

/2/ Federal Office for Radiation Protection (BfS): Internet: http://www.bfs.de/de/endlager/morsleben.html



Design and approval planning for the upgrade of number 2 shaft at Asse II mine and for the sinking of a new Asse number 5 shaft

A heritage protected head frame of the hoisting shaft Asse 2 in 2011

In August 2010 THYSSEN SCHACHTBAU GMBH of Mülheim/Ruhr won the contract to draw up design and approval plans for the renovation of the existing shaft (number 2 shaft) at the Asse II mine. The company is also part of the winning consortium that in January 2011 was commissioned to undertake design and approval work for the new 'number 5' shaft.

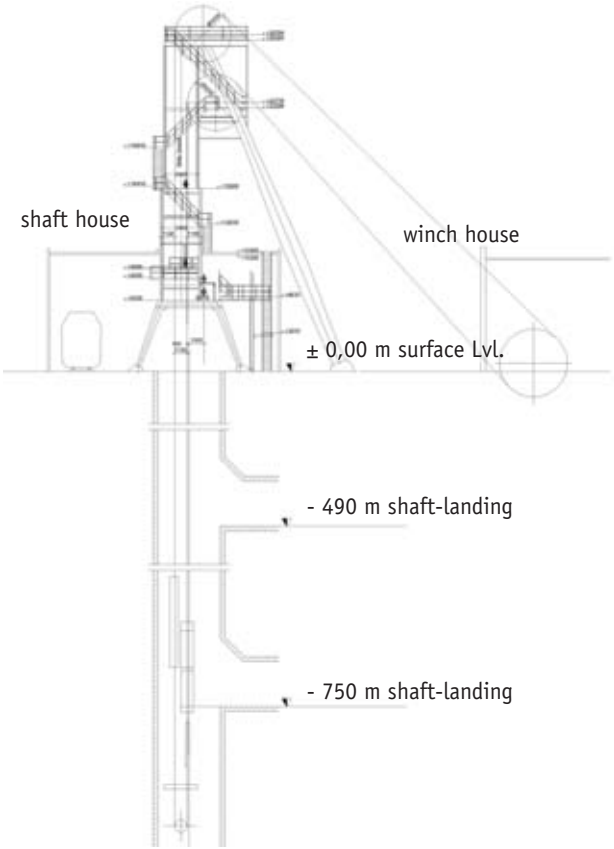
Background

Between 1967 and 1978 the old Asse II mine in Lower Saxony, which formerly served as a test site and final waste repository, was used for the storage of more than 125,000 drums of low and medium-level radioactive waste. Because rock movements and uncontrolled brine inflow have now cast doubts about the

facility being given a long-term safety certificate, the Federal Office for Radiation Protection (BfS), after weighing up the various options available, decided that the waste material currently stored below ground should be safely brought back to the surface.
Transporting the waste containers back to the surface via the Asse II winding shaft calls for an efficient, high-performance winding installation. To this end THYSSEN SCHACHTBAU began work on a situation study in August 2010 to determine whether and under what conditions the existing number 2 shaft would be capable of undertaking such an operation.
Rather than awaiting the outcome of the study on number 2 shaft, which could mean losing valuable time, the Federal Office for Radiation Protection decided that the design and approval planning process for a new (number 5) shaft should be commissioned at the same time. In January 2011 the contract to undertake this work was awarded to a consortium comprising THYSSEN SCHACHTBAU (Mülheim/Ruhr), DMT GmbH & Co. KG (Essen), TÜV NORD SysTec GmbH&Co. KG (Hamburg) and K-UTEC AG Salt Technologies (Sondershausen).

Main elements for planning the shaft number 2 upgrade

The operation to upgrade the shaft winding installation with a view to bringing it back into service is very much governed by the constraints imposed by mining and nuclear safety legislation. This particularly relates to aspects such as accident/incident prevention and radiation prevention. The actual recovery of the slightly and moderately heat-generating radioactive waste material (LAW und MAW) is subject to a nuclear-law planning approval procedure that requires the shaft winding installation to be 'accident and incident safe'. Particular attention was also paid to the logistic demand for doubling the useful payload of the existing winding installation to some 20 tonnes, and possibly also installing a skip winding system.
The situation was further complicated by the fact that the headframe and winder house were classified as listed buildings (see photos of winder house and shaft headgear). The project was also affected to a significant extent by the nature of the existing shaft section. Not only did the shaft have an internal diameter of just 4.25 m at the pit bank but it also featured an air separator further down as part of the number 2 shaft twin-compartment ventilation system (see figure showing shaft section for Asse number 2 shaft).
Special care was also required so as not to compromise the contingency plans for emergency response, which constitutes measures to safeguard the repository in the event of a sudden rock failure or an uncontrolled brine inflow. Work is proceeding steadily on this contingency plan. This imposes constraints on the planning of the number 2 shaft upgrade, which is an essential part of the operation, in that winder downtimes have to be kept to an absolute minimum.



Asse 2, Design for refurbishment
SFA Overview

Procedures for planning the shaft upgrade

An actual-state inventory of the shaft winding installation and shaft column was first carried out in order to compare the stated requirements with the technical feasibility of the project.
A safety and verification plan then showed that the waste containers could be safely transported to the surface using the proposed winding system.
An equipment and variant comparison was then undertaken to identify the most suitable winding system, the most effective shaft profile design and the renovation concept that would be compatible with the proposed contingency plan. Proof of plant safety and performance also had to be provided on the basis of the safety and verification concept and approval plans drawn up for submission to the relevant authorities.

Interim results shaft number 2

The inventory ruled out any prospects of upgrading to a payload of 20 tonnes using the old headframe structure. The winding installation had at the time been designed and dimensioned for a payload of only 10 tonnes. Moreover, the condition of the head-

frame, which was over 100 years old and subject to a preservation order, made any structural reinforcement measures impractical. The design study therefore focused on a completely new winding installation.

The small shaft profile in number 2 shaft, which was a mere 4.25 m at its narrowest point, also posed a significant challenge. Retrieving the waste containers, which were about 20 tonnes in weight, required a transport capability that was simply beyond the capacity of the old shaft conveyance with its loading width of 1.15 m. The safety and verification plan generally provided for reusable pallets or transport pallets and containers of at least 1.6 m in width. There was therefore no other option other than to build a completely new shaft conveyance. The conversion of the winding installation and all the shaft fittings would result in a lengthy interruption to normal winding operations. This proposal clearly conflicted with the remit that normal mining operations should be impeded as little as possible, in compliance with the aforementioned contingency planning requirements.

Key elements in the planning of the new shaft

A suitable site for an exploration drilling operation was identified on the basis of an analysis of the current circumstances prevailing at Asse 2 mine in terms of geology, hydrogeology, rock mechanics, mine workings, surface situation and radiology. The feasibility of a new shaft sinking at the proposed collaring point was then to be assessed on the basis of horizontal boreholes to be drilled below ground in order to explore potential shaft inset positions, these to be followed-up by a series of geoscientific vertical surface drillings. The findings from the vertical exploration drillings will be used to determine the methods that will be employed for the shaft sinking and shaft support operations. A safety and verification plan will then be used to coordinate the project objectives with the basic conditions and realities of the site. Here too proof of plant safety and performance also has to be provided on the basis of the safety and verification concept and approval plans drawn up for submission to the relevant authorities as part of the planning approval process.

Interim results shaft number 5

As the project involved a nuclear facility the relevant planning and approval process was most specific about the methods and procedures to be adopted for setting up operations in such an installation. Each and every aspect of the safety and verification plan for the new shaft project therefore has to be examined in detail from the outset. This is a less complex task when a new shaft is involved, as it is easier to take account of constraints such as the time pressure imposed by yielding strata as far as any supposed or predicted failure of the underground

A heritage protected winch house from the Asse II mine (built in 1908)

structures are concerned. The logistical requirements can therefore be planned and implemented as would be the case in a new mine project.

One inhibiting factor was that the flooded workings of Asse 1 and Asse 3 mine severely restricted the choice of a new shaft site. The situation was further complicated by the requirement that the northern and southern flanks of the Asse salt incline, which runs from north-west to south-east, were not to be penetrated. Finally the survey team was forced to find a site for the new shaft in a limited area around Asse 2 mine. According to current planning the proposed location could well lie within a conservation area for flora, fauna and habitat.

Markus Westermeyer
Thomas Dreyszas

Drilling operation for freezing holes with both drilling rigs RB50

Ice-cold and dead accurate

In May 2008 EuroChem Volgakalij awarded THYSSEN SCHACHTBAU GMBH the contract to sink a new mine shaft for the extraction of potash near the town of Kotelnikovo in the Volgograd administrative district of Russia.

Planning

The geological and hydrological conditions prevailing at the site – the strata comprise loose rock, sands and clays traversed by a number of water bearing measures, some of which are used for the provision of the region's drinking water – dictated that a stable freeze-wall would be needed to strengthen the strata sufficiently for the planned sinking operation.

Calculations indicated that the freeze-wall needed to sink the shaft with its planned internal diameter of 8.0 m would require 44 freeze holes set around an 18 m-diameter circle and extending to a depth of about 520 m, along with four temperature measurement holes drilled to a depth of 550 m. Each hole would be fitted with a protective casing 339.7 mm in diameter to a depth of approximately 33.0 m and was to be supported by freely suspended freeze pipes 146.05 mm in diameter that would extend to the bottom of the freeze-wall at a depth of about 520 m.

The uniform propagation of the freeze-wall was crucially dependent on maintaining the very tight tolerances for the deviation of the freeze pipes from the vertical over the entire length of the casing. A drilling diameter of 216 mm was specified for each of the holes.

Operating equipment

The operation was carried out using two new and highly manoeuvrable RB 50 universal drilling rigs with hydromechanical drives, each mounted on a trailer chassis and equipped with a mast extension. These machines, which boast a large hook load of 500 kN and can deliver 31.580 Nm of torque at the power swivel head, have the advantage of being very compact. The mast extension allows each rig to deploy casings with unit lengths of up to 12 m. A flexibly mounted, 12 m-long deck with integral

drill-rod carriage was used as a working/drill-rod platform. The modular design of the working platform meant that a safe and effective workplace was available for the drilling team to carry out the various tasks required during each stage of the operation.

The drilling mud circulation was provided by four Gardner-Denver mud pumps that were permanently installed in 20-foot shipping containers along with their hydromechanical drives and all components required for transport and operation. The pumps were operated from the drilling-rig control console by way of a cable-linked remote control system. Mission centrifugal pumps were connected upstream as booster units in order to maintain troublefree and efficient operation of the triplex pumps.

Vibrating dewaterers, desanders and three agitator tanks each of 26 m^3 capacity were employed for cleaning and servicing the drilling mud. As the strata yielded a large quantity of sand during the drilling operation, which caused serious wear at the pumps, an extra centrifuge was obtained to provide additional mud cleaning. The continuous monitoring and conditioning of the drilling fluid was carried out in conjunction with a Russian mud servicing company, which also supplied the reactants needed for preparing the drilling fluid on site.

Transport

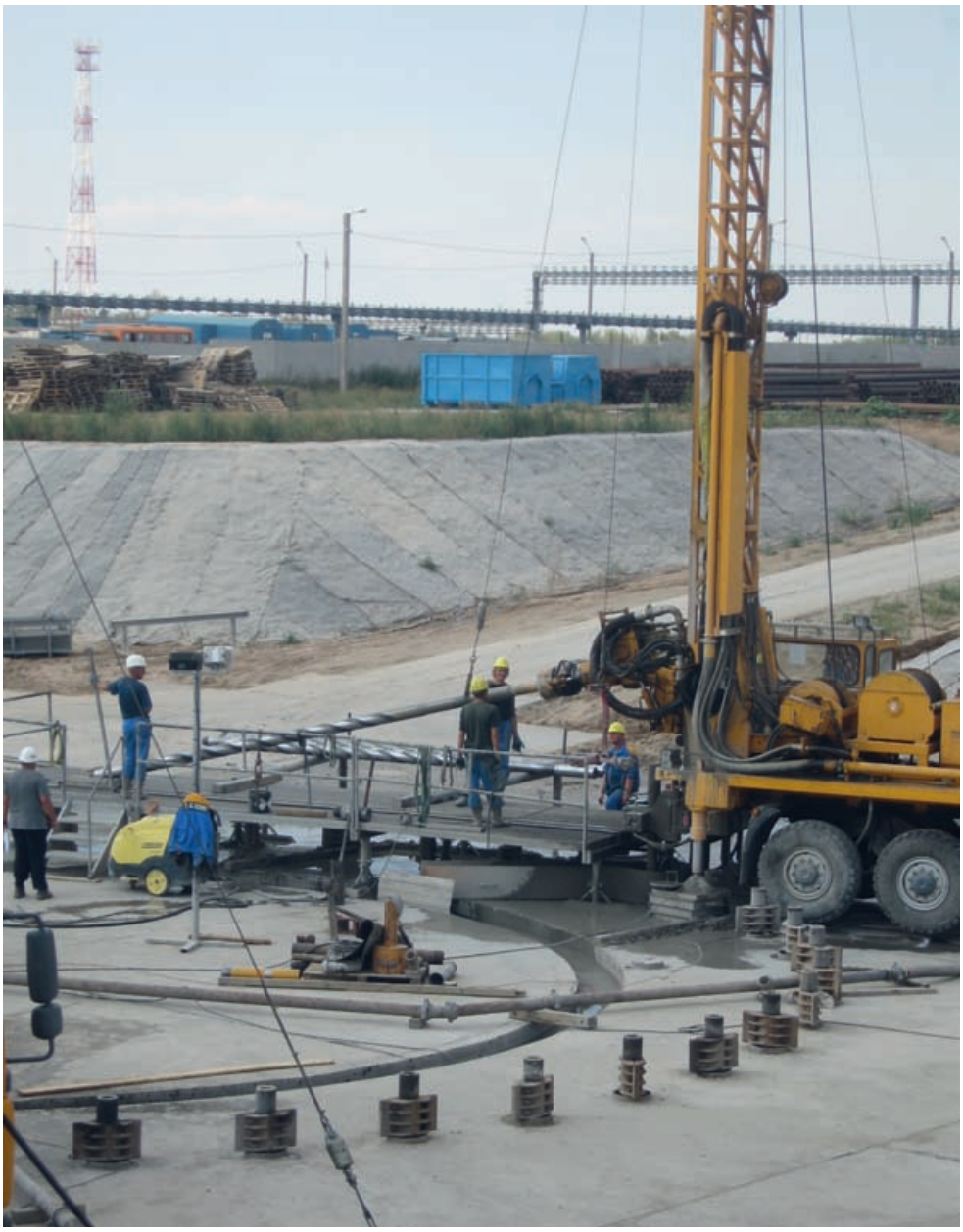
The entire site installation was assembled in Germany and in spite of all the logistic problems, which included having the equipment certified for the Russian market, cleared through customs and transported to Russia, the Thyssen Schachtbau shipping and logistics department succeeded in delivering everything to the drilling site with the assistance of an international haulage company. EuroChem, the Russian authorities and Thyssen Schachtbau worked closely together to ensure that the operating permit required for the entire drilling installation was obtained without delay.

Drilling system

Because of the extremely high demands on drilling accuracy the holes were drilled using MWD technology (measurement while drilling) combined with an external, stand-alone EMS (Electronic Multishot) system. This technology allows the course of each hole to be steered in any direction on the basis of the data being received on hole orientation and inclination, with the result that drilling tolerances can be maintained very precisely.

As the drilling work had to be completed within a very narrow timeframe a total of six drill motors of 171.45 mm diameter were available throughout the entire drilling phase, with two motor

Facility for de-sanding the drilling mud



Drilling of the freezing holes

units generally being serviced at any one time. This rotation principle effectively eliminated drilling downtime caused by defective drilling motors. In addition, service engineers from the operating companies were on site around the clock to ensure that the MWD equipment and EMS system gave troublefree service at all times.

Not all the geological data required for the final shaft design were available when the project commenced. Test cores of 102 mm diameter were therefore taken from various parts of the drilling zone. A special core pipe fitting with a plastics liner was used to minimise the stress acting on the core samples during the drilling operation. This system proved successful in allowing a total of some 150 m of core samples to be safely extracted from depths of as much as 550 m.

Summary

In spite of the adverse climatic conditions the 48 holes were successfully drilled and cased in a mere six months and the work was completed in August 2009. The project had involved the installation of nearly 26,000 m of freeze pipes of 146.05 mm diameter. Each of the 48 holes drilled met the very stringent specifications for directional accuracy and maximum drilling performances of more than 200 m a day were repeatedly achieved by each drilling machine. During this period the drilling equipment underwent about 60 rebuilds. Thanks to the rigorous implementation of THYSSEN SCHACHTBAU's own certified safety standards not a single accident was recorded on site throughout the construction period.

Rolf Krause

Second skip winding shaft will increase potash output at EuroChem Volgakali's Gremyachinski mine

Figure 1:
View of the three shaft sites at the EuroChem-VolgaKali mine; from left: second skip winding shaft, first skip shaft, service shaft

In September 2011 EuroChem took the strategic decision to increase production at the Gremyachinski potash mine, currently under construction. This is to be achieved by starting work earlier than planned on a second skip winding shaft, which will therefore bring forward the production start date at the site. The shaft construction work is scheduled to commence as early as December and the shaft centre drilling (see Figure 1) is already under way, so that the construction phase can begin immediately thereafter. In view of the positive experiences acquired when sinking the first skip shaft EuroChem has decided to use the same freeze sinking method for this second shaft project.

In order to keep to the tight deadlines EuroChem wasted no time in enlisting the services of THYSSEN SCHACHTBAU GMBH to undertake the drilling and freeze-hole operation. The contract was quickly signed and concluded, thanks in no small part to the very good working relationship that EuroChem and THYSSEN SCHACHTBAU have enjoyed over the last three years. Add to this the fact that Thyssen Schachtbau already has extensive drilling and freeze plant of its own in Russia, which will allow the construction work to commence with minimum delay.

The contractual services break down as follows:

- Drilling and casing of 44 freeze and temperature measurement holes to a depth of 520 m
- Extensive modification of the on-site freeze plant (currently being operated by TS at the first skip winding shaft) for deployment at the second sinking project
- Operation of the freeze plant for the duration of the freeze-shaft sinking at the second skip shaft
- Execution of all necessary project planning and development work.

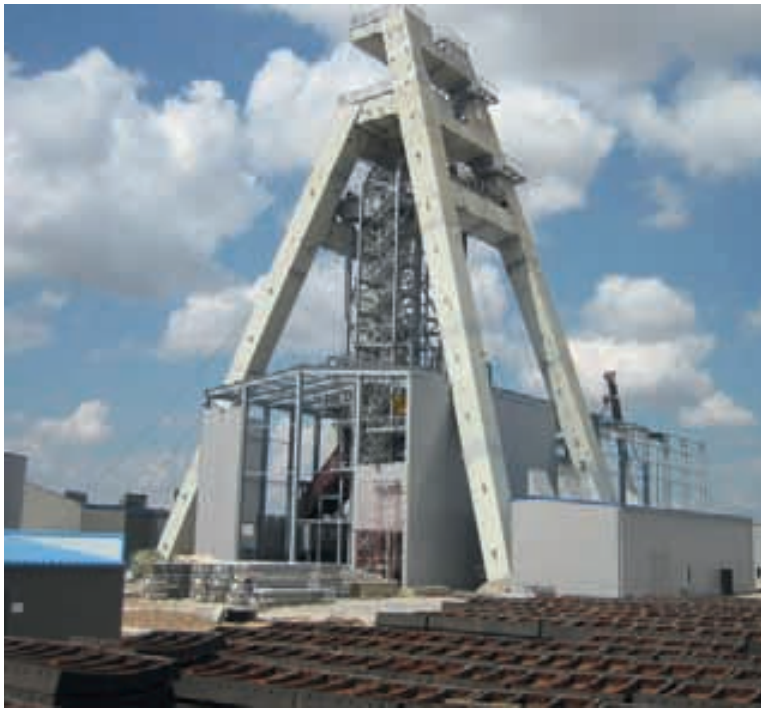
View of the shaft construction site

Freezing facility next to skip-shaft 1

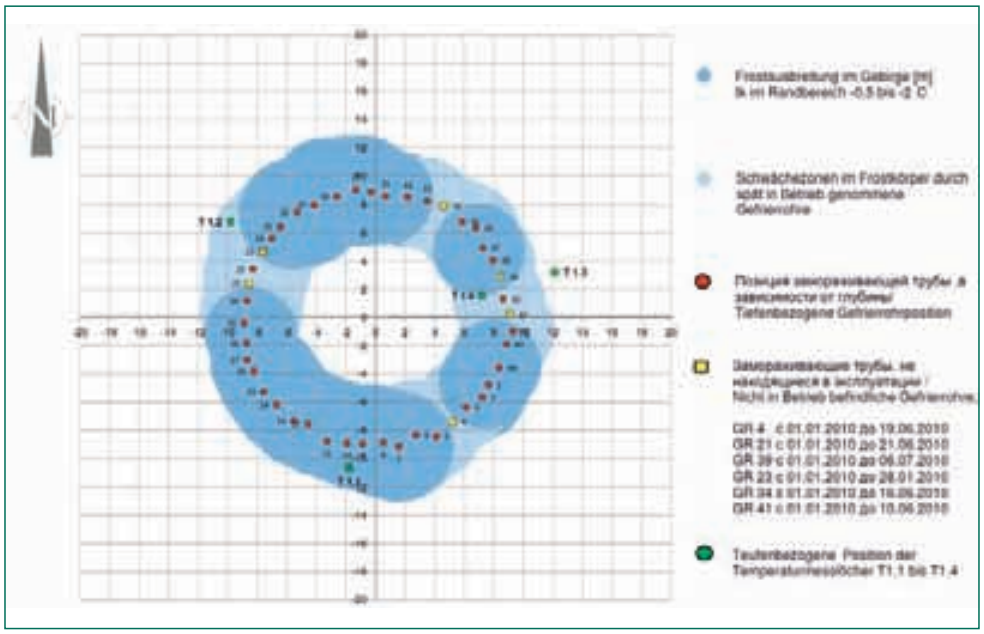
THYSSEN SCHACHTBAU is now engaged in transporting to the site the drilling equipment that was successfully used for the Palasherski project (see page 44) so that drilling work can start as early as December 2011. EuroChem has stipulated that as the drilling operation progresses the freeze plant still in service at the first skip shaft is to be modified in such a way that the equipment can be used to undertake freeze work for both shafts simultaneously. The freeze unit required for the second shaft is to be commissioned in September 2012.

The excellent and constructive working relationship that EuroChem and THYSSEN SCHACHTBAU have enjoyed to date augurs well for the success of the project.

Tim van Heyden
Rolf Krause
Eduard Dorn



Head frame of shaft 2



Horizontal cutting of ice spreading in cap-rock

Freeze-hole drilling and ground freezing for the sinking and lining of number 1 and number 2 shafts at the 'Usolski Combine' Potash Mine in the Russian Federation

Potash mining in the Russian Federation

Potash fertilisers are Russia's most important mineral export by far. This product has until now only been mined in one area, namely at Verkhne-Kamsky in the Perm region, where the world's second largest reserves of potash salt are to be found. The seam-like deposits in this region are at depth of between 380 and 500 m, including some 270 m of water-bearing overburden.

Deep mining operations are underway in this region on a vast scale. One of the biggest problems encountered when accessing the underground deposits is protecting the shaft from water inflow and preventing the workings from being flooded. Shafts in water-bearing, unstable ground have traditionally been sunk using the special 'freeze shaft' technique. The freeze-wall created around the shaft column prevents water ingress into the cavity as the shaft is being sunk. This protective role is then taken over by the permanent lining, once this watertight structure has been put in place.

Geographic location of THYSSEN SCHACHTBAU projects in Russia

Freeze shaft sinking has been tried and tested for many years and during this period has proved to be the most reliable special shaft construction technique for conditions of this type. Since the 1930s a total of 24 surface shafts have been sunk in the Verkhne-Kamsky potash region. All these have been freeze shaft sinkings apart from one, which used the cementation method[1]. The choice of sinking method has a huge influence on the future outcome of the entire project.

EuroChem – a growing potash empire

Back in 2008 the Moscow-based chemicals company EuroChem announced that it intended to go ahead with the development of the potash mining concession in the Perm region that it had acquired for some 1.4 bn US$. This project would involve the construction of a mining facility with a potash processing plant that would produce potash-based products. The company immediately set about implementing a geological exploration programme that focused on the 'Palashersky and Balakhontsevsky zones of the Verkhne-Kamsky deposits'. The potash processing plant was initially to be laid out for an annual production capacity of 2.5 million tonnes of potash products, though EuroChem's long-term plans for the extremely promising Perm project are aiming for six million tonnes of potassium chloride a year. EuroChem is best known as a manufacturer of nitrogen and phosphate based fertilisers and the company is still setting up its potash operations in the Volgograd and Perm regions.

The contract

On 29 June 2010 EuroChem commissioned THYSSEN SCHACHTBAU to undertake planning, drilling and freeze operations for the new skip shaft and service shaft that would be required for the Usolski potash mine in the Perm region of the central Ural Mountains. This gave THYSSEN SCHACHTBAU an opportunity to build on the Gremyachinski project that had already been undertaken in the Volgograd region and in this way expand and develop its business relationship with EuroChem. The new commission is the fourth freeze shaft sinking that the company had carried out for EuroChem.

THYSSEN SCHACHTBAU has been involved in freeze shaft sinking for more than one hundred years and these projects have given the company an opportunity to demonstrate its expertise to the Russian market.

The scope of the contract is as follows:

- Preparation of all project documentation for the approval and execution phase
- Completion of 90 freeze holes/temperature measurement holes (each about 270 m in depth) for two shafts
- Supply and assemble the freeze plant for both shafts
- Operate the freeze plant, monitor and calculate the freeze wall development for the duration of the sinking operation

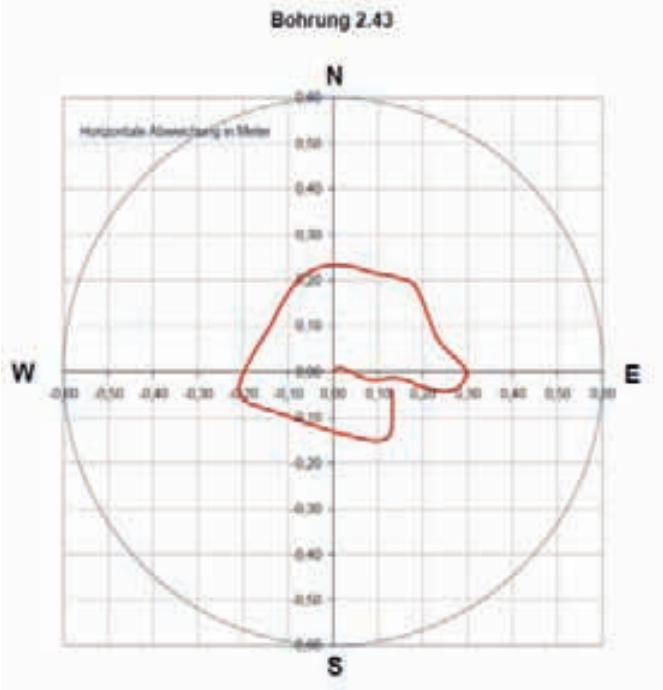
EuroChem had set strict deadlines, one of which was that the freeze plant should be commissioned by 1 July 2011. The sinking work was undertaken by a Russian company that in the Soviet Union era had built rocket shafts and underground caverns and bunkers.

Project planning

The planning process began immediately after the contract was awarded and was synchronised with the approval procedures and construction sequence. This meant that the construction work could commence without delay and the project could keep to schedule. The planning documents were drawn up strictly in accordance with Russian documentation requirements, as based on the extensive knowledge and experience already acquired in this sector. This not only ensured that the construction work could start on time but also avoided any hold-ups to the approval process.

Drilling work

At the time the contract was awarded all the drilling equipment was still in storage in Volgograd. Most of the preparations and repairs were therefore carried out at the depot before the transport operation began. The spare parts needed for the refit were supplied from Germany.
The drilling equipment was then transported in its entirety by truck from Volgograd to Beresniki. This meant a 2,000 km trip from the depot to the drilling site. The first items arrived at the site on schedule, on 1 October 2010, along with some of the drilling team. As the standpipes for number 1 shaft had



already been delivered by a Russian subcontractor the drilling operation was able to commence on 15 October.

The freeze holes for number 1 shaft followed a circle diameter of 17.0 m and were to be drilled and cased to a depth of 270.6 m. This involved drilling a total of 41 freeze holes and three temperature measurement holes. As the first 120 m of ground contained a number of aquifers that were used as a source of drinking water a pipe connection was run into this zone and permanently cemented up to the surface.

In order to pinpoint the transition from the overburden to the potash deposits a total of 10.0 m of drill core were recovered from one of the holes at a depth of between 262.6 and 272.6 m. These samples were subsequently analysed by the EuroChem geological department.

On 1 November 2010 the good weather suddenly changed and the drilling operation was attended by snow and extreme cold until well into April the following year. Snow 2.0 m deep, snowstorms and temperatures of as low as -40 °Celsius placed an enormous strain on men and machines. In spite of these extremely adverse climatic conditions the drilling operation at number 1 shaft progressed without any weather-related interruptions and was completed on time and to the client's complete satisfaction.

Work on the second shaft began immediately after the first project had been completed. The entire drilling plant was moved and made operational in just three weeks. The second shaft was to have 43 freeze holes and three temperature measurement holes drilled to a cased depth of 273.6 m and arranged in an 18 metre-diameter freeze ring. As shaft number 2 was 4.0 m higher than shaft number 1 the interconnecting pipe at this point was installed and cemented in place to a depth of 125.0 m.

A total of 10.0 m of core samples were also recovered from one of the drilling holes at a depth of 265.6 to 275.6 m and sent to EuroChem for analysis. Thanks to the high level of commitment shown by the drilling team, which consisted of German and Russian specialists, the drilling work at number 2 shaft was completed well ahead of schedule.

The operation was carried out using the same two RB 50 universal drilling rigs that had been used on the Kotelnikovo project. These highly manoeuvrable, trailer-mounted machines are fitted with hydromechanical drives and come equipped with a mast extension. The RB 50 has the advantage of being extremely compact and yet features a large hook load of 500 kN and can deliver 31,580 Nm of torque at the power swivel head.

The mast extension allows each rig to deploy casings with unit lengths of up to 12 m. A flexibly mounted, 12 m-long deck with integral drill-rod carriage was used as a working/drill-rod platform. The well-proven modular design of the working platform meant that a safe and effective workplace was available for the drilling team to carry out the various tasks required during each stage of the operation.

Because of the extremely high demands on drilling accuracy when sinking the two shafts for the Palashersky mine the holes were drilled using MWD technology (measurement while drilling) combined with an external, stand-alone EMS (electronic multishot) system. A gyrocompass device was also employed on occasions to measure the inclination and orientation of the drilled holes. This technology, which even operates inside cased holes, allows the course of each hole to be steered in any direction on the basis of the data being received on hole orientation and inclination, with the result that tolerances can be maintained very precisely when drilling the freeze holes.

In order to keep stoppages to an absolute minimum a total of six drill motors were kept available throughout the entire drilling phase, with two motor units generally being serviced at any one time. This rotation system effectively eliminated drilling downtime caused by defective drilling motors. In addition, to ensure that the measurement equipment operated incident-free at all times a sufficient stock of spare parts was kept at the site and service engineers from the operating companies were also on-hand around the clock.

The drilling mud circulation was provided by four triplex mud pumps (two per drill), each delivering 1,500 litres a minute, that were permanently installed in 20-foot shipping containers along with their hydromechanical drives and all components required for transport and operation. The pumps were operated from the drilling-rig control console by way of a cable-linked remote control system. A number of centrifugal pumps were connected upstream as booster units in order to maintain trouble-free and efficient operation of the triplex pumps.

The continuous monitoring and conditioning of the drilling fluid was carried out in conjunction with a Russian mud servicing company, which also supplied the high-grade reactants needed for preparing the drilling fluid on site. The drilling mud was cleaned and serviced by a combination of de-waterers, a triple-chamber agitator and a series of de-sanders incorporated into the mud system. As mud loss was expected during the drilling operation a total of 120 m^3 of fluid was kept available in back-up tanks together with a sufficient quantity of packing and cementation material. Like the Volgograd project of 2009 the drilling operation also began in the autumn and lasted well into the winter season. Winter in the Perm region is somewhat longer, colder, more severe and less predictable than in Kotelnikovo – and the snowfalls are heavier. The project was indeed a challenging one and required the drilling of 90 freeze holes and temperature measurement holes within nine months, including the deployment of the entire drilling plant from one shaft to another.

The drilling crews were flown in in turns, a local hotel providing the accommodation. A catering company was employed to supply meals to the workforce on site. Despite the extremely difficult conditions prevailing at the construction site THYSSEN SCHACHTBAU was able to complete the project safely and with almost no lost shift time (illness-related absences constituted less than 1.5 % of the total working hours, while accident-related absences were less than 0.34 %). This can be attributed in no small measure to the consistent application of safety regulations by the site management. Each and every operational activity was analysed at the planning stage and the findings were then used to produce operating instructions that were issued to the workforce as part of their on-site training. Safety training sessions given by experienced drillers completed the programme.

The drilling work was successfully completed one month before the contract deadline, very much to the client's satisfaction.

Freeze work

The contract specified that the freezing process should begin at the first shaft and then switch to the second shaft with a time-shift of four months so that the freeze operation could then continue in parallel at the two shaft sites. THYSSEN SCHACHTBAU therefore decided to set up a central freeze plant that would be capable of carrying out the freeze operation simultaneously for both shafts. The two shaft sites were about 150 m apart and had a height difference of 6 m. After examining the plans for the mine site during the sinking phase a decision was taken on the ideal location for the freeze plant and this was then incorporated into the overall layout of the surface facilities. This meant that the plans for the various buildings, with their foundations, power supply and pipe routing from the freeze plant to the shafts, had to take account of the existing and proposed infrastructure. In order to be best equipped for the adverse weather conditions, especially during the winter months, it was decided that the installation's core components should be erected under the protection of a hangar building. The pipes could then be routed from this hangar through buried concrete ducts to the shaft site. This construction phase also involved incorporating a number of changes that EuroChem wanted to make at very short notice.

The drilling team celebrates the end of the drilling phase

A large volume of geological and hydrological data had to be analysed in order to determine the required refrigeration capacity. Using the results as a starting point detailed calculations were then produced of the freeze-wall statics and refrigeration performance. This process eventually established that a maximum refrigeration output of 3,600 kW would be needed for the ground freezing operation at the two shafts. The brine temperature was specified at -40 °Celsius.
THYSSEN SCHACHTBAU's considerable experience in freeze-shaft sinking, which goes back some 100 years, together with the knowledge gained during the Gremyachinski project (report number 17), proved invaluable for planning the freeze plant and designing and refining the associated engineering systems.

Technical highlights:

Total drilling distance:	24,976.5 m
Total cased pipes:	approx. 38,500 m
Cement consumption:	approx. 1,950 t
Diesel consumption:	approx. 630,000 l
Drill mud consumption:	approx. 400 t
Outside temperatures winter/summer:	-40 °C / +40 °C

View of freeze plant and headgear for shaft number 1

As in the Palashersky project, the general concept was to provide for a high degree of pre-fabrication of the refrigeration equipment so that the plant could be assembled very quickly at the site. This principle was applied to all the components, including the refrigeration machines, pipework and power supply system. The plan was for a total of six refrigeration machines to be installed in containerised modules that were to be completely manufactured in Germany and transported to the site in early 2011. The pipe circuit and all its components were also prefabricated in Germany and pre-insulated as far as possible. The 400-volt power supply was sub-distributed into three 20-foot containers that included client-side feed connections and distribution boxes for the refrigeration machines and pumps.

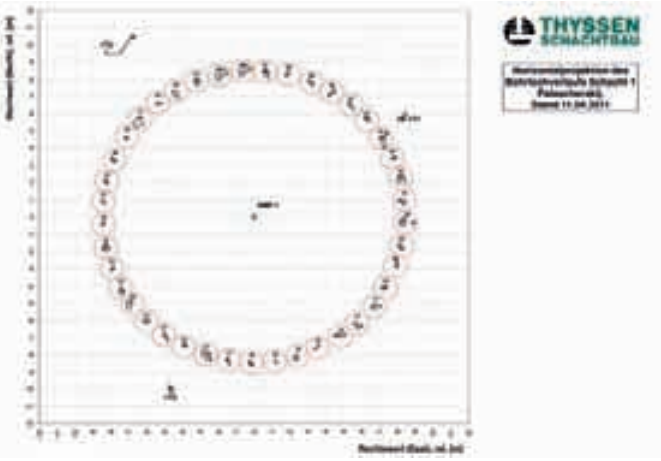
This essentially led to the development of a modular system that required much less time and effort for assembly and installation on site and meant that THYSSEN SCHACHTBAU could commission the plant before the contractual deadline, which had penalties attached. After eight weeks of assembly and commissioning work EuroChem was able to celebrate the start-up of the freeze plant on 22 August 2011. The operation had involved the installation of 900 m of pipes, 3,500 m of power and data cables, five brine pumps with filters and six refrigeration machines.

THYSSEN SCHACHTBAU turned to already proven measurement technology for monitoring the freeze process and freeze-wall development. This involved the use of fibre optic sensors for measuring the temperature levels. This system was first employed for the Gremyachinski project and, after a number of modifications and refinements, was then used at Palashersky to take rock temperature measurements for each metre of depth, thereby producing a very detailed temperature profile over the entire freeze shaft column. The accuracy of the system was then further improved with the result that the freeze-wall calculations carried out by THYSSEN SCHACHTBAU using this particular set of measurements were able to achieve an even higher level of precision. Incorporating the actual freeze pipe and sensor pipe intervals into the monitoring process produces a very clear image of the actual status of the freeze wall and the ongoing development of the freeze zone can therefore be predicted to an accuracy of within a few percent.

All the measurement data were relayed to the central control station so that the freeze plant could be controlled directly at any time for optimum effect. The freeze wall was very soon fully established and the sinking phase was able to commence. On 1 October EuroChem drew the first full bucket of muck from the shaft sinking rig, marking another milestone in the course of the Palashersky project.

Having such a finely tuned freeze process available will also mean that the freeze work at number 2 shaft can begin earlier than scheduled. The time interval between the freeze start-ups at the

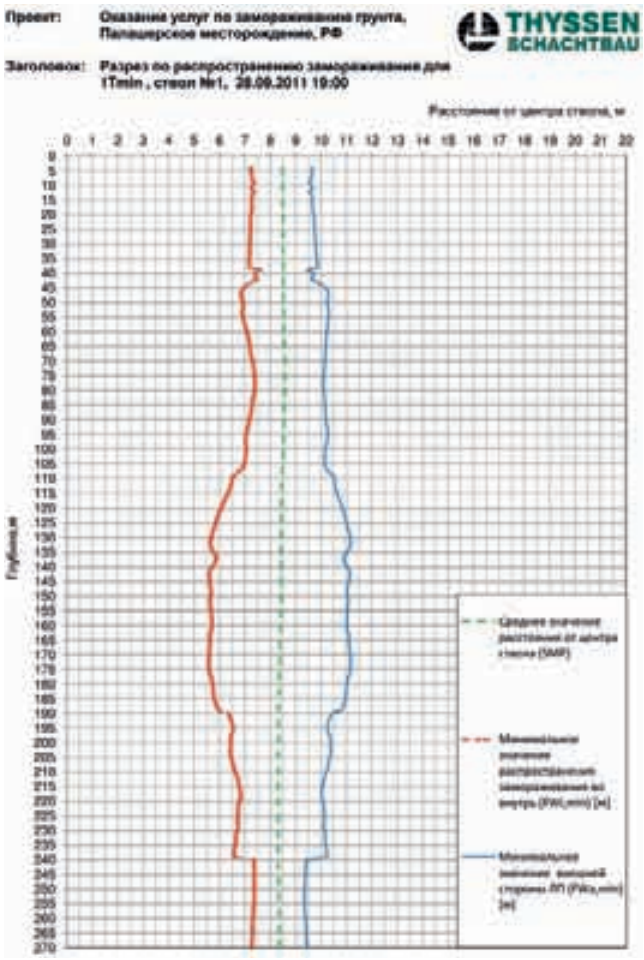
The startup ceremony for the freeze plant was held on 22 August 2011. Photo (bottom): client's technical managers and members of the THYSSEN SCHACHTBAU team in front of the freeze hangar. (Top left): In front of the main brine pipe looking towards number 1 shaft. (Top right): behind the symbolic start button in the brine-pump hangar.



Horizontal alignment for all freezing and measurement holes

Brine heads in the freeze cellar at number 1 shaft

Ice build-up on the brine pumps



Vertical section of ice spreading in cap rock along the freezing pipe area

two shafts can therefore be reduced by about 25 percent – which means that the team is aiming to start sinking at shaft number 2 on 1 January 2012.

Summary

Thanks to the high level of commitment displayed by everyone involved the operation was completed on schedule and to the complete satisfaction of the client, EuroChem. For THYSSEN SCHACHTBAU the project was a great success, in spite of the huge challenges of having to operate in virgin countryside at the foot of the Ural Mountains. The cordial and cooperative nature of the working relationship with EuroChem was hugely motivating for the workforce, who were keen to do their bit to help develop the new mining complex as quickly as possible.

Tim van Heyden
Rolf Krause
Eduard Dorn

[1] OLHOVIKOV, Ju. P. 'Planning and operation of potash mining shafts', Gorni Journal No. 10, [1] 2008

Sunset at the Ural Mountain

Impressions of a student

Externship at the Palasherski drilling site in Russia

Preparations and induction

The first seven days of my work placement were spent at the head office of THYSSEN SCHACHTBAU GMBH in Mülheim an der Ruhr. Through discussions with staff from the technical and commercial departments I was able to gain a first insight into the Palasherski Project. Reading through the contract between THYSSEN SCHACHTBAU and EuroChem also gave me some idea of the agreed targets and mutual obligations. On 13 June 2011 I set off for Russia. On the way I got to know an electrical engineer from THYSSEN SCHACHTBAU who spoke enthusiastically about his work on the control and imaging systems used for shaft freezing operations. As a student of economics I could see that there were challenges lying ahead for me in the special technical world of mining engineering.

The following morning I travelled in a Russian 4 x 4 vehicle to the THYSSEN SCHACHTBAU site and after receiving safety instructions was able to have a look around. Drilling was in full swing and the team was busy preparing the last of the 84 freeze holes and 6 temperature measurement holes. Work had begun on assembling the drill pipes for the refrigerant and constructing the freeze plant. I therefore had an opportunity to see for myself all the key stages involved in the Palasherski Project prior to the start-up of the freeze machines. This provided me with a complete picture of the practical operations under way at the drilling site.

My first job was to help the site managers in the preparation of the Russian drilling documentation. I worked with them on the extensive body of documents required for operating the site and was given an opportunity to draw up material lists and borehole direction profiles. I learned how to adapt to Russian conditions and the pace of life on the site. The placement also gave me a chance to perform other duties. I was able to move freely about the site and this gave me the opportunity to get to know all the

different areas of activity. I was able to meet members of the THYSSEN SCHACHTBAU team and from them learned a great deal about the work under way and the technical procedures being carried out at the site. Though most of my work has been theory based, I am a practical minded person and I found it especially pleasing to see how technical problems and tasks were resolved in the field. Here it became particularly clear to me just how important the local experience of the workforce was when it came to fulfilling the assignment.

The working routine, including daily travel to and from the site, dominates the life of the THYSSEN SCHACHTBAU employees during their six-week stints. This indicates only too clearly just how difficult the working conditions are at the Palasherski site. Add to this the extreme weather – short and very hot summers followed by long and extremely cold winters (when temperatures can drop as low as -40°C). The drilling and assembly work is all done in the open air. THYSSEN SCHACHTBAU personnel on site repeatedly stressed how important it was to wear the right clothing in the winter months for health and safety reasons.

Staff at a company party and out on site

The work has to be carried out flawlessly and speedily in order to meet the contractual deadlines set by the client. This clearly imposes a high degree of stress on the personnel from THYSSEN SCHACHTBAU and from my experiences during my three-month stay I was most impressed at how the THYSSEN SCHACHTBAU team was able to adapt to the local operating conditions. Everyone was really focussed on the job at hand, spirits were high and working relationships were cordial and cooperative. Everyone from THYSSEN SCHACHTBAU showed a masterly capacity for coping with the extremely tough operating conditions.

The THYSSEN SCHACHTBAU site management team is committed to organising targeted training sessions for the TS workforce and this ensures a continuous supply of trained recruits, particularly in the drilling sector of operations. There is also an organised exchange between the generations, as it were, with younger members of staff being trained up and then assigned to particular areas of responsibility. Dialogue between the site managers and the workforce generates an intense transfer of knowledge and this makes a huge contribution to productivity levels. This all has its roots in the sustainable and forward-looking personnel management approach that has been adopted by THYSSEN SCHACHTBAU. About one third of the workforce engaged at the site come from Russia and in spite of the language barriers and cultural differences the German and Russian workers are able to work together very effectively. The Russian personnel are instructed in key areas of responsibility,

The workforce at the Palasherski site

View of the freeze plant and state of progress at number 2 shaft

such as workplace safety and energy economics. They are also introduced to the corporate culture and operating methods of THYSSEN SCHACHTBAU, while the German workers learn about the techniques and working methods that will enable them to deliver the level of performance needed – even in extreme weather conditions. The dedication and commitment shown by the site management has been a key factor in establishing contact with specialists and skilled labour from the area and through locally organised education and training sessions Russian workers have now become an important part of the THYSSEN SCHACHTBAU project team.

During my externship with THYSSEN SCHACHTBAU I found that my interest in the mining industry was well-founded. Through my many exchanges with the on-site management team I was able to acquire technical knowledge about the operational aspects of the project and also learned something about how such operations are managed and directed. Russia's apparently inexhaustible sources of raw materials make the future outlook very promising indeed – and this is a future I would very much like to be part of.

Daniel Büdel

Daniel Büdel, 24 years old, student of economics in Dundee (Scotland). Ongoing study plans post 2012: Technical business management (Masters) at the University of Clausthal-Zellerfeld.

Shaft site WS-10

THYSSEN SCHACHTBAU GMBH starts project build for the construction and assembly of the 2,500 metre-deep SKS 1 production shaft complex for OJSC MMC Norilsk Nickel

WS 10 shaft complex for OJSC MMC Norilsk Nickel – operations are running to schedule and the work is progressing well: ready to commence the main shaft sinking below the 150 m level

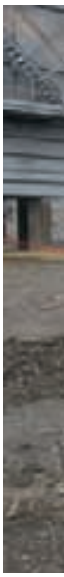
OJSC MMC Norilsk Nickel took the decision to build the Skalisty ore mining complex near the town of Talnakh in the Norilsk region of the Russian Federation in order to establish a production base for accessing and extracting more of the area's rich ore deposits. The valuable ores are to be extracted from within the Oktyabrskaya deposits. The Skalisty mine project includes the construction of the SKS 1 shaft complex that will enable Norilsk Nickel to access and extract the rich deposits of precious-metal and copper ores for years to come. The proposed new site of the SKS 1 shaft is about 2,000 m from the WS 10 ventilation shaft.

THYSSEN SCHACHTBAU emerged as the winning bidder from a tender procedure that included many international specialist mining companies. The works contract was signed by the parties at the end of May 2011 and construction work commenced at the shaft site on 20 June 2011.

1.5 million tonnes a year

The SKS 1 production shaft is to be fitted with a skip and cage winding system. The specified target is a production figure of of around 1.5 million tonnes of ore a year. All construction and assembly services required for the SKS 1 shaft complex are to be delivered turnkey-ready.

The permanent installations and equipment are to be procured by OJSC MMC Norilsk Nickel in accordance with THYSSEN SCHACHTBAU specifications and are to be made available to THYSSEN SCHACHTBAU for the assembly and commissioning of the shaft complex.



Solemnly start of surface working near the shaft SKS-1

The shaft construction project comprises the following individual operations: erection of surface infrastructure at the site proposed for the shaft sinking and for the permanent mine installation, sinking and lining of the 2,050 m-deep shaft, excavation and support of connecting structures below ground (including the shaft insets) and installation of the permanent winding, transport and service equipment. The skip plant for the shaft winding system is to comprise an underground ore loading station for the skip winder and a skip unloading station built into the shaft head frame.

SKS 1 shaft complex to be commissioned at end of 2019

The shaft complex is to be fully operational by the end of 2019. Norilsk Nickel estimates that the shaft will have an operating life of 50 years. The SKS 1 complex, which is to be planned and delivered by the contractor as a turnkey-ready installation, is composed of the following individual engineering services and permanent installations and fixtures:

- SKS 1 shaft completed to a depth of 2,050.5 m (9 m finished diameter)
- 110 kV/6 kV high-voltage transformer plant
- shaft headframe with shaft buildings and rope duct
- building to house the shaft winders
- skip winder designed for 1.5 million t/a
- cage winding system with a 20 t payload, large-capacity cage with counterweight
- loading and unloading equipment for the skip winding system
- decking and discharge equipment for the skip winding system
- surface belt tunnel for ore transport
- shaft fittings and guides for the shaft conveyance
- gas-powered air heating and cooling plant incl. admission-pressure axial flow fan with a delivery rate of 450 m³/second
- fan drift.

The shaft cavity is to be excavated by drilling and firing from a highly mechanised sinking platform system with seven working decks.

To reduce construction times and cut costs it has been decided that any temporary buildings and structures will be kept to an absolute minimum. Permanent installations and buildings will be used as far as possible for the shaft sinking phase.

The permanent guide fixtures are to be installed as the shaft sinking progresses so that when the shaft reaches its final depth the entire shaft complex can be commissioned without undue delay.

The shaft is to be sunk to a final depth of 2,050.5 m and will have an internal diameter of 9.0 m. The shaft column will be lined with a combined stabilisation and internal support system, as dictated by geological, hydrological and geomechanical conditions.

The inner lining for the shaft top section and the upper water-bearing zone to a depth of about 225 m is being constructed

Shaft sinking in impressive nature

from cast-iron tubbing sections that are backfilled with concrete to create a fully embedded tubbing column. The backfill concrete provides a frictional connection to the surrounding rock. Below the tubbing section the inner lining is constructed from poured concrete that is placed in individual 4.2 m high sections using a sliding formwork system that descends at the same rate as the shaft sinking.

The concrete thickness of the fibre-reinforced lining is in keeping with the principles of the New Austrian Tunnelling Method (NATM), which makes effective use of rock pressure control and monitoring. This technique involves installing the permanent inner lining at a distance of about 40 m above the sinking floor. A combined system of rockbolts and shotcrete is systematically installed in the floor zone ahead of the concrete.

By maintaining an interval of 40 m between the shaft floor and the permanent lining the rock strata around the contours of the shaft are relieved of stress and this prevents critical loading of the inner lining during the concrete curing phase (the first 3 to 4 days), which in turn protects the concrete shell from overstress and crack formation.

This approach means that a thinner shaft lining can be used, which makes for lower project costs and shorter construction times.

Making an early start

Like the WS 10 shaft sinking project that preceded it (see Thyssen Mining Report 2010) the SKS 1 sinking posed a huge challenge for everyone involved in the operation.

Working stage on the rope pulley WS-10

View down from headgear WS-10

Snow drift

Extreme climatic working conditions

The difficult nature of the construction project, with its extreme sinking depth of 2,020.5 m and finished shaft diameter of 9 m, was further complicated by the site's exposed location in the Norilsk region north of the Arctic Circle – which meant having to employ special construction and engineering techniques. Practically every item of material and equipment had to be transported by ship across the Polar Sea. This called for some forward-looking logistical planning.

A major consideration when working in the Polar region is the difference in performance between the summer and winter seasons. Labour efficiency in the summer, for example, is five times greater than in the winter.

Winter work is made extremely difficult by the heavy snowfalls, wind-storms and temperature levels of as low as -57 °C Celsius, combined with the long Polar nights. Highly weather-dependent operations, such as earth-moving, concreting and assembly work, therefore have to be postponed as far as possible to the summer months when teams can work the whole day long for seven days a week. At this time of the year the site manning levels at WS 10 are increased to about 350, compared to the 120 or so who are present during the winter period.

The main objective for the SKS 1 project is to make the most of what remains of the 2011 summer period – and this means having to plan operations well ahead of the contract negotiations. By implementing these measures at an early stage the company has already achieved its objective of completing the plans for the key project stages for 2011 well in advance. This meant that work could start on the construction of the shaft collar as early as 20 June (i.e. within four weeks of the contract signing) – leading to the successful completion of the first stage of the SKS 1 project.

Good luck, good fortune

In spite of the adverse climate and logistical conditions, and their operational impact, everyone involved is looking forward to this fresh challenge. The THYSSEN SCHACHTBAU team is convinced that the SKS 1 shaft construction project – like the WS 10 operation – can be delivered on time and to the complete satisfaction of the client, OJSC MMC Norilsk Nickel.

The company pursues the strategic objective of bringing younger employees into the project so that they can learn from the experience and know-how of the older generation of THYSSEN SCHACHTBAU shaft construction engineers. For many of these young specialists the project will prove to be a rigorous start to their career and a tough introduction to the world of shaft sinking and to modern shaft building technology – but at the same time it will almost certainly be a most instructive and inspiring experience.

We wish every member of the project team good luck and good fortune for the job ahead.

Dr. Oleg Kaledin
Rainer Lietz
Andreas Neff

Logistical challenge for the WS 10 and SKS 1 shaft sinking projects on the Arctic Circle

Digging a mine for someone requires a massive amount of material. Just ask Mülheim-based THYSSEN SCHACHTBAU GMBH, who are currently sinking two mine shafts at Norilsk in northern Siberia.

Undertaking such major projects in this remote region above the Arctic Circle is a huge challenge that requires an enormous amount of coordination between the purchasing and logistics departments and those involved on the technical execution side. An operation of this magnitude calls for a vast amount of special equipment and this has to be obtained from Germany, other European countries and even from the USA and South Africa. What is more, it has to be delivered to the different operating sites by the set deadline – and there is a lot of it. For the Norilsk project alone THYSSEN SCHACHTBAU is contracted to build two fully-functional mine shafts each topped by an imposing winding tower some 65 in height and weighing close on 2,500 tonnes. Both these projects will eventually require in excess of 500 individual containers and crates to be packed up and delivered to the port of Rotterdam. In the meantime, some 14,000 to 15,000 tonnes of materials and equipment of every kind – winding machines, fans and complete electrical systems – have already taken the sea route to Siberia. Every single crate and container has to be transported by sea to a destination that has no road or rail link to Eastern Europe. The whole process is further complicated by the fact that the sea route is closed every year for a period of at least three months because of the snowmelt on the Yenisei River. Precise planning and scheduling is therefore vital for the subsequent materials shipments.

The shafts that the team of specialists from THYSSEN SCHACHTBAU will be sinking in Russia are deep and no mistake. At Norilsk the men from Mülheim are working some 2,000 m below ground level. Here in the world's most northerly city the company has been contracted by global market leader MMC Norilsk Nickel to sink two surface shafts (WS 10 and SKS 1) for a new ore mine. This means drilling and firing through frozen ground metre by metre, day by day, year by year, until the WS 10 shaft is ready

for operation some time in 2016 – providing access to the region's enormous ore deposits. The SKS 1 shaft is scheduled for completion by 31.12.2019.

Finding new solutions time after time

When managing projects on such a large scale it is extremely important to have reliable and efficient partners on the logistics and transport side. And here we are in very good hands. The cooperation and teamwork has been pragmatic and very much focused on the job in hand. Problems are rarely mentioned – even though any supply chain to Russia will have problems aplenty to contend with. Rather the talk is all about finding a new solution that works. This means for example preparing the equipment for its long journey and protecting it from the extreme climate conditions. Then there is the accompanying and often very comprehensive documentation that is absolutely essential for the customs clearance formalities. This all has to be done properly so that the whole process goes without a hitch and the site managers are later able to gain direct access the shipments. And of course large numbers of 'parcels' and 'packages' all arrive at once. The really large ones can be up to 13 m in length, 5 m in height and 5 m in width. Over the years since the project started it has not been uncommon to have to handle individual items weighing in at as much as 50 tonnes.

Above all it is important to have good lines of communication with the management teams on site, the logistics service providers and the relevant customs authorities at every stage of the process; the flow of goods also has to be efficiently coordinated and optimised packaging procedures and seamless transport arrangements put in place. These are the key factors on which the success of the procurement and logistics project ultimately depends.

For us the mining industry always has been and always will be a market with a future. For those engineers and specialists who work on today's high-tech mining assignments the end of the shift is still a long way off.

Andreas Masthoff
Christiane Bajohr

Broad-based training sessions at the service workshop

Reconstruction of a Gardner Denver Triplex mud pump

View onto the rod storage

The service workshop, which is part of THYSSEN SCHACHTBAU GMBH, includes a stores depot and adjoining area of open space for repair and maintenance work. This is where overhauls are carried out on items of plant and equipment from the company's 'mining' and 'shaft sinking and drilling' divisions. The service workshop operates as an autonomous department; as well as carrying out repairs and renovation work the unit also plays host to instruction and in-plant training sessions for company personnel.

The workshop teams carry out refits and repairs on machines and equipment that are used at the project sites of the company's various operational units. The workshop covers an area of about 1 500 m² and its remit includes the repair and overhaul of all kinds of equipment, ranging from small jack-hammers, concrete pumps, mud flushing pumps and core drilling rigs to heavy raise boring machines. Drill jumbos, loaders, roadheaders, platform hoists, emergency winches, shaft-sinking winches and mine hoists undergo general refits or are modified and converted for new projects. The unit also undertakes mechanical and electrical maintenance, repair and modification work on mining equipment. The workshop has procured all the tools, lifting appliances and measuring instruments needed to meet the highest technical requirements. These are used for mechanical, electronic and hydraulic adjustment and calibration procedures both in the workshops and out on site.

The increased demand for storage room has been met by the lease of an additional site in Duisburg. The workshop personnel have used the 600 m² of covered space to install heavy-duty shelving, cantilever racking for long components and new storage cabinets for measuring instruments, hydraulic components, spare parts and other items.

The workshop also undertakes maintenance and servicing commissions for outside companies and its facilities are therefore assured of a high utilisation rate.

Instruction sessions for trainees

The service workshop also undertakes all kinds of training sessions that seek to familiarise junior employees with different tools and items of equipment. This means that the knowledge acquired by older members of staff can be passed on to the younger employees. The scheme ensures that a larger number of personnel will be available in future to undertake repair, assembly and commissioning work on mechanical equipment. This know-how transfer makes a valuable contribution towards improved plant reliability, which in turn will translate into fewer machine breakdowns and operating stoppages.

The workshop facility also serves as a test site for major new purchases, such as the RHINO2007xDC raise boring machine. Before going into service machines can therefore be used for operator instruction sessions, which involve the equipment being assembled and put through its paces in the presence of the manufacturer's engineers.

Introduction of the Rhino 2007

New organization of drilling tools

Close collaboration with the purchasing and logistics departments

Trouble-free project management depends to a large extent on being able to repair, rebuild and modify mechanical systems, procure spare parts at very short notice and deliver equipment on time. Integrating purchasing and logistics into the servicing and maintenance section contributes towards the efficient structuring of this important operation.

Restructuring has proved its worth

The parts depot for the company drilling division has been reorganised and inventoried. This reorganisation has included a restructuring of the warehouse facilities and the introduction of a new inventory control system and an electronic, database supported spares and materials management system. All drilling equipment and tools held at the Mülheim warehouse and at the operating sites are now recorded at a central data point. This provides the service workshop with a time-saving and cost-efficient inventory management system and means that drilling equipment can be delivered and returned in a transparent and traceable manner.

Participation in the health and safety system

Health and safety always take top priority in all our daily activities and each and every member of staff is trained and instructed in the use of the machinery and equipment before taking on their first job in the service workshop.

Summary

The service workshop for the THYSSEN SCHACHTBAU mining, shaft sinking and drilling divisions is an important in-house service provider. It also plays host to valuable instruction and in-house training sessions for junior staff. On-site assembly demonstrations are efficiently organised and make a huge contribution towards plant safety and operational reliability.

Meinolf Koch
Peter Tomczak
Norbert Schnee

Three of the four main elements that make up the new connection to mine level 7 have now been completed:

1. 2.5 m-long haulage incline from level 7 to level 6
2. In-seam conveyor road running east to west and
3. 270 m-deep extension for number 10 shaft.

The fourth part of the excavation programme commenced in 2008: the north and south shaft connection via lateral roadways C467 and C432 and the completion of the inset extensions. The first phase of this operation was described in REPORT 2010.

Steel support assembly with systhematic bolts at the bottom

Curve C432 in direction southern pit bottom

Prosper-Haniel colliery

An ongoing development plan for mine level 7 in shaft number 10 district is now a crucial factor for Prosper-Haniel colliery if the mine is to remain an efficient coal producing unit in the years ahead. The excavation of the south shaft landing has been an important part of the overall expansion programme.

Planning phase

The planning of the 'south landing' development project was based on experience acquired from the north installation as well as on geological exploration data from core drillings. This information helped establish the technical ground-rules and plan out the permanent support system.

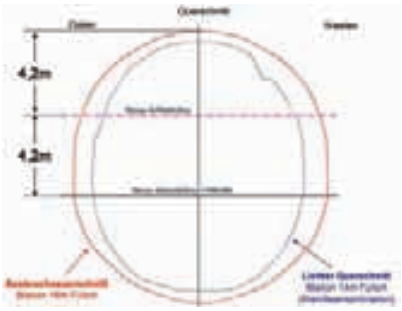
The results obtained from a numerical model prepared by Essen-based DMT GmbH & Co. KG indicated that the following approach would have to be used:

1. In order not to compromise the rigid support lining of the existing landing the new inset would have to be driven out from the shaft side.
2. The final cross section (approx. 100 m^2 of clear space) was to be excavated in a series of stages/part sections.
3. The final support system was to comprise a combination of immediate-bearing shotcrete, systematic rockbolting and backfill of various thicknesses, plus standing supports.

Excavation concept

After laying down the general operating parameters, detail plans and variant designs the technical strategy was discussed and agreed with the client. A fixed working stage was erected for roof excavation work in the existing landing. This stage was to perform the following functions:

- To provide an operating base for a drill jumbo and loader unit
- To act as a safe shotfiring refuge for number 10 shaft
- To serve as a reception point for blasting debris from the first shotfiring phase
- To allow efficient clearing of debris to the bottom-level platform



Pic. left:
Volumetric picture Prosper-Haniel mine, area Shaft 10: western elements of the tunneling concept

Pic above:
Local front face at the level of the bottom stage

- a materials transit point and transport route
- As a travelway for the drivage team and storage point for tools and instruments.

A vertical section taken through the landing, showing the existing and proposed profiles, clearly illustrated the scale of the project and the problems that the operation would pose.

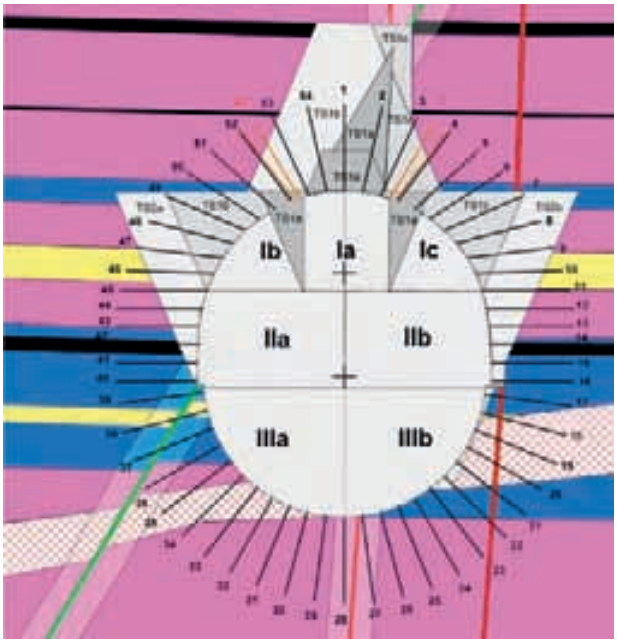
The working stage was constructed and delivered by Maschinenfabrik Hese GmbH. A repositionable hatchway was built into the structure to allow debris to be transferred through the stage and on to a chain conveyor installed on the floor platform.

A type BTRL 1 drill jumbo was chosen for the excavation and rock-bolting work, this decision being based on the machine's low overall weight of only 12 tonnes. As most of the rockbolts to be used would be four metres in length the jumbo was fitted with a telescopic drill slide designed for extension drilling work.

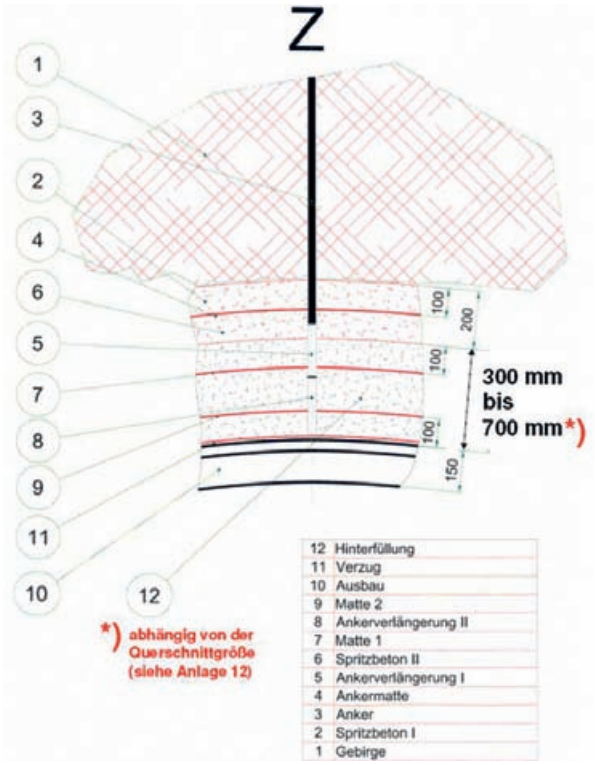
A Bobcat loader was chosen for debris clearance. Though an unusual choice for a colliery based project the Bobcat, which first had to be modified for the job, was preferred because of its low unladen weight and excellent manoeuvrability for a machine in this class.

The excavation project also included extending the shaft landing by a total of 24 m. This comprised a conically tapering section some 16 m in length and a further 8 m of cavity with a profile to match that of mine infrastructure roadway C432.

Design of the part cross sections



Scheme of the final support



Excavation of the south shaft landing – operating experience

Unlike the north landing project that was completed in 2008/2009, which had been a stand-alone operation completely unrelated to any other activities under way at the time, the work to be undertaken in the south landing was to prove much more extensive and complex. Scheduled materials and personnel transport movements would have to continue in parallel with the excavation work and additional activities would also have to be carried out as part of the technical installation work for the shaft inset on mine level 7.

Equipment installation and preparatory work

The conveyances and all necessary machines and equipment were assembled and installed in line with the detail plans for the drivage concept.
This was followed by the installation of two blasting screens – one fixed screen was set up in the immediate vicinity of the shaft and another mobile screen was positioned right up against the heading face. The mobile design of the roadhead screen meant that an additional and extremely effective protection system was available for immediate use at any time. The preparatory work also included product familiarisation and driver training sessions with the Bobcat loader.

Tunnelling section 1a

Excavation work

Drivage operations commenced in the pilot roadway (part-section 1a) at the end of September 2009. Lengths of up to about 8 m were blasted out in four rounds of shots. It was decided to use a parallel cut with eight 100 mm-diameter clearing holes. The advance per round was initially 0.8 m. From 8 m into the drivage until the end of the pilot tunnel firing was based on two rounds of shots with a maximum advance per round of 1.6 m.
The Bobcat proved to be an outstanding loading machine. Its mobility and acceptable loading performance meant that it

Bobcat next to the tipping area

Bobcat while mucking

Start of steel support assembly in the roof section

remained in service until part-section 1c was completed. Unlike its track-mounted counterparts, however, the Bobcat vehicle needs a level road surface for its operations.

The performance of the BTRL 1 drill jumbo also impressed the drivage crew and the machine proved to be well up to the job of drilling the shotholes and setting rockbolts of various types. A sliding track system mounted on the working stage meant that the jumbo was able to deploy easily to different positions.

After completion of the pilot drivage at the end of November 2009 section 1b was driven eastwards followed by 1c westwards. The supports were then installed in sections working outwards from the roadhead.

The figures below show the individual drivage sections and the installation of the steel supports in the top slice.

The infrastructure roadway C432 was driven at the same time as the operation in the south landing. After the steel supports had been installed in section I of the landing extension all was ready to make the cut-through from infrastructure road C432 to the south shaft inset.

The steel supports in the top slice were reinforced with additional floor arches and struts in order to create the necessary stability for the superstructure when excavating the lower sections, and also to counteract any convergence movements.

The colliery surveying team carried out twice-weekly convergence checks as the drivage work progressed. Telltale extensometers were also installed at various control points. These two monitoring systems concurred in finding no increase in measurement levels compared with the numerical model predictions.

The excellent progress made in the C432 cut-through, combined with the fact that virtually no convergence was recorded, led the engineering team to rethink their strategy for driving sections II and II of the shaft inset.

It was consequently decided to depart from the original plan and to excavate the next sections from C432. There were a number of important advantages in adopting this approach:

1. By turning the debris clearance direction towards C432 it would be possible to carry out assembly and installation work in the shaft zone in parallel with the drivage operation
2. The use of larger and more powerful machines and equipment would help increase drivage performance
3. The permanent inset support system could be installed in as short a time as possible
4. Separating the operations under way in and around the shaft would help increase safety levels at the workplace.

After infrastructure roadway C432 had been fitted with its type A combination support system as far as the shaft inset, work could begin on driving sections IIa and b. Cavities were excavated in

Steel support in section I with props

Tunnelling in section 2a and 2b

The final breakthrough C432 for the southern shaft-landing

succession to the east and west sides and the rockbolts and/or shotcrete lining were set in place. The advance per round was about 1.2 m.

After every three pulls had been completed with rockbolt-shotcrete to provide support the final steel supports were installed in this section and backfilled. This routine ensured that as the drivage approached number 10 shaft only a short section of roadway was ever standing under temporary supports.

Even during this phase of the operation the convergence monitoring instruments failed to indicate any unusual events. Once a separate shotfiring screen had been set up the breakthrough to the shaft zone was achieved after several rounds of shots.

In order to eliminate all conceivable risks it was decided to leave the inverted arches of the top slice in place as additional security until the permanent ring supports were installed.

The bottom slice was then excavated via a drivage ramp. The requirement in this section too was to have as short as possible a delay until the installation of the permanent support system. For this reason the roadway profile was again removed in sections, rather than excavating the entire face all at once. Unlike the approach adopted in the overlying sections, however, the embedded arch supports were installed and backfilled as complete units.

After the cut-through had been made to the number 10 shaft cellar and the supports had been installed the remainder of the excavation was completed towards C432. The permanent support system was also installed in this area. An end-wall was additionally constructed at roadway C432 to seal off the zone with the embedded floor arches.

Work began at the same time on erecting the steelwork needed to fit out the shaft inset. The shotfiring screens and working stage for section I were partly dismantled in order to create additional working space.

The excavation machinery was then dismantled and taken away. After completion of the steel girder platform in the south landing the remaining floor arches could be removed from section I.

Southern shaft-landing with railway track

Summary

1. The overall concept used for excavating the south inset proved to be highly successful in practical application
2. The drivage work was completed within schedule
3. The restrictions imposed on number 10 shaft operations remained within predetermined limits and hold-ups only occurred when shotfiring was being carried out
4. All modifications to the original plan of operations – for example turning the drivage direction when excavating the second and third slices – had a positive impact on the overall project
5. With the help of the numerical model and the operating experience acquired during the drivage project it was possible to improve and refine the procedures used
6. In spite of the unfamiliar nature of the work no notifiable accidents were reported by the drivage team in the course of the project.

Reiner Reese
Ulrich Barth

Tunnelling C432 in combined support type

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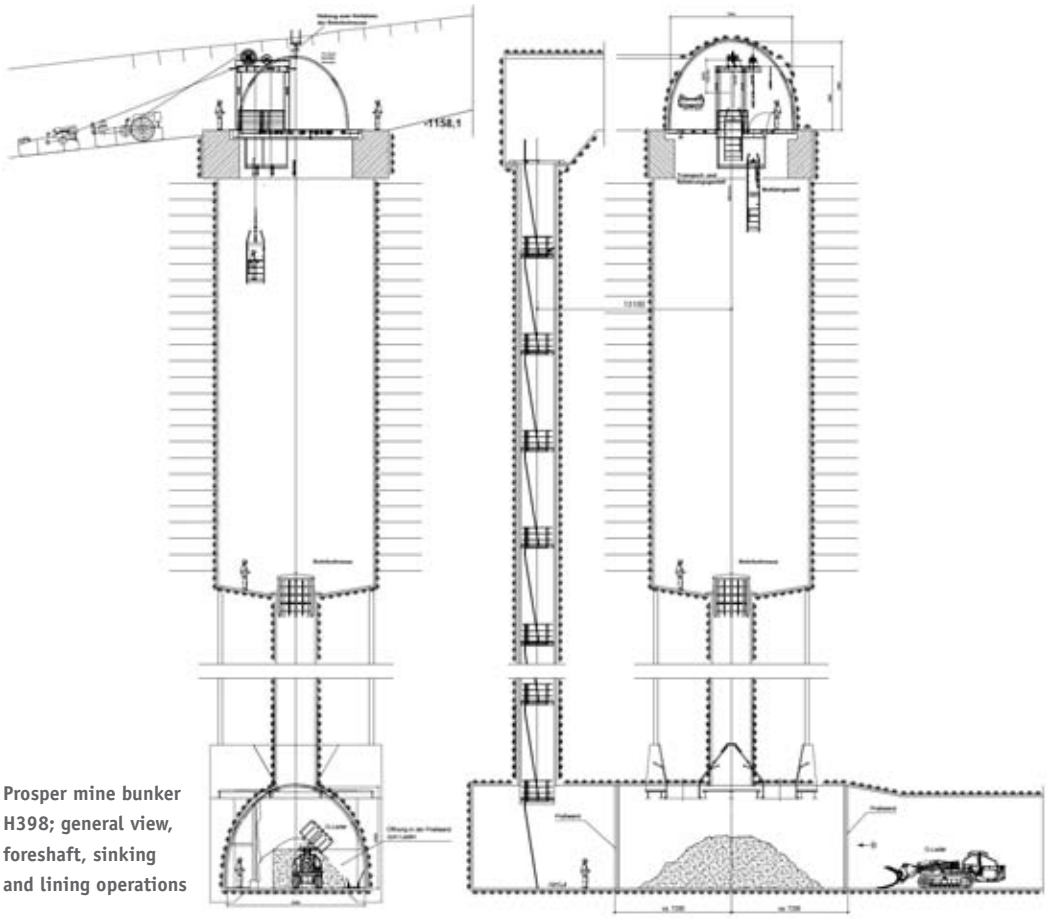
Installation of reinforcement at bunker collar

Prosper-Haniel and Auguste-Victoria collieries: Three bunkers at one stroke

The 'three-bunker project' comprised the excavation and fitting-out of three gravity-fed coal bunkers at Prosper-Haniel and Auguste-Victoria collieries. The three installations were to be constructed one immediately after the other in order to save time and money.

One major advantage of this approach was that the engineering could be carried out as part of a concentrated effort. The engineering services undertaken at one project site could then be adopted – either completely or with some slight modification – at the next bunker.

Another huge benefit was in the provision of logistics: after working on one bunker the mechanised equipment could be deployed to the next site with little effort and expense.



Prosper mine bunker H398; general view, foreshaft, sinking and lining operations

Technical data for the three bunkers

	Prosper-Haniel 1	*Auguste-Victoria*	*Prosper-Haniel 2*
Excavated profile	approx. 9.70 – 10.10 m	approx. 9.70 m	approx. 9.70 m
Final diameter	9.00 m	9.00 m	9.00 m
Length	48.00 m	approx. 20.00 m	approx. 40.00 m
Bunker outlet	Finished section: 8.00 m external: approx. 12.00 m		
Supports	GEWI grouted bolts 25 × 3000 Grouted bolts M33 × 4000/5000	GEWI grouted bolts 25 × 3000 Grouted bolts M33 × 4000	GEWI grouted bolts 25 × 3000 Grouted bolts M33 × 4000/5000
Concrete	Stabilising grout CM 45 Shotcrete Z 01.8 S Hydraulic remote supply (Plempe) Strength class 20/25	Stabilising grout CM 45 Shotcrete Z 01.8 S Hydromechanical supply via stationary bunker and oscillating pump Strength class 20/25	Stabilising grout CM 45 Shotcrete Z 01.8 S Hydromechanical supply via two stationary bunkers Strength class 20/25

Plant and equipment	
Raise boring machine	Wirth HG 160
Extension drill head	2400 mm diameter, Sandvik
Loader vehicle	DH G 211/K 311
Man winch	30 kN with ZU 50 – compressed air
Emergency travel winch	30 kN electric drive
Dry-spraying machine	Aliva AL 265
Uni-mixer	40.2 L

Project 1 – Bunker H398 at Prosper-Haniel

RAG Deutsche Steinkohle AG put the three-bunker project out to tender in the summer of 2009. The mining division of THYSSEN SCHACHTBAU submitted a bid for the contract and was given the go-ahead in the winter of 2009/2010. The projects were to be completed between late 2009 and the end of 2012.

In February 2010, after the TS Engineering Office had drawn up the planning details, work was able start on the sinking of bunker number H398. The client, RAG Deutsche Steinkohle AG, commissioned the DMT to produce a report on the strata support measures that would be required at the bunker outlet and on any additional measures needed in and around bottom roadway D331.

Drilling chamber, access to ventilation borehole

Loader and loading box, (left) access to ventilation borehole

Geology

Coal seam G2/F, which is about 2.2 m in thickness, lies some 8.00 m above the roof of the bottom road. The floor of this seam follows the line of a 2.00 m-thick, slightly sandy bed of root clay along with extremely sandy clay-shales with a sandstone layer. Non-sandy and weakly sandy shales are also present in the roof and side-walls of the bottom roadway. Seam D in the roadway floor was removed and the side-wall segments extended.

The bunker sinking traverses seams H, G1 and G2/F, which range in thickness from 1.28 m (seam H) to 2.20 m (seam G2/F). Including the root clay bed – which is mainly composed of slightly sandy clay-shale – the sinking has to pass through three low-strength sections of 2.50 m to about 4.50 m in thickness. The surrounding strata mainly consist of sandy to extremely sandy clay-shales with individual fine-sand layers.

Ventilation borehole (air-shaft) and pilot hole

The twin borehole project involved close collaboration between the borehole sinking crew and the THYSSEN SCHACHTBAU drilling department.

After the HG 160 had been assembled the directional drilling was completed to a diameter of 216 mm. The hole was then raise bored to the final diameter of the pilot hole and ventilation borehole of 2400 mm.

The ventilation borehole was cased using the HG 160 machine; the final inside diameter is 2100 mm. The casing is formed from

Sinking winches and diesel trolley operations

1.00 cm-thick steel plates that are joined together by push-fit and screw joints. An inspection compartment was also completed in parallel with the casing work. After assembly of the steelwork the annulus between the strata and the support system was filled with concrete (cement suspension).
The drilling debris collected at the loading point was transferred by a G 211 loader on to the PF 3 chain conveyor. It was then passed through a roll crusher before being transported out by belt conveyor.

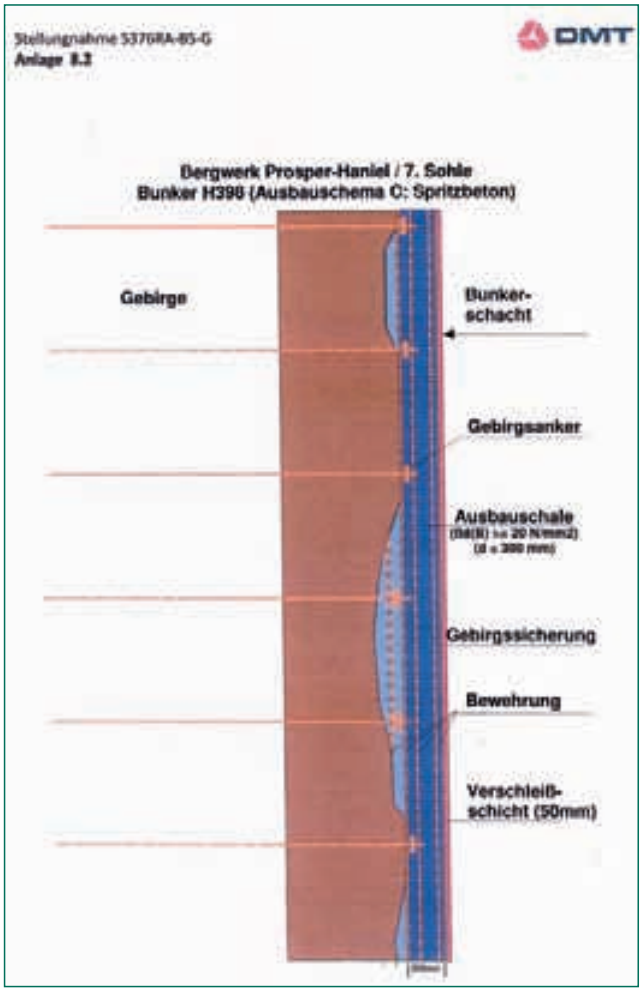
Bunker collar and preparatory work

The colliery had stipulated that belt conveyor operations, diesel trolley movements and travelling arrangements along the bottom roadway should continue uninterrupted for the entire duration of the project.
This meant that extensive preparations had to be put in place before the bunker construction work could start: a walkway bridge had to be installed and additional work was needed to reinforce the roadway supports; finally, extensive measures were needed to provide protection for the belt and cable systems. After all these precautions had been put in place, and the drilling machine dismantled, work could begin on the construction of the bunker collar.
The bunker collar has an excavated diameter of 12 m, an inside diameter of 7 m and a depth of 3 m. However, the top roadway only has an inside profile of 8 m. After the drilling and firing had been completed, the arch supports in the lateral axis of the existing roadway therefore had to be extended by 3.50 m using TH steel beams. In order to create the best possible friction connection with the roadway the reinforcement for the bunker collar was installed after undercutting the roadway supports, and the arches were then incorporated into the new structure.

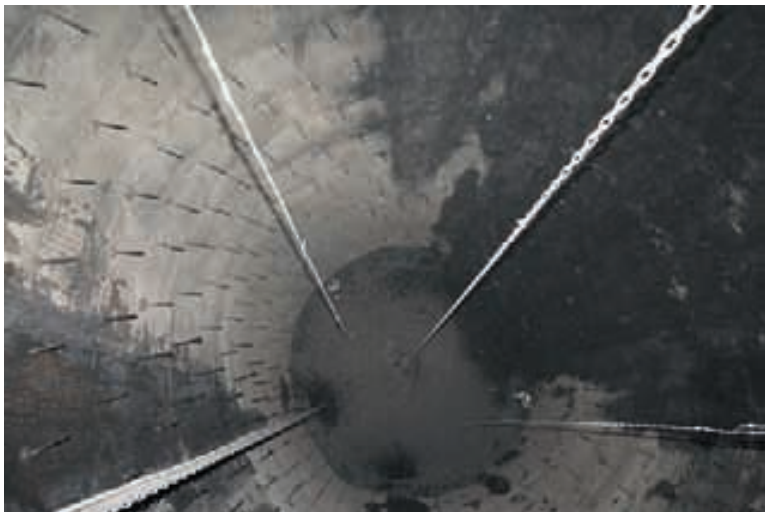
Sinking phase

Once the bunker collar had been concreted into place work could start on the sinking operation. After reaching a bunker depth of 15 m an inspection system had to be installed along with an emergency winder. A ring ladderway system was used to enter the bunker as far as the 15 m level.
Sinking was carried out conventionally by drilling and firing. About 50 kg of explosive was expended for each round of shots and a bunker catch-net used to channel the blasting debris down through the pilot hole.
A temporary support system was put in place, comprising GEWI M 25 × 3000 grouted bolts, rollmesh lagging and a 5 cm-thick layer of supporting shotcrete. The cavity diameter in the coal-seam areas had to be increased by about 20 cm in height so as to prevent any spilling out of the coal.
At a sinking depth of 15.80 m slumping occurred with a run-out of coal from the pilot hole. This created a wedge-shaped cavity 5 m deep and the coal was washed out across an area of 5 × 5 m.
It was then agreed, after discussion with the shaft operators and DMT, that the pilot hole should be completely refilled with

DMT support diagram



Boarding point for lowered cage entrance for bunker inspection, (right) belt road with steel cladding as shotfiring protection



View looking down on to the bunker sinking floor

concrete and drilled out to a new borehole diameter of 1600 mm. After this had been done the sinking was able to continue and was completed without further incident.

Bunker outlet

The bunker hopper zone had to be widened to create a rectangular profile measuring 12.60 × 11.50 m and extending to a height of some 3.60 m. Extra support was provided in this area in the form of M 33 × 4000 and M 33 × 5000 grouted rock-bolts, a reinforcing layer and a coat of stabilising shotcrete.
The supports around the bunker bottom road were removed and the platform could then set up on a stable floor surface for the working team – who were then able to spray the final layer of shotcrete into place.

With the platform all set up so that it could operate inside the bunker work was able to begin on the hopper walls. Four steel-concrete structures had to be built to support the twin hopper system and bunker draw-off device. This required the use of heavy reinforcement for the walls.
Overhead screens had to be erected in the bunker because the reinforcing work on the hopper support walls was being under-taken simultaneously with the placement of the final shotcrete layer. This protected the reinforcement from spray rebound and contamination.
The final shotcrete support shell was installed in two phases. In phase one the platform was wound from the bunker outlet up to the bunker collar and the first layer of reinforcement mesh and shotcrete set in place. On its final descent to the bottom of the bunker the platform was then used to install the final layer

Spraying under way during the first platform ascent

Constructing the walls for the hopper support surfaces, overhead screens to prevent contamination of the reinforcement

of reinforcement and spray on the last concrete coating to give the bunker its final diameter dimensions. A ventilation pipe was also installed section by section. This was required because bunker H398 was later to be used for storing and stocking high-volatile coking coal.

The spraying operation concluded with a coating of wear-resistant concrete, which was applied over an area extending from the upper edge of the hopper to a height of about 10.00 m.

Final support system

The geomechanical parameters and influences were assessed by DMT and a support plan was drawn up.

Strata stabilisation usually involves reinforcing the surrounding rock with early-bearing building material and rockbolts (25 x 3000 GEWI grouted bolts). Because of the proposed widening of the shaft diameter from 10 m to 12 m and the geomechanical interaction between the bunker shaft and the bottom roadway additional measures were needed in this area.

Type GW 25 rockbolts 4 m in length (3.85 m grout embedded in the rock) were required to connect the floor of seam G2/F to the upper limit of the free rock body above the bottom roadway. These were to be set at an angle of 90 degrees to the shaft side-walls. The rockbolts were to be installed at 1.00 m intervals with 1.00 m between rows.

The bolts in the rock body around the bottom roadway were to be installed at a rising angle of 27 degrees to the horizontal. It was specified that the five rows of M 33 rockbolts would be between 4 and 5 m in length, the aim being to divert as much of the total load as possible into the roof beds.

The shotcrete was delivered in Big Bags, which were filled below ground at the shaft bypass on mine level 7. From the filling point the Big Bags were transported by diesel trolley to the head of the bunker. As the maximum daily transport capacity was 40 Big Bags, the shotcreting operation had to be restricted to two shifts a day, with 20 Big Bags being used per cubic metre on each shift.

Summary

Bunker H398 is another important element in the connection that is being established between the Zollverein working districts and shaft number 10. This major underground construction project began in 2004 with the deepening of number 10 shaft, to be followed in 2009/2010 by the extension of lateral roadway C467 and the interconnection to the shaft inset on level 7.

Bunker H398 was completed to everyone's satisfaction, thanks to the smooth and efficient teamwork shown by all involved in the project – particularly the underground workforce, which comprised a group from mining specialists Ruhr-Lippe mbH, a subsidiary of THYSSEN SCHACHTBAU, plus various Thyssen personnel. This seasoned team is well used to working together and was also involved in the coal bunker H293 and ventilation borehole G272 (West colliery) projects.

The operation was completed successfully and without accidents – a tribute to the vast experience that the THYSSEN SCHACHT-BAU mining division has acquired over many years of contract work for the coal industry.

Reiner Reese
Witold Krawiec
Reiner Spekowius

Sources

[1] Strata stabilisation at the bunker outlet and additional measures needed in and around the bottom roadway. Bunker H398/7. Prosper-Haniel colliery, DMT

The legendary breakthrough at the 15th oct. 2010

Swiss project sets new world record

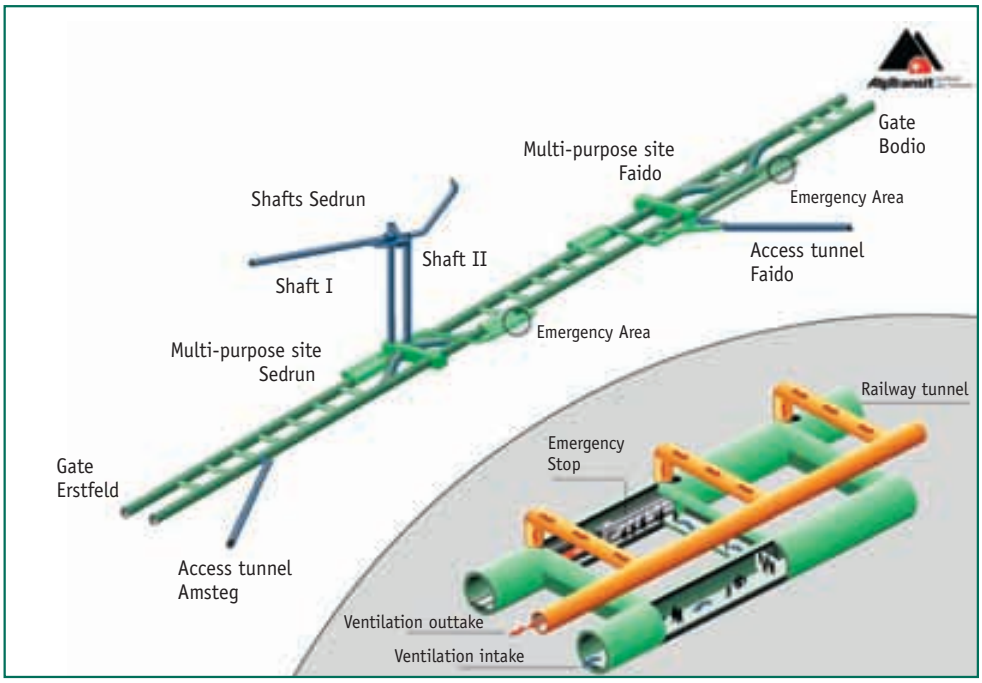
The Gotthard base tunnel finally broke through at a depth of some 2,000 m on Friday, 15 October 2010. At 57 kilometres it is currently the longest rail tunnel in the world. The event, which was acclaimed internationally as an engineering masterpiece and an unprecedented achievement, was also an impressive demonstration of how engineers, mining teams and geologists – and governments and people too – could work effectively together. AlpTransit Gotthard AG is the principal developer of the new NEAT rail link (Neue Eisenbahn Alpentransversale) at the Gotthard. THYSSEN SCHACHTBAU GMBH was also involved in the project, carrying out shaft sinking, drilling and logistics work during the tunnel construction phase.

The Gotthard base tunnel is the centrepiece of the AlpTransit Project that has driven a new route through the Gotthard massif. The 57 km-long tunnel consists of two parallel single-track tubes that are linked every 312.5 m by a series of connecting galleries. The tunnel starts off at Erstfeld and follows a slightly curved line towards Biasca, thereby connecting the two part-sections of Uri and Riviera.

The Erstfeld portal is sited on the northern side of the Alps, while the Bodio portal is on the south side. The tunnel is divided into three sections of almost equal length by the two multifunction stations (MFS) of Sedrun and Faido. These two MFS consist of large underground chambers that house the technical infrastructure and equipment needed for the railway operations and will also serve as emergency stopping stations that provide a link between the east and west tubes.

When this impressive engineering project is completed it is expected that some 30,000 passenger trains and 77 400 goods trains will make the journey through the two tunnel tubes every year. The first trains are scheduled to pass through the tunnel in December 2016. The breakthrough to link up the final two sections of tunnel is a transport milestone for Switzerland and the whole of Europe. The section from Erstfeld to Bodio will cut the journey time from Zurich to Milan by 60 minutes to a mere 2.5 hours. Inside the tunnel the trains will travel at a maximum speed of 250 km/h.

Overview inside the Gotthard base tunnel (Source: AlpTransit Gotthard)



The breakthrough is broadcast live around the world

The major event of the tunnel breakthrough was broadcast live in many countries. The 9.5 m-high and 400 m-long tunnel boring machine cut through the last 1.8 m of rock between the Faido and Sedrun sections at about 14.00 hrs on 15 October 2010. The little town of Sedrun, in the heart of the Alps, was at that moment the centre of the world.

TIMDRILLING

Swiss-based Implenia Bau AG – a major construction company that played a significant role in the tunnelling operation – provided the technical leadership for three of the five part-sections. In 2002 Implenia Bau AG and THYSSEN SCHACHTBAU set up the permanent joint venture TIMDRILLING with a view to collaborating in major construction projects – with the Gotthard base tunnel very much in mind. The main services offered by the partnership include:

- Preventer supported rotary percussive and core drilling operations for exploratory survey work in tunnel construction projects
- Rotary percussive and core drilling without a pressure closure device
- Conventional and mechanised shaft sinking, especially for tunnel and hydro-electric construction projects
- Transport of construction materials and heavy items
- Installation and operation of vertical and inclined shaft winding systems
- Installation of infrastructure and supply lines for tunnel construction projects
- Injection work for strata sealing and reinforcement
- Raise boring
- Microtunneling
- Ground freezing

TIMDRILLING will continue to provide specialist services for clients after the Gotthard base tunnel project comes to an end in late 2016. With the expected increase in infrastructure projects and pumped storage schemes there will be no shortage of demand for competent providers of construction and engineering services in the years ahead.

Michael Müller
Dr.-Ing. Axel Weißenborn

Areal view Cigar Lake uranium mine

Cigar Lake – back on track

Thyssen Mining Construction of Canada and joint venture partner Mudjatik Enterprises are contracted to provide both mining and construction services to meet present and future mining production requirements of the Cigar Lake Mine. Full construction of the Cigar Lake Project began in January 2005 and as of October 2006 capital construction was 60 % complete. At this time the mine encountered a water inflow and the mine flooded.

Introduction

Cigar Lake is the world's second largest known high-grade uranium deposit in the world and is located near Waterbury Lake, approximately 660 km North of Saskatoon, Saskatchewan. Operated by Cameco, that ownership structure includes 50 % Cameco Corporation, 37 % AREVA Resources, 8 % Idemitsu Uranium Exploration Canada Ltd. and 5 % TEPCO Resources Inc. The Cigar Lake mine has an expected 15 year mine life.

The Cigar Lake deposit was discovered in 1981 by a regional program of diamond drill testing of geophysical anomalies. It occurs at depths ranging between 410 and 450 m below the surface. The project will be developed using a jet boring mining method, a full face tunnel boring machine and ground freezing techniques. Underground grinding of the ore will take place and will be followed by trucking to Areva's McClean Lake mill for leaching.

Scope of work

Mudjatik Thyssen Mining (MTM) is involved in all underground excavations, including probe hole drilling and pressure grouting ahead of development; ground support including shotcrete, bolts and screen; concrete for the sill and construction; various other mining activities and shaft sinking.

Manpower and supervision

There are four crews each of mining, shaft sinking, construction, mechanical, surface and electrical on a shift rotation schedule of two weeks in and two week out. MTM provides the supervision for these crews from superintendent to shift boss. MTM presently employs over 250 people at the Cigar Lake Mine. Planes flying five days a week and provide transports for these crews to the jobsite with the majority from Northern Saskatchewan.

Mine dewatering

In October 2006 the mine serviced by No.1 Shaft encountered a water inflow that flooded the mine. Dewatering began late in 2006 with an extensive drilling program to target the inflow area on the 465 m Level for concrete backfilling and to position submersible well pumps to dewater. Entry into the mine was achieved but a second inflow was encountered on the 420 m Level in 2008 while refurbishing the shaft. After successfully sealing this area, the mine was completely dewatered in early 2010.

Re-entry

Crews re-entered the 480 Level early in 2010 facing a great deal of work to restore access to the main area of the mine. Prior to this, complete refurbishing of the No.1 Shaft including a new man-way system, new service lines, temporary power cables and a temporary pumping system were completed. The mine was secured from potential water inflows with the placement of twenty pressure tested hydrostatic bulkheads on the 420, 465 and 480 m Levels. The bulkheads were completed in June 2011. Slimes from the flood were stored in geo-textile bags and are being removed from the mine by mixing the somewhat dry slimes with development muck. The flooded equipment was dismantled and sent to surface.

No. 1 Shaft

Development and construction started again in the summer of 2010 and are continuing on schedule. Additional ground support was added in numerous areas, once access was achieved. All areas were inspected and cable bolts, rebar bolts, screen and shotcrete were added wherever was deemed necessary. The 480 Level Refuge Stations and Lunch Room were established. The 480 Level Heat Exchanger Plants were completed allowing for the freezing of the remainder of the ground between the No. 2 Shaft bottom and the breakthrough to the 480 Level. The ground freezing system for the ore body located at the North-end of the mine was re-commissioned. Some preparation work has begun for the scheduled start up of the full face tunnel boring machine to establish more production tunnels. A freeze wall with 6 m thickness was established around the No. 2 Shaft in May from the 480 Level Station allowing for the shaft sinking of No. 2 Shaft beyond the depth reached in 2006, when the shaft flooded. Numerous contractors are working in No. 1 Shaft with a 2013 production schedule in mind.

No. 2 Shaft

After No. 2 Shaft was pumped out, a probe and grout cover at the 390 Level was completed and a 3.0m concrete plug was placed and the extensive preparation work to prepare for the last 100m of sink began. The shaft liner design changed from a concrete liner to a tubbing liner and the shaft sinking setup was modified accordingly. A 4.0 m section of the concrete shaft liner was removed from the shaft and a 4.0 m grout cover to serve as the top tubbing seal was completed in early April of 2011. After removal of the bottom section of the shaft concrete liner work began to install the 100 m tubbing liner in the shaft. This is being achieved by installing 1.5 m high steel tubbing rings complete with lead gaskets and concrete backfill. Breakthrough into the 480 Level will follow shortly after the completion of this liner. The breakthrough area on the 480 Level is being prepared along with the requirements for sinking the shaft to the 500 Level. Once the shaft is completed, work will begin to slipform a 490 m concrete divider wall, furnishing the shaft, installing power cables and all other requirements for the service shaft to be changed over to permanent mode.

MTM Safety

MTM employees attend daily and weekly safety meetings where safety concerns can be discussed. MTM employees are held accountable for their own safety and the safety of others by following all procedures and standards that are in place. By following these guidelines and being conscientious about safety, MTM employees have been able to accomplish a 5 Year Lost Time Accident-Free Record, which is an outstanding achievement.

Steve Farrell

Shotcrete vehicle with silo truck

Jetcrete North America

The Jetcrete North America Joint Venture between Thyssen Mining Construction of CANADA and Jetcrete Australia was formed in July 2008 to import some of the vast shotcreting technology from Australia to North America.

The worldwide down turn in the mining industry and the financial crises unfortunately hampered these efforts through the end of 2008 and into the early parts of 2009. During this period gaining new works in a new market for a specialist shotcreting contractor proved somewhat difficult.

The somewhat "quiet time" was utilized by Jetcrete North America to acquire some new as well as used equipment and as such preparing themselves for busier times to come. Presently, Jetcrete NA owns

- 3 transmixers,
- 4 Normet shotcrete sprayers,
- 1 complete setup to remotely apply shotcrete in raise bore holes,
- 1 batch plant and
- variable pieces of gear related to specialist shotcrete applications.

Shotcrete vehicle while grouting a concrete layer

With the current upturn in the mining industry, we have seen a steady increase in the demand for the specialized shotcreting services throughout North America. Jetcrete North America has seen a steady increase in the demand for alternate works such as remote shaft lining, the supply of batch plants, with our first batch plant being commissioned in Northern Saskatchewan in late July 2011, predominantly used for the production of shotcrete, general purpose concrete, along with full time shaft lining works already awarded.

Some of our present clients include mining companies such as Cameco Corporation in Northern Saskatchewan, Xstrata in Ontario, New Gold Inc. in British Columbia, Procon Contracting in the Yukon. Jetcrete North America has also seen an increase in general enquiries from other potential clients through North America.

With the influx of additional work, Jetcrete North America has been able to maintain a steady growth for the last two years and is currently seeing somewhat of a small boom in 2011, with our monthly turnover and workforce doubling in size. As the demand for our services grows, Jetcrete North America will continue to expand, purchase additional equipment required to accommodate new and future works and employ the always increasing amount of qualified/certified staff.

Scott Johnston

The headgear for entering the cavern

Catlettsburg Cavern #2 Project

The Catlettsburg Cavern #2 will be an underground liquid Butane storage cavern. It is being excavated by Thyssen Mining for an oil refinery owned by Marathon Petroleum in Catlettsburg – Kentucky. The refinery is located at the West shore of the Big Sandy River in Kentucky, while the cavern site is at the East shore of the river in West Virginia.

The cavern is being excavated in a shale formation at a depth of 170 m. The current design volume of the cavern is for 1,000,000 barrels (159,000 m³) of Butane at a maximum pressure of 120 psi (8.3 bar). Access to the underground work areas is via a blind bored steel lined shaft with a diameter of only 2.4 m. Additionally, two steel lined boreholes with a diameter of 0.9 m provide the means for an efficient ventilation circuit and a second escape way.

After the completion of the main access shaft and the excavation of the initial 228,000 barrels (36,200 m³) by a different contractor, the project was at a care and maintenance stage

Transport of a wheelloader into the underground

since mid 2008. Thyssen Mining was asked to help with some remedial work during 2009 and 2010, aiding with the maintenance of the underground openings and the installation of additional ground support.

At the end of 2010, Marathon Petroleum decided to continue the project and Thyssen Mining was awarded the contract by PB Energy Storage, the designer of the cavern. Work on site started on January 10, 2011 with a scheduled 10 weeks of remedial and preparation work. The on-site mobilization and the initial scope of work included in the start-up period were completed eight days ahead of schedule. A lot of effort and dedication by all involved went into achieving this milestone.

Besides mobilizing additional equipment to site and especially to the underground work areas via an 8 ft (2.44 m) diameter shaft, the initial scope of work included replacing the existing service pipe lines, repairs to the entire electrical distribution system, the application of around 300 m3 of shotcrete, cleaning and rehabilitation of the existing excavations, repairs to the loading pocket/surface shaft arrangements and the installation of additional ground support.

One of the biggest challenges was the replacement of some of the existing underground equipment to allow for the on-schedule start of the cavern excavation. Not an easy task considering the 2.4 m diameter size service shaft. The work was completed safely without a single incident.

The actual cavern excavation commenced mid March of 2011. The cavern will consist of three East-West crosscuts and eleven North-South drifts; mostly all of these drifts 25 feet (7.62 m) wide by 28 feet (8.53 m) high. Some of the drifts will be benched later on to achieve the final cavern volume and give the cavern floor the desired grade for a smooth flow of the liquid butane from the furthest point of the cavern to the shaft.
All of the excavated rock is being hoisted to surface via a single 4 ton skip, making this the bottleneck of the entire operation. Through the end of July 2011, Thyssen Mining has excavated a volume of approximately 320,000 barrels (50,900 m³), which puts us slightly ahead of the schedule.
Following the completion of the excavation, the entire cavern will be cleaned. The equipment and any installations required for the excavation will be dismantled, followed by the installation of all piping and pumping systems required for the liquid butane storage. Lastly, the main shaft as well as the two ventilation shafts will be capped off.

Thyssen Mining's involvement in a cavern excavation for liquefied gases in the petroleum industry is a first for us. With the experience gained on this project, we are confident that a new niche has been opened for future business.

Adrian Bodolan

Working stage No. 4 is ready for transport

Thyssen Mining Construction of Canada Ltd Technical Services Department

Our Technical Services Department's two main objectives are to provide our clients with support and engineering solutions for the many operations where TMCC is involved, and to prepare cost estimating and scheduling services for project studies and bids.

Engineered Designs

„Necessity is the mother of all creation." This well known statement is our driving force for the development of construction techniques and procedures, as well as the design and fabrication of various tools and equipment. These routine activities form part of TMCC's scope of work. We strive to design and build these devices in a simple yet innovative manner, many of which are so task specific that they belong in a class by themselves. It could be said that what does not exist is invented, if needed for a given task. We work very closely with the people on site, honing the worker's ideas and knowledge to develop tools that are as practical at the work place as possible.

Every item we design must comply with specific safety standards regulated by the place where it is to be used. Since some of the equipment we design is used to transport personnel, such as a cage, safety standards are strict, and the design parameters must be carefully calculated in terms of dimensioning, and material specifications.

Considering that TMCC operates all around Canada, our team includes Professional Engineers, each registered in one or more provinces, so that we are able to certify and stand behind our designs, no matter where the job is located.
We have the skills, along with the experience. We can design for any job, no matter how big or how small. In short, we have what it takes to rise to the challenge.

Estimating & Costing

Increased interests in the mining industry have many potential clients offering TMCC a chance to assist in developing their project. In almost all situations, cost is the factor that forms a business relationship. TMCC's Technical Services group works in cooperation with the Mine Operations group to offer potential clients the option of either using proven experienced mining methods or developing new and innovative methods. An estimate of costs is built around the method that the client prefers or provides.

Estimates and costing are calculated by Technical Services, which is made up of a team of vastly experienced technical and operational personnel from the mining industry. This unique blend of support is combined with the many years of historical project operational data, and provides the client with a legitimate and accurate estimate of their project costs, whether it is still in the pre-feasibility stage or scheduled for construction.

Cigar Lake Project's Shaft # 2 – Cameco

TMCC's Technical Services Department undertook the task of supplying design and procurement work required to complete the sinking of shaft #2 at Cameco's Cigar Lake in Northern Saskatchewan. This shaft was originally designed to have a 6 m finished diameter, lined with concrete and sunk with a grouting cover. However, poor ground conditions, including massive sand pockets, along with extreme water inflows, required a change in approach. To handle these conditions, ground freezing was implemented from the underground 480 m mine level up to the 376 m level.

Steel tubbings were chosen from a number of options as the technology that could handle the difficult site conditions while meeting the client's requirements. Since the initial sinking setup was designed for a concrete liner, modifications to handle a tubbing liner were required. This is the first tubbing liner ever installed in a Uranium mine in Canada. As the shaft concrete lined section incorporated a set of grooves for slipforming the divider wall, similar provisions were required to accommodate this feature through the new tubbing liner section.

Various analyses were needed to study the potential thermal impacts associated with this particular feature. This is the first tubbing liner design in which such a divider wall was incorporated, making it a one-of-a-kind design. Using a team of experienced people and fresh minds, the end result has been a combination of practical yet innovative solutions to simplify installation and minimize the construction schedule.
The design team consisted of TMCC engineers, as well as designers from Poland. The work included engineering, procurement and a quality control program.

Since the sinking setup was not designed for a tubbing liner installation, numerous modifications were required. Changes were made to the three existing shaft decks; the fourth deck of the galloway was replaced with a newly designed one, and a fifth, movable deck added. Among the new features, a monorail was added to allow efficient operations for the handling of tubbings with a high level of safety.
The tubbing segments were manufactured at Chofum, a foundry of the GWARANT group in Poland. Our construction design required that structural concrete be placed behind the tubbing ring using pumps located on the sinking stage. The above work was still in progress at the time this article was written, and when completed, concrete cold joints will be grouted using innovative grouting products and methods specifically designed for this project.

To minimize unsupported height of excavation, a top-down approach was selected as the tubbing installation method. A special jacking ring was designed. The ring was suspended on hanging rods and the tubbing segments assembled on this ring. Then the hydraulic jacking system was used to lift the assembled tubbing ring and bolt it to the previously installed ring. Before any fabrication was started, 3D modelling software was used to perform a full parametric study in order to optimize the design. Through smart construction techniques, and the help of an experienced fabricator, the end result was a welded and bolted assembly of the numerous laser-cut components. The as-built tolerance of the assembled joints is less than 1 mm over 6 m. The design methods used not only made the engineering easier, but reduced engineering and fabrication costs, while eliminating modifications in the field.

In order to lift the installation ring with a full 40 ton tubbing load, TMCC devised a simple yet effective hydraulic jacking system. Comprised of a number of jacks, the self levelling system allowed for fast and precise lifting of the tubbing rings in place.
Numerous other specialty tools and brackets were designed in-house for the installation.

Once the shaft is lined, a concrete divider wall will be poured and keyed into the tubbing lining.
This project is the first new shaft where tubbings are used in Canada in over 30 years. The successful design and construction of this unique tubbing liner is testament to TMCC's desire to innovate and adapt to unique project conditions.

Research and Engineering – Cameco / MRX

Our Technical Services Department is fully capable of providing engineering knowhow which spans from designing mining tools and equipment to all aspects of mine design. However, our expertise does not end there. We are constantly looking for novel solutions to common mining problems, and are able to conduct research and testing of various different products, thereby placing TMCC at the forefront of mining technology, and helping drive the mining industry into the future.
A clear example of our pioneering work can be seen in the testing of a special shaft-wall waterproofing membrane, which we conducted in February and March of 2011. The membrane in question has never been used to line a mine shaft before, and

the positive results of our tests could result in this product becoming a standard component in the lining of future shafts within Canada and abroad.

Because of the fact that some shaft wall temperatures can dip below freezing, a methodology for applying a layer of shotcrete prior to applying the waterproofing membrane was devised. In theory, the hydration temperature of the shotcrete would raise the surface temperature above freezing, thus allowing for successful application of the membrane. However, this idea needed to be tested. Consequently, a testing environment, which simulates actual shaft conditions, was designed and implemented at our TMCC shop, in Regina.

A freezing circuit was designed to circulate glycol at -10 °C along heat exchangers, to simulate the most extreme shaft wall conditions. Test panels, equipped with thermocouples, were built and placed over the heat exchangers. These panels were used as the testing surface over which shotcrete was sprayed. The special membrane was then applied over the shotcrete, and allowed to cure. During the spraying and curing process, temperature and time data was collected with specialized software for subsequent analysis.

The conclusions drawn proved invaluable and have empowered us to continue with our design work for the implementation of this membrane in upcoming shafts. Indeed, based on the success we have had thus far, it is expected that the implications will be far reaching: not only can the use of this hydrostatic lining system provide water tight shaft walls like never achieved before, but the cost savings alone, when compared to conventional lining systems, is likely to make this the product of choice for shafts of the future

Mine design support and freeze ring engineering Tamerlane Ventures – Pine Point Project

Tamerlane Venture – Company Profile

Tamerlane Ventures Inc. is an exploration and development mining company with advanced base metal development projects in Canada and Peru. The Company is working toward bringing the world-class lead-zinc Pine Point Property back into production in the Northwest Territories, Canada, and developing its Los Pinos heap leach copper project in Peru. The Company's primary focus is the Pine Point Project. The historic Pine Point Mine was the largest and most profitable base metal mine in Canadian history. Tamerlane owns 100 % of the Pine Point Project, along with a large contiguous property to the west.

The Pine Point Project

Significant open pit and underground mining occurred on the property by Cominco from the period of 1964 to 1988. The Pine Point Project is a lead and zinc mineral resource property and Tamerlane is proposing to produce a nominal 2.800 tonnes per day using an underground mechanized, long-hole-stoping mining method. Ore will be transported to the surface for dense media separation and flotation processing of the lead and zinc ores.

The depth of the ground water table and historic quantities of water that were pumped by Cominco was a major hindrance to historic mining at the Pine Point property. All of the Pine Point

Shooting shotcrete onto test panels

Project ore zones will require dewatering. Due to the high cost of dewatering, Tamerlane proposes to use freeze wall technology for the development and mining of each of the ore zones and the respective development.

Mine Design Support

Thyssen Mining Technical Services evaluated methods to provide access to the underground development. Baseline design established at the feasibility study level included vertical shaft access at the R190 ore zone with a vertical conveyor system for hoisting ore and waste from the mine. Access to the other ore zones was to be accomplished using underground connecting drifts.

Ramp access designs and layouts, with various methods of excavation through the overburden were developed by Thyssen Mining. Engineers used Maptek Vulcan™ 3D mining software to complete this work. Various excavation methods were examined including ground freezing, open cuts and the sequential excavation method. Cost, schedule and risk factors were then used to evaluate the alternatives and provide a recommended approach to Tamerlane management for mine development of the Pine Point Project.

As a result of the Thyssen Mining led study, the new design for mine access will utilize portals and ramps to access each deposit. Only two of the deposits in close proximity to each other will have a common ramp with a connecting drift. This change to ramp access will provide much more project flexibility. When the mining of a deposit is completed, the freeze ring for that deposit will be shut down, the workings rehabilitated, and the equipment moved to another deposit. It will be possible to mine ore from more than one deposit at a time, allowing more mining flexibility and milling options for Tamerlane.

Freezing machine

Freeze Ring Engineering

Tamerlane will utilize ground freezing to create a freeze perimeter to control groundwater for the Pine Point Project. Artificial ground freezing is an effective method of stabilizing wet, unconsolidated ground and controlling groundwater inflows. Thyssen Mining Technical Services has been contracted to design and engineer the water-tight frozen barrier around the perimeter of the R190 orebody.

The ground freezing system will consist of approximately 300 freeze pipes, approximately 180 m deep, installed around the perimeter of the proposed excavations and will toe into the impervious rock strata below the ore zone.

Jacques Ouellet

Education and research mine Reiche Zeche

Repair and renovation of the Rothschönberger adit at the Reiche Zeche/ Alte Elisabeth education and research mine

Background

The Reiche Zeche/Alte Elisabeth education and research mine, which is a test facility under mining authority control, is used by the Freiberg Mining Academy for teaching and research purposes. The Rothschönberger adit, which has been in service since 1877, is the deepest drainage gallery both for the mine and for the entire Brander and Freiberger mining area. It has a total tunnel length of some 51 kilometres (including side-entries), making it the longest drainage adit in all Europe. The devastating floods of 2002 also caused a number of collapses along the drift, which resulted in an uncontrollable backup of water. The acute risk that this posed for public safety and security prompted the Chief Mines Inspectorate in Freiberg to commission an underground renovation project under its remit to protect against threats to public security posed by disused mining installations in the Free State of Saxony. This operation began with the preparation of plan of action that would ensure there was no interruption to the normal functioning of the Rothschönberger adit. On the basis of this action plan it was recognised that a central access route would be required for the future inspection and repair work to facilitate the transport of large items and material loads to their underground destinations. The Reiche Zeche vertical shaft was chosen as the most central point for the operation. Located on the northern outskirts of Freiberg this shaft is sited in the central part of the Freiberg deposits – an area covering some 38 square kilometres and the most extensive body of silver deposits in the whole continent of Europe. The shaft was first sunk in 1841 to serve the Himmelfahrt Fundgrube workings and by the time production ceased in 1969 it had reached a final depth of 724 metres. It is currently used as a manwinding and materials shaft between the surface and mine level 1. Extensive dismantling, reinforce-

ment and repair work first had to be carried out below this level in order to create a machine-usable access to the Rothschönberger adit in the vicinity of the Reiche Zeche shaft. The Chief Mines Inspectorate of Saxony commissioned the Jena branch of TS BAU GmbH to carry out this operation.

Underground work in the shaft and in the Rothschönberger adit

The contract provided for the renovation and reinforcement of the shaft (cross section 2 x 8 m) from mine level 1 downwards, along with the installation of bottom frames, a new ladderway and a shaft bunton and guide system. The old shaft fittings below the guide distensions first had to be removed before the installation work could commence. It was a requirement of the contract that normal mine operations, including the training and research activities, should not be impeded in any way down to mine level 1. In view of the actual condition of the shaft beneath this level a number of changes and modifications had to be made to the original project plan.
The renovation work involved the removal of the old shaft fittings and a large number of cables that had been installed in the area between the half third level and the Rothschönberger adit. The vertical brickwork partition running down the centre of the shaft was completely removed. The concretions on the shaft walls were cleaned off and rockbolts were installed to provide support. This work was undertaken using a three-deck mobile stage that was set up beneath the active manwinding system. Normal operations were therefore able to continue uninterrupted throughout the entire renovation project. The working stage could be reached and deployed from a travelling cage. The winch for the temporary manwinding system was set up at the shaft landing on mine level 1. The four-man cage was rope operated.

Mobile stage for shaft work

As no final decision has yet been taken on the future use of the Reiche Zeche shaft installations the Chief Mines Inspectorate of Saxony ruled that the bottom frames and bunton/guide system should not be installed for the time being.
Repair work at the Rothschönberger adit level commenced at the same time.
This operation involved widening the tunnel profile, strengthening and supporting the shaft beneath the flood-water level and installing a bottom frame and supporting structure in the shaft and crosscut.
This was the first time that an operation had been undertaken to lower the water level since the cessation of mining operations (overflow of 20 March 1971).
The entire central area of the Freiberg deposits is drained via the Reiche Zeche shaft.

The task ahead was therefore to reduce the water level of the entire area. This was accomplished by means of three dewatering pumps (each delivering 100 litres a second). The dewatering phase took three days to reach the desired shaft level, during which some 77,760 m^3 of water were pumped from the workings. A permanent drainage operation was then set up on a single-pump basis. A heavy thunderstorm and power failure over one week-end subsequently interrupted the pumping operation and this unfortunately resulted in the flooding of the site.
Over the course of the project a total of 328,320 m^3 of water was pumped to the surface. A ripping was made in the crosscut between the shaft and the drift in order to divert the inflow. The original rectangular profile of 2.2 x 1.5 m was extended by drilling and firing to create an opening measuring 3 x 3 m^2. The blasting debris was stowed below ground.
A new concrete structure was built to support the shaft.

As soon as this operation had been completed work started on the ladderway. Step-off platforms were fitted every 4 m starting at the level of the Rothschönberger adit. A total of 20 ladders and rest-platforms were installed in this way down to mine level 1. Service pipes (compressed air and water) and garlands were also installed at the same time.
Another separate task was to provide long-term support for a deep cavity along the Rothschönberger adit that had already been temporarily secured. This zone, which was located about 70 m from the shaft, was supported using type HEP 120 steel beams set in a gap-free arrangement.

Geothermal project

Further construction work had to be undertaken in connection with the geothermal project that is being carried out by the Freiberg Mining Academy. This geothermal installation will eventually be delivering 1.5 megawatts of cooling capacity

Inset at Rothschönberger adit

Formwork and reinforcement being installed in the shaft beneath the flood-water level

for a synthesis gas plant already in operation. The contract awarded by the state-owned Property and Construction Management Company provides for the construction of a pump chamber on level three to accommodate the heat pumps. This operation included clinker brickwork, concrete bedding, rockbolts for roof reinforcement and a drainage system. Epoxy resin-coated DN 150 pipes were installed in the shaft for the aforementioned installation. Work also included the reinforcement of a lode fault zone around the landing on mine level 1, which involved rebuilding and cutting through a fracture in the roof beds. The cavity was then packed with 100 tonnes of fill material. In lateral gallery north a drilling chamber was prepared and fitted with permanent supports at the point where the vertical pipes break through from the surface.

Logistical challenges

The project posed a huge logistical challenge as all materials and equipment had to be transported to the workplaces without disrupting the regular haulage movements or the ongoing training and research activities. This transport operation was carried out using a single-deck conveyance (payload 2.0 tonnes, conveyance width 890 mm) and the materials and manwinding cage that had been installed to provide access during the repair project.

The following quantities of material and equipment were brought in over the course of the project:

- approx. 75 t of steel
- approx. 380 t of concrete
- approx. 46 t of timber
- approx. 50 t of masonry/brickwork
- approx. 450 rockbolts
- approx. 10 t of other building materials
- approx. 500 m of pipes
- approx. 300 m of temporary supply pipes.

Conclusions

The project remit had to be amended in view of the actual state of the old shaft beneath mine level 1 and the fact that the repair work needed to reconstruct this 170-year old structure had to be carried out in line with current TAS rules (Technical Requirements for Shaft and Inclined Haulage Systems). After completion of the status survey a number of adjustments therefore had to be made to the project specifications. It took a collaborative and committed effort on the part of the Chief Mines Inspectorate of Saxony and TS BAU to ensure that the main objectives of the project were achieved while at the same time paying particular regard to the economic and efficient use of public funds.

Ongoing operations

The shaft cage installation between mine level 1 and the bottom of the Rothschönberger adit is being constructed under contract to the Freiberg Mining Academy. The Jena branch of TS BAU is the general contractor for this work.

Olaf Einicke
Frank Reuter

Jena – city of light

Work has been underway for some twenty years in the historic centre of Jena as part of a major redevelopment and regeneration project that is very much in keeping with the town's medieval heritage.

The Jena branch of TS BAU GMBH is now continuing the work that was first begun in the early 1990s by its predecessors, TSG TIEF-, STRASSEN- UND GLEISBAU GmbH and PROTERRA STRASSEN-, TIEF-, GLEIS- UND BERGBAU GmbH, and has played a major role in the successful implementation of the overall architectural design.

Hundreds of square metres of paths, streets and squares have already been re-laid, with the main focus being on the use of natural stone materials.

Market place in Jena

The old Grietgasse has been restored, Engelplatz square now has an interesting new fountain and the Nonnenplan and Löbderstrasse have been embellished with depictions of the medieval city walls and the ancient Löbder Gate. Here TS BAU had to use a fully-bonded surface finish for the first time, as much of Löbderstrasse is sited above an underground garage that is not visible from street level.

The project also took in the new development area – itself the focus of some controversy – on the western side of the old marketplace, which had been destroyed during the Second World War. The newly designed Market Passage is in direct contrast to the rest of the medieval Old Town, with its 14th Century guildhall, but has been edged with granite to reflect the ancient heritage of this part of the town.

A mixture of natural stone and modern design media, including concrete, was used for the Johannisplatz. One innovative aspect of the work undertaken here was the use of teflon as a coating for the pavement slabs, which will help reduce the unsightly problem of chewing gum litter.

The most prestigious project involved the renovation of the Unterm Markt shopping area right in the heart of the town. Here highly polished granite was laid to create a pedestrian-friendly walking surface. One particularly eye-catching feature is the use of stainless-steel motifs set into the granite and limestone paving slabs – an unconventional 'fingerprint' for TS BAU to leave behind.

Renovation work is currently focussed on the Neugasse, one of the main routes leading to the town centre, which is being surfaced with granite as part of a three-phase operation. This street terminates at the square in front of the Phyletisches Museum, where a new fountain is also to be installed.

Down the market square

As Jena is emerging as a centre of science and technology it can also boast some very modern architecture too. The coach station, for example, has been given a complete facelift in the style of the new Paradies rail station on the edge of town, which is on the Berlin-to-Munich intercity express line. With its futuristic roof and eye-catching supporting pillars in the form of five metre-high letters spelling out the word BUS, the coach station certainly has a distinctive look. One interesting technical feature is the use of a special type of asphalt – or 'semi-rigid surfacing' – in which the voids are filled with a cementitious grout, the aim being to prevent the high wear rates normally associated with bus and coach traffic always travelling along the same line.

Jörg Romankiewicz

Town hall

Coat of arms of Jena

Central bus station

Entrance Area Hilton Hotel

"THE SQUAIRE"

new contracts in a high-rise with a difference

THE SQUAIRE is a new office development that 'floats' on 86 columns above the inter-city railway station that serves Frankfurt International Airport. The building is located at a key motorway intersection and has a covered walkway leading directly into flight terminal 1. The glass and steel structure, which measures 660 m in length by 50 m in height by 65 m in width, provides around 140,000 m² of rental space – enough to accommodate 7,000 office workers out of a total of some 10,000 people who use the building every day. The building offers a versatile occupancy mix and is essentially a one-stop city complex in itself. Dubbed New Work City, the spectacular new business facility – which apart from office accommodation also includes two hotels, restaurants, cafés, doctor's surgeries, fitness and wellness areas, shops and a childcare centre – is connected to a 3,100-space car park via a system of overhead gondola cars that operate 18 m above ground level between the road network and rail platforms.

DIG Deutsche Innenbau GmbH has been providing turnkey internal fitting and construction services at 'The Squaire' since mid-2008. This huge fit-out includes some 180,000 m² of drywalls and plasterboard ceilings, 80,000 m² of plasterwork and filling, 100,000 m² of wallpaper and paint substrate in 47 different designs in the two hotels alone (the HILTON and HILTON Garden

Aerial view of „THE SQUAIRE"

Ballroom ceiling Hilton hotel during construction phases

„THE SQUAIRE“

INN), 60,000 m² of wall and floor tiles in 85 different designs spread across the entire building, 141,000 m² of screed and cavity flooring, 31,000 m² of floor coatings in the equipment rooms and technical areas, 25,000 m² of parking-deck surfacing, 75,000 m² of carpeting, 2,500 m of glazed balustrades and stainless-steel handrails, along with extensive fire-protection panelling to a total value of more than € 2.5 million. Our project partners have also supplied and fitted nearly 7,000 wooden and aluminium-frame doors.

The services provided under the contract have already run to more than € 100 million and this figure is set to go on rising right through to the end of 2012 as a result of additional tenant-specific improvements.

The location of the site – between a six-lane motorway and a four-lane highway and above a high-speed rail line – not only imposed a huge logistical challenge but also required a major effort to coordinate the activities of the 24 different working teams. In spite of these complications units 1 and 2 (KPMG) were completed in March 2011 and unit 6 (Hilton and Hilton Garden INN) followed in November 2011. The company is currently carrying out extensive refitting work on the central unit, which is to be used by Deutsche Lufthansa, Bilfinger Berger, IVG, doctor's surgeries, a wellness and fitness studio and a daycare facility, and this operation is expected to last through next year.

Markus Gevers
Marco Malm

Final Ballroom ceiling in the Hilton Hotel

Turbine housing

Industrial machining – T+S develops a new specialist service

In 2008 – at the peak of the engineering boom – T+S took the decision to purchase a new milling and drilling machine.
This large-capacity machining centre was commissioned in August 2010 – thanks to our affiliate TS BAU, who delivered the foundation and construction work exactly on time, and Bimatec Soraluce, who completed the assembly operation according to schedule.

New recruits and experienced T+S machinists alike quickly became familiar with the new high-tech machine and everyone wanted to take their turn on the FX 2400 CNC lateral milling and machining centre. Even T+S operators of many years standing consider it something special to work on the new machine, which has a turntable capacity for items weighing up to 100 tonnes, and to be able to machine components of up to 120 tonnes in weight and measuring as much as 24 m in length by 6 m in height.
However, the market situation turned out to be less favourable than had been assumed at the time of the machine's acquisition.

Nevertheless, machining commissions were received from a number of prominent customers and the company was given an opportunity to demonstrate the skills of its workforce and the precision of the new machining centre. This included work on the turret of an RH 340 machine, which was subsequently accepted by the client TEREX without reservation. Welding work was also carried out to reinforce various weak points on an excavator arm and the component was successfully delivered in good time to the same very satisfied customer.
An excellent working relationship has also been developed with Stork Technical Service – a company that places a high value on immediate machine availability and a high level of workforce flexibility. Stork is involved in the repair business and the short response times for component machining services plays a key role in their operations as this ensures that they can adhere to deadlines that have already been agreed with other clients.

The machining centre is of course also used to enhance the quality of the large components that are fabricated in the company's own welding workshop. While most of the weld

Top carriage boom

preparations were previously carried out in-house using welding torches, unless the sheet metal had already been pre-finished by the original suppliers, much of this preparatory work can now be carried out mechanically. Producing the welds in this way presents a number of advantages. With the old method of preparing the sheet metal the weld joints had to be ground down manually before the actual welding stage and this was a tedious and costly process. This time-consuming operation can now be omitted and by introducing a clearly defined edge angle the space that will accommodate the filler metal now follows an absolutely straight line and is therefore perfectly formed. This optimum geometry is synonymous with optimum welding times. The peaks and troughs produced at the weld flanks by the manual burning and grinding process, which in itself presented an increased risk of weld defects, are no longer present.

While the new machine has certainly had a positive impact on in-house fabrication work, the main focus of the FX 24000 has been on processing and finishing large components for external clients and the new machining centre has enabled T+S to make a quantum leap as a provider of high-tech machining and fabrication services.
T+S has also recruited a new member of staff who was previously in a senior position at a industrial engineering company and has more than 30 years experience in the machining sector. We are certain that his experience and reputation will do much to ensure that the new machining centre – and indeed all our machining operations – are deployed more effectively for the benefit of our customers.

Alfons Dieckmann

Top carriage

New activities at T+S

From crane servicing to complete crane engineering

Services / T+S has been carrying out crane servicing work for many years as part of its assembly and installation operations. We now want to expand our existing and developing expertise in line with customer needs and demands – to include for example a support service for crane installations serving the container and bulk handling sector.

View from the crane cab

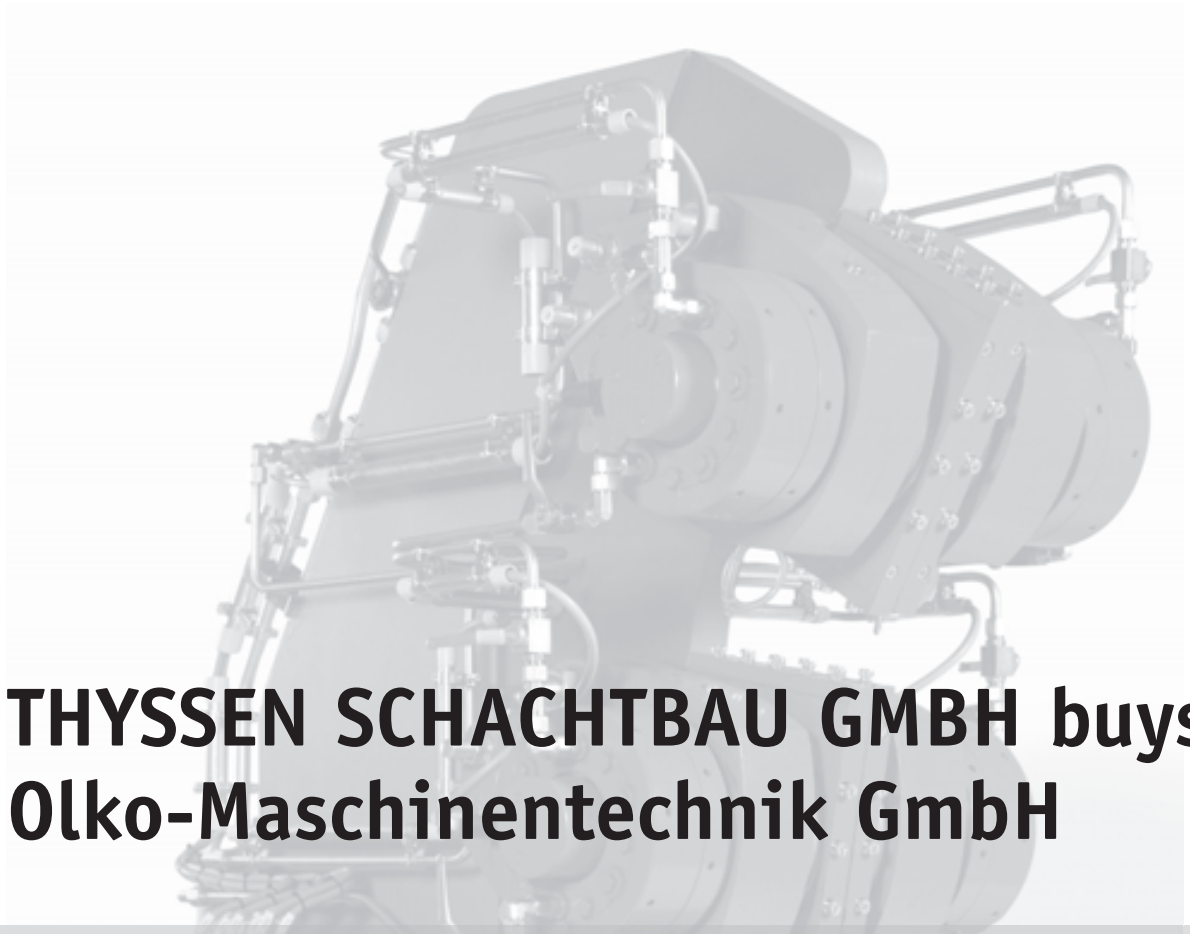
Until the end of last year T+S was mainly engaged in undertaking simple repair work on crane installations for our client TKSE. The acquisition of new technical personnel has meant that we are now able to expand and develop these activities. Whereas the previous focus was exclusively on mechanical components, we are now extending our remit to include crane controls and electrical systems. Much of this additional work involves upgrading and modernising outdated control systems by integrating the latest components – an operation that naturally has to take account of increased loading requirements and higher turnaround performances. This often involves carrying out mechanical and electrical refits on complete drive systems to bring them up to date with the latest technological standards.

We provide an efficient emergency support service around the clock to deal with crane breakdowns and other problems. Technical discussions held between the operators and our specialists following the repair work frequently result in a detailed analysis of the underlying problem – leading to a reduction in operational breakdowns and a subsequent improvement in cost-efficiency. Crane controls and electrical equipment are often so outdated that an upgrade in line with the latest technical practice allows the client to restore crane operating times back to full availability. This generally results in a 15 % increase in cargo turnover.

By extending our portfolio of services we have now entered a highly sensitive area of the logistics chain, namely the 'just-in-time' ship, rail and road transhipment sector. Vessel loading and

unloading operations are now dominated by gantry cranes and maximum availability is a key factor here. High quayside berthing fees that can very quickly run up to several hundreds of thousands of euros make reliable and efficient cargo handling an absolute imperative. Modern dockside cranes make an impressive sight and today's installations can weigh as much as 600 t, stand 445 m in height with bridge lengths of 120 m and can lift loads of up to 50 t in weight. Crane installations can even be designed for heavy duty lifts of 250 t and more. To ensure that these transloading operations can continue uninterrupted the T+S team of experienced crane technicians is on standby 24 hours a day, 365 days a year to provide advice and on-hands technical support. Our highly trained personnel and modern technical facilities guarantee clients the highest possible level of service – as is regularly confirmed by many satisfied clients and the trust and confidence they place in us.

Christoph Obermann



THYSSEN SCHACHTBAU GMBH buys Olko-Maschinentechnik GmbH

After years of financial restraint, during which the focus has remained on existing core competences, and in spite of the ongoing difficulties facing the world financial markets, THYSSEN SCHACHTBAU GMBH has decided to invest in the future and to expand its product portfolio by purchasing Olko-Maschinentechnik GmbH, a move that will enable the company to operate in future as a system provider of mining, shaft sinking and winding technology.

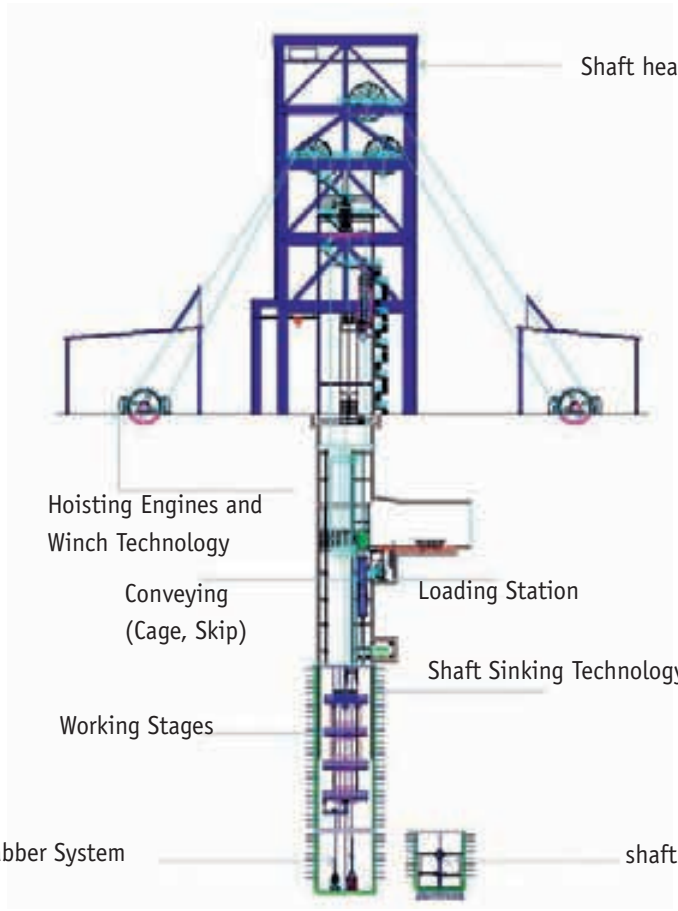
Olko-Maschinentechnik GmbH, which was founded by Dieter Hilgenberg in 1989, currently employs some 70 persons and has an annual turnover of about € 12 million. Over the years the company has built up a solid reputation both nationally and internationally for the production of shaft winding equipment and building materials. More recently Olko has succeeded in gaining a secure foothold in Russia and the former CIS area, and in China too, through the successful marketing of own-developed products.

As well as producing shaft winding systems and building products the company also has an extensive portfolio of hoisting and winching equipment that includes inspection hoists, auxiliary and emergency winching systems and mobile and fixed rescue winches. Olko also serves the steel industry by supplying mobile dust hoods for blast-furnace bunker operations and stationary extraction hoods for coke works. The company is certified to DIN ISO 9001 standards and holds comprehensive welding qualification certificate to DIN 18 800-7.

THYSSEN SCHACHTBAU has learned by experience from various shaft construction projects undertaken in Russia over the years that when it comes to shaft winding equipment, in particular, German technology is very highly regarded and is frequently top of the client's request list. This latest acquisition will in future enable THYSSEN SCHACHTBAU to supply key components from its own sources and in this way to reduce the number of order handling and processing interfaces.

On the basis of the excellent working relationship with Olko in recent years both companies decided some months ago to discuss the possibility of setting-up a joint business arrangement – and this ultimately led to THYSSEN SCHACHTBAU taking over the company at the end of 2011.

The acquisition represents a logical extension of THYSSEN SCHACHTBAU's new business philosophy, in which the company no longer sees itself as just a mining and shaft construction



Shaft Sinking Technology and Hoisting Technology from one Source

contractor but is seeking through the strategic expansion of its product portfolio to become a system provider that can deliver a full range of modern mining and shaft construction services, from shaft sinking and winding technology through to the turnkey construction of entire mining complexes.

This unique selling point, which is unparalleled in the industry, will in future help to ensure that clients involve the company early-on in the planning of shaft sinking and winder installation projects so that recurring interface problems can be kept to an absolute minimum and resolved as far as possible before the project commences.

This 'one face to the market' strategy, combined with the mutual benefits of being able to use the contacts that both firms have already built up in various markets, promises to deliver a significant competitive edge in the long term and will create real opportunities for developing additional target markets for the products and services of the entire THYSSEN SCHACHTBAU group. THYSSEN SCHACHTBAU is proud of this new acquisition and looks forward to integrating OLKO into the Thyssen family of companies. We are convinced that the purchase will give us a unique selling point and will also enable us, by operating in conjunction with our subsidiary TS Technologie + Service GmbH, to deliver construction, engineering and structural steel projects from a single source. Synergies will also be created through collaboration with two other members of the THYSSEN SCHACHTBAU group, namely Byrnecut Mining Pty Ltd of Australia and Thyssen Mining Construction of Canada Ltd. This is sure to result in a further expansion of the group's existing know-how and is likely to boost market acceptance of our products and services.

Markus Beermann

TECHNOLOGY FROM ONE SOURCE

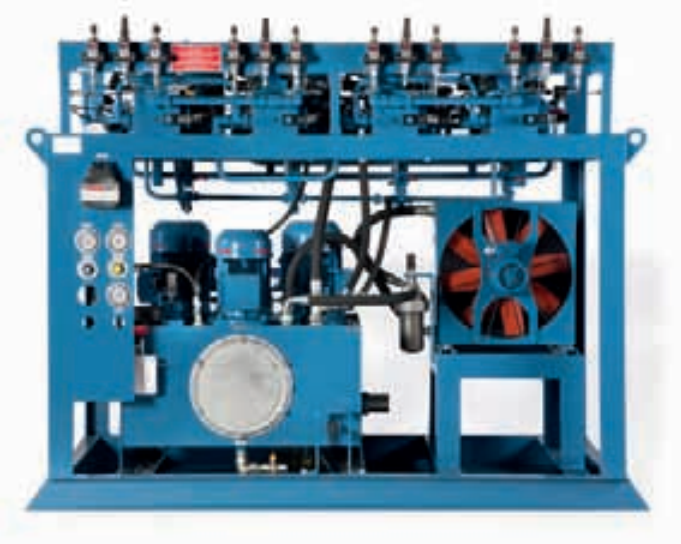
Aerial view of OLKO-Maschinentechnik GmbH

OLKO-Maschinentechnik GmbH – a new member in the THYSSEN SCHACHTBAU Group

The exploration and production of raw materials has for many years played a vital role in helping to safeguard our future and develop new technologies.

Building materials plant at RAG Anthrazit Ibbenbüren GmbH

Shaft sinking winches for the Gremyachinski project



SBE 115 and COBRA01 braking force generators

OLKO-Maschinentechnik GmbH has been active in this area since the company was first established in 1989.
OKLO started off as an engineering company with most of its staff originally coming from the Prinz Rudolph Foundry Works (EPR). The firm's main focus was on specialised machine building and heavy engineering work for the mining industry and its first production facilities were set up in Olfen in 1990.

OLKO has continuously developed and refined its range of shaft winding systems and building materials with the international market very much in mind.

By developing its own range of products the company has successfully gained a foothold in international markets such as China and Russia.

The firm currently operates eight production facilities in Olfen – the newest and largest of these, which was completed in 2011, has a total crane capacity of 130 t and covers an area of

Drum winder for Bartensleben

2,000 m². This new facility is used for fabricating large welded assemblies and for pre-assembling and commissioning winding machines and structural steelwork.
OLKO now offers a range of services that includes planning, design, construction, commissioning and servicing in the following areas:

- shaft winding installations
- sinking equipment
- rescue winches
- rope fitting
- building materials
- specialised engineering
- electrical engineering and automation technology
- structural steelwork and welding systems.

In the building materials sector OLKO has already supplied a large number of materials delivery systems for RAG and RAG Anthrazit Ibbenbüren GmbH. A pneumatic delivery plant was commissioned for Ibbenbüren mine in 2006. OLKO supplied and assembled this installation on a turnkey basis. The facility comprises surface silos and pneumatic dispatching systems all housed in a single building. The electric controls were also manufactured by OLKO.

In 2008 THYSSEN SCHACHTBAU placed a major order with OLKO for shaft sinking equipment and winches that were destined for the Gremyachinski mining project. The mechanical and electrical systems were pre-commissioned in-house in collaboration with our subsupplier Siemens, a process that ensures troublefree assembly and commissioning at the construction site.

Another milestone was the development of braking force generators and the COBRA01 delay controlled braking system. In simple terms this brake operates rather like the ABS system fitted to motor vehicles. It ensures a constant braking rate irrespective of the coefficient of friction, payload or direction of travel. This particular braking system has now been delivered

to Chinese clients via Siemens and is also being used at one of the mines in the K + S group.

OLKO has also been commissioned by the DBE (German Service Company for the Construction and Operation of Waste Repositories) to supply and assemble a tower-mounted drum winder for the Bartensleben shaft. This project successfully got under way in the summer of 2011 and involved project leader OLKO along with our subsupplier Siemens, THYSSEN SCHACHTBAU and Funke und Huster.

Another winding project was also successfully commissioned in 2011 at the esco-owned Borth salt mine. This comprised the modernisation of two shaft winders on behalf of the Siemens company – one single-rope service machine of 6-m diameter and one four-rope tower-mounted production machine of 4-m diameter with a payload of 20 t and a winding speed of 18 m/s.

At the end of 2011 OLKO was awarded a contract to install two shaft winding systems at the Garlyk mine in Turkmenistan. The client is the Belarusian company Belgorkhimprom, which as the prime contractor will be responsible for the mine construction work and for all the infrastructure facilities.

OLKO has also received another contract from DBE to supply a mobile rescue winch, while RAG has asked the firm to drawn up plans for the conversion of friction winders and rescue winching equipment.

OLKO-Maschinentechnik has taken the decision to team up with THYSSEN SCHACHTBAU in this way in order to respond to future demand and to strengthen its position as a systems provider with the capability to supply customers with everything from exploration drilling services through to turnkey shaft winding installations.

THYSSEN SCHACHTBAU became the sole shareholder of OLKO-Maschinentechnik GmbH with retrospective effect from 01.01.2012.
Markus Beermann has been appointed to head the company as the new managing director.

The company will retain its legal status and the name 'OLKO-Maschinentechnik GmbH' and the firm's personnel and points of contact will remain unchanged.

Reinhard Rosga

Shaft winders – Borth 2 (right) and Borth 1 (left)

Thyssen Schachtbau Immobilien GmbH (TSI)

energy management – needs based and renewable – ecological and environment friendly

Thyssen Schachtbau Immobilien GmbH (TSI) has been investing in environmental projects since 2009 by undertaking a whole range of modernisation and renovation schemes.

That same year saw the completion of a full glazing refit to the TS building on Sandstrasse. This involved fitting K25 profiled glass (double glazed system with thermally insulated 'Plus 1.7' coating) that will significantly reduce energy consumption levels.
In 2009 two photovoltaic systems were also installed on the roof of TS headquarters on Sandstrasse.
This installation allows us to generate about 300,000 kWh of solar energy a year.

Producing electricity from solar energy makes an important contribution to reducing CO_2 emissions, as excessive burning of fossil fuels such as coal, gas and oil is causing a rapid rise in atmospheric CO_2 levels. This is considered to be the main driver of the greenhouse effect and is thought to be associated with the global increase in natural disasters.

TS photovoltaic systems – technical specifications

Installation I

The first system was set up on top of our production building in Mülheim an der Ruhr, which has some 5,200 m² of roof space. Thin-film photovoltaics technology was used in combination with an aerodynamic roof structure so as to minimise the additional load acting on the roof of the building. The 270 kilowatt-peak (kWp) generator consists of 3,600 modules and the energy produced is fed into the public grid by means of three central inverters. The installation produces about 250,000 kWh of 'green' energy a year and thereby prevents some 175 t of harmful carbon dioxide from being released into the environment.

Installation II

The second installation has also been set up at our premises in Mülheim an der Ruhr where the available roof space is around 1,700 m². This thin-film photovoltaic system has been designed with an aerodynamic roof structure so as to minimise the additional load acting on the roof of the building. The 54 kWp generator comprises 720 individual modules and the energy produced is fed into the public grid by way of a central

Installation I – details:	
Installation size:	270 kWp
Annual electricity output:	approx. 250,000 kWh
Number of modules:	3,600 units
Module area:	approx. 2.600 m²
Module technology:	CdTe thin film
Substructure:	ELOBOX
Year commissioned:	2009
Operating life:	at least 25 years

inverter. The installation produces about 50,000 kWh of 'green' electricity a year and in so doing prevents about 35 tonnes of harmful carbon dioxide from being released into the environment.
In 2010 we began to replace the radiant heaters in the production shops, which are essentially part of TS Technologie + Service GmbH. Here too we were able to reduce gas consumption by 15 to 20 % a year.
The following year we completed the refurbishment of the lighting system in our workshops.
Based on our own specifications novalux produced a fully integrated and sustainable lighting solution to DIN EN 12464-1 standards that is designed to suit the prevailing conditions in production shops 11, 10 – 16 and 54.

The existing mercury-vapour lamps have now been replaced by energy-efficient metal halide items with special reflectors and electronic ballasts. Special control software was also installed that allows the system to be regulated to the required level of brightness on an individual and time-dependent basis. This means for example that an energy saving lighting schedule can be used for cleaning periods and during non-operating hours. Thanks to the control software new lighting requirements (which may result from changes to process routines or a new workspace allocation) can be quickly and easily factored-in merely by re-programming the lighting system. A sensor control system provides for daylight dependent dimming of the lights, thereby saving additional energy.
The much improved lighting environment also provides an added benefit by increasing productivity levels, reducing the error rate and preventing accidents. Furthermore, the new system promotes the general wellbeing of the staff and enhances their visual conditions and this in turn contributes to greater employee satisfaction and has a positive impact on the sickness figures.

This innovative and tailor-made system has enabled us to achieve a 74% reduction in the electricity required for lighting the building and this reduced energy consumption equates to an annual saving of some 37,000 euros. The 40,000 euros invested in the new lighting system will therefore pay off within a mere 16 months. And as an additional benefit the new technology will help cut CO_2 emissions by more than 247 tonnes a year.

The long operating life of the lamps and control devices also makes for a significant reduction in servicing and maintenance costs, which in turn helps conserve valuable resources and reduce the amount of electronic waste.

In May 2011 Thyssen Schachtbau Immobilien GmbH also signed a heat servicing contract with company medl that includes arrangements for renovating the existing heat supply units.
After carrying out a comprehensive analysis of the technical installations and an assessment of the heat requirement medl was able to draw up extensive plans for the technical modernisation and improvement of the entire heat supply system.
The key elements of the upgrade involved replacing the pumps, rebuilding every one of the heat distributors and installing a centralised system to control the various operating devices.
The installation of high-efficiency pumps alone can reduce power consumption for driving the pumps by as much as 66%. Heating is provided by a set of modern condensing boilers with flue-gas systems, each producing about 570 kW.
Another stand-alone condensing boiler is used for hot-water heating. The conscious decision to install three individual boiler units ensures a high level of supply security. The operation of this newly developed system can also be remotely controlled at any time by switching over to medl's own IT set-up. Another very important feature of this arrangement is that the decentralised design allows the local heating network to be completely taken out of operation during the summer months. This results in an impressive energy saving potential of more than 200,000 kWh a year.

These measures provide an indication of how Thyssen Schachtbau Immobilien GmbH is doing its bit to help shape our future along ecological and environment-friendly lines.

Gottfried Pannenbäcker
Markus Walter

Installation II – details:

Installation size:	50 kWp
Annual electricity output:	approx. 50,000 kWh
Number of modules:	720 units
Module area:	approx. 520 m²
Module technology:	CdTe thin film
Substructure:	ELOBOX
Year commissioned:	2009
Operating life:	at least 25 years

Training – work experience – employment in the THYSSEN SCHACHTBAU Group

Training

We know that targeted training is the key to developing young, motivated and ambitious personnel who will fit really well into the company organisation.
The successful communication of specialist knowledge and professional skills has always been high on our priority list and our trainees and apprentices have traditionally been the top students in their discipline.
We currently provide training in a number of different fields so that we can recruit as far as possible from the ranks of our own junior employees when filling new posts as and when they become available throughout the company as a result of demographic change.

The THYSSEN SCHACHTBAU group provides training for

- electronic technicians
- engineering technicians
- milling machine operators
- engineering draftsmen and
- industrial clerks

Our construction companies also organise training courses for

- plant operators
- road builders and canal builders
- track layers
- underground workers/machine operators and
- mining technologists

Work experience

Our training programme is not just directed at trainees and apprentices but also provides an opportunity for TS interns to get to know the company and its business operations.

Employment

With a whole range of fresh challenges ahead we are now compelled to re-define our future managerial functions and responsibilities. For this reason we are seeking young graduates and academics who can be prepared for specific positions within the company by way of our in-house career advancement scheme.
And as well as academic trainees we also require young technicians and craftsmen to help with the challenging projects that the company will have to deliver in the months and years ahead.

Applications wanted now!

Gottfried Pannenbäcker
Ralf Herzberg

Department head of informatics Paul Küpper (l.) and his collegue Gisbert Malyga

Server for file services and virtualisation with emergency power supply

Presenting the TS in-house IT department

The THYSSEN SCHACHTBAU IT section provides a wide range of services connected with 'electronic data processing' and 'office communications'. Service and support operations are mainly carried out for in-house departments and group subsidiaries, but commissions are also undertaken for external firms and joint venture groups that have an association with THYSSEN SCHACHTBAU GMBH. The one-stop service environment comprises SAP applications, hardware with desktop (workstation computers) and server systems, networking, software, fixed and mobile telephony and first level support.

Apart from the SAP server, which is hosted externally and is therefore housed outside the company network, the entire in-house IT landscape is managed directly by TS's own IT department.
The world of IT is changing and this affects hardware and software in equal measure.
THYSSEN SCHACHTBAU has been focusing on hardware virtualisation since 2008.

As a general rule a server is only employed for one particular application. This means that a printer server, for example, only has to perform when there is a demand for printing services, while a file server is only called upon when data have to be written or read. For the rest of the time these servers, although they have to be available and ready for action at all times, are little used.
In the case of virtualisation several physical servers are installed in just one large, high-performance machine. The advantage of such a system is that the usage rate of the existing physical hardware is increased by the fact that the devices are 'virtualised'. This means that operating costs, space requirements and energy consumption can be reduced several times over, while the value and flexibility of the system is increased. The TS group currently operates 10 hardware servers incorporating some 30 virtual machines.

Paul Küpper

IT section – facts and figures	
5	Staff with responsibility for SAP applications (1), office communications and network systems (4)
500	Desktop systems and/or notebooks (workstation PCs)
80	Servers for printing services, file storage, terminal services, calculations, archiving and management tasks
270	mobile speech and data devices
90	Network components – such as switches, routers and W-LAN adapters
310	Landline telephones with ISDN or IP technology for 3 telephone switchboards
21	Locations (operating sites in Germany)
Diverse	Provision of email services for mobile terminal devices and internet web mail
Diverse	Portal services for home workstations and network access points for international offices
Diverse	Archive systems for the long-term storage of electronic data




F. l. t. r.: August Thyssen, Josef Thyssen, Anita Thyssen, Fritz Thyssen
Source: THYSSENKrupp venture group archive

140 years of Thyssen & Co. – an industrial success story

140 years ago, in April 1871, August Thyssen and his father Friedrich founded the Thyssen Compagnie in Styrum near the town of Mülheim an der Ruhr. This was to lay the foundations for one of the largest industrial undertakings of the 19th and 20th centuries – a heritage that continues to this day with THYSSEN SCHACHTBAU GMBH and ThyssenKrupp AG.

The beginnings

The economic development of the Ruhr basin began in the mid-19th century. The reason was the growing demand for iron and steel-based industrial products, on one hand, and the existence of coal – the chief ingredient for turning iron ore into iron and steel – on the other.

The entrepreneurial pioneers of those early years were men like Franz Haniel, Mathias Stinnes, Alfred Krupp and Friedrich Grillo – who are still celebrated to this day in company names and place-names all over Germany.

The Thyssen family first lived in Eschweiler, near Aachen. This region underwent a dramatic process of industrialisation even before the Ruhr, this also being based on the local coal and iron ore deposits. Friedrich Thyssen, whose son August Thyssen was born on 17.05.1842, had a wire factory in the town.

With the realisation that the boom period had passed its high point, due to competition from the Ruhr and the dwindling reserves of raw materials, Friedrich Thyssen went on to set up a successful banking company in 1859. Disagreements with business partners had led him to switch to a different trade entirely.

From his early years, therefore, August Thyssen already had an insight into the worlds of engineering and business management. On completion of his studies, which took him from Eschweiler to Aachen, Karlsruhe and Antwerp, he first worked at his father's banking company before finally settling in the Ruhr in 1867. Clearly he could not escape the gold-rush mentality of the time and together with a number of business partners he founded Thyssen, Fossoul & Co. in Duisburg, which was a puddling works and steel-strip rolling mill. Like Emil Kirdorf, another extremely successful entrepreneur of the period, he was therefore one of the 'second generation' of industrialists to set up in the Ruhr. In early 1871 August Thyssen left this joint undertaking and in April established the Thyssen Compagnie (Thyssen & Co.) in Styrum, near Mülheim an der Ruhr.

This date 140 years ago constitute the cornerstone of all follow Thyssen companies and partnerships, thus it is also the early mile stone in a still existing development of the THYSSEN SCHACHTBAU GMBH and ThyssenKrupp AG today. This rolling mill first produced steel strip and then went on also to manufacture flat bar, rods and blooms. His father Friedrich had a 50% holding in this limited partnership, as August – despite the healthy profits earned from a previous company – still did not have sufficient capital. At this time, and at later periods too, family members made useful and in some cases significant contributions to his business ventures and in this way helped him survive the hard times.

In the early and mid 1870s, at the time of the first Ruhr crisis, he had been quick to recognise the importance of the pipe

industry. This allowed him to protect his business by supplying an important market at a time of a general sales crisis that was affecting other rolling mills. By the end of the years after 1870 he was manufacturing his own pipes and by 1883 was Germany's second-largest producer of steel piping.
Even at this time August Thyssen recognised the importance of the Russian market and personally attended to developing and cultivating business relations. After the death of his father his brother Joseph (Josef), with whom he had a good personal relationship all his life, entered the company. At the beginning of the 1880s he set up his first steel works, though technical problems prevented this venture from prospering in its early years.

Entrepreneurial skill creates a mega-company

Right from the outset August Thyssen was keen to place his company on a broader basis. For this reason he set up and acquired interests in many other undertakings, not only in the Ruhr and in Germany and Europe as a whole but also all around the world, including non-industrialised countries.
But his core business always remained iron and steel. With a view to setting up his own supply base he began to acquire and buy shares in iron-ore and coal mines. In 1883, for example, he bought shares in the Gewerkschaft Deutscher Kaiser coal mining company in Duisburg-Hamborn.

By 1891 the entire coal company belonged to him and this laid the foundations for his involvement in the Ruhr mining industry. The headgear of the old Friedrich 6 pit, which has been placed under architectural conservation, can still be seen in Hamborn, as can the ThyssenKrupp steel works.
The Gewerkschaft Deutscher Kaiser company also provided the springboard for a fully integrated iron smelting business. From the mining of the coal and its conversion into coke at the company's own coke-works, to the smelting of the iron ore that was delivered by company-owned trains and ships, partly from own iron ore colliery and on to the processing of the steel in the adjacent rolling mill – everything was done 'in house' and on-site.

Up to the time of the First World War Gewerkschaft Deutscher Kaiser was one of the most up-to-date and productive iron and steel works in the whole of Europe. August Thyssen ranked alongside the Krupp, Stinnes and Grillo families in being one of the most important industrialists of his era. His company owned, or had significant interests in, shipyards, engineering factories, iron-ore mines, collieries, coke works, iron and steel works, steel and rolling mills, trading companies and banking houses – and not only in Germany but elsewhere in Europe and around the world.

Shaft sinking and drilling

In 1898 a specialist drilling and shaft sinking department was set up at Gewerkschaft Deutscher Kaiser in order to focus on mining activities in the Ruhr coalfield. This second mile stone can be seen as the really birth of the THYSSEN SCHACHTBAU company that we know today.

The aim was to maintain independence from other specialist mining companies and also to build up a major body of expertise. Shaft sinking projects aimed at extending existing mines or accessing new deposits were becoming increasingly challenging. This was due to the increasing shaft depths and the westwards and northwards migration of the mine workings, which meant more complex geological conditions (unstable, water-bearing overburden). The new department could also carry out its own survey drillings ahead of the actual shaft sinking projects.

After the acquisition of the Tiefbohr AG company the drilling and shaft sinking department was set up as a stand-alone company in 1905 and became Bohr- und Schachtbau GmbH Mülheim/Ruhr. If the establishment of the drilling and shaft sinking department within Gewerkschaft Deutscher Kaiser in 1898 can be regarded as the birth of the modern-day THYSSEN SCHACHTBAU GMBH, then the formation of Bohr- und Schachtbau was without doubt the third and next milestone in the company's history.
In 1905, early on in the life of the new company, the first freeze shaft was sunk at the Gewerkschaft Deutscher Kaiser site. The successful completion of this operation was followed by another two freeze shafts, Lohberg 1 und Lohberg 2, which each had freeze depths of 415 m. At this time Bohr- und Schachtbau GmbH was developing groundbreaking technology in the field of borehole plumbing and alignment, shaft sinking and shaft support.

The company's group structure meant that all the components needed for shaft sinking, such as freeze pipes, tubbings, refrigeration machines and other sinking equipment, could be produced in house. However, the ban on survey drilling imposed in 1907 meant no more exploration of new mining areas and the market for exploration drilling collapsed.

Bohr- und Schachtbau GmbH was therefore dissolved in 1909 and the company was reincorporated into Gewerkschaft Deutscher Kaiser as a shaft construction department. However, shaft sinking services were still offered in other countries, with the deepest freeze shaft in the world at that time being sunk at Zwartberg in Belgium. This freeze project involved sinking through more than 560 m of water-bearing ground before the shaft reached the carboniferous strata.

Restructuring after the Great War

The end of the First World War led to expropriations – particularly of foreign investments – and Gewerkschaft Deutscher Kaiser was broken down into the iron and steel companies of August Thyssen Hütte and Gewerkschaft Friedrich Thyssen. August Thyssen Hütte continued in one form of another, including the merged group Vereinigte Stahlwerke, to become today's ThyssenKrupp AG.
Gewerkschaft Friedrich Thyssen represented the group's mining interests and took over the running of the Deutscher Kaiser mining operations 1/6, 2/5, 3/7 and 4. This was the fourth milestone in the history of the present-day company. On 7 May 1919 Schachtbau Thyssen GmbH was established with its head office at Mülheim.

The Weimar Republic and the Second World War

On the death of August Thyssen in 1926 the fortunes of Thyssen & Co. AG then passed into the hands of new owners, namely his son Fritz Thyssen and his nephews Julius and Hans, the children of his brother Joseph, who died in 1915. Though initially a sympathiser of National Socialism, Fritz Thyssen soon dissociated himself from it and – unlike many other of the Ruhr industrialists – became an opponent of Hitler. As a result of this his property was confiscated and he was eventually sent to a concentration camp.

In 1940 the remaining shares held by his nephews Julius and Hans in Thyssen & Co. AG were acquired by the Prussian State for a fraction of their value. This meant that Schachtbau Thyssen GmbH also passed into the hands of the Prussian State. That same year it was sold on to the state-run ore mining and iron works enterprise Reichswerke (Herman Göring) AG für Erzbergbau und Eisenhütten and 1941 the new owners merged the company with Bergbau AG Salzgitter to form Grossdeutscher Schachtbau und Tiefbohr GmbH. In 1945, at the end of the war, the company changed its name to Deutsche Schachtbau und Tiefbohr GmbH.

Break-up and reconstruction

After the war Fritz Thyssen spent several years in detention under the Allies and was compelled to undergo a de-nazification process – even though he had opposed Hitler and spent time in a concentration camp as a result. Thanks to the support of Federal Chancellor Konrad Adenauer and the North Rhine-Westfalia government part of the assets confiscated by the Nazis and by the Allies were returned to him, and after his death in 1951 to his wife Amélie and his daughter Anita Countess Zichy-Thyssen.

Then in 1952 Schachtbau Thyssen GmbH was finally established in Mülheim an der Ruhr and has been in the sole possession of the family of Fritz Thyssen – the son of August Thyssen – ever since. This is the fifth milestone in history of the company.
In 1970 the company adopted the name that it still holds today – THYSSEN SCHACHTBAU GMBH. Anita Countess Zichy-Thyssen, the daughter of Fritz Thyssen, continued the legacy after the death of Amélie Thyssen, and her two sons, Counts Frederico and Claudio Zichy-Thyssen, inherited the business on an equal ownership basis. Claudio Count Zichy-Thyssen, the great-grandson of August Thyssen, has been sole proprietor since 2002.

After 1945, in addition to the mining activities of the Gewerkschaft Friedrich Thyssen business, the shares held in the iron and steel operations of Thyssen AG (formerly August Thyssen Hütte) were again in the hands of Fritz Thyssen – and his heirs. At the end of the 1990s Counts Frederico and Claudio Zichy-Thyssen sold their holdings to Thyssen AG and retired from the Board of Directors, which means that THYSSEN SCHACHTBAU GMBH – a company that can trace its history back to the establishment of the Thyssen Compagnie by August Thyssen in 1871 – is now the only part of the Thyssen group of companies still in family hands.

Operating out of its head office in Mülheim an der Ruhr, today's THYSSEN SCHACHTBAU GMBH – through its "mining" as well "shaft sinking and drilling" divisions – is primarily involved in shaft sinking and roadway drivage projects in Germany, Austria, Switzerland and Russia; it also undertakes borehole drilling and shaft sinking work for the tunnelling and exploratory drilling sectors and builds pressure tunnels and surge shafts for pumped-storage power stations.

The company is therefore one of the largest specialist mining undertakings in Europe. Its Canadian and Australian subsidiaries and affiliates are also engaged in numerous shaft sinking and tunnel drivage projects – making THYSSEN SCHACHTBAU one of the biggest specialist companies in international mining.

Norbert Handke
Dr.-Ing. Axel Weißenborn

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Eyjafjallajökull – the Icelandic volcano
or 85 hours from Moscow to Mülheim

It was to have been the same return trip from Moscow to Mülheim that THYSSEN SCHACHTBAU personnel had done countless times before: departures hall at Sheremetjevo Airport in Moscow, check-in, shoes off and through the scanner, a nice chat with the passport control officials and then waiting in the café by the gate drinking coffee, wait a bit longer, drink another coffee, another wait, then boarding at last, three hours in a stuffy and full aircraft with an exquisite three-course menu, then a relaxed arrival in Düsseldorf, the drive home and then into the week-end – and the prospect of a league match between Schalke 04 and Borussia Mönchengladbach. But things didn't quite turn out that way…

The journey began in the departures hall at Sheremetjevo Airport in Moscow. It was Friday, 16 April 2010, sometime between 6:30 and 9:00 in the morning, when six THYSSEN SCHACHTBAU employees, travelling independently, happened upon each other almost by chance at the airport. At that time none of those involved could imagine that this was to be the beginning of an unforgettable trip through five countries and three time zones. At about 9:30 the group met up with a colleague from the CFT company, who – like us – was somewhat grim-faced by the news of a delay to the scheduled flight that was to have marked the start of a well-earned week-end break.

The following journal is a less than serious record of the 'highlights' of our unconventional journey from Moscow to Mülheim:

Friday, 16.04.2010

9:30 hrs The travel groups gather in the departures lounge at Sheremetjevo Airport; the mood is good with the prospect of the coming week-end. We had heard about the disruption to air traffic but did not attach much importance to it. Then we find that our flight to Düsseldorf has been cancelled.

10:00 hrs We rule out the option of booking on a flight to Zürich at 14:00 hrs. The train journey from Zürich Airport to Mülheim is a long and tedious one, someone says. Better to wait for another direct flight to Düsseldorf. Time for the first beer of the day – which is quickly served up.

11:00 hrs But as time passes it becomes clear that there are simply no more flights to the West, so we leave the airport and wait around to see what the day brings.

13:00 hrs There are friends aplenty in Moscow and one in particular, a certain Hermann from Selm, invites us to drop by. We did not need to be asked twice, for

the weather was glorious and there was a spring-like atmosphere in the air.
The party of frustrated travellers received a truly warm welcome and the barbecue was already heating up nicely by the summer-house when we arrived. We were truly overwhelmed by our host, who treated us to some real hospitality Russian-style. There followed a great BBQ, only interrupted by a quick visit to the airport to have a look at the departures board. With cancellations all over the place we wonder if we should have to wait until the evening for a flight out.

14:00 hrs The group returns to the BBQ and the 'company' is kitted-out in black T-shirts with red logos. It was Hermann's way of saying 'forget the flight home, enjoy the day and the hour, switch off. The beer was then followed-up by plum brandy made from last season's fruit. What could be better!

21:00 hrs We are amazed by the motor stunt show 'the evil quad' on the streets of Moscow: Hermann is showing off one of his special vehicles – a black quad bike – and then we all took to the woods for a quick spin on this 150 horse-power rocket on wheels.

24:00 hrs Who would have thought it! The airport announces that there will be no more westbound flights that day. This is just what the group needs. But we are all technicians and can fully sympathise with the situation. So it looks like an early flight the following morning. Hermann invites us to another beer and plum brandy and we all clear our throats for a rendering of the miners' song.

01:20 hrs Good night.

Saturday, 17.04.2010

9:00 hrs A bread-and-water type breakfast at the Moscow country club. Life can be quite good even in unpleasant circumstances. But hold on a minute – we have to ring home: 'Things have got really grubby here in Moscow since yesterday morning. We have had nothing to eat and all feel terrible. But see you later, should be home in time for the Schalke match.'

12:00 hrs Arrive at the airport and march up to the departures board full of expectation. But our hopes are dashed:

14:00 hrs The only possible and practical flight to Riga is cancelled.

16:00 hrs Flying home seems to be a lost cause. A more sober mood takes hold. We calmly reflect on what to do next. Someone at the airport comes up and asks if we need a taxi. We certainly do, is the reply – to Riga. He goes off to speak with his boss. We are amazed at this. A short time later the taxi driver returns: 'OK, no problem, I can do it. My colleague will be here with a second car – then we can get going.'
So we plan making the 900 kilometre journey to Riga by car. Soon we have two drivers with their vehicles all ready to make the 'short trip' to Riga. After that we can make our own way home, or so we think.

16:15 hrs As we agree on the final details of this 'short trip' the drivers regretfully tell us that they will probably have to drop us off at the border as they have no visas to cross the frontier.

16:30 hrs With gritted teeth we abandon thoughts of a car ride to Riga. Now what?

17:00 hrs After mulling things over we have a sudden flash of inspiration: if we cannot do it by air or by car, why not make our escape by rail. We are soon all agreed and the trip is on.

19:00 hrs More frustration – the train to Warsaw is fully booked.

20:00 hrs A glimmer of hope: there is a train with some free seats travelling to Helsinki via St. Petersburg. The decision is soon made to book on to the Helsinki train. We will be able to travel on from there by boat. There are just eight seats left – that was close! Meanwhile Schalke 04 wins 3:1 – how could they do it without us!

21:00 hrs We have our farewell dinner in Moscow in the café round the corner. Farewell Moscow – one final vodka and we scurry on board.

22:00 hrs But not before we stock up on provisions in a little shop, also just around the corner.

22:40 hrs The loss of our only bottle of vodka on the station platform. It was to have provided comfort during the trip – but got broken as we clambered on board. But

The ferry to Stockholm arriving in Turku

rescue is to hand – the train has a restaurant car.

22:50 hrs The night train to Helsinki pulls away.

23:00 hrs We check into our different 4-bed suites

23:30 hrs We poke fun at three English travellers who plan to travel on from Helsinki to Turku and then take the ferry to Stockholm. Ludicrous! We are glad that our travel plans are much better laid – as we are taking the easy route from Helsinki by ship straight to Travemünde. How could they be so stupid …?

23:59 hrs Unfortunately we have no takers for the fourth berth in senior members' compartment.

00:00 hrs The vodka bottles start to circulate around the compartment – no one knows where the stuff comes from. But we don't care. Someone has bought dried meat and dried fish in Moscow and this goes down really well with the vodka. Our fellow travellers are a talkative bunch – as well as the Englishmen there are Belgians, French and Danes. Most of them are ringing up various coach and travel companies – and telephoning home too of course.

00:30 hrs The 'devushka' in our compartment brings us a selection of little patties to eat – just great. No one wants to sleep.

03:30 hrs It slowly becomes light outside and peace returns to the compartment.

06:00 hrs The devushka brings coffee for those who cannot sleep – simply wonderful!

Sunday, 18.04.2010

9:00 hrs Border formalities are carried out in Russian and Finnish.

9:30 hrs With beaming faces we return to the EU.

10:30 hrs Some of us think they glimpse the Lahti ski-jump out of the train window. But how could this be – were we not travelling to Helsinki?

12:00 hrs We pull into Helsinki

12:30 hrs But dash it – there are no places left on the ferry to Travemünde; that would have been just too easy. But we have a guardian angel somewhere who is watching over us every step of the way: Margarete Wehling finds a solution for us on the internet from head-office in Mülheim and helps us get out of the impasse as well as she can from her remote desk: 'Boys, take the train to Turku – I have managed to grab two cabins for you on the ferry – with a shower and berths'. There is real relief all round.

The word spreads around Helsinki station about the 'service' and organisational support from Mülheim and a growing number of strangers attach themselves to our group – which is getting ever larger. We need to get out of here fast …. !

15:00 hrs And so we travel on to Turku by train.

17:00 hrs Arrive in Turku: thank goodness the tickets for the ferry to Stockholm have been reserved and we do not have to join the queue in a waiting hall that is crammed full to bursting. We just want to check-in as quickly as possible. Again we are suddenly accosted by touts who are keen to buy our tickets for lots of money. They have come to the wrong place!

18:00 hrs Taking in some pre-journey sustenance in the Best Western at the port of Turku we meet up again with the three Englishmen, who this time greet us with broad grins: 'Germans, nice to see you again. Did you chaps not want to go to Travemünde by ferry?' Yes, yes, yes…. So those three were not so stupid after all – we must give them that. 'But you know, chaps, that extra-time goal in the '66 World Cup final should never have been given. You diddled us!!'

20:30 hrs At last: we clamber up the boarding ramp to the ferry.

20:45 hrs The two cabins quickly become the scene of some serious watersport activities. Following our travel exertions the liberal application of soap and water is now well overdue.

21:30 hrs The substantial menu provided at the Scandinavian buffet in the ship's restaurant leaves us all fully satisfied. We gaze through the porthole and admire the ice floes drifting past in the Baltic Sea. Beer, wine and vodka – this kind of Scandinavian buffet has its own special appeal.

Cheers!

22:30 hrs Unfortunately our failure to follow the alcoholic beverage rules results in our ejection from the buffet room. The ferry staff are in no mood for joking! We have gone way over the top of the average consumption pattern for normal passengers.

23:00 hrs We pay a visit to the on-board casino and disco – no Scandinavian blondes respond to the SMS messages being sent out by our senior member and so the fourth berth in the senior compartment stays unoccupied for the night.

Like in the hit song 'Mit dem taxi nach Paris'... Rødby at last

Monday, 19.04.2010

1:00 hrs The snorers' concert then strikes up in cabin number 5130. Here the CFT outfit is in a class of its own and the adjoining cabins get a free musical concert whether they like it or not.

6:00 hrs We dock in Stockholm

6:30 hrs We manage to get a taxi that holds seven and its off to the railway station.

6:31 hrs The involvement of the taxi driver in our route planning takes an interesting turn – the train to Helsingborg is fully booked and there are apparently no rental cars to be had in Stockholm until nine in the morning. In fact there is a good chance that the city has no cars for hire at all.

6:32 hrs The taxi journey starts with a lively debate as to what our next course of action should be. There would appear to be doubts about the train and hire-car options.

6:34 hrs We enter into negotiations with the taxi driver as to the cost of a trip to Helsingborg and reach an agreement in a few minutes.

6:38 hrs So off we go to Helsingborg – non-stop by taxi. The driver is much commended for his flexibility in all this.

10:30 hrs Once again our driver is brought into the route planning process.

10:31 hrs 'Could you not take us straight to Rødby?'

10:32 hrs The taxi duly heads for Rødby.

14:45 hrs We arrive in Rødby

15:15 hrs The ferry sets off for Puttgarden

15:16 hrs A wager is struck between THYSSEN SCHACHTBAU and CFT: CFT is absolutely certain that the symmetrically designed ferry (the front looks like the back) will have to turn about after departing.

15:17 hrs The ferry refuses to perform a turning manoeuvre.

15:18 hrs CFT is obliged to admit defeat through gritted teeth and comes in for some ridicule at the hands of the THYSSEN SCHACHTBAU men: six against one does admittedly seem a bit unfair. Fifty euros change hands. Time for a round of drinks – which are duly set up!

15:45 hrs The ferry docks in Puttgarden – and of course there is no turning manoeuvre here either.

16:15 hrs We set out for Lübeck in a taxi.

16:17 hrs Back in Germany at last. However, our driver turns down any notion of going on to Mülheim. My goodness! The business-minded Scandinavians were much more cooperative in this respect!

17:15 hrs We arrive at the car hire shop in Lübeck. Our commercial department in Mülheim has pulled out all the stops and managed to book us the last two available hire cars in the whole of Europe.

17:30 hrs The two hire cars set off for the Ruhr. Now we can really start to unwind.

18:00 hrs We go on an extended tour of a building site on the A1: how nice is that!

21:45 hrs CFT takes leave of the entourage in Gladbeck.

22:15 hrs We arrrive in Mülheim and the travel party spills out in all directions – everyone heads for home.

The end of an unforgettable trip and time to do some totting up:

- 1,050 km by train from Moscow to Helsinki
- 190 km by train from Helsinki to Turku
- 270 km by ferry from Turku to Stockholm
- 850 km by taxi from Stockholm to Rødby
- 90 km by taxi from Puttgarden to Lübeck
- 410 km by hire car from Lübeck to Mülheim

In spite of – or perhaps because of – all the anxious waiting around and all the stresses and strains of the trip this experience will live on in our memories as a most unusual, interesting and, it has to be said, amusing journey from Moscow to Mülheim an der Ruhr.

The travellers:
Norbert Handke
Erhard Berger
Oleg Kaledin
Hubertus Kahl
Tim van Heyden
Viktor Morlang
Heiko Blak (CFT)
Margarete Wehling
(travel arrangements and back-up in the Mülheim office – without whom we would probably still be travelling)
Hermann
(workmate, host, motivator and back-office for the entire trip – without whom the journey would not have been half as agreeable)

Tim van Heyden
Journal writer


www.thyssen-schachtbau.de