USE OF MOBILE EQUIPMENT IN OPEN PIT LIGNITE MINES PROFEN AND ZWENKAU[1]

by

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Abstract. MIBRAG is a lignite mining company located in former East Germany south of Leipzig which was privatized into the ownership of an Anglo-American Consortium in 1994. Bucketwheel and bucketchain excavators tied to conveyor belts have been the primary equipment used for overburden and lignite removal. In order to improve recovery and lignite quality, mobile equipment has been introduced to supplement large excavators. The primary uses to date have been the removal of a hard sandstone layer in overburden, the recovery of coal in a depression of a lower seam and the removal of interburden. The introduction of this equipment has presented challenges such as developing ways to transfer lignite from trucks to conveyor, the need for increased road construction and maintenance, the need for mobile service equipment, purchase of support equipment, managing increased traffic and modifying safety training. Mobile equipment has also provided advantages such as greater flexibility, increased responsiveness to changing conditions, increased opportunities for updating equipment, increased lignite recovery, improved lignite quality control and increased overall equipment availability.

Additional Key Words: bucketchain excavators, bucketwheel excavators, EASI-MINER, Germany

Introduction

The Mitteldeutsche Braunkohlengesellschaft mbH (MIBRAG) is a lignite mining company in the industrial area of middle Germany south of Leipzig. It was formed through the privatization process of a mining/power/lignite products company which had been created by the German Government from a former state-owned conglomerate after the political change in 1989. With privatization on 1 January 1994 the ownership was transferred to a joint-venture of Morrison Knudsen Corporation, Boise, Idaho (MK); NRG Energy, a subsidiary of Northern States Power, Minneapolis, Minnesota; and Power Gen plc., England.

Before the political change, the MIBRAG conglomerate consisted of twenty-one strip mines, twenty-five briquette factories, three low-temperature carbonizing plants and one mineral wax factory with a combined work force of over 57,000 people.

MIBRAG, which operates in three of the "New States" of Germany, Saxony, Saxony-Anhalt and Thüringia, produces lignite, electricity, briquettes, lignite dust, and steam with a work force of 2,600 workers. MIBRAG currently operates three mines: two, Profen and Schleenhain, which it owns and one, Zwenkau, which it leases from the Lausitzer und Mitteldeutschen Bergbau-Verwaltungsgesellschaft (LMBV, Lausitz and Middle-German Lignite Mine Management Company). Production for 1989 and 1996 are presented in Table 1.

Table 1. MIBRAG Results Comparison.

Product	1989	1996
Lignite (Mt)	105.6	16.3
Sold Electricity (GWh)	n/a	1.102
Briquettes (Mt)	22.5	.474
Lignite Dust (Mt)	n/a	.257

n/a = not applicable

The Role of Morrison Knudsen Deutschland GmbH

When MIBRAG was privatized, MK founded Morrison Knudsen Deutschland GmbH (MKD) as a German subsidiary to provide mining consulting and management services; MKD is currently contracted by MIBRAG to provide such services. To date, this activity has focussed on broadening the once-confined world of the Soviet block engineer/technician/operator to the vastly increased choice in equipment, parts and materials and computer hard- and software now available. This paper addresses new applications of equipment,

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specifically the deployment of mobile equipment in Profen and Zwenkau mines.

Introduction of Mobile Equipment

The primary overburden and lignite production equipment in MIBRAG's mines was and is large bucketwheel and bucketchain excavators utilizing in-mine conveyors to transport overburden and lignite. This equipment will continue to dominate producing 75-80% of material moved. However, specific conditions lend themselves to the application of mobile equipment. Current examples are:

- quartzite mining in Profen Mine;
- lignite production in a deep pocket in the lower seam in Profen Mine; and
- interburden production in Zwenkau Mine.

Stratigraphy at Profen consists of two main seams (Figure 1). Within the overburden is a layer of hardened sandstone locally known as quartzite. The existing bucketwheel and bucketchain excavators are not capable of mining this material due to its hardness. Before privatization in 1994, the quartzite was produced by drilling, blasting, loading with electric Russian shovels and hauling by rail to an inside dump or to a nearby crushing facility for sale off site. By fall 1994, production equipment was changed consisting of a Caterpillar 992 wheel loader, a Caterpillar 5130 hydraulic front shovel (10.6 m^3 bucket) and a fleet of five 85-ton Caterpillar trucks. Production costs were reduced by 20% in 1995 compared to 1993 and another 28% in 1996 compared to 1995 (Maier, 1996). For 1997, MIBRAG plans to mine about 2.5 M m^3 with this fleet.

Lignite Production with Mobile Equipment

In another part of Profen mine, mobile equipment is employed in the mining of lignite. MIBRAG normally mines lignite using bucket wheel and bucket chain excavators but Profen's unusual geology provided this opportunity. When carbonaceous material was being deposited in the Tertiary, there was a simultaneous subrosion of underlying salts causing depressions (kessels) in which lignite is 30-40 m thicker than the normal lower seam (Eissmann, 1985). The side walls of this kessel, the Steingrimma Kessel, are too steep to permit effective, safe recovery of the lignite with the large excavators (Maier, 1996). Therefore, two EASI-MINERs (Huron Manufacturing Co.) and a fleet of five 85-ton Komatsu trucks are operating to produce the lignite at a nominal rate of 2,000 t/h. A Stamler Flat-Back Hopper has been installed to transfer lignite from trucks to conveyor. A bucket chain excavator continues to operate in the upper part of the kessel providing a good marriage of the two technologies. With this equipment fleet MIBRAG expects to produce over 5 M t of lignite from the kessel alone in 1997.

New Mobile Equipment in Zwenkau Mine

Mobile equipment has also been deployed at Zwenkau Mine. The Zwenkau deposit also consists of two main seams (Figure 2). The overburden is mined by a crosspit bridge and conveyor and two bucket chain excavators. The interburden would have been mined by a bucket wheel excavator and transported by rail 15-18 kilometers to the inside dump. An alternative was found by using a Caterpillar 5130 hydraulic backhoe and a fleet of four 85-ton trucks which reduced the haul distance to three kilometers and costs by 21%.

Challenges of Mobile Equipment

The introduction of mobile equipment presented challenges which had to be met. For example:

- Lignite transfer from trucks to conveyor
- Road building and maintenance
- Equipment maintenance and service
- Support equipment purchase
- Traffic congestion solutions
- Modified safety program implementation
- Fuel price differential

The transfer of lignite to conveyor is accomplished by use of a Stamler Flat-Back Feeder. 85-ton trucks haul lignite from the EASI-MINER to the feeder which is located less than one kilometer away and within 15 m elevation of the lignite bench. As the kessel is mined deeper, the feeder will be relocated to lower elevations.

Before mobile equipment played such a large role at MIBRAG, road construction and maintenance were not a high priority. However, the need to transport equipment, quartzite, lignite and road construction materials requires that excellent roads be constructed and maintained. The often continual wet conditions throughout the year and the freezing/thawing in the late fall through spring require that the right materials be used, and properly applied and maintained. A road design and construction program has been implemented to insure the quality of the mine roads.

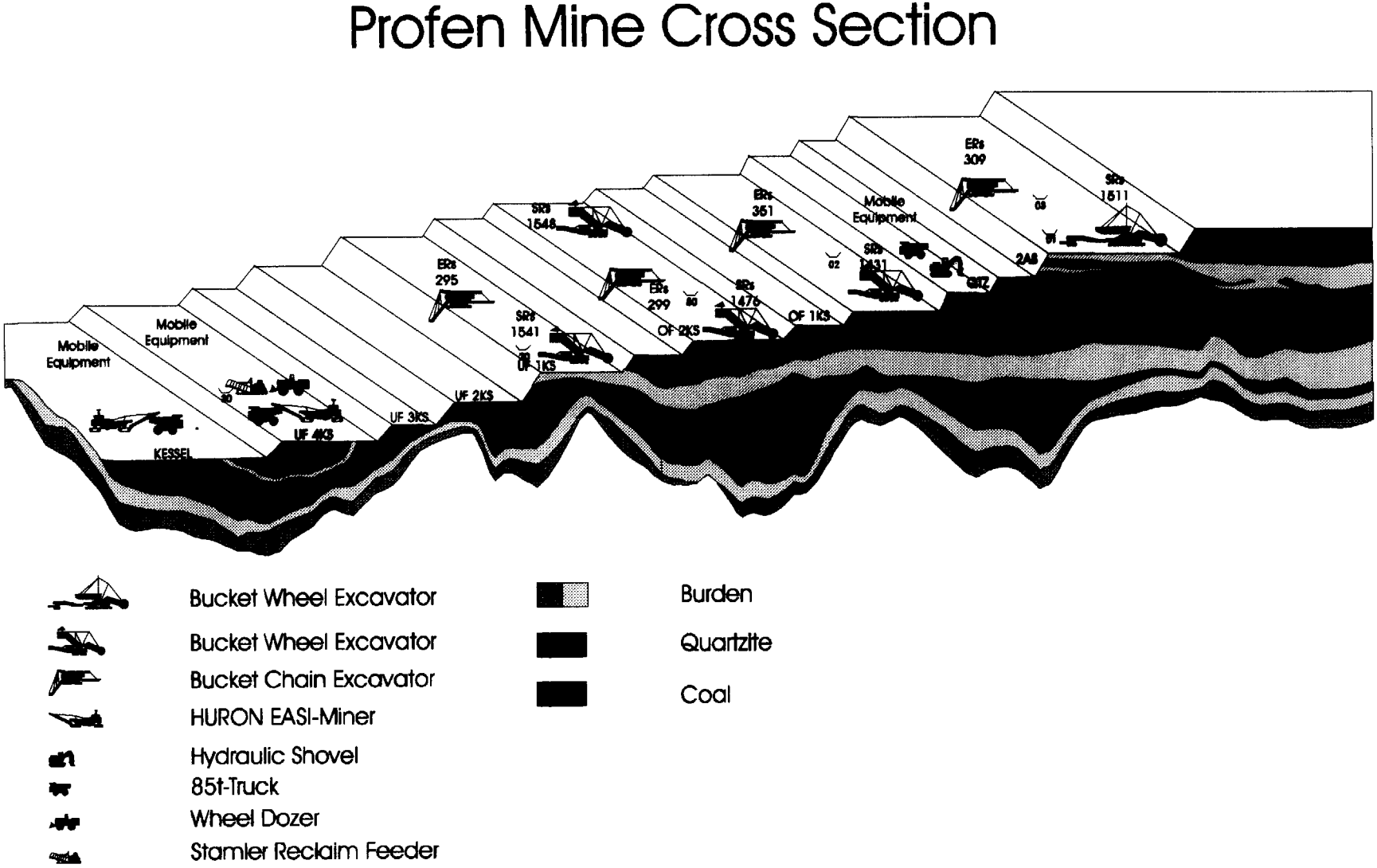


Figure 1. Profen Mine Cross Section.

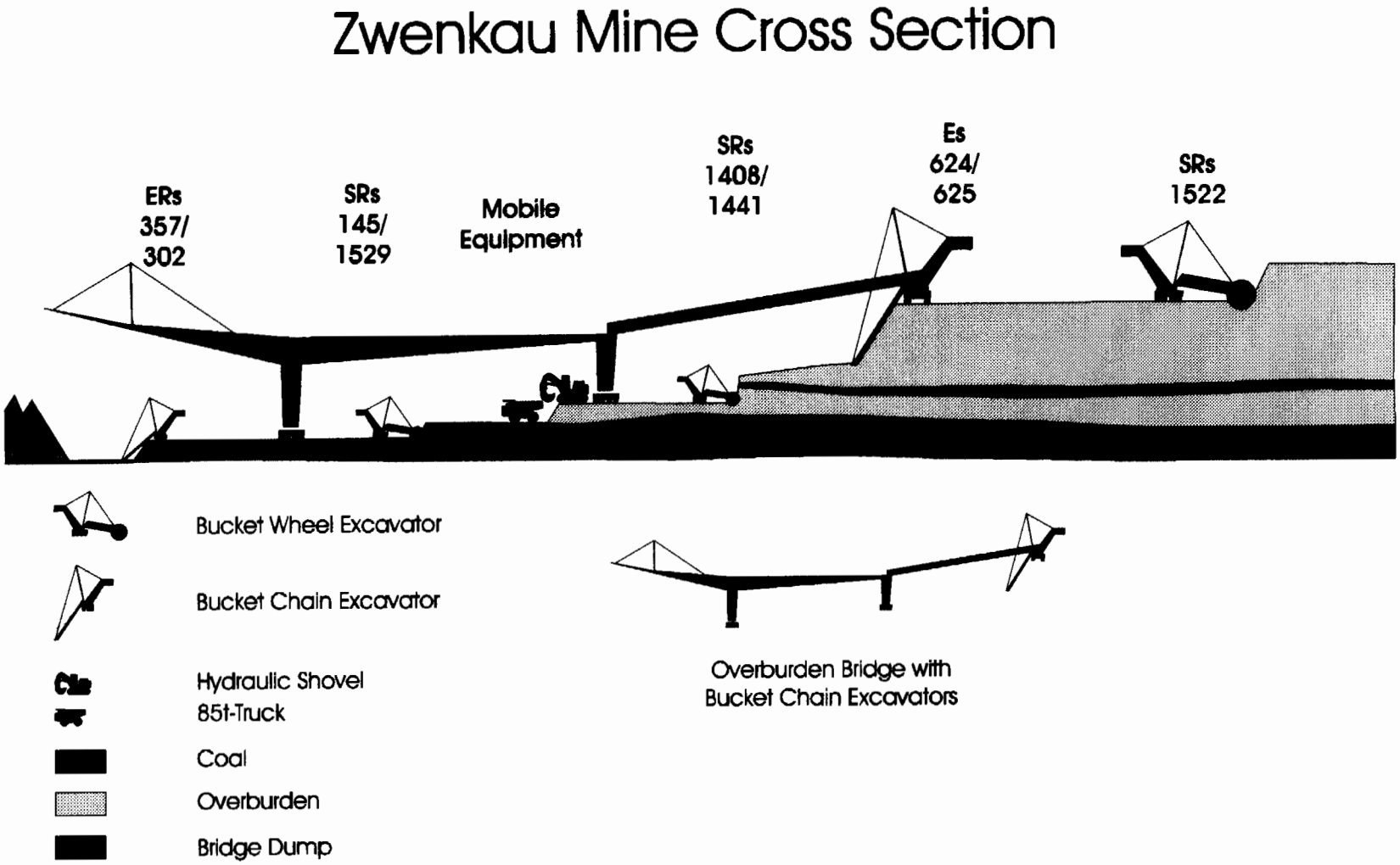


Figure 2. Zwenkau Mine Cross Section.

Efficient routine service such as fueling, oil changes and small repairs must be done in such a way as to maximize operating hours. This is accomplished by providing those services with a fleet of service vehicles so that such servicing can take place near the point of application and during short scheduled breaks such as meal time. The implementation of mobile equipment also required the introduction of the necessary support equipment: graders, water trucks, dozers and compactors. MIBRAG staff were trained in the safe operation of this equipment to maximize its utilization.

The significant increase in mobile equipment has required particular attention to safety. Long dark days which are often foggy require that every driver be well trained and fulfill his/her safety responsibilities behind the wheel. Strict rules of the road were established and followed.

Safety is an area in which MIBRAG has excelled during the increasing use of mobile equipment. In 1994, 1995 (see Figure 3) and 1996, MIBRAG had the lowest reportable accident rate of the three German lignite companies (Debriv, 1996; Dr. Baldermann, 1997) and continues to stress the importance of safety through a training, awareness and awards program. Individuals are rewarded for achievement of personal and group safety milestones.

The price of fuel has a larger impact on mobile equipment operations in Germany than in the U.S. For example, the average price of diesel fuel for MIBRAG in 1996 was 93 pfennig/L ($2.07/gal @1.7 DM/$). It is very important that when considering deployment of mobile equipment, the price of fuel is properly accounted for in comparisons.

Advantages of Mobile Equipment

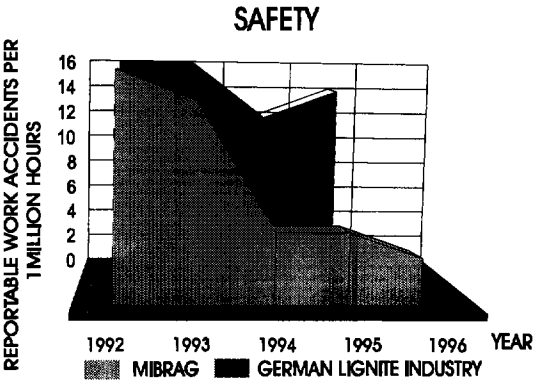
Mobile equipment has proven to have benefits in parts of our mining operation. Some of the primary ones were:

- Greater flexibility in choosing locations for coal recovery
- More responsiveness to changing conditions
- Increased opportunities for updating equipment
- Increased lignite recovery in specific situations
- Better quality control because the EASI-MINER is better able to separate out partings that larger excavators cannot
- Increased overall theoretical availability because, for example, if one truck is out of service the fleet can continue to operate; whereas, if one conveyor flight is down an entire production line is out of service.

Large excavator operations, tied to conveyors, result in a mine design based on advancing benches from an established pivot point. When excavator operational constraints affect lignite quality, the increased mobility offered by mobile equipment can frequently overcome lignite quality problems.

This flexibility allows us to more readily respond to changing mining and economic conditions. This is especially important as the capital costs for a new bucketwheel requires a long period of effective operation to recover the investment. The lower capital costs of mobile equipment also allow MIBRAG to take advantage of changes in technology by replacing equipment on a more frequent basis.

Figure 3. MIBRAG Safety Record.



An example of increased recovery in the Steingrimma Kessel with mobile equipment was discussed above in which "Kessel" lignite could not be recovered with the large excavators. In this application we have also improved quality because the EASI-MINER operator can "feel" parting in the lignite and can load it separately for hauling to a nearby waste dump.

For a continuous system to work all parts must be working, i.e., the bucketwheel and all conveyors to either the coal blending yard or the burden dump. With a mobile equipment fleet, as long as one excavator is available lignite can still be mined allowing stockpiles to be created for later use. This also better utilizes the workforce.

Summary and Conclusions

MIBRAG will continue to use bucketwheel and bucketchain excavators to move the majority of overburden and lignite. However, MIBRAG has also learned that mobile equipment can be an excellent supplement to continuous mining equipment providing cost savings (for example, in mining of quartzite) and operational benefits by using mobile equipment in those circumstances that call for greater flexibility or selective handling capability that mobile equipment offers.

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