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Major Contract for Shaft and Heavy-duty Hoisting Systems for the Woodsmith Mine Shafts in North Yorkshire in United Kingdom

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Polyhalite in North Yorkshire

The Sirius Minerals PLC is constructing one of the deepest underground mines in United Kingdom. The Woodsmith Mine is located under the protected region of the North York Moors National Park in the proximity of the English north-east coast, roughly 6 km south-west of Whitby (Fig. 1). The underground potash and polyhalite reserves are found at a depth of roughly 1,500 m and extend several kilometres out under the North Sea. Strict environmental considerations must be taken into account in developing these reserves. For instance, the Woodsmith Mine is to be connected to Teesside harbour at Middlesbrough via a 37 km long tunnel to provide a dedicated material transport system (MTS). Once the overall project is completed as planned in 2021, the annual output of fertiliser bearing the trade name POLY4 will amount to 13.4 million t. The service and production shafts as well as the two shafts for the MTS tunnel represent substantial underground facilities of the mine [1, 2, 3].

Contract

The Siemag Tecberg group, Haiger, Germany, was commissioned to provide four tendered supply packages by DMC Mining Service (UK) Ltd. (DMC) in September 2018. The contract involves the planning, production as well as delivery of a total of 8 hoisting machines and 16 stage winches including the corresponding automation and drive technology, braking systems with ultra-high safety standards as well as supervisory and coordination control units for the hoisting systems installed in the shaft (Fig. 2).

Added Value through international Networking and Expertise

Siemag Tecberg with its associated companies was in a position to convince the client DMC as well as the ultimate client Sirius Minerals PLC (Sirius), United Kingdom, of the value of group-wide cooperation with networked structures, interlinked production processes and manufacturing methods at various locations, state-

The Siemag Tecberg group received a major contract in September 2018 from the DMC Mining Service (UK) Ltd., United Kingdom, to deliver a total of 8 hoisting machines and 16 stage winches for application in several shafts at depths of 1,600 m and 370 m for the new Woodsmith Mine and the Lockwood Beck Shaft in the North York Moors National Park in the north-east of England.

Mining • Tunnelling • Shaft hoisting technology • High performance mining • Supplier • United Kingdom

of-the-art technologies, features relevant to safety and the provision of sustainable project schedules.

The packages mainly stem from the Siemag Tecberg headquarters in Haiger. These are rounded off by deliveries and services from subsidiaries Winder Controls Europe Ltd., United Kingdom, and Siemag Tecberg Inc., USA.

Further convincing arguments in favour of the corporate group were provided by unique reference pro-

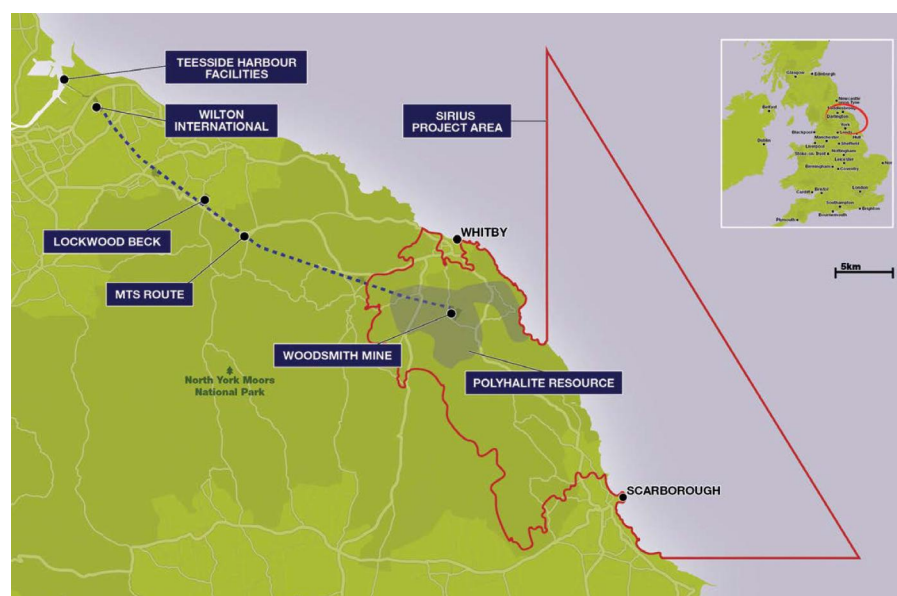


Fig. 1: Overview of the mine project
Source: Sirius Minerals PLC



Fig. 2: Signing the contract

by John Luckock (Chief Operations Officer & Project Director with DMC, Jürgen Peschke (CEO of the Siemag Tecberg group) and Ian Bailey (Chairman Winder Controls, Great Britain, and Siemag Tecberg Inc., USA) (from left to right)

jects throughout the world involving hoisting machines, stage winches and braking systems, especially for different mines, including some for mining polyhalite, for tunnelling projects, such as e. g. the Gotthard Base Tunnel, as well as regional service bases. The client DMC ultimately decided to award the total package to Siemag Tecberg. Due to the complexity and time critical aspects of this technically demanding project it was deemed best supplied by a single source with global experience in supplying integrated heavy duty hoisting systems.

Table 1: Technical data of the shaft hoisting systems for the production and service shafts

Designation	SBR Winch	Utility Winch	Sinking Hoist
Type of hoisting	single-rope drum	single-rope drum	single-rope drum
Number	2 × 4	2 × 2	2 × 1
Means of conveyance	shaft boring machine (SBR)	multi-deck shaft working platform	kibble
Rope system	triple-sheaved	rope deflection	rope deflection
Number and type of rope sheaves	2 × 10 diameter 1,575 mm, one-piece	2 × 4 diameter 1,140 mm, one-piece	2 × 2 diameter 3,680 mm, two-piece 2 × 2 diameter 4,480 mm, two-piece
Rope capacity	5,000 m	1,750 m	1,700 m
Single rope layer	525 kN	250 kN	360 kN
Rope speed	0.13 m/s	0.13 m/s	10.67 m/s
Type of machine	SDW / 2400 / PG	SDW / 1520 / PG	SDW / 4267 / G
Drum diameter	2.4 m	1.52 m	4.267 m
Motor performance	90 kW	45 kW	2 × 1,800 kW
Number and type of brake calipers	3 × BE 350	4 × BE 125	12 × BE 125

System Integration and complete Solutions from a single Source

In the interim, the scope of delivery has been extended by 53 rope sheaves and additional equipment for automation technology stemming from the supplier. The initial batch consisting of 5 hoisting machines, 4 stage winches as well as 33 rope sheaves will be supplied in late March, 2019, to the construction sites and will become operational after assembly. Further deliveries will follow throughout 2019.

The Shaft Hoisting Systems for the Production and Service Shafts

The production and service shafts each possessing a diameter of roughly 6.75 m with depths of down to 1,600 m are being sunk parallel to one another for time considerations. Both shafts will be tackled by a Shaft Boring Roadheader (SBR) made by Herrenknecht AG. The SBR is equipped with a telescopic roadheader boom and a rotating cutting drum, which excavates the entire shaft cross-section in a single cycle. As the SBR descends on ropes and winches installed on the surface, permanent lining is inserted in sections from an upper working deck. The project involves depths of roughly 1,600 m, and so is a showcase project, posing the highest demands on the shaft and heavy duty hoisting systems [4].

Altogether eight stage winches (SBR winches) are to be supplied (Table 1). An SBR is driven in the shaft by four synchronously operated SBR winches. Each SBR winch can also be driven individually to balance the rope load. The ropes are triple-sheaved to minimise the resultant maximum operating load. The approx. 367.5 t heavy SBR is thus suspended in the shaft on a total of 12 rope strands. The individual SBR winch for its part has a service weight of roughly 67 t providing a maximum rope tensile strength of 525 kN. The coiled rope package weighs a further approx. 68 t with the rope capacity amounting to 5,000 m.

Above the SBR there is a mobile shaft working platform for shaft development and assembling the shaft fixtures. Towards this end, in each case, two so-called utility winches are to be supplied. They are installed directly on shaft beams above the two shafts. A sinking hoist unit is to be supplied for transporting personnel in the rope-guided kibble, mucking operation and material transport.

The Shaft Hoisting Systems for the MTS Shaft and Tunnels

For environmental reasons the underground Material Transport System (MTS) links the Woodsmith Mine directly with the Teesside harbour at Middlesbrough. The tunnel is to be driven from three points of attack in parallel with several tunnel boring machines (TBMs) made by Herrenknecht. One point is located directly at

Table 2: Technical data of the shaft hoisting systems for the MTS shafts

Designation	Stage Winch	Auxiliary Hoist	Sinking Hoists	TBM Cage Hoists
Type of hoisting	single-rope drum	single-rope drum	double-drum	single-rope drum
Number	2 × 2	2 × 1	2 × 1	2 × 1
Means of conveyance	multi-deck shaft working platform	cage	cages, kibbles, further equipment	cage
Rope system	triple-sheaved	-	-	single-sheaved
Number and type of rope sheaves	2 × 4 diameter 2,800 mm, one-piece 2 × 2 diameter 2,200 mm, one-piece	2 × 1 diameter 1,920 mm, one-piece	2 × 2 diameter 4,640 mm, two-piece	2 × diameter 5,120 mm, two-piece
Rope capacity	1,400 m	520 m	550 m	1,220 m
Single rope layer	352 kN	45 kN	263 kN	400 kN
Rope speed	0.51 m/s	2.54 m/s	7.62 m/s (engaged) 3.56 m/s (disengaged)	7.62 m/s
Drum diameter	3.072 m	1.92 m	4.64 m	5.76 m
Motor performance	250 kW	112 kW	2 × 875 kW	2 × 1,600 kW
Number and type of brake calipers	3 × BE 250	2 × BE 100	4 × BE 250 2 × BE 65	14 × BE 125

the Wilton portal near the harbour and the other two points of attack are found at the so-called MTS shafts of the Woodsmith and Lockwood Beck sites. The two MTS shafts possess a diameter of roughly 8 m and are approx. 370 m deep.

The shaft hoisting supplier provides all hoisting machines, stage winches and rope sheaves necessary for sinking the MTS shafts and for the subsequent tunnelling phase involving mucking operation and material transport. They include four stage winches, two double-drum hoisting machines, two single drum heavy duty hoisting machines and two single-drum hoisting machines as permanent auxiliary hoists (Table 2). During the sinking phase for an MTS shaft, two synchronously operated stage winches are used to operate a multi-deck shaft working platform. The shafts are sunk by means of

conventional drill+blast and lined parallel to the shaft with the permanent shaft fixtures being assembled. The double-drum hoisting machine is used to transport material and muck while the shaft is sunk and the tunnel lined. The transportation of personnel to the shaft working platform or to the shaft bottom is undertaken by the auxiliary hoist. The tunnel boring operation us-

Sirius Minerals PLC, United Kingdom

York Potash Limited, a subsidiary of Sirius Minerals PLC, was established to plan and set up the Woodsmith Mine to produce the fertiliser polyhalite.

DMC Mining Services (UK) Ltd.

DMC Mining Services (UK) Ltd., United Kingdom, is the British subsidiary of the global mining company, DMC Mining Services Ltd., with head office in Vaughan, Ontario, Canada. For more than 35 years, the company has provided extensive services in the mining sector from shaft construction to the complete development of mines. For the North Yorkshire Polyhalite Project, DMC Mining Service (UK) Ltd. is relying in highly efficient shaft boring machines to produce the production and service shafts, whereas the two MTS shafts are being produced by conventional drill and blast methodology.

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The Siemag Tecberg Group

The SIEMAG TECBERG group with German roots, stretching back to the year 1871, is represented on all continents and is independent and owner-managed. With its roughly 350 members of staff it performs knowledge-based services to supply individual machines and systems for a total of five industrial applications:

- ▶ Shaft hoisting technology for recovering raw materials as well as storing contaminated waste materials
- ▶ Conveying and transporting heavy loads
- ▶ Ventilation and cooling of underground mines
- ▶ Technologies for the efficient application of energies

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ing the TBMs takes place after the MTS shafts are excavated. Large components of the TBMs are lowered down the shaft with the stage winches and assembled underground. The TBM cage hoist supplied by Siemag Tecberg will be used to transport required material for lining the tunnel and to transport conveyor components to the MTS tunnel level.

Conclusion

The North Yorkshire polyhalite project is a major project in European underground mining, with significant economic benefits for the UK. It opens up the world's biggest polyhalite reserve via a 37 km long access tunnel to minimise impact on the landscape of the national park. It is planned to produce the fertiliser POLY4 at the Woodsmith Mine as from 2021.

The cited tasks accorded the hoisting machines, rope sheaves and complex superordinated electric and automated techniques pose extremely high demands on the availability and reliability of the shaft hoisting systems for a total of four shafts during the various operational phases of shaft sinking and lining the tunnel. In order to comply with these high demands, tried-and-tested shaft and heavy-duty hoisting systems with their own automation technology from the Siemag Tecberg group are utilised.

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is Project Manager with the SIEMAG TECBERG GmbH. He was already in charge of this project during the marketing phase and is responsible for handling the contract for the mechanical components for the shaft and heavy-duty hoisting systems within the SIEMAG TECBERG GmbH.

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