



**SIEMAG  
TECBERG**



**TECHNICAL INFORMATION**

# SHAFT-HOISTING SYSTEM

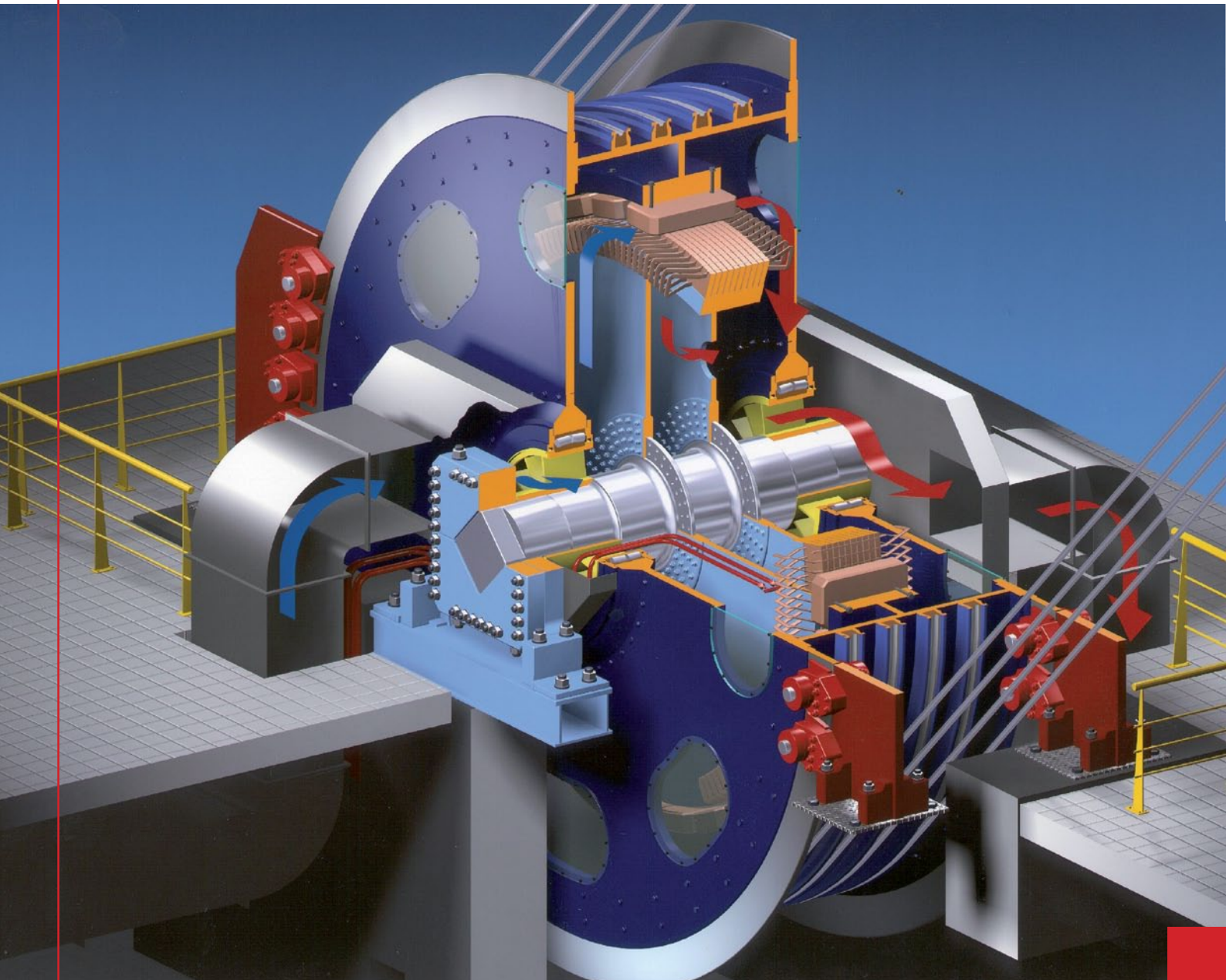
(BHP BILLITON, OLYMPIC DAM MINE, SOUTH AUSTRALIA)

## TECHNICAL INFORMATION

# SHAFT-HOISTING INFORMATION SCOPE OF PROJECT

- Completion of the shaft-hoisting system from planning to successful commissioning within only two years
- Completion of the system as scheduled, including planning and execution of shaft sinking, through optimum coordination of technology and project timing
- Design and execution of the machinery for maximum availability and minimum maintenance through use of highly reliable state-of-the-art technology

In South Australia BHP BILLITON operates the underground copper and uranium mine Olympic Dam. The deposits concerned are enormous (approx. 570 million tons) and have been mined since 1988. At the end of 1996, Western Mining Corporation (taken over by BHP BILLITON in 2005) decided to increase the capacity of Olympic Dam from 85,000 tpa. to 200,000 tpa.



Integrated winder principle

**PLANNING**

At this point, SIEMAG TECBERG was asked to carry out a study including the planning of the entire shaft hoisting operations and calculation of the investment and operating costs involved. With the assistance of Australian partners, the study was completed within a single month. The principal points of the study were as follows:

- Planning of the hoisting machinery for 1,375 tons per hour from the surge bin below ground to the discharge bunker above ground.
- Optimisation of the hoisting operation with regard to maximum availability and safety.
- Optimisation of the time schedule to minimise the financing costs of the investment.

- Statement of the investment and operating costs.
- Comparison of the technical data, design, and availability of the planned machinery with reference plants.

Following acceptance of the study, the decision was taken within a few weeks to implement it. SIEMAG TECBERG received the order to execute the entire shaft hoisting machinery on the basis of the study submitted. The decisive factors in placing the order were:

- Convincing study, adherence to schedule.
- Reference to comparable plants elsewhere.
- Reference with regard to availability.



3+1 Channel brake system



4-Rope Koepe winder

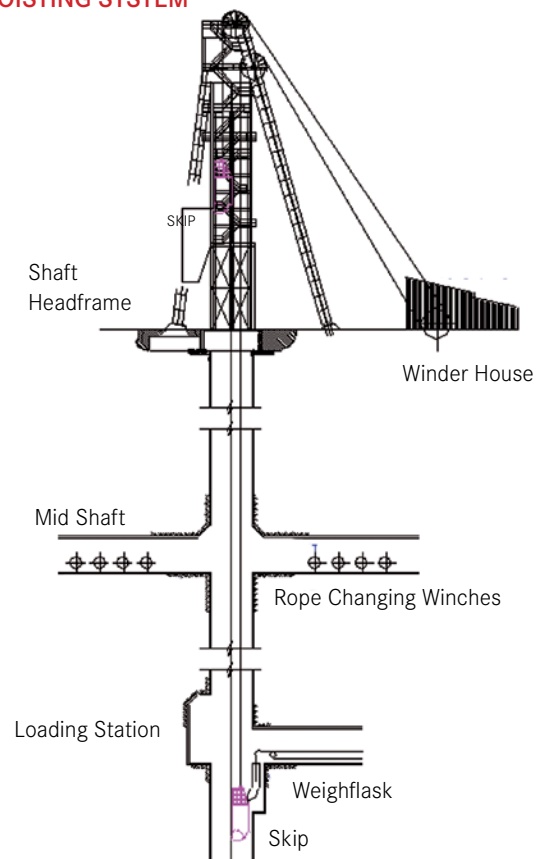


Assembly of the winder in the workshop



Headframe with hanging guide frame

**HOISTING SYSTEM**



## SUPPLIES AND SERVICES TO BE PROVIDED

The execution of the project commenced in 1997. Supplies and services to be provided by us included:

- Planning and design of the entire hoisting plant.
- Manufacture of key components in house, otherwise by sub-contractors in Australia.
- Extensive acceptance testing in workshop to allow fastest possible start-up on site.
- Planning of work to allow maximum assembly at a location remote from the site, transport of large pre-assembled components.
- Assembly and start-up with the customer's main contractor.

## DESIGN

The Olympic Dam Shaft 3 is designed as a downcast shaft for a capacity of 9.27 million tons of ore per annum. With a depth of 854 m, a high capacity of this nature is only achievable with a two-sided skip hoisting system and highly efficient Koepe winding technology. Four-rope hoisting was selected and the design necessitated a shaft diameter of 7 metres.

In order to make the construction time as short as possible, the following decisions were taken:

- A plant with a type of headgear was chosen for which the winder could be built at surface level and partially commissioned while the shaft was being constructed.
- To guide the skips in the shaft on ropes to minimise the time-consuming installation work in the shaft.
- To design the machinery underground in such a way that the excavation of the shaft could be realised as quickly as possible.



Swing-out type skip



Unloading station

**To guarantee optimum availability and safety, all the machine components were selected and equipped with various auxiliary means to assure a minimum of maintenance.**

### **Winder**

The winder is a 4-rope Koepe winding machine with integrated motor. This type of technology is especially robust with regard to changes in the bearing clearance in the motor. The concentric design of the friction pulley and the motor connection as well as the symmetrical design of the winder guarantee long-term stability of the entire drive system. In the case of conventional winders, changes in the clearance of the motor (which is mounted on separate bearings) may be caused by settling processes, which in some cases have led to complete standstill of the hoisting machinery due to failure of the motor.

### **Motor**

The use of an integrated 3-phase asynchronous motor is an absolute novelty. Following the successful introduction of asynchronous technology on a large double-drum machine in South Africa, a further important development in this technology has now been made at Olympic Dam. As a cage rotor type motor, this unit is even more robust than a 3-phase synchronous type which is fitted with a number of poles plus a power supply for these poles and therefore requires a certain amount of maintenance.

### **Braking system**

The braking system of the winder is designed as a multi-channel brake with a fully closed-loop controlled safety brake. Also in cases of malfunction, deceleration has to be controlled, otherwise rope slippage would occur. It was decided not to raise the limit of rope slippage as this would have increased the investment and subsequent costs. The brake is of the "3+1" type, which means

that three brake circuits are in normal operation while one channel is a stand-by reserve. In case of defect or malfunction, this reserve channel is immediately ready to take over the function of the defective channel. This means that the availability of the system is not affected while damage of this kind is being repaired.

### **Skips**

The skips are of the swing-out type with a large cross section allowing rapid loading and unloading. Besides, with this type of skip, the carrying frame or bridle which takes the load and rope forces, is separate from the actual payload container or tub which is filled with ore. This enables the tub to be replaced more quickly; it is exposed to wear and tear by the ore. The tubs are lined with a special type of rubber which is highly durable with this type of copper ore. Downtime for maintenance can therefore be kept to a minimum by having tubs in reserve and the capacity to reline worn tubs while hoisting operations continue.

### **Loading hopper**

The loading hopper is also designed as a removable container and is lined with rubber, too. The worn loading hopper can be hooked into the bridle of the skip for fast transport above ground where it can then be replaced by a reserve hopper in the same way as the skip tub. The life spans of skip and hopper are adapted to one another so that they can be replaced in one operation. The loading hopper is also designed for weighing the skip load. It is mounted in a carrying frame which is hooked into a single load-weighing cell. This type of singlepoint suspension is designed to facilitate adjustment and calibration.

### **Discharge hopper**

The discharge hopper is also lined with rubber. The skips are discharged by swinging out the tubs by use of slewing beams operated by hydraulic cylinders. This design allows



## TECHNICAL DATA (METRIC DIMENSIONS)

Type of Hoisting	Production
Shaft Capacity	9.27 mt/a @ 6,740 h/a
Conveyances	2 Skips
Hoisting Distance	854 m
Payload	36.5 t
Hoisting Speed	16.5 m/s
Type of Winder	Koepe – KW / 5000 / IM
Drum Diameter	5.0 m
RMS Power	6,500 kW
Winder Speed	63 rpm
Suspended Rope Load	1,050 kN
Rope Breaking Load	4 x 1,680 kN
Hoisting Ropes/Diameter	4 x 46 mm
Balance Ropes/Diameter	4 x 45 mm
Guide Ropes/Diameter	8 x 45 mm
Type of Brake	Disc Brakes, 2 Discs
Number of Brake Posts	4
Number and Type of Brake Calipers	16 Calipers BE 100
Type of Brake Control	ST N+1 (N=3)
Type of Emergency Braking	Fully Closed-Loop Controlled Retardation

the skips to be brought into their unloading position with maximum speed and avoids unnecessary loading of the headgear through high-dynamic impacts.

### Headgear

To a large extent, the headgear is designed as a box-type structure with a minimum of smoothly painted surfaces which make it especially resistant to corrosion. The guide frame is hooked into a tripod block frame to keep foundation work at the shaft collar to a minimum.

### Rope sheaves

Each set of rope sheaves on the headgear is mounted by means of anti-friction bearings on a stationary axle. This dispenses with the frequent greasing required by the conventional design with bronze sleeves. Highly durable plastic lining of the rope grooves saves much wear to the hoisting ropes.

### Safety arrestors

The use of SIEMAG TECBERG safety arrestors (Selda principle) on the headgear and in the shaft sump reduces the overwinding distance required for cases of uncontrolled deceleration of a hoisting operation. In case of overwinding, the skips are brought to a controlled halt by the safety equipment, thus avoiding serious damage. To keep the expenditure of rope-force equalization as low as possible, the rope attachments are fitted with an electronic measuring device which allows to take the required measures quickly. The rope forces are balanced by means of hydraulic adjustment using resetting ranges of up to 1.0 metre in length.

This unusual length considerably increases the period before the highly time-consuming operation of pulling the ropes through the rope thimble becomes necessary.





Roping-up



Erection of guide frame



CLD in operation



Pre-assembled sheaves and upper headframe



Catching gear



Unloading station arriving on site

### Clamping and lifting device (CLD)

To simplify work on the rope (including pulling the ropes through the rope thimble), a clamping and lifting device (CLD) is provided that is designed to clamp all four hoisting ropes under full load. The device consists of a stationary clamping device and a movable clamping device (for lifting and lowering) located above it. Lifting cylinders allow the maximum operating load to be lifted

by 1.5 metres. By transferring the load from the stationary to the movable clamping device, lifting the load and then transferring it back to the stationary clamping beam, it is possible to pull the rope (and everything suspended from it) in steps over considerable distances.



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