

Dragline drives and control system retrofit ABB gives new life to a valuable 35 year old machine



Dragline after revamp

“The positive result of the revamp showed how to proceed with worn out draglines. There are 17 draglines in operation. The cost of one new similar dragline is approximately 30 million Euros – the total cost of the revamp is only about 4 million. The saving for 17 draglines will be 400 million Euros, not including the savings from energy, maintenance and cycle time”, said Mati Jostov, CEO of the Estonian Oil-Shale Company.

With its four mining plants, the Estonian Oil-Shale Company achieves a yearly output of approximately 15 million tons of oil-shale. Employing 4000 people, it is one of the biggest and most important employers in this northern European country.

The entire electrical system of the dragline, originally commissioned in 1972, was worn out and had not operated for many years. The old drive system to be revamped had a motor-generator principle DC system with one 2 MVA 6 kV asynchronous motor mechanically connected to three DC generators to provide DC supply for all main drives. As AC squirrel-cage motors have proved to be reliable, it was decided to replace the DC system with AC frequency converters to feed new reversible induction motors. The installed drive system is divided between two climate controlled containers including two identical supply units and several inverter units for eight motors (Fig. 1).

Direct Torque Control (DTC) significantly increases pull and drag forces and provides greater performance and constant power capability. Because of the high requirements of low harmonics (Voltage THD <5 %) and the voltage fluctuation of a weak grid, an active rectifier solution was used. In addition, when lowering the bucket, recovered braking energy is returned to the network. All drives and other devices are controlled by a PLC based system. The digital control system has been fully integrated with an extensive machine diagnostics package and touch-screen controls to speed maintenance work, increase operation efficiency and reduce down-time.

Scope of supply and customer benefits

The old DC hoist, drag and swing drives, the control system and all cabling were dismantled. Squirrel-cage induction motors and DTC transistor based frequency converters with an over-riding PLC based control system were installed. The mechanical construction of the foundations was adapted to the new equipment dimensions and weights. For the high-tech power electronics, reliable containers were built with air cooling and cleaning units.

Scope of supply

- Dry type transformers
- Frequency converters
- Motors
- Auxiliary LV panels
- MV switchgear
- Control system
- Dragline remote monitoring
- Cable system
- Design and commissioning

Features

Thanks to quick and accurate drive control with reliable feedback it was possible to realize a very stable and smoothly operating machine without current peaks, which had been one of the main problems with previous DC system (Fig. 2).

A separate digital control system with its own display is used to monitor all the different operation cycles including working time, number of cycles and buckets, walking time and steps, etc. Temperature monitoring of motors and cooling air flux measuring is carried out. Electrical parameters as consumed and generated active power and reactive power are recorded. Reports for variable periods are produced. All information is transmitted wirelessly and archived to a common Scada system where it is possible to make productivity analysis and plans for service or repairing and data archiving.

Benefits

- Higher reliability and lower maintenance costs
- Lower losses in drive system, saving 1,2 MWh/year
- Lower dynamic load – longer lifetime for gearbox and ropes
- 1–3 seconds shorter working cycle – 2–4% higher productivity
- 15 years longer lifetime for total dragline

After renovation, the dragline has an excellent dynamic performance and overload characteristics with the speed and torque control. There is less mechanical stress and guaranteed longer lifetime for the gearboxes. Its average productivity exceeds others by 10–40%. Also important is its energy consumption, which is 40% less than average.

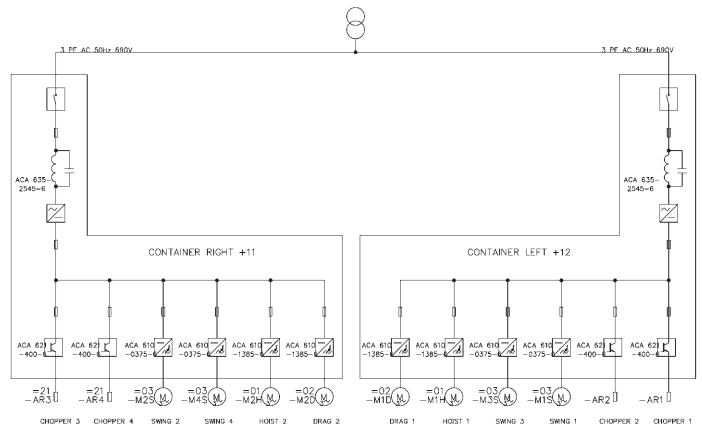


Fig. 1: Principle connection of AC drive system

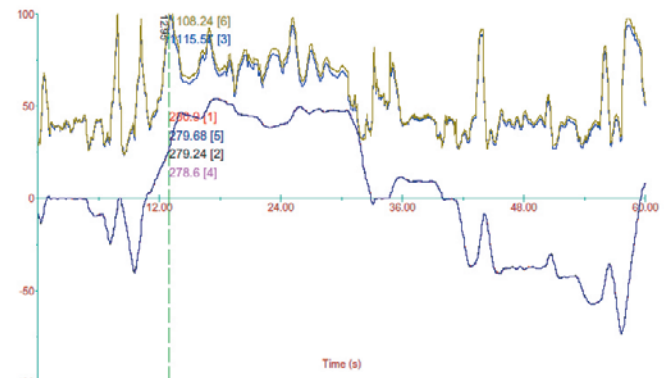


Fig. 2: Smooth operation with new AC drives

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