SIMINE DRAG
Innovative solutions for maximum productivity and reliability

Mining Technologies
Lowest cost per ton for material moved

Your challenge:
In the mining business, our customers are challenged to develop and manage safe, efficient, technology-driven, low-cost mining operations. They have a responsibility to their stockholders to provide a superior return on their investment, as well as a commitment to their customers to provide a reliable supply of minerals. To meet this challenge, they need to constantly strive to reduce the production cost/ton ratio. They must seek out a competitive advantage wherever possible, implementing breakthrough innovations on the foundation of proven technologies. Customers demand innovative machines with the highest possible yield; reduced maintenance costs; methods for continuously improving the productivity of their equipment; and a more efficient use of power.

Our solution:
Siemens has been in the mining business for over 30 years, delivering cutting-edge technology to meet our customers’ requirements. Siemens’ powerful AC drives are the most efficient available, requiring the least maintenance and boasting the shortest Mean-Time-To-Repair (MTTR) than any other drive on the market. In other words, the machine spends more operating time in the bank, which results in the lowest cost/ton ratio available. Siemens’ innovations, such as the gearless dragline drive, reduce operating costs even more, eliminating the need for gear maintenance and lubrication systems. Innovation, efficiency, productivity, and reliability are key elements in our extensive mining portfolio. Siemens is proud to be your partner in mining, where your requirements are met with our technology.
Power requires control –
electrical system overview
The incoming primary line voltage is transformed to 900 V secondary voltage and then fed through a reactor to the Active Front End (AFE). The AFES convert the AC voltage to a steady 1,800 V for the DC link. The inverters then convert the DC voltage to a variable-frequency/variable-voltage AC supply for the motors (0-1,400 V).

This modular design can be used to power machines with different requirements. It also can control traditional induction motors for geared applications, as well as synchronous motors for innovative gearless applications.

Active Front End
The AFE control algorithm can regulate unity or even a leading power factor to compensate for the effects of existing equipment at the Point of Common Coupling (PCC). This feature can be used to minimize voltage fluctuations in the mine’s distribution system. In addition, the high pulse rate of the AFES, as registered by the network, results in a very low Total Harmonic Distortion (THD) – typically less than 2.5%. These features improve the power quality of the entire mine. Furthermore, the AFES’ dynamic response to load changes results in a system that is extremely robust against power grid disturbances.

Inverter
During operation, the inverters (INV) take power from the DC link to drive the dragline motors. During regenerative braking, the inverters send power from the motors back to the DC link. The common DC link enables the exchange of energy between motoring and regenerating drives.

Motors
For conventional geared draglines, Siemens developed an induction motor with ideal motor characteristics for all motions. The motors are coupled to a common gear case to meet the power demands of each motion. Their interchangeability simplifies spare parts management. These motors were designed with a special emphasis on longevity and high efficiency. A patented new technique cools both sides with fresh air, leading to low winding temperatures and high utilization.

For gearless draglines, Siemens custom designs one synchronous ring motor for the hoist and drag motions. These motors are coupled directly to the drums.

IGBT technology
The power electronic devices for AFES and inverters are Insulated Gate Bipolar Transistors (IGBTs). These ideal switches for AFES and INVs feature:
- high switching frequencies, which improve the current quality to the motors
- no snubbers and simple gate drivers
- high overload capacity; electronic protection circuits with no fuses

Heavy-duty cabinet design
The converter cabinets are ideally suited for mining conditions. They are constructed as a single unit, making them very strong and capable of withstanding extreme shock and vibration. Since the water-cooled design requires no external air input, our cabinets are sealed against harsh mining environments.

Comparison – Geared/Gearless
A conventional dragline utilizes multiple inverters to power multiple AC asynchronous induction motors, coupled through gearboxes to a common drum. Siemens’ gearless dragline utilizes multiple inverters to power multiple windings in a single AC synchronous ring motor, with the drum built into the rotor assembly.

In summary, both conventional and gearless drive systems provide a highly efficient drive through the use of a static AFE for the line side control. The gearless drive provides even more efficiency by eliminating the gearboxes.
The synchronous ring motor operates at very low speeds and is coupled directly to the drum. The induction motors operate at very high speeds and are coupled to the drum through a gearbox, which reduces the speed and increases the torque. The synchronous ring motor has only one speed feedback, regardless of the number of inverters. In contrast, each induction motor has its own speed feedback.

Remote access and data analysis
For the past eight years, we have been improving our drive systems by integrating custom software solutions that:
- remotely troubleshoot machines (SIRAS).
- monitor real-time performance (MIDAS).
- review historical log files for troubleshooting/performance enhancement (MIDAS).

SIRAS – support from anywhere in the world
When a dragline goes down, and the costs of lost production are mounting, maintenance personnel need to get the machine back into operation as soon as possible. Siemens' remote access system, SIRAS, allows trained personnel to access the onboard drive system and diagnostic tools and immediately determine the source of the issue.

The fast diagnosis greatly streamlines the repair process. On-site service technicians can prepare the equipment required to repair the machine before they leave the workshop. For more challenging situations, remote support can be provided from factory-trained field service engineers, with a direct line to the original equipment design engineers.

From the Siemens Remote Response command center, qualified factory experts can remotely connect to machines all across the world and access all of the troubleshooting tools available on board the machine. SIRAS not only enables access to diagnostic tools, but it also provides access to the drive control system itself. This makes loading new software or adjusting parameters much easier, faster, and more economical.

Quick problem diagnosis leads to a lower MTTR, which increases the availability of the machine and the potential for higher productivity.

MIDAS – boosting dragline efficiency
MIDAS is the key element that allows the dragline to be used most effectively. Its heart is the real-time data logger, where system statistics are stored for later analysis. The data is visualized – either in real time or after the fact – through an intuitive GUI. The report generator pinpoints and describes areas for operational improvements that could lead to yield higher production.

By integrating the MIDAS system into their daily planning and monitoring habits, customers can gain more insight into the machinery itself and how it operates. In addition, they will be able to identify ways to use their equipment more effectively to maximize production capability.
Good reasons for SIMINE DRAG

- **Higher productivity**
  Our faster bucket filling times, higher hoisting and lowering speeds, and faster payout reduce machine cycle time and increase productivity. Analyses of several existing dragline operations have identified significant increases in productivity of up to 20% and more.

- **Higher drive system efficiency**
  Implementation of the static AFE increases system efficiency by approximately 15% and lowers energy costs by the same amount, in comparison with rotating M-G sets. Furthermore, gearless draglines increase efficiency and reduce energy costs by up to 20%.

- **Less maintenance**
  Our AC solution, with static AFE and brushless AC motors, eliminates the costs associated with the maintenance of M-G sets and DC motors. Gearless draglines further improve profitability by eliminating the maintenance costs of mechanical gears and associated lubrication systems.

- **Lower life-cycle operating costs**
  Lower energy costs and significantly reduced maintenance overhead – together with longer uptime and greater productivity – translate into lower operating costs over the life cycle of the machine, and the lowest cost/ton of material moved of any excavator in existence.

With higher reliability, increased availability, and lower maintenance, the Siemens AC dragline drive system is available when you are. Shown above, the 8750 conventional geared dragline is in nighttime operation in Australia.
For further information please contact:

Siemens Industry, Inc.
Industry Solutions Division
3333 Old Milton Parkway
Alpharetta, GA 30005, USA
Phone: 1-800-964-4114
E-mail: info.us@siemens.com

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