

# Motor Management Plays A Key Role In Successful Operation Of Extensive Conveyor Line



## Material Handling Industry Application Profile

Incorporating state-of-the-art motor control technology and network communications in a mile-long conveyor line has provided Pacific Rock Products, Vancouver, Washington, with a reliable, cost-effective material handling solution. The company's experience in building this extensive conveyor line demonstrates the benefits that today's advanced automation and motor management technologies can meet the most demanding application requirements.

Founded in 1978, Pacific Rock Products is the leading producer of crushed stone, aggregate, sand and gravel for the construction, transportation, and aggregate markets in the Portland/Vancouver metropolitan area. Since 1985, Pacific Rock Products has been operating the English Pit. First excavated in the late 1800's, the English Pit produces approximately 1.5 million tons per year of rock material which is crushed, sorted, and processed for



*Approximately 15,000 tons of rock per day pass through the giant rock crusher at Pacific Rock Products' Fisher quarry. Controlled by Allen-Bradley programmable controllers, the rock crusher — one of the Pacific Northwest's largest — crushes bulk rocks trucked in from other sites.*

use in a variety of building and construction applications.

Pacific Rock recently purchased the mineral rights to a 200-acre section of land across the road from the English Pit where a business park eventually will be developed. Excavation of various sections of the site will be ongoing during the next few years and will produce an estimated 10 million tons of material. However, lacking the permits needed to place a permanent crushing and sorting facility on the site, Pacific Rock was faced with the

dilemma of how to transport tons of rock material from this new site to its existing English Pit processing plant across the road.

Among the options Pacific Rock considered were using trucks to continuously haul the material to the processing plant, or to build a conveyor line. Both of these options posed significant challenges. Using large trucks and the resources and manpower needed to operate them would be quite expensive. On the other hand, a conveyor line would have to extend more than 1,6 km

length and would need to pass beneath a major county road overpass. After weighing the options, Pacific Rock determined that building a conveyor was the most cost-effective solution.



*Pacific Rock Products is the leading producer of crushed and graded rock products for construction, transportation and aggregate markets in the Portland, Oregon area. At Pacific Rock Products' Fisher quarry, approximately 15,000 tons of rock per day is crushed, sorted and washed. Motor control centers (MCC) house Allen-Bradley programmable controllers, 1336 PLUS variable speed drive and SMC Dialog Plus™ motor controllers for efficient process control.*

## **Operational Concerns Of A Long Conveyor**

Keeping tons of rock and gravel moving smoothly along 1,6 km-long conveyor requires precise, dependable control. A primary concern in this application was providing adequate, overload protection for the large 300 and 400 horsepower motors required to drive the conveyor. Because of the heavy load requirements (a conveyor segment may carry up to 12 tons of rock within a one minute time period), advanced overload protection was necessary to protect the motor and motor circuits from overheating due to excessive currents.

Another concern was the ability to monitor and prevent unexpected stops, stalls and jams. According to John Hjaltalin, vice president of operations at Pacific Rock, the success of the conveyor ultimately depends on its reliability. "If one section of the conveyor unexpectedly stops due to a motor overload or jamming of the conveyor belt, it could bury another segment under tons of rock and shut down the system anywhere from 30 minutes to several hours," Hjaltalin said.

"If this was to occur several times a day, the potential for equipment damage would be significant, and the hours in lost production and downtime would be costly."

## **The Motor Management Solution**

In addition to smooth, reliable control and the ability to monitor, diagnose and troubleshoot problems quickly and accurately, Pacific Rock also needed a conveyor that was inexpensive to install, easy to main-

tain and flexible enough to accommodate future updates. With the help of Consolidated Electrical Distributors, Inc., the Rockwell Automation/Allen-Bradley distributor in the area, Pacific Rock developed a conveyor system that addresses each of these concerns.

First, to help ensure reliable operation of the conveyor line, control panels located along the conveyor line included nine Allen-Bradley SMP-3™ Smart Motor Protectors. These solid-state overload relays monitor motor current and thermal capacity to protect against trip conditions and simplify data acquisition. They also enable operators to obtain more detailed motor management data at rates higher than those transmitted by traditional control wiring.

The SMP-3 overload relays communicate operating data to an Allen-Bradley SLC 5/03™ processor via a Remote I/O communications network. With this information, operators can determine when a conveyor is nearing capacity or evaluate the condition of motor bearings and other mechanical elements -- actions that are more preventative in nature. In addition, the SMP-3 overload relays can be programmed



*Pacific Rock Products' Fisher quarry uses variable speed control of mixing conveyors to assure accurate quantities of specified rock exist in the final product mixture.*



Located in control booths 6 meter in the air, Pacific Rock Product's Fisher quarry operations are monitored via Allen-Bradley PanelView 1400e operator interface terminals. The terminals provide operators with state of the art monitoring of the quarry indicating the status of all conveyor lines.

with pre-warning levels for various conditions such as ground fault, phase unbalance, high overload or jam conditions. This enables operators to change process conditions to prevent the device from tripping, which would interrupt production.

Unlike hardwired, relay-based controls which can only turn motors on and off, the SMP-3 devices are linked to a communications network providing valuable information such as motor current to help diagnose and prevent problems before they occur.

"With the solid-state overload relays, we're able to monitor the performance of the motors as they're being loaded," said Hjaltalin. "If one goes down, we can go immediately to that spot and begin correcting it and don't have to guess where the problem is, significantly minimizing downtime. If we didn't have this system we would have to manually inspect each section of the conveyor to pinpoint the fault condition."

## Solving The Starting Problem

Because of the high starting current required by the large conveyor motors, the local power company required a reduced voltage starter on all motors over 250 horsepower. To meet this requirement, Allen-Bradley SMC Dialog Plus™ controllers with current monitoring capabilities and a soft start feature was employed. The soft start option provides smooth motor acceleration, reducing the starting torque of the motors and mechanical shock to the conveyor. This minimizes damages to gears, couplings and belts.

The metering capabilities of the SMC Dialog Plus controller allows the motor current draw to be accurately monitored, meeting the power company requirements. The stall and jam detection capabilities, along with the built-in communications of the SMC Dialog Plus, significantly increase the level of motor protection and diagnostics functions.

As an extra precaution to ensure that the conveyors do not stall under a load, Allen-Bradley Bulletin 871 proximity sensors connected to FLEX I/O™ modules are located at the tail pulley (non-driven end) of each conveyor segment to monitor belt rotation. An in-line scale monitors the amount of product passed over the conveyor every hour. Analog signals from the in-line product scales are also brought into the SLC™ controller via FLEX I/O modules. Control panels, located at five different drop points along the conveyor line, house the motor management components, communications modules and other devices. All control (manual and

automatic) and system monitoring is performed over the Remote I/O link.

According to Dale Williamson, of control contractors Prairie Electric, the use of network communications simplified and reduced the amount of wiring necessary to construct the conveyor. Communication will also ease component replacement and maintenance procedures. These added benefits will reduce the time it takes to change, add, or re-route a conveyor section.

"Traditional wiring would have required running a wire to each device," Williamson said. "With the Remote I/O network, we ran one



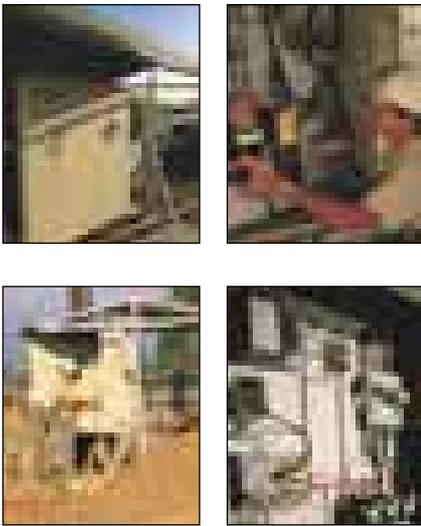
Keeping tons of rock and gravel moving smoothly along 1,6 km long conveyor requires precise, dependable control. In order to ensure reliable operation of the conveyor line, control panels located along the Pacific Rock's conveyor line include Allen-Bradley SMP-3 Smart Motor Protectors to protect against trip conditions.

Raw rock material takes 20 minutes to travel to Pacific Rock's English Pit quarry from a satellite excavation. In order to prevent unexpected stops, stalls and jams, Pacific Rock incorporated Allen-Bradley motor management products into their line which help monitor the line to prevent unexpected stops and stalls.

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cable to each of the five control panels, significantly reducing the amount of wiring needed to install the line." This is important because the conveyor will need to be expanded and re-positioned as Pacific Rock excavates different areas of the site.

The conveyor system is monitored by an Allen-Bradley PanelView™ 1400e operator interface terminal located at the English Pit processing



*Pacific Rock Products positioned five control panels with Allen-Bradley SMP-3 Smart Motor Protectors along the length of their 1,6 km English Pit conveyor. The control panels via Remote I/O communicate real-time application data enabling operators to respond to problems with greater speed and avoid conditions that could result in equipment damage and conveyor shutdowns.*

facility. The operator simply selects the automatic start option on the PanelView terminal to begin the start-up sequence. Each segment of the conveyor system starts in sequence, beginning with the segment that discharges to the production plant, working backward to the excavation site. Interlocks with the "wash plant" and the downstream portions of the conveyor system ensure that no rock is transferred onto a non-moving or non-operational section of the system. The entire start-up sequence takes less than two minutes.

The use of state-of-the-art motor management technology and network communications have provided Pacific Rock with the advanced motor data and diagnostics necessary to operate a conveyor of this length and complexity. With access to real-time application data, operators are able to respond to problems with greater speed and precision. They avoid conditions that could result in equipment damage and conveyor shutdowns. Indeed, the efficient, reliable operation of the conveyor is key to its continued success.



*Pacific Rock Products' English Pit conveyor line is segmented into five sections controlled by Allen-Bradley motor management technology and network communications which provide advanced motor data and diagnostics necessary to operate a mile long conveyor.*



*Conveyor status information from Pacific Rock Products' mile long conveyor is transmitted to a PanelView 1400e operator interface terminal. The PanelView terminal provides operators with state-of-the-art monitoring of the quarry conveyor system indicating status information such as a load weight and speed of each section.*



*As an extra precaution to ensure that the conveyors do not stall under a load, Pacific Rock installed Allen-Bradley Bulletin 871 proximity sensors at the tail pulley (non-driven end) of each conveyor segment to monitor belt rotation.*

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Rockwell Automation Headquarters, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414 382-2000 Fax: (1) 414 382-4444  
 Rockwell Automation European Headquarters SA/NV, avenue Herrmann Debrouxlân, 46, 1160 Brussels, Belgium, Tel: (32) 2 663 06 00, Fax: (32) 2 663 06 40  
 Rockwell Automation Asia Pacific Headquarters, 27/F Citicorp Centre, 18 Whitfield Road, Causeway Bay, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846