PLC-based control increases grain handling efficiency, saves energy

The situation
Replacing a landscape dotted with wooden crib elevators on the rail lines is a network of large concrete structures – the new generation of “high-throughput” elevators, known as inland grain terminals. As a result, expanded operations and railcar loading quotas require increased efficiency, capacity and specialized electrical/automation components. Elevator capacities have expanded from 650-800 tonnes to 12-45K tonnes.

Improved efficiency and larger loading equipment allow the Saskatchewan Wheat Pool to meet increased railcar loading quotas of grain, oilseeds and specialty crops

Some of the inland grain terminals operate 24 hours per day, 7 days per week. Daytime activities include buying, receiving, storing and shipping grain, while the nighttime shift is kept busy cleaning and drying the grain. To achieve the increased loading quota requires the use of larger loading equipment, which in turn requires specialized electrical and automation components to maximize productivity.
The Saskatchewan Wheat Pool (SWP) has embarked on a major expansion investment of more than $270 million, which includes plans to retrofit two existing grain elevators and build 20 new elevators over the next two to three years. Long term plans will see operations expanded even further to include port terminals in Mexico and Poland.

In 1988, SWP replaced their relay logic system with Modicon® Compact™ 984 PLCs and have continually upgraded the older elevator systems to the latest available hardware (Quantum PLCs) and software platforms.

Objective

The control system chosen for the Saskatchewan Wheat Pool expansion had to meet specific criteria – increased storage capacity, longer operating hours, and improved cycle times – yet be reliable and easy to maintain. Equipment manufacturers must provide a high level of service and expert technical/backup support. Manufacturer proximity to SWP’s operations and their ability to provide a complete electrical/automation system were key to maximizing the productivity of SWP’s operations.

Solution

In each of SWP’s 30 existing grain elevators in Saskatchewan, Modicon® PLCs control the grain bid sorting by inventory and grades of grain. The weigh scales for grain loading and unloading interface with the PLCs, which feed data to a PC terminal. Each elevator has between 1,500 and 2,000 I/O points, which link to one Modicon PLC via a Modbus Plus communications network. The PLC relays information to the central Regina location via modem. The system’s Ladder Logic capability enables the central location to easily and quickly troubleshoot problems identified by the local maintenance crews.

Elevator cleaning equipment motors are controlled by four 600V Square D® VSD17 variable speed drives. To maximize floor space, each elevator is equipped with one to two 600V Telemecanique® TMD-2 motor control centers fitted with control bays and special wiring in the starter spaces. To complete the wiring from the starters to the control bays, Schneider Canada installed Merlin Gerin Multi-9 mini circuit breakers and Telemecanique LC1D contactors, LR2 overloads, terminal blocks and pushbuttons.
Telemecanique LT3 thermister relays improve motor protection and Square D definite purpose contactors are used for resistive loads. Electrical distribution equipment includes Square D transformers and Federal Pioneer load centers and circuit breakers. In all of the 18 high throughput elevators, each motor has a Square D capacitor bank for power factor correction.

To reduce downtime on one of the bucket elevators, Schneider Canada suggested replacing the expensive and unreliable gear drive and full voltage, non-reversing motor starter with a simpler, less expensive gear drive and a softstarter. The softstarter allows for a ramped, smooth start, which reduces mechanical stress on the machinery. The softstarter’s jog feature runs the elevator motor at 10% of its normal speed, which allows mechanics to check the buckets without causing the frequent downtime experienced with the original gear drive. The ability to soft start a motor is crucial to minimizing mechanical stress in a harsh environment that often reaches below -30˚C.

To facilitate preventive maintenance (and minimize the risk of machine overheating/failure), Schneider Canada Services technicians have done infrared scans on SWP’s older electrical equipment to identify hot spots, which indicate the presence of problems such as loose wiring connections.

Modicon Quantum PLCs will control all the new elevator terminal operations/processes (bucket elevators, conveyors, seed cleaning and grain drying). The PLCs will ensure consistent, reliable operation of the entire network of 22 terminals, each of which has been designed in one of four different configurations. To minimize downtime and maintenance costs, each of the 22 terminals will run on a Modbus Plus Level 1 control network linked via Modbus modem to a single central supervisory control station in Regina. Existing Quantum installations will facilitate integration – via Ethernet using TCP/IP – of elevator facilities/process control systems and central accounting systems.

Square D fixed capacitors and PowerLogic energy management system will help SWP maximize energy savings. The PowerLogic metering system will consist of PowerLogic 2450 circuit monitors which will feed energy usage information through analog I/O modules to the PLCs. Waveform, power factor, voltage and peak demand are captured on PowerLogic SMS 3000 software. An alarm installed in the circuit monitors will alert the local operator shortly before peak demand is reached.

Telemecanique TMD-2 motor control centers will operate all electrical processes in the elevator such as elevation, cleaning, distribution, drying and weighing. Other Schneider Canada components will include Telemecanique starters and terminal blocks; contactors, overloads, relays and pushbuttons; and Federal Pioneer, Merlin Gerin and Telemecanique circuit breakers.

Customer benefit
Besides providing a system which minimized downtime and maintenance costs, Schneider Canada provides ready access to replacement parts and technical support. The proximity of Schneider Canada’s manufacturing operations and convenience of one supplier was a key benefit. “We were able to put a complete package together with the PLCs, MCCs and loose components, basically from one vendor. There is definitely an advantage there,” says Willie Unger, Community Electric President.

Savings in energy demand for the first year of project Horizon (the 22 new sites) are forecasted at $145,000. Payback is forecasted at 10 months. SWP will save at least 50 KVA per site per month or 600 KVA per site per year.

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