Case Study

Elspec Power Quality Systems Compensate Dynamic VAr for Panama Canal

For over 15 years Elspec Equalizer power factor correction systems are serving in the Panama Canal obtaining high power quality performance.

Elspec PQ solutions were installed in the Panama Canal to reduce the Canal grid voltage disturbances and harmonic distortions, to eliminate transit delays, and to make wide PQ monitoring system.

The Panama Canal is an artificial 82 km waterway in Panama, connecting the Atlantic and Pacific oceans. It provides transit service to around 815,000 vessels annually – reaching 340.8 million tons of shipping per year. To transit vessels from one ocean to the other, the canal uses a series of locks, and a fleet of electric towing locomotives.

The Canal Locks & Locomotives Operation Challenges

The Canal locomotives mare sensitive to frequency variations, transients, voltage dips & swells as well as to unbalanced voltage and current. Therefore, the quality of the supplied power must be high. 17 years ago, when Elspec started to work with the Panama Canal Authority (ACP), the Canal's aging 90-year-old grid was weak and faulty. The towing locomotives had extremely heavy and fast-changing loads, caused by the many starts and stops typical of their operation. Consequently, power quality and voltage stability issues emerged. The Canal's hilly terrain aggravated existing complications. Locomotives would cease to function on uphill climbs and plummet backwards, crashing into oncoming locomotives. To effectively respond to such eventualities, the Panama Canal Authority had to employ 24/7 on-site maintenance crews.

Improving Power Quality, Reducing Voltage Fluctuations and Delays

The Panama Canal Authority (ACP) sought to resolve the Panama Canal Locks' and locomotives' PQ problems with the following objectives in mind:

- Improve the overall quality of the electrical system.
- Reduce impact of voltage fluctuations and disturbances on equipment and machinery.
- Implement a local and remote monitoring system.
- Reduce, or altogether avoid, delays due to electrical disturbances.

As a pilot, ACP personnel initially installed four Equalizer power factor correction systems in the Miraflores Lock central east wall, in the four transformers that feed the locomotives. The Equalizers were evaluated for three months.

Following a successful pilot, the entire project went online with an additional 44 Equalizer systems installed on both the Pacific and Atlantic sides. ACP then conducted a hand-over inspection, as a team from Elspec performed the inaugural system start-up.
An almost complete mitigation of voltage disturbance was observed during these installation checkups at the three Locks (Miraflores, Pedro Miguel and Gatun). Essential Canal Machinery, previously prone to electric disturbances and shutdowns, ran smoothly and eliminated costly traffic flow delays. To augment the system's overall PQ, harmonic distortions were drastically reduced (5th and 7th harmonic especially).

From then on, Elspec power quality solutions are serving in the Panama Canal systems. Today (2022), 52 Equalizers with a total of 20MVAr are installed in the project, all of them are equipped with an ELSPEC G4400 analyzers and are connected to the ACP's SCADA system, enabling ACP to continuously monitor and control the Locks' electrical network.
According to an ACP spokesperson, "The ELSPEC G4400 analyzer has many advantages over their competition, one of the most important is the capacity to record all electrical parameters cycle-by-cycle without establishing limits (thresholds). Elspec successfully met the requirements set by the contract and its amendments for the compensation of reactive energy, voltage control, harmonic filtering and power monitoring in the Locks of the Panama Canal."

"We chose to use Elspec technology and products because of the cycle-by-cycle compensation speed, in addition to the company's extensive experience in this field, providing solutions for all industries (e.g., wind turbine generation, port cranes, electric trains, cement, plastic, high rise buildings, hotels, hospitals, and car assemblers), and other industrial applications require an electrical quality provision for their continuous and reliable operation."

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