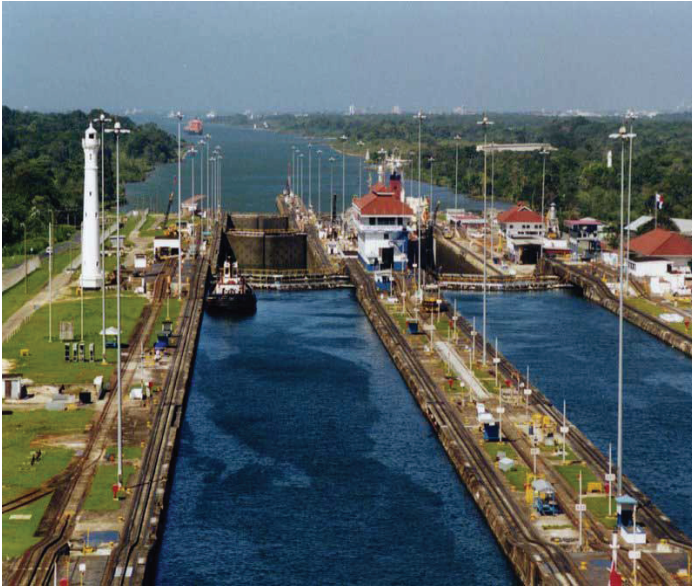




Case Study

Panama Canal Locks Dynamic VAR Compensation Project



Panama Canal Gatun Locks

The Panama Canal, the waterway between the Atlantic and Pacific Oceans, provides transit service to vessels of all nations, some 13-14,000 per year. This number accounts for approximately 5% of the commercial world trade. The canal uses a series of locks, as well as a tow track with a fleet of locomotives to transit vessels through the canal.

The Panama Canal had problems due to a weak grid over 90 years old. The locomotives that pull the ships through the canal had extremely heavy and fast changing loads caused by the many starts and stops, thus creating power quality and voltage stability issues. The locomotives require delivered power to be free of transients, over-and-under voltage, unbalanced voltage and current and maintain a stable frequency to ensure a safe transit. The hilly terrain added

to the existing complications. Locomotives would cease to function on uphill climbs and plummet backwards, crashing in to oncoming locomotives. The canal had many technicians and maintenance crew on staff 24 hours a day.

In the ACP's own words, they chose to use Elspec technology because of "the cycle-by-cycle compensation speed, in addition to a large experience developed by the company in this field through applications for all type of industries such as Wind Turbine Generation, Port Cranes, Electric Trains, Cement, Plastic, High Rise Buildings, Hotels, Hospitals, Car Assemblers, etc., as well as other industrial applications that an electrical provision for quality for its continuous and reliable operation requires."

The Panama Canal Authority (ACP) searched

"This company also showed a world-wide leadership in the development of equipment of electrical measurement interconnected remotely with an innovative product called ELSPEC G4K (BLACKBOX) which is able to record up to a year of electrical parameters continuously."

for a solution to their PQ problems with the following objectives in mind:

- Improve the electrical quality in the Panama Canal Locks;
- Reduce the impact of the fluctuations and disturbances of voltage on the equipment and machinery in both the Locks and Locomotives;
- Implement a monitoring system in a local and remote methodology;
- Reduce or avoid delays at the Locks due to electrical disturbances.

Initially, four (4) prototype Equalizer systems were installed by ACP personnel in the Miraflores Lock central east wall in the four transformers that feed the locomotives. The Equalizers were then monitored for three months before the entire project was realized. An additional 44 Equalizer systems were then

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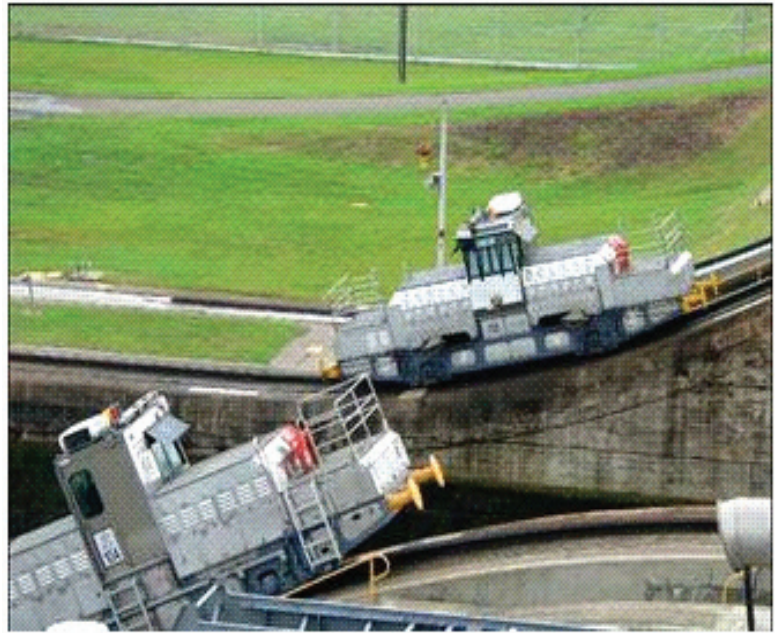
Read how the Elspec EQUALIZER and G4K BLACKBOX:

- Reduced voltage disturbances in the Panama Canal Locks and eliminated costly transit delays
- Reduced harmonic distortion in the Locks
- Allowed the ACP to monitor PQ in the Panama Canal Locks

installed by ACP personnel on both the Pacific and Atlantic sides of the canal with a final inspection made by the ACP with system start-up performed by Elspec.

Immediately upon installation, the three Locks (Miraflores, Pedro Miguel and Gatun) saw an almost complete mitigation of voltage disturbance. Machinery, which may have gone off-line because of the disturbances, continued running smoothly, eliminating the costly delays in traffic flow. In addition, harmonic distortion, especially the 5th and 7th was drastically reduced.

All 48 Equalizer systems were also equipped with the ELSPEC G4K BLACKBOX and connected to the ACP's SCADA system, enabling the ACP to monitor continuously the electrical network of the Locks. Says the ACP, *"The ELSPEC G4K has many advantages in relation to the competition, one of the most important being the capacity to record all of the electrical parameters cycle-by-cycle with no need to establish limits (thresholds). Elspec properly fulfilled the requirements demanded in 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."*



Views of the Locomotives in the Panama Canal

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