

October 25, 2006

To Whom It May Concern:

Ref.: The Panama Canal Locks Dynamic Var Compensation Project and Integration of ELSPEC-G4K (Monitoring Data Center).

Introduction

The Panama Canal Authority (ACP) serves to the international marine commerce shortening the distance between the ports of the North Atlantic, the American Pacific and the Asian Countries. For such reason, the Canal requires of a reliable provision of electrical energy at all times to guarantee the benefit of its services in a continuous way. Nevertheless, the electrical system of the Panama Canal Locks is affected by external and internal disturbances. The internal ones are the result of the daily operations of the machinery, the operation of the distribution network and transmission. The external events are like failures in the distribution network and national transmission, damages of the network and lightning bolts.

The incidence of these events has become more significant as a result of putting into operation of the new locomotives. Those new locomotives require in addition a good power quality (free of transients, free of over voltage, desbalances of voltage and current, a stable frequency, etc.), they include more sensitive internal circuits of protection, causing in many occasions the out of operation of the locomotives, causing delays and even accidents during its routine operation.

Searching for a solution or at least mitigation of these problems, we made a study of the equipments and manufacturers available in the world-wide market with the technology to provide this solution.

The study included the type of applied technology, benefits, advantages and disadvantages of each one and its cost. The survey determines that there are two (2) existing technologies based on semiconductors, one (1) analogous and other (1) digital.

Finally, the digital technology based on commutation to SCR, (Thyristors) offers the best's advantages and benefits such as:

Compensation *cycle by cycle*. The risk of explosions or damage of the components is diminished, the digital system does not use the slow magnetic switching mechanisms and the selected digital system uses the mentioned SCR or Thyristors, which allows a commutation cycle by cycle or real time. In 8 milliseconds the decisions is taken.

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- Monitoring and communication of all the electrical parameters locally and remote.
- Allowed an easy integration to our SCADA system.
Include tools to record data and parameters of operation for its analysis in case of faults. Following the mentioned analysis and the determination of the technological and economic feasibility of the project, we proceed with the investments stage to fulfill the following:

Objectives

- Improve the Electrical Quality in the Panama Canal Locks.
Reduce the impact of the fluctuations and disturbances of voltage, on the equipment and machineries. (PLC's and Locomotives)
- Implement a monitoring system in a local and remote way.
- Reduce or to avoid the delays at the Locks due to this cause.

Dynamic Var Compensation Project

The final investigation and formulation of the specifications were comprised by the Engineering Division of ACP. These included the criteria of evaluation and acceptance of the contractor, required performance of their equipment, guarantees and the training of the personnel. Following that the tender was published.

four (4) companies participated in the tender, two (2) of them with analogous technology, one (1) of them with well-known digital technology like step by step (three (3) cycles by group) and another one (1) with digital technology of compensation in real time (all the compensation inside to outside in a cycle). Finally the winner of the tender was the digital technology in real time brand ELSPEC.

Some of the main reasons for this decision were the compensation speed *cycle by cycle*, in addition to a large *experience* developed by the company beneficiary in this field through applications for all type of industries such as the Wind Turbine Generation, Port Cranes, Electric Trains, Cement, Plastic, High Rise buildings, Hotels, Hospitals, Car Assemblers, etc., as well as any industrial application that an electrical provision of quality for its continuous and reliable operation requires.

This company also, showed a world-wide leadership in the development of equipment of electrical measurement interconnected remotely with an innovating product called ELSPEC-G4K Data Center, able to record up to a year of electrical parameters of continuous form.

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The last two (2) stages of the project began with the installation of **four (4) prototypes systems** of reactive power compensation (VAR's) to test on the capacities in the matter of control and measurement, in addition to tests required by the manufacturer, in order to guarantee the correct operation of these Equalizers according to the electrical characteristics of our locomotives and machineries. The installation of the four (4) prototypes was made in the Miraflores Lock central east wall; in the four (4) transformers that feeds the locomotives. The installation was made by our personnel. It was completed on July 15, 2005 and the prototypes were monitored within a period of three (3) months. Once was determined that the contractor

had fulfilled the terms, exigencies and objectives of the contract, the ACP emitted the order (notice to proceed) for the remaining systems.

The last stage was the installation of **forty and four (44) systems**, It's started in March 2006, for the Pacific and the Atlantic sides of the Panama Canal. This second installation was made also with personnel of the locks and the final inspection was made by us on the contractor side. The commissioning and conditioning of the systems were made by the contractor according to the indicated schedule.

The obtained benefits were appreciated in an immediate way in the three (3) Locks (Miraflores, Pedro Miguel and Gatun). The delay caused by putting out of order machineries has been reduced almost in their totality before the disturbances or electrical disturbances of voltage. Another obtained benefit is the drastic reduction of the harmonic distortion, mainly in the fifth (5) and seventh (7) ones as required expressively in the contract and its amendments.

Integration of ELSPEC-4K (Monitoring Data Center).

The equipment as indicated in the amendment includes a network monitoring system based on the mentioned ELSPEC-G4K, which allows recording all the electrical data. This system is connected to machinery control network of the Locks and allows observing and registering in a permanent way. It also includes remote and local operation as required.

The Panama Canal lies between Panama City (Pacific) and Colon (Atlantic); it has a physical distance of eighty (80) kilometers. There are three (3) Locks along the way as mentioned, two (2) on the Pacific side (Miraflores and Pedro Miguel) and one (1) on the Atlantic side (Gatun). Miraflores Lock which is the first on the Pacific side is four (4) thousand feet and there are sixteen (16) Equalizers installed. Pedro Miguel Lock is the second on the Pacific side and is three (3) thousand feet and there are twelve (12) Equalizer units installed. Gatun Lock is the first on the Atlantic side and is five (5) thousand feet and there are twenty (20) Equalizer units installed.

All the systems, **forty and eight (48) units** altogether, are equipped with ELSPEC-G4K. This power quality analyzer is connected to the Scada system of the ACP and enables monitoring the mains of the Locks. This technology is able to analyze cycle by cycle all the parameters of the mains to control any event and monitoring the power quality in a simultaneous way. This capacity is implemented using compression technology and on board flash memory.

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The ELSPEC-G4K has many advantages in relation to the competition, being one of the most important capacities to record *cycle by cycle* all the electrical parameters with no need to establish limits (thresholds).

The Contracts Division of the Panama Canal Authority (ACP) has notified officially The Contractor, ELSPEC ENGINEERING LIMITED to have fulfilled properly the requirements demanded in the contract and its amendments for the compensation of reactive energy, voltage control, harmonic filtering and monitoring in the Locks of the Panama Canal.

Sincerely,



Eric Delgado

Electrical Engineer (Project Manager)
Locks Division