Transnet National Ports Authority
Industry: Transport and Logistics

Goals
- Mitigate the effect of power outages from the national grid
- Centralised engineering
- Implementation of standards
- Stable, scalable and flexible operational information and control software platform
- Increased security
- Operational safety
- User-defined reporting facilities
- Traceable cause-and-effect scenarios

Challenges
- Multiple contractors
- Resistance to change
- Limited time for full functional test

Solutions and Products
- Wonderware System Platform
- Wonderware InTouch
- Wonderware Historian
- Software Toolbox’s Top Server I/O suite

Results
- Power outages reduced from hours to minutes
- Secure remote access and switching of MV switchgear
- Reduced solution deployment time and costs
- Scalable solution will cater with port expansion
- Rapid data analysis through real-time reporting
- Fault finding down to the device level
- Early involvement of relevant personnel for the resolution of issues
- Remote VPN for faster service provider support
- Fail-safe operation through extensive redundancy measures

“In my view, some of the new system’s outstanding aspects are its redundancy features, hot standby capability, remote access with stable security and ease of modification.”

- Johan Sauerman, Electrical Engineer, Transnet
Background

Durban, South Africa – A 40-minute national grid power outage in the Port of Durban in 2007 due to load shedding resulted in an estimated R20-30 million loss as the complex 30 square kilometre facility first turned into chaos and then took two hours to resume normal operations after the power was restored.

Grid-locked cargo traffic including container lorries and chemical trucks were only the start as shipping itself ground to a standstill. Even electricians couldn’t get to the substation to switch to the alternative incoming supply to restore power.

The Port of Durban plays a vital role in South Africa’s economy by being responsible for handling more than 60% of the country’s imports and exports. It is the largest and busiest shipping terminal on the African continent. Strategically placed on international shipping routes, the port handles more than a million tons of cargo from over 4500 commercial vessels that call at the port each year.

Further power disruptions to this giant enterprise could not be tolerated, especially in view of the planned expansions to cope with the growth in shipping. These include extension of the pier 1 terminal to increase its capacity from 700,000 to a potential 1.3-million containers by 2019 and increasing the capacity of the pier 2 terminal from 2.1 to 3.3 million containers by 2021 – all this during a seven-year berth deepening and refurbishment exercise that started in 2012.

Project Requirements and Goals

Quite obviously, the first priority was to mitigate the effects of load shedding and minimise the downtime of port operations through the monitoring and control of the electrical grid network and generators. But it soon became clear that this was not the only goal. Transnet needed a vision to keep capacity ahead of demand and this meant taking a holistic view of the port’s operational needs which went beyond limiting the effect of power outages. This meant including the sand dredging and pumping scheme, the central fire system, the millennium tower and the air conditioning plant.

This would require a system that was scalable, adaptable and that would support quick and well-informed control decisions. The criteria included:
Centralised engineering – The system would need to be simple to maintain, able to cope with future growth and provide for the quick rollouts of projects without downtime. The original topology consisted of 15 stand-alone Wonderware InTouch HMI/SCADA stations distributed over the 30 square kms. of the port with each one connected to the local area PLC. Not only did this present major difficulties with updating and maintenance but such a topology was insufficient to realistically handle the planned rapid expansions and developments at the port.

Stable industrial software platform – This would have to improve processing speed and provide redundancy on both data storage and end device communications. The speed of the network had decreased as more equipment, data, tags and systems were added to a SCADA system that was already struggling to cope because of the lack of a supportive infrastructure.

Robust and flexible security – The ability to switch power sources remotely at any site while allowing authorisation to be changed as and when and needed all within the strict 33/11/6.6 kV switching regulations.

Operational safety – The system must have the ability to step through automatic control sequences to safely setup the network and allow synchronisation of the diesel generators with the port’s grid feeders.

Improved power supply efficiency and cost – Power Factor Correction (PFC) is a key element to getting the most from available supplies so a key requirement was that the system must be able to not only manage power factor control in local sub-station zones but also globally override and adjust PFCs where necessary to manage total port power factor correction.

The introduction of user-defined reporting facilities – This would be based on trend data which would be used for analytical purposes.

Implementation of software standards - With the changes envisaged during the port’s expansion, it was important to introduce and maintain standards which would reduce engineering time and costs while minimising errors and rework and speeding up project deadlines.

Traceable cause-and-effect scenarios – Immediate access to real time and historical data would help analyse what went wrong and what caused the failure.
The introduction of standards has definitely reduced engineering time and costs and also ensured more accurate and correct work in the port.”

Warren Hofland, CSS systems engineer

**Implementation**

The port’s complex electrical system uses medium voltage (MV) circuit breakers from a variety of manufacturers, various power monitoring meters and protection relays as well as synchronising relays and engine management controls. It is comprised of:

- Two separately-located primary 33kV supply feeds from the municipality
- One 33kV ring main unit link as backup
- 33kV to 11kV transformers,
- 33kV to 6.6kV transformers,
- Four 2.5MVA diesel generators
- Ten power factor correction banks
- Feeders, bus couplers, regenerative cranes at the berths and more

TNPA chose systems integrator Convenient Software Solutions (CSS) to implement the extensive upgrade project because of the company’s experience and knowledge of Wonderware’s ArchestrA’s technology and their local presence, which meant good support and access to professional services when needed.

CSS chose to continue with the Wonderware solution set by adding System Platform based on ArchestrA technology and the real-time Historian. This would not only integrate seamlessly with the existing InTouch systems but also ticked all the boxes of flexibility, scalability, centralised software engineering, redundancy and the enforcement of standards in TNPA’s list of system requirements.

Bearing in mind the key system requirements, the design phase included numerous meetings to establish and finalise the software structure, the network and communication layout, tag naming convention, the HMI and its navigation facilities, documentation requirements, security provisions, data logging and trending needs as well as alarm management.
“Using the agreed operational criteria, CSS then developed a thin-slice implementation as proof of concept,” says Transnet electrical engineer Johan Sauerman. “This helped to confirm that we were on the right track with respect to our overall design philosophy and that the inherent flexibility of the chosen solutions could meet our current control and information needs. Equally important was that the same solutions would meet our changing needs in the future with regard to the port’s planned expansions and increased complexity.”

“The system as it stands today is quite extensive,” says CSS systems engineer Warren Hofland. “It comprises 13 PLCs, 8 remote I/O drops, 3 servers, 13 SCADA control stations with local Application Object Server (AOS), 5 Historian Client stations, over 2000 physical I/Os and 65 SCADA/HMI screens.”

Software Toolbox’s Top Server I/O suite is used to communicate with various equipment such as Schneider PLCs, deep sea controllers, CAT engine control panels, GE protection relays, Landis and Gyr power meters, IFM vibration monitoring instrumentation and a Cogent OPC Datahub.

“We paid particular attention to redundancy as this was a critical requirement,” says Hofland. “40 km of redundant fibre optic network now links the key elements of the system such as the hot standby controllers and the redundant AOS peer network to 13 local stations which will fail over to the centralised AOS server in case of problems. ’Store and forward’ functionality protects the data while a wireless VPN is used for the remote control and operation of MV switchgear and generators.”

The wealth of organised information available in the real-time Historian is designed to support operational decisions and in this regard, Transnet personnel were able to diagnose the past and plan for the future. “We have found immense value in using the historian client to access historical trend information for investigative and diagnostic purposes,” says Sauerman.

A project of this scale will naturally involve many players and this was clear from the start. So the goal was to keep one’s eye on the objective and to ensure that all the various contractors did the same while respecting one another’s contributions. “Change is always a
“The trick is to make it exciting rather than threatening by showing that end-user needs are truly being addressed through everybody’s collaborative contributions.”

**Conclusion**

Perhaps the most significant benefit of all for the TNPA is the peace of mind that the Port of Durban, the most important international import/export hub in the country, is now master of its own fate with respect to the reliability of its electrical supply. But while the effect of power interruptions by the national grid has been reduced from hours to minutes, perhaps the wisest decision the TNPA took was to review their operational information and control infrastructure in its entirety and adopt a solution with the flexibility and scalability to deal with the port’s ambitious expansion plans.

**Benefits**

- Far more secure and controllable power supply to the port
- Secure remote access and switching of MV switchgear.
- Centralised development environment greatly reduces solution deployment time and costs
- System capability to easily handle future port expansions.
- Rapid data analysis through real-time reporting
- Fault finding down to the device level from any InTouch view station.
- Accurate diagnostics enable operators to involve the right people the first time
- Remote VPN for faster service provider support.
- Redundancy on historian SQL server using ‘Store and Forward’ function – provides guarantee of data trail.

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