Case Study

Ergon Energy - Network Dynamic Ratings
Horstmann Smart Navigator Fault Indicators assist with Real Time Capacity Monitoring
Overview
Ergon Energy is a corporation owned by the Government of Queensland. It distributes electricity to around 700,000 customers across Queensland, excluding South East Queensland through a distribution network. Ergon Energy set out to establish Dynamic Feeder Ratings through the use of devices installed on the conductor lines. It was Ergon’s view that these support devices would:
- Improve asset utilisation through better management of network loads.
- Reveal capacity in the network and manage thermal events.
- Refine capital augmentation plans.

The aim of Ergon’s initiative was to:
- Optimise the utilisation of OH lines and UG cables.
- Integrate data from multiple sensors containing load, environmental and asset condition information providing MVA available to Operators and other ESC Initiatives.
- Analyse and report on utilisation levels compared to probabilistic ratings.

The original strategies used by Ergon’s Planning and Strategy teams were to rely on static fixed ratings to account for the worst of conditions. Using actual temperature versus predicted temperature; allows for additional capacity to be utilised when you may need it.

Ergon needed to source a product which would assist in this data acquisition. The chosen device was the Horstmann Smart Navigators. Ergon was already familiar with using the Smart Navigators throughout their networks with the sole purpose of fault circuit indicators. The success of the product for the reliability teams had instilled confidence in the technology and provided reassurance to asset management teams.

The information required to calculate dynamic load ratings was already there and available to them on the Smart Navigators, but were never utilised by Ergon at the time.

The Smart Navigator continuously monitors and transmits circuit status information (such as, temperatures and line currents) which helps to identify distribution grid capacity, improves grid planning and supports analysis of predictive or post-fault switching decisions. Smart Navigators were chosen for their ability to reliably and accurately provide continuous unsolicited reporting of key parameters required to assist in calculating dynamic line ratings.

These parameters included:
- Ambient Temperature
- Conductor Line Temperature
- Line Current.

Case Study
Ergon Energy

Customer:
Ergon Energy is a corporation owned by the Government of Queensland. It distributes electricity to around 700,000 customers across Queensland, excluding South East Queensland through a distribution network regulated by the Australian Energy Regulator (AER), who set the prices that Ergon is allowed to charge for distribution.

Challenge:
Real-time Capacity Monitoring (RTCM) provides a solution to network capacity concerns as an alternative to traditional augmentation projects, at a fraction of the cost.

Solution:
Horstmann Smart Overhead Navigator Line Fault Indicator with conductor temperature monitoring directly reporting in SCADA via DNP3

Results:
Deferral of major capital expenditure by accurately determining dynamic load ratings through Horstmann Smart Fault Indicators whilst achieving all other benefits associated with implantation of reliable fault Indictors in a power grid.
**Challenge**

Real-time Capacity Monitoring (RTCM) provides a solution to network capacity concerns as an alternative to traditional augmentation projects, at a fraction of the cost. RTCM can deliver up to 20% additional capacity on overhead lines the vast majority of the time.

However, to make capacity increases a reality; the data gathered in the field must dynamically update the alarm limits for feeders in the control room environment. Updating alarm limits in real time requires system architecture development, including operational technology and corporate information technology systems.

**Solution**

The load, current monitoring of the Smart Navigators, permitted Ergon to receive an update every 15 minutes of the following information:

*Load Current Monitoring*
- Actual load, sample taken 1s prior to 15 minute period reporting
- Minimum load, for that 15 minute period
- Peak load, for that 15 minute period
- Average load, for that 15 minute period

*Temperature monitoring (15-minute values)*
- Ambient temperature
- Conductor temperature

The ratings are governed by:
- Ambient weather conditions
- Conductor size and resistance
- Current (provided by Smart Navigator)
- Temperature (provided by Smart Navigator)
- Wind speed and direction (provided by Weather Station, which can also be connected to the pole mounted Smart Reporter).
- Solar radiation (either by assumed value which is dependent on the time of day or calculation, which considers radiation heat loss)

Additionally, the Smart Navigator continuously monitors and transmits circuit status information (such as, temperatures and line currents) which helps to identify distribution grid capacity, improves grid planning and supports analysis of predictive or post-fault switching decisions.

Compiling this data over a short period has allowed Ergon to develop an algorithm and put in place a system to carry out calculations on their chosen feeder assets. This data is used to determine any underutilised, and more importantly over utilised or constrained assets during peak demand periods.

**Results**

An example of applying this methodology was at Ergon’s Warwick – Stanthorpe 33kV feeder. In this particular case, the 110kV supply to T60 Stanthorpe was taken out of service for pole-top refurbishment between 29th Sep & 28th Oct 2014.
During this time, the 33kV feeder from East Warwick was used to supply Stanthorpe Town and Pozieres substations.

In preparation for load transfer, Ergon carried out the following checks;
- Performed Line Survey to ensure a max operating temp of 50°C on the 19/.083” Cu line.
- 33kV line works to rectify inter-circuit clearances and refurbish cross-arms and discs.
- Thermal Scanning for hot joints.
- 33kV Regulator installed.
- At 50°C line temp, static line rating was 154A / 8.8MVA
- Historical dynamic line rating analysis showed just over 12MVA could be achieved.

Using the Smart Navigators, Ergon were able to achieve an additional 22% in capacity (1.9MVA) from the 33kV Warwick – Stanthorpe feeder on a record 38°C day on 27th October 2014. No statutory line clearances were breached.
Summary
Over time, Ergon Energy continues to use this data for real-time capacity monitoring. Through the use of the Horstmann Smart Navigators, Ergon can see the following benefits:
- Accurate and live detection of faults.
- Reduced response time for crews, reducing fatigue times. Staffs are quickly transitioned from fault finding to restoration work.
- Savings with vehicle running costs and maintenance, lost time due to bogging in wet weather.
- Reducing risk to Ergon assets and the public when re-energising for unknown faults. Reduced risk of starting fires and property damage to customer’s infrastructure.
- Cost savings with a reduction in helicopter patrols during high impact weather events.
- Accurate and live detection of faults.
- Improved data acquisition.
- Extension of assets life using real-time capacity monitoring.
- Safely increase capacity on feeders as needed.
- Display and awareness of the actual situation.
- More effective and reliable management of the Grid.
- The solution currently makes the most of new technology and consists of no moving parts.
- Smart and cost effective.

These benefits are experienced by different departments within the utility;
- **Operations**
  - Direct notification of fault locations.
  - Localized network conditions.
- **Network Planners**
  - Extended asset life.
  - Improved reliability.
  - Increased capacity.

By not having to use static fixed ratings, Ergon Energy has been able save an exponential amount of funds utilising the Smart Fault Indicators. Having real-time, actual data Ergon Energy are no longer under utilising or upgrading feeders and substations unnecessarily to cope with demands determined by worst case scenarios.

Ergon Energy has been able to achieve greater visibility of network conditions on targeted assets. Ergon is installing Horstmann Navigators on overhead line assets nearing capacity constraint to monitor temperature profiles at key sites prior to any upgrades. In some cases, this delays augmentation and expensive network costs.

Ergon Energy are using the Horstmann Navigators as part of Safety Net, reliability based economic security criteria. Under Safety Net, low probability-high impact events can still cause significant disruption to supply and customer hardship. The Horstmann Navigators are being installed on key feeders to assist in supply restoration for these low probability-high impact events.

Deferral of major capital expenditure by accurately determining dynamic load ratings through Horstmann Smart Fault Indicators while achieving all other benefits associated with implementation of reliable fault Indicators in a power grid.
The Smart Navigator overhead faulted circuit indicator is designed for smart grid automation applications. The Smart Navigator can be installed on overhead transmission and distribution power lines up to 46kV and provides event based fault status in addition to continuous circuit data.

The Smart Navigator can be integrated into an existing SCADA or Smart Grid system and can operate in various Communication environments. A pole mounted concentrator, Smart Reporter, receives and manages all Navigator data as an access point into a communication environment. This Smart Reporter contains a Smart Receiver, which can connect with up to 12 Smart Navigator FCIs.

The Smart Navigator detects fault events and provides digital and analogue fault data information for intelligent switching and restoration decisions. A conductor temperature sensor is available as an important diagnostic tool to evaluate line sag, potential hotspots and assist with dynamic load rating calculations.

The load levelling and load memory features enable the unit to set the fault trip level automatically current rating in relation to peak load current. Once the unit detects fault current above its trip current rating, the FCI sends a signal to the Pole mounted concentrator and begins to flash a bright red blinking LED. In addition to event based fault identification, The Smart Navigator also communicates fault data, load current, and status data.

**FCI Information (DNP3 data) Alarms / Events:**
- Overhead line fault indication (permanent / momentary)
- Fault current magnitude
- Overhead line de-energization (loss of voltage)

**Continuous reports:**
- Average load current
- Peak load current (min & max)
- Counters: permanent faults / temporary faults
- Device temperature, conductor temperature (option)
- Routine call and health check
- Battery status

**Technical Data**
- Trip current: 50 – 1,200 A
- Accuracy: ±10 % @ 20 °C Self
- adjustment: ≥15 A
- Peak load memory: 72 h
- Reset: Manual / time: 4 h / Current restoration
- Power supply: Lithium cells, replaceable, shelf life ≥20 years
- Operating voltage: ≤46 kV L-L
- Withstand Current: 25 kA / 1 s
- Indication: Bright red LED
- Flashing frequency: 30 per min., total indicating time >500 h
- Conductor temperature measurement range: -40 to +130 °C
- Range: >30 m (>100 ft) line-of-sight
- Cable diameter range: 8 – 29 mm (0,31 – 1,15 “)
- Current transformer: Closed core stainless steel
- Housing material: Glass-fibre reinforced plastic / UV stable
The Smart Reporter is a robust, pole mounted solution that works together with the Horstmann line of Smart Navigator overhead line faulted circuit indicators. Together they provide detailed information about fault events, fault locations and load data for distribution and sub-transmission overhead lines.

The Smart Reporter acts as an access point that relays information from the smart navigators through different wan environments like cellular, licensed / unlicensed radio, etc. Into SCADA or network management systems. The Smart Reporter can monitor and manage up to 12 Smart Navigators. Together the solution forms a dnp3 level 2+ compliant outstation.

The Smart Reporter contains the Smart Receiver DNP3 that receives and manages data of the overhead line faulted circuit indicators and that provides the information in a DNP3 compliant format. The Smart Reporter includes as option an intelligent power management unit (Smart PMU) that monitors power supply and back-up battery status and enables selective power-down modes. The Smart Reporter can be fitted with selected 3rd party modems/routers or gateways to enable different WAN connections.

**SMART REPORTER Features**
- SMART RECEIVER DNP3/2.0
- Controls up to 12 SMART NAVIGATOR FCIs
- DNP3 outstation Level 2+ (IP or Serial)
- Local and remote configuration
- Wide range AC power supply & Solar option
- Rechargeable backup battery
- SMART PMU: Intelligent power management unit (option)
- Advanced charger with rechargeable battery supervision
- Power-down modes of connected load for extended battery life
- Mounting space for selected modem/router/gateway
- Tamper detection
- IP 66 / NEMA 4X rated enclosure, mounting brackets, lockable

**Technical Data**

**Features**
- Door contact switch (mapped in DNP3) for tamper detection
- MicroSD card slot for system and DNP3 logging
- Internal LEDs to support installation and commissioning

**FCI radio**
- Short Range Radio Link Controller for up to 12 NAVIGATOR FCI’s
- Range FCI ↔ SMART REPORTER 30m (line-of-sight)

**Power supply**
- LV: 85 – 264 V AC / 47 - 63 Hz / 120 - 370 V DC
- Solar: 16 – 33 V DC

**Surge protection (Hot line to ground)**
- Rated / maximum voltage: 230 / 275 V AC, current (8/20 us): 40 kA

**Back-up battery**
- 12 V / 7.2 Ah, SLA (sealed lead acid), rechargeable
- Lifetime 10 years at 20 °C
- Back-up time >24 hours

**Router / gateway options**
- Cellular
  - Standard option: 2.5G / 3G / 4G Cellular; CDMA on request

**Antenna**
- 2.4 GHz Low Profile Puck Antenna

**Interfaces**
- 2 Serial Ports (RS485, RS232)
- Ethernet RJ45 10/100 Port for DNP3 IP or local access and configuration
- Mini-USB for local access and configuration

**Temperature range**
- -30 to +70 °C

**Humidity**
- 0 to 95 % non-condensing

**Degree of protection**
- NEMA4(X), IP66
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