# Case Study

## SA Power Networks – Implementation of FCI's for customer and STPIS benefit

Horstmann Line Fault Indicators

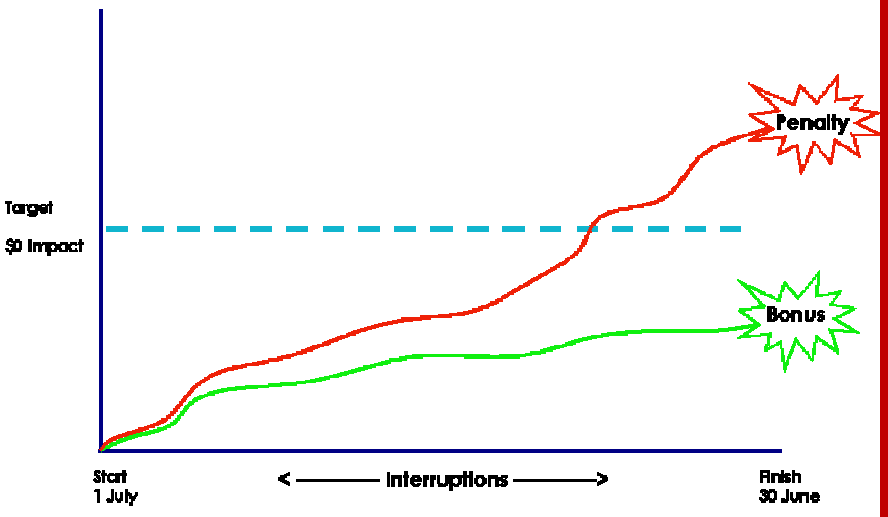
## Overview

SA Power Networks is a South Australian utility with 830,000 customers, 2000 employees, 87,000km (majority is overhead), 723,000 poles (steel, susceptible to being hit by lightning). This privately owned utilities aim was to manage reliability performance to their customers and provide a positive return to the business. SA Power Networks looked to source a means of managing interruptions times resulting in the widespread implementation of fault indicators throughout their network while achieving benefits delivered from the Australian Energy Regulators, performance-based incentive scheme known as STPIS – Service Targeted Performance Incentive Scheme.

*STPIS: A STPIS* target is set by the regulator fixed over a 5 year regulatory period based on the Distributors previous average 5 year performance.

Depending on annual network performance it can result in a monetary reward or penalty each year of up to +/- 5% of a distribution company's annual revenue.

Less Customers & Minutes interrupted = Bonus




More Customers & Minutes interrupted = Penalty

# Case Study
# SA Power Networks

**Customer:**
SA Power Networks is the operator of the South Australian electricity distribution network, delivering electricity from the high voltage transmission network connection points through a network of about 87,500 kilometres of powerlines, to about 830,000 residential and business customers throughout most of South Australia.

**Challenge:**
Manage reliability performance to their customers, and provide a positive return on reliability performance investment delivered through a performance based incentive scheme known as STPIS – Service Targeted Performance Incentive Scheme.

**Solution:**
The widespread installation of Horstmann Navigator Overhead Line Fault Circuit Indicator rollout across its network (5000+ units) with comprehensive training and support for field workers.

**Results:**
The installation of FCI's improved restoration times resulting in greater customer satisfaction, reliability and cost-savings to the organisation delivered though a positive Service Targeted Performance Incentive Scheme outcome.

Example of typical STPIS impact of an interruption:

| SUMMARY | Customers | Duration (Hrs) | Customers Interrupted Cost | Hourly Rate | Total Duration Cost | STPIS Impact |
|---|---|---|---|---|---|---|
| Substation Interruption or 33kv TX Line | 8000 | 2 | $ 320,000 | $ 206,000 | $ 412,000 | $ 732,000 |
| Metro feeder Interruption | 2260 | 3 | $ 100,000 | $ 64,333 | $ 193,000 | $ 293,500 |
| Rural Town Feeder | 1200 | 4 | $ 67,000 | $ 29,500 | $ 118,000 | $ 183,000 |

***Included***

- Unplanned Interruptions
- All-Cause Types (3rd party, weather, equipment failures, etc.)
- Interruptions Greater than 1 Minute
- LV Interruptions

***Excluded***

- Upstream Generator / Transmission provider Interruptions
- Planned Interruptions
- Interruptions less than 1 Minute
- Major Event Days
    - Greater than 6.1 SAIDI Mins (System Average Interruption Duration Index) in 24hr Set Period
    - About five events per year

## Challenge

There are always challenges faced by utilities in managing reliability performance to its customers, such as:

- Increasing equipment failures and ages of network assets
- Increased weather impact
- Increasing focus on managing network risk
- Increasing focus on managing Work Health and Safety risks

To manage ongoing network performance challenges, SA Power Networks identified the need to implement a program to manage restoration times, which can be a monumental task when operating such a widespread network. In rural and remote areas radial lines can be over hundreds of kilometres long often taking whole days to patrol to and in metro areas the ongoing increase in traffic density impacts supply restoration times.

## Solution

SA Power Networks Implemented their 'Find the Cause' program:
To better identify the cause of interruptions & improve supply restoration times.

The program began with the training for key front line staff across all Line Depots to provide an overview and understanding of network reliability impacts, how to improve fault identification and to provide more detailed training of how line protection and fault indicators operate.

Training on the common issues was provided on where to look and how to utilise the tools provided which further hands-on training on the fault indicators themselves, understanding the functionality and FCI operation

They took their employees on the journey, created visibility, provided incentive and encouraged feedback.
Instilling an understanding that "Every interruption, every customer, every minute counts…!"
Providing active, constant, reminders –by the means of posters, internal newsletters, etc

In conjunction with the education program Line Fault Indicators where installed at a least 2 locations on each feeder with greater than 500 customers.

The Horstmann Navigator was the preferred fault indicator used in the programs they rolled out.

Typically for an average network interruption, restoration times can be divided accordingly:

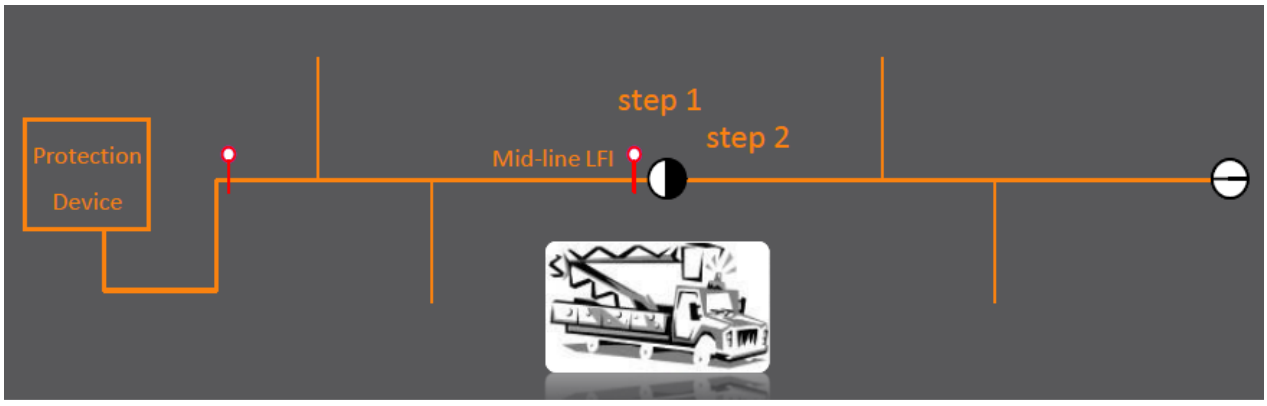
- 20% is travelling to the fault.
- 20% is finding the fault.
- 20% isolation of the fault and restoration of healthy sections to the majority of customers
- 30% is repairing the fault.
- 10% is restoring the system to normal.

Very quickly SA Power Networks realised the benefits of introducing proven reliable technology, the Horstmann Navigators, through the time and effort saved to identify and isolate faulted sections and restore the majority of their customers utilising the Navigators FCI's located at strategic locations across their network.

As the time taken to isolate the fault and restore healthy line sections is 20% of the overall interruption time; for one set of Navigators installed per feeder this time saved is reduced to around 50%, two sets of Navigators is 65%, and three FCI's is 75%.

With one set of Horstmann Navigators, you can expect to half your fault finding and major restoration times.
SA Power Networks has realised the cost benefits their return on investment in FCI installation, based on STPIS returns over the regulatory period.

***Typical Metro LFI set up***




***Feeder exit LFI no indication - check feeder exit and patrol line***

The implementation of the program to utilise the Horstmann Navigator fault indicators assisted SA Power Networks in managing supply restoration times, repeat interruptions to their customers and assisted in providing a positive return to their business through a positive STPIS outcome, as well as providing further skills and job satisfaction to their employees.

The introduction on STPIS from the AER requires utilities provides incentives to evaluate strategies and utilise proven technologies to ensure positive commercial outcomes. This clearly, in turn, benefits customers with increased levels of supply reliability.

SA Power Networks case study demonstrates how proven technology carefully implemented with employee engagement and support can provide positive financial rewards in a very short period.

The caluclator provided, shows the cost of FCI's installation is quickly recovered even in a single average fault occurrence, with returns on investment of over 20 times over a five-year regulatory period.

A well thought out strategy utilising Horstmann Fault Circuit Indicators will provide exceptional return on investment through STPIS benefits.

## Summary

Through the correct implementation of reliable fault circuit indicators across the distribution network, a private utility can achieve significantly faster restoration times, resulting in greater customer satisfaction, labour utilization, improve reliability and cost benefits through STPIS returns to the organisation.

SA Power Networks have implemented this strategy for over 5+ years and have realised the benefits of widespread FCI installation across their network providing a positive return on investment whilst providing benefits to both customers and Network operators.

# Horstmann Navigator LM
# Technical Data


- LED indication with 360 degrees of visibility
- Battery status indication
- Double-flashing mode upon detection of a second fault
- Reset depending on type: Manual, Current restoration, timed, on restoration of voltage
- Mounting can be performed while equipment is energised
- NAVIGATOR-LM HV: permissible voltage ≤161 kV

The NAVIGATOR short-circuit indicator is an electronic device which is designed for medium voltage utility overhead lines. The indicator is provided with a self-adjusting load-dependent control of the trip current level. This function allows the indicator to continuously sample the load current on overhead lines and electronically set a corresponding trip value for fault detection as a function of the load current. The maximum load current sampled by the indicator, is kept in a memory for a period of at least 72 hours. Thus, the indicator is most favourably adapted to the network to be monitored, even if low load is currently present.

The indicator is provided with a built-in battery control. When the battery capacity decreases from a total indicating time of 400 hours to a residual time of 50 hours, the yellow LED of the display starts flashing for a period of 6 months.
The NAVIGATOR-LM differentiates between two subsequent short-circuit detections. Upon the detection of a first short-circuit, the LED indicator light starts flashing at equal rates. The detection of a second short-circuits (e. g. after ARC) switches the LED to double flashing mode. Reset options provided by the various versions

NAVIGATOR Version A
Faults are indicated by means of 6 high-intensity LEDs. The indication is reset automatically on restoration of current or after expiry of a preset time, or can be reset manually, whichever criterion occurs first.

NAVIGATOR Version B
Faults are indicated by 6 high-intensity LEDs. The indication is reset automatically after expiry of a preset time, or manually.

NAVIGATOR Version C
Faults are indicated by means of 4 red LEDs and 2 yellow high-intensity LEDs. The red LED indicator lights are reset automatically on restoration of current, after expiry of a preset time, or manually. The yellow LED indicator lights are reset automatically after expiry of a preset time, or manually.

NAVIGATOR Version E
The indicator samples both the line current and line voltage on the line.
The device is tripped only if the line has been under voltage for at least 60 seconds. Automatic reset after 60 seconds upon restoration of voltage, after passage of a preset time, or manual reset. Its design blocks high inrush currents for indication, even upon reclosure. Both the overbuilt and underbuilt conditions shall be avoided!

| Technical Data | NAVIGATOR-LM / LM HV<br>Version A | Version B | Version C | Version E |
|---|---|---|---|---|
| Trip current range | 200 A/100 ms, load-dependent self-adjustment (see Current/Time Characteristic) | | | |
| Accuracy | ±10 % at 20 °C | | | |
| Self-adjustment | Load current ≥50 A | | | |
| Trip factor | 4 – 6 times the load current (see current/time characteristic) | | | |
| Adjustment delay | Load current flow time ≥50 s | | | |
| Holding time of self-adjustment | 72 h | | | |
| Indications (short circuit/earth fault) | ▪ 4 red LEDs (>5,000 mcd or 7,000 mLm per pc.)<br>▪ 2 yellow LEDs | | | |
| Visibility | >50 m during daytime, >150 m during night /360 degrees of visibility | | | |
| Flash rate | 30 flashes per minute, total indication time >500 h | | | |
| Reset | ▪ Manual reset by means of a permanent magnet<br>▪ Automatic time reset: 4 h ±10 % (2 or 8 h) | | | |
| | Current restoration | — | Current restoration | — |
| | — | — | — | Voltage restoration, line voltage ≥5 kV |
| Power supply | Lithium cells, replaceable, lifetime ≥20 years | | | |
| Battery check | 1 yellow LED, flash rate: 6 per minute, 0.5 years | | | |
| Max. permissible voltage | ▪ NAVIGATOR-LM: ≤46 kV/50 Hz or 60 Hz<br>▪ NAVIGATOR-LM HV: ≤161 kV/50 Hz or 60 Hz | | | |
| Withstand Current | ▪ NAVIGATOR-LM: 25 kA/200 ms<br>▪ NAVIGATOR-LM HV: 40 kA/1 s | | | |
| Cable diameter range | ▪ NAVIGATOR-LM: 8 – 29 mm<br>▪ NAVIGATOR-LM HV: 13 – 36 mm | | | |
| Influence | No influence by vicinal power lines with a horizontal distance of at least 250 mm from the indicator | | | |
| Housing | UV-resistant polycarbonate/polyamide, IP68<br>Clamping mechanism: stainless steel | | | |
| Temperature range | -30 to +70 °C (ANSI Test -40 to +85 °C) | | | |

NAVIGATOR PM without self-adjustment facility provided with fixed trip currents (e. g. 800 A/100 ms) available ex works after consultation with the manufacturer.


For more information on this project or any other projects please contact MV Technology Solutions on:

**Phone**: +61 2 9531 6002
**Fax**: +61 2 8076 8677

**Email**: Info@mvtech.com.au
**Web**: www.mvtech.com.au