

Proven Trackside  
Technology Since

**2018**

# **CABLEGUARDIAN**

**THE BUSINESS CASE FOR  
SMARTER SIGNALLING  
POWER MANAGEMENT**

 **CABLE  
GUARDIAN®**  
A VIPER INNOVATION





**CableGuardian** is the only product to offer proactive monitoring, detection and location of both insulator and conductor faults on live signalling power systems as specified in Network Rail specification NR/L2/SIGELP/27725 - Insulation Monitoring and Fault Location Systems for use on Signalling Power Systems.

✓ **Tier 1**  
Approved

✓ **Tier 2**  
Approved

✓ **Tier 3**  
Approved

This advanced system has been proven in operation since August 2018, with multiple UK regions already benefitting from the technology and further installations scheduled across the network this year.

## Key benefits:

- Fewer boots on ballast fault finding and cable testing.
- Reduced number of service-affecting failures.
- Quickly and accurately locate cable faults and cable theft.
- User friendly web portal for fault diagnosis and location.
- Allows trending of insulation resistance and insulation capacitance at a cable section level.
- Technological alternative to the five-yearly manual cable testing requirements.

**CableGuardian** - Helping passengers to arrive on time.

## Contents:

<b>Document Purpose .....</b>	<b>4</b>
<b>Viper Innovations &amp; CableGuardian .....</b>	<b>4</b>
<b>Business Case Support Overview .....</b>	<b>5</b>
<b>Justifications for Claims Made .....</b>	<b>9</b>
<b>CP7 Specific KPI Improvement .....</b>	<b>12</b>
<b>Service &amp; Support from Viper Innovations .....</b>	<b>17</b>
<b>Supporting Data .....</b>	<b>17</b>

## Document purpose

This document has been prepared to support Asset Managers, Maintenance and project teams to set out business cases for the use of **CableGuardian** on the UK rail network. It describes how they can use readily available and product-approved digital technology to reduce overall capital costs of projects and reduce lifecycle operational expenditure by reducing maintenance and improving management of signalling power supply assets in the field.

Failures of signalling power supplies cost millions over a typical year, and maintenance of the asset can run to millions of pounds per control period. **CableGuardian** eliminates many costs and includes associated safety and asset management benefits.

This note will document, in a simple form, how using the Viper Innovations **CableGuardian** system can improve business across a broad range of metrics. It will describe and show examples of how **CableGuardian** can positively affect Network Rail KPIs across the whole lifecycle and how it aligns with major initiatives. This document has been prepared to enable easy copying of justifications into relevant documentation with minimum effort and to assist in outlining the technology to inform interested parties of how it can be integrated.

## Viper Innovations & CableGuardian

Viper Innovations is a UK-based technology SME developing products and services for the safe, effective and efficient management of electrical assets. Established over 15 years ago, Viper delivers products and systems to the Subsea Oil and Gas and Railway sectors. Viper has a strong balance sheet and client base and is a net exporter of technology worldwide.

Viper's **CableGuardian** system is aimed at monitoring Insulation Resistance, Insulation Capacitance, Voltage, Current and Voltage Drop with the aim of preventing failure and reducing maintenance and operational costs in lineside railway signalling power supplies, including cables, switchgear and transformers.

The system has full product acceptance for Tiers 1, 2 and 3 and is integrated into Network Rail's Intelligent Infrastructure and RADAR systems for all tiers of use.



**CableGuardian** differs from competing products by being able to measure more parameters and reach a far greater range, thus providing a much more attractive business benefit across the whole lifecycle. Unlike other products on the market, **CableGuardian** does not suffer from technological issues relating to the rail application, nor does it require complicated set-up processes. This simplicity, wider range, and greater number of measured parameters reduces lifecycle costs and allows for early intervention to prevent system failure. It also provides greater asset insights, allowing users to predict and prevent a wider range of failure modes and better plan renewals based on precise asset conditions.

**CableGuardian** also includes Spread Spectrum Time Domain Reflectometry (SSTDR) technology which helps detect core-to-core faults on live, operational electrical systems and is unique to **CableGuardian**. It guides staff to the location of incidents and can significantly reduce delays caused by catastrophic failures such as cable theft or rodent damage. The system is currently fitted widely in Southern, Eastern, Wales and Western Regions, with a smaller population in the North West & Central Region. Other regions are being targeted for a wider roll-out, with success expected across CP7.

## Business case support overview

The following information is provided to support a narrative that may be added to a business case to show how the inclusion of **CableGuardian** will improve key performance indicators and business metrics.



### Safety Improvements

- Removing road travel and boots on ballast by eliminating time-intensive activities in the project and maintenance phase of work.
- Eliminating the safety risk of managing complex failures in the operational phase of work by predicting and preventing failures from occurring by improved monitoring technology.
- Reducing electric shock risk in the maintenance and operations phase of work by improved monitoring of touch-potential precursors (SIN119).

## Project delivery benefits

- **CableGuardian** will greatly reduce the amount of raw materials used in signalling power systems moving forward by allowing spot-replacement of assets based on true asset-condition assessment. This will help eliminate the need for large-scale power system replacement projects.
- Replacing signalling power auto-reconfiguration systems with **CableGuardian** in a Tier 1 configuration will achieve the following:
  - Removing millions in capital expenditure by eliminating the hardware, design, installation, and testing costs from a project whilst still achieving RAMS requirements enables more work to be won.
  - Achieving Minimum Viable Product status for signalling power supplies on projects by removing complexity and hardware from designs by replacing them with **CableGuardian**.
- Simplify testing and commissioning systems by using **CableGuardian** to provide continual monitoring of signalling power systems for soak testing.
- Handback can be simplified by using results from **CableGuardian** to prove performance of signalling power systems for maintenance clients.
- **CableGuardian** power system asset condition surveys can provide the justification for renewal projects by accurately detailing the condition of the existing signalling power assets to accurately identify design requirements.
- The use of **CableGuardian** can help increase the proportion of SME work in the regions by enabling the delivery of new services based on the data and insights it provides.
- **CableGuardian** supports Project SPEED and PACE by eliminating hardware, design, installation, testing and commissioning activities and templates, which is much of the paperwork required in the GRIP process.
- Viper Innovations has a strong Scottish presence, thus providing business cases with an opportunity to demonstrate their 'buy local' requirement for projects north of the border.





## Maintenance stakeholder benefits

- Inclusion of **CableGuardian** into business cases will reduce the overall maintenance costs on signalling power supplies to a delivery unit by millions of pounds over the lifecycle of the asset by eliminating the need to do manual periodic cable and switchgear testing.
- Using **CableGuardian** will reduce overall maintenance expenditure by greatly reducing the number of failure incidents that need to be rectified, cutting down on unplanned site work and reducing materials costs.
- Including **CableGuardian** in place of auto-reconfiguration reduces the overall maintenance testing and replacement parts costs by millions per delivery unit over the lifecycle of the asset.
- **CableGuardian** can be used to monitor flood-prone areas and avoid the need for maintenance testing and monitoring following a flooding event, reducing maintenance costs.

## Operations stakeholders benefits

- Using **CableGuardian** will reduce service-affecting failures and delay-per-incident in catastrophic damage scenarios. This will significantly reduce delay minutes and regional Schedule 8 and 4 costs by multiple millions of pounds over a single control period. It does this by enabling maintenance staff to predict and prevent cable, switchgear, and transformer failures well before they reach actionable levels.
- Equipment can be brought back into service much sooner following a flooding event by providing continuous monitoring of cables and equipment, providing confirmation that the system is safe to use as soon as possible.
- Incident management operational costs will be reduced by millions for each region over the control period by reducing the need to manage significant failure incidents requiring large numbers of operational staff, replacement bus services and train timetable rescheduling.



## Business stakeholder benefits

- Viper Innovations provides main and subcontract suppliers with an opportunity to improve their Corporate Social Responsibility evidence base by sharing in the range of activities of the company, such as the managed woodland that Viper own and use for CSR and environmental events.
- **CableGuardian** improves environmental performance by reducing CO<sub>2</sub> emissions from maintenance, operational and public service vehicles involved in incident management and maintenance of the asset.
- **CableGuardian** will improve capacity on the network by reducing the time to find and fix faults and removing the need to take lengthy possessions or switch off power to deliver maintenance.
- Using **CableGuardian** will reduce overall maintenance expenditure by greatly reducing the number of failure incidents that need to be rectified, cutting down on unplanned site work and reducing materials costs.
- Including **CableGuardian** in place of auto-reconfiguration reduces the overall maintenance testing and replacement parts costs by millions per delivery unit over the lifecycle of the asset.
- **CableGuardian** can be used to monitor flood-prone areas and avoid the need for maintenance testing and monitoring following a flooding event, reducing maintenance costs.



# Justifications for claims made

## SAFETY

**CableGuardian** improves safety across the whole lifecycle.

### At the asset level:

- **CableGuardian** can detect a loss of earthing at a location case, avoiding the risk of an electric shock to an employee or the public.
- **CableGuardian** continuously monitors insulation resistance and capacitance of cables, meaning it can detect a first earth fault occurring due to capacitance in long feeder cables or cable insulation degradation, again avoiding electric shock risk.

### In the maintenance & operations space:

- Prevent completely or greatly reduce the duration of signalling power supply failures. This avoids issues relating to travelling to the site and working trackside to remediate failures.
- Avoids road traffic accidents, such as slips, trips, and falls, as well as hand, arm, and back injuries from moving and terminating large cables.
- Signalling power failures can be wide-area and very high delay minutes. Using **CableGuardian** avoids the operational issues related to a significant signalling outage.
- Provides a significant reduction in the need to de-train and use replacement bus services, thus avoiding safety issues such as station over crowding, crowd control and potential road traffic accidents.
- Avoid the need to instigate Temporary Block Working, avoiding irregular working incidents and accidents associated with travelling to and working on-site for operations and recovery staff.

## PERFORMANCE

**CableGuardian** can prevent signalling power failures by identifying the maximum number of precursors, many months, and potentially years, prior to occurrence and reduces delay per incident down to the lowest possible level by detecting the location of failure and monitoring asset condition during flood events.

A single incident can incur over 5000 delay minutes and millions in penalty payments. This will save hundreds of thousands of delay minutes over a control period from:

- High-impact signalling failures due to cable theft and damage from rodents or during trackside project work.
- Signalling failure due to cable and equipment degradation from age and attrition.
- Intermittent signalling failure from loose or high resistance connections and damage from vibration and overload causing intermittent loss of signalling, red reversions and potential for fire in locations.
- Loss of feeders from Transformer winding failures.
- Ability to bring systems back into operation in the shortest possible time following a flood incident by fitting monitoring equipment to the systems and continuously monitoring insulation resistance and capacitance until it reaches a safe level.

## ASSET SUSTAINABILITY

**CableGuardian** provides the widest possible list of measured parameters for cables, switchgear and transformer windings.

This will save millions of pounds and delay minutes over multiple control periods:

- Current asset condition reports rely on manually measuring the cable insulation resistance at a single point, which can lead to replaced assets that are still in good condition or vice versa.
- The continuous monitoring of insulation resistance, insulation capacitance, voltage, current and volt drop (for Insulation Resistance in the gigaohms scale right down to ohms) provided by **CableGuardian** allows for very early intervention, based on true asset condition, in the event of an anomaly with the asset and provides insight into the characteristics of all potential failure modes associated with the asset.
- **CableGuardian** allows for a wide range of phenomena to be captured and machine learning algorithms/AI developed over the long term that capture increasing numbers of precursors to failures, maximising every opportunity to improve asset sustainability.

## EFFICIENCY

**CableGuardian** will save millions across a control period in maintenance and operational expenditure, through reduced maintenance delivery and failure incident recovery. It will also deliver similar savings in capital expenditure by allowing Project RAMS targets to be met with much cheaper systems.

- Reduction in the need to implement degraded mode working for significant power outages, cutting the number of people required to manage an incident.
- Significantly reduced maintenance activity by targeting NR/L2/SIGELP 50000 suite of standards with automated activities.
- Elimination of the need for contract labour for periodic inspection and testing and access planning.





- Fewer teams are required to diagnose and rectify faults, enabling staff to focus on other tasks.
- Reduced need for disruptive or planned possessions.
- Significant capital reductions with the opportunity to meet RAMS targets on projects by using **CableGuardian** to justify predicting and preventing failures rather than mitigating their effects using Auto-recon systems, removing millions from project budgets.
- Increased lifecycle of existing cables and switchgear by having accurate continuous measurement of operating parameters, allowing renewals to be more accurately planned.
- Smoothing of control period spending by having a long-term view of asset condition and eliminating peaks of spending.

## Sustainable growth:

- Capacity: **CableGuardian** supports the increase of capacity on the network by eliminating some of the most disruptive failures experienced on the network.
- Environment: **CableGuardian** allows much more accurate identification of life-expired cables and switchgear to be replaced and will lengthen the lifecycle of the overall asset base, reducing the use of virgin materials.

## Customer & community:

- Customer: **CableGuardian** will eliminate one of the most disruptive failure modes that affects customers on the network and will remove a significant cause of customer complaints.
- Community: Work to test and repair lineside cabling is usually done at night and is noisy and disruptive to lineside neighbours. **CableGuardian** can remove a significant portion of this work and thus reduce complaints.

# CP7 specific KPI improvement

The following table provides a summarized overview of how current KPIs are improved using **CableGuardian**:

KPI	Description	CableGuardian Benefits
<b>Safety outcomes measures</b>		
<b>Workforce fatalities and weighted injuries</b>	A weighted measure of fatalities and non-fatal injuries, which is presented as a numeric score.	Reduced range of accidents from avoidance of boots on ballast due to elimination of maintenance and fault finding requirements. Avoidance of road traffic accidents from travelling to site. Improved monitoring of a range of parameters will prevent electric shocks.
<b>Personal accountability for safety (PAFS)</b>	The number of breaches in 'life saving rules' and high potential events. It is a measure of how Network Rail is improving culture and behaviours to help keep staff safe.	Reduced number of visits to site to deliver maintenance and faulting eliminates potential of unsafe working. Improved management of electrical safety through monitoring of systems prevents electric shock risk.
<b>Train service delivery outcomes measures</b>		
<b>Passenger on time</b>	This measure tracks the percentage of recorded passenger train station stops arrived at early or less than one minute after the scheduled arrival time.	Improved predict and prevent capability will significantly improve ability to detect and prevent lineside signalling power failures, thus reduce a significant element of perturbation.
<b>Passenger cancellations</b>	The percentage of planned passenger trains which either did not run their full planned journey or did not call at all their planned station stops. The measure is a score which weights full cancellations as one and part cancellations as half.	Lineside power failures present a significant disruption to railway operations, leading to cancellations and significant lateness (CaSL). Improved monitoring of a range of parameters allows predict and prevent capabilities to avoid power failures, reduce delays caused by catastrophic damage, such as cable theft, or damage by rodents or trackside work significantly reduces delay per incident.

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KPI	Description	CableGuardian Benefits
<b>Scotland train performance measure</b>	The percentage of planned trains arriving at their final scheduled destination early or less than five minutes after their scheduled arrival time having called at all their planned station stops, (adjusted to remove delays caused by the need for speed restrictions during severe weather, or to permit connections from other late running trains or ferries).	Lineside power failures present a significant disruption to railway operations, leading to cancellations and significant lateness (CaSL). Improved monitoring of a range of parameters allows predict and prevent capabilities to avoid power failures, reduce delays caused by catastrophic damage, such as cable theft, or damage by rodents or trackside work significantly reduces delay per incident.
<b>Freight cancellations</b>	The percentage of commercial freight services that are cancelled by Network Rail or another operator that is not a commercial freight operator.	As above.
<b>Composite sustainability index (CSI)</b>	The percentage improvement of asset sustainability compared to the end of CP6. Depending on the asset type, asset sustainability is measured either by remaining life of the asset or by asset condition score and is weighted by the replacement value of the asset.	Ability to accurately predict time to live for assets by continued monitoring of a full range of parameters will enable spot replacement of an asset to maintain the required asset quality across the entire asset base. Elimination of large scale renewals and the ability to predict required replacement strategy over multiple control periods will enable best in class CSI.
<b>Efficiency outcomes measures</b>		
<b>Efficiency</b>	A measure of efficiency savings against our CP7 delivery plan. This is split between our operational (opex) and capital (capex) expenditure.	Reduced opex by reducing maintenance, failure remediation costs and penalty payments from failures. Reduced capex costs by enabling spot replacement of signalling power supplies cables and assets instead of complete system renewals.
<b>Financial Performance Measure (FPM)</b>	Compares actual income and expenditure to a 'post-efficient' baseline (such as budget), adjusted for delivery of outputs. It covers most items of Network Rail's income and expenditure but excludes some that are not as controllable such as	Outperformance is expected if use of <b>CableGuardian</b> to eliminate the need for maintenance had not been previously planned within the control period. Also if renewals have already been planned then using <b>CableGuardian</b> to spot replace assets will reduce the scope of a renewal and thus save

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KPI	Description	CableGuardian Benefits
	network grant, fixed track access charges, traction electricity income and costs, and business rates. All other things being equal, if the expected efficiency is achieved, the target FPM is equal to zero. Outperformance is achieved when more work is delivered for the agreed cost or the work is delivered at a lower cost than was agreed (underperformance implies the opposite scenario(s)).	money. Elimination of failures to improve Public Performance Measure (PPM) above a baseline will enable outperformance on the opex budget.

### Sustainable growth outcomes measures

<b>Carbon emissions</b>	All scope 1 and scope 2 carbon emissions as defined under the Greenhouse Gas Protocol. Scope 1 emissions are all direct emissions from the activities of the infrastructure manager or under its control including fuel (oil, gas) combustion on site such as gas boilers for heating and fuel for fleet vehicles. Scope 2 emissions are all indirect emissions arising from the generation of electricity purchased and used by the infrastructure manager.	Fuel reduction from reduced scope of project work. Reduced fuels from reduced maintenance activities, reduced fuel use from incident management, people movement and recovery of operations.
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### Customers & communities outcome measures

<b>Passenger satisfaction</b>	The average score between the range of 1-10 given by customers when surveyed in relation to satisfaction with their overall journey, a higher score out of 10 represents greater satisfaction.	Reduced number of service affecting failures and reduced scope of disruptive projects will increase passenger satisfaction score.
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### People outcome measures

<b>Employee engagement</b>	An index representing the percentage of employees surveyed who responded favourably to key questions on engagement.	Reduced working under pressure during a failure created by ability to predict when work needs to be done to the asset will improve elements of work satisfaction. Move from antisocial working under pressure to simpler working practices without pressure.
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# Service & support from Viper Innovations

Viper Innovations will provide a full support service for your project, including:

- Providing analysis, worked examples, calculations and business case writing support to maximise the likelihood of success.
- Working with the client and project teams to identify the most efficient specifications and optimized design to meet project requirements.
- Team briefing and documentation to support the project across the whole lifecycle, including handover to test and handback to maintenance.
- Providing all training materials and ongoing support for the system in the project and maintenance phase.
- Providing coaching and support all staff across the whole process.

## Supporting data

The following data provides the building blocks of a financial business justification for the use of **CableGuardian**. It offers prospective cost ranges that can be used as multipliers to suit the respective project being tendered for. Support can be provided for the analyses of improvements on specific tenders, as well as input into RAMS analyses for projects.

- Calculation of maintenance costs of delivering PT1 from M001: £1800 per location (PSP or similar).
- Calculation of maintenance costs of delivering 5 yearly cable testing and/or PT2 from M001: £1800 per cable.
- Calculation of maintenance costs of C service per FSP: £1000 per location case.
- Calculation of maintenance and operational costs for major failure recovery, assuming Degraded Mode Working Practices: £500k-£1m per incident.
- Calculation of maintenance and operational costs for minor failure recovery: £20k per incident.
- Overall reduction in maintenance delivery unit costs of 80% for Signalling Power Supply Maintenance over lifecycle of asset.
- It is probable that a region will save a number of significant signalling power failures over the lifetime of the asset, potentially in the range of 15-20 incidents over a 30-year period. With each failure likely to generate between 5-10,000 delay minutes.
- It is possible that 100+ minor failures will occur across a region over the lifetime of the asset.
- It is expected that a catastrophic failure incident will be reduced in time by a number of hours by reducing the time take to locate a failure and switch it out.



Get in touch with one of our experts today and learn what  
**CABLEGUARDIAN** could do for you.

**[www.viperinnovations.com/cableguardian](http://www.viperinnovations.com/cableguardian)**

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