SET LIMITED

REMOTE CONDITION MONITORING & ANALYSIS

SPECIALISTS IN ELECTRONIC & ELECTROMECHANICAL
ROOT CAUSE FAULT FINDING AND RESOLUTION

Monitoring and recording the status levels of an in-service electrical system environment provides visibility of the anomalies when an intermittent or hard to identify fault occurs.

TARGETED DATA ACQUISITION AND ANALYSIS

Delivering data and evidence not available in existing diagnostic tools

Improving understanding of electronic environment

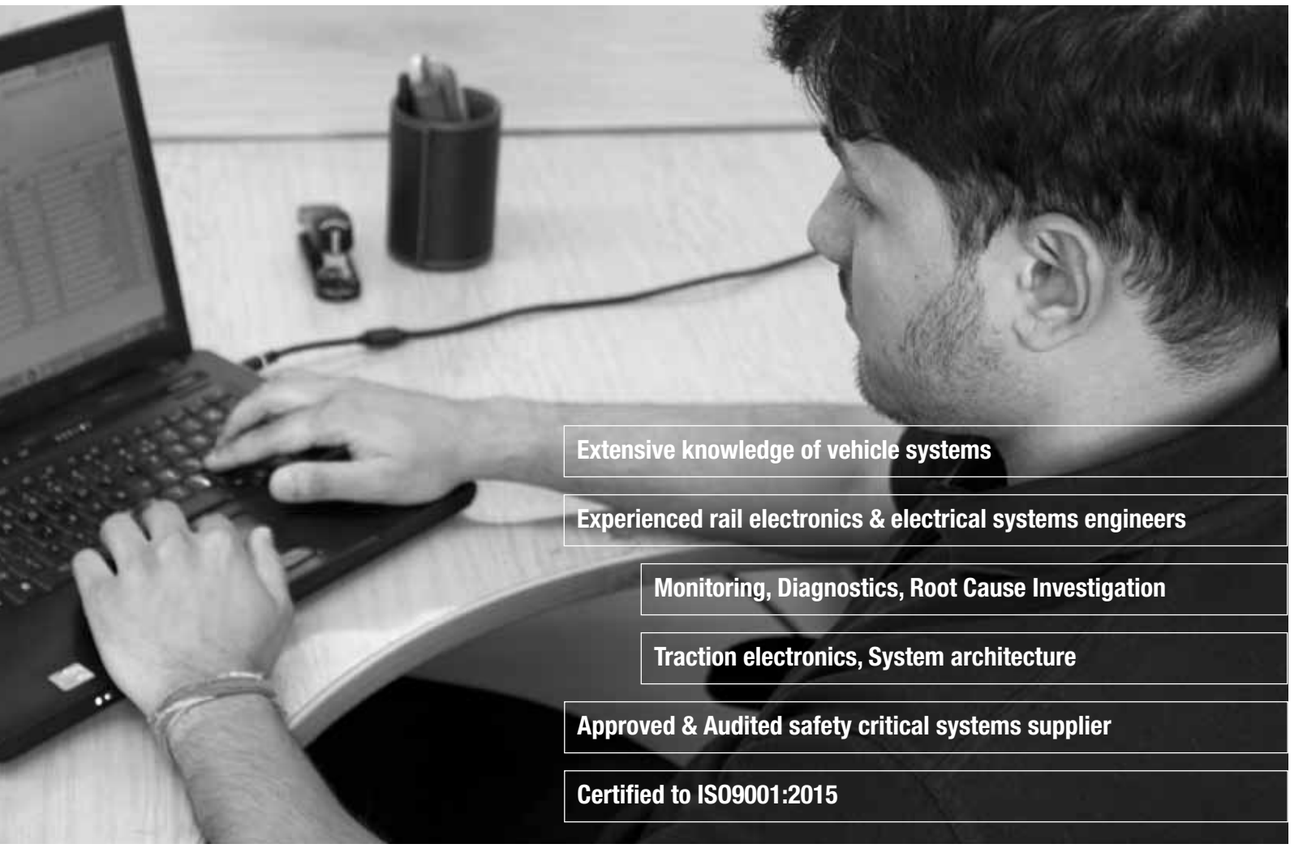
Customised to deliver focused data and analysis relevant to client issue

Live data delivery; local or remote

Full analysis and reporting service

Full installation service

Fully safety compliant



UNDERSTANDING THE ISSUES

The datalogger instrumentation was originally developed as part of an investigation to identify the root cause of charging systems issues on class 171s. This was driven by repeated and somewhat random operational issues with significant 'TiNS'.

The range of existing repair actions often did not provide a secure problem resolution and when parts were removed and sent for examination they were invariably found to be NFF.

By paying close attention to the descriptions given by the client's engineers and staff we developed the broadest picture around the issues. These included:

Reported fault symptoms.

Existing remedial actions.

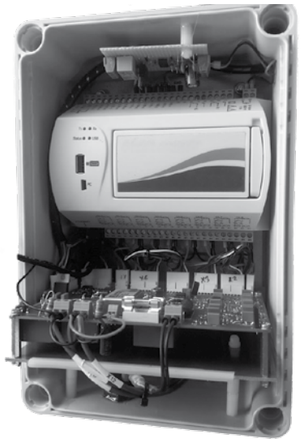
Success of existing remedial actions.

Reported repairs/defects/NFF with components from repair processes.

Design changes.

Full review of published data.

Modelling of existing system.



As this issue had been occurring for most of the fleet's service life the existing repair procedures could continue as the interim containment action - nothing in the initial engagement with the client and early system and component evaluation pointed to a quick solution.

It became clear that the symptoms could be as a result of the abnormal behaviour of a range of components within the vehicle electrical systems as the problems occurred whilst in service. Attempts to repeat the problem in a controlled environment had not been successful.

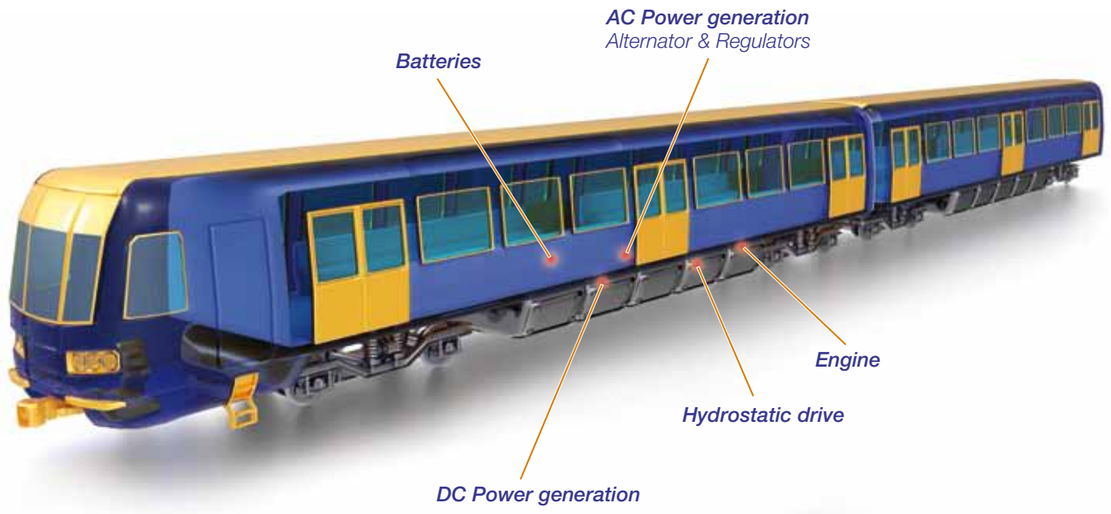
Despite trawling through the available data and reverse engineering the system's architecture, insufficient evidence was available to make a diagnosis other than presenting a range of potential root causes.

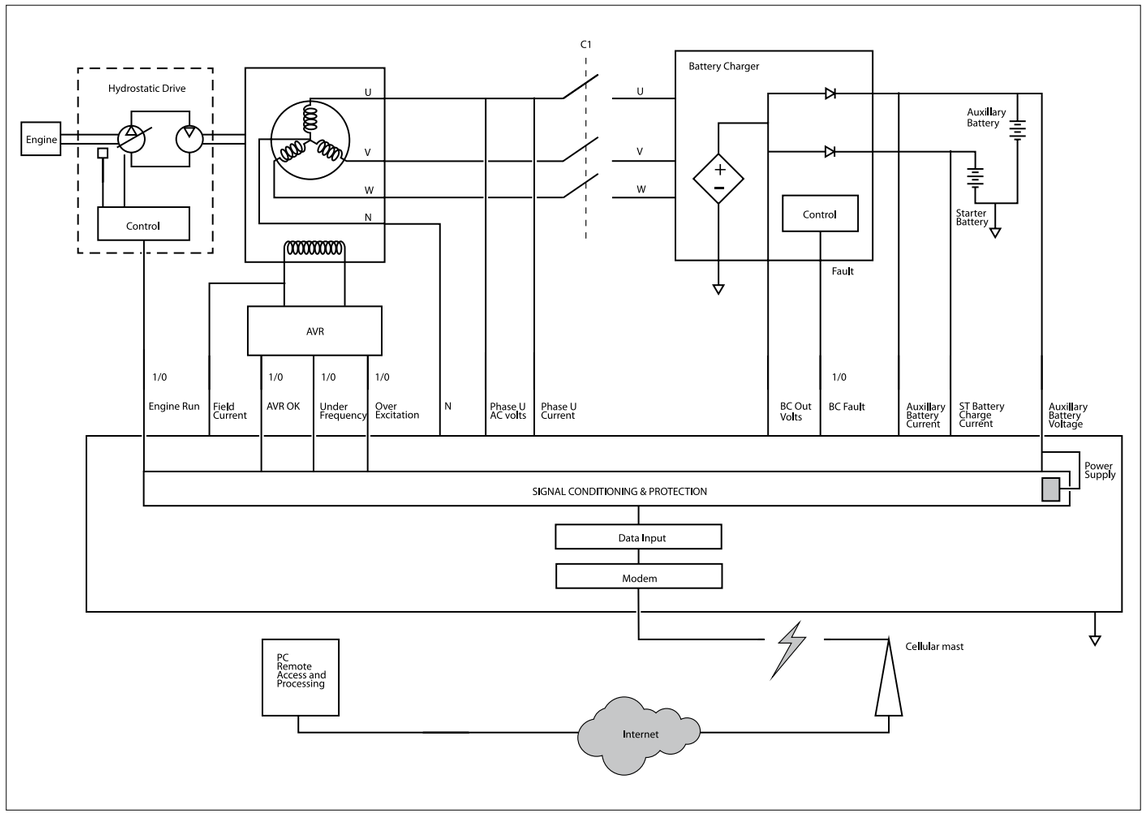
On agreement with the client that further data gathering was the most appropriate route to identifying the cause and given the operating requirements and constraints, SET recommended a remote monitoring, datalogging system as the most suitable solution.

IDENTIFYING AND COLLECTING THE DATA

A monitoring strategy, based on hypotheses developed earlier in the investigation, was adopted that would be able to identify a range of potential failure sources and behaviours across the vehicle electrical systems

The datalogger system was installed on a sample of the fleet that should statistically experience the reported issues within a 12 month period.





Monitored

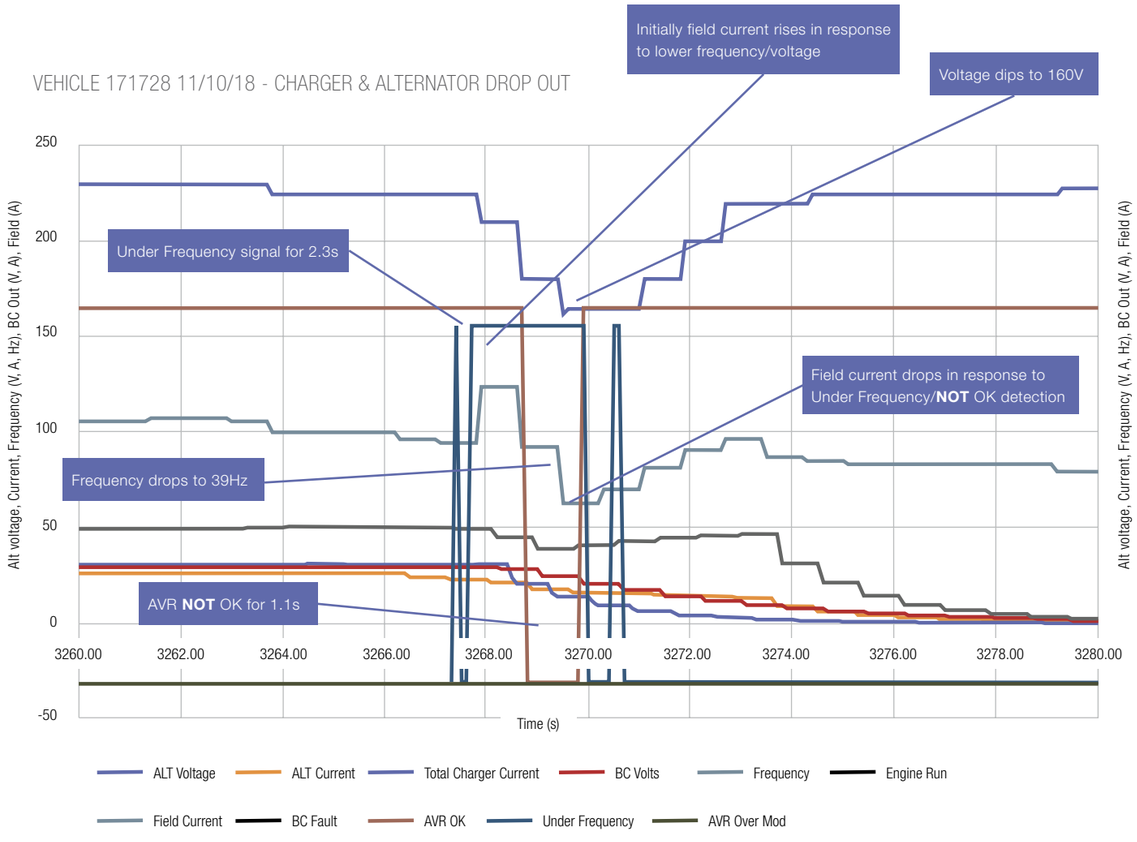
Pre-diode charger voltage	Voltage, DC (30V, max 36V) -
Auxiliary battery voltage	Voltage, DC (30V, max 36V) -
Starter and auxiliary battery current	Current, DC (410, max 600A) -
Field current	Current (0 - 10ADC)
Alternator output voltage	Vac (230V or 400V, max 320 or 550V)
Alternator output current	Current AC (90A, max 200A)
Alternator O/P frequency	Frequency (20 - 80Hz)
AVR fault indication	Digital signals (independent ground)
Engine Run	Digital signals (24V)
BC Fault	Digital signal (24V)

Specifications

Bandwidth >10Hz
Storage >80 days local storage
GPS location reporting
Remote access to data: 4G comms
Power Supply from vehicle 24v auxiliary batteries, <1A
Galvanically isolated
Underframe installed
Removable
Conform to relevant railway standards

DATA ANALYSIS EXAMPLE

Monitoring is for events where variables deviate from their normal operating condition.
These deviations are flagged by event triggers in the data logger.



CONCLUSION

This logger data sample demonstrates an event where the alternator speed dipped below the AVR's under-frequency detection level, creating a chain of events that led to a temporary loss of lighting. The alternator speed was generally within specification for over 99% of the time, making this difficult to detect after the event - when the vehicle returned to the depot. This data implicates the stability of the alternator speed (hydrostatic drive/ engine), where traditionally this behaviour would have resulted in either AVR or alternator replacement.

The analysis and conclusion were available with a few hours of the issue presenting.

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