CWRM Longitudinal Stress Monitor

INTRODUCTION

CWRM, Continuously Welded Rail Monitor, is a network of track-mounted monitoring systems that facilitate the management of track forces in continuously welded rails.

The system measures track forces and temperatures in near real-time, allowing these track parameters to be monitored at all times.

The use of multiple measurement points allows for the effective management of Continuously Welded Rails (CWR), with the aim of preventing rail breaks and buckling, in addition to carrying out optimised rail maintenance. The CWRM system therefore comprises an invaluable contribution to predictive rail maintenance and derailment prevention.

OPERATIONAL OVERVIEW – WIRELESS SYSTEM

A CWRM measurement node consists of a Mast Processor and up to four Track Nodes, each of which monitors the force and temperature within a rail leg. The Track Nodes report data wirelessly to the Mast Processor which in turn relays the information to a back-office server. Communication to the back-office occurs direct via a GSM network or indirectly via a license-free CWRM High Site, which caters for areas with poor GSM coverage.

A virtually unlimited number of these measurement nodes can be added to a CWRM network. These nodes collectively paint a picture of the status of the lines or sections that are monitored, allowing appropriate action to be taken whenever required.

REPORTING AND DATA OPTIONS

Access to measured data is provided via three independent means: Web Interface, Scheduled Reporting and Trending Application Interface.

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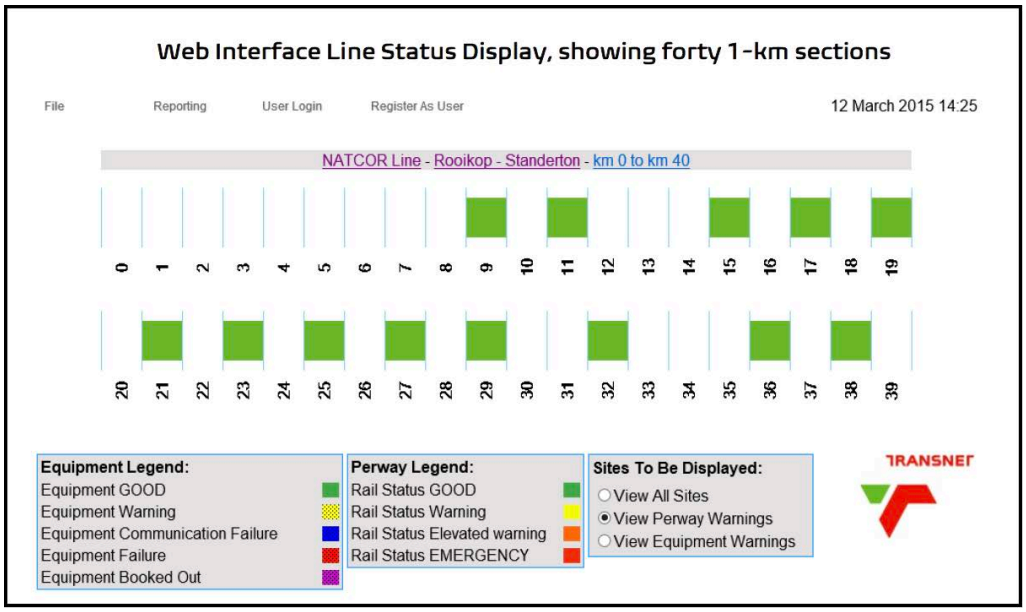
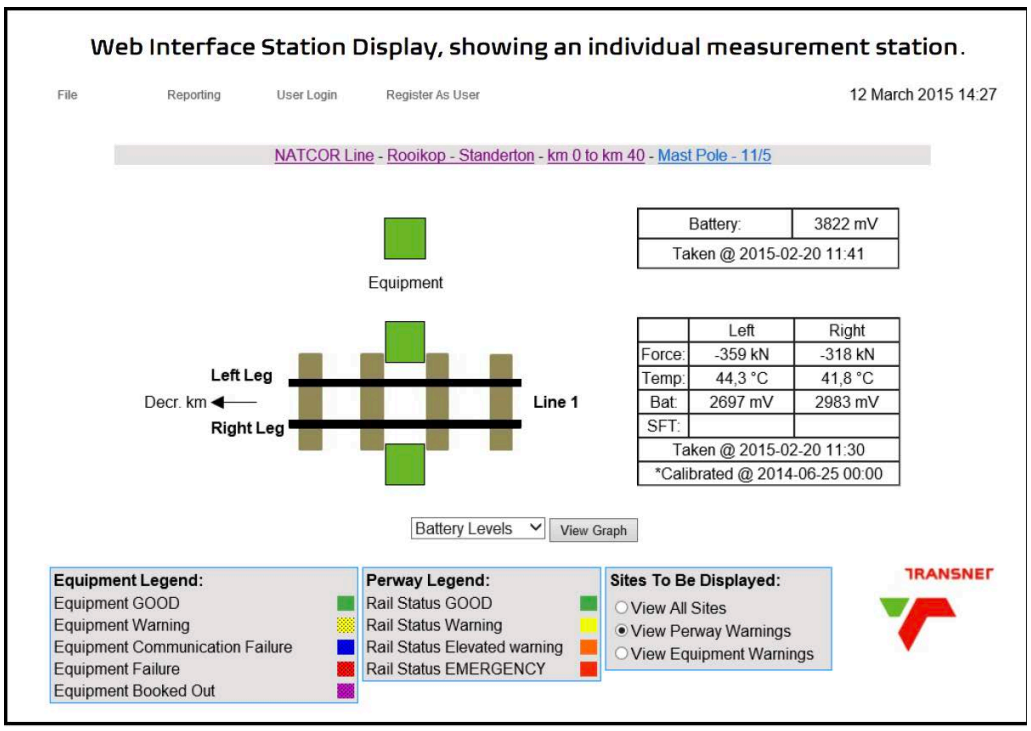
WEB INTERFACE – STATUS VIEW

An interactive Web Interface provides a drill-down view, starting from a top-level view of the line, all the way down to a view of an instrumented site. The interface is based on a series of nodes, which are colour-coded to highlight each node's status. At top-level, each node represents an entire section of line and as one drills down, the representation becomes more detailed, until finally the representation is of an actual measurement node.

At this bottom level, tabulated measurement data is presented alongside the coloured nodes. The graphical approach allows a quick status assessment at a glance, without the need to spend a long time drilling down or studying datasets for each instrumented site. For each site, a full set of plots are available, including Force, Temperature and Stress-Free Temperature vs. Time. From an equipment status perspective, plots of battery and RF levels are also available, as well as communication history.





The colour-coding caters for two distinct user groups: perway and signalling users.

The colours for perway users indicate the status of the force or stress-free temperature levels at the location, while colours for signalling users highlight the condition of the measurement equipment itself. Each group would view data specific to them, extracting maximum value for their role.

The Web Interface thus provides a good top-level Trending Tool, allowing users to monitor the system at a glance and identify where undesirable conditions may be developing.

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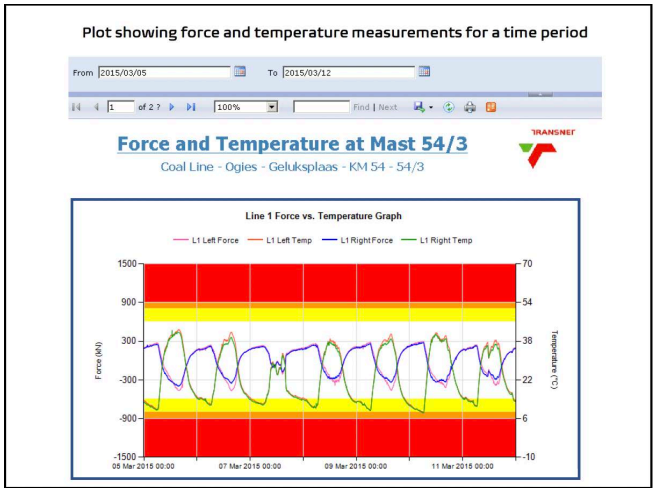
SCHEDULED REPORTING

A Scheduled Reporting function periodically distributes exception reports that highlight any areas of concern. Similar to the Web Interface, two distinct report families are available: one for perway and one for signals. Reports are scheduled to coincide with the start of shifts, providing users with an up-to-date list of exceptions within the network. The report includes the value of the parameter in exception condition, the severity, and the location at which the condition was detected. These reports add another invaluable tool, where management can take place on exception, rather than continually monitoring large datasets.

TRENDING APPLICATION

This Trending Interface provides a means of performing more detailed viewing and analysis of the measurement data. Temperature, Force and Stress-Free Temperature, can all be plotted vs. Time. This detailed information can also be exported should the need for further (external) analysis arise.



In a similar way, various diagnostic plots are also available, allowing maintenance staff to monitor the condition and performance of the measurement equipment. Diagnostic plots include parameters such as battery levels, RF signal strength and GSM signal quality.

PRODUCT FEATURES AND HIGHLIGHTS

- **Compact, Microprocessor-Based System**

Both Mast Processor & Track Nodes are controlled entirely by dedicated microprocessors making the system energy-efficient & reliable, while providing excellent performance. Each sub-system performs a specific, dedicated task that it is designed to do. The small size of microprocessors & their energy-efficiency results in a compact system that is not easy to spot, hard to damage during track maintenance & vandal resistant. The Mast Processor has dimensions 260 x 150 x 35 mm & the Track Nodes 150 x 140mm. Full installation is easily carried by two people within an hour.

- **Retrofit Technology**

The rail monitoring sensors are retrofitted to the existing rail section. No rail cutting, no sleeper modification or disruption of operations is required. Installation is carried out safely between train movements. In the event of maintenance activities, such as rail replacement, the track sensors can be safely removed from the track for re-installation on the new track. This ability also allows for relocation of the system and thus ensures the best possible return on equity.

- **Modular Design**

System nodes are designed to be modular, facilitating a swap out approach. This allows for simple replacement of any major system components. This includes batteries, processors & sensors. Importantly, this ensures a proportional approach to sparing & repairs, rather than a 100% cost implication on any replacement activity. In the event that equipment is damaged, a full repair or refurbishment service is available.

- **Self-Powering**

The Mast Processor makes use of an integral solar panel and lithium battery to power the Main Processor. A primary cell is used to power the Track Nodes, providing ~3 years of operational life, with extended options available. There is therefore no requirement for local power supply.

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CONFIGURATION OPTIONS

Each Mast Processor can manage up to four rail legs, or two lines. This is a configuration option and the number of monitored rail legs can be increased or decreased at any time. This provides cost benefit as well as a smaller hardware footprint

Where there is a need for three or more lines to be monitored, additional Mast Processors can be installed with no risk of interference between themselves.

COMMUNICATIONS OPTIONS

The Mast Processor utilises the GSM network to report measurement data to the back-office server. Transmitted data is compressed binary data, ensuring a small payload and minimal usage of communication resources.

In cases where GSM signal is poor or unavailable, a High-Site approach is used. In this scenario, up to four Mast Processors report to a single CWRM High Site, in a Mesh network. The High Site consists of a slightly modified Mast Processor serving as a Gateway to the GSM network – the shared Mast Processor platform reduces costs and simplifies stock holding.

Communications between the High Site and Mast Processors is via a license-free radio with an effective range of up to 10km. Note that multiple hops can occur between standard Mast Processors and the High Site. This communication setup ensures that the High Site can be located in an area with adequate GSM coverage, while still reaching the Mast Processors.

The various communication options offered therefore ensure continuous and reliable data delivery, even for the remotest of sites.

SPECIFICATIONS

MAST PROCESSOR	
Dimensions	260mm x 150mm x 35mm
Weight	1.2 kg
Solar Panel	3W
Battery Type and Capacity	Li-Po, 6.8Ah
Autonomy without Solar Panel	10 days
Ambient Temperature	-15° – 55°C
TRACK PROCESSOR AND TRANSDUCER	
Temperature Measurement Range	-25°C – 75°C
Temperature Accuracy, Absolute	<1.5°C
Force Measurement Range	±4,000kN
Force Accuracy	±2%
Sensor Application Method	Adhesive
Measurement Interval	1, 5, 10 minutes
Battery Type and Capacity	Li-MnO_2, 7.2Ah
Battery Life	Up to 3 years

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