RAMJACK Technology Solutions

In Cooperation with:

CONSPEC

NEWTRAX

Mine Design technologies

Project Charter for the implementation of the Mine Hop, Conspec, MDT, uGPS systems. Wits University Sterkfontein Caves - South Africa

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Project

Name: Wits Sterkfontein Caves, Newtrax Mine Hop, CONCPEC Weather station and MDT ground monitoring Implementation Project

History

RTS met with Wits Sterkfontein Caves to discuss monitoring the stability, gas readings and mapping the Caves, with a particular focus on real time monitoring in the event conditions change in the Caves. Personnel in RTS wish to take this opportunity to introduce the benefits of real-time technology.

During discussions, a number of factors/issues were identified:

- Caves had a F.O.G in the past. The need for real time ground monitoring is essential when the Sterkfontein Caves is visited by Tourist.
- Atmospheric conditions can change during season changes and influx of tourists visiting the caves. These effects can have a direct impact on the Caves rock formation and Carbon gasses build up in the Caves. The changes can be displayed in real time, alarms can be set on certain thresholds and warn personnel.
- Continues accurate scanning of the caves will over time display convergence. The scanning will also be displayed at Wits University Digi mine as innovative technology.

Representatives of RTS, CONSPEC, uGPS, MDT and Newtrax Mine Hop presented the benefits of an integrated best-of-breed system combining ground monitoring, Atmospheric conditions, UGPS mapping and real time telemetry monitoring. That can be displayed and reacted on as change occur.

Wits - Sterkfontein has a great amount of tourists visiting the caves on a yearly basis. The implementation of an integrated System with REAL TIME, ACTIONABLE DATA, to make decisions that will ultimately lead to detecting change and rapid sharing of important information.

Developed for interoperability for these systems operating together will give Wits Sterkfontein an extremely effective real time monitoring solution. RTS' solutions will provide a central platform with which to manage day-to-day operations at a fraction of the cost and complexity of current solutions on the market.

The following document is intended to provide a summary of the discussion and outline the steps to undertake an initial rollout at Wits Sterkfontein Caves

Purpose

The purpose of this project is to Develop and implement a real time monitoring system that captures real-time data, that will indicate and alarm any changes in Rock Formation and atmospheric changes.
This will be accomplished with the implementation of a combination of the CONSPEC, MDT, uGPS and Newtrax systems.

Objectives

Ramjack Technology Solutions and its partners CONSPEC, uGPS, MDT and Newtrax have been invited by Wits - University to install the CONSPEC, uGPS, MDT and Newtrax system's at the Sterkfotein Caves.

- ✓ Implementation 1x CONSPEC weather station.
  - CONSPEC weather station to measure Atmospheric changes in the caves, during season changes and influx of tourists.
  - CONSPEC weather station to measure humidity, Carbon monoxide.
  - CONSPEC devise will provide Data that can be used to assist determine erosion rate or factors that might lead to accelerated erosion.
  - CONSPEC weather station will identify accumulation of CO in the caves and will alarm as warning not to allow any person to enter until alarms levels has decreased.
  - CONSPEC will connect to Newtrax Mine Hop nodes for real time display and alarming.
- ✓ Implementation 8x MDT ground monitoring devises.
  - MDT devises will be installed at identified areas, that pose a risk.'
  - MDT devises will monitor any movement at areas installed.
  - MDT devises will connect on the Newtrax Mine Hop network and display real time monitoring and alarm if any change occurs.
  - *please see scope change section: An additional rock bolt has been identified in an area that movement has been identified.
  - Rock bolt will ad support and reinforce the loose rock to prevent ant y further separation and movement. Ultimately ''bolt the rock'' in its current position.
- ✓ Scanning with uGPS rappid mapper Designed to provide quality 3D data while minimizing collection times.
  - uGPS; offers a diverse range of possible applications, ranging from convergence monitoring to Cave inspection.
  - Detailed data sets that enable surveyors and engineers to make better day-to-day decisions.
  - Note drilling and installation of mounting brackets for uGPS targets will be permanent installations due to the accuracy of mapping for future scans.
  - uGPS targets will only be temporary fixtures and will be removed after the scan is completed.
- ✓ Implementation of Newtrax Mine Hop network. 1x Newtrax Gateway and 6x wireless nodes.
  - To solve network connectivity challenges in fringe areas of the Caves.
  - Newtrax provides a battery-powered wireless network called MineHop: the only technology simple enough for timely monitoring.
  - Mine Hop, creates a network where MDT and CONSPEC can connect to for real time monitoring and alarming.
- ✓ Scoping and implementation of CONSPEC, MDT, uGPS and Newtrax Mine Hop network.
- ✓ Validate the operation of CONSPEC, MDT, uGPS and Newtrax software application and related components.

In Scope

System components

CONSPEC Weather Station Hardware

Hardware	Features
CONSPEC Weather station 	**Applications** • Fresh Air Applications Mining **Benefits** • Low Power Consumption • Natively offers both Modbus and Accessor protocols over RS485 or Trunk Networks • Supports Several Gas Sensing Technologies (Infra-red, Photoionization, Electrochemical) • Improved Graphical Display and User Interface • Multiple I/O options • Backwards/Forwards Compatible • Multiple Gas Support such as CO, CH4, NO2, H2S, O2, etc. • Reliable & Stable Operation **Compatibility** • Compatible with existing AMS networks including cables & Mod-bus / Legacy Systems Internal Scripting for Corrected Gas Readings • Compatible with existing sensor technology which allows customers to continue to use same inventory and part numbers PC Based Soft-ware for Remote Configuration. • Capability to swap the door out and using existing sensor hardware. • Expandable to Conspec's next generation products.

MDT- GMM Hardware

Hardware	Features
MDT – GMM 	**Operation** • A GMM is a displacement based sensor. • As the stainless steel rod moves, a very precise change in resistance is generated at the wiper terminal. • This resistance change is converted to a to a voltage, relative to a reference voltage. • The displacement is calculated as a ratio of these data. **Specifications** • Borehole diameter: 35 mm minimum • Transducer: linear potentiometers • Stroke: 101.6 mm (4″) • Accuracy: +/- 1% F.S • Thread size: M20, M24, 3/4", 5/8"

Hardware	Features
MDT- GMM 	**Features and Benefits** • Easy to install with no grouting required • Cost effective monitoring of primary support • Can be monitored wirelessly **Applications** • Primary support monitoring • Ideal for salt and potash mines • Crack monitor with optional bracket • Shaft convergence monitoring • Floor-to-back monitoring in salt mines with optional spring kit

Newtrax Mine Hop Hardware

Hardware	Features
Newtrax Gate way 	**Operation** • TCP/IP/Ethernet connection with Newtrax Central Server • Immediate notification of alarms by email and cellular SMS • Monitoring of system integrity • Web-based GUI for suite of electronic safety and automation applications • Option of external line power for use in areas where wires are not problematic • Provides both mobile access and backhaul routing functionality • Battery-powered wireless multi-hop router with years' battery life **Specifications** • Packets received on RS-232 port from Wireless Node are forwarded on Ethernet port to Central Server • Packets received on RS-422 port from Post-Accident Network Probe are forwarded on Ethernet port to Central Server • Packets received on Ethernet port from Central Server are forwarded on RS-232 or RS-422 port for routing to destination node **Power Supply** • If XX = AC, then 90-264 VAC @ 20 W • If XX = DC, then 12-15 VDC @ 400 mA • All: Power over Ethernet: 36-57 VDC **Physical Characteristics** • Operating temperature: -40ºC to +70ºC • Weatherproofing: IP65 • Dimensions: 180 mm x 120 mm x 60 mm + Connectors/Cables

Hardware	Features
Newtrax Wireless node.  **Newtrax MDT GMM wireless Node** 	**Operation** • Battery-powered wireless multi-hop router with years battery life • Option of external line power for use in areas where wires are not problematic • Provides both mobile access and backhaul routing functionality **RF front end:** • 915-928 MHz • NMO antenna connector • +3dBi omnidirectional antenna • TX radiated power: configurable from 1mW to 25mW • RX sensitivity: at least -100 dB • 32 x 200 kHz channels • Typical omnidirectional range in underground mines: 50 m to 150 m depending on antenna placement, tunnel dimensions and curvature, obstructions and rock type • Typical omnidirectional range on surface: 50 m to 600 m depending on antenna placement and obstructions **Spread spectrum protocol** • TDMA / FHSS • Synchronization for communications: ad hoc, per link and distributed • Hopping speed: once per time slot • Hopping pattern: pseudorandom • Link level acknowledgements • 76.8kbps data rate with effective link throughput up to 2.6 kbps (half duplex) **Wireless multi-hop networking protocol** • 16-bit network address • Ad hoc self-organizing and self-healing • Routing capability: any-to-any unicast, broadcast, and to/from Central Server via nearest Gateway **Internetworking port** • 4-pin RS-232 serial port for optional connection to Gateway **RFID** • Unique 32-bit identification number • User configurable label set via Central Server web console

uGPS Hardware

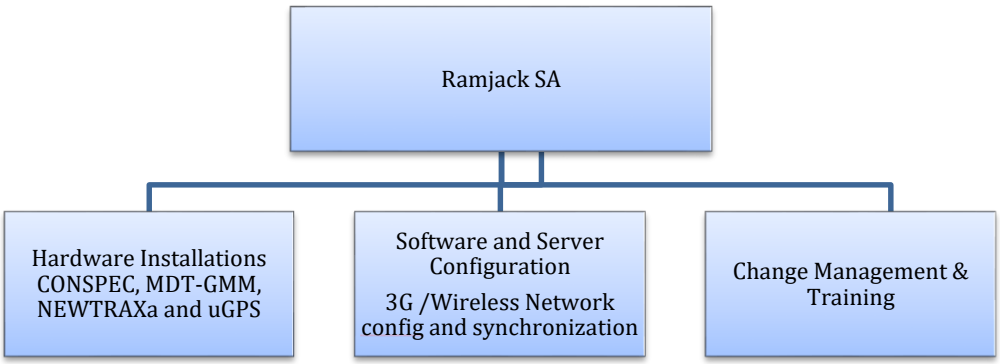
Hardware	Features
uGPS Rapid Mapper	**The technical and performance specifications.** • Power Supply Input Range: 10V to 30V DC • Operating Temperature Range: -30° to 60° C • Environmental Sealing of Core System Components:

Hardware	Features
 uGPS Rapid Mapper™ Box: 2 laser scanners, onboard computer, and RFID tag reader	IP 67 • Open Loop Mapping: ~0.5 % accumulated error (drift) per unit distance travelled • Closed Loop Mapping: Eliminates drift error by snapping to known points • Relative Accuracy to Ribs: +/- 3cm (~1 in) Application. • uGPS; offers a diverse range of possible applications, ranging from convergence monitoring to Cave inspection. • Detailed data sets that enable surveyors and engineers to make better day-to-day decisions. • Note drilling and installation of mounting brackets for uGPS targets will be permanent installations due to the accuracy of mapping for future scans. • uGPS targets will only be temporary fixtures and will be removed after the scan is completed.

Hardware Installation.

Execution Approach

The project is a turnkey installation approach with Ramjack SA being responsible for the delivery of the hardware and the installation of the hardware in the Caves.



The programme of installation is highly reliant on obtaining drilling license to allow Ramjack to drill required holes in rock face to mount hardware.
Also schedule access to the Caves to allow suitable time for installation. The installation is not complex and can be done after hours to prevent delay in tourist visitations.

Installation details/methodology.

CONSPEC Weather Station Installation.

Installation Areas and Supporting Hardware	Installation details and methodology.
CONSPEC Weather station. Area identified.  ***CONSPEC Weather station steel Stand.***  ***CONSPEC Wrieless node.*** 	**Installation.** • Connect to existing 220v power connection available at close to light source in cave. • Mount CONSPEC weather station to cemented stand. • Stand to be supplied by Ramjack • Connect to 220v power source. • Connect CONSPEC weather station to wireless node. • Power up CONSPEC weather station.

MDT- GMM Hardware Installation.

Installation Areas and Supporting Hardware	Installation details and methodology.

MDT- GMM areas Identified.
Area identified. (Areas of installation hardware indicated with the red line).
 
 
 
	Installation.
	• Use of min 3-Meter-High ladder to reach areas intended to drill holes for installation.
	• Drill holes each side of the MDT –GMM Collar plate.
	• Hole dimension is m12 roll bolt 5 cm deep.
	  ○ Estimated number of holes to be drilled for MDT GMM will be 32.
	• Mount GMM in each side of the proposed side wall, on the Collar Plate.
	• Tension GMM to desired tension.
	• Connect GMM to MDT wireless nodes.
	• MDT Wireless nodes to be mounted on Role bolts one per Node.
	  ○ Number of holes to be drilled for GMM wireless nodes is 6.
	• Hole dimensions m12 role bolt 5 cm deep.
	• Connection to wireless nodes with GMM harness supplied.
	• Power Up wireless nodes.
	• If needed install additional wireless nodes to ensure connectivity to the Gateway. Due to the Caves orientation.
	• Estimated 5x GMM wireless nodes to be used. With 2x Nodes.

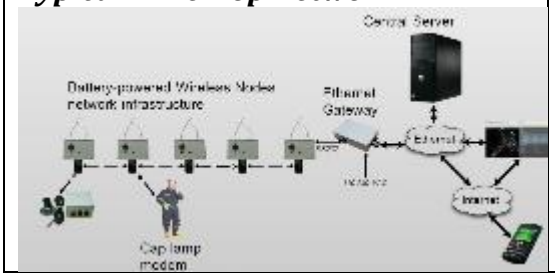
Installation Areas and Supporting Hardware	Installation details and methodology.
  	

Installation Areas and Supporting Hardware	Installation details and methodology.
 ***M12x5cm – Role bolt***  ***MDT – GMM Wireless Node.*** 	

uGPS Scanning

Scanning and Hardware scanning support.	Scanning methodology.
uGPS Buggy mounted.  ***uGPS Target***  ***uGPS target mounting bracket.*** 	**Scanning requirements and method.** • Known Survey point to start scanning. • Additional scanning point to be surveyed due to existing targets not high enough. • Target placement must occur concurrent with additional survey points surveyed. • Additional survey points will be a permanent fixture. • The actual target will be removed after scanning is completed. • The target mounts will be small survey spuds that is flush with the rock face 8mm diameter and 5cm in depth. • The mounting bracket with the target is temporary. • Due to the amount of steps leading in to the caves, Planks will be placed on the path over the steps to ensure uGPS has a smooth surface to travel on. • Once the Survey points are drilled and check surveyed back to known survey point and the planks are placed along the areas where the steps are located, the scanning can commence.

Newtrax Mine Hop Hardware Installation.

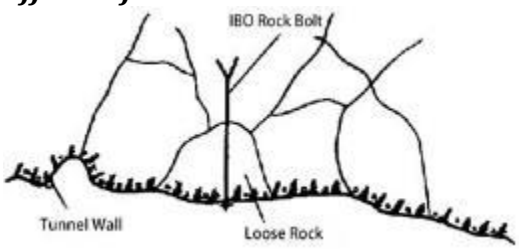
Installation Areas and supporting Hardware.	Installation Methodology.
Sterkfontein DB box in Caves at close to the Elephant.  *(Please note the DB box in Picture is not the actual DB box located in the Caves.)* ***Mine Hop Sync Node.***  ***M12x5cm Role Bolts.***  ***Typical Mine Hop Network.*** 	**Installation.** • Install Gate way near DB power box located inside the caves at the Elephant area. • Connect the Gateway to the Sync Node, Harness supplied. • Gateway can be mounted to the actual DB box. • Drill hole and mount Sync node to side wall close to where Gateway is mounted. • Sync Node will be mounted with 1x 12mx5cm Role bolt. • As mentioned before wireless nodes for MDT – GMM, CONSPEC and Mine Hop will be installed with m12x5cm Role bolts. • See picture of an installed network typical found in an underground operation which would be similar to your application.

Out of Scope / Customers Responsibilities and additional requirements.

Additional support requirements identified.

- During the site audit a rock was observed that all ready sown signs of movement.
- Due to the size of the rock and the area the rock is located, its likelihood to cause harm to Tourists passing underneath it is a high risk, so the decision was made to install additional support.
- The rock will be supported with 1 meter in length 18mm in diameter rock bolt.
- Please see Hardware and installation methodology below.

Additional Support summary.

Installation Area and supporting Hardware.	Technical data and installation methodology,
Area loose rock is identified.  ***Z bar rock bolt.***  ***Effects of installed Rock bolt.*** 	**Technical Data.** • a Steel bolt inserted and anchored in a hole drilled in rock to prevent caving of the roof of a tunnel or subterranean chamber. • Rock bolt is composed of high tensile strength steel- 500 - 650 MPA of 18mm 1meter length. • 18mm bolt has a load carrying capability of approximately 10 tons. • The rock to be supported is about estimated 206kg • This will then yield a factor of safety, of (48) (Factor of safety = capacity over demand) • Z bar rock bolt grouted with resin is an active support upon tensioning. • The rock bolt will clamp the suspected loose block to the surrounding rock mass. **Installation.** • Sound test the loose rock to obtain competency. • Install additional temporary support to re enforce rock whilst drilling. • Determine a level 90 degrees to rock face. • Drill 28 mm hole 1meter in length. • Insert resin capsule in hole. • Insert roof bolt with sharp back end facing direction of the hole. • Pres roof bolt in and rotate roof bolt whilst force is applied to mix resin capsule contend. • Press roof bolt until roof bolt plate is flush with rock face. • Rotate roof bolt again for 15 seconds. • Leave resin to set for 45 seconds. • Tension roof bolt until load shell on roof bolt indicate roof bolt is properly tensioned.

Connecting up previously installed GMM devises at entrance of the caves.

Previous installed GMM.	Requirements.
Previous installed GMM. 	• Wits Sterkfontein to supply information regarding the technical detail of previously installed instruments. • Ramjack with MDT in support to assist reflecting Data from the installed instruments. • This Data to be displayed on the same Network as the MDT – GMM instruments.

Additional surveyed requirements identified.

- Additional scanning point to be surveyed due to existing targets not high enough.
- Wits to ensure survey points are surveyed correctly during target installation to check reference to known survey station.

Power supply CONSPEC weather station.

- 220V power supply as indicated is needed to power up the CONSPEC weather station.
- Power supply must be in the form of 3-point power port.
- Power supply must be done by approved Electrician approved by Wits Sterkfontein Caves.

Sterkfontein Caves Database Server Specifications and Fibre installation.
Newtrax Server Specifications

Real Time Server

Operating System:	Linux Ubuntu
Processor:	Two (2) Quad Core Xeon Processors 3.0GHz-Hyper thread enabled, appearing as 16 processors to the system
Memory:	16 GB
Drives:	120 GB HDD space
CD/DVD ROM:	24x IDE CD/DVD RW Drive
Network Interfaces:	Dual Gigabit
Power Supply:	Redundant Power Supply
Fan Options:	Redundant Fan
Maintenance:	3-Year Onsite Next Business Day
UPS:	Three Hour network and servers recommended

Note: Hard disk storage requirements will vary based on the amount of historical data & retention policies and other site specific variables.

Hosted on Site by Wits Sterkfontein, this server will be the primary API platform & Microsoft SQL Database server.
One (1) Microsoft Business Reporting server configured as an "SQL Database Server"
One (1) Backup storage SAN configured to accept data exports

Partitions should be configured as follows:

C: Operating System with at least 10 Gb free
D: 120 GB drive installed with Microsoft SQL Server

Applications
- API Platform
- Microsoft SQL Server 2012 with BI tools installed

Reporting Server Specifications

Operating System:	Windows Server
Processor:	1 to 2 processors
Memory:	4 GB
Drives:	10 GB HDD space
CD/DVD ROM:	24x IDE CD/DVD RW Drive
Network Interfaces:	Dual Gigabit

Hosted on Site
by Wits Sterkfontein, this server will be the Web Server
One (1) Microsoft servers dedicated as a web server
One (1) Backup storage SAN configured to accept data exports

Partitions should be configured as follows:

C: Operating System with at least 10 GB free
D: 10 GB free
- One of the following Web Servers
  - Apache
  - IIS
  - NODE JS

Wits Sterkfontein Fibre installation.

Fibre Installations.

- Fibre to be installed from old shed on top of the Caves.
- Fibre Cable to be pulled through the opening in the caves located at the identified DB box in side the caves. (near the Elephant)
- Server is to be placed in the Shed at the Top of the caves

Application for drilling license.

This document also serves as application for the drilling licence. The installation date can only be determined when the license is approved. The intended installation date is scheduled to commence during November 2018.

Support

Telephone / Email Support

Unlimited support by telephone or email 24 hours per day, 7 days per week, 365 days per year for Priority 1 and/or 2 issues & Unlimited support by telephone or email during normal office hours (GMT+2), Mon - Fri for Priority 3 and/or 4 issues:

- By Phone: Call the RAMJACK Hotline
- By EMAIL: support@ramjackteck.com

Three Levels of Support

The Customer will have access to a three-tier support escalation process for issue resolution

LEVEL	WHO	WHAT
1st Tier	RAMJACK (Johannesburg)Technical Support Team	Logging of customer issue and expert advice, troubleshooting and diagnosis
2nd Tier	Facilitated OEM Technical Support Team	Escalation from 1st tier and escalation to 3rd tier. Approval of any workaround issued.
3rd Tier	OEM Product Development	Use of compiler and debugging tools, ability to issues a customer specific patch

Project approval and sign-of

Commercial Agreement

This charter will be used as the mechanism to guide the successful implementation of the project and all assumptions of Roles and responsibilities for the Project will be defined here.

Stakeholder Charter Agreement

Authorized by _____ Date __/__/__
Ramajck (Martin Grobler)

Authorized by _____ Date __/__/__
Ramjack (Kevin Ramsey)

Authorized by _____ Date __/__/__
Ramjack (Mike Jackson)

Authorized by _____ Date __/__/__
Wits University – Sterkfontein Caves (Prof. Frederick Cawood)