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Executing A Massive Signalling Project – Successfully

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Executing A Massive Signalling Project – Successfully

The project, which is worth approximately R3.4 Billion, is the largest signalling project ever to have been awarded in South Africa. Scheduled for completion end 2021, it will control railway traffic in Gauteng, allowing an increase in the number of passengers that are safely transported every day by rail.

Siemens is a global leader in the supply of signalling technology and associated rail infrastructure. In South Africa, Siemens Mobility has been contractually involved with the upgrade of the obsolete signalling for PRASA in Gauteng since 2011. Two contracts were awarded to Siemens Mobility to replace the signalling and train control systems in Johannesburg and Pretoria, which included the delivery of SICAS S7 electronic interlocking system, the Gauteng Nerve Centre, ACM 200 Axle Counting Systems and BSG9i Points Machines, among other items.

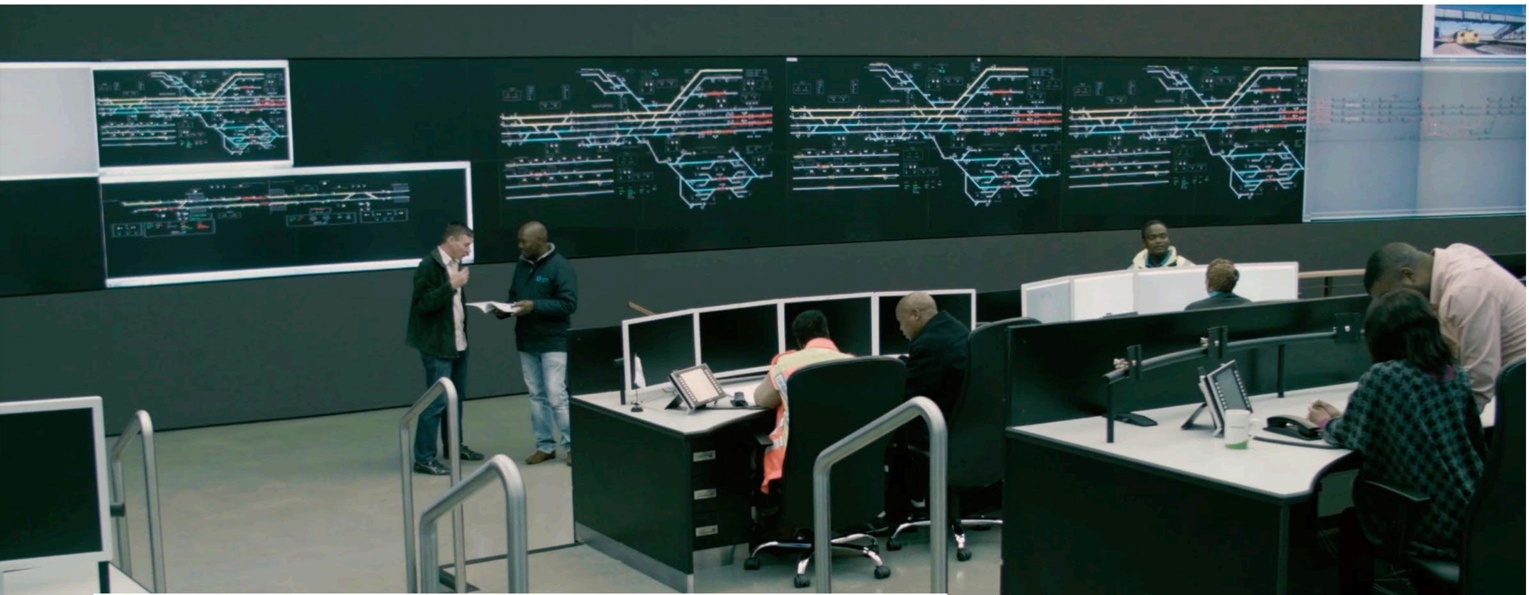
No one is blind to that fact that the signalling system in South Africa is obsolete and no longer meeting the commuter transport needs of the country. The Gauteng region, probably the most adversely affected, just based on its size and the number of passengers, often makes headlines. Manual authorisation, currently a standard method for train authorisations, in Gauteng anyway, is about to be a thing of the past. To the relief of passengers, PRASA and the Railway Safety Regulator.

At the time of the initial contract, it was noted that the new Railway Signalling System and construction of the Train Control Nerve Centre will enhance operational capacity and allow higher flexibility, improved safety, reduce train delays and remove human error factors.

PRASA set in motion the priority areas for the introduction of the new signalling system in high-volume priority corridors which are; Naledi in Soweto; Pretoria to Johannesburg; Mabopane to Pretoria; Mamelodi to Pretoria.

These type of projects are not only massive from an investment perspective, but they also take time to execute and South Africa has a somewhat complicated regulatory environment which can sometimes lead to delays in implementation.

But, let's take a step back and appreciate the intricacies involved in this resignalling project, and how it has all come together - through local participation, local manufacturing, skills development, job creation and the expertise required to execute.



The Gauteng Nerve Centre

Siemens was commissioned to build the new command centre bringing together all the existing control rooms to one location. The Gauteng Nerve Centre (GNC) as it is known, is the core component of South Africa's largest signalling project, and was built and delivered in just over two years.

Situated on 8,500m² near the Kaalfontein Station, the 3,400m² building serves as the "eye" that overlooks the entire PRASA network. The GNC provides a central location to manage and control the commuter train movement within Gauteng. And, integrates all essential auxiliary services required to efficiently manage train service.

The GNC will provide greater efficiencies in the not-too-distant, future rail operations and train safety while offering a more frequent service through higher line capacity.

The heart of the centre; the command room is equipped with a 52m long video wall used for the monitoring of train movements, the display of the traction electrical supply as well as weather and other operational information. Train movements are controlled from 30 multi-screen workstations each equipped with an integrated communication module consolidating telephone, trunk radio and GSMR communication.

The centre also incorporates; Passenger Information Systems, Overhead Track Equipment monitoring, CCTV monitoring of stations, training room and a crisis control room. Also included are technical room, workshop and maintenance areas, press room, storage of paper and electronic records. The facility is designed to operate 24 hours a day, seven days a week and is equipped with many redundant systems to ensure uninterrupted service.

Two separate electrical supplies, supported by 2 x 800 KVA diesel-powered Rotary uninterrupted power supplies, each able to provide power to the GNC for up to 48hrs. The communications fibre network is fed from a ring system with redundant hardware to minimize network interruption.

Staffed by 70 PRASA personnel consisting of thirty train control operators; five train control supervisors; five CCTV operators; three system supervision; four technical supervision; six maintenance technicians; ten CIS operators; six Security and other support staff and one GNC Chief.

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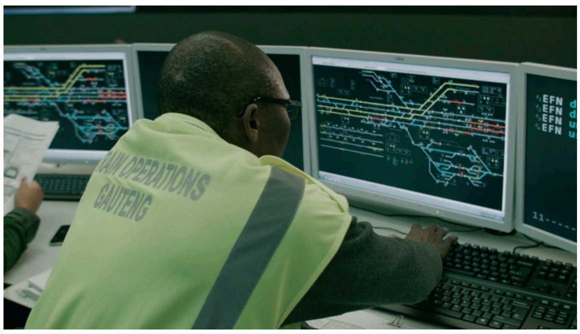
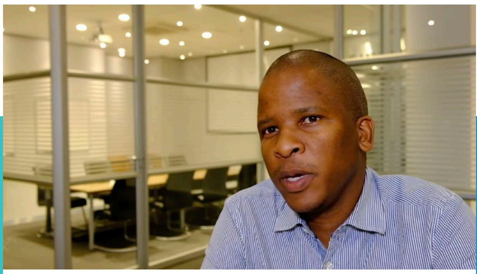




Thomas Mashishi
Project Execution Manager

Takes us through the entire project process from design, engineering and installation and FAT (Factory Acceptance Testing) how this comes together onsite - linking design, implementation and commissioning of each site. Including site related tasks, subcontractor management, scheduling and community engagement.

https://youtu.be/VG4BO_zSK-E

Project Scope

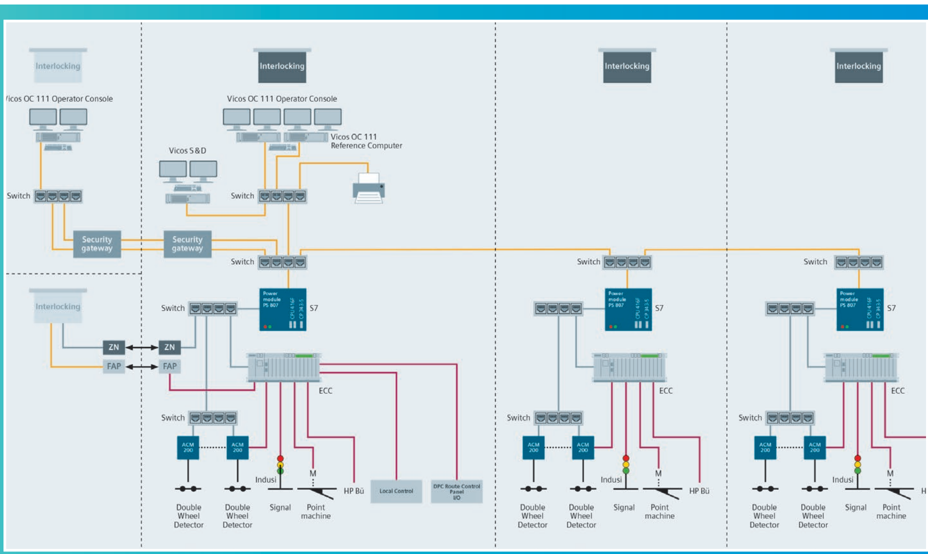
The project scope for Siemens Mobility is the design, supply, installation and commissioning of the new electronic interlocking system at 89 stations that will connect to the already built and operational command centre (the Gauteng Nerve Centre).

The project comprises of the modernisation of the signalling system to meet internationally recognised safety levels, and the development of train control software. Both indoor equipment as well as all the trackside signalling equipment will be upgraded to the latest technologies. The outdoor activities include over 500km of trenching and the replacement of cables. The new signals use LED light units which will reduce both maintenance and energy consumption as well as improve visibility of the signals for train drivers.

The completion of the rail signalling project will see the Gauteng railway network aligned to modern urban rail networks seen across the world. The new train protection system will not only increase capacity by the reduction of headways from 15 minutes to 2.5 minutes, but will also provide for bi-directional signalling by enabling trains to “overtake” or pass obstructions that may be blocking one of the lines, thereby ensuring the operator has greater control of the service with the freedom and flexibility needed to reduce train delays.

The system's safety is also improved with the introduction of axle counters for track vacancy detection instead of the traditional track circuits. For this, the very modern ACM200 axle counting system is combined with the robust and reliable ZPD43 trackside equipment to provide track vacancy information to the interlocking.

The new interlocking makes provision for future upgrades to ETCS Level 2 which is a radio based system that displays signalling and movement authorities in the cab. This system brings two key benefits, firstly it increases safety through automatic train protection feature and, secondly, reduces the trackside equipment.



Technology Trackguard SICAS S7

Interlockings, train control systems and track vacancy detection systems are essential for efficient rail operation. Powerful and highly available signalling and control systems help to make rail services even safer and more cost-effective.

Trackguard SICAS S7 electronic interlockings functionality includes:

- Control and detection of points, signals and other outdoor components
- Route setting and releasing
- Connection of intermittent and continuous train control systems
- Relief operations and cancellation of operator actions
- Locking and unlocking of individual element
- Highest safety level rated signalling system – a SIL4 rated system

Trackguard SICAS electronic interlockings allow operation via control centres or local control and display equipment which also permits operation per area or section.

Siemens Mobility has locally developed a train control system for South Africa called SATCOS (South African Train Control Operator System). This computer-based system allows the Train Control Operator (TCO) to control signalling field elements and set routes for safe train operations.

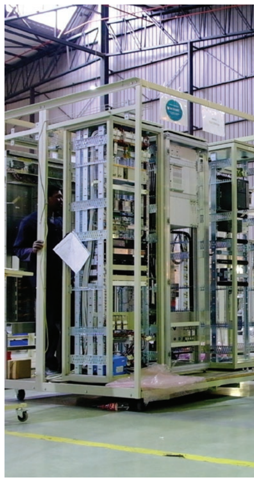
Track vacancy detection creates the basis for rail automation. A track vacancy detection system supplies the information about whether a track in a particular section is clear or occupied, thereby permitting safe, trouble-free and efficient operations management.

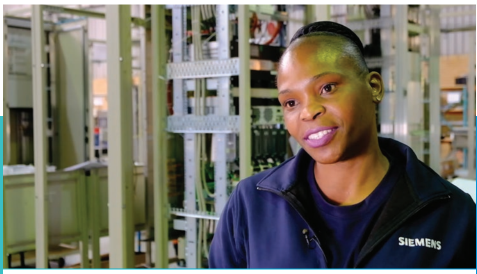
For this project, they have chosen Siemens' Clearguard ACM 200 axle counting system. This system is made up of maintenance-free ACM 200 modules, which are programmed via an ID plug and combined with the Ethernet bus and counting heads of the ZP D43 into a fail-safe axle counting system. The system conforms to the highest safety integrity level, SIL4.

Benefits
Low acquisition and operating costs High availability
Highest safety level (SIL4)
Less hardware
Compact design
Flexbility
Optimized energy consumption
Long service life

The whole project is underpinned by stringent testing and safety processes to ensure a SIL4 solution, the highest safety level, is installed. Localisation is an important aspect of the project for Siemens Mobility, and they have set up a local facility in Northriding where the majority of the engineering, manufacturing and testing takes place.

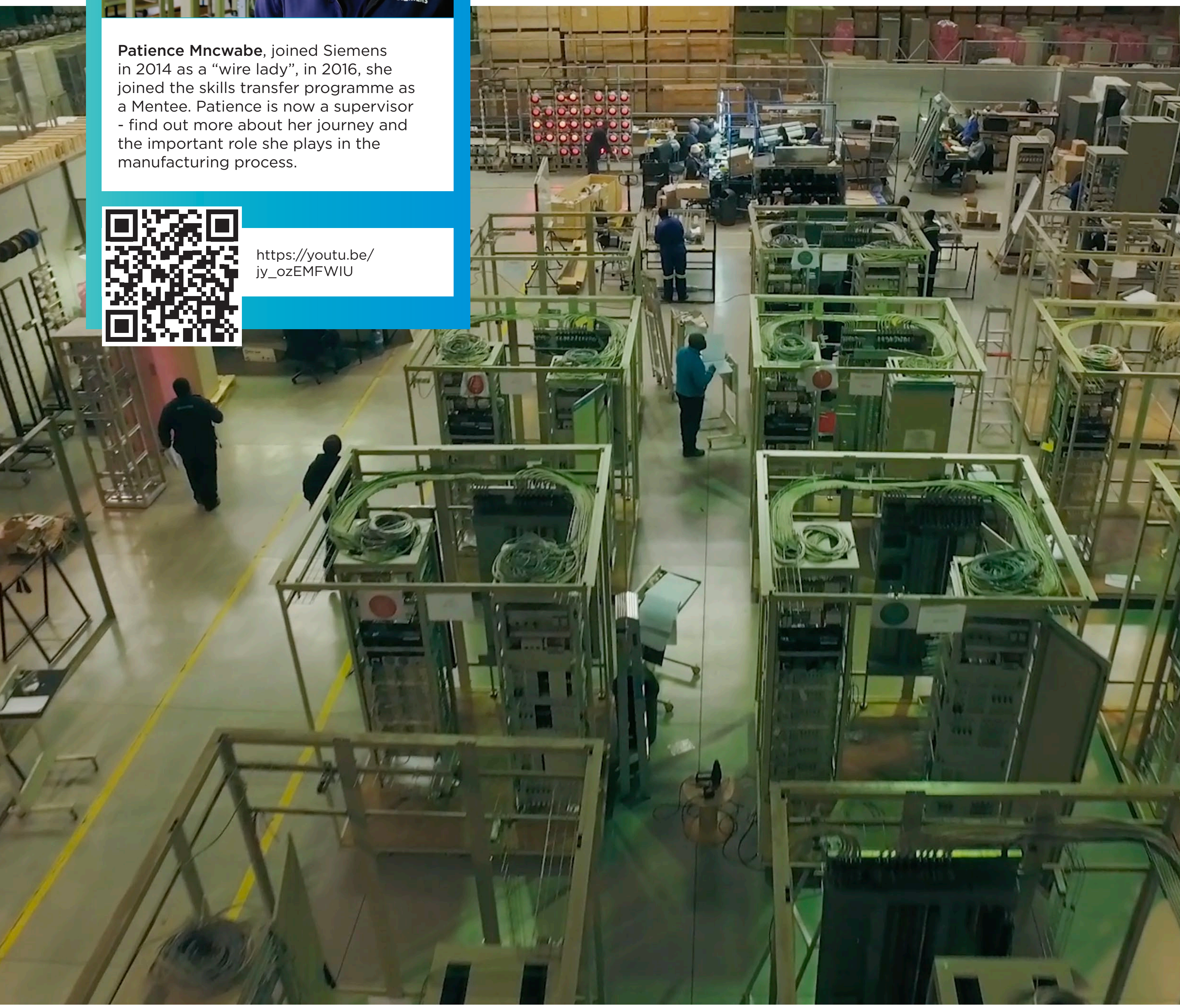
Extensive training is being provided to bridge the skills gap from existing technologies to the new electronic-based signalling system. Training of PRASA train operators and maintenance staff is ongoing. Also, on the job training is being provided to young technicians and engineers at the factory and the various sites.





Patience Mncwabe, joined Siemens in 2014 as a "wire lady", in 2016, she joined the skills transfer programme as a Mentee. Patience is now a supervisor - find out more about her journey and the important role she plays in the manufacturing process.

https://youtu.be/jy_ozEMFWIU



Bringing It Home And Making It Local

Siemens Mobility sets out to design and engineer systems that enable safe reliable transport. Each system is designed to achieve a “zero tolerance” approach to incidents caused by the functionality of their systems. Globally, the Siemens teams work seamlessly to assure the safe application of their interlocking system - no, matter where in the world the site happens to be. For the Gauteng Signalling project, the SICAS S7 interlocking has been developed by Siemens within Germany and subjected to stringent EU verification and validation processes to achieve SIL4 certification.

Within South Africa, the local Siemens Mobility team undertakes equipment manufacturing, assembly and all station-specific interlocking design, testing and implementation. Each stage of development in the application of the SICAS S7 interlocking to each station is rigorously and independently checked and confirmed to comply with the relevant requirements.

SIL4 is the highest defined level of safety in the rail industry and has been developed and applied in Europe to run their passenger rail network signalling, including high-speed train operation.

The local engineering team, comprising of 65 employees, is responsible for the design work for all sub-systems in the project. The signalling engineers issue the book of circuits to the manufacturing facility, where every design is station-specific. Software engineers will programme the software required to run the electronic interlocking. Other engineers will design and engineer key sub-systems such as power, network, and the train control system. Finally, test engineers are responsible for ensuring all systems are tested to meet the pre-defined test conditions. All engineering process ensure what is delivered meets the stringent SIL4 requirements.

Gasbia Michael - *Factory Manager* - Siemens Mobility (Pty) Ltd walks us through the facility and the processes, highlighting how the project is being executed in the factory, localisation and skills development.

https://youtu.be/cLYhxf0ES8I

Manufacturing

Manufacturing and assembly activities takes place at the Siemens Mobility factory in Northriding, Randburg. All the equipment required for the SICAS electronic interlocking system makes its way through this factory. Key local suppliers support the factory with materials and components, with some equipment being supplied from Germany due to safety-critical certification. They have been able to reach a 60% local content from a manufacturing perspective and taking labour into account then the total project reaches 70%.

From a productivity perspective, the factory plays an important role in ensuring that there are no bottlenecks on site - so production is always seven stations ahead, which means that if there is a change to site for whatever reason, there is the ability for the project to re-prioritise installation works.

Striving for zero defect, each step is checked and verified before it’s been handed over to the test team. The factory has a staff complement of 28 people, 17 in factory and 11 are part of the installation team.

Interlocking Testing Facility

As part of the project, and with the localisation in mind, Siemens has invested in an Interlocking Testing Facility (ITF) at the Northriding facility. Siemens is the first company in the southern hemisphere to introduce a test facility at this scale. The ITF is used for Factory Acceptance Testing (FAT) before commissioning and fault finding on already commissioned stations.

The procedures in the ITF will test both hardware, delivered form the factory, and software, delivered from the engineering team. The hardware and software tests are done independently to reduce reliance on one another during FAT.

The hardware or indoor equipment, such as the control racks and axle counter racks, go through a rigorous Factory Acceptance Test before being released to site. As the testing is done independently, the indoor equipment can be completed early to build up an equipment buffer for project execution in case the project schedule changes.

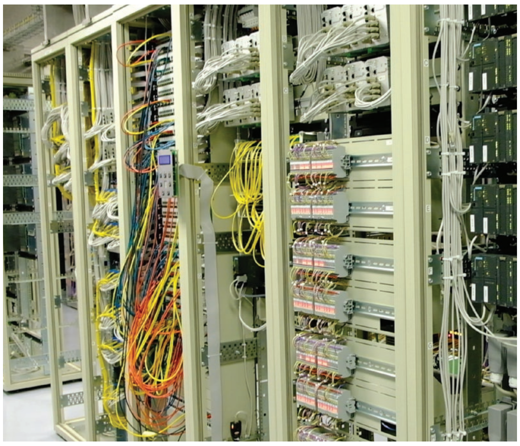
For software testing, the ITF has been successful in digitising the test process. Permanent racks, with specialised modules, simulate the trackside equipment (Signals, Points and Axle Counter Heads) defined by each station configuration.

Desktop computers with special software programs are used to test the system. This set-up reduces the testing set-up times significantly as the ITF test engineers can configure any station without having to dismantle and assemble hardware destined for site.

During the software testing, train movements are simulated as well as equipment failures and site conditions. The ability to simulate various scenarios increases the scope of testing done during FAT, which results in less testing on site. Once the software FAT has been completed and passed, the tested station is ready for site commissioning.

Through digitisation, the ITF has provided numerous benefits for the project. The ITF can be easily configured to match any specific PRASA or Transnet Freight Rail (TFR) station. It has the capability of testing three stations simultaneously and has reduced testing times by 40 to 50 percent depending the size of the station. Additional testing procedures can be performed in the ITF, which results in reduced testing time on site. The installation can be used for the training of personnel with simulated real-life installation without interfering with working installations.

With the ITF, the project can execute its works faster, better and more accurately.



Sipho Nzama – Systems Architecture Engineer for Siemens, takes us through the process at the Siemens Interlocking Testing Facility in Northriding.

https://youtu.be/F4Odu2IKjdc

On Site

Seeing the actual installation on site brings the project full circle, and makes one understand the complexities involved in delivering a project of this magnitude. The continuous quality inspection and verification from initial manufacturing and assembly, through to testing and the rigorous standards and processes on-site. All, to ensure the project is implemented per the customers' standards, is what makes this a successful project.

Arthur McMillan
Health and Safety Officer
Takes us through the general process on-site, specifically that of Health and Safety, and how this role impacts the success of the project. Safety on-site is key.

https://youtu.be/sVibm1AtBMA

Azania Dlokweni
Project Execution Manager
Explains the physical installation of equipment on-site, specifically some of the critical aspects such as stage works, inverters and points machines.

https://youtu.be/PjWzwFHJwP4

Tshego Mogomotsi
Quality Manager Project
Quality, quality, quality - it is not negotiable. Tshego ,takes us through her role on site and the different inspections they conduct and role between quality and the customer. Quality is the link between, design, implementation and the customer.

https://youtu.be/eLkcVnv7iiQ

This project has developed local skills, created manufacturing capacity, brought in technology transfer and created jobs. The execution of this project will give Gauteng a fully functioning state-of-the-art signalling system, bringing reliability, availability and safety to commuters.

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Wayne Davies - *Business Development*

https://youtu.be/pA8auUaKWZA

SIGNALLING | RAILWAYS AFRICA | 1:2019

Africa's Busiest Railway Stations Have Been Commissioned With A New Signalling System

Siemens Mobility commissions three of the busiest railway stations in Africa

Additional Content

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Railways Africa - Coffee with the Editor
Signalling team:Just after the commissioning of Johannesburg Park Station.

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