

SC 2023

INTERNATIONAL RAILWAY
SAFETY COUNCIL

“Reshaping Railways in an Uncertain World”

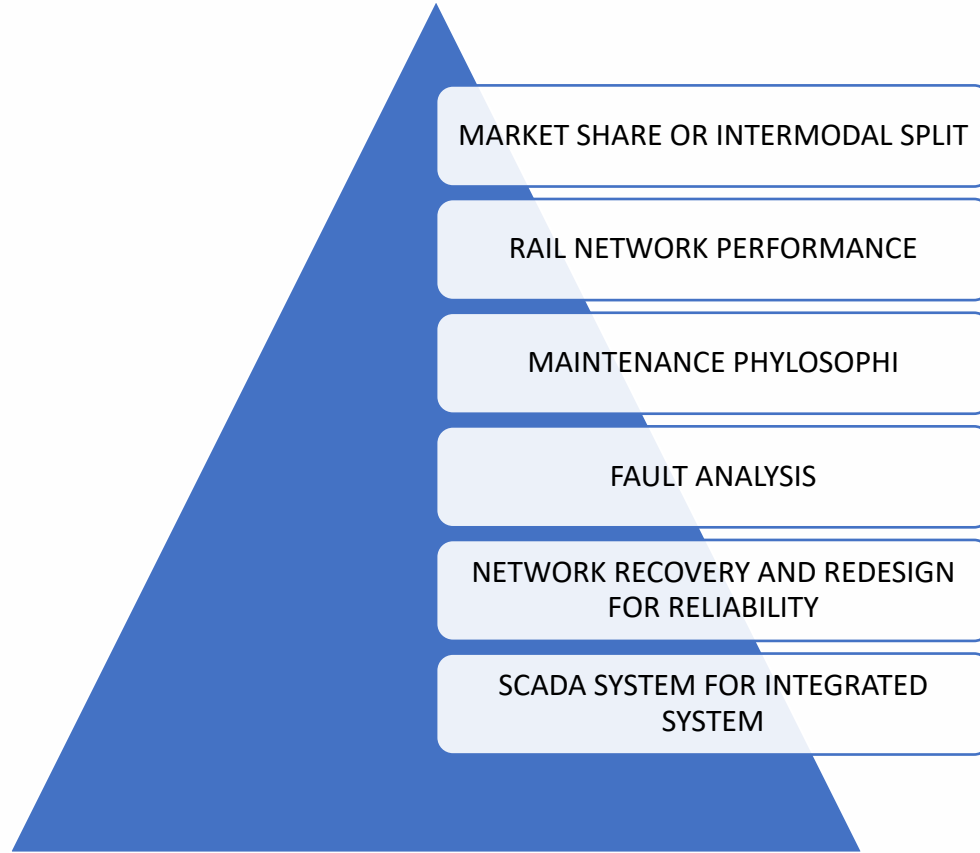
CAPE TOWN, OCTOBER 1 - 6, 2023



Ayanda Bani
Passenger Rail Agency of South Africa (PRASA)

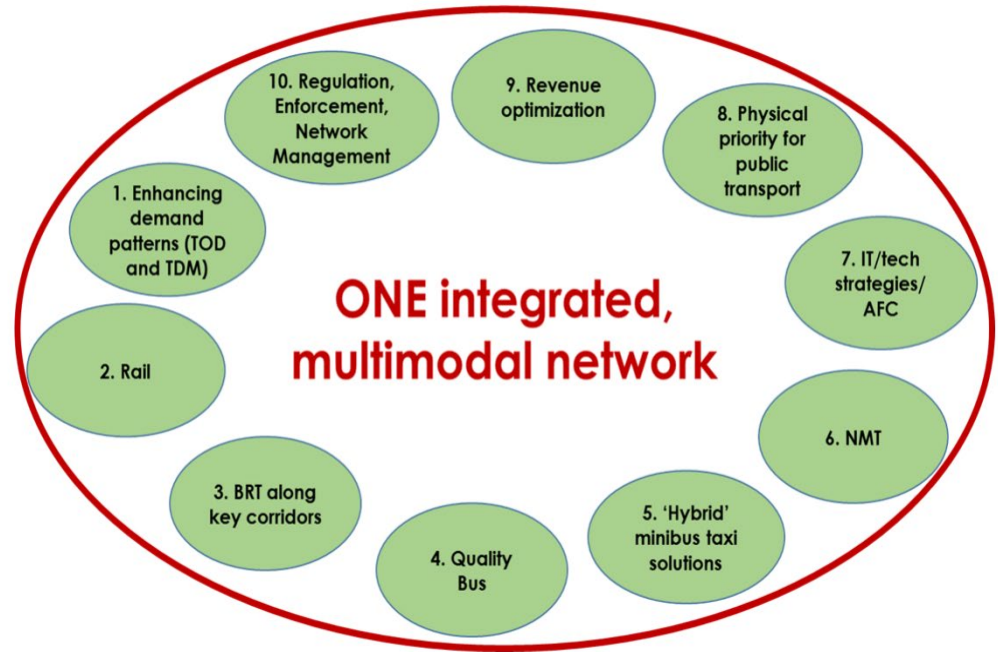
TRACTION NETWORK RELIABILITY TO IMPROVE CUSTOMER EXPERIENCE

INTRODUCTION

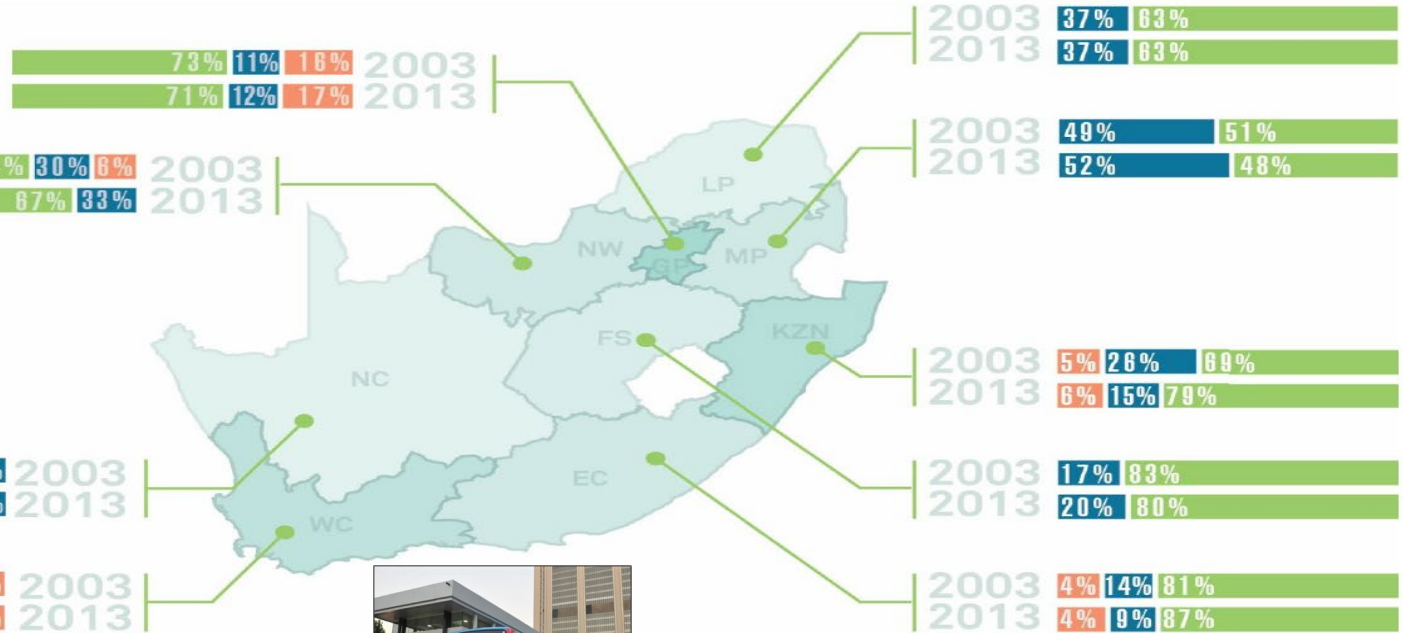


MARKET SHARE – INTEGRATED TRANSPORT – ONE TICKET & TIMETABLE

One Plan
One Network
One Management System
One Contracting Authority
One Ticket and Timetable
One Unified Enforcement System
One Unified Structure
One Brand



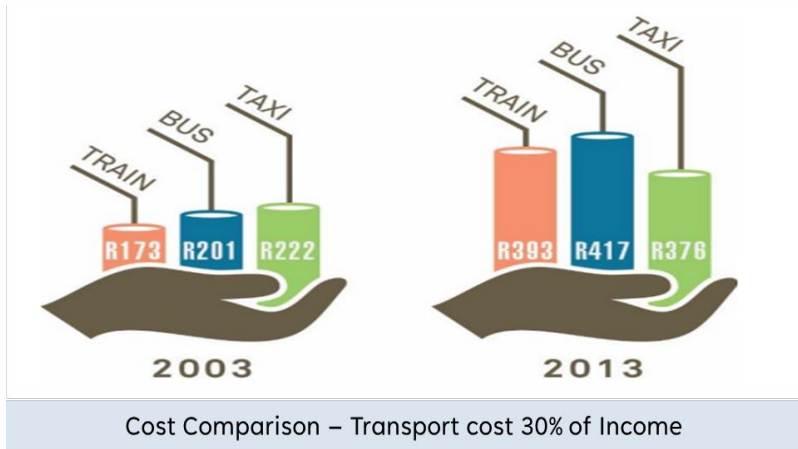
INTERMODAL SPLIT – NATIONAL MARKET SHARE



MARKET SHARE - NATIONALLY

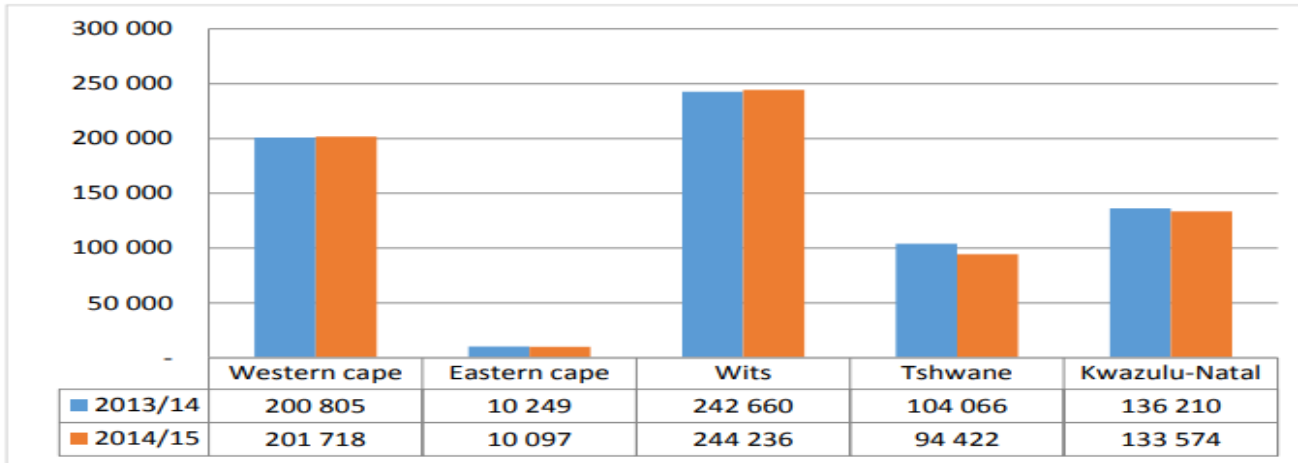


MARKET SHARE – NATIONAL COST COMPARISON



RAIL NETWORK PERFORMANCE – REGIONAL PASSENGER TRIPS

Rail Monthly Train Trips per Region, Year 2013/14 to 2014/15



Train Trips increased in Western Cape, but km distance travelled reduced (2013/14 – 2014/15)

RAIL NETWORK PERFORMANCE – REGIONAL PASSENGER NUMBERS

Rail Passengers by Region in 1000, Year 2013/14 to 2014/15

2013/14	April	May	June	July	August	September	October	November	December	January	February	March	Total
Western cape	16,315	17,367	13,745	15,382	17,086	15,815	17,838	16,286	12,418	14,325	16,610	16,637	189,825
Eastern cape	774	920	734	738	860	760	871	772	503	724	870	858	9,386
Wits	15,946	16,471	14,443	15,489	17,442	16,518	18,007	16,480	11,196	15,378	17,161	16,916	191,447
Tshwane	5,887	6,333	5,305	5,756	6,338	6,205	6,870	6,355	4,407	6,147	6,362	6,479	72,443
Kwazulu-Natal	6,702	7,122	6,489	6,491	7,204	6,622	7,280	6,630	5,221	6,163	6,888	7,105	79,916
Metrorail Total	45,625	48,213	40,717	43,856	48,931	45,921	50,867	46,523	33,744	42,736	47,891	47,994	543,017
2014/15	April	May	June	July	August	September	October	November	December	January	February	March	Total
Western cape	15,480	15,556	14,378	14,591	14,319	14,974	16,176	14,948	11,491	12,343	15,061	15,618	174,935
Eastern cape	791	843	774	781	838	833	841	775	531	684	866	899	9,457
Wits	15,846	16,362	15,659	14,963	15,636	16,041	16,854	15,580	10,414	12,952	15,372	15,599	181,278
Tshwane	6,236	6,446	6,158	6,293	6,222	6,191	6,608	6,030	4,160	5,146	5,930	6,111	71,529
Kwazulu-Natal	6,467	6,478	6,360	6,580	6,755	6,843	7,269	6,790	5,436	5,948	6,799	7,085	78,811
Metrorail Total	44,820	45,684	43,329	43,207	43,770	44,883	47,748	44,123	32,033	37,073	44,028	45,311	516,010

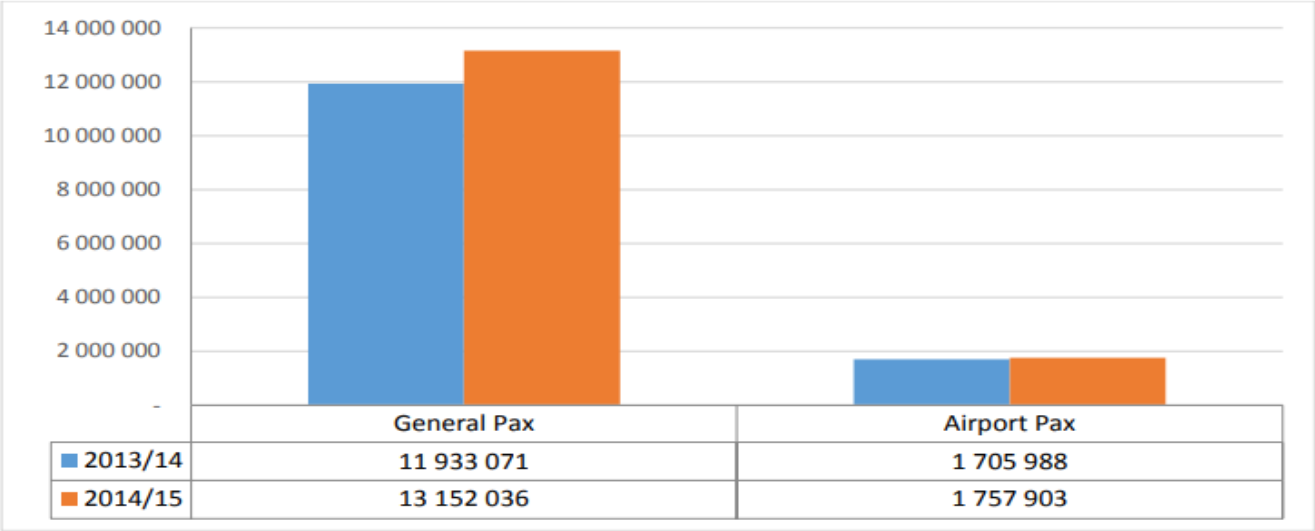
RAIL NETWORK PERFORMANCE – ON TIME PERFORMANCE

On Time Regional Performance, Year 2013/14 to 2014/15

Region	2013/14	2014/15
Western cape	79.7%	74.1%
Eastern cape	92.7%	90.5%
Wits	83.7%	85.4%
Tshwane	84.7%	85.9%
Kwazulu-Natal	82.0%	79.9%
Metrorail Total	82.5%	81.2%

RAIL NETWORK PERFORMANCE – GAUTRAIN PASSENGER NUMBERS

Gautrain Passenger Numbers, Year 2013/14 to 2014/15



RAIL NETWORK PERFORMANCE – WESTERN CAPE REGION

Cape Town's Transport Picture 2015

Transport Network

City	11 700km roads
Province	194km
SANRAL	146km
Footbridges	109
Road Bridges	339
Rail Bridges	10
Culverts	94
Stormwater	8 700km
Traffic Signals	1 500 signalised intersections

2,455km²
3,7 million citizens

52% of these citizens
rely on public transport
2,528,000
passengers every day

95%
of public transport
users in the low to
low-middle income
brackets in the City

Busiest Public Transport Interchanges (PTI)

1. Cape Town 150 368
2. Belville 108 676
3. Khayelitsha Site C 57 661

11% Passenger Rail

610km of rail network
23 routes on 4 Main corridors
118 stations
25% of trains are delayed
2.7% of trains are cancelled
84% of operating trains
622 000 passenger trips (IPTN, 2014)

15% Minibus Taxis

SANTACO Western Cape
6 Regional Bodies
102 associations
7 576 licensed minibus taxis
323 263 passengers
565 routes
49% of operators have a valid operating licence

Metered Taxi

525 Licenced
44% have a valid operating licence
Top 5 activity nodes
– CBD; Gardens; Foreshore;
Sea Point and Green Point

48% Private Transport

Car ownership
95% in high to middle
income communities

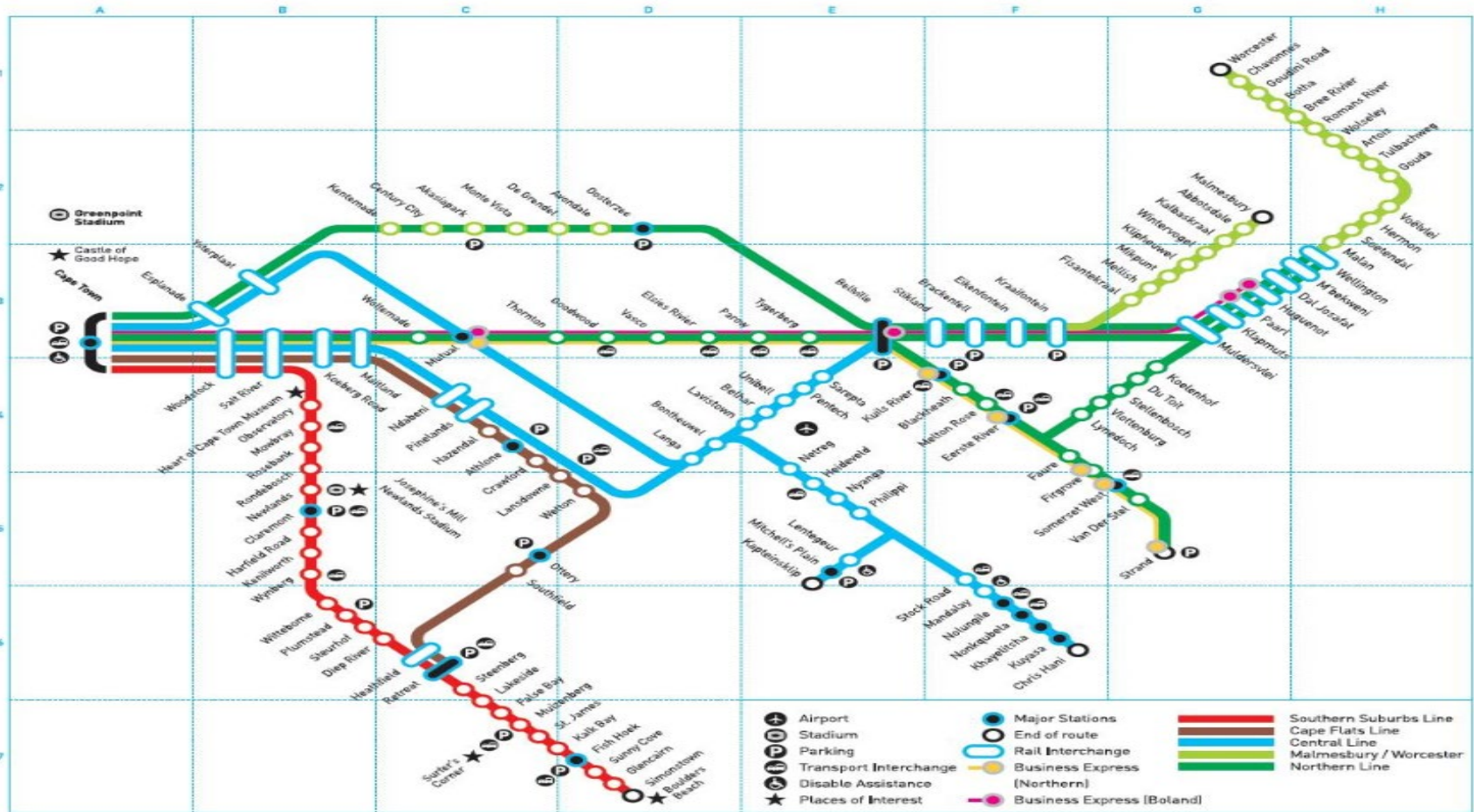
21% of the population's main mode of transport is walking

435km of cycle lanes

7.9% Contracted Bus Services

GAABS and Sibanye
240 000 passengers a day
4 064 bus registrations

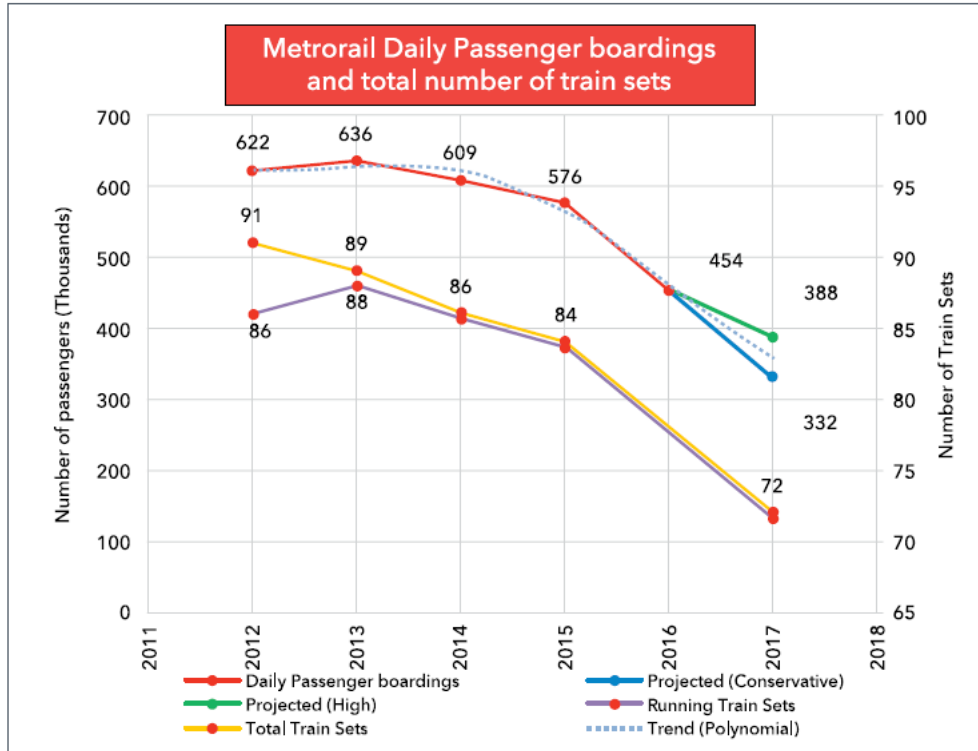




Sub-theme 3: Demand-based technology interventions



RAIL NETWORK PERFORMANCE – WC PASSENGER NUMBERS – YEAR 2000 TO 2017



Year	All Day Passenger Boarding's	Trainsets		
		Running	Spare	Total
2000	675 607	90	4	94
2004	621 285	85	5	90
2007	635 046	81	6	87
2012	621 833	86	5	91
2013	635 832	88	1	89
2014	608 533	86	0	86
2015	575 845	84	0	84
2016	454 000	82	0	82
2017	360 000	72	0	72

MAINTENANCE PHILOSOPHY OR STRATEGY

Maintenance is Centered around Reliability – RCM

This requires intensive understanding of failure modes of all the components of the systems.

Requires intensive **Asset Maintenance Management System**

The goal of asset management is to meet a required level of service in the most cost-effective way through the creation, acquisition, maintenance, operation, rehabilitation, and disposal of assets, to provide for present and future customer needs

Institute of Asset Management, UK, 2002

MAINTENANCE PHILOSOPHY OR STRATEGY

The following blocks are very important in Rail Maintenance Strategy

INFRASTRUCTURE
PERWAY
ELECTRICAL
SIGNALS/TELECOMS

ROLLINGSTOCK
TRAIN

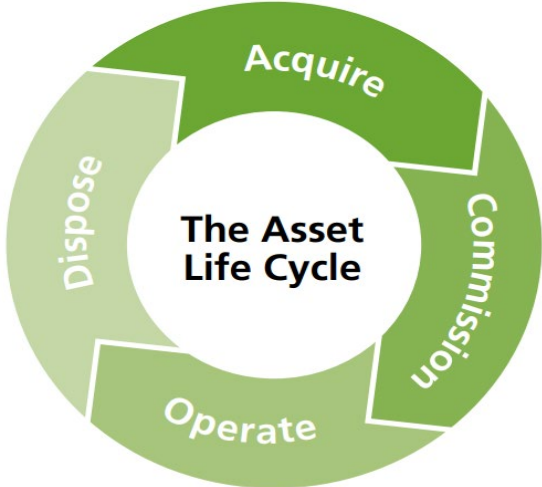
TRAIN OPERATIONS
DRIVERS
TRAIN CONTROL

CUSTOMER
SERVICES
REVENUE
COLLECTION

SUPPORT
HCM
FINANCE
SCM
ICT

MAINTENANCE PHILOSOPHY OR STRATEGY

Asset life cycle

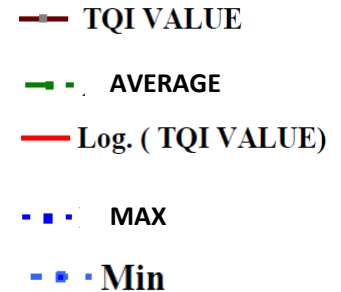
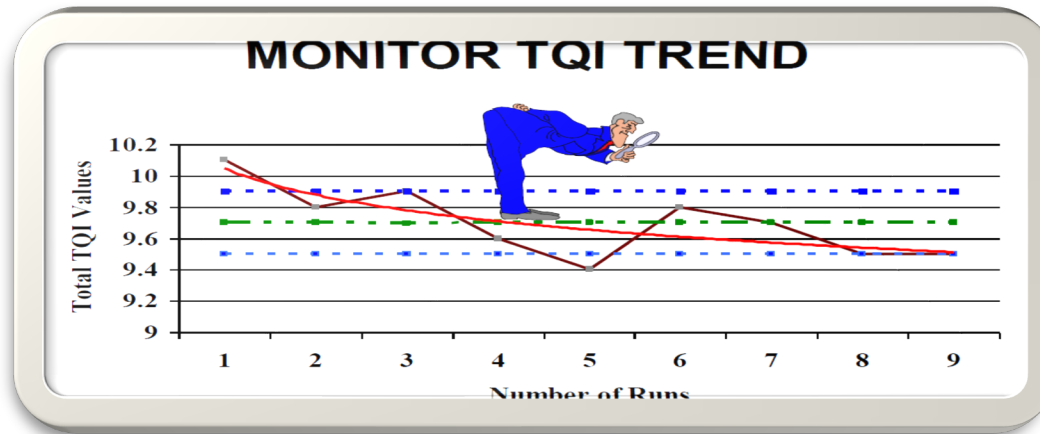


MAINTENANCE PHILOSOPHY OR STRATEGY

Reliability Centered Maintenance

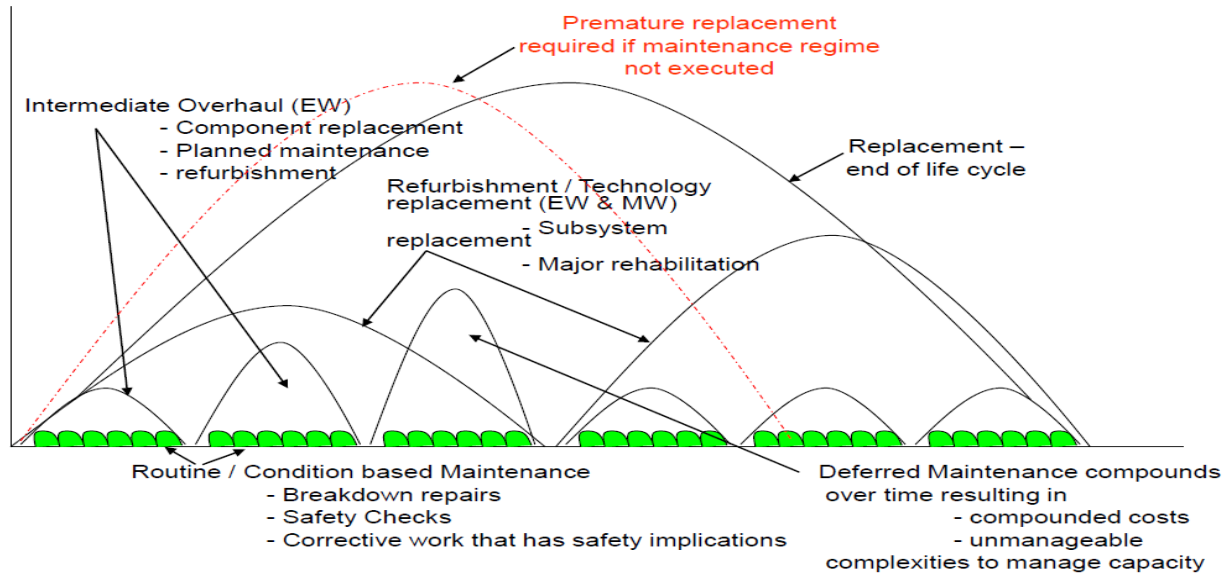
Type of maintenance strategy that focuses on functional failure modes analysis:

- Research failure types
- Failure Modes and Effects Analysis (FMEA)
- Proactive Maintenance (Preventative & Predictive)



MAINTENANCE PHILOSOPHY OR STRATEGY

Asset Maintenance Life Cycle



MAINTENANCE PHILOSOPHY OR STRATEGY – LIFECYCLE REQUIREMENTS



Design standards



Operational requirements



Maintenance requirements based on



Failure Modes and Effect Analysis



Risk Assessment

MAINTENANCE PHILOSOPHY - OPERATIONAL REQUIREMENTS



Tools



Equipment



Machine and



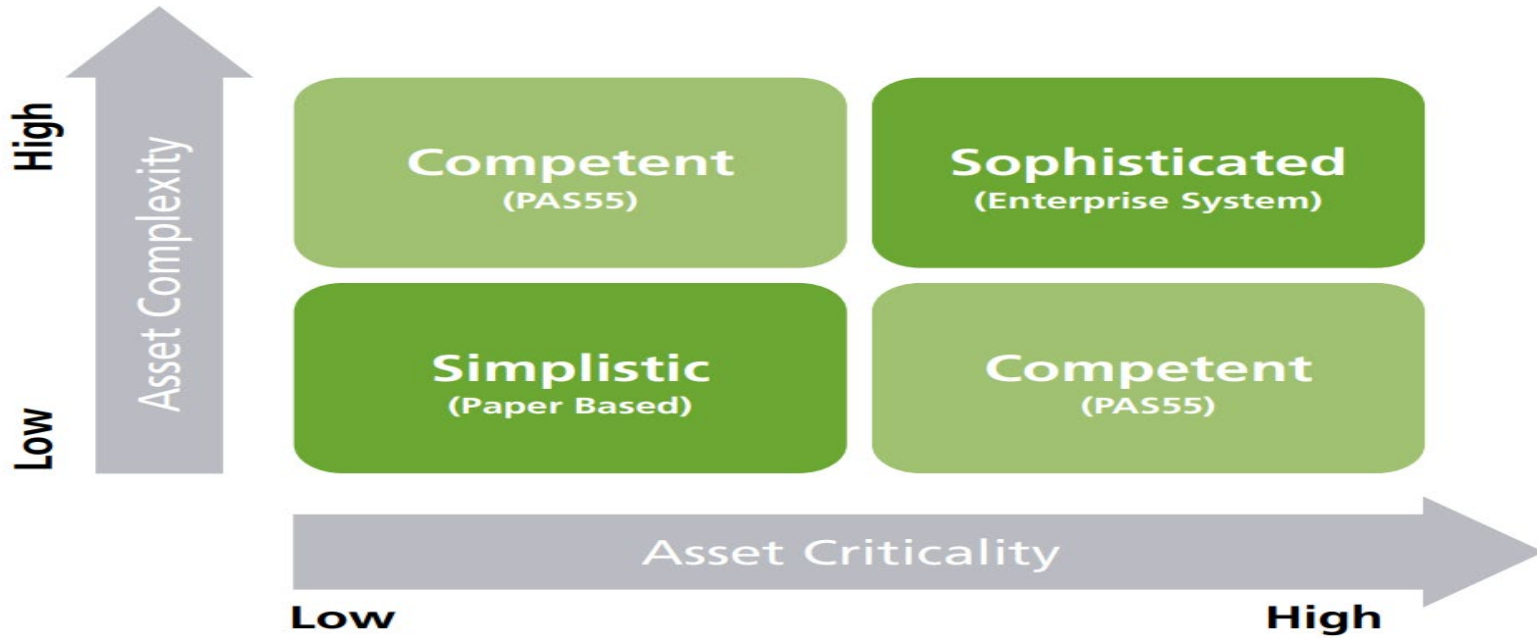
People



Sub-theme 3: Demand based technology interventions



MAINTENANCE PHILOSOPHY - OPERATIONAL REQUIREMENTS – SKILLS MATRIX



MAINTENANCE PHILOSOPHY - OPERATIONAL REQUIREMENTS – SKILLS MATRIX

Training Requirements are based on Asset Category

Simplicity → Sophisticated



MAINTENANCE PHILOSOPHY – RELIABILITY CENTERED MAINTENANCE

Less or few faults

Quick response to faults

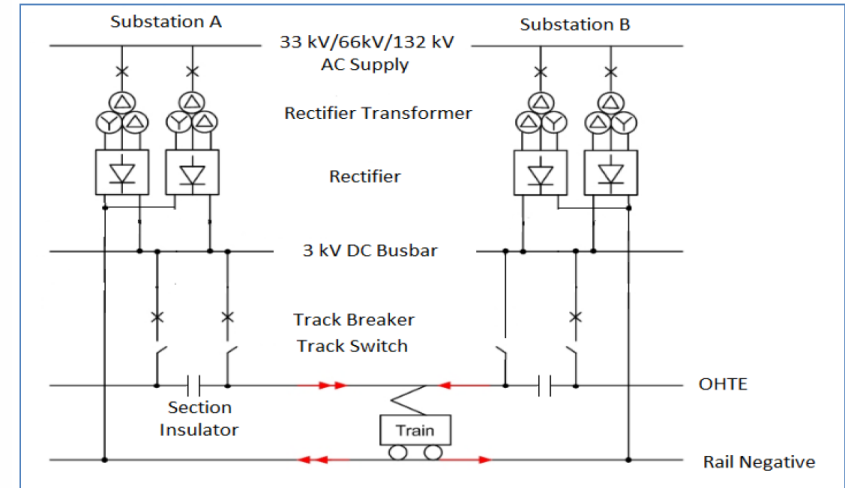
Effective Fault-Finding Techniques

Fixing faults quickly

A – Availability

MTBF - Mean Time Between Failures

MTTR - Mean Time To Repair



$$A = \frac{MTBF}{MTBF + MTTR}$$

FAULT ANALYSIS

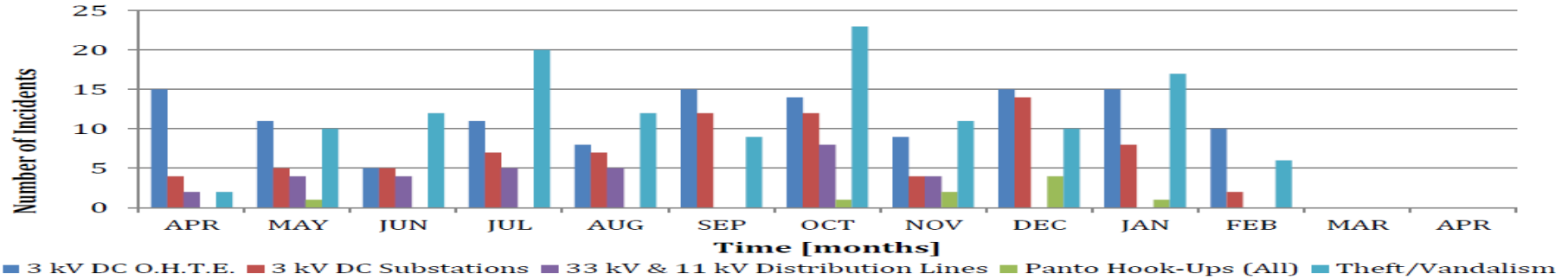
Major Faults – **Pantograph Hookups & Derailments**

Electrical Control - Has no Information on Fault Currents

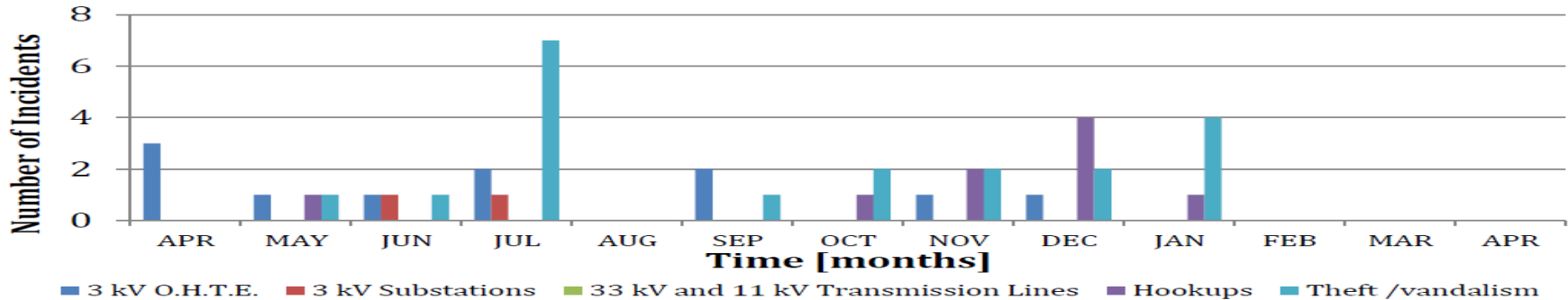
Teams – Patrolling Lines

FAULT ANALYSIS - MANAGEMENT INFORMATION (MIS)

Total Monthly Incidents - 2014/15 Financial Year



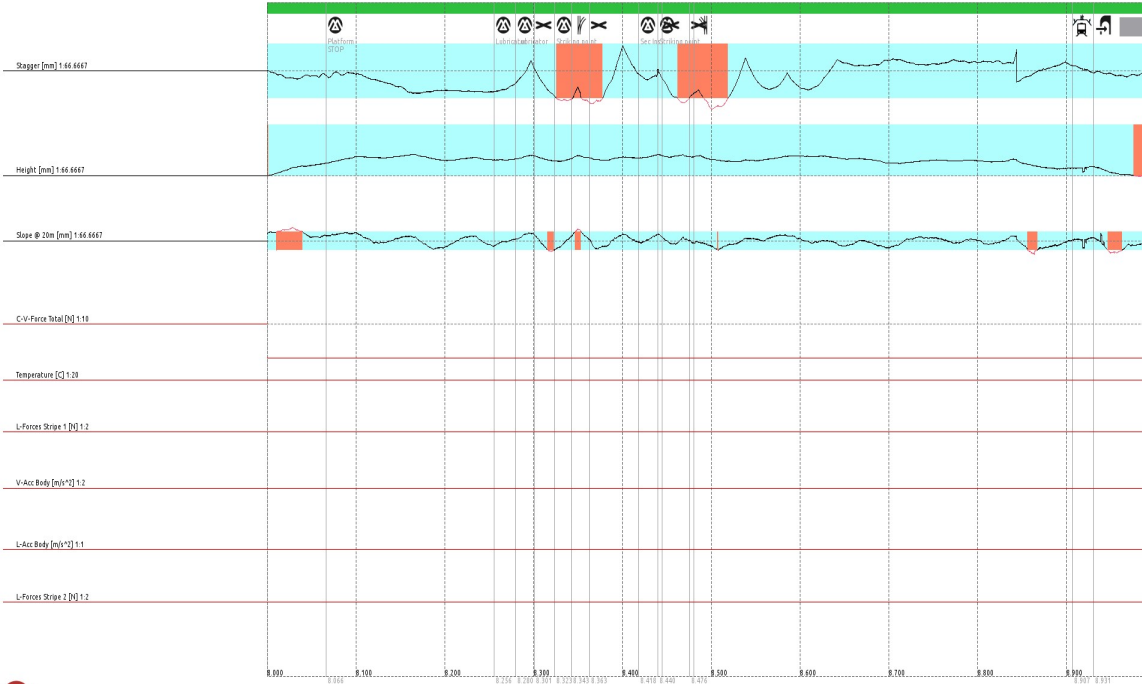
Incidents Affecting Train Service - 14/15 Financial year



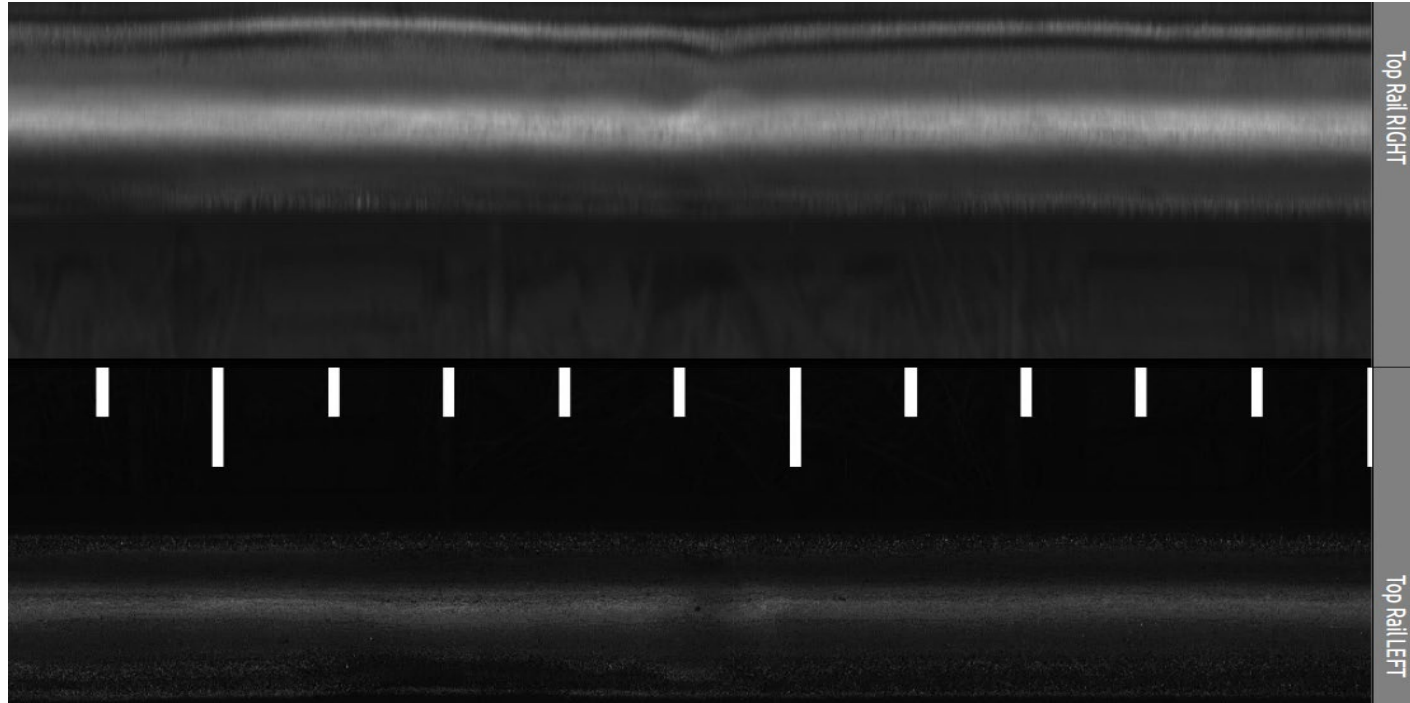
FAULT ANALYSIS – TGIV TEST

MTR Vehicle: TGIV

20220919127_M81JK1-001 - Traci: 1 - Railway -> Section M81JK1 - Sectional Speed: 75 - Km: 1 - Date: 19/09/2022 - Time: 12:28

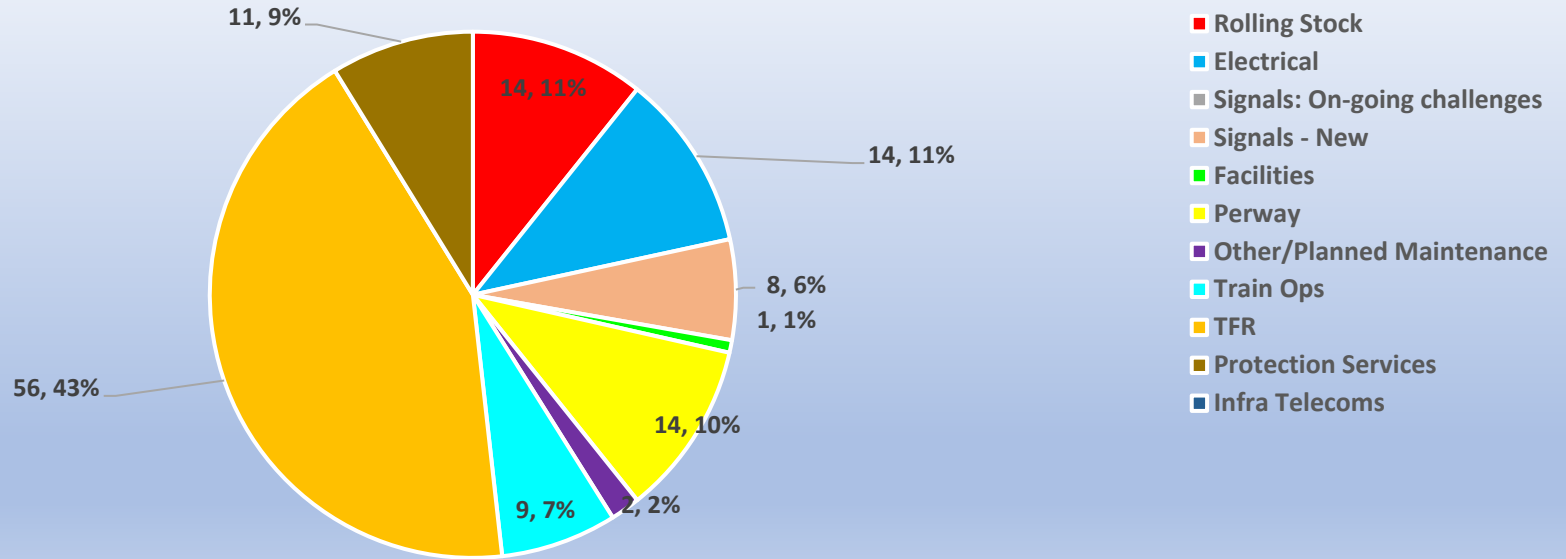


FAULT ANALYSIS – TGIV TEST



FAULT ANALYSIS – DEPARTMENTAL FAULTS AUGUST 2023

Delays per department for the Week: 23 - 29 Aug 2023

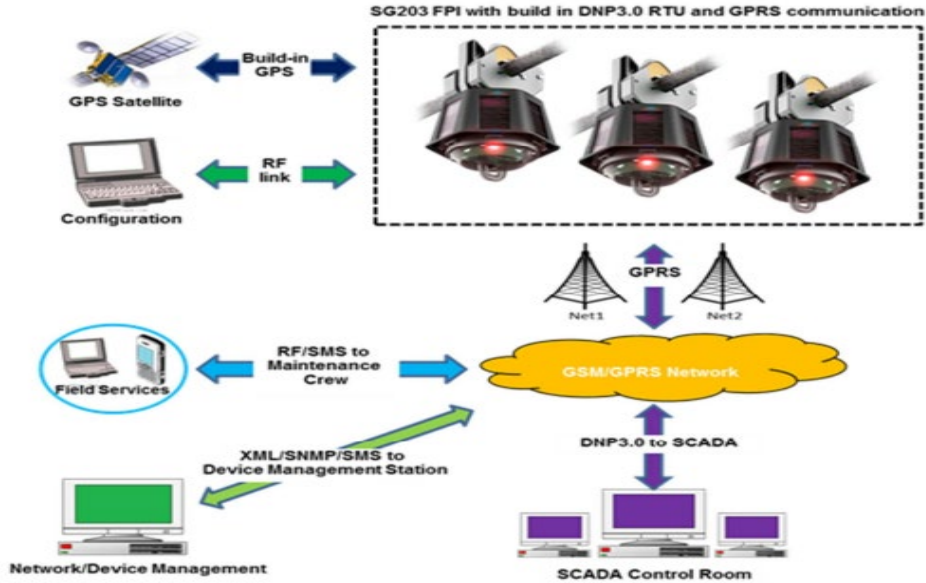


The number before the comma is

FAULT ANALYSIS – VEGETATION CONTROL – TREES TOUCHING OVERHEADS

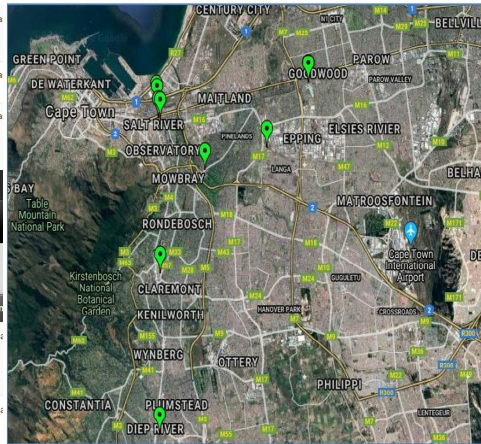


FAULT ANALYSIS – FAULT PATH INDICATORS FOR RELIABILITY



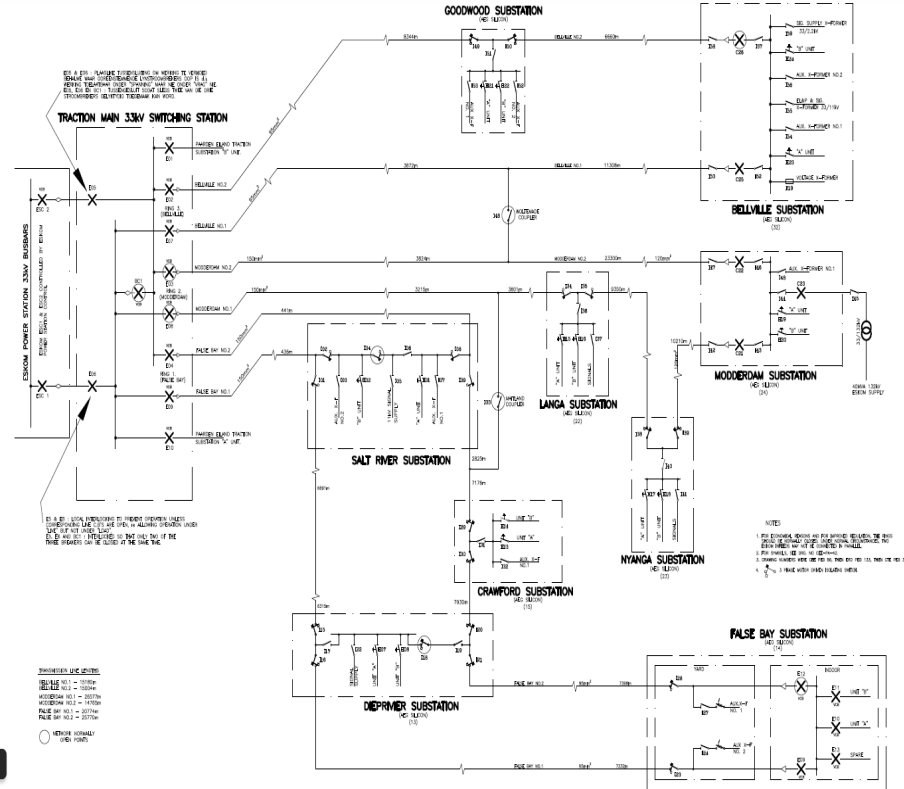
FAULT ANALYSIS – FAULT PATH INDICATORS FOR RELIABILITY

Management Studio		Device	Device Setup	Account	Zola Mdlankomo - Logout					
Salt River Yard	Falsebay No.1	A-FRAME I09			Prasa	Western Cape	✓	✓	203M-18040603	203M-18040603 FLB - 2 @Salt River Bus yard
Goodwood Station	Bellville No. 2	OA111492			Prasa	Western Cape	✓	✓	203M-18040503	203M-18040503 Good Wood
Salt River No. 1	Falsebay No. 1	JF3/879			Prasa	Western Cape	✓	✓	203M-18040630	203M-18040630 FLB - 1 Salt River Substation
Langa (3kV Substation)	Modderdam No1				Prasa					
Traction Main	Falsebay No.1	Falsebay No. 1 Pylon			Prasa					
Yesterplat Station *Platform*	Falsebay No.2				Prasa					



Management Studio		Device	Device Setup	Account
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Device List		Filters					
Zone	Sector	Feeder_Name	Pole_Number	Sectionalized	Upstream_Breaker	RTU	Client
Claremont Station	Falsebay No.1	JK10/061					Prasa
Falsebay Station Platform*	Falsebay No.1						Prasa
Pinelands Station First Bridge*	Modderdam No.1						Prasa
Diep River Station Platform*	Falsebay No. 1	JK16/368					Prasa
Goodwood	Bellville No. 1	OA11/544					Prasa



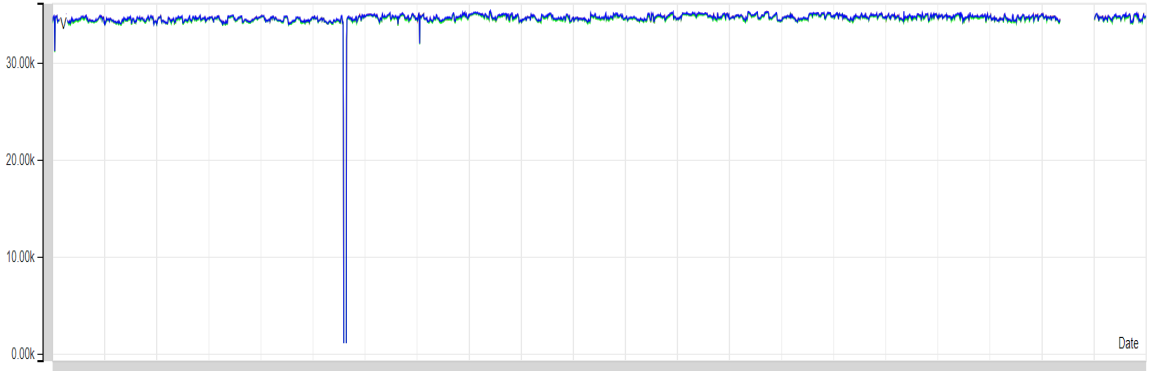
FAULT ANALYSIS – FAULT PATH INDICATORS FOR RELIABILITY

Date hh:mm:ss:ms	Phase	Fault Description	Text 1	Text 2
2020/02/18 13:42:17:790	PhaseC	VoltageReturn		
2020/02/18 13:42:15:500	PhaseA	VoltageReturn		
2020/02/18 13:42:12:600	PhaseB	VoltageReturn		
2020/02/18 13:42:12:600	PhaseB	PermanentClear		
2020/02/16 14:55:36:700	PhaseC	VoltageLoss		
2020/02/16 14:55:36:900	PhaseA	VoltageLoss		
2020/02/16 14:55:36:700	PhaseB	VoltageLoss		
2020/02/16 14:55:36:700	PhaseB	PermanentRaise		
2020/02/16 14:55:06:500	PhaseB	FaultCurrent	Imax=839A	TLine=24.6°C
2020/02/16 14:55:06:500	PhaseB	UnderVoltage	Imax=839A	TLine=24.6°C
2020/02/14 09:40:11:700	PhaseC	VoltageReturn		
2020/02/14 09:40:09:400	PhaseA	VoltageReturn		
2020/02/14 09:40:07:100	PhaseB	VoltageReturn		
2020/02/14 09:39:29:200	PhaseC	VoltageLoss		

Date hh:mm:ss:ms	Phase	Fault Description	Text 1	Text 2
2023/05/26 22:33:59:0	PhaseB	BatLow		
2023/05/25 12:00:25:0	PhaseA	CommsLinkError		
2023/05/26 12:00:20:800	PhaseA	BatLow		
2023/05/26 00:00:17:900	PhaseA	BatGood		
2023/05/25 12:00:25:600	PhaseA	BatLow		
2023/05/25 10:25:36:500	PhaseB	VoltageReturn		
2023/05/25 10:25:36:500	PhaseB	PermanentClear		
2023/05/25 10:25:31:500	PhaseC	VoltageReturn		
2023/05/25 10:17:51:900	PhaseC	VoltageLoss		
2023/05/25 10:17:52:100	PhaseB	VoltageLoss		
2023/05/25 10:17:52:100	PhaseB	PermanentRaise		
2023/05/25 10:17:21:800	PhaseB	FaultCurrent	Imax=876A	TLine=-273.1°C
2023/05/25 10:17:21:800	PhaseB	UnderVoltage	Imax=876A	TLine=-273.1°C



FAULT ANALYSIS USING SMART/ENERGY METERS FOR RELIABILITY



Legend:
■ Traction Main - Eskom 1 - VRms1
■ Traction Main - Eskom 1 - VRms2
■ Traction Main - Eskom 1 - VRms3

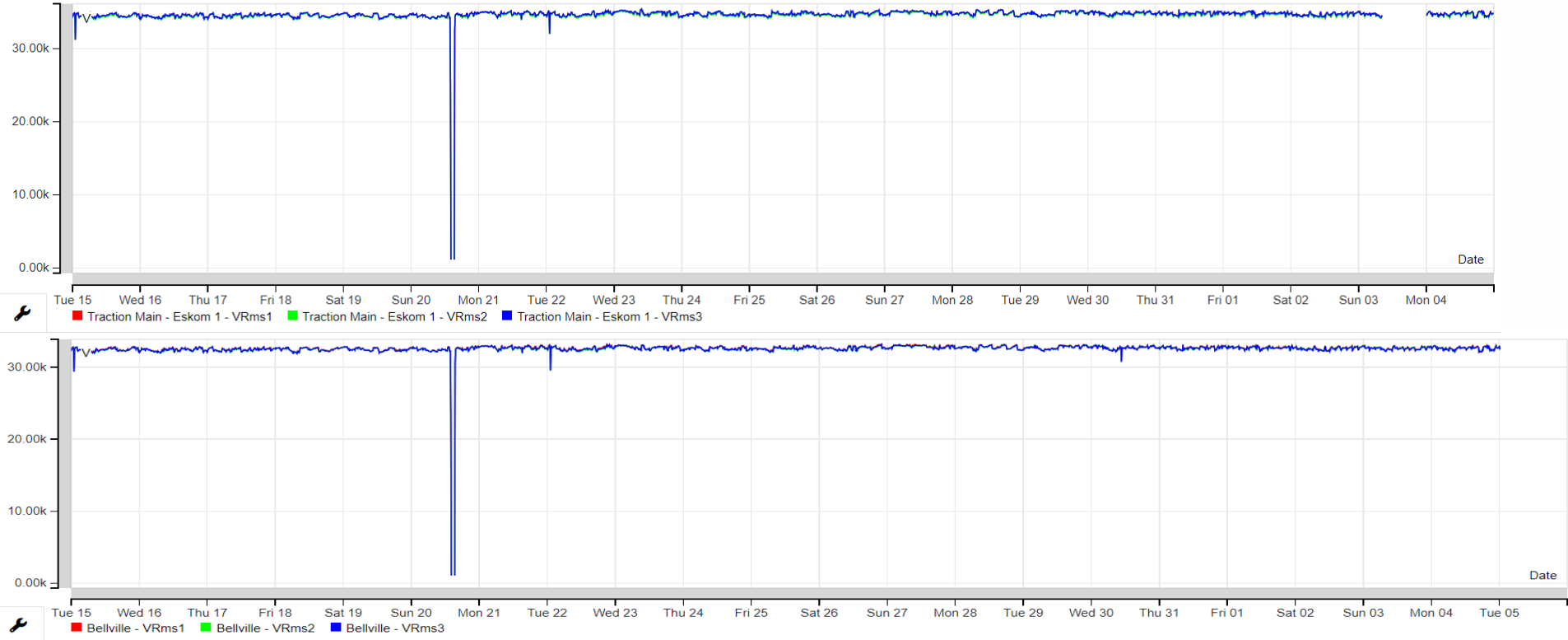


Legend:
■ Saltrivier - VRms1
■ Saltrivier - VRms2
■ Saltrivier - VRms3

Sub-theme 3: Demand based technology interventions



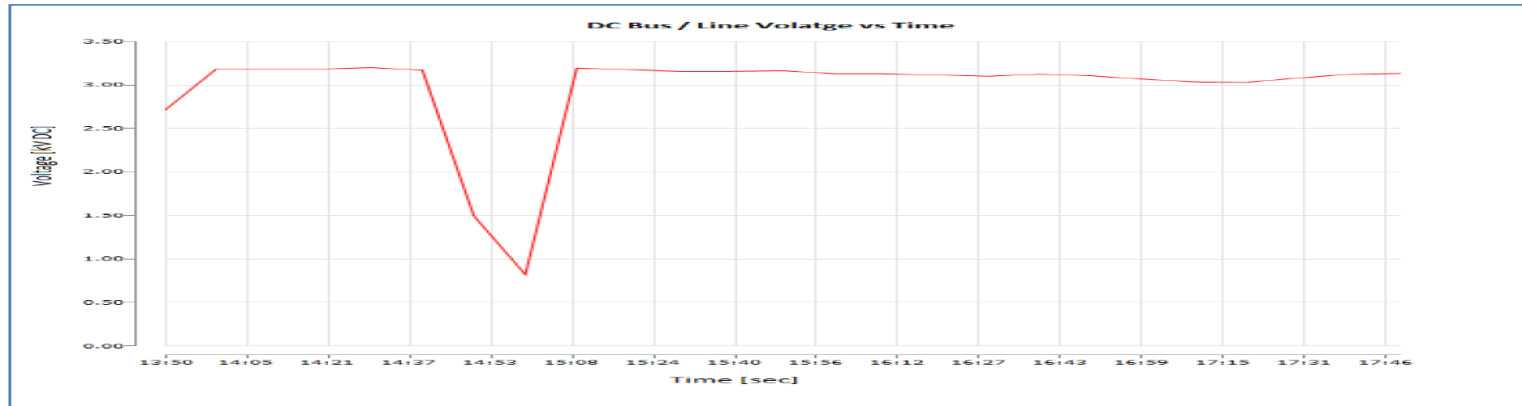
FAULT ANALYSIS USING SMART/ENERGY METERS – REDUCE DOWNTIME



Sub-theme 3: Demand based technology interventions



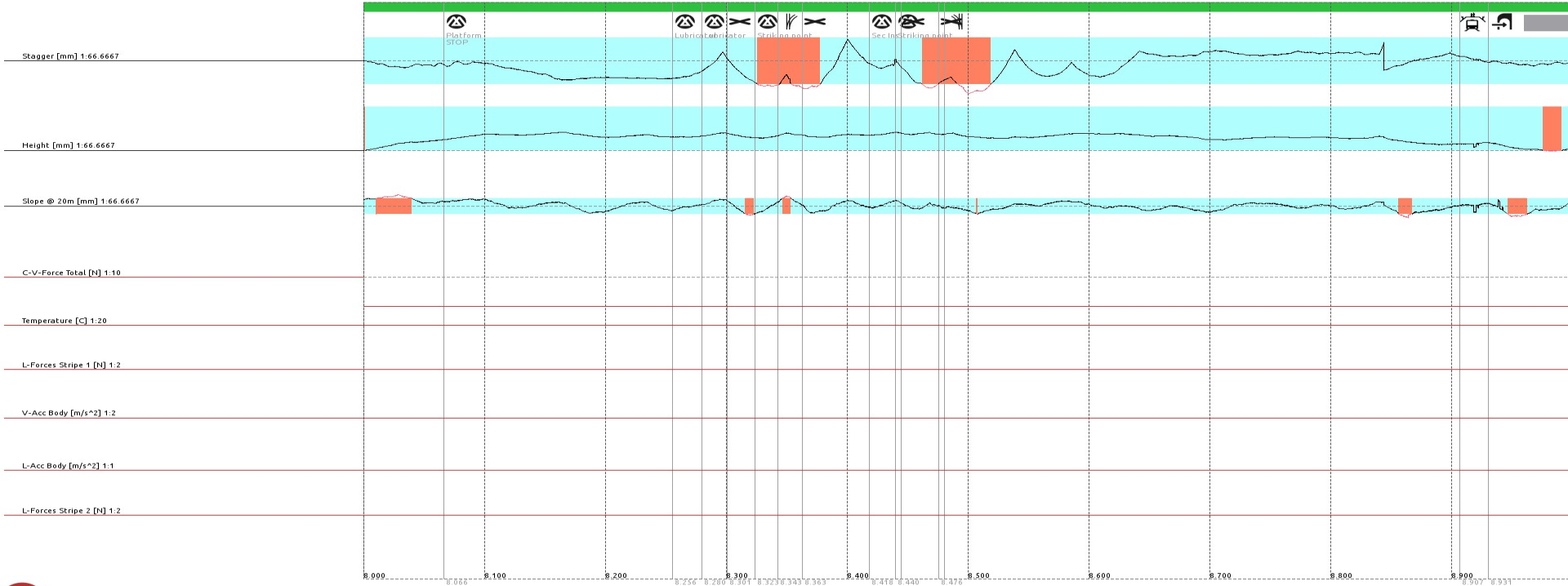
FAULT ANALYSIS USING SMART/ENERGY METERS FOR RELIABILITY SECT. INSULATOR



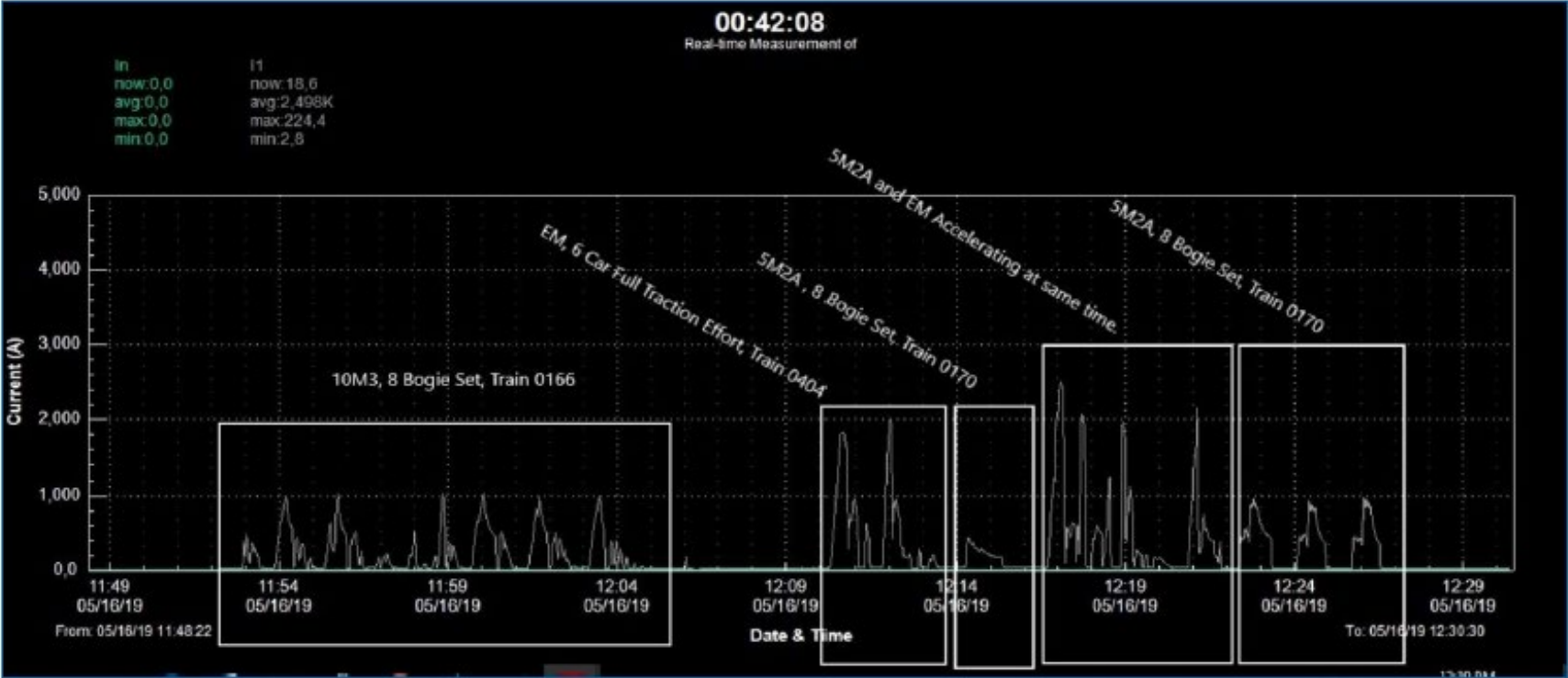
FAULT ANALYSIS USING TGIV FOR RELIABILITY SECT. INSULATOR/MAKEOFFS

MMTR Vehicle: TGIV2

202209191227_MB1JK1-001 - Track: 1 - Railway: -- - Section: MB1JK1 - Sectional Speed: 75 - Km: 1 - Date: 19/09/2022 - Time: 12:28



FAULT ANALYSIS USING SMART/ENERGY METERS FOR RELIABILITY



NETWORK RECOVERY AND REDESIGN FOR RELIABILITY –SIGNAL ASSETS

PROGRESS OF INTERNAL RECOVERY TEAMS

SECTION	SIGNALS NON-FUNCTIONAL	SIGNALS RECOVERED	AXLE COUNTERS NON-FUNCTIONAL	AXLE COUNTERS RECOVERED	POINTS NON-FUNCTIONAL	POINTS RECOVERED	% Recovered
Cape Town (CT)	27	24	77	77	0	0	97%
Mowbray (MB)	0	0	12	12	1	1	100%
Wynberg (WB)	7	0	24	4	3	0	12%
Plumstead (PMS)	12	8	29	0	0	0	20%
Diepriver (DPE)	0	0	2	0	0	0	0%
Southfield (SFS)	11	11	6	4	0	0	88%
TOTALS	57	43	150	97	4	1	67%

PROGRESS OF INTERNAL RECOVERY TEAMS

SECTION	SIGNALS NON-FUNCTIONAL	SIGNALS RECOVERED	AXLE COUNTERS NON-FUNCTIONAL	AXLE COUNTERS RECOVERED	POINTS NON-FUNCTIONAL	POINTS RECOVERED	% Recovered
Salt River (SR)	26	0	21	19	0	0	40%
Fish Hoek (VSK)	0	0	8	8			100%
Simonstown (ST)	21	0	14	0			0%
Newlands (NL)	0	0	10	6			60%
TOTALS	47	0	53	33	0	0	33%

NETWORK RECOVERY AND REDESIGN FOR RELIABILITY –SIGNAL ASSETS



NETWORK RECOVERY AND REDESIGN FOR RELIABILITY –ELECTRICAL ASSETS



NETWORK RECOVERY AND REDESIGN FOR RELIABILITY –ELECTRICAL ASSETS



Secured Cable in steel pipes

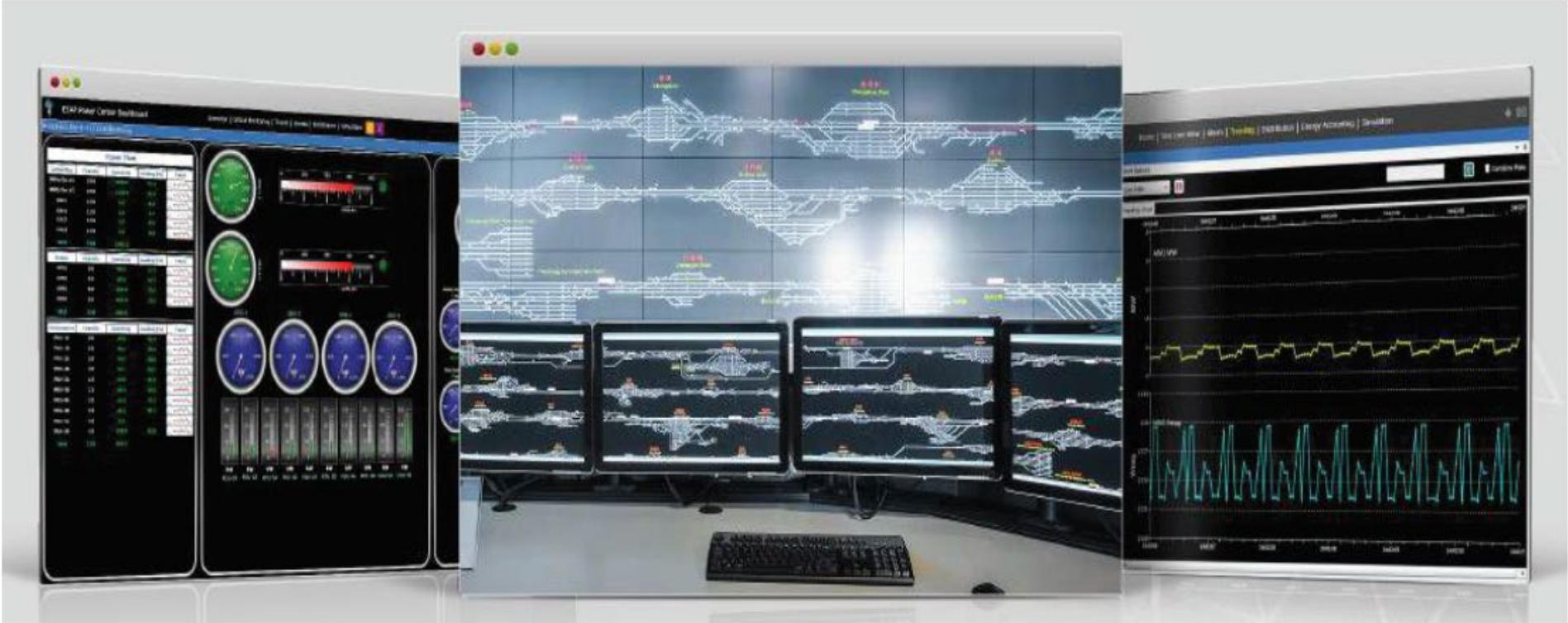


Easily accessible doors

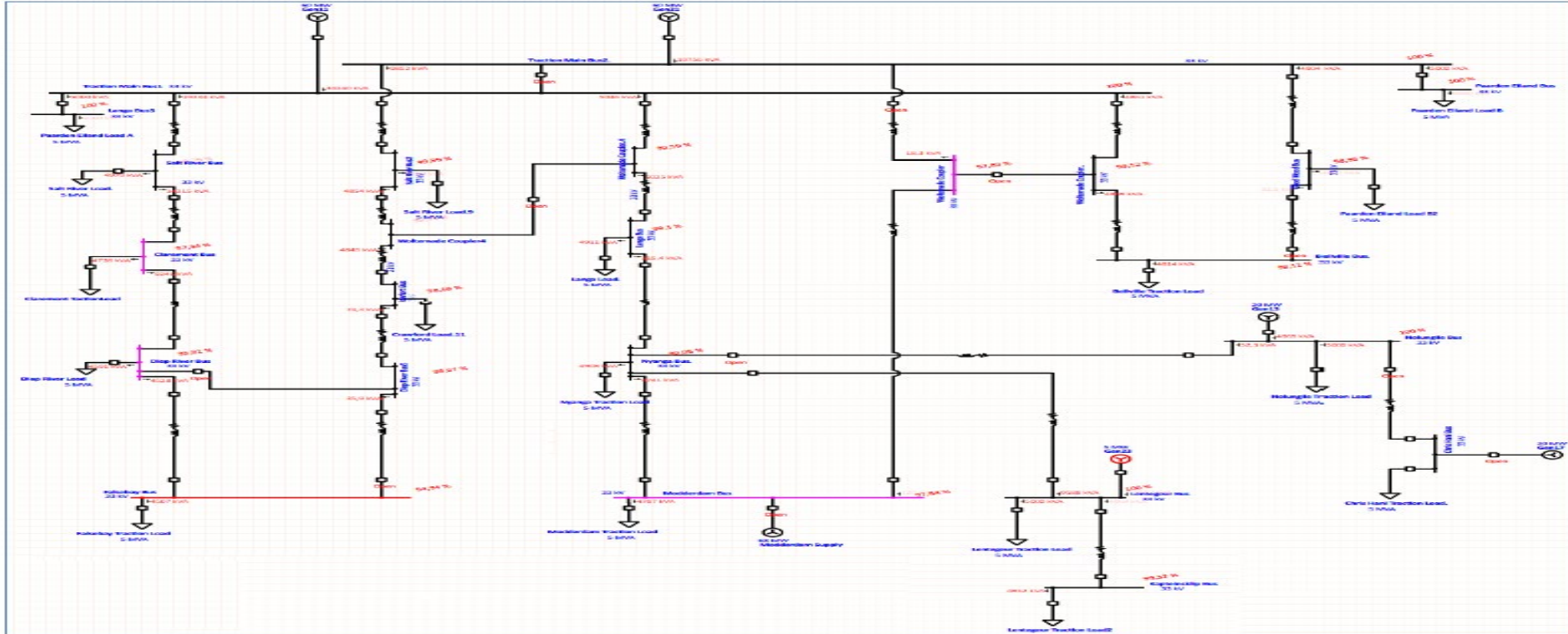


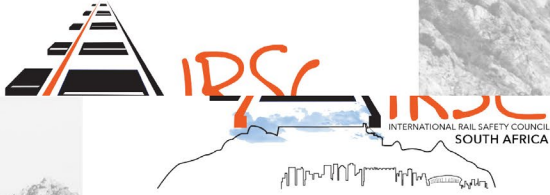
Safe Security/Steel doors

SCADA SYSTEM FOR INTEGRATED SOLUTIONS



SCADA SYSTEM FOR INTEGRATED SOLUTIONS – SIMULATION SOFTWARES





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RAIL SAFETY ON THE RIGHT TRACK

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REFERENCES

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Transport Statistics Bulletin 2015

2. Energy Efficiency, Power Quality and Reliability Evaluation of a Traction Electricity Network, Thesis