

ENERGY DEPARTMENT

REPORT ON ELECTRICAL INFRASTRUCTURE PLAN

MAY 2022

EXECUTIVE SUMMARY

Overview

The electricity supply for the entire Nelspruit town and surrounding areas is from Delta Substation which has a capacity of 80MVA and was constructed in 1972 with a lifespan of 40 years.

Problem Summary

Delta substation is experiencing constant outages due to ageing infrastructure and poor maintenance.

33kV lines in the electricity network have high transmission losses and have aged. The current network will struggle to accommodate further developments.

Solution

Funding has been made available to upgrade the existing infrastructure at Delta and also to extend the substation yard so as to extend its lifespan.

The 33Kv transmission lines need refurbishment and upgrading to 132kV to reduce transmission losses and to accommodate development growth.

FINANCIAL IMPLICATIONS

The following picture depicts the financials needed to upgrade electrical infrastructure:

Description	Available budget	Total Project Cost
Delta Substation Upgrade	R33m	R68m
New 132kV line from West Acres to Steiltes to Valencia	R12m	R24m
New 132kV line Valencia to Delta	R0	R16M

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Valencia substation upgrade	R10M	R48m
Seiltes substation Upgrade	R0M	R58

Addressing the aforementioned concerns will reduce outages and improve technical losses. Also, the electricity supply will be sustainable.

DETAILED REPORT

1. Introduction

The report focuses on the main supply areas in Nelspruit central (i.e. wards 14, 15, 16, 17 and 18) which take power from the old Delta Substation. The main Delta Substation is experiencing constant outages prompting the department to do a thorough investigation. The investigation was divided into physical audits of the substation yard and the lines, also the 2011 electrical infrastructure master plan conducted by Netgroup.

2. Site description

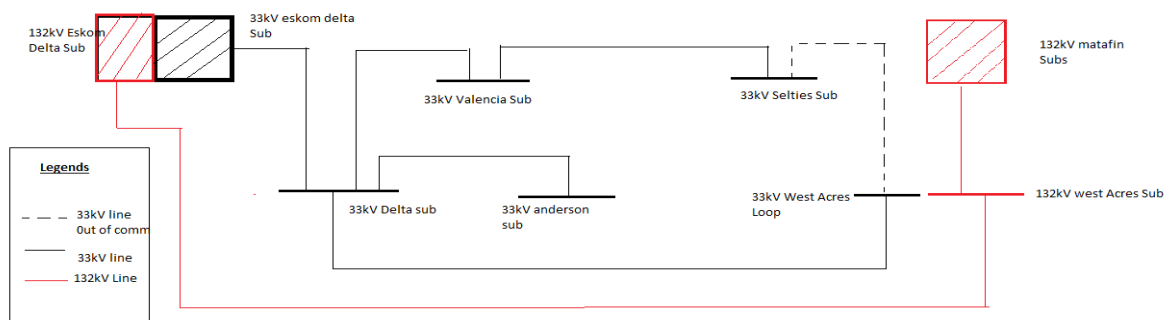
The City of Mbombela Delta Substation is fed from Eskom Delta Substation 33kV system feeding into four 15 MVA 33/11kV transformers and four 33kV feeders, namely:

- Delta to Steiltes 33kV Feeder overhead line that is tapped to feed Valencia Substation
- Delta to West Acres 33kV Feeder a short underground cable and the remainder is a 33KV overhead line on dual circuit structures to west acres substation and
- The Delta to Anderson 33kV the feeder which is an underground cable to Anderson Substation 33kV indoor switchgear.
- The Steiltes and West Acres substations are then linked by an overhead line and underground cable combination 33kV ring circuit with Delta Substation as the source.

The aforementioned ring was built in 1972 and commissioned in 1973 it had a life expectancy of 40 years and is in dire need of refurbishment for the purpose of extending its lifespan.

The equipment is obsolete and the procurement of spares is a difficult exercise due to the fact that production of some of these has been discontinued. Also, residential and commercial growths and business developments are putting more demand and overloading the infrastructure.

Figure 1: 33kV & 132kV Ring current status

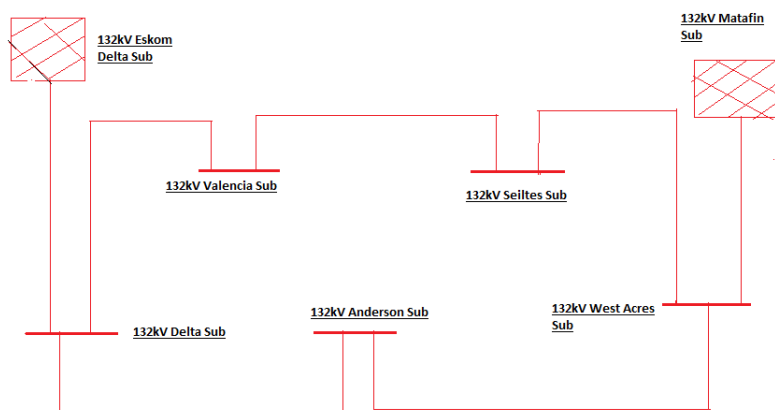


2.1 Future network ring configuration

The network ring is desired to be a 132kV for the following reasons:

- High voltage capacity is less sensitive to low fault currents.
- Technical losses will be significantly reduced
- Additional Capacity for city growth up to year 2040

Figure 2: 132kV network Ring desired



3. Network conditions

3.1 Delta substation risk analysis

Delta substation has several aged equipment which is not functional and imposes the following risks on operators/ personnel:

- Explosion of protection and switchgear equipment
- Exposed and damaged equipment that may lead to electrocution
- The yard is without proper fencing allowing monkeys to touch live equipment
- Aged lightning protection does not offer protection during storms and outages are experienced.
- The current Installed capacity is 60 MVA with a Firm Capacity of 45 MVA it is expected to reduce from a base of approximately 35 MVA to 15 kVA. This accounts for the separation of Anderson, Seilttes and West Acres 132kV load from Delta.

3.1.1 Scope of work at delta substation

The Supply from Delta Substation to Valencia and Seilttes Substations needs to be upgraded to 132kV system. The upgrade of the delta 132kV switching station shall consist of:

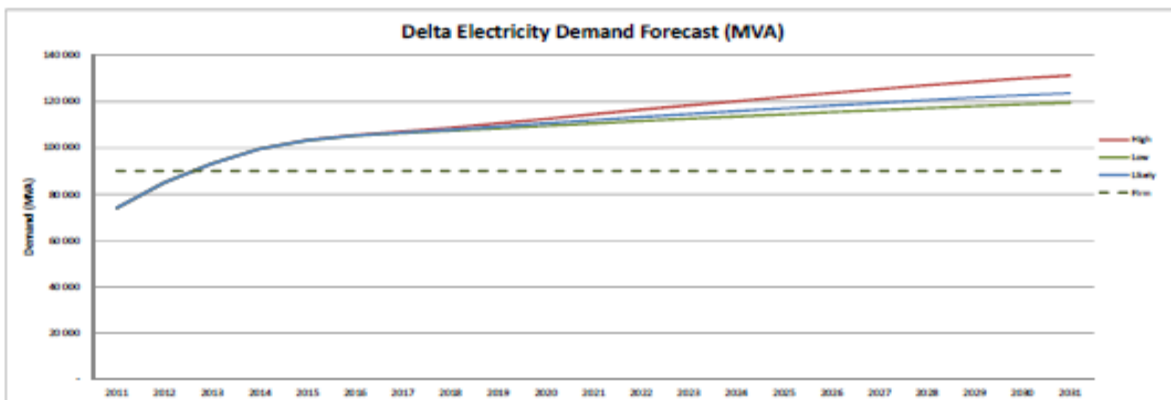
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- Construction of 132kV Incomer from Eskom
- Construction of 132kV Feeder to Valencia Substation
- Construction of 132kV Feeder to West Acres Substation
- procurement 2x 20MVA 132/11kV Transformers and the associated equipment at Delta Substation
- construction of 132kV Overhead line to Valencia Sub Station

3.1.2 Scope of work at delta substation for year 2022

The scope of work during this year include

- Procurement of 20MVA transformers
- Earth work
- Construction of steel structures
- Construction of HV control room



3.2 Valencia substation

Valencia switching station is currently supplied at 33 kV with a cut-off from Delta to Steiltes Substation. The current load at Valencia including KaMagugu is approximately 7 MVA. The current supply arrangement from Delta Substation puts the network adequacy and associated supply to Valencia under severe pressure. The demand within the Valencia area of supply is expected to grow to 18MVA as a result of the KaMagugu, Orchard's View developments and the proposed hospital (from 2011 master plan)

3.2.1 Scope of work to be done at Valencia substation

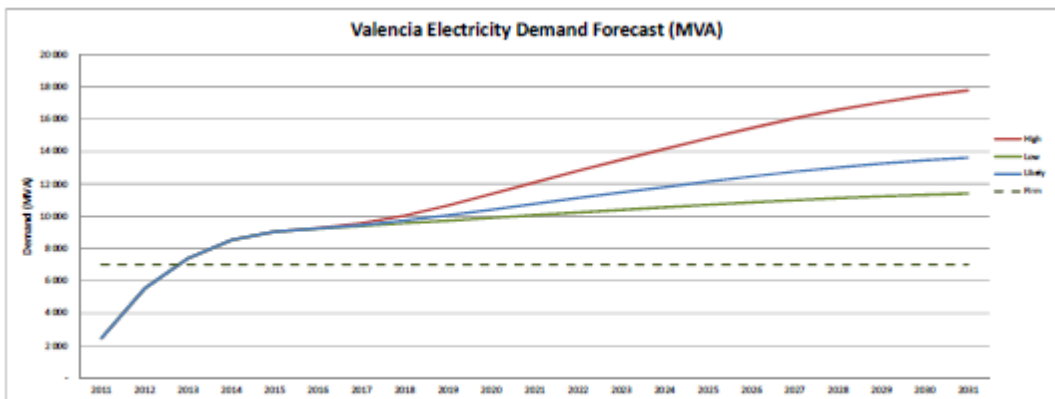
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- Upgrade the substation capacity from 33/11kV to 132/11kV, 2 X 20 MVA
- Transformer Installations of 132kV 2X20 MVA Transformers systems with sustainable schemes that include minimum protection requirements.
- Build a new control room and renovate HV yard
- The DC Systems must be replaced with a new system with adequate rating and appropriate cables and labels.
- 132kV Overhead line to Delta Substation

3.2.2 Scope of work at Valencia substation for year 2022

The scope of work during this year include

- Procurement of 20MVA transformers
- Earth work
- Construction of steel structures
- Construction of HV control room



3.3 Steiltes Substation

The built supply capacity at Steiltes Substation is 2X10MVA Transformers of which one is designed to operate at a given time (N-1) condition and the other is supposed to be back up. The audit shows that the pick consumption is now sitting at 16MVA causing transformers to work simultaneously. This shows that the substation needs to be upgraded to 2X20MVA transformers so as to have one operating transformer and a backup.

The substation DC system cannot sustain DC when the AC supply is temporarily lost. When power is lost to the auxiliary Transformer, a portable generator is needed to start up the substation Steiltes

10MVA. 33/11KV Transformer 1 Protection Scheme does not have an On-Load Tap Changer Control and Monitoring System. The results thereof are that the Transformer secondary voltage cannot be automatically adjusted as the load varies, resulting in voltage fluctuations.

10MVA 33/11KV Transformer 2 Protection Scheme is not in fully commissioned and a contractor left it not connected to the transformer, investigation needs to be conducted.

3.3.1 Scope of work to be done at Steiltes

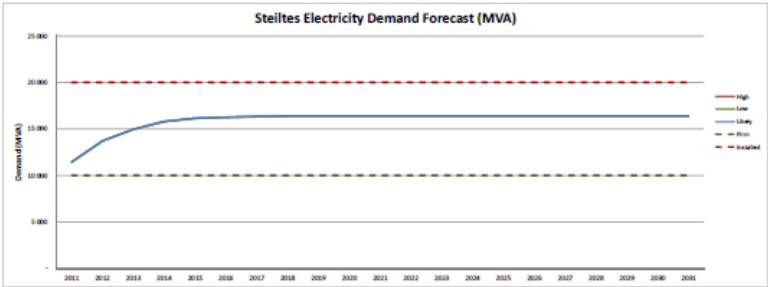
- Upgrade the substation capacity from 33/11kV to 132/11kV, 2X20MVA transformers Installation of 132kV 2X20MVA Transformers systems with suitable schemes that include minimum protection requirements.
- Renovate control room and HV yard.
- Decommission the existing transformer protection panel and DC system panels. Install all control and monitoring cables.
- The DC Systems must be replaced with a new system with adequate rating and appropriate cables and labels.
- Test and commission the DC system and the Protection Panel. Remove from site decommissioned panels.
- 132kV Overhead line to West Acres Sub Station

3.3.2 Scope of work at Steiltes substation for year 2022

The scope of work during this year include

- Design works
- Upgrade of the 33kV line to 132kV line (West Acres to valencia via steilties)
- The Delta Steiltes 33kV Circuit Breaker must be repaired and
- 33kV transformers maintainence
- Vegitagitation management

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Discussion	Steilttes Substation
The Steilttes area of supply is expected to grow from a base of just under 11 MVA to an approximate 16 MVA. The current firm 33kV capacity at Steilttes Substation is 10 MVA.	

3.4 West Acres Substation

West acres 132/11kV Substation is fed from Matsafeni 132kV overhead line, it was previously fed from Delta with a 33kV overhead line. The 33kV feeder comprises of a short underground cable and the remainder is a 33kV overhead line on a dual circuit structure. The feeder was used to feed two 10MVA 33/11kV transformers that have since been decommissioned and out of service. The substation has now been upgraded to 132 kV system with 1x20MVA 132/11kV transformer feeding into the 11kV metal clad indoor distribution panel. The 11kV switchgear is not upgraded since 1973 and is also aged and obsolete.

Scope of work to be done at West acres 132/11kV Substation:

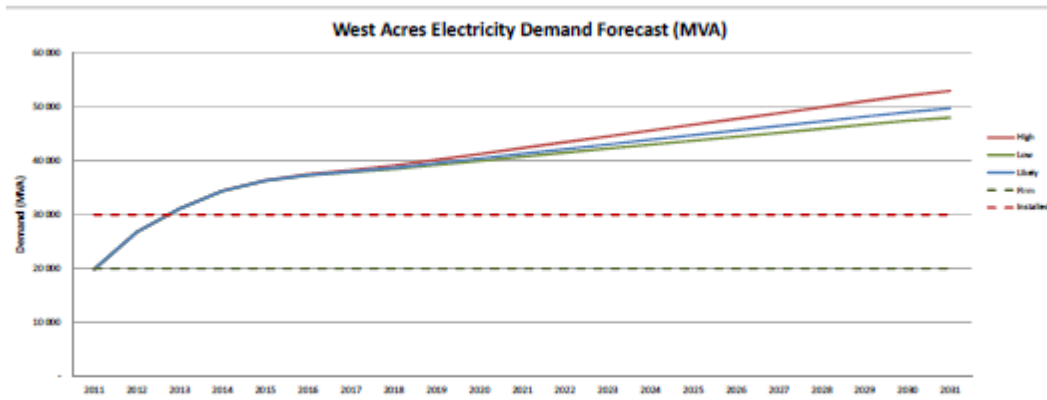
There is a need to refurbish the 11kV oil switchgear to improve reliability and reduce technical losses. The maintenance of HV yard shall be done using OPEX budget.

3.4.2 Scope of work at west acre substation for year 2022

The scope of work during this year include:

- Circuit Breaker maintenance
- 132kV transformers maintenance
- Vegetation management

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4. Maintenance work to be done

4.1 Delta Substation Steiltes 33kV Feeder

- The Delta Steiltes 33kV Circuit Breaker must be repaired and tested and if suitable for use be put on commission,
- The West Acres 10MVA 33/11kV Transformers were decommissioned. One of those 33kV Circuit breakers can be used to replace the Circuit Breaker referred to in 4.1.1 above.
- The Delta Steiltes 33kV Feeder Protection Scheme must be tested in its entirety and repaired where necessary.

4.2 Delta West Acres 33kV Feeder

- The Current Transformer must be installed and commissioned, or
- The West Acres decommissioned 10MVA 33/11kV Transformers Current
- The Delta West Acres 33kV Feeder must be tested and, where necessary, be repaired and be put on commission.

4.3 Steiltes Substation 10mva 33/11kV Transformers

- Steiltes 10MVA 33/11kV Transformer 1 Protection Scheme must be fitted with an On Load Tap Changer Control and Monitoring System.
- Steiltes 10MVA 33/11kV Transformer 2 Protection Scheme must be fitted with an On Load Tap Changer Control and Monitoring System.
- Steiltes 10MVA 33/11kV Transformer 1 Protection Schemes (with the installed OLTC Control and Monitoring System) must be connected to the transformer.
- Steiltes 10MVA 33/11kV Transformer 1 and 2 Protection Schemes (with the installed OLTC Control and Monitoring System) must be tested and commissioned.

4.4 West Acres Steiltes 33kV Feeder

- The West Acres Steiltes 33kV Feeder cable section must be repaired
- The West Acres Steiltes 33kV Feeder must be tested and, where necessary, be repaired.
- The West Acres Steiltes 33kV Feeder should be put in commission
- The Mbombela 33kV Ring must always be in commission at ALL times, with either Steiltes West Acres 33kV Feeder Circuit Breaker or West Acres Steiltes 33kV Feeder Circuit Breaker as a normally open point.

5. Conclusion

The municipality is auditing all electrical equipment and distribution systems to establish the condition and suitability of the network, in the process we develop, document and implement maintenance, repair and monitoring (inspection), which shall include:

- Maintenance / inspection intervals
- Maximum permissible periods that equipment/systems may be out of commission.
- Safe Operation Procedures

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Table 1: Operation and Maintenance Plan 2022/2023

Item No.	Installation/ Equipment	Condition	Remedial Action	Period For Action			
				Jul- to -sept	Oct.- to - Dec	Jan- to - March	April - to- June
1	West Acres Substation 11kV Indoor Board	Protection Relays obsolete and unreliable	Replace the old protection relays with the approved newer version	vegetation removal and oil samples collation	Installation	testing and commissioning	
2	Geelhout 11/6.6kV Substation	1. Protection Relays obsolete and unreliable 2. DC System not working	1. Replace the old protection relays with the approved newer version Replace the DC system.	Transformer refurbishment and DC system procurement	Installation, testing and commissioning		
3	Dale substation	Old 11kV circuit breakers are obsolete and unreliable	Replace the old 11kV switchgear with SF6 or Vacuum. Replace the old existing DC system with a new one.	Vacuum Switchgear procurement	Installation,	testing and commissioning	
4	Water Works Substation	Old 11kV circuit breakers are obsolete and unreliable	Replace the old 11kV switchgear with SF6 or Vacuum.	Vacuum Switchgear procurement	Installation,	testing and commissioning	
5	2x6MVA Transformers		Refurbishment of 2x6MVA transformers	strip transformer and quote, repair	testing and delivery to municipal workshop		

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Item No.	Installation/ Equipment	Condition	Remedial Action	Period For Action			
				Jul- to -sept	Oct.- to - Dec	Jan- to - March	April - to- June
6	Steiltes Substation	routine maintenance	Protection system maintenance. Switchgear maintenance, vegetation management	vegetation removal and oil samples collation	maintain, testing and commissioning		
7	White River Central	routine maintenance	Protection system maintenance. Switchgear maintenance, vegetation management	maintain, testing and commissioning			
8	ilanga switching station	strengthening for firm supply	installation of additional cable from matafin substation to ilanga mall substation	Installation	testing and commissioning		

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Table 2: Capital Upgrades to be implemented in 2022/2023

Item No.	Description	Scope of Work		Implementation Period			
				2022/2023			
1	Upgrade of Valencia 33kV substation	strengthening for firm supply in the Valencia and Orchard	upgrade of 33kV substation to 20MVA 132/11 kV and looping of 132kV Line	Transformer procurement	Installation of panels	cabling	commissioning
2	upgrade of Delta 33kV substation	strengthening for firm supply in the Nelspruit central and suburbs	upgrade of 33kV substation to 20MVA 132/11 kV and looping of 132kV Line	Transformer procurement	Installation of panels	cabling	commissioning
3	Upgrade of 132kV line from Valencia via Steiltes to west acres	strengthening for firm supply in the Steiltes and West Acres	upgrade 33KV line to 132kV Line	Pole erections	Cables stringing	commissioning	
4	Upgrade of 132kV line from Valencia to Delta	strengthening for firm supply in the Valencia and Orchard	upgrade 33KV line to 132kV Line	excavations	Pole erections	Cables stringing	commissioning
5	KaMagugu Switching	strengthening for firm supply in the	contraction of new switching	Installation of MV Panels	Construction of 11kV line	Commissioning	

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Item No.	Description	Scope of Work		Implementation Period			
				2022/2023			
	Station contraction	KwaMagugu Area	station and upgrade of existing power lines				

Table 3: Capital Upgrades to be implemented in 2022/2023 and 2023/2024

Item No.	Description	Scope of Work		Implementation Period	
				2022/2023	2023/2024
1	Upgrade of 33kV Steiltes substation	strengthening for firm supply in the Steiltes	upgrade of 33kV substation 20MVA 132/11 kV and looping of 132kV Line	design, Civil works	construction and commissioning
2	Upgrade of 33kV Anderson substation	strengthening for firm supply in the CBD	upgrade of 33kV substation 20MVA 132/11 kV and looping of 132kV Line	design, civil works	construction and commissioning

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