
THE PLAYHOUSE COMPANY**SCOPE OF WORK / TECHNICAL SPECIFICATION****APPOINTMENT OF A SINGLE SERVICE PROVIDER FOR VOLTAGE TRANSFORMER (VT) FAULT DIAGNOSTICS, ENGINEERING REPORT AND RECOMMENDATIONS, SUPPLY, REPLACEMENT, TESTING AND COMMISSIONING**

11kV Incomer Switchgear – Voltage Transformer (VT), The Playhouse Company, Durban

1. The Background

The Playhouse Company's 11kV Incomer switchgear has experienced a second failure of its instrument Voltage Transformer (VT). eThekweni Electricity confirmed on site that the VT is faulty and that the associated meter is off, while the premises continue to consume electricity; the municipal account has since been estimated pending repair.

Given that this is the second VT to fail at this installation, an investigation and testing of the switchgear is required to identify the root cause before a replacement VT is installed. eThekweni cautioned that installing a new VT without first correcting the underlying fault risks a repeat failure and could endanger the municipal 11kV network by feeding a fault back through the consumer's installation. eThekweni confirmed that the required isolation, investigation and testing may be carried out by a service provider appointed by The Playhouse Company, provided the isolation is properly arranged and coordinated with the municipality.

2. Purpose and Objective

To appoint one (1) competent, appropriately registered and CIDB-graded service provider to:

- Conduct a full diagnostic investigation into the VT failure and associated 11kV switchgear;
- Compile an engineering report, signed off by a professional engineer, setting out root cause findings and recommendations;
- Supply and install a replacement VT (and any associated components identified in the report) in line with those recommendations;
- Test and commission the replacement installation; and
 - Formally close out the VT fault, restoring normal metering and full compliance.

No part of this scope may be split between multiple contractors. The appointed service provider carries end-to-end responsibility and accountability for the outcome, including the engineering sign-off.

3. Scope of Work**Phase 1 – Diagnostic Investigation**

The service provider shall arrange isolation of the installation from the municipal supply, in coordination with eThekweni Electricity and The Playhouse Company's maintenance department, and shall thereafter conduct the following tests and inspections on the 11kV Incomer switchgear:

- Pressure testing of the 11kV busbar and the three (3) 11kV circuit breakers;
- Secondary injection testing of the protection relays on the three (3) breakers (one Incomer and two Transformer breakers);
- Primary and secondary testing of the current transformers (CTs), covering both protection and metering applications;
- Testing of the voltage transformer(s) (VT);
- Ductor (Micro-Ohm) resistance testing of the three (3) 11kV circuit breakers; and

-
- Investigation of the VT secondary circuits to establish the root cause of the repeated VT failures.

All testing shall be conducted with due regard to the risk previously flagged by eThekwini Electricity, namely that a replacement VT installed without addressing the underlying cause may fail again and place the municipal 11kV network at risk.

Phase 2 – Engineering Report and Recommendations

Following diagnostics, the service provider shall compile a written engineering report, signed off by an electrical engineer/technologist registered with the Engineering Council of South Africa (ECSA), which shall include, as a minimum:

- A summary of tests conducted and results obtained;
- The identified root cause(s) of the VT failure(s);
- A risk assessment covering continued operation, and of installing a replacement VT without corrective action;
- Clear, actionable recommendations for remedial work, including replacement of the VT and any other components found to be defective or contributory to the failure;
- A recommended specification for the replacement VT (rating, type, and any protection/CT coordination requirements); and
- A proposed implementation, testing and commissioning plan.

The Playhouse Company (Facilities Manager) and eThekwini Electricity shall be given the opportunity to review the report prior to implementation proceeding.

Phase 3 – Implementation: Supply and Replacement of the VT

Based on the approved recommendations in the Phase 2 report, the same appointed service provider shall:

- Supply a replacement voltage transformer (and any ancillary components identified as required) meeting the specification recommended in the report;
- Carry out the removal of the failed VT and installation of the replacement, including any corrective work to the VT secondary circuits or associated protection/CT circuits identified as the root cause;
- Coordinate all necessary isolations with eThekwini Electricity and The Playhouse Company for the duration of the installation; and
- Ensure all work is carried out in accordance with the Occupational Health and Safety Act (OHS Act), relevant SANS standards, and eThekwini Electricity's requirements for work on or adjacent to municipal supply infrastructure.

Phase 4 – Testing and Commissioning

- Post-installation testing of the replacement VT and associated protection and metering circuits to confirm correct operation;
- Verification/re-testing of the CTs, relays and circuit breakers where these were disturbed during the works;
- Functional testing of metering to confirm accurate registration of consumption, in conjunction with eThekwini Electricity, to enable the account to move off estimated billing; and
- Submission of a commissioning certificate, signed by the responsible professional engineer, confirming the installation is safe, compliant and fit for service.

Phase 5 – Close-Out

- Submission of a close-out report consolidating the diagnostic findings, remedial actions taken, test results, and commissioning certificate;
- As-built documentation of any circuit changes made;
- Formal written confirmation to The Playhouse Company and eThekweni Electricity that the VT fault has been resolved and the installation restored to full compliance; and
- Handover of a maintenance/inspection recommendation to reduce the risk of recurrence.

4 Deliverables

Phase	Deliverable	Sign-off / Format
1	Diagnostic test results for all items listed in Phase 1	Raw test data and summary sheet
2	Engineering report with root cause and recommendations	ECSA-registered engineer sign-off
3	Replacement VT supplied and installed per recommendations	Site installation record
4	Test and commissioning certificate	ECSA-registered engineer sign-off
5	Close-out report and as-built documentation	Signed close-out letter

5 Eligibility and Qualification Criteria

Bidders must meet all of the following minimum requirements. Non-compliance may render a bid non-responsive:

1. Valid CIDB registration in grading designation 1EB, 2EB, 1EP or 2EP.
2. Certificate of registration as an Electrical Contractor from Department of Employment and Labour.
3. A professional engineer registered with ECSA must be part of the bidder's team (employed or formally sub-contracted under the bidder's single appointment) and must personally sign off the Phase 2 report and Phase 4 commissioning certificate.
4. Valid Central Supplier Database (CSD) registration.
5. Valid, current B-BBEE certificate/affidavit.
6. Completed SBD 4 (Declaration of Interest) and any other standard bid documents required by The Playhouse Company's supply chain management (SCM) process.
7. A valid Letter of Good Standing (COIDA) and relevant method statements/risk assessments for live/HV switchgear work.
8. Demonstrable prior experience in MV/HV (11kV) switchgear diagnostics, VT/CT testing, protection relay testing, and VT supply and installation – to be evidenced by at least two (2) relevant reference projects of similar scope completed in the last five (5) years.
9. Confirmation that the bidder can arrange, or work within, isolations coordinated with eThekweni Electricity.

6 Health, Safety and Coordination Requirements

- All work on or affecting the 11kV switchgear requires isolation from the municipal supply; the service provider is responsible for requesting and coordinating this isolation with eThekweni Electricity and The Playhouse Company's Facilities Manager in advance.
- Work shall be carried out by suitably qualified and authorised HV personnel in accordance with the OHS Act, the Electrical Installation Regulations, and eThekweni Electricity's requirements.
- A method statement and risk assessment specific to this scope shall be submitted for approval prior to commencement of any on-site work.
- The Playhouse Company's Safety Officer and Facilities Manager must be notified of, and where required present for, all isolations and live-adjacent work.

SANS Standards

Instrument transformers (VT/CT):

- **SANS 60044**
- **SANS 61869**
- **NRS 030**

Switchgear and protection:

- **SANS 62271** series (High-voltage switchgear and controlgear), specifically:
 - SANS 62271-1 (Common specifications)
 - SANS 62271-100 (AC circuit breakers)
 - SANS 62271-102 (AC disconnectors and earthing switches)
 - SANS 62271-200 (AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to 52 kV) — this superseded SANS 60298, applicable to the 11kV incomer switchgear itself
- **SANS 60255** series (Measuring relays and protection equipment) — applicable to secondary injection testing of the protection relays
- **NRS 034/041/048** (relevant Eskom/municipal Rationalised NRS specifications for reticulation and MV switchgear, where eThekweni requirements reference them)

General electrical installation and safety:

- **SANS 10142-1** (The Wiring of Premises — Low-voltage installations) — for any LV auxiliary/control wiring disturbed during the works
- **SANS 10198** series (The selection, handling and installation of electric power cables) — for VT secondary wiring/cabling
- **SANS 10292** (Earthing of low-voltage (LV) distribution systems)
- **SANS 61936-1 / IEC 61936-1** (Power installations exceeding 1 kV a.c.) — general MV installation requirements
- **SANS 10380** or relevant HV/MV maintenance and testing codes of practice
- **SANS 121-60529** (IP degrees of protection) — applicable to switchgear/VT enclosure ratings

Legislative Acts and Regulatory Framework

Instrument	Relevance
Occupational Health and Safety Act 85 of 1993 (OHS Act)	Overarching HV/live work safety duty, explicitly cited in the SOW
Electrical Installation Regulations, 2009 (under OHS Act)	Governs work on/testing of electrical installations, competency of persons doing the work
Electrical Machinery Regulations, 2011 (under OHS Act)	Governs HV switchgear, transformers and machinery safety
Construction Regulations, 2014 (under OHS Act)	If the isolation/replacement work constitutes "construction work" requiring a safety file, method statements, risk assessments
Engineering Profession Act 46 of 2000	Basis for the ECSA registration requirement for the sign-off engineer
Construction Industry Development Board (CIDB) Act 38 of 2000 and CIDB Regulations	Basis for the 1EB/2EB/1EP/2EP grading requirement

Electricity Regulation Act 4 of 2006	Governs the interface with eThekweni Electricity as licensed distributor, network protection obligations
eThekweni Municipality Electricity By-law	Local supply authority rules for isolation, connection, metering and work near municipal MV infrastructure
Broad-Based Black Economic Empowerment Act 53 of 2003	B-BBEE certificate/affidavit requirement
Compensation for Occupational Injuries and Diseases Act 130 of 1993 (COIDA)	Basis for the Letter of Good Standing requirement
National Building Regulations and Building Standards Act 103 of 1977	If any structural/enclosure work is affected (less central here, but standard reference)

ANNEXURE A**BILL OF QUANTITIES – VT DIAGNOSTICS, ENGINEERING REPORT, REPLACEMENT, TESTING, COMMISSIONING AND CLOSE-OUT**

Bidders must price every line item below. All items are to be priced excluding VAT unless otherwise indicated. Quantities marked “provisional” are estimates for pricing purposes only and shall be adjusted, if required, based on the confirmed findings and recommendations of the Phase 2 engineering report before Phase 3 proceeds.

Phase 1: Diagnostic Investigation and Testing

Item	Description	Unit	Qty	Rate (R)	Amount (R)
1.1	- Request, permit and coordinate isolation of the 11kV supply with eThekweni Electricity - Mobilisation, site establishment and safety file (Contractor to have public liability insurance after being appointed /method statement submission for diagnostic works)	Sum	1		
1.2	Provision of calibrated HV test equipment (injection kit, ductor tester, VT/CT test set) for the duration of testing	Sum	1		
1.3	Pressure (tightness/overpressure) testing of the 11kV busbar	Item	1		
1.4	Pressure testing of 11kV circuit breakers	No.	3		
1.5	Secondary injection testing of protection relays (1 Incomer + 2 Transformer breakers)	No.	3		
1.6	Primary injection testing of current transformers (CTs) – protection application	Set	3		
1.7	Secondary/ratio testing of current transformers (CTs) – metering application	Set	3		
1.8	Ductor (Micro-Ohm) resistance testing of 11kV circuit breakers	No.	3		
1.9	- Investigation and fault-tracing of VT secondary circuits to establish root cause - Compilation of raw test data sheets and diagnostic summary	Sum	1		
	Phase 1 Subtotal (excl. VAT)				

Phase 2: Engineering Report and Recommendations

Item	Description	Unit	Qty	Rate (R)	Amount (R)
2.1	- Analysis and interpretation of Phase 1 diagnostic results - Root cause determination and technical write-up - Risk assessment: continued operation risk and risk of re-failure / impact on municipal 11kV network - Development of remedial recommendations - Preparation of replacement VT technical specification (rating, type, protection/CT coordination) - Preparation of implementation, testing and commissioning plan - Compilation, formatting and issue of engineering report document - Professional engineer (ECSA-registered) technical review and sign-off of report - Presentation of findings and recommendations to The Playhouse Company and eThekweni Electricity	Sum	1		
	Phase 2 Subtotal (excl. VAT)				

Phase 3: Supply and Replacement of VT

Item	Description	Unit	Qty	Rate (R)	Amount (R)
3.1	Supply and installation of voltage transformer per Phase 2 specification	No.	1 (provisional – adjust per Phase 2 report)		
3.2	Supply of ancillary materials (fuses, links, secondary wiring, terminations, labelling)	Sum	1		
3.3	Corrective works to VT secondary circuits / protection wiring identified as root cause in Phase 2 report	Sum	1(provisional)		
3.4	Isolation coordination and permit-to-work with eThekweni Electricity during installation	Sum	1		
3.5	Site safety compliance, method statement and supervision during installation	Sum	1		
3.6	Standby/labour for work executed within municipal isolation window (incl. after-hours, if required)	Hour	10(provisional)		
	Phase 3 Subtotal (excl. VAT)				

Phase 4: Testing and Commissioning

Item	Description	Unit	Qty	Rate (R)	Amount (R)
4.1	Post-installation testing of replacement VT	No.	1		
4.2	Re-verification testing of CTs, relays and circuit breakers disturbed during installation works	Set	3		
4.3	Functional metering test in conjunction with eThekwini Electricity to confirm accurate registration	Item	1		
4.4	- Compilation and issue of commissioning certificate - Professional engineer (ECSA-registered) sign-off of commissioning certificate	Sum	1		
Phase 4 Subtotal (excl. VAT)					

Phase 5: Close-Out

Item	Description	Unit	Qty	Rate (R)	Amount (R)
5.1	Compilation of close-out report consolidating findings, remedial actions and test results	Sum	1		
5.2	As-built documentation of any circuit changes made	Sum	1		
5.3	Formal written confirmation of fault resolution to The Playhouse Company and eThekwini Electricity	Item	1		
5.4	- Handover of maintenance/inspection recommendations to reduce risk of recurrence - Submission of complete documentation set (electronic and hard copy)	Sum	1		
Phase 5 Subtotal (excl. VAT)					

Summary

Description	Amount (excl. VAT)
Phase 1 Subtotal – Diagnostic Investigation and Testing	
Phase 2 Subtotal – Engineering Report and Recommendations	
Phase 3 Subtotal – Supply and Replacement of VT	
Phase 4 Subtotal – Testing and Commissioning	
Phase 5 Subtotal – Close-Out	
SUBTOTAL (excl. VAT)	
VAT (15%)	
TOTAL (incl. VAT)	

BID EVALUATION CRITERIA**APPOINTMENT OF A SINGLE SERVICE PROVIDER FOR VOLTAGE TRANSFORMER (VT) FAULT DIAGNOSTICS, ENGINEERING REPORT, SUPPLY, REPLACEMENT, TESTING AND COMMISSIONING - 11kV INCOMER SWITCHGEAR**

This document sets out the evaluation methodology to be applied by The Playhouse Company in assessing bids received for the above scope of work. Bids will be evaluated in four (4) phases, in line with the Preferential Procurement Regulations, 2022, issued under the Preferential Procurement Policy Framework Act (PPPFA), Act 5 of 2000, using the 80/20 preference points system. A minimum threshold of 80 points (out of 100) must be achieved at Phase 2 (Functionality) for a bid to proceed to Phase 3 and Phase 4 evaluation, given the safety-critical, live-HV nature of the works.

PHASE 1: MANDATORY REQUIREMENTS

Failure to submit any of the documents listed below will render a bid non-responsive; the bid will not be evaluated further.

No.	Mandatory Criteria	Yes	No
1	Valid CIDB registration - Grading Designation 1EB / 2EB / 1EP / 2EP		
2	Certificate of registration as an Electrical Contractor from Department of Employment and Labour.		
3	Bill of Quantities (Annexure A) fully priced, completed and signed.		
4	Attendance of the compulsory site briefing meeting - attendance register signed.		
5	SBD 4 - Declaration of Interest, fully completed and signed.		
6	Valid Central Supplier Database (CSD) registration report.		
7	Valid, current B-BBEE Certificate / Sworn Affidavit.		
8	Proof that a Professional Engineer registered with ECSA forms part of the bidder's team (employed or formally sub-contracted under the single appointment).		
9	A valid Letter of Good Standing (COIDA).		

PHASE 2: FUNCTIONALITY EVALUATION

Bids that pass Phase 1 will be evaluated for functionality against the criteria below, reflecting the two implementation phases of this scope of work (diagnostic investigation, and supply/replacement/testing/commissioning) together with the bidder's proposed programme, methodology and experience. Each sub-criterion is rated 0-5 by the evaluation panel; the rating is converted to a score out of the weight allocated. A minimum functionality threshold of 80 points applies.

Criteria	Sub-Criteria / Evidence Required	Rating (0-5)	Weight	Score (Rating × Weight ÷ 5)
1. Team Capability - Phase 1 (Diagnostic Investigation)	Electrical Engineer or Electrical Technologist, registered with ECSA, to lead the diagnostic investigation and sign off the Phase 1 engineering report. Electrical Artisan (HV-competent) to carry out on-site testing (pressure testing, secondary injection, CT/VT testing, ductor testing). Artisan may be subcontracted by the service provider and SLA to be in place. Attach: CVs, ECSA registration proof/certificate, trade test certificate, organogram showing reporting lines for this phase.		10	
2. Team Capability - Phase 2 (Supply, Replacement, Testing & Commissioning)	Electrical Engineer / Technologist (ECSA registered) responsible for the replacement specification and commissioning sign-off. Electrical Technician to support implementation, testing and verification of protection/CT/relay circuits. Electrical Artisan (HV-competent) to carry out removal, installation and commissioning work on site. Artisan may be subcontracted by the service provider and SLA to be in place. Attach: CVs, qualifications, registrations/affiliations, organogram for this phase.		15	
3. Proposed Implementation Programme	A comprehensive task list covering isolation coordination, diagnostics, reporting, supply, replacement, testing and commissioning, and close-out.		20	

	Tasks are specific to the Playhouse Company / eThekwin Electricity 11kV VT scope, with clear milestones (e.g. Phase 2 report sign-off, isolation windows, commissioning date). A realistic timeline (programme/Gantt chart) with time estimates per activity and dependencies between phases.			
4. Methodology	Project execution plan covering isolation arrangements with eThekwin Electricity and The Playhouse Company's Maintenance Department. Methodology aligned to each phase of the scope: diagnostic testing approach; engineering report and ECSA sign-off process; VT supply/replacement approach; testing and commissioning approach; close-out and hand-over. Clear installation methods, safety approach (OHS Act, live/HV work method statements and risk assessments) and timeframes for each task.		25	
5. Past Relevant Experience	At least two (2) verifiable reference projects of similar scope (MV/HV 11kV switchgear diagnostics, VT/CT testing, protection relay testing, and VT supply and installation) completed in the last five (5) years. Award letters and completion certificates, with contactable references confirming scope, value and performance. Evidence of prior work involving isolations coordinated with a municipal electricity distributor.		30	
TOTAL FUNCTIONALITY SCORE			100	100

Rating Scale

Rating	Description
0	No submission / not addressed.
1	Poor - largely non-compliant; minimal or irrelevant detail.
2	Below average - partially addresses the requirement; significant gaps.
3	Average / Acceptable - meets the minimum requirement with adequate detail.
4	Good - clearly addresses the requirement with relevant, project-specific detail.
5	Excellent - comprehensive, project-specific, evidences strong understanding of the 11kV VT scope.

20 April 2026

The PLAYHOUSE COMPANY

Main Substation - 400V

INDEX:

1. Overview
2. Voltage & Current / Frequency
3. Voltage Dips & Swells
4. kW, kVA, kVar & Power Factor
5. Harmonics
6. Energy

Report compiled by:

Shaheel Moonilal

Magnet Electrical Technician

(Tel) 031 274 1050

(Email): shaheelm@magnet.co.za

1. Overview

Report on a Power Quality Analysis that was done at the Playhouse.

Instrument used:  PQ Box 150 ser.no: 2138-004

System:	3-wire system
Nominal Voltage PE/PP (primary):	230.94 V / 400.00 V
Frequency:	50 Hz
Current Measurement:	Rogowski coil 3kA
Interval:	60 s
Ripple-control Frequency:	75 Hz
Start:	13.04.2026 07:48:00
End:	20.04.2026 09:13:00
Duration:	7d 1h 25m 0s
Number of Intervals:	10,157 / 10,165
Flagged values:	Excluded
PQ-Box:	PQ-Box 150: Expert 2-9kHz
Serial-No.:	2138-004
Firmware:	4.135
DSP-Version:	4.061

This report is based on a recording that was done over a period of 7 days. Starting on Monday 13 April 2026 and ending on Monday 20 April 2026.

PLACEMENT OF METER

2. VOLTAGE & CURRENT



Marker

Curve 1:	IL2	Curve 2:	IL2
Time 1:	2026-04-17 17:52:00.000	Time 2:	2026-04-17 19:50:00.000
Value 1:	749.069 [A]	Value 2:	711.201 [A]
Time delta:	1h 58m 0s 0ms	Value delta:	37.8673 [A]

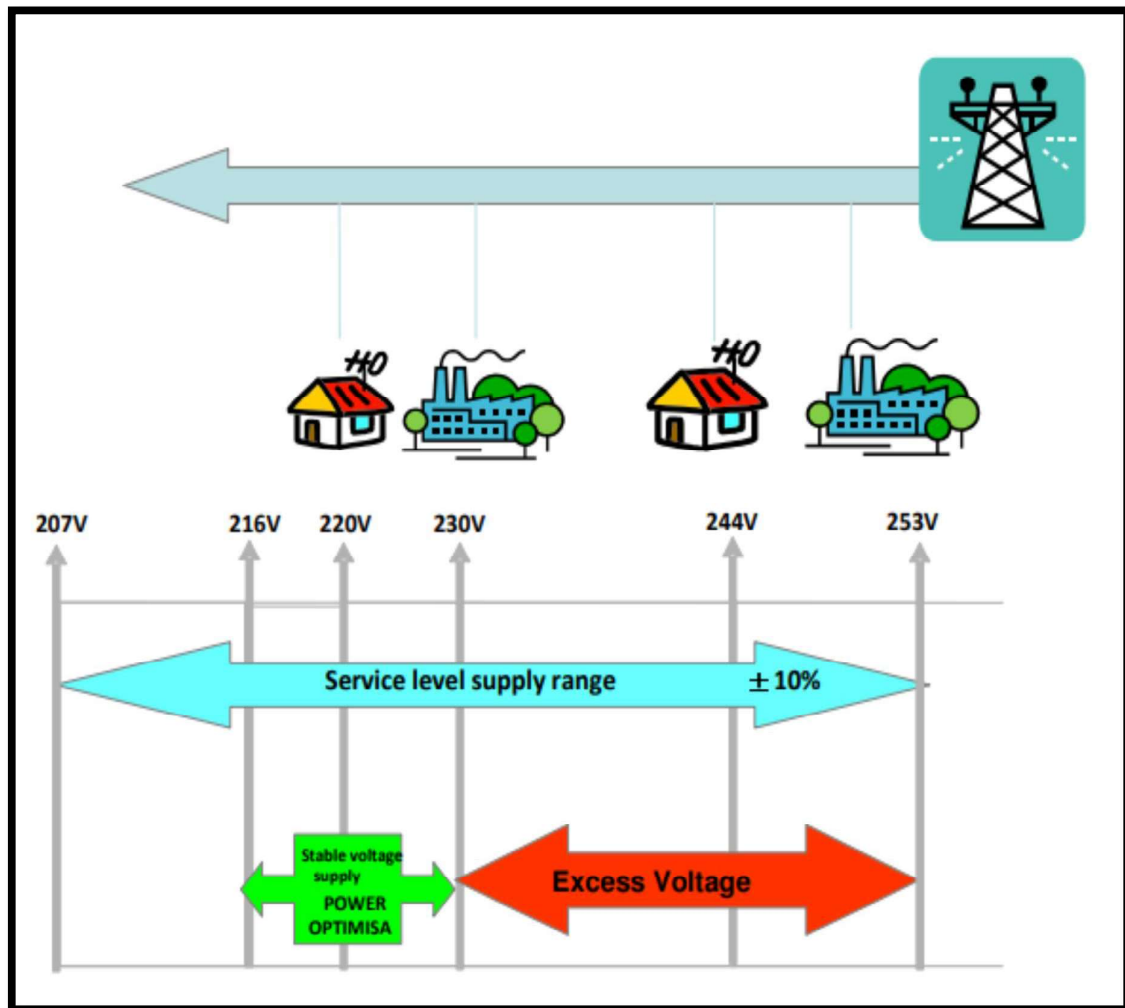
Details

	Min	Mean	Max
U12	388.956 V	397.772 V	408.240 V
U23	387.476 V	396.103 V	407.593 V
U31	384.967 V	393.115 V	402.923 V
UL1	223.490 V	228.240 V	233.893 V
UL2	224.742 V	229.868 V	236.399 V
UL3	222.512 V	227.205 V	233.276 V
UNE	0.465 V	0.631 V	1.232 V
IL1	103.894 A	318.780 A	737.939 A
IL2	79.034 A	302.948 A	749.282 A
IL3	78.707 A	286.683 A	670.524 A
I Neutral	41.933 A	62.448 A	120.004 A

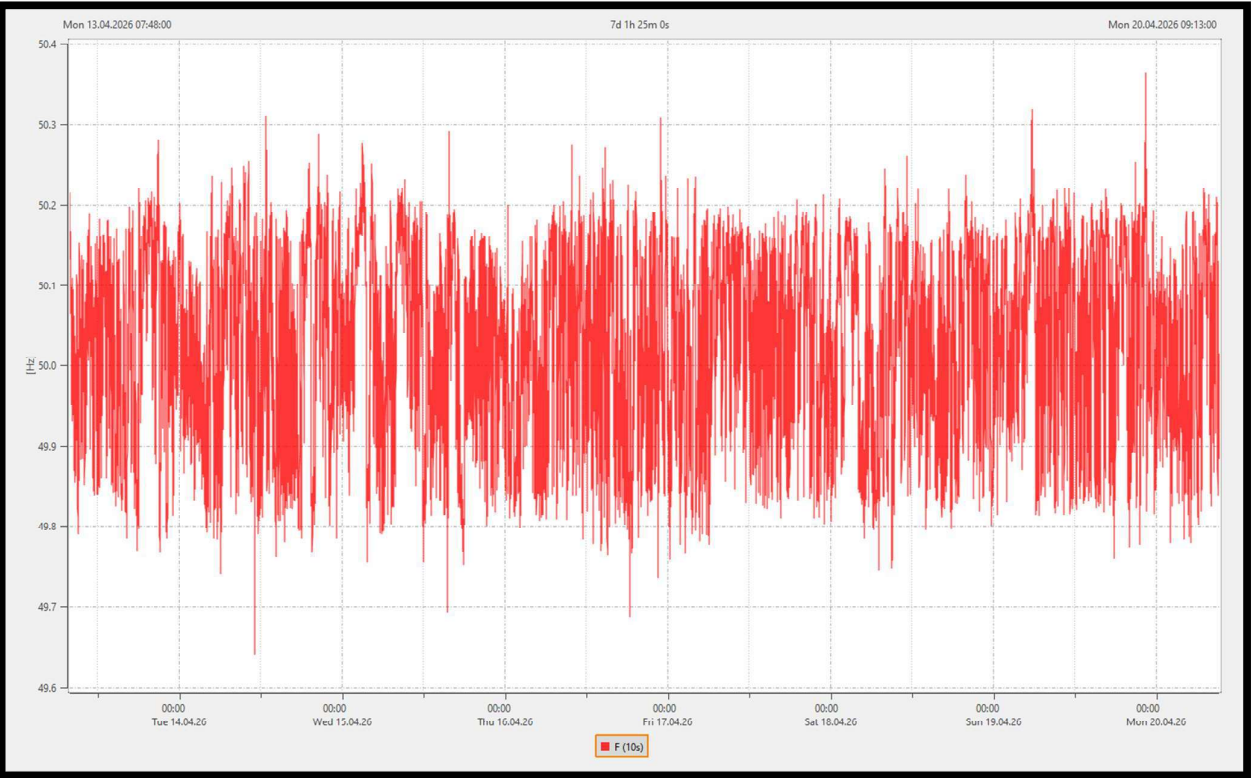
The highest current measured during this recording, was **749.282 A** on the white phase. The above load profile illustrates that during the 7 days of logging, the voltage seems within range.

VOLTAGE LIMITS

The statutory **voltage band**, within which the **South Africa** electricity providers deliver our three-phase electricity, has changed in recent years from 380 volts to 400 volts (220 volts single phase to 230 volts), plus or minus 5% (or $\pm 10\%$ in the prescribed range within which all electrical equipment must operate effectively). Therefore, all electrical devices must be able to operate effectively between **207 volts and 253 volts single phase**. See diagram below.



Frequency



Details			
	Min	Mean	Max
F (10s)	49.640 Hz	50.023 Hz	50.364 Hz

The frequency is within an acceptable range.

3. Voltage Dips & Swells

Dips

There are dips during this recording, however their amplitude and duration are 500ms and below.

(Please see below)

	Event	Start Time	Max. Value [V]	Δ Uss [V]	End Time	Duration
1	Dip U12	14.04.2026 04:53:49,046	334.311		14.04.2026 04:53:49,096	0s 50ms
2	Dip U12	14.04.2026 15:48:09,687	352.547		14.04.2026 15:48:09,726	0s 40ms
3	Dip U12	14.04.2026 15:54:07,861	300.358		14.04.2026 15:54:08,132	0s 270ms
4	Dip U23	14.04.2026 15:54:07,861	260.336		14.04.2026 15:54:08,153	0s 291ms
5	Dip U31	14.04.2026 15:54:07,861	268.209		14.04.2026 15:54:08,173	0s 311ms
6	Dip (poly phase)	14.04.2026 15:54:07,861	260.336		14.04.2026 15:54:08,173	0s 311ms
7	Dip U12	14.04.2026 16:01:10,273	346.047		14.04.2026 16:01:10,372	0s 100ms
8	Dip (poly phase)	14.04.2026 16:01:10,273	322.542		14.04.2026 16:01:10,382	0s 110ms
9	Dip U31	14.04.2026 16:01:10,312	322.542		14.04.2026 16:01:10,382	0s 70ms
10	Dip U12	16.04.2026 09:40:19,387	334.391		16.04.2026 09:40:19,457	0s 70ms
11	Dip (poly phase)	16.04.2026 09:40:19,387	331.105		16.04.2026 09:40:19,476	0s 90ms
12	Dip U23	16.04.2026 09:40:19,397	338.100		16.04.2026 09:40:19,457	0s 60ms
13	Dip U31	16.04.2026 09:40:19,397	331.105		16.04.2026 09:40:19,476	0s 80ms
14	Dip U23	17.04.2026 08:05:20,621	184.515		17.04.2026 08:05:20,732	0s 110ms
15	Dip (poly phase)	17.04.2026 08:05:20,621	184.515		17.04.2026 08:05:20,742	0s 120ms
16	Dip U31	17.04.2026 08:05:20,631	293.548		17.04.2026 08:05:20,742	0s 110ms
17	Dip U12	17.04.2026 08:05:20,641	330.762		17.04.2026 08:05:20,721	0s 80ms
18	Dip U23	18.04.2026 04:59:23,796	316.372		18.04.2026 04:59:23,875	0s 80ms
19	Dip (poly phase)	18.04.2026 04:59:23,796	316.372		18.04.2026 04:59:23,885	0s 90ms
20	Dip U31	18.04.2026 04:59:23,805	321.811		18.04.2026 04:59:23,885	0s 80ms
21	Dip U12	19.04.2026 18:13:10,457	323.726		19.04.2026 18:13:10,516	0s 60ms
22	Dip U31	19.04.2026 18:13:10,457	302.738		19.04.2026 18:13:10,516	0s 60ms
23	Dip (poly phase)	19.04.2026 18:13:10,457	302.738		19.04.2026 18:13:10,516	0s 60ms

Swells

There are no swells during this recording

Voltage swells and dips, also known as voltage fluctuations or power quality disturbances refer to sudden and temporary changes in the magnitude of electrical voltage in an electrical power system.

These fluctuations can occur due to various reasons and can have significant impacts on the performance and reliability of electrical equipment. Understanding the motivation behind voltage swells and dips is essential for maintaining stable and efficient power supply systems.

1. **Voltage Swells:** Voltage swells are characterized by a temporary increase in voltage levels above the normal range. They typically last for a short duration, ranging from a few cycles to several seconds. The main motivations behind voltage swells include:
 - **Faulty Equipment Operation:** Malfunctioning of equipment within the power system, such as faulty transformers or switching devices, can cause sudden voltage swells.
 - **Network Switching:** Switching operations within the power grid, such as energizing or de-energizing large loads or capacitor banks, can result in voltage swells due to the sudden change in the system's impedance.
 - **Load Disconnection:** Abrupt disconnection of heavy loads, such as large motors or industrial machinery, can lead to voltage swells as the reactive power demand reduces rapidly.
2. **Voltage Dips:** Voltage dips, also known as voltage sags or voltage drops, are characterized by a temporary decrease in voltage levels below the normal range. They can last from a few milliseconds to a few seconds. The motivations behind voltage dips include:
 - **Faulty Equipment Operation:** Similar to voltage swells, faulty equipment within the power system, such as short circuits or overload conditions, can cause voltage dips.
 - **Faults in the Grid:** Faults in the power grid, such as line faults or ground faults, can lead to voltage dips. These faults can occur due to various reasons, including lightning strikes, tree contact with power lines, or equipment failure.
 - **Starting of Large Loads:** When large loads with high starting currents, such as motors or compressors, are connected to the power system, voltage dips can occur due to the initial inrush currents required by these loads.

4. kW, kVA, kVar & Power Factor



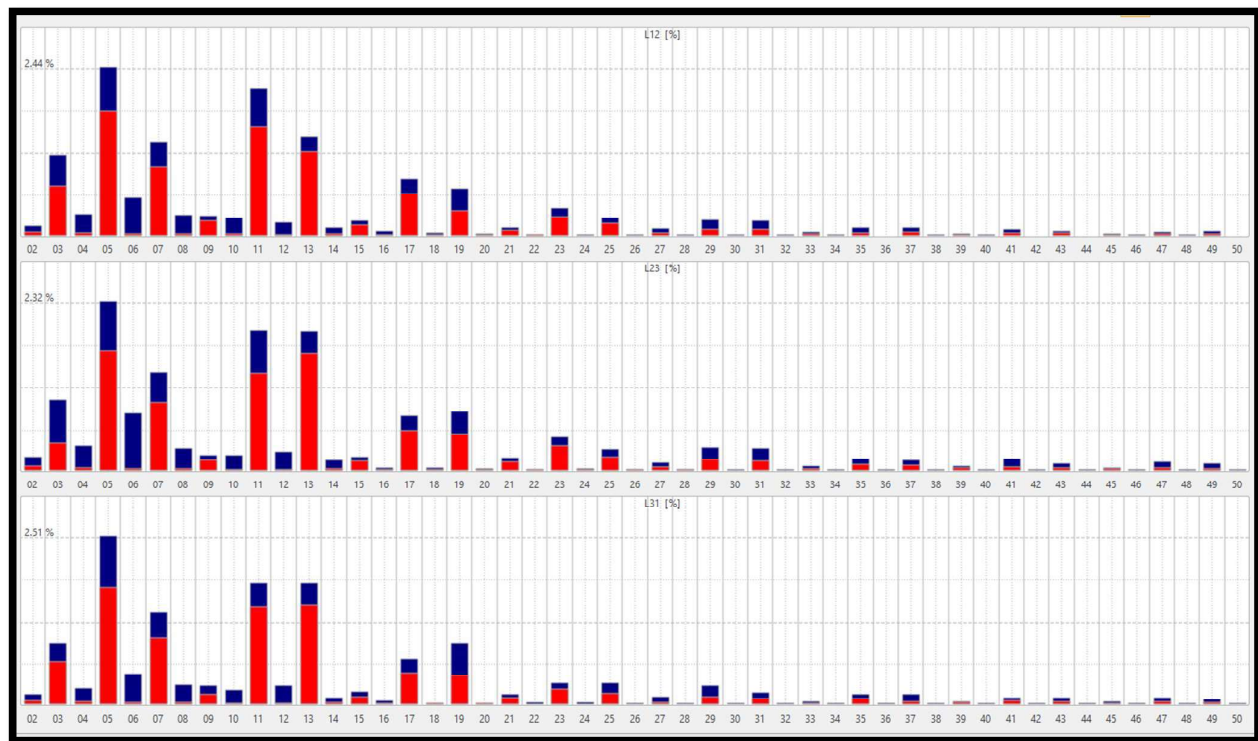
Details

	Min	Mean	Max
P L1	23.024 kW	70.471 kW	162.005 kW
P L2	16.614 kW	67.027 kW	162.921 kW
P L3	16.675 kW	62.837 kW	144.292 kW
P total	57.142 kW	200.335 kW	468.252 kW
S L1	23.881 kVA	72.712 kVA	167.282 kVA
S L2	18.071 kVA	69.620 kVA	171.974 kVA
S L3	17.988 kVA	65.118 kVA	151.539 kVA
S total	61.556 kVA	207.760 kVA	490.353 kVA
Q L1	5.715 kVar	17.766 kVar	43.906 kVar
Q L2	3.832 kVar	18.478 kVar	55.777 kVar
Q L3	3.264 kVar	16.711 kVar	46.496 kVar
Q total	14.288 kVar	54.325 kVar	146.846 kVar
PF L1	0.898	0.968	0.989
PF L2	0.875	0.961	0.989
PF L3	0.854	0.962	0.990
PF total	0.891	0.962	0.987

5. HARMONICS

Voltage Harmonics:

THD (Voltage)

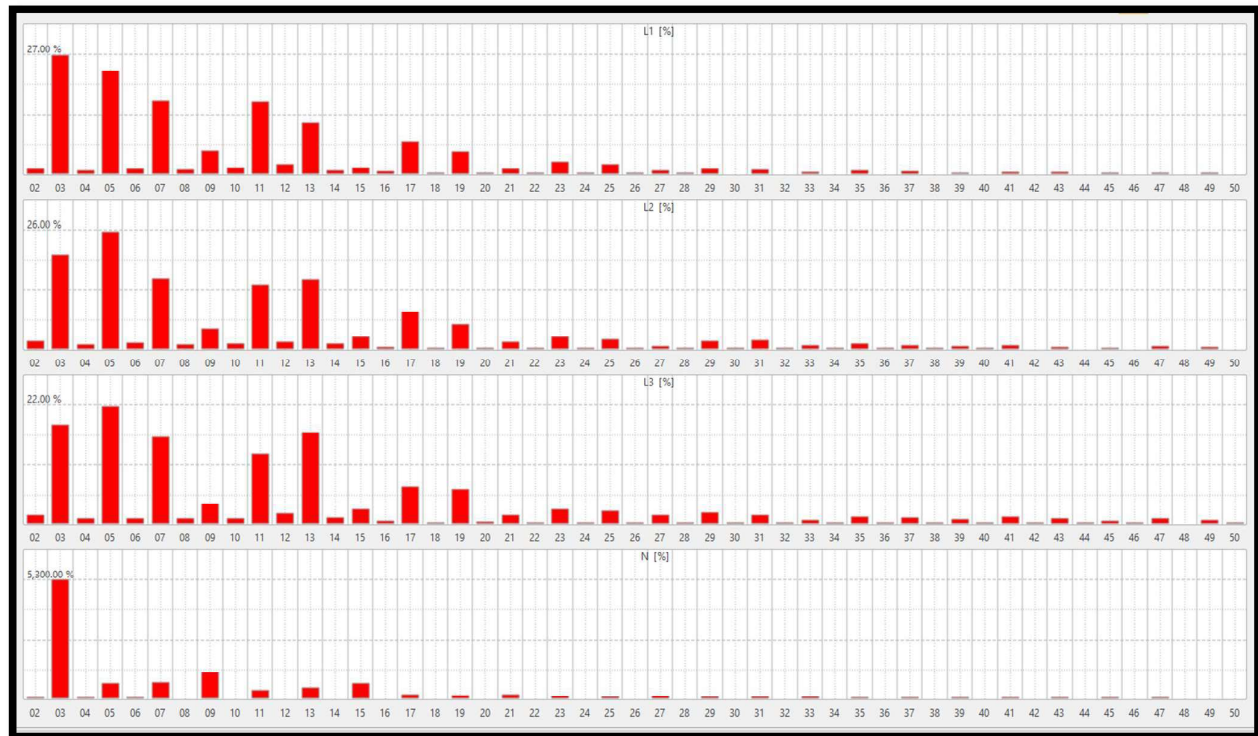


Details			
	Min	Mean	Max
THDL1	1.060 %	1.936 %	3.440 %
THDL2	0.893 %	1.839 %	3.288 %
THDL3	0.869 %	1.831 %	3.305 %

The average voltage THD should not exceed 6% according to IEC61000-2-2/4.

Current Harmonics

THD (Current)

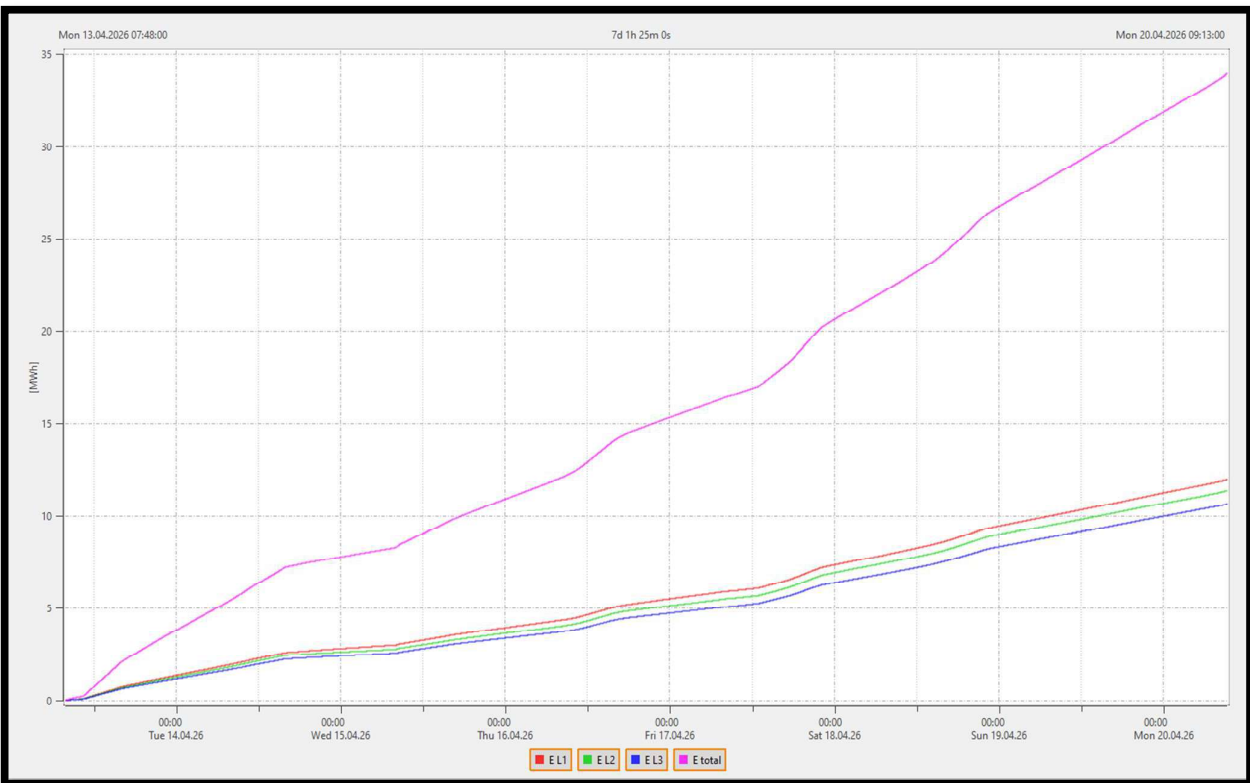


Details			
	Min	Mean	Max
THD I1	13.685 %	24.083 %	32.265 %
THD I2	11.935 %	23.002 %	32.486 %
THD I3	11.155 %	21.675 %	31.142 %
THD IN	78.920 %	264.985 %	5.502 k%

The average current THD should not exceed 10% according to IEC61000-2-2/4.

Having harmonics in the system is normal due to all the non-linear loads in the network, however should you have power factor correction it is advisable to have detuned reactors (harmonic filters) in series with the capacitors to avoid harmonic amplification.

6. ENERGY



Details			
	Min	Mean	Max
E L1	2.822 kWh	5.655 MWh	11.940 MWh
E L2	2.580 kWh	5.322 MWh	11.357 MWh
E L3	2.433 kWh	4.937 MWh	10.647 MWh
E total	7.834 kWh	15.914 MWh	33.944 MWh

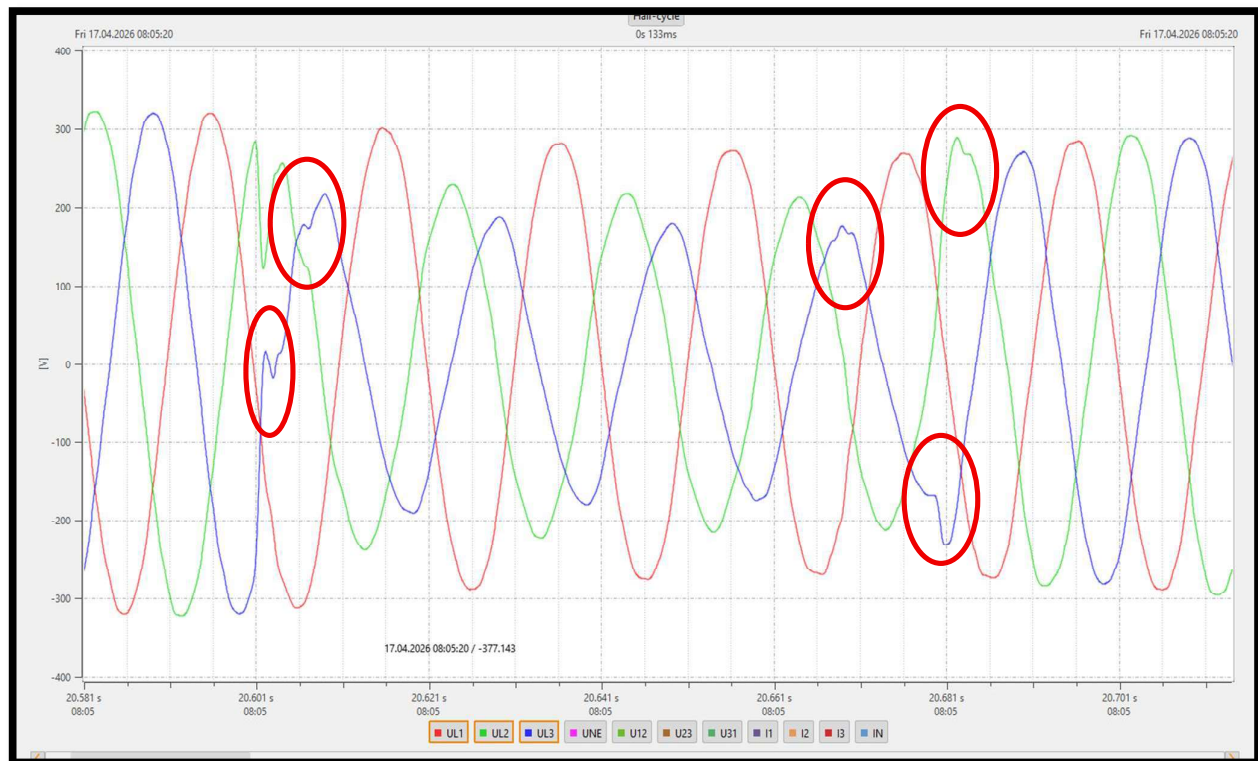
Conclusion

- The voltage levels are within the acceptable range
- During the recording, I had observed that there were voltage dips that occurred in the electrical network. These could be caused by the switching of loads.
- The current harmonics are also higher than the nominal expected.
Causes – variable speed drives, non-linear loads, inverters etc.
Effects/impacts – High neutral currents – overheating neutral conductors, overheating transformers, voltage distortion, and loss of system capacity, excessive heating in induction motors can produce resonance in the system.
Solution – Install filters on the equipment that generates harmonics (i.e. drives)

Recommendations:

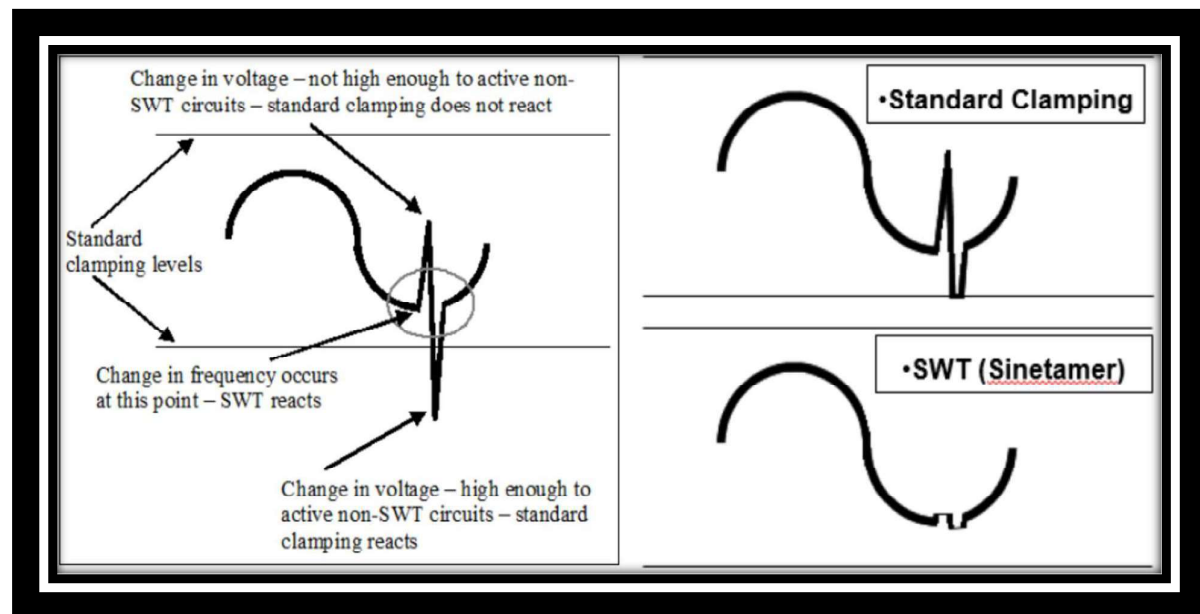
- Earthing Survey – Conduct to verify the quality of the earthing this will ensure effective protection against surges.
- There are transients in the system, which is expected because only $\pm 20\%$ of transients are generated from outside and $\pm 80\%$ are generated from within the network caused by electronic switching devices, which includes switching of LED lights, etc. Transients cause damage to electronic equipment such as, LED lamps and electronic balasts, Refrigeration and AC unit, security, and fire alarms failures, etc.

Clear indications of transients:



We would recommend to install a sine tamer, when power is restored from municipality there is a great surge in the electrical network. Unlike standard surge protection, sine tamers are sinewave tracking devices and therefore will also protect equipment within the standard clamping levels, which standard surge protection cannot offer. Sine tamers do not get rid of the voltage dips, but it will protect sensitive equipment when transients / surges are generated as a result of dips.

See comparison below:



Report

Should any further clarity or assistance be required, I will be willing to assist wherever possible. Please do not hesitate to contact me.

Report compiled by:

Shaheel Moonilal

Magnet Electrical Technician

(Tel) 031 274 1050

(Email): shaheelm@magnet.co.za