

ILONG COMPANY LIMITED



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TRANSFORMER MAINTENANCE REPORT

**PROVISION OF ELECTRICAL MAINTENANCE SERVICE FOR ELECTRICAL
MEDIUM VOLTAGE
SUBSTATIONS IN MONUSCO FIELD OFFICES IN DEMOCRATIC REPUBLIC OF
CONGO (DRC) AND ENTEBBE
SUPPORT BASE- UGANDA
(RFP NUMBER: 3100005226)**

Submitted to

THE ELECTRICAL SECTION

MONUSCO



MONUSCO



1 Introduction

MONUSCO through the contract # 4700026638 Provision of Electrical Maintenance Service for Medium Voltage Substations in MONUSCO, Field Offices in Entebbe, Uganda. Offered to Ilong Company Limited on 16th October 2024 on issued a Task Order No.1 for Maintenance of Transformers and Switchgear in the Medium Voltage Substations at the Entebbe Service Base. requires transformers to be serviced and maintained to ensure reliable operation of its plant equipment with the least downtime possible.

The current system consists of 11kV/415V switchgears and transformers.

This exercise is a planned annual maintenance activity aimed at ensuring the plant equipment is safe, compliant and operational as required.

MONUSCO contracted Ilong to carry out these services according to agreed standards and specifications.

2 Scope

Supply with all consumables/tools an adequate transformer oil purification and treatment equipment and service the selected transformers according to MONUSCO standards and industry best practice.

The agreed scope of work is detailed below:

2.1 Transformers

- i. Onsite oil analysis of all transformers.
- ii. Insulation resistance test (Megger test) for all transformers.
- iii. Functioning test for all transformer protection instruments and oil filtration if required from the analyzed results.
- iv. Filtration and treatment of the insulating oil.
- v. Conducting an insulation resistance test on the transformer MV & LV windings.
- vi. Checking the Buchholz relays for functionality.
- vii. Checking the functionality of the tap changer step operations.
- viii. Checking for leakages and thereafter cure as required.
- ix. Topping up the insulating oil to the required levels.
- x. Hand over the serviced, repaired, tested and commissioned transformers to MONUSCO.

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3 Transformer Service Details

3.1 1MVA 11kV/400V, Transformer No.1 (23/11/2024)

3.1.1 Transformer Details

TABLE 1 TRANSFORMER NO.1 DETAILS

Manufacturer/Make	EPT
Year of Manufacture	
Serial No.	200949097
Rated Power	1MVA
Voltage Ratio	11kV/400V
Vector Group	Dyn 11
Tap Changer	Off-load

3.1.2 Main Transformer Works

The following works were carried out on transformer No.1:

- Winding Insulation resistance was carried out before and after filtration
- Insulating oil breakdown voltage tests were carried out before and after filtration.
- The silica gel was found to have taken in moisture and in bad state.
 - Serviced the breather and changed Silica gel.
- Thorough cleaning of the transformer was carried out.

3.1.3 Tests Performed

3.1.3.1 Insulation Resistance Test

TABLE 2 1MVA TX INSULATION RESISTANCE TEST

Before Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR	Temperature
HV - LV	11.14G Ω	14.14G Ω	1.46	34 $^{\circ}$ C
HV - E	10.78G Ω	14.57G Ω	1.3	
LV - E		Couldn't disconnect cables		

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		in time		
After Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR	Temperature
HV - LV	15.75G Ω	20.5G Ω	1.31	42°C
HV - E	14.92G Ω	21G Ω	1.4	
LV - E	4.68G Ω	6.08G Ω	1.31	

Remarks:

Great improvement of insulation resistance and Dielectric absorption ratio (DAR) after filtration.

3.1.3.2 Insulating Oil Breakdown Voltage (BDV) Test

TABLE 3 1MVA TX INSULATING OIL BREAKDOWN VOLTAGE

INSULATING OIL BREAKDOWN VOLTAGE (BDV) TEST.OIL BREAKDOWN			
Test	Before Oil Filtration (BOF)	After Oil Filtration (AOF)	Remarks
Break Down Voltage (BDV)	61.2kV	80kV	Good dielectric strength improvement after oil filtration (AOF).

3.1.3.3 Earth Resistance Test

TABLE 4 1MVA TX EARTH RESISTANCE TEST

EARTH RESISTANCE TEST.			
Test	Point 1	Point 2	Remarks
Earth Resistance	1.3 Ω	N/A	Measured value is within acceptable values of 1 Ω .

3.1.3.4 Visual Accessories Checks

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TABLE 5 1MVA TX VISUAL CHECKS

TRANSFORMER ACCESSORIES CHECK			
Accessory	Check (Tick if done)	Remarks	Action Taken
Bushings	✓	In good state	Cleaned and tightened.
Valves & Fittings	✓	OK	In good state
Conservator gauges - main tank	✓	N/A	N/A
Conservator gauges – Tap Changer	✓	OK	N/A
Earth connections to main tank.	✓	Sound	In good condition
Transformer body	✓	Dusty	Cleaned
Breathers - main tank	✓	N/A	No conservator
Breathers – Tap Changer		N/A	N/A
Buchholz Relay	✓	OK	In good state
Pressure Relief Value/Explosion Vent	✓	OK	N/A
Winding temperature relay	✓	OK	Not connect to supply yet
Oil temperature Relay	✓	OK	Not connected yet to supply
Control Cabinet	✓	OK	N/A
Silica Gel	✓	N/A	N/A

3.1.3.5 Overall Remarks:

- Both DAR (Dielectric Absorption Ratio) values and the BDV (Break Down Voltage) of oil obtained show a healthy transformer.
- Oil filtration was carried out and there was great improvement on the BDV after filtration.
- For a transformer to live its whole expected lifetime of 30 years and above, service should be done beginning with the first five years from time of commissioning and from there on every year during the transformer's lifetime.
- The transformer was tested, found to be healthy and energised successfully.
- The next scheduled maintenance should be done in December 2025.

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3.2 500kVA 11/0.415KV Transformer (Tx 5) (24/11/2024)

3.2.1 Transformer Details

Manufacturer/Make	Tanalec
Year of Manufacture	2010
Serial No.	T-31378
Rated Power	500KVA
Voltage Ratio	11/0.415 KV
Vector Group	Dyn 11
Tap Changer	Off-Load

3.2.2 Transformer Works

The following works were carried out during this exercise:

- Both HV and LV bushings had leakages and all seals were replaced with cork gaskets.
- The Buchholz relay seals had leakages and were replaced with cork gaskets.
- Insulating oil breakdown voltage tests were carried out before and after filtration.
- Winding Insulation resistance tests were carried out before and after filtration.
- The breather was serviced and silica gel changed.
- Thorough cleaning of the transformer was carried out.

3.2.3 Tests Performed

3.2.3.1 Insulation Resistance Test

TABLE 6 500KVA TRANSFORMER IN SUBSTATION 5 TX INSULATION RESISTANCE TEST

Before Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR= (R) 60secs / @30secs	Temperature.
HV - LV	33.4GΩ	44.6GΩ	1.33	30°C
HV - E	34.7GΩ	45.5GΩ	1.31	
LV - E	13.8GΩ	16.4GΩ	1.20	
After Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR= (R) 60secs / @30secs	Temperature.

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HV - LV	43.5GΩ	60.6GΩ	1.39	46°C
HV - E	32.4GΩ	43.8GΩ	1.35	
LV - E	22.4GΩ	29.1GΩ	1.3	

Remarks: Great improvement of Dielectric absorption ratio (DAR) after filtration.

TABLE 7 500KVA INSULATION OIL BREAKDOWN VOLTAGE

INSULATING OIL DIELECTRIC STRENGTH TEST.			
Test	Value in KV Before Oil Filtration (BOF)	Value in KV After Oil Filtration (AOF)	Remarks
Break Down Voltage (BDV)	55.8kV	72kV	Good dielectric strength improvement after oil filtration (AOF).

3.2.3.2 Earth Resistance Test

TABLE 8 500KVA TX EARTH RESISTANCE TEST

EARTH RESISTANCE TEST.			
Test	Point 1	Point 2	Remarks
Earth Resistance	0.9 Ω	N/A	Measured value is below the recommended value of 1 Ω. Earth resistance is good.

3.2.3.3 Visual Checks

TABLE 9 500KVA TX VISUAL CHECKS

TRANSFORMER ACCESSORIES CHECK			
Accessory	Check (Tick if done)	Remarks	Action Taken
Bushings	✓	Both HV and LV leaking	Cured by changing seals
Valves & Fittings	✓	Checked	Ok
Conservator gauges - main tank	✓	In good condition	Topped to half

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Tap Changer	✓	Offload tap changer	In Normal tap 3
Earth connections to main tank.	✓	Checked	OK
Transformer body	✓	Covered in dust	Cleaned
Breathers - main tank	✓	In good condition	Serviced
Buchholz Relay	✓	In good condition	Tested ok
Oil Gauge and View Glass	✓	In good condition	ok
Silica Gel	✓	In bad condition	Replaced.

3.2.3.4 Overall Remarks:

- Both DAR (Dielectric Absorption Ratio) values and the oil BDV (Break Down Voltage) obtained show a healthy transformer.
 - Oil filtration was carried out and there was great improvement on the test values after filtration.
 - For a transformer to live its whole expected lifetime of 30 years and above, service should be done beginning with the first five years from time of commissioning and from there on every year during the transformer's lifetime.
 - The transformer was tested, found to be healthy and energized successfully.
- The next scheduled maintenance should be done in December 2025.

3.3 1MVA 11/0.415KV Transformer (TX 4)

3.3.1 Transformer Details

Manufacturer/Make	Electric power transformer
Year of Manufacture	2009
Serial No.	200909098
Rated Power	1MVA
Voltage Ratio	11/0.400 KV
Vector Group	Dyn 11
Tap Changer	Off-Load

3.3.2 Transformer Works

The following works were carried out during this exercise:

- Carried out oil filtration up to 60°C.

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- b) Insulating oil breakdown voltage tests were carried out before and after filtration.
- c) Winding Insulation resistance tests were carried out before and after filtration.
- d) Thorough cleaning of the transformer was carried out.

3.3.3 Tests Performed

3.3.3.1 Insulation Resistance Test

TABLE 10 1MVA TX INSULATION RESISTANCE TEST

Before Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR= (R) 60secs / @30secs	Temperature.
HV - LV	2.03GΩ	2.44GΩ	1.2	34°C
HV - E	2.32GΩ	2.65GΩ	1.14	
LV - E		Couldn't disconnect the cables		
After Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR= (R) 60secs / @30secs	Temperature.
HV - LV	1.43Ω	1.87GΩ	1.3	58°C
HV - E	1.32GΩ	1.76GΩ	1.33	
LV – E		Couldn't disconnect the cables		

Remarks: Great improvement of Dielectric absorption ratio (DAR) after filtration. The insulation values after filtration are lower than the values before filtration since insulation resistance is inversely proportional to temperature. Therefore, according to the BDV values if the transformer was left to cool to the starting temperature, then the insulation resistance values are expected to shoot above the starting values tremendously.

3.3.3.2 Insulating Oil Breakdown Voltage (BDV) Test

Summary BDV Test Results

TABLE 11 1MVA TX INSULATION OIL BREAKDOWN VOLTAGE

INSULATING OIL DIELECTRIC STRENGTH TEST.			
Test	Value in KV	Value in KV After	Remarks

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	Before Oil Filtration (BOF)	Oil Filtration (AOF)	
Break Down Voltage (BDV)	51.5 kV	59.8 kV	Good dielectric strength improvement by after oil filtration (AOF).

3.3.3.3 Earth Resistance Test

TABLE 12 1MVA TX EARTH RESISTANCE TEST

EARTH RESISTANCE TEST.			
Test	Point 1	Point 2	Remarks
Earth Resistance	1.6 Ω		Measured value is within the recommended value of 1 Ω . Earth resistance is good since the ground was so dry on testing.

3.3.3.4 Visual Checks

TABLE 13 1MVA TX VISUAL CHECKS

TRANSFORMER ACCESSORIES CHECK			
Accessory	Check (Tick if done)	Remarks	Action Taken
Bushings	✓	Full of dust with no leakages	Cleaned
Valves & Fittings	✓	Checked	OK
Conservator gauges - main tank	✓	N/A	
Tap Changer	✓	Checked	OK
Earth connections to main tank.	✓	Checked	OK
Transformer body	✓	Covered in dust	Cleaned
Breathers - main tank	✓	N/A	
Buchholz Relay	✓	Checked	OK
Oil Gauge and View Glass	✓	Checked	OK
Silica Gel	✓	N/A	

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3.3.3.5 Overall Remarks:

- a) Both DAR (Dielectric Absorption Ratio) values and the BDV (Break Down Voltage) of oil obtained show a healthy transformer.
- b) Oil filtration was carried out and there was great improvement on the BDV after filtration.
- c) For a transformer to live its whole expected lifetime of 30 years and above, service should be done beginning with the first five years from time of commissioning and from there on every year during the transformer's lifetime.
- d) The transformer was tested, found to be healthy and energized successfully.
- e) The next scheduled maintenance should be done in December 2025.

3.4 1.25MVA 11kV/380V Transformer (Transformer no. 3)

3.4.1 Transformer Details

Manufacturer/Make	SHFE Electricals
Year of Manufacture	2014
Serial No.	YD1404300176
Rated Power	1.25MVA
Voltage Ratio	11kV/380V
Vector Group	Dyn 11
Tap Changer	Off-Load

3.4.2 Transformer Works

The following works were carried out during this exercise:

- a) Both the HV and the LV bushings were leaking and seals replaced
- b) Insulating oil breakdown voltage tests were carried out before and after filtration.
- c) Winding Insulation resistance tests were carried out before and after filtration.
- d) Carried out oil filtration up to a temperature of 65°C
- e) Thorough cleaning of the transformer was carried out.

3.4.3 Tests Performed

3.4.3.1 Insulation Resistance Test

TABLE 14 1.25MVA TX INSULATION RESISTANCE TEST

Before Oil Filtration (BOF)

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Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR= (R) 60secs / @30secs	Temperature.
HV - LV	5.02GΩ	7.43GΩ	1.48	36°C
HV - E	4.81GΩ	5.95GΩ	1.24	
LV - E	3.44GΩ	4.45GΩ	1.3	
After Oil Filtration (BOF)				
Test	(R) 30secs (Ω)	(R) 60secs (Ω)	DAR= (R) 60secs / @30secs	Temperature.
HV - LV	3.9GΩ	5.23GΩ	1.34	50°C
HV - E	3.8GΩ	4.49GΩ	1.3	
LV - E	3.05Ω	3.65GΩ	1.2	

Remarks: The insulation values after filtration are lower than the values before filtration since insulation resistance is inversely proportional to temperature. Therefore, according to the BDV values if the transformer was left to cool to the starting temperature, then the insulation resistance values are expected to shoot above the starting values tremendously.

3.4.3.2 Insulating Oil Breakdown Voltage (BDV) Test

Summary BDV Test Results

TABLE 15 1.25MVA TX INSULATION OIL BREAKDOWN VOLTAGE

INSULATING OIL DIELECTRIC STRENGTH TEST.			
Test	Value in KV Before Oil Filtration (BOF)	Value in KV After Oil Filtration (AOF)	Remarks
Break Down Voltage (BDV)	38.9kV	60.2 kV	Good dielectric strength improvement after oil filtration (AOF).

3.4.3.3 Earth Resistance Test

TABLE 16 1.25MVA TX EARTH RESISTANCE TEST

EARTH RESISTANCE TEST.			
Test	Point 1	Point 2	Remarks
Earth Resistance	1.4 Ω		Measured value is below the recommended value of 1 Ω . Earth resistance is good.

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3.4.3.4 Visual Checks

TABLE 17 1.25MVA TX VISUAL CHECKS

Accessory	Check (Tick if done)	Remarks	Action Taken
Bushings	✓	HV and LV had leakages	Changed seals with cork gaskets
Valves & Fittings	✓	Checked	OK
Conservator gauges - main tank		N/A	N/A
Tap Changer	✓	Checked	OK
Earth connections to main tank.	✓	Checked	OK
Transformer body	✓	Covered in dust	Cleaned
Breathers - main tank		N/A	N/A
Buchholz Relay		N/A	N/A
Oil Gauge and View Glass	✓	In good condition	Tested ok
Silica Gel		N/A	N/A

3.4.3.5 Overall Remarks:

- The oil BDV and DAR indicated great improvement after filtration
- Oil filtration was carried out and great insulation values are expected when temperatures drop to ambient.
- For a transformer to live its whole expected lifetime of 30 years and above, service should be done beginning with the first five years from time of commissioning and from there on every year during the transformer's lifetime.
- The transformer was tested, found to be healthy and energized successfully.
- The next scheduled maintenance should be done in December 2025.

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PHOTO GALLERY



FIGURE 1 I LONG TEAM GETTING ACCESS TO SUBSTATION NO.4 AND NO.5

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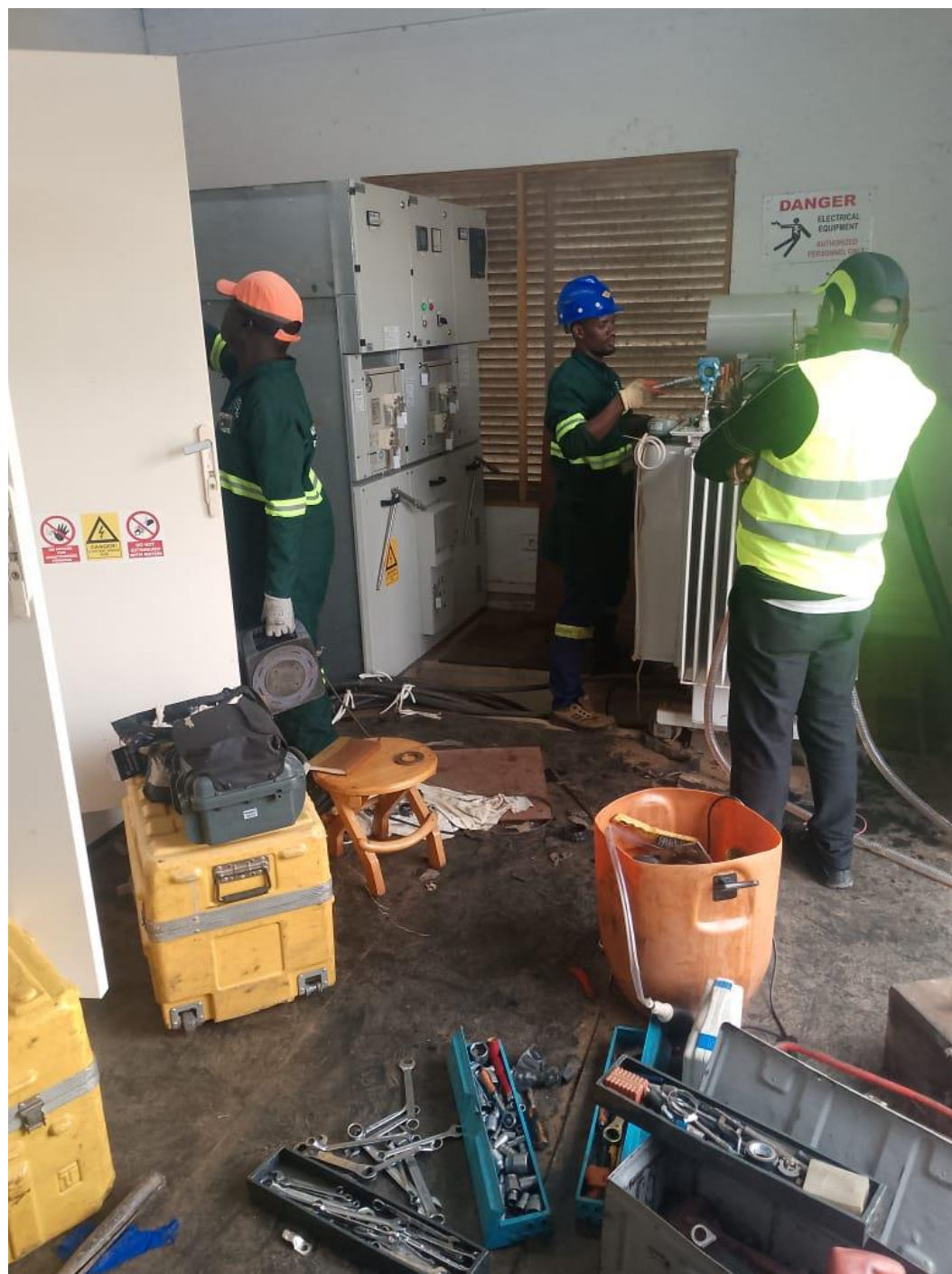


FIGURE 2 SUPERVISION FROM MONUSCO ELECTRICAL ENGINEER

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FIGURE 3 FIGURE 3 ILONG TEAM TAKING MAINTENANCE ACTIVITIES

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