JOINT COMMISSIONING REPORT OF AGATOBWE MHPP UPGRADE

Date: 13-14 March 2020

1. Introduction

AGATOBWE MHPP is a hydropower plant located on Agatobwe river in Southern province, Nyaruguru district and Ngoma. Before being leased to CARERA-EDERER&TIGER LTD , it was operating as off grid power plant with installed capacity of 200kW. Among the conditions to be fulfilled by developer to operate the plant but not limited to, are to upgrade from 200kW to 390kW and connect the plant to the grid. These conditions were achieved with the maximum load is 400kW during commissioning tests. The maximum runaway speed achieved during load rejection was 1052rpm while the run-away speed of turbine manufacturer is 1190rpm. They performed a number of civil works and electromechanical works at head race channel and power house. Testing and commissioning tests started in December 2019 up to March 2020. Dry tests and hydraulic tests were performed by developer himself without the presence of the purchaser and wet commissioning tests were performed under the presence of purchaser's representatives.

2. Specifications features of the plant

2.1. Turbine

Manufacturer: Rain power

Type: Horizontal Francis

Net head: 24m

Rated power: 405kW

Nominal speed: 600rpm

Nominal flow: 1.9m^3/sec

2.2. Generator

Manufacturer: NIDEC LEROY-SOMER

Nominal Voltage: 400V

Nominal current: 707.3A

Rated output: 392kW/490kVA

Power factor: 0.8

Excitation voltage: ~~4V~~ ~~4V80~~ 40 volt

Excitation current: 1.8 -4A

Nominal speed: 600rpm

3. Activities performed by the developer for plant rehabilitation and upgrade

S/N	Part	Performed works	Remarks
1	Intake	✓ Replacement of the existing trash racks by the new ones with 5cm clearance between the bars to allow the flow equivalent to the new plant capacity ✓ Attend the leakage on undersluice gate ✓ Insert of GRP pipe and installed in parallel of the existing channel and meet near the forebay ✓ Installation flow meter under the bridge at intake ✓ Drainage of rain water from the road that was bring soil and sedimentation from the road into intake tank ✓ Fencing the intake tank	Undersluice gate leakage was not completely attended because heavy rain in the area that washes the poured conctrete and it shall be attended during dry season
2	Headrace canal and GRP pipe	✓ Installation of the GRP pipes in parallel with the existing canal ✓ Attend the landsliding uphill the canal and greening down side of GRP	As the canal is located down side of the road, it was difficult to attend water from the road that causes landsliding. As it is difficult to attend it during rain season, and the best solution will be implanted during dray season by canalizing road rainwater
3	Forebay tank	✓ Height of forebay was	Sand flushing gate

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		increased by 50cm to accommodate enough quantity of water flow for generation ✓ Painting of the existing trash racks ✓ Fencing the forebay tank and energy reducer	will be motorized and automated for reducing intermittent operation of intake gate when there is loss of grid or plant break down
4	Spill way channel	✓ Crest level of spill way channel was increased by 50cm to 100cm along its length ✓ Protection of down side of the forebay tank	It needs to be increased more 20cm at the section near the forebay tank
5	Penstock	Total replacement of the existing penstock	
6	Power house	✓ All electromechanical equipment in power house were replaced ✓ Power house was refurbished ✓ Protection of power house uphill side against landsliding ✓ Rainwater drainage ✓ Power house site fencing ✓ Grounding all electromechanical equipment in power house, switchgear and interconnection system ✓ Fencing the powerhouse site and transformer site	Main entrance gate of power house is not yet in place and it will be done before the end of March 2020
7	Tail race	Tailrace was modified and results to the increase of net head and there is no more leakage at this part as it was in December 2019.	
8	Security	Cameras for security monitoring were installed at different parts of power plant such as intake site, forebay site and power house (Inside and outside) as well	

4. Performed commissioning test under the presence of Purchaser representatives

Before conducting conducting the tests, joint team made a tour to different parts of the projects and found that most of civil works were completed and there is no leakage on penstock, headrace channel.

Tests performed under the presence of purchaser's representatives are as follows:

- ✓ Starting sequence of the machine
- ✓ Bearings and winding temperatures testing for 1hour to check their stabilization
- ✓ Excitation of the machine
- ✓ Synchronisation of the plant to the grid
- ✓ Loading the machine at the different loads (25%, 50%, 75% and 100%). At each step of load, the machine was running at least 20minutes and there was no abnormal observation during this loading test
- ✓ Load rejection tests at 25%, 50%, 75% and 102.5% and the results of testing are attached on this report
- ✓ Protection testing was done in December 2019 and confirmed by protection specialist at that time.
- ✓ Flow meter for river flow measurement was installed its results were confirmed

5. Energy meters reading at 10:34 AM of March 14, 2020

5.1. Meter number SN:216566533

- Import active energy: 978.121kWH
- Import Reactive energy: 378.663KVARH
- Export Active energy: 4924.990kWH
- Export reactive Energy: 1515.628KVARH

5.2. Meter number SN:216566457

- Import active energy: 978.022kWH
- Import Reactive energy:377.559 KVARH
- Export Active energy:4924.421 kWH
- Export reactive Energy:1514.042 KVARH

6. Pending activities to be carried out by developer

S/N	Issue	Resolution
1	Leakage on undersluice gate at intake and land sliding along headrace channel	It will be attended during dry season
2	Overspilling of spillway channel (Escape	This will be attended within

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	channel) at the section near the forebay and this shall not affect the plant operation during the time of attending this issue	next week by adding 20cm and it will done while the plant is operation
3	Power house main entrance gate is not yet welded and put in place while plant commissioning	This will be done within one week starting from the end of wet commissioning tests
4	Firefighting system for safety purpose of personnel and machinery and switchgear as well	Firefighting extinguishers and water shall be put in place within one week starting from the date of completion of wet commissioning test
5	Reliability test of 72hours is under process and once completed, results will be added to the full testing and commissioning tests to be submitted	This test shall be completed in three days starting from today March 14, 2020

7. Conclusion and recommendation

7.1. Conclusion

- ✓ During the test, no abnormal observation to plant operation and grid.
- ✓ Capacity of the plant is achieved and maximum reading during the test was 400.2KW
- ✓ Voltage, frequency and power factor found during the operation are of acceptable range according to grid requirement and the plant operation doesn't show any negative impact to the grid.
- ✓ Energy meters were recorded after load rejection test
- ✓ Flow meter for river water flow measurement is providing the realistic results

7.2. Recommendations

For better operation of the plant safely, the developer is recommended the following:

- Complete all pending issues on agreed timeline

Done on 14 March and Signed 2020 by:

CARERA-EDERER&TIGER LTD's representatives

S/N	Names	Function	Institution	Signature
1	Lars Helvik	Project manager	Malthe Winje Automasjon	
2	T. Nanda Gopal	Resident Engineer	Malthe Winje Infrapower	
3	Ole Henrik Torekoven	Scada Engineer	Malthe Winje Automasjon	

Purchaser's side (REG) representatives

S/N	Names	Position	Institution	Signature
1	NTANYUNGURA Jean Bosco	IPPs Manager	EUCL	
2	SIKA Robert	IPP management Team member	REG	
3	INGABIRE ANNICK	IPP Engineer	EUCL	

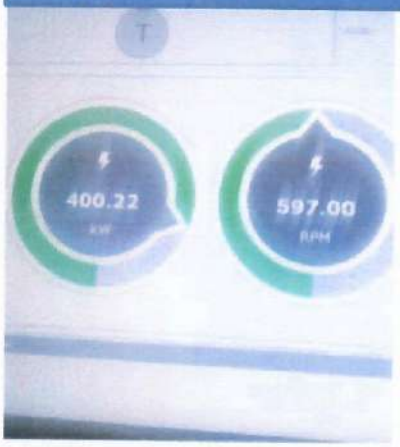
PICTURES ILLUSTRATING THE SOME TESTS RESULTS

section of spillway escape channel

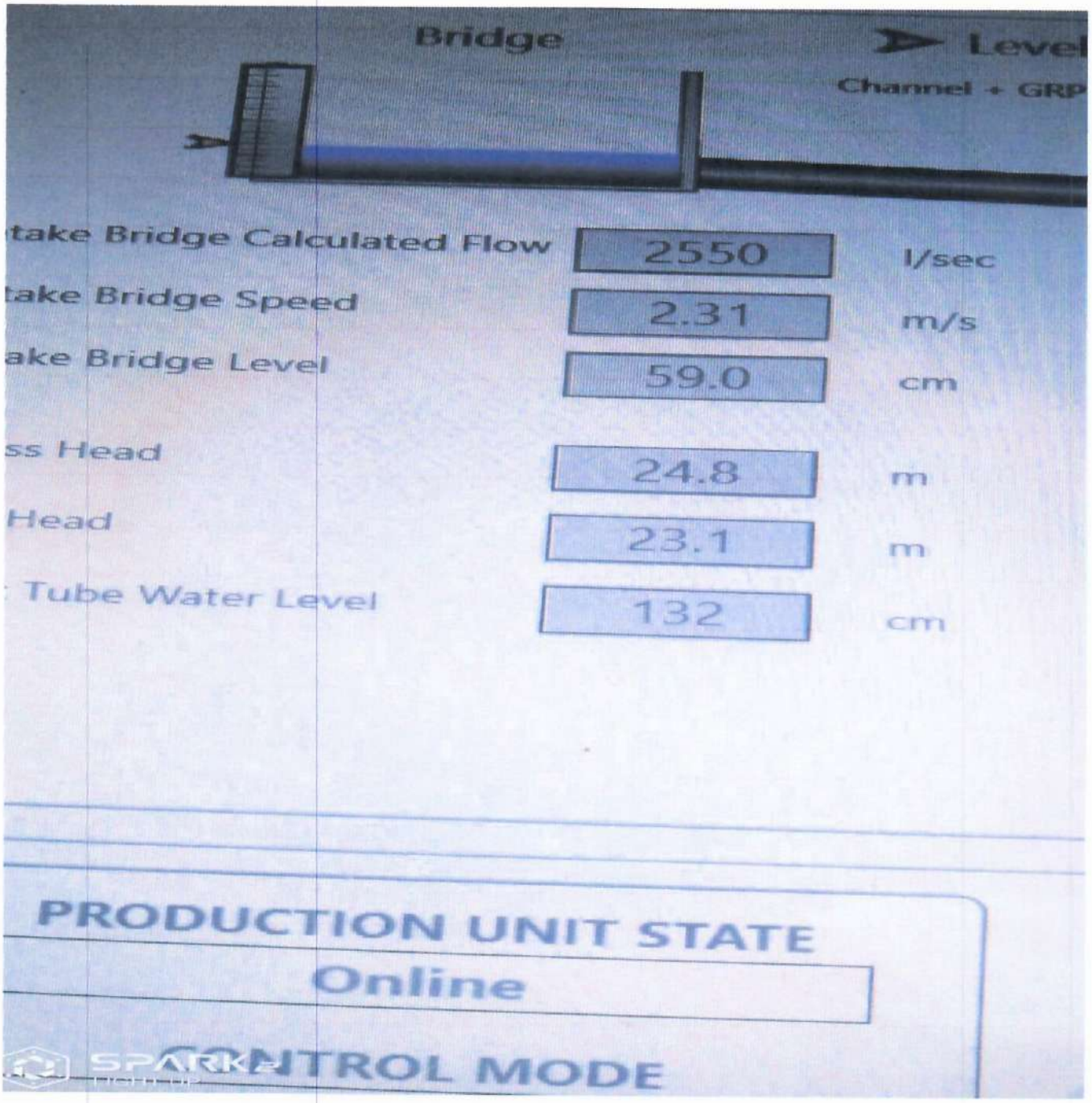
Machine running at 25% of rated capacity

Machine running at 100% load

The maximum achieved capacity during test



RIVER FLOW METER READINGS FROM CONTROL ROOM



Agatobwe River. **14/3-2020**
Extra note made during test and commission.

The attached description explains the chosen device to measure the river flow in Agatobwe River.

Main reason for choosing this kind of measurement device for this river is:

- *This river carries huge size of tree logs and huge quantity of derbies And not suited to have direct instrument into the water.*

Type off woodlogs carried by river.

- *The chosen device is also more accurate and widely used for this kind of rivers.*

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Manuel test readings:14 March 10.50 AM.

Manually measured in measurement area: = 0.77 m

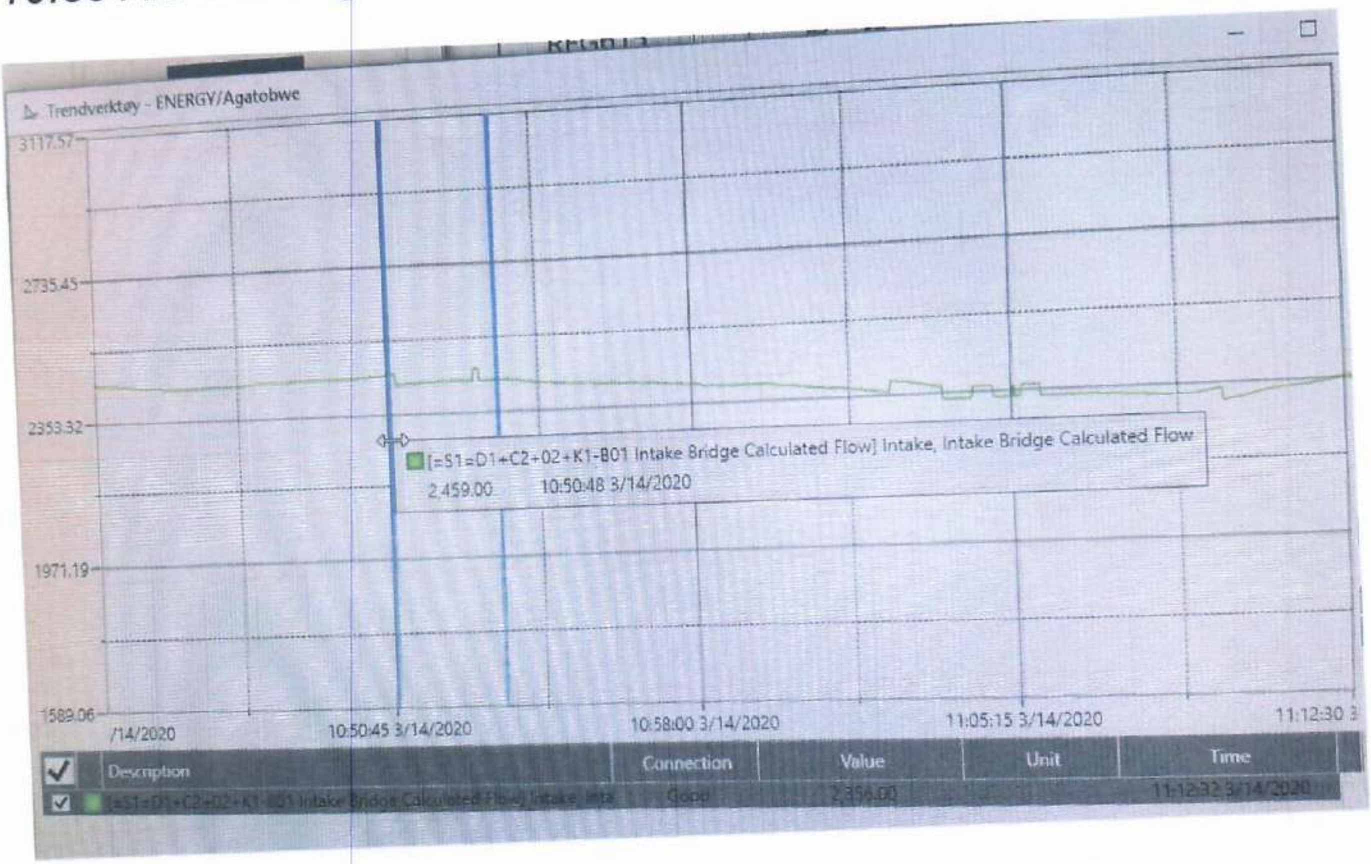
Manually measured surface velocity (m/s) = 1.2 m/s

Width of measurement Area = 3.12 m

Q = A x (0.85 x Vsurface)

Manual measured flow Q = 3.12*0.77 *(0.85*1.2) = 2.45 m3/s

Trend from scada during manual test period.
10.50 AM showing 2.46 m3/s..



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Malthe Winje
Infrapower AS

1. Introduction

Currently there are no gauging structures installed along the Agatobwe River. In order to accurately determine the flow rate of the Agatobwe river for the generation calculation of the Agatobwe Small Hydropower Plant, a gauging system needs to be installed. Due to the small project cost an innovative solution for the measurement of the river flow is proposed.

An existing bridge is located 44 m upstream of the Agatobwe weir. There are no tributaries between the bridge and the weir and the existing bridge provides a fixed cross section to determine the flow area. Therefore, we propose the use of a **Non-Contact Open Channel Flow Velocity and Level Meter** installed under the bridge. The instrument measures both the water level and the surface velocity and calculates the flow rate using the method described below.

Figure 1: Example of Non-contact Open Channel Flow Velocity and Level Meter installed on a bridge

2. Method

The method of measurement proposed is the area velocity method. The equation for calculating the flow:

$$\mathbf{Q = A \times (0.85 \times v_{surface})}$$

Q = river flow rate (m^3/s)

A = *calculated area* (m^2)

v = *measured surface velocity (m/s)*

The calculated area will make use of the existing bridge cross section, illustrated in the sketch below. During the upgrade of the existing works, a base is to be built along the river bed below the bridge to provide an even floor for measurement. The newly constructed base together with the existing bridge cross section provides a fixed cross section to determine the flow area and is used as inputs to the instrument to calculate the flow rate.

The flow height of the cross section (h2) will be measured by the instrument using an infrared sensor, installed below the bridge. The flow depth together with the fixed base and side walls, will provide the *calculated flow area A, see Table 1.*

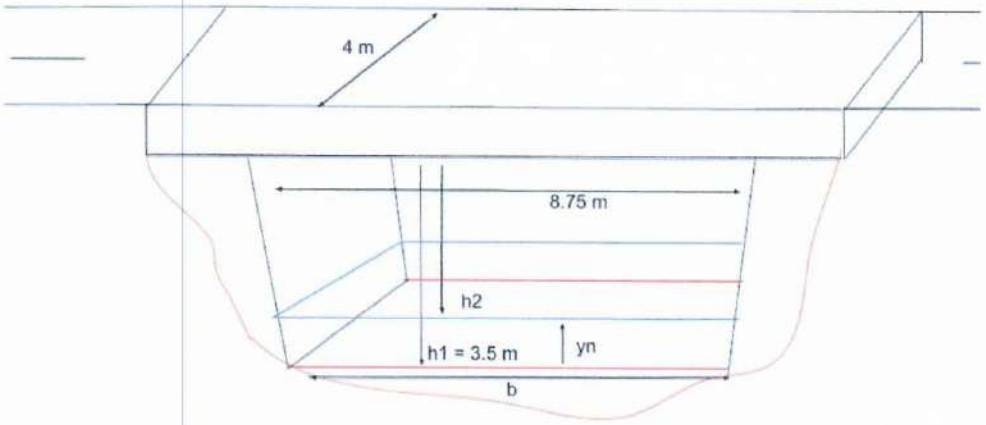

Figure 2: Sketch of bridge located 44 m upstream of Agatobwe weir

The second measurement will be of the *velocity*. The velocity will be measured using an ultrasonic sensor installed in the same instrument. The ultrasonic measurement makes use of the Doppler Effect. Surface velocity measurement functionality is achieved by transmitting an electromagnetic wave in 24 GHz frequency range (K-band), and measuring the frequency shift of the electromagnetic wave reflected from the flowing water surface. The frequency shift is caused by the Doppler effect of the moving surface on the electromagnetic wave. As the relative speed between the radar sensor and the water surface increases, the detected frequency shift also increases, thus enabling the flow meter to precisely determine the surface flow velocity. Ultrasonic level measurement is achieved by transmitting specially formed series of pulses and with waveform measurements and return analysis very precise distance (level) measurement is achieved.

Table 1: Flow rate variables and measurements

Fixed Variables	Measurements
b	h2 (reading from radar lever sensor)
h1	$v = v_{surface} \times 0.85$ $v_{surface}$ (reading from surface velocity sensor)
	0.85 factor (Studies performed by USGS reveal that, typically, the mean velocity is 80-95% of the surface velocity, the average being 85%.)

Area of trapezoidal channel

$$A = (b + z*(h1-h2))*(h1-h2))$$

b = fixed bottom width of bridge

z = fixed side slope of bridge

h1 = fixed depth from bridge deck

h2 = reading from radar level sensor

Using the readings h2 and $v_{surface}$ the flow in the Agatobwe River can be calculated within an accuracy of 1 % with the radar water level reading and 0.5 % with the ultrasonic sensor. The instrument datasheet is only a representation and the supplier may vary.

Appendix A – Photos of site

Appendix B – Data Sheet of Flow meter

Figure 1: Agatobwe weir with bridge further upstream

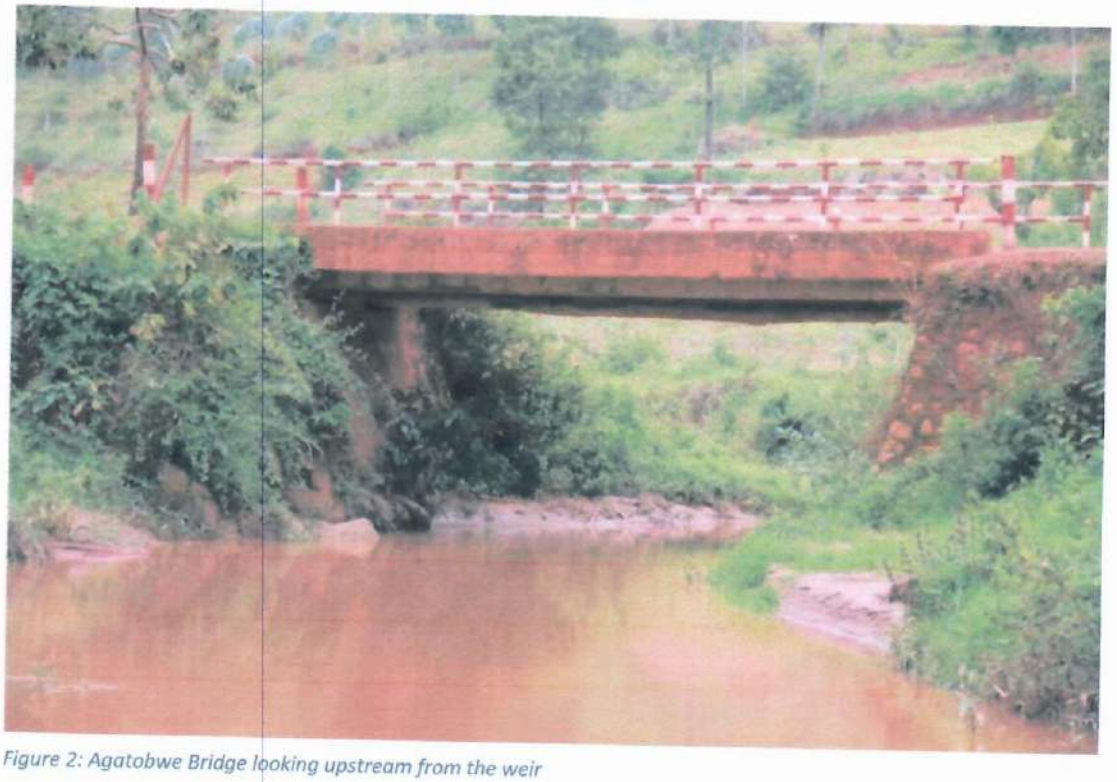

Figure 2: Agatobwe Bridge looking upstream from the weir

Figure 3: On Agatobwe Bridge looking upstream

Geolux RSS-2-300 WL Flow Meter

HIGH-PRECISION NON-CONTACT OPEN CHANNEL FLOW VELOCITY & LEVEL METER

HIGHLIGHTS

- Contactless, above the water, flow measurement
- Surface flow velocity measured with radar sensor
- Water level measured with ultrasonic sensor
- Wide velocity measurement range from 0,02m/s to 15m/s
- Distance measurement range from 0,5, to 10m
- Long range operation up to 10m above water level
- Compact, low-power design
- Wide input voltage range, suitable for solar applications
- Supports variety of communication interfaces (RS-232, RS-485, CAN, Alarm open-drain outputs)
- Optional SDI-12 support
- IP68-rated enclosure (for outdoor applications and harsh environments)
- K-band 24.125 GHz or 24.200 GHz radar option
- Automatic mounting angle compensation (cosine correction)
- Configurable direction of the flow measurement
- PC application for radar setup and live flow monitoring
- Simple integration with existing SCADA or telemetry systems
- Easy pole, wall or enclosure mounting

PRODUCT DESCRIPTION

Geolux RSS-2-300 WL flow velocity and level meter uses radar technology to provide precise contactless measurement of surface flow velocity, and ultrasonic robust sensor for measuring the distance from the sensor to the water level. Contactless radar & ultrasonic technology enables quick and simple sensor installation above the water surface, and requires minimum maintenance.

RSS-2-300 WL flow meter is used to monitor flow velocity and level of open channels such as rivers, irrigation channels or sewer systems, and for monitoring and control of hydropower plants and wastewater treatment plants. The flow meter is also suitable for various mass flow metering applications in mining processing plants, industrial installations, and, due to operation without moving parts and robust mechanical design, is ideal for measurement of flammable fluids and harsh chemical applications.

The radar operates in K-band (at 24.125 or 24.200 GHz), and provides flow speed readings 20 times per second over serial (RS-232, RS-485) and CAN interfaces. Ultrasonic level sensor operates in frequency range between 20 kHz and 350 kHz.

Variety of supported communication interfaces and protocols enable easy integration with existing telemetry equipment and SCADA systems. Integrated tilt sensor measures inclination angle of the sensor and the flow velocity measurement is automatically cosine-corrected according to the measured mounting tilt angle.

Geolux RSS-2-300 WL radar sensor is certified according to both European and American standards, and is being used worldwide.

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Geolux is a company based in the European Union that develops and manufactures radar sensors for use in traffic, security and hydrology applications.

DETAILED SPECIFICATIONS

GENERAL

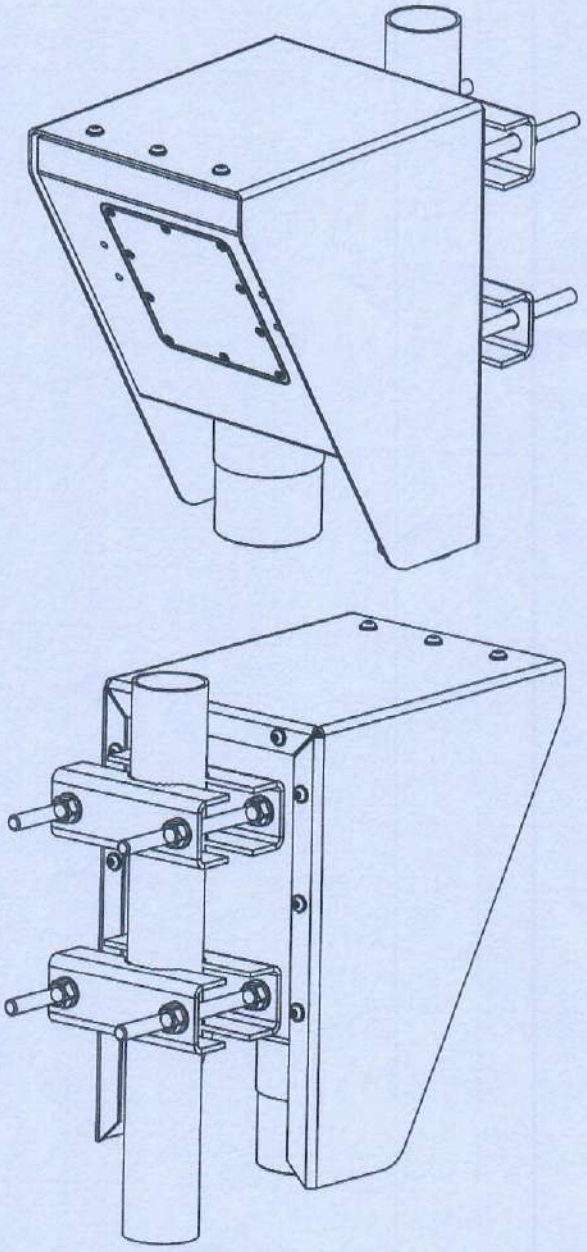
Radar Type	K-band 24.125GHz/24.200GHz Doppler radar, 27 dBm EIRP
Beam Angle	12° Azimuth, 24° Elevation
Detection Distance	50 m
Speed Range	0,02 m/s to 15 m/s
Speed Resolution	0,01 mm/s
Ultrasonic Frequency	20 kHz to 350 kHz
Distance Range	0,5 m to 10 m
Distance Resolution	1 mm
IP Rating	IP68

INTERFACE

Serial Interface	1 x serial RS-485 half-duplex 1 x serial RS-232 (two wire interface)
Serial Baud Rate	1200 bps to 115200 bps
Serial Protocols	ASCII-S, GLX-NMEA
CAN Interface	Up to 1Mbps CAN2.0
Alarm Outputs	2 x open collector, max 50V 200mA
Connector	M12 circular 12-pin

ELECTRICAL & MECHANICAL

Power Input	9 to 27 VDC
Power Consumption	< 1,35W (typical 1,0W)
Maximal Current	< 250 mA
Temperature Range	-40°C to +85°C (without heating or coolers)
Enclosure Dimensions	150 mm x 200 mm x 250 mm



FCC & CE APPROVED

EN 50293:2000
EN 61000-6-2, EN 61000-6-4:2007
EN 61000-3-2:2006+A1:2009+A2:2009
EN 61000-3-3:2008
EN 300 440-1, EN 300 440-2

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For more information, please visit our web page:
www.geolux-radars.com/hydrology or contact us at: geolux@geolux.hr

Agatobwe Mini Hydro Power Plant

Commissioning and Final Inspection

Commissioning and Final Inspection
T. Nanda Gopal, January, 2020

Based on ESAP, Reference Mini-hydropower Standard

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A. Salient Features

Name of plant: **Agatobwe MHPP**	Name of Owner: **CARERA-EDERER & TIGER Limited**
Location: **Agatobwe River, Ngoma, Nyaruguru District, Rwanda**	
Manufacturer: **Rain Power, NIDEC, ABB & Malthe Winje**	Supplier/Installer: **Malthe Winje**
Ownership: **Private**	No of households: **Connected to National Grid**
Gross head: **30 Meter**; Design flow: **1.9 m³/s**	Rated output: **390 kW / 490 kVA**
System: **Three-phase**	Voltage: **400 V**; Maximum current **707.3 A**
Start of construction of project: **07/01/2019**	day/month/year
Commissioning date: **13/03/2020**	day/month/year

B. Technical Status

B.1 Intake	
Type of intake: **Permanent**	**Permanent/Temporary**
If permanent, any cracks observed:	**No**
Any leakage observed:	**Yes**
Trash rack at intake: **Installed**	**Installed**
If installed, Clearance: **5 cm**	
Any structured cracks observed:	**No**
Type of Trash rack: **Metal**	**Metal**
Flow controlling mechanism: **Sluice Gate & Knife Gate**	
Remarks on Intake - Briefly discuss any major defects observed. **Repairs intended at intake drain gate are not effective due to heavy rains. The same has to be addressed in the dry season to have 100 % leak proof. Trash rack painting has to be completed**	

B.2 Headrace	
Length of headrace : **525 m (2 runs)** **1 Rectangular & 1 Circular**	Type of headrace: **Top Covered Cemented (Rectangular) & GRP Pipe (Circular)**
Any leakage observed:	**No**
Any cracks observed:	**No**
Remarks on Headrace – Briefly discuss any major defects observed **However while the machine stopped there are some over spillings in the channel at the forebay side. The same issue can be addressed be placing an automatic gate control system at forebay flush gate.**	

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B.3 Forebay	
Type of Forebay: **RCC**	**RCC**
Trash rack: **Installed**	**Installed**
If installed, Clearance: **2 cm**	
Any structured cracks observed:	**No**
Type of Trash rack: **Metal**	**Metal**
Spillover: **Incorporated**	**Incorporated**
Flushing arrangement: Works well	**Works well**
Air vent pipe: **Not installed**	**not installed**
Remarks on Forebay - Briefly discuss any minor/major defects observed: **As discussed in B.2.**	

B.4 Penstock Pipes	
Penstock Length : **50 m**	Material: **MS**; Thickness: **8 mm**; OD: 914 **Mm**
Any leakage observed in Penstock:	**No**
Expansion Joint: **Flange connected**	**Flange connected**
Any leakages in expansion joint:	**No**
No. of joints: **1 Nos**	
No. of Penstock Sections: **3**	
Remarks on Penstock pipes - Briefly discuss any major defects observed	

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B.5 Anchor Blocks/Support Pier

Any cracks observed in Anchor blocks: **No**

Any cracks observed in support piers: **No**

Remarks on Anchor blocks/support piers - Briefly discuss any minor/major defects observed

B.6 Powerhouse	
Powerhouse size (internal):	L__**10.5**__m B_**6.2**_ m H **6.0**_____m
Construction: **Brick masonry**	**Stone masonry in c**
Powerhouse roof: **Corrugated GI**	**Corrugated GI**
Powerhouse floor: **Cemented**	**Cemented**
Adequate working space for O/M:	**Yes**
Cleanliness:	**Yes**
Adequate lighting in PH:	**Yes**
Free of undue leakages:	**Yes**
Tailrace safely disposed off:	**Yes**
Earthing done properly:	**Yes** (Earth resistance < 1 ohm:)
Remarks on Powerhouse - Briefly discuss any major defects observed	

B.7 Tailrace	
Construction: **Stone masonry in c**	**Stone masonry in c**
Section: **Rectangular**	**Rectangular**
Condition of tailrace:	**Good**
Any cracks observed in structure:	**No**
Remarks on Tailrace - Briefly discuss any major defects observed	

B.8 Turbine and Driving System		
Type of Turbine: **Francis**	**Francis**	
Pressure gauge installed:	**Yes**	
If yes, Size of gauge:	**0-6.12**	kg/cm²
Pressure head during plant operation:	**1.91**	kg/cm²
Pressure head during plant closure:	**2.04**	kg/cm²
Type of valves installed: **Gate Valve**	**Gate valve**	
Runner mounting: **Vertical**	**Horizontal**	
Driving System: **Overhung on Generator shaft**		
Alignment:	**Well aligned**	
Remarks on Turbine and driving system - Briefly discuss any major defects observed		

B.9 Generator			
Specification:			
Type:	**Synchronous**		
Phase:	**3 –phase**		
Capacity:	**392kW**	Voltage:	**400V**
RPM	**600**	PF	**O.8**
Frequency:	**50Hz**	Full load current:	**707.3 A**
Insulation class:	**H / F**		
Manufacturer:	**NIDEC**	Protection class:	**IP23**
Earthing done properly:	**Yes**		
Remarks on Generator: - Briefly discuss any major defects observed **The generator power factor can be maintained in a range of 0.8 lagging and 09. leading.**			

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B.10 Control Panel and Switchgear

Protection provided:

		Yes	No
	Generator	**ABB-REG 615**	
	Feeder	**ABB-REF 615**	
Size of Feeder Breaker:	**630 A**	Rated breaking capacity of the breaker:	**20 kA**
Feeder Circuit breaker is locally (**Yes**)/Remotely (**Yes**) operated			
Are the installed fuses/breakers of adequate size:		**Yes**	
Size of Synch Breaker:	**800 A**	Rated breaking capacity of the breaker:	**35 kA**
Type of Fuse installed:	**HRC Fuse with Tripping Device**	Rating:	**25 A on MV**
OFF/ ON feeder switches working properly:		**Yes**	
Lightning arrestors installed at the Feeder side:		**Yes**	
Earthing of lightning arrestors properly done		**Yes**	
All metal parts in power house well connected to earth		**Yes**	

Measuring instruments incorporated in the SCADA panel to measure the following:

1. Main voltage and Excitation voltage	Yes (x)	No ( )
2. Load currents	Yes (x)	No ( )
3. Frequency	Yes (x)	No ( )
4. Power (kW)	Yes (x)	No ( )
5. Energy (KWh)	Yes (x)	No ( )
6. Reactive Energy (kVAr)	Yes (x)	No ( )
6. Indicator lamps	Yes (x)	No ( )
7. Time totalizer (turbine operating hours)	Yes (x)	No ( )

Remarks on Control Panel and switchgears - Briefly discuss any defects observed
Feeder circuit breaker can be operated locally from panel and remotely from SCADA through a selector switch.

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B.11 Cable, Connections and supply	
Type of power cable used in the power house: Size of Cable Cable jointing and connections properly?	**Copper** **2 run 4 core 185 mm²** **Yes**
B.12 Transmission	
Type of transmission Length of the system: Voltage transmission line: Type of cable: Type of Pole:	**Partially underground** **26 m;** **30 kV** **CU/XLPE/SWA/PVC** **GI**
Lightning arrestor installed at each end of line · Are earthings provided to each lightning arrestor? · Are all joints along the earth path being **clamped**? · Is measured ground resistance < 1 ohm?	 **Yes** **Yes** **Yes** **Yes**

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Remarks on Electrical lines: Briefly discuss

Transformer: ABB Oil immersed ONAN

Capacity: Type: **TSPH-19009** No: **1 LTR 0043262**

630 kVA Operating Altitude: **2000 M**

No. of Phases: **3** Frequency: **50Hz**

Vector Group: **Dyn11** Voltage : **30 KV/400V**

Rated Current: **12.12 A / 909.33 A**

installed at: **masonry**

installation height above ground: **1.5 m**

transformers well protected against any form of unauthorized access: **Yes**

Cable with connected: **Yes**

feeder switches and fuses installed and well working: **Yes**

Remarks on Transformers:

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C. Performance Check of Installation

Gross head

y filled and water expelled via spillover channel.)

Static head indicated by pressure gauge in powerhouse, Hg = 25.5 m (1 bar = 1 kg/cm² = 10m)

1. Flow-controlling mechanism at intake

a. Flow can completely be blocked if desired, and amount of water flowing toward headrace can be controlled (acceptable) X

b. Flow cannot be stopped and controlled (not acceptable - non critical) ☐

2. Headrace performance:

a. Minor leakage or no leakage through headrace (Acceptable) X

b. Minor leakages but in many parts of the headrace (Not acceptable- non critical) ☐

c. Major leakages and cracks in the structure (Not acceptable-critical) ☐

3. GRP pipe Burial

a. All HDPE sections along headrace are buried or covered (acceptable) X

b. Any portion not buried or not covered (not acceptable - critical) ☐

4. Spillway

a. All of design flow can safely be expelled from the spillover channel (acceptable) X

b. All design flow can not be expelled safely from spillway channel (not acceptable - critical) ☐

6. Penstock

a. No water leakage from penstock joints/welded section (Acceptable) X

b. Water leakage from penstock joints/welded section (not acceptable - critical) ☐

7. Support piers and Anchor blocks

a. Metal penstocks are adequately supported to form straight lengths (acceptable) X

b. Penstock line sagging (not acceptable - critical) ☐

c. Cracks in the structure (not acceptable - critical) ☐

8. Earth resistance Test

a. Neutral earthing at powerhouse < 1 ohm (acceptable) X

b. > 10 ohm (not acceptable - non critical) ☐

c. > 50 ohm (not acceptable - critical) ☐

Value: **0.48** Ohm

d. Any other remarks for performance check during static condition

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C.2 Situation 2 - Dynamic condition

(All valves are slowly opened to maximum open condition so as to operate the set at full flow condition. Forebay should still be filled with water up to the spillover channel crest level. Bring more water if required)

Note dynamic head indicated by the pressure gauge in powerhouse, Hn = **24.5** m **Net head**

Water discharge at tailrace, Q = **1.9** m³/s (approximate measure by means of weir at tailrace)

Give the Value power produced, P: 400 kW

Guaranteed power produced: **(Yes)**

The following tests are mandatory during commissioning:

No-load test with AVR Excitation test

Loading test (Load acceptance, load rejection, output test, stability of controller/governor)

Efficiency test water to wire using calibrated test and instruments

3. Meter readings as compared to readings of other measuring device readings	
a.Within 5% (acceptable)	X
b. More than 5% (not acceptable - non critical)	☐

Any other remaining remarks or observation on dynamic test performed — (Requirements as per the prevailing standards for MHP installation should be met)

#	Unit Starting mode	Yes/No	Remark
1	Manual mode (Each step of the sequence is initiated by an operator up to synchronization stage)	**YES**	Semi-automatic mode
2	Auto mode (Each step of sequence is executed by the system itself up to synchronization as long as start command is initiated)	**YES**	

m LH

MECHANICAL SPINNING, INITIAL SYNCHRONIZING & LOADING								
Sr. No	**PARAMETERS**	**STAND STILL**	**Idle w/ voltage 10 min**	**Idle w/ voltage 20 min**	**Idle w/ voltage 30 min**	**Idle w/ voltage 40 min**	**Idle w/ voltage 50 min**	**Idle w/ voltage 60 min**
1.0	**Starting Time**	-	5.8 sec	118 sec				
2.0	**Stopping Time**	-						
3.0	**HWL, M**							
4.0	**TWL, M**							
5.0	**Net Head**	25.7	25.3	25.3	25.3	25.3	25.3	25.3
6.0	**Intake Gate Opening - %**	30	30	30	30	30	30	30
7.0	**BFV Opening - %**	0	100	100	100	100	100	100
8.0	**G.V % opening**	0	4.5 %	5 %	5 %	5 %	5 %	5 %
9.0	**Speed of Generator – RPM**	0	600	600	600	600	600	600
10.0	**Load – KW**	0						
11.0	**Turbine OPU**							
11.1	System Oil Pressure		99 Bar	95.4 Bar	104 Bar	97 Bar	93 Bar	103 Bar
12	**Generator Temp.**							
12.1	Bearing NDE (in °C)	30.1	31.3	31.0	30.3	29.5	29.1	28.5
12.2	Bearing DE (in °C)	30.7	31.9	32.9	34.0	34.7	35.3	35.6
12.3	U Winding (in °C)	43.2	45.6	47.1	48.2	48.8	49.1	49.4
12.4	V Winding (in °C)	47.4	49.8	51.2	52.1	52.7	53.0	53.3
12.5	W Winding (in °C)	47.7	49.8	51.1	51.9	52.6	53.1	53.4
13	**Transformer**							
13.1	Oil temperature (in °C)							
13.2	Winding temperature	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14.0	**Pressure Kg/cm²**							
14.1	Spiral / Turbine casing	0	2.01 Bar	2.01 Bar	2.01 Bar	2.01 Bar	2.01 Bar	2.01 Bar
14.2	Penstock	2.12 Bar	2.01 Bar	2.01 Bar	2.01 Bar	2.01 Bar	2.01 Bar	2.01 Bar
14.3	Draft tube pressure	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15.0	**Feeder Supply**							
15.1	Voltage							
15.2	Current							
16.0	**Excitation voltage**			40 V	40 V	40 V	40 V	40 V
16.1	Voltage generator			402.8 V	403.0 V	402.4 V	402.8 V	402.8 V
16.2	Current field			1.5 A	1.5 A	1.5 A	1.5 A	1.5 A

LH

MECHANICAL SPINNING, INITIAL SYNCHRONIZING & LOADING								
19.0	**Power factor – Cos Ø**							
20.0	**MIV Opening time**	36 sec						
21.0	**MIV closing time**	103 sec						

SIGNATURE : NAME : Annick INGABIRE DATE : 14/03/2020 **EUCL REPRESENTATIVE**	SIGNATURE : Lars Helvik NAME : LARS HELVIK DATE : 14/03/2020 **CARERA- EDERER & TIGER LIMITED REPRESENTATIVE**
SIGNATURE : NAME : NTANYUNGURA J. Bosco DATE : 14/03/2020 **EUCL REPRESENTATIVE**	SIGNATURE : NAME : T. Nanda Gopal DATE : 14/03/2020 **CARERA- EDERER & TIGER LIMITED REPRESENTATIVE**

MECHANICAL SPINNING, INITIAL SYNCHRONIZING & LOADING								
Sr. No	PARAMETERS	STAND STILL	AT RATED SPEED & NO LOAD	AT RATED SPEED & RATED VOLTAGE	STABLE LOAD (KW)			
					25 %	50 %	75 %	100 %
1.0	**Starting Time**							
2.0	**Stopping Time**			440 sec				531 sec
3.0	**HWL, M**							
4.0	**TWL, M**							
5.0	**Net Head**				25.1	24.6	24.0	22.7
6.0	**Intake Gate Opening - %**				70	70	100	100
7.0	**BFV Opening - %**				100	100	100	100
8.0	**G.V % opening**				21.8	34.5	48.7	70
9.0	**Speed of Generator – RPM**				595	600	602	605
10.0	**Load – KW**				98	196	294	392
11.0	**Turbine OPU**							
11.1	System Oil Pressure				94 Bar	94 Bar	100 Bar	95 Bar
12	**Generator Temp.**							
12.1	Bearing NDE (in °C)				26.9	26.2	25.8	25.7
12.2	Bearing DE (in °C)				36.7	37.3	37.9	38.3
12.3	U Winding (in °C)				50.2	52.6	57.3	64.3
12.4	V Winding (in °C)				54.0	56.5	61.1	68.4
12.5	W Winding (in °C)				54.1	56.5	61.1	68.0
13	**Transformer**							
13.1	Oil temperature (in °C)				35.2	34.7	34.6	34.3
13.2	Winding temperature							
14.0	**Pressure Kg/cm²**							
14.1	Spiral / Turbine casing (in Bar)				2.01	1.97	1.92	1.81
14.2	Penstock (in Bar)				2.0	1.98	1.94	1.85
14.3	Draft tube pressure							
15.0	**Feeder Supply**							
15.1	Voltage (in kV)				29.9	30.1	30.0	30.4
15.2	Current (in A)				0.21	0.47	0.7	0.9
16.0	**Excitation**							
16.1	Voltage (in V)				40	40	40	40
16.2	Current (in A)				1.8	2.2	2.6	3.2

MECHANICAL SPINNING, INITIAL SYNCHRONIZING & LOADING								
Sr. No	PARAMETERS	STAND STILL	AT RATED SPEED & NO LOAD	AT RATED SPEED & RATED VOLTAGE	STABLE LOAD (KW)			
					25 %	50 %	75 %	100 %
19.0	Power factor – Cos Ø				0.95	0.95	0.95	0.95
20.0	Geerator voltage (in V)				401.6	404	496	413
21.0	Generator current (in A)				131	270	407	535

SIGNATURE : ~~[illegible]~~ NAME : NTANYUNGURA J. Bosco DATE : 14/03/2020 **EUCL REPRESENTATIVE**	SIGNATURE : Lars Helvik NAME : LARS HELVIK DATE : 14/03/2020 **CARERA- EDERER & TIGER LIMITED REPRESENTATIVE**
SIGNATURE : [illegible] NAME : Annick INGABIRE DATE : 14/03/2020 **EUCL REPRESENTATIVE**	SIGNATURE : [illegible] NAME : T. Nanda Gopal DATE : 14/03/2020 **CARERA- EDERER & TIGER LIMITED REPRESENTATIVE**

LOAD THROW OFF TEST					
Sl No	**PARAMETERS**	**PERCENTAGE OF LOADS**			
		25%	**50%**	**75%**	**100%**
1.0	**STARTING TIME**	168	178	180	236
2.0	**STOPPING TIME**	419	434	441	452
3.0	**Head Water Level (HWL) in Meters**				
4.0	**Tail Water Level (TWL) in Meters**				
5.0	**GROSS HEAD AVAILABLE in meters**	25.5	25.5	25.5	25.5
6.0	**Net Head Available in Meters**	24.8	24.6	24.0	23.2
7.0	**% LOAD in KW at the time of load throw off**	98	196	294	400
8.0	**SPEED**				
8.1	Before load throw off ---- RPM	599	599	603	599
8.2	Max. during throw off ---- RPM	756	916	987	1052
8.3	% Speed rise	26.2	52.9	63.7	75.6
8.4	Time taken for speed stabilization	13 sec	21 sec	21 sec	23 sec
9.0	**PRESSURE**				
9.1	Penstock Pressure Before load throw off (in Bar)	2.02	2.01	1.94	1.88
9.2	Maximum Pr. during throw off (in bar)	2.11	2.11	2.10	2.10
9.3	% Pressure rise in penstock	4.5	4.5	8.2	11.7
10.0	**GUIDE VANE**				
10.1	GV % opening - Before load throw off	22	34.2	48.2	71.7
10.2	GV closing time during load throw off	3.5 sec	5.3 sec	8 sec	11 sec
11.0	**BUTTER FLY VALVE (BFV)**				
11.1	BFV % opening - Before load throw off	100	100	100	100
11.2	BFV closing time during load throw off	103	103	103	103
12.0	**Turbine Oil Pumping Unit (OPU)**				
12.1	System oil pressure before load throw off	102	101	102.5	101
12.2	System oil pressure after load throw off	101.3	100	100	98
13.0	**Stator voltage (V)**				
13.1	Before load throw off	400	400	409	411
13.2	Max. during throw off	400	400	409	539
13.3	**% rise** in voltage	0	0	0	31.1

9 m Rb. LH

LOAD THROW OFF TEST					
SI No	PARAMETERS	PERCENTAGE OF LOADS			
		25%	50%	75%	100%
SIGNATURE : NAME : NTANYUNGURA J. Bosco DATE : 14/03/2020 **EUCL REPRESENTATIVE**		SIGNATURE : Lars Helvik NAME : LARS HELVIK DATE : 14/3/2020 **CARERA- EDERER & TIGER LIMITED REPRESENTATIVE**			
SIGNATURE : NAME : Annick INGABIRE DATE : 14/03/2020 **EUCL REPRESENTATIVE**		SIGNATURE : NAME : T. Nanda Gopal DATE : 14/03/2020 **CARERA- EDERER & TIGER LIMITED REPRESENTATIVE**			

AGATOBWE HYDRO POWER PLANT TEST REPORT OVER ALL CONTENT SHEET

FIELD TEST REPORT FOR GENERATOR PROTECTION RELAY

Location : Power House

Panel Name : 400V TN-C-S

General inspection : OK

Relay Details			
Type/Model No	REG615	Make	ABB
Relay Nominal Current	1.0 A	Relay SI, No	1VYHR91452759
Aux. supply	230V AC	Relay nominal voltage	110V AC

Testing Equipment Details

Equipment Name	Make & Model	Serial Number
Relay Test kit	OMICRON/CMC 256	GK132P

1. MEASUREMENTS:

CT RATIO: 750/1A VT RATIO: 0.400KV/110V

Ref	Injected Current (A)	Applied Voltage(V)	Reading of the Relay (A)	Reading of the Voltage(KV)
Ia	1.0	63.51	751.8	0.399
Ib	1.0	63.51	749.8	0.400
Ic	1.0	63.51	749.9	0.400
In	1.0	-	100.0	-

2. Over Current Protection: (I >)

Set Current: 1.0A TMS: 0.15 Curve: IDMT - NI

Ref	Injected Current (A)		Operating Time (Sec)	
	X2	X5	X2	X5
R	2.0	5.0	1.511	0.650
Y	2.0	5.0	1.511	0.650
B	2.0	5.0	1.511	0.650
Calculated Value			1.504	0.642

Tested by	Witnessed by
M/S VEPL	M/S Malthe Winje
Sign:	Sign:
Name: P. Sakthivel	Name: T. Nanda Gopal
Designation: Sr. Protection Engg	Designation: Resident Engineer

3. Over Current Protection: (I>>)

Set Current: 4.0A Set Time: 0.02 Sec

Phase	Injected Current (A)	Operating Time (Sec)
R	4.0	0.037
Y	4.0	0.037
B	4.0	0.037

4. Negative Phase Sequence:

Set Current: 0.2A Set Time: 1.0 Sec

Phase	Injected Current (A)	Operating Time (Sec)
R	0.2∟0	1.034
Y	0.2∟120	1.034
B	0.2∟-120	1.034

5. Voltage control with Over Current Protection:

Set Current: 1.0A Set volt: 0.8*Un TMS: 0.3 Curve: IDMT - NI

Ref	Applied Voltage	Injected Current (A)		Operating Time (Sec)	
		X2	X5	X2	X5
R	50.8	2.0	5.0	3.004	1.281
Y	50.8	2.0	5.0	3.004	1.281
B	50.8	2.0	5.0	3.004	1.281
Calculated Value				3.009	1.284

6. Earth Fault Protection: (I0 >)

Set Current: 0.1A TMS: 0.2 Curve: IDMT - NI

Ref	Injected Current (A)		Operating Time (Sec)	
	X2	X5	X2	X5
N	0.2	0.5	2.018	0.856
Calculated Value			2.006	0.856

Tested by	Witnessed by
M/S VEPL	M/S Malthe Winje
Sign:	Sign:
Name: P. Sakthivel	Name: T. Nanda Gopal
Designation: Sr. Protection Engg	Designation: Resident Engineer

7. Earth Fault Protection: (I0 >)

Set Current: 0.5A

Set Time: 0.04 Sec

Phase	Injected Current (A)	Operating Time (Sec)
RN	0.5	0.061

8. Under Voltage Protection:

Set Voltage: 0.9*Un

Set Time: 0.5 Sec

Phase	Applied Voltage (V)	Operating Time (Sec)
R	57.1	0.509
Y	57.1	
B	57.1	

9. Over Voltage Protection:

Set Voltage: 1.1*Un

Set Time: 2.0 Sec

Phase	Applied Voltage (V)	Operating Time (Sec)
R	69.90	2.023
Y	69.90	
B	69.90	

10. Under Frequency Protection:

Set Voltage: 0.98

Set Time: 1.0 Sec

Phase	Applied Voltage (V)	Operating Time (Sec)
R	63.51@49HZ	1.098
Y	63.51@49HZ	
B	63.51@49HZ	

Tested by	Witnessed by
M/S VEPL	M/S Malthe Winje
Sign:	Sign:
Name: P. Sakthivel	Name: T. Nanda Gopal
Designation: Sr. Protection Engg	Designation: Resident Engineer

11. Over Frequency Protection:

Set Voltage: 1.02

Set Time: 1.0 Sec

Phase	Applied Voltage (V)	Operating Time (Sec)
R	63.51@51HZ	1.097
Y	63.51@51HZ	
B	63.51@51HZ	

12. Over Excitation Protection:

Set Voltage: 100%

Set Time: 0.5 Sec

Phase	Applied Voltage (V)	Operating Time (Sec)
R	70.51@50HZ	0.518
Y	70.51@50HZ	
B	70.51@50HZ	

13. Under Excitation Protection:

Set Voltage: 100%

Set Time: 0.5 Sec

Phase	Applied Voltage (V)	Injected Current (A)	Operating Time (Sec)
R	20.0	2.5∟300	0.762
Y	20.0	2.5∟180	
B	20.0	2.5∟60	

14. Reverse Power Protection:

Set Voltage: 0.2

Set Time: 1.0 Sec

Phase	Applied Voltage (V)	Injected Current (A)	Operating Time (Sec)
R	63.51	0.2∟180	1.017
Y	63.51	0.2∟60	
B	63.51	0.2∟300	

15. Remarks:

1. Relay Found Healthy.
2. Operating LED checked ok.

Tested by	Witnessed by
M/S VEPL	M/S Malthe Winje
Sign:	Sign:
Name: P. Sakthivel	Name: T. Nanda Gopal
Designation: Sr. Protection Engg	Designation: Resident Engineer

VOLTECH EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES	SITE TEST REPORT	Malthe Winje	Tiger ltd. Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Circuit Breaker**
BOARD NAME	**400V TNC-S MNS 3.0 SWDB**	**PAGE**	**Page 1 of 3**
FEEDER NAME & NO	**+01 Generator Breaker**	**DATE :**	**08/12/2019**

TEST REPORT FOR CIRCUIT BREAKER

1. CIRCUIT BREAKER DETAILS:

NAME PLATE DETAILS		
Make : ABB	Rated voltage: 415V	
Rated current : 800 A	Frequency : 50-60Hz	
Type : SACEE2.2N	Aux. volts	Closing Coil Supply Voltage : 24V DC
Sr. No. : BM11109325		Opening Coil Supply Voltage : 24V DC
IEC Standard : 60947-2		Motor Supply Voltage : 24V DC

2. INSULATION RESISTANCE TEST:

Applied Voltage	Reference	Measured Value		
		L1	L2	L3
500V	Pole – Earth(Close)	>1GΩ	>1GΩ	>1GΩ
	Across Pole(Open)	>1GΩ	>1GΩ	>1GΩ

Applied Voltage	Reference	Measured Value
500 V	L1 to L2	>1GΩ
500 V	L2 to L3	>1GΩ
500 V	L3 to L1	>1GΩ

3. CONTACT RESISTANCE TEST:

Reference	Measured Value in micro ohms (μΩ)		
	L1	L2	L3
CB Close Condition	37.4	37.6	37.8

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'Ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Circuit Breaker**
BOARD NAME	**400V TNC-S MNS 3.0 SWDB**	**PAGE**	**Page 2 of 3**
FEEDER NAME & NO	**+01 Generator Breaker**	**DATE :**	**08/12/2019**

4. BREAKER TIMING TEST:

Reference	Measured Value in micro ohms (μΩ)		
	L1	L2	L3
Closing Time	65.4	65.6	65.7
Tripping Time	44.6	44.8	44.5
C-O	60.9	61.2	61.1

5. Rack In / Rack Out : OK

6. Spring Charge Mechanism

Electrical Operation : OK

Mechanical operation : OK

7. Spring Charge Indication

Electrical : NA

Mechanical : OK

8. COIL RESISTANCE TEST:

Reference	Coil Resistance
Tripping Coil	6.43 MΩ
Closing Coil	5.49 MΩ

9. TRIPPING & CLOSING OPERATION

Operation	Electrical	Mechanical
Trip	OK	OK
Close	OK	OK

10. Open / Close Indication

Electrical : NA

Mechanical : OK

11. Auxiliary Contacts : OK

12. Test, Service and Disconnected Operation : OK

13. Breaker Close - Open Operation Counter : NA

14. Breaker found healthy : OK

Tested by M/S VEPL	**Witnessed by M/S Malthe Winje**
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Circuit Breaker**
BOARD NAME	**400V TNC-S MNS 3.0 SWDB**	**PAGE**	**Page 3 of 3**
FEEDER NAME & NO	**+01 Generator Breaker**	**DATE :**	**08/12/2019**

15. TEST INSTRUMENTS USED:

S.No	Description	Make / Model
1	Digital Megger	Kyoritsu / 3125
2	CRM Kit	Scope / CRM 200B
3	3 Pole Timer Kit	Scope / SCOT M3K
4	Digital Multimeter	Fluke / 115

16. REMARKS: CB Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	AGATOBWE HYDRO POWER PLANT		
LOCATION	POWER HOUSE	EQUIPMENT :-	Current Transformer
BOARD NAME	400V TNC-S MNS 3.0 SWDB	PAGE	Page 1 of 2
FEEDER NAME & NO	+01 CBCT	DATE :	07/12/2019

TEST REPORT FOR CURRENT TRANSFORMER

GENERAL DETAILS

NAME PLATE DETAILS	
Make : NORATEL	Frequency : 50-60 Hz
Type REF: LGU430x150	S.NO: 19/1362680
Ratio: 100/1A	KV: 0.72/3
VA: 2	Class: 10P10
Standard: IEC 61869-2	

1. INSULATION RESISTANCE MEASUREMENT:

	Applied Voltage	Reference	Measured Value
1	500 V	Secondary to Earth	>1GΩ

2. SECONDARY WINDING RESISTANCE

Core Reference	Terminal	Measured Value In Ohms (Ω)
Core	S1 - S2	0.6

3. POLARITY TEST

Core Reference	Terminal		Measured Value
Core	S1 (+VE)	S2 (-VE)	OK

4. CURRENT RATIO TEST :

Core Reference	Injected Primary Current (A)	Measured Secondary Current (A)
Core S1 – S2	25	0.249
	50	0.501
	75	0.751
	100	0.999

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES	Agatobwe Hydro Power Plant	Malthe Winje	Tiger ltd. Travaux d'Ingenierie generale du Rwanda
	TESTING		
Panel ref:+01	Test Report For Feeder Protection Relay	Date:06/12/2019	

FIELD TEST REPORT FOR FEEDER PROTECTION RELAY

Location : Power House

Panel Name : HT PANEL

General inspection : OK

Relay Details			
Type/Model No	REF615	Make	ABB
Relay Nominal Current	1.0 A	Relay SI, No	1VHR91453536
Aux. supply	230V AC	Relay nominal voltage	110V AC

Testing Equipment Details

Equipment Name	Make & Model	Serial Number
Relay Test kit	OMICRON/CMC 256	GK132P

1. **MEASUREMENTS:**

CT RATIO: 80A

Ref	Injected Current (A)	Applied Voltage(V)	Reading of the Relay (A)	Reading of the Voltage(KV)
Ia	1.0	-	80.1	-
Ib	1.0	-	80.0	-
Ic	1.0	-	80.0	-
In	1.0	-		-

2. **Over Current Protection: (I >)**

Set Current: 1.2A TMS: 0.15 Curve: IDMT - NI

Ref	Injected Current (A)		Operating Time (Sec)	
	X2	X5	X2	X5
R	2.4	6.0	1.513	0.652
Y	2.4	6.0	1.513	0.652
B	2.4	6.0	1.513	0.652
Calculated Value			**1.504**	**0.642**

Tested by	Witnessed by
M/S VEPL	M/S Malthe Winje
Sign:	Sign:
Name: P. Sakthivel	Name: T. Nanda Gopal
Designation: Sr. Protection Engg	Designation: Resident Engineer

3. **Over Current Protection: (I>>)**

Set Current: 4.0 A

Set Time: 0.04 Sec

Phase	Injected Current (A)	Operating Time (Sec)
R	4.0	0.064
Y	4.0	0.065
B	4.0	0.064

4. **Earth Fault Protection: (I0 >)**

Set Current: 0.2A

TMS: 0.2

Curve: IDMT - NI

Ref	Injected Current (A)		Operating Time (Sec)	
	X2	X5	X2	X5
N	0.2	0.5	2.018	0.858
Calculated Value			**2.006**	**0.856**

5. **Earth Fault Protection: (I0 >)**

Set Current: 0.5A

Set Time: 0.04 Sec

Phase	Injected Current (A)	Operating Time (Sec)
RN	0.5	0.067

6. **Remarks:**

1. Relay Found Healthy.
2. Operating LED checked ok.

Tested by	Witnessed by
M/S VEPL	M/S Malthe Winje
Sign:	Sign:
Name: P. Sakthivel	Name: T. Nanda Gopal
Designation: Sr. Protection Engg	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Current Transformer**
BOARD NAME	**33KV SWITCHGEAR PANEL**	**PAGE**	**Page 1 of 2**
FEEDER NAME & NO	**METERING CT**	**DATE :**	**07/12/2019**

TEST REPORT FOR CURRENT TRANSFORMER

GENERAL DETAILS

NAME PLATE DETAILS			
Make : ABB		Frequency : 50Hz	
Type : TPU 70.53 or n.715224		Idyn : 15.8KA	
Icth : 12A		Ith : 6.3 (1s) KA	
STANDARD : IEC 61869-2		Mfd.year: 2019	
Core-1 Metering	1S1-1S2 : 10/5A	Core-2 Protection	2S1-2S2 : 10/5A
	5VA		5VA
	0.2SFS10		0.2SFS10
	ext. 120%		ext. 120%
S.No:	R Phase: 1VLT5119006714	Y Phase: 1VLT5119006715	B Phase: 1VLT5119006716

1. INSULATION RESISTANCE MEASUREMENT:

S.No	Applied Voltage	Reference	Measured Value		
			L1	L2	L3
1	5000 V	Primary to Earth	296 GΩ	254 GΩ	232 GΩ
2	5000 V	Primary to Secondary-1	312 GΩ	281 GΩ	257 GΩ
3	5000 V	Primary to Secondary-2	339 GΩ	356 GΩ	302 GΩ
4	500 V	Secondary-1 to Earth	>1 GΩ	>1 GΩ	>1 GΩ
5	500 V	Secondary-2 to Earth	>1 GΩ	>1 GΩ	>1 GΩ
6	500 V	Secondary-1 to Secondary-2	>1 GΩ	>1 GΩ	>1 GΩ

2. SECONDARY WINDING RESISTANCE:

Core Reference	Terminal	Measured Value In Ohms (Ω)		
		L1	L2	L3
Core 1	1S1 - 1S2	0.3	0.3	0.3
Core 2	2S1 - 2S2	0.3	0.3	0.3

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	AGATOBWE HYDRO POWER PLANT		
LOCATION	POWER HOUSE	EQUIPMENT :-	Current Transformer
BOARD NAME	33KV SWITCHGEAR PANEL	PAGE	Page 2 of 2
FEEDER NAME & NO	METERING CT	DATE :	07/12/2019

3. POLARITY TEST:

Core Reference	Terminal		Measured Value		
			L1	L2	L3
Core 1	1S1 (+VE)	1S2 (-VE)	OK	OK	OK
Core 2	2S1 (+VE)	2S2 (-VE)	OK	OK	OK

4. CURRENT RATIO TEST :

Core Reference	Injected Primary Current (A)			Measured Secondary Current (A)		
	L1	L2	L3	L1	L2	L3
Core 1 1S1 – 1S2	5.0	5.0	5.0	2.500	2.501	2.502
	10.0	10.0	10.0	5.000	5.000	5.000

Core Reference	Injected Primary Current (A)			Measured Secondary Current (A)		
	L1	L2	L3	L1	L2	L3
Core 2 2S1 – 2S2	5.0	5.0	5.0	2.501	2.500	2.499
	10.0	10.0	10.1	4.999	5.000	4.999

5. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1	Digital Megger	Kyoritsu / 3125
2	Digital Multimeter	Fluke / 115
3	Galvanometer	--
4	Variac	Sudharsan
5	Loading Transformer	Sudharsan / SI/STR-10
6	Digital Clamp Meter	Kyoritsu / KEW SNAP 2003A
7	Digital Leakage Tester	Kyoritsu / KEW SNAP 2434

6. REMARKS: CT Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Voltage Transformer**
BOARD NAME	**33KV SWITCHGEAR PANEL**	**PAGE**	**Page 1 of 2**
FEEDER NAME & NO	**METERING VT**	**DATE :**	**06/12/2019**

TEST REPORT FOR VOLTAGE TRANSFORMER

GENERAL DETAILS

DETAILS						
MAKE : ABB		Standard : IEC : 61869-3				
Type: TJC 7.1 or n.715224		Freq: 50Hz				
S.No:	R Phase: 1VLT5219001050	Ratio	33000/√3//110/√3/110/3V			
	Y Phase: 1VLT5219001051		a-n: 33000/√3//110/√3V	Cl: 0.2	5 VA	1.9xUn/8h
	B Phase: 1VLT5219001052		da-dn: 33000/√3//110/3V	Cl: 3P	30VA	1.9xUn/8h
Mfg: 2019		36/70/170KV				

1. INSULATION RESISTANCE MEASUREMENT:

Core	Applied Voltage	Measured Value		
		L1	L2	L3
Primary – Earth	5000V	289 GΩ	267 GΩ	367 GΩ
Primary – Secondary Core 1	5000V	356 GΩ	253 GΩ	381 GΩ
Primary – Secondary Core 2	5000V	302 GΩ	398 GΩ	290 GΩ
Secondary Core 1 - Earth	500 V	>1 GΩ	>1 GΩ	>1 GΩ
Secondary Core 2 - Earth	500 V	>1 GΩ	>1 GΩ	>1 GΩ
Sec.Core 1 - Sec.Core 2	500 V	>1 GΩ	>1 GΩ	>1 GΩ

2. SECONDARY WINDING RESISTANCE:

Core	Terminal	Measured Value in Ohms (Ω)		
		L1	L2	L3
CORE 1	a-n	0.4	0.4	0.4
CORE 2	da-dn	0.8		

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'Ingenierie générale du Rwanda

PROJECT	AGATOBWE HYDRO POWER PLANT		
LOCATION	POWER HOUSE	EQUIPMENT :-	Voltage Transformer
BOARD NAME	33KV SWITCHGEAR PANEL	PAGE	Page 2 of 2
FEEDER NAME & NO	METERING VT	DATE :	06/12/2019

3. POLARITY TEST

Core	Between		Measured Value		
			L1	L2	L3
CORE 1	a (+VE)	n (-VE)	OK	OK	OK
CORE 2	da (+VE)	dn (-VE)	OK	OK	OK

4. VOLTAGE RATIO TEST

Applied Voltage at Primary			Measured Voltage at Secondary		
L1	L2	L3	L1	L2	L3
1002	1001	1008	3.421	3.414	3.434
2007	2003	2007	6.790	6.750	6.740
3003	3005	3004	10.09	10.00	10.01

Applied Voltage at Primary		Measured Voltage at Secondary	
Reference	Measured Value	Core-2	Measured value
L1-L2	400.2	da-dn	0
L2-L3	400.0		
L3-L1	400.8		

5. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1.	Digital Megger	Kyoritsu / 3125
2.	Digital Multimeter	Fluke / 115
3.	Variac	Sudharsan
4.	Step Up Transformer	Sudharsan / 91/HV-5/2
5.	Galvanometer	--

6. **REMARKS:** VT Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Current Transformer**
BOARD NAME	**400V TNC-S MNS 3.0 SWDB**	**PAGE**	**Page 2 of 2**
FEEDER NAME & NO	**+01 CBCT**	**DATE :**	**07/12/2019**

5. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1	Digital Megger	Kyoritsu / 3125
2	Digital Multimeter	Fluke / 115
3	Galvanometer	--
4	Variac	Sudharsan
5	Loading Transformer	Sudharsan / SI/STR-10
6	Digital Clamp Meter	Kyoritsu / KEW SNAP 2003A
7	Digital Leakage Tester	Kyoritsu / KEW SNAP 2434

6. REMARKS: CT Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'Ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Voltage Transformer**
BOARD NAME	**GENERATOR**	**PAGE**	**Page 1 of 2**
FEEDER NAME & NO	**Generator VT**	**DATE :**	**06/12/2019**

TEST REPORT FOR VOLTAGE TRANSFORMER

GENERAL DETAILS

DETAILS			
MAKE : RS ISOLSEC		Standard : IEC : 61869-3	
Type: TP126-1		Freq: 50/60Hz	
S.No:	R Phase: 18/380386/2	Ratio	400/√3//110/√3
	Y Phase: 18/380386/3	Burden	10
	B Phase: 18/380386/1	Class	0.2
Ins. Cl: E		0.72/3KV	

1. INSULATION RESISTANCE MEASUREMENT:

Core	Applied Voltage	Measured Value		
		L1	L2	L3
Primary – Earth	500V	>1 GΩ	>1 GΩ	>1 GΩ
Primary - Secondary	500V	>1 GΩ	>1 GΩ	>1 GΩ
Secondary - Earth	500 V	241 MΩ	326 MΩ	298 MΩ

2. SECONDARY WINDING RESISTANCE:

Core	Terminal	Measured Value in Ohms(Ω)		
		L1	L2	L3
CORE	a-n	0.5	0.5	0.5

3. POLARITY TEST:

Core	Between		Measured Value		
			L1	L2	L3
CORE	a (+VE)	n (-VE)	OK	OK	OK

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Voltage Transformer**
BOARD NAME	**GENERATOR**	**PAGE**	**Page 2 of 2**
FEEDER NAME & NO	**Generator VT**	**DATE :**	**06/12/2019**

4. VOLTAGE RATIO TEST:

Applied Voltage at Primary		Measured Value at Secondary	
Reference	**Measured Value**	**Core-1**	**Measured value**
L1-L2	400.1	1a – 1b	110.1
L2-L3	400.1	1b – 1c	110.1
L3-L1	401.4	1c – 1a	110.4

5. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1.	Digital Megger	Kyoritsu / 3125
2.	Digital Multimeter	Fluke / 115
3.	Variac	Sudharsan
4.	Step Up Transformer	Sudharsan / 91/HV-5/2
5.	Galvanometer	--

6. REMARKS: VT Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**OUTDOOR POWER HOUSE**	**EQUIPMENT :-**	**Transformer**
BOARD NAME	**TRANSFORMER**	**PAGE**	**Page 1 of 4**
FEEDER NAME & NO	**TRANSFORMER**	**DATE :**	**07/12/2019**

TEST REPORT FOR TRANSFORMER

GENERAL DETAILS

DETAILS						
Make : ABB				Year of manuf. : 04 .2019		
Maker's Serial No. : 11 TR0043262				Type: TSPH-19009		
Frequency : 50Hz				No of phases : 3		
Operating Altitude (m) : 2000				Cooling Type : ONAN		
Voltage (V)	1	28500		Vector Group : Dyn11		
	2	29250		INS. Level	HV (KV)	170/70
	3	30000	400		LV (KV)	-/3
	4	30750		Temp. Rise O/W (K) : 60/65		
	5	31500		Impedance Volt. (%) : 4.57		
Rated Current	(A)	12.12	909.33	Filling & Sealing Temperature (°C) : 25		
Active Part (Kg) : 991				Insulating Oil : NYNAS N. LYRAN		
Oil Weight (Kg) : 462				Year of Manuf. : 04.2019		
Total Weight (Kg) : 1964				Specification : IEC 60076		

1. INSULATION RESISTANCE MEASUREMENT:

Core	Applied Voltage	Measured Value		
		1 minute	10 minute	PI Value
HV – Earth	5000V	34.6 GΩ	126.1 GΩ	3.644
LV – Earth	500V	>1 GΩ	>1 GΩ	--
HV – LV	5000V	42.9 GΩ	139.9 GΩ	3.261

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**OUTDOOR POWER HOUSE**	**EQUIPMENT :-**	**Transformer**
BOARD NAME	**TRANSFORMER**	**PAGE**	**Page 2 of 4**
FEEDER NAME & NO	**TRANSFORMER**	**DATE :**	**07/12/2019**

2. MAGNETIC BALANCE TEST:

Tap Reference	Applied Voltage at Primary			Measured voltage at Primary			Measured voltage at secondary					
	IU-IV	IV–IW	1W-IU	IU-IV	IV-IW	1W-IU	2u–2v	2v-2w	2w-2u	2u-2n	2v-2n	2w-2n
1	401.3	--	--	--	314.2	86.8	6.035	2.292	3.788	3.258	2.528	0.716
	--	400.0	--	228.2	--	170.9	5.045	4.686	0.371	1.809	3.248	1.435
	--	--	401.9	56.09	345.2	--	2.806	6.268	3.525	0.432	2.789	3.262
3	401.1	--	--	--	316.5	84.4	5.715	2.120	3.612	3.093	2.398	0.666
	--	400.2	--	227.9	--	172.1	4.733	4.469	0.297	1.660	3.074	1.406
	--	--	402.0	57.68	343.4	--	2.674	5.949	3.345	0.395	2.668	3.097
5	401.1	--	--	--	312.8	88.1	5.457	2.109	3.417	2.933	2.229	0.690
	--	400.3	--	212.8	--	187.2	4.604	4.209	0.398	1.662	2.931	1.282
	--	--	402.2	59.3	343.5	--	2.613	5.733	3.145	0.366	2.598	2.942

3. MAGNETIING CURRENT TEST:

Tap Reference	Applied Voltage at Primary			Measure Current in Secondary (mA)		
	IU-IV	IV–IW	1W-IU	1U	1V	1W
1	401.2	400.3	402.0	0.7	0.4	0.6
3	400.7	400.6	402.6	0.6	0.3	0.5
5	401.2	400.4	402.0	0.6	0.3	0.5

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**OUTDOOR POWER HOUSE**	**EQUIPMENT :-**	**Transformer**
BOARD NAME	**TRANSFORMER**	**PAGE**	**Page 3 of 4**
FEEDER NAME & NO	**TRANSFORMER**	**DATE :**	**07/12/2019**

4. VOLTAGE RATIO TEST:

Tap Reference	Applied Voltage at Primary			Measure Voltage at Secondary					
	IU-IV	IV–IW	1W-IU	2u–2v	2v-2w	2w-2u	2u-2n	2v-2n	2w-2n
1	401.0	400.2	402.1	5.619	5.629	5.643	3.251	3.241	3.256
2	401.3	400.3	402.0	5.474	5.487	5.499	3.166	3.160	3.174
3	401.1	400.4	402.5	5.338	5.360	5.355	3.083	3.084	3.097
4	401.3	400.2	402.1	5.207	5.216	5.230	3.012	3.009	3.018
5	401.1	400.2	401.9	5.085	5.097	5.105	2.940	2.936	2.947

5. WINDING RESISTANCE TEST:

Tap Reference	Measured Value at Primary in Ohms (Ω)		
	IU-IV	IV–IW	1W-IU
1	14.871	14.869	14.866
2	15.319	15.307	15.308
3	15.758	15.743	15.744
4	16.196	16.176	16.180
5	16.612	16.607	16.608

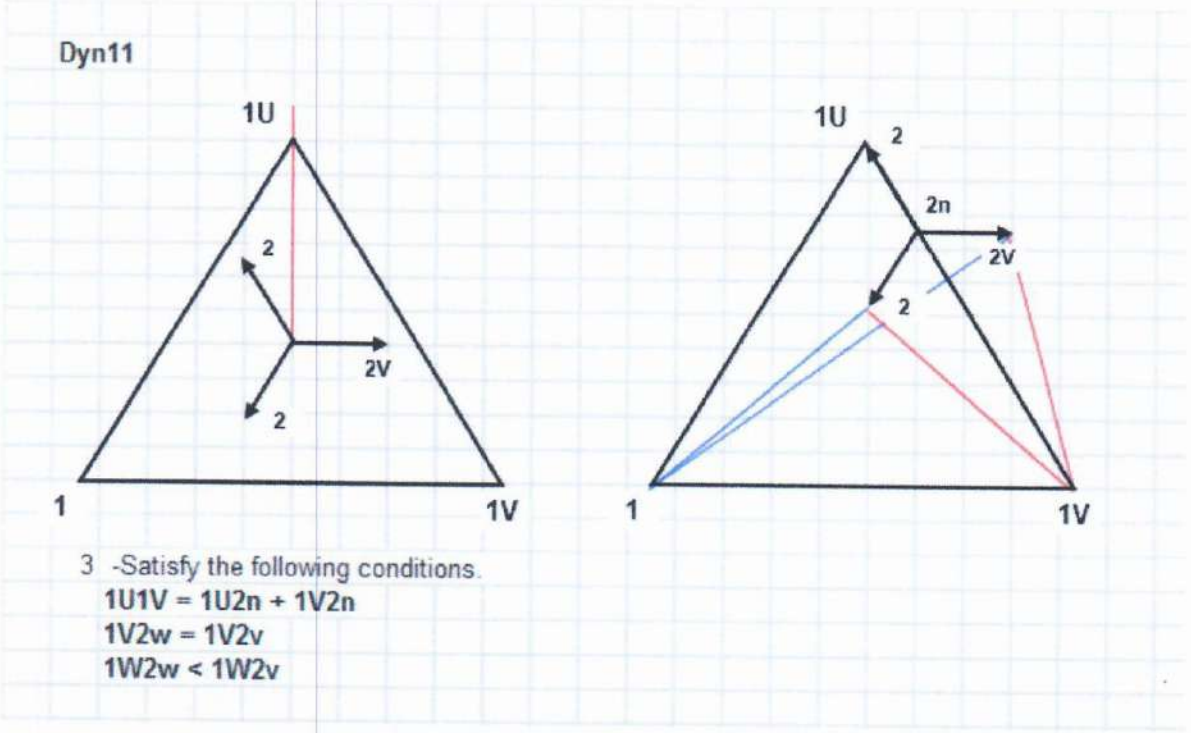
Measured Value at Secondary in mΩ	
2u – 2v	1.659
2v – 2w	1.669
2w – 2u	1.667
2u – 2n	0.894
2v – 2n	0.897
2w – 2n	0.903

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES	**SITE TEST REPORT**	Malthe Winje	Tiger ltd. Travaux d'ingénierie générale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**OUTDOOR POWER HOUSE**	**EQUIPMENT :-**	**Transformer**
BOARD NAME	**TRANSFORMER**	**PAGE**	**Page 4 of 4**
FEEDER NAME & NO	**TRANSFORMER**	**DATE :**	**07/12/2019**

6. VECTOR GROUP TEST:



3 -Satisfy the following conditions.

1U1V = 1U2n + 1V2n

1V2w = 1V2v

1W2w < 1W2v

Conditions	Measured Value	Result
1U1V = 1U2n + 1V2n	401.1 = 3.069 + 398.2	OK
1V2w = 1V2v	396.6 = 396.5	OK
1W2w < 1W2v	397.4 < 402.1	OK

7. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1.	Digital Megger	Kyoritsu / 3125
2.	Digital Multimeter	Fluke / 115
3.	Transformer Winding Resistance Kit	Scope / TRM 104
4.	Digital Leakage Tester	Kyoritsu / KEW SNAP 2434

8. REMARKS: Transformer Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**HT Cable**
BOARD NAME	**33KV SWITCHGEAR PANEL**	**PAGE**	**Page 1 of 1**
FEEDER NAME & NO	**Incomer A01 and Outgoing A03**	**DATE :**	**10/12/2019**

TEST REPORT FOR HT CABLE

1. INSULATION RESISTANCE MEASUREMENT:

INCOMER A01

Reference	Applied Voltage	Measured Value		
		L1	L2	L3
Primary – Earth	5000V	12.5 GΩ	13.8 GΩ	12.9 GΩ

OUTGOING A03

Reference	Applied Voltage	Measured Value		
		L1	L2	L3
Primary – Earth	5000V	15.6 GΩ	14.9 GΩ	16.8 GΩ

2. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1.	Digital Megger	Kyoritsu / 3125

3. REMARKS: Cable Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**EARTH PIT**
BOARD NAME	**EARTH PIT RESISTANCE**	**PAGE**	**Page 1 of 1**
FEEDER NAME & NO	**POWER HOUSE EARTH PIT**	**DATE :**	**10/12/2019**

TEST REPORT FOR EARTH PIT

1. EARTH PIT RESISTANCE:

Reference	Measured Value in ohms (Ω)
Power House Earth Pit	0.4

2. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1.	Earth Megger	CIE / DET-2000

3. REMARKS: Earth Pit Value found ok.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Current Transformer**
BOARD NAME	**GENERATOR**	**PAGE**	**Page 1 of 2**
FEEDER NAME & NO	**Generator CT**	**DATE :**	**06/12/2019**

TEST REPORT FOR CURRENT TRANSFORMER

GENERAL DETAILS

NAME PLATE DETAILS			
Make : Elek Tronik		Frequency : 50-60Hz	
Type :		Mfd.year: 2019	
STANDARD : IEC 61869-2		Ref. LS: 00040031951	
Core-1 Metering	1S1-1S2 : 750/1A	10VA	5P10
S.No:	R Phase: PT-03366-26	Y Phase: PT-03366-25	B Phase: PT-03366-24

1. INSULATION RESISTANCE MEASUREMENT:

S.No	Applied Voltage	Reference	Measured Value		
			L1	L2	L3
1	500 V	Primary to Earth	>1GΩ	>1GΩ	>1GΩ
2	500 V	Primary to Secondary	>1GΩ	>1GΩ	>1GΩ
3	500 V	Secondary to Earth	>1GΩ	>1GΩ	>1GΩ

2. SECONDARY WINDING RESISTANCE

Core Reference	Terminal	Measured Value In Ohms (Ω)		
		L1	L2	L3
Core	1S1 - 1S2	0.2	0.2	0.2

3. POLARITY TEST

Core Reference	Terminal		Measured Value		
			L1	L2	L3
Core	1S1 (+VE)	1S2 (-VE)	OK	OK	OK

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
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SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Current Transformer**
BOARD NAME	**GENERATOR**	**PAGE**	**Page 2 of 2**
FEEDER NAME & NO	**Generator CT**	**DATE :**	**06/12/2019**

4. CURRENT RATIO TEST :

Core Reference	Injected Primary Current (A)			Measured Secondary Current (A)		
	L1	L2	L3	L1	L2	L3
Core 1S1 – 1S2	75.6	75.2	75.9	0.99	0.98	0.99
	186.9	186.3	186.5	0.248	0.247	0.246
	351.2	350.9	350.6	0.497	0.496	0.497

5. INSTRUMENTS USED:

Sl. No	Description	Make / Model
1	Digital Megger	Kyoritsu / 3125
2	Digital Multimeter	Fluke / 115
3	Galvanometer	--
4	Variac	Sudharsan
5	Loading Transformer	Sudharsan / SI/STR-10
6	Digital Clamp Meter	Kyoritsu / KEW SNAP 2003A
7	Digital Leakage Tester	Kyoritsu / KEW SNAP 2434

6. REMARKS: CT Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

VOLTECH
EXCELLENCE IN ENGINEERING PRODUCTS & SERVICES

SITE TEST REPORT

Malthe Winje

Tiger ltd.
Travaux d'ingenierie generale du Rwanda

PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Current Transformer**
BOARD NAME	**GENERATOR**	**PAGE**	**Page 1 of 2**
FEEDER NAME & NO	**Generator Droop CT**	**DATE :**	**07/12/2019**

TEST REPORT FOR CURRENT TRANSFORMER

GENERAL DETAILS

NAME PLATE DETAILS	
Make : RS ISOLSEC	Frequency : 50-60 Hz
Type REF: TA301	S.NO: 19/380489/1
Ratio: 750/5A	Ins. Cl: E
VA: 10	Class: 0.5
Standard: IEC 61869-2	

1. INSULATION RESISTANCE MEASUREMENT:

	Applied Voltage	Reference	Measured Value L2
1	500 V	Secondary to Earth	>1GΩ

2. SECONDARY WINDING RESISTANCE

Core Reference	Terminal	Measured Value In Ohms (Ω) L2
Core	S1 - S2	0.3

3. POLARITY TEST

Core Reference	Terminal		Measured Value L2
Core	S1 (+VE)	S2 (-VE)	OK

4. CURRENT RATIO TEST :

Core Reference	Injected Primary Current (A)	Measured Secondary Current (A) L2
Core S1 – S2	75.6	0.498
	186.8	1.247
	352.3	2.498

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer

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PROJECT	**AGATOBWE HYDRO POWER PLANT**		
LOCATION	**POWER HOUSE**	**EQUIPMENT :-**	**Current Transformer**
BOARD NAME	**GENERATOR**	**PAGE**	**Page 2 of 2**
FEEDER NAME & NO	**Generator Droop CT**	**DATE :**	**07/12/2019**

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6. REMARKS: CT Found Healthy.

Tested by M/S VEPL	Witnessed by M/S Malthe Winje
Sign:	Sign:
Name: K.Nesamani	Name: T. Nanda Gopal
Designation: Sr. Commissioning Engineer	Designation: Resident Engineer