NIGERIAN ELECTRICITY MANAGEMENT SERVICES AGENCY

(NEMSA)

SOKOTO INSPECTORATE FIELD OFFICE

NEMSA INSPECTION REPORT

38 MEGAWATT DUAL - FUEL FIRED TURBINE INDEPENDENT POWER PLANT, KALAMBAINA ROAD, SOKOTO

1.0 Location: Kalambaina Road Arkilla, Sokoto – GPS:

2.0 Introduction

Sokoto Independent Power Plant (SIPP) was constructed to address the chronic power shortages experienced by Sokoto State from the power supply allocation of 40MW shared to the State. The Independent Power Plant is expected to run as a dual fuel Power plant using Gas and Diesel, but at the moment it is expected to run on diesel until when the Gas processing facilities are put in place. The Power plant is of 38MW installed capacity having fuel consumption capacity of 260 metric tons of LGP and 290,000 liters of diesel daily (in 24 hours).

3.0 Inspection of Sokoto Independent Power Plant (SIPP):

The inspection of Sokoto Independent Power plant was carried out on the above stated date by NEMSA's team led by the General Manager Technical Standard and Inspectorate services with the MD/CEO Vulcan Elvaton Nig. Ltd, TCN and the representative from the Consultant (MBS Engineering Ltd) in attendance.

3.1 NEMSA Monitoring Team

i. Engr. T. T. Aliyu.....GM(TS & IS) NEMSA
ii. Engr. William Metieh.....S. A. Technical to MD/CEO & CEIF NEMSA
iii. Engr. M.G.M Konduga.....Area Inspecting Engineer, NEMSA Kano.
iv. Engr. Ntuen E. Anthony.....Area Inspecting Engineer, NEMSA Sokoto.
v. Abdullahi Abdulhafeez.....NEMSA Sokoto
vi. Abubakar Shehu.....NEMSA Sokoto
vii. Bello Muhammad.....NEMSA Sokoto.

3.2 Client Sokoto IPP

i. Barr. Bello Muhammad Goronyo……Hon. Commissioner Ministry of Energy, Sokoto State

ii. Mallam……Permanent Secretary, Ministry of Energy, Sokoto State

3.3 Contractor:

i. Mr. Theo Ubani……..MD/CEO, Satel Construction/Vulcan Elvaton Nig. Ltd

3.4 TCN:

i. Engr. Usman Wangala……..TCN Birnin Kebbi.

3.5 Consultant:

i. Engr. Ajao Dauda……MBS Engineering Ltd

The NEMSA inspection team visited the 38MW Power Plant and was conducted round the Plant by the MD/CEO Satel Construction/Vulcan Elvaton Nig Ltd, Mr Theo Ubani**.**

The turbine is a dual fuel fired Frame 6 type mounted on skid and sound proofed. The auxiliaries such as oil cooling fuel filtration are external to the turbine skid.

4.0 OBSERVATIONS AND RECOMMENDATIONS REQUIRING URGENT ATTENTION

4.1 38 MW SKID MOUNTED SOKOTO INDEPENDENT POWER PLANT

4.1.2 Power Plant Area:

Construction works seen going on with the storage tanks for the liquid fuel. Further civil works are ongoing on the access roads and bond wall for the tanks.

4. 1.3 Turbine Control Room:

i. The Air conditioners in control room at the Power Plant were seen non-operational. These should be operational at all times in the control room for adequate cooling of the control panel equipment to prevent thermal runaway on the electronic equipment which are sensitive to high temperatures as is experienced in the plant location.

ii. Insulation mat was not laid in front of the Power plant control panels. Insulation mats should be laid in front of the control panel to ensure the safety of the operator on duty.

iii. Danger plate was not fitted at the metallic entrance gate of the control room. This should be fitted at the entrance gate of the control room and at other points of access into the turbine, alternator and HV equipment areas.

4.1.4 Battery bank:

i. Several damaged and swollen batteries were seen at the lower level of the battery bank located just outside the control room at the power plant. This could have occurred as a result of direct exposure

of the batteries to weather, or inadequate ventilation and lack of cooling facilities in the battery bank. All the damaged and swollen batteries in the battery bank should be replaced with functional ones.

ii. The battery bank at the power plant is of wet cells type, exposed to rain water during rainy season. The battery bank should be kept in a more spacious shaded/room having enough cooling system and should not be exposed to rain water.

iii. No changeover switching system between the AC and DC panels.

4.1.5 The lube oil coolant:

i. Not all the supports of the Lube oil coolant platform were earthed. All the supports of the lube oil coolants platform should be earthed for safety.

ii. The lube oil pipes were seen not well protected against corrosion. There should be adequate arrangement to protect the lube oil pipes against corrosion.

iii. The pipe has not been given the correct colour code. The appropriate colour for lub oil should be used in identifying the piping for lub oil. Ditto for fuel pipes.

4.1.6 The Power Generating Plant:

i. No lightning protection at the highest point of the turbine exhaust stack. Lightning protection should be provided at the point of the exhaust.

ii. Earth shielding wire was not provided from the switchyard to the exhaust stack. Earth shielding wire should be provided from the switchyard to the exhaust stack.

iii. Some of the earthing points at the power plant area were seen corroded. All corroded earthen points should be checked and replaced with good ones.

iv. A sign of termite dumps were seen at the power plant area. The termite dumps should be checked and fumigated.

v. Cable lugs were well covered, but however the entry point of the cables to the LV panel of the power plant and the circuit breaker were not covered. This would create an access route for rodents/reptiles to enter inside the turbine control and switchgear areas and destroy some cables. The entry point of the cables should be covered to avoid access for rodents that could eventually damage the cables and other equipment.

vi. The cable tray was not earthed and could cause electric shocks to personnel. The cable tray should be properly earthed.

vii. The connected plate at the exhaust pipe was seen corroded. The corroded plate at the exhaust pipe should be replaced with non-corroding plate.

viii. The fuel supply pipe from the main storage was seen open and unflanged. This fuel pipe as seen can allow some reptiles to enter inside the pipe causing fuel supply challenges. The pipe open end should be blocked using a blind flange.

ix. Cables at the generating plant, the circuit breaker and the dummy load side were not labeled for proper identification. This could cause confusion during fault tracing. All cables should be properly and adequately labeled.

x. Oil leakages/ spillage were seen within the vicinity of the Black Start generator. This could be sign of a major leakage and could also cause fire. The oil leakages should be checked and stopped.

xi. From the markings on the body, the cables connecting the auxiliary transformer and the turbine appear to be LV cable for both the HV and LV side of the transformer. The cables ratings/nomenclature should be checked/confirmed or replaced with appropriately sized cables for 11kV.

xii. Gravelling of the generating plant and switchyard area, fencing of the active area of the generating plant and slabs covering for the cable trenches between the generating plant and the switchyard control area was not done. These should be completed before commissioning of the power plant.

4.1.7 Fire Hydrants/Extinguishers:

i. The servicing dates for the fire extinguishers should be maintained, while the expired fire extinguishers should be serviced and replaced with functional ones.

4.1.8 Fuel Storage Tanks:

i. The construction of the main fuel storage tank was on-going.

ii. The raw and pure fuel tanks had no proper identification. There should be proper identification on the fuel tanks.

iii. No danger signs fitted at the fuel tank. Danger signs should be fitted at the two tanks.

5.0 33KV Substation/Switchyard Area:

i. The 11kV cables outgoing from the generating plant to the substation were yet to be connected to the transformer. The 11kV cables should be connected to the transformer and properly terminated with appropriate cable lugs.

ii. At the time of our visit the contractor was replacing CTs and VTs that were found having lower ratings at the switchyard. All CTs and VTs should be checked properly to ensure they are in

accordance with specifications with respect to the current and voltage ratings of the main power transformer before installation.

iii. The transformer bus bar isolator was yet to be installed as at the time of our visit. The transformer bus bar isolator should be installed and adequately earthed.

iv. The evacuation line isolator was seen without an earth switch for grounding the line during maintenance work at the 33kV substation. Earth switch should be incorporated at the evacuation line isolator.

v. The pot insulators supporting the conductors at the secondary side of the step-up 50MVA 11/33kV transformer were of 22kV ratings. The pot insulators should be replaced with those of 33kV ratings.

vi. The gantry support structures for the bus bar were not on the same height level, and this created an imbalance between the support structures. The middle support structure was higher than the remaining two by the sides. Gantry support structures should always be on the same height level to avoid imbalance situation, and this should be corrected before the station is put into use.

vii. There was no provision for flexibility at the switchyard as Single bus bar was used as against the double bus bar seen in the switchyard control panel. Even the single bus bar provided was not sectionalized. Additional bus bar should be provided at the switchyard for flexibility purpose.

viii. The jumper connection from the step up transformer to the transformer isolator has a big curvature that can allow rain water to follow the conductor down to bolt and nuts, this can cause corrosion. This curvature should be reduced to avoid rain water from running down the bolt and nuts.

ix. The lightning arrester used was not of the right specification. The counter type lightning arrester which records the number of lightning strikes on the equipment should be used. The lightning arrester used should be replaced with a counter-type lightning arrester.

x. At the time of our visit, the contractor was seen busy fixing the lighting points at the switchyard control room. Adequate illumination is required at the switchyard control room.

xi. We observed that the earth conductor used at the rectifier was undersize. An earth conductor of $70mm^2$ should be used at the rectifier.

xii. No silica gel at the step up transformer. Silica gel of the correct specification should be fitted on the step up transformer.

xiii. Transformer oil and winding temperature indicators were not provided in the control room panel. Oil and winding temperature indicators should be provided in the control room panel.

xiv. The installation of some equipment within the switchyard is still on-going. Cablings and jumper terminations were still on-going at the switchyard.

5.1 Control room:

i. The metal door frames at the control room were not earthed. All metal door frames should be properly earthed.

ii. The cable trenches at the control room were not covered with concrete slabs. All cable trenches at the control room should be well covered with concrete slabs.

6.0 Short 33kV Double Circuit (DC) Overhead Transmission Line:

i. The tower members forming the tip/cage of the first tower outgoing from the 33kV substation was seen tilted. The tilted cage of the first tower should be checked and amended.

ii. The second tower was seen not designed for an angle tower, but it is now used as an angle tower due to the change in the entry point to the transmission substation. This has caused the tower to twist creating an unstable situation where stay wires were used to stabilize the tower. Angle towers should always be constructed in accordance with designed constructional specifications and standards.

iii. The stay wires used were not properly erected; they were already touching the live conductors. Also, the stay insulators provided were 11kV and so are undersize. The stay wires should be properly erected, relocated away from the live conductor and replace the undersize stay insulators with appropriate size stay insulators.

iv. The uppermost cross-arms and the middle cross-arms of the second tower were seen bent due to excessive tension. These bent cross-arms in dangerous twist should be replaced with good ones.

v. The base of the second tower was seen exposed to flooding of water during rainy season. This could submerge the funnels and degrade the strength of the tower leg foundations. The tower base should be covered with laterite to avoid flooding during rainy season.

vi. No anti-climbing devices, phase identification (I.D.), I.D number and danger signs on both towers. There should be provisions for anti-climbing devices, phase I.D, I.D number and danger signs on each tower.

vii. The tower legs were not adequately earthed, only one leg was earthed. At least two diagonally opposite legs of each tower should be earthed.

viii. The earthing conductor used in the leg of each tower is undersize. An appropriate earthing conductor size of 70mm^2 should be used.

ix. Legs B and C of the first tower were seen buckled. The buckled legs of the first tower should be checked and amended.

x. The clearance between the new SIPP overhead line and the existing 33kV overhead line was inadequate. The clearance between the SIPP and the existing 33kV overhead line should be checked and improved upon to within specified values.

xi. The lines from the power plant to the TCN substation were not provided with earth shielding wires.

xii. No communication links or sky wire between the TCN substation and the power plant.

7.0 Concrete poles:

i. The first section poles beyond the transmission tower were seen not planted to the required planting depth. All poles should be planted to the planting depth marked on the pole boot.

ii. No pole numbering seen, and no danger signs and anti-climbing devices on all the concrete poles. There should be a provision for pole numbering, danger signs and anti-climbing devices on each concrete pole.

iii. Conductor kink was seen at the yellow phase on the line circuit one before the pole. The conductor kink on the yellow phase should be checked and removed.

iv. The red and yellow phases on the second section pole were seen touching each other due to unplugged pilot insulator. The pilot insulator should be checked and installed back properly.

v. The second section pole was seen bending. Also, there was no lightning arrester and no adequate stay wire to support the section, which has given rise to a high sagging on the line. Lightning arrester and adequate stay wires should be provided.

vi. All channel irons on concrete poles were seen not earthed and no adequate ground clearance on the line networks of the second and the third poles. The channel iron should be earthed and adequate ground clearance should be provided on the line networks of both the second and the third poles.

vii. The fourth concrete pole was a three-pole structure; the jumpers of circuit two on it were not connected properly. A crack was seen on one of the concrete poles. The jumper connection of circuit two and the crack seen on one of the poles should be checked and corrected.

viii. The sixth double pole was not planted to the planting depth and the jumpers were seen in close proximity to circuit one. The planting depth of the sixth double pole and the jumpers that are in close proximity to circuit one should be checked and amended.

ix. The planting depth of the three-pole structure at the point of entry of the 33kV double circuit line into the TCN substation was not adequately planted to the required planting depth. The planting depth of the three-pole structure at the point of entry of the line into TCN substation should be checked and corrected.

8.0 TCN Substation:

i. Only one of the circuits was observed terminated on a makeshift connecting bay of a double concrete pole, instead of terminating the whole two circuits on one bay. A corridor for a connecting bay should be provided by TCN to terminate the second circuit.

ii. At the connecting bay, the channel iron of the connecting bay was not earthed and the jumpers of the outer phases (R and B) phases were almost touching the concrete pole. The Channel iron of the connecting bay should be earthed, while the jumpers of the outer phases that are almost touching the concrete pole should be checked and corrected.

iii. There was no lightning arrester at the connecting bay, the gantry for the VTs were not earthed, the gantries on the circuit breaker was earthed only on one leg, likewise the earthing on the gantry isolator and CTs were only on one leg. Lightning arrester should be provided at the connecting bay, while diagonally opposite legs of all gantries should be earthed.

iv. There was no interlock between the isolator and isolator earthing switch. This is a serious hazard that could lead to short circuit, explosion, fire and electrocution. Therefore, it is of utmost

importance that both electrical and mechanical interlocks should be provided between this incoming isolator and its associated earthing switch.

v. The control boxes of the line isolator and bus bar isolator were yet to be installed. The control boxes of line and bus bar isolators should be installed immediately.

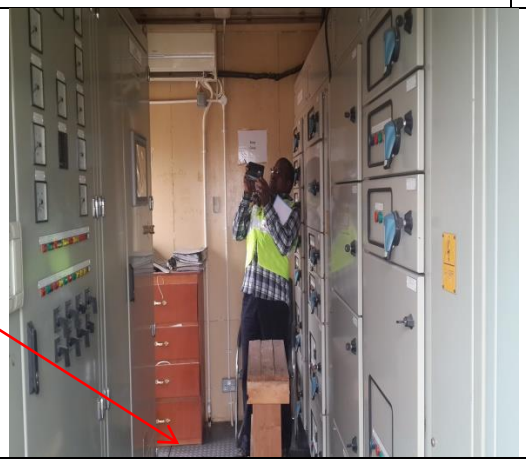
vi. The phase identification (I.D.s) of the bus bar and the incoming lines from the power plant were not matching. The Red and blue phases were wrongly tagged. This is a serious issue and the phases must be clearly identified and matched appropriately.

vii. Loose and corroded nuts were seen on the gantries. These could eventually wear out causing the gantries to fall. The loose nuts on the gantries should be tightened, while the corroded nuts should be should be replaced with galvanized ones.

viii. Concrete slabs were observed placed on the control cable, coming from the circuit breaker at the TCN switchyard. This would injure the cable insulation and lead to premature failure of the cables. The concrete slabs should be lifted off the cables completely.

DETAILED INSPECTION OF THE POWER PLANT AREA:

9.1 OBSERVATIONS AND RECOMMENDATIONS

S/N	PROJECT DESCRIPTION	OBSERVATIONS	PICTORIAL PRESENTATION OF ITEMS	RECOMMENDATION
1a	**control room**	The control room at the Power Plant was seen without Air conditioners working thereby subjecting the panel instrumentation to high ambient temperatures.		i. Air-conditioners should be constantly provided in the control room for adequate cooling of the control panel equipment.
1b		ii. Insulation mats were not laid in front of the Power plant control panels.		ii. Insulation mats should be laid in front of the control panel in order to ensure the safety of the operator on duty.

1c		iii. Danger plates were not fitted at the metallic entrance gate of the control room and elsewhere around the turbine skid.		iii. Danger signs should be fitted at the entrance gate of the control room and around the turbine skid.
2a.	**Battery bank:**	i. The lower battery arrangement in the battery bank at the power plant was seen with several damage and swollen batteries. This occurred as a result of inadequate ventilation and lack of cooling facilities in the battery bank.		i. All the damaged and swollen batteries in the battery bank should be replaced with functional ones and adequate ventilation and cooling system should be provided.

2b		ii. The battery bank at the power plant is using wet cell and is exposed to rain water during rainy season.		**ii.** The battery bank should be kept in a spacious shed/room having enough cooling system and should not be expose to rain water.
2c		**iii.** No interlocked changeover between the AC and DC panels.		iii. There is the need to provide interlocked changeover between the AC and DC panels.
3a	**The lube oil coolant:**	i. Not all the steel supports /legs of the Lube oil coolant platform/system were earthed.		i. Diagonally opposite legs of the lube oil coolants assembly should be earthed.

3b		ii. The fuel supply pipe from the main storage was seen open and unflanged. This fuel pipe as seen can allow some reptiles to enter inside the pipe causing fuel supply challenges.		ii. The pipe open end should be blocked using a blind flange temporarily until completion of the piping works. iii. The pipes should also be flushed through prior to being put into use.
3c		iii. The pipes were seen not well protected against corrosion.		iv. There should be adequate arrangement to protect the fuel supply pipes against corrosion.
4a	**Generating plant.**	i. No lightning protection installed at the highest point of the turbine exhaust stack.		i. Lightning protection (arrestors) should be provided at the highest points of the exhaust stack.

4b		ii. Earth shielding wire was not provided around the switchyard up to the turbine exhaust stack to protect against lightning strikes.		ii. Earth shielding wire should be provided from the switchyard to the exhaust stack to form a protection shield from lightning for the entire station.
4c		iii. Some of the earthing points at the power plant turbine skid area were seen corroded.	 	iii. All corroded earthing points should be checked, cleaned, re-terminated /replaced with good contacts.

4d		iv. A sign of termite dumps were seen at the power plant area.		iv. The termite dumps should be destroyed/checked and fumigated.
4e		v. Cable ducts were well sealed/covered with a sealing compound to prevent ingress of water and access to rodents. However, the entry points of the cables to the LV panel of the power plant and the circuit breaker were not covered. This could become an access route for rodents/reptiles to enter into the turbine and destroy cables or cause bridging of live wires.	 	v. The entry point of the cables should be covered to prevent rodents from entering into the turbine/control panels and damaging the cables or bridging live circuits.

4f		vi. The cable tray was not earthed.		vi. The cable tray should be properly earthed.
4g		vii. The connected plate at the exhaust pipe was seen corroded.		vii. The corroded plate at the exhaust pipe should be replaced with non- corrodible plate.
4h		viii. Cables at the generating plant, the circuit breaker and the dummy load were not labeled for proper identification. This could cause difficulties during maintenance/fault tracing.		viii. The cables should be properly identified and labeled.

4i		ix. Oil leakages/ spillage were seen at the black starting generator area within the turbine skid. This could be a source of fire and degradation of the blackstart generation performance.	 	ix. The oil leakages should be checked, identified and remedied.
4j		x. The cables connecting the auxiliary transformer has 1000V engraved on the outer insulation. These cables are used for both the HV and LV side of the transformer.		x. The cable connection should be checked and replaced with appropriate cable size for 11kV.

4k		xi. Gravelling of the generating plant and switchyard area, fencing of the active area of the generating plant and slabs covering for the cable trenches between the generating plant and the switchyard control area was not done.		xi. Gravelling of the generating plant and switchyard area, fencing of the active area of the generating plant and slabs covering for the cable trenches between the generating plant and the switchyard control area should be done.
		xii. A cable supplying power to an electric security lamp was seen hanging dangerously in the step ladder that leads up to the turbine filter. platform		xii. This cable should be removed and laid properly away from the step ladder cage.

5a	**Fire Hydrants/ Extinguishers**	i. The servicing dates for the fire hydrants were not maintained.	 	i. The servicing dates for the fire hydrants should be maintained, while the expired fire hydrants/fire extinguishers should be replaced with functional ones.
6a	**Fuel Storage Vessels/Tanks**	i. The construction of the pure fuel tank is on-going and has reached an advanced stage at the time of our inspection visit.		i. The construction of the pure fuel tank should be completed before the next inspection visit.

				
6b		ii. The raw and pure fuel tanks have no proper identifications numbers. iii. No danger signs fitted at the fuel tanks. iv. No lightning arrestor at the top of the higher fuel tank for protection against lightning strikes.		ii. There should be proper identifications on the fuel tanks. iii. Danger signs should be fitted at the two tanks. iv. Lightning arrestor should be provided at the top of the higher tank.

10. DETAILED INSPECTION OF THE SIPP SWITCHYARD AREA:

10.1 OBSERVATIONS AND RECOMMENDATIONS

S/N	PROJECT DESCRIPTION	OBSERVATIONS	PICTORIAL PRESENTATION OF ITEMS	RECOMMENDATION
1a	**33kV Switchyard**	i. The 11kV cables from the generating plant were laid on cable trays inside the cable trenches. However, the cables were yet to be connected and terminated at the main 50MVA 11/33kV step-up transformer.		i. The 11kV cables should be connected to the transformer.
1b		ii. At the 33kV switchyard, the contractor was seen replacing CTs that are of lower rating.		ii. All CTs and VTs should be in line with the current and voltage ratings of the transformer.

1c		iii. The transformer bus bar isolator was yet to be installed as at the time of our visit.		iii. The transformer bus bar isolator should be installed.
1d		iv. The evacuation line isolator was seen without an earth switch.		iv. Earthing switch should be provided at the evacuation line isolator.

1e		v. The pot insulators supporting the conductor at the secondary side of the step up transformer were of 22kV ratings.		v. The pot insulators should be replaced with appropriately sized and rated 33kV insulators.
1f		vi. The gantry support structures for the bus bar were not on the same height level, and this created an imbalance between the support structures. The middle support structure was higher than the remaining two by the sides.		vi. Gantry support structures should always be on the same height level to avoid imbalance situation.

1g		vii. There was no provision for flexibility at the switchyard as Single bus bar was used as against the double bus bar seen in the switchyard control panel. Even the single bus bar provided was not sectionalized.		vii. Additional bus bar should be provided at the switchyard for flexibility purpose.
1h		viii. The jumper conductor from the step up transformer to the current transformer (CT) isolator has a big curve- out that can allow rain water to follow		viii. This curve-out should be reduced to avoid rain water from running down to bolt and nuts. The installation should be done in such a way that rain water will be discharged before it

		the conductor down to bolt and nuts, accumulate in the clamps and cause corrosion.		enters the clamp by creating a loop.
1i		ix. The lightning arrester used was not of the right specification. The counter type lightning arrester counting the number of lightning arresters falling on the equipment should be used.		ix. The lightning arrester used should be replaced with the counter type lightning arrester.

1j		x. We observed that the earth conductors used on some gantry support structures were undersized.		x. An earth conductor size of 70mm^2 should be used to earth each support structure.
1k		xi. No silica gel at the step up transformer.		xi. Silica gel should be fitted on the step up transformer.
1l		xii. The installation of some equipment within the switchyard is still on-going.		xii. The installation of some equipment within the switchyard should be completed before the next visit.

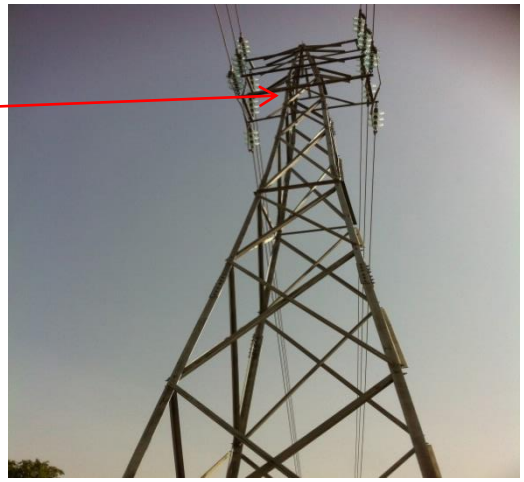
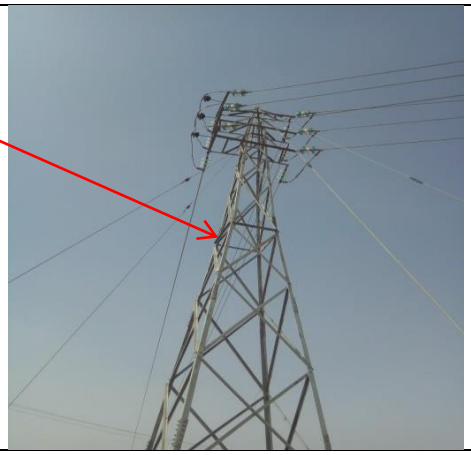
1m		xiii. Cablings and jumper terminations were still on-going at the switchyard and turbine plant ends.		xiii. The cablings and jumper terminations should be completed before the next inspection visit.
2a	**Switchyard battery bank**	i. The battery bank room has no good ventilation and industrial extractor fan was not provided. ii. No adequate illumination in the battery bank room.		i. Adequate ventilation and industrial extractor fan should be provided in the battery bank room. ii. Adequate illumination should be provided in the battery bank room.

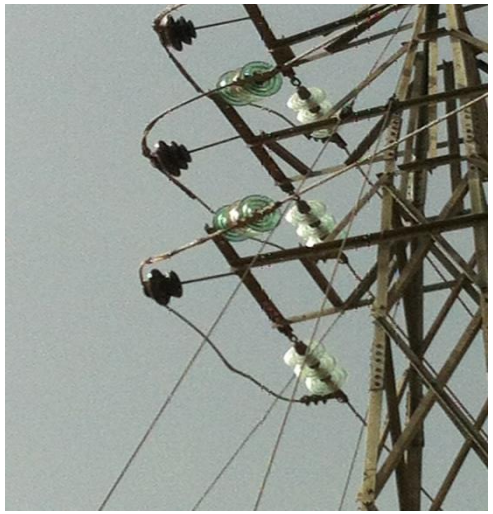
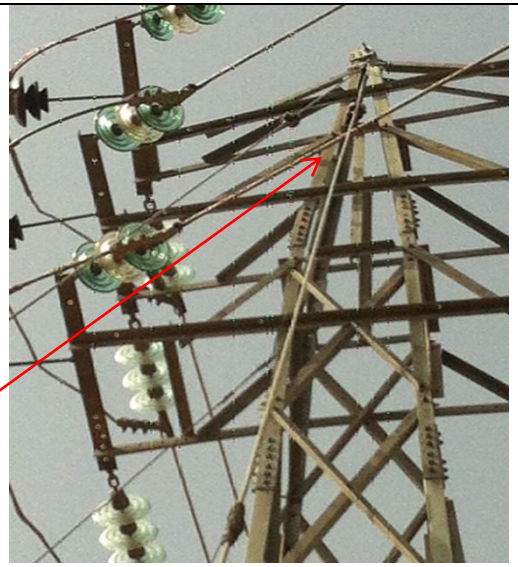
3a	**Switchyard Control room**	i. We observed that the earth conductor used at the rectifier in the control room and some gantries was undersize.		i. An earth conductor size of 70mm^2 should be used at the rectifier.
3b		ii. The metal door frames at the control room were not earthed.		ii. All metal door frames should be properly earthed.
3c		iii. The cable trenches at the control room were not covered with concrete slabs.		iii. All cable trenches at the control room should be well covered with concrete slabs.

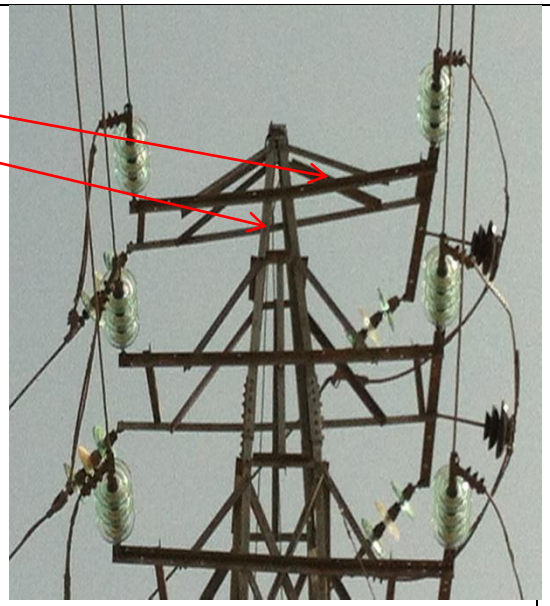
				
3d		iv. At the time of our visit, the contractor was seen busy fixing the lighting points at the switchyard control room.		iv. Adequate illumination is required at the switchyard control room and the switchyard itself.
3e		v. The step-up transformer oil and winding temperature indicators were not provided for in the control panel.		v. Oil and winding temperature indicators should be provided in the control panel.

11.0 DETAILED INSPECTION OF THE 33KV DOUBLE CIRCUIT OVERHEAD LINES:

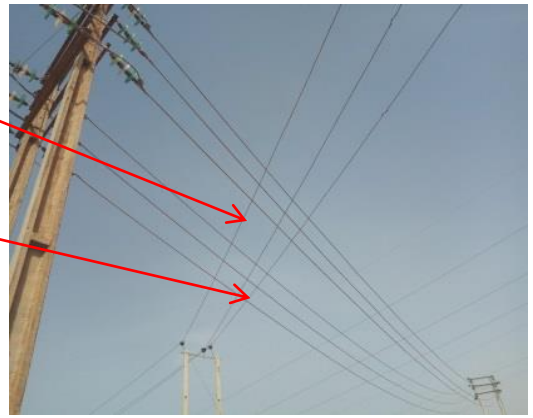
11.1 OBSERVATIONS AND RECOMMENDATIONS

S/N	PROJECT DESCRIPTION	OBSERVATIONS	PICTORIAL PRESENTATION OF ITEMS	RECOMMENDATION
1a	**33kV overhead Lines**	i. The tips/cage of the first tower was seen tilted/twisted.		i. The tilted cage of the first tower should be checked and amended.
1b		ii. The second tower was not designed for an angle, but it is now used as an angle tower due to the change in the entry point to the transmission		ii. Angle towers should always be constructed in accordance with designed constructional specifications and standards.

		substation. This has created an unstable situation where stay wires were used dangerously to stabilize the tower.		
1c		iii. The stay wires used were not properly installed as they were touching the live conductors. Also, the stay insulators used were undersized/under-rated.		iii. The stay wires should be properly positioned, erected and relocated away from the live conductor. iv. Also, the undersize stay insulators should be replaced with appropriate size stay insulators.

1d		v. The uppermost cross-arms and the middle cross-arms of the second tower was seen bent due to excessive tension. 		vi. All bent cross-arms observed should be replaced with good ones.
1e		vii. The base of the second tower was seen not properly sand filled and thus exposed to retention of water during rainy season, while the two legs B & C were seen buckled out.		vi. The tower base should be covered with laterite to avoid flooding and retention of water during rainy season, while the buckled legs B & C should be checked and amended.

1f		vii. Not all the legs of the tower are earthed, only one leg was earthed.		viii. At least two diagonally opposite legs of the supports of each tower should be earthed.
1g		ix. No anti-climbing devices, phase identification (I.D.), tower/poles numbering plates and danger signs on both the steel towers.		viii. Anti-climbing devices, phase identification marks, tower and poles numbering and danger signs must be installed on each tower.
1h		ix. The earth conductors used in tower legs are undersized.		x. An appropriate earth conductor size of 70mm^2 should be used.

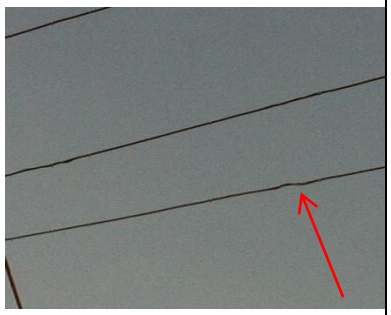
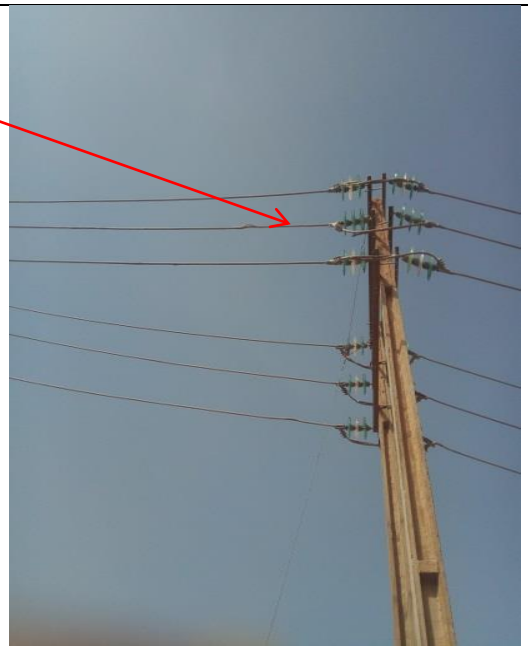
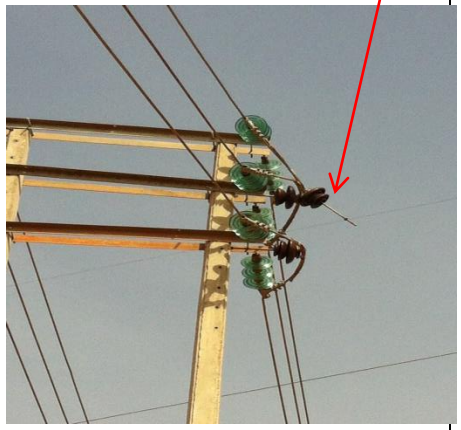
1i		xi. Legs B and C of the first tower were seen buckled.		x. The buckled legs of the first tower should be checked and amended.
1j		xi. The line crossing between the SIPP overhead line and the existing 33kV overhead line has inadequate clearance.		xii. The clearance between the SIPP and the existing 33kV overhead line should be checked and improved upon to meet minimum standard requirements.

1k		xiii. The lines from the power plant to the TCN substation were not provided with vibration dampers and earth shielding wires.		xii. Earth shielding wires and vibration dampers should be provided from the power plant to the TCN substation.
1l		xiii. No communication links or sky wire between the TCN substation and the power plant.		xiv. Communication links or sky wire should be provided between the TCN substation and the power plant.

12. DETAILED INSPECTION OF CONCRETE POLES:

12.1 OBSERVATIONS AND RECOMMENDATIONS

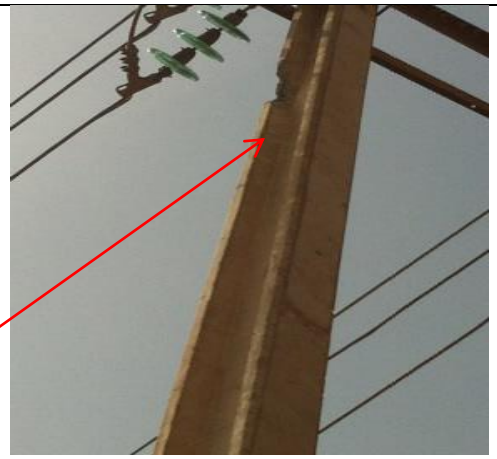
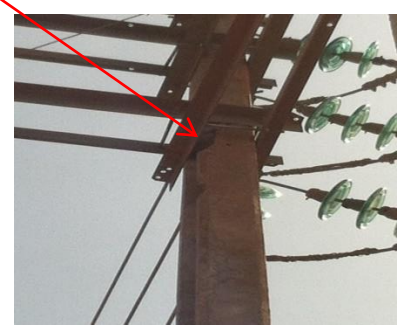
S/N	PROJECT DESCRIPTION	OBSERVATIONS	PICTORIAL PRESENTATION OF ITEMS	RECOMMENDATION
1a	**Concrete Poles**	i. The lines have mixed support structures, i.e., lattice towers (two) and concrete poles. The poles were not planted to the required planting depth as the poles foundation markings were visible. (See arrow).		i. All poles should be planted to the marked planting depth on the pole boot.
1b		ii. No pole numbering, danger signs and anti-climbing devices on all the concrete poles inspected.		ii. All concrete poles should be numbered, while danger signs and anti-climbing devices should be fitted on each concrete pole.

1c		iii. Conductor kinks were seen on the yellow and blue phases on circuit one. 		iii. The conductor kink on the yellow phase should be checked and removed, or the conductor span replaced.
1d		iv. The red and yellow phases on the second section pole were seen touching each other due to a detached pilot insulator.		iv. The pilot insulator should be checked and tied back. 

1e		v. At the underground crossing of the 132kV Overhead line, one of the double poles structure was seen dangerously tilted and on the verge of collapse. It does not have adequate stay wire to support it, which has also led to extensive sagging on the line. vi. Also, lightning arresters were not installed on the poles.	 	v. The tilted poles should be re-erected, adequate stay wires installed and lightning arrester should be provided for the two circuits at the crossings.

1f		vi. All channel irons on concrete poles were seen not earthed and no adequate ground clearance on the line networks between the second and the third pole.		vii. The channel iron should be earthed and adequate ground clearance should be provided on the line networks of both the second and the third pole.
1g		viii. The fourth concrete pole was a three pole structure, the jumpers of circuit two on it was not connected properly and cracks were seen on one of the concrete poles.		vii. The jumper connection of circuit two and the cracks seen on one of the poles should be checked and corrected.

1h		viii. The sixth double pole was not planted to the planting depth and the jumpers were seen in close proximity to circuit one.		ix. The planting depth of the sixth double pole and the jumpers that are in close proximity to circuit one should be checked and amended.
1i		x. The planting depth of the three pole structure at the point of entrance to TCN substation was not adequately planted to the planting depth.		ix. The planting depth of the three pole structure at the point of entrance to TCN substation should be checked and corrected.

		xi. Many of the concrete poles were seen cracked. These are likely to cause line instability. They may break and disrupt power supply.	  	x. All cracked poles with exposed reinforcement should be replaced for stability of the line and for safety of lives and property.

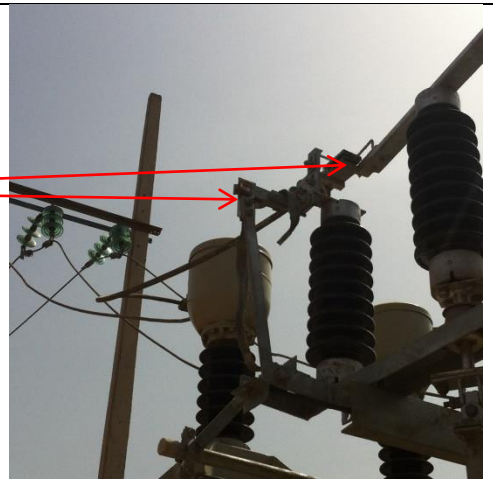
13. DETAILED INSPECTION OF THE PROJECT TIE-IN TCN 132/33KV SUBSTATION:

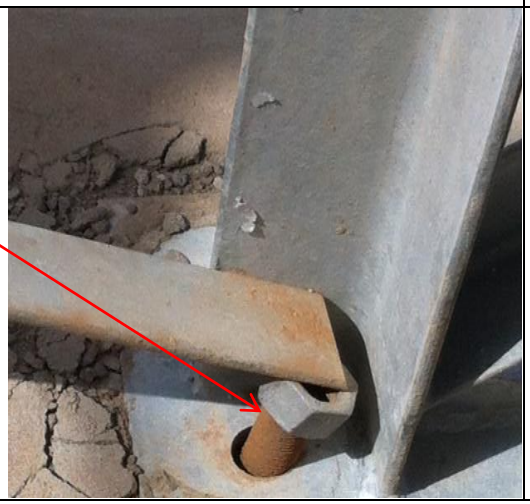
13.1 OBSERVATIONS AND RECOMMENDATIONS

S/N	PROJECT DESCRIPTION	OBSERVATIONS	PICTORIAL PRESENTATION OF ITEMS	RECOMMENDATION
1a	**TCN Substation**	i. Only one of the double circuit SIPP line was terminated at the TCN substation on a bay of double concrete pole, instead of terminating the whole two circuits on proper gantries. No proper provision has been made for the interconnection of the second circuit		i. A corridor for a connecting bay should be provided by TCN to terminate the second circuit.

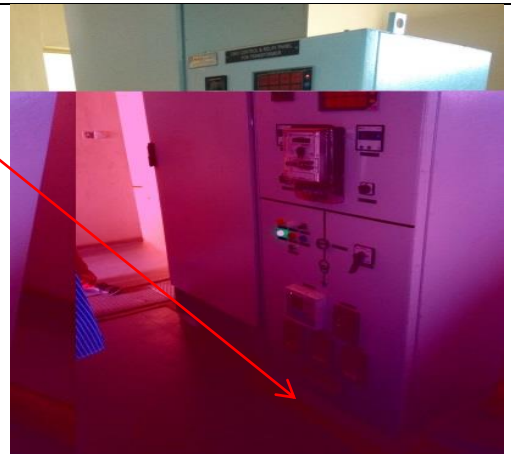
1b		ii. At the connecting bay, the channel iron of the connecting bay was not earthed. Also, the jumpers between the outer Red and Blue phases were almost touching the concrete pole, as there was inadequate clearance.		ii. The Channel iron of the connecting bay should be earthed, while the jumpers of the outer phases that are almost touching the concrete pole should be checked and corrected.
1c		iii. There was no lightning arrestor at the connecting bay of the incoming SIPP 33kV feeder lines to the TCN substation. Also, all the gantry supports for the		iii. Lightning arrestor should be provided at the connecting bay, while the legs of all gantries should be earthed.

		VT's were not earthed, while the gantry for the circuit breaker and the CT's was earthed only on one leg.		
1d		iv. There was no interlock between the main incomer isolator and its earthing switch. This is a major safety lapse that can lead to serious electrical accidents.		iv. At least a mechanical interlock should be provided between the incoming isolator and the earthing switch. This is a very major safety hazard that can result in electrical accident, explosion and fire.

				
1e		v. The control boxes of line isolator and bus bar isolator were yet to be installed.		v. The control boxes of line and bus bar isolators should be installed immediately.

1f		vi. The phase identification marks (I.D.s) of the SIPP incoming line from the power plant were at variance with the phase identification marks on the TCN substation bus bars - (the red and blue phases were interchanged).		vi. The Red and blue phases which were wrongly tagged should be properly traced, identified and corrected.
1g		vii. Loose and corroded nuts were seen on the gantries.		vii. The loose nuts on the gantries should be tightened while the corroded nuts should be should be replaced with galvanized types.

				
1h		viii. Concrete slabs were observed placed on the control cables, coming from the circuit breaker at the TCN switchyard. This would further injure the cable insulation and degrade the cable.		viii. The concrete slabs that were fouling on the control cables from the circuit breaker at TCN switchyard should be removed to avoid injury on the cable insulations.

				
2a	**TCN Control room**	i. Insulation mat was not laid in front of the control panel. This is for the safety of the operations personnel.		i. Appropriately rated insulation mat should be laid in front of the control panel .

APPENDICES

14. POWER TRANSFORMER DATA

T/F	MAKE	CAPACITY	VOLTAGE	S/NO	FREQUENCY	CURRENT	PHASE	COOLING	DATE		REF. STD	VECTOR GROUP	IMP%
STEP UP	ELSEWEDY TRANSFORMER	30/40/50MVA	11-(35+-2X2.5%)		50Hz		3	ONAN/ ONAF1/ ONAF2		OUTDOOR		YND1	
AUXILARY	Emirates transformer and Switchgear Ltd	1000KVA	11/0.400kV	14010827	50Hz	52.5/1443.4	3	ONAN	2008		IEC60076	Dyn11	4.70%

15. VOLTAGE TRANSFORMERS DATA:

VTs	MAKE	S/N	VOLTAGE RATIO	VA	CLASS	BIL	FREQUENCY	MODEL	YR OF MANUFACTURE.
VT1	Electrical Controls & System	NIPP09/OC/8465	33,000Q3/110.3V	200/200	0.5/3P	36/70/170K/P	50	OPT33	2010
VT2	,,	NIPP09/008654	,,	,,	,,	,,	,,	,,	,,
VT3	,,	NIPP09/007748	,,	,,	,,	,,	,,	,,	,,

16. CURRENT TRANSFORMERS DATA:

CTs	Make	S/No.	Core		Secondary Current A		Burden (VA)		Class		ISF/ALF		Year of Man.	Phase	Frequency	Insulation Class	HSV
CT1	Gemini Instratech	3433901012	1	2	1	1	20	20	10	SP	-	10	2017	1	50 HZ	A	36kV
CT2	,,	3433901009	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT3	,,	3433901008	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT4	,,	3433901010	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT5	,,	3433901001	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT6	,,	3433901014	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT7	,,	3433901003	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT8	,,	3433901011	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,	,,
CT9	Gemini Instratech	3433901005	1	2	1	1	20	20	10	SP	-	10	2017	1	50 HZ	A	36kV

17. LUCY 11KV SWITCHGEAR DATA:

TYPE REFERENCE	S/NO	YEAR OF MAN	MASS Kg	INSULANT /MASS SF6 Kg	RATED VOLTAGE kV	FREQUENCY	IMPULSE WITHSTAND VOLTAGE
VRN2A	SF00019566	2008	410	1.46	12	50/60HZ	95

18. 33KV CIRCUIT BREAKER DATA:

S/N	Production year	Type	Rated voltage	Rated current	Frequency	Insulation level	Short circuit breaking current	Short circuit withstanding current and duration	Short circuit making current
OHB3373	2011	OHB36.16.32	36kV	1600A	50HZ	70kV/170kV peak	315kArms	31.5KVA 3sec	79KVA peak

19. 38MW GENERATOR DATA:

Make	S/N	Type	Year Of man.	Apparent power	Rated voltage	Rated current	Power factor	speed	frequency	Class of insulation	Duty	Excitation	Standard	Protection
Alsthom	412014	3Q T190-240	1986	45,362KVA	11,000 V	2381A	0.8cosQ	3000rpm	50HZ	F	Continuous	244A, 507A	IEC	IP54

20. GENERATOR EXCITATION DATA:

Make	Type	S/N	Year Of man.	Output	Rated voltage	Rated current	Speed	Excitation by	Excitation voltage	Excitation Current	Class of insulation	Duty	Standard	Protection	Made In
Alsthom	Multipurpose TKJ70-10	412025	1986	123.7KW	244V	507A	3000rpm	Separated	39V	56A	F	Continuous	IEC	IP54	France

21. CABLE SIZES - FROM TURBINE CIRCUIT BREAKER TO STEP UP TRANSFORMER:

HV side of 50MVA transformer: 6x120mm^2 single core XLPE cables.
LV side of 50MVA transformer: 6x500mm^2 single core cables.

21.1 CABLE SIZES TO SWITCHGEAR:

3x630mm^2 Single Core, 600/1000Volts.

21.2 CABLE SIZES TO 1000KVA AUXILLARY TRANSFORMER:

LV SIDE OF 1000KVA: 3x630mm^2 Single Co re , 600/1000Volts.
HV SIDE OF 1000KVA: 3x630mm^2 Single Core , 600/1000Volts.

22. EARTH RESISTANCE MEASUREMENTS

S/N	LOCATION	MEASURED VALUE (OHMS)	REMARKS
1.	Each legs of power plant	1.5 ohms	Good
2.	Motors	1.54 ohms	Good
3.	Filter Fans	0.03ohms	Good
4.	Power plant control panel	1.1ohms	Good
5.	Turbine	0.63ohms	Good
6.	Switchyard control panel	1.1 ohms	Good
7.	Auxiliary TF(1MVA)	1.1 ohms	Good
8.	Step up TF(30/40/50 MVA)	0.5 ohms	Good
9.	Gantries	0.5 ohms	Good
10.	Isolators	0.5 ohms	Good
11.	Gantries (TCN Switchyard)	1.6 Ohms	Good
12.	Isolators(TCN Switchyard)	1.6 Ohms	Good

23. 50MVA TRANSFORMER OPEN CIRCUIT TEST

Transformer Open Circuit Test							Sec Vol		
Tap position	APPLIED VOLTAGE(V)			Imag(measured in mA)					
	R-Y	Y-B	B-R	IR(mag)	IY(mag)	IB(mag)	Vry	Vyb	Vbr
1	392	370	392	33.3	27.34	44.3	121	115	117
2	385	362	381	34.5	27.8	44.1	124	118	120
3	385	367	392	36.3	29.69	48.1	127	121	123
4	390	364	381	37.6	30.4	50.2	130	121	120
5	390	370	393	39.1	32.4	52.9	134	128	129

Remarks: Satisfactory.

24. TRANSFORMER SHORT CIRCUIT TEST OF 50MVA :

Tap Position	PRIMARY APPLIED VOLTAGE (V)			PRIMARY MEASURED CURRENT(A)			I (SHORT CIRCUIT CURRENT) (A)		
	R-Y	Y-B	B-R	IR	IY	IB	Ir	Iy	Ib
3									

Remarks: This test was not carried because of under size test cables.

25. INSULATION RESISTANCE TEST OF 50MVA TRANSFORMER

PHASE	APPLIED VOLTAGE (MEGGER)	RESISTANCE IN GΩ	REMARKS
RHV-G	5KV	1.19 GΩ	Okay
YHV-G	5KV	1.22 GΩ	Okay
BHV-G	5KV	1.31 GΩ	Okay
NHV-G	5KV	8.00 GΩ	Okay
r-G	5KV	5.65GΩ	Okay
y-G	5KV	7.23GΩ	Okay
b-G	5KV	6.22GΩ	Okay
R-r	5KV	7.96 GΩ	Okay
Y-y	5KV	7.76GΩ	Okay
B-b	5KV	7.88GΩ	Okay

Remarks: Satisfactory.

26. GENERAL REMARKS

i. The 38MW dual fuel Frame 6 turbine/alternator on skid has been well installed. A few observations requiring the attention of the contractor have been outlined in the sections dealing with the turbine above. In particular, the source of the oil leakages found around the blackstart generator should be identified and rectified.

ii. The 33kV switchyard has a new 50MVA 11/33kV transformer installed and the switchyard was seen being updated with new equipment (VT's and CT's). Galvanized supports were seen now being used. Finishing touch was being put on the control room.

iii. The 33kV transmission line between the 33kV substation and the TCN 132/33kV substation was poorly executed and needs to be reappraised. All defects pointed out should be corrected for safety of the installation and safety of lives and property.

27. STATUTORY INSPECTION FEES

You are required to pay the statutory inspection fee in the sum one million one hundred thousand two hundred and fifty naira only (₦1,100,250.00 only). All payments should be made through '**TSA /NIGERIAN ELECTRICITY MANAGEMENT SERVICES AGENCY VIA REMITA'** the bank teller and print out showing the evidence of payment should be submitted to the NEMSA office and payment receipt should be given to you.

Submitted for your information and necessary compliance, please.

Engr. Ntuen O. Anthony
AIE, NEMSA Sokoto.

CC: Managing Director/CEO & CEIF NEMSA HQ, ABUJA

AERIAL VIEW OF THE ASSOCIATED SOKOTO IPP 33KV SWITCHYARD

GOOGLE EARTH 2018 SATELLITE PHOTOGRAPH OF THE 38MW SOKOTO IPP PROJECT SITE