ELECTRICITY MANAGEMENT SERVICES LIMITED

REPORT ON INSPECTION AND TESTING OF THE PARAS ENERGY 90MW POWER STATION AT OGIJO, OGUN STATE

26TH AND 27TH FEBRUARY 2015.

ELECTRICITY MANAGEMENT SERVICES LIMITED

4, Dar Es Salem Crescent, Off Aminu Kano Crescent, Wuse II, Abuja, FCT

INSPECTION OF PARAS ENERGY 90 MW GENERATION POWER PLANT AND 33KV/132KV SUBSTATION IN OGIJO, OGUN STATE

ON 26TH AND 27TH FEBRUARY 2015

SUMMARY OF OBSERVATIONS AND RECOMMENDATIONS

Please find below the observations recommendations of Electricity Management Services Limited (EMSL) inspection team for implementation and compliance.

MAIN CONTRACTOR: Wartsila Finland Company

CONSTRUCTION CONSULTANTS: Wartsila India Ltd

SUBCONTRACTOR ELECTRICAL: Remmy Engineers (Nig) Ltd

CLIENT: African Foundries Ltd / Paras Energy

SUPERVISING AGENCY: Transmission Company of Nigeria (TCN)

INSPECTING/TESTING AUTHORITY: Electricity Management Services Limited (EMSL)

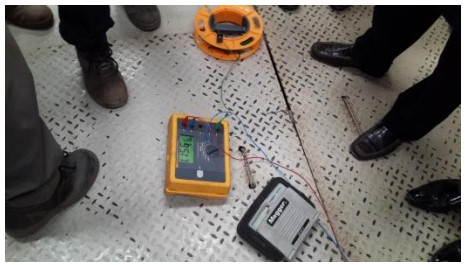
INTRODUCTION

The plant comprises nine number of Wartsila 20V34SG gas-fired engines coupled to ABB alternators details of which are attached in Appendix 1. Generation is at 11KV with an initial step-up to 33KV and subsequent and further step-up to 132KV for connection to the national grid through a single circuit Turn In/ Turn Out arrangement of the Ikorodu - Shagamu 132KV line.

Hard and soft copies of all design drawings and data were given to the EMSL Team by Paras Energy.

S/NO.	PROJECT AREA	OBSERVATIONS	PICTORIAL VIEW OF ITEM	RECOMMENDATION
1.	**GENERATING STATION**	There are nine gas-fired 20-cylinder Wortsila Type 20V34SG gas-fired fuel efficient reciprocating engines. The 20V-engines are coupled to 11KV ABB alternators with details as below: 1. GEN-1: 8.73MW 2. GEN-2: 8.73MW 3. GEN-3: 9.73MW 4. GEN-4: 9.73MW 5. GEN-5: 9.73MW 6. GEN-6: 9.73MW 7. GEN-7: 9.73MW 8. GEN-8: 9.73MW 9. GEN-9: 9.73MW		It is recommended that the numbering of Generators 6 to 9 [GEN-6, GEN-7, GEN-8, GEN-9] should be completed as done for Generators 1 to 5.
				
		The Power Plant is well laid out with adequate provision for maintenance space. Floor of generator areas was treated with Dipox epoxy coating for prevention of ingress of oils and solvents onto the generators bases; also for ease of cleaning and generally for good housekeeping.		Commendable Layout and installation.
		The Power Station has “Black Start” capability.		This is useful for grid management.

2.	**GENERATING STATION**	The generated voltage is 11KV from ABB alternators powered by the Wartsila 20V34SG engines. Provision for future expansion has been made in the Power Station building. The alternators are synchronized and the output voltage is first stepped up to 33KV and subsequently again stepped up to 132KV for connection/transmission to the national grid.		**Ok**
3.	**GENERATING STATION**	Generated voltage and frequency were at 11KV and 50 Hz respectively. Observed load was 3.3 MW balanced on the three phases. Grid meters have also been procured and sent to National Meter test Station Oshodi for certification.		**Ok**

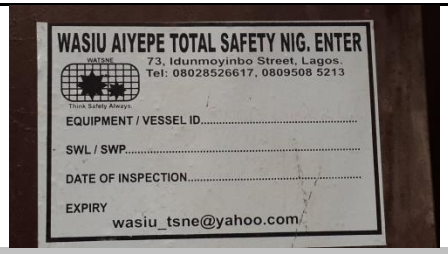
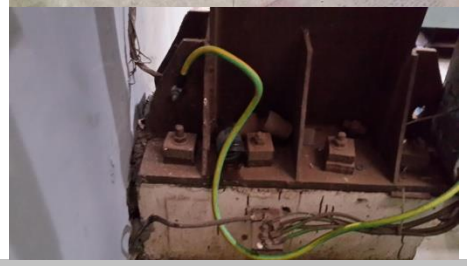
4.	**GENERATING STATION**	Two overhead cranes of 2-tonnes were provided and were found well maintained. Regular safety tests are carried out on them.		SOP for the cranes should be provided. Regular Safe Working Load Test should be carried out and documented.
		The generator area is well lit with both natural lighting and flood lights. However three of the flood lights bulbs were found not functioning.		The faulty lighting units should be repaired and burnt bulbs replaced.
		The hand rails and other stand-alone barriers were seen painted with yellow, same colour as the gas lines.		The handrails and other stand-alone barriers should be painted alternate black and yellow stripes.
		The earth resistance of all the generators were measured and found to be as in Appendix 3. However the earth resistance of the handrails and steps were high.		An improvement on the earth resistance of the handrail and steps could be achieved by connecting them to earth continuity as done in the workshop area as shown below.

		Two earth Megger testers were used for the readings and these correlated very well.		
5.	**GENERATING STATION**	The First Aid box label in the generator area was upside down.		Please reverse this label.
		Adequate safety, warning and danger signs abound in the entire plant and this is commendable. A safety officer is also employed.		

Gas leak detectors are in place both inside the generating station and gas stations.

A MUSTER point is also designated for assembly of staff in case of safety alert.

6.	**GENERATING STATION**	The air compressors and the compressed air receivers/surge vessels were well installed.		All air receivers/vessels must be hydrostatically tested with labels on the body showing SWP, Test pressure and Date of last test. All OH cranes/hoists must be tested and labeled on the body showing SWL and Date tested.

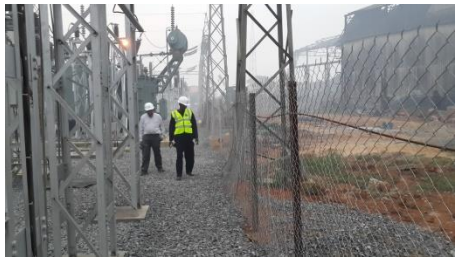
		However, there was no evidence of SWP routine hydrostatic tests done on the body of the air vessels.		
7.	**GENERATING STATION**	The louvres of the generator cooling fans are badly damaged thereby exposing the rotating blades. This is a potential danger for operators and others in their vicinity.		Replace all damaged louvres and set up routine inspection and maintenance schedule for these.
8.	**GENERATING STATION**	The earthing of all the generators, auxiliaries, steel structures, control panels were found adequate and within specified values. The earth continuity conductors were of adequate size with correct colour codes.	 	Okay

9.	**GENERATING STATION**	Cable ducts were adequately covered with checker plates, and the stairways and generator platforms with steel gratings.		Okay
		The Cable trays were all well laid out and not overloaded, and cables well strapped to the trays with plastic cable ties.		Okay
		All cable entries to the generators and panels are well gland.		Okay
10.	**33/132KV SUBSTATION**	Two bays; one serving the main factory as 132/33KV, the other serving as a turn-out 33/132KV transmission substation for connection to the national grid.		Okay.

33/132KV SUBSTATION Cont'd

The gantries were well constructed and erected on concrete foundations. All the gantries and steel structures were of galvanized steel as per standard specifications. The entire substation grounds are well graveled.

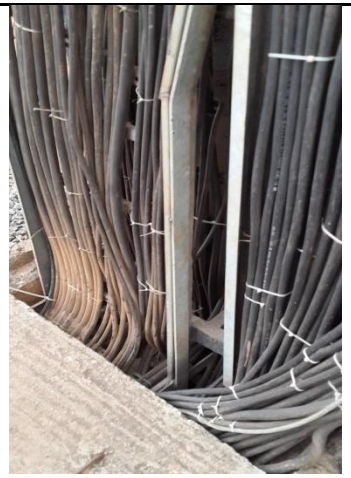
All the equipment support structures were well labeled and earthed.
The mass earth for each unit was well constructed which ensured that all earth resistance readings were well below 1 ohm.
This is highly commended.



Well-constructed and erected gantries made from galvanized steel.

	33/132KV SUBSTATION Cont'd	Adequate earthing of all support structures observed.		
11.	**33/132KV SUBSTATION**	The entire substation was well protected from lightning using sky wire lattice.	 	Okay

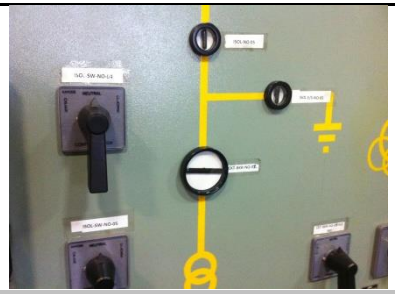
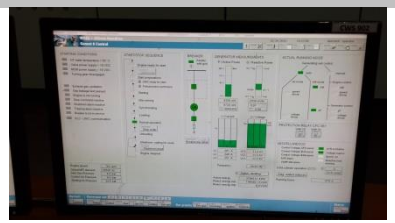
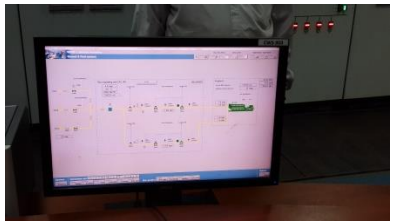
	33/132KV SUBSTATION Cont'd	However, part of the extension of the substation to a future expansion was not enclosed in the main substation fenced-off area.		It is recommended that all equipment associated with the substation should be fenced in even though this particular portion is not energized but is structurally linked with the rest of the substation.
		Some gantries bearing lightning protection skywires are located outside the fenced off area of the substation.		
12.	**33/132KV SUBSTATION**	Adequate concrete separating wall put in place between transformers as standard safety requirement.		Okay

13.	**33/132KV SUBSTATION**	Some portions of the cable trenches leading into the main building are exposed.		The exposed portions of the cable trenches leading into the main building should be covered to avoid entry of rodents and flooding.
14.	**33/132KV SUBSTATION**	The phase indication on the 40MVA breakers and isolators was in conflict with the phase sequence, red and blue were interchanged.	 	It is recommended that all phase indicators be aligned with the transformers and the incoming/outgoing TCN lines.

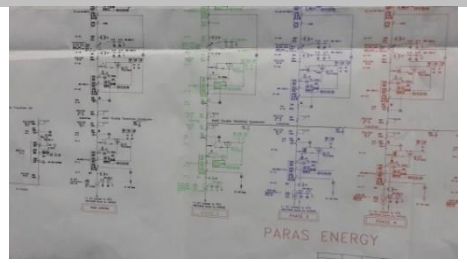
15.	**33/132KV SUBSTATION**	The cable trench covers had some of the lifting handles turned inwards, some turned outwards making tripping of personnel inevitable. These should be uniformly turned outwards, thereby also providing more and unimpeded movement space.		
16.	**33/132KV SUBSTATION**	The lighting in the substation was extremely poor and in the night of day 1 of our visit the entire substation was in darkness.	 	It is recommended to ensure that any faulty illumination installation be rectified. If none were really available as we observed then it is essential that the substation is adequately illuminated all round the periphery of the substation with the lights shining into the switchyard.

17.	**33/132KV SUBSTATION**	Fire extinguishers were located at strategic positions in the substation. They were standard CO_2 types. However they were exposed to weather and could malfunction as a result.		It is recommended that the top of the fire extinguishers be covered and protected particularly from rain.
18.	**11/0.433KV SUBSTATION**	The 11/0.433KV substation is well constructed and protected with safety, warning and danger signs. Earth resistance results		
19.	**ENVIRONMENTAL AND CONVENIENCES**	Well maintained clean toilets manned by a cleaner is commendable and indicates good staff welfare practice.		
		However the smoke emanating from the adjoining steel manufacturing process is inimical to the environment and workers.		It is recommended that processes be put in place to ameliorate environmental pollution and to protect the health of the workers.

20.	**CONTROL ROOMS**	The Substation control room was very well laid out. Provision for airconditioning good. A demonstration of the capabilities of this digital substation was undertaken to determine performance of: Opening and closing of isolators and circuit breakers. Switching Interlocks. Flexibility of the HMI and alarm marshaling. Bus coupling and protection. Transformers switching, Tap Change panel and general circuit protection. The Control voltage 110 Volts Battery supply and battery bank room is well laid out with state-of-the art battery packs; no exposed conducting connections thereby assuring of safety of personnel. High voltage insulation mat is spread in front of all panels. Distance/Remote switching and interlock protection was demonstrated. Local operations of the couplers, earthing switches, also observed,	  	On completion of installation works client to ensure high voltage insulation mats are laid in front of all panels. All panels must be adequately connected to an appropriate earth system.

		etc (However, Communication and SCADA with TCN were yet to be completed.)	
21.	**CONTROL ROOMS**	The generator control system is from a HMI; all parameters are monitored and controlled by the DCS from the HMI's including synchronization of the generators and synchronization of power station supply with the grid. Speed, droop, frequency and engine fuel optimization are all electronically controlled on the WECS portal. All the interface, monitoring and controls of the entire substation are also operated from the HMI in the control room. All control schemes are well designed and executed.	  

22.	**CONTROL ROOMS**	The interface between the generating station and the switchyard was demonstrated. The generating station control room was well demarcated from the substation control room and battery room. Visual contact with the 132KV substation from the control room quite adequate and makes for good operational practice.		This is commended.
23.	**CONTROL ROOMS**	The operational indicators of the Substation Control panels show “Red” for Breaker on and “Green for breaker off. This is standard and correct.	 	It is recommended that a unification to “Red” for Breaker on, and “Green” for breaker off should be made as standard. This is critical.

		The indicators on the Generator controls are reversed, showing "Green" for breaker on and "Red" for breaker off. This is incorrect, is confusing to operators, and may be unsafe for operational and maintenance situations and personnel.		Indicators must be uniform throughout the plant in order to forestall accidents and confusion. "Red" for Breaker on, and "Green" for breaker off should be made as standard.
24.	**CONTROL ROOMS**	Soft and hard copies of documentation requested for by EMSL from the project team: were provided. These include, generators and transformers parameters, Relay settings and their response results; Interface drawings between generators and substation, etc. Relevant line drawings for the Turn in-Turn Out arrangements.		It is recommended that adequate risk management techniques be adopted to safeguard software, data and records by storing them at least 100 kilometres apart. Suggest replicate data and store in India, or elsewhere.
25.	**LIGHTNING PROTECTION**	Lightning arrestors were provided at the highest points in the power station (at the exhaust stacks), main building, gas stations; and the substation proper.		Lightning protection using radial coverage type should be provided as a matter of priority for the safety of lives and installed equipment.

		Faraday lightning rods and spikes types have been utilized as the most effective types. A radial type was seen on the steel manufacturing shop adjoining the power station.		
26.	**EXHAUST STACK**	The exhaust stacks were observed rusting.		It is recommended that adequate stack surface preparation, priming with weather-proof undercoat and final coating with High Temperature Aluminium (HTA) be done to preserve these stacks.
27.	**GAS STATIONS**	The two gas regulating stations were adequately constructed. All the metal stanchions were found adequately connected to earth. Spike lightning arrestors were installed on top of each of the sheds. The earth resistance readings on the near side unit however were relatively high at 4.32 – 5.43 ohms		Improvement of earth resistance recommended so as to obtain values of 2 ohms and less.

		whilst that of the far side was 0.6 ohms and the wire mesh fence was between 1.29 – 2.76 ohms.		
28.	**GAS STATIONS**	The near-side gas station pipes and equipment were still in aluminium colour.		The gas installation and equipment and should be painted yellow as has been done on the other station.
29.	**REVIEW MEETINGS**	The Managing Director EMSL Engr Peter O. Ewsesor listening attentively to the Managing Director Paras Energy Mr Yashwant Kumar during the Inspection.		
		The Managing Director EMSL Engr Peter O. Ewsesor making his remarks on Enforcement of Safety, Standards and compliance to Specifications during the Day 1 Review Meeting.		

Signed by:

MAIN CONTRACTOR: Wartsila Finland Company:

CONSTRUCTION CONSULTANTS: Wartsila India Ltd:

SUBCONTRACTOR ELECTRICAL: Remmy Engineers (Nig) Ltd:

CLIENT: African Foundries Ltd / Paras Energy:

SUPERVISING AGENCY: Transmission Company of Nigeria (TCN):

INSPECTING/TESTING AUTHORITY: ELECTRICITY MANAGEMENT SERVICES LIMITED---------- Date:_____

SUMMARY

One site meeting was held on each day of the inspection exercise. The attendance was as below:

DAY 1: 26th February 2015

S/NO.	NAME	ORGANISATION	DESIGNATION	E-MAIL ADDRESS	TELEPHONE
1	Engr Peter O. Ewesor	**EMSL**	MD/CEO	ogetomeegbe@yahoo.co.uk	08036745149
2	Engr Tukur Gidado	**EMSL**	ED (Tech)	engrgidado@gmail.com	08034518055
3	SA Technical	**EMSL**	Senior Advisor	Cynbil.ltd@gmail.com	08070990009
4	Engr K.O. Ikpo	**EMSL**	Area Inspection Engineer (Ogun State)	kaluiyke@yahoo.com	08037442084 08079209354
5	Adewale Oyinlade	**EMSL**	Area Inspection Engineer (Ikeja)	best_oyinlade@yahoo.com	08034417901
6	Mr Yashwant Kumar	**PARAS ENERGY**	MD	yashwant.kumar@parasenergy.com	08159793772
7	H.S. Pandey	**PARAS ENERGY**	Manager – Project	hs.pandey@parasenergy.com	08159094227
8	Manjinder S. Bittu	**PARAS ENERGY**	Electrical Manager	nmajinder.bitoo@africanindustries.com	08159093198
9	Lakshman Prasad	**PARAS ENERGY**	Power Plant Manager	i.prasad@parasenergy.com	08159094279
10	Daniel S. Adekunle	**PARAS ENERGY**	Mechanical Engineer	voyaseedsexcel@yahoo.com	08180966940
11	Heant Limaye	**PARAS ENERGY**	Manager Electrical/Instrumentation	h.limaye@parasenergy.com	08159094280
12	Engr M. B. Izah	**TCN**	PM (DS+IP)	send2musa@yahoo.com	08023558540

1. EMSL observed and commended the good workmanship and adherence to standards displayed at the generating station, 132KV switchyard and other facilities in the power station.

2. It was generally noted that the power station was constructed, commissioned and is now being run with world best practices. All test results presented were accepted because those verified during the inspections correlated with the relevant tests.

3. Safety standards must be adhered to at all times in order to assure safety of lives and property, and to also ensure steady supply of energy to the grid.

DAY 2: 27th February 2015

S/NO.	NAME	ORGANISATION	DESIGNATION	E-MAIL ADDRESS	TELEPHONE
1	Mr Yashwant Kumar	**PARAS ENERGY**	MD	yashwant.kumar@parasenergy.com	08159793772
2	Lakshman Prasad	**PARAS ENERGY**	Power Plant Manager	i.prasad@parasenergy.com	08159094279
3	H.S. Pandey	**PARAS ENERGY**	Manager – Project	hs.pandey@parasenergy.com	08159094227
4	Heant Limaye	**PARAS ENERGY**	Manager Electrical/Instrumentation	h.limaye@parasenergy.com	08159094280
5	Manjinder S. Bittu	**PARAS ENERGY**	Electrical Manager	nmajinder.bitoo@africanindustries.com	08159093198
6	Daniel S. Adekunle	**PARAS ENERGY**	Mechanical Engineer	voyaseedsexcel@yahoo.com	08180966940
7	Engr Bukar	**TCN**	PM (DS+IP)	send2musa@yahoo.com	08023558540
8	Engr Tukur Gidado	**EMSL**	ED (Tech)	engrgidado@gmail.com	08034518055
9	SA Technical	**EMSL**	Senior Advisor	Cynbil.ltd@gmail.com	08070990009
10	Engr K.O. Ikpo	**EMSL**	Area Inspection Engineer (Ogun State)	kaluiyke@yahoo.com	08037442084 08079209354
11	Adewale Oyinlade	**EMSL**	Area Inspection Engineer (Ikeja)	best_oyinlade@yahoo.com	08034417901

1. The Paras Energy 90 Megawatt gas-fired power station, Ogijo, Ogun State, is recommended for approval and issuance of EMSL certificate.

WLCM.

APPENDIX 1

GENERATORS DETAILS

S/No.	Make	Fuel Type	Engine Type	Engine Serial No.	Alternator Type/Make	Engine Capacity (MW)	Alternator Capacity (KVA)	Output Voltage (KV)	Output Current (Amps)	Year
1	Wartsila	Nat. Gas	W20V34SG	PAAE 139220	AMG1120LT08DSE / ABB	8.73	10913 KVA @ 0.8pf	11	573	2008
2	Wartsila	Nat. Gas	W20V34SG	PAAE 141593	AMG1120LT08DSE / ABB	8.73	10913 KVA @ 0.8pf	11	573	2009
3	Wartsila	Nat. Gas	W20V34SG	PAAE 213054	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2011
4	Wartsila	Nat. Gas	W20V34SG	PAAE 213055	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2011
5	Wartsila	Nat. Gas	W20V34SG	PAAE 213056	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2011
6	Wartsila	Nat. Gas	W20V34SG	PAAE 248804	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2013
7	Wartsila	Nat. Gas	W20V34SG	PAAE 248805	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2013
8	Wartsila	Nat. Gas	W20V34SG	PAAE 248806	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2013
9	Wartsila	Nat. Gas	W20V34SG	PAAE 248807	AMG1120LT08DSE / ABB	9.73	12163 KVA @ 0.8pf	11	638	2013

APPENDIX 2

TRANSFORMER DETAILS

S/No.	Make	Capacity (KVA)	Voltage Ratio (KV)	Current (Amp)	Serial No.	% Impedance	Vector Group	Year
1	**ABB**	**40000**	**132/33**	**175/700**	**AGH-00**	**10**	**YNd11**	**2012**
2	**Kiloskar Electric**	**45000**	**11/33**	**2362/787**	**2YG003/01**	**9.76**	**YNd1**	**2009**
3	**Kiloskar Electric**	**2000**	**11/0.433**	**105/2666**	**07POD045**	**6.63**	**Dyn11**	**2009**
4	**Kiloskar Electric**	**2000**	**11/0.433**	**105/2666**	**OD 227/01**	**6.63**	**Dyn11**	**2014**

APPENDIX 3

EARTH RESISTANCE READINGS IN OHMS (Ω)

AREA	POINT 1	POINT 2	REMARK
Generating Station			
Generator 2	0.692	0.716	
Generator 5	0.852	0.821	
Generator 8	0.78	0.79	
Generator 9	0.84	0.77	
Control Panel Gen 2	0.75		
Air Compressor	0.58		
Gas Regulating Unit Gen 2	0.57		
Steel Frame Gen 2	0.59		
Gas Stations			
Gas Plant 118	0.6	0.64	
Gas Plant 118 Wire Mesh Fence	1.29	2.76	1.80
Gas Plant 123	4.41	4.32	5.43
SwitchYard			
Gantry by Switchyard Entrance	0.64		
Main Station Building Stanchion	0.49		
Wire Mesh Fence	14.25		
45000KVA Transformer			
33KV side	0.59		
PT	0.65		
Circuit Breaker 1 Support	0.62		
Ist Line Isolator support	0.63		
Insulators Support	0.61		
2nd Line Isolator support	0.65		
Circuit Breaker 2 support	0.55		
3rd Line Isolator support	0.78		
40MVA Transformer			

Transformer body	0.69		
Transformer Neutral	0.67		
132KV L.A.	0.67		
132KV CT support	0.72		
132KV SF6 Circuit Breaker support	0.860		
4^{th} Line Isolator support	0.66		