



**AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE POWER
AND ENERGY DEVELOPMENT (ACESPED)
UNIVERSITY OF NIGERIA, NSUKKA**

Developed documents for expanding of testing facility

OCTOBER, 2022

Administrative office:	Responsibility	ACE-SPED regional testing facility
Date which was documents for expanding of testing facility report developed:		October, 2022
Report documents for expanding of testing facility developed by:		ACE-SPED expanding of testing facility Committee
Authorized by:		ACE-SPED BOARD
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Web link to document		

1.0 BACKGROUND

The ACE-SPED, after receiving the report of the feasibility study for testing facilities needed in the region from the committees in March 2021, set up committees to develop a document on expanding testing facilities in the University of Nigeria, Nsukka Enugu State, Nigeria. The Applied Research Officer (ARC) of the center headed the committee, with other members including Industrial Liaison Officers (ILO) and various program heads from the center.

2.0 The committee's terms of reference

- i. The goal is to develop an expanding testing facility that will be beneficial to the regional partners.
- ii. Search for specialists or suppliers the suggested equipment and set up advisory services that will benefit the region.

3.0 Outcomes of the committee work

The University of Nigeria, Nsukka, being a foremost centre of excellence in teaching and research within the region, is at the forefront of fostering regional and international integration through teaching and research. The ACE-SPED expansion of the testing facilities is to further strengthen the regional impact of the university through impactful testing and cutting-edge research in the area of sustainable power and energy development. This document established ACE-SPED as a laboratory hub for sub-regional testing facilities.

ii) University of Nigeria, Nsukka have standard Nano-laboratory, NLNG advanced materials characterization laboratory, high voltage laboratory, energy research centre, equipment research and maintenance centre, centre of entrepreneurship and development and innovation science

park. These laboratory and centre are equipped with modern testing equipment such as solar and PV analyzer, high voltage materials, battery, electrochemical,

iii.) The following testing facilities were proposed to enhance the testing needs of the region:

A. Control and Instrumentation Equipment

CE110 Servo Trainer	A compact self-contained bench mounting d.c. servo apparatus designed to allow students at all academic levels to investigate basic and advanced principles of control. In particular the CE110 deals with control issues relating to position and speed control in servo systems
Microgrid	The microgrid combines the outputs of Wind Turbine emulator, PV Emulator and Fuel Cell at a common DC link via different DC-DC converters which is further connected to a three-legged programmable inverter to deliver the combined power to an Actual Grid. Microgrid system enables user to do research in the field of Microgrid management, load side management, priority allocation to renewable sources etc.
Solar PV Grid Tied Training System	Enables user to study wiring and interconnections of different components involved in the system to develop basic understanding of working and operation of a Grid connected system
5kW Wind Emulator	Wind turbine emulator mimics the behaviour of wind turbine for hardware level simulations. This system has a DC motor coupled with the Induction generator/Permanent Magnet Synchronous Generator, speed of which is controlled as per the speed reference calculated by solving the mathematical model of wind turbine. An induction generator is coupled to the DC motor and bidirectional inverter is connected to the terminals of the generator.
B. Advanced Materials Characterization	
AA6000 mini Desktop Scanning Electron Microscope	Scanning electron microscope (SEM) is one of the most widely used instrumental methods for the examination and analysis of micro- and nanoparticle imaging characterization of solid objects. One of the reasons that SEM is preferred for particle size analysis is due to its resolution of 10 nm, that is, 100 Å.
7600 FTIR spectrometer	It is a valuable tool for various analytical applications in fields such as chemistry, medicine, food and beverage, wine industry, material , energy, and power, engineering and quality process control and for examining the functional group

STA 449 F5 Jupiter® Simultaneous Thermal Analyzer (TG- DSC/DTA Apparatus)	<p>The Nano DSC and the Multi-Cell DSC represent ultrasensitive differential scanning calorimeters with unmatched flexibility for characterizing molecular structure and stability. The Nano DSC, with fixed-in-place cells, is specifically designed to analyze in-solution samples. The Multi-Cell DSC offers three removable cells and one reference cell for maximum sample flexibility.</p>
<p>c. RENEWABLE AND NEW ENERGY SYSTEMS</p>	
Elemental Analyzer with complete accessories Brand/Model: Perkin Elmer CHNS(O) Specification: Perkin Elmer 2400 Series II	<p>The 2400 Series II offers multiple analysis modes and fast analysis times. Modes Time (Minutes) CHN 6 CHNS 8 Oxygen 4 Productivity and precision are your partners with the 2400 Series II. User-selected calibration procedures of single-standard calibration (multiple linear regression) offer the user increased precision throughout the broad analysis range of the 2400 Series II.</p> <p>Uses: For determination of elemental composition of Organic Liquids</p>
Oxygen Bomb Calorimeter Brand/model: CAL3K-F CALORIMETER WITH MANUAL OXYGENCAL3K- AP Specification: 3K- F - CAL3K-F BOMB CALORIMETER SYSTEM.	<p>Uses: For determination of Heating value of fuels. The CAL3K-A Oxygen Bomb Calorimeter System can be used with most applications including such as Coal Analysis, Fuel Analysis, Alternative Energy, Waste Analysis, Animal Feed Research, University Research, Food/Nutrition Analysis, Explosives Analysis, Coal Analysis, Oil Analysis, and other traditional and non-traditional applications.</p>

4.0 Conclusions

The committee concluded that the center should prioritize the characterization of advanced materials, given the scarcity of this facility in the region and the difficulties faced by partners to send their jobs overseas for testing. They recommended the following equipment to the center and requested experts or vendors to submit proposals.

LIST OF EQUIPMENT WITH INVIOCES

EQUIPMENT	COST	COMPANY
AA6000 mini Desktop Scanning Electron Microscope	\$109,780.00	www.angstrom-advanced.com
EDS	\$60,500.00	www.angstrom-advanced.com
BSD, Back Scattered Electron Detector	\$19,800.00	www.angstrom-advanced.com
Stage Motorization (X/Y/R/T/Z)	\$4,950.00	www.angstrom-advanced.com
Ion Coater (pump included)	\$7,700.00	www.angstrom-advanced.com
Configuration Upgrade• 10x-200,000x• Feature of Compressed Gas AntiVibration• Tilted Holder 0°~60° (Max 90°)	\$10,450.00	www.angstrom-advanced.com
ADX8000 X-ray Diffraction Instrument	\$86,190.00	www.angstrom-advanced.com
ADCX Sample Changer	\$16,740.00	www.angstrom-advanced.com
Output Power Upgrade (1200W)	\$9,612.00	www.angstrom-advanced.com
ADX-9800 XRF Spectrometer Angstrom Advanced	\$68,500.00	www.angstrom-advanced.com
Vacuum System (Optional)• For the ability to test light elements of(Na) Sodium to (S) Sulfur.	\$2,500.00	www.angstrom-advanced.com
Automatic Sample Changer (Optional)• Interchangeable between	\$9,800.00	www.angstrom-

10 samples simultaneously.		advanced.com
7600 FTIR spectrometer	\$35,175.00	www.angstrom-advanced.com
ATR Attachment	\$9,100.00	www.angstrom-advanced.com
		www.angstrom-advanced.com
AAS machine		www.angstrom-advanced.com

TO: The Director General. March 16th 2023
 ACE-SPED,
 UNN (University of Nigeria, Nsukka)
 Nigeria.

QUOTATION No: LCN-Q-004-16-03-23 FOR LABORATORY INSTRUMENTS

SN	DESCRIPTION	UNIT COST(USD)	QTY	AMOUNT(USD)
1.0	<p>Analytical Technologies XRD Model: 3010 with X-ray tube Specification:</p> <ul style="list-style-type: none"> ○ Tube Type: Ceramic or glass tube are optional ○ Target: Cu, Fe, Co, Cr, Mo, Ti, W ○ Default : Cu ○ Focus size: 1×10mm ○ Power : 2KW X-ray Generator: <ul style="list-style-type: none"> ○ Tube voltage: 10-30KV or 10-40KV ○ Tube current : 5-20mA or 5-30mA ○ Filament current : DC 0-3A ○ Stability: ±0.001%, Voltage deviation 10% ○ Max power: 600W or 1200W Vertical Goniometer: <ul style="list-style-type: none"> ○ Radius: 150mm ○ Scan Type: $\theta/2\theta$ linkage ○ 2θ Scan range: -3° - 150° ○ 2θ Detecting range: $+2^{\circ}$ - 150° ○ Position Speed: $1000^{\circ}/\text{min}$ (2θ) ○ Scan Speed : 0.01 - $100^{\circ}/\text{min}$ ○ 2θ Min stepping : 0.0002° ○ Accuracy: 0.001° ○ 2θ Repeatability accuracy : 0.0005 Slit: <ul style="list-style-type: none"> ○ Divergent slit (DS) : θ shaft changeable slit (Max 4.2°) ○ Scatter slit (SS) : $0.5^{\circ}/1^{\circ}/2^{\circ}$ ○ Receiving slit (RS) : $0.1\text{mm}/0.2\text{mm}/0.3\text{mm}/0.4\text{mm}$ ○ Soller slit : $\pm 2.5^{\circ}$ ○ X-ray extraction angle: 6° ○ Proportional Detector (PC): ○ Max counting $1 \times 10^6 \text{cps/s}$; 	91,000.00	1 set	91,000.00

	<ul style="list-style-type: none"> ○ Spectrum resolution $\leq 20\%$; ○ Counter voltage 0-2100V; High-voltage stability above 0.005% ○ Cooling Water System: <ul style="list-style-type: none"> ○ Supply Power: 220V/50HZ ○ Flow: 3L/min ○ Pressure: 0.1Mpa-0.30.1Mpa ○ System temperature: 18-30°, control accuracy : $\pm 1^\circ$ ○ Control panel light : Power, Cooling, Flow indicator ○ Data Analysis Software Instruction: The system includes data ○ Collecting and application package, one is for data collecting while the other is for analysis. ○ Software ○ Data Collecting Software ○ Data Analysis 			
2.0	<p>Analytical Technologies Handheld Portable XRF 3005:</p> <p>Specification:</p> <ul style="list-style-type: none"> ○ Model: The 4th generation EDX analyzer-Genius XRF series. ○ Analysis method: Energy dispersive X-ray fluorescence analysis method. ○ Measuring range of elements: Mg to U. ○ Simultaneously detect elements: Simultaneously detect tens of elements. ○ Processor and RAM: CUP: 667MHz, RAM: 256M, Maximum expanded storage: 32G, Standard configuration: 2G, can store large amounts of data. ○ Content range: ppm \sim 99.99%. ○ Testing time: 3-30 seconds. ○ GPS 、 WIFI: Built-in system. ○ Battery time: Lithium battery, which can be charged, with maximum capacity of 7800mAh, can continuously work for 8 hours; Equipped with wide voltage (110V-220V) general adapter, can work under alternating current. ○ Testing object: Solid, liquid, powder. ○ Detector: 25mm \times 0.3mil, SDD detector. ○ Detector resolution: Lowest resolution can be 139eV. ○ Excitation source: 40KV/100uA-Ag anode window miniature X light tube and high voltage source. ○ Collimator and filter: Collimator of 4.0 or 2.0 diameter, automatic switch of 6 types filter groups. 12 kinds of groups, world's most compound mode, can satisfy various kinds of samples testing. ○ Screen: TFT-LCD touch screen, resolution 640*480. ○ Detection limit: Lowest detection limit accounts to ppm level. ○ Testing window: 12mm.20.Safety: Self-contained password manager mode. ○ Gas charging system: Helium charging at ordinary pressure system. 	32,600.00	1 set	32,600.00

	<ul style="list-style-type: none"> ○ Data transmission: Digital multi-channel technology, SPI data transmission, quick analysis, high counting rate, waterproof miniature USB, which can be connected to desktop computer ○ PC Control software ○ PC/21 Inch Monitor/Printer ○ Humidity: ≤90%. 			
3.0	<p>Analytical Technologies Scanning Electron Microscope (Model: 3000)</p> <p>Resolution :</p> <ul style="list-style-type: none"> ○ 5.0nm (30KV, SE Image) ○ W (Tungsten), Pre-Align Cartridge Filament <p>Magnification:</p> <ul style="list-style-type: none"> ○ x15 ~ x150,000 (Free scale Magnification) ○ Effective Magnification : x80,000 <p>Detector:</p> <ul style="list-style-type: none"> ○ Secondary Electron Detector ○ Accelerating Voltage : 1 to 30kV <p>Lens System</p> <ul style="list-style-type: none"> ○ 2 Step Condenser lens ○ 1 Step Objective lens <p>Objective Aperture:</p> <ul style="list-style-type: none"> ○ 4 Levels Variable Aperture ○ 30um, 50um, 50um, 100um <p>Image Shift: 1. +/- 25um</p> <ul style="list-style-type: none"> ○ Stage : 1. X (35mm), Y (35mm), T (0 ~ 45°) ○ Auto Step Motor Stage ○ Beam Rotation (360°), Z (5 ~ 50mm) ○ Manual Stage <p>Specimen :</p> <ul style="list-style-type: none"> ○ Standard Stub Φ30-9mm / MC30-1218-A ○ Tilted Sutb Φ : 0(90°&45°) / MC30-1313-A <p>Scanning Mode:</p> <ul style="list-style-type: none"> ○ Focus Mode (160 x 120 pixels) ○ Reduced Mode (320 x 240 pixels) ○ TV Mode (640 x 480 pixels) ○ Slow Screen Scan Mode (800 x 600 pixels) ○ Photo Screen Capture Mode I (1280 x 960 pixels) ○ Photo Screen Capture Mode II (2560 x 1920 pixels) ○ Photo Screen Capture Mode III (5120 x 3840 pixels) <p>Navigation CAM :</p> <ul style="list-style-type: none"> ○ Take the sample image for reference of location <p>Image Format</p> <ul style="list-style-type: none"> ○ JPG, TIFF, BMP, PNG <p>Image Display</p> <ul style="list-style-type: none"> ○ 27" FHD Monitor x 1set (For the case EM-30 is selected.) <p>Convenient Function :</p> <ul style="list-style-type: none"> ○ Auto Filament Saturation ○ Auto Focus ○ Auto Contrast/Brightness ○ Line Profile measure ○ SE+BSE Image Merge 	2,030,000.00	1 set	2,030,000.00

	<ul style="list-style-type: none"> ○ SE/BSE Image Split Working Distance: ○ Max height : 5 ~ 50mm ○ General height : 7~25mm ○ Use by special holder Vacuum System : ○ Fully Automation ○ Roughing : Rotary Pump ○ High Vacuum : Turbo Molecular Pump Control System : ○ PC Controlled by USB ○ i5 Processor, 8gb RAM ○ S/W Measuring Functions : ○ Length, Angle, Area, Panorama(Ver 1.0) ○ s. Power : ○ AC220V or AC110V +/-10%, 50/60Hz, 1.5kVA ○ 3kVA with EDS Equipment Configuration : ○ Gun Unit ○ Column Unit ○ Condenser and Object Lens Module ○ Chamber Unit ○ Detector and Stage Module ○ Vacuum Unit ○ Rotary Pump(100L/min) and TMP(80L/sec) ○ Control Unit ○ Board Unit ○ Image part and Vacuum Part ○ High Voltage Power Supply ○ Detail Description Ext. Price Spare Parts : ○ Tungsten Filament & Cartridge ○ EM Holder set ○ Carbon Tape and Silver Paste ○ Wrench ○ Blower ○ Driver ○ User Manual ○ Carrier Box accessories & tools included <u>EDS (Electronic Data Systems):</u> ○ Tru-Q Analysis Engine: Accurate Result By Multi Algorithm. ○ Multilingual Operation. ○ Fast & Easy Analysis With Functions: Point & ID, Line Scan ○ Mapping, Line Overlap & Background Correction. ○ Quantitative Mapping (Quant-lineScan, QuantMap). ○ Highest Performance SDD. ○ Sensor Size: 300mm². ○ High quality Light Element Analysis: Be(4)~Am(95). ○ Diverse Element Analysis Functions: Point&ID Line Scan, ○ Mapping. 			
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	<ul style="list-style-type: none"> ○ PC Control software ○ PC with dual monitor ○ UPS 6KVA 			
4.0	<p>Analytical Technologies FTIR Spectrophotometer model FTIR 3000A</p> <p>Analysis range 7800-375 wavenumber. Supplied complete with the following accessories;</p> <ul style="list-style-type: none"> ○ Standard spectral Library ○ Solid sampling analysis accessories ○ Demountable cell with KBR window cell ○ Demountable cell with NaCl window cell ○ ATR analysis accessory ○ PC with 21 inch monitor/1.5 KVA UPS and printer ○ PC control software 	37,800.00	1 set	37,800.00
5.0	<p>Analytical Technologies Atomic Absorption Spectrophotometer model AD 2800 Flame only configuration with fully Automatic sample introduction</p> <p>Supplied complete with the following;</p> <ul style="list-style-type: none"> ○ 20 sets of Hollow Cathode Lamp with 1,000 ppm calibration standard solution ○ Air acetylene burner head ○ Nitrous Oxide Acetylene Burner head ○ HP Printer/ Blue gate 4.0 KVA UPS ○ Acetylene cylinder, gas and regulator ○ Nitrous-Oxide cylinder, gas and regulator ○ Fume extractor 	29,645.00	1 set	29,645.00
6.0	Biodiesel simulator			No offer
	<p>Analytical Technologies Bomb Calorimeter (BCal3015 Series)</p> <p>Specification:</p> <ul style="list-style-type: none"> ○ Analysis Time (min) : 11 min ○ Precision : <0.1%RSD ○ Jacket Type : Isoperibol ○ Gas Requirement : Oxygen (99.5% purity) ○ Water Requirement : Distilled water ○ Bomb Identification : Automatic ○ Heat capacity Stability : ≤0.20% within three month ○ Max Power : 1.5kw ○ Bucket Fill : Automatic 	30,800.00	1 set	30,800.00
4.0	<p>Analytical Technologies Muffle Furnace GMP Model (Model: 3000series)</p> <p>Features:</p> <ul style="list-style-type: none"> ○ Sturdy construction for long term use : Compact in design and space saving ○ Available with 800°C to 1800°C temperature : Safe and trouble free performance ○ Microprocessor PID controller : Over temperature and short circuit breaker ○ High ceramic fiber blanket and board insulation : Ventilation or chimney at the back ○ Only branded heating elements are used : Uniform heating inside chamber ○ CE and ISO marked : Comply to DIN and ASTM 	8,400.00	1 set	8,400.00

	standards o Volume 13 litres			
5.0	Analytical Technologies Atmospheric Control furnace, model BOX-1400Q o Heating element SiC heating element o Max. heating rate 15°C/min o Temperature departure $\leq 2^{\circ}\text{C}$ o Thermocouple S type o Voltage AC 110V/220V/380V, 50/60Hz, o Temperature control 50 programmable and PID automatic control o With ports for connection of Nitrogen, argon and inert gases o Volume 13 Litres	8,400.00	1 set	8,400.00
6.0	Analytical Technologies Sieve Shaker o Operating voltage: 230 V, 50 Hz order 110 V 60Hz o Time switch: 0-99 minutes - digital o Revolution/ min: 278 10 o Taps per min: 150 5 o Sound emission: 86 dB8 o Supplied complete with 6 sieves, receiving pan and collector.	7,700.00	1 set	7,700.00
7.0	Analytical Technologies Dual Combustion Furnace Infrared Carbon, Nitrogen, Hydrogen & Sulphur Analyzer (Model: 3300) with four chamber infra-red detection. o Supplied complete with the following; o Carrier Gas: Oxygen 99.5%, 3L/min(Cylinder, Regulator and installation piping) o Power Gas: Nitrogen gas (Cylinder, Regulator and installation piping) o Chemical Reagent: Magnesium perchlorate,CO2 absorbent o Standard Reference material o PC Control software o PC/Printer/21 Inch monitor/6KVA Blue gate UPS	55,600.00	1 set	55,600.00
8.0	Analytical Technologies drying oven model FD-110 with digital control. Volume 110L, Temperature range Ambient to 300°C	6,220.00	1 set	6,220.00
8.1	Analytical Technologies Multiple Gas Analyzer (Model: MGA 3200) Specification: o Type : Rack / panel mount o Detectable gases / parameters : Toxic, Combustible, O2, CO, CO2, SO2, HF, HCL, CL2, NO, CNG, CH4, H2, H2S, NH3, HCN, o3. o Electronics / processor : Micro-controller o Technology : 1. Sensor Specific (Electrochemical/TCD/PID) o 2. UV Photometry Technology o 3. Infra-red Technology o Resolution : 1 mg/m3, 1 PPM, 1% V/V, application defined o Accuracy : $\pm 0.5\%$ FS o Response time : less than 30 sec, sensor dependent	13,720.00	1 set	13,720.00

	<ul style="list-style-type: none"> ○ Operating temperature : 0 - 55 °C ○ Sampling / input: Direct plug-in through sampling system / 4 -20 mA 			
	SUB-TOTAL			2,351,885.00
	Freight, clearing and custom duties charges			20,000.00
	Installation, Commissioning and Operational charges			35,400.00
	SUB-TOTAL			2,387,285.00
	VAT@ 7.5%			179,046.00
	GRAND TOTAL			2,566,331.00

ACCOUNT DETAILS

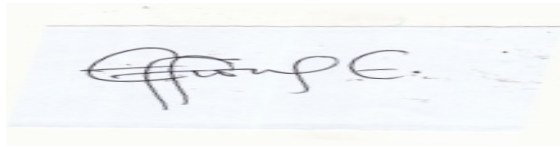
Leedex and company Nigeria Ltd

Acc/No: USD 0052828367

Union Bank Plc

OFFER/DELIVERY AND PAYMENT DETAILS

1. Within 8-10 weeks after receipt of LPO
2. Order will attract 80% advance payment with order and balance minimum of 14 days after successful delivery and Installation completion.
3. Offer valid for acceptance up till 30th of March 2023 and subject to review thereafter



Manager (Sales)