Technical Specifications

Jos Electricity Distribution Plc.

REVISED TECHNICAL SPECIFICATION OF SINGLE-PHASE AND THREE-PHASE SMART PREPAID METERS

1.0   GENERAL

This Technical Specification is a summary of the minimum requirement for the design, manufacturing, testing, and supply of single-phase and three-phase alternating current (AC) Smart Prepaid Meters with Time of Day (TOD) and Real Time Clock (RTC) provisions.

It is not the intent to specify completely herein all the details of the design and construction of the meter. However, the meter shall conform in all respects to high standards of engineering, design, and workmanship and shall be capable of performing in continuous operation up to the supplier's guarantee in a manner acceptable to the purchaser, who will interpret the meanings of drawings and specification and shall have the power to reject the meter in his judgment, if not in accordance therewith.

The meter shall be designed and constructed in such a way as to avoid introducing any danger under normal operating conditions to ensure:

- ·   Personal safety against electric shock
- ·   Personal safety against the effects of excessive heat
- ·   Protection against ingress of dust moisture and vermin.
- ·   Protection against the spread of fire.

The Bidder shall give documentary evidence of conformity of the supplies and works to the technical specification and submit with the Bid the following in the English language:

- ·   A detailed description of supply essential technical and performance characteristics guaranteed by the manufacturer as requested in the Technical Guarantee Schedule with appropriate drawings and type test certificates.
- ·   Technical documents to support all materials described herewith and that proposed by the Bidder. The documents shall be comprehensive and be evidenced that the materials conform to the required specifications.
- ·   Work implementation schedule in days

The Bidder should supply the following technical documents

- Description of the operation of the meter
- Complete circuit diagram
- Component layout drawings

The Meters and the User Interface shall be clearly marked in **BLACK COLOUR** with the following:

i. "Tampering with Energy meters is a crime under the laws of the Federal Republic of Nigeria"
ii. Visible Unique meter number
iii. Serial number
iv. Meter model
v. Meter variant
vi. Manufacturer's trade name or trademark or both
vii. JED PLC logo
viii. "Property of JEDC" as may apply to individual Disco
ix. Meter Accuracy class index
x. Rated voltage and current
xi. Year of manufacture
xii. Specification standard
xiii. Overall mass
xiv. "Tested" sticker

The meter supply shall be disconnected under the following conditions;

- When the credit balance in the meter reached Zero;
- When tamper condition is detected;
- When the set power limit is exceeded;
- When the programmed current overload limit is exceeded;
- When the under-voltage limit is exceeded;
- When the over-voltage limit is exceeded;
- Due to abnormal terminal temperature;
- During reverse power flow mode

There should be a provision to enable customers to borrow credit once-only of not more than 10 units for the Single Phase and 15 units for the Three Phase.

The Meter should be able to operate in both Pre-paid and Postpaid mode.

The Meter should have a GPS module integrated into them to enable us to geolocate and geofence them.

The Meter Should have a Test Tripping function to ascertain the functionality of the relay.

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The Meter should have a Last Gasp 1st breath feature to enable the meter to send a signal to the HES during Power failure for outage monitoring and management.

The Meter should have a dynamic Password generated only for authorized personnel to assess the meter.

The meter should have an Over-The-Air remote updates feature to keep the meter up to date with the latest functions.

Additionally, all meters must be supplied with manufacturer documentation showing:

1. OBIS Code implementation
2. Ciphering and any authentication methods
3. Meter configuration utility with GPRS
4. Modem configuration tool

1.1   STANDARDS APPLICABLE

Unless otherwise specified elsewhere in this specification, the performance and testing of the prepaid meters shall conform to the following International Standards including all parts of the standards, and all related international standards to conform to up-to-date and latest amendments/revisions thereof.

S/No	Standard No.	Title
1	IEC 60060	HV test techniques
2	IEC 60068	Shock and vibration withstand
3	IEC 60387	Marking symbols for kWh meters
4	IEC 60529	Degree of protection provided by enclosures (IP51)
	IEC 60695	Resistance to heat and fire
5	IEC 61036	AC static Watt-hour meter for active energy class 1&2
6	IEC 62052	Electricity metering equipment (a.c)-General requirements and tests
7	IEC 62053	Electricity metering equipment (a.c)- static Watt-hour meter for active energy class 1&2
	IEC 62054-21	Electricity metering (a.c)- Tariff & Load Control- Part 21: particular requirements for time switches
	IEC 62055-41 (2018)	Standard Transfer Specification (STS), specifying the application layer protocol for transferring units
8	IEC 62056-41	Electricity metering Data Exchange for meter reading tariff and load control. Data Exchange using WAN, PSTN, with LlINK + Protocol

9	IEC 62056-21	Electricity metering Data Exchange for a meter reading tariff and load control, Application for larger control
10	IEC 62056-61	Electricity metering Data Exchange for meter reading tariff and load control- part 61: object identification system OBIS for G, H, sW, meters OBIS codes are specified in EN 13757-1 (CEN TC 294), Interface objects are common.
	NERC/Reg/4/2017	Nigerian Electricity Smart Metering Regulation

The Encryption Algorithm shall be in Standard Transfer Specification (STS) as per the latest version of IEC 62055. The 3rd Edition is STS 6. B default STS SGC 999014.

1.1.1 Integration to Advanced Metering Infrastructure (AMI)

JEDC maintains a single HES to which all compliant meters will be integrated. Therefore, the supplier shall provide APIs and means of integrating meters into the existing HES based on the DLMS/COSEM and OBIS code standards, including the output of Compliance Test Tool (CTT).

1.2 SERVICE CONDITIONS

The service conditions indicated below shall be taken into consideration for the design of the equipment.

| No. | Description | Requirements | |
		Unit	Data
1	Maximum Ambient Temperature	°C	Up to 40
2	Minimum Ambient Temperature	°C	+12
3	Annual average temperature	°C	+25.9
4	Maximum ground temperature	°C	+30.3
5	Maximum solar radiation	(W/m2)	1200
6	Soil temperature at 0,50 – 1,00 m depth	°C	+35
7	The altitude of the site above sea level	M	<1000
8	Relative Humidity (max at 35ºC)		
	Maximum	%	100
	Average	%	80
10	Seismic condition		
	Richter's (Earthquake) Magnitude Scale	-	6

	Maximum peak ground acceleration	g	0.2
11	Maximum Velocity of wind	m/s	40
12	Average annual rainfall		
	Maximum	mm	1700
	Minimum	mm	800
	Average Isokeraunic level	-	70

1.3 SEALING OF METER

The fundamental purpose of sealing electrical energy meters is to ensure and secure that the metering measurement mechanisms are restricted access.

The meter seal shall have a steel wire and a Polycarbonate body. The terminal cover of the input and output conductors of the meter shall be sealed. The diameters of the sealing holes shall not be less than 2.0 mm.

1.4 MECHANICAL REQUIREMENTS

Meters shall be designed and constructed in such a way as to avoid danger in use to ensure in particular personal safety against electric shock and the effects of excessive temperatures, protection against fire propagation, and protection against penetration of solid objects, Dust, water, and spread of fire in compliance with **IP65.**

All parts subject to corrosion must be properly protected. Any protective coating shall not be liable to damage by normal handling or damage caused by exposure to ambient air. Meters must be able to withstand solar radiation without significantly degrading the materials.

1.5 BASE

The Meter Base must be of rigid construction, and must not have screws, rivets, or fixtures of internal parts that can be removed without breaching the meter cover seals.

The Base must have a device to support the meter and one or more holes in the bottom for its fastening, located to prevent removal of the counter without tampering with the terminal block cover.

1.5.1   COVER

The cover must be transparent and constructed/adjusted in such a way as to ensure the correct functioning of the meter, even in case of non-permanent deformation. The transparent cover shall also have a transparent window to read the meter display and observe the operation indicators.

It should be impossible to remove the displays without damaging the cover or breaking any of the seals.

1.5.2 TERMINALS

The meter's current terminals shall be provided with two screws to ensure secure and permanent attachment of conductors from 4 mm2 to 35 mm2 for single-phase meters and from 4 mm2 to 50 mm2 for Three-phase meters until 120,0 A.

The terminals shall not be capable of being displaced into the meter, irrespective of the fastening screws of the connecting cables.

1.6 DESIGN CHARACTERISTICS AND FEATURES

The meter's Technical Specification is as shown below:
1.

2. TECHNICAL GUARANTEE TABLE FOR SMART 1-PHASE AND 3-PHASE METERS (CATEGORY 1)

TECHNICAL SPECIFICATION FOR SMART 1-PHASE AND 3-PHASE METERS (CATEGORY 1)			
S/No.	**ITEM/ DESCRIPTION**	**JEDC REQUIREMENT (NERC METERING CODE/NESMR)**	**VENDORS'S GUARANTEE**
1	Nominal Voltage	1Ø-230V, 1-ph, 2-wire system,	
		3Ø- 230/400V, 3-ph, 4-wire system (balanced and unbalanced load conditions)	
2	Operating Voltage	-40% to +10% Nominal Voltage	
		-40% to +10% Nominal Voltage	
3	Current Rating	5(60)A – Single Phase	
		3 X5(100)A – Three Phase	
4	Frequency	50 ±2%Hz	
5	Accuracy Class	Class 1 (Applicable IEC Standards as in Section 7.1.3 of the Nigerian Electricity Smart Metering Regulation 2015)	
6	Encryption Algorithm for PPM	Standard Transfer Specification (STS6)	
7	Operating Temp.	from -40°C to 70°C	
8	Storage Temp.	Up to 70°C	
9	Relative Humidity	95% at 45oC non-condensing	
10.	Maximum KWH credit stored	99,999.9 kWh(1Ø), 999,999.9KWh(3Ø)	
11.	Credit transfer number	20 Digits encryption	
12.	Protection	High resistance to short circuit	
13.	Impulse withstand voltage	6 KV	

14.	Insulation withstand voltage	2 KV per minute	
15.	Nameplate	a) Indelible Meter serial number shall be eleven (11) digits and legibly printed. (Provisions of the Metering Code shall be maintained)	
		b) The size of the digit of the Meter serial number shall be a minimum of 5mm x 3mm.	
		c) Bar code shall be printed below the Meter serial number	
		d) Manufacturer's name and Trademark.	
		e) Place of manufacture.	
		f) Year of manufacture.	
		g) Reference Voltage, Current, and frequency.	
		h) Class index.	
		i) Meter Constant.	
		j) Owner/Utility's Identity.	
16.	Front panel Indication/Display	Include but not limited to the following:	
		Three-level credit LED display	
		Green-when energy stored is full	
		Yellow-when remaining credit will last for 3 days.	
		The red flashes when the remaining energy will last for 11/2 days.	
		Blue/Amber Consumption rate indicator. LCD credit status display.	
		Credit transfer number accept/reject	

		Tamper.	
17.a.	Meter display	Display up to 3 parameters in auto-scroll mode: The parameters will be visible for 5 seconds each before the next one is shown	
		- Display test - Relay Status - Meter Serial Number - kWh cumulative - kW instantaneous - Instantaneous Current - Instantaneous Voltage - Power Factor	
17. b.	Special Mode Display for Engineering / Management		
		Display up to 3 parameters according to programming to be specified:	
		a. Normal display – LCD	
		i. Duplicate copy of token inserted	
		ii. Credit Dispensing Unit identification number and KWh (or voucher serial number) inserted.	
		iii. Electricity Dispenser (LED) full of units.	
		iv. Power ON LED	
		v. No credit on LED	
		vi. Credit rejects or accepts.	
		vii. Remaining Credit.	
		viii. Instantaneous Power	
		ix. Total KWh used in the past 24 hrs.	
		x. Total KWh used in the past 30 days.	
		xi. Total KWh used since the LED was	

		installed.	
		b. Display only available with valid codes.	
		c. Display only available within chosen programming or engineering mode.	
		d. Last Token Inserted	
	Configuration Software	For these specifications, items b) and c) above are treated as one. These shall be accessible only to utility staff through a secure mechanism. (Configuration Software shall be accessed through the Optical Port/Remote medium)	
		a.　　Over current trip level.	
		b.　　Green-yellow light emitting diode (LED) display change over the KWh (high) level.	
		c.　　Yellow-Red LED display change over the level in KWh (low).	
		d.　　Test on LED for tripping function.	
		e.　　Display of LED number.	
		f.　　Electronics faulty.	
		g.　　Power failure counter (Number of times power supply failed or disconnected)-400 cycles and back to Zero.	
		h.　　Enabling of disabled LED caused by tampering.	
		i.　　Number of days/hours into the current 30 days when power and total KWh were used during the period.	
		Historical Value minimum 6 months KWh	
		Users interface unit. Wire or wireless	

		BS Meter Standard type P N N P for 1Ø	
		Communication protocol as per IEC Standard 6256-21	
		The meter should have its keypad for token entry	
		The Meter should support a split-type Keypad with UIU	
18.	EMC Compliance	The relevant section of IEC 62052-11:2003 & 62053-21:2003	
19.	Burden	Preferably less than 2 VA per phase (without the burden of the communications module).	
20.	Terminals	Extended cover type. The hole diameter shall be between 8.5mm-9mm	
21.	Casing/Cover Material	Fire retardant- Bakelite or polycarbonate material Transparent polycarbonate material	
22.	Sealing	Provision must be adequate to prevent tampering. Seals on either side of the meter/Ultrasonic sealing/Chemical bounding Terminal Cover: One sealing provision shall be provided at the meter terminal cover	
23.	Power Factor Range	-1 to +1	
24.	Data Storage	Non-volatile EPROM with a minimum of 16MB	
25.	Switching	Latching contactor.	
26.	EMC Susceptibility	According to IEC 62052-11:2003 & 62053-23:2003. Not adversely affected by external magnetic fields.	

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27.	Life Span of Meter	Minimum 10 years	
	Life Span of UIU	Minimum 5 years	
28	Meter type	1Ø 1-Ph, 2-Wire System. CT on Neutral line measurement 3Ø 3- Ph, 4 Wire System	
29	Measurement	1Ø 1-ph, 2-wire system,3Ø 3- ph, 4 wire system and neutral current measurement	
30	Disconnection relay	Maximum switching voltage: 400V AC Maximum switching current: Single Phase – 90A Three Phase - 120A Maximum switching power: Single Phase – 13KVA Three Phase - 45KVA The utilization category of the relay shall be UC1 for single-phase and UC3 for three-phase meters.	
31	Battery	• Internal and external lithium battery life span 10 years minimum • External backup: Easily replaceable and accessible only after breaking the seal	
32	Environmental	• Specified operating range: -25ºC to +65ºC • Operating range limit: -40ºC to +80ºC • Storage range limit: -40ºC to +85ºC • Relative humidity: Up to 85% mean, 95% non-condensing for 30 days • Ingress protection: Transparent IP65 casing (Outdoor)	
Communication Specifications (Smart features)			
The meter will record data in its Non-Volatile memory with a time/date stamp and an activity indicator LED shall be provided on the front of the meter.			

33	Communication interface	Optical as per IEC62056-21, supporting DLMS/COSEM protocol capable of transferring data with provenance via the Conformance Test Tool (CTT) documentation and/or Golden Tool certification for the IP4 Transport Layer. (**All meters shall be smart with prepaid/postpaid modes**) Minimum support for following as per DLMS / COSEM to enable integration of meter to HES uniformly across meter types 1) Profiles Nameplate, block load, daily load, billing, and instantaneous including events and alarms such as tampers 2) Firmware upgrade over the communication link using DLMS image transfer 3) Remote configuration of the meter	
34	Remote Communication interface	The Meter Shall be able to communicate with the Head-end system in either of the following ways – 1) Meter to HES using 4G NIC 2) Meter to DCU using RF (WI-Sun FAN) / PLC (G3) and then DCU to HES using 4G	In terms of the RF / PLC technologies, it should be ensured that no proprietary solutions are proposed and only those conforming to widely accepted industry standards should be tendered. For example, RF – is based on WI-Sun FAN, and PLC – is based on the G3 alliance.
35	Midnight Energy Snapshot	Capable of recording and storing midnight snapshots of kWh, for a minimum of 30 days andtransferring same on demand and as per predetermined schedule to HES.	
36	Interval data recording	30 minutes with 3 voltages, current, and power factor readings	
37	Billing History	Current month + minimum last 6 months	

		billing data	
38	Event recording	The meter shall have the facility to download using both optical ports and via remote communication capability (HHD) with date and time stamp. Following events to be recorded: **(Vendor shall provide Meter Configuration in Software with unlimited License)**	The HHD should have the capacity to read 10,000 meters within a radius of 150 meters.
	Event recording - Alarmsare stored in event logs	Specify 25 events per category of event type. Meter shall log a minimum of 225 tamper events, compartment-wise division of each event and their persistence time shall be indicated, with the facility to download using both optical ports, HHD, and via 4G/PLC with the date and time stamp. The following are compulsory events to berecorded: a) Terminal Cover open b) Partial meter Bypass c) Phase reversal d) Phase missing e) Neutral disturbance f) Magnetic disturbance g) Current reversal or short or open h) Current unbalance i) Low power factor j) Power On/Off Phase wise outage h) Phase sequence reversal	The logic and threshold values for tamper detection will be frozen by DISCOs at the contract stage before delivery. The HHD should possess the capability to read 10,000 meters within a radius of 150 meters.
	Additional Tamper Events & Meter Behavior applicable for Single Phase Meter	a) Phase & neutral interchanged - Meter shallrecord forward energy b) In-coming(I/C) & Outgoing (O/G) interchanged - Meter shall record forwardenergy c) I/C neutral disconnected, neutral of loadconnected to the earth - Meter shall open the relays to disconnect the load.	

		I/C neutral disconnected, I/C phase connected to neutral, neutral of load connectedto the earth - Meter shall open the relays to disconnect the load.	
39	Remote connection-disconnection	Relay for remote load connection or disconnection with date and time stamp. Visual indication (Relay on/off) is to be provided on the display unit.	
40	Remote load control features	Feature to set threshold values to control the load (overload Limit) of customers if demand is exceeded (Set by STS6 Token)	
41	Other remote functions	• Remote reading (Read by Modem) • Remote crediting (Set by STS6 Token with online transfer mechanism) • Acquire Meter profile/configuration data • Remote configuration of meters and DCUs. • Read meters according to pre-defined schedule or on-demand • Automatic re-reading of meters to acquire missed data • Remote disconnection/reconnection of energy supply • Upgrade meter firmware remotely	
42	Tariff Management	TOD billing and updates to tariffs should be possible to configure in the meters.	
43	Measured values	• Import/Export/Absolute: Wh, VArh and VAh • Per quadrant Wh, VArh and VAh • Power: W, VAr, VA, Vrms, Irms • 3 Power factors, 3 currents, 3 voltages frequency, phase sequence	

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44	Monitoring of the supplyMeter to be able to detect and record the following: • Variation in voltage • Variation in frequency • System imbalance	Monitoring of supply Meter to be able to detect and record thefollowing: • Variation in voltage • Variation in frequency • System imbalance • No-load situation	
45	Terminal Connection Configuration	Ph-N, N-Ph (Symmetrical Single PhaseTerminal Configuration) PhR1- PhR2, PhY1- PhY2, PhB1- PhB2, N- N (Asymmetrical Three-Phase Terminal Configuration	
Communication Technologies & HES Application			
46	Single Phase PPM	i) 4G for Stand-alone meter to HES communications. i) Meter in cluster to DCU through RF/ PLC and then DCU to HES using 4G communications	
		Meter to Handheld Unit (HHU using optical port/remote medium. The HHU data should be possible to upload to HES)	
47	Three Phase PPM	i) 4G for Stand-alone meter to HES communications i) Meter in cluster to DCU throughRF / PLC and then DCU to HES using 4G communications	
		Meter to Handheld Unit (HHU) using optical port/remote medium. The HHU data should be possible to upload to HES	
48	HES	Servers deployed in a multi-tiered	

		environment	
		• Communication server for connecting to Meters	
		• Application server	
		• Database server deployed in a multi-tiered environment	
		• Meters and Data Concentrators should be connected to the HES via APNs	
		• HES application server must be web-based, with a W3C-compliant web browser supporting HTTP and HTTPS over TCPIP	
		• The HES system must expose open interfaces for data exchange with Disco's Meter Data Management System (MDMS)	
		Working on both communication options i.e. 1. Meter to HES directly through 4G 2. Meterto DCU through RF / PLC, and then DCU to HES system through 4G	
49	Data Concentrator Unit	The DCU should be capable of operating within up to a 500-meter distance. However, the utility shall pay for the actual number of DCUs deployed based on consumer density.	
50	Communication	4G with fallback capability to 2G The Meter must have the capability for modem replacement/upgrade	
51	Standard Transfer Specification (STS)	Minimum STS Version 6 (IEC 62055) with all meters following the same encryption methodology.	

52	Communication interface - as per 62056-21 (DLMS / COSEM protocol)	Minimum support for following as per DLMS / COSEM to enable integration of meter to HES uniformly across meter types 1) Profiles – Nameplate, block load, daily load, billing, and instantaneous including events and alarms such as tampers 2) Firmware upgrade over the communication link using DLMS image transfer 3) Configuration of meters	
53	Remote Communication Interface - To support 4G.	4G with fallback capability to 2G Bidder shall ensure the offered system (meter, communications, HES) can achieve a service level capability of the system to gather >98% of the daily data averaged over the calendar month	
54	HES system must expose open interfaces for data exchange with Disco's Meter Data Management System (MDMS)	HES must be OPEN interfaces/Web Services as per IEC 61968.	
55	User Interface Unit (UIU)	Each meter shall have a provision to connect to a UIU with a friendly display and keypad installed in a convenient location inside the customer's premises to enter credit and view the remaining credit balance. The keypad shall display all the parameters as the meter displays and have a buzzer for alarm.	

		The UIU shall be paired securely with a specific meter using a process that can be applied by the utility/installation engineer only. The consumer should not be able to change this pairing once done.	
		The UIU shall have a buzzer that will indicate to the user if any warning is there for "Low Credit", "High Load" etc. UIU shall have features for the user to turn off the buzzer after hearing the buzzer.	
		The UIU needs to be powered through electricity mains with a battery backup	
		Split meter shall communicate with UIU over PLC(G3) / RF.	

		The following displays will be available –
		· Tariff details
		· Meter relay status
		· Load limit setting
		· Consumption (kWh & Naira) for
		   o Last day
		   o Last week
		   o Last month
		· Display maximum load occurrence
		· Display instantaneous Load
		· Additional for Prepay customers
		· Current credit available
		· Emergency credit enabled / disabled
		· Outstanding debt (Time and payment based)
		· Last 5 tokens entered
		· Display test	

Additional requirements			
56	Warranty	All meters, communication equipment, and UIUs shall carry a warranty of 5 years from the date of supply to the DISCO	

57	Expected Life	All meters, communication equipment, and UIUs shall have an expected life of 10 years. Vendor to provide test reports from independent test houses in support of the expected life	

INSPECTIONS AND TESTS

2.1 GENERAL

The tests specified herein for electricity meters comprise three categories i.e. type tests, routine tests, and factory acceptance tests (FAT) as detailed below. These tests shall be performed by their latest IEC 62052 standards (as a minimum requirement).

Tests shall be carried out to ensure the function and safety of the electricity meters and to confirm the technical data sheets and other design data as well as safe operation over its life duration.

Tests shall be carried out on the completed in accordance with IEC 62052 unless otherwise stated below. Where test methods are not defined by standards, or there is a choice of standards, the Contractor shall submit to the Purchaser the methodology of the tests, by which he proposes to perform tests.
The Purchaser, however, reserves the right to witness any other tests as he deems necessary.

The electricity meters shall be subjected to inspections and acceptance tests to be performed at

the manufacturer's premises (recognized and certified at least by ISO 9001).

All test instruments, which will be used for the tests shall have certified, traceable accuracy and be subjected to periodic calibration, according to the rules given in ISO 9001. The certificate shall be reviewed by the Purchaser before starting the tests.

2.2 Type Test

The Bidder shall submit the type test reports and certificates from an accredited laboratory based on ISO / IEC Guide 25 / 17025 and the test reports submitted shall be of the tests conducted within the last 7 (seven) years before the date of bid opening. Offers without Type test certificates will be rejected.

Where type tests of the respective devices are already available, such tests can be omitted if the respective test certificate is presented. If any of the Type Tests Certificates submitted do not apply to the component or equipment offered, the Purchaser reserves the right to require re-testing or the inclusion of additional tests in the routine test program.

The following tests shall be carried out as a minimum requirement:

    2.2.1   Test of Insulation Properties
    2.2.2   Tests of Accuracy Requirements
    2.2.3   Test of Electrical Requirements
    2.2.4   Test for electromagnetic compatibility (EMC)
    2.2.5   Test of climatic influences

2.2.6   Tests of Mechanical Requirements
2.2.7   Test of resistance to heat and fire

2.3 Routine Tests

Routine tests shall be performed at the manufacturer's works on every electricity meter to be supplied.

Routine test certificates shall be submitted for the Purchaser's review/approval at least one (1) month before shipment.

The following tests shall be carried out on each board as a minimum requirement:

2.3.1   Test of Insulation Properties
2.3.2   Tests of Accuracy Requirements
2.3.3   Test of Electrical Requirements

2.4   Factory Acceptance Tests – FAT

The factory acceptance test (FAT) shall be performed once the manufacturing of the first **100,000 meters** is completed**.** Subsequent FATs will be conducted at an interval of **90,000 meters**. The FAT will be conducted at the manufacturer's premises and in the presence of the Purchaser and his representative.
The Bidder/Contractor is obligated to submit for approval the proposed Inspection and Test Plan at least two (2) months before testing.

The Inspection and Test Plan shall define the following:

2.4.1   Detailed test program (time schedule)
2.4.2   Detailed test procedures (approval criteria; record forms; test instruments)
2.4.3   Test Specifications

All the expenses related to the factory acceptance tests, including the participation of the Employer (two persons) shall be borne by the **Employer**. The expenses shall include the costs related to travel, visa (if applicable), full accommodation, daily allowances, and other expenses related to acquaintance with manufacturing.

If any of the test results of the FATs and routine test do not satisfy the Technical Specifications, the Employer **SHALL REJECT** the equipment and demand from the Contractor to replace this equipment for re-testing. The Contractor shall be responsible for all the expenses relating to the re-testing of the meters, including the participation of the Employer.

After successful completion of FAT, the Contractor shall submit the completed and signed

FAT records to the Purchaser. The results of factory tests shall be submitted in the approved report format of the manufacturer.

The following tests shall be carried out on each type of electricity meter as a minimum requirement:

2.1.1   Test of Insulation Properties
2.1.2   Tests of Accuracy Requirements
2.1.3   Test of Electrical Requirements
2.1.4   Tests of Mechanical Requirements
2.1.5   Vibration test
2.1.6   Shock test
2.1.7   Inter-terminal voltage test

REVIEW COMMITTEE MEMBERS

NAME	DESIGNATION	TITLE	SIGNATURE	DATE
Engr John O. Emeruwa	Head Regional Operations	Chairman		
Abdullahi H. Mohammed	Acting Chief Digital Officer	Member		
Engr Felix Shalzim	Head Metering	Member		
Mohammed Turaki	Acting Head Procurement/Chief HR & CS	Secretary		
Barrister Vershima Tiv	Acting Head Legal	Member		