वर्गीय आवश्यकताओं के लिए मानक

टीईसी ६६११०:२०२५

सं: टीईसी ६६११०: २०२४ को अधिक्रमित करता है

STANDARD FOR GENERIC REQUIREMENTS

TEC 66110:2025

(Supercede No. TEC 66110:2024)

एसएमपीएस बेस्ड पावर प्लांट

SMPS BASED POWER PLANTS

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली–110001,भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of the Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE) Policy
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located in New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document contains the generic requirements of Power Plants, based on High Frequency Switch Mode Techniques, using switching frequencies of 20KHz and above, for the use in Indian Telecom Network. The Power Plant as per this GR shall be compatible with VRLA battery and / or Li-ion battery. However, at any point of time VRLA & Li-ion battery cannot work simultaneously with the SMPS power plant. Purchaser may decide for power plant to be compatible with conventional Lead Acid batteries, if ordered. The power plant compatible with VRLA batteries and / or Li-ion battery shall be certified as "SMPS power plants compatible with VRLA and / or Li-ion battery" as applicable.

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HISTORY SHEET

Sl. No.	Standard/ Document *No.*	*Title*	*Remarks*
1	G/SMP-01/01 JUL 94	SMPS Based Power Plants	First issue
2	G/SMP-01/02 SEP 96	SMPS Based Power Plants	Second issue
3	G/SMP-01/03 MAR 97	SMPS Based Power Plants	Third issue
4	GR/SMP-01/04 FEB 2001	SMPS Based Power Plants	Fourth issue
5	GR/SMP-01/05 JAN 2005	SMPS Based Power Plants	Fifth issue
6	TEC/GR/FLA/SMP – 001/06/June.2010	SMPS Based Power Plants	Sixth issue: Clauses pertaining to surge protection devices for protecting the telecom site, have been separated from the GR. Changes in few parameters have been incorporated to accommodate advancement. All cases for certification shall be treated as fresh cases, and no incremental tests are recommended for renewal of type approval
7	TEC 66110:2017 (TEC/GR/FA/SMP –	SMPS Based Power Plants	Seventh issue: aligned with latest TEC template

	001/07/MAR-17)		in addition to made it compatible with Li-ion battery.
8	TEC 66110:2024	SMPS Based Power Plants	Eighth issue: aligned with latest TEC template in addition to make it compatible with RS232/RS245 and Ethernet in case of remote monitoring requirement.
9	TEC 66110:2025	SMPS Based Power Plants	Ninth issue: Changes in few parameters have been incorporated to accommodate advancement and for better clarity.

REFERENCES

S. No.	*Document No.*	*Title/Document Name*
1.	CISPR 32 (2015) with A1(2019)	Electromagnetic compatibility of multimedia equipment – Emission requirements.
2.	QM-115	Quality standard for calculation/verification of MTBF
3.	QM-118	Quality reliability in product design.
4.	QM-202	Pictorial guidelines for Visual assessment of quality of printed board assemblies (PBA) & discrete terminal assemblies.
5.	QM-204	Guidelines for workmanship standards for repair & modification of printed wiring board assemblies.
6.	QM-205	Guidelines for standard of workmanship for printed boards.
7.	QM-206	Guidelines for standard of workmanship for printed boards assemblies
8.	QM-207	Guidelines for soft solder and fluxes for Telecom Equipments.
9.	QM 210	Guidelines for standard of workmanship for surface Mounting Devices.
10.	TEC GR No.14016:2010 (Old no.QM-333)	Specification for Environmental Testing of Electronic Equipments for Transmission and Switching use.
11.	ITUT Rec. O.41	Psophomeric noise requirements.
12.	IS: 5	Standard on colours & shades.
13.	IS: 101	Methods of Sampling & Test for Paints, Varnishes & Related Products.
14.	IS: 168	Ready Mixed Paint, Air Drying, For General Purpose-Specification
15.	IS: 613	Standard on Bus-bars

16.	IS: 1248	Standard on Shunts.
17.	IS: 1359	Specification for Tinning requirements.
18.	IS: 1554 with Amend. - 1 (June 1994)	Standard for Cables & Wires.
19.	IS 10437(1986)	Safety requirements for radio transmitting equipment's" (equivalent to IEC 60215).
21.	ISO-9001-2000	Quality Management Systems Requirements.
22.	EN 61643 – 11 / A11	Low Voltage Surge Protective Device – Part 11: Surge Protective Device connected to low voltage power system – Requirement and Tests
23.	IEC 61000-4-18	Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Damped oscillatory wave immunity test
24.	IEC 60215	Safety requirements for radio transmitting equipment - General requirements and terminology
25.	IEC 62305 – 1	Protection Against Lightening – Part 1: General Principle
26.	IEC 62305 – 2	Protection Against Lightening – Part 2: Risk Management
27.	IEC 62305 – 3	Protection against lightening – Part 3: Physical damage to structures and life hazard
28.	IEC 62305 – 4	Protection Against Lightening – Part 4: Electrical & Electronic System Within Structure
29.	IEC 60364 – 5 – 53	Electrical Installation Of Building – Part 5 – 53: Selection & Erection of Electrical Equipments
30.	IEC 61643- 1 (Second Edition 2005 – 03)	Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power distribution systems –

		Requirements and tests
31.	IEC 60364-5-53: 2001 Amendment-1 2002 – 04	Electrical installations of buildings – Part 5-53: Selection and erection of electrical equipment – Isolation, switching and control
32	IS/IEC 61204 : Part 7 : 2016	Low-voltage switch mode power supplies - Part 7: Safety requirements

Note: Unless otherwise explicitly stated, the latest approved issue of the standard/GR/IR, with all amendments in force listed in this References Table, on the issuance date of this GR/IR applies.

CHAPTER 1

1.1 TECHNICAL REQUIREMENTS

1.1.1 Scope

1.1.1.1 This document contains the generic requirements of Power Plants, based on High Frequency Switch Mode Techniques, using switching frequencies of 20KHz and above, for the use in Indian Telecom Network. The Power Plant as per this GR shall be compatible with VRLA battery as well as Li-ion battery. However, at any point of time VRLA & Li-ion battery cannot work simultaneously with the SMPS power plant. Purchaser may decide for power plant to be compatible with conventional Lead Acid batteries, if ordered. The power plant compatible with VRLA batteries as well as Li-ion battery shall be certified as “SMPS power plants compatible with VRLA and / or Li-ion battery” as applicable.

1.1.1.2 The DC Distribution cabinet does not form part of this GR.

1.1.1.3 The system shall be capable of meeting the load requirements of various telecom equipment and battery bank in Telecom Network. The system should be expandable at rack level itself or by additional racks using the basic FR/FC and/ or FR/BC modules of the same rating. The prescribed FR/FC and FR/BC ratings are 6.25A, 12.5A, 25A, 50A, 100A and 200A. These power plants may be mainly classified in two categories:

1.1.1.3.1 Large capacity Power plants systems:

“These types of power plants are envisaged for large or very large telecom systems. Power plant systems with ultimate capacity of above 600A are envisaged for this application. Battery back-up for these systems may vary as per specific field requirements, but normally it is

6 hours. SMPS power plants based on 50A, 100A and 200A basic modules are envisaged for these applications. All these modules use three phase supply except 50A module, 50A module may be with single phase or three phase input, modules are equally distributed on three phase input while building power plant system up to 1500A".

1.1.1.3.2 Small capacity Power plants systems:

These type of power plants are envisaged to serve small telecom systems in rural and semi-urban areas. Battery back-up for these types of systems is 6 to 72 hours, depending on the electric supply conditions. This type of power plant may also be used with small telecom systems such as mobile base stations etc. in the urban and metros areas. SMPS power plants based on 6.25A, 12.5A, 25A and 50A basic modules are envisaged for these applications. They all use single phase supply except for 50A basic module, which may be with single phase or three phase supply."

1.1.1.4 The power plant system shall consist of a Distribution, Switching, Control, Alarm and Monitoring arrangement (DSCA) and Float Rectifier-cum-Float Chargers (FR/FCs) and Float Rectifier-cum-Battery Chargers (FR/BCs) in a rack. It shall employ modular configuration for flexible provision of DC power.

Note: FR/BC is only used for conventional flooded Lead Acid batteries only. Power plants compatible with VRLA or Li-ion batteries, do not require FR/BC modules and as such only FR/FC are used in such power plants.

1.1.1.5 The system shall be sufficiently flexible to serve any load from 6.25A onwards, depending on manufacturer's design, rating, number of FR/FC modules used in a rack and system configuration.

1.1.1.6 To cater to higher load requirements, same type of FR/FCs mounted in the same rack or different racks, shall be capable of working in parallel load sharing arrangement.

1.1.2 Functional and Technical Requirements

1.1.2.1 Functional Requirements

1.1.2.1.1 Lightning & Surge Protection

The protection of Telecom Site against the lightening and high voltage surges shall be as per GR of Lightening and Surge Protection of Telecom Site (GR No. TEC 66130:2024).

1.1.2.1.2 Stage–2 Protection:

This protection against, low voltage surges of up to 1.5 KV, shall be provided at the power plant level. This protection shall be equipped with thermal disconnection and potential free contact for arrestor(s) connected between live & neutral and neutral & earth. This protection shall be in compliance of IEC 62305 & 60364-5-53 for the following values of current:

Between	Protection Requirement
R, Y, B & N	Greater than or equal to In: 20KA, 8/20μS for each phase
N & PE	Greater than or equal to In: 40KA, 8/20μS.

Where In: Value of nominal discharge current 8/20μS.

Note: Voltage rating of MOVs shall be 320V minimum.

1.1.2.1.3 Response time of the Stage II device shall be ≤ 25 nano seconds.

1.1.2.1.4 Installation procedures of SPDs

The power plant shall contain Stage-II protective device for protection against low voltage surges of voltage up to 1.5 KV.

1.1.2.2 Technical Requirements

1.1.2.2.1 System Applications

SMPS is intended to be used in Auto Float-cum-Charge mode as a regulated D.C. Power Source.

1.1.2.2.1.1 Switching frequencies of these power plants shall be 20 KHz and above.

1.1.2.2.1.2 The system shall only be based on menu driven Microprocessor Controlled Techniques (both DSCA as well as FR/FC, FR/BC module) for control, monitoring & alarms. DSCA shall display the Software version and checksum number for both DSCA and FR/FC, FR/BC. Setting of all the parameters shall be through menu-driven microprocessor control only. DSCA shall have menu for selection of type of battery between VRLA and Li-ion battery and type of battery should be displayed on DSCA. The failure of Microprocessor or DSCA shall not affect the setting of individual FR/FC, FR/BC. No parameter of FR/FC, FR/BC modules shall be disturbed on the failure of DSCA. In this condition all the FR/FC FR/BC modules shall take care of the load on default settings and share the load collectively. Only the setting of new parameters from DSCA, shall be affected. In case of failure of microprocessor of FR/FC, FR/BC module its last settings shall not be affected.

The system shall be RS 485/RS 232 and Ethernet (SNMP) compatible, if remote monitoring is required. It shall be feasible to set any monitoring control parameter from a remote site through RS 485/RS 232 and Ethernet (SNMP). All the information regarding Control and monitoring of Power Plant data shall be accessible on demand from the remote site. The exchange of information and protocol format shall be as given in the Clause 1.3. RS485/RS 232 and Ethernet communication cable of suitable length shall be protected with Pluggable and DIN Rail Mountable surge protection devices (to be decided by purchaser) to be mounted on both side of the cable. SPD shall have surge discharge current capacity of 10KA (8/20 µsec) and lightening discharge current capacity of equal or more than 0.5 KA per line (10/350 µsec). The SPDs shall have an end of life indication either via signal disruption or a visual indication.

1.1.2.2.2 The DSCA shall be provided for the ultimate capacity of the Power Plant. However, it shall preferably be provided either in the first rack or in a separate rack. The DSCA, in addition to control, monitoring and alarms, shall provide for the following:

a) Termination for the batteries*.
b) Termination for the exchange load.
c) Interconnecting arrangement for power equipment.
d) Battery Switching arrangement (Connection to / isolation from system)**
e) Termination for AC input to the rack shall be finger touch proof, flame retardant, insulated. Use of bus-bars for the purpose is precluded. However, for terminating cables of large cross sectional area, especially in high ultimate capacity power plants, copper bars may be provided as terminal blocks to handle such high currents.
f) Termination for AC and DC to FR/FC modules.
g) Circuit Breakers/ fuses etc.

* The capacity and number of batteries shall be as per order. For the purpose of Type Approval, it shall be taken as three batteries.

** Only CACT approved DC contactor or `MCBs' (which do not produce spark while cutting in or out) shall be used for manual isolation and reconnection of the battery. The manual isolation/reconnection of the battery by tripping the contactor through an external switch is not permitted.

Note-1: Battery shall be protected against the short circuit from any source, including switching equipment such as contactor, MCB coil and their control and sensing circuitry.

Note-2: Solid state switching device may preferably be used. Relays, if used, shall be UL or CE compliant.

1.1.2.2.2.1 **Interlocking of batteries:** Necessary interlocking arrangement for batteries shall be provided so as to ensure that at-least one battery remains floated across the load under all working conditions. (Optional)

1.1.2.2.3 **Power Plant compatibility with Engine alternator:** The power plant system (including FR/FCs, FR/BCs and DSCA), shall be suitable for operation from A.C mains or a DG set (of capacity 1.25 times AC load of power plant).

1.1.2.2.4 **Load Sharing (Parallel operation):** FR/FC modules shall be suitable for operating in parallel with one or more modules of similar type, make and rating, other output conditions remaining within specified limits.

1.1.2.2.4.1 The current sharing shall be within +/- 10% of the average current per rectifier module in the system (mounted in the same or different racks),

when loaded between 50 to 100% of its rated capacity for all working conditions.

1.1.2.2.4.2 In the event of failure of DSCA, FR/FC, FR/BC modules' parameters shall not be disturbed. All the FR/FC FR/BC modules shall take care of the load on default settings and share the load collectively.

1.1.2.2.5 **Battery Monitoring:**

1.1.2.2.5.1 **Battery under voltage isolation:** There shall be a provision for Automatic isolation/reconnection of each battery from the load. The DC contactor used for the purpose shall be of single pole only. The operate and release voltages for the above conditions shall be as follows:

For VRLA Battery:

Cut-off: 1.85V/cell (44.4V for 48V units and 11.1V for 12V units). It shall be settable between 1.85V and 1.9V/cell. A tolerance of 0.01V/cell is permissible in this case.

Reconnect: When the FR/FC voltage has built-up fully. It shall be settable between 2.15V to 2.3V/cell.

For Li-ion Battery:

Cut-off Voltage (V): Between 11.2V to 11.6 V for 12V battery, 22.4V to 23.2 V for 24V battery, 42V to 44 V for 48V battery.

Reconnect: When the charger voltage has built-up fully. Battery voltage more than 12.8V for 12V battery, 25.6V for 24V battery& 48 V for 48V battery.

1.1.2.2.5.2 **Battery Health Monitoring in Auto Mode:**

For VRLA: To keep the battery in healthy state, the battery condition shall be continuously monitored. On restoration of AC mains after an

interruption, depending on the sensed battery condition (depth of discharge), the system shall change over to Auto Charge mode to charge the battery at higher voltage of 55.2V till the battery is fully recouped.

For Li-ion battery: When Li-ion battery selected setting of Float & Charge voltage should be 54.0V or specified by the purchaser based on the requirement.

1.1.2.2.5.3 **Battery Health Check:** There shall be a provision of monitoring the voltage, current, trickle current, conductance and temperature (programmable) of the batteries associated with the power plant at a set periodicity. There shall also be a provision of monitoring of each cell of the battery bank for voltage and temperature.

The provision for conducting a partial discharge (about 20%) test, of a pre-determined duration and frequency, shall be made available in the power plant (Frequency and duration of partial discharge test shall be programmable). During this test, the current and voltage of the battery as well as each individual cell shall be recorded. It shall also record the conductance and temperature of each cell.

Conductance measurements/observations shall be off-line to prevent noise interference. First observations of conductance, recorded by the power plant system, for the battery shall form the base values for future comparison.

The provision of partial test discharge shall be implemented in such a way that at a time only one battery is put to discharge, so as to ensure that necessary battery reserve is available in case of power failure during or immediately after the test discharge. Provision shall be made for observing the state of charge of battery before commencing this

test. In case the battery is not fully charged this test may be deferred till the battery is fully recouped.

Any abnormality observed during above observations shall be highlighted by initiating an alarm. All the above information shall be made available to the remote site through RS 485 / RS 232 and Ethernet (Refer Clause 1.3 for specified protocol).

Note-1: The manufacturer will give the list of hardware equipment required, for the purpose, at the time of procurement. Purchaser shall clearly indicate the requirement of battery health check feature while ordering the power plant. The manufacturer shall also undertake that the above provision will become fully function by adding the hardware/software, for the purpose, if ordered by purchaser.

Note-2: This clause is optional and applicable to VRLA battery.

1.1.2.2.5.4 SMPS Management (Optional)

The purchaser may decide the requirements for optional SMPS Management features like

i. Energy saving Management,
ii. DG Efficiency & Fuel Saving Management,
iii. Battery Efficiency & Management,
iv. Rectifier Control – Efficiency Management, etc.
v. Data Logging to all the SMPS parameters and alarms which may be downloadable in excel or any new readable format.
vi. Ability to calculate and display run hrs. SMPS on EB, Battery, DG (if DI provided)

vii. Redundancy supervision to calculate no.of redundant and no. of lacking rectifiers Based upon load current and battery AH setting.

viii. USB port or any other secured mode to download log file in pen drive, other authorised storage devices, etc.

1.1.2.2.5.5 **Battery path Current Limiting Circuit:**.In Auto Mode the current in each battery path (For VRLA type battery) shall be settable as per the battery capacity and DG capacity as applicable so that the battery path current is kept at 5% to 10% of battery AH capacity. When Li-ion battery selected setting the current in each battery path should be settable as per the battery capacity and DG capacity as applicable so that battery path current is kept at 5% to 50% of battery AH capacity and actual battery path current will be decided by the purchaser. Further, purchaser will give the capacity of the battery and DG set if applicable to be used for this purpose. For the type approval the manufacturer shall demonstrate the facility and undertake to make provision as per order."

1.1.2.2.5.6 **Temperature Compensation for Battery:**

For VRLA: In auto float/charge mode there shall be provision for monitoring the temperature of battery and consequent arrangement for Automatic temperature compensation of the FR/FC, FR/BC output voltage to match the battery temperature dependant charge characteristics. The output voltage of the rectifier in Float/Charge operation shall decrease or increase at the rate of 72mV (3mV/cell, 24 cell battery) per degree increase or decrease in temperature over the set voltage. The output voltage shall decrease till the open circuit voltage of the battery is reached. The open circuit voltage range shall be settable between 2.1V/cell to 2.2V/cell. At this voltage, the power plant voltage gets locked and further increase in temperature shall not decrease the voltage any further. This voltage shall also remain locked

till the temperature falls below the value corresponding to set value. When the output voltage reaches 55.8V, due to increase in the output voltage owing to decrease in temperature, it shall get locked at this voltage & any further decrease in temperature shall not lead to further rise in the output voltage of the power plant. This voltage shall also remain locked till the temperature rises above the value corresponding to set value. A tolerance +/- 5 mV may be acceptable over the specified rate of 72mV/degree C. The nominal distance between the battery & power plant may be 20 metres. The manufacturer shall provide the necessary sensor and cord for the purpose with the power plant. Failure of temperature compensation circuit including sensors (including the open or short circuit) shall create an alarm and shall not lead to abnormal change in output voltage. Proper sign-writing shall be made in DSCA and both ends of temperature compensation cord for its easy termination.

For Li-ion battery: Temperature compensation for battery should be disable when Li-ion battery selected. Temperature sensor is not required.

1.1.2.2.6 Protections

Failure of control and sensing circuitry shall not cause any hazard. The voltages of the system shall not abnormally increase to endanger the load.

1.1.2.2.6.1 **AC Input:** FR/FC module should be automatically cut off as the AC input of the FR/FC module is beyond the specified operating range (230V+10 % to 230V-15% for single phase and 415V ±10% for three phase Supply systems). However, keeping in view of specific requirement for rural area, purchaser may specify the requirement as a special case as: - “The Power Plant shall operate from single phase AC mains supply 230 V with variation from 120 V to 290 V with linearde-rating and frequency as 50 Hz +/-2Hz”. Suitable alarm

indication shall also be provided. The FR/FC module shall resume normal working automatically when the input is restored within the working limits. Hysteresis within specified working limits shall prevent shutting down of the FR/FC. A tolerance of +/- 5V is acceptable for protection & alarm operation. Reconnection shall occur at a voltage, 10V lower than the set voltage for high isolation limit and 10V higher than the lower set limit, to avoid hunting. The circuitry used for sensing the voltage for operation of isolation/ reconnection device shall be able to withstand a voltage 15% higher than the specified extreme limit of isolation.

1.1.2.2.6.1.1 The module shall be isolated (if required for the protection of the unit) in the event of unbalance beyond 10% and shall restore when the input is within limits. (Applicable only for three phase module or system)

1.1.2.2.6.2 **D. C. Over voltage:** Each rectifier module shall be fitted with an internal over- voltage protection circuit.

1.1.2.2.6.2.1 In case output DC voltage exceeds –56V, the over voltage protection circuit shall operate and shut-off the faulty module. A tolerance of +/- 0.25V is permitted in this case. Restoration of the module may be through manual or through DSCA".

1.1.2.2.6.2.2 Shutting-off of faulty FR/FC module shall not affect the operation of other FR/FCs operating in the rack.

1.1.2.2.6.2.3 Operation of over-voltage shut down shall be suitably indicated on the module and also extended monitoring/control unit.

1.1.2.2.6.2.4 The circuit design shall ensure protection against the discharge of the Battery through the FR/FC module in any case.

1.1.2.2.6.2.5 The over voltage protection circuit failure shall not cause any safety hazard.

1.1.2.2.6.3 **Fuse / Circuit Breakers:** Fuses or circuit breakers shall be provided for each FR/FC, FR/BC module as follows:

a. Live AC input line (MCB)
b. Negative D.C output (enclosed ultra-fast blow fuse assembly or DC circuit-breaker).
c. Against failure of Control sensing circuit.

1.1.2.2.6.3.1 All fuses/circuit breaker used shall be suitably fault rated.

1.1.2.2.6.4 **Over Load/Short Circuit:** The FR/FC shall be protected for over load/short circuit as per clause 1.1.2.2.9.9.2.

1.1.2.2.7 **Monitoring Alarms and Indicating Lamps**

Visual indications/display shall be provided by means of bright LCDs/LEDs on each FR/FC module and DSCA to indicate:

1.1.2.2.7.1 **Functional Indications:** The following functional indications shall be provided on FR/FC & DSCA :

a) Mains available
b) FR/FC, FR/BC On Auto Float
c) FR/FC, FR/BC On Auto Charge

Note: The functional indication a) shall be provided on both DSCA & FR/FC/BC module, while b) & c) may be provided either on DSCA or on both FR/FC and DSCA.

1.1.2.2.7.2 Alarm Indications:

A. On FR/FC:

a. LED Green - Healthy

b. LED Amber - Warning

c. LED Red – Major

Functional Indications and alarm indications shall be extended to DSCA

B. On DSCA:

a) Load Voltage High (above 56V)/Low (below 45.6V)
b) Alarms on FR/FC, FR/BC (As per clause 1.1.2.2.7.2 (A))
c) Mains Out of range
d) System Over Load
e) Mains "ON"/Battery Discharge
f) Fan Fail (in case fan provided at rack level)
g) Temp. sensor fail (for VRLA battery only)
h) Battery Fail or No Battery (separate for each Battery)
i) Battery isolated from the load
j) Lightning and surge protection Stage II Fail

1.1.2.2.7.3 All the alarms shall be DC operated only. Also all alarm circuits shall be provided with suitable delay to ensure that they do not operate with transients.

1.1.2.2.7.4 All the alarms and protection limits shall be settable through a menu driven program.

1.1.2.2.7.5 All the protections/alarms shall be within tolerance of 0.25V in case of DC voltage and 1% in case of current. For AC voltage it shall be +/- 5V.

1.1.2.2.7.6 Every Alarm condition shall be accompanied with an Audio alarm, with Auto/manual audio cut-off facility.

1.1.2.2.7.7 Potential free contact two (one for alarm and one redundant) shall be provided for extending the common fault alarm to Switch room.

1.1.2.2.8 Remote control and monitoring

1.1.2.2.8.1 The power plant shall be RS 485/ RS 232 and Ethernet (SNMP) compatible. It shall provide for the monitoring, alarm and control of the power plant and its associated batteries from a remote site through RS 485/ RS 232 and Ethernet (SNMP). The exchange of information and protocol format between the power plant and remote site shall be as given in the Clause No. 1.3.

1.1.2.2.9 Electrical Requirements

1.1.2.2.9.1 **AC input Supply:** The Power Plant using FR/FC modules of 6.25, 12.5 and 25A, 50Ashall operate from single phase AC input & FR/FC modules of 50A, 100A & 200A capacity shall operate from three phase/4wire AC input. The nominal input frequency is 50Hz, which may vary from 48-52Hz. The input voltage range shall be as given below:

a) Single Phase (Nominal 230V-15% to 230V+10%) : 196V to 253V
b) Three Phase/4 wire (Nominal 415V$\pm$10%) : 374V to 457V

1.1.2.2.9.1.1 For three phase/4 wire FR/FC, FR/BC modules only delta connections are permitted. FR/FC, FR/BC modules shall work satisfactorily for unbalance of +/- 10% of nominal input. Phase current unbalance, under all working conditions, mentioned in this document, shall not be

more than 10%. Neutral phase current shall not exceed 100mA under all specified input and load conditions.

1.1.2.2.9.2 **DC output Characteristics (Auto Float Charge operation):** The Module shall be capable of operating in “Auto Float-cum- Charge” mode. It shall be programmed to operate as a float rectifier or a charger, depending on the condition of the battery sets being sensed by the DSCA.

1.1.2.2.9.2.1 **Auto Float Mode:** The float voltage of each rectifier module shall be continuously adjustable and pre-settable at any value in the range of -48 to -56V from FR/FC, FR/BC modules or DSCA. There shall also be a provision of setting the float/charge voltages globally from DSCA. There shall also be a provision so that DSCA may override the values set by individual module. The prescribed float voltage settings are -52.8V for conventional battery and -54V for VRLA battery respectively. Float Voltage adjustment may be made globally, and not for individual rectifiers.

1.1.2.2.9.2.2 **Auto Charge Mode:** In Auto charge mode FR/FC shall supply battery & equipment current till terminal voltage reaches set value, which is normally 2.3V/cell (-55.2V, this value shall be settable between -48V and -56V) and shall change over to constant voltage mode. It shall remain in this mode till a change over to float mode signal is received. (This Clause is applicable for VRLA Battery only”)

1.1.2.2.9.2.3 The DC output voltage at the terminals shall be maintained within +/-1% of the half load preset voltage from 25% load to full load condition when measured over the full-specified input range.

1.1.2.2.9.3 **Efficiency:** The efficiency of the single phase and three phase unit shall be as given below:

(a) Rectifier rating < 50A

Condition	Single Phase AC	Three Phase AC
At nominal input, output and full rated load	better than 90%	better than 91%
Other specified Input, output conditions and load between 50% to 100%.	better than 85%	better than 87%

(b) Rectifier rating 50A and above

Condition	Single Phase AC	Three Phase AC
At nominal input, output and full rated load	better than 93%	better than 93%
Other specified Input, output conditions and load between 50% to 100%.	better than 88%	better than 88%

1.1.2.2.9.4 **Input Power Factor:** The true input Power Factor at nominal input, output voltage and rated load shall be better than 0.98 and shall be better than 0.95 in any other working condition and load between 50% to 100%. Active Power factor correction only shall be employed for the purpose.

1.1.2.2.9.5 A resistor shall be provided to discharge the capacitors after the Rectifier modules have stopped operation and output is isolated.

1.1.2.2.9.6 **Electrical Noise:** The Rectifier (FR/FC) Modules shall be provided with suitable filter on the output side.

1.1.2.2.9.6.1 **Psophometeric Noise:** Psophometeric Noise (e.m.f. weighted at 800Hz), with a battery of appropriate capacity connected across the output should be within 2mV, while delivering the full rated load at nominal input (400V AC for three phase supplies and 230V for single phase supply). For test purposes, this shall be taken as equivalent to 4mV when the battery is not connected, other conditions remaining the same as per ITU-T Rec. O.41.

1.1.2.2.9.6.2 **The Peak-to-Peak Ripple :** Voltage at the output of the rectifier module, without battery connected, shall not exceed 300 mV at the Switching Frequency measured by an Oscilloscope of 50/60 MHz band-width (Typical).

1.1.2.2.9.7 **Transient Response**

1.1.2.2.9.7.1 **Soft Start Feature:** Slow start circuitry shall be employed such that FR/FC module input current and output voltage shall reach their nominal value within 10 seconds. The maximum instantaneous current during start up shall not exceed the peak value of the rectifier input current at full load for the lowest input voltage specified.

1.1.2.2.9.7.2 **Voltage overshoot/Undershoot:** The requirements of this clause shall be achieved without a battery connected to the output of FR/FC module. The FR/FC modules shall be designed to minimise output voltage Overshoot/ Undershoot such that when they are switched on the DC output voltage shall be limited to +/-5% of the set voltage & return to their steady state within 20 ms for any load of 25% to 100%.

1.1.2.2.9.7.3 The DC output voltage overshoot for a sudden change in AC mains from specified lowest to highest and vice-versa shall not cause shut-down of FR/FC module and the voltage overshoot shall be limited to +/- 5% of its set voltage and return to steady state within 20 ms.

1.1.2.2.9.7.4 The modules shall be designed such that a sudden load change of 25 to 100% shall not result in DC output voltage Overshoot/ Undershoot of not more than 5% and return to steady state value within 10 ms without resulting the unit to trip.

1.1.2.2.9.8 **Total Harmonic Distortion**

1.1.2.2.9.8.1 **Total Voltage Harmonic Distortion:** The Total line harmonic voltage distortion shall not be more than 10% in conformity with CIGRE's limits.

Note: The above Harmonic Distortion limits are as per communication received from Central Electricity Authority vide their office letter No. GO2/Comm.I/1/1-95/962 dated 22.12.92.

1.1.2.2.9.8.2 **Total Current Harmonic Distortion:** The total harmonic distortion shall be limited as per EN 61000-3-2 Ed.2:2000. The total current harmonic distortion contributed by the unit at the input shall not exceed 10% for input voltage range 120V-290V for single phase units and 374V to 457V for three phase systems; for load between 50 to 100% of the rated capacity.

1.1.2.2.9.9 **Current limiting (Voltage Droop):** The Current limiting (Voltage Droop) shall be provided for Float/Charge operation. The float/charge current limiting shall be continuously adjustable between 50 to 100% of rated output current for output voltage range of -44.4 to -56 volts. For test purposes upper limit of 100% + 5% and lower limit of 50% - 5% shall be acceptable.

1.1.2.2.9.9.1 The float and charge current limit adjustment shall be provided:

Either on the front panel of the individual FR/FC, FR/BC module through a menu driven program

or

Through a provision at the centralised location on front panel of DSCA through a menu driven program capable of adjusting the float and charge current limits of each FR/FC, FR/BC module individually, irrespective of the rating and number of modules located in the same rack or in other racks of the power plant for the ultimate capacity of the system.

1.1.2.2.9.9.2 The FR/FC modules shall be fully protected against short circuit. It shall be ensured that short circuit does not lead to any fire hazard. The unit shall start delivering output automatically when the short circuit is removed.

1.1.2.3 Power Plants Compatible with Conventional Batteries

1.1.2.3.1 The conventional lead acid batteries have special requirement of periodic Boost charging @ 2.7V/cell. To meet this requirement, the power plant shall be so configured that in addition to the specification requirements, shall also have a provision of a group of FR/BC (as per battery capacity) for charging the batteries (one set at a time) @2.7V/cell after isolating both the battery and FR/BC group from the load bus. In addition to FR/FCs the power plant shall have the following additional units.

1.1.2.3.2 Float Rectifier-Float Charger-Boost charger (FR/BC):

The FR/BC module shall be programmable to work as FR/FC or BC.

1.1.2.3.2.1 When programmed, FR/FC it shall be capable of working as FR/FC with other FR/FC and shall comply with all the requirements of FR/FC. The rated capacity of the FR/BC as FR/FC shall be same as that of the other FR/FCs. The prescribed Float voltage setting for conventional batteries is 52.8V.

1.1.2.3.2.2 It shall also be programmable as a Boost Charger (BC) under manual control after isolating it from the float bus.

1.1.2.3.2.2.1 As a Boost charger its output voltage shall be continuously adjustable and pre-settable at constant current up to 100% for voltage range 44.4V to 56V and up to 50% of the rated capacity at any value in the range 56V to 64.8V.

1.1.2.3.2.2.2 The Boost voltage shall be maintained within +/-1% of the set value over the full boost current range as specified in clause.

1.1.2.3.2.2.3 The Float and Boost current limit adjustment shall be provided on the front panel of the FR/BC module.

1.1.2.3.2.3 **Parallel operation in BC mode**: When programmed in BC mode FR/BC modules shall be working in parallel load sharing arrangement with other FR/BC modules in the same mode, other output conditions remaining within specified limits.

1.1.2.3.2.3.1 The current sharing shall be within +/- 10% of the average current per FR/BC module (in BC mode) in the system (mounted in the same or different racks) when loaded between 50 to 100% of its rated capacity (as BC) for all other working conditions.

1.1.2.3.2.4 In addition to the Visual indications/display specified for FR/FC the following shall also be provided:

Functional Indications: FR/BC on Boost mode

Alarm Indications: Following Alarms shall actuate in BC mode:

a. FR/BC over voltage
b. FR/BC Over Load (Voltage Droop)

1.1.2.3.2.5 **Protection:** The module shall also be protected against D. C. Over voltage in BC mode.

1.1.2.3.2.5.1 Shutting-off of faulty FR/BC module in FR/FC mode shall not affect the operations of other FR/FC & FR/BC in FR/FC mode and other BC while working in BC mode.

1.1.2.3.3 **Distribution, Switching, Control, Alarm and Monitoring Unit:** The Distribution/ switching/ Control and alarm unit, in addition to the facilities specified earlier shall also provide for:

1.1.2.3.3.1 Switching Arrangement: The switching arrangement may have handled enclosed knife fuse assembly or any other suitable arrangement in the same or separate rack for the following facilities:

a) FR/BCs in Auto Float
b) Selection and switching a Group of FR/BC for Boost or Float Charge operation.

To achieve the above the switching arrangement shall be capable of selecting the required facilities.

1.1.2.3.3.1.1 Battery Auto Float Charge/Boost selection arrangement for selecting:

i) All the batteries in Auto Float Charge Mode
ii) Battery-1 on Boost others on Auto Float Charge.

iii) Battery-n on Boost others on Auto Float Charge

1.1.2.3.3.1.1.1 The above arrangement shall be provided with a suitable inter-locking arrangement so that one of the batteries is always on Float. In case interlocking arrangement is not feasible due to the rack size, a provision of Alarm shall be made in the event of all the batteries are isolated accidentally.

1.1.2.3.3.1.1.2 The capacity and number of batteries shall be as per order. For the purpose of Type Approval, it shall be taken as three batteries.

1.1.2.3.3.1.2 **FR/BC switching arrangement:** This switching arrangement shall be provided for connection of FR/BC group to the Float bus for Auto Float Charge operation or Boost Charge bus for Boost Charging of the battery after its isolation from the Float Bus.

1.1.2.3.3.2 **Alarms:** The following additional alarms shall be provided for Boost Charge operation FR/BCs.

Functional Indications: FR/BCs in Boost Charge Mode

Alarm Indication

a) Boost Load Voltage High (above 66V)/Low (below 44.4V)

1.2 GENERAL REQUIREMENTS

1.2.1 **Radio Frequency Interference (RFI) Suppression:** The system (FR/FC, FR/BC & DSCA modules) shall be designed to minimize the level of electromagnetic interference (EMI), both conducted and radiated, detected in its vicinity and generated by the

module and shall comply the following clauses :

1.2.1.1 **Conducted and Radiated Emission from the single phase and three phase Power equipment.**

Name of EMC Standard: CISPR 32 (2015) with A1(2019) "Electromagnetic compatibility of multimedia equipment – Emission requirements; Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment".

Limits:-

i) To comply with Class A of CISPR 32 (2015) with A1(2019).

ii) The values of limits shall be as per relevant tables under CISPR 32 (2015) with A1(2019).

Test Procedure: Test setup, Test procedure & Measurements shall be conducted as per IEC- CISPR 32 (2015) with A1(2019).

1.2.1.2 **Conducted Susceptibility Limits**: Power equipment used in Telecom Network shall not malfunction when high voltage surge as specified below is superimposed at the input power mains to the power equipment, for more than two seconds as per IEC 61000- 4-18. The equipment shall also not fail or degrade in performance after the surge is withdrawn.

Test levels:

Voltage Rise time (First peak): 75 nano sec +/- 20%.

Oscillation Frequencies: 100KHz & 1 MHz +/- 10%

Repetition rate: at least 40/s for 100KHz and 400/s for 1 MHz

Decaying: 50% of the peak value between the 3rd & 6th periods

Burst duration: not less than 2 s

Surge amplitude: 250V(-10%) to 2.5 KV(+10%)

Wave shape: Damped

Test Procedure: Test set up, test procedure & Measurements shall be as per IEC 61000-4-18. EMI surge of specified levels injected on power leads of test sample shall not cause degradation of performance or malfunction.

1.2.1.3 **Electrostatic discharge (ESD) immunity limits:** The limits shall be as per IEC 61000- 4-2, 9(1) (both Contact discharge method and Air discharge method) as given below:

Test level:

Contact discharge		Air discharge	
Level	Test voltage (KV)	Level	Test voltage (KV)
4	8	4	15

Test Procedure: This test shall be conducted as per IEC 61000-4-2 for both requirements & unit shall comply of clause 9(1) of IEC 61000-4-2

1.2.1.4 **Electrical fast transient/Burst immunity limits:** The limits shall be as specified in IEC 61000-4-4.

Test level:

Open–circuit output test voltage (+/-10%) &repetition rate of impulses (+/-20%)		
Level	On Power supply port, Protection Earth	
	Voltage peak KV	Repetition rate KHz
4	4	2.5
Rise time of one Pulse - 5 ns +/- 30% Impulse duration - 50 ns +/- 30%		

Test Procedure: This test shall be conducted as per IEC 61000-4-4. Test results shall be in compliance of clause 9(1) of IEC 61000-4-4.

1.2.1.5 **Radiated radio-frequency Electromagnetic field immunity limits:** The limits as per IEC 61000-4-3.

Test level:

Frequency range : 80 MHz to 1000 MHz.	
Level	Test field strength V/m
3	10

Test Procedure: This test shall be conducted as per IEC 61000-4-3. Test results shall be in compliance of clause 9(a) of IEC 61000-4-3.

1.2.1.6 **Surge immunity limits:** The limits as per IEC 61000-4-5.

Test level:

Level	Open circuit test voltage(+/- 10%) KV
1	0.5
2	1.0

3	2.0
4	4.0
Voltage surge - 1.2/50 μs Amplitude - 2 KV(DM) - 4 KV(CM) - After testing for 4KV, the amplitude shall also be increased to 6 KV (1.2/50 μs) Combined wave form as per IEEE C62.41-1991 to cover Lightening/ Surge protection test also. - Test results shall be in compliance of clause 9(b) of IEC 61000-4-5.	

Test Procedure: This test shall be conducted as per IEC 61000-4-5. After testing for 4KV, the amplitude shall also be increased to 6 KV (1.2/50 μs) Combined wave form as per IEEE C62.41-1991(to cover Lightening/ Surge protection test also).

Note: The rated voltage of the MOVs used for the above shall not be less than 320V.

1.2.1.7 **Radio-Frequency Conducted Susceptibility immunity limits:** The limits as per IEC 61000-4-6.

Test level:

Frequency range : 150 KHz- 80 MHz	
Level	Voltage level (e.m.f.)
3	10

Test Procedure: This test shall be conducted as per IEC 61000-4-6. Test results shall be in compliance of clause 9(a) of IEC 61000-4-6.

1.2.1.8 At the time of Type approval the testing officer shall ensure that the power plant is in compliance of the clauses 1.2.1.1 to 1.2.1.7 given above.

1.2.2 **Power Plant System Configuration:**

1.2.2.1 The system shall employ a modular configuration to provide flexibility, keeping in view the future load requirements of D.C. Power.

1.2.2.2 The FR/FC, FR/BC modules shall be accommodated in a rack. DSCA, for the ultimate capacity, shall be provided in first rack or in a separate rack as per manufacturer's design. AC and DC distribution may, however, be provided in First/separate rack or in the individual racks. In case, distribution arrangement is provided in First/separate rack, it shall be for the ultimate system capacity. In case the Distribution is provided in the individual racks DC distribution/switching shall be for the ultimate system capacity, while AC distribution shall be for fully equipped rack. All factory wiring for the rack shall be for the ultimate capacity so that only plugging-in of FR/FC or FR/BC module shall enhance the DC power output.

1.2.2.3 The requirement for Single Rack & Auxiliary Rack will be defined by purchaser, depending upon the requirements and ultimate capacity of power plant.

1.2.3 **Rack Configuration:** Rack is composed of following units, accommodated in 19" (482.6 mm) Sub-rack in general or as per the purchaser’s requirement in specific if any.

a) Float Rectifier-cum-Float Charger (FR/FC) and/or Float Rectifier-cum-Battery Charger modules (FR/BC).

b) Distribution, Switching, Control, Alarm and Monitoring (DSCA) unit.

1.2.4 Constructional features:

1.2.4.1 Rack (Indoor and Outdoor): The rack structure shall be made up of rigid frame work of steel profiles and shall be free of sharp edges or sharp corners. The structural strength of the rack shall be able to withstand the ultimate mechanical load capacity of the rack without any deformity. The rack shall have suitable ventilating arrangements (forced cooling from the sides is not permitted). The front door (if provided) and rear door may be of hinged or removable type. The gauge of metal sheet for load bearing part shall not be less than 1.5 mm and for rest of the parts shall not be less than 1.2mm. The unit may be floor-mounted or wall-mounted as specified by the purchaser. The unit may be either expandable or of ultimate size, as per purchaser's requirement".

Sheet used in cabinet manufacturing should be Galvanized Iron (GI – 120gsm) for Outdoor Rack and GI/MS for Indoor Rack duly powder coated as per the colour given in clause no. 1.2.12.4.

1.2.4.1.1 The base of rack shall ensure uniform floor loading of not more than 975 kg/Sq metre. Lifting facilities shall be provided by removable eyebolt located at the top of the rack. The necessary arrangement for fixing the rack on the floor shall also be provided. The rack shall also be provided with bottom clearance of 110 mm with a tolerance of +/- 10mm.

1.2.4.1.2 **Indoor Rack:** -The top of the rack shall be fully covered except for proper ventilation and bus bar or cable entries. Each air flow vent shall be covered by a grill to prevent foreign material larger than 5 mm dropping into the rack.

Outdoor rack:- Rack shall be protected from dust & water complying to IP55 in accordance with IEC 60529.

1.2.4.1.3 **Indoor Rack:** -The rack shall be designed for easy maintenance and installation. Rack mounting arrangement shall provide easy access from front, rear and top for Installation and Maintenance.

Outdoor Rack:- The rack shall be designed for any maintenance and installation. Rack mounting arrangement shall provide easy access from front and rear for Installation and Maintenance.

1.2.4.1.4 The individual FR/FC module shall be easily mounted to/removed from the front side of the rack. The FR/FC module shall be designed to slide into the rack on a suitable mechanical arrangement. The associated AC input, DC output connections, Control, alarms & interface cable connecting the modules shall be connected/disconnected easily without causing any interruption in the supply and damage to load or other working module.

1.2.4.1.5 Proper thermal engineering of hardware design shall be done by the manufacturer so as to ensure the uninterrupted use of the equipment. The rack completes with all panels fitted shall be designed to allow cooling by natural convection. For the systems, using 25A, 50A, 100A & 200A FR/FC, FR/BC modules force cooling is permitted.

For Outdoor racks, use of temperature-based speed-controlled DC Fans are only permitted for the purpose. There shall be an arrangement for automatic Switching-OFF of fans during AC input failure. If required, individual modules may be separated by air baffle to provide effective convection. The manufacturer shall also ensure that

the failure of fan does not cause any fire hazards. The failure of any of the fans shall draw immediate attention of the maintenance staff.

1.2.4.1.6 Facility shall be made to connect external AC power at the top/bottom of rack and alarm cable & DC output distribution module at the top of the rack. Where cables pass through metal panels suitable bushing shall be provided to protect cables from damage. Bus-bars, if used, shall be suitably spaced, insulated and bushed (where it passes through holes) to prevent any possibility of short circuit between bus-bar and/or rack.

1.2.4.1.7 **Indoor Racks:-** With doors in position, all Visual alarms & meters shall be clearly visible. In case of hinged door meters & alarm indications are permitted on door provided, the fixtures on the door do not restrict the movement of door in any way.

Outdoor Rack :- Meters and alarm indications (if any) shall remain inside the cabinet and shall not be positioned on the door.

1.2.4.1.8 **Dimensions / Configurations:**

Purchasing authority shall clearly specify the height of the rack as per his power room/equipment room requirements. The configuration of racks shall be as given below:

System Type	System capacity (Module Rating/ultimate system capacity)
Small Power plants systems	6.25A/25A (Single phase); 12.5A/75A (Single phase); 12.5A or 25A / 100A (Single phase); 50A/100A (Single / three phase); 25A / 150 A (Single phase) or 50A/150A (Single /three phase);

	25A / 200 A (Single phase) or 50A/200A (Single /three phase); 50A / 300A (single/three phase) ; 50A/450A (Single/ Three Phase); 50A/600A (Single / Three Phase)
Large Power plants systems	50A/800A (Single phase/ Three Phase); 50A/1500A (Single phase/ Three Phase); 100A/800A (Three phase); 100A/1500A (Three phase); 100A/3000A (Three phase); 200A/3000A (Three phase); 200A/4800A (Three phase)

Note: Phase mentioned in brackets referred to rectifier module design.
Single phase: Rectifier module is single phase
Three phase: Rectifier module is three phase"

1.2.4.2 FR/FC, FR/BC Module:

1.2.4.2.1 The FR/FC, FR/BC modules shall be cooled by natural convection for smaller capacities i.e. 6.25A, 12.5A. FR/FC or FR/BC modules of 25A, 50A, 100A and 200A may have natural or forced cooling.

1.2.4.2.2 AC input to FR/FC or FR/BC shall be through composite type hot plug-in connectors. DC output shall be through hot plug-in connector on the FR/FC or FR/BC side and through lugged termination on the bus-bar/termination end. Control, alarm and monitoring connections shall only be through polarised connectors.

1.2.4.2.3 The FR/FC, FR/BC module shall be removable from the front of the rack only. All AC input, DC output and alarm/control/monitoring cables interconnecting the modules and racks shall be easily disconnected by plugs or connectors.

1.2.4.3 Distribution, Switching, Control, Alarm and Monitoring (DSCA)

1.2.4.3.1 The Distribution/Switching sub-system of DSCA shall preferably be modular but Control, alarm and monitoring sub-system shall only be modular. The Distribution/Switching sub- system may be accommodated in a rack with other FR/FCs, FR/BC or in a separate rack. These sub-systems shall be rack mountable.

1.2.4.3.2 DSCA shall preferably be housed in the upper portion of the rack above the FR/FC or FR/BC modules.

1.2.4.3.3 DSCA shall be provided for the ultimate system capacity as explained in Clauses 1.2.2.2 and 1.2.2.3. All AC, DC or control/alarm cabling/wiring shall be pre-wired for the ultimate capacity so that mere plugging-in of FR/FC, FR/BC module shall add to the DC power output. It shall be ensured that the modules are not site specific.

1.2.5 Accessibility

1.2.5.1 All the termination points shall be easily accessible from front, rear or top.

1.2.5.2 AC and DC terminals shall be separated by physical barriers to ensure safety.

1.2.5.3 All the terminals except AC earth shall be electrically isolated.

1.2.6 Terminations:

1.2.6.1 AC Terminations

1.2.6.1.1 The input terminals shall be clearly marked as R, Y, B & N for three phase and L and N for single phase as applicable.

1.2.6.1.2 AC input termination shall be suitably protected against the accidental touch/contact with the working staff for their protection & shall also have clear & prominent "DANGER" marking. AC terminations shall be through standard finger safe lock-in type connectors conforming to BIS or any other international standard, with the concurrence of CACT.

1.2.6.1.3 Screening shall be provided between AC & DC components to prevent accident.

1.2.6.1.4 The AC input connection to the rectifier module shall be by a composite type hot plug-in connectors and socket arrangement.

1.2.6.1.5 All the connections between Distribution and FR/FC, shall be through proper rated cables only.

1.2.6.1.6 Fuses and Circuit-breakers for each FR/FC, FR/BC shall be easily accessible and properly rated.

1.2.6.1.7 Proper terminations for AC at the input of the circuit-breakers and its output to the FR/FC.

1.2.6.2 DC Terminations

1.2.6.2.1 The male connectors shall be mounted in the FR/FC, FR/BC module and female connectors be terminated to the cable.

1.2.6.2.2 The DC output to Battery and Load shall be through cable/bus-bars up to the rack capacity of 450A ultimate capacity and bus-bar only for higher capacities or as per user's requirement. However, for inter-rack connections, cables of proper rating are permitted.

1.2.6.2.3 The provision for interconnection between exchange and FR/FC, FR/BC or battery (along with switching arrangement) and terminations for Exchange, Battery & FR/FCs, FR/BCs shall be made. The isolation of any of the battery from the load shall create an alarm.

1.2.6.2.4 All DC + ve and – ve leads shall be clearly marked.

1.2.6.3 All the AC, DC Control & alarm cabling shall be supplied with the rack.

1.2.7 **Bus Bars:**

Tinned Bus-bars or tinned High conductivity electrolytic copper strips with purity of 99.90% (min) as per BIS 613 latest issue, be able to withstand maximum Load current. The Bus-bar shall be capable to carry current density of 2 Amps/mm square. Nuts & bolts shall be of stainless steel with tinned copper washers only. The size of bus-bars chosen for battery and load path shall be capable to take care of the current of maximum power plant capacity for which it is designed. The Bus-bar/cable size shall also ensure that the voltage drop between the output of the farthest FR/FC module riser and also between battery and exchange riser, as per the layout drawing shall be less than 500mV. The tinning shall be in compliance of IS 1359: 1992 and its thickness shall be 10 μm (minimum).

1.2.7.1 Bus-bar Riser height, wherever applicable, shall be 250 mm for both exchange and battery. Bus-bar Riser can be used for higher capacity of

exchange load and battery more than 450 Amp, if specified by purchaser. There shall be no bus-bar in outdoor units.

1.2.8 **Cabling and Wiring :**

All insulated conductors except those within the confines of a printed circuit board assembly shall be of the rating enough to withstand the maximum current and voltage during fault and overload. All the wires and cables used shall be fire retardant as per IS 1554 with amendment 1 (June 94). All the cables & wires used shall also be Rodent & reptiles repellent. Uninyvin cables are also allowed to use in system."

1.2.8.1 All wiring shall be neatly secured in position and adequately supported. Where wires pass through any part of metal panel or cover the hole through which they pass shall be suitably bushed.

1.2.9 **Earthing**

Proper Earth terminal (two in each rack), in effective electrical contact with framework, shall be provided. All metal parts of the components, which do not carry current, shall be bonded thereto. Nominal cross-sectional area of earth continuity conductor, not contained within the cable, shall be half (minimum) of each current carrying conductor to be protected but in no case, it shall be less than 3 mm diameter. Continuity conductor used for the purpose shall only be of copper. Suitable terminals shall be provided for terminating earth conductor.

1.2.10 **Mounting of component & layout**

1.2.10.1 Component mounting and fixing methods shall be secured.

1.2.10.2 Suitable mechanical structure/ arrangement for holding modules in position shall be provided so that the module is held firmly by sliding through it.

1.2.11 Documentation

Technical literature in English with complete layout, detailed block schematic and circuit diagrams of its assemblies with test voltages at different test points of the units shall be provided. A soft copy / QR code as well as a hard copy of the above shall also be provided both in Hindi and English. All aspects of installation, operation, maintenance, trouble shooting and repair shall be covered in this manual. The manual shall also include the following:

a) Installation, Operation and Maintenance manual part shall include:

i) Safety measures to be observed in handling of the equipment.
ii) Precautions at the time of installation, operation and maintenance.
iii) Required Test Jigs and fixtures.
iv) Procedures for routine maintenance, preventive maintenance, trouble shooting and replacement.
v) Illustration of internal and external mechanical parts.
vi) Complete layout, detailed block schematic and circuit diagrams of its assemblies with test voltages at different test points.
vii) Circuit description and working of FR/FC module at various stages staring from AC mains input to the DC output with Block Schematic.
viii) Circuit description and working of DSCA.
ix) Instructions for the termination of Temperature Compensation Probes at DSCA as well as battery.
x) A Table giving details of size/dimension of maintenance of cables and Bus-bar used in the design.
xi) Earthing Guide lines for the Power Plant as per BIS Specification.
xii) Co-ordination distance (length & gauge of the cable to be used)/ de-coupling inductance between stage –I & Stage – II surge protection.

b) Repair manual :

i) List of replaceable parts used with the source of procurement.

ii) Detailed ordering information for all replaceable parts for ordering of spares as and when required.

iii) Procedure with flowchart for trouble shooting and sub-assembly replacement.

iv) Test Instruments, Test fixtures, accessories and tools required for maintenance and repair.

v) Systematic trouble shooting charts (fault tree) for probable faults and their remedial action.

vi) Address and telephone numbers of Maintenance centre.

1.2.11.1 Hard copy of the documentation shall be prepared using good quality paper with clear and crisp printing. All the drawings in clear printing shall be attached to the hand-book binding. The binding of the manual shall be long lasting and presentable. One set of flow chart drawings necessary for trouble-shooting shall be provided with lamination, with each manual.

1.2.12 Quality Requirements

1.2.12.1 **Components:** The component parts of the equipment shall be of professional grade of reputed manufacturer to ensure prompt and continuous service and delivery of spare parts. Use of potentiometer is precluded. Switching components used on the input side shall be rated at 600V (minimum)

1.2.12.1.1 **Power transformers and Chokes:** Power transformers & chokes shall use class B or higher grade of insulation. The transformers and chokes shall be wound with copper wire and provided with adequate insulation.

1.2.12.1.2 Fuses or circuit breakers shall be provided wherever appropriate for the protection against failure of control/sensing circuit. Fuses shall conform to B.I.S specification.

1.2.12.1.3 **Meters:** There shall be provision to monitor AC voltage of the system and DC current as well as voltage with the help of Digital meters to read the voltage and current of the System, any of the Battery or any of the individual FR/FC (at individual FR/FC module also permitted). Digital meter's display/resolution should be such that it is clearly and unambiguously readable from a distance of 1 metre. Normally the meters mounted at DSCA shall indicate the System voltage and current.

a. Current: +/- 1.5% of the range or better, shall be able to read up to full digit for meter range 50A & above and 1 place decimal for lower meter range.

b. Voltage: +/- 1.5% of the range or better with a resolution of one decimal point in case of DC voltmeter and full digit in case of AC voltmeters.

1.2.12.1.4 **Component Approval:** The components used in SMPS Power Plant, shall be certified by recognised National/International Institutions and approved by CACT wing of BSNL. Components shall neither be combustible nor support combustion. NABL approved test reports are also be acceptable as an alternative to approval of CACT wing of BSNL.

1.2.12.2 **Quality and Workmanship:**

a) The equipment shall manufacture in accordance with international quality management systems ISO-9001-2015, for which the manufacturer shall be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer would be required to be submitted.

b) The equipment shall be manufactured as per the latest BSNL QA Guidelines indicated in Quality Manuals QM-118 (Quality reliability in product design), Manuals QM-202 (Pictorial guidelines for Visual assessment of quality of printed board assemblies (PBA) and discrete

terminal assemblies), QM-204 (Guidelines for workmanship standards for repair & modification of printed wiring board assemblies), QM-205 (Guidelines for standard of workmanship for printed boards), QM-206 (Guidelines for standard of workmanship for printed boards assemblies), QM-207 (Guidelines for soft solder and fluxes for Telecom Equipments) and QM 210 (Guidelines for standard of workmanship for surface Mounting Devices).

All wiring shall be neatly secured in position and adequately supported. Metal panel or cover holes through which the wires or cables pass shall be suitably bushed.

c) All materials and workmanship shall be of professional quality to ensure the MTBF requirements.

1.2.12.3 **Quality Assurance Tests:** Each of the units supplied against the specific order after type approval shall be inspected and tested to ensure that the requirements of this document have been met. These tests shall be carried out by QA wing of BSNL.

1.2.12.4 **Finish and painting:** The finish of the structure and panels shall conform to the latest issue of IS 101 and IS 168. The structure and panels shall only be powdered coated. The thickness of powder coating shall be between 60 to 100 Micron for Indoor rack and 80 to 120 Micron for outdoor rack. The Colour used shall conform to IS 5 latest issue. Colour scheme shall be as follows:

a. **Rack & Door:** Satin Blue, No. 177

b. **Modules and inside:** Shall harmoniously match with rack colour

c. **Outdoor Rack:** Light Grey (RAL7035)

1.2.12.5 **Marking and Labelling:**

1.2.12.5.1 It shall be possible to locate each component on the PCB with the help of layout and circuit drawing. All terminals shall be properly sign-written

and all components properly labelled so that it shall be easy to identify them with reference to the supplier's Instruction and Maintenance Manuals. Designation of keys, switches and other components mounted on the front/inside panel and their operating positions shall be clearly engraved or sign- written. The wiring shall be clearly and permanently identified with the designation or colour code which corresponds to the equipment circuit diagram. Where non-standard colours are used cable functions shall be clearly and permanently labelled at both ends.

1.2.12.5.2 Fuse holder identification shall include details of fuse rating and type. In case of fuses on PCBs the rating shall be either on the fuse or PCB.

1.2.12.5.3 A cabling diagram, screen printed or any other better arrangement ensuring better life expectancy shall be placed in the inside of the front door or any other convenient place for ready reference of the maintenance staff.

1.2.13 Name plate

A name plate anodised, screen printed or any other better arrangement ensuring better life expectancy shall be suitably fixed inside / on each rack & on each module and contain following information:

1. Specification Number:
2. Type of the Unit:
3. Manufacturer's name and identification:
4. Model No. :
5. Unit Serial No. :
6. TAC No.
7. Input voltage and phase:
8. Output Voltage and Current:
9. Year of manufacture:

1.2.13.1 On the front top of the Rack an anodised, screen printed or any other better arrangement ensuring better life expectancy Designation plate in BOLD letters showing " LARGE / SMALL CAPACITY SMPS POWER PLANT SYSTEM, COMPATIBLE WITH (VRLA AND LI-ION BATTERY) / (VRLA AND CONVENTIONAL LEAD ACID) BATTERIES " shall be provided.

1.2.14 Module Replacement Time & MTBF

1.2.14.1 **Module Replacement Time:** The mean time to replace / restore (MTTR) a faulty rectifier module shall be less than 20 minutes.

1.2.14.2 **MTBF (Mean Time between Failures):** MTBF of the system shall not be less than 100,000 hours. The MTBF for fans shall be better than 70,000 hours at 40 degree C. The concurrence of CACT of QA wing of BSNL in this regard is mandatory. The MTBF shall be verified as per QM-115. MTBF, predicted and observed values shall be furnished along with calculations by the manufacturer. Based on these figures three years maintenance spares shall be specified by the equipment supplier. The equipment availability shall exceed 99.9%.

1.2.15 Field Observations

For new products field observation may be carried out by purchaser

1.2.16 Packing

Packing shall be done in accordance with latest guidelines for the SMPS Power Plants issued by QA wing of BSNL.

1.2.17 Environmental requirements

Each system shall be capable of operating in conditions conforming to TEC GR No.14016:2010 (old SD QM-333 Issue March 2010) category B2 of QA Wing of BSNL. It shall also comply with vibration requirements of clause 12.0 of TEC GR No.14016:2010 (Old no.QM-333). The system shall also be capable of working in saline atmosphere of coastal areas and up to an altitude of 3000 Metres in compliance of TEC GR No.14016:2010 (Old no.QM-333). The environmental tests shall be performed by configuring the power plant as follows:

(i) DSCA for ultimate capacity
(ii) One FR/FC, FR/BC (Conventional Battery Power Plant) module

1.2.17.1 Burn-in tests

The fully equipped rack shall be capable of withstanding a burn-in test for 72 hours at an ambient temperature of 50°C when the equipment is working at full rated load. This test may be performed in a temperature controlled room with free air flow. The ambient temperature shall be measured at a distance of 1 foot from the equipment under test. The necessary set-up for the purpose shall be provided by the manufacturer.

The temperature rise of the heat dissipating components above the ambient, measured directly or at heat sink in the first eight hours of the test, shall not be more than :

a) **Transformers and Chokes**: 70 deg C for Grade B insulation.

For higher grade of insulation, higher temperature rise may be permissible, subject to the following conditions:

(i) It is at least 20 deg C below the permissible limit for the grade of insulation used.

(ii) The temperature rise shall be at least 30 deg C below Curie temperature of the magnetic material.

(iii) This temperature shall neither affect other components nor shall lead to fire hazard.

b) Semiconductor devices: 60 deg C or as per component spec.

1.2.17.2 Insulation Resistance and Voltage Proof Tests:

1.2.17.2.1 The insulation resistance test

The insulation resistance of a fully wired FR/FC, when tested with a 500V DC megger, shall be as given below :

a) AC Input & Earth - Greater than 2 meg Ohm

b) DC Output & Earth - Greater than 1 meg Ohm

c) AC Input & DC out put - Greater than 5 meg Ohm

1.2.17.2.2 Voltage Proof Test

With EMI/RFI capacitors and MOVs/Tranzorbs removed from the circuit a test voltage of 1500V/50Hz is applied for one minute.

- Between earth and interconnected output terminals.
- Between interconnected input and output terminals.

Alternatively, without removing EMI/RFI capacitors, the lightning protection circuitry and Tranzorbs etc., but with EMI/RFI discharge resistors removed:

a) A 2150V DC can be applied for one minute between interconnected input & output terminals.

b) 650V DC can be applied for one minute between interconnected output terminals & earth.

This DC voltage test is in accordance with UL 950 & IEC 950 Standards. No breakdown or abnormal temperature rise shall occur.

1.2.17.3 Noise and Vibration

The fully equipped rack at full load shall not contribute more than 15 dB (weighted) to the ambient noise level taken as 45dBA. It shall be measured at a distance of 1 metre from the unit & 1.25m above the floor level in the Acoustic Range. The correction factor for Total Noise when the ambient noise level is more than 45dBA, shall be as given below:

Ambient Noise	Correction Factor	Ambient Noise	Correction Factor	Ambient Noise	Correction Factor
45dBA	0dB	51dBA	1.41dB	57dB	3.69d
46dBA	0.18dB	52dBA	1.73dB	58dB	4.17d
47dBA	0.39dB	53dBA	2.07dB	59dB	4.68d
48dBA	0.61dB	54dBA	2.43dB	60dB	5.21d
49dBA	0.86dB	55dBA	2.82dB		
50dBA	1.12dB	56dBA	3.25dB		

Note: The correction Factor shall be added to the limit of 60 dBA to arrive at the limit when the ambient is greater than 45 dBA.

1.2.18 **Safety Requirements**: The equipment shall conform to relevant safety requirements as per IS/IEC 61204: Part 7: 2016 as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024'.

1.3 SNMP and RS232/RS485 Modbus Communication Specifications for sequence of Exchange of information between Power Plant & Remote Site monitoring equipment

1.3.1 Simple Network Management Protocol (SNMP):

Simple Network Management Protocol (SNMP) is an Internet Standard protocol for collecting and organizing information about managed devices on IP networks and for modifying that information to change device behaviour. Devices that typically support SNMP include cable modems, routers, switches, servers, workstations, printers, and more.
SNMP is widely used in network management for network monitoring. SNMP exposes management data in the form of variables on the managed systems organized in a management information base (MIB), which describes the system status and configuration. These variables can then be remotely queried.

Three significant versions of SNMP have been developed and deployed. SNMPv1 is the original version of the protocol. More recent versions, SNMPv2 and SNMPv3, feature improvements in performance, flexibility and security.
Communication of information for remote monitoring through SNMP and RS232/RS485 is explained through following block diagram:-

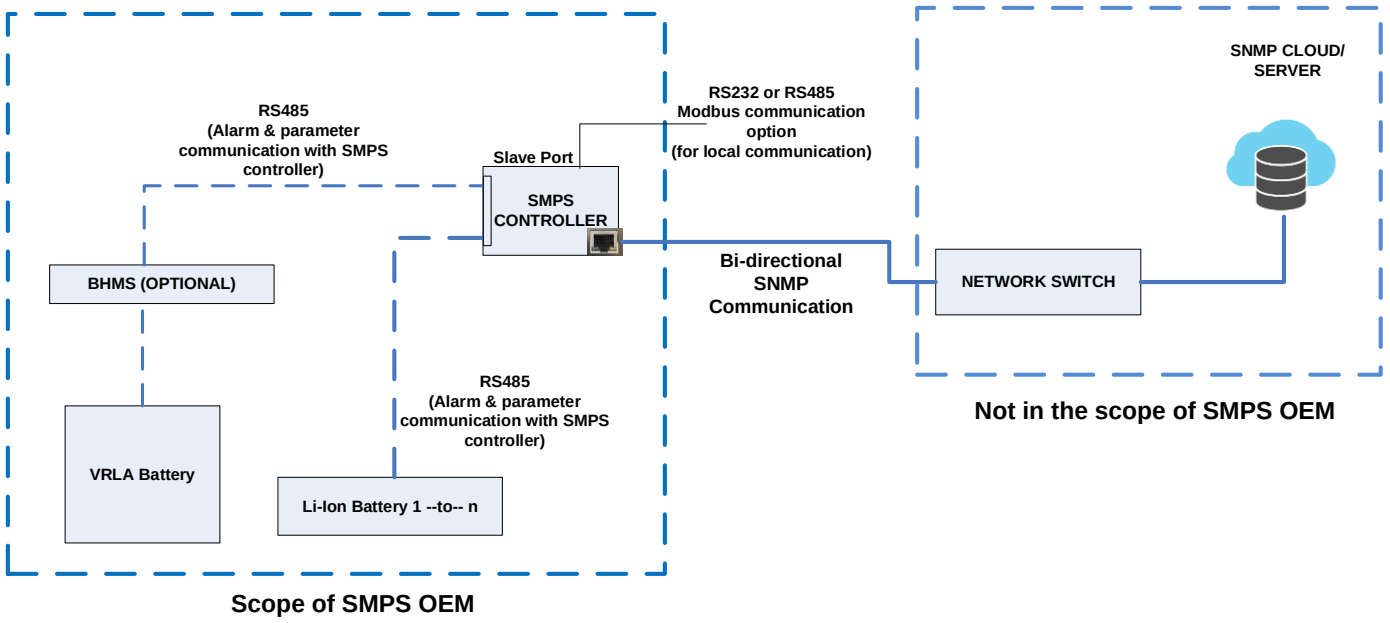

Fig.1 Exchange of information between Power Plant & Remote Site monitoring equipment through SNMP and RS232/RS485 Modbus Communication

1.3.2 Technical Specifications for SNMP:

i. All future SMPS shall be compatible with SNMP protocol.

ii. System shall support both SNMP V2 or SNMPV3 or latest SNMP protocol.

iii. Ethernet port of SMPS controller shall support 10/100Base-T or Gigabit Ethernet.

iv. System shall have the option to assign both Static IP and Dynamic IP.

v. SMPS Controller should have the option to assign minimum 3 trap destination IP & corresponding ports.

vi. Controller shall support both IPv4 & IPv6 interface.

vii. Each alarm trap should have unique SNMP & Trap OID.

viii. OEM shall share Alarm OID and Trap OID to the purchaser for SNMP protocol and Modbus addresses for RS232/RS485 protocol as applicable.

1.3.3 RS232/RS485 Modbus: RS 232 / RS485 Modbus communication interface at

Baud rate of 9600 2 (minimum) shall be used for both monitoring & control between power plants and Remote site monitoring & control unit. The data format shall be as given below ;

Following data format should be used for Standard Modbus Protocol.

(a) Data byte: -

Start bit (1)	Data bits (8bits)	Stop bit (1)

(b) Baud rate: -

Default 9600 with option to set other standard baud rates.

(c) Query from Master:-

Slave Address	Function code	Starting address (Hi)	Starting Address (Lo)	Numbers of data (Hi)	Numbers of data (Lo)	CRC (Lo)	CRC (Hi)
8bit	8bit	8bit	8bit	8bit	8bit	8bit	8bit

(d) Response by slave

Slave Address	Function code	Byte count	Data 1 (Hi)	Data 1 (Lo)	Data n (Hi)	Data n (Lo)	CRC (Lo)	CRC (Hi)
8bit	8bit	8bit	8bit	8bit	8bit	8bit	8bit	8 bit

1.3.4 Alarm list:

List of alarms to be extended over (a) SNMP and (b) RS232 or RS485 MODBUS are as under:-

S. No.	Alarms	SNMP	Modbus
	SMPS related alarms	**Yes (√) / No (x)**	**Yes (√) / No (x)**
1	Mains Fail	✓	✓
2	Site on Battery	✓	✓
3	Site Battery Low	✓	✓
4	Battery LVD	✓	✓
5	Single Rectifier Fail	✓	✓
6	Multiple Rectifier Fail	✓	✓
7	System Overload	✓	✓
8	Mains on Battery discharge	✓	✓
9	Battery Cabinet High Temperature	✓	✓
10	Battery Cabinet Temperature Sensor Fail	✓	✓
11	DC Voltage High	✓	✓
12	Battery Fuse Fail (If fuse is a part of SMPS)	✓	✓
13	Load Fuse/Load MCB fail/trip (If fuse/MCB is a part of SMPS)	✓	✓
14	SPD Fail	✓	✓
15	Cabinet Fire/Smoke (If sensor is available in Outdoor system)	✓	✓
16	Cabinet High Temperature (For Outdoor SMPS)	✓	✓
17	Cabinet Fan Fail (For Outdoor SMPS)	✓	✓
18	FLOAT Mode (For VRLA Only)	✓	✓
19	BOOST Mode (For VRLA Only)	✓	✓
20	EQUALIZE Mode (For VRLA only)	✓	✓
21	Cabinet Door open (If sensor available in SMPS)	✓	✓
22	Single Solar MPPT Fail (If Solar MPPT modules are part of SMPS)	✓	✓
23	Multiple Solar MPPT Fail (If solar MPPT modules are part of SMPS)	✓	✓
24	AC Under Voltage	✓	✓
25	AC Over Voltage	✓	✓
26	Spare Alarm / digital input from other equipment at site	✓	✓
27	Spare Alarm / digital input from other equipment at site	✓	✓
28	Spare Alarm / digital input from other equipment at site	✓	✓
29	Spare Alarm / digital input from other equipment at site	✓	✓
30	Spare Alarm / digital input from other equipment at site	✓	✓

	Li-ion battery related alarms (SMPS compatible with Li-ion battery) – Subject to availability of alarms in Li-ion battery BMS protocol		
31	Li-Ion BMS Communication Lost	✓	✓
32	LIB 1 to 16 Low SOC warning	✓	✓
33	LIB 1 to 16 Charge over temperature Warning	✓	✓
34	LIB 1 to 16 Discharge over current warning	✓	✓
35	LIB 1 to 16 Charge over current warning	✓	✓
36	LIB 1 to 16 Low cell voltage Warning	✓	✓
37	LIB 1 to 16 Cell Over voltage warning	✓	✓
38	LIB 1 to 16 Low voltage protection	✓	✓
39	LIB 1 to 16 Over voltage protection	✓	✓
40	LIB 1 to 16 Cell over voltage protection	✓	✓
41	LIB 1 to 16 Cell Low voltage protection	✓	✓
42	LIB 1 to 16 Batt. Low voltage warning	✓	✓
43	LIB 1 to 16 Batt. Over voltage warning	✓	✓
44	LIB 1 to 16 Charge over temperature protection	✓	✓
45	LIB 1 to 16 charge low temperature protection	✓	✓
46	LIB 1 to 16 Discharge low temperature protection	✓	✓
47	LIB 1 to 16 Charge over_Current_protection	✓	✓
48	LIB 1 to 16 Discharge over_Current_protection	✓	✓
49	LIB 1 to 16 Mosfet over Temp.warning	✓	✓
50	LIB 1 to 16 MOSFET over temp.Protection	✓	✓
51	LIB 1 to 16 Discharge low temperature warning	✓	✓
52	LIB 1 to 16 Short Circuit Protection	✓	✓
	VRLA battery related alarms (SMPS compatible with VRLA battery and optional and applicable where BHMS /BMS feature is available)		
53	Battery Bank 1 to 5 - Voltage High	✓	✓
54	Battery Bank 1 to 5 - Voltage Low	✓	✓
55	Battery Bank 1 to 5 - Temperature High	✓	✓
56	Battery Bank 1 to 5 - Temperature Low	✓	✓
57	Battery Bank 1 to 5 - Current High	✓	✓
58	Battery Bank 1 to 5 - Any of the Cell Fail 1, 2, 3 …. to 24	✓	✓

S. No.	Parameters	Unit	Status	SNMP	Modbus
	SMPS Related Parameters			**Yes (√)/No (x)**	**Yes (√) / No (x)**
1	Site ID	NA	Read Only	✓	X
2	System Serial No.	NA	Read Only	✓	X
3	System Make	NA	Read Only	✓	X
4	SMPS Date	NA	Read Write	✓	X
5	SMPS Time	NA	Read Write	✓	X
6	Total System Capacity	W	Read Only	✓	✓
7	RECTIFIER OUTPUT CURRENT	A	Read Only	✓	✓
8	BATERY CAPACITY	Ah	Read Only	✓	✓
9	BATTERY CURRENT	A	Read Only	✓	✓
10	BATT VOLTAGE	V	Read Only	✓	✓
11	LOAD CURRENT	A	Read Only	✓	✓
12	RECTIFIER OUTPUT POWER	Kw	Read Only	✓	✓
13	Total Installed Rectifiers	NA	Read Only	✓	✓
14	Number of working rectifiers	NA	Read Only	✓	✓
15	Number of faulty rectifiers	NA	Read Only	✓	✓
16	Rating of rectifiers	NA	Read Only	✓	✓

17	Solar Ultimate capacity	W	Read Only	✓	✓
18	Total Installed MPPT	NA	Read Only	✓	✓
19	Number of working MPPT	NA	Read Only	✓	✓
20	Number of faulty MPPT	NA	Read Only	✓	✓
21	Number of SPV Panel	NA	Read Only	✓	✓
22	Rating of SPV Panel	W	Read Only	✓	✓
23	RM redundant *	NA	Read Only	✓	✓
24	RM lacking **	NA	Read Only	✓	✓
25	BATTERY Cabinet TEMPERATURE	DegC	Read Only	✓	✓
26	SMPS CABINET TEMPERATURE	DegC	Read Only	✓	✓
27	RM replaced ***	NA	Read Only	✓	✓
28	AC Mains RUN HRS	Hr	Read Only	✓	✓
29	BATTERY RUN HRS	Hr	Read Only	✓	✓
30	SOLAR CURRENT	A	Read Only	✓	✓
31	Solar Run hours	Hr	Read Only	✓	✓
32	SOLAR ENERGY	Kwh	Read Only	✓	✓
33	RECTIFIER OUTPUT ENERGY	Kwh	Read Only	✓	✓
34	BATTERY DISCHARGE	Kwh	Read	✓	✓

	ENERGY		Only		
35	BATTERY CHARGE ENERGY	Kwh	Read Only	✓	✓
36	LOAD ENERGY	Kwh	Read Only	✓	✓
37	Rectifier 1 to 30 - O/P Current (As applicable)	A	Read Only	✓	✓
38	Rectifier 1 to 30 - O/P Voltage (As applicable)	V	Read Only	✓	✓
39	MPPT 1 Output current	A	Read Only	✓	✓
40	MPPT 2 Output current	A	Read Only	✓	✓
41	MPPT 3 Output current	A	Read Only	✓	✓
42	MPPT 4 Output current	A	Read Only	✓	✓
43	MPPT 5 Output current	A	Read Only	✓	✓
44	MPPT 1 Output voltage	V	Read Only	✓	✓
45	MPPT 2 Output voltage	V	Read Only	✓	✓
46	MPPT 3 Output voltage	V	Read Only	✓	✓
47	MPPT 4 Output voltage	V	Read Only	✓	✓
48	MPPT 5 Output voltage	V	Read Only	✓	✓
49	MPPT 1 Output power	W	Read Only	✓	✓
50	MPPT 2 Output power	W	Read Only	✓	✓
51	MPPT 3 Output power	W	Read Only	✓	✓

52	MPPT 4 Output power	W	Read Only	✓	✓
53	MPPT 5 Output power	W	Read Only	✓	✓
54	MPPT 1 Delivered energy	KWH	Read Only	✓	✓
55	MPPT 2 Delivered energy	KWH	Read Only	✓	✓
56	MPPT 3 Delivered energy	KWH	Read Only	✓	✓
57	MPPT 4 Delivered energy	KWH	Read Only	✓	✓
58	MPPT 5 Delivered energy	KWH	Read Only	✓	✓
59	MPPT 1 Input current	A	Read Only	✓	✓
60	MPPT 2 Input current	A	Read Only	✓	✓
61	MPPT 3 Input current	A	Read Only	✓	✓
62	MPPT 4 Input current	A	Read Only	✓	✓
63	MPPT 5 Input current	A	Read Only	✓	✓
64	MPPT 1 Input voltage	V	Read Only	✓	✓
65	MPPT 2 Input voltage	V	Read Only	✓	✓
66	MPPT 3 Input voltage	V	Read Only	✓	✓
67	MPPT 4 Input voltage	V	Read Only	✓	✓
68	MPPT 5 Input voltage	V	Read Only	✓	✓
69	MPPT 1 Input power	W	Read	✓	✓

			Only		
70	MPPT 2 Input power	W	Read Only	✓	✓
71	MPPT 3 Input power	W	Read Only	✓	✓
72	MPPT 4 Input power	W	Read Only	✓	✓
73	MPPT 5 Input power	W	Read Only	✓	✓
74	Battery LVD Set	V	Read write	✓	✓
75	Battery Low Alarm Voltage Set	V	Read write	✓	✓
76	Rectifier unit overload	A	Read write	✓	✓
77	Battery AH Set - VRLA 1	Ah	Read write	✓	✓
78	Battery AH Set - VRLA 2	Ah	Read write	✓	✓
79	Battery AH Set - VRLA 3	Ah	Read write	✓	✓
80	Battery AH Set - VRLA 4	Ah	Read write	✓	✓
81	Battery AH Set - VRLA 5	Ah	Read write	✓	✓
82	Battery Current Limit 1	A	Read write	✓	✓
83	Battery Current Limit 2	A	Read write	✓	✓
84	Battery Current Limit 3	A	Read write	✓	✓
85	Battery Current Limit 4	A	Read write	✓	✓
86	Battery Current Limit 5	A	Read write	✓	✓

87	Float Voltage Set	V	Read write	✓	✓
88	Boost Voltage Set	V	Read write	✓	✓
89	DC Voltage High Set	V	Read write	✓	✓
90	Equalize Voltage Set	V	Read write	✓	✓
91	Boost Start Amp Set	A	Read write	✓	✓
92	Boost Stop Amp Set	A	Read write	✓	✓
93	Boost Max Duration Set	Hrs	Read write	✓	✓
94	Equalize duration Set	Min	Read write	✓	✓
95	Equalize Interval Set	Days	Read write	✓	✓
96	LIB Charging Current Set – Max	A	Read write	✓	✓
97	LIB Charging Current Set - Each module	A	Read write	✓	✓
98	Solar VPGM voltage set	V	Read write	✓	✓
99	AC Under Voltage Set	V	Read write	✓	✓
100	AC Over Voltage Set	V	Read write	✓	✓
	Li-ion battery related parameters (SMPS compatible with Li-ion battery)- Subject to availability of alarms in Li-ion battery BMS protocol				

101	LIB 1 to 16 Manufacturer name	NA	Read Only	✓	X
102	LIB 1 to 16 Current	A	Read Only	✓	✓
103	LIB 1 to 16 Pack Voltage	V	Read Only	✓	✓
104	LIB 1 to 16 SOC (state of charge)	%	Read Only	✓	✓
105	LIB 1 to 16 SOH (state of health)	%	Read Only	✓	✓
106	LIB 1 to 16 Cumulative Charging KWH	KWH	Read Only	✓	✓
107	LIB 1 to 16 Cumulative Discharging KWH	KWH	Read Only	✓	✓
108	LIB 1 to 16 Maximum Cell Temperature	DegC	Read Only	✓	✓
109	LIB 1 to 16 Cycle Count	Nos	Read Only	✓	✓
110	LIB 1 to 16 Total_Batt_Capacity.	AH	Read Only	✓	✓
111	LIB 1 to 16 serial no.	NA	Read Only	✓	X
112	LIB 1 to 16 Cell01voltage	V	Read Only	✓	✓
113	LIB 1 to 16 Cell02 voltage	V	Read Only	✓	✓
114	LIB 1 to 16 Cell03 voltage	V	Read Only	✓	✓
115	LIB 1 to 16 Cell04 voltage	V	Read Only	✓	✓
116	LIB 1 to 16 Cell05 voltage	V	Read Only	✓	✓
117	LIB 1 to 16 Cell06 voltage	V	Read Only	✓	✓
118	LIB 1 to 16 Cell07 voltage	V	Read	✓	✓

			Only		
119	LIB 1 to 16 Cell08 voltage	V	Read Only	✓	✓
120	LIB 1 to 16 Cell09 voltage	V	Read Only	✓	✓
121	LIB 1 to 16 Cell010 voltage	V	Read Only	✓	✓
122	LIB 1 to 16 Cell011 voltage	V	Read Only	✓	✓
123	LIB 1 to 16 Cell012 voltage	V	Read Only	✓	✓
124	LIB 1 to 16 Cell013 voltage	V	Read Only	✓	✓
125	LIB 1 to 16 Cell014 voltage	V	Read Only	✓	✓
126	LIB 1 to 16 Cell015 voltage	V	Read Only	✓	✓
127	LIB 1 to 16 Cell016 voltage	V	Read Only	✓	✓
128	LIB 1 to 16 Cell Temp-1	DegC	Read Only	✓	✓
129	LIB 1 to 16 Cell Temp-2	DegC	Read Only	✓	✓
130	LIB 1 to 16 Cell Temp-3	DegC	Read Only	✓	✓
131	LIB 1 to 16 Cell Temp-4	DegC	Read Only	✓	✓
132	LIB 1 to 16 Cell Temp-5	DegC	Read Only	✓	✓
133	LIB 1 to 16 Cell Temp-6	DegC	Read Only	✓	✓
134	LIB 1 to 16 BMS Cooling/ MOSFET Temp.	DegC	Read Only	✓	✓
135	LIB 1 to 16 Batt. Module Internal/ Ambient Temp.	DegC	Read Only	✓	✓

136	LIB 1 to 16 Minimum Cell Temp.	DegC	Read Only	✓	✓
137	LIB 1 to 16 Cell Voltage Difference	mV	Read Only	✓	✓
138	LIB 1 to 16 Remaining Battery Kwh	KWH	Read Only	✓	✓
139	LIB 1 to 16 Remain Battery Cycles	Nos.	Read Only	✓	✓
140	LIB 1 to 16 Estimated Backup Time	Minutes	Read Only	✓	✓
141	LIB 1 to 16 Batt Installation & Power On Year	NA	Read Only	✓	X
142	LIB 1 to 16 Batt Installation & Power On Month	NA	Read Only	✓	X
143	LIB 1 to 16 Module Remaining_AH	Ah	Read Only	✓	✓
144	LIB 1 to 16 Cumulative Charging AH	Ah	Read Only	✓	✓
145	LIB 1 to 16 Cumulative Discharging AH	Ah	Read Only	✓	✓
146	LIB 1 to 16 BMS Version No.	NA	Read Only	✓	X
147	LIB 1 to 16 Batt_Status	NA	Read Only	✓	X
148	LIB 1 to 16 Batt_Warning	NA	Read Only	✓	X
149	LIB 1 to 16 Batt_Protection	NA	Read Only	✓	X
150	LIB 1 to 16 Batt_Error	NA	Read Only	✓	X
VRLA battery related parameters					
151	No. of battery bank	NA	Read Only	✓	✓

152	Make Battery 1	NA	Read Only	✓	X
153	Commissioning date Battery 1	NA	Read Only	✓	X
154	AH Capacity Battery 1	Ah	Read Only	✓	✓
155	Make Battery 2	NA	Read Only	✓	X
156	Commissioning date Battery 2	NA	Read Only	✓	X
157	AH Capacity Battery 2	Ah	Read Only	✓	✓
158	Make Battery 3	NA	Read Only	✓	X
159	Commissioning date Battery 3	NA	Read Only	✓	X
160	AH Capacity Battery 3	Ah	Read Only	✓	✓
161	Make Battery 4	NA	Read Only	✓	X
162	Commissioning date Battery 4	NA	Read Only	✓	X
163	AH Capacity Battery 4	Ah	Read Only	✓	✓
164	Make Battery 5	NA	Read Only	✓	X
165	Commissioning date Battery 5	NA	Read Only	✓	X
166	AH Capacity Battery 5	Ah	Read Only	✓	✓
167	Battery 1 to 5 Voltage Cell 1,2,3 …24	V	Read Only	✓	✓
168	Battery 1 to 5 Temperature Cell 1,2,3…24	DegC	Read Only	✓	✓
169	Battery 1 to 5	mho	Read	✓	✓

	Conductance Cell 1,2,3…24		Only		
170	Battery 1 to 5 Voltage limit Cell 1,2,3….24	V	Read Write	✓	✓
171	Battery 1 to 5 Temperature limit Cell 1,2,3,….24	DegC	Read Write	✓	✓
172	Battery 1 to 5 Conductance limit Cell 1,2,3….24	mho	Read Write	✓	✓

***RM Redundant (Rectifier Module Redundant): -** SMPS controller will calculate actual no. of redundant rectifier modules available in the system based on load power and reserved battery charging power. This parameter is a read only parameter which will give whole number.

For example: -

If Load = 4KW

Battery charging reserved power = 2KW

Capacity of each rectifier module = 3KW

No. of rectifiers connected and communicating with the controller = 4 nos.

Total rectifier power = 4 x 3 = 12KW

Total power requirement = 4+2 = 6KW

Then, Actual no. of redundant rectifier module = (12 – 6)/3 = 2 nos.

****RM Lacking: -** SMPS controller will calculate how many rectifiers modules are less in the system which are required to feed the load and charge the battery.

This is the difference between Required Number of Redundant RM and Actual Number Of Redundant RM.

*****RM Replaced: -** This parameter indicates the numbers of rectifiers replaced in the system since the system is powered up. This shall not include removal or insertion of same module in different slot or same slot.

Note: Purchaser may specify the additional alarms to be extended for remote monitoring over and above the alarms listed above.

CHAPTER 2

2.1 Guidelines for the Purchaser/User

2.1.1 The purchaser must ensure the availability of separate coordinated Stage-I & II protection devices, as per GR No. TEC 66130:2024 at telecom site, for protection of the Power Plant, against lightening and high voltage surges.

2.1.2 The purchaser shall specify the requirement and dimensions for Single Rack and/or Auxiliary Rack, depending on the needs of expansion and ultimate capacity. The type of rack – floor mounted or wall mounted – shall also be specified.

2.1.3 The purchase may specify the requirement of field-trial. Feedback, if any, may be furnished to TEC for improvement in the GR.

2.1.4 The purchaser shall specify the requirements for optional management features like Battery Health Monitoring, Energy Saving Management, proper functioning during voltage and phase outages, DG Efficiency & Fuel Saving Management, Battery Efficiency & Battery Management, Rectifier Control – Efficiency Management, etc.

2.1.5 Purchaser may decide the features/specifications of the power plant to be compatible with conventional Lead Acid batteries, if ordered.

2.1.6 Keeping in view of specific requirement for rural area, purchaser may specify the requirement as special case as: The Power Plant shall operate from single phase AC mains supply 230 V with variation from 120 to 290 V and frequency as 50 Hz +/-2Hz.

2.1.7 RS 485/ RS 232 and Ethernet (SNMP) communication cable of suitable length shall be protected with surge protection devices (to be decided by purchaser) to be mounted on both side of the cable.

2.1.8 Purchaser shall clearly indicate the requirement of battery health check feature while ordering the power plant.

2.1.9 Purchaser may specify the additional alarms to be extended for remote monitoring over and above the alarms listed in clause 1.3 of Chapter 1.

2.1.10 Actual battery path current will be decided by the purchaser. Further, purchaser may specify the capacity of the battery and DG set if applicable.

2.1.11 Purchaser may specify necessary provision in respect of requirement of specific sub-rack size.

2.1.12 Purchaser may specify necessary provision in respect of requirement of utilizing Bus-bar Riser for higher capacity of exchange load and battery more than 450 Amp.

2.2 ORDERING INFORMATION

The following items need to be specified while ordering by Tendering Authority depending on the requirements.

i) **Application:**

AC Input: Single phase

Three Phase

Rack Height: 1500mm

2200mm

ii) Category and Ultimate capacity of power plant as per clause 2.2.3

iii) Rating of the basic module: 6.25A/12.5A/25A/50A/100A/200A as per Category.

iv) Number of basic modules required at present including redundant units.

v) Power Plant Compatible with both VRLA and / or Li-ion batteries or with both VRLA and conventional batteries.

vi) Remote Monitoring requirements: Required/Not Required

vii) Battery Health Check requirements: Required/not required

viii) Capacity of the battery proposed in Ampere Hours.

ix) Number of batteries proposed at present and ultimate.

Important Notes:

1. Load shall include equipment load, battery load at C/10 rate of charge and other load (inverter etc.) if any. Higher battery load for Lithium battery may be considered.
2. While choosing the power plant the user shall ensure that the redundancy requirement has been taken care of.
3. It may be ensured that minimum two Batteries are chosen to meet the load requirement.
4. Float & Charge voltage shall be normally 54.0V in case of Li-ion battery compatible power plant. However, the purchaser may also specify Float & Charge voltage based on their requirements. Also, of required, the purchaser may specify the battery path current in respect of Li-ion battery, if required.

****

Abbreviations

A or Amps	Amperes
AC	Alternate Current
AH	Ampere Hour
AM	Air Mass
BIS	Bureau Of Indian Standards
BSNL	Bharat Sanchar Nigam Limited
CACT	Component Approval Centre of Telecommunication
CCU	Charge Controller Unit
CIGRE	International Conference on Large High Voltage Electric Systems
Db	Decibel
dBA	Decibel Absolute
DC	Direct Current
deg C	Degrees Celsius
DG	Diesel Generator
DI	Digital Input
DOT	Department of Telecommunication
DSCA	Distribution, Switching, Control, Alarm and Monitoring Unit
emf	Electro motive force
EMC	Electro Magnetic Compatibility
EMI	Electro Magnetic Interference
FET	Field Effect Transistor
gL/gG	General line/General Gracia (slow action fuses)
FSD	Full Scale Deflection
FR/FC	Float Rectifier cum Charger
FR/BC	Float Rectifier cum Battery Charger
GD	Gas Discharge
GR	Generic Requirements
IEC	International Electro-technical Commission

IS	Indian Standards
ISO	International Organisation for Standardisation
ITU-T	International Telecommunication Union-Transmission.
I-V	Current vs Voltage
Kg	Kilo Grams
KHz	Kilo Hertz
KW	Kilo Watts
LA	Flooded Type Lead Acid
LED	Light Emitting Diodes
LCD	Liquid Crystal Device
LM	Low Maintenance
MCB	Miniaturized Circuit Breaker
MHz	Mega Hertz
MIB	Management Information Base
MOV	Metal Oxide Varistor
MPPT	Maximum Power Point Tracking
MSL	Mean Sea Level
MTBF	Mean Time between Failures
MTTR	Mean Time To Restore
MS	milli seconds
NPL	National Physical Laborites
PCB	Printed Circuit Board
PF	Power factor
PIV	Peak Inverse Voltage
PTC	Positive Temperature Co-efficient
PWM	Pulse Width Modulation
QA	Quality Assurance
QM	Quality Manual
RFI	Radio Frequency Interference
RTEC	Regional Telecom Engineering Centre
SMPS	Switch Mode Power Supply
SNMP	Simple Network Management Protocol

SPV	Solar Photo voltaic
SS	Self-Supporting
T & D	Technical & Development
V	Volts
VDE	Verband Der Elektrootechniker
VRLA	Valve Regulated Lead Acid
W	Watts