TECHNICAL SPECIFICATION FOR DC POWER PLANT

(SWITCH MODE TYPE)

TCI
POWER PLANNING & ENGINEERING DEPARTMENT

Ordibehesht 82 – DC-Power-Plant.DOC

6.4 Mode Of Operation
6.5 Transient Withstand Capability
6.6 DC Output

7 Operational Requirements for the DC Plant
7.1 Normal Operation
7.2 Mains Outage
7.3 Battery Charging

8 DC Distribution
8.1 Design
8.2 Over Current Protection
8.3 Instruments
8.4 Transient Limits

9 Alarms and Status Indicators
9.1 Alarms Categories
9.2 Alarm Indication
9.3 Alarm Condition

10 Earthing System

11 Installation Material

12 Documentation
12.1 General
12.2 Documentation Structure
12.3 Operation and Maintenance Manuals

13 Test Equipment and Spare Parts
13.1 Test Equipment and Tools
13.2 Spare Parts and Consumable Items

14 Training

15 Guarantee

16 Condition of Technical Evaluation

17 Condition of Delivery

18 References

19 Type of DC Power Plant

1. Introduction

1.1 Scope

This Specification covers information and requirements for a centralized communication power plant providing regulated - 48 volts DC.
The power plant may be equipped with a conventional supervision unit.
Although the centralized power plant is intended to furnish uninterrupted power to potentially all the equipment in a communication facility, it may be suitable for installation in a room shared with communication equipment.
This Specification provides detailed requirements for DC power system elements except Batteries .

1.2 Objective

The objective of this Specification is considered that TCI will obtain a communication power plant that can serve a variety of communication systems, that can be extended in accordance with the extension of the communication system, using the latest technology, and that will meet all technical requirements while being easy to be planned, acquired, operated and maintained. The human - machine interface for technicians is especially important. The displays, messages and commands must be unambiguous and easily to be interpreted. This helps assure that technicians will properly analyze Operating or fault conditions. Consequently they can execute the appropriate Responses to assure uninterrupted service to communication equipment.
TCI seeks the following basic characteristics for power plants furnished under this Specification:

1.2.1 Advanced Technology :

The power system shall incorporate the latest technologies for power plants.

1.2.2 Multi - Purpose Design :

The power system shall be capable of supplying all types of equipment in a facility.
The DC output voltage set points shall be adjustable to accommodate the levels required by the communication systems and the batteries. DC power shall be distributed in conventional manner.

1.2.3 Flexibility :

The power system shall be suitable for new or replacement applications, and suitable for installation in a separate power room or alongside the communication equipment. Batteries may be located separately. The power plant shall be organized as an "open" system that can be re-engineered and re- configured in the future.

1.2.4 Modularity :

batteries, bus system connections, distribution overcurrent protectors and distribution feeders without interrupting or jeopardizing service to the existing loads.
It should be possible to Replacement rectifiers for this purpose and they should be the same in all plants.
The rectifiers should have facilities in such away that each of them can be used individually.

1.2.5 Monitoring & Control Unit (MCU) and Remote Supervision:
The power system shall offer a Monitoring & Control Unit (MCU) and Remote supervision. The MCU shall interface with a Network Management System.

2. General Information

2.1 Description of Central Power Supply System

The Power plant covered by this Specification includes system elements such as AC distribution, rectifiers, DC distribution, control unit, and protections. The basic plant circuitry provides voltage and current monitoring and alarm reporting and also the interface for remote supervision. The power plant includes the distribution cables from the DC distribution module to termination points that can be unique to the communication system.
The power plant provides uninterrupted DC power to the communication equipment. By floating the batteries on the DC output of the rectifiers, the batteries are able to provide power to the communication load without delay if power from the AC mains is interrupted. When the diesel engine set is in operation, the rectifiers will feed again the communication load and recharge the batteries .
When AC mains power returns, the rectifiers will return to normal operation, powering the communication load and recharging the batteries.

2.2 Elements of the System

2.2.1 AC Distribution :
This element distributes single - phase AC power at 220 volts or three - phase 380 volts to the rectifiers.

2.2.2 Rectifiers :
The rectifiers convert the AC voltages from the mains to well regulated - 48 volts DC to power the communication loads and float the batteries. The rectifiers provide internal voltage regulation even if external sensing of the battery voltage from the bus system is lost, and shutdown circuitry to prevent high output voltage in the event of component failure. This Specification calls for high - frequency switch mode rectifiers with power factor correction . Such rectifiers create less distortion of the AC

2.2.3 Battery Circuit Breaker Unit :

A battery circuit breaker unit provides a safe interconnection between the battery strings and the bus system fed by the rectifiers.

2.2.4 Batteries :

The batteries provide energy to power the communication loads when AC power is not available. The batteries are arranged in multiple paralleled strings of cells to provide of reserve time (Reserve time & type of batteries would be mentioned in table 1.).

2.2.5 DC Board & PDB (Power Distribution Board) :

The DC distribution system includes overcurrent protections for the feeders carrying power to the communication loads via PDB. The distribution feeders are sized to limit the voltage drop from the power plant to the loads.

2.3 Configuration

The power plant furnished under this Specification shall be completely equipped with the system elements needed to supply uninterrupted - 48 volts DC (positive terminal connected to earth) to the communication loads.

2.4 Norms

The Tenderer shall state which electrical and safety norms, the proposed power plant will meet.

3 General Requirements for all System Elements

3.1 Architecture

The Tenderer shall furnish a complete communication power plant equipped with all the system elements needed for the supply, distribution of uninterrupted, regulated - 48 volts DC for the communication equipment.

A plurality of rectifiers , each fed from a dedicated AC Distribution feeder , shall be connected in parallel to a bus system and to at least two paralleled, nominal - 48 volt battery strings.

A battery circuit breaker unit shall be connected between the bus system and batteries.

The plant voltage regulation point, Vp, is the voltage on the bus system to which the outputs of the rectifiers are connected. It is this voltage that is sensed and regulated by the DC power plant.

3.2 Capacity

N : should be designed for communication load & recovery charge of batteries at the recharge time (recharge time will be mentioned in table 1).

n : should be designed for stand-by and will be selected at least 20% of N (minimum one unit).

NOTE : All rectifiers (N+n) should be operated in normal operation (equal load sharing).

3.3Reliability

The failure of a rectifier shall not shut down any other rectifiers. The Tenderer shall state the calculated mean time between failures (MTBF) for system elements and for the overall power plant. These calculations shall take into account the expected quality and availability of the AC mains, and the battery reserve time. Replacement of components known to have a limited service life. such as electrolytic capacitors. shall be permitted in these calculations.

The MTBF of each rectifier shall be at least 20 years at 25°C , excluding electrolytic capacitors and fans. The MTBF at 45°C shall be stated by the Tenderer.

3.4 Environment

All system elements, shall be cooled by natural convection of air .

Paragraph 6.3 discusses conditions when rectifiers may employ forced air cooling .

All system elements , shall operate at full ratings at temperatures from 0 C to +50 C and relative humidity up to 90% . Installed system elements shall not be damaged by temperatures from - 10°C to + 55°C .

3.5 Electrical and Safety Standards

The power plant shall be certified by Supplier's Declaration of Conformity to EN60950 (CENELEC version of IEC950) These standards provide the requirements necessary to protect operations and service personnel from hazardous voltages. No single fault shall expose personnel to a hazardous voltage.

3.6 Electromagnetic Interference

The power plant shall be suitable for operation when placed in a line-up next to any communication equipment . It shall not interfere with the operation of the communication equipment nor be disturbed by that equipment.

The power plant shall meet the electromagnetic interference (EMI) emissions requirements of EN55022 (CENELEC version of CISPR 22) to the Class A level.

compliance with local regulations, over the load and AC mains ranges specified in Paragraph 6.3.
The power plant shall operate without degradation (Criterion 1) in an electric field intensity of 3.0 V/m as described in IEC801-3.

3.7 Transient Immunity

The power plant shall be immune to Severity Level 2 Electrical Fast Transient/Burst (EFT) voltages on AC lines and signal / control lines longer than three meters, as specified in IEC801-4 . These transients are 1000 volts on AC leads and 500 volts on other leads. the pulses are 50 ms wide with a rise time of 5 ms and occur in 5KHz bursts that are 15 ms long repeated every 300ms. These transients are coupled capacitively in the common mode.

3.8 Electrostatic Discharge

The power plant shall operate without degradation after Level 3 electrostatic discharge (ESD) exposures per IEC801-2 positive and negative polarity air discharges at 8.0 KV and positive and negative polarity contact discharges at 6.0 KV are required at this Level . Test discharges shall be made to T.C.I - accessible points and sensitive points shall be subjected to ten discharges one second apart.

3.9 Frame Currents

In the interests of personnel safety, electrical noise reduction and proper equipment operation, the metal enclosures and framework shall not be used to carry return currents from the communication loads. Return currents shall be carried to the rectifiers by cables.

3.10 Acoustic Noise

The acoustic noise level from any system element such as a rectifier shall not exceed 50 dB A measured 1.0 m form the front of the face plate, 1.5 m above floor level .

3.11 Protection of Personnel

All external metal surfaces shall be earthed. Voltages exceeding safe limits shall be marked with warning labels and guarded to prevent accidental contact by personnel. Surfaces at temperatures of +52 C or more (at +25 C ambient) should have warning labels.

3.12 Physical Design

3.12.1 General

The design, workmanship , materials and finish of all apparatus and equipment shall be of the necessary quality and reliability to withstand

surface All components and wiring shall be clearly labeled corresponding to items indicated on circuit drawings.

3.12.2 Location

The power plant shall be suitable for placement in the same room as the communication equipment . The Tenderer shall therefore state , separately for the power plant heat dissipation data in KW and in BTU/hour, floor loading in kg /m, required floor coverings and clearances for front, rear and top.

3.12.3 Enclosures, Operation and Maintenance

The power plant shall consist of cabinets in which the rectifiers, battery disconnect circuit breakers, DC distribution fuses and instruments are mounted. The design shall provide for front access only, to facilitate simple and rapid installation and removal of units and assure personnel safety during installation, operation and maintenance. Switches and other controls, displays, and meters shall be placed on the front panels of the units. Replaceable components such as fuses and control circuit shall also be accessible from the front of the unit. The equipment in the cabinets shall be of modular design. To the extent possible, modules shall be used . The individual units shall be sized to be easily handled by one person when weight permits . it shall be possible to expand the power plant, and to remove and replace units, without interrupting power to the communication load.

3.12.4 Busbars, Cables Signal Leads

Bus system currents shall be carried by busbars and/ or insulated cables. wiring carrying small currents such as control signals, voltage sensing signals, alarms, etc. shall preferably be terminated in plugs and jacks.

3.12.5 Corrosion and Environmental protection

Metal parts shall have a corrosion - resistant unless they are inherently corrosion- resistant. Protection against electrolytic corrosion shall be provided when dissimilar metals are in contact with each other. If the power plant is to be installed in a subtropical or tropical location, conform coatings or other means shall be used on printed wire boards and other components as necessary to protect equipment from mould . fungus, etc.

3.12.6 Components

Transformers and inductors shall wound with copper wire . Insulation suitable for the maximum operating temperature of the coil shall be used. The insulation shall be suitable for the expected humidity and dust of the environment where the coils will be used . Resistors, capacitors and semiconductors shall be suitably designed to achieve long operational life at normal loads. Temperature rises and ripple currents in electrolytic capacitors shall be controlled, these capacitors shall be equipped with vents, and the capacitors shall discharge when power is removed from the equipment .Fuses are permitted for overcurrent protection. Fuses

protection. Circuit breakers shall be of the type that can not be held closed by holding the lever. Knife switches with exposed blades shall not be used on exposed panels.

3.12.7 Operation

All the system elements shall be designed for unattended operation. Alarms shall be generated , collected and reported as described in paragraph 9 of this Specification. In particular, no intervention by communication personnel shall be required during AC mains outages. The rectifiers shall restart when power returns to the AC mains . Recharging of the batteries after an AC power outage shall also be accomplished automatically.

3.12.8 Routine Maintenance

Routine maintenance shall be limited to checks system elements once every year.

4 AC Distribution

4.1 AC Supply Voltage

Under normal operating conditions, the communication power plant shall be powered from the public AC mains. Nominal parameters of the public AC mains are :

Voltage :	380/220V
Voltage Range :	-15% to +10%
Frequency :	50 Hz
Frequency Range :	47-53 Hz

Note: Hysteresis of shut down and return to operation should be about 10V for low AC input and 5V for high AC input.

4.2 AC Distribution System

A suitable distribution unit and distribution cabling to the rectifiers shall be provided . The distribution unit shall be equipped with overcurrent protection devices for the feeders to the rectifier . The Tenderer shall provide information to demonstrate that the overcurrent protection devices for the feeders to the rectifiers are of the correct size , and meet the inrush current and full - load power characteristics of the rectifiers specified for the power plant.

5 - 48 Volt DC Power Plant

5.1 Introduction

The - 48 volt DC power plant shall be equipped with the basic plant functions of paragraph 5.5 It shall also be equipped with the battery charging regimes of paragraph 7.3 applicable to the type of battery furnished.

5.2 Electrical Performance of System (load)

The specified power supply is required for the systems consumption, which must be considered and designed according to the following requirement :

5.2.1 Nominal voltage of the system	**- 48 V (positive ground)**
5.2.2 Acceptable voltage range	**- 40 V to - 58 V**
5.2.3 Ripple must be less than	**100 mV (pick to pick)**

5.3 Noise

The noise measured at the output of the DC power plant shall meet the following requirements of prETS 300 132-2. Noises shall not exceed the values shown in the table below . In the table , 0 dBm is mW, 50 ohm Bandwidths for narrow band noise measurements are 10 Hz for the range from 25Hz to 10 kHz and 200 Hz for the range from 10kHz - 20kHz.

Narrow Band Noise Limits			
Frequency Range	Limit (mV)	Limit (dBm)	Remark
25 Hz to 300 Hz	50 mV	-13 dBm	
300Hz to 1000Hz	50 to 7.07 mV	-13 to -30 dBm	
1000Hz to 20kHz	7.07 mV	-30 dBm	Decreasing linearly on a log-scale of voltage versus frequency
Wide Band Noise Limits			
25 Hz to 5kHz	< 2.0 mV		psophometric (weighted)
25 Hz to 20kHz	< 50 mV		rms (unweighted)

5.4 Failure Group sizes

The power plant shall be fully redundant, containing a plurality of rectifiers and at least two strings of batteries.
All control, monitoring and alarm circuits in all elements of the DC power plant shall operate from -48V and remain fully functional if power from the AC mains is lost. Control circuits shall be connected to dedicated over current protection devices .

5.5 Basic Plant Functions

5.5.1 Voltage Monitoring
The plant shall monitor the voltage Vp across the bus system, and shall monitor the voltage for each rectifier's individual , this voltages shall be

displayed on a suitable meter. The meter accuracy shall be ± o.5% in the range of 40V to 60V . (For analog type Accuracy shall be at least ± 1.5).

5.5.2 Current Monitoring

The plant shall monitor the following current:

- Total output current of the plant
- Charge and discharge current of battery
- Output current of each rectifier
- The meter accuracy shall be ± 1% over the upper half scale.

5.5.3 Alarm Reporting

The plant shall indicate the alarms and status indicators specified in Paragraph 9. All alarms produced by the DC power plant shall be integrated into the Network Management System and identified as power alarms, when displayed.

6 Rectifiers

6.1 Circuit Topology

The rectifier shall be high - frequency switch mode type . operating at a switching frequency of 40kHz or higher. Soft switching (Zero Voltage Switching – ZVS , Zero Current Switching – ZCS) technology are preferred.

6.2 Technical design

Controls, LCD and indicators shall be located on the front panel of the rectifier . Modules shall be plug-in type and easily disconnected and removed from the equipment cabinets. Removal and replacement shall not require the removal of any other equipment other than covers of the unit involved.

6.3 General Technical Characteristics

6.3.1 Voltage Regulation

The rectifier shall have adjustable output voltage . This voltage shall be maintained with an accuracy of ±0.2V for output power from no load to full load, AC input voltage variations between -15% and +10% of nominal, and AC frequencies from 47Hz to 53Hz. The rectifier output voltage shall remain within regulation limits for at least 10 ms after interruption of the AC input.

6.3.2 Efficiency, Power Factor and Harmonic Distortion

The rectifier shall have an efficiency of at least 90% for loads from 25% to 100% of full power the rectifier total/true power factor (ratio of watts to

volt - amperes at the 50Hz fundamental frequency) shall be at least 0.90 at full load.

The rectifier crest factor (ratio of peak current to rms current) shall be no greater than 1.5 from no load to full load. Total current/voltage harmonic distortion shall be in compliance with local regulations, over the load and AC mains ranges as specified. Tenderer shall indicate typical values for rectifiers proposed.

6.3.3 Limitation of surge Currents & inrush current

The rectifier shall incorporate a "current walk - in " feature to prevent surge currents when the rectifier is turned on into heavy loads such as discharged batteries .The time to reach full load shall be at least eight seconds. Input inrush current of rectifier should be less than %150 of nominal input current.

6.3.4 Disconnect of Faulty Rectifier

If a fault occurs in a rectifier, only that rectifier shall disconnect from the load.

6.3.5 AC Mains Outage

The rectifiers shall not be damaged by any voltage from 0.0 volts to more than limit specified in paragraph 4.1 Input circuit breakers shall not operate under these conditions. The rectifiers shall operate normally when the AC mains voltage returns to a value within the normal range. The voltage returns to normal operation should be adjustable.

The three phases rectifiers shall not be insensitive to phases sequence.

6.3.6 Control, Meters, Alarms and Indicators

the rectifiers shall be equipped with an ammeter and for local control shall include the necessary front panel indicators to show the following conditions :

- ON
- ALARM
- INDICATORS

The following local status and alarm indications shall be provided as minimum :

* Rectifier - normal
* Rectifier - input failed
* Rectifier - output failed
* Rectifier - output out of limits

6.3.7 Parallel Operation

The rectifier shall be capable of being operated in parallel with any number of rectifiers of the same or different output power ratings. The rectifiers shall share the load. Accuracy of load sharing should be less than %5 of nominal current output of rectifiers.

6.3.8 Power or Current Limiting

The rectifier should incorporate an output power limiting system that reduces the output voltage as the current increases so that the output power remains essentially constant. Alternatively. If the Tenderer furnishes rectifiers with traditional current limiting, this shall commence at 110% of rated output current.

6.3.9 Cooling

The rectifiers shall be cooled by natural convection of air as specified in paragraph 3.4. When the space available for rectifiers is limited, and if the environment is satisfactory as regards dust. etc., the rectifiers may employ forced air cooling, If the temperature becomes high Fans shall have an MTBF of at least five years (Temperature dependant).

6.4 Modes of Operation

The rectifiers shall operate at the float, equalize and initial voltage. see Paragraph 7.3 for further information.

6.5 Transient withstand Capability

IEC801-5/D and ANSI/IFFF C62.41 require that power equipment tolerate common mode and differential mode Lightning transients on the AC mains. Rectifiers furnished under this Specification shall withstand common mode pulses/Waves at Level 4 (4okV) and different mode pulses / waves of Level 3 (2.0kV) for 1 to 2 50 us pulses and for ring waves.

6.6 DC Output

The rectifier -48 volt DC output shall be protected by a fuse or circuit breaker . This overcurrent protection device shall not operate when the rectifier is in power or current limit.

6.7 Interface to the Network Management System

Communications between the rectifiers and the Network Management System shall be made with copper wires and suitable cable connectors or other appropriate devices.

7 Operational Requirements for the DC Plant

7.1 Normal Operation

Under normal operation conditions, the outputs of all the rectifiers are conducted in parallel , as are all the battery strings. When AC is present on the mains, the rectifiers' output voltage is held constant for variations of AC voltage and frequency per paragraph 4.1 and from no load to full load on the output of the plant.

The plant voltage (Vp) is chosen so that the plant supplies not only the load current for the communications equipment , but also the small charging current required to compensate for self- discharge of the batteries The recommended float voltage shall be stated by the tenderer as required in paragraph 6.4

7.2 Mains Outage

7.2.1 Transfer to Batteries

When power from the AC mains is interrupted , the batteries shall provide the load current without interruption.

7.2.2 Low Voltage Alarms During Discharge

When the batteries are in discharge. two alarms, with independently adjustable thresholds, shall be provided :

* Under voltage Alarm
* Severe Under voltage Alarm (load disconnection optionally)

Tenderer shall recommend settings of the two thresholds.

7.2.3 Rectifier Automatic Restart

When power from the AC mains returns the rectifiers shall restart automatically.

7.3 Battery Charging

7.3.1 Recharge

If batteries are recharged at a voltage higher than the float voltage level, Tenderer shall provide for the following option. The batteries shall be recharged for a controlled time interval as discussed below . This regimen helps assure equal charging of all cells, provides a minimum float voltage and avoids overcharging, helping assure a maximum battery life.

When a mains outage occurs, the battery voltage drops to value below the open circuit voltage and battery discharge begins. Tenderer shall state whether a voltage value or time delay interval is used to define the start -of discharge time . When the AC mains power returns, the battery voltage begins to rise as recharging begins automatically and manually. The Tenderer shall state whether the return of AC mains power or a voltage value is used to define the end - of - discharge time . Tenderer shall state how the resulting recharge interval, at the recharge voltage specified is determined. Tenderer shall also state the maximum duration permitted for the recharge interval, which shall not exceed 12 hours. It should be possible to select recovery charge manually. in this case after recharge duration the rectifiers should return to float charge automatically.

The rectifiers may be used with either wet type or sealed type batteries.

Initial charge by doing some stages shall be available in away that the selection of initial charge should be done manually (by using selector). the rectifier should not select in initial mode before disconnecting the load.

8 DC Distribution

8.1 Design of Distribution System

The DC distribution system shall provide a distribution network engineered for a voltage drop not exceeding 0.7 volts from the battery to

the distribution frame and 1.0 volts from the distribution frame to the communication load. Each DC – PDB of communication system shall be fed by paired distribution cables directly from DC distribution frame, and each negative cable shall be equipped with its own overcurrent protection device.

A short circuit condition in on branch of the distribution network shall not affect other branches. or equipment connected to them or other inter connected systems.

8.2 Overcurrent Protection

An appropriate number of distribution circuit breakers positions shall be provided. circuit breakers shall be provided at installation.

8.3 Instruments

Meters indicating Rectifier and bus system voltage, and rectifier and plant distribution current, as specified in paragraph 5.5, shall be provided.

8.4 Transient Limits

8.4.1 General

EN41003 requires that the remainder of the system shall function again within its operational specifications without manual intervention after an overcurrent protection device operates and clears a fault. Overcurrent protection devices in other feeders shall not operate. Equipment served by other feeders is required to continue normal operation after the fault - clearing transient.

8.4.2 DC Distribution System

For the distribution system the requirements of EN41003 regarding transient voltages shall apply. Distribution systems that are short, using cables and having a predominately capacitive load, are allowed to propagate the pulse described below to other feeders when a fault is cleared;

The pulse may reach 100 volts with a rise time of 5.0 us fall to 70 volts within 50 us. and return to 0.0 volts within 4.0 Ms. Additionally, the voltage may drop to 0.0 volts for a maximum of 4.0 ms during fault clearing.

Distribution systems that are long, using busbars and having a predominately resistive or inductive load, are allowed to propagate the pulse described below to other feeders when a fault is clear.

The pulse may reach 300 volts with a rise time of 50 us. fall to 100 volts within 700 us. and return to 0 volts within 2.0 Ms. Additionally, the voltage may drop to 0.0 volts for a maximum of 10 ms during fault clearing.

9 Alarms and Status Indicators

9.1 Alarms Categories

In the event of faults, abnormalities, or parameters out of range . alarm signals shall be generated. It shall be possible to combine and group the alarms.

9.2 Alarm Indication

The visual alarms may be displayed at the power cabinet. The system element reporting an alarm shall have visual indications. These indications shall provide sufficient information for staff to locate the failed system element and determine the corrective action necessary.

9.3 Alarm Conditions

The following alarms shall be integrated into the Network Management system and identified as power alarms, when displayed:

* Rectifier fail (one unit)
* Rectifier fail (two or more units)
* Rectifier AC input fail
* Low voltage (1.70 --- 1.80 V/Cell Adjustable)
* Battery on discharge
* Battery disconnect or battery fuse blow out
* Rectifier AC mains outage
* Rectifier input fuse or circuit breaker
* Rectifier output fuse or circuit breaker
* Rectifier over voltage shutdown
* Rectifier low current alarm
* Rectifier in power or current limit
* Rectifier turned off
* Displacement of phase sequence (only for Three phases rectifiers)
* Fan fault

10 Earthing System

A good earthing system is essential to providing a disturbance - free electrical environment, a stable reference for transmitting low level logic signals in a communication system and most important, protecting the operations maintenance personnel.

The DC system shall be earthed at a single ground point. The frame of all equipment shall be interconnected to this point.

11 Installation Material

Installation materials such as trunk , cable tray, cables ,bolts , nuts and other related materials should be proposed by tenderers according to enclosed LOM & drawing .

12 Documentation

12.1 General

The Tenderer shall supply documentation which shall describe the system in such a format and quality that the administrative as well as operational features of the system can be evaluated. This documentation shall include all necessary schematic diagrams, circuit drawings, technical descriptions. operational and testing instructions. Examples of documentation which is to be used for operation and maintenance . installation and at the network management center, shall be part of the offer.

12.2 Documentation Structure

The documentation library to be provided with the equipment for all systems shall be structured and divided into modules according to the following :

1. Document descriptions of all document types included in the documentation library
2. Operation and maintenance manuals for all regular actions which have to take place on the network and / or at the network management center
3. System specific documents as circuit diagrams, component layouts, component lists. block diagrams, wiring diagrams, mechanical drawings, material lists
4. Text documents for system descriptions
5. Hardware documents down to the module level
6. Installation manuals for installation of equipment
7. Test manuals for testing of installed functions and equipment

12.3 Operation and Maintenance Manuals

The operation and maintenance manuals shall give a description of the equipment and the facilities offered with sufficient information for the following :

1. Fault locating to enable faults to be cleared
2. Handling of data and handling of measuring facilities
3. Description of periodic routine maintenance
4. Repair manuals

13 Test Equipment, Tools and Spare Parts

13.1 Test Equipment and Tools

1.1 Main offer

The Tenderer shall detail the requirements for special tools and test equipment required for normal maintenance, with details the test equipment necessary to enable modules to be repaired down to *Electronic boards level* in TCI Repair Center. The type and quantity of modules that can be tested in relation to the whole system should be quoted for each type of test equipment .

1.2 Option offer

The Tenderer shall detail the requirements for special tools and test equipment required for normal maintenance, with details the test equipment necessary to enable modules to be repaired down to *component level* in TCI Repair Center. The type and quantity of modules that can be tested in relation to the whole system should be quoted for each type of test equipment .

2. The Tenderer shall indicate the manufacturer and model number of all test equipment offered and specified in the Bill of Quantity.

3. Tenderers should recommend robust test equipment that can withstand transportation through rough roads. Test equipment and spares modules shall be supplied with transport boxes for safe transportation.

4. All Test equipment shall be supplied with all necessary interfaces i.e. plugs, cords, sockets, adapters etc. necessary for correct operation.

13.2 Spare Parts and Consumable Items

1. Tenderer should deliver a complete list of used quantity in each unit including all electronics boards , main component , fuses , switches ,lamps etc.

2. TCI will select spare parts and spare units base on 5% of total price of equipment from above mentioned list.

3. All spares shall be clearly identified with regard to function, type number, model number .

4. The Tenderer shall supply the consumable material necessary for the operation of the offered system. Therefore a list of estimated items and quantities of the required consumables sufficient for an operation period (during guarantee period) .

5. The consumable items shall be specified in the Bill of Quantity.

6. All spares , consumables of otherwise used material during commissioning of the system shall be replaced by the contractor free

of charge prior to provisional acceptance of the individual system units.

7. The Tenderer shall list in detail the components in all equipment provided under this specification that are of special manufacture and as such can only be obtained through the Tenderer or the Tenderer's representative.

8. The Tenderer shall guarantee the supply of spare and consumable parts preferably for the whole lifetime of the supplied system but at least for a period of 15 years.

14 Training

Training should be done according to the training annex by contractor.

15 Guarantee

15.1 All equipment should be guarantee by contractor for 24 months from date of delivery to TCI ware - house .

15.2 The contractor(s) shall guarantee the supply of spare & consumable parts preferably for the whole lifetime of the supplied system but at least for a period of 15 years.

16 Condition of Technical Evaluation

All tenderers must enclosed following documents and information in envelope B.

16.1. Point to point answer to the technical specification must be given . fully confirmed is not sufficient.

16.2. Description of experiences in the power electronic field and supply record for type of equipment required in this project.

16.3. Description of facilities R & D , planing , production in power electronic field .

16.4. Technical documents including catalogue , installation drawing description of operation , type of equipment.

16.5. Complete list of all equipment (LOM) according to the attached list.

16.6. List of used quantity, which is mentioned in item 13.2.1 .

16.7. Detail information of tools and testers according to para. 13.

16.8. Tenderer should deliver a complete plant consist of two units of rectifier to technical Department for approval.

16.9. Production specimen should be tested and approved by technical Department before mass production.

NOTE : Production of equipment must be exactly as the specimen tested.

17 Condition of Delivery

In providing and delivering the system and the related equipment the following notes should be taken into consideration :

17.1. All system parts & equipment must be packed firmly in such a way that they be durable against environmental condition (moisture , dust , high and low temperatures and shocks) during transportation and storage.

17.2. The electronic boards & elements should be tested , controled & adjusted in the factory before shipment .

18 References

1. EN60950 Safety of Information Technology Equipment. Including Electrical Business Equipment , Issue 3, November 1992 , CENELEC

2. EN55022, Limits and Methods of Measurement of Radio Interference characteristics of Information Technology Equipment. April 1987. CENELEC

3. IEC801-3, Electromagnetic Compatibility for Industrial - process Measurement and Control Equipment - Radiated Electromagnetic Field Requirements, Issue 1, April 1988, IEC

4. IEC801-4 Electrical Fast Transient /Burst Requirements. First Edition. 1988, IEC

5. IEC801-2, Electromagnetic Compatibility for Industrial - process Measurement and Control Equipment - Electrostatic Discharge Requirements, Issue 2, April 1988, IEC

6. prETS300 132-2, Equipment Engineering Power Supply Interface at the Input to Communication Equipment, Version 4.0 July 1993 , European Communication Standards Institute.

7. IEC801-5/D, Electromagnetic Compatibility for Electrical and Electronic Equipment. part 5: Surge Immunity Requirements. Draft, June 1993, IEC

8. IEEE Recommended practice On Surge Voltages in Low - Voltage AC power Circuits, ANSI/IEEE C62.41-1991

9. EN41003, particular Safety Requirements for Equipment to be Connected to Communication Networks, Issue 1, October 1991, CENELEC

19 Type of DC Power Plant

This specification is provided for two type of DC power plant:

- "A" Type (Low Capacity)
- "B" Type (High Capacity)

Note: *"A" Type is included two models ("A1" Model & "A2" Model).*
" B" Type is included two models ("B1" Model & "B2" Model) .

A-20 : Attachment

The following documents are attached :

- Attachment " A" :

A0- Related information of stationary battery for "A" type (Low capacity)

A1-1- Front view of plant for "A1" model (Low capacity)

A1-2- wiring diagram for " A1" model (Low capacity)

A1-3- List of material for "A1" model (Low capacity)

A1-4- Installation material for "A1" model (Low capacity)

A1-5- Consumable spare part (Fuse & lamp) for "A1" model (Low capacity)

A1-6- Complete list of used quantity in each unit for "A1" model (Low capacity)

A2-1- Front view of plant for "A2" model (Low capacity)

A2-2- wiring diagram for " A2" model (Low capacity)

A2-3- List of material for "A2" model (Low capacity)

A2-4- Installation material for "A2" model (Low capacity)

A2-5- Consumable spare part (Fuse & lamp) for "A2" model (Low capacity)

A2-6- Complete list of used quantity in each unit for "A2" model (Low capacity)

- Attachment " B" :

B0- Related information of stationary battery for "B" type (High capacity)

B1-1- Front view of plant for "B1" model (High capacity)

B1-2- wiring diagram for " B1" model (High capacity)

B1-3- List of material for " B1" model (High capacity)

B1-4- Installation material for " B1" model (High capacity)

B1-5 Consumable spare part (Fuse & lamp) for " B1" model (High capacity)

B1-6- Complete list of used quantity in each unit for " B1" model (High capacity)

B2-1- Front view of plant for "B2" model (High capacity)

B2-2- wiring diagram for " B2" model (High capacity)

B2-3- List of material for " B2" model (High capacity)

B2-4- Installation material for " B2" model (High capacity)

B2-5 Consumable spare part (Fuse & lamp) for " B2" model (High capacity)

B2-6- Complete list of used quantity in each unit for " B2" model (High capacity)

ATTACHMENT (A)

(LOW CAPACITY)

A0 : RELATED INFORMATION OF STATIONARY BATTERY FOR "A" TYPE (Low Capacity)

STATIONARY BATTERY

The batteries will be provided by TCI
DC equipment should be able to operate with two kind of batteries :

A) Wet type OPZS
Charging voltage :
-Initial charge : equal to 2.7 V/Cell (adjustable from 1 to 2.7 V/Cell)
-Recovery charge: equal to 2.35 V/Cell (adjustable from 2.25 to 2.4 V/Cell)
-Floating charge : equal to 2.23 V/Cell (adjustable from 2.1 to 2.3 V/Cell)

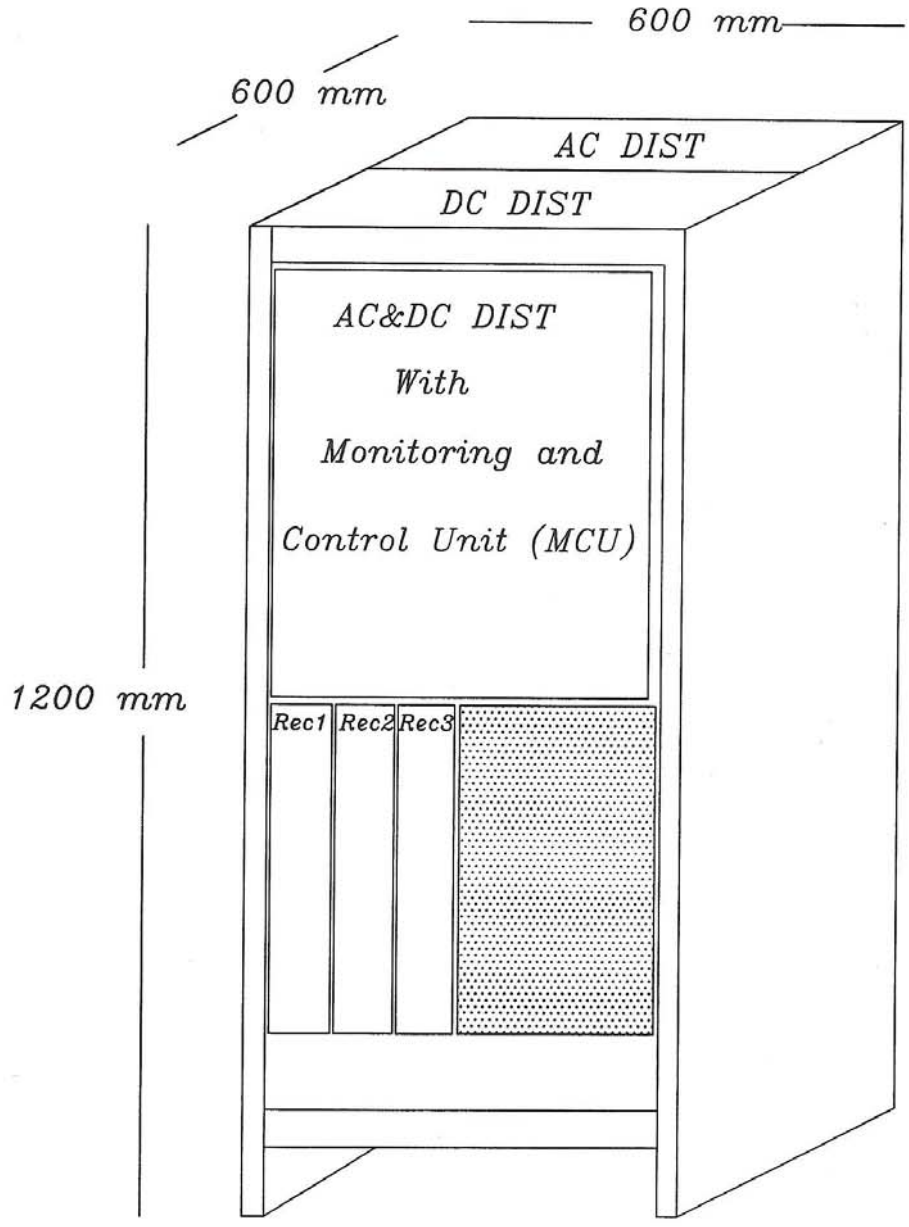
B) Dry type sealed battery (maintenance free)
Charging voltage 2.25 V/Cell (adjustable from 2.2 to 2.3 V/Cell)

Number of cell in each series : 24 Cells
Capacity of each series : UP to 600 AH
No. of series : 1 serie less than 300AH for "A1" model & 1 serie 600AH or 2 serie about 400AH in parallel for "A2" model.
Reserve time : 8 hours
Recharge time : 12 hours

Note : Initial charge by doing some stages shall be available in away that the selection of initial charge should be done manually (by using selector) the rectifier should not select in initial mode before disconnecting the load.

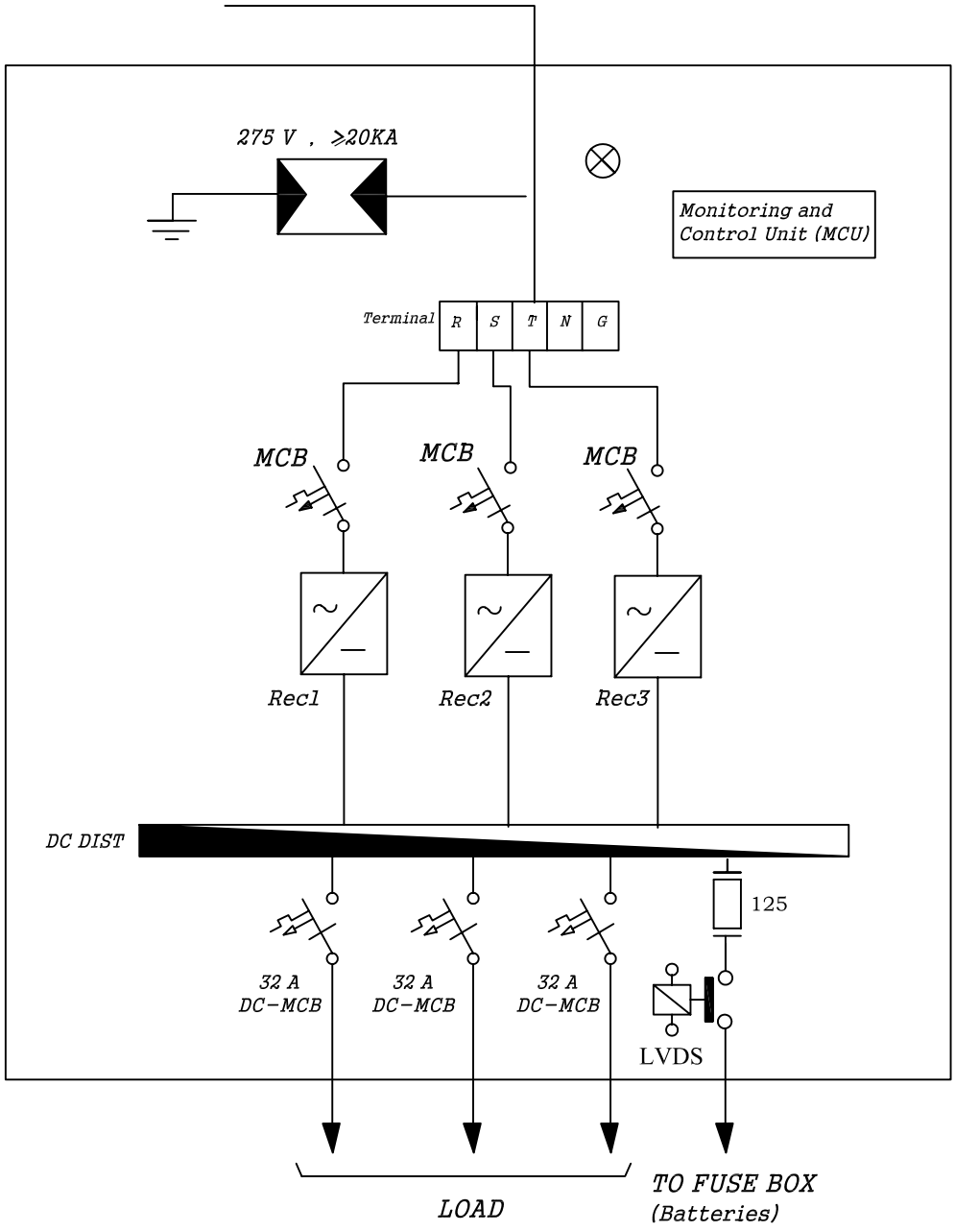
A1–1– FRONT VIEW OF PLANT FOR "A1" MODEL

(Low Capacity)



Note: The Rectiriers cabinet should be designed for 3 Modules.

A1-2 - WIRING DIAGRAM FOR "A1" MODEL (Low Capacity)



A1-3 : LIST OF MATERIAL FOR "A1" Model (Low Capacity)

No.	Item Description		Quantity	Remark
1	Rectifier Module 48V/1600W		---	
2	Cabinet for 3 Modules with AC & DC Distribution & MCU		---	
3	Installation Material (Set)		---	According to the Attachment A1-4
4	Consumable Spare Part (Set)		---	According to the para. 13.2 & Attachment A1-5
5	Maintenance Spare Part (Set)		---	5% of Total Price of No. 1 & 2 of this table, According to the para. 13.2 & Attachment A1-6
6	Special Tools		*	Should Be Specified by Tenderers
7	Tester (Set)	1. Main offer	2	According to the para. 13.1-1.1
		2. Option offer	2	According to the para. 13.1-1.2
8	Documents (Set)			
	8-1 General		---	According to the para. 12.1
	8-2 Structure		---	According to the para. 12.2
	8-3 Operation & Maintenance Manual		---	According to the para. 12.3
9	Training		---	According to the Training Annex

A1-4 : INSTALATION MATERIAL FOR "A1" MODEL (Low Capacity)

No.	Description	Length/QTY.		Remark
		Each Set	Total	
1	Cable / Multicore .... mm2 Blue	---	---	---
2	Cable / Multicore ... mm2 Red	---	---	---
3	Cable / Multicore ... mm2	---	---	---
4	Cable Shoe ... mm2	---	---	---
5	Earth Cable / Multicore ... mm2	---	---	---
6	Lader ...cm With Accessories	---	---	---
7	Plastic Cable Trunk ... cm With Accessories	---	---	---
8	Related Connection for System Installation (Connecting Set)	---	---	*

* The price of this item should calculate with the price of main equipment.

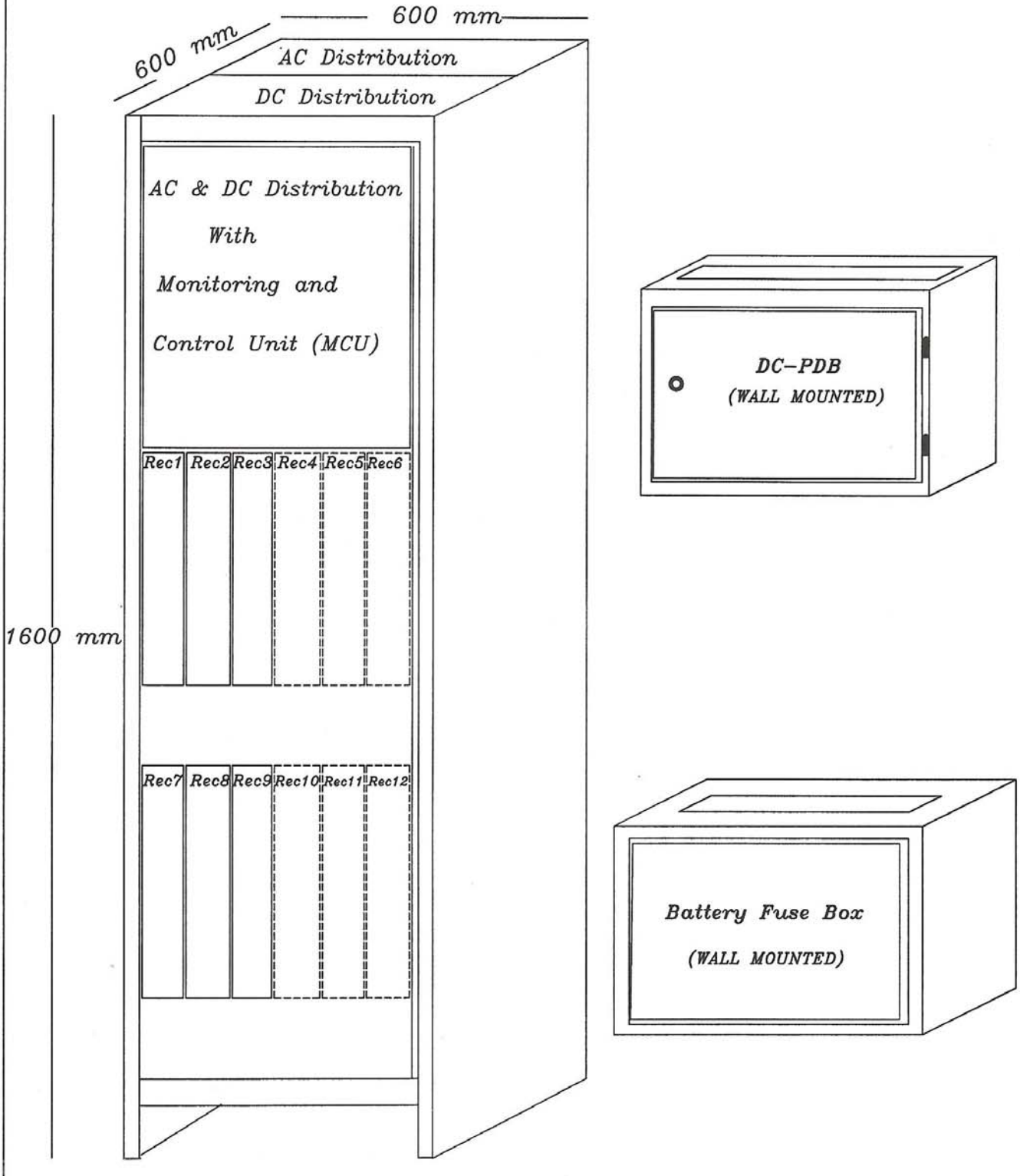
A1-5 : Consumable Spare Part (Fuse & Lamp) for "A1" MODEL (Low Capacity)

	Item	Description	Type/ Capacity	Used Quantity	Offered	
					For each Unit	Total
Rectifier module	1 2 3 4 . . .					
Cabinet With AC & DC Dist. And MCU	1 2 3 . .					

A1-6 : Complete List of Used quantity in each unit including all electronics boards, main component, fuses, lamps and etc. for "A1" MODEL (Low Capacity)

	Item	Description	Type/ Capacity	Used Quantity
Rectifier module	1 2 3 4 . . .			
Cabinet With AC & DC Dist. & MCU	1 2 3 . .			
Complete Rectifier Module	1	Rectifier Module 48V/1600w		
Complete MCU	1	Monitoring and control Unit		

A2–1– FRONT VIEW OF PLANT FOR "A2" MODEL
(Low Capacity)



Note: The Rectiriers Cabinet could be designed for 6,9 or 12 Modules

IN THE NAME OF ALLAH

TECHNICAL SPECIFICATION FOR DC POWER PLANT

TABLE OF CONTENTS

1 Introduction
1.1 Scope
1.2 Objective

2 General Information
2.1 Description of Central Power Supply System
2.2 Elements of the System
2.3 Configuration
2.4 Norms

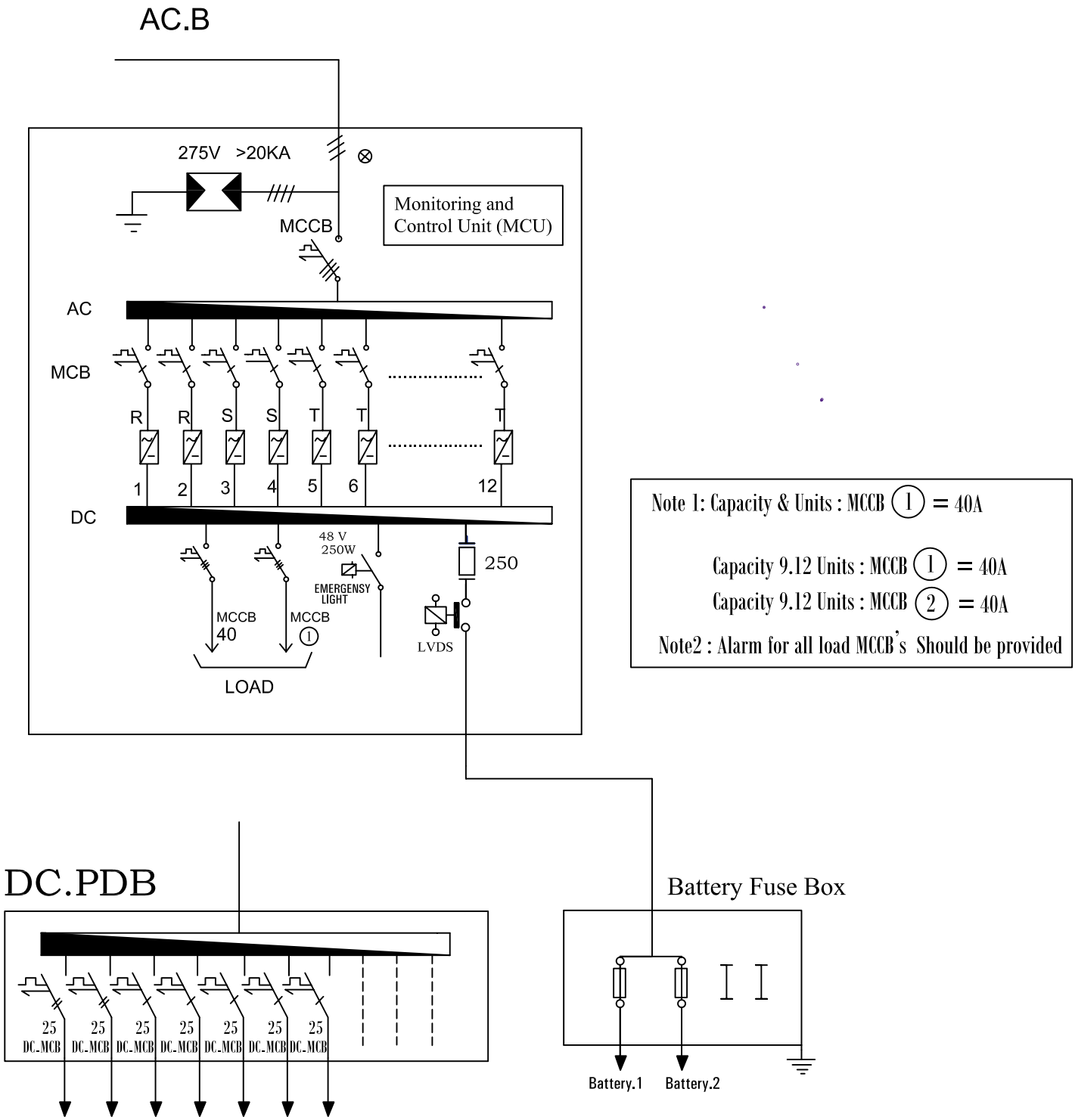
3 General Requirements for all System Elements
3.1 Architecture
3.2 Capacity
3.3 Reliability
3.4 Environments
3.5 Electrical and Safety Standards
3.6 Electromagnetic Interference
3.7 Transient Immunity
3.8 Electrostatic Discharge
3.9 Frame Currents
3.10 Acoustic Noise
3.11 Protection of Personnel
3.12 Physical Design

4 AC Distribution
4.1 AC Supply Voltage
4.2 AC Distribution System

5 - 48 Volts DC Power Plant
5.1 Introduction
5.2 Electrical Performance of Communication system
5.3 Noise
5.4 Failure Group Sizes
5.5 Basic Plant Function

6 Rectifiers
6.1 Circuit Topology
6.2 Technical Design
6.3 General Technical Characteristics

A2-2 – WIRING DIAGRAM FOR "A2" MODEL (LOW Capacity)



Note 1: Capacity & Units : MCCB (1) = 40A

Capacity 9.12 Units : MCCB (1) = 40A

Capacity 9.12 Units : MCCB (2) = 40A

Note2 : Alarm for all load MCCB's Should be provided

A2-3 : LIST OF MATERIAL FOR "A2" MODEL (Low Capacity)

No.	Item Description		Quantity	Remark
1	Rectifier Module 48V/1600W		--	
2	Cabinet for ..... Modules with AC & DC Distribution & MCU		--	The cabinet coulde be designed for 6 , 9 or 12 modules. Please specify
3	DC – PDB		--	According to the Attachment A2-1 , A2-2
4	Fuse Box		--	According to the Attachment A2-1 , A2-2
5	Installation Material (Set)		--	According to the Attachment A2-4
6	Consumable Spare Part (Set)		--	According to the para. 13.2 & Attachment A2-5
7	Maintenance Spare Part (Set)		1	5% of Total Price of No. 1 & 2 of this table, According to the para. 13.2 & Attachment A2-6
8	Special Tools		*	* Should Be Specified by Tenderers
9	Tester (Set)	1. Main offer	2	According to the para. 13.1-1.1
		2. Option offer	2	According to the para. 13.1-1.2
10	Documents			
	10-1 General		--	According to the para. 12.1
	10-2 Structure		--	According to the para. 12.2
	10-3 Operation & Maintenance Manual		--	According to the para. 12.3
11	Training		*	* According to the Training Annex

A2-4 : INSTALATION MATERIAL FOR "A2" MODEL (Low Capacity)

No.	Description	Length/QTY.		Remark
		Each Set	Total	
1	Cable / Multicore ... mm2	--	--	
2	Cable / Multicore ... mm2 Blue	--	--	
3	Cable / Multicore ... mm2 Red	--	--	
4	Cable / Multicore ... mm2 Blue	--	--	
5	Cable / Multicore ... mm2 Red	--	--	
6	Alarm Cable ... mm2	--	--	
7	Earth Cable / Multicore ... mm2	--	--	
8	Cable Shoe ... mm2	--	--	
9	Cable Shoe ... mm2	--	--	
10	Lader ... cm With Accessories	--	--	
11	Plastic Cable Trunk ... cm With Accessories	--	--	
12	Related Connection for System Installation (Connecting Set)	1 Set	--	*

* The price of this item should calculate with the price of main equipment.

A2-5 : Consumable Spare Part (Fuse & Lamp) for "A2" MODEL (Low Capacity)

	Item	Description	Type/ Capacity	Used Quantity	Offered	
					For each Unit	Total
Rectifier module	1 2 3 4 . . .					
Cabinet With AC & DC Dist. And MCU	1 2 3 . .					
Fuse Box	1 2 3 . .					
DC-PDB	1 2 3 . .					

A2-6 : Complete List of Used quantity in each unit including all electronics boards, main component, fuses, lamps and etc. for "A2" MODEL (Low Capacity)

	Item	Description	Type/ Capacity	Used Quantity
Rectifier module	1 2 3 4 . . .			
Cabinet With AC & DC Dist. And MCU	1 2 3 . .			
Fuse Box	1 2 3 . .			
DC-PDB	1 2 3 . .			
Complete Rectifier module	1	Rectifier module 48V/1600W		
Complete MCU	1	Monitoring & Control Unit		

ATTACHMENT (B)

(HIGH CAPACITY)

B0: RELATED INFORMATION OF STATIONARY BATTERY FOR "B" TYPE
(High Capacity)

STATIONARY BATTERY

The batteries will be provided by TCI
DC equipment should be able to operate with two kind of batteries :

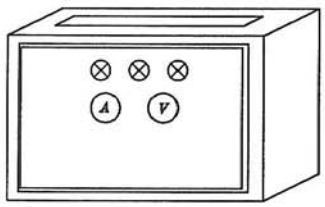
A) Wet type OPZS
Charging voltage:
-Initial charge : equal to 2.7 V/Cell (adjustable from 1 to 2.7 V/Cell)
-Recovery charge: equal to 2.35 V/Cell (adjustable from 2.25 to 2.4 V/Cell)
-Floating charge : equal to 2.23 V/Cell (adjustable from 2.1 to 2.3 V/Cell)

B) Dry type sealed battery (maintenance free)
Charging voltage 2.25 V/Cell (adjustable from 2.2 to 2.3 V/Cell)

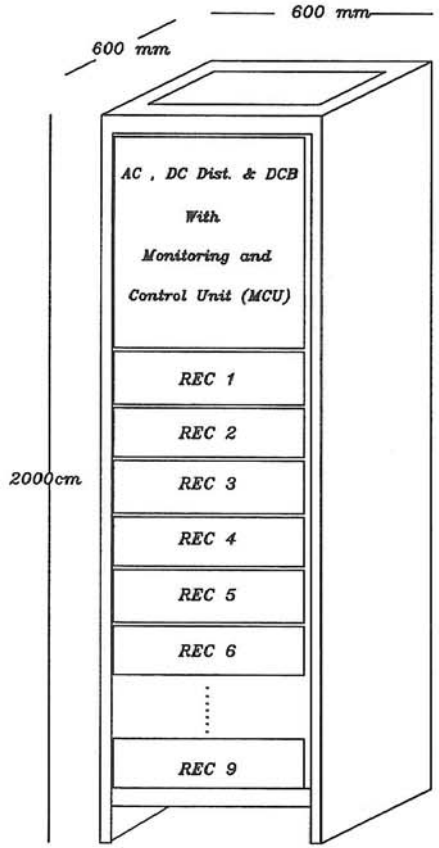
Number of cell in each series : 24 Cells
Capacity of each series : UP to 3000 AH
No. of series : 2, 3 or 4 series in Parallel
Reserve time : 4-10 hours
Recharge time : 20 hours

Note : Initial charge by doing some stages shall be available in away that the selection of initial charge should be done manually (by using selector) the rectifier should not select in initial mode before disconnecting the load.

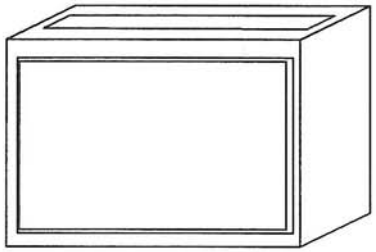
B1–1–FRONT VIEW OF PLANT FOR "B1" MODEL (High Capacity)



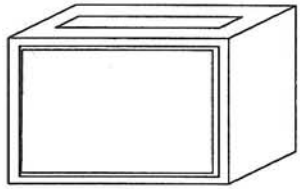
Main AC Panel
(Wall Mounted)



Rectifiers Compact Cabinet



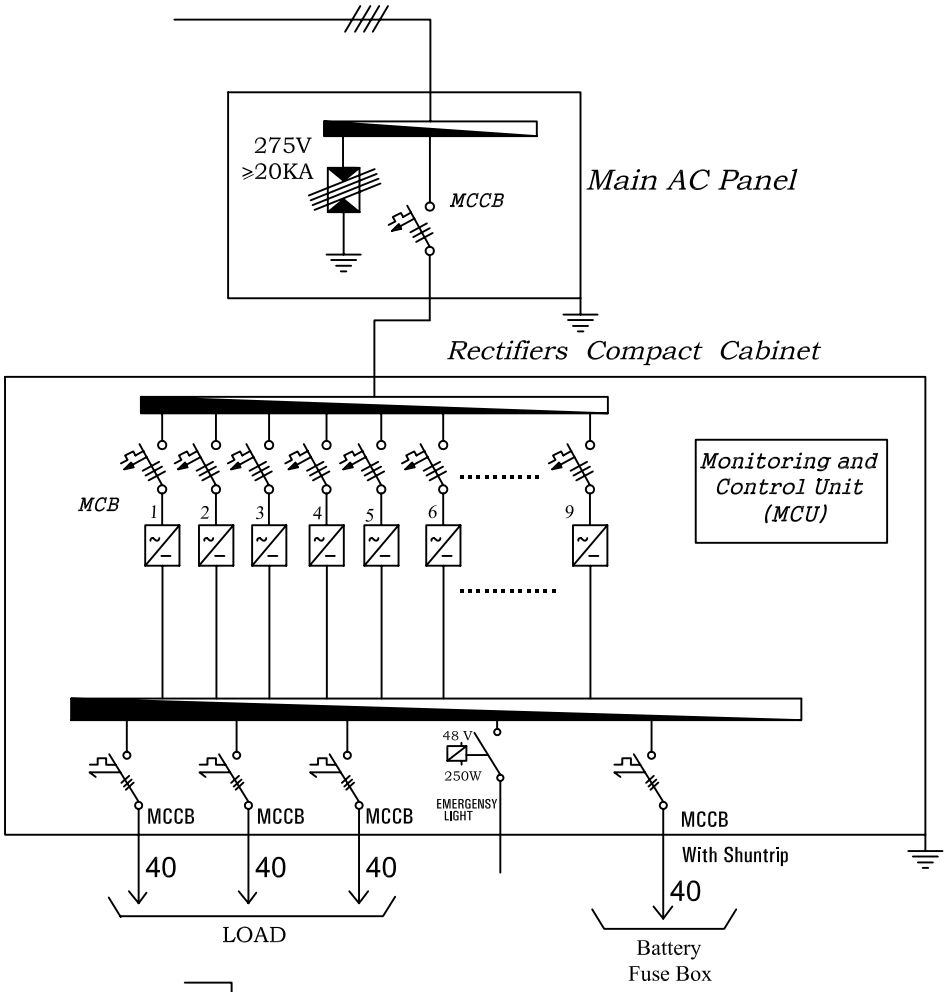
DC–PDB
(Wall Mounted)



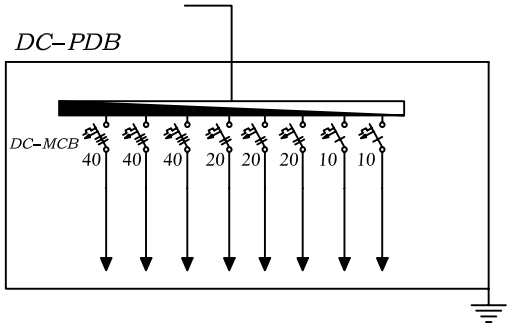
Battery Fuse Box
(Wall Mounted)

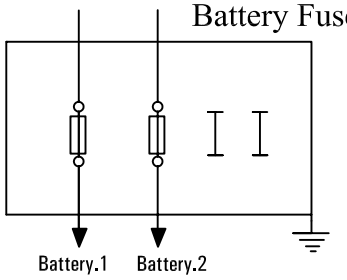
Note : The Rectifiers Cabinet could be designed for 6 or 9 Modules.

B1-2 - WIRING DIAGRAM FOR "B1" MODEL (High Capacity)



Note :
- For 6 Modules fuse (1) = 400A
- For 6 Modules fuse (2) = 160A
- For 6 Modules fuse (3) = 300A
- For 6 Modules fuse (4) = 250A
- For 9 Modules fuse (1) = 630A
- For 9 Modules fuse (2) = 250A
- For 9 Modules fuse (3) = 600A
- For 9 Modules fuse (4) = 400A





Note : All Fuses in the cabinet should be breaker type (Load breaker) and equiped with Alarm.

B1-3 : LIST OF MATERIAL FOR "B1" Model (High capacity)

No.	*Item Description*		*According to the para.*	*According to the Attach.*	*Quantity*	*Remark*
1	Main AC Panel		--	B1-1, B1-2		
2	Rectifiers Compact Cabinet for ..... Modules with AC,DC Dist. & DCB and MCU		--	B1-1, B1-2		The Cabinet could be designed for 6 or 9 modules. Please Specify
3	Rectifier Module 48V/6000W		--	--		
4	Battery Fuse Box		--	B1-1, B1-2		
5	DC-PDB		--	B1-1, B1-2		
6	Installation Material (set)		--	B1-4		
7	Consumable Spare Part (set)		13.2	B1-5		
8	Maintenace Spare Part (set)		13.2	B1-6		5% of total price of item no. 1 to 5
9	Special Tools		--	--		Should be Specified by tenderers
10	Tester (set)	Main offer	13.1-1.1	--	2	
		Option offer	13.1-1.2	--	2	
11	Document: 11.1General 11.2 Structure 11.3 Operationl & Maintenance Manual		 12.1 12.2 12.3	 -- -- --		1set for each system
12	Training		14	*	--	* According to the Training Annex

B1-4 : INSTALATION MATERIAL FOR "B1" MODEL (High capacity)

No.	Description	Length/QTY.		Remark
		Each Set	Total	
1	Cable / Multicore --- mm2			
2	Cable / Multicore --- mm2 Blue			
3	Cable / Multicore --- mm2 Red			
4	Cable / Multicore --- mm2 Blue			
5	Cable / Multicore --- mm2 Red			
6	Alarm Cable --- mm2			
7	Earth Cable / Multicore --- mm2			
8	Cable Shoe --- mm2			
9	Cable Shoe --- mm2			
10	Lader --- cm With Accessories			
11	Plastic Cable Trunk --- cm With Accessories			
12	Related Connection for System Installation (Connecting Set)	1Set		*

*The price of this item should calculate with the price of main equipment.

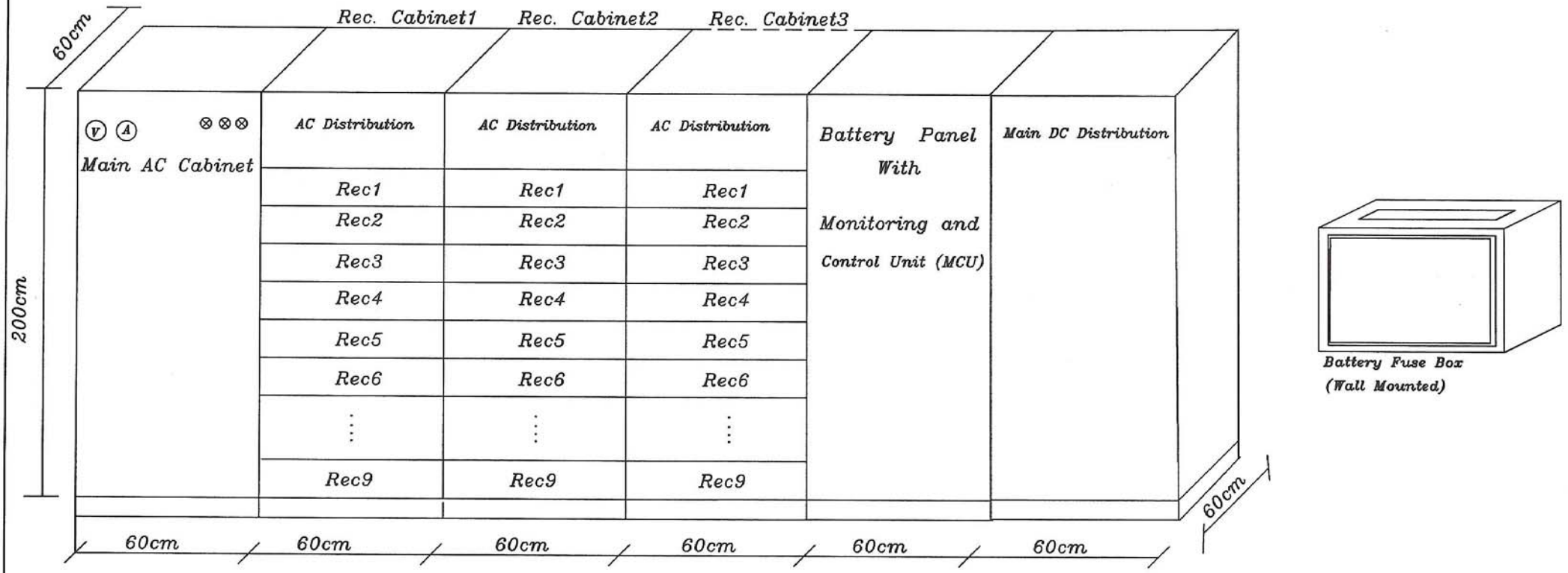
B1-5 - Consumable Spare Part (Fuse & Lamp) for "B1" Model" (High Capacity)

	Item	Description	Type/ Capacity	Used Quantity
Main AC Panel	1 2 3 . .			
Rectifiers Compact Cabinet For ..... Modules with AC,DC Dist. & DCB and MCU	1 2 3 . .			
Rectifier Module 48V/6000W	1 2 3 . .			
Battery Fuse Box	1 2 3 . .			
DC – PDB	1 2 3 . .			

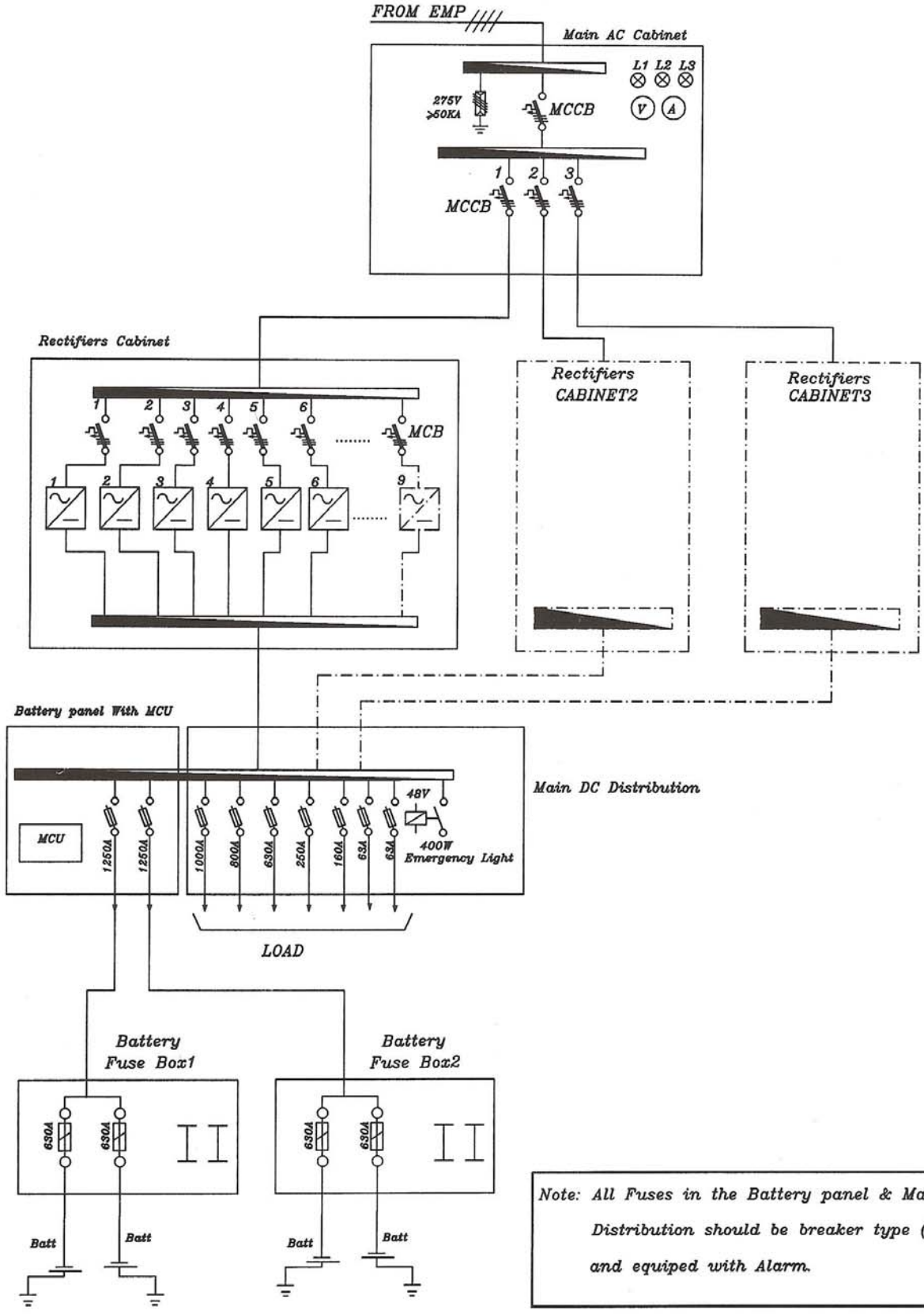
B1-6 - Complete List of Used quantity in each unit including all electronics boards, main component, fuses, lamps etc. for "B1" model (High Capacity)

	Item	Description	Type/ Capacity	Used Quantity
Main AC Panel	1 2 3 . .			
Rectifiers Compact Cabinet For ..... Modules with AC,DC Dist. & DCB and MCU	1 2 3 . .			
Rectifier Module 48V/6000W	1 2 3 . .			
Battery Fuse Box	1 2 3 . .			
DC – PDB	1 2 3 . .			
Complete Rectifier Module	1	Rectifier ModulE 48V/6000W		
Complete MCU	1	Monitoring and Control Unit		

B2-1 –FRONT VIEW OF PLANT FOR "B2" MODEL(High Capacity)



B2–2 – WIRING DIAGRAM FOR " B2" MODEL (High capacity)



Note: All Fuses in the Battery panel & Main DC Distribution should be breaker type (load Breaker) and equiped with Alarm.

B2-3 : LIST OF MATERIAL FOR "B2" Model (High capacity)

No.	*Item Description*		*According to the para.*	*According to the Attach.*	*Quantity*	*Remark*
1	Main AC Cabinet		--	B2-1, B2-2		
2	Rectifiers Compact Cabinet for 9 Modules with AC Distribution		--	B2-1, B2-2		
3	Rectifier Module 48V/6000W		--	--		
4	Battery Panel with MCU		--	B2-1, B2-2		
5	Main DC Distribution		--	B2-1, B2-2		
6	Battery Fuse Box		--	B2-1, B2-2		
7	Installation Material (set)		--	B2-4		
8	Consumable Spare Part (set)		13.2	B2-5		
9	Maintenace Spare Part (set)		13.2	B2-6		5% of total price of item no. 1 to 6
10	Special Tools		--	--		Should be Specified by tenderers
11	Tester (set)	Main offer	13.1-1.1	--	2	
		Option offer	13.1-1.2	--	2	
12	Document: 12.1General 12.2 Structure 12.3 Operationl & Maintenance Manual		 12.1 12.2 12.3	 -- -- --		1set for each system
13	Training		14	*	--	• According to the Training Annex

B2-4 : INSTALATION MATERIAL FOR "B2" MODEL (High capacity)

No.	Description	Length/QTY.		Remark
		Each Set	Total	
1	Cable / Multicore --- mm2			
2	Cable / Multicore --- mm2 Blue			
3	Cable / Multicore --- mm2 Red			
4	Cable / Multicore --- mm2 Blue			
5	Cable / Multicore --- mm2 Red			
6	Alarm Cable --- mm2			
7	Earth Cable / Multicore --- mm2			
8	Cable Shoe --- mm2			
9	Cable Shoe --- mm2			
10	Lader --- cm With Accessories			
11	Plastic Cable Trunk --- cm With Accessories			
12	Related Connection for System Installation (Connecting Set(	1Set		*

*The price of this item should calculate with the price of main equipment.

B2-5 - Consumable Spare Part (Fuse & Lamp) for "B2" MODEL (High capacity)

	Item	Description	Type/ Capacity	Used Quantity
Main AC Cabinet	1 2 3 . .			
Rectifiers Cabinet For 9 Modules with AC Distribution	1 2 3 . .			
Rectifier Module 48V/6000W	1 2 3 . .			
Battery Panel with MCU	1 2 3 . .			
Main DC Distribution	1 2 3 . .			
Battery Fuse Box	1 2 3 . .			

B2-6 - Complete List of Used quantity in each unit including all electronics boards, main component, fuses, lamps etc. for "B2" model (High Capacity)

	Item	Description	Type/ Capacity	Used Quantity
Main AC Cabinet	1 2 3 . .			
Rectifiers Cabinet For 9 Modules with AC Distribution	1 2 3 . .			
Rectifier Module 48V/6000W	1 2 3 . .			
Battery Panel with MCU	1 2 3 . .			
Main DC Distribution	1 2 3 . .			
Battery Fuse Box	1 2 3 . .			
Complete Rectifier Module	1	Rectifier Module 48V/6000W		
Complete MCU	1	Monitoring and Control Unit		