

APPENDIX I

APPENDIX I

1.1 Appendix A - CP STATION SPECIFICATION:

Reference Documents

International Standards Organization

ISO 9001:	Quality systems – Model for quality assurance in design, development, production, installation and servicing
ISO 9004:	Guideline for quality management

British Standard (BS)

BS 6346	Specification for PVC-insulated cables for electricity supply
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National Association of Corrosion Engineers

1NACE RP 0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP 0177	Standard Recommended Practice - Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems
NACE RP 0286-97	Electrical Isolation of "cathodically" protected pipelines
NACE RP 0196	Galvanic Anode Cathodic Protection of Internal Submerged Surfaces of Steel Water Storage Tanks
NACE RP 0193	External Cathodic Protection of On-Grade Carbon Steel Storage Tank Bottoms
NACE SP 0286	Electrical Isolation of Cathodically Protected Pipeline

ICCP System:

a) Design Life	-	25 years
b) Current Density	-	0.08 mA/m ² (KP 1195, KP 190+308) 0.1mA/m ² (KP 275+308, KP 351+440)
c) Coating	-	FBE
d) Coating Breakdown	-	75%
e) System	-	Impressed Current Cathodic protection system using High Silicon Iron Anodes
f) Isolation	-	Isolation shall be provided at both ends to isolate the underground & above ground sections of the pipeline

The Permanent Cathodic Protection system for CP Station will comprise of:-

- Ground Bed (Shallow Bed CP system).
- DC-DC converter.
- Anode Junction Box (AJB)
- Negative Junction Box (NJB)
- Drain Point Test Stations (DPTP)
- Cu/CuSO₄ Reference Cell
- Associated Cables

System Configuration:

It is proposed to install new ground bed near the midpoint between CP16 & CP17

High silicon iron anodes shall be installed for the cathodic protection system of the underground pipeline. The pipeline CP system shall be powered by DC-DC converter. Positive main cable from the DC-DC converter Unit positive shall be routed to the AJB and the negative cable from the DC-DC converter Unit negative shall be routed to the NJB and connected to the pipeline. The location of all equipment like anode junction box, transformer rectifier, negative junction box, drain point test station etc...

Ground bed Configuration:

Shallow Bed CP System

The Shallow Bed CP system consists of 6 numbers of High Silicon Iron anodes installed in single horizontal ground bed.

The ground bed will be positioned such a way that there are no foreign structures between the ground bed and pipeline. Proposed ground bed is located 100m away from structure. Anodes shall be installed 3m below the grade level parallel to pipeline. Anodes shall be installed inside a trench of dimension 400mmx400mm filled with coke breeze to create a low resistive environment. Anode to anode spacing shall be 2m. Vent pipe pipes to be installed above the anode.

Anode Junction Box (AJB)

Anodes with individual tail cable and these cables shall be routed and terminated to the anode junction box installed near the anode ground bed. Current controlling resistors (1 Ω /100w) and current measuring shunts (10A/100mV) will be included in all anode circuits. From the power supply unit (35mm² XLPE/PVC) shall be routed and terminated inside the anode junction box. Resistors and Current measuring shunt shall be installed in each circuit of the anode junction box. Anode junction box shall be SS316L type.

Negative Junction Box (NJB)

Structure cable (35mm² XLPE/PVC) and negative cable from the power supply unit (35mm² XLPE/PVC) shall be routed and terminated inside the negative junction box. Resistors and Current measuring shunt shall be installed in each circuit of junction box. Negative junction box shall be SS316L type.

Drain Point Test Post (DPTP) DPTP

Shall be provided at drain point of the pipeline. These test stations facilitate measurement of pipe to soil potentials with a portable/permanent reference electrode. One multicore cable shall be taken from the test post and connected to the transformer rectifier for remote monitoring.

Power Supply Sizing

Power supply sizing of the system depends on the current requirement and the circuit resistance. The circuit resistance dictates the output voltage required to push the design current. In order to standardize the units we are proposing the DC-DC control units to be sized as 24V / 10 Amps

Reference Cell

Reference cell shall be installed near to the pipeline and shall be routed to the drain point test post for monitoring purpose.

Monitoring

Monitoring the performance of the permanent cathodic protection system will be carried out utilizing portable/permanent reference electrodes and the pipeline monitoring terminals provided at test facilities.

Pipe to cable Connections

Pipe to cable connections shall be carried out by means of direct Thermite welding connections. Thermite welding shall be done for all bonding and monitoring connections. Welded pad connection shall be done in the drain point for negative connection. The distance between one point to other point shall be 300mm.

1.2 Appendix B
1.2.1 BOM

Item No.	Item Description	QTY	Unit
1	Solar powered system including batteries, solar panels, charge controller and DC-DC controller(10A/24V) European brand is required	1	Ea
2	High Silicon Iron anode, 25.4mm dia x2130mm long. Anode tail cable: 16mm ² Kynar/HMWPE tail cable length A1=25m, A2=23, A3=21, A4=21, A5=23, A6=25	6	Ea
3	Petroleum Coke breeze 22.5 Kg/bag	237	Bags
4	Anode Junction Box with current controlling resistors and shunts, SS316L enclosure IP65, safe area use with support	1	Ea
5	Negative Junction box with current controlling resistors and shunts, SS316L enclosure IP65, safe area use with support	1	Ea
6	35mm ² XLPE/PVC positive cable	150	m
7	35mm ² XLPE/PVC negative cable	50	m
8	Monitoring 10mm ² XLPE/PVC cable	30	M
9	Drain Point Test post (Box type-SS316L) with 3" GI conduit	1	Ea
10	Permanent Cu/CuSO ₄ reference electrode with 10mm ² XLPE/PVC tail cable	1	Ea
11	Multicore cable	100	m
12	Thermite welding materials	1	Lot
13	Coating repair material (Intergaurd), 5 liter pack	1	Lot
14	Installation consumables	1	Lot

1.2.2 BOM- Solar module & accessories

SL NO	DESCRIPTION	QTY
Solar module & accessories		
1	330 Wp monocrystalline PV module, supplied along with module junction box and cables	10
2	Galvanized steel mounting structure for 10 of solar modules with adjustable tilt angle	Lot
Charge controller & accessories		
1	Charge controller 24V, MPPT based, rated for 3300W along with input and output MCBs, battery MCCB, ammeter, voltmeter, installed in a painted steel enclosure	1
2	MC4 connectors, branch connectors and accessories	Lot
Battery bank and accessories		
1	2x1000Ah, @ C10 24V, VRLA battery 24 cells along with required connecting links and accessories.	1 Set
2	Painted mild steel / GRP enclosure for the above	1 Nos
Cables and accessories		
1	PV1-F type cables required from solar array to charge controller	Lot
2	HO7RN-F type cables required from charge controller to battery bank as well as to CP controller	Lot

1.3 Appendix C. Materials Data Sheets:

1.3.1 DC-DC converter

Technical details of the DC- DC converter are as follows:

DC input voltage:	24V
Modes of operation:	Manual / Automatic (with RMU)
DC output voltage:	0-24V
DC output current:	0-10A
Enclosure / Construction:	Painted steel, outdoor safe area type, IP65

1.3.2 HIGH SILICON IRON ANODE

Technical details of the canister type HSI tubular anode are as follows:

Type:	Tubular
Model:	BTSI-500T
Material:	High Silicon Chrome Cast Iron
Anode dimensions:-	
Diameter:	56 mm
Length:	2130 mm
Weight:	23 kg
Cable:	16mm ² HMWPE/Kynar, copper conductor, rating 600/1000V
Current Discharge:	34.44 – 40.9 A/m ²
Consumption rate (Buried in coke breeze):	0.31 kg/Amp-year
Design life:	In excess of 30 years

1.3.4 CONDUCTIVE BACK FILL (COKE BREEZE)

Low resistive pump able grade carbon back fill for all impressed current anodes in earth

Type:	Lyreco –SC3 low resistive carbonaceous back fill
Material:	
Fixed carbon:	99.35%
Ash:	0.6%
Moisture:	0.05%
Volatiles:	0 %(9500C)
Particle sizing:	To be dust free with a maximum particle size of 1mm.
Bulk density:	74lbs per cubic foot

1.3.4 CABLES

Technical details of cables are as follows:

Type:	1 Core, Cu/XLPE/PVC
Size & color:	10mm ² , black 35mm ² , black
Rated voltage:	600/1000V
Conductor:	Soft annealed stranded copper wires
Insulation:	Double insulated (XLPE/PVC)
Core:	Conductor insulated with a layer of extruded cross linked polyethylene compound
Compound:	Over the insulated conductor is applied an outer protecting layer of extruded PVC compound
Operating temperature:	90o C normal operation

1.3.7 REFERENCE ELECTRODE:

Technical details of reference electrode are as follows:

Type:	Copper/ copper sulphate (Cu/CuSO ₄)
Operating Temperature:	0 °C to 57° C (min.)
Packing:	1.5" Dia. X 6" Space age yellow inert Praseodymium membrane ceramic tube with yellow protective caps packed in a special non-polarizing backfill
Stability:	+/- 5 Millivolts with 3.0 Microamp load
Application:	For buried application
Tail cable:	1 x 10mm ² copper conductor, XLPE/PVC insulation
Design life:	30 years

1.3.8 ANODE JUNCTION BOX (AJB)

Technical details of anode junction box are as follows:

Material -	SS 316L
Gasket - Chloroprene	
Front facing door fixing -	Hinged front facing door Hub - G.I
Enclosure -	IP65
Internals –	Shunts: 10A/100mV Resistors: 1Ω/100W

1.3.9 NEGATIVE JUNCTION BOX (NJB)

Technical details of negative junction box are as follows:

Material -	SS 316L
Gasket -	Chloroprene
Front facing door fixing -	Hinged front facing door Hub - G.I
Enclosure -	IP65
Internals -	Shunts: 10A/100mV
	Resistors: 1Ω/100W

1.3.10 TEST STATION

Technical details of Test Station are as follows:

Material -	SS 316L
Gasket -	Chloroprene
Front facing door fixing -	Hinged front facing door
Hub -	G.I
Enclosure -	IP65

1.4 Appendix D: DATA SHEET FOR 24V, 10A AUTOMATIC CP: DC-DC CONVERTER UNIT

A) D.C. Input Voltage:	24V DC (Range 19V - 24V DC)
B) D.C. Input Current:	16.19 A (Maximum)
C) D.C. Power Output:	240 W
D) D.C. Output Voltage:	0 to 24V
E) D.C. Output Current:	0 to 10A
F) Factor of safety for Diodes/SCRs:	Voltage - 300% factor of safety Current - 300% factor of safety
G) Full load efficiency:	About 75%
I) Insulation Level:	2 kV for 1 minute
J) Cable Entry:	D. C. input, D. C. output, Reference Cells, from the Box at the side of the unit thru suitable cable glands.
L) Filtering circuit:	L.C. Filter
M) Ripple & Hum:	Less than 5% RMS at rated output
N) Surge Diverters for Diodes/SCRs:	Metal oxide varistors/capacitors/R-C Networks, Shunt Zener Diodes
O) Lightning Arrestor:	At both Input & output side of the Dc-DC converter R.M.S. Voltage Rating: 500V R.M.S. Current Rating: 5KA Type: LT 0.5 or Eqv.
P) Protection:	2 pole MCB in DC input. 2 pole MCB in DC output. Glass cartridge fuses in the live line of all auxiliary power lines to control circuit.
Q) Reference Electrode:	3 Nos. Cu/CuSO ₄ Facility shall also be provided to select one out of two ref. Electrodes by means of a manually operated Reference Selector switch.
R) Control element :	The DC output will be controlled using latest solid state Mosfet/ Transistors/IGBT These Mosfet/Transistors/IGBT will be controlled by the commands from the control circuits. All the electronic circuits will be assembled on plugin type control cards.
S) Modes of operation:	Following modes of control shall be provided: a) Auto Ref. Mode: The operation of the unit in this mode will be fully Automatic and will be controlled by the Reference electrode feedback. The unit will automatically maintain Reference voltage or P.S.P. within $\pm 20\text{mV}$ of the set value under all conditions. b) CVCC Mode: This will be the second mode of operation. In this mode the unit can be operated in either constant voltage or constant current mode. In constant voltage mode the DC output voltage will be adjustable from 0 to rated value in stepless manner by means of a voltage setter potentiometer. In constant current mode the DC output current will be adjustable from 0 to rated value in stepless manner by means of a current setter potentiometer.

T) Ref. Fail safe Feature:	In the event of failure of the Reference Electrode, the DC output voltage of the unit will get to a preset value. This preset voltage is adjustable from 0 to rated voltage.
U) Ref. (P.S.P.) voltage setting range in Auto Ref. Mode:	-0.8V to -2.5V
V) Ref. Regulation in Auto Mode:	± 20mV
W) Voltage setting range in CVCC Mode:	0 to 24V
X) DC Voltage regulation in CVCC (Manual) mode:	± 0.25V
Y) Current setting range in Auto Mode & CVCC Mode:	0 to 10A
Z) Current regulation in current Limit Mode:	Better than ±1.5 A
AA) Indications / Annunciations:	<ul style="list-style-type: none"> a) DC supply ON b) Under protection c) Overprotection d) Reference fail e) Auto Ref Mode f) CVCC Mode g) Current Limit
AB) Meters / Instruments:	<p>72mmX 72mm Analog meters for the following:</p> <ul style="list-style-type: none"> - Input DC Voltage: 0 to 40V DC Dial - Input DC Current: 0 to 15A DC Dial with shunt 48 X 96 mm Digital Voltmeter - For PSP: Range ± 20V DC - Output DC Voltage: 0 to 200V DC (digital) - Output DC Current: 0 to 15A DC with shunt
AC) Current Interruption:	Current interruption facility will be provided by means of a built-in contactor & Multi-Functional Digital Timer. 0.1 sec to 999 Hr. ON Time & OFF time setting facility by digital key pad. Timer will have START, STOP facility through local keypad. GPS synchronize-able interrupter will be provided for synchronizing interrupter with other interrupters.
AD) Cooling:	Natural AIR cooled.
AE) Enclosure/Construction:	Floor mounted Indoor/outdoor type enclosure fabricated from 2.5 mm Steel sheets. Confirming to IP55 degree of protection.
AF) Painting:	Surface preparation by Sand Blasting, Hot Dip galvanizing/hot zinc spray, zinc rich epoxy middle coat, Final coat of PU paint of shade Light Grey RAL7035
AG) Weight:	200 Kgs. (Approx.)
AH) Earthing:	2 Nos. 12MM earthing bolts shall be provided.

1.5 Appendix -E Photovoltaic Power System Design and Data Sheet:

INTRODUCTION

This document defines the design data and calculation for Solar Power Systems, in accordance with the client's technical specifications.

SCOPE

Design, Engineering and supply of photovoltaic power supply system for 24 Volts, 10 Amps continuous electrical load for cathodic protection system which includes solar panels, support frames, batteries, battery racks and electronic control unit in accordance with standard specifications

DESIGN BASIS

The design basis for the proposed photovoltaic power supply system is as follows:

Solar modules:	Monocrystalline silicon modules
Battery bank:	Sealed lead acid type (VRLA)
Battery enclosure:	Painted Mild Steel, powdered coating conforming to IP-44
Charge Controller:	MPPT type Array support structure: Galvanized steel to BS 729
Control panel:	Outdoor, non-hazardous
Location:	Port Sudan Coordinates: Latitude 18.12° N Longitude 35.30° E
Solar data:	NASA Surface meteorology and Solar Energy resources (PVSYST V6.70)
Battery autonomy:	Suitable for longest expected "no sun" period

Reference Documents

Approved drawings / documents

IEEE1526:	Performance testing of Photo Voltaic Systems
ISO 9001:	Quality systems – Model for quality assurance in design, development, production, installation and servicing.
ISO 9004:	Guideline for quality management.

ABBREVIATIONS

Ah:	Ampere hour
CPP:	Central Processing Plant
CVCC:	Constant Voltage Constant Current
DC:	Direct Current
DEP:	Design and Engineering Practice
EPC:	Engineering, Procurement and Construction
GA:	General arrangement drawing
GI:	Galvanized Iron
IP:	Ingress Protection
kA:	kilo Ampere
kWh:	kilo Watt hour

mA:	Milli Ampere
mm:	millimeter
MPPT:	Maximum Power Point Tracking
mV:	milli Voltage
NACE:	National Association of Corrosion Engineers
NASA:	National Aeronautics and Space Administration
PV:	Photo Voltaic
SS:	Stainless Steel
VRLA:	Valve Regulated Lead Acid
Wh:	Watt hour
Wp:	Peak Wattage
T.B.A:	To be Advised

1.5.1 Technical Details of Solar System

System Sizing Parameters a)

Design Ambient Conditions [Refer- Attachment-1 for NASA Solar Data (18.120 N and 35.30oE)]

Design Temperature: 42 0 C

Minimum Temperature: 13 0 C

Wind speed: 44.7 m/s

Humidity: 95%

The following data were taken from NASA Surface meteorology and Solar Energy resources:

Solar Module tilt angle: 45 Degree

Average Solar Energy Per Day: 4.49 kWh/m2/day (with tilt 45 degree)

Average 'No Sun' days: 2 days

1.5.2 Battery Sizing

CP Controller Efficiency: 0.85 (As per actual equipment data)

Battery system voltage: 24 V

Autonomy period: 2 days (48 hrs.)

Maximum depth of discharge (DOD): 80% (As per shell DEP 33.65.60.30)

Battery aging dating: 10% (Considered)

Design margin: 10% (As per IEEE 1013 Std)

Battery temperature de-rating: 11% (for average minimum temp as per battery datasheet)

Battery type considered: Sealed Lead Acid Battery (VRLA type)

1.5.3 PV Array Sizing

Charge Controller considered is MPPT type.

Minimum solar insolation data @ 45 degrees inclination: 4.40 kWh/m2/day

Charge Controller Efficiency: 95 %

Array de-rating factor for dust & efficiency mismatch: 90 %

Array de-rating factor for ageing: 90 %

Battery Wh Efficiency: 85 %

Array to Load Ratio: 1.1

1.5.4 System Sizing Calculation:

SL. NO.	Design Requirements	UOM	24V, 10A
1	Voltage	V	24.00
2	Current	A	10.00
3	Power	W	240.00
4	CP Controller Efficiency		0.85
5	CP Load in Ah per day	Ah	282.35
6	CP Load in Wh per day	Wh	6776.47
	Total Load in Wh per day	Wh	5647.06
1	System voltage	V	24.00
2	Battery autonomy for CP System Power Supply	days	2.00
3	Battery Type		
4	Average Battery voltage / cell		V
5	No. of Battery Cells	No.	12.00
6	Average Battery voltage	V	24.00
7	Minimum Battery voltage / cell	V	1.85
8	Minimum Battery voltage	V	22.20
9	Maximum Battery Voltage / cell	V	2.36
10	Maximum Battery Voltage	V	28.28
11	Minimum Shade Temperature	o C	13.43
12	Maximum depth of discharge (DOD)		0.80
13	Temperature de-rating factor		1.11
14	Ageing factor		1.10
15	Design Margin		1.10
16	Calculated capacity for required Autonomy	Ah	948.07
17	Battery Proposed @ C48 rating	Ah	2x1000
18	No. of cell per series battery string		12.00
19	Daily depth of discharge % (Max)	%	18.45
20	Maximum Depth of discharge (DOD) after required autonomy	%	28.24

SL. NO.	Design Requirements	UOM	24V, 10A
1	Solar Insolation @45 Degree	KWh/M2/day	4.40
2	Charge Controller Efficiency		0.95
3	Array de-rating factor for dust & efficiency mismatch		0.90
4	Array de-rating factor for ageing		0.90
5	Battery Wh Efficiency		0.85
6	Module peak power as per manufacturer data	Wp	330.00

	(in STC)		
7	Module Temperature Co ef.		0.44
8	Design Temperature	Degree C	50.00
9	Solar Module Rating @ design Temp.	W	276.28
10	Array to Load Ratio		1.10
11	No. of module strings calculated to obtain solar array output(MPPT)		7.81
12	Proposed Module strings		10.00
13	Total solar array in Wp (MPPT)	Wp	3300.00
14	Days required to recharge the battery with load	Days	40.87
15	Days required to recharge the battery without load	Days	6.04

1.5.5 Data sheet for Solar Modules:

Item	Description	Units	Vendor Data
	Module type		Mono crystalline
	Module manufacturer		T.B.A
	Width	mm	990
	Length	mm	1955
	Thickness	mm	42
	Weight	kg	24.69
	Power rating Pmax (STC)	Wp	330
	Module efficiency	%	17.18
	Rated voltage (Vmpp)	V	38.64
	Rated current (Impp)	A	8.35
	Open circuit voltage (Voc)	V	46.15
	Short circuit current (Isc)	A	8.95
	Solar cells	No	72
	Junction box		IP 67
	Bypass diodes	Nos	3
	Cable size	mm ²	4
	Temperature range	o C	- 40 o C to + 85 o C

T.B.A – To be advised later

1.5.6 Data sheet for Batteries:

Item	Description	Vendor Data
	Battery rating	24 V - 2X1000 Ah at C10 to 1.8 V/C at 20°C
	Type of battery	Lead antimony acid, Tubular gel maintenance free valve regulated lead acid battery
	Model offered	T.B.A
	Cell capacity	1000 Ah at 10 hour rate to 1.8 V/C at 20°C
	No of cells	24 cells (12 Cells in each bank will be connected in series and each bank will be connected in parallel)
	Battery dimensions	T.B.A
	Applicable standards	IEC 60896 – 21 & 22; IEC 61427 IEEE 1188, 1189
	Ah efficiency	> 95%
	Wh efficiency	> 85
	Self-discharge	< 0.5% per week at 27°C
	Design float life	20 years design life at 20 °C
	(a)For float application	T.B.A
	(b) For cyclic application	T.B.A
	Recommended max. period of storage	6 months at 27°C
	Operating temperature range	-20°C to +55°C
	Grid alloy	Lead calcium tin alloy with special additives
	Container & lid material	Poly propylene co-polymer
	Sealing method	Heat sealing
	Safety vent	Self-resealing, pressure regulating valve with flame arrestor
	Ventilation	Normal ventilation is required
	Plate type	Tubular
	Separator	Micro porous synthetic separator
	Electrolyte	Gel type
	Terminals & ICC	Lead plated brass & copper with PP molding.
	Cell enclosures	Steel enclosures with acid resistant epoxy powder coating
	Make	T.B.A / 10 opzv Sonnenschein Exide make recommended

1.5.7 Data Sheet for Cables:

Sl.#	Description	Vendor data
1	Type	PV1-F
2	Application	Solar module (Array) to charge controller
3	Size	6 mm ² and 10 mm ²
4	Conductor	Stranded bare or tinned copper
5	Rated Voltage	0.6/1KV
6	Insulation	XLPE
7	Operating Temperature	90°C normal operation

Sl.#	Description	Vendor data
1	Type	HO7RN-F
2	Application	Charge controller to CP controller Charge controller to battery ban
3	Size	1C x 35 mm ²
4	Conductor	Flexible copper conductor
5	Rated Voltage	450/750V
6	Insulation	Thermosetting rubber compound
7	Operating Temperature	90°C normal operation

1.5.8 Data Sheet for Charge Controller:

Sl.#	Description	Vendor data
Electrical		
1	Charge controller type	MPPT
2	Battery voltage	24 V
3	Battery operating voltage range	21.6 -29.6V
4	Maximum solar panel voltage	150 V
5	Maximum charging current	160 A
6	Nominal maximum operating power	3300 W
7	Maximum self-consumption	12 W
8	Product efficiency	95%
9	Peak efficiency	99%
10	Buck converter duty cycle range	Duty cycle Up to and including 100%
11	Protection	<ol style="list-style-type: none"> 1. Battery overcharge 2. wrong polarity 3. short-circuit protection 4. low battery protection 5. Lightning protection 6. Reverse current flow protection
12	Display type	16x2 LCD digital display
13	Displayed parameters on LCD	<ol style="list-style-type: none"> 1. PV voltage 2. PV current 3. PV power 4. Cumulative PV KWHr 5. Battery voltage 6. Battery current 7. Battery charging mode 8. Night mode 9. Time since dusk 10. Load On/Off status 11. Ambient/Battery temperature 12. Load current
14	Battery type	Lead acid-flooded, VRLA, Ni-Cd
15	Charging method	4 Stage battery charging
16	Temp. compensated battery charging	Built-in ambient temperature sensor & battery temp. sensor accessory
17	Load Cut-off in low battery condition	21.6V
18	Battery deep discharge cut-off voltage	21V
19	Instruments	<ol style="list-style-type: none"> 1. DC voltmeter for array voltage & battery Voltage by Selector Switch 2. DC ammeter for battery current
20	Remote connection facility	<ol style="list-style-type: none"> 1. Battery voltage 2. Load voltage 3. Battery current 4. Load current
Additional		

1	Accessories	Battery temperature sensor with 10 meters cable
Mechanical		
1	Material for enclosure	Painted MS
2	Dimensions	T.B.A
3	Weight	T.B.A
4	Enclosure	Outdoor, IP-56
General		
1	Ambient temperature	0 C to +55 °C
2	Storage temperature	0-40°C
3	Humidity	98%
4	Manufacturer	T.B.A
5	Country of origin	T.B.A

- END OF APPENDIX I-