VISHNU
UNIVERSAL LEARNING

B.V.RAJU COLLEGE

VISHNUPUR, BHIMAVARAM

SOLAR ENERGY 7.1.2 INDEX

V R Krishnam Raju

B.V.RAJU COLLEGE VISHNUPUR W.G. Dist. (A.P.) Pin-534 202 BHIMAVARAM

ORIGINAL FOR RECIPIENT / DUPLICATE FOR TRANSPORTER / TRIPLICATE FOR SUPPLIER / Extra copy

TAX INVOICE

(See Rule US-31 of CGST ACT read with Rule 1 of Invoice,Debit & Credit Note Rule.)

HAVELLS

JYOTI ELECTRICALS

#5-2-30 HYDERBASTI R.P. ROAD,
OPP GUJARATHI SEVA MANDAL HALL, SECUNDERABAD. 500003
Phone: 09849167815 Email : jyoti.electricals@yahoo.com

wipro

Serial No.of Invoice :	C0098	GSTIN.: 36AKMPS2609B1Z8	D C No : C0098
Date of Invoice :	16/09/2022		P O No : POD-BVRCD/22/9/H/1
Date & Time of Supply :		State : Telangana	L R No : 0
		State Code: TS 36	Transporter:

CIN :

Details of Receiver (Billed to) :

B V RAJU COLLEGE-DEGREE
VISHNUPUR, BHIMAVARAM,
WEST GODAVARI

City : BHIMAVARAM Pin : 534202
Phone : 9949016923
State : Andhra Pradesh
GSTIN/Unique ID : State Code : 37

Details of Consignee (Shipped to) :

Same as Billed to

Sl. No.	Description of Goods	HSN Code	Qty	Unit	Rate	Taxable Amount	IGST %	IGST Amt.	%	Amt.	Total Amount
1	LD80-171-XXX-60-XX 18W IRIS SLIM LED (Tube Light)	94051010	20.000	NOS	795.00	15900.00	18.00	2862.00			18762.00
2	LD81-281-XXX-60-XX 24W SQ LED PANEL	94051010	20.000	NOS	1299.00	25980.00	18.00	4676.40			30656.40
			40.000			41880.00		7538.40		0	

Our Bank Details :

BANK NAME : PUNJAB NATIONAL BANK
BRANCH : M.G. Road Branch
A/C No : 3631008700001988
IFSC Code : PUNB0363100

GROSS TOTAL	41880.00
CGST	0
SGST	0
IGST	7538.40
TCS	
ROUNDED OFF	0.40
TOTAL	49418.00

Rupees Forty Nine Thousand Four Hundred Eighteen Only

1. Goods once sold can not be taken back or exchanged.
2. Int @ 24% will be charged if bill is not paid with in 15 days
3. All disputes sub to Secunderabad Jurisdiction
4. PAN NO. : AKMPS2609B

Total Outstanding Balance as on date Rs. 49418.00

For JYOTI ELECTRICALS

Authorised Signatory

varshini power
Committed to Sustainable Future

TAX INVOICE

Buyer:	Invoice No: VPPIPL-INV-0204001/032/13-14	Dated: 05/03/2014
Sri Vishnu Educational Society, Vishnupuri, Bhimavaram, West Godavari, Andhra Pradesh.	DC NO: NILL	Mode/Terms of Payment:
	Despatch Documents No: Nill	Destination:Bhimavaram
	Despatched through :	

Sl No	Description	QTY.in Nos	RATE	Amount
1	**200kWp On-Grid Roof Top Solar PV Power Plant** **Installed at Sri Vishnu Educational Society, Vishnupuri, Bhimavaram,** West Godavari, Andhra Pradesh.			
	Material	LUM	10,442,857.00	10,442,857.00
	[illegible]			522,143.00
	TOTAL INVOICE VALUE:			**10,965,000.00**

Amount (in words) : One Crore Nine Lakhs Sixty Five Thousands Only

RTGS Details:

Name:Varshini Power Projects India Pvt Ltd
Bank:IDBI BANK
A/C No: 0872102000001946
Branch:Jubilee Hills
IFSC : IBKL0000872

Company's VAT TIN : 28976475565
Company's CST No : 28976475565
Company's PAN No : AADCV6003E
Company's STC No : AADCV6003ESD001

Declaration:
We declare that this invoice shows the actual price of the goods described and that all particulars are true and correct.

For Varshini Power Projects India Pvt Ltd

Authorised Signatory

VPPIPL

S R Krishnam Raju

S.L.BAJU COLLEGE VISHNUPURI BHIMAVARAM

varshini power
Committed to Sustainable Future

TAX INVOICE

Buyer:	Invoice No: VPPIPL-INV-0204001/033/13-14	Dated: 05/03/2014
Sri Vishnu Educational Society, Vishnupuri, Bhimavaram, West Godavari, Andhra Pradesh.	DC NO: NILL	Mode/Terms of Payment:
	Despatch Documents No: Nill	Destination:Bhimavaram
	Despatched through :	

Sl.No	Description	QTY.In Nos	RATE	Amount
1	200kWp On-Grid Roof Top Solar PV Power Plant Installed at Sri Vishnu Educational Society, Vishnupuri, Bhimavaram, West Godavari, Andhra Pradesh.			
	Design,Transportation ,Installation and Commissioning	LUM	1,722,143.00	1,722,143.00
	Service Tax @ 12%			206,657.00
	Education cess & higher education@3%			6,200.00
	TOTAL INVOICE VALUE:			1,935,000.00

Amount (in words) : Nineteen Lakhs, Thirty Five Thousand, Only

RTGS Details:
Name:Varshini Power Projects India Pvt Ltd
Bank:IDBI BANK
A/C No: 0872102000001946
Branch:Jubilee Hills
IFSC : IBKL0000872

Company's VAT TIN : 28976475565
Company's CST No : 28976475565
Company's PAN No : AADCV6003E
Company's STC No. : AADCV6003ESD001

Declaration:
We declare that this invoice shows the actual price of the goods described and that all particulars are true and correct.

For Varshini Power Projects India Pvt Ltd

Authorised Signatory

VARSHINI POWER PROJECTS INDIA PVT. LTD. VPPIPL

S R Krishnam Raju

V. RAJU COLLEGE VISHNUPUR W.G. Dist. (A.P.) Pin-534 202 BHIMAVARAM

KUMAR ENTERPRISES

P.P.ROAD,BHIMAVARAM - 534201
Phone Numbers : 08816-234771,9866228009
GST NO: 37BUDPS2468E2ZE

INVOICE

B V RAJU COLLEGE- DEGREE COLLEGE
BHIMAVARAM
GST NO :

PH NO :
Invoice Date. 29-Oct-2022
Invoice No. GST/5511
Mode CREDIT

S.No	Item Name	HSN	Qty	Unit	Rate	Tax%	Total
1	HAVELLS OCTANE 24W CEILING L	940540	7.00	NOS	1480.00	18	10360.00
2	HAVELLS 20W LED TUBE SET	940510	20.00	NOS	230.00	18	4600.00
3	HAVELLS 9W LED TUBE SET	940510	10.00	NOS	230.00	18	2300.00

Rupees Seventeen Thousand Two hundred Sixty Only TOTAL 17,260.00

		TAX %	Gross Total	SGST	CGST	TAX Total
Total Amount Before Tax :	14627.12					
Total CGST :	1316.44	12 %	0.00	0.00	0.00	0.00
Total SGST :	1316.44	18%	14,627.12	1,316.44	1,316.44	2,632.88
Tax Amount : GST	2632.88					

CUSTOMER SIGN. & PH NO

For KUMAR ENTERPRISES

Authorised Signatory

BANK DETAILS : KUMAR ENTERPRISES
A/C NO : 0366651100003346 BANK : IDBI BANK
BRANCH : BHIMAVARAM IFSC : IBKL0000366

KUMAR ENTERPRISES

P.P.ROAD,BHIMAVARAM - 534201
Phone Numbers : 08816-234771,9866228009
GST NO: 37BUDPS2468E2ZE

INVOICE

B.V.RAJU COLLEGE- DEGREE COLLEGE
BHIMAVARAM
GST NO :

PH NO :
Invoice Date : 16-Nov-2022
Invoice No. : GST/5891
Mode : CREDIT

S.No	Item Name	HSN	Qty	Unit	Rate	Tax%	Total
1	HAVELLS OCTANE 24W CEILING L	940540	17.00	NOS	1480.00	18	25160.00

Rupees Twenty Five thousand One hundred Sixty Only

		TOTAL	25,160.00
Total Amount Before Tax	21322.03		
Total CGST	1918.99		
Total SGST	1918.99		
Tax Amount : GST	3837.97		

TAX %	Gross Total	SGST	CGST	TAX Total
12 %	0.00	0.00	0.00	0.00
18%	21,322.03	1,918.99	1,918.99	3,837.97

CUSTOMER SIGN. & PH NO

For KUMAR ENTERPRISES

BANK DETAILS : KUMAR ENTERPRISES
A/C NO : 036665110000334 6 BANK : IDBI BANK
BRANCH : BHIMAVARAM IFSC : IBKL0000366

Authorised Signatory

B.V. RAJU COLLEGE
VISHNUPUR
W.G.Dist. (A.P.)
Pin:534 202.
BHIMAVARAM

V R Krishnam Raju

Tax Invoice

AVGHNI RENEWABLE ENERGY SYSTEM INDIA PVT LIMITED 63/64,Seshachala Colony, West Marredapally Secunderabad-26 GSTIN/UIN: 36AALCA3474C2ZR State Name : Telangana, Code : 36 E-Mail : info@aughnisolar.com	Invoice No.: **97/a/Avghni/21-22** | Dated: **31-Jan-22** Delivery Note | Mode/Terms of Payment: **By NEFT** Reference No. & Date. | Other References Buyer's Order No.: **POD-BVRCD/21/12/L/2** | Dated: **3-Dec-21** Dispatch Doc No. | Delivery Note Date Dispatched through: **By Road** | Destination: **Bhimavaram** Terms of Delivery
Consignee (Ship to) **B V Raju College - Degree** BV Raju Foundation Vishnupur, Bhimavaram West Godavari (Dist) State Name : Andhra Pradesh, Code : 37	
Buyer (Bill to) **B V Raju College - Degree** BV Raju Foundation Vishnupur, Bhimavaram West Godavari (Dist) State Name : Andhra Pradesh, Code : 37	

Sl No.	Description of Goods	HSN/SAC	Quantity	Rate	per	Amount
1	**40kw Solar Inverter** *Make: Kirloskar* *Model:700094* *GW-III-40K ON GRID INVERTER*	3917	**1 No**	1,39,000.00	No	**1,39,000.00**
2	**Remote Monitoring Stick**	3917	**1 No**	1,500.00	No	**1,500.00**
						1,40,500.00
	IGST					**16,860.00**
	Total		**2 No**			**₹ 1,57,360.00**

Amount Chargeable (in words) *E. & O.E*

INR One Lakh Fifty Seven Thousand Three Hundred Sixty Only

HSN/SAC	Taxable Value	Integrated Tax		Total Tax Amount
		Rate	Amount	
3917	1,40,500.00	12%	16,860.00	16,860.00
Total	**1,40,500.00**		**16,860.00**	**16,860.00**

Tax Amount (in words) : **INR Sixteen Thousand Eight Hundred Sixty Only**

Remarks:
Towards Supply of 40kW Inverter with Remote Monitoring Stick

Company's PAN : **AALCA3474C**

Declaration
We declare that the particulars given above are true, correct and the amount indicated represents the price actually charged and that there is no flow of additional consideration directly or indirectly from the buyer Terms & Condictins.
1) Interest @24% per annum will vbe charged on payment beyond our payment terms.
2) Subject to SECUNDERABAD jurisdiction
3) E & O.E.

Company's Bank Details
Bank Name : **Bank of India CC**
A/c No. : **860230110000028**
Branch & IFS Code: **Malkajgiri & BKID0008602**

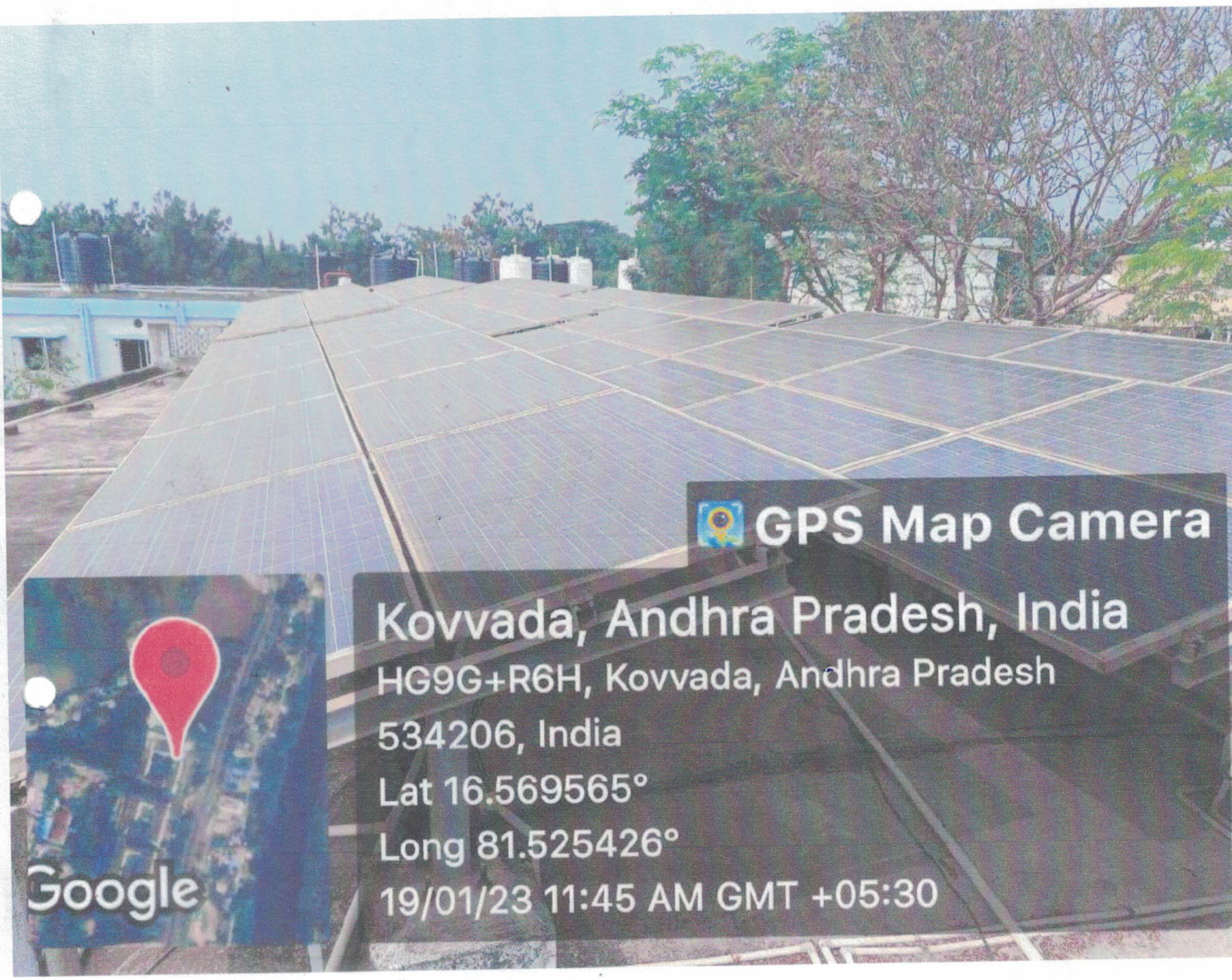
for AVGHNI RENEWABLE ENERGY SYSTEM INDIA PVT LIMITED

Authorised Signatory

SUBJECT TO SECUNDERABAD JURISDICTION

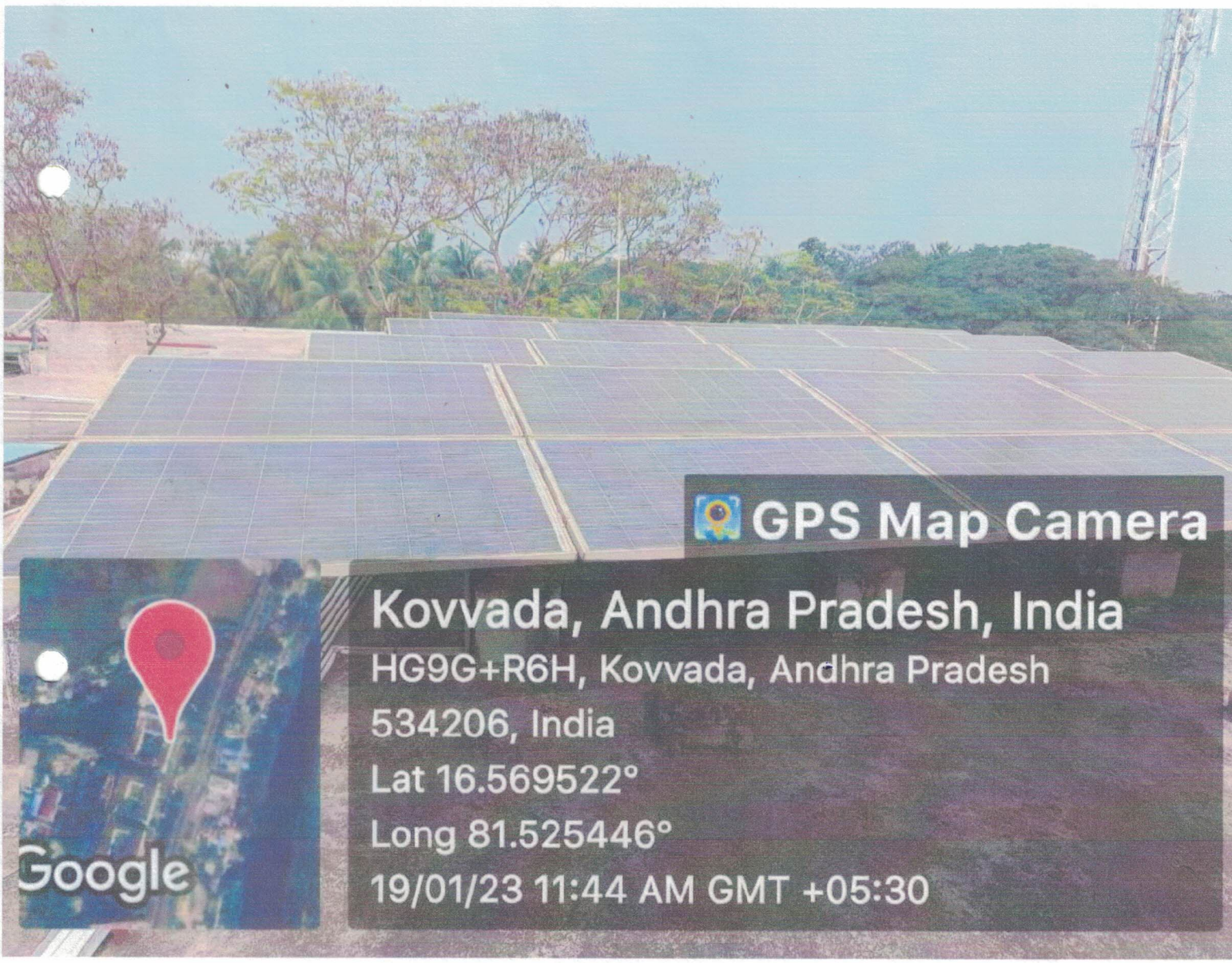
This is a Computer Generated Invoice

B.V. RAJU COLLEGE VISHNUPUR W.G.Dist.,(A.P.) Pin-534 202 BHIMAVARAM



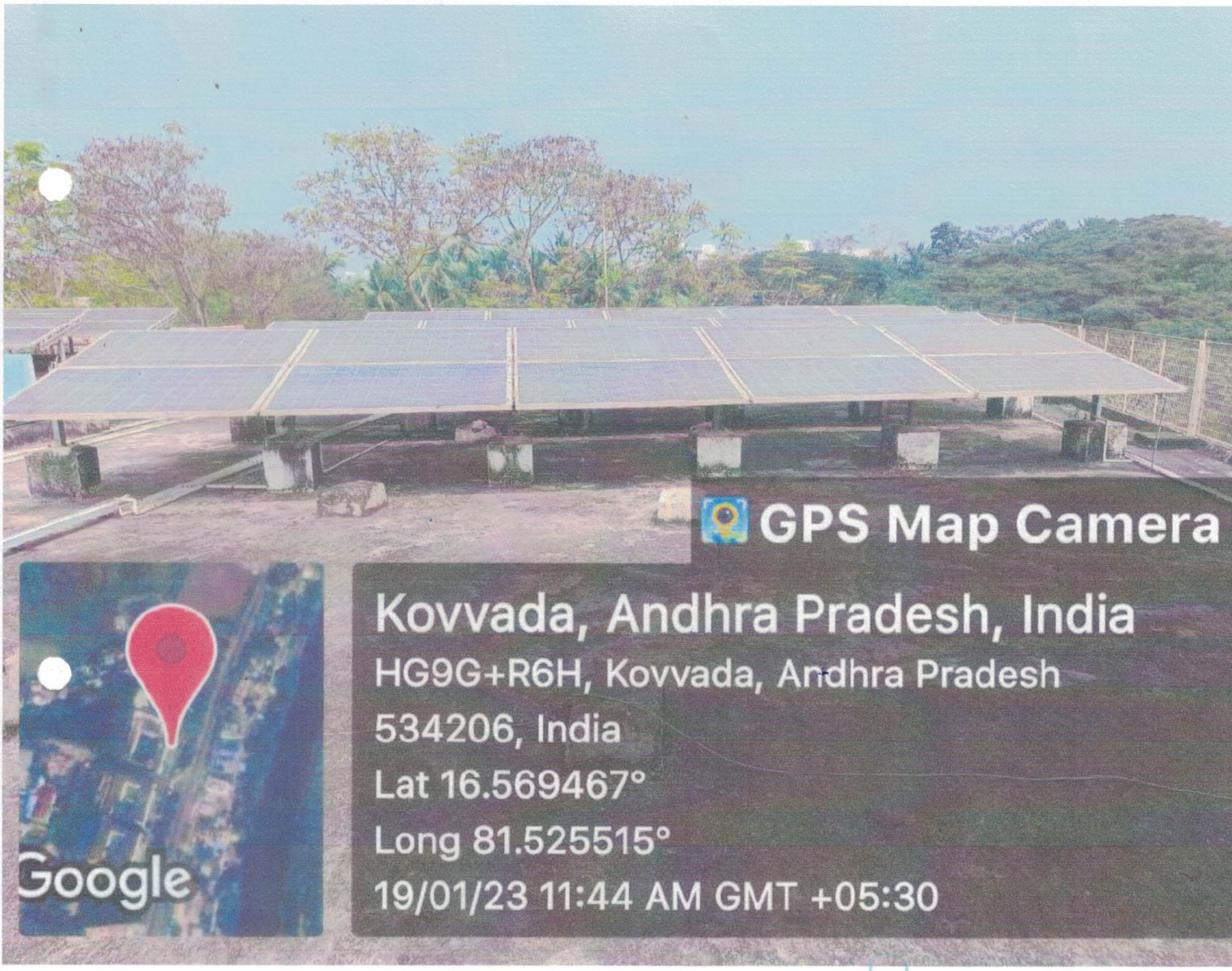
V R Krishnam Raju

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist. (A.P.)
Pin-534 202.
BHIMAVARAM



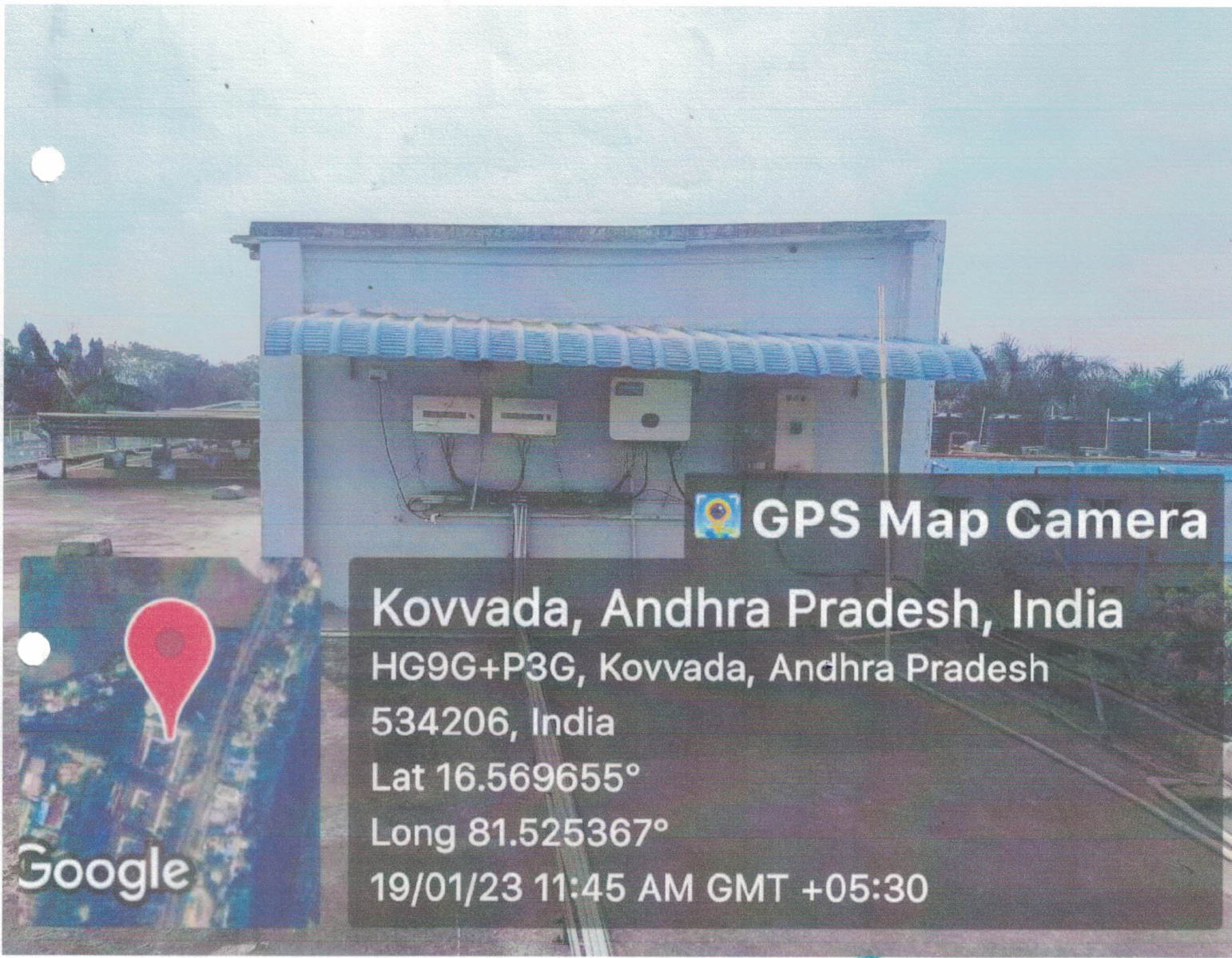
Dr. R Krishnam Raju

N. RAJU COLLEGE



Dr. R Krishnam Raju

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202
BHIMAVARAM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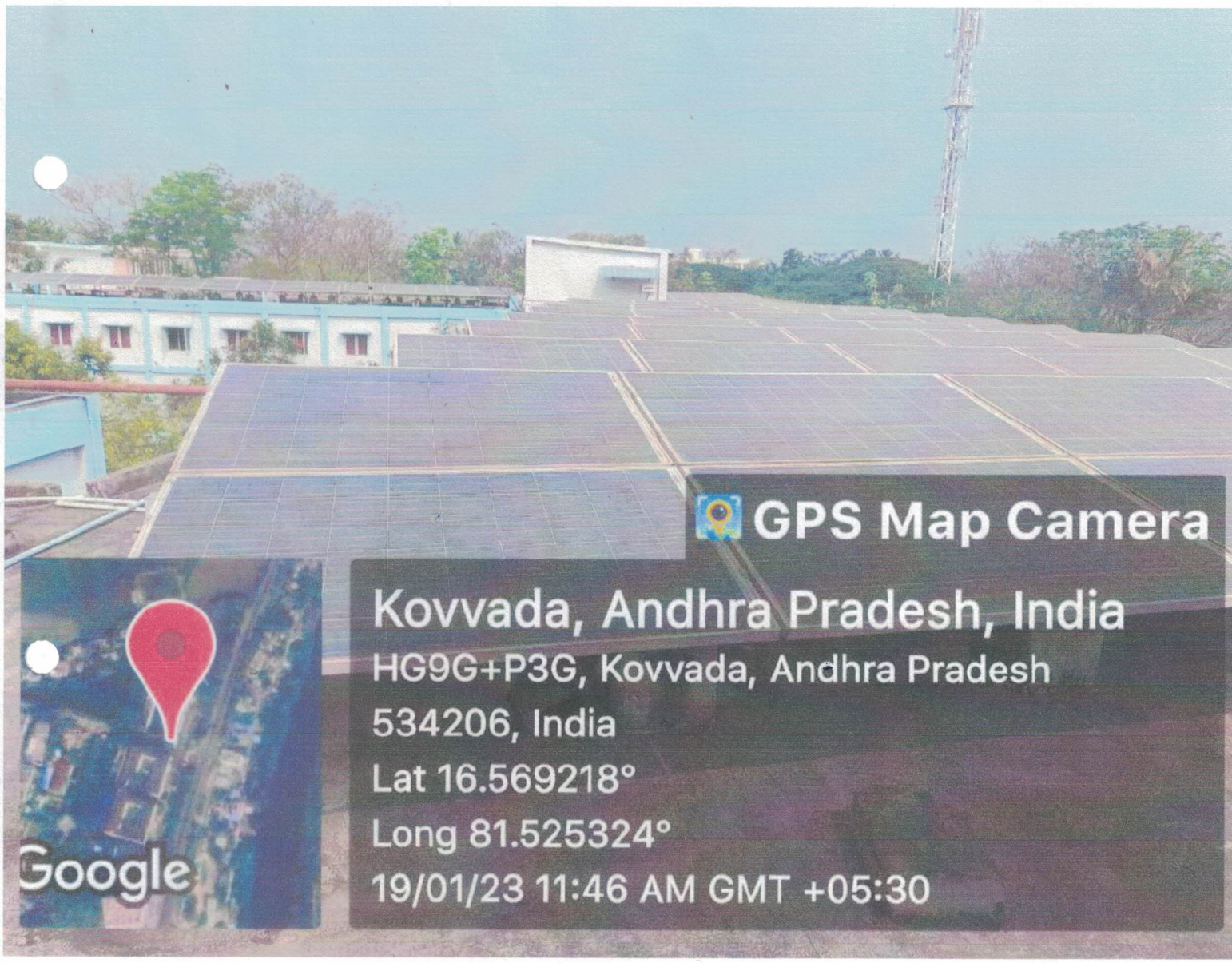
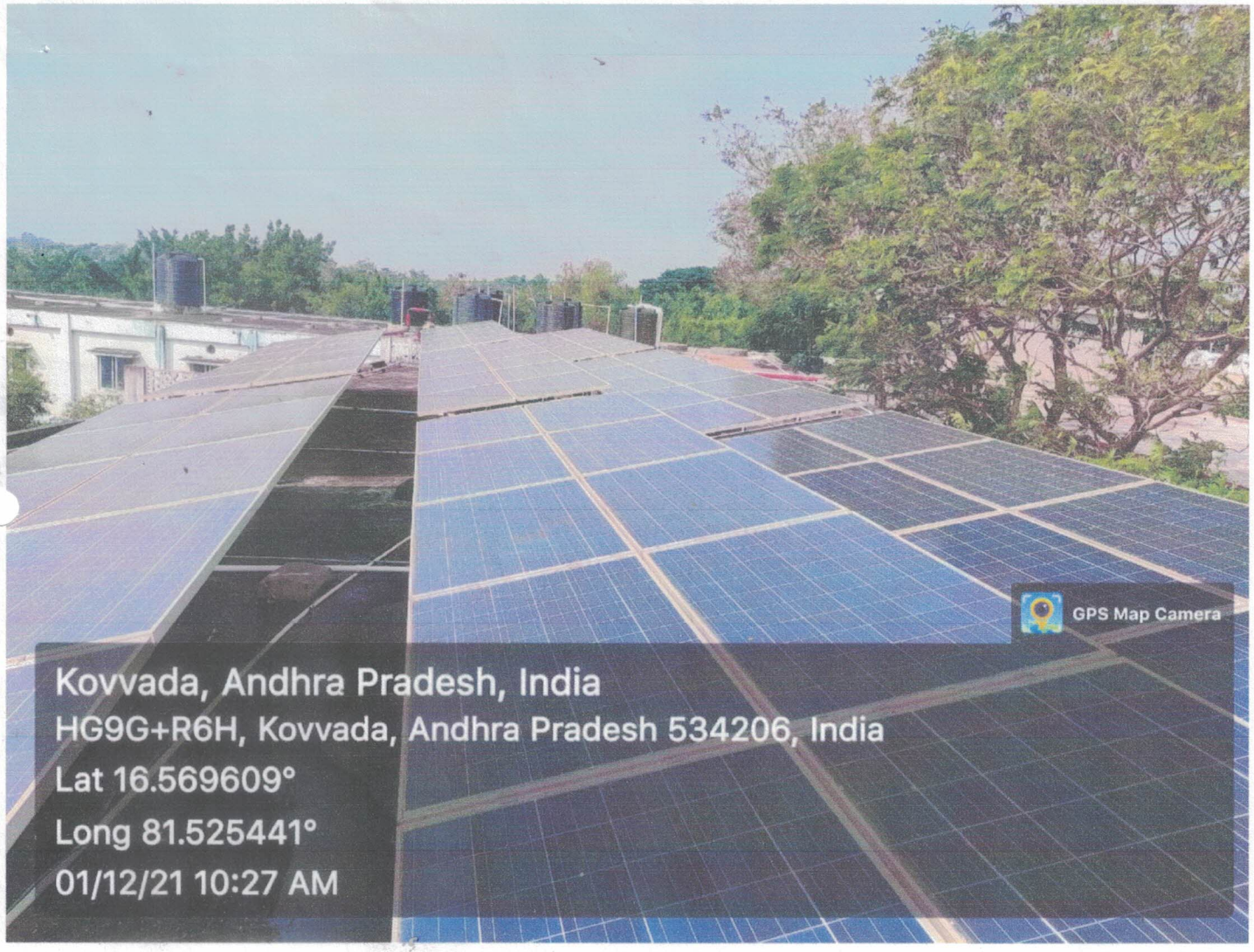
Kovvada, Andhra Pradesh, India
HG9G+P3G, Kovvada, Andhra Pradesh
534206, India
Lat 16.569655°
Long 81.525367°
19/01/23 11:45 AM GMT +05:30
Google



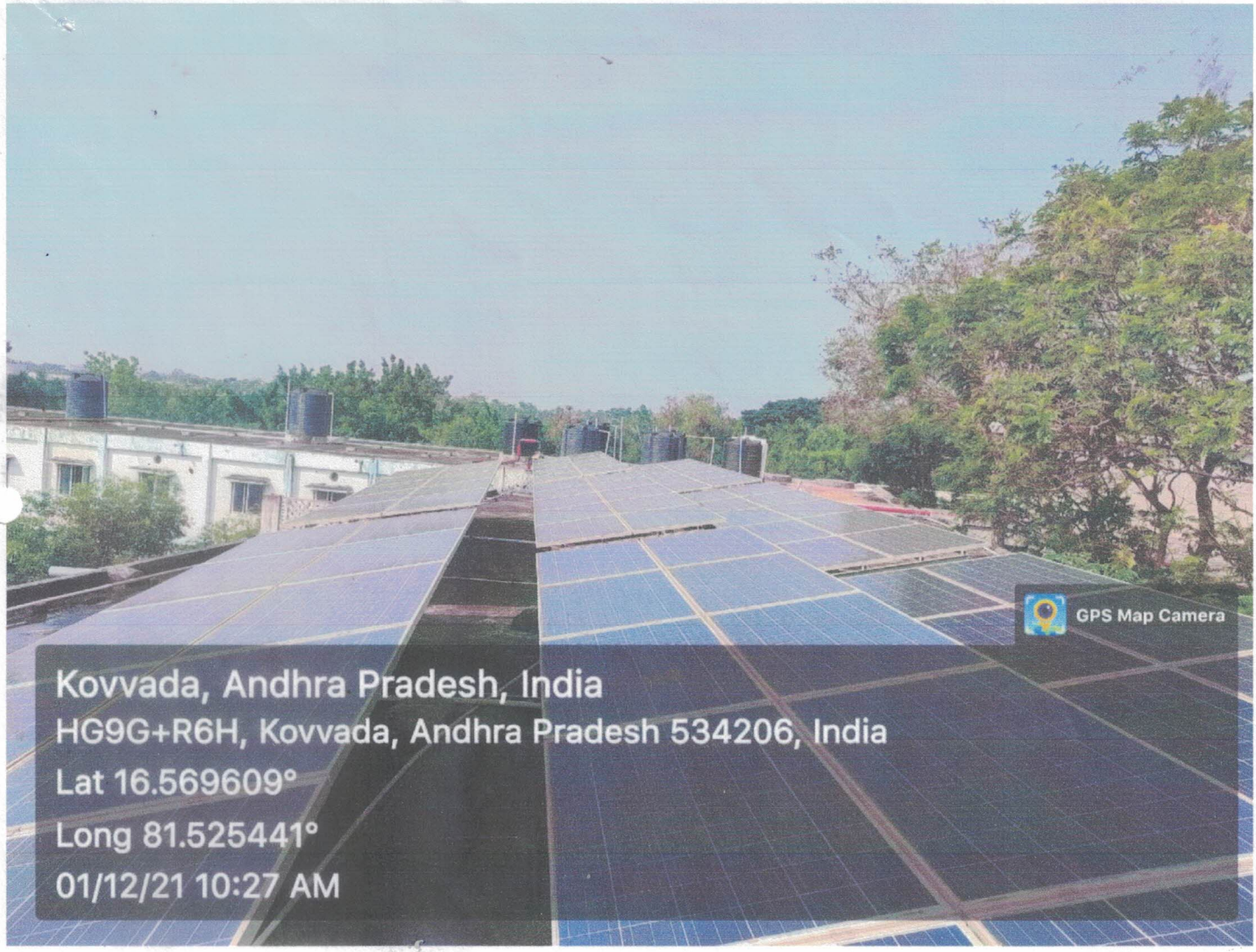
B.V. RAJU COLLEGE
VISHNUPUR
W.G Dist. (A.P.)
Pin:534 202
BHIMAVARAM

B.V. RAJU COLLEGE
VISHNUPUR
W.G.Dist. (A.P.)
Pin-534 202.
BHIMAVARAM



P. Krishnam Raju

D.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202
BHIMAVARAM



B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202
BHIMAVARAM

No.32/49/2012-13/PVSE (Part-LCI)
Ministry of New and Renewable Energy
(SPV off Grid Division)

Block No14, CGO Complex,
Lodi Road, New Delhi-110 003
Dated: 21st January 2013

To
The Pay and Accounts Officer,
Ministry of New and Renewable Energy,
New Delhi – 110003

Sub: Sanction for installation of five no. of SPV Power plants with aggregate capacity of 400kWp at three locations in Andhra Pradesh and Karnataka and Delhi by M/s Gensol Consultants Pvt. Ltd Ahmadabad

Sir,

With reference to the proposal from M/s Gensol Consultants Pvt. Ltd. (GCL) Ahmadabad vide letter No .nil dated 19th November 2012 and on the above cited subject and this Ministry's Guidelines issued vide order No., No.5/23/2009-P&C dated 8th June 2012 for Off Grid Solar Applications under JNNSM, I am directed to covey the sanction of the President for grant of Central Financial Assistance **(CFA) of Rs. 1,56,18,000/- (Rupees One Crore Fifty Six Lac Eighteen Thousand Only)** to Director, M/s Gensol Consultants Pvt. Ltd Ahmadabad installation of five no. of SPV Power plants with aggregate capacity of 400kWp at three locations in Andhra Pradesh and Karnataka at a project cost of **Rs. 5,20,60,000/-(Rupees Five Crore Twenty Lac Sixty Thousand Only)** as per the details given in their above referred proposal.

2. The sanction of the CFA will be subject to the provisions of the Ministry's modified Guidelines No.5/23/2009-P&C dated 8th June 2012 and 8th July 2011.**Only indigenously manufactured PV modules will be used in the project.**

3. GCL will maintain and present their annual accounts in the standard format as required under GFR 209 (xiii). These accounts shall be open for inspection by the sanctioning authority and audit, both by the Controller & Auditor General of India under the provision of C&AG (DPC) Act, 1971 and internal audit party by the Principal Accounts Office of the Ministry whenever called upon to do so.

4. The last date to completion of the project is **eight months from date of issue of sanction (21/09/2013)**. GCL will submit monthly progress report of the project to the Ministry during implementation phase. If the project implementation is delayed, 1% of CFA will reduced automatically for first four months and 2% for the delay beyond four months.

Annexure

Location	Capacity (kWp)	Project cost (Rs.)	Applicable CFA(Rs.)
Vasireddy Venkatadri Institute of Technology, Namburu, Guntur	100*	13015000	3904500
Dental Hospital Block, Sri Vishnu Educational Society, Bhimavaram, Andhra Pradesh	50*	6507500	1952250
Computer Educational Block, Sri Vishnu Educational Society, Bhimavaram	50*	6507500	1952250
Block No 1, Vishnu Institute of Technology, Bhimavaram, Andhra Pradesh	100*	13015000	3904500
Nagarjuna College of Engineering & Technology, Bangalore	100*	13015000	3904500
Total	**400**	**52060000**	**15618000**

***System without battery**

V R Krishnam Raju

B.V. RAJU VISHNU W.G. Dist. Pin

5. Entire eligible CFA will be reimbursed upon satisfactory installation and commissioning of the system and submission of completion report, invoice, photographs, audited statement of expenditure, generation date for one month and further verification of the system.

6. The expenditure involved is debitable to Demand No.68, Major Head :2810 New and Renewable Energy, Sub Major Head: 00, Minor Head :101-Grid Interactive and Distributed Renewable Power, Sub Head: 02-Off Grid/ Distributed and Decentralized Renewable Power, Detailed Head: 04 Solar Power, Object Head :31 grant-in Aid during the year 2012-13 (plan).

7. This issues under the powers delegated to this Ministry and with the concurrence of IFD, **dated 08/01/2013**, vide their **Dy. No. IFD/1979/12-13 dated 27/12/2012**

8. The sanction has been entered at S.No. **253** on Page No. **16** in the Expenditure Control Register of Programme on Off Grid Solar Applications under JNNSM during 2012-13.

Yours faithfully,

(Dr. G.Prasad)
Scientist-E/Director

Copy to:-

1. Director, M/s Gensol Consultants Pvt. Ltd, 14-15,2nd floor, Camps corner-2, Opp. AUDA Garden, Anand Nagar Road, Prahladnagar, Ahmadabad-380015
2. Managing Director, Karnataka Renewable energy Development Ltd, #39, Shati Gruha, Bharat Scouts & Guide Building, Opp to Chief Post Master General Office, Palace Road, Bangalore-560001 (For information)
3. Vice Chairman & Managing Director, NREDCAP, 5-8-207/2, Pisgah Complex, Nampally, Hyderabad-500001(For information)
4. The Principal Director of Audit, Scientific Departments, DGACR Building, IP Estate, New Delhi.
5. JS (TK)/Director (AR)
6. DS(F)/PSO(SKS)/US (PV)/SSO (TS)
7. PSO to Secretary, MNRE
8. Sanction folder.

(Dr. G.Prasad)
Scientist-E/Director

V R Krishnam Raju

B.V. RAJU COLLEGE
VISHNUPUR
W.G.Dist. (A.P.)
Pin-534 202
BHIMAVARAM

PROJECT

HANDOVER DOCUMENTS

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50 kW_P
GRID-TIED SOLAR PHOTOVOLTAIC POWER PROJECT

(PROJECT CODE – 0204001/3)

AT

B V RAJU INSTITUTE OF COMPUTER EDUCATION (BVRICE)

SRI VISHNU EDUCATIONAL SOCIETY, BHIMAVARAM.

COMMISSIONED ON 27TH JANUARY, 2014.

BY

VARSHINI POWER PROJECTS INDIA PVT. LTD.

B.V. RAJU COLLEGE VISHNUPUR W.G.Dist., (A.P.) Pin-534 202 BHIMAVARAM

INDEX

V R Krishnam Raju

B.V. RAJU COLLEGE
VISHNUPUR
W.G.Dist., (A.P.)
Pin-534 202
BHIMAVARAM

SECTION - 1

SOLAR PV POWER PLANT

ACRONYMS & DEFINITIONS

Acronyms

PV	Photo Voltaic
PCU	Power Conditioning Unit
CCU	Charge Controller Unit
kW	Kilo Watt
STC	Standard Test Conditions
AC	Alternating Current
DC	Direct Current
ACDB	AC Distribution Board
DCDB	DC Distribution Board
CT	Current Transformer
PT	Potential transformer
V_{oc}	Open circuit Voltage
V_{mp}	Maximum Peak Voltage
I_{sc}	Short circuit current
I_{mp}	Maximum peak current
P_{max}	Maximum peak Power

Definitions

Photovoltaic	The physical effect of direct generation of electrical energy from Sunlight.
PV Cell	The elementary PV gradient, which generates electricity from Photon.
PV Module	A collection of interconnected PV Cells encapsulated between Protective materials such as glass, often mounted in an aluminium frame. Modules can also be made using "Thin Film" semi-conductors.
Full sun	The amount of power density in sunlight as received onto the Earth's surface at noon on a clear sky(about 1000 Watts/square meter).
Kilowatt (kW)	A standard unit of electrical power equal to 1000 Watts, or to the energy consumption at a rate of 1000 joules per second.
Irradiance	The power which falls on the earth surface from the sun is called as Solar Irradiance or solar power and the radiant solar power per unit area is measured in W/m^2
Solar Insulation	The radiant solar energy generated per unit area, or the solar Irradiance summed over time is measured in kWh/m^2
Inverter	An electronic device used to convert DC into AC
String	Multiple PV modules connected in series to achieve required Voltage
V_{oc}	The maximum voltage, a Photovoltaic cell or module can generate with output terminals in short circuit mode.
Isc	The maximum current a Photovoltaic cell or module can generate with output terminals in short circuit mode.
Standard Test Conditions	To generate maximum peak power the STC conditions required are:

(i) Solar irradiance – $1000W/m^2$
(ii) Ambient Temperature – 25^0C
(iii) Air Mass – 1.5
(iv) NOCT – 47^0C

SECTION - 2

SOLAR PV POWER PLANT

INFORMATION

PROJECT INFORMATION

- **Project Scheme** : JNNSM Off-grid Solar PV Power Systems
- **Project Sanction** : 21st January, 2013.
- **Location**
  - State : Andhra Pradesh
  - Locality : Vishnupur, Bhimavaram Mandal, West Godavari District.
  - Beneficiary : B V Raju Institute of Computer Education (BVRICE), Sri Vishnu Educational Society.
  - Latitude : 16.34° N
  - Longitude : 80.52° E
- **SPV Power Plant**
  - Plant Capacity : 50 kW_P
  - Solar Modules : 200 nos
  - Solar Inverters : 3 nos
  - Roof area : 628 m^2
  - Insolation : 4.33 kWh/m2/day (based on 2012-13 solar radiation data)
  - Performance ratio : 75.3%
  - CUF : 16.07%
  - Generation
    - Annual : 70,262 kWh
    - Ave. daily : 192 kWh
  - Emission Reduction : 84.8 tCo2e
- **Solar PV module**
  - a) PV Module type : Poly Crystalline
  - b) Module make : Alpex, Himachal
  - c) Modules Efficiency : 15.54%
  - d) Quantity : 200
  - e) Capacity : 250 W_P
- **Solar Inverter**
  - Type : Grid-tied (IGBT based)
  - Make : Danfoss, Denmark.
  - Number of Units : 3
  - Capacity : 16.5 kW DC

V R Krishnam Raju

B.V. RAJU COLLEGE VISHNUPUR W.G.Dist., (A.P.) Pin-534 202. BHIMAVARAM

❖ **Solar Array Support Structure (Roof mount)**

- Type : Elevated roof mount
- Material : Galvanized Iron
- Table configuration : 20 no's of 2 x 5 = 200 modules

❖ **AC Distribution Board (ACDB)**

- Type : 3 In and 1 Out
- Make : Onexis Automation, Noida.
- Major Components : 3P, 32A MCB for each Inverter on Input side
  Surge Protecting Device for each phase
  32A Fuse for each phase
  Disconnect Switch on Output side

❖ **Synchronization Panel**

- LV Panel : Existing BVRICE Load Distribution Board
- Disconnect : L&T Make 4 Pole 25k 125A MCCB with enclosure
- Parameters : Voltage : 320 – 480V
  Frequency : 48 – 52 Hz

❖ **Electrical Conductors**

- DC Side:

  Siechem Make – 1Core 4sq. mm, Annealed tinned flexible copper conductor Electron Beam Cross Linked XLPO 120 deg C insulated and sheathed 1.8kV DC rated Solar cable (1500 m, Modules Inter looping and String to Inverter)

- AC Side:

  Poly Cab Make – 4Core 16 Sq. mm, Armored Aluminum Conductor with XLPE Insulated 1.1kV rated. (100 m, Inverters to ACDB)

  Poly Cab Make – 3.5Core 50 Sq. mm, Armored Aluminum Conductor with XLPE Insulated 1.1kV rated. (50 m, ACDB to VDC Panel Board) – 50kW$_P$ BVRICE Project

B.V. RAJU COLLEGE VISHNUPUR W.G. Dist., (A.P.) Pin-534 202 BHIMAVARAM

❖ EPC CONTRACTORS

Varshini Power Projects India Pvt. Ltd.
44-4/A, ECO House,
Nagarjuna Hills, Punjagutta.
Hyderabad – 500082.
Ph: +914023355552
Email: info@varshinipower.com
support@varshinipower.com
Web: www.varshinipower.com

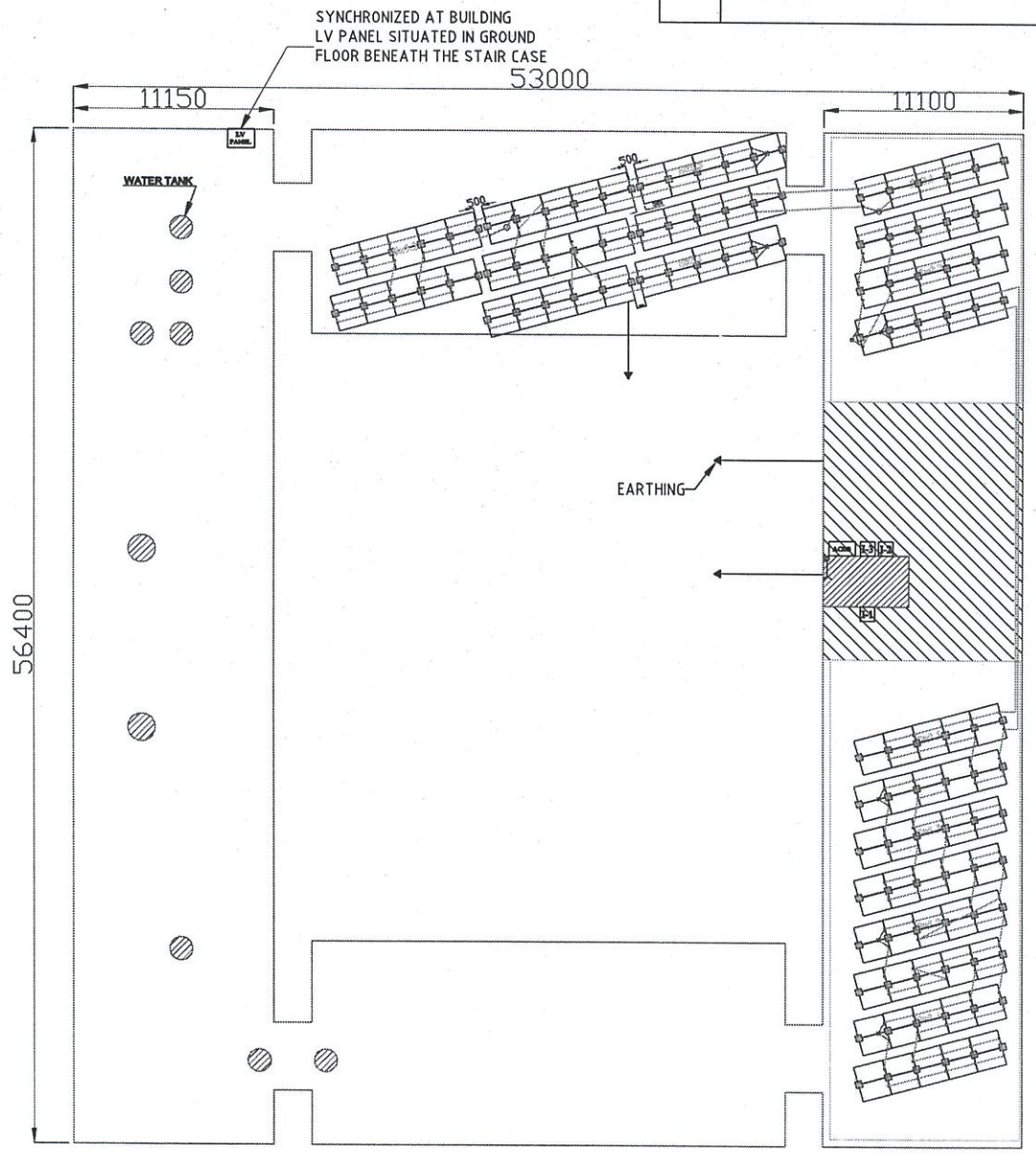
Gensol Consultants Pvt. Ltd.
108,Pinnacle Business Park,
Corporate Road, Prahalad Nagar,
Ahmedabad-380015
Ph: +917940068238
Email: solar@gensolconsultants.com
Web: www.gensolsolar.com

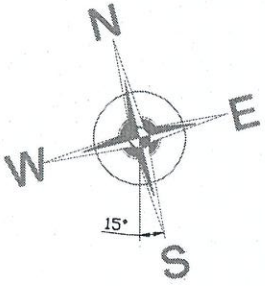
SECTION - 3

SOLAR PV POWER PLANT

LAYOUT & SINGLE LINE DIAGRAM

RevNo	Revision note	Date	Signature	Checke





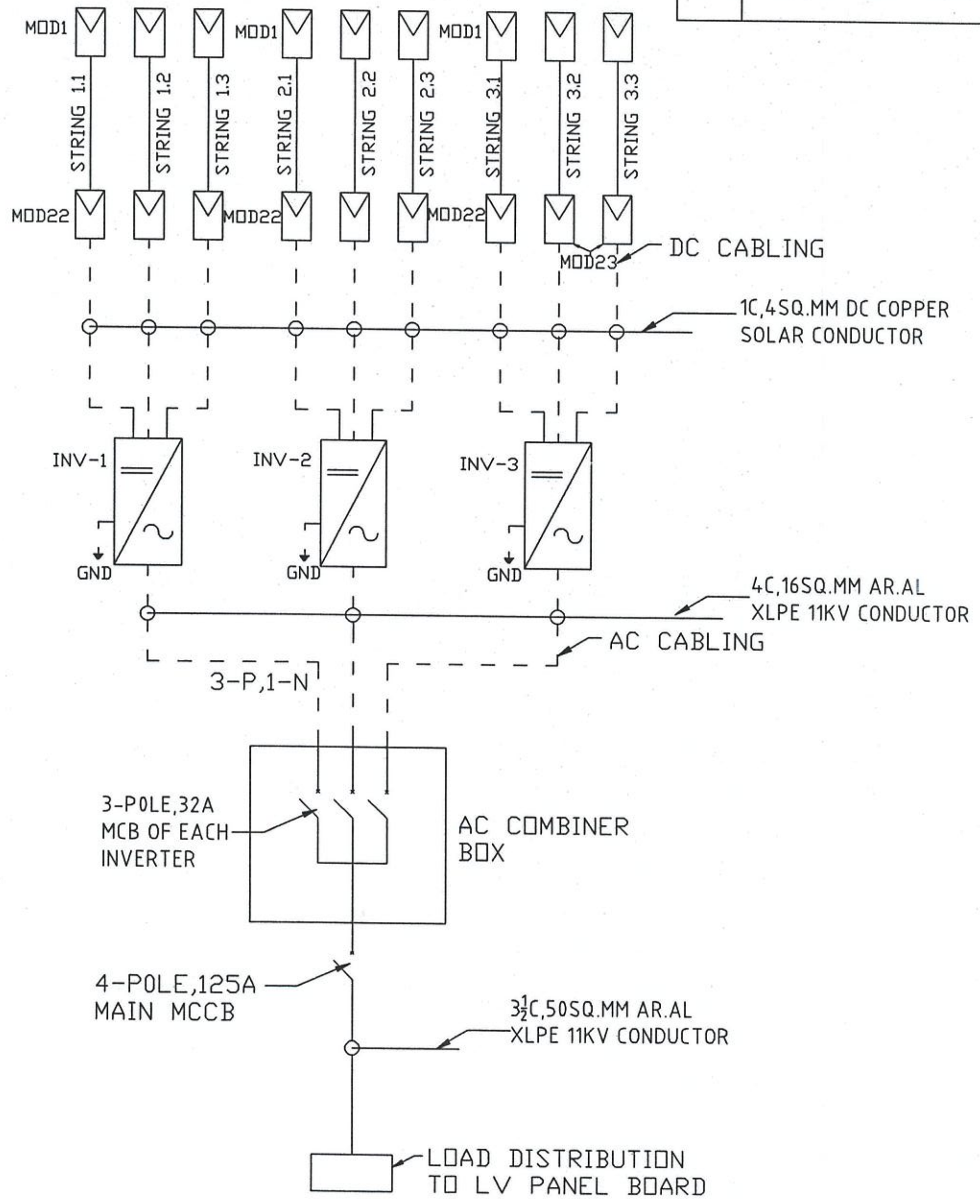
NOTES:

1. Str - STRING, 7 STRING HAS 22MODULES ARE IN SERIES & ANOTHER 2 STRINGS HAS 23 MODULES ARE SERIES
2. I- INVERTER, WE CONSIDERED 3 INVERTERS IN THIS 50kWp SYSTEM
3. Str 1.1 TO Str 3.3 CONNECTED TO THE I.1, I.2,I.3
4. EACH INVERTER HAVING 3 STRINGS
5. ACDB - AC DISTRIBUTION BOARD

VARSHINI POWER PROJECTS INDIA PVT. LTD
PLOT: 44-4/A, NAGARJUNA HILLS
PUNJAGUTTA, HYDERABAD- 500 082
ANDHRA PRADESH,INDIA.
TEL:+91 40 23355552
EMAIL: info@varshinipower.com

PROJECT: 50kWp GRID-TIED SOLAR POWER SYSTEM		ALL DIMENSIONS ARE IN MILLI METERS
PRD. BY:JYOTHI	CKD. BY: VSD	CUSTOMER:VISHNU EDUCATIONAL SOCIETY, BHVM
REV. NO:00	DATE: ----	TITLE:50kWp BVRICE BLOCK - PLANT LAYOUT
DWG. SIZE:A4	SHT. NO:01	
DWG. DATE:26/12/2013		DWG.NO:VISHNU/LAY/13/01

RevNo	Revision note	Date	Signature	Checked



S R Krishnam Raju

B.V. RAJU COLLEGE VISHNUPUR W.G.Dist., (A.P.) Pin-534 202 BHIMAVARAM

NOTES:
1. MOD - MODULES, MOD1 TO MOD23 ARE CONNECTED IN SERIES- 2 STRINGS CONNECTED TO INV-3
2.MOD1 TO MOD22 ARE CONNECTED IN SERIES - 7 STRINGS, THESE ARE CONNECTED TO THE INV-1,2,3
3. INV- INVERTER, GND- GROUND
4. MCCB-MOULDED CASE CIRCUIT BREAKER

VARSHINI POWER PROJECTS INDIA PVT. LTD
PLOT: 44-4/A, NAGARJUNA HILLS
PUNJAGUTTA, HYDERABAD- 500 082
ANDHRA PRADESH,INDIA.
TEL:+91 40 23355552
EMAIL: info@varshinipower.com

PROJECT: 50kWp GRID-TIED SOLAR POWER SYSTEM		ALL DIMENSIONS ARE IN MILLI METERS
PRD. BY:JYOTHI	CKD. BY: VSD	CUSTOMER: VISHNU EDUCATIONAL SOCIETY, BHVM
REV. NO:00	DATE: ----	TITLE:50kWp BVRICE BLOCK - SLD
DWG. SIZE:A4	SHT. NO:01	
DWG. DATE:26/12/2013		DWG.NO:VISHNU/LAY/13/01

SECTION - 4

SOLAR PV POWER PLANT

EQUIPMENT DETAILS

SECTION – 4.1

SOLAR PV POWER PLANT

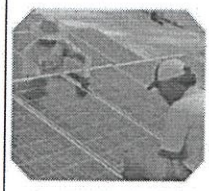
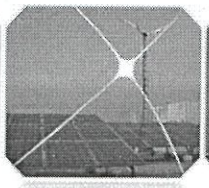
PV MODULES

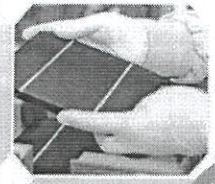
SECTION – 4.1.1

SOLAR PV POWER PLANT

PV MODULES

– SPECIFICATIONS



alpex
Power Forever

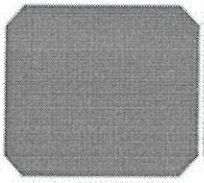
SUPER EFFICIENT MULTI PV MODULES

World Class Solar PV Modules

MNRE / ICRA APPROVED CHANEL PARTNER
Xtra Long Life
Xtra Energy / Power
Xtremely Compact Size

Features:

- Rated No. 7 in world wide Photon Lab test report.
- IEC/VDE Germany/MNRE/UL accredited.
- MNRE/ICRA approved channel partner for subsidiary.
- Super BOM.
- With RFID Tags.



Data Sheet

Technical		ALP220W	ALP225W	ALP230W	ALP235W	ALP240W	ALP245W	ALP250W
Typical Power* (Pmax)	W	220	225	230	235	240	245	250
Tolerance	%	± 3	± 3	± 3	± 3	± 3	± 3	± 3
Max. Power Voltage	V	28.82	28.90	29.00	29.20	29.50	29.70	29.95
Max. Power Current	A	7.65	7.80	7.95	8.05	8.15	8.25	8.35
Open Circuit Voltage	V	36.20	36.31	36.40	36.58	36.72	36.92	37.20
Short Circuit Current	A	8.00	8.15	8.25	8.40	8.51	8.65	8.75
Max. System Voltage	V	1000	1000	1000	1000	1000	1000	1000
Cell Efficiency	%	15.50	15.75	16.00	16.25	16.75	17.00	17.25
Module Efficiency	%	13.67	13.98	14.30	14.60	14.92	15.23	15.54

Temperature Coefficient & Nominal Operating Conditions	
NOCT*	46°C±2°C
Coefficient Power (%/°K)	-0.45%/°K
Coefficient Voltage (%/°K)	-0.31%/°K
Coefficient Current (%/°K)	0.05%/°K
Temperature Range	-40°C to 85°C

Physical Parameters		
Number of Cells	Nos	60
Module Dimension	mm	1639x982x35
Weight-Approximate	kgs	20.30
JB Cable		4mm2, with Plugin type connectors, TUV certified, 1000mm
Glass Type		High Transmission, Low Iron, Tempered, 4.0mm

* NOCT irridance 800 W/m², ambient temperature 20° C, wind speed 1m/sec
Due to constant product modifications, Alpex reserves the right to amend the above specifications without prior notice.

Alpex Solar (A Renewable Energy Division of Alpex Exports Pvt. Ltd.)

Head / Sales Office:
81/2, 1st Floor, Sri Aurobindo Marg,
Adhchini, New Delhi -110017 India.
Tel: +91 11 2654 7000-32
Fax: +91 11 2651 5355

Factory:
Village Berson, Post Manjholi,
Nalagarh, Solan - 174101 (HP), India.
Tel: +91 1795 265365/67
Fax: +91 1795 265368

Email: info@alpexonline.com **Website:** www.alpexsolar.com

ISO 9001:2008 CERTIFIED COMPANY (100% EOU)

IEC 61215, IEC 61730, IEC 61701 approved.

Solar Charge Controller | Solar Power Plants | Solar Pumps | Solar Appliances | Solar Electrical Resco

Ludhiana | Mumbai | Noida | Patna | Pune | Tirupur | Seoul | Sydney

SECTION – 4.1.2

SOLAR PV POWER PLANT

PV MODULES

– IDENTIFICATION

ALPEX SOLAR MODULES IDENTIFICATION NUMBER AT 50 kW_P BVRICE

1644P6013L22 7047 TO 1644P6013L22 7090 (044 NO'S)

1644P6013L22 7092 TO 1644P6013L22 7096 (005 NO'S)

1644P6013L22 7098 TO 1644P6013L22 7115 (018 NO'S)

1644P6013L22 7117 TO 1644P6013L22 7249 (133 NO'S)

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SECTION – 4.1.3

SOLAR PV POWER PLANT

PV MODULES

– IV CURVES

V R Krishnam Raju

SECTION – 4.1.4

SOLAR PV POWER PLANT

PV MODULES

– CERTIFICATIONS

Govt. of India
Ministry of New & Renewable Energy,
Solar Energy Centre
P.O & Village Gwalpahari, Distt: Gurgaon
Haryana, India
2010-2011

Test Report No. 670/0607/SEC/2010-Module	Date: 23 / 12 / 2010	Page 1of 3

A.SCOPE

1.	Service Request No.	670/10
2.	Requested By (Name & Address of the organization)	M/S ALPEX EXPORTS (P) LTD 81/2, KHASRA NO 210, ADHCHINI, NEW DELHI-110017
3.	Details of the test item	
	a. Nomenclature	PV Module
	b. Manufactured By	M/S ALPEX EXPORTS (P) LTD, NEW DELHI.
	c. Model / Type No.	Ref. page no. 02
	d. Serial No.	Ref. page no. 02
4.	Date of Submission of Samples	18/ 11/ 2010
5.	Condition of samples on receipt	Good
6.	Date of Completion of Tests	21/ 12 / 2010
7.	Applicable test specifications	Customer's
8.	Test category	STC Performance Test as per IEC-60904-1

B.MAJOR EQUIPMENTS USED

S.N.	NOMENCLATURE	MAKE	MODEL	CAL VALIDITY
1.	SUN SIMULATOR	ENDEAS	QUICKSUN 700A	OCT 2010

NOTE:

1. This test report refers only to the particular items submitted for testing as per specifications/requirements stipulated by the customer.
2. The results reported in the Test Report are valid at the time of and under the stipulated conditions of measurements.
3. The test report shall not be reproduced except in full , unless written permission for the publication of an approved abstract has been obtained from the Director , Solar Energy Center.
4. The client is requested to collect the tested sample back within 30 days from the date of issue of the report

Ministry of New and Renewable Energy Solar Energy Centre

31/12/2010 R Krishnam Raju

B.V. RAJU COLLEGE VISHNUPUR W.G Dist. (A.P.) Pin-534 202 BHIMAVARAM

Certificate Number ULI-NABL (ELT)-MNRE-0002/2012
Issue Date 2012-02-06

Certificate No: T-1432

CERTIFICATE

The product Photovoltaic Module has been tested by UL India Private Limited and found to comply In accordance with the Standard indicated on this Certificate

Applicant	: ALPEX EXPORTS PVT LTD KHATA KHATONI NO 140/142, KHASRA NO 802/285 MANJHOLI, TEHSIL NALAGARH, DISTT SOLAN, HP 174101, INDIA
Manufacturer	: ALPEX EXPORTS PVT LTD KHATA KHATONI NO 140/142, KHASRA NO 802/285 MANJHOLI, TEHSIL NALAGARH, DISTT SOLAN, HP 174101, INDIA
Tested Model	: ALP-230
Models Covered	: ALP-230 representing the following series 1. ALP-XXX where XXX is any number from 035 to 040 2. ALP-XXX where XXX is any number from 045 to 055 3. ALP-XXX where XXX is any number from 070 to 080 4. ALP-XXX where XXX is any number from 110 to 130 5. ALP-XXX where XXX is any number from 140 to 155 6. ALP-XXX where XXX is any number from 180 to 275
Standard(s)	: IEC 61701 – SALT MIST CORROSION TESTING OF PHOTOVOLTAIC (PV) MODULES, First Edition, issued on March 1995.

B.V. RAJU COLLEGE BHIMAVARAM VISHNUPUR W.G Dist. (A.P.) Pin-534 202

UL Logo and Marks shall not be used on or in connection with the above tested product(s).

Issued By:
MOUMITA DEBNATH
UL India Private Limited

Reviewed By:
SRIPARN SAURABH
UL India Private Limited.

Authorized By:
KRUSHNENDRA S PATIL
UL India Private Limited

VDE Prüf- und Zertifizierungsinstitut

ZEICHENGENEHMIGUNG
MARKS APPROVAL

Alpex Exports Pvt. Ltd.
81/2.F.F., Adhchini, Sri Aurbindo Marg.
110017 NEW DELHI
INDIA

ist berechtigt, für ihr Produkt /
is authorized to use for their product

Terrestrische Photovoltaik-Module mit Silizium-Solarzellen
Crystalline silicon terrestrial photovoltaic modules

die hier abgebildeten markenrechtlich geschützten Zeichen
für die ab Blatt 2 aufgeführten Typen zu benutzen /
the legally protected Marks as shown below for the types referred to on page 2 ff.

Geprüft und zertifiziert nach /
Tested and certified according to

DIN EN 61215 (VDE 0126-31):2006-02; EN 61215:2005-08
DIN EN 61730-1 (VDE 0126 Teil 30-1):2007-10; EN 61730-1:2007-05
DIN EN 61730-2 (VDE 0126 Teil 30-2):2007-10; EN 61730-2:2007-05
IEC 61215(ed.2)
IEC 61730-1(ed.1)
IEC 61730-2(ed.1)

Aktenzeichen: 5009713-3972-0001 / 140528
File ref.:

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Zertifizierungsstelle / *Certification*

Ausweis-Nr. 40027070 Blatt 1
Certificate No. *Page*

Weitere Bedingungen siehe Rückseite und Folgeblätter /
further conditions see overleaf and following pages

Offenbach, 2009-04-14
(letzte Änderung/updated 2011-11-17)

VDE Zertifikate sind nur gültig bei Veröffentlichung unter:
VDE certificates are valid only when published on:
http://www.vde.com/zertifikat
http://www.vde.com/certificate

B.V. RAJU COLLEGE VISHNUPUR W.G Dist. (A.P.) Pin-534 202 BHIMAVARAM

VDE

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Alpex Exports Pvt. Ltd., 81/2.F.F., Adhchini, Sri Aurbindo Marg., 110017 NEW DELHI, INDIEN

Aktenzeichen / *File ref.*
5009713-3972-0001 / 140528 / FG82 / ROT

letzte Änderung / *updated* 2011-11-17

Datum / *Date* 2009-04-14

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40027070
This supplement is only valid in conjunction with page 1 of the Certificate No. 40027070.

Terrestrische Photovoltaik-Module mit Silizium-Solarzellen
Crystalline silicon terrestrial photovoltaic modules

Typ(en) / *Type(s)*:

A) ALPxxxW
B) ALPxxx
C) ALPxxx
D) ALPxx
E) ALPxx
F) ALPxx

Struktur der Typenbezeichnung *Structure of typename*	xxx im Typ ersetzt die Leistung bei STC und kann jeder Wert zwischen: *xxx in the Typenumber replaces the power at STC and can be any number between:* 185 - 255 W Für / *for* A) 140 - 155 W Für / *for* B) 110 - 130 W Für / *for* C) 70 - 80 W Für / *for* D) 45 - 55 W Für / *for* E) 35 - 40 W Für / *for* F)
Max. Systemspannung *Max. system voltage*	DC 1000 V
Schutzklasse *Class*	II
Anwendungsklasse *Class of application*	A
Brandbeständigkeit *Fire resistance*	Brandklasse C. *fire rating class C.*

B.V. RAJU COLLEGE VISHNUPUR W.G Dist. (A.P.) Pin-534 202 BHIMAVARAM

Fortsetzung siehe Blatt 3 /
continued on page 3

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Alpex Exports Pvt. Ltd., 81/2.F.F., Adhchini, Sri Aurbindo Marg., 110017 NEW DELHI, INDIEN

Aktenzeichen / *File ref.*
5009713-3972-0001 / 140528 / FG82 / ROT

letzte Änderung / *updated* 2011-11-17
Datum / *Date* 2009-04-14

Dieses Blatt gilt nur in Verbindung mit Blatt 1 des Zeichengenehmigungsausweises Nr. 40027070
This supplement is only valid in conjunction with page 1 of the Certificate No. 40027070.

Max. Rückstrombelastbarkeit *Max. Reverse current*	20 A Für / *for* A) 13 A Für / *for* B), C) 6,5 A Für / *for* D), E), F)
Weitere Angaben *Further information*	siehe Anlagen Nr. 1-3 *see Appendices No. 1-3* Geprüft für erhöhte Schnee- und Eisbelastung (5400 PA) *Qualified to withstand heavy accumulations of snow and ice (5400 PA)*

Dieser Zeichengenehmigungs-Ausweis bildet eine Grundlage für die EG-Konformitätserklärung und CE-Kennzeichnung durch den Hersteller oder dessen Bevollmächtigten und bescheinigt die Konformität mit den grundlegenden Schutzanforderungen der **EG-Niederspannungsrichtlinie 2006/95/EG** mit ihren Änderungen.
*This Marks Approval is a basis for the EC Declaration of Conformity and the CE Marking by the manufacturer or his agent and proves the conformity with the essential safety requirements of the **EC Low-Voltage Directive 2006/95/EC** including amendments.*

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Fachgebiet FG82
Section FG82

V R Krishnam Raju

B.V. RAJU COLLEGE VISHNUPUR W.G. Dist., (A.P.) Pin-534 202 BHIMAVARAM

VDE Prüf- und Zertifizierungsinstitut
Zeichengenehmigung

Ausweis-Nr. / Certificate No. 40027070
Beiblatt / Supplement

Name und Sitz des Genehmigungs-Inhabers / *Name and registered seat of the Certificate holder*
Alpex Exports Pvt. Ltd., 81/2.F.F., Adhchini, Sri Aurbindo Marg., 110017 NEW DELHI, INDIEN

Aktenzeichen / *File ref.*
5009713-3972-0001 / 140528 / FG82 / ROT

letzte Änderung / *updated* 2011-11-17

Datum / *Date* 2009-04-14

Dieses Beiblatt ist Bestandteil des Zeichengenehmigungsausweises Nr. 40027070.
This supplement is part of the Certificate No. 40027070.

Terrestrische Photovoltaik-Module mit Silizium-Solarzellen
Crystalline silicon terrestrial photovoltaic modules

Fertigungsstätte(n)
Place(s) of manufacture

Referenz/*Reference*	
30019494	Alpex Exports Pvt 141-142 Khata Khatoni, Khasra No. 802-285 174101 BERSON, MANJHOLI, NALAGARH, SOLAN INDIEN

VDE Prüf- und Zertifizierungsinstitut GmbH
VDE Testing and Certification Institute
Fachgebiet FG82
Section FG82

B.V. RAJU COLLEGE
VISHNUPUR
W.G Dist. (A.P.)
Pin-534 202
BHIMAVARAM

VDE Prüf- und Zertifizierungsinstitut
Zeichengenehmigung

Ausweis-Nr. / Certificate No. 40027070

Infoblatt / Info sheet

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Alpex Exports Pvt. Ltd., 81/2.F.F., Adhchini, Sri Aurbindo Marg., 110017 NEW DELHI, INDIEN

Aktenzeichen / *File ref.*
5009713-3972-0001 / 140528 / FG82 / ROT

letzte Änderung / *updated* 2011-11-17

Datum / *Date* 2009-04-14

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Produkte, die das Biozid Dimethylfumarat (DMF) enthalten, dürfen gemäß der Kommissionsentscheidung 2009/251/EG nicht mehr in den Verkehr gebracht oder auf dem Markt bereitgestellt werden.
Der VDE-Zeichengenehmigungsausweis wird ausschließlich auf der ersten Seite unterzeichnet.

Approval to use the legally protected Mark of the VDE as shown on the first page:
Basis for the use are the general terms and conditions of the VDE Testing and Certification Institute (www.vde.com\terms-institute). The right to use the mark is granted only to the mentioned company with the named places of manufacture and the listed products with the related type references. The place of manufacture shall be equipped in a way that a constant manufacturing of the certified construction is assured.
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Products containing the biocide dimethylfumarate (DMF) may not be marketed or made available on the EC market according to the Commission Decision 2009/251/EC.
The approval is solely signed on the first page.

SECTION – 4.2

SOLAR PV POWER PLANT

SOLAR INVERTERS

SECTION – 4.2.1

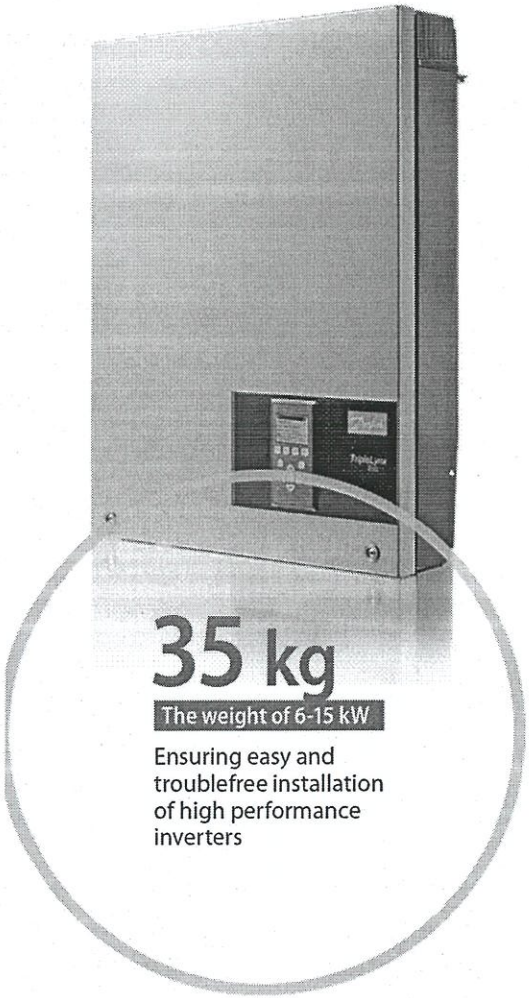
SOLAR PV POWER PLANT

SOLAR INVERTERS

– SPECIFICATIONS

TLX Inverter Series
Three phase transformerless inverter series from 6-15 kW

The TLX series includes TLX, TLX+, TLX Pro and TLX Pro+

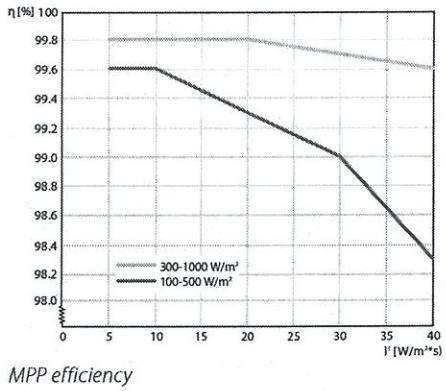


The high performance transformerless three-phase TLX inverter series, with efficiency of 98 % deliver maximum energy in all conditions.

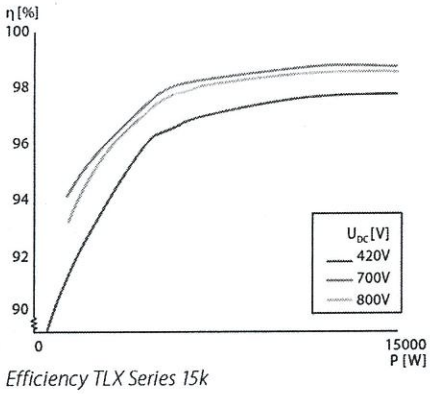
Flexibility
Integrating 1000 V_{DC} input range, 250-800 V MPP range and multiple DC inputs with each their own individually regulated MPP tracker, allows for more modules in a series and longer strings, while providing greater flexibility in the PV setup.

Simplicity
The TLX Pro series includes master inverter technology capable of controlling up to 100 inverters from a single inverter. Likewise, the integrated webserver, allows you to control, monitor and adjust your PV system from any online device.

2 Billion hours of Experience
The TLX series has been installed all over the world in both residential 6 kW systems to over 100 MW utility plants.



MPP efficiency



Efficiency TLX Series 15k

- η98 %
- 1000 V_{DC}
- 250-800 V_{MPP}
- 3x230 V_{AC}
- 6-15 kW
- PV Sweep
- Compact dimensions
- 12 pcs per pallet place
- 35 days integrated data storage
- 35 kg
- Full built-in monitoring
- 2-3 independant MPP trackers
- SMS via GSM option
- Replication of setting to 100 inverters
- Multiple languages and grid-codes
- ConnectSmart™ compliant

www.danfoss.com/solar

For additional technical data and functional descriptions please refer to the reference manual found on www.danfoss.com/solar

Unit	Parameter	TLX series				
	AC					
|S|	Rated apparent power	6.0 kVA	8.0 kVA	10 kVA	12.5 kVA	15 kVA
$P_{ac,r}$	Rated active power[1]	6.0 kW	8.0 kW	10 kW	12.5 kW	15 kW
	Reactive power range	0-3.6 kVAr	0-4.8 kVAr	0-6.0 kVAr	0-7.5 kVAr	0-9.0 kVAr
$V_{ac,r}$	Rated grid voltage (range)	3P + N + PE – 230 V / 400 V (± 20 %)				
	Nominal current AC	3 × 8.7 A	3 × 11.6 A	3 × 14.5 A	3 × 18.1 A	3 × 21.7 A
I_{acmax}	Max. current AC	3 × 9.0 A	3 × 11.9 A	3 × 14.9 A	3 × 18.7 A	3 × 22.4 A
	AC current distortion (THD %)	< 4 %			< 5 %	
$cosphi_{ac,r}$	Power factor – unregulated	> 0.99 at 100 % load and 0.95 at 20 % load				
	Power factor – regulated	0.8 over-excited – 0.8 under-excited (TLX+ and TLX Pro+)				
	"Connecting" power loss	10 W				
	Night-time power loss (off grid)	< 5 W				
f_r	Rated grid frequency (range)	50 Hz ± 5 Hz				
	DC					
$P_{mpptmax}$	Maximum PV input power per MPPT	8.0 kW				
$\Sigma_{P\ mpptmax}$	Max./nom. converted PV input power, total	6.2 kW	8.25 kW	10.3 kW	12.9 kW	15.5 kW
$V_{dc,r}$	Nominal voltage DC	700 V				
V_{mppmin} V_{mppmax}	MPP voltage-nominal power[2]	260 - 800 V	345-800 V	430-800 V	358-800 V	430-800 V
	MPP tracker	2 (2 × MC4)			3 (3 × MC4)	
V_{dcmax}	Max. DC voltage	1000 V				
$V_{dcstart}$	Turn on voltage	250 V				
V_{dcmin}	Turn off voltage	250 V				
I_{dcmax}	Max. current DC	2 × 12 A			3 × 12 A	
	Max. short circuit current DC at STC	2 × 12 A			3 × 12 A	
	Min. on grid power	20 W				
	Efficiency					
	Max. efficiency	97.8 %	97.9 %	98 %		
	Euro efficiency at $V_{dc,r}$	96.5 %	97.0 %	97.0 %	97.3 %	97.4 %
	MPP efficiency, static	99.9 %				
	Enclosure					
	Dimensions (H, W, D)	700 × 525 × 250 mm				
	Weight	35 kg				
	Acoustic noise level	max. 56 db(A)				
	Operation temperature range	-25..60 °C (45..60 °C – degrading at high loads)				
	Storage temperature	-25..60 °C				
	Relative humidity	95 % (non-condensing)				
	Ancilliary Services					
	Active power	Fixed, set point curves, remotely controlled, Fault Ride Through				
	Reactive power	Constant, set point curves, remotely controlled, Fault Ride Through (TLX+ and TLX Pro+)				
	Safety					
	Approvals and certificates	www.danfoss.com/solar → Download				
	Electrical Safety	IEC 62109-1/IEC 62109-2 (Class I, grounded – communication part Class II, PELV)				
	Functional safety	Voltage and frequency monitoring, islanding detection, residual current monitoring				

[1] At rated grid voltage (Vac,r), Cos(phi) = 1
[2] At symmetric input configuration. At asymmetrical input configuration. V_{mppmin} can be as low as 250 V.

Danfoss Solar Inverters A/S · Nordborgvej 81 · 6430 Nordborg · Denmark · Tel: +45 7488 1300 · Fax: +45 7488 1301
solar-inverters@danfoss.com · www.danfoss.com/solar

SECTION – 4.2.2

SOLAR PV POWER PLANT

SOLAR INVERTERS

– IDENTIFICATION

DANFOSS SOLAR INVERTERS SERIAL NUMBERS AT

50 KW_P BVRICE BLOCK

139F0013301702N383

139F0013303502N383

139F0013303702N383

SECTION – 4.2.3

SOLAR PV POWER PLANT

SOLAR INVERTERS

– CERTIFICATIONS

TÜVRheinland®

Factory Inspection Certificate

Registration No.: AK 60041106.0002 Page 1 **Report No.: 21173707.002**

License Holder:
Danfoss Solar Inverters A/S
Ulsnæs 1, Danmark
DK - 6300 Gråsten
Denmark

Product:
Inverter
Type:

TLX8k; TLX10k; TLX12,5K; TLX15k

Manufacturing Plant :
Danfoss Solar Inverters A/S
Nordborgvej 81, E1
DK - 6430 Nordborg
Denmark

Above stated products and types have been assessed during an inspection of the manufacturing plant. Main assembly and quality control of these models is performed at the above mentioned manufacturing plant located within the European Union.

Below stated main production steps where inspected:

- development
- assembly
- quality control

Remarks:
This certificate is valid until the next scheduled inspection or up to 12 months, at the discretion of TÜV Rheinland Group.

Certification body

B.V. RAJU COLLEGE VISHNUPUR W.G Dist. (A.P.) Pin-534 202 BHIMAVARAM

TÜV Rheinland LGA Products GmbH TÜVRheinland® Zertifizierungsstelle

Cologne, 20 September 2011

Dipl.-Ing. F.Möcking

Danfoss Solar Inverters A/S
Power Electronics Division

Ulsnæs 1
DK-6300 Gråsten
Denmark
CVR no.: 19 88 38 76

Tel: +45 7488 1300
Fax: +45 7488 1301
E-mail: solar-inverters@danfoss.com
Homepage: www.solar-inverters.danfoss.com

UK ER G59/2-1 declaration for FLX product line

The Manufacturer
Danfoss Solar Inverters A/S
Power Electronics Division
Ulsnaes 1
DK-6300 Graasten
Denmark

declares under our sole responsibility that the below product line

FLX 12.5	FLX Pro 12.5
FLX 15	FLX Pro 15
FLX 17	FLX Pro 17

is in conformity with the Engineering Recommendation G59, Issue 2, Amendment 1: Requirements for the connection of generating plant to the distribution systems of licensed distribution network operators in the United Kingdom.

The test results are summarized in the enclosure of this declaration.

Date	Approved by
2013-12-17	Steffan Hansen Senior Director, Product Development

Enclosure:

Engineering Recommendation G59, Issue 2, Amendment 1

Generating Plant Type Verification Test Sheet
for Nominal Grid Voltages of 230V and 240V

Generating Plant Type Verification Test Sheet

Type Approved Generating Plant (>16A per phase but ≤ 50 kW 3 phase)

GENERATING PLANT DETAILS

Generating Plant Type reference: a) FLX12.5, FLX Pro 12.5 b) FLX15, FLX Pro15 c) FLX 17, FLX Pro 17		
Generating Plant Technology: PV inverter		
Manufacturer:	TEL: (+45) 7488 2222 FAX: (+45) 7489 0949	Address: DANFOSS SOLAR INVERTERS A/S POWER ELECTRONICS DIVISION ULSNAES 1 DK-6300 GRAASTEN, DENMARK
Technical file reference No:	1) Danfoss 2013-09-25_FLX17_MX45_ptf 2) M.O.E. Unit certificate for PV inverter MOE 13-0168-16 3) M.O.E. Declaration of conformity for power generator unit MOE 13-0573-03	
Maximum export capability: a) 12.5 kW, b) 15 kW, c) 17kW (**Generating Plant** rating less parasitic load)		

TEST HOUSE DETAILS

Name and address of test house	DANFOSS SOLAR INVERTERS A/S ULSNAES 1 DK-6300 GRAASTEN, DENMARK
Telephone number	(+45) 7488 2222
Facsimile number	(+45) 7489 0949
E-mail address	DANFOSS@DANFOSS.COM

TEST DETAILS

Date of test	2013-09-26
Name of tester	Mads Bernecker
Signature of tester	Mads Bernecker

POWER QUALITY

Harmonics Emissions								
Minimal Short Circuit Ratio R_{sce}: 33								
Value of Short Circuit Power S_{sc} corresponding to R_{sce}: 561 kVA								
Equipment Phases: Three Phase								
Description	Harmonic Current % = $100I_n/I_1$						Harmonic Current Distortion Factors (%)	
Harmonic:	I_3	I_5	I_7	I_9	I_{11}	I_{13}	THD	PWHD
Limit:	21.6	10.7	7.2	3.8	3.1	2	13	22
Actual Value L1:	0.045	0.09	0.05	0.287	0.425	0.427	1.09	3.34
L2:	0.029	0.078	0.056	0.272	0.371	0.428	1.02	3.24
L3:	0.035	0.085	0.05	0.251	0.391	0.437	1.01	3.3
Notes: Detailed requirements are specified in BSEN 61000-3-12, data for representative unit.								

Voltage Fluctuations					
Equipment meets BSEN 61000-3-3 Yes					
If equipment does not meet BSEN 61000-3-2 : N/A i) Does equipment require a supply rated ≥ 100A? Yes / No (delete as appropriate) ii) If the answer to i) is no, specify the value of Z_{ref}: (ohms) iii) If the answer to i) is no, specify the value of Z_{max}: (ohms)					
	Voltage Disturbance				
	P_{st}	P_{lt}	d(t) %	d_c %	d_{max} %
Limit (at Z_{ref})	1	0.65	3.3	3.3	4
Actual Value (at Z_{ref})	0.28	0.28	N/A	3	0.3

Notes:

Detailed requirements are specified in BSEN 61000-3-11 and BSEN 61000-3-3.

If the equipment requires a supply rated at ≥ 100A the maximum system impedance is deemed to be 0.15 + j0.15 ohms for each phase and 0.1 + j0.1 ohms for the neutral.

If the voltage disturbance values are above the limits for the specified reference impedance (Z_{ref}) then the manufacturer shall declare a maximum value of system impedance (Z_{max}) for which the equipment satisfies the voltage disturbance requirements of BSEN 61000-3-11.

	DC injection			Power factor		
Limit	20mA, tested at three power levels *			0.95 lag – 0.95 lead at three voltage levels		
Test Point	10%	55%	100%	212 V	230 V	248 V
Value Measured	22mA	22mA	22mA	> 0.99	> 0.99	> 0.99

* Indicative values are shown for minimum, medium and maximum power levels.
# insert maximum value of dc injection and worst case pf value recorded during testing

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PROTECTION TESTS (NOMINAL VOLTAGE: 230V)				
Protection	**Setting**		**Test Results**	
Over Voltage Stage 1	Volts %	Sec	Volts %	Sec
L1-N or L1-L2	253 V	1 s	253.5 V	1.03 s
L2-N or L1-L3			253.2 V	1.06 s
L3-N or L1-L3			254.1 V	1.06 s
Over Voltage Stage 2	Volts %	Sec	Volts %	Sec
L1-N or L1-L2	264 V	0.5 s	264.4 V	0.54 s
L2-N or L1-L3			263.7 V	0.56 s
L3-N or L1-L3			264.1 V	0.55 s
Under Voltage Stage 1	Volts %	Sec	Volts %	Sec
L1-N or L1-L2	200 V	2.5 s	201.4 V	2.54 s
L2-N or L2-L3			200.4 V	2.54 s
L3-N or L1-L3			200.7 V	2.58 s
Under Voltage Stage 2	Volts %	Sec	Volts %	Sec
L1-N or L1-L2	184 V	0.5 s	185.5 V	0.60 s
L2-N or L2-L3			184.6 V	0.57 s
L3-N or L1-L3			186.1 V	0.55 s
Over Frequency Stage 1	51.5 Hz	90 s	51.2 Hz	90.03 s
Over Frequency Stage 2	52 Hz	0.5 s	52 Hz	0.53 s
Under Frequency Stage 1	47.5 Hz	20 s	47.5 Hz	20.04 s
Under Frequency Stage 2	47 Hz	0.5 s	46.9 Hz	0.53 s

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PROTECTION TESTS (NOMINAL VOLTAGE: 240V)				
Protection	**Setting**		**Test Results**	
Over Voltage Stage 1 L1-N or L1-L2 L2-N or L1-L3 L3-N or L1-L3	Volts % 264 V	Sec 1 s	Volts % 264.6 V 264.7 V 265.2 V	Sec 1.04 s 1.04 s 1.07 s
Over Voltage Stage 2 L1-N or L1-L2 L2-N or L1-L3 L3-N or L1-L3	Volts % 276V	Sec 0.5 s	Volts % 276.4 V 276.2 V 275.8 V	Sec 0.56 s 0.55 s 0.56 s
Under Voltage Stage 1 L1-N or L1-L2 L2-N or L2-L3 L3-N or L1-L3	Volts % 209 V	Sec 2.5 s	Volts % 209.9 V 209.9 V 209.9 V	Sec 2.53 s 2.54 s 2.55 s
Under Voltage Stage 2 L1-N or L1-L2 L2-N or L2-L3 L3-N or L1-L3	Volts % 192 V	Sec 0.5 s	Volts % 192.4 V 192.8 V 192.8 V	Sec 0.55 s 0.54 s 0.53 s
Over Frequency Stage 1	51.5 Hz	90 s	51.2 Hz	90.03 s
Over Frequency Stage 2	52 Hz	0.5 s	52 Hz	0.53 s
Under Frequency Stage 1	47.5 Hz	20 s	47.5 Hz	20.04 s
Under Frequency Stage 2	47 Hz	0.5 s	46.9 Hz	0.53 s

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LOSS OF MAINS TEST

Method used	ROCOF		
Output power level *	10%	55%	100%
Trip setting	0.5 s	0.5 s	0.5 s
Trip value	0.50 s	0.53 s	0.53 s

* Indicative values are shown for minimum, medium and maximum power levels.

RECONNECTION TIMES

Reconnection Time	Under/Over voltage	Under/Over Frequency	Loss of mains
Minimum value	180 sec	180 sec	180 sec
Actual Setting	180 sec	180 sec	180 sec
Recorded value	>180 sec	>180 sec	>180 sec

FAULT LEVEL CONTRIBUTION

Short Circuit Test

This test should determine the value of short circuit current at the **Generating Plant** terminals.
The **Generator** shall declare, to the **DNO,** the maximum short circuit current contribution from the **Generating Unit** and the conditions under which this exists.
One method for determining the short circuit current contribution is described below.
The short circuit current contribution of the **Generating Unit** shall be measured upon application of a short circuit on the **Generating Unit** terminals (all phases / phase to neutral) with the machine operating at full load output steady state conditions.
Current measurements shall be taken from application of fault until the time the fault has been disconnected, following operation of the **Generating Unit** protection. A current decay plot shall be produced for each phase from inception of the fault until the **Generating Unit** has been disconnected. The plot will need to show the highest value of peak short circuit current, eg for a **Generating Unit** supplying a purely inductive load the highest value of peak short circuit current will result when the fault is applied at a voltage zero. Where practicable the tests will need to determine values for all of the relevant parameters listed in the table below. These parameters are described in IEC 60909[1] whilst this standard is primarily for three-phase generators the methodology for determining these parameters can be applied to single-phase generators.

For rotating machines and linear piston machines the test should produce a 0 – 2.0s plot of the short circuit current as seen at the **Generating Plant** terminals.

Short Circuit Parameters

Parameter	Symbol	Value
Peak short-circuit current	i_p	N/A**
Initial value of aperiodic component	A	N/A**
Initial symmetrical short-circuit current *	I''_k	N/A**
Decaying (aperiodic) component of short-circuit current *	i_{DC}	N/A**
Reactance / Resistance Ratio of source *	$^X/_R$	N/A**

* Values for these parameters should be provided where the short circuit duration is sufficiently long to enable interpolation of the plot
** As photo-voltaic SSEG are inverter-connected, they are deemed to comply automatically with regulations and no further testing is needed

SELF MONITORING – SOLID STATE SWITCHING

Test	Yes / No
It has been verified that in the event of the solid state switching device failing to disconnect the **Generating Plant**, the voltage on the output side of the switching device is reduced to a value below 50 volt within 0.5s.	N/A

Not applicable because electro-mechanical relays are used.

[1] **IEC 60909-0:2001** - Short-circuit currents in three-phase a.c. systems. Calculation of currents

primara Test- und Zertifizier-GmbH	Factory Inspection "Made in EU"	Report No.	11KFS089-02-0
		Date	19.oct.2012

Client	Danfoss Solar Inverters	Development address (if different)	
Address	Jyllandsgade 28 6400 Sønderborg Denmark		
Manufacturing address (if different)	Nordborgvej 81 6430 Nordborg Denmark	Testing address (if different)	
Contact Information:			
Main Contact:	Stefan Hahne	Phone:	+4574881447
Title	Electrical engineer	~~Fax:~~ Email:	Hahne@danfoss.com
Alternate Contact Information:			
Main Contact:		Phone:	
Title		Fax:	
Main Person Responsible For Quality Assurance:		Yitzhak Shoshan	
Main Person Responsible For Engineering:		Steffen Hansen	
Main Person Responsible For Manufacturing:		Birgit Ballegaard	
Main Person Responsible For Routine Testing:		Jim Svenningsen	

Requirement		Compliance			
Section	Design, Development	Yes	No	N/A	Comment
1.1	Is the design and development independent from the manufacturing?	X			verified
1.2	Is there a defined structure in design and development (hardware, software, product lines)? How many people?	X			27 people
1.3	Is design and development subcontracted? If yes, to who/where?		X		
1.4	Is the facility being inspected authorized to make product design changes or component substitutions?	X			
1.5	Are procedures in place to ensure that changes to product design and manufacturing process is performed in a controlled manner and reviewed by someone familiar with Regulatory matters?	X			
1.6	Is there a documented procedure ensuring that no changes to the construction of certified products will be implemented without the permission of the Licence Holder?	X			
Section	Production Control	Yes	No	N/A	Comment
2.1	Is there a documented quality system to control	X			

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	production?				
2.2	Is the Quality Manager independent from manufacturing?	X			~~PCB asse~~
2.3	Is production or parts of production subcontracted? If yes, to who/where?	X			PCB assembly in china
2.4	If the manufacturer produces the same product at a different manufacturing location, what method is used to mark the product with a unique factory identifier?	X			only one factory
2.5	Are procedures in place to uniquely identify batches or runs of product?	X			serial rumber
2.6	Is there a parts list or similar evidence available specifying the components/parts to be used during production?	X			
2.7	Are materials, components and sub-assemblies verified by the manufacturer as complying with appropriate specification and origin?	X			
2.8	Are there up-to-date documents, assembly instructions, photographs, drawings and the like readily available?	X			assembly instructions + drawings
2.9	Was there production during visit? *Identify the type number and any certification mark that appeared on products seen in production at the time of the visit. If no certified products were seen, indicate what kind of products were manufactured at the time of visit.*	X			PV inverters FLX 15KProt

Section	**Production Line Testing**	Yes	No	N/A	Comment
3.1	Are all mandatory production line tests such as ground continuity and/or hi-pot performed after the final stage of assembly?	X			
3.2	Are production units identified, marked or labeled to provide verification that testing was performed with satisfactory results?	X			
3.3	Is a logbook or other equivalent means provided to document each unit, by serial number or date code?	X			
3.4	Does the aforementioned logbook or equivalent means provide at least the following information: (a) The date all required production testing was performed (b) The test equipment used (c) The serial number of the EUT (d) a checkbox to indicate the pass/fail of the tests performed (e)The name of the technician performing the tests	X			a,b,c) yes d) pass/fare indication automatically e) automatic test
3.5	Is the tester in good working condition and				

	verified before use?	X			internal self test
3.6	Is the test equipment calibrated and is there a label or similar method indicating the next calibration date?	X			checked label see cal. cert
3.7	Is the test technician provided with a written test procedure for each test?	X			
3.8	Is the test area segregated from other production areas due to the potentially hazardous nature of the testing?	X			
3.9	Does the Manufacturer provide a secured area for failed units to insure they are not inadvertently returned to production before repair/rework?	X			
3.10	Does the Manufacturer provide a tag, flyer, or other identifiable means for visually identifying failed units?	X			
3.11	Are repaired and reworked products re-inspected in accordance with documented procedures?	X			
Section	**Miscellaneous**	**Yes**	**No**	**N/A**	**Comment**
4.1	Are records kept at least for the period between two inspection visits?	X			
4.2	Are the records maintained and satisfactory?	X			
4.3	If there were any unsatisfactory findings entered in the previous inspection report, have these been corrected?			X	No findings yet

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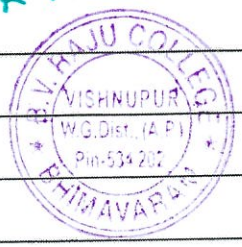
Inspectors Evaluation (Informative):

V R Krishnam Raju



Inspectors Evaluation (Findings):	
= Related section of this report	Inspector's points requiring corrective action from the manufacturer
	No findings

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		Date	19. Oct. 2012

Inspectors Evaluation

List your findings on the INSPECTORS EVALUATION *page(s) by referencing the applicable clauses in this report (including comments, recommendations, etc.) and explain them to the manufacturer. If possible indicate also the corrective actions the manufacturer intends to take.*

Give your **recommendations** by ticking the appropriate box:

1. No unsatisfactory findings.	**Grant or continue certification.**	■
2. Minor unsatisfactory finding(s).	**Manufacturer's corrective action(s) will be checked at next visit. Grant or continue certification.**	☐
3. Major unsatisfactory finding(s), certification not directly affected.	**Manufacturer shall confirm corrective action(s). Grant or continue certification**	☐
4. Critical unsatisfactory finding(s), certification directly affected.	**Certification refused/suspended and repeated factory inspection recommended after the manufacturer has confirmed implementation of corrective action(s).**	☐

Total number of attachments : ...1.....

A copy of this report shall be provided to the undersigned contact person who should be aware of the contents and sign for its receipt.

Time in factory: .....3..... hours.

The responsibility for ensuring that a product is manufactured in accordance with the standard to which it was originally approved rests with the licence holder.

Date: 19. October 2012	Date: 30.10.2012
Inspector's name (printed letters): Amélie Haug	Contact person's name (printed letters): Stefan Mahne
Signature: Amélie Haug	Signature: Stefan Mahne

Dr. R Krishnam Raju

B.V. RAJU COLLEGE VISHNUPUR BHIMAVARAM

primara
Test- und Zertifizier-GmbH

Certificate

Applicant:

Danfoss Solar Inverters A/S
Jyllandsgade 28
6400 Sonderborg
Denmark

Factory:

Danfoss Solar Inverters A/S
Nordborgvej 81
6430 Nordborg
Denmark

Product type: Solar Inverter

Model:	TLX+ 6k TLX Pro+ 6k	TLX 8k TLX+ 8k TLX Pro 8k TLX Pro+ 8k	TLX 10k TLX+ 10k TLX Pro 10k TLX Pro+ 10k	TLX 12,5k TLX+ 12,5k TLX Pro 12,5k TLX Pro+ 12,5k	TLX 15k TLX+ 15k TLX Pro 15k TLX Pro+ 15k
Rating:	6,0kW	8,0kW	10,0kW	12,5kW	15,0kW

Certification Mark:

BAUART GEPRÜFT
TYPE APPROVED
primara

A representative test sample of above stated model passed the tests according to:

Standard: **DIN V VDE V 0126-1-1 (VDE V 0126-1-1):2006-02**

The following alternative grid disconnection parameters are set as default for Portugal:
UV (stage 2): 115V, 100ms disconnection time
UV (stage 1): 196V, 2000ms disconnection time
OV (stage 1): 253V, 200ms disconnection time
OV (stage 2): 300V, 50ms disconnection time
49Hz<f<51Hz

The factory is inspected annually by the certification body, the program is in accordance with:

ISO/IEC Guide 67:2004 – System N°5

Report no: 11KFS089-01

Certificate no: 11-067-02

Date of issue: 2012-02-24 **Valid until:** 2016-10-25

B.V. RAJU COLL

Zertifizierstelle
Certification

DAkkS
Deutsche Akkreditierungsstelle
D-ZE-12089-01-01

SECTION – 4.3

SOLAR PV POWER PLANT

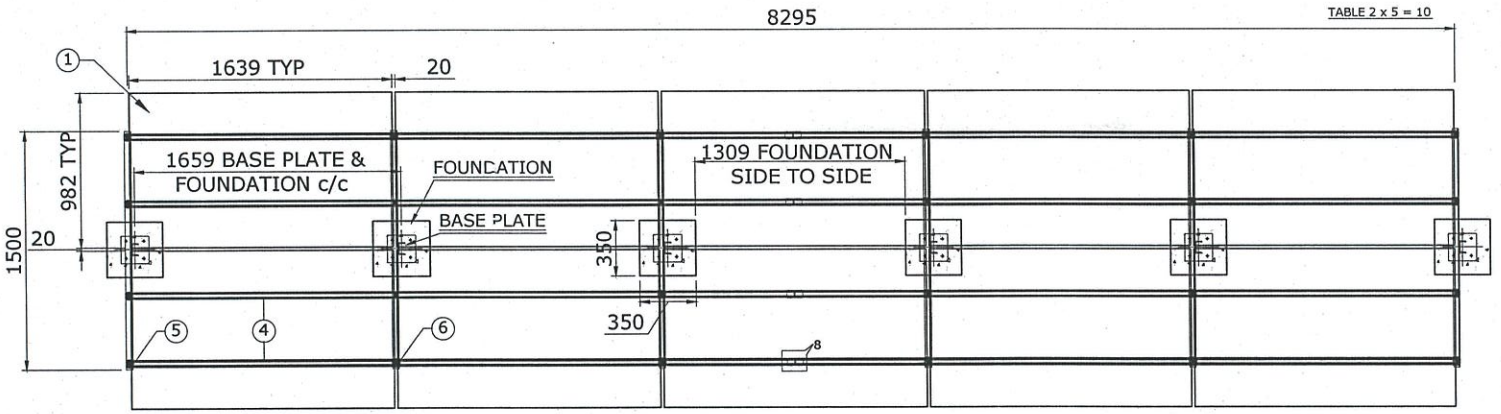
BALANCE OF MATERIAL

SECTION – 4.3.1

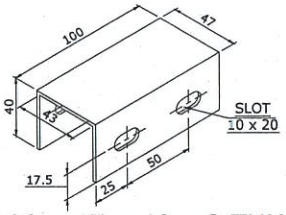
SOLAR PV POWER PLANT

BALANCE OF MATERIAL

– STRUCTURES

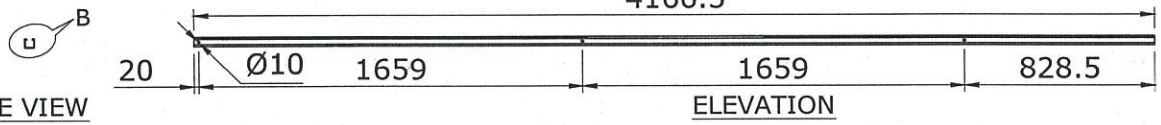


DETAIL -8

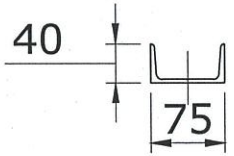


100 x 47 x 40 x 2 THK

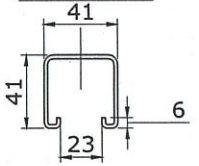
DETAIL-4 PURLIN OF STRUT (41 x 41 x 2 THK)



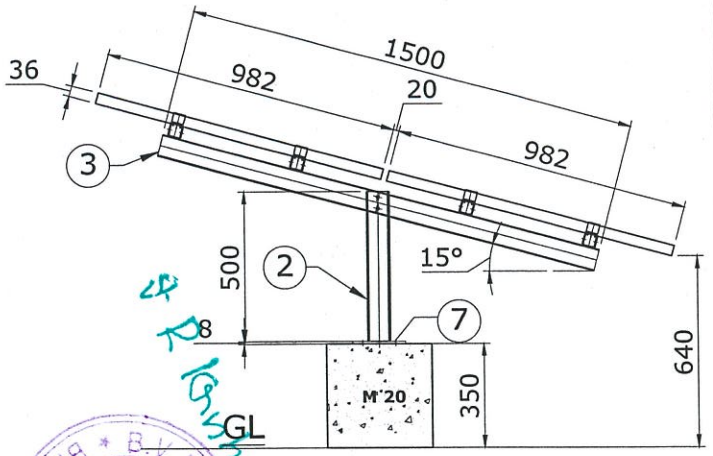
DETAIL-A



DETAIL-B

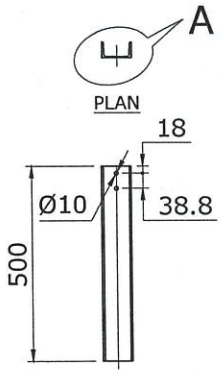


STRUT-41x41x2THK.



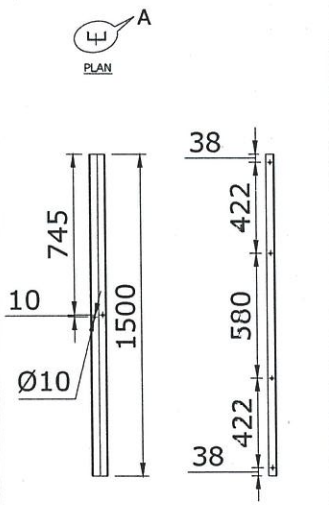
ASSEMBLY

DETAIL-2



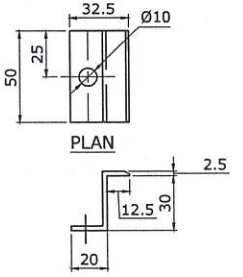
POLE OF (ISLC 75)

DETAIL-3

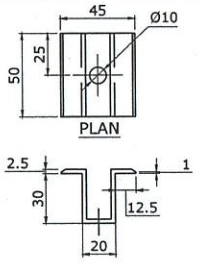


RAFTER OF (ISLC 75)

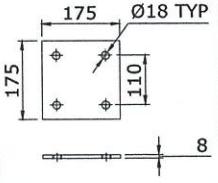
DETAIL -5 (PANEL MOUNTING Z'CLAMP)



DETAIL -6 (PANEL MOUNTING U'CLAMP)



DETAIL-7 POLE BASE PLATE



STERLING STRIPS LIMITED
301/302 AVIOR NIRMAL GALAXY LBS ROAD MULUND (W) MUMBAI–400080

DRAWN:	AMOL	CLIENT:	GENSOL ENGINEERING PVT.LTD (TABLE - 2 x 5 = 10)
DATE:	31.01.13		
CHECKED:	B.H	TITLE:	100 KW PV PLANT
DATE:	31.01.13		
APPROVED:	S.V	SCALE: N.T.S.	DRG. No: SSL-GEPL-2013 REV. 2
DATE:	31.01.13		

SECTION – 4.3.2

SOLAR PV POWER PLANT

BALANCE OF MATERIAL

– CONDUCTORS

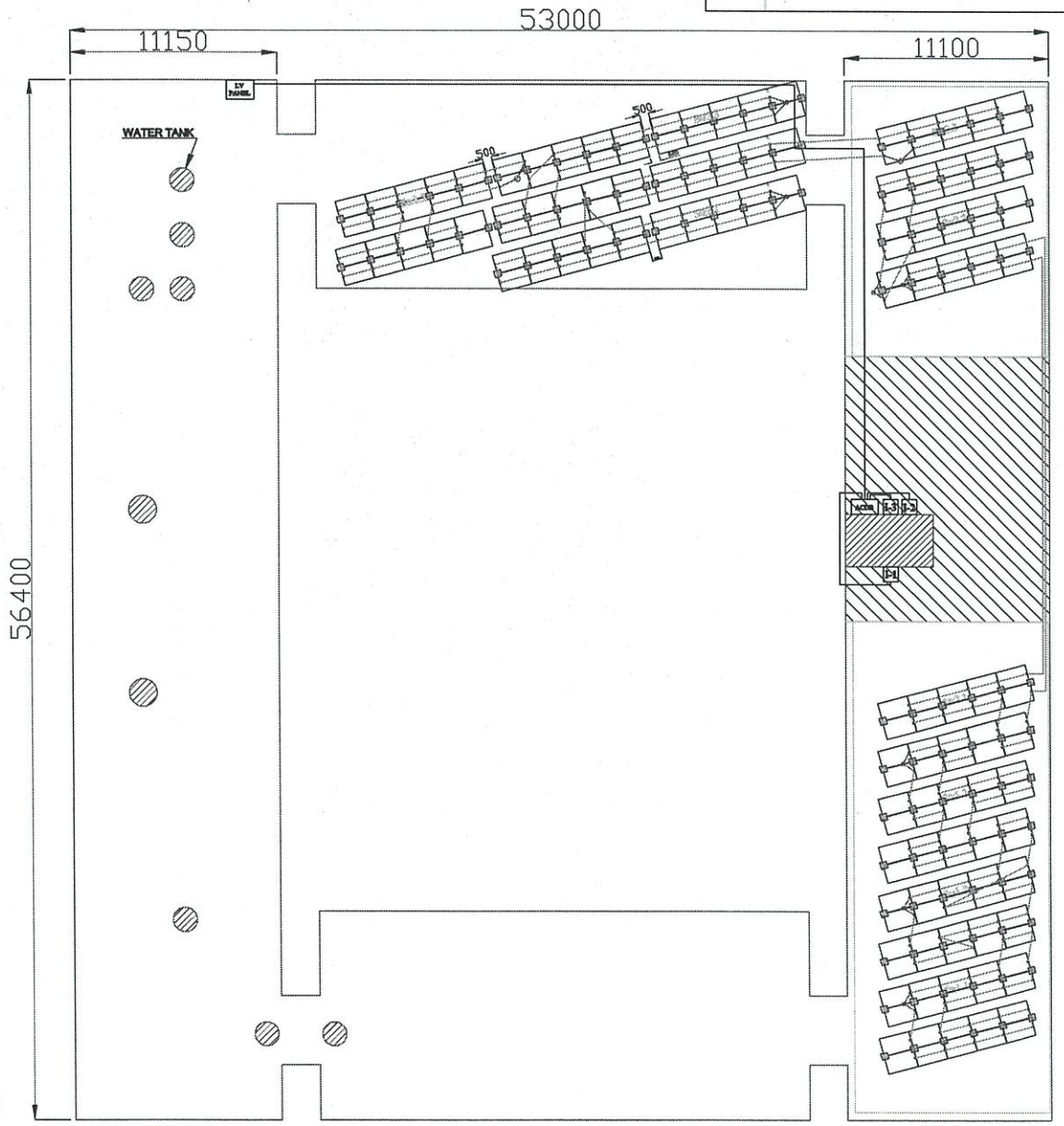
SECTION – 4.3.2.1

SOLAR PV POWER PLANT

BALANCE OF MATERIAL

–AC CONDUCTORS

RevNo	Revision note	Date	Signature	Checke



B.V. RAJU COLLEGE BHIMAVARAM W.G.Dist. Pin-534

NOTES:
1. Str – STRING, 7 STRING HAS 22MODULES ARE IN SERIES & ANOTHER 2 STRINGS HAS 23 MODULES ARE SERIES
2. I- INVERTER, WE CONSIDERED 3 INVERTERS IN THIS 50kWp SYSTEM
3. Str 1.1 TO Str 3.3 CONNECTED TO THE I.1, I.2,I.3
4. EACH INVERTER HAVING 3 STRINGS
5.ACDB – AC DISTRIBUTION BOARD

VARSHINI POWER PROJECTS INDIA PVT. LTD
PLOT: 44-4/A, NAGARJUNA HILLS
PUNJAGUTTA, HYDERABAD- 500 082
ANDHRA PRADESH,INDIA.
TEL:+91 40 23355552
EMAIL: info@varshinipower.com

PROJECT: 50kWp GRID-TIED SOLAR POWER SYSTEM		ALL DIMENSIONS ARE IN MILLI METERS
PRD. BY:JYOTHI	CKD. BY: VSD	CUSTOMER:VISHNU EDUCATIONAL SOCIETY, BHVM
REV. NO:00	DATE: ----	TITLE:50kWp BVRICE BLOCK – AC CABLING
DWG. SIZE:A4	SHT. NO:01	
DWG. DATE:26/12/2013		DWG.NO:VISHNU/LAY/13/01

THE COMPANY

POLYCAB, an ISO 9001:2008, ISO 14001:2004, OHSAS 18001:2007 company is the largest Wire & Cable manufacturer in India with a proven track record of over three decades. The fastest growing company in the Indian Cable Industry with consistent growth. Polycab group has crossed Rs. 3600 crore turnover in the year 2010-11 and is set to achieve Rs. 4000 crore turnover in the year 2011–12.

From a modest beginning with Wires and Cables, over three decades ago Polycab set up State of Art manufacturing facilities at Daman in 1996.The last 3 decades have seen the core business develop along different product lines: Low Voltage Cables, Medium Voltage Cables, Extra High Voltage Cables, Fire Survival & Fire Resistant Cables, Telecommunication Cables, Control & Instrumentation Cables and Aerial Bunched Cables. In the manufacture of cables, a competitive edge lies not so much in product innovation as in providing consistent quality, guaranteeing reliability and ready availability. Polycab's Daman factory was created to address these key market determinants. The manufacturing set up is sourced out from the world renowned Machinery and Technology suppliers with constant upgradation and expansions.

CUSTOMER SATISFACTION

In an ongoing process to improve Customer Satisfaction Polycab offers a variety of services:

- Commercially competitive prices.
- Reliable & consistent quality.
- Reliable & just in time delivery.
- Product development for a changing market.
- A targeted stocking policy.
- Technical Support for Applications/ Projects

CUSTOMER FOCUSED

POLYCAB derives its strength from its customers. The growth of the latter is a prerequisite to the growth of the company and hence customers' satisfaction is its prime objective. Over the years sincere service and dedication to its Customers has earned the Company distinguished Customers which includes demanding leaders in Sectors like Utilities, Power Generation, Transmission & Distribution, Petroleum & Oil Refineries, Oem's, EPC contractors, Steel & Metal, Cement, Chemical, Atomic Energy, Nuclear Power, Consultants & Specifiers etc.

POLYCAB has highly experienced, qualified and dedicated professionals with strong adherence to the quality management system. Polycab has offices all over the country and also has a wide network of authorized distributors and dealers to cater to all the customer segments in India and abroad.

POLYCAB has earned the trust and reputation in India and abroad by winning the customers' confidence. Several thousands kilometers of LT XLPE Cables in the voltage range of 1.1KV have been manufactured and are in operation in India and abroad.

Polycab LT XLPE Cables are preferred choice in Power Plants, Distribution Systems, Heavy Industries, Various Utilities, The Titans of Indian Industry & Consultants / Specifiers.

DETAILS MAKE THE DIFFERENCE

More than 3 decades of experience have enabled POLYCAB to develop a specific know how for each individual productline. Attention to details allows the company to apply optimum technical solutions and material selections to each and every different project or application.

Other available Catalogues:
Flexible Cables
LT PVC Power & Control Cables.
HT Cables upto 45KV
EHV Cables upto 132Kv
Fire Survival Cables.

The XLPE insulated heavy duty cables were introduced worldwide in mid sixties. These cables have overcome the limitations of PVC Insulated Cables such as thermal degradation, poor moisture resistant and thermoplastic in nature.

The advantages of XLPE Insulated cables in comparison to PVC insulated cables are as under:

A. Technical Advantages :

1. Higher current rating, higher Short Circuit Rating Approx 1.2 times that of PVC.
2. Thermosetting in nature.
3. Higher insulation resistance – 1000 times more than PVC cables.
4. Higher resistance to moisture.
5. Better Resistance to surge currents.
6. Low Dielectric Losses.
7. Better resistance to chemicals.
8. Longer service life.
9. Comparatively higher cable operation temperature 90°C and short circuit temperature 250°C.

B. Commercial Advantages:

1. Lower laying cost because of comparatively smaller diameter of cable and lighter weight*.
2. Lower installation charges as the diameter of cable is comparatively lesser with smaller bending radius, requiring less space requirement for laying of cables.
3. **One size lower cable can be used as compared to PVC insulated cable.

** Density of XLPE is lower than PVC*

***For longer cable length voltage drop shall be considered*

Polycab Cable of 33KV E 3 x 400 Sq.mm have been successfully type tested at KEMA - Netherland (an internationally acclaimed Testing Laboratory).

"BASEC CERTIFICATION OF OUR BUSINESS DEMONSTRATES OUR COMMITMENT TO NOT ONLY THE QUALITY OF OUR PRODUCTS, BUT ALSO THE LEVEL OF OUR COMMITMENT FOR CONTINUOUS IMPROVEMENT"

Advantages of Polycab XLPE Cables

HIGHER ELECTRICAL STRENGTH RETENTION

HIGHER SHORT CIRCUIT RATING

BETTER ELECTRICAL, MECHANICAL & THERMAL PROPERTIES

EASY JOINTING & TERMINATION

Selection of Cables

Power Cables are generally selected considering the application. However, following factors are important for selection of suitable cable construction required to transport electrical energy from one end to the other.

1) Maximum operating voltage,
2) Fault Level,
3) Load to be carried,
4) Possible overloading duration & magnitude,
5) Route length and voltage drop.
6) Mode of installation considering installation environment such as ambient & ground temperature chemical & physical properties of soil.
7) Flame retardant properties.

All sizes of POLYCAB XLPE cables are designed to standard operating conditions in India and abroad. The standards adopted are considering the geographical/ climatical conditions and general applications of power for utilities, distribution and generation purposes.

The cables are manufactured conforming to Indian & International cables specifications for XLPE Insulated cables. Customer specific requirements can also be met.

Comparative current Rating and Short Circuit Rating for XLPE Cable Vis-à-vis PVC Cables

POLYCAB WIRES & CABLES

COMPARATIVE CURRENT RATINGS OF 650/1100 VOLTS MULTICORE HEAVY DUTY PVC INSULATED CABLES & XLPE INSULATED CABLES.

(3. 3.5 & 4 Core Unarmoured / Armoured PVC Sheathed Cables with Aluminium Conductor.)

Nominal Size of cable	3, 3.5 & 4 Core PVC Insulated & Sheathed Cables as per IS - 1554 (Part-1) 1988			3, 3.5 & 4 Core XLPE Insulated & Sheathed Cables as per IS - 7098 (Part-1) 1988		
	In Ground	In Air	Approx Voltage Drop	In Ground	In Air	Approx Voltage Drop
Sq. mm	Amp	Amp	Mv / amp / mtr	Amp	Amp	Mv / amp / mtr
16	60	51	4.0	73	70	4.20
25	76	70	2.5	94	96	2.70
35	92	86	1.8	113	117	1.90
50	110	105	1.3	133	142	1.40
70	135	130	0.93	164	179	0.99
95	165	155	0.68	196	221	0.72
120	185	180	0.54	223	257	0.58
150	210	205	0.46	249	292	0.48
185	235	240	0.38	282	337	0.39
240	275	280	0.28	326	399	0.31
300	305	315	0.25	367	455	0.26
400	335	375	0.20	420	530	0.21

COMPARISON OF SHORT CIRCUIT RATING FOR 1 SECOND DURATION FOR

*** PVC & XLPE Insulated Cables ** with Copper and Aluminium Conductors.** (Current in kAmps)

Nominal Size	PVC Insulated		XLPE Insulated	
Sq. mm	Copper	Aluminium	Copper	Aluminium
1.5	0.173	-	0.21	-
2.5	0.283	-	0.36	-
4	0.46	0.303	0.57	0.38
6	0.690	0.455	0.86	0.57
10	1.15	0.758	1.40	0.94
16	1.84	1.21	2.30	1.50
25	2.88	1.90	3.60	2.40
35	4.03	2.65	5.00	3.30
50	5.75	3.79	7.10	4.70
70	8.05	5.31	10.00	6.60
95	10.90	7.20	13.60	9.00
120	13.80	9.10	17.10	11.30
150	17.30	11.40	21.40	14.20
185	21.30	14.02	26.40	17.50
240	27.60	18.20	34.30	22.60
300	34.50	22.80	42.90	28.30
400	46.00	30.40	57.10	37.70
500	57.50	38.00	71.40	47.20
630	72.50	47.25	90.00	59.40
800	92.00	60.00	114.30	75.50
1000	115.00	75.00	142.90	94.30

* PVC Type 'A' Insulation as per IS-5831 '84.
** PVC Cables as per IS-1554 (Part-1)-1988.
** XLPE Cables as per IS-7098 (Part-1)-1988.

1) Max. Conductor Temperature during operation: PVC 70°C, XLPE 90°C

2) Max. Conductor Temperature During Short circuit: 160°C, 250°C

Formula relating Short Circuit Rating with duration

$$I_t = \frac{I_{sh}}{\sqrt{t}}$$

Where

It = Short Circuit Rating for t Seconds.
t = Duration in seconds
Ish = Short Circuit rating for 1 second.

R Krishnam Raju

CAPACITANCE APPROXIMATE CAPACITANCE (Microfarads/ Km) 1.1 KV XLPE CABLES.

Nominal Area of Conductor	Single Core		Two Core	Three, Three & Half and Four Core
	Unarmoured	Armoured		
1.5	0.19	-	0.051	0.15
2.5	0.24	-	0.058	0.18
4	0.29	-	0.065	0.22
6	0.34	-	0.071	0.25
10	0.43	0.32	0.081	0.31
16	0.51	0.38	0.088	0.36
25	0.49	0.38	0.089	0.41
35	0.57	0.44	0.096	0.47
50	0.58	0.46	0.098	0.50
70	0.63	0.51	0.100	0.53
95	0.73	0.59	0.110	0.61
120	0.74	0.61	0.110	0.63
150	0.73	0.61	0.110	0.64
185	0.69	0.59	0.110	0.65
240	0.74	0.64	0.110	0.66
300	0.80	0.69	0.120	0.67
400	0.83	0.70	0.120	0.67
500	0.83	0.71	0.120	0.69
630	0.87	0.75	0.110	0.73
800	0.92	0.78	-	-
1000	0.94	0.81	-	-

REACTANCE APPROXIMATE REACTANCE AT 50 HZ (Ohm/Km) 1.1 KV XLPE CABLES.

Nominal Area of Conductor	Single Core		Multi Core
	Unarmoured	Armoured	
1.5	0.155	-	0.107
2.5	0.142	-	0.0985
4	0.132	-	0.0927
6	0.123	-	0.0884
10	0.114	0.134	0.0837
16	0.108	0.125	0.0808
25	0.103	0.120	0.0805
35	0.0986	0.114	0.0783
50	0.0937	0.108	0.0750
70	0.0900	0.102	0.0740
95	0.0865	0.100	0.0724
120	0.0841	0.0968	0.0712
150	0.0839	0.0941	0.0716
185	0.0836	0.0932	0.0718
240	0.0813	0.0900	0.0710
300	0.0795	0.0881	0.0705
400	0.0787	0.0873	0.0704
500	0.0779	0.0859	0.0702
630	0.0785	0.0843	0.0698
800	0.0755	0.0826	-
1000	0.0752	0.0825	-

CONDUCTOR TECHNICAL INFORMATION FOR SINGLE CORE AND MULTICORE CABLES CONFORMING TO IS-8130/1984 (STRANDED - CLASS-2) COPPER & ALUMINIUM CONDUCTORS.

Nominal Size of Conductor	Minimum no. of wires				Max D.C. Resistance at 20°C		A. C. Resistance at 90°C	
	Non Compacted		Compacted Round/ Shaped		Plain Copper	Aluminium	Plain Copper	Aluminium
Sq.mm	CU.	ALU.	CU.	ALU.	Ohm/Km	Ohm/Km	Ohm/Km	Ohm/Km
1.5*	3	3	-	-	12.1	18.10	15.50	23.17
2.5*	3	3	-	-	7.41	12.10	9.48	15.50
4*	7	3	-	-	4.61	7.41	5.90	9.48
6*	7	3	-	-	3.08	4.61	3.94	5.90
10*	7	7	6	-	1.83	3.08	2.34	3.94
16	7	7	6	6	1.15	1.91	1.47	2.44
25	7	7	6	6	0.727	1.20	0.930	1.54
35	7	7	6	6	0.524	0.868	0.671	1.11
50	19	19	6	6	0.387	0.641	0.495	0.82
70	19	19	12	12	0.268	0.443	0.343	0.567
95	19	19	15	15	0.193	0.320	0.247	0.410
120	37	37	18	15	0.153	0.253	0.196	0.324
150	37	37	18	15	0.124	0.206	0.159	0.264
185	37	37	30	30	0.0991	0.164	0.127	0.210
240	61	37	34	30	0.0754	0.125	0.0965	0.160
300	61	61	34	30	0.0601	0.100	0.0769	0.128
400	61	61	53	53	0.0469	0.0778	0.0602	0.100
500	61	61	53	53	0.0366	0.0605	0.0468	0.0774
630	91	91	53	53	0.0283	0.0469	0.0362	0.0600
800	91	91	53	53	0.0221	0.0367	0.0283	0.0470
1000	91	91	53	53	0.0176	0.0291	0.0225	0.0372

** These sizes can be manufactured with solid conductor having single strand*

POLYCAB RECOMDATIONS FOR CURRENT RATINGS

1. The values given in the table are valid for on circuit in a three phase system under conditions specified. For grouping cables rating factors must be used.
2. The current carrying capacities mentioned in POLYCAB technical data are intended as a guide, to assist operating engineers in selecting cables for safety and reliability.
3. Basic assumptions and condition of installation:
   * Ambient ground Temperature : 30° C
   * Ambient air Temperature: 40° C
   * Depth of Cable Burial : 1.0 m
   * Thermal resistivity of soil : 150° C. Cm/W
4. Single Core Cables are installed as indicated in the table, spacing between cables in flat formation is as indicated.
5. For 3 and 4 core cables, it is usual to assume the same current carrying capacity for 4 core cables as for 3 core cables. Our calculated values are based actually on 3 core cables. These values are suitable with enough accuracy also for 4 cables in most cases. Only for large 4 core cables in air the values are too conservative, due to the large cable surface and consequent high heat dissipation factor.
6. To obtain the maximum current carrying capacity of a cable operating at different conditions from the standard. Various rating factors are to be multiplied as follows:

   Ia = K Is (in Amperes) Where

   Ia = Current Rating at actual Operating Conditions (amperes)
   Is = Current Rating at Standard Operating Conditions (amperes)
   K = Rating Factor as applicable

TABLE-7 "POLYCAB" THREE AND HALF CORE ALUMINIUM CONDUCTOR, XLPE INSULATED

UNARMOURED & ARMOURED CABLE CONFORMING TO IS 7098 PART-1/1988

650/1100 VOLTS

WEIGHT AND DIMENSIONS

Nominal Size of Conductors	Form of Conductor Shaped ○/△	Nominal Thickness of XLPE Insulation Main / Neutral		Minimum Thickness of PVC Inner Sheath	Unarmoured Cable			Formed Wire/ Strip Armoured Cable				Round Wire Armoured Cable				Current Rating.		*Normal Delivery Length.
					Nominal Thickness of PVC Outer Sheath	Approx. Overall Diameter of Cable.	Approx. Weight of Cable.	Nominal Dimension of GI Flat Strip.	Minimum Thickness of PVC Outer Sheath	Approx. Overall Diameter of Cable.	Approx. Weight of Cable.	Nominal Dimension of GI Round Wire.	Minimum Thickness of PVC Outer Sheath	Approx. Overall Diameter of Cable.	Approx. Weight of Cable.	In Ground	In Air	
Sq.mm.	mm	mm	mm	mm	mm	mm	Kgs./Km	mm	mm	mm	Kgs./Km	mm	mm	mm	Kgs./Km	Amps.	Amps.	Mtrs.
25/16	Stranded △	0.9	0.7	0.3	2.0	22.0	525	4 x 0.80	1.40	23.0	850	1.60	1.40	25.5	1050	94	96	1000
35/16	Stranded △	0.9	0.7	0.3	2.0	24.0	625	-do-	1.40	25.0	980	1.60	1.40	26.5	1200	113	117	1000
50/25	Stranded △	1.0	0.9	0.3	2.0	27.5	800	-do-	1.40	28.0	1240	1.60	1.56	29.5	1500	133	142	1000
70/35	Stranded △	1.1	0.9	0.4	2.2	31.0	1100	-do-	1.56	32.0	1600	2.00	1.56	34.0	2050	164	179	500
95/50	Stranded △	1.1	1.0	0.4	2.2	35.0	1400	-do-	1.56	36.0	1900	2.00	1.56	38.0	2450	196	221	500
120/70	Stranded △	1.2	1.1	0.4	2.2	37.5	1650	-do-	1.72	39.0	2300	2.00	1.72	41.0	2800	223	257	500
150/70	Stranded △	1.4	1.1	0.5	2.4	41.0	2000	-do-	1.72	42.0	2650	2.00	1.88	45.0	3350	249	292	500
185/95	Stranded △	1.6	1.1	0.5	2.6	46.5	2550	-do-	1.88	47.5	3250	2.50	2.04	50.0	4500	282	337	500
240/120	Stranded △	1.7	1.2	0.6	2.8	52.5	3200	-do-	2.04	53.5	4100	2.50	2.20	56.0	5450	326	399	500
300/150	Stranded △	1.8	1.4	0.6	3.0	56.0	4000	-do-	2.20	57.0	4950	2.50	2.36	61.0	6400	367	455	500
400/185	Stranded △	2.0	1.6	0.7	3.4	64.0	5250	-do-	2.52	65.0	6150	3.15	2.68	70.0	8300	418	530	500
500/240	Stranded △	2.2	1.7	0.7	3.6	72.5	6500	-do-	2.68	73.5	7600	3.15	2.84	77.0	10000	470	612	250

The above data is approximate and subject to manufacturing tolerance.

* Delivery Length tolerance is ± 5 %. Length more than normal as per customer request.

TABLE-9 "POLYCAB" FOUR CORE ALUMINIUM CONDUCTOR, XLPE INSULATED,

UNARMOURED & ARMOURED CABLE CONFORMING TO IS 7098 PART-1/1988

650/1100 VOLTS

WEIGHT AND DIMENSIONS

Nominal Size of Conductor	Form of Conductor Circular Shaped ○/△	Nominal Thickness of XLPE Insulation	Minimum Thickness of PVC Inner Sheath	Unarmoured Cable: Nominal Thickness of PVC Outer Sheath	Unarmoured Cable: Approx. Overall Diameter of Cable.	Unarmoured Cable: Approx. Weight of Cable.	Formed Wire/ Strip Armoured Cable: Nominal Dimension of GI Flat Strip.	Formed Wire/ Strip Armoured Cable: Minimum Thickness of PVC Outer Sheath	Formed Wire/ Strip Armoured Cable: Approx. Overall Diameter of Cable.	Formed Wire/ Strip Armoured Cable: Approx. Weight of Cable.	Round Wire Armoured Cable: Nominal Dimension of GIRound Wire.	Round Wire Armoured Cable: Minimum Thickness of PVC Outer Sheath	Round Wire Armoured Cable: Approx. Overall Diameter of Cable.	Round Wire Armoured Cable: Approx. Weight of Cable.	Current Rating: In Ground.	Current Rating: In Air	*Normal Delivery Length.
Sq.mm.	mm	mm	mm	mm	mm	Kgs./Km	mm	mm	mm	Kgs./Km	mm	mm	mm	Kgs./Km	Amps.	Amps.	Mtrs.
4	Solid ○	0.7	0.3	1.8	15.0	160	-NA-	-NA-	-NA-	-NA-	1.40	1.24	16.5	510	34	31	1000
4	Stranded ○	0.7	0.3	1.8	16.0	180	-NA-	-NA-	-NA-	-NA-	1.40	1.24	17.5	560	34	31	1000
6	Solid ○	0.7	0.3	1.8	16.5	200	-NA-	-NA-	-NA-	-NA-	1.40	1.24	17.5	580	43	50	1000
6	Stranded ○	0.7	0.3	1.8	17.5	215	-NA-	-NA-	-NA-	-NA-	1.40	1.24	18.5	625	43	50	1000
10	Solid ○	0.7	0.3	1.8	18.0	250	-NA-	-NA-	-NA-	-NA-	1.40	1.40	19.0	700	57	67	1000
10	Stranded ○	0.7	0.3	1.8	18.5	260	-NA-	-NA-	-NA-	-NA-	1.40	1.40	20.5	765	57	67	1000
16	Stranded △	0.7	0.3	1.8	17.5	350	4 x 0.8	1.40	20.0	715	1.60	1.40	21.0	895	73	70	1000
25	Stranded △	0.9	0.3	2.0	21.0	550	-do-	1.40	23.0	940	1.60	1.40	25.0	1150	94	96	500
35	Stranded △	0.9	0.3	2.0	23.5	680	-do-	1.40	25.0	1050	1.60	1.40	26.5	1325	113	117	500
50	Stranded △	1.0	0.3	2.0	26.0	875	-do-	1.56	28.0	1280	1.60	1.56	29.5	1640	133	142	500
70	Stranded △	1.1	0.4	2.2	30.5	1200	-do-	1.56	32.0	1700	2.00	1.56	34.0	2175	164	179	500
95	Stranded △	1.1	0.4	2.2	33.5	1530	-do-	1.56	35.0	2100	2.00	1.72	38.0	2775	196	221	500
120	Stranded △	1.2	0.5	2.4	37.5	1850	-do-	1.72	39.0	2600	2.00	1.88	42.0	3250	223	257	500
150	Stranded △	1.4	0.5	2.6	42.0	2280	-do-	1.88	43.5	3000	2.50	2.04	47.0	4175	249	292	500
185	Stranded △	1.6	0.5	2.8	46.5	2800	-do-	2.04	48.0	3650	2.50	2.20	52.0	5000	282	337	500
240	Stranded △	1.7	0.6	3.0	52.5	3700	-do-	2.20	54.0	4700	2.50	2.36	57.5	6050	326	399	500
300	Stranded △	1.8	0.7	3.2	58.0	4600	-do-	2.36	59.5	5600	3.15	2.52	64.5	7850	367	455	500
400	Stranded △	2.0	0.7	3.6	65.5	6000	-do-	2.68	66.5	7000	3.15	2.84	71.5	9500	418	530	500

The above data is approximate and subject to manufacturing tolerance.
* Delivery Length tolerance is ± 5 %. Length more than normal as per customer request.

Wiring the World

POLYCAB
WIRES & CABLES

POLYCAB WIRES PVT. LTD.

(an ISO 9001:2008, 14001:2004 & 18001:2007 Company)

Regd. & Head office :
Polycab House, 771, Pandit Satwalekar Marg,
Mahim (W), Mumbai 400 016.

Tel. : 91-22-2432 7070 / 4, 6735 1400
Fax : 91-22-2432 7075

E-mail : enquiry@polycab.com
Website : www.polycab.com

FIRST QUALITY CERTIFICATION

CERTIFICATE OF CONFORMITY

This certificate is granted to the organization, MANUFACTURER

POLYCAB WIRES PVT. LTD.

H.O : Polycab House, 771, Pandit Satwalekar Marg, Mahim (W),
Mumbai – 400 016, India.
Works: 74/8-11, Daman Industrial Area, Village Kadaiya, Daman – 396210, UT
Survey No. 67-69, 71-72, 105, 106, Nurpura, District Panchmahal, Halol - 389 350, Gujarat, IND

Products Description:

1. HO5v – U/R/K/F
2. HO7v – U/R/K/F
3. HO5v – U/R/K
4. HO7z – U/K
5. HO5vv – U/R/K/F
6. HO7vv – U/R/K/F
7. Panel Board Wiring Cables
8. L V Power & Control Cables
9. MV & HV Power Cables
10. Flame Retardant / Fire Resistant Cables
11. Instrumentation & Signaling Cables
12. Co- Axial, LAN & Communication Cables

products described above conforms with the essential health and safety requirements of Council Directive low voltage directive 2006/95/EC on the approximation of the laws of the Member States relating to the safety of products.

The following harmonized standards and/or technical specifications applied:

BS 5467, BS 6724, BS 6346, BS 6622, BS 7835, BS 6004, BS 6500, BS 6231, BS 6211, IEC 60502-1, IEC 60502-2, IS 7098-Part 1, IS 7098 Part – 2, IS 694, IS 1554 – Part 1, IS 1554 – Part 2, BS EN 50228, IEC 60227, EIA/TIA-568.B-2

Certificate confirms that the product complies with essential safety requirements and objectives of mentioned directive/standards for Certification.

The manufacturer, or his representative, declares that a product being placed on the EU 25 market complies with all the essential health and safety requirements that apply to it. An EC declaration is often referred to as a "manufacturer's declaration.

Certificate No : 08.12.5006
Date of Issue : 30.07.2012
Expiry date : 29.07.2017

CE

First Quality Certification
Product Certificate Approved
Istanbul

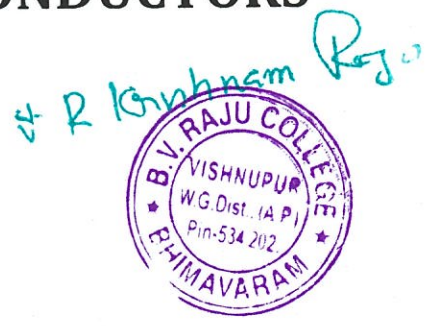
This certificate remains the property of FQC and the certificate validation shall be ensured through regular surveillance audits. This must not be copied in whole or in part without the written permission of the managing Director of FQC Deliberate misuse of the certificate or schedule will result in cancellation without notification. The product liability rests with the manufacturer or his representative in accordance with Council Directive 2006/42/EEC. To check current validity of the certificate. Please contact info@fqc.com.tr

SECTION – 4.3.2.2

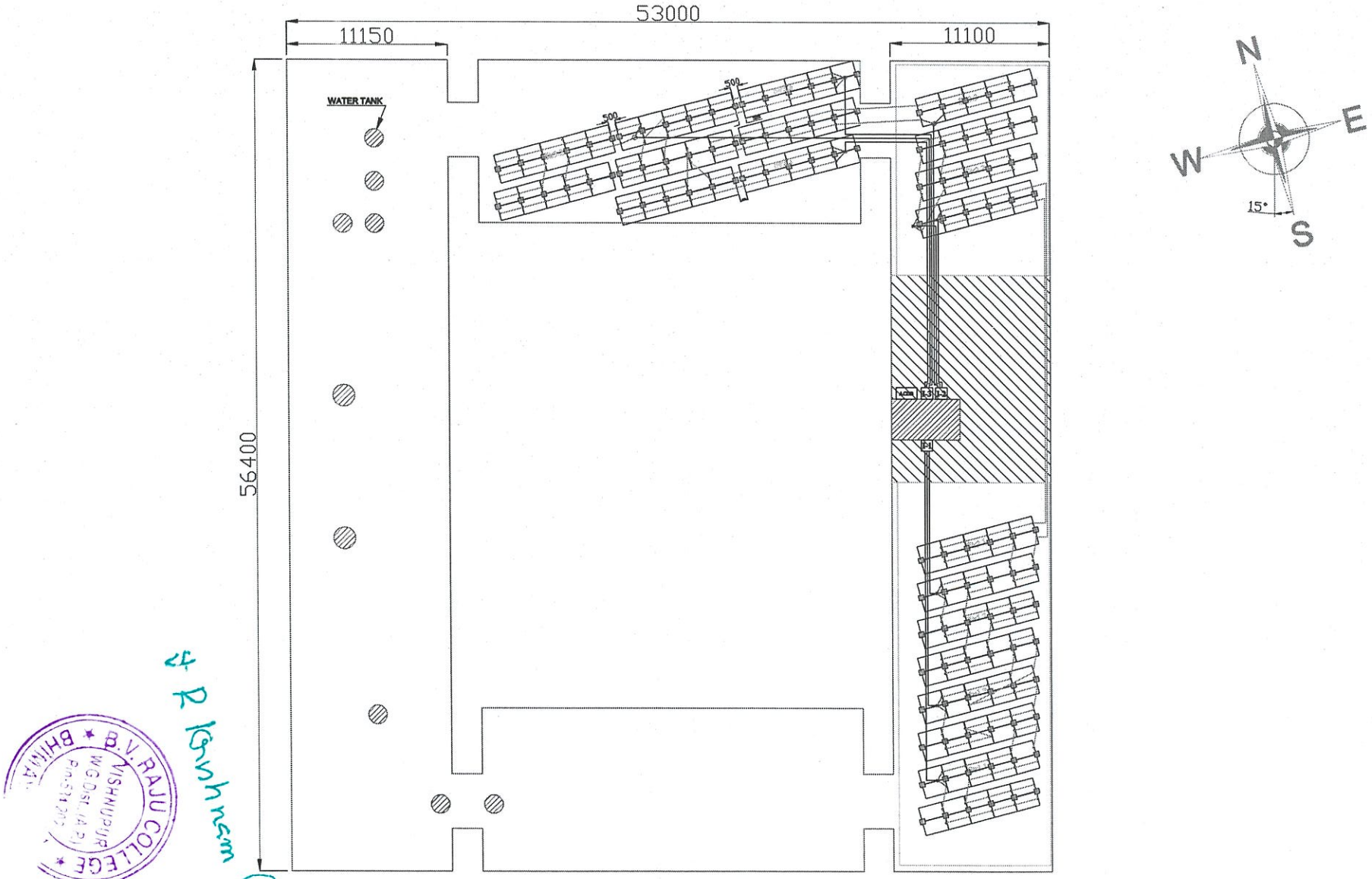
SOLAR PV POWER PLANT

BALANCE OF MATERIAL

– DC CONDUCTORS



RevNo	Revision note	Date	Signature	Checke



B.V. RAJU COLLEGE * BHIMAVARAM * W.G.Dist. (A.P.)

NOTES:
1. Str - STRING, 7 STRING HAS 22MODULES ARE IN SERIES & ANOTHER 2 STRINGS HAS 23 MODULES ARE SERIES
2. I- INVERTER, WE CONSIDERED 3 INVERTERS IN THIS 50kWp SYSTEM
3. Str 1.1 TO Str 3.3 CONNECTED TO THE I.1, I.2,I.3
4. EACH INVERTER HAVING 3 STRINGS
5.ACDB - AC DISTRIBUTION BOARD

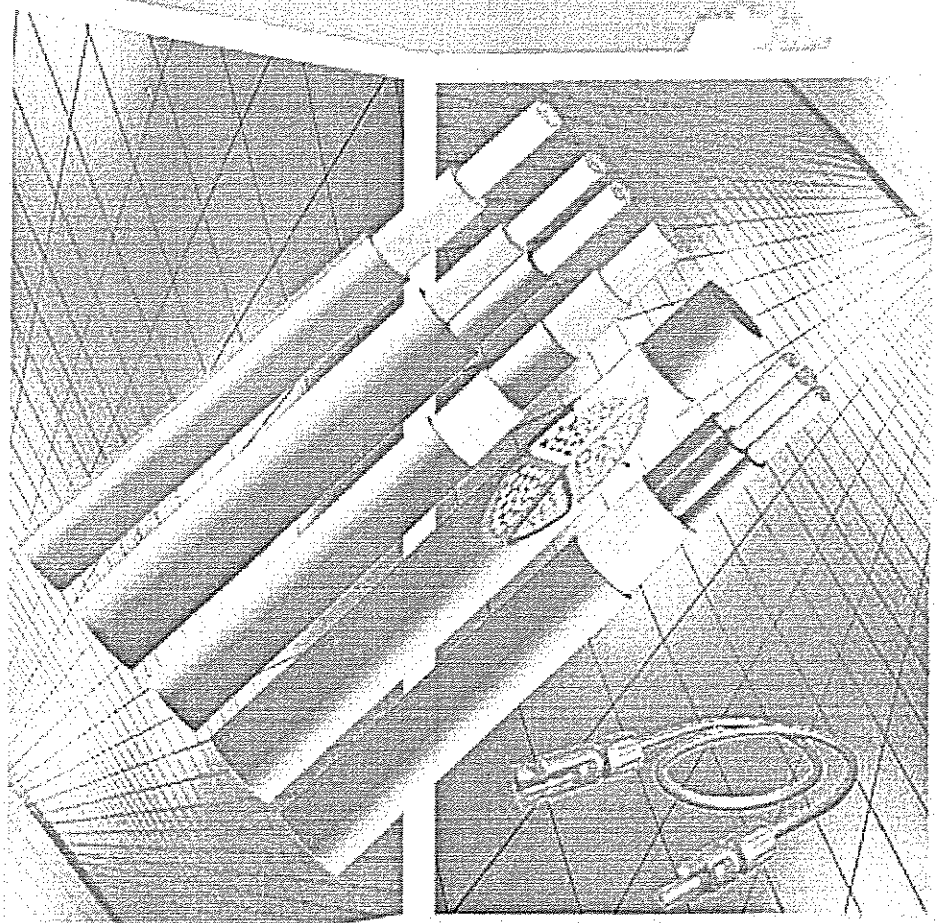
VARSHINI POWER PROJECTS INDIA PVT. LTD
PLOT: 44-4/A, NAGARJUNA HILLS
PUNJAGUTTA, HYDERABAD- 500 082
ANDHRA PRADESH,INDIA.
TEL:+91 40 23355552
EMAIL: info@varshinipower.com

PROJECT: 50kWp GRID-TIED SOLAR POWER SYSTEM		ALL DIMENSIONS ARE IN MILLI METERS
PRD. BY:JYOTHI	CKD. BY: VSD	CUSTOMER:VISHNU EDUCATIONAL SOCIETY, BHVM
REV. NO:00	DATE: ----	TITLE:50kWp BVRICE BLOCK - DC CABLING
DWG. SIZE:A4	SHT. NO:01	
DWG. DATE:26/12/2013		DWG.NO:VISHNU/LAY/13/01

Siechem

Wires & Cables

India's largest PV Cable Manufactu



Siechem Profile :

Siechem a market leader in India for speciality wires and cables, established in 2002 is having its head office at Chennai and factory at Pondicherry, India, equipped with fully automated manufacturing plant spread over 100,000 sq feet built-up area in an environment friendly surrounding. The Company employs about 300 people and has in-house R&D, Design, Manufacturing and Compounding facilities and hence cost effective and reliable in terms of its performance. The Company is zero debt and growing rapidly year on year with its innovative products. Siechem's In-house cable design studio can design and develop any type of cable with its experts supported by R&D team to make insulating, sheathing and jacketing compounds that any competitor can offer. The company's current production capacity is about 250 kms a day and is expanding to reach a half a million meters a day shortly. Siechem has nearly a million part numbers for the various segments/market as mentioned below.

Siechem PV Cables are type tested and approved by TUV. Siechem PV cables are in use at different sites of Solar generating stations of over 1000 MW and Siechem is India's No.1 Solar cable manufacturer with maximum market share. Siechem do have the following range of cables in its portfolio:

S.No.	Range of Products
1	Automotive Cables
2	Aerospace Cables
3	Appliance Wires & Cables
4	Building Wires
5	Battery Cables
6	Composite/Hybrid Cables
7	Control & Switchboard Cables
8	Contract Manufacturing of Wires & Cables
9	Elastomeric & Special Thermoplastic & Thermoset Electron Beam Cross Linked Wires & Cables
10	Fluoro Elastomer Insulated Cables
11	Flexible Cables
12	Fire Resistant Cables
13	Halogen free, Heat, Oil & Flame Resistant Cables
14	Heat Shrinkable Products
15	Jelly filled Telecom Cables
16	Instrumentation Cables
17	Mining Cables
18	Nuclear Cables
19	Offshore and Marine Shipboard Cables
20	Oil and Gas - Petrochemical Cables
21	Power Cables
22	Power Cords
23	Railway Quad & Signaling Cables
24	Rolling stock Cables for Electric Locos, Metro Rail & Diesel Loco Cables
25	Solar Cables
26	Telecommunication Cables
27	UL/ ETA/ CSA Standards Cables
28	Welding Cables
29	Wind Energy Cables
30	Wiring Harness

Siechem an early bird in Solar Cable segment in India

Early entry in to PV segment has helped Siechem to develop the varities of PV cables, Junction Boxes and Connector that would definitely benefit customers to

- ✓ Get cost effective solutions
- ✓ Ready solution for any complex design
- ✓ Easy installation
- ✓ Reliability in delivery & producer performance

A brief about Siechem PV Products :

Siechem PV Power cables for the harsh environments of solar energy applications—the hot and cold of climate extremes, ozone and UV radiation, moisture, oil, and for direct burial. In-house R & D and compounding facility of XLPO/XLPE insulation and special UV resistant Jacket which is Electron Beam Cross Linked provide years of reliable service, withstanding the extreme environments without failing or degrading. PV applications demand higher level of reliability with enhanced Thermal, Electrical,Mechanical and Weathering properties of Solar Cables. When downtime is unacceptable in extreme remote locations where environment is also severely challenging, Siechem Solar cables offer reliable performance from -45°C to + 120°C as continuous operating temperature. Siechem also offers single stop solution for entire cabling with wide range of PV application such as

- ✓ Single Core EBXL Solar Cables
- ✓ Multi Core EBXL Solar Cables,
- ✓ Control, Instrumentation & Data Transmission Cables,
- ✓ Junction boxes with ready to use wire harnessing,
- ✓ MC4 Connectors, B4A & B4B Branch Plug Connectors and DFA Diode & Fuse Connectors.

Siechem PV products are environment friendly, meets RoHS norms as per European Standards. Designed for easy handling, quick assembling at site, rugged, reliable and comparable with the best in the world and also meets latest TUV / UL standards.

V R Krishnam Raju

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202
BHIMAVARAM

Siechem - TUV Certificate

Zertifikat *Certificate*

TÜVRheinland®

Zertifikat Nr. *Certificate No.*
R 60077463

Blatt *Page*
0001

Ihr Zeichen *Client Reference*	Unser Zeichen *Our Reference*	Ausstellungsdatum	*Date of Issue* *(day/mo/yr)*
	0001-- 02423620 002	02.07.2012	

Genehmigungsinhaber *License Holder*
SIECHEM TECHNOLOGIES PRIVATE LIMITED
26/27 ERRABALU CHETTY STREET
CHENNAI 600001
India

Fertigungsstätte *Manufacturing Plant*
SIECHEM TECHNOLOGIES Pvt.Ltd.
RS 104/8 & 105/7 SEDARAPET MAIN ROAD
PONDICHERRY 605101
India

Prüfzeichen *Test Mark*

www.tuv.com ID 2000000000 TÜVRheinland
* BAUART GEPRÜFT
* TYPE APPROVED

Geprüft nach *Tested acc. to*
2 PfG 1169/08.07

Zertifiziertes Produkt *Certified Product* **(Geräteidentifikation)** *(Product Identification)*

Lizenzentgelte - Einheit *License Fee - Unit*

PV-Cables

Code designation:	PV1-F SOLAR CABLE	11
Cross section:	2,5mm² , 4,0mm² , 6,0mm² , 10,0mm²	15
	16,0mm² , 25,0mm² , 35,0mm² , 50,0mm²	
	70,0mm² , 95,0mm² , 120,0mm² , 150,0mm²	
	185,0mm² , 240,0mm² , 300,0mm²	

Max. conductor temp.:	120°C (for 20.000h)
Rated voltage:	0,6/1 kV AC; 0,9/1,8 kV DC
Ambient temperature:	-40°C to 90°C
Material of insulation:	Halogen free cross-linked compound
Material of sheath:	Halogen free Cross-linked compound
Color of insulation:	black
Color of sheath:	black
Trade mark:	Siechem

26

Dem Zertifikat liegt unsere Prüf- und Zertifizierungsordnung zugrunde und es bestätigt die Konformität des Produktes mit den oben genannten Standards und Prüfgrundlagen. Zusätzliche Anforderungen in Ländern, in denen das Produkt in Verkehr gebracht werden soll, müssen zusätzlich betrachtet werden. Die Herstellung des zertifizierten Produktes wird überwacht.
This certificate is based on our Testing and Certification Regulation and states the conformity of the product with the standards and testing requirements as indicated above. Any additional requirements in countries where the product is going to be marketed have to be considered additionally. The manufacturing of the certified product is subject to surveillance.

TÜV Rheinland LGA Products GmbH, Tillystraße 2, 90431 Nürnberg
Tel.: +49 221 806-1371 e-mail: cert-validity@de.tuv.com
Fax: +49 221 806-3935 http://www.tuv.com/safety

Zertifizierungsstelle

TÜV Rheinland LGA Products GmbH TÜVRheinland Zertifizierungsstelle

Dipl.-Ing. H. Schmiede

B.V. RAJU COLLEGE VISHNUPUR W.G.Dist.(A.P.) Pin-534 202 BHIMAVARAM

Siechem - ISO 9001 : 2008

Certificate of Registration

MOODY INTERNATIONAL

This is to certify that the Quality Management System of :

Siechem Technologies Pvt Ltd

R.S. No. 104/8 & 105/7, Sedarapet Main Road, Pondicherry - 605 101, India

has been assessed and found compliant with the requirements of :

ISO 9001: 2008

Approval is hereby granted for registration on the proviso that the certification rules and conditions are observed at all times.

Certification Scope:

Design, Manufacture, Testing and Marketing of:

1) Jelly filled telephone cables, 2) XLPE/PVC/Elastomeric wires & cables, 3) Power/ Control/Aerial Bunched cables, 4) Instrumentation/data/communication cable, 5) flexible wires & cables for Automotive, Battery, Building & Appliances, 6) Railway signaling & QUAD cables, 7) Electron Beam Irradiated wires & cables, 8) Marine, Solar & Wind energy cables,9) Wires and cables for Fire prone & any specific application, 10) Heat shrink tubings /sleeves, Heat shrink cable jointing & termination kits/accessories for PVC/ XLPE/PILC cables upto 33kV (for Various Industrial, Commercial, Transport & Defence applications), 11) Range of Compounds & master batches, 12) Power cords, 13) E-beam services.

Certificate No.: ICH-0037.06

Issue Date: 02 December 2011

Expiry Date: 01 December 2014

Chandrakant Kulkarni

Authorised Signature

Moody International Certification Ltd.

www.moodyint.com

UKAS MANAGEMENT SYSTEMS 014

B.V. RAJU COLLEGE VISHNUPUR W.G. Dist., (A.P.) Pin-534 202

This use of the Accreditation Mark indicates accreditation in respect of those activities covered by the Accreditation Certificate 014. The certificate remains the property of Moody International Certification Limited to whom it must be returned on request.

For any Queries contact: Moody International Certification India Limited (011-47133900)

Siechem - OHSAS 18001 : 2007

Zenith
Let's Grow Together

assessors of quality
| evaluate | assess | certify |

Zenith Quality Assessors Pvt. Ltd.
Management System Certificate

Certificate No. **OHS/91/R/2008**

This is to certify that

SIECHEM TECHNOLOGIES PVT. LTD.

at

Regd. Off. : 26/27, Errabalu Chetty Street, Chennai - 600 001, Tamil Nadu, India.
Works : RS 104/8 & 105/7, Sedarapet Main Road, Puducherry - 605 111, India.

has been found to conform to Management System Standard :

OHSAS 18001:2007

This certificate is valid for the following products / service ranges :

Manufacture & Supply of *EBXL* Wires & Cables for Power, Control, Instrumentation, Aerial Bunched, Switch Board, Building, Submersible, Industrial, Solar, Rolling Stock, Wind Energy, Aerospace, Firm-alarm, Automotive, Appliance, Signaling, Quad, Networking, Telecom, Jelly Filled, PCM, Welding, Battery, Submarine, Shipbuilding, Elastomeric, *Diamond Colorization* and other Specialized Applications.

Initial Certification : 20th January, 2012
Valid until : 19th January, 2015

ZQA
ASCB(E) Accrediting Certifying Bodies
UK

Management Representative
Zenith Quality Assessors Pvt. Ltd.

Further clarification regarding the scope of this certificate and the applicability of OHSAS 18001:2007 requirements may be obtained by consulting the organization.
Lack of fulfilment of conditions as set out in the Certification Agreement may render this certificate invalid.

Zenith Quality Assessors Pvt. Ltd.
366, 4th Floor, Sai Apex, Near Datta Mandir, Vimsan Nagar, Pune - 411 014, Maharashtra, India.
Tel : +91-20-41322014/41322042/41322043/41322064/41322082 Fax : +91-20-41314107 Email: certification@zenith-worldwide.com

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202
BHIMAVARAM

Siechem - CE Certificate

SAFA*TECH* Ltd.

Safatech

Certificate of Compliance

Issued in cognisance of the requirements of LVD 2006/95/EC as amended, we certify that the technical file of the products as named below and detailed in Annexure A:

Flexible Wires & Cables

Responsible Organisation :

Siechem Technologies Pvt. Ltd.

at

Regd. Off. : 26/27, Errabalu Chetty Street,
Chennai - 600 001, Tamil Nadu, India.
Works : RS 104/8 & 105/7, Sedarapet Main Road,
Puducherry - 605 111, India.

is registered with Safatech Ltd as per the declaration of the organisation as documented in line with the requirements of LVD 2006/95/EC and as per the declaration of the organisation the product falls within the category defined as Class 1.

Safatech Ltd nominated body, Zenith Quality Assessors Pvt. Ltd., has performed the review of the technical file covering the requirements of the certified products as per Internal Production Control Procedure .

The detailed description of the review is presented in the nominated body final report ref no. CE/91/A/2008-1.

Siechem Technologies Pvt. Ltd. is required to inform the nominated body of any changes to the product design, its manufacturing environment and its technical documentation. Changes may require re-audit and re-assessment in order to verify the validity of this certificate.

Failure to notify the nominated body of changes to the design, its manufacturing environment or related technical documentation, may invalidate this registration. Audits and assessments will be conducted on a yearly basis and additionally at the discretion of the nominated body and advised to Safatech Ltd.

Initial Certification	15-Feb-12
Current Certificate Date	15-Feb-12
Valid until	14-Feb-15

Certificate authorised for issue by

Managing Director
Safatech Ltd.

CE

B.V. RAJU & CO. VISHNUPUR W.G.Dist., A.P. Pin-534 202 BHIMAVARAM

Registration Certificate Reference:	500838CE
Nominated Body Certificate Reference:	CE/91/R/2008-1
Nominated Body :	Zenith Quality Assessors Pvt. Ltd.

Certified that the above product / organisation has been registered in the International Register of Quality Assessed Organisations (www.irqao.com) in accordance with the Safatech Ltd. terms and conditions.

Safatech Ltd.
6, Ferris Place, Bournemouth, Dorset, United Kingdom BH8 0AU
Tel 0044 1202 302 772, Fax 0044 870 838 1070
bh8@safatech.co.uk www.safatech.co.uk
Registered in England & Wales ref 401448

SAFA(F)13:2.1

Single Core Copper Conductor Electron Beam Cross Linked Solar Cable as per TUV & UL Specification

Construction:

Conductor : Annealed Tinned Copper (APC Optional) according to IEC 60228, Class 5 or as per customer order

Insulation : XLPO 120°C (Colour Red & Black). Other colours as per customer order

Jacket : XLPO Highly weather & UV Resistant (Colour Black or Black with Red strip)

Features:

Resistance against UV, Water, Ozone, Fluids, Oil, Salt & General Weathering.
Electron Beam Cross Linked,
Halogen Free, Flame Retardant, Low Smoke emission,
Fire retardant to meet IEC 607541-1/EN 50268-2
RoHS compliant as per EU norms
Max.Temp. at Conductor : 120°C (20,000h)
Test Voltage : 6500V AC
Voltage Resistance Test : EN 50395
Rated Voltage : 600/1000 V AC, 1800 V DC
Short Circuit Temp : +280°C

Type of Solar cables:

TUV : Siechem Single & Multi Core and Screened Solar cables meets specn.2Pfg 1169/08.2007

UL : Siechem Single & Multicore and Screened Solar cables meets UL 4703

Dual : Siechem Single & Multicore and Screened cables to meet both TUV & UL specn.

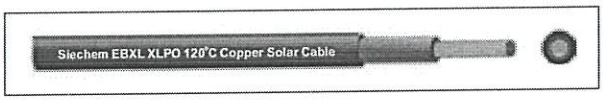
Siechem Solar Cable Range:

Single Core : 1.5 to 400sq.mm or its equivalent size in AWG

Multi Core : 2 to 4 cores x 1.5 to 70 sq.mm or its equivalent size in AWG

Multi Core (EMC) : Up to 61 core screened cables (data sheet against specific request for EMC cables)

ISO 9001-2008 | OHSAS 18001 - 2007 | CE | TUV



Singlecore Solar Cable

Part Number	Cross Section (nom.)	Max. diameter of wires in Conductor Design	Conductor (ATC) DC res at 20°C (max.)	Cable Diameter (nom.)	Copper Weight (nom.)	Cable Weight (nom.)	Current Rating Two Cables adjacent on Surfaces
	Sq.mm	mm	ohm/km	mm	Kg/Km	Kg/Km	Amps
649 13 XX*	1.5	0.26	13.7	4.5	13.0	32.0	24
649 16 XX	2.5	0.26	8.21	5.0	21.0	43.0	33
649 19 XX	4	0.31	5.09	5.5	33.6	60.0	44
649 23 XX	6	0.31	3.39	6.5	51.6	87.0	57
649 27 XX	10	0.41	1.95	7.8	85.5	134.0	79
649 28 XX	16	0.41	1.24	9.3	140.6	206.0	107
649 30 XX	25	0.41	0.795	11.8	218.6	325.0	142
649 32 XX	35	0.41	0.565	13.0	307.7	429.0	176
649 34 XX	50	0.41	0.393	15.3	427.5	593.0	208
649 37 XX	70	0.51	0.277	17.1	608.0	797.0	255
649 38 XX	95	0.51	0.210	19.7	802.3	1056.0	306
649 41 XX	120	0.51	0.164	21.5	1027.0	1312.0	346
649 42 XX	150	0.51	0.132	24.0	1276.8	1629.0	390
649 44 XX	185	0.51	0.108	26.6	1561.8	2000.0	436
649 46 XX	240	0.51	0.0817	30.0	2061.5	2605.0	507
649 48 XX	300	0.51	0.0654	31.7	2621.0	3238.0	571
649 49 XX	400	0.51	0.0495	37.4	3485.0	4282.0	649

Note : XX* : Please add last two digits in the part number as per the colour code given hereunder replacing XX while ordering.
Red - 01 & Black - 04

Catalogue No 649

For most plastic materials, equivalent properties may be obtained by the use of either continuous vulcanizing or moisture cross linking, but irradiation may have the following advantage in addition to what is discussed above:

1. Irradiation has no lower limit on physical size, smaller conductor sizes, and thin insulation walls may be provided.
2. Irradiation does not use high temperature or pressure. Separator tapes are not required to prevent thin wall insulations from being forced into the conductor strand surface.
3. Irradiation offers the insulation compounder design freedom. Compound additives may be chosen without regard to their reaction to high temperatures and to moisture.

Fire Retardant

Fire retardant cables are designed for use in fire situations where the spread of flames along a cable route need to be retarded. Due to relative low cost, fire retardant cables are widely used as fire survival cables. No matter the cables are installed in single wire or in bundles, during a fire, the flame spread will be retarded and the fire will be confirmed to a small area, thus reducing the fire hazard due to fire propagation.

Flame Retardant

Siechem Solar EBXL XLPO Cable offers reliable fire retardant or slow the progress of fire in extreme fire conditions and flame along the cable. This is possible because of specially formulated XLPO jacketing materials that do not readily burn and will tend to self-extinguish.

Low Smoke & Halogen Free & Fire retardant (LSZH)

Siechem Solar Cable combines LSZH-rated insulation and jackets with rugged performance. Low smoke means easier visibility for evacuation and reduced respiratory damage due to smoke, while the zero-halogen material reduces toxicity to almost to negligible level from halogenated gases. Siechem Solar Low-smoke Zero-halogen cables feature tinned copper conductors that resist corrosion and stranded conductors for installation flexibility. The LSZH cable is available in multi conductor / multi pair configurations, shielded or unshielded, foil shielded for EMI protection and improved signal integrity, as well as color-coding. The LSZH cables are suited to confined-space applications to reduce harm, save lives, and reduce damage to electronic components.

Thanks to halogen free solar cables the formation of extremely aggressive corrosive and toxic gasses are prevented.

Low Smoke Fume (LSF)

The low halogen content and low corrosivity of low smoke fume cables lies somewhat in between fire retardant cables and LSZH cables. Low Halogen cable also contains halogen but the content is much less than PVC cables. LSF cable is designed to reduce the spread of fire, toxic gases and smoke during fire. The LSF cable is usually manufactured from flame retardant PVC blended with HCL additive and smoke absorbent. These materials help improve the fire performance of the LSF cables.

Fire Resistant

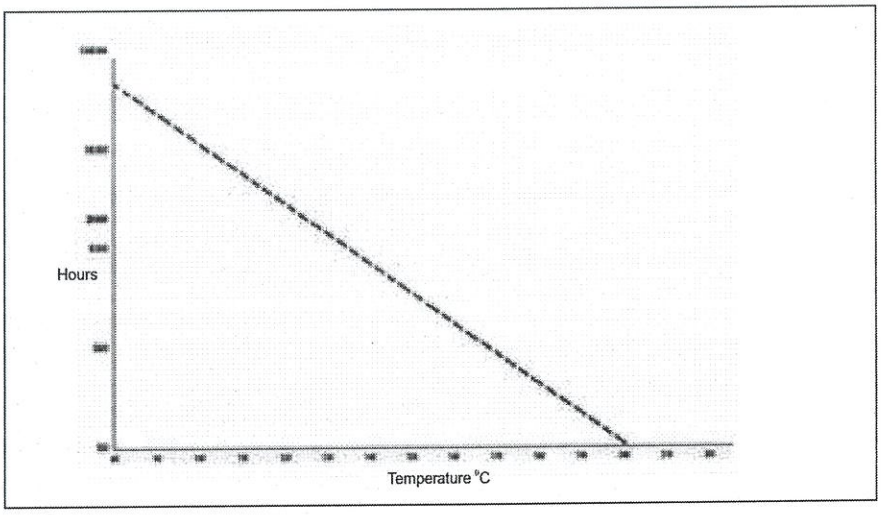
Cables are designed to maintain circuit integrity of those vital emergency services during the fire. The individual conductors are wrapped with a layer of fire resisting mica / glass tape which prevents phase to phase and phase to earth contact even after the insulation has been burnt away. The fire resistant cables exhibit same performance even under fire with water spray or mechanical shock situation.

Fire Performance Class

The main concern for the cable in its fire survival properties are its flame spread, smoke characterization and gas toxicity. In American fire standard, the concern lies more on the first two and it differs from the European standard which concerns all these aspects. In USA , it is believed that the fire hazard is mainly due to CO toxic gas emitted and the heat release during the conversion of CO to CO2 during the fire. Therefore, to control the heat release is the most important concern for reducing the fire hazard. However, in European countries, halogen content, the corrosively of the gases, the smoke density and the toxicity of the gas are equally important factors affecting the safety and survival of human during a fire.

Temperature Index as per IEC 60216/VDE 0304 part 21

The temperature index describes the long-term performance of insulating materials. The temperature index defines the ageing temperature (in °C), at which the insulating material still has an absolute elongation at break of 50 % after 20 000 hours. A 10 °C higher temperature index results in approximately doubling the life expectation of the insulating materials. In order to determine the long term temperature stability of an insulating material the different ageing times corresponding to different temperatures are measured and recorded in a so called Arrhenius- Diagram (ordinate-axis: log time, abscissa axis: the reciprocal absolute temperature). A straight line is drawn to connect the various recorded points. By prolonging the straight line until it intersects the 20 000 hour axis it is possible to determine the lifetime or the temperature index.

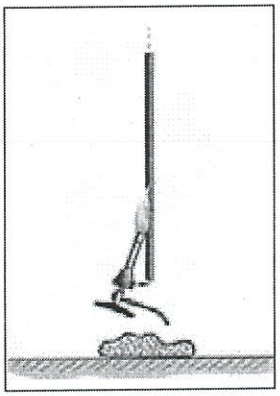


The European Electrical Committee categorized the fire performance of the cables into three classes, namely

IEC60332-1, IEC60332-2 & IEC60332-3. IEC 60332-1 and IEC 60332-2 are used to assess the flame propagation characteristics of a single wire. IEC 60332-3 is used to assess the flame propagation chacteristics of bundled cables. Comparatively speaking, IEC 60332-3 for bundled cables is more demanding than IEC60332-1 for single wires.

IEC 60332-1/ BS EN 60332-2-3-10 ; 2009 (Flame Test on Single Vertical Insulated Wires/Cables)

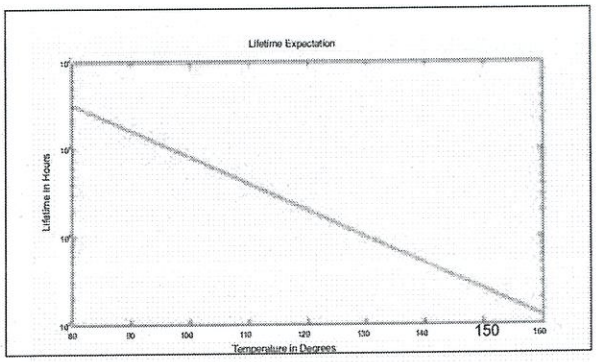
This test details a method of test for the assessment of the flame propagation characteristics of a single wire or cable. In this test , a 60cm cable sample is fixed vertically inside a metallic box and a 175 mm long flame is applied at 45°C from a gas burner placed at 450 mm from the top at the upper portion. The specimen is deemed to have passed this test, of after burning has ceased, the charred or affected position does not reach within 50mm of the lower edge of the top clamp which is equivalent to 425 mm above the point of flame application. The test method is not suitable for the testing of some small wires due to the melting of the conductors during the time of application of the flame.



Vertical Flame Test

Lifetime Expectation

If cross linked wires are used at higher temperatures than indicated by the temperature index of IEC 60216, the lifetime is reduced accordingly, conversely, the lifetime will increase at lower temperatures. Siechem EBXL Solar cable 125 for example has a life span of 20'000 h at a conductor temperature of +120°C, which is approx. 2.5 years. If it is used at another temperature, lifetime expectations are as follows:



Current Rating 120°C
Ambient Temperature 30°C

Construction Sq.mm	Free Air	On Surfaces without Opposite Contact	On Surfaces with Opposite Contact	In Conduict, Duct
1.5	39	37	26	21
2.5	51	48	34	27
4	68	65	45	36
6	88	84	59	47
10	121	115	80	64

Ambient Temperature 90°C

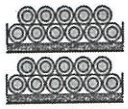
Construction Sq.mm	Free Air	On Surfaces without Opposite Contact	On Surfaces with Opposite Contact	In Conduict, Duct
1.5	21	21	17	12
2.5	29	28	23	15
4	39	37	31	20
6	50	48	40	27
10	70	66	56	37

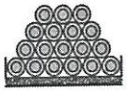
Ambient Temperature 60°C

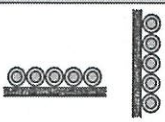
Construction Sq.mm	Free Air	On Surfaces without Opposite Contact	On Surfaces with Opposite Contact	In Conduict, Duct
1.5	32	30	21	17
2.5	42	39	28	22
4	56	53	37	30
6	72	69	48	39
10	99	94	66	52

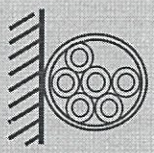
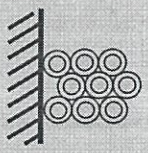
Installation Method	Connecting lead in free air or perforated tray								
Number of simultaneous loaded conductors on									
each tray	1	2	3	4	6	8	10	16	20
Reduction Factor	1	0.87	0.81	0.78	0.75	0.74	0.73	0.72	0.71
Copper conductor cross section mm^2	Current capacity in A								
1.5	39	34	32	30	29	29	28	28	28
2.5	51	44	41	40	38	38	37	37	36
4	68	59	55	53	51	50	50	49	48
6	88	77	71	69	66	65	64	63	62
10	121	105	98	94	91	90	88	87	86
16	161	140	130	126	121	119	118	116	114
25	215	187	174	168	161	159	157	155	153
35	266	231	215	207	200	197	194	192	189
50	336	292	272	262	252	249	245	242	239
70	423	368	343	330	317	313	309	305	300
95	502	437	407	392	377	371	366	361	356
120	589	512	477	459	442	436	430	424	418
150	682	593	552	532	512	505	498	491	484

Installation Method	Connecting lead in free air or perforated tray						
Number of simultaneous loaded conductors on							
each tray	1	4	6	8	10	16	20
Reduction Factor	1	0.71	0.62	0.57	0.53	0.47	0.45
Copper conductor cross section mm^2	Current capacity in A						
1.5	39	28	24	22	21	18	18
2.5	51	36	32	29	27	24	23
4	68	48	42	38	36	32	31
6	88	62	55	50	47	41	40
10	121	86	75	69	64	57	54
16	161	114	100	92	85	76	72
25	215	153	133	123	114	101	97
35	266	189	165	152	141	125	120
50	336	239	208	192	178	158	151
70	423	300	262	241	224	199	190
95	502	356	311	286	266	236	226
120	589	418	365	336	312	277	265
150	682	484	423	389	361	321	307

Installation Method	Connecting lead in free air or perforated tray						
Number of simultaneous loaded conductors on							
each tray	1	4	6	8	10	16	20
Reduction Factor	1	0.67	0.59	0.54	0.5	0.45	0.43
Copper conductor cross section mm^2	Current capacity in A						
1.5	39	26	23	21	20	18	17
2.5	51	34	30	28	26	23	22
4	68	46	40	37	34	31	29
6	88	59	52	48	44	40	38
10	121	81	71	65	61	54	52
16	161	108	95	87	81	72	69
25	215	144	127	116	108	97	92
35	266	178	157	144	133	120	114
50	336	225	198	181	168	151	144
70	423	283	250	228	212	190	182
95	502	336	296	271	251	226	216
120	589	395	348	318	295	265	253
150	682	457	402	368	341	307	293

Installation Method	Connecting lead in free air or perforated tray						
Number of simultaneous loaded conductors on							
each tray	1	4	6	8	10	16	20
Reduction Factor	1	0.71	0.58	0.52	0.48	0.41	0.38
Copper conductor cross section mm^2	Current capacity in A						
1.5	39	28	23	20	19	16	15
2.5	51	36	30	27	24	21	19
4	68	48	30	35	33	28	26
6	88	62	51	46	42	36	33
10	121	86	70	63	58	50	46
16	161	114	93	84	77	66	61
25	215	153	125	112	103	88	82
35	266	189	154	138	128	109	101
50	336	239	195	175	161	138	128
70	423	300	245	220	203	173	161
95	502	356	291	261	241	206	191
120	589	418	342	306	283	241	224
150	682	484	396	355	327	280	259

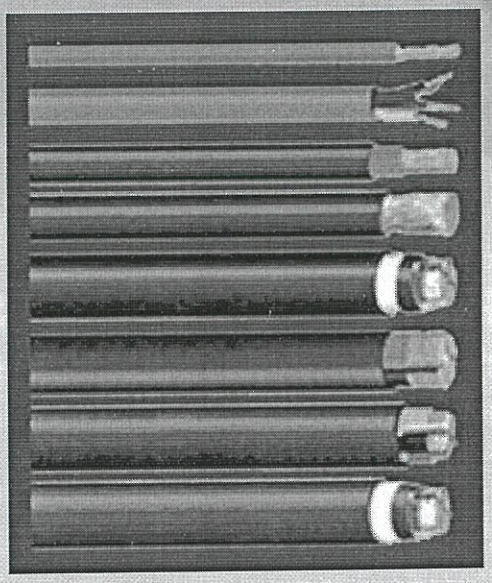
Installation Method	on floor or wall				fixed on a ceiling or under floor								
Number of simultaneous loaded conductors on													
each tray	1	2	3	4	1	2	3	4	5	6	7	8	9
Reduction Factor	1	0.85	0.79	0.75	0.95	0.81	0.72	0.68	0.66	0.64	0.63	0.62	0.61
Copper conductor cross section mm^2	Current Carrying capacity in A												
1.5	35	30	28	26	33	28	25	24	23	22	22	22	21
2.5	48	41	38	36	46	39	35	33	32	31	30	30	29
4	64	54	51	48	61	52	46	44	42	41	40	40	39
6	84	71	66	63	80	68	60	57	55	54	53	52	51
10	118	100	93	89	112	96	85	80	78	76	74	73	72
16	158	134	125	119	150	128	114	107	104	101	100	98	96
25	212	180	167	159	201	172	153	144	140	136	134	131	129
35	262	223	207	197	249	212	189	178	173	168	165	162	160
50	330	281	261	248	314	267	238	224	218	211	208	205	201
70	420	357	332	315	399	340	302	286	277	269	265	260	256
95	499	424	394	374	474	404	359	339	329	319	314	309	304
120	580	493	458	435	551	470	418	394	383	371	365	360	354
150	670	570	529	503	637	543	482	456	442	429	422	415	409

In conduit in a void or in a pipe													
1	2	3	4	5	6	7	8	9	10	12	14	16	20
1	0.8	0.7	0.65	0.6	0.57	0.54	0.52	0.5	0.48	0.45	0.43	0.41	0.38
Current Carrying capacity in A													
29	23	20	19	17	17	16	15	15	14	13	12	12	11
39	31	27	25	23	22	21	20	20	19	18	17	16	15
52	42	36	34	31	30	28	27	26	25	23	22	21	20
66	53	46	43	40	38	36	34	33	32	30	28	27	25
92	74	64	60	55	52	50	48	46	44	41	40	38	35
120	96	84	78	72	68	65	62	60	58	54	52	49	46
160	128	112	104	96	91	86	83	80	77	72	69	66	61
196	157	137	127	118	112	106	102	98	94	88	84	80	74
248	198	174	161	149	141	134	129	124	119	112	107	102	94
309	247	216	201	185	176	167	161	155	148	139	133	127	117
457	366	320	297	274	260	247	238	229	219	206	197	187	174
426	341	298	277	256	243	230	222	213	204	192	183	175	162

Siechem

Wires & Cables

Next is Ready™



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Technologies Pvt. Ltd.

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Email : admn@siechem.com
Web : www.siechem.com

Approvals & Licenses					
ISO 9001:2008	OHSAS 18001:2007	UL	DGQA	ISI	IHQ Indian Navy
	CE	TUV	RDSO	AERB	DSIR

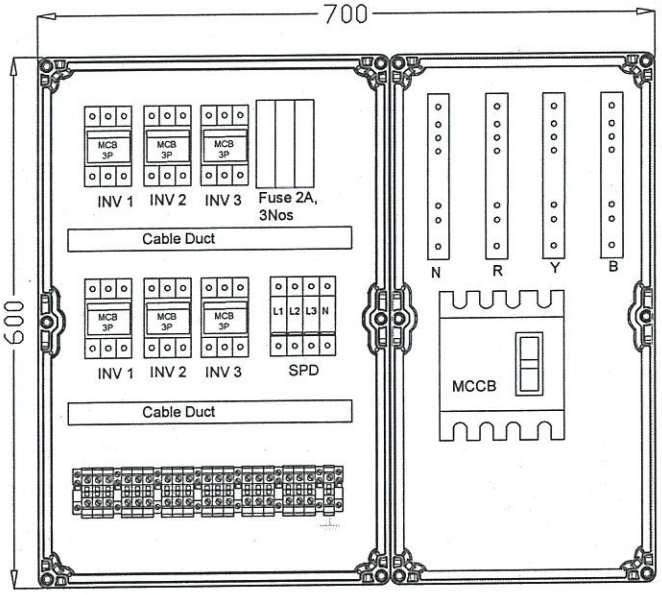
SECTION – 4.3.3

SOLAR PV POWER PLANT

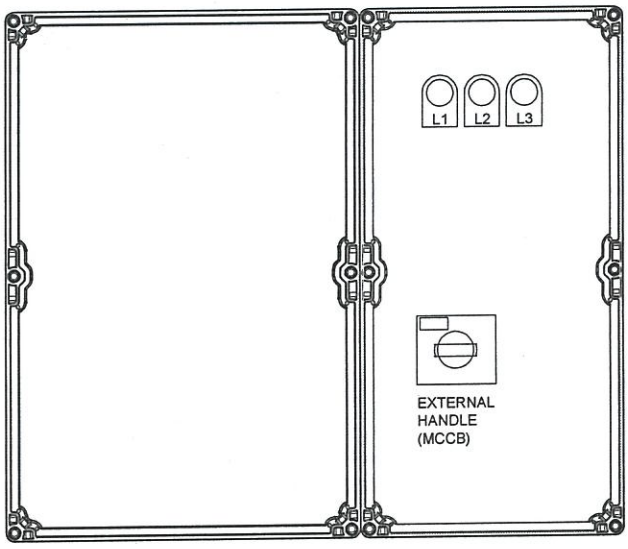
BALANCE OF MATERIAL

– ACDB

ID	Description	MAKE	QTY
1	Enclosure : Polycarbonate 600 x 700 x 187 mm (Compartalised, IP66)	ENSTO OY, Finland	1
2	MCB 40A, 3P	L&T	3
3	MCCB : 200A 3P with external handle	Schneider	1
4	Copper Busbar (Tin plated) 20 x 5 (W x T)	Onexis	4
5	Cable Gland : IncomingPG21, Outgoing : CBW070	Ensto Oy, Finland	3, 1
6	Terminal : Incoming 16 sqmm,	Phoenix	12
7	SPD 450V, 3 Ph Type 1+ 2	CITEL	1
8		AE	3
9		Schneider	1
10	Indication Lamp RYB	L&T	3
11	Fuse 2A, for Control (Lamp & EM)	L&T	3



BODY



COVER

Dimensions in mm

B.V. RAJU COLLEGE VISHNUPUR W.G. Dist., (A.P.) Pin-534 202 BHIMAVARAM

model OPCP406013T PART	Material: Polycarbonate, fiberglass-reinforced		Color: RAL 7035		
drawing CUBO_O_1B DRAWING	Supplier:	Tool No: -	Weight [kg]: 3.76	Volume:	
	onexis		ACCB 6 INV IN 1 OUT	Replaces:	
				Replaced:	
			DWG: OA/ GEPL/ ACCB/6/1	Drw No: -	B
	Scale	Date		Ref: Cubo O	
	1:8	By	PKos	Code:	
	-	Checked		Sheet No:	
	-	Ctrl			

SECTION – 4.3.4

SOLAR PV POWER PLANT

BALANCE OF MATERIAL

– EARTHING

POWER PLANT EARTHING:

Here in this project the entire plant equipment like solar modules and its mounting structures, Inverters, ACDB and lightning Arrester has been grounded to avoid shock regard.

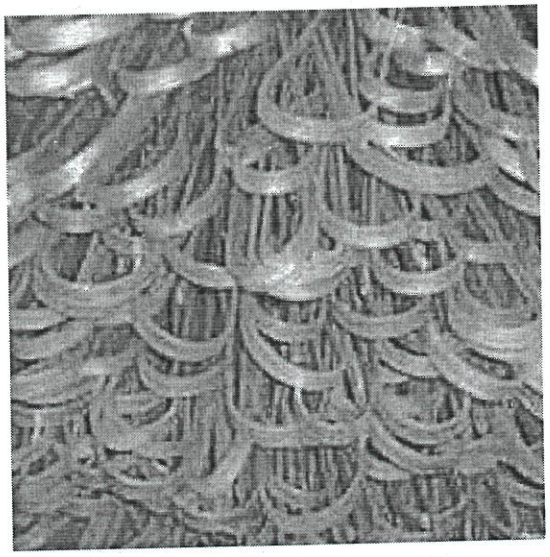
A separate earthing has been provided for DC equipment like modules and its mounting structures. AC equipment like inverters, ACDB and lightning arrester. One earthing has been provided for modules and its mounting structures, one earthing for the inverters & ACDB & a separate earthing for lightning arrester. Following are material used in the plant earthing.

1. LIGHTNING ARRESTERS:

A lightning Arrester is a metal rod or metallic object mounted on top of a building, electrical power systems and telecommunications systems electrically bonded using a wire or electrical conductor to interface with ground or "earth" through an electrode, engineered to protect the building and the electrical power system from the damaging effects of lightning strike. If lightning targets preferentially strike the rod and be conducted to ground through the wire, instead of passing through the building, where it could start a fire or cause electrocution. The typical lightning arrester has a high-voltage terminal and a ground terminal. A lighting arrester made from GI rod and copper bounded rod in form of single point and multipoint's system.

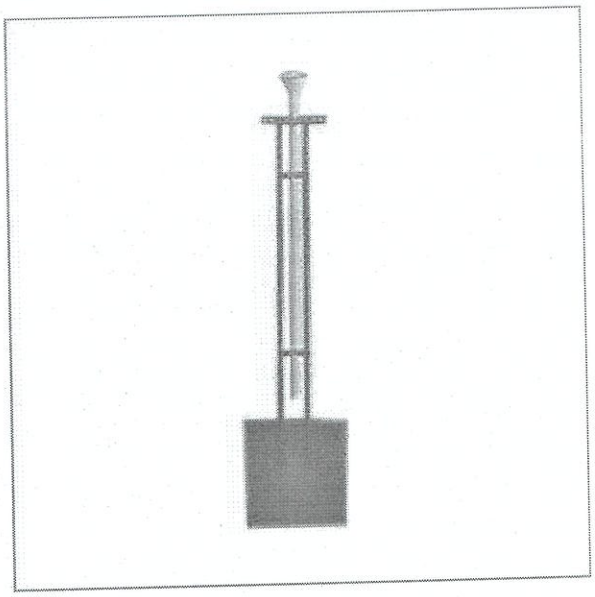
2. GI STRIP:

A 25 X 3 mm GI strip has been used to interconnect the DC & AC equipment separately and lightning arrester to the earth pipe in the earth pit.



3. GI EARTH PIPE WITH COPPER PLATE:

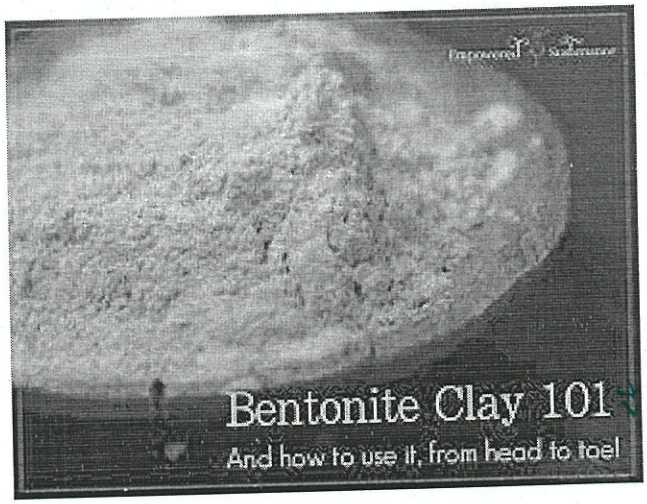
A 2 inches diameter GI earth pipe with 300 X 300 copper plate welded at the bottom has been used to ground the GI strip connecting the equipment.



4. BENTONITE POWDER:

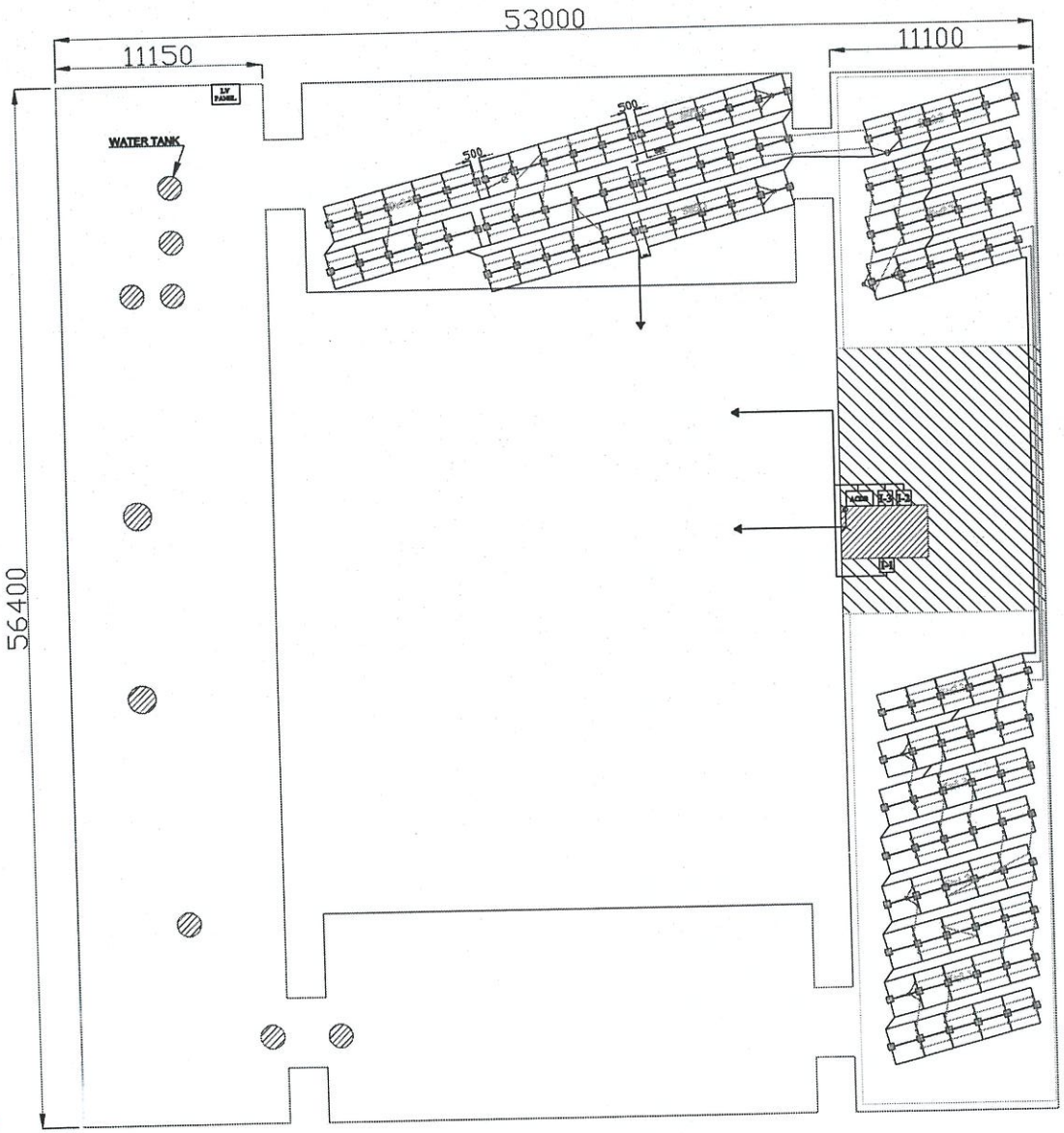
Sodium bentonite expands when wet, absorbing as much as several times its dry mass in water. Because of its excellent colloidal properties, it is often used in drilling mud for oil and gas wells and boreholes for geotechnical and environmental investigations.

The property of swelling also makes sodium bentonite useful as a sealant, since it provides a self-sealing, low permeability barrier. It is used to line the base of landfills. For example various surface modifications to sodium bentonite improve some rheological or sealing performance in geoenviromental applications, for example, the addition of polymers.



R Krishnam Raju

RevNo	Revision note	Date	Signature	Checked



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B.V. RAJU COLLEGE BHIMAVARAM

NOTES:
1. Str - STRING, 7 STRING HAS 22MODULES ARE IN SERIES & ANOTHER 2 STRINGS HAS 23 MODULES ARE SERIES
2. I- INVERTER, WE CONSIDERED 3 INVERTERS IN THIS 50kWp SYSTEM
3. Str 1.1 TO Str 3.3 CONNECTED TO THE I.1, I.2,I.3
4. EACH INVERTER HAVING 3 STRINGS
5.ACDB - AC DISTRIBUTION BOARD

VARSHINI POWER PROJECTS INDIA PVT. LTD
PLOT: 44-4/A, NAGARJUNA HILLS
PUNJAGUTTA, HYDERABAD- 500 082
ANDHRA PRADESH,INDIA.
TEL:+91 40 23355552
EMAIL: info@varshinipower.com

PROJECT: 50kWp GRID-TIED SOLAR POWER SYSTEM		ALL DIMENSIONS ARE IN MILLI METERS
PRD. BY:JYOTHI	CKD. BY: VSD	CUSTOMER:VISHNU EDUCATIONAL SOCIETY, BHVM
REV. NO:00	DATE: ----	TITLE:50kWp BVRICE BLOCK - EARTHING
DWG. SIZE:A4	SHT. NO:01	DWG.NO:VISHNU/LAY/13/01
DWG. DATE:26/12/2013		

SECTION – 5

SOLAR PV POWER PLANT

WARRANTIES

SECTION – 5.1

SOLAR PV POWER PLANT

WARRANTIES

– PV MODULES

alpex
Power Forever

Warranty of Solar PV Panels / Modules

This document is the only valid document for any warranty / guarantee claims to be made on Alpex Exports Private Limited - having a manufacturing unit at Village Berson, Post Manjholi, Tehsil Nalagarh, Diatrict Solan, Himachal Pradesh, INDIA PIN-174101 related to Solar PV Panels / Modules. The Warranty is applicable from the date of first sale to the original end customer / user. The Warranty is divided in two parts:

1. Manufacturer's Limited Product Warranty
2. Extended Term Limited Warranty on Power Output

1. Manufacturer's Limited Product Warranty

Alpex Exports Private Limited warranties that the standard photo-voltaic modules manufactured by them and which are not explicitly prototypes will be - under normal application, installation, use and service - free of defects conditions such as:

- defects and/or failures due to manufacturing;
- defects and/or failures due to materials;
- cracking of the front glass surface due to foreign objects inside the glass; or
- non-conformity to specifications due to faulty manufacturing and/or inspection processes for a term of five (5) years as from the delivery of the modules by Alpex Exports Private Limited or their Authorised Agent to the original end customer (the customer). This Limited Product Warranty does not warrant a specific power output, which shall be exclusively covered under clause 2 hereinafter (Extended Term Limited Warranty on Power Output).

If the PV modules fail to conform to this warranty, then for a period ending five (5) years from date of delivery to the original end-customer ("the Customer"), Alpex Exports Private Limited will, at its option, either repair or replace the product, or refund the purchase price as paid by the Customer ("Purchase Price"). The repair, replacement or refund remedy shall be the sole and exclusive remedy provided under the Limited Product Warranty and shall not extend beyond the five (5) year period set forth herein. In cases where subsequent delivery has failed or where a defect cannot be removed, the customer will be required to accept a further attempt to make a subsequent delivery or to repair the defect.

This Manufacturer's Warranty does not cover transportation cost for return of the PV Module(s) to Alpex Exports Private Limited or Alpex Exports Private Limited's authorized agent and the transportation cost for reshipment of any repaired or replaced PV Module(s) to the applicable location, and costs associated with installation, removal or reinstallation of the PV Module(s). The transportation of the modules to and from Alpex Exports Pvt Ltd. shall be at the cost and risk of the customer.

Note:This limited warranty shall exclude cracking of the front glass surface due to external shock from flying objects or external stress.

2. Extended Term Limited Warranty on Power Output:

Subject to Alpex Exports Private Limited determining in its sole discretion that any power loss is due solely to defects in materials or workmanship, Alpex Exports Private Limited warrants the power output of the PV Module(s) as follows:

V. P. Krishnam Raj

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202.
BHIMAVARAM

specifications, installation manuals, operation manuals, or labels attached to the PV Module(s);

d) defects and/or failures caused by unauthorized maintenance, operation or modification;

e) defects and/or failures caused by removal from the original place of installment;

f) defects and/or failures caused by repairs not in accordance with Alpex Exports Pvt. Ltd's instructions;

g) defects and/or failures caused by inappropriate handling during transportation or storage;

h) defects and/or failures caused by use on a mobile unit including, but not limited to, vehicles, vessels, etc.;

i) defects and/or failures caused by external accidents such as fire, explosion, and civil disorder;

j) defects and/or failures caused by natural forces, acts of God or force majeure events and other unforeseen circumstances or causes beyond Alpex Exports Pvt. Limited's reasonable control including, but not limited to, earthquakes, typhoons, hurricanes, tornadoes, volcanic action, floods, tsunami, lightning, snow damage, etc.; or

k) defects and/or failures caused by installation of modules in corrosive environment, smoke and/or other pollution, salt damage, acid rain etc

Neither does the "Extended Term Limited Warranty on Power Output" apply if the type or serial number of the module has been altered, deleted, removed or made illegible.

II. Limitation of the Extended Term Limited Warranty on Power Output

This Limited Power Output Warranty shall not form the basis for further claims against Alpex Exports Private Limited, in particular for compensation claims, due to lost profits, compensation for loss of use, indirect damage and claims for replacement due to damage occurring exterior to the product. In no event shall Alpex Exports Private Limited's aggregate liability exceed the depreciated value of the PV module(s) which is the subject of a claim or dispute.

III. Recourse of the Extended Term Limited Warranty on Power Output

If you believe you have a justified claim from this "Extended Term Limited Warranty on Power Output", inform your respective vendor or Alpex Exports Private Limited within 15 days following the discovery of any defect covered by this warranty, with specific details, and provided Alpex Exports Pvt Ltd or its agents are permitted a commercially reasonable opportunity to examine and analyze the material or workmanship claimed to be defective. In case the module is to be further examined, it shall be delivered at a nominated location by the customer and the costs incurred for this and the risk covered shall be borne by the customer. The original invoice (showing the date of delivery, module type, and serial number) is to be presented at the same time.

This Manufacturer's warranty and "Extended Term Limited Warranty on Power Output" shall apply to modules delivered from 1st Jan 2011".

(a) Within the first ten (10) years from the date of sale to the Customer, the PV Module(s) exhibits a power output of less than ninety percent (90%) of the original minimum rated power at standard test conditions (STC) specified on the label on the module at the time of sale, or

(b) if a module performs at less than 80% of the original minimum rated power at STC as specified on the label on the module within a period of twenty-five (25) years as from the date of sale by Alpex Exports Private Limited / or by its Authorised Agent and provided Alpex Exports Private Limited attributes a loss of output of this nature to the ageing of glass, the cell or EVA foil (delamination) following its own investigation with its own instruments, Alpex Exports Private Limited will at its sole discretion deliver additional PV Module(s) to replace the missing power output, or repair or replace the PV module(s).

Standard Test Conditions:
(a)light spectrum of AM 1.5; (b) irradiation of 1,000w per m², and (c) a cell temperature of 25 degrees).

This applies only to modules used on the dry land. The "Extended Term Limited Warranty on Power Output" can only be given in respect of the ageing process of glass, the cell or the EVA foil (delamination) selected for processing by Alpex Exports Private Limited itself, not for those processed at the request of the customer.

The exchange or the additional delivery of modules neither renews nor extends the warranty period or the period of the Limited Power Output Warranty. Alpex Exports Private Limited is entitled to deliver another type of module (varying sizes, shapes, colors and/or output parameters) if at the time of the claim the modules, which are the subject of the complaint, are no longer manufactured. The modules which have been removed for exchanging will become the property of Alpex Exports Private Limited . This Limited Power Output Warranty does not cover the transportation cost for reshipment of any repaired or replaced PV Module(s) to the applicable location, and does not cover the transportation cost for return of the PV Module(s) to Alpex Exports Private Limited or Alpex Exports Private Limited 's authorized agent and costs associated with installation, removal, or reinstallation of the PV Module(s).

I.Exclusion of Recourse

This Limited Power Output Warranty shall not apply in cases of the reduced output of a module if it is attributable to a cause other than the ageing of the materials listed under Point 2 above.

This Limited Warranty shall not cover defects and/or failures of the PV Module(s) from the following causes even though such defects and/or failures are discovered within the applicable warranty period:

a) defects and/or failures caused by devices and/or parts other than the PV Module(s) or by mounting methods of such devices and/or parts;

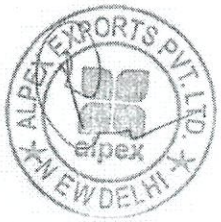
b) defects and/or failures caused by defective wiring, installation, or handling;

c) defects and/or failures caused by installations not in conformance with PV Module(s);

Both the above warranties are applicable only to Customers, who have purchased the PV Module(s), either directly from Alpex Exports Private Limited or from their authorized agent. To qualify for this warranty, it is necessary for the Customer to prove that the PV Module(s) was purchased from Alpex Exports Private Limited or such authorized agent. When applying for warranty coverage, please provide Alpex Exports Private Limited or their authorized agent with the PV Module(s) model name, a description of the defect and/or failure, and the serial number located on the PV Module(s) label attached to the backside of the PV Module(s) at the time of manufacture.

Warranty Limitations:

THE LIMITED WARRANTY SET FORTH HEREIN IS EXPRESSLY IN LIEU OF AND EXCLUDES ALL OTHER EXPRESS OR IMPLIED WARRANTIES INCLUDING, BUT NOT LIMITED TO, THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER OBLIGATIONS OR LIABILITIES ON THE PART OF ALPEX EXPORTS PRIVATE LIMITED, UNLESS SUCH OTHER WARRANTIES, OBLIGATIONS OR LIABILITES ARE EXPRESSLY AGREED TO IN WRITING BY ALPEX EXPORTS PRIVATE LIMITED. ALPEX EXPORTS PRIVATE LIMITED SHALL HAVE NO RESPONSIBILITY OR LIABILITY WHATSOEVER FOR DAMAGES OR INJURY TO PERSONS OR PROPERTY, OR FOR OTHER LOSS OR INJURY RESULTING FROM ANY CAUSE WHATSOEVER ARISING OUT OF OR RELATING TO THE PV MODULE(S) INCLUDING, WITHOUT LIMITATION, ANY DEFECTS AND/OR FAILURES IN THE PV MODULE(S) OR FROM USE OR INSTALLATION. ALPEX EXPORTS PRIVATE LIMITED SHALL NOT BE LIABLE UNDER ANY CIRCUMSTANCES FOR ANY INCIDENTAL, INDIRECT, CONSEQUENTIAL OR SPECIAL DAMAGES, HOWSOEVER CAUSED. IN NO EVENT SHALL ALPEX EXPORTS PRIVATE LIMITED 'S AGGREGATE LIABILITY EXCEED THE VALUE OF THE PV MODULE(S) WHICH IS THE SUBJECT OF A CLAIM OR DISPUTE.



SECTION – 5.2

SOLAR PV POWER PLANT

WARRANTIES

– SOLAR INVERTERS

Danfoss Solar Inverters A/S

Nordborgvej 81
DK-6430 Nordborg
Denmark

Homepage: www.solar-inverters.danfoss.com

WARRANTY

For Danfoss inverters

We hereby confirm that the inverter

AppID: 139F0013 303702N383

based on our Standard Warranty Conditions
has a warranty of 5 years.

If you have any questions please contact the dealer of your inverter or contact our service hotline – see contact information at www.solar-inverters.danfoss.com (see Service).

End of warranty: 03/2019

Nordborg, 23.01.2014

Danfoss Solar Inverters A/S

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., (A.P.)
Pin-534 202
BHIMAVARAM

Danfoss Solar Inverters A/S

Nordborgvej 81
DK-6430 Nordborg
Denmark

Homepage: www.solar-inverters.danfoss.com

WARRANTY

For Danfoss inverters

We hereby confirm that the inverter

AppID: 139F0013 303502N383

based on our Standard Warranty Conditions
has a warranty of 5 years.

If you have any questions please contact the dealer of your inverter or contact our service hotline – see contact information at www.solar-inverters.danfoss.com (see Service).

End of warranty: 03/2019

Nordborg, 23.01.2014

Danfoss Solar Inverters A/S

Danfoss Solar Inverters A/S

Nordborgvej 81
DK-6430 Nordborg
Denmark

Homepage: www.solar-inverters.danfoss.com

WARRANTY

For Danfoss inverters

We hereby confirm that the inverter

AppID: 139F0013 301702N383

based on our Standard Warranty Conditions
has a warranty of 5 years.

If you have any questions please contact the dealer of your inverter or contact our service hotline – see contact information at www.solar-inverters.danfoss.com (see Service).

End of warranty: 03/2019

Nordborg, 23.01.2014

Danfoss Solar Inverters A/S

V. K. Krishnam Raju

B.V. RAJU COLLEGE
VISHNUPUR
W.G. Dist., A.P.
Pin-534 202
BHIMAVARAM

SECTION – 6

SOLAR PV POWER PLANT

OPERATIONS AND MAINTENANCE

SECTION – 6.1

SOLAR PV POWER PLANT

OPERATIONS AND MAINTENANCE

– SAFETY STANDARDS

6.1. Safety Standards

PV System – Safety Management

A photovoltaic system is a system which uses solar cells to convert light into electricity. A photovoltaic system consists of multiple components, including cells, mechanical and electrical connections and mountings and means of regulating and /or modifying the electrical output.

Due to the low voltage of an individual solar cell (typically ca. 0.5V), several cells are combined into photovoltaic modules, which are in turn connected together into an array. The electricity generated can be either stored, used directly (island. Standalone plant) or fed into a large electricity grid powered by central generation plants (grid-connected / grid-tied plant) or combined with one or many domestic electricity generators to feed into a small grid (hybrid plant). Depending on the type of application, the rest of the system ("balance of system") consists of different components. The BOS depends on the load profile and the system type. Systems are generally designed in order to ensure the highest energy yield for a given investment.

Balance of Systems

The balance-of-systems (BOS) is defined as everything except the PV modules and the load. The BOS includes: the land, fencing, buildings, module support structures, external wiring, connection boxes, power conditioning equipment like, inverters, controllers, transformers, safety and protective equipment, diodes, switches, lighting protection, circuit breakers, ground rods and cables, energy storage batteries, utility grid interface and its connection devices, weather monitoring instruments like, pyranometer, thermometers, anemometers, data acquisition equipment for monitoring and evaluating the PV system performance.

System Hazards and Recommendations

Cuts, bumps, falls and sprains hurt just as much and cause as much lost time as the electrical shock and burn hazards generally thought of. Although, most safety suggestions are just plain common sense, people still get hurt in industrial accidents. The goal is to reduce the number of injuries to zero. This requires good work habits, awareness of potential hazards and a program where safety rules are frequently reviewed.

Non-Electrical Hazards

There is an incorrect perception among many that you can't get hurt working on a PV system. Anyone who has seen a car battery explode could explain this point. Safety should be foremost in the mind of anyone and every-one working on PV systems. Some common hazards that may be encountered are discussed below.

Exposure

PV systems are installed where the sun is brightest and no shade exists. When you work on a PV system you should wear a hat, keep the limbs covered, and/or use plenty of lotion with a sunscreen rating of 15 or higher. In the summertime, drink plenty of liquid but never have alcoholic drink and take a break and get into the shade for a few minutes each hour. In the winter, use warm dress, wear gloves whenever possible, and if you are working on a pumping system, don't stick your tongue on the pump handle.

Insects, Snakes, and Other Vermin

Spiders, wasps, and other insects often move in and inhabit junction boxes in PV systems. Some wasps build nests in the array framing. Rattlesnakes use the shade provided by the array and fire ants are commonly found under arrays or near battery storage boxes. Always be prepared for the unexpected when you open junction boxes. Look carefully before you crawl under the array. It may sound funny, but fire ants or Black widow spiders (can cause painful injury and any poisonous snake alone can take away your life.

Cuts & Bumps

Most PV systems contain metal framing, junction boxes, bolts, nuts, bare wires, anchor bolts, etc. Most of these common items has sharp edges and can cause injury if you are not careful. Wear gloves when handling metal, particularly if you are drilling or sawing. Metal silvers from drill bit often remain around a hole and these can cause severe cuts to a bare hand. Wear a dielectric hard hat any time you are working under an array or on a system with hardware higher than your head.

Falls, Sprains and Strains

Many PV systems are installed in remote areas in rough terrain. Walking to and around the site, particularly carrying materials or test equipment can result in fall and/or sprains if not walking carefully. Wear comfortable shoes, preferably with sofa soles, steel toe reinforced shoes not to be worn around PV systems because that would lower the resistance of a potential current path. Be careful when lifting and toting heavy equipment, particularly batteries. Lift with the legs and not the back to avoid back strains. If climbing is required, be sure the ladder is firmly anchored and remember a PV module can act as a wind sail and knock you off a ladder on windy days.

Burns—Thermal

Metal left exposed in the sun can reach temperatures of 50degC. This is too hot to handle, but is unlikely to cause burns if hold in bare hand. Concentrating PV systems pose an added hazard from burns. Some concentrating PV systems focus up to 400 suns on the PV cell. This added thermal energy is dissipated using active or passive cooling mechanisms with temperatures far exceeding 100°C. Momentary contact can cause serious burns. An active cooling system contains a heat transfer fluid that can scald flesh (it may also be caustic). Wear gloves anytime you have to work on PV systems in the summertime. Survey the system and make sure you do not bump into cooling elements.

Burns – Acid

Most Stands- alone PV system contains batteries. A large percentage of the batteries are the lead-acid type and the hydrochloric acid and both are hazardous. Chemical burns can occur if the acid makes contact with an unprotected part of the body, particularly your eyes are more vulnerable. Anytime, working around lead-acid batteries, one should wear non-absorbent gloves, protective eye wear, and a neoprene coated apron.

Electrical Hazards

Common electrical accidents results in shocks and/or burns, muscles contractions, trauma injuries associated with falls after the shock. These injuries can occur anytime, when electrical current flows through the human body. The amount of current that will flow is determined by the difference in potential (Voltage) and the resistance in the current path. At low frequencies (60Hz or less) the human body acts like a resistor but the value of resistance varies with conditions. It is difficult to estimate when current will flow or the severity of the injury that might occur because the resistivity of the human skin varies from just under a thousand ohms to several hundred thousand ohms depending primarily on skin moisturizer.

If a current greater than 0.02 amperes flows through your body, you are in serious jeopardy because you may not be able to let go of the current carrying wire. This small amount of current can be forced through sweaty hands with the voltage as low as 20volts and the higher the voltage the higher the probability that current will flow. High voltage shock (>400 V), may burn away the protective layer of outer skin at the entry and exit points. When this occurs, the body resistance is lowered and lethal currents may cause instant death.

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Electrical Shock Hazards

Reaction	Current (in m Amp)	
	AC	DC
Perception-Tingle, Warmth	1	6
Shock- Retain muscle control; reflex may cause injury	2	9
Severe Shock - Loose muscle control, burns; asphyxia	20	90
Ventricular Fibrillation- Probable death	100	500
Heart Frozen - Body temperature rise ; death will occur in minutes	> 1 amp	>1 amp

- Electrical shock is painful and a potentially minor injury is often aggravated by the reflex reaction of jumping back away from the source of the shock, Anytime a PV array contains more than two PV modules, a shock hazard should be presumes to exist.
- The best way to avoid shock is always measure—the voltage from any wire to any other wires, and to ground.
- Use a clamp-on ammeter to measure that current flowing through the wires.
- Never disconnect a wire before you have checked the voltage and current.
- Do not presume everything is in perfect order.
- Do not trust switches to operate perfectly and do not "believe" schematics. A digital voltmeter is a wonderful instrument and using is often could save your life.

AC Power Hazards

If alternating current (ac) power is to be supplied, a power conditioning unit is required to convert the dc power from the PV system to ac power. This equipment will have high voltage at both input and output when it is operating. The output is nominally at 120 V or 240 V and enough current will be present to kill. All the precautions for ac circuits are given in the National Electric Code should be followed.

Safe PV Systems Applicable Safety systems

a. Over current Protection
b. Grounding
c. Writing Methods
d. Underground
e. Feeders
f. Storage Batteries
g. Interconnected Power Sources
h. Low Voltage Systems

Systems Current and Voltage

When designing a PV system, consider the following:

a. Use open-circuit voltage as the related voltage in any PV source circuit.
b. Voltage should be less than 600 Volts.
c. Conductors and over current devices shall be able to carry at least 125 percent of the short-circuit current of the source circuit.
d. PV source circuit, inverter and battery conductors shall have over current protection.
e. A sign indicating the PV system operating voltage and current, the open –circuit voltage and the short-circuit current shall be placed near the system disconnect point.

Wring and Disconnect Requirements

a. The grounded conductor should to be white.
b. Convention is for the first ungrounded conductor of a PV system to be red and the second ungrounded conductor black (negative in a center tapped PV system)
c. Single-conductor cable is allowed for module connections only. Sunlight resistant cable should be used if the cable is exposed.
d. Modules should be wired so they can be removed without interrupting the grounded conductor of another source circuit.
e. Any wiring in junction boxes should be accessible.
f. Connectors should be polarized and guarded to prevent shock. Means to disconnect and isolate all PV source circuits will be provided. All ungrounded conductors should be able to be disconnected from this inverter.
g. If fuses are used, you must be able to disconnect the power from both ends.
h. Switches should be accessible and clearly labeled.

Grounding

The purpose of grounding and electrical system is to prevent unwanted currents from flowing (especially through people) and possibly causing equipment damage, personal injury or death. Lightning, natural and man-made ground faults and line surges can cause high voltages to exist in an otherwise low-voltage system.

Proper grounding along with over current protection, limits the possible damage that a ground fault can cause. Consider the following and recognize the difference between the equipment grounding conductor and the grounded system conductor:

One conductor of a PV system (>50 volts) must be grounded and the neutral wire of a centre tapped three wire system must also be grounded. If these provisions are met, this is considered sufficient for t eh battery ground (if batteries are included in the system).

- All exposed metal parts shall be grounded (equipment's ground).
- The equipments grounding conductor should be bare wire or green wire.
- The equipments grounding conductor must be large enough to handle the highest current that could flow in the circuit.

Switch Yard and HT Equipment's:

- Switch yard should be well fenced to avoid unauthorized entry/entries
- Only Authorized persons should be allowed to carry out operation & maintenance activity.
- Work to be carry-out only after getting wok permit & MEN AT WORK signboard must be provided.
- No metallic ladder, pipe, pole, rod or any other metallic item should be stored in switch yard.
- Sufficient quantity of fire extinguishers (ready to use) should always be kept in switch Yard/control room.
- All O&M and other persons working in plant premise should be very well trained in fire fighting equipments.
- A Periodical drill for fire fighting & fire alarm system should be organized.

THE PV SYSTEM OUTPUT: If an inverter is used to interconnect the PV system to an utility. It must disconnect automatically if the utility power goes off & if the inverter is operating in a standalone hybrid system it may continue to supply power to the load.

- The output of a single-phase inverter should not be connected to a three –phase service.
- The AC output from a PV system inverter must be grounded in accordance with requirements of AC systems.
- A circuit breaker or fuse/switch mechanism must be included so that the PV system output can be disconnected.
- The interconnection shall be made so that all ground fault interrupters remain active.
- If batteries are used in a system they must be guarded to prevent unauthorized access if the voltage is greater than 50 volts dc. Otherwise the voltage must remain below 50 volts dc.
- Charge controllers must be used with batteries

Testing a PV SYSTEM - safety Hints

Sometimes it is necessary to troubleshoot a PV system that is not working correctly. Safety should be the main concern both in planning before you go to the site & during the actual testing. Some recommendations are given.

Remember Do Not test a PV system alone!

Before testing any PV system: You should become familiar with the electrical configuration.

- How many modules make up a source circuit?
- What are the systems Voltages and Currents?
- How Many circuits are there?
- Do Over current devices exist and where?
- How can the system be disconnected?
- What safety equipment is available?

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Safety measures must be taken at PV system Site:

a) Remove Jewellery
b) Walk around the PV system and record any apparent hazards such as:
c) Take photographs of the system and any hazards if possible.
d) Locate the safety equipment, fire extinguisher, etc., and check their condition.
e) Where is the nearest telephone or means of communications?
f) Check the actual system configuration against the electrical schematics.
g) Locate and inspect all subsystems such as the batteries, inverter, and the load.
h) Determine if, how and where the system is grounded.
i) Check to see if the ac & dc grounds are common.
j) Locate and inspect all disconnect switches.
k) Disconnect the sources circuit s and measure all open circuit voltage to verify the proper operation of the disconnect switch
l) Measure the voltage from each conductor to ground and from line to line.
m) Keep the work area clear of obstacles, particularly the area behind you.
n) Never disconnect a wire before measuring voltages.
o) Keep your hands dry and/or wear gloves.
p) Have your buddy (co-worker) stationed near to disconnect switches.
q) Once a wire is disconnected don't leave the end exposed—tap it or use a wire nut for temporary covering.
r) Reconnect the wires from one source circuit before disconnecting a second source circuit.

Health of worker

If you witness an accident or are the first person to arrive at the scene:

- Survey the scene for potential hazards.
- Try to determine if a shock hazard still exists.
- Is a live conductor still lying on or near the victim's body?
- Is the victim still holding a live conductor?
- Are there other hazards such as fire or spilled caustic material that would put you in jeopardy? You will be safer in assisting a victim if you are with someone else.

✓ Check the victim for breathing and pulse.
✓ Call for help and give victim status.

Non-Electrical Injuries:

These injuries include cuts, sprains, broken bones, exposure, and insect or snake bites. In most cases they are not life threatening, but if care is not given immediately, the victim may go into shock and could die. Respond quickly

- Cuts
- Sprains, Strains, Dislocations, and Fractures
- Exposure-Cold
- Exposure-Heat
- Insect/Snake Bites

Electrical Injuries:

The number one priority in assisting injured people should always be your (the rescuer's) safety. This is especially important in situations involving electrical hazards. Avoid becoming a second victim. Electrical injuries consist mainly of shocks, burns, muscle contractions, and traumatic injuries associated with falls after electric shocks. Electric shock is a general term, indicating any situation where electric current flows through the body. The intensity of a shock can vary from a barely perceptible tingle, to a strong zap, to instant death. A stabling pain or intense tingling and burning is usually associated with electric shock. The points of entry and exit are often badly burned.

Frequently a shock involves involuntary muscle contraction. If the strong muscle of the back and legs contract, this can lead to falls and broken bones. The large muscle of the chest, throat, and diaphragm can contract, and cause respiratory arrest. When electrical current passes through the heart, it can cause spasmodic contraction and relaxation of the ventricles, called ventricular fibrillation. This is one of the major causes of death associated with shocks. Once a person's heart has begun fibrillating, it is difficult to stop. Sometimes another electric shock, administered by paramedic using a defibrillator, can restore the heart to its normal beating cycle.

Fire Hazards:

In case of fire in PV System of both solar form and roof top installation, following action needs to be taken.

- Ensure the power disconnected from inverter and incoming source of power supply.
- It should be ensured while installation that free access is available for fire fighting in case of roof top installation.
- Take care while installing Arrays on flammable surfaces. If possible, non-flammable materials should be used during mounting.
- Location of inverter should be on same floor with resistance lining. Well ventilation and installation of smoke detector preferred.
- To prevent short circuit which is a major cause of fire in any electrical installation, ensures that the module output cables are kept relatively short with protection devices in place.
- Use of DC Ground fault Interrupters is recommended.

As such there are no such hazards in the PV systems. The fire may occur in only case of electrical sparkling and battery explosion. A CO2 type fire extinguisher may be place at appropriate places to protect the PV systems in case of any fires.

Occupational Health and Safety issue related to PV systems:-

The operation of PV systems does not produce any emissions. Although tiny amounts of semiconductor materials (e.g. 5g per m2) are imbedded in the module, toxic compounds cannot cause any adverse health effects unless they enter the human body in harmful doses. The only pathways by which people might be exposed to PV compounds from a finished module are by accidentally ingesting flakes or dust particles, or inhaling dust and fumes. The photovoltaic material layers are stable and solid, and are encapsulated between thick layers of glass or plastic. Unless the module is ground to a fine dust, dust particles cannot be generated. All the photovoltaic materials examined herein have a zero vapor pressure at ambient conditions. Therefore, it is impossible for any vapors or dust to be generated during normal use of PV modules.

The potential exits for exposure to toxic vapors via inhalation if the modules are consumed in residential fire and people breathe the smoke from fire. The potential for significant photovoltaic material emission may exist only in large externally fed industrial fires. In case, the fire itself probably would pose a much greater hazard than any potential emissions of photovoltaic materials.

WARNING!!

ELECTRIC SHOCK!!

IMPROPER OPERATION, MAINTENANCE AND SERVICE OF EQUIPMENT, AND ANCILLARY SUPPORT SYSTEMS CAN CREATE A POTENTIAL HAZARD TO EQUIPMENT, OPERATING PERSONNEL AND BUILDING OCCUPANTS RESULTING IN SERIOUS DAMANGE TO THE EQUIPMENTS AND/OR PROPERTY, PERSONAL INJURY AND/OR DEATH. PHOTOVOLTAIC SYSTEM, COMPONENTS, ANCILLARY DEVICE AND EQUIPMENT MUST BE MAINTAINED AND OPERATED ONLY BY COMPETENT AND QUALIFIED OPERATING AND SERVICE PERSONNEL, WHO ARE FULLY TRAINED, AND THOROUGHLY FAMILIAR, WITH SAME EQUIPMENT, SYSTEM APPLICATION AND ANCILLARY SUPPORT SYSTEMS, AND ACCOMPANYING OPERATION AND MAINTENANCE MANUALS, AND PROCEDURES, PROVIDED WITH EQUIPMENT.

DO NOT ATTEMPT TO RESTART OF EQUIPMENT UNLESS THE FAILURE OR MANUAL RESET, CONDITION THAT OCCURRED IS THOROUGHLY INVESTIGATED, CAUSE OF SAME IDENTIFIES, AND FULLY CORRECTED PRIOR TO RESTART SERVICE OF ANY COMPONENT. THIS IS TO BE DONE ONLY BY THE RESPECTIVE COMPETENT AND QUALIFIED SERVICE PERSONNEL.

DO'S & DON'Ts

Sr. no.	DO'S	DON'Ts
1	Clean the PV modules regularly, by spraying water using a hose and a clean wiper, thereby keeping the PV modules free of dust to achieve good energy generation.	Do not cover or block the PV modules during the sunshine hours, as this minimize or stop the energy generation.
2	Ensure that no shadow falls on the solar module. Shadow will limit the module performance.	Do not keep any object on the solar module nor allow any kind of shadow to fall on module.
3	Use opaque material to cover the PV modules or keep the contacts disconnected/isolated during reinstallation of the system or during the maintenance of the system.	Avoid any direct contact, in the PV module array, Array junction Box or in the DC Input of the Inverter, as there would be high risk of electric shock. The system generates potentially lethal high DC Voltage.
4	Check for ay loose connections in the PV modules, Array junction Box (AJB) and the inverter input every quarterly and ensures that all the connections are intact.	Do not connect any external equipment's in the DC points in the AJB. This will result in damage to the equipment and the PV system with a risk of electric shock.
5	Always keep clean inside the STB, DCDB & ACDB, PCU and HT Panel.	Do not clean inside when system is in running condition. First shut down the whole systems as per the procedure and then clean.
6	Check all the DC and AC cables every quarterly for any external damage or disconnection.	Do not short any of the DC terminals in the PV module, STB and in the Inverter. Any shorting may result in damage to the PV system, other connected component and equipment.

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7	Check and ensure that all the DC isolators / Breakers are in switch ON condition.	Do not attempt to open or repair any of the product/component provided along with the solar PV system.
8	Always keep the Inverter Room well ventilated and ensure that there is good air circulation.	Do not open or touch any of the components inside the Inverter when switched on. This will lead to high risk of electrical shock. Even when the inverter is disconnected, high contact voltages may still be present within
9	System must be connected / Disconnected (switched ON & OFF) as per the sequence described in this Document.	Do not connect /disconnect (switch ON & OFF) the system in wrong sequence. Wrong sequence may damage the system components

Environment health & safety policy

We are fully committed to develop and operate a safe, healthy and clean environment to protect vital human resources, plant, machinery and the environment from the hazards and risk through.

Complying with applicable environmental. Occupational health & safety legislation and requirement of all interested parties. Continually improving the process, work practices for prevention of ill health and injury, resources conservation and risk minimization through objectives driven targets. Ensuring safe work practices towards achieving "Zero Accident". Continual improvement in all areas of working with special emphasis through. Resource optimization through improvement in material efficiency.

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Standards for Installation, Commissioning and servicing

Follow prior to commencement of installation of Photovoltaic system ensure that Person(s) involved in Installation, Commissioning and servicing of PV System(s):

- Should be qualified with basic knowledge on the product and, is trained for such installations.
- Should be familiar with the Health, Safety and Environmental standards of PV Systems.
- Should be familiar with Cautions, Precautions and Informative symbols applicable in PV Systems.
- Should have the knowledge on the usage of tools and the precautions during Installations.

SPECIFIC HEALTH & SAFTEY INSTRUCTIONS

Generally, Photovoltaic Systems / products consist of following major building blocks.

A. Solar module
B. Control electronics
C. Earthing Lightning
D. Structural Assembly

SOLAR MODULES

The Solar Modules generate DC electricity whenever sunlight shines on the solar cells. Solar modules should be mounted firmly on to the structure. Potentially lethal voltages can be developed from arrays. Therefore the Modules should be shaded from sun by opaque sheeting, before any electrical connections are made to the modules.

CONTROL ELECTRONICS

- Use only insulated tools and meters during installation and periodic maintenance. Otherwise, it may cause an electric shock.
- Do not interfere with any electronic components while it is in working condition. It may contain dangerous voltages.
- Ensure electronic equipment is properly earthed (as applicable).
- Follow the connection and disconnection sequence as recommended.

EARTHING & LIGHTNING

- Use the lightning protection components as recommended and install at appropriate places.
- Earthing the solar PV system is important for both safety and protection against lightning.
- Earthing all the equipment. Ensures that the system voltage cannot drift away from ground potential and thus reduces the risk of electric shocks. Adequate earthing also provides a path for fault currents induced by lightning.

- To make the solar power system as safe and secure, all exposed metal (e.g. solar array structure, charge Controller / panel enclosure, metal cable conduits etc.) should be earthed.

STRUCTURAL ASSEMBLY

- Use safety equipment like safety Helmet, Gloves, Belt etc.
- Care must be taken in lifting structural members and while working at above the ground levels.

Refer relevant drawings for structures and foundation details. Follow the installation sequence. As we are aware that Photovoltaic System is lack of moving parts & very simple connection, for that this system requires low maintenance & high safety while operational phase. However it is necessary to ensure continued access to sunlight, by cleaning the Panels at adequate interval (depending upon site location). The Electrical connections should be checked at regular interval to eliminate various problem e.g. corrosion, loose connections.

Most of operational problem occurs as a result of poor maintenance of BOS components (including loads) or allowing the array to become damaged. This later problem indicates a lack of understanding of operation personnel and are not well trained & educated about the system.

As per the site conditions this Module Mounting Structure is designed to withstand the wind speed of 175 km/hr. corrosion is one of the key issues for steel structures to have a long life. To prevent corrosion, the structures are galvanized.

SAFETY:

It is recommended that installation, operation, Maintenance schedules should be compliance with local standards.

Erection & maintenance of structure should not be attempted in high wind speed.

SECTION – 6.2

SOLAR PV POWER PLANT

OPERATIONS AND MAINTENANCE

– MAINTENANCE

6.2. Maintenance

P.V.MODULE MAINTENANCE

Maintenance Schedule	Activities	Precautions
Daily	Cleaning of modules using soft service water. Process: Spray water on the PV modules using hose pipe and remove all the dust particles. Use smooth wiper to remove any permanently settled particle. Timings : Cleaning of modules in evening 7 pm to 10 pm (Continue the process after every 3 days)	➢ Do not use hard water to clean the modules. ➢ Do not spray water inside any of the terminals or Array junction boxes. ➢ Do not use dry clothes to clean the modules.
Weekly	Checking the module for any cracks or Damages & replacements of the same	➢ Take special care in removal of Modules
Fort Nightly	String current monitoring	
Monthly	Check for any disconnection of male & female couplers in the PV modules arrays	➢ Use the recommended tools for coupling & decoupling of male or female cable couplers. ➢ Ensure that the cable counters are locked fully. ➢ Do not apply force on the terminal junction box during coupling or decoupling of connectors. ➢ Do not connect or disconnect the cable couplers under load condition.
Quarterly	Check for any detachment of module terminal junction box & replace with new module.	➢ Disconnect the modules & the string from the circuit to avoid any power loss or short circuit.
Yearly	Randomly check & test the Open Circuit Voltage & Short circuit current of modules for degradation.	➢ Isolate & Disconnect the module array string from the AJB before testing.

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INVERTER MAINTENANCE:

Maintenance Schedule	Activities	Precautions
Daily	No Maintenance required	
Weekly	Cleaning of panel filters	➢ Open the panel in OFF condition for cleaning
Fort Nightly	No Maintenance required	…
Monthly	Test the Voltage & Current in every individual input coming from the SMJB	➢ Use the proper meters for measurement of DC Voltage & Current ➢ Check & select the proper range & units of measurement in the meter before testing ➢ Do not short the polarities in any circumstances
	Check all the cable terminations	➢ Use Insulated tools & tackles for all the cable terminations
Quarterly	Check all the cable glands are properly tightened & sealed	➢ Use the proper tool and keys for Tightening the glands ➢ Do not over tight the glands
	Clean the outer surface of the DCDB using a Dry cloth	➢ Do not touch any of the terminals during the cleaning process
Half Yearly	No Maintenance required	…
Yearly	Cooing fan functionality test. Visually check all fuses and disconnectors. Emergency shut off functionality test	…
Tools Required : Soft cloth, Digital Multimeter DC 1000V, Digital Clamp meter DC 1000A & Spanner set		

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SECTION – 6.3

SOLAR PV POWER PLANT

OPERATIONS AND MAINTENANCE

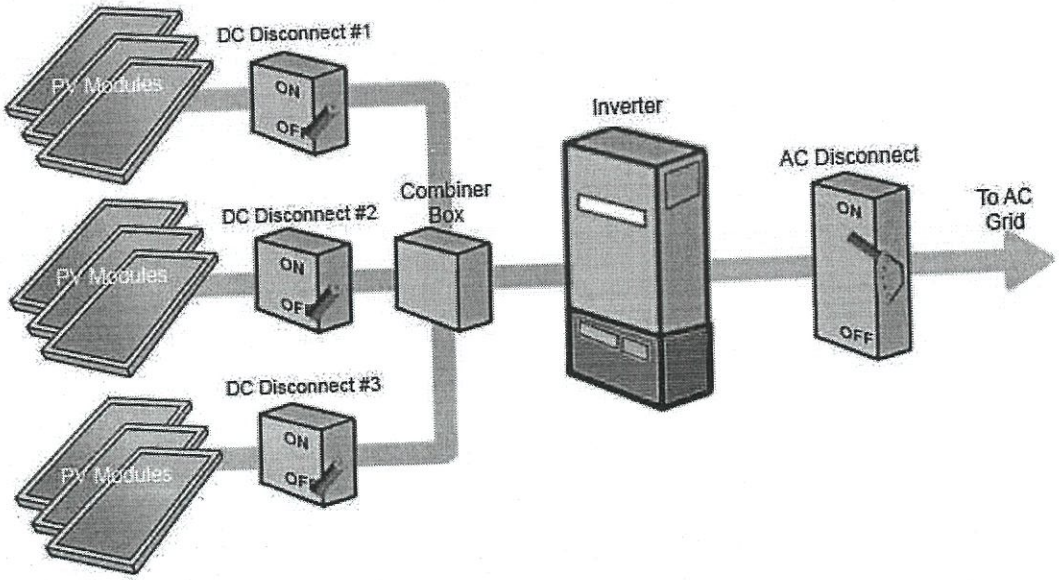
– SHUTDOWN PROCEDURE

Open the AC Disconnect switch first. This is critical. The inverter is designed to immediately stop drawing power when there is no AC signal from the grid. Once the AC disconnect switch is opened, open the DC disconnect as well. At this point, the inverter should only be lasting a few moments on its capacitor bank. Give it thirty seconds before beginning maintenance under normal conditions.

This method of powering down the array is effective if the inverter is on fire or malfunctioning because it isolates the inverter from the rest of the system, preventing any possible damage from spreading to other equipment. It also isolates the output from the

PV-array from the rest of the facility's electrical system. However, this method still does not deactivate the DC distribution system, which means that if there are other inverters in this array, they would still be receiving DC power. In order to completely de-energize all of the inverters and equipment in the PV array, you have to shut off all of the DC disconnects.

Full systemic shutdown at all DC disconnects



This method is functionally similar to the inverter isolation method, with the exception of turning off the AC disconnect, and the key difference that ALL DC disconnects must be deactivated, not just the ones connected to the inverter in question. Inverters are designed to shut down in the event that their DC source is removed, so once the DC disconnects have all been switched to the "OFF" position, there is no output on the AC side. It is important to remember that even though the inverters are off, all of the AC lines are still energized from the grid.

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The DC disconnect switches will look very similar to the AC disconnect switch, except for the fact that the DC switches will be noticeably smaller than their AC counterpart. This is also related to the many DC disconnects because of the fact that the DC disconnects are distributed throughout the array, so that each switch controls its own small branch of DC, while the AC disconnect switch typically controls the entire array at a single location. In either case, look for a box with a red lever attached to one side labeled "DC DISCONNECT" and switch it into the "OFF" position. Repeat this process for all switches and be sure to measure the voltage at all inverter DC inputs as safe before beginning any maintenance.

With any luck, you'll never be a witness to an electrical malfunction of any kind, however in the event of an emergency, with no qualified personnel available; you now know how to shut down a PV-array safely and effectively.

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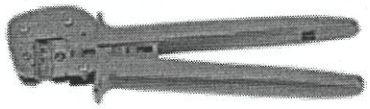
6.4. Tools & Equipment:

Safety Equipment's required in Site:

1. Hand Gloves
2. Helmet
3. Ear Protection
4. Aprons
5. Respirator
6. Eye Protection (Goggles & Shields
7. Footwear

Tools List:

1. Digital Multimeter
2. Screw Driver set
3. MC4 Crimping tool set



4. Piler
5. Nose Piler
6. Combination Piler
7. Standard Tool Box

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APEPDCL

Eastern Power
Distribution Company of A.P. Ltd

O/o Superintending Engineer,
Operation Circle :: Eluru

Memo.No.SE/O/ELR/DE.T/ADE.C/AAE.T1/F. /D.No. 61 /18, Dt: 02-02-2018

Sub:- APEPDCL - Operation Circle, Eluru - Erection of 300 KWp Solar Roof top SPV Generator at M/s Sri Vishnu Educational Society, bearing HT SC.No. ELR 431, 1200 KVA CMD at 11 KV Potential - Approval Accorded for Synchronization - Regarding.

Ref:- 1. Application No. 21710117480240, dt.11.10.17
2. Lr. No. DEE/O/BVRM/AE.Tech. /F.Doc /D.No. I/143534/18, Dt. 12-01-2018
3. Lr. No. DE/M&P/ELR/AE.T/F.No. /D.No. 29/18, Dt.02-02-18

>>>> <<<<

With reference to the 1st cited above, the consumer of HT SC. No. ELR431, M/s Sri Vishnu Educational Society having CMD 1200 KVA at 11 KV Potential of Bhimavaram D3 Section of Bhimavaram Sub Division has been applied for installation of 300 KWp solar roof top SPV Generator at their premises.

The consumer of HT SC. No. ELR431, M/s Sri Vishnu Educational Society have been installed Solar Rooftop Project (SRP). The Divisional Engineer/ Operation/ Bhimavaram and DE/M&P/Eluru have inspected the premises and certified that the consumer has installed the SPV module having Grid Tie Inverter with sufficient protective devices vide reference 2nd & 3rd cited above respectively. It is also reported that the existing two meters (Main & Check meter which were installed long back for open access) are ABT meters of 0.2S class accuracy, bi-directional, existing CTPT capacity of 75/5A, 0.2S class accuracy and the metering arrangement is compatible for solar net metering for release of 300KWp.

Hence, the Divisional Engineer/ Operation/Bhimavaram is instructed to synchronize the SRP within seven (7) working days of inspection approval / payment of meter and also instructed to issue Commissioning Certificate which should conform to the Regulatory requirements / Standards.

The test report shall be submitted by the concerned ADE through DE to SAO/Circle Office/Eluru and billing process shall start within one month / next billing cycle of Synchronizing the SRP.

Further, the Divisional Engineer/ Operation/ Bhimavaram should ensure submission of necessary CEIG approval by the consumer and see that the consumer to follow all the statutory inspections before commissioning of Solar Plant.

SUPERINTENDING ENGINEER
OPERATION CIRCLE :: ELURU

To
The Divisional Engineer/ Operation/Bhimavaram.
Copy to the M/s Sri Vishnu Educational Society, Bhimavaram for safe-Keeping during the interim period until grid Synchronization.
Copy transmitted to the General Manager/Solar/Corporate Office/ Visakhapatnam.

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ANNEXURE-V(a)

HT NET METER Solar Roof top PV system Synchronization Report/Test Report

A	Applicant Details	
1	Net Meter Registration Number	1710117480026
2	Registration Date	11.10.2017
3	Name of the applicant	Sri Vishnu Educational Society
4	Service Number	ELR-431
5	Category	HT -II
6	Load	1200 KVA
7	Distribution/Section	11KV / D-3 Section
8	Address	Sri Vishnu Educational society
9	MobileNo	

CEIG Approval Ref No: _____

Solar Roof top PV system Connection details:

Sl No.	Date	InterConnection Point (LTBus/HTBus)	Existing Solar Capacityifany	Now Commissioned Capacity	Total Capacity
1.	05.02.2018	HT Bus	-	300 Kw	300

PV Modules Details:

SlNo.	Make	Serial Number	Typeof Module	No.of modules	Capacityofeach Module	Total capacity
1.	Renewsys	Attached	Multi	960	315 Wp	302.4 Kwp
2.						

Details of protective system available: (Commissioning shall be done only on availability of the protective equipment)	

Main Meter details:

Meter Make	Serial No.	Class	Capacity	MF	Final Readings on 17.8.21.29	
					Import	Export
Secure	AP913335	0.2S	75/5 A	1000	MWH : ~~17878.96~~	2.97
					MVAH: 18019.34	3.17

Check Meter details:

MeterMake	SerialNo.	Class	Capacity	MF	Initial Readings on Dt: 05.02.2018	
					Import	Export
Secure	AP 13380	0.2S	75/5 A	1000	MWH: 17878.96 MVAH: 18016.93	MWH: 2.97 MVAH: 3.17

CERTIFICATE

It is certified that there is no return voltage from the inverter to the meter when incoming grid supply is switched off. It is further certified that the protective equipment is installed and functioning as prescribed. The above Solar Rooftop PV system was synchronized as per DISCOM guidelines and the Performance of the above plant is satisfactory. The date of synchronization of the plant is 5.2.2018

Vendor Signature (with stamp)

Eligible Consumer

DE/MRPDE/Op

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ANNEXURE-V(b)

HT NET METER Solar Roof top PV system Synchronization Report/Test Report

A	**Applicant Details**	
1	Net Meter Registration Number	17101174800026
2	Registration Date	11.10.2017
3	Name of the applicant	Sri Vishnu Educational society
4	ServiceNumber	ELR-431
5	Category	HT Category – II
6	Load	CMD- 1200 KVA
7	Distribution/Section	11KV / D-3 Section
8	Pole number	-
9	Address	Sri Vishnu Educational society
10	MobileNo	
B	**Main Meter Details**	
1	Meter make	Secure
2	Serial number	AP13335
3	Capacity	75/5 A
4	MF	1000
5	Finalreading	Import Export
	i)kWh	~~[illegible]~~ 17981.28 2.97
	ii)kVAh	18019.34 3.17
6	Date of replacement	-
C	**CheckMeterDetails**	Secure
1	Meter make	AP913380
2	Serial number	75/5 A
3	Capacity	1000
4	Meter M.F	
5	Initial reading (Tri vector parameters)	Import Export
	i)KWH	17878.96 2.97
	ii)KVAH	18016.93 3.17
D	**Detailsofprotectivesystemavailable(** Commissioningshallbedoneonlyon availabilityoftheprotectiveequipment)	Earthing

CERTIFICATE

Itiscertifiedthatthereisnoreturnvoltagefromtheinvertertothemeterwhenincoming gridsupplyisswitchedoff.

Itisfurthercertifiedthattheprotectiveequipmentisinstalledandfunctioningasprescribed. Theabove SolarRooftopPV system wassynchronized asperDISCOMguidelinesand theperformanceoftheaboveplantissatisfactory. Thedateof synchronizationof theplantis 5-2-201[illegible]

Vendor/Agency (with stamp) EE/DE/Consumer ADE/MRT&P&DE/Op

SURE ENERGY SYSTEMS TIRUPATHI

SRI VISHNU EDUCATIONAL SOCIETY BHIMAVARAM VISHNUPUR

S R Krishnam

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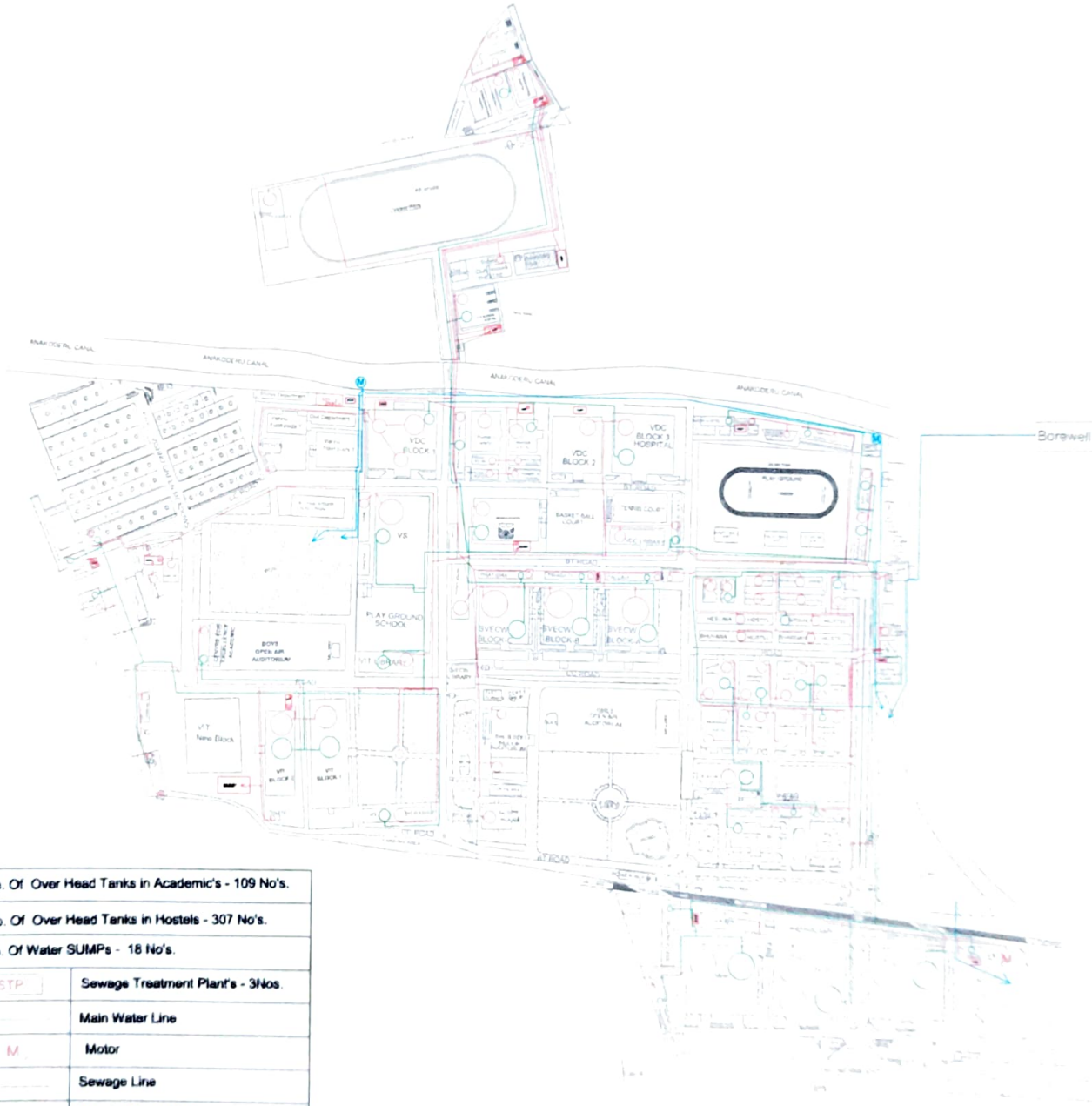
WATER DISTRIBUTION ROUTE MAP



No. Of Over Head Tanks in Academic's - 109 No's.	
No. Of Over Head Tanks in Hostels - 307 No's.	
No. Of Water SUMPs - 18 No's.	
STP	Sewage Treatment Plant's - 3Nos.
	Main Water Line
M	Motor
	Sewage Line
	Drinking Water Line
	RAW Water Line
	RAW Water Sump
	Drinking Water Tank
	RAW Water Tank

SRI VISHNU EDUCATIONAL SOCIETY

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1. Sump water tanks in campus(Below Ground Level)

Sump tank Details		
Sl.No	Name of Location	Qty
1	1st phase water plant	1
2	Polytechnic College Back side	1
3	1st phase water plant	1
4	Ganga Hostel	1
5	VDC Block -2	1
6	Pragna Hostel	1
7	VDC Block -1	1
8	STP - 3	1
9	Pragathi Hostel	1
10	VIT Block 2	1
11	VIT New block	1
12	3rd Phase water plant	1
13	Sahiti Hostel	1
14	CV Raman Hostel	1
15	Swimming Pool	1
16	Dhanavanthri Hostel	1
17	Medha Hostel	1
18	Alluri Sita Rama Raju Hostel	1
	Total No. Of SUMP tanks	18

Water Storage tanks in Campus			
Sl.No	Name of Location	RAW Water tanks	Drinking Water tanks
1	In Hostel Block's	269	38
2	In Academic Block's	91	18
Total water tanks in No's		360	56
		416	

Total Water Storage in Campus			
Sl.No	Name of Loacation	RAW Water Capacity in Ltr	Drinking Water Capacity in Ltr.
1	In Hostel Block's	772000	51500
2	In Academic Block's	312000	25000
Total storage in Ltr.		1084000	0
		1084000	

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B.V.RAJU COLLEGE
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WATER STORAGE TANK DETAILS IN Academic Block's

SL No	Name of College		RAW Water in (ltr)					Drinking Water in (ltr)	
			Sintex Tank in Ltr.			RCC Tanks in Ltr		Sintex Tank in Ltr.	
			3000	2000	1000	Over Head Tank (1,00,000)	Cement (40,000)	2000	1000
1	Frount Campus	MCA							
2		Degree College							
3		BVRC (Old)	2	12				1	
4		SVCP	4						1
5		SBPc		10				1	
6	VIT College	VIT 1		7					1
7		VIT 2	4						1
8		VIT workshop			3				1
9		VIT Public Toilet			1				
10		VIT Drawing Hall		2					
11		VIT Centre of Excellence		4					1
12		VIT Library			2				1
13	SVECW Colege	SVECW A	2						1
14		SVECW B	0	4					1
15		SVECW C	3					1	
16		SVECW D							
17		SVECW Liabrary							
18	Vishnu School	VS			3				1
19		Vishnu school Toilets	2	1					
20	Dental College	VDC Block 1	8	12				3	
21		VDC Block 2					2		
22		VDC Hospital Block					1	1	1
23		VDC CSSD		1					1
24		VDC Libraray Block	0	1					
25	Total No. Of Tanks (109No's)		25	54	9	0	3	7	11
			91					18	
26	Total water capacity in Ltr.		312000					25000	

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WATER STORAGE TANK DETAILS IN HOSTEL BLOCK's

Sl.No	Name of Hostel		RAW Water in (Ltr)					Drinking Water in (Ltr)		
			Sintex Tank in Ltr.			RCC Tanks in Ltr		Sintex Tank in Ltr.		
			3000	2000	1000	Over Head Tank (1,00,000)	Cement (40,000)	2000	1000	500
1	Boy's Hostel's	Dhanawantri Hostel		13	1					
2		Vivekananda Hostel		13				5		
3		Visweswaraiah Hostel		13						
4		Alluri Sita Rama Raju Hostel		14						
5		Sir Aurther Cotton Hostel		6	1					
6		C.V. Raman Hostel					1	2		
7		Boys GYM		2						
8		Swining Pool		3	1					
9	Seeta Canteen Side	Narmada Hostel		4						
10		Seet Mess		6	1			2		
11		Ganga Hostel							1	
12		Yamuna Hostel			8				1	
13		Girls GYM		1						
14		Ganaga Hostel Toilets	3							
15		Lundry		1						
16		Driver Colony		1					1	
17	Annapurna Canteen	Annapurna Kitchen				1				
18		Annapurna Canteen						1		
19		Annapurna Kitchen						1		
20		Poojari Quartors		1					1	
21		2nd Gate Juse point			1				1	
22		Temple Square			2					

G R Khramm Raj

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Vishnupur, BHIMAVARAM-534 202

Sl.No	Name of Hostel		RAW Water in (Ltr)					Drinking Water in (Ltr)		
			Sintex Tank in Ltr.			RCC Tanks in Ltr		Sintex Tank in Ltr.		
			3000	2000	1000	Over Head Tank (1,00,000)	Cement (40,000)	2000	1000	500
23	"53" Room's	Bhuvana Hostel			8					
24		Bhargavi Hostel			8					
25		Neelima Hostel			8					
26		Nirmala Hostel		1	8				1	
27		Manasa Hostel			3					
28		Mrudhula Hostel			5					
29		Revathi Hostel			3					
30		Rohini Hostel			5					
31		Spoorthy Hostel		4					2	
32		Srujana Hostel		4						
33		Sadhana Hostel		3					1	
34	"8" Hostel's	Gayatri Hostel	5						1	
35		Videhi Hostel	5						1	
36		Vishnavi Hostel	5						1	
37		Sarada Hostel	4						1	0
38		Padmavathi Hostel					2		1	
39		Saraswathi Hostel	5							
40		Rajyalakshimi Hostel	5					1		
41		Rajeswari Hostel	5							
42	VIT college Area	3rd Gate			1				1	
43		3rd Gate Public toilet			1					
44	Frount campus	Seeta Hostel							1	
45		Kaveri Hostel			6					
46	Guest House Area	Guest House		2						
47		FM		1						
48		Seeta Indoor Auditorium		2						
49	Store side	Vishnu Food Plaza Toilets		1						
50		Medha Hostel					1	2		

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Sl.No	Name of Hostel		RAW Water in (Ltr)					Drinking Water in (Ltr)		
			Sintex Tank in Ltr.			RCC Tanks in Ltr		Sintex Tank in Ltr.		
			3000	2000	1000	Over Head Tank (1,00,000)	Cement (40,000)	2000	1000	500
51	Dental Hostels	Prathima Hostel			3					
52		Parmitha Hostel			4					
53		Pranavi Hostel			3					
54		Praveena Hostel			4					
55		Prasanthi Hostel		10					1	
56		Pragna Hostel		9						
57		Poojitha Hostel			8				1	
58	SVECW side	Pratibha Hostel		3						1
59		Pragati Hostel		3						1
60		Pallavi Hostel	2							1
61	3rd Phase water Plant side	Idea Lab		2						
62		WTP		2						
63		Community Hall		1					1	
64		Sahiti					1		1	
65		Iconic		3				1		
66		Power House 2		1						
67		Beauty Parlour		1						
Total No. Of Tanks (307 No's)			39	131	93	1	5	15	20	3
			269					38		
Total water capacity in Ltr.			772000					51500		

PRINCIPAL
R.V. RAJU COLLEGE
BHIMAVARAM-534 202

CREATIVE CENTRAL

TAX-INVOICE

Date: **2022-10-17**
Invoice No: **CC222300010**

From

CREATIVE CENTRAL

Address: DOOR NO 5-89, MAIN ROAD, DODDANAPUDI, West Godavari, Andhra Pradesh, 534237

GSTIN: 37AARFC0580E1ZF

To

B V R COLLEGE DEGREE

Address: Tadepalli Gudem Rd, Vishnupur, Bhimavaram, Andhra Pradesh, 534202

#	Description	Unit Price	Price
1	Blue Wingler (Smart Water System For 11 Units)	11x₹ 21,650.00	₹ 2,38,150.00
		Sub Total:	₹ 2,38,150.00
		CGST(9%) :	₹ 21,433.50
		SGST(9%) :	₹ 21,433.50
		Total:	₹ 2,81,017.00

Amount in Words: Two Lakh Eighty One Thousands Seventeen Rupees Only

Note:

1. Cheques to be favour of "**CREATIVE CENTRAL**"
2. **Account Name:** CREATIVE CENTRAL
   A/C Number: 070405003365
   IFSC CODE: ICIC0000704
3. Get In touch: +91 8989040449, www.creativecentral.in

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

For CREATIVE CENTRAL
Areti Sai Padmarao

Tax Invoice

(TRIPLICATE FOR SUPPLIER)

National Scientific Products
28-17-7, Ramamandiram Street
Eluru Road, Arundel Pet
VIJAYAWADA - 520002
PH: (0866)2435945, Cell: 9949515872
ARN No.AD3703210079 97X
GSTIN/UIN: 37AGRPJ3860E1Z6
State Name : Andhra Pradesh, Code : 37
E-Mail : nspvja@gmail.com

Buyer (Bill to)

The Principal
Dr.B.V.Raju Institute of Computer Education,
Vishunupur,Durgapuram,
Bhimavaram-534202,
W.G.Dist.
Ph No.08816-251333
State Name : Andhra Pradesh, Code : 37

Invoice No.	Dated
NV/642/22-23	**28-Oct-22**
Delivery Note	Mode/Terms of Payment
DC-9/88	
Reference No. & Date.	Other References
Buyer's Order No.	Dated
PO.NO:POD-SVESB/22/10/L/15	**6-Oct-22**
Dispatch Doc No.	Delivery Note Date
	28-Oct-22
Dispatched through	Destination
Terms of Delivery	

Sl No	Description of Goods	HSN/SAC	GST Rate	Quantity	Rate	per	Disc. %	Amount
1	EDTA Disodium Salt ER 500G Thermofisher (Q12635-500GM)	29224990	18 %	**2 Nos**	665.00	Nos		**1,330.00**
2	Ammonium Chloride SQ 500G Qualigens (Q21405-500GM)	2827	18 %	**2 Nos**	190.00	Nos		**380.00**
3	Sodium Hydroxide Pellets SQ 500gm Thermofisher (Q27815)	28151200	18 %	**2 Nos**	255.00	Nos		**510.00**
4	Ammonium Purpurate (Murexide) SQ 5g Qualigens (Q37551)	29335400	18 %	**5 Nos**	323.00	Nos		**1,615.00**
5	Ethylene Glycol - 500ml - Merck (82232905001730-500ml)	2905	18 %	**1 Nos**	355.00	Nos		**355.00**
6	Sulphuric Acid SQ 2.5L Qualigens (Q29307-2.5LTR)	2807	18 %	**1 Nos**	755.00	Nos		**755.00**
7	Methyl Orange Indicator Solution 125ML Qualigens (Q37833-125ML)	29270090	18 %	**1 Nos**	111.25	Nos		**111.25**
8	Phenolphathalin Indicator Solution 125ml Thermofish (Q37923)	3822	18 %	**1 Nos**	97.50	Nos		**97.50**
9	Water Testing Kit 3x200 Test Pack Nice (W25560 Nitrate,Nitrite and Ammonium)	3822	12 %	**1 kit**	908.00	kit		**908.00**
10	Ammonia Solution About 25% ER 2.5L Qualigens (Q11237)	28142000	18 %	**1 Nos**	564.00	Nos		**564.00**
11	Triethanolamine SQ 500ML - THERMOFISHER (Q28565)	2922	18 %	**1 Nos**	440.00	Nos		**440.00**
12	Erichrome Black T 25G Qualigens (Q39952-25Gm)	32041299	18 %	**1 Nos**	262.00	Nos		**262.00**
								7,327.75
	CGST @ 6%					6 %		**54.48**
	SGST @ 6%					6 %		**54.48**
	CGST @ 9%					9 %		**577.78**
	SGST @ 9%					9 %		577.78
Less	*Round Off*							**(-)0.27**
	Total							**₹ 8,592.00**

E. & O.E

Amount Chargeable (in words)
INR Eight Thousand Five Hundred Ninety Two Only

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Company's Bank Details
A/c Holder's Name : **National Scientific Products**
Bank Name : **Karnataka Bank GNT**
A/c No. : **2557000100226901**
Branch & IFS Code : **Guntur & KARB0000255**
SWIFT Code

Declaration
We declare that this invoice shows the actual price of the goods described and that all particulars are true and correct.

for National Scientific Products

Authorised Signatory

This is a Computer Generated Invoice

B.V.RAJU COLLEGE

(Dr. B.V. Raju Foundation & Sri Vishnu Educational Society)

Vishnupur, Bhimavaram

Water Analysis

week	Sample Collecting Locations						
	Colleges	Girls Hostel	Boys Hostels	Canteens	Kitchens	Dining Halls/ Food Courts	Water bodies
Week 1	Smt.B. Seetha Polytechnic Sri Vishnu College of Pharmacy Dr. B.V. Raju College	Rajeswari hostel	Visweswaraiah hostel	Girls Canteen	Annapurna kitchen	Dining Hall back side SBSP college	Canal & Treated water
Week 2	Vishnu Dental College block 1 SVECW Block -A Vishnu School	Rajya Lakshmi hostel	Vivekananada hostel	Canteen open shed	Kitchen and stores for Sita Mess	sita mess	Canal & Treated water
Week 3	SVECW Extention of block A SVECW Block -B SVECW Extention of block B	Saraswathi hostel	Dhanvantari hostel	Canteen open shed	Girls fast food kitchen	Food Court 2nd phase	Canal & Treated water
Week 4	SVECW block C SVECW Extention of block C SVECW Block -D Class room	Padmavathi hostel	Alluri Sita Rama Raju hostel	Canteen open shed	Kitchen for visnu canteen	Food Court 3rd phase	Canal & Treated water
Week 5	SVECW Block -D Computer labs SVECW Library Block Music Class room in pond	Gayathri hostel	Sir Aurther Cotton boys hostel	Vishnu canteen	Fresh choice bakery unit	Tasty corner	Canal & Treated water
Note: 10 sample will be collected from different locations & will be tested weekly once.							

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week	Sample collecting Locations						
	Colleges	Girls Hostel	Boys Hostels	Canteens	Kitchens	Dining Halls/ Food Courts	Water bodies
Week 6	Vishnu Dental College block 2 (college)	Vaidehi hostel	C.V. Raman hostel		Fast food centre near BSNL office	Coffe Shop	Canal & Treated water
	Vishnu Dental block 3 (hospital)	Vaishnavai hostel					
	Vishnu Dental block 4						
Week 7	VDC library block	Sarada hostel	Boys dining Hall at VIT Hostel			Temple Sqare	Canal & Treated water
	VIT block 1	Bhuvana hostel					
	VIT block 2	Bhargavi hostel					
Week 8	VIT Library	Nirmala hostel	Kaveri boys hostel			Lake View Court	Canal & Treated water
	VIT Work shop 1	Neelima hostel					
	VIT Work shop 2	Manasa hostel					
		Mrudula hostel					
Week 9	VIT New block (centre for Aceademic Excellence)	Roshini hostel	Tungabhadra boys hostel			VDC patients dining hall	Canal & Treated water
	VIT New block	Revathi hostel					
	MCA block	Srujana hostel					
		Spoorthi hostel					

week	Sample Collecting Locations						
	Colleges	Girls Hostel	Boys Hostels	Canteens	Kitchens	Dining Halls/ Food Courts	Water bodies
Week 10		Sadana quarters Pallavi hostels Pragathi hostel prathibha hostel Prashanthi hostel Pragnya hostel	Godavari Hostel			New dining Hall for seeta canteen	Canal & Treated water
Week 11		Pratima hostel Pranavi hostel Praveena hostel Parmitha hostel Poojitha hostel Yamuna hostel	Iconic hostel			New dining hall at Vishnu food plaza	Canal & Treated water
Week 12		Ganga hostel Narnada hostel Medha hostel HCL Girl hostel HCL Girl hostel Sumedha girls hostel Sahithi hostel (outside)				Vishnu food plaza	Canal & Treated water

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B.V.RAJU COLLEGE
(Dr. B.V.RAJU FOUNDATION & SRI VISHNU EDUCATIONAL SOCIETY)
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 28-10-2022

Date of Analysis: 29-10-2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY
					PHENOLPHTHALEIN	METHYL ORANGE	
1	CANAL WATER	168	88	80	0 PPM	122	0 PPM
2	RO WATER	20	12	8	0 PPM	27	0 PPM
3	VISHNU PUBLIC SCHOOL	20	12	8	0 PPM	27	0 PPM
4	SVECW BLOCK1	28	12	16	0 PPM	32	0 PPM
5	DENTAL BLOCK1	24	12	12	0 PPM	27	0 PPM
6	RAJYA LAKSHMI HOSTEL	24	12	12	0 PPM	32	0 PPM
7	VIVEKANANDA HOSTEL	20	12	8	0 PPM	32	0 PPM
8	SITA MESS	28	12	16	0 PPM	32	0 PPM
9	KITCHEN SITA MESS	24	16	8	0 PPM	32	0 PPM

Signature of Principal

PRINCIPAL
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Vishnupur, BHIMAVARAM-534 202

Sri vishnu Educational Society & B.V Raju Foundation

Smart Water Grid Project

Chemical Analyis of Water samples in Green Meadows Campus

Date of Sample Collection: 02/12/2022

Date Of Analysis: 03/12/2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM <30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE <40 PPM	NITRITE 0PPM	AMMONIUM 0PPM
					PHENOLPHTHALEIN	METHYL ORANGE				
1	CANAL WATER	100	75	25	5	145	0	5	0	0
2	R.O WATER	30	15	15	0	50	0	0	0	0
3	VISHNU DENTAL BLOCK-2	25	15	10	0	50	0	0	0	0
4	VISHNU DENTAL BLOCK-3HOSPITAL	30	15	15	0	50	0	0	0	0
5	COFF SHOP	30	15	15	0	50	0	0	0	0
6	CANTEEN KITCHEN	25	20	5	0	45	0	0	0	0
7	C.V.RAMAN HOSTEL	35	20	15	0	50	0	0	0	0
8	VAISHNAVI HOSTEL	30	15	15	0	45	0	0	0	0
9	VAIDEHI HOSTEL	30	15	15	0	50	0	0	0	0

SIGNATURE OF PRINCIPAL

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Sri vishnu Educational Society & B.V Raju Foundation
Smart Water Grid Project
Chemical Analyis of Water samples in Green Meadows Campus

Date of Sample Collection: 7/12/2022
Date Of Analysis: 7/12/2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM <30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE <40 PPM	NITRITE 0PPM	AMMONIUM 0PPM
					PHENOLPHTHALEIN	METHYL ORANGE				
1	Canal water	165	50	115	5	160	0	5	0	0
2	Treated water	30	10	20	0	50	0	0	0	0
3	VIT block 2	20	15	5	0	45	0	0	0	0
4	VDC library block	30	10	20	0	50	0	0	0	0
5	VIT block 1	35	15	20	0	50	0	0	0	0
6	Boys dining Hall at VIT Hostel	25	10	15	0	45	0	0	0	0
7	Temple Sqare	15	10	5	0	50	0	0	0	0
8	Bharathi hostel	35	15	20	0	50	0	0	0	0
9	Bhargavi hostel	30	15	15	0	50	0	0	0	0
10	Sarada hostel	30	15	15	0	50	0	0	0	0

Dr R Krishnam Raju
PRINCIPAL
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Vishnupur, BHIMAVARAM-534 202

Sri vishnu Educational Society & B.V Raju Foundation
Smart Water Grid Project
Chemical Analyis of Water samples in Green Meadows Campus

Date of Sample Collection: 14/12/2022
Date Of Analysis: 14/12/2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM <30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE <40 PPM	NITRITE 0PPM	AMMONIUM 0PPM
					PHENOLPHTHALEIN	METHYL ORANGE				
1	Canal water	168	50	118	5	160	0	5	0	0
2	Treated water	30	20	10	0	32	0	0	0	0
3	VIT Library	20	15	5	0	36	0	0	0	0
4	VIT Work shop 1	30	10	20	0	32	0	0	0	0
5	VIT Work shop 2	35	15	20	0	32	0	0	0	0
6	Nirmala hostel	25	10	15	0	34	0	0	0	0
7	Neelima hostel	25	20	5	0	32	0	0	0	0
8	Manasa hostel	35	15	20	0	32	0	0	0	0
9	Mrudula hostel	30	20	10	0	34	0	0	0	0
10	Kaveri boys hostel	28	15	13	0	32	0	0	0	0
11	Lake view court	35	15	20	0	32	0	0	0	0

Dr R Krishnam Raju
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Vishnupur, BHIMAVARAM-534 202

B.V.RAJU COLLEGE
(Dr. B.V.RAJU FOUNDATION & SRI VISHNU EDUCATIONAL SOCIETY)
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 04-01-2023

Date of Analysis: 04-01-2023

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY
					PHENOLPHTHALEIN	METHYL ORANGE	
1	CANAL WATER	168	88	80	0 PPM	122	0 PPM
2	RO WATER	20	12	8	0 PPM	27	0 PPM
3	M.C.A NEW BLOCK	20	12	8	0 PPM	27	0 PPM
4	VIT NEW BLOCK	28	12	16	0 PPM	32	0 PPM
5	CENTER OF ACADAMIC EXCELLENCE	24	12	12	0 PPM	27	0 PPM
6	V.D.C PATIENT DINING HALL	24	12	12	0 PPM	32	0 PPM
7	SRUJANA HOSTEL	20	12	8	0 PPM	32	0 PPM
8	REVATHI HOSTEL	28	12	16	0 PPM	32	0 PPM
9	SPOORTHI HOSTEL	24	16	8	0 PPM	32	0 PPM

Signature of Principal

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Vishnupur, BHIMAVARAM-534 202

B.V.RAJU COLLEGE
VISHNUPUR :: BHIMAVRAM

DATE OF COLLECTION OF SAMPLE :- 30.07.2022
DATE OF ANALYSIS OF SAMPLE :- 04.08.2022

S.NO	VARIOUS PARAMETERS							
	HARDNESS	pH	ALKALINITY	ACIDITY	CHLORIDES	NITRATES	CALCIUM	MAGNESIUM
PERMITTED LEVELS	<80 PPM	6.5-7.8	<50 PPM	< 10 PPM	<20 PPM	< 20 PPM	< 40 Ppm	< 40 Ppm
II PHASE RAW WATER	60	8.3	30	NIL	5.2	4	30	30
II PHASE PRETREATMENT WATER	50	7.88	30	NIL	2.8	2	30	20
II PHASE R.O WATER	45	7.81	25	NIL	3.2	2	20	25

ANALYSED BY BRLC 04/08/2022

PRINCIPAL

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Vishnupur, BHIMAVARAM-534 202

Sri vishnu Educational Society & B.V. Raju Foundation
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 16-11-2022

Date of Analysis:16-11-2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE <40 PPM	NITRITE 0 PPM	AMMONIUM 0 PPM
					PHENOLPHTHALEIN	METHYL ORANGE				
1	CANAL WATER	140	85	55	5	175	0	5	0	0
2	RO WATER	40	20	20	0	36	0	0	0	0
3	S.V.E.C.W BLOCK-D COMPUTER LABS	40	20	20	0	36	0	0	0	0
4	S.V.E.C.W LIBRARY BLOCK	40	20	20	0	36	0	0	0	0
5	MUSIC CLASS ROOM IN POND	45	20	25	0	36	0	0	0	0
6	FRESH CHOICE BAKERY	35	20	15	0	36	0	0	0	0
7	TASTY CORNER	40	15	25	0	44	0	0	0	0
8	VISHNU CANTEEN	40	15	25	0	40	0	0	0	0
9	SIR AURTHER COTTON BOYS HOSTEL	35	15	20	0	40	0	0	0	0
10	GAYATHRI HOSTEL	40	15	25	0	40	0	0	0	0

Signature of Principal

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Signature of Director

Sri vishnu Educational Society & B.V. Raju Foundation
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 09-11-2022

Date of Analysis:09-11-2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE PPM <40	NITRITE PPM 0	AMMONIUM PPM 0
					PHENOLPHTHALEIN	METHYL ORANGE				
1	CANAL WATER	145	80	65	5	165	0	5	0	0
2	RO WATER	40	20	20	0	36	0	0	0	0
3	KITCHEN FOR VISHNU CANTEEN	40	15	25	0	36	0	0	0	0
4	S.V.E.C.W BLOCL -D CLASS ROOM	35	20	15	0	36	0	0	0	0
5	CANTEEN OPEN SHED	35	15	20	0	36	0	0	0	0
6	S.V.E.C.W EXTENSION BLOCK-C	35	15	20	0	36	0	0	0	0
7	VISHNU FOOD COURT 3RD PHASE	30	15	15	0	36	0	0	0	0
8	ALLURI SITA RAMA RAJU HOSTEL	25	15	10	0	36	0	0	0	0
9	S.V.E.C.W BLOCK-C	30	15	15	0	36	0	0	0	0
10	PADMAVATHI HOSTEL	30	15	15	0	36	0	0	0	0

Signature of Principal

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B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Signature of Director

Sri vishnu Educational Society & B.V. Raju Foundation
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 04-11-2022

Date of Analysis:05-11-2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE PPM <40	NITRITE PPM 0	AMMONIUM PPM 0
					PHENOLPHTHALEIN	METHYL ORANGE				
1	CANAL WATER	165	100	65	5	175	0	5	0	0
2	RO WATER	30	15	15	0	32	0	0	0	0
3	DHANVANTHARI HOSTEL	30	25	5	0	36	0	0	0	0
4	CANTEEN OPEN SHED	205	115	90	0	104	0	0	0	0
5	SVECW EXTENSION BLOCK-B	35	15	20	0	36	0	0	0	0
6	GIRLS FAST FOOD KITCHEN	35	15	20	0	36	0	0	0	0
7	SVECW BLOCK-B	30	15	15	0	36	0	0	0	0
8	FOOD COURT 2nd PHASE	30	15	15	0	36	0	0	0	0
9	SARASWATHI HOSTEL	40	20	20	0	36	0	0	0	0
10	SVECW EXTENSION BLOCK-A	40	20	20	0	36	0	0	0	0

Signature of Principal

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Signature of Director

Sri vishnu Educational Society & B.V. Raju Foundation
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 28-10-2022

Date of Analysis: 29-10-2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY
					PHENOLPHTHALEIN	METHYL ORANGE	
1	CANAL WATER	168	88	80	0 PPM	122	0 PPM
2	RO WATER	20	12	8	0 PPM	27	0 PPM
3	VISHNU PUBLIC SCHOOL	20	12	8	0 PPM	27	0 PPM
4	SVECW BLOCK1	28	12	16	0 PPM	32	0 PPM
5	DENTAL BLOCK1	24	12	12	0 PPM	27	0 PPM
6	RAJYA LAKSHMI HOSTEL	24	12	12	0 PPM	32	0 PPM
7	VIVEKANANDA HOSTEL	20	12	8	0 PPM	32	0 PPM
8	SITA MESS	28	12	16	0 PPM	32	0 PPM
9	KITCHEN SITA MESS	24	16	8	0 PPM	32	0 PPM

Signature of Principal

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Signature of Director

Sri vishnu Educational Society & B.V. Raju Foundation
Smart Water Grid Project
Chemical Analysis of Water Samples in Green Meadows Campus

Date of Sample Collection: 20-10-2022

Date of Analysis: 21-10-2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM < 30 PPM	ALKALINITY <200PPM		ACIDITY
					PHENOLPHTHALEIN	METHYL ORANGE	
1	CANAL WATER	145 PPM	90 PPM	55 PPM	0 PPM	139 PPM	0 PPM
2	RO WATER	20 PPM	15 PPM	5 PPM	0 PPM	27 PPM	0 PPM
3	SVCP	35 PPM	15 PPM	20 PPM	0 PPM	32 PPM	0 PPM
4	SBSP	25 PPM	20 PPM	5 PPM	0 PPM	23 PPM	0 PPM
5	BVRC	30 PPM	20 PPM	10 PPM	0 PPM	27 PPM	0 PPM
6	ANNAPURNA KITCHEN	25 PPM	15 PPM	10 PPM	0 PPM	27 PPM	0 PPM
7	GIRLS CANTEEN	30 PPM	15 PPM	15 PPM	0 PPM	27 PPM	0 PPM
8	RAJESWARI HOSTEL	20 PPM	20 PPM	0 PPM	0 PPM	27 PPM	0 PPM
9	DINING HALL BACKSIDE OF SBSP	20 PPM	20 PPM	0 PPM	0 PPM	40 PPM	0 PPM
10	VISWESWARAIAH BOYS HOSTEL	25 PPM	15 PPM	10 PPM	0 PPM	32 PPM	0 PPM

Signature of Principal

PRINCIPAL
B.V. RAJU COLLEGE
Vishnupur, BHIMAVARAM-534 202

Signature of Director

B.V.RAJU COLLEGE
(Dr B.V.RAJU FOUNDATION & SRI VISHNU EDUCATIONAL SOCIETY)
Smart Water Grid Project
Chemical Analyis of Water samples in Green Meadows Campus

Date of Sample Collection: 2/12/2022
Date Of Analysis: 3/12/2022

S.NO	SAMPLE LOCATION	TOTAL HARDNESS <200 PPM	CALCIUM <75 PPM	MAGNESIUM <30 PPM	ALKALINITY <200PPM		ACIDITY	NITRATE <40 PPM	NITRITE 0PPM	AMMONIUM 0PPM
					PHENOLPHTHALEIN	METHYL ORANGE				
1	CANAL WATER	100	75	25	5	145	0	5	0	0
2	R.O WATER	30	15	15	0	50	0	0	0	0
3	VISHNU DENTAL BLOCK-2	25	15	10	0	50	0	0	0	0
4	VISHNU DENTAL BLOCK-3HOSPITAL	30	15	15	0	50	0	0	0	0
5	COFF SHOP	30	15	15	0	50	0	0	0	0
6	CANTEEN KITCHEN	25	20	5	0	45	0	0	0	0
7	C.V.RAMAN HOSTEL	35	20	15	0	50	0	0	0	0
8	VAISHNAVI HOSTEL	30	15	15	0	45	0	0	0	0
9	VAIDEHI HOSTEL	30	15	15	0	50	0	0	0	0

SIGNATURE OF PRINCIPAL

PRINCIPAL
B.V. RAJU COLLEGE
pur, BHIMAVARAM-53

BVRICE Solar and Apepdcl power consumption report

All are in KWH (Units)

S.No	Year	Apepdcl	Solar	Total
1	2016	1,26,835	64,320	1,91,155
2	2017	1,20,143	60,603	1,80,746
3	2018	1,31,755	62,060	1,93,815
4	2019	1,38,526	63,036	2,01,562
5	2020	53,800	63,058	1,16,858
6	2021(upto March)	29,753	16,277	46,030
		6,00,812	3,59,728	9,60,540

VISHNU
UNIVERSAL LEARNING

Generation of Solar Power in BVRICE (50Kwp)

S.No	Month	Units by Solar
1	April-21	6227
2	May-21	5952
3	June-21	4717
4	July-21	4379
5	August-21	2716
6	September-21	4125
7	October-21	3765
8	November-21	2117
9	December-21	2621
10	January-22	3085
11	February-22	2828
12	March-22	5697
		48,229

B.V. RAJU COLLEGE
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W.G Dist. (A.P.)
Pin-534 202