ROTARY CLUB OF CENTRAL RUPANDEHI

PROJECT PARIWARTAN

AN INITIATIVE FOR SCHOOL
ELECTRIFICATION WITH SOLAR POWER PLANT

PROJECT PARIWARTAN

Rotary club of Central Rupandehi
Rupandehi, Nepal

Introduction

Pariwartan Solar Project aims to supply solar electricity to Nepal Rastriya School located at a remote location on Pariwartan Gaunpalika, Rolpa.Nepal Rastriya School is a Technical school located in Rangkot, Pariwartan 5, Rolpa which provides education to almost 850 Nepali students in the field of agriculture, forestry and veterinary science. The school is also proposed as a model school by the government of Nepal.
Despite being a major hotspot of Nepali Maoist Civil war in 2000s, the people in the place are now all determined to have a better future and are supporting the initiative of a technical school in the area for better future economically and upgradation of lifestyle heavily affected by violent maoist war.

Currently, the school is supplied by a local micro grid produced electricity supply (Saharin Sagura Khola Laghu Jalabidhhut Aayojana, Rangot, Pariwartan 5, Rolpa) but is facing scheduled power cuts for 3 hours during peak time. This directly affects the multimedia classes, computer training, operation of lab equipments and thus compromising the effectiveness of the technical education provided. The school has 30 computers used for multimedia classes. The school also has heavy lab equipments such as incubators. The School currently is in following situation:

Location: Pariwartan Gaunpalika, Ward number 5, Rolpa

Number of beneficiaries: 850 students

Ownership: Government owned school

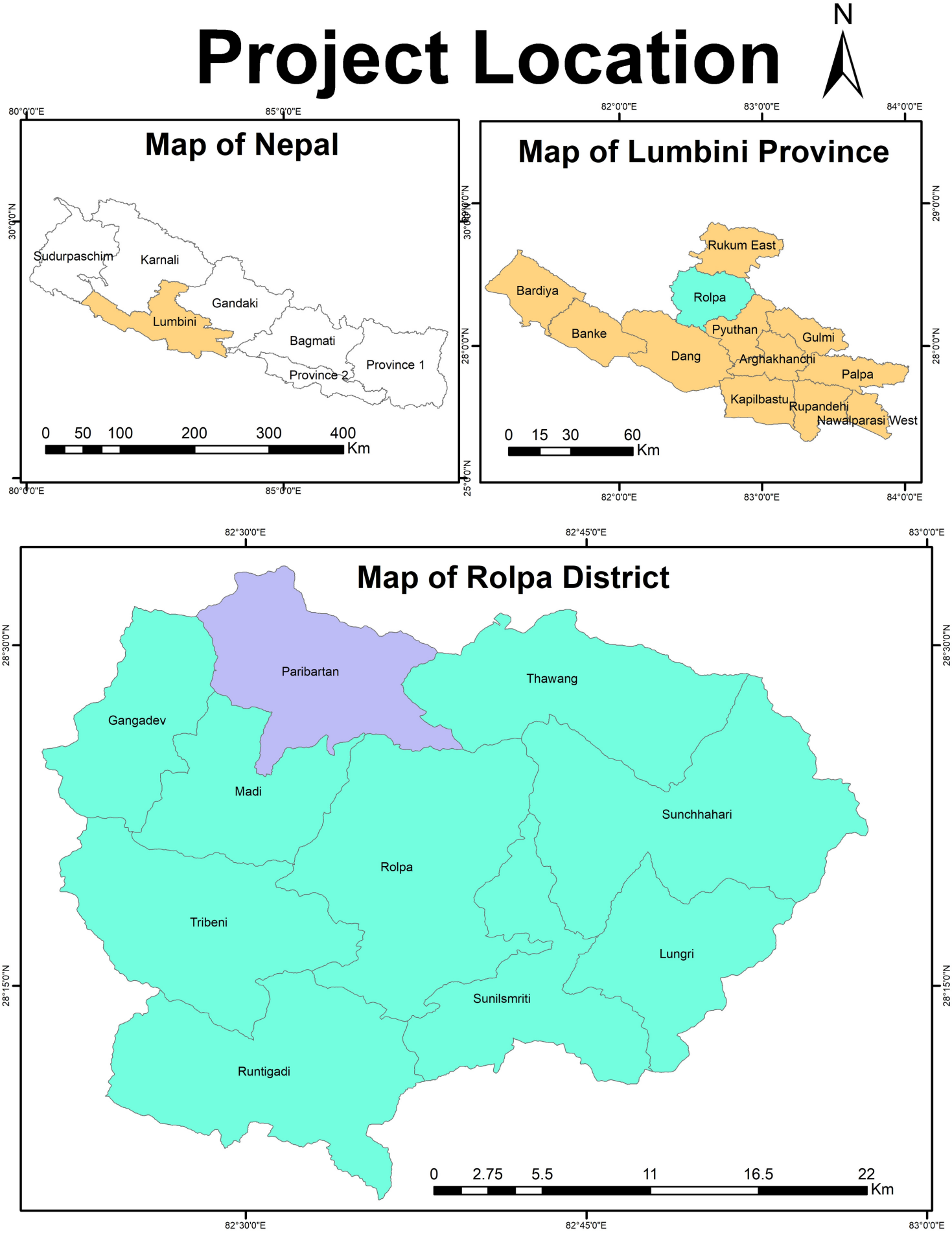
Existing Supply: Local micro hydro

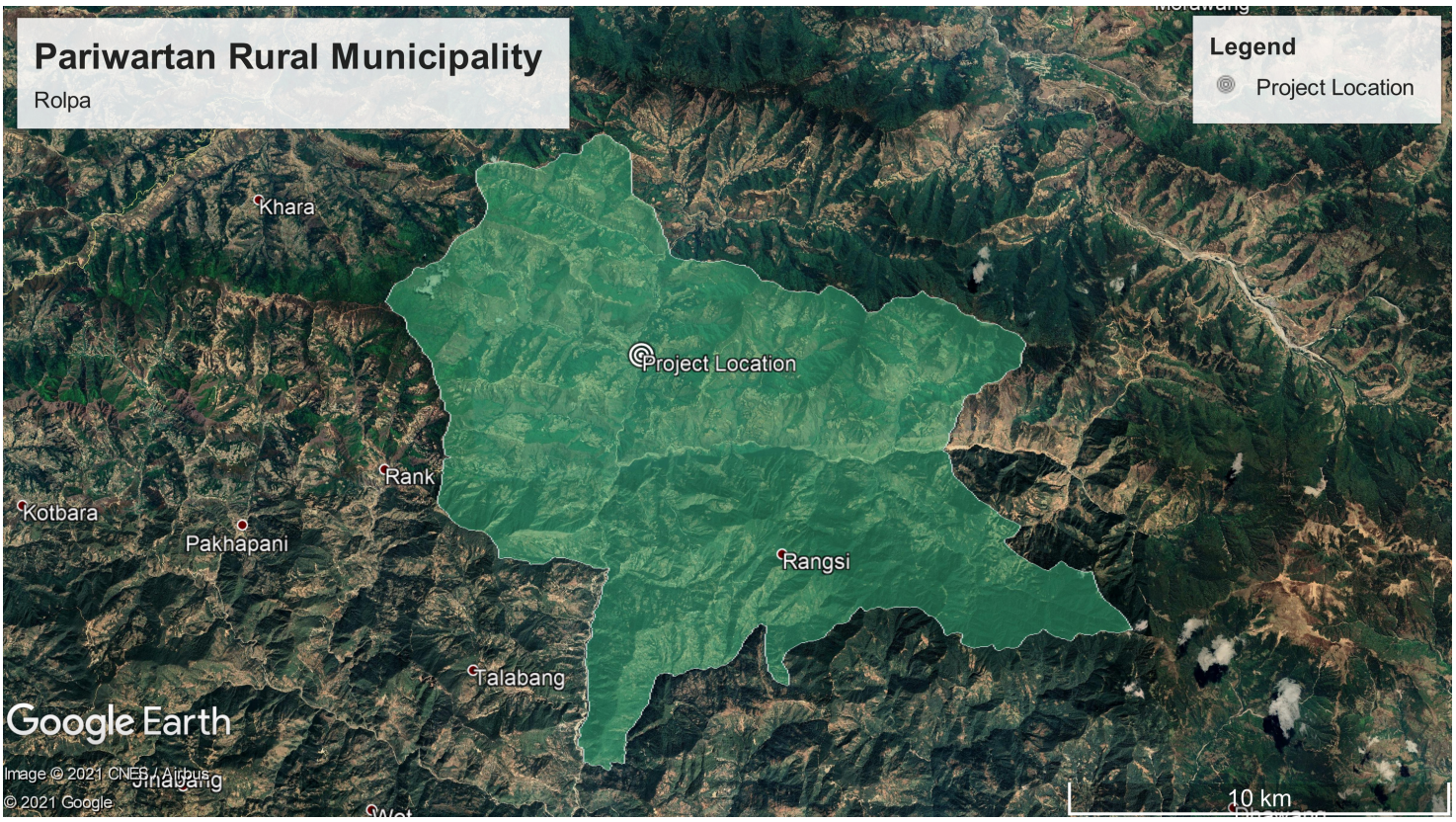
Grid type: Isolated

Capacity of micro hydro: 60kW

Power cuts: Yes

Project Location





Location

Country : Nepal
Province:Lumbini
District : Rolpa
Municipality :Pariwartan Rural Municipality
Place :Rangkot
Distance from Nearest highway : almost 4km
Altitude: 1479m
Latitude: 28°30'04.9"N , Longitude: 82°32'00.6"E
Standard of living: at poverty line

Photos

1. Healthcare facility in schhol (has refrigirators)
2. .Students in biology class
3. Veterinary practical classes
4. Multimedia classes (not regular)
5. Computer training and classes (has 30 computers)

6&7. Biology classes (has incubators)

Background

Rotary Club of Central Rupandehi for now in coordination with local community & government and in the financial support of Rotary Proposed the enhancement of Electric load capacity of Nepal Rastriya school Rolpa by commissioning and installation of 3.75kWp solar plant in School Premise at Pariwartan Gaupalika Rolpa.

Problem Statement

1. Regular power cuts during class hours hampering the effective teaching (mainly multimedia classes).
2. Low reliability of the existing electrification system due to improper management of the micro hydro.
3. Ineffectiveness in technical education due to difficulty in operation of lab equipments and computers.

Objectives

The Project proposes on expanding the capacity of currently available Electricity supply by adding the Solar power plant of 3.75kWp capacity in the school with following objectives:

1. Preliminary Survey,Planning and Design of 3.75kWp Solar power plant in the school.
2. Implementation of Design by transportation, fabrication, installation, testing and commissioning works of Solar power plant components.
3. Training the local people and authority for its optimal use and Handing over to the school.
4. Checking the effectiveness of the project

Summing up, the overall objective is to enhance the effectiveness of technical education in the area by upgrading the infrastructure and thus improving the quality of education and making people more capable for income generation.
In addition to that a workshop on safety on usage of electricity and awareness on safe operation of electrical devices will also be conducted. Different first aid measures for electricity induced accidents and shocks will also be featured in the workshop.

The Project will strengthen the capacity of the school for better technical education which will ultimately enhance the quality of education in the area, increasing income generating opportunities and ultimately maintaining the peace in the region.

Benefits

- Sufficient Electricity supply for effective technical education
- Enhancement in quality of education, enhancing income generating opportunities for people of this region.
- Educational and economic empowerment in war affected area of Nepal.
- Eventually uplifting the living standard of the people.

Sustainability

The project will be sustainable and have a long term impact because of following reasons:

- Emphasis on practical education will be enhanced
- Students will learn new technologies more effectively
- The officials will be trained for the proper use of technology and only be handed over

Timeline of Project

Overall Project- Implementation Plan with Timeline												
S.No.	Work Description	Days	Weeks									
			1	2	3	4	5	6	7	8	9	10
1	**Preliminary Survey**											
2	**Planning and Design**											
3	**Preparation**											
4	**Implementation**											
i.	Equipment Delivery and Travel	5 days										
ii.	Team mobilization	1 day										
iii.	Site clearance	2 days										
iv.	System installation	8 days										
v.	Testing and Commissioning	3 days										
vi.	Training to local authority	2 days										
vii.	Handover	1 day										
viii.	Travel	3 days										
ix.	Reserve days	3 days										
5	**Workshop**											
6	**Commissioning Report**											
Total		**10 weeks**										

Monitoring and Evaluation

Site Supervisor will also be hired to ensure the quality of the works along with the assistance from the clients as well whenever available. Supervisor will be selected from among the local people to enhance local participation and will be assigned a role of liaison officer as well who will not only monitor but also help in maintaining the coordination with the local authorities, people and school administration.
A Commissioning Report will be published after the completion of the project and project effectiveness survey will be conducted which will be used to assess the achievement of the project with respect to the goal.

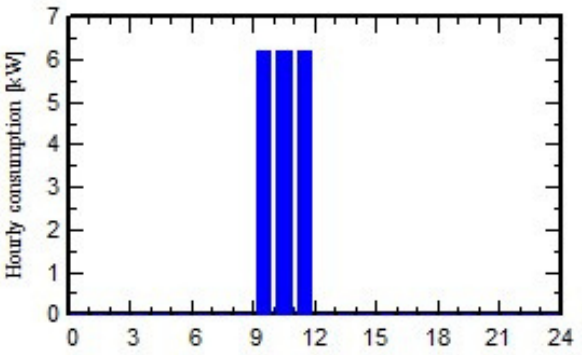
Technical Analysis

Electric Demand Calculation

S.N.	Load	Quantity	Wattage	Hours of use	Total Wattage	Total Wh
1	Desktop Computers	30	200	3	6000	18000
2	Lamps	5	30	3	150	450
3	Incubators	5	30	3	150	450
					∑W=6300	∑Wh=18900

Considering the system is used 3 hours a day(during power cuts), with all the loads turned on.
Total daily energy Demand= 18,900 Wh/day
Total monthly energy Demand= 18900*25= 472,500 Wh/month

Daily load profile:



Site Meteorological Data (Meteonorm 8.0)

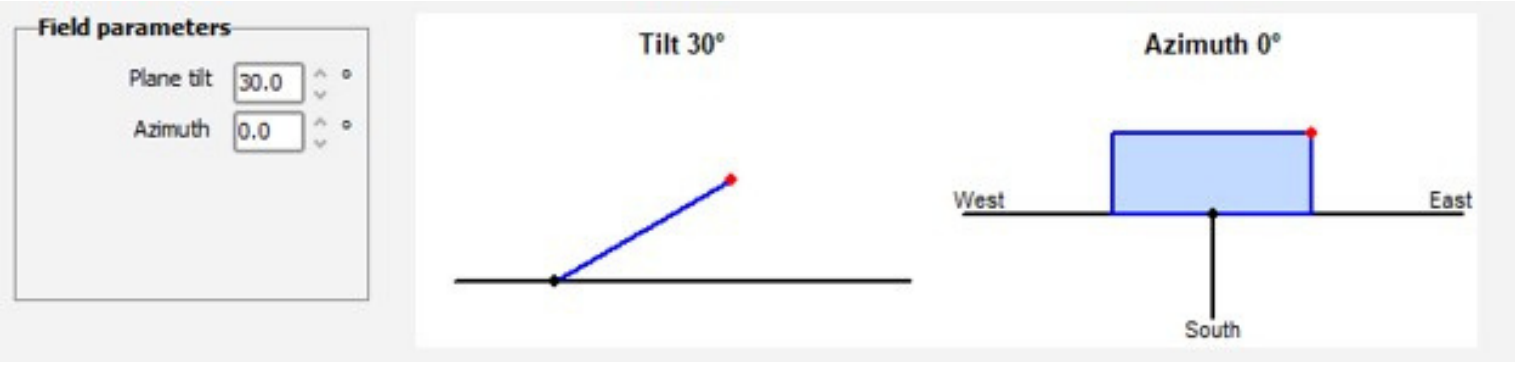
	Global horizontal irradiation	Horizontal diffuse irradiation	Temperature	Wind Velocity	Linke turbidity	Relative humidity
	kWh/m²/day	kWh/m²/day	°C	m/s	[-]	%
January	4.10	0.84	7.2	1.19	3.051	80.5
February	4.56	1.34	11.2	1.60	3.566	71.7
March	5.95	1.54	17.3	1.90	4.035	56.3
April	6.19	2.24	23.5	2.00	5.383	48.0
May	6.38	2.50	27.4	2.00	6.448	49.9
June	5.35	2.78	27.0	1.90	6.292	63.1
July	4.40	2.67	25.1	1.60	4.679	75.8
August	4.65	2.72	24.0	1.49	4.073	80.1
September	4.75	2.11	22.8	1.50	3.887	79.9
October	5.20	1.30	20.2	1.39	3.764	70.1
November	4.69	0.84	13.9	1.10	3.347	75.6
December	4.33	0.69	8.7	1.09	2.911	81.0
Year	**5.05**	**1.80**	**19.0**	**1.6**	**4.286**	**69.3**

Global horizontal irradiation year-to-year variability 5.5%

PV System Design

1. Module Orientation

The general rule of thumb is to tilt the module at the angle same as the latitude angle of the location. Therefore, the module is tilted at a fixed plane at 30 degrees with respect to the ground surface and the azimuth angle is taken 0 degrees. The loss at this orientation with respect to the optimum orientation is 3.2% and global energy incident on the collector plane is 2114 kWh/m



Considering the average insolation as 5.05 kWh/m2 day from PVsyst

2. Battery Selection

Average daily need= 29.2 kWh/day
Accepted level of PLOL= 5%
Number of autonomous days= 1 day

From PVsyst, sizing based on yearly meteo and user need data:

Suggested capacity= 1824Ah
Battery system voltage= 24V

Battery type: Lead acid battery
Model: Exide Classic OPzS Solar 210
Nominal Voltage: 12 V
Capacity at C10: 155 Ah
Internal Resistance at reference temperature: 6.48 mΩ
Coulombic efficiency: 97%

Total number of batteries= 12
In series: 2
In parallel: 6

Battery Pack Voltage: 24 V
Capacity of Battery pack: 930 Ah
Stored Energy at 80% DOD: 17.9 kWh
Number of cycles at 80% DOD: 992
Total stored energy during the battery life: 19666 kWh

3. Selection of PV modules

The selected PV module is Generic Mono 250 Wp 60 cells.

Specifications:
Model: Mono 250 Wp 60 cells
Manufacturer: Generic
Technology: Monocrystalline Silicon
Maximum Power Point (mpp): 249.9 W
Current at Pmpp (Impp): 8.15 A
Voltage at Pmpp (Vmpp): 30.7 V
Open Circuit Voltage (Voc): 37.4 V

Short-circuit current (Isc): 8.63 A
Efficiency per cell area: 17.57%
Efficiency per module area (ηpv): 15.36%

From PVsyst,
Module in series: 1
No. of strings: 15
Total number of modules= 15
Area covered by modules= 24m2

Max. operating power= 3.7kW (at 1000 W/m2 and 50 Degree Celsius)

4. Selection of charge controller

Generic universal controller with MPPT converter
Technology: MPPT converter
Control Mode: SOC Voltage
Maximum Efficiency: 97%
Maximum charging current: 114.5 A
Maximum discharging current: 88.2 A
Number of controllers: 1

5. Selection of Inverter

Sizing of inverter= $\frac{Total\ watts}{pf * \eta inverter}$ = 6200/(0.8*0.94)= 8244 VA

Considering surge of 2 times, inverter size= 2*8kVA= 16kVA

Cost Estimation

S.N.	Description	Quantity	Unit	Unit Price (NRs.)	Amount
1	Preliminary and Detailed survey	1	work	96433	96433
2	Design works	1	work	412368	412368
3	Equipment delivery	1	work	52500	52500
4	Site clearance and fencing including foundation works and anchor blocks	1	work	215312	215312
5	Civil works including the racks for the modules	1	work	475788	475788
6	PV module works	15	Nos	22825	342375
7	PV module support works	15	Nos	1875	28125
8	Storage battery works	12	Nos	28550	342600
9	MPPT Charge controller works	1	Nos	60500	60500
10	Installation works	1	work	180,825	180,825
11	Electrical accessories works including changeover switch and Panel boards	1	work	178,387	178,387
12	Electrical armoured cable 2 core works	1	work	63,258	63,258
13	Protection devices works including Lightning arrester	1	work	103,215	103,215
14	Other general accessories	1	work	95,050	95,050
15	Inverter	1	work	255,200	255,200
16	Training works	1	work	10500	10500
17	Site Supervisor works	1	work	160000	160000
18	Construction works of control room	1	work	118,525	118,525
19	Accomodation	1	work	42320	42320
20	Travel	1	work	75125	75125
21	Workshop	1	work	68220	68220
22	Commissioning Report	1	work	25000	25000
Total					3401626
Contractor's Overhead (15% for construction work only)					368874
Grand Total					3770500
Average US-Nepal Exchange Rate for 2020 : 1 Dollar = 120 Nepali Rupees					
Grand Total (USD)					$31,420.83

all costs are inclusive of VAT

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