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Intelligent Microgrid Connected Rooftop Solar Power Plant 2kwp

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Abstract - *Microgrid is a power pool in which a number of generating sources, storage devices and loads are interconnected with each other to exchange power. A load survey was carried out in the project site to determine the load profile of the residential building, and system. The objective of the project is to design an AC-DC hybrid microgrid to meet various load profiles, taking the project site as an example. Three operating modes of the microgrid are considered: grid dependent, grid independent and grid back up. Actual hardware are yet to built and testing with the emulated loads. The controllers for regulating power from various sources like solar PV, battery, and interlinking inverter are supposed to be select as per the requirement and designed the system according to load. Which results in improved transient response and tight regulation of the DC bus voltage. The microgrid has the capacity upto a power rating of 2 kW.*

***Key Words*: Solar PV 1, Battery 2, Interlinking Inverter 3.**

1. INTRODUCTION

While a majority of the world's current electricity supply is generated from fossil fuels such as coal, oil and natural gas, these traditional energy sources face a number of challenges including rising prices, security concerns over dependence on imports from a limited number of countries which have significant fossil fuel supplies, and growing environmental concerns over the climate change risks associated with power generation using fossil fuels. As a result of these and other challenges facing traditional energy sources, governments, businesses and consumers are increasingly supporting the development of alternative energy sources and new technologies for electricity generation. Renewable energy sources such as solar, biomass, geothermal, hydroelectric and wind power generation have emerged as potential alternatives which address some of these concerns. Before going to this entire plant operation has to be done in practically, so taken the existing 100kw ''Pravara Rural Education Society's, Sir Visvesvaraya Institute Of Technology''. Solar PV plant as a reference. The plant was installed on July-2015 and this is situated in Nashik district, Maharashtra. PV arrays consist of parallel and series combination of PV cells that are used to generate electrical power depending upon the atmospheric conditions (e.g. solar irradiation and temperature).

1.1 System Design and Objectives

The general objective in designing a Solar Power Plant to adequately match the capabilities to the load requirements of the consumer, at a minimum cost of the system to the consumer. In order to accomplish this, the designer will need to know the following types of questions about the system.

(1) Power Requirements, (2)Solar Data Availability, (3)Type and Size of Solar Power Plant Required, (4) Cost of Energy Produced, (5) Solar Power Viability, (6) System Characteristics, (7) System Requirement, (8) Evaluation Criteria, (9) Design Optimization, (10) Economic Viability and (11) Prospects of Cost Reduction.

1.2 Components Used in Solar Power Plants Major components

1. Solar PV Model
2. Power Conditioning Unit/grid tie inverter
3. Utility Grid/Grid System

Minor components

1. DC array junction box
2. AC bus bar(LT and HT Switch gear)
3. Control room
4. Cables
5. Mounting structures
6. Earthing and lightening

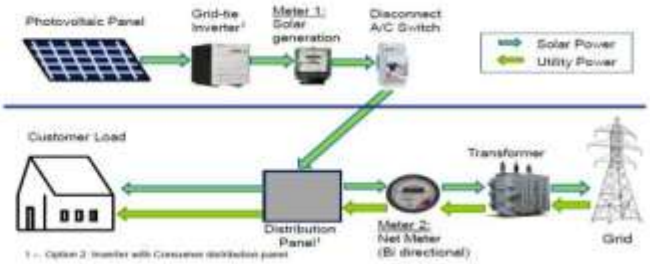

Fig-1: Schematic diagram of solar PV grid Connected plant

1.2 Factors should be Consider While Designing the System
1. The efficient sunshine hours in the location.
2. The proportion of the rainy/cloudy days in the location.
3. How many rainy-cloudy days for the system to work normally.

4. The database of the local weather report, such as sunshine hours, wind power, cloudy-rainy days, and natural disaster and so on.
5. The installation location should be wide, and make sure that there is no high building or other things to cover the solar panels & the sunshine.
6. Should take full investigation while designing the system,
a. Survey the local climatic conditions,
b. The current needs and future potential demands clearly,
c. Focus on performance and consider energy composition,
d. Structure, cost, transportation, construction conditions,
e. System protection should be complete and easy to operate and the Maintenance, other conditions and the maintenance should be a little as possible.

1.2 DC Side PV Plant Design

a. Modules in Series
1. Total MPP voltage at Max Module temperature > Inverter Min MPP Voltage
2. Total Open circuit voltage at Min Module temp < Inverter Max Voltage

b. Modules in Parallel
1. Max current shall not be more than Inverter Max Input current
2. No of Array combiner boxes – with or without string monitoring based on number of inputs selected for each box

c. No. of Main Junction Boxes – based on the Number of Inverter inputs

1.3 AC Side PV Plant Design

1. AC side cable
2. LT Switchgear and MV switchgear
3. Power Transformer (LV to MV)
4. HT Switchyard, Protection and Metering
5. Transmission lines

2. SITE AND TECHNICAL DETAILS

2.1 Site Location

The proposed site is located at Trimurti Chowk, Nashik city in Maharashtra at Latitude 19.98 and Longitude 73.755 N 19^{0}59’3.55844’’E 73^{0}45’19.86216’’ 500 ft^2 of rooftop is identified and is taken to possession

The detailed estimate and the power evacuation scheme along with proposed solar power plant building are enclosed hereby.

2.1 Solar PV Technology

Solar PV Technology converts sun’s natural energy to useful electrical energy. Photo Voltaic modules are made of mono crystalline / polycrystalline solar cells connected in series and parallel modes. Type of solar panel used in this project is mono crystalline.

Mono crystalline solar panels are the most efficient type of solar panels but are also the most expensive. Their performance, somewhat is better in low light conditions. Overall efficiency on average is about 12-15%.warranted of this type of panels about 20-25 years.

Fig-3: Mono Crystalline PV Panels

Table -1: Solar Panel Specification

Watt	220 Watt
Voltage	360 Volts
Current	7.6 A
Type	Monocrystalline
No’s of module	10 no’s
No’s of modules per kW	5 no’s
Tilt angle(slope) of PV Module	15 degree
Efficiency	14.3%
Temperature	Min 15 o and Max 40 deg c
Dimensions of single module(mm)	1655(L) × 995(w) × 50(T) mm Area of single panel = 1646725 (mm) Area of single panel = 1.64 meter^2
Wind speed rating	150 Km/h

2.2 Inverter

GEC [Grid Export Condition] inverters are used here for suppressing the harmonics produced after DC to AC conversion.

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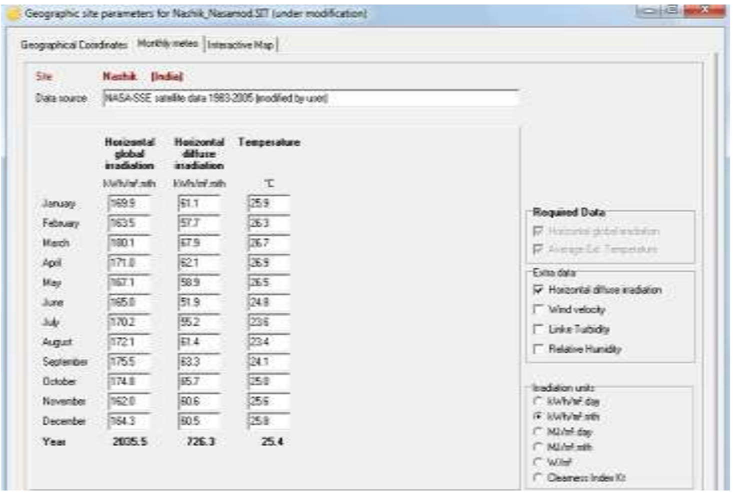
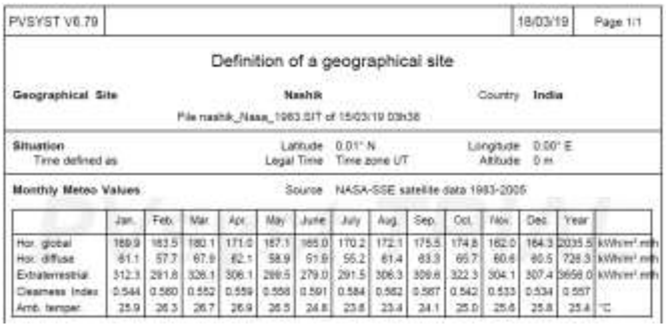
2.6 Combiner Box/ Junction Box

Wires from the individual PV modules or strings are run to the combiner box, typically located on the roof. These wires may be single conductor pigtails with connecters that are pre-wired onto the PV modules. The output of the combiner box is one larger two wire conductor in conduit. A combiner box typically includes a safety fuse or breaker for each string and may include a surge protector.

3. Metrological values



	Horizontal global irradiation	Horizontal diffuse irradiation	Temperature
	kWh/m².mth	kWh/m².mth	°C
January	169.9	61.1	25.9
February	163.5	57.7	26.3
March	180.1	67.9	26.7
April	171.0	62.1	26.9
May	167.1	58.9	26.5
June	165.0	51.9	24.8
July	170.2	55.2	23.6
August	172.1	61.4	23.4
September	175.5	63.3	24.1
October	174.8	65.7	25.0
November	162.0	60.6	25.6
December	164.3	60.5	25.8
Year	2035.5	726.3	25.4



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Definition of a geographical site

Geographical Site Nashik Country India
File nashik_Nasa_1983.SIT of 15/03/19 03h38

Situation Latitude 0.01° N Longitude 0.00° E
Time defined as Legal Time Time zone UT Altitude 0 m

Monthly Meteo Values Source NASA-SSE satellite data 1983-2005

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Year	
Hor. global	169.9	163.5	180.1	171.0	167.1	165.0	170.2	172.1	175.5	174.8	162.0	164.3	2035.5	kWh/m².mth
Hor. diffuse	61.1	57.7	67.9	62.1	58.9	51.9	55.2	61.4	63.3	65.7	60.6	60.5	726.3	kWh/m².mth
Extraterrestrial	312.3	291.8	326.1	306.1	289.5	279.0	291.5	306.3	309.8	322.3	304.1	307.4	3656.0	kWh/m².mth
Clearness Index	0.544	0.560	0.552	0.559	0.558	0.591	0.584	0.562	0.567	0.542	0.533	0.534	0.557	
Amb. temper.	25.9	26.3	26.7	26.9	26.5	24.8	23.6	23.4	24.1	25.0	25.6	25.8	25.4	°C

4. RESULTS AND DESCUSSION

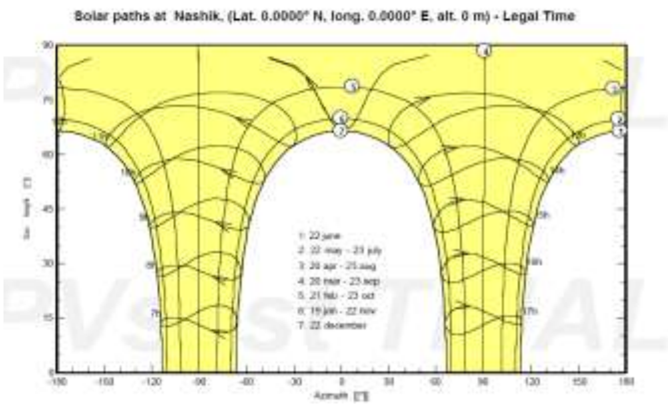

Chart-1: Solar Paths at Nashik (Lat. 19.980N, Long. 73.755)

All the parameters underlying this simulation: Geographic situation and Mateo data used, plane orientation, general information about shadings (horizon and near shadings), components used and array configuration, loss parameters, etc.

Shows the variation in energy generation of solar modules with insolation and the effect of effect of module temperature on their efficiency.

Energy generation shows direct dependent on the incident solar irradiation and reaches the maximum during peak insolation hours, the efficiency of the modules the main reason is to increase in the module temperature. This negatively impacts the efficiency more during that hours. Efficiency of the module decreases from 13.3% at 30OC to 11.5% at 55oC.

It also clear that the temperature of modules increases with the increase in the solar irradiation and reaches the maximum during peak irradiation hours. In other side reduced conversion efficiency.

4. CONCLUSIONS

Using PV SYST V6.10 simulation software, the energy yield analysis for 2kW PV Solar power generation was performed for site .Which is located at latitude of 19.980 N and longitude 73.755E, performance ratio about 84.4%.The available energy at the inverter output which can be fed to the nearby grid with a specific power production.

The impact of temperature variation on the performance of photovoltaic mono crystalline silicon was studied both on daily and yearly basis. It is observed that the efficiency of modules is more sensitive to temperature than the solar irradiation. The normal daily wise is that the efficiency of the plant is high during morning time but low during middle of the day and starts increasing from late afternoon. The efficiency of modules varies from 14.5% to 11.5% with variation in the averaged module temperature from 250C to 500C.Hence cooling of solar modules may be desirable to increase the efficiency.

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