IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 08, Issue 7 (July. 2018), ||V (IV) || 16-19

Life Cycle Performance & Analysis of 100kw Solar PV Plant

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Abstract: Renewable energy source turn out to be exceptionally well known and are commonly utilized these days. The energy generated using solar photovoltaic (PV) system is an example of a clean sustainable power source. Because of utilizing PV solar panels as a sustainable power resource components of PV system such as an inverter turn out to be broadly utilized for this reason and keeping in mind the end goal to improve the desired maximum power from PV, distinctive strategies were utilized to accomplish the coveted power, where it turn into an extremely extensive to use diverse technique to accomplish desired maximum power from PV. The fundamental objective of this manuscript is to present the usage of a photovoltaic system installed at NISE, GURUGRAM of 100kw and to measure the performance of this system in terms of system life cycle solar radiation data will be used to gauge the early energy yield using PVSYS programming tool. The performance ratio of this PV system is also calculated based on the measured output power and the radiation intensity.

Keyword :- Monthly Specific Yield (kWh/kW), Monthly Performance Ratio, Plant Load Factor/ CUF based on AC nominal Capacity.

Date of Submission: 30-06-2018 Date of acceptance: 17-07-2018

I. INTRODUCTION

. Solar photovoltaic system is one of sustainable power source system which utilizes PV modules to change over sun radiation into electrical power. The power created can be either put away or utilized straightforwardly, encouraged once again into lattice line or joined with at least one other power generators or more sustainable power source.[1-2] Solar PV system is extremely solid and clean wellspring of power that can suit an extensive variety of uses, for example, home, industry, agribusiness, animals, and so on.

- Installed capacity 100kwp
- Total modules 308
- Inverter 100kva
- Wattage of module 327wp
- Tilt angle 28
- Orientation – single axis tracker (east to west)
- **Module**

Total Module = total load / wattage of module (Pmax) =100kw/327=308

- **STRING**= Total module / Number of modules in series=308/28=11

II. SOLAR PV

Solar Photovoltaic (PV) is a technique for changing over sun ray illumination in to direct current power utilizing semiconductor that display the Photovoltaic effect.[3-4] Photovoltaic power age utilizes sun powered boards made out of various sunlight based cell containing a photovoltaic material. Materials directly utilized for photovoltaic incorporate mono crystalline silicon, poly crystalline silicon, indistinct silicon, Cadmium Telluride (CdTe) and copper indium gallium selenite/sulfide (CIGS) Due to the developing interest for sustainable power sources, the assembling of sun powered cells and photovoltaic framework has progressed significantly in ongoing years.[5]

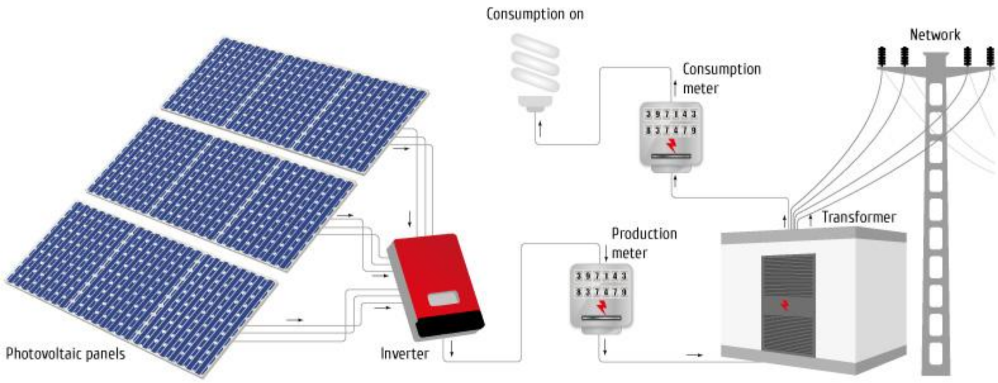


Figure 1: grid connected solar pv system

III. MAJOR SYSTEM COMPONENTS

Solar PV system includes different components that should be selected according to your system type, site location and applications.

- **PV module** – converts sunlight into DC electricity.
- **Solar charge controller** – regulates the voltage and current coming from the PV panels going to battery and prevents battery overcharging and prolongs the battery life.
- **Inverter** – converts DC output of PV panels or wind turbine into a clean AC current for AC appliances or fed back into grid line.
- **Battery** – stores energy for supplying to electrical appliances when there is a demand.
- **Load** – is electrical appliances that connected to solar PV system such as lights, radio, TV, computer, refrigerator, etc.
- **Auxiliary energy sources** - is diesel generator or other renewable energy sources .

IV. PV MODULE

A Solar panel (likewise sun based module,) is an, associated gathering of sun based cell. The solar panel can be utilized as a segment of a bigger photovoltaic system to produce and supply sunlight based power in business and private applications. Each board is evaluated by its DC yield control under standard test conditions, and commonly goes from 100 to 450 watts. The solar cell efficiency of a panel decides the territory of a panel given the same appraised yield - a 8% productive 230 watt board will have double the region of a 16% effficient [7-8]

V. INVERTERS

Solar inverter changes over the dc power to ac power to facilitate feeding in to the grid. The inverter is the most muddled piece of the PV system. It needs to go about as the interface between the pv cluster and the matrix. As the pv exhibit yield fluctuates with the sun oriented radiation and the inverter needs to adapt to the same. The inverter has assurance highlights for overvoltage, under voltage, surge and so on. The inverter is furnished with the highlights for logging and show of parameters identified with plant activity and issues and so on. The inverter will utilize mppt to expand vitality drawn from the exhibit. The mppt will be chip based to limit control misfortunes. The yield from the inverter will be sustained to the air conditioner circulation board.[9-10]

VI. CABLES

The Unique Capability Of Wire Harness Of Connecting Parallel Strings Eliminates. The Use Of Array Junction Box. 2 Wire Harness Are Used In Each Array One For Connecting All The Positive Terminals At One Side And Negative Terminals At The Other Side. The Multi-Strand Copper/Aluminum Cables Will Be Used For Interconnection Of Electrical Components Like PV Modules, Junction Boxes, Distribution Boards and Inverter. All The Cabling Will Be Carried Out As Per The Standards. The Size And Length Of The Cable Will Be Selected Such That There Will Be Minimum Voltage Drop And The Effect Of Temperature Is Minimum. The Size Of Cables Will Be Selected Considering The Short Circuit Current That Can Flow Through The Cables. Links Will Be Housed Inside PVC Conduit Pipe For Unarmored Cables And All Cables Will Be Underground Cabling With The Cable Trench At A Minimum Depth Of 80 CM.[13**]**.

V. CALCULATION

a. $\boldsymbol{Generation\ of\ one\ month\ energy = panel\ rating\ \times\ efficiency\ of\ cell\ \times days\ \times hour}$

= 100kw x 19% x 31 x 24= 147,859 kwh

b. $\boldsymbol{Monthly\ Specific\ Yield}\ \left(\frac{kWh}{kW}\right) = \frac{\boldsymbol{Actual\ energy\ yield}}{\boldsymbol{nominal\ solar\ power}}$

=147,859 kwh / 100kw= 142.86

c. $\boldsymbol{Performance\ ratio(pr)} = \left[\left\{\frac{\boldsymbol{Measured\ output\ in\ kW}}{\boldsymbol{Installed\ Plant\ capacity\ in\ kWp}}\right\} \times \left\{\frac{\boldsymbol{Measured\ radiation\ intensity\ in}\frac{W}{m^2}}{\boldsymbol{1000}\frac{W}{m^2}}\right\}\right]$

=147859kwh/100kw × 5.79/1000

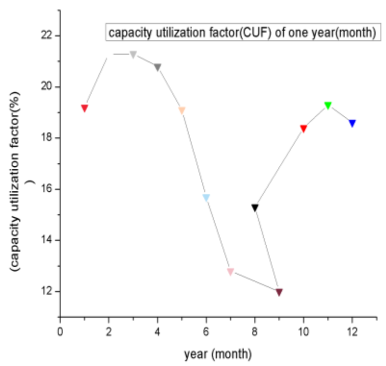
=79.6.1%

d. capacity utilization factor (CUF)= energy measured(kwh)/ 365 x 100kw x 24

= 147859kwh / 365 x 100kw x24= 19.2%

Month	Days	Average Daily solar radiation (GHI) (kWh/m2/day)	Day time average temperature (deg C)	Cell Temperature (deg C)	Temperature Derating Factor	Average Shadow Loss	Derating Factor for shadow loss	Derating Factors for Other Losses	Total Derating Factor	Energy Yield (kWh)	Monthly Specific Yield (kWh/kW)	Monthly Performance Ratio	Plant Load Factor / CUF based on AC nominal Capacity	Generation loss due to temperature	Months	Total
January	31	5.79	20.7	46.70	0.91	0.12%	0.999	0.87	0.80	147,859	142.86	79.6%	19.2%	8.90%	January	147,859
February	28	6.49	23.4	49.40	0.90	0.13%	0.999	0.87	0.79	147,862	142.86	78.6%	21.3%	10.00%	February	147,862
March	31	6.65	28.1	54.10	0.88	0.07%	0.999	0.87	0.77	164,247	158.69	77.0%	21.3%	11.93%	March	164,247
April	30	6.61	32.5	58.50	0.86	0.04%	1.000	0.87	0.75	154,803	149.57	75.4%	20.8%	13.74%	April	154,803
May	31	6.16	35.3	61.30	0.85	0.01%	1.000	0.87	0.74	147,133	142.16	74.4%	19.1%	14.88%	May	147,133
June	30	4.97	31.5	57.50	0.87	0.00%	1.000	0.87	0.76	116,995	113.04	75.8%	15.7%	13.33%	June	116,995
July	31	3.98	27.6	53.60	0.88	0.00%	1.000	0.87	0.77	98,599	95.26	77.2%	12.8%	11.73%	July	98,599
August	31	3.72	27.1	53.10	0.88	0.01%	1.000	0.87	0.77	92,363	89.24	77.4%	12.0%	11.52%	August	92,363
September	30	4.75	27.6	53.60	0.88	0.04%	1.000	0.87	0.77	113,833	109.98	77.2%	15.3%	11.73%	September	113,833
October	31	5.69	26.2	52.20	0.89	0.04%	1.000	0.87	0.78	141,822	137.03	77.7%	18.4%	11.15%	October	141,822
November	30	5.89	22.7	48.70	0.90	0.23%	0.998	0.87	0.79	144,091	139.22	78.8%	19.3%	9.72%	November	144,091
December	31	5.61	20.1	46.10	0.91	0.23%	0.998	0.87	0.80	143,491	138.64	79.7%	18.6%	8.65%	December	143,491
Annual	365	5.52	26.9	52.90	0.89	0.08%	0.999	0.87	0.77	1,613,097	1558.55	77.4%	17.8%	11.44%	Annual	1,613,097

Table 1: Measured Value Of 100kw Solar PV Plant.



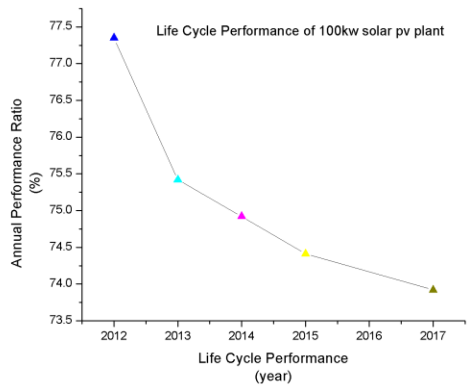


Fig 2: Graph is showing the life cycle performance of 100kw solar PV plant

VI. CONCLUSION

The method to achieve the life cycle performance 100kw solar PV Plant in NISE (National Institute of Solar Energy) , Guru gram .was studied and performance ratio of the solar power plant is measured during the 2017. From the graph of capacity utilization factor for the year 2017, the utilization is minimum during the month of July to September. This is because in north India these month are experiencing rain season and most of the time the sun is covered by thick cloud so, there is negligible or less solar irradiance during these month. Similarly, from the graph of solar energy yield for the same yield it is clear that July and august Experiencing the lowest solar energy yield as , there is observe of solar irradiance due to heavy rainfall in these two month in the north India region.

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Mohd Tahseen “Life Cycle Performance & Analysis of 100kw Solar PV Plant.” IOSR Journal of Engineering (IOSRJEN), vol. 08, no. 7, 2018, pp. 16-19.