A Standby Power Supply To Power Well Testing Equipment, Using Renewable Energy

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Abstract- Years from now, with the estimated growth in world population and economic activities, fossil fuels which currently generate more than half of the world's energy needs would not be able to keep up with this pace because it is a non-renewable source of energy, in other words exhaustible. It has a problem of shortage of oil in the location where it was to supply to. Nigeria today is witnessing perhaps the worst power generation and distribution crisis in many years. To redress this situation, experts in the field of green energy have since lent their views in support of pursuing renewable energy in delivering power and as well as powering even the remotest parts which are without grid infrastructure. The study is to demonstrate the possibility of using solar energy to power oil Well (the fluid characteristic) testing equipment in flow stations in the oil and gas industries. This demonstration was done by using PVsys to show the possibility with the results detailed in the body of the main study. By applying this study to flow stations in the oil and gas industries, it will elimination power outage to Oil well testing equipment due to generating set break down, it will ensure steady power supply, save cost and save operators from legislative challenges with the regulators due to the challenges associated with not testing a flowing oil Well within a stipulated period.

I. INTRODUCTION

The growing use of renewable energy requires additional techniques and analyses of its influences on the economy and the reliability of the electrical system in order to provide the system operator the tools to compensate for the intermittency of renewable sources in real time, considering the actual reaction times of the fossil and pumped storage units and their availabilities to back up renewables. The challenge of combining energy storage units with the electrical network, aiming towards mechanisms for smart consumption and encouraging flexible generation, is becoming feasible in light of recent developments in communications and smart grid. While it is clear to all that, in parallel with developing storage technologies, it is necessary to develop smart grids that will be able to provide a solution and tools to the system operator to overcome the undesirable phenomena stemming from the intermittency of renewable energy sources. Nevertheless, the value of energy storage is captured best with additional renewable energy generation, thus reducing the use of conventional generation. Valuing the function of storage with renewable sources requires continuous analysis, improved data logging, and developing new techniques in order to assess the activity of smarter and more dynamic networks in the future to integrating renewable energy technologies.

Production facilities are often both in remote locations and require large amounts of electricity that could be generated with renewable sources (wind, solar). EOR and oil refining also require large amounts of heat, which may be supplied by renewable thermal technologies (solar thermal, geothermal). Use of waste heat or gas to run cogeneration facilities can, in some cases, also be economic. Furthermore, the combination of increasing energy intensity in the petroleum industry and dramatic decreases in costs for many renewable energy technologies is shifting the economic calculus in favour of more integration. However, renewable energy technologies are not applicable in all cases. Renewable energy technologies must be both reliable and economically competitive to be commercially viable.

The worldwide interest in renewable energy technology has failed to diminish even during the period of low oil prices. This is due to problems regarding greenhouse gas emissions and conventional energy production technologies threatening environmental safety, which are tied to the Paris Agreement. Currently, eco-friendly renewable energy technologies that are sustainable, such as solar thermal energy, photo-voltaic, geothermal energy, tidal power, wave power, wind power, hydropower, and biomass energy are being widely used in almost every industry. Renewable energy, along with fossil fuel energy and nuclear energy, has come to provide significant amounts of energy that help sustain the energy supply to our society. From a conservative point of view, renewable energy is a competitor to fossil fuels. However, recently renewable energy is being used to extract and produce fossil fuel resources, which makes it more difficult to view them as clear competitors. The mining industry, which extracts fossil fuel resources like bituminous coal, is applying renewable energy technologies to supply electricity to mines operating in remote areas and to cultivate alternative industries using the land abandoned by exhausted mines. Research Efforts have been made by (Choi, 2002) to meticulously study cases in which renewable energy technologies were applied in the mining industry. Furthermore, many studies have been done within the country to evaluate the potential of renewable energy resources obtainable around exhausted mines. Furthermore, studies were done on applying photovoltaic (PV) systems to supply electricity to run treatment plants for mine drainage. In the oil and gas industry, renewable energy technology is being used to resolve problems of supplying electricity for offshore production and to supply the thermal energy required for the enhanced oil recovery (EOR) technique.

II. STATEMENT OF THE PROBLEM

Production operations, oil well (fluid characteristic such as temperature, pressure and flow rate etc) testing is a critical requirement to both the regulating authorities and business owners. To carried out monthly, every 1 months, 3 months or 6 months as required by the regulators in the smaller and older flow stations, there must be a constant power source.
It has a problem of shortage of oil in the location where it was to supply it. This is because sometimes at this remote location which is not connected to national power grid fails for weeks or months while the station are running on pneumatics. This makes the oil well testing impossible within this because the equipment's needs electricity to function. If the operator fails to test the oil well due to power beyond certain period, the regulator will ask the operator to shut in oil, and hence the need for this project

i.

- OBJECTIVES

i. To evaluate the various renewable energy technologies that can be used in the oil and gas industry.
ii. To calculate and estimate the operating load and power requirement for oil well testing equipment using simple power equations based on power specification of oil testing equipment in an oil and gas operations.
iii. To simulate solar based renewable energy supply as a means to drive the oil and gas equipment using the PVsysts software
iv. To compare the cost of using of renewable energy source to the use of turbines and high-capacity diesel engines.

III. LITERATURE REVIEW

As population is increasing day by day, the demand of energy (mostly in the form of electricity) is also increasing. To fulfill our Energy demands, we must have to discover/introduce more resources and ways to generate it so as to meet up with the fast evolving and dynamic sectors that power supply is required(Nkwetta et al., 2012).

Alternative energy sources or renewable energy sources however have found its way in the global energy market in a major way, due to the increasing conventional fuel prices, environmental degradation caused by the burning of fossil fuels. Climate change and global warming concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization.

It is evidential in literature that replacing fossil fuel-based energy sources with renewable energy sources, which includes: bio-energy, direct solar energy, geothermal energy, hydro-power, wind, and ocean energy (tide and wave), would gradually help the world achieve the idea of sustainability. Governments, intergovernmental agencies, interested parties and individuals in the world today look forward to achieving a sustainable future due to the opportunities created in recent decades to replace petroleum-derived materials from fossil fuel-based energy sources with alternatives in renewable energy sources.

Nigeria is endowed with sufficient renewable energy resources to meet its present and future development requirements. However, hydropower is the only sustainable resource currently exploited and connected to the grid. This study will therefore is pointed in the direction of the analysis of renewable energy sources which and its feasibility in Nigeria with aim of using the most efficient source to drive well testing equipment in the oil and gas sector.

The emergence of wind as an important source of the World's energy has taken a commanding lead among renewable sources. Wind exists everywhere in the world, and in some places, with considerable energy density (Zhang et al., 2011).Wind power, as an alternative to burning fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, consumes no water, and uses little land. The net effects on the environment are far less problematic than those of non-renewable power sources.

IV. MATERIALS AND METHOD

This chapter presents in details the materials and approaches employed in using renewable energy as an efficient source for powering well testing equipment. The approach presented will center on solar power as the primary renewable energy option for sourcing well testing equipment. The design approach presented in this study will be geared towards generating 3kva rated supply from solar energy and this generated power will be used to power the equipment. Simulation software of choice is PVsystss

Equipment Power Ratting

S/N	Equipment	Rating (Watts)	Daily Use	Daily Consumption w/h
1	Computer	300	2	600
2	G E Sensing	200	2	400
3	Fox Boro temperature transmitter	250	2	500
4	Rosemount pressure transmitter	250	2	500
5	Miscellaneous	200	2	400
6	PLC	175	2	2400
7	Total	1375	2	2800

PV System Calculation

Solar generating factor = 3.3 (3.1)

Determine power consumption demands

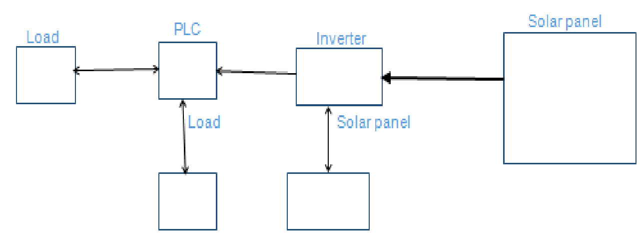
Daily wattage daily = 1.2KW (3.2)

There should be at least 25% increase for load expansion

For a 30% increase = 1.56kw For kilowatt yearly usage

= 1.56kw * 2hour *365days = 1138800kwhh/year (3.3)

= 1138.8kwh/y



Block Diagram of a Standby Power Supply for Powering Well Testing Equipment

Sizing of PV panel module

Total Wp of PV panel capacity = 3120 / 3.3 (3.4)

= 945.4Wp

Number of PV panels needed = 945.4 /320 = 3 (3.5)

Actual requirement = 4
This system should be powered by at least 4 modules of 320watts PV module.

Inverter Sizing
Total Watt of all appliances = 15600W
For safety, the inverter should be considered 25-30% bigger size.

The inverter size should be about 2028W or greater
But since there is no 2028watts inverter then a standard value of a 3kva inverter should be used.

Sizing for the battery
Total appliances use = 3120Wh/day (3.6)
Battery voltage = 48V
Autonomy selected is 1 day

Battery capacity = 3120 * 1 / (0.85*0.6*48) (3.7)
Ampere-hours required 125.8Ah
The minimum battery ratting should be 48 V 125Ah.
PVsysts Simulation

- Method

The method used in this research work is called "power hybrid system, in this several sources of energy are combine to have an effective output"

RESULTS

Chapter four discusses the results obtained from the simulation carried out using PVsysts software. The PVsysts simulation report is divided into five different sub-heading.

i. Simulation Parameters
ii. Main Result
iii. Loos Diagram
iv. Economic evaluation
v. CO_2 Balance

Simulation Parameters
The first part of the report is the parameters used in the simulation like PV panel, the battery charge controller specification, the users' needs and some other details which can be found on Figure 4.1.

The performance ratio is one of the most important variables for evaluating the efficiency of a PV plant. The performance ratio is a measure of the quality of a PV plant that is independent of location and it therefore often described as a quality factor. The performance ratio (PR) is stated as percent and describes the relationship between the actual and theoretical energy outputs of the PV plant. It thus shows the proportion of the energy that is actually available for export to the grid after deduction of energy loss (e.g. due to thermal losses and conduction losses) and of energy consumption for operation.

The closer the PR value determined for a PV plant approaches 100 %, the more efficiently the respective PV plant is operating. In real life, a value of 100 % cannot be achieved, as unavoidable losses always arise with the operation of the PV plant (e.g. thermal loss due to heating of the PV modules). High-performance PV plants can however reach a performance ratio of up to 80 %.

From Figure 4.2 the simulation PF is at 75% which is very OK since 100% PF cannot be achieved in reality but a very good PV plant can get to 80% make 75% not far from an excellent design.

PVSYST V6.70		10/01/20	Page 2/5

Stand Alone System: Main results

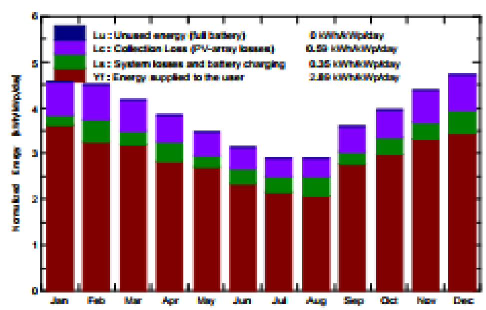
Project : **PV SYSTEM FOR POWER WELL TESTING EQUIPMENT**

Simulation variant : **New simulation variant**

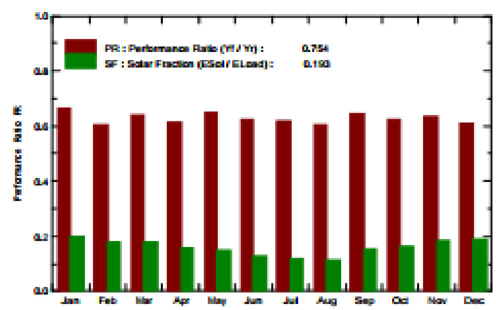
Main system parameters	System type	**Stand alone**		
PV Field Orientation	tilt	30°	azimuth	0°
PV modules	Model	AE7M320VB4B	Pnom	320 Wp
PV Array	Nb. of modules	6	Pnom total	**1920 Wp**
Battery	Model	S12-290 AGM	Technology	Lead-acid, sealed, AGM
Battery Pack	Nb. of units	8	Voltage / Capacity	**48 V / 468 Ah**
User's needs	Fixed constant load	1200 W	Global	10.51 MWh/year

Main simulation results				
System Production	**Available Energy**	**2136 kWh/year**	Specific prod.	1113 kWh/kWp/year
	Used Energy	2027 kWh/year	Excess (unused)	0 kWh/year
	Performance Ratio PR	75.38 %	Solar Fraction SF	19.28 %
Loss of Load	Time Fraction	79.4 %	Missing Energy	8485 kWh/year
Investment	Global incl. taxes	1943000 #	Specific	1012 #/Wp
Yearly cost	Annuities (Loan 0.0%, 0 years)	1943000 #/yr	Running Costs	0 #/yr
Energy cost		**959 #/kWh**		

Normalized productions (per installed kWp): Nominal power 1920 Wp



Performance Ratio PR and Solar Fraction SF



New simulation variant

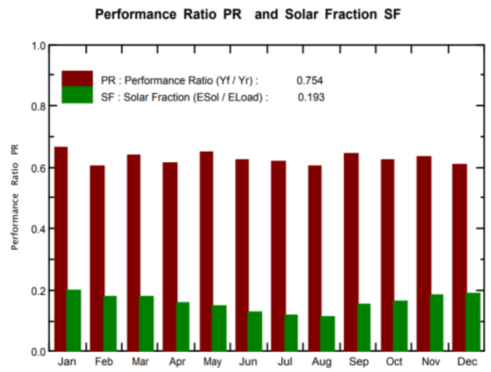
Balances and main results

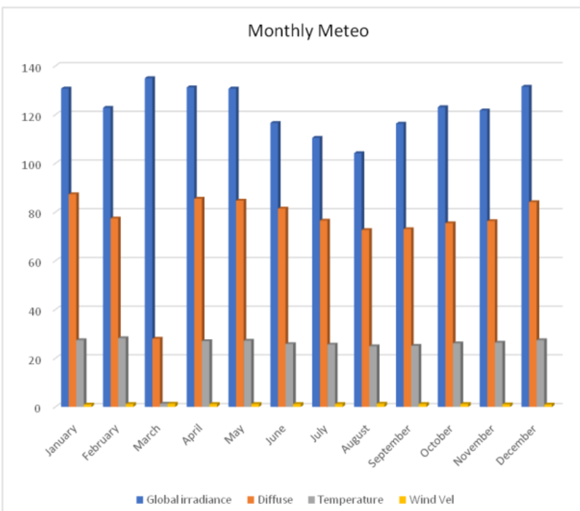
	GlobHor kWh/m²	GlobEff kWh/m²	E Avail kWh	EUnused kWh	E Miss kWh	E User kWh	E Load kWh	SolFrac
January	130.7	137.3	213.9	0.011	676.5	216.3	892.8	0.242
February	122.8	122.1	188.7	0.000	630.8	175.6	806.4	0.218
March	135.0	124.8	198.2	0.011	701.9	190.9	892.8	0.214
April	131.2	110.9	176.3	0.000	701.4	162.6	864.0	0.188
May	130.7	102.7	164.9	0.000	731.5	161.3	892.8	0.181
June	116.6	89.3	145.7	0.000	729.1	134.9	864.0	0.156
July	110.5	85.8	140.0	0.000	764.7	128.1	892.8	0.144
August	104.2	85.9	139.8	0.000	768.7	124.1	892.8	0.139
September	116.3	103.6	165.4	0.000	703.8	160.2	864.0	0.185
October	123.1	118.8	188.3	0.023	715.8	177.0	892.8	0.198
November	121.7	127.1	198.8	0.000	672.7	191.3	864.0	0.221
December	131.5	141.4	220.1	0.000	688.4	204.4	892.8	0.229
Year	1474.4	1349.6	2136.2	0.044	8485.3	2026.7	10512.0	0.193

Legends:

GlobHor	Horizontal global irradiation	E Miss	Missing energy
GlobEff	Effective Global, corr. for IAM and shadings	E User	Energy supplied to the user
E Avail	Available Solar Energy	E Load	Energy need of the user (Load)
EUnused	Unused energy (full battery) loss	SolFrac	Solar fraction (EUsed / ELoad)

Here is the main result gotten from the simulation, it shows the performance ratio (PR) and the solar fraction (SF) which is represented in the below figure of the main result





CONCLUSION

After all design and setup of a PV system, the major property to look out for is the performance which is a measure of the quality of a PV plant that is independent of location and it therefore often described as a quality factor. The performance ratio (PR) is stated as percent and describes the relationship between the actual and theoretical energy outputs of the PV plant.

The closer the PR value determined for a PV plant approaches 100 %, the more efficiently the respective PV plant is operating. In real life, a value of 100 % cannot be achieved, as unavoidable losses always arise with the operation of the PV plant (e.g. thermal loss due to heating of the PV modules). High-performance PV plants can however reach a performance ratio of up to 80 %.Considering the fact that the designs performance ratio is 75.4% it cannot be said that the system design is a good one.

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