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Optimization of Solar Energy Storage in a Battery for Hybrid Photovoltaic System

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Abstract: *Growing trend of intense usage of electric grids amid rising population, growing development and advancement in solar power generation technology, calls for using solar power as an emergency backup, and storage for non sunlight hours. Solar Panels afre widely used now-a-days which generates energy sufficient for day hours as well excess for storing for usage during night hours. However, Solar Energy so far has not been able to fully replace the conventional energy and thus author draws attention to optimize the storage along with usage of conventional power which is termed here as Hybrid Photovoltaic System. The hybrid system includes the day time usage of Solar power and night time usage of conventional power along with battery storage which stores the access daytime solar power and can be used as an emergency battery backup similar to what we use inverter for. These emergency storage can also be used in any disaster circumstances.*

Keywords: *Hybrid Photovoltaic System, Battery Storage, PV, Renewable, Solar*

INTRODUCTION

Solar PV and related technologies have advanced considerably, but even today diesel gensets continue to dominate disaster relief efforts. This is the time for considering the solar energy when planning for disaster management for vast cities, primarily the areas prone to natural disasters like flood, storms, earthquakes causing severe power outages and damages to vast areas and emergency response needed to save lives [1].

Solar power is best suited solution for its sustainable and stand-alone capabilities. It is not a question of whether solar power can be used for disaster relief, moreover it is a recommendation to switch to this alternative looking into the other disastrous consequences of depending on generator power and fossil fuel damaging the environmental stability and causing more threats for the disasters. This article intends to explore and identify possible solar applications for disaster relief and preventing power outages during disaster. The community is also interested in having solar powered schools and hospitals which are shelters and life savers during disasters [2].

The study is done by identifying and evaluating widespread solar equipment's which can be used in different situations of disaster mainly to recover the power outage caused by it. The effectiveness of various equipment's is also evaluated from disaster data and statistics available on the scale of damage caused and the amount spent on disaster rescue and relief. In addition, a pilot implementation of DC equipment based solar setup is done in a school which also acts as a shelter during disaster situations [3].

The data and statistics have been collected form the regional and national bodies from the energy and disaster management agencies [4].

RESEARCH ON SOLAR TECHNOLOGIES AND EMERGENCY PLANNING

As of late, there has been some utilization of photovoltaics in emergency requirements as an alternative to diesel generators. They have turned out to be a compelling option in contrast to gas or diesel control generators. PV modules can be a substitute for gas or diesel-controlled generators in a portion of the disaster activities. They are extremely basic frameworks which take into consideration fast reaction to a disaster. Lighting, water treatment, communications and so on are required by the disaster relief specialists to work and these can be quickly met with solar power [10]. The Florida Solar Energy Center (FSEC) and the National Renewable Energy Laboratory (NREL) have been the pioneers on utilizing photovoltaic power for crisis circumstances [11]. They have both created and utilized PV fueled disaster help in the repercussions of disasters. FSEC, for instance, gave PV gear to create control for safe houses and healing centers after tropical storms Andrew and Hugo. NREL has given specialized guidance to the Federal Emergency the executives Administration (FEMA). NREL has given direction on the best way to teach FEMA's staff on the employments of photovoltaics for disaster relief and for building disaster-safe networks.

SOLAR IS THE SOLUTION

As we are aware the fossil fuel is reducing at a very high rate and if we do not switch to other form of energy at this stage, we will leave nothing for our coming generations. Fossil fuel on the earth is finite. People won't be able to burn and derive energy any more beyond the lasting periods which is as close as the following for some of the fuels[17]:

(i) Coal ... 120 years

(ii) Oil .... 250 years

(iii) Nuclear fuel … 200 years

Moreover, how far is it justifiable for the energy packs, which have taken millions of years to form to consume in the next few generations. Just because the future generation is not present to bid today we are claiming our stake on the entire coal blocks and the oilfields.

Solar energy being abundant in nature is a suitable alternative at this stage, since we now have the technology to channelize this solar energy for power generation. Half of the earth is always receiving incessant energy in the form of solar radiation.

Two apparently separate patterns are at present impacting. One is the more extreme and broad harm being perpetrated on electric frameworks amid cataclysmic events, particularly from the inexorably more grounded tempests like tropical storm Maria that crushed Puerto Rico. The second is the numerous innovative advances in solar power age and vitality stockpiling, which additionally lead to progressing cost decreases over the solar esteem chain.

The possibility of utilizing solar power on an impermanent basis, including for disaster response and relief, isn't new, obviously. Practically, Hurricane Hugo in 1988 is accepted to be the first occasion when the solar power was utilized for recovery in the aftermath of severe disaster. Despite the way that solar PV and related innovations have progressed extensively amid the about three decades from that point forward, diesel gensets keep on commanding disaster aid projects. So, is it at long last time for the solar power industry to emphasize about this developing need?

THE CASE FOR SOLAR

The survey of the World energy resources gives an example of Latin America showing that the renewable energy portion of the energy matrix is reduced, and it is mainly distributed in two generation methods: hydropower and biofuels, representing 36% and 62% of the total renewable energy quota (World Energy Council, 2013) [19].

One concern regarding hydropower is that, besides the impact it generates to the environment, such as microclimate changes and flooding of large areas to create the required dams, it is also difficult to ensure energy continuity, as the availability is directly affected by rain seasons and droughts.

Large hydropower is also responsible of social conflicts, especially in sensitive areas like the jungle of Amazon. During the construction of hydroelectric plant "Tucuruí", in the rainforest of Brazil, about twenty-four hundred square kilometers of rain-forest were flooded, forcing near 30,000 people to leave their territories.

Biofuels are the natural fuels associated with conventional energy consumption for subsistence (like firewood and grass), while the industrial and mechanical forms relate broadly to the production of biofuels like ethanol.

Both traditional and industrial biofuels have been criticized for a variety of reasons. The popularly known is that even though biofuels have a reduced impact in the refining and production processes when compared to conventional, they fail to contribute to reduce industrial greenhouse gases and can lead to deforestation and other non-sustainable practices.

Considering the rainfall rates and the rugged topography of some of the countries, small hydropower plants becomes a good alternative for the supply of electric power, particularly in remote

places. Energy wave along with the tidal wave, together with other different forms of energy found in the sea, opens a huge energy prospect for continents in those areas.

In 2007, Intergovernmental Panel on Climate Change stated that only 12.4% of the total primary energy supply worldwide was delivered from sustainable power sources. Other sources of energy represented: 34% for oil, 26.4% for coal, 20.9% flammable gas and 5.9% nuclear energy [9].

The International Energy Agency (IEA) includes renewable fuels and waste (solid biomass, charcoal, renewable municipal waste, gas and biomass, liquid biomass), hydropower, solar, wind and tide as renewable energy sources, while non-renewable industrial and municipal waste sources are not included as renewable energy.

In developing countries, the solid biomass is by far the largest source of renewable energy, representing 9.3% of global total power energy supply (TPES), or 73% of the worldwide renewable energy source. The second biggest source is hydropower, which gives 2.2% of the worldwide TPES, or 17.7% of renewable energy. Geo-thermal is the third biggest renewable source, much lower, representing 0.4% of the global TPES or 3.3% of the renewable energy supply in the world as per the International Energy Agency, Renewables Information of 2016.

The contribution of the "new" renewable energy sources (solar, wind and tide) for the supply of energy is still very marginal, which represents about 0.2% of global TPES, or the 1.6% of the renewable energy supply. Since 1990, renewable energy sources have grown at an average annual rate of 1.7%. Development has been especially high for wind energy, which grew at a normal yearly rate of 25%. Moreover, this is because of to its very low base in 1990, and the generation is still very less. OECD nations (those belonging to the Organization for Economic Co-operation and Development) record most of the generation and growth of solar and wind energy. Photovoltaic solar energy and thermal solar experienced annual growth rate of 9.8%. The average annual growth rate of hydropower was of 3.7% between 1990 and 2007 in the non-OECD countries and only 0.4% for OECD countries.

Major Environmental and Economic Benefits to the customer include:

- The Solar Plant will generate 3 million kWh over 20 years [20]
- Diesel savings over 20 years will aggregate to 3.5 Lakhs Liters at Gangaganj MSC
- Equivalent to offsetting 2,000 tons of Carbon or taking 400 cars off the road
- Innovative financing solution: combination of part payment, capital subsidy and feed in tariff, with a per unit of cost of delivered electricity being cheaper than blended cost at MSC site of Rs. 9.5/kWh
- Annual Benefit due to Solar Plant - >INR 5 Lakhs / year
- Annual Diesel Savings – 18,000 Liters of Diesel / year
- Land Savings due to utilization of unused roof space & reduction in transmission losses

Time, and not the capacity or the cost, is currently the most basic factor for why solar power manages a suitable, and frequently prevalent, option to gensets for disaster recovery. At the point when quick failover from the electric grid is most critical, for what it's worth for medical facilities, it is hard to compete with backup generators powered by diesel fuel, fluid flammable gas or propane. Indeed, even a medical center on a solar-powered microgrid would almost certainly have a generator for power backup.

At the point when recovery can happen on the magnitude of hours or days, be that as it may, with systems being pulled or flown in, the playing field is currently genuinely level. For systems with a similar size and weight (counting battery stockpiling for the solar framework), the generator will probably have preference as far as kilowatts created. In any case, generators require fuel, which should likewise be pulled or flown in, and once as well as for whatever length of time that power is required.

This need to constantly refuel generators is the thing that gives solar its real favorable position: The more it may take to completely reestablish the electric lattice, the better the case for solar. This is particularly valid for secluded ground mount solar exhibits, which scale more effortlessly and cost-successfully than different designs (secured straightaway). What's more, the more extended the

recuperation time frame, the more prominent the preferred standpoint solar and storage arrangements appreciate.

SCALING SOLAR POWER

Amid times of disaster reaction, limited requirements for impermanent power can go from 100 watts to 100 kW, and this can likewise be leeway for solar. At the danger of over-improvement, versatile solar frameworks are accessible in four designs: bag, trailer, holder and full cluster. Every ha a task to carry out in various use cases in basically every disaster reaction and recuperation situation.

The bag is perfect for reestablishing interchanges by giving power to both convenient 3G/4G cells and client gadget charging stations. These frameworks, which can likewise be utilized to power some medicinal gear, extend in size from around 50 to 200 watts with somewhere in the range of 10 and 100 amp-long stretches of battery stockpiling.

The run of the mill trailer may have a 5-kW solar cluster and 100-200 kWh of capacity and can be completely operational in under 30 minutes. The higher limits make these reasonable for powering little restorative centers and safe houses.

Delivery compartments are usually used to transport gear and supplies amid disaster aid ventures, and they are additionally perfect for bundling an entire solar plus storage power station. A 20-foot compartment, for instance, could bolster up to 50 kW of power and 500 KWh of capacity to oblige bigger facilities, havens and organizations, just as little lodgings, flats, and water siphons or wells.

Those three frameworks are financially accessible in various sizes to address diverse issues, for disaster alleviation, as well as for transitory/strategic arrangements, for example, those required by the military. What has been missing for solar power is an arrangement that scales more expense adequately, and the convenient and ground mount solar cluster is presently filling this need.

Making measured ground mount solar exhibits compact and reasonable for disaster reaction and recuperation necessitates that the whole framework—including its establishment—be installable rapidly by little groups utilizing just handheld instruments. The earth stays, which has for some time been utilized by electric utilities for fellow wiring powerline posts, gives the fundamental innovation expected to make such basic establishment conceivable.

For instance, an entire, pre-gathered 5-kW framework, which can be conveyed collapsed on a trailer or truck, or in a delivery compartment, can be introduced by a three-man group in around 60 minutes [21]. The whole framework is similarly as fast and effectively uninstalled (to be "lifted and moved" to another site or put away in anticipation of the following disaster), deserting just the moderately modest earth stays, and those can even be expelled whenever required.

Notwithstanding there for all intents and purposes boundless versatility, these "brief" secluded ground mount solar frameworks have one other favorable position that likewise includes time: They can wind up lasting in appropriated microgrids, even in sea tempest inclined spots like Puerto Rico. Thorough testing in wind burrows has guaranteed a standard earth stay as having the capacity to anchor inspire powers caused by 150 miles-per-hour winds—a class 4 storm. For more noteworthy security, more grounded or potentially extra earth grapples can be utilized.

A CALL FOR ACTION

A generator on its own will be cheaper to begin with, but ongoing fuel costs are hefty, working out in current fuel costs 40p kWh [22]. This means the average house that uses 4,000kWh per year will end up paying £1,600 per year [12]. This is only going to increase. Once solar PV is installed, it will provide free energy for the life of the system, which is well over 30 years. On the off chance that each industry engaged with solar power generation or storage take some initiative in disaster response and recovery activity, regardless of whether alone or in organizations, this wellspring of sustainable power source could put a noteworthy imprint in diesel's predominance. To help with aid ventures in Puerto Rico and demonstrate the suitability of secluded ground mount solar and storage, the solar enterprises gave 10 finish frameworks, each comprising of an Osprey PowerPlatform, 16 solar panels and an Eco Intelligent Battery System (EIBS), alongside any staff assets required. Given that the utilization of diesel and other

non-renewable energy sources adds to storms getting to be more grounded and increasingly visit, it truly is the ideal opportunity for the integration of disaster management with Solar Technology for Disaster Relief.

CONCLUSION

In this way, investigating the developing pattern of progressively serious harm on electric grids amid cataclysmic events, and mechanical advances in solar power generation and power storage, the possibility of utilizing solar power as a crisis reinforcement, including for disaster response and recovery is developing. Solar PV and related innovations have progressed extensively, however even today diesel gensets keep on commanding disaster aid ventures. Anyway, is it at last time for the solar vitality industry to get serious about this developing need? In any disaster circumstance, restoring power winds up a standout amongst the most urgent parts of disaster recovery. rapid-deployment of solar energy could potentially bring quick normalcy in the disrupted lives of the people affected by such calamities. Time, and not the capacity or the cost, is currently the most basic factor for why solar power manages a practical, and regularly prevalent, option to gensets for disaster help. At the point when prompt failover from the electric lattice is basic, all things considered for medical facilities, it is hard to contend with backup generators powered by diesel fuel, fluid gaseous petrol or propane. For portable solar, it isn't important to have solar designers measure the specific site and ascertain explicit solar field positions and arrangements before sending. For instance. Rapid Roll framework is a portable solar innovation which spread out solar panels like a cover from behind a truck with it's high-proficiency solar panels that could help create emergency power in disaster zones, which convey enough solar panels to power a medical facility with 120 beds powering mobile clinics in disaster zones and lessening or wiping out the requirement for non-renewable energy source caravans [18]. At the point when reaction can happen on the request of hours or days, the generator will probably have leverage as far as kilowatts delivered. In any case, generators require fuel, which should likewise be pulled or flown in, and once as well as for whatever length of time that power is required. This need to consistently refuel generators is the thing that gives solar its significant preference: The more it may take to completely reestablish the electric grid, the better the case for solar. Amid times of disaster reaction, restricted requirements for impermanent power can run from 100 watts to 100 kW [23], and this can likewise be favorable position for solar. At the danger of over-improvement, convenient solar systems are accessible in different arrangements i.e. suitcase, trailer, container and full array. Each has a role to play in different use cases in virtually every disaster response and recovery situation. Given that the utilization of diesel and other petroleum products adds to storms getting to be more grounded and frequent, it truly is the ideal opportunity for the solar business to get serious about disaster response and recovery.

LIST OF ABBREVIATIONS

TW	Terawatt
AC	Alternating Current
DC	Direct Current
KWH	Kilo-Watt Hour
AHr	Ampere Hour
UPS	Un-Interrupted Power Supply
PV	Photo Voltaic
ROI	Return on Investment
UPNEDA	Uttar Pradesh New and Renewable Energy Development Authority
MNRE	Ministry of New and Renewable Energy
SECI	Solar Energy Corporation of India
UPPCL	UP Power Corporation Limited
MW	Megawatt
PV	Photo Voltaic
IOT	Internet of Things
ICT	Information and Communication Technology

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