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BATTERY UTILIZATION IN PLACE OF DUMMY LOAD FOR LOSS MINIMIZATION IN HYBRID ENERGY SYSTEM

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ABSTRACT

The latest trend in electricity is deployment of renewable sources in power generation. It has also accelerated the growth of battery utilization. Batteries in the power sector can be employed in a variety of ways and for multiple time periods, ranging from seconds to hours .The batteries applications like storage, frequency and voltage regulation, LVRT, transmission curtailment, oscillation damping, load following etc. are popular mostly where wind generation is the part for power system. The variation in the load and generation requires stabilizing elements for uninterrupted power supply .This paper investigate the new hybrid model and aims at replacement/elimination of dummy load with the battery to minimize losses in the system.

Keywords: LVRT, dummy load, oscillation damping

I INTRODUCTION

In countries around the world, there are many communities/islands not served by national or regional electric grids. In many of these communities, power is generated by small diesel power plants that range in size from about 100 kW to several MW. Diesel generators are by far the lowest capital cost electric generation technology in the sub- MW size range. These are a well-established and well-understood technology and there is a worldwide support infrastructure in place. When properly designed for continuous running, properly operated and maintained these generators are also very robust and reliable. However, diesels also have major disadvantages. They too emit significant smoke, cause air pollution and can be noisy. Though relatively cheaper on the world market, transportation costs can make diesel fuel very expensive in remote locations. The risks of major fuel spills are greater because diesel require frequent oil changes and other services at regular intervals. These generators have a relatively high maintenance cost per kWh delivered.

The latest trend is to renewable these off grid connected power plants, but there are many constraints such as stability and dummy load requirement. Mostly the hybrid systems consist of diesel as the reference machine, wind and solar generation. Remotelocation usually has smaller landarea, anddo not have enough availability of renewable sources throughout the year.So, the generation is based on diesel generation in most of the cases.

An overview of the case study and observation:

A case study was taken of the proposed hybrid system of wind and diesel meeting the daily demand of load for an island Kavaratti,Lakshadweep inIndia. This report was prepared by National Institute of Wind Energy,Chennai in 2011. The power flow by the Wind turbines and Diesel generators is shown below in the table 1. An analysis was made with the table and it was observed that there was dummy load usage one times during the peak wind generation an doff peak load.

Plant description:

There are five Diesel sets installed twowith rating 1000kw and three of 600kw.The entire electricity demand is met through these generators only.There was a proposed wind diesel system to meet the electricity demand and reduce the dependency of the system on diesel.Three demands were considered with different scenarios and presented in the table below.

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No.	Case Description	Month	kW	Dumped Load in kW			Wind Generation						Diesel Generation			
				Stage 1 load = 50 kW	Stage 2 load= 100 kW	Stage 3 load= 150 kW	WTG1 250kW	WTG2 250kW	WTG3 250kW	Total wind generation in kW	DG1 1000 kW	DG2 1000 kW	DG3 1000 kW	DG4 600 kW	DG5 600 kW	Total DG generation in kW
1	Base Case(a)- System peak load with no wind generation	January	1530	OFF	OFF	OFF	-	-	-	-	0	0	550	542	450	1542
2	Base Case(b)- System Minimum load with no wind generation	January	790	OFF	OFF	OFF	-	-	-	-	0	0	343	450	0	793
3	Case-1 :2011 System peak load without wind generation	July/ August	1870	OFF	OFF	OFF	-	-	-	-	700	739	-	450	-	1889
4	Case-1a :2011 System peak load with maximum wind generation –WF pooling at HT.	July/ August	1870	OFF	OFF	OFF	250	250	250	750	0	0	700	450	0	1150
5	case 1b: System peak load with maximum wind generation –WF pooling at HT with capacitor bank at Fisheries	July/ August	1870	OFF	OFF	OFF	250	250	250	750	0	0	699	450	0	1149
6	case 1c: System peak load with average wind generation – WF pooling at HT with capacitor bank at	July/ August	1870	OFF	OFF	OFF	160	160	160	480	0	0	512	450	450	1412

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	Fisheries															
7	Case 2:2011 System peak load with maximum wind generation for 2011 – Wind Farm pooling at LT	July/ August	1870	OFF	OFF	OFF	250	250	250	750	0	0	710	450	0	1160
9	Case-3: -System Minimum load with maximum wind generation for 2011 .	July/ August	790	OFF	**ON**	**ON**	250	250	250	750	0	0	306	0	0	306
10	Case-3a: -System Minimum load with average wind generation for 2011 - WF pooling at HT.	July/ August	790	OFF	OFF	OFF	160	160	160	480	0	0	318	0	0	318
11	Case 4: -2011 System peak load with minimum (20% of maximum generation) wind generation – Wind Farm pooling at HT. with cap bank at fisheries	- January	1870	OFF	OFF	OFF	50	50	50	150	0	587	700	450	0	1737
12	Case 5:-2011 System Minimum loadwith Minimum(20% of maximum generation) wind generation-Wind farm pooling at HT	July/ August	790	OFF	OFF	OFF	50	50	50	150	0	0	643	0	0	643

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Case 3 Description: With peak wind generation and off peak system loads

During the system minimum load of 790 kW and peak wind season, 750 kW can becatered from wind generation and remaining power has to be scheduled from DGs. During this scenario a dump load of 150kW can be switched ON to ensure that DG is loaded to minimum of 30%.DG3 is loaded up to 30% of its capacity and at least one DG set is needed as back up for varying wind generation.During peak wind season and system minimum load, the DG may have to run less than 30% of its capacity which lowers its efficiency and may have operational Difficulty.Therefore, a dumped load of 250kW in steps of 50kW, 100kW and 150kW in termsof any resistive/heating loads may be connected at the pooling station. Consideringthe system load and wind generation profile these loads can be switched on.

The batteries deployment in such cases can be a solution to prevent losses and maintain stability. Batteries can be an optimal solution in place of dummy load. Already batteries have been popularly employed for various purposes in the hybrid system.

Previously the system was designed without batteries and solar, and it was found that dummy load was required for a particular case which alone result in losses oh 250kW.It is necessary to minimise loses to attain higher efficiency.Therefore the system was redesigned to eliminate dummy load which completely results in losses.The new model description is given below:

New Model Description

The new proposed model consists of three DG sets, battery bank and solar PV.The size description is given below in the Table2. The optimization of size and battery was done using software HOMER.The optimized battery bank size consists of 21 strings in parallel each consist of 40 batteries of size 1kwh and 12Volt.

Technology	Model	Size selected
Generator1	Diesel	2x1000kw
Generator2	Diesel	3x600kw
Converter		200kw

Wind turbine	WES30	3x250kwturbines
Solar PV	-	1200kw
Batteries	Lead Acid	840 kWh

Table:2 Description of new hybrid system

II RESULT AND DISCUSSION

It was observed that the state of charge of battery was 100kW during the month of July .And the discharge rate of the battery was around 50kW as shown in figure 1 and 2respectively.From the powerflow table it was concluded that the early morning demand was satisfied with the wind and diesel. Now with the new hybrid system the 790kW load is met through wind and battery only. No diesel set is required.Wind is feeding 750 kW power whereas battery is feeding rest 40Kw.

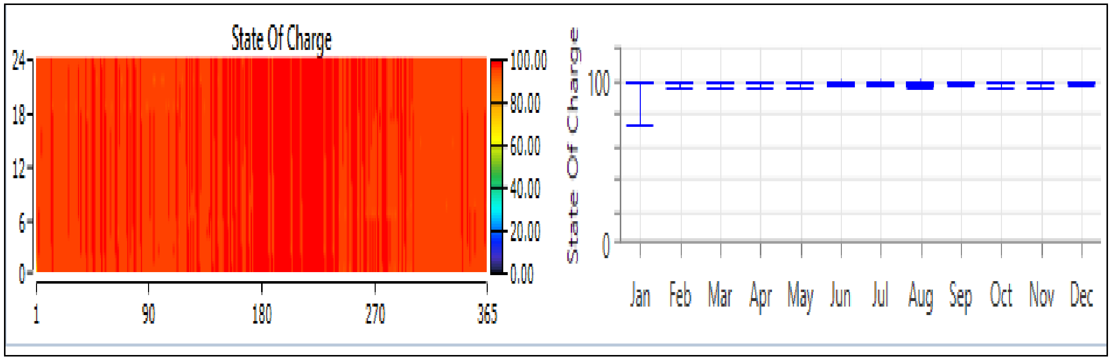

Figure1: State of charge of battery in kW of different months

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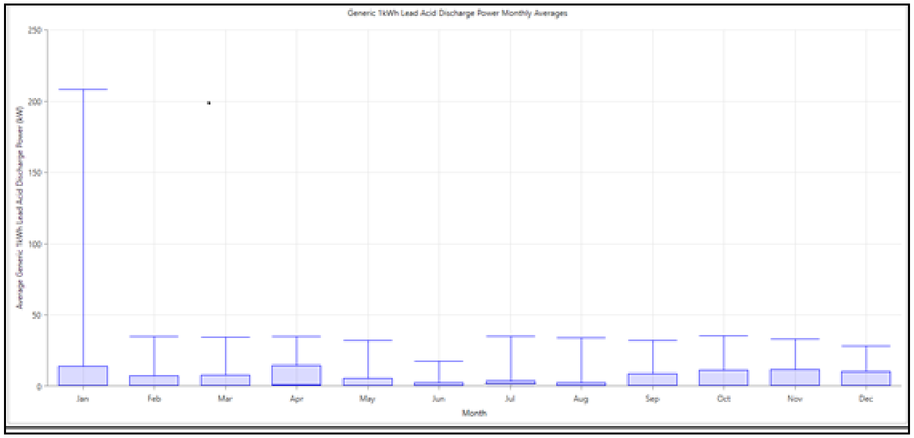

Figure 2: Monthly profile of State of Discharge of battery

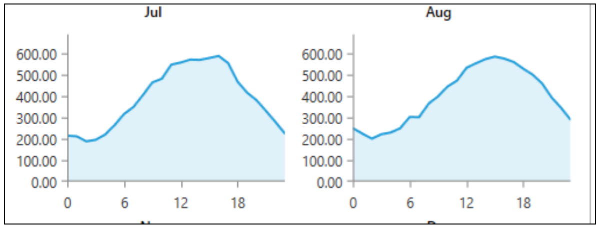

Figure 3: Daily profile of power generated from wind(power generated in kwvs. hours)

The battery discharge graph shows that the battery has capacity to discharge up to 40kW.The losses were around 859kwh/year where previously 250kW losses were there alone for an typical scenario in month of July/august as mentioned in case 3.

III CONCLUSION

The new model with battery is an optimized solution for the case study with minimum losses.The implementation of the battery in the system has successfully eliminated the requirement of dummy load.

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