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1 Probabilistic Operation Cost Minimization of Micro-Grid

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7 Abstract—In recent years due to the increasing integration of Renewable Energy Sources (*RES*) into the
 8 Micro-Grid (*MG*), necessity of Battery Energy Storage (*BES*) has increased quickly and size of *BES* plays
 9 vital role in this regard. Present paper aims to minimize total operation cost of *MG* in presence of *BES* of
 10 optimal size, by considering uncertainties present in the *MG*. Here, $2m$ point estimate method (PEM) has
 11 been applied to model the uncertainties in load demand, market prices and available power from *RES* in
 12 the *MG*, as it is computationally efficient and reliable probabilistic method. Moreover, Gram-Charlier
 13 expansion is used to provide more accurate probability distribution of *MG* operation cost. Classical
 14 techniques may be applied here to solve the problem, but these techniques may increase complexity of the
 15 problem and hence may affect the accuracy. As evolution of soft computing techniques are not
 16 restricted by the complexity of system model, therefore Swine Influenza Model Based Optimization with
 17 Quarantine (SIMBO-Q) and Whale Optimization Algorithm (WOA) have been applied here to minimize
 18 operation cost of *MG*. Simulation results obtained by SIMBO-Q and WOA prove the effectiveness of the
 19 algorithms. Here incorporation of *BES* of optimum size reduces operation cost of *MG* effectively.

20 *Keywords:-* Distributed Generation; Micro-Grid; Uncertainty; Battery Energy Storage; Swine Influenza
 21 Model Based Optimization with Quarantine; Whale Optimization Algorithm

22 Nomenclature:

23 *Indices:*

24 *PV, WT* indices of Photo-Voltaic (*PV*) and Wind Turbine (*WT*) respectively

25 *MT, FC* indices of Micro-Turbine (*MT*) and Fuel Cell (*FC*) respectively

26 *BES, grid* indices of Battery Energy Storage (*BES*) and grid respectively

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