MICROGRID ENERGY MANAGEMENT SYSTEM USING GENETIC ALGORITHM

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Abstract:

Microgrids are to play vital role in the electric power system of the near future, because microgrids are incorporate with EMS, RER, DER, DES.The (EMS) which performs the balancing task between the produced and consumed energies and solve an optimization problem, and communicate back to each distributed energy resources (DER) its correct allocation of energy. MGEMS can regulate power flow for each source depend on the output's commands from the optimization program. Microgrid energy management system (MGEMS) can coordinate the operation of MG in grid-connected mode or in islanded mode. the power generation in a microgrid including wind plants, photovoltaic (PV) plants and a combined heat and power (CHP) system. In order to evaluate the performance of the proposed approach So, this paper proposes Genetic Algorithm is applied to the Microgrid energy management system (MGEMS) to analyses the function of the system.

Index terms: *Microgrid, Energy Management System, Distributed Energy Resources, Distributed Energy System. Genetic Algorithm.*

I.INTRODUCTION:

Now a days large-scale distributed power sources have been widely integrated into power systems in the form of microgrids (MGs). The MG units require an accurate economic model to describe the operating cost taking into account the output power produced. Microgrids are always helpful to interchange the power through major grid and/or other microgrids based upon the electricity price and trading conditions, so optimization tools are needed to reduce the operating costs to a minimum level. Sparse of researchers to analyze the optimization problems over the energy management system in the microgrid.

In microgrids, the payload is right off the bat met by the DERs, BecauseDERs are utilized to improve the force framework activity by decreasing contamination gas discharges, expanding vitality save and adding to promotive amenities. As of late, the consideration of littler lender has been situated toward entering the vitality advertise particularly power propagation in microgrids.Energy management system, with affectability investigation for vitality stockpiling limit venture and power load request development, for looking through ideal working strategies for augmentation of benefit in a microgrid framework in Taiwan is introduced in [1]. Energy management system to assign the forward to initiations sources in microgrid to play a part in the power systems and reduce world energy

management costs, Because Energy management system to stabilize the produced and consumed energies [2].

Based on this assumption that at each hourthe accessible DERs have the capacity of providing the mentioned power, the EMS can choose which DER (in which extent) ought to be utilized to give the mentioned power. the EMS can take vitality from the capacity frameworks, virtual force plants (VPPs) and utility network. Ideal force planning is a decent technique to minimization of the imperative expense. Because of the intricacy of intensity framework, load vulnerability, stochastic nature of the force delivered by RERs and enormous number of end-clients and DERs, constant force planning and adjusting issue is at present an essential and testing region of exploration in microgrid condition. The microgrid comprises of wind power, consolidated warmth and force (CHP) framework, battery and network power. In [3], optimal power management of a microgrid including RESs and capacity gadgets has been tended to by control of charging and releasing paces of individual batteries. the most significant destinations is the capacity to improve the framework's situational mindfulness and take into account quick acting changes in power age. Thus, EMS will be confronted with troublesome issues as far as correspondence and control. As per the past examinations, it is seen that the force booking issue has been concentrated from various perspectives, yet the thoughtfulness regarding this issue from the enhancement perspective is once in a while explored. In this paper, another streamlining agent dependent on hereditary calculation (GA), has been created to ideally share the requested force among various DERs by the base creation cost. Created in 1975 by Holland [4], GA is one of the most well-known developmental streamlining calculations which attempts to locate the ideal arrangement of advancement issues by stochastic standards. A microgrid including wind plants, PV plants and CHP has been considered to assess the presentation of the proposed approach.

II.PROBLEM DEFINITION

Generation cost

EMS faces with an enormous number of ways for sharing the mentioned power among DERs. The most ideal way is that one by which the force age cost is limited. To arrive at this objective, a quadratic capacity which is a typical acknowledged cost work for DERs in microgrid writing is considered for streamlining as follows [5,7]

Cost function

$$C = [\alpha_i \times P^2 + \beta_i \times P_i + \gamma_i] \quad (1)$$

where C = hourly cost,

i= no of variable i^{th} DER,

P=generated power by DER (MW),

α, β &γ=the function coefficients which depend on the DER technology (fuel cost, efficiency, etc). Among the function coefficients, α introduces nonlinearity in the optimization problem

Objective function and constraints:

Generation cost of the necessary force, an objective function (OF) is characterized dependent on a quadratic expense work for each DER. The all expense of the vitality creation in the microgrid is the rundown of the generation cost of each DER. To accomplish the adjusting appraisal of EMS, the generated energy ought to be equivalent to the mentioned power [1]. To below mentioned optimization should be give the solution for the scheduling problem at every hour .

$$\sum_{i=1}^{NDER} [\alpha_i \times {P_i}^2 + \beta_i \times P_i + \gamma_i] \quad (2)$$

$$\sum_{i=1}^{NDER} P_i = P_l \quad (3)$$

Where Pl is the requested power to solve this problem, the energy transformation of every DER is contemplate as a recommended variable. The recommended variables into a vector and make a solution $x = [x1\ x2\ \dots\ xi]$. In this paper, there are three wind plants, three PV plants and two CHP as DERs. So, the number of the recommended variables is eight and each solution is represented by $x = [Pwp1\ \ Pwp2\ \ Pwp3\ \ PPV1\ \ PPV2\ \ PPV3PCHP1\ \ PCHP2]$ where *Pwp1*, *Pwp2*, *Pwp3*, *PPV1*, *PPV2* *PPV3* ,*PCHP1*and *PCHP2*are the output power of wind plant 1, wind plant 2, wind plant 3, PV plant 1, PV plant 2 ,PV plant 3 ,CHP1and CHP2.In optimization theory, the route by which the fairness limitation is taken care of is a difficult issue. By utilization of penalty function, an improvement issue with balance limitation is changed over to a streamlining issue without fairness imperative whose number of the recommended variables are same as those of the actual issue. By penalty function recommended minimization of microgrid equation defined as

A. Minimize objective function

$$\sum_{i=1}^{NDER} [\alpha_i \times P^2 + \beta_i \times P_i + \gamma_i] + P_f \left| \sum_{i=1}^{NDER} P_i - P_l \right| \quad (4)$$

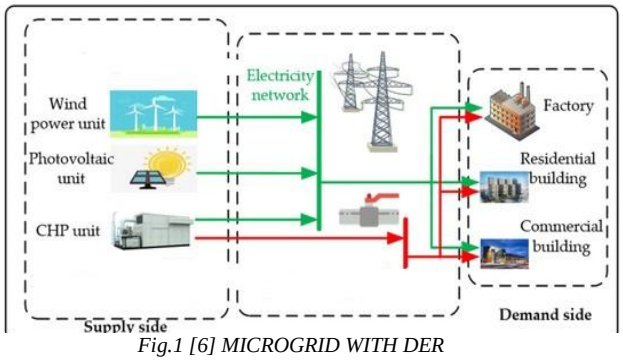

Fig.1 [6] MICROGRID WITH DER

As Fig. 1 shows[v], at every hour, the EMS ought to ideally share the mentioned power among the accessible DERs so that the heap is met and the estimation OF is limited. This objective can be accomplished by the assistance of a proficient enhancement calculation. As for the DERs considered in this paper, Eq. (3) is communicated as follows:

$$[\sum_{i=1}^{NDER} [\alpha_i \times P_i^2 + \beta_i \times P_i + \gamma_i]] + P_f \times | P_{wt1}+P_{wt2}+P_{wt3}+P_{pv1}+P_{pv2}+P_{pv3}+P_{chp1}+P_{chp2}-P_l | \quad (5)$$

III.GENETIC ALGORITHM

GA is one of the most well-known calculations which endeavors to copy the procedure of characteristic determination [8]. In GA, every arrangement is called chromosome. To execute GA, the accompanying advances ought to be utilized:

Step 1: *Initialization*-

From the start, a populace of N chromosomes is esteemed in the pursuit space. Every chromosome has d qualities where d indicates the number DERs. Chromosome iis appeared by a vector, where is quality d of chromosome I. The network of populace is appeared by X as follows:

$$\mathbf{x} = \begin{vmatrix} P_{wt1} & P_{pv1} & P_{chp1} \\ P_{wt2} & P_{pv2} & P_{chp2} \\ & & \\ & & \\ P_{wt8} & P_{pv8} & P_{chp8} \end{vmatrix}$$

Step 2: *Objective function evaluation*- For each chromosome, the related qualities (choice factors) are placed into the target capacity and its worth is determined.

Plant	α	β	γ

wind Plant 1	0.0027	17.83	4.46
wind Plant 2	0.0026	17.54	4.45
wind Plant 3	0.0025	17.23	4.44
PV Plant 1	0.0055	29.30	4.45
PV Plant 2	0.0055	29.58	4.46
PV Plant 3	0.0055	29.86	4.47
CHP1	0.0083	75.73	5.21
CHP2	0.0083	75.73	5.21

Table1. Cost coefficients of the microgrid DERs.

Step 3: *Selection*- Preference of N chromosomes by a methodology based of natural selection and moves them to the mating pool. Here, as one of the most well-known determination administrators, roulette wheel approach has been utilized to choose the chromosomes. In roulette wheel, the chromosome with better OF esteems have progressively possibility of being chosen. In this methodology, the fittest chromosomes might be remembered for the
mating pool more than one time.

String No.	Initial Population	X Value	Fitness Function	Prob $F_i/\sum F_i$	Exp Count (F_i/F_{avg})	Actual Count
1	01101	13	4050	0.27	1.08	1
2	11000	16	2850	0.19	0.76	0
3	01000	8	6050	0.40	1.61	1
4	10010	18	2050	0.13	0.54	0

Table2.Minimization of cost using GA

Where penalty factor =50 and Required power=185kw ,Sum=15000, Average=3750, minimization=2050

Step 4: *Crossover*- Applying the crossover operator, two chromosomes (as guardians) are arbitrarily chosen from the mating pool and two posterity are produced. Hybrid administrator is applied by the likelihood of Pc. By the likelihood of 1 – Pc, the chose chromosomes are straightforwardly moved to the people to come. Frequently, curved hybrid is utilized to consolidate guardians and produce posterity. In the event that an and b are the guardians and abdominal muscle and ba are the produced posterity, the posterity is as per the following:

String No.	mating pool	crossover point	offspring after crossover	x value	fitness
1	01101	13	01100	12	4450
2	11000	16	10001	17	2450
3	01000	8	11010	26	1150
4	10010	18	10000	16	2850

Table3.GA Crossover

Sum=10900, Average=2725, minimization=1150

Step 5: *Mutation*- Mutation operator is applied by the likelihood of Pm to every quality of the posterity generation. the estimation of the transformed quality is supplanted by an arbitrary incentive from the conceivable range.

String No.	offspring after crossover	offspring after mutation	x value	fitness
1	01100	01100	12	4450
2	10001	10100	20	1250
3	11010	11010	26	1150
4	10000	10000	16	2850

Table4.GA Mutation

Sum=9700, Average=2425, Best iteration=1150

Step 6: *Evaluation of offspring generation*- The objective function value is calculated for every chromosome of the offspring generation results as follows.

[[3.04793048 0.77077211 -3.23021702 -3.02669935 1.61734874 -0.79737548

-0.28707356 2.79577343]

[2.17264574 3.16358558 3.82187776 1.73776866 -0.65208759 3.33260272

2.8407078 1.5909232]

[-0.46053259 2.25196124 0.55878385 -0.34965408 -2.35173202 3.77887779

[[-3.79260252 0.53991028 3.9868684 -0.49950346 1.58504633 -0.41525955

0.43884787 3.93051852]

Step 7: *Replacement*- N chromosomes ought to be chosen among the parent and posterity chromosomes as the number of inhabitants in the next generation. Regularly, the posterity age is considered as the number of inhabitants in the cutting edge just the most noticeably terrible chromosome among the posterity age is supplanted by the best chromosome among the parent chromosomes.

Step 8: *Termination criterion*- Stages 4 to 7 are rehashed until greatest number of ages (gmax) is reached. At last, the best chromosome is returned as the ideal arrangement of the issue viable

IV.CONCLUSION

Optimal scheduling of power generation among different DERs in a microgrid needs a robust and well-organized optimizer which is able to escape local optima. based on GA, In order to evaluated the performance of the proposed microgrid energy management system.

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