META HEURISTIC ALGORITHM FOR PLACEMENT OF EVs AND DGs IN CONVENTIONAL AND RENEWABLE ENERGY

P.RIZWAN
Asst.Professor
Dept of Electrical and Electronics Engineering
JNTUA College of Engineering (Autonomous)
Anantapur, India

MANJULA GANESH
M.Tech(Electrical Power System) Scholor
Dept of Electrical and Electronics Engineering
JNTUA College of Engineering (Autonomous)
Anantapur, India

Y. MANASA
Asst. Professor
Dept of Electrical and Electronics Engineering
JNTUA College of Engineering (Autonomous)
Anantapur, India

ABSTRACT

The best solution for reducing pollution from transportation is to use electric automobiles. Due to its sustainability and low green house gas emissions, electric vehicles are predicted to become the primary mode of transportation in the future. Due to the misuse of conventional vehicles, there is a sustained rise in temperature and a significant release of carbon dioxide that has a negative impact on the environment. Because of the uneven rains and temperature rise brought on by global warming, the earth's biological system is harmed. In order to combat the environmental consequences of the traditional mode of transportation, an electric mode of transportation, i.e., battery-based transport, is required. Proper integration of Electric Vehicle Charging Stations (EVCS) at the right locations is crucial to resolve the problems brought on by the increased penetration of electric load. New difficulties will arise when an EVCS is connected to the power grid. In order to reduce this environmental calamity, renewable sources like wind turbines and photovoltaic systems are used in place of conventional sources due to their limits. On the other hand, using solar or wind energy to charge EVs fully maximises their advantages. By overcoming them, this study's charging stations and Distribution Generator (DG) units work together to improve voltage profiles, reduce active and reactive power losses, and increase the drive to use electric vehicles and renewable energy sources. This work uses a meta-heuristic method called "Whale Optimization Algorithm (WOA)" to analyze the fitting nodes for DGs and Electric Vehicle Charging Stations in biased distribution systems. The suggested approach will be examined on the IEEE-33 bus system in MATLAB software.

Keywords:- Electric Vehicle Charging Stations (EVCS), Whale Optimization Algorithm (WOA), Distribution Generator (DG).

I. INTRODUCTION

A balanced distribution system, which connects low voltage service mains with high voltage transmission lines, is a crucial component of the power system. For appliances, machinery, and other devices to operate properly, power quality must be maintained. To do this, system losses must be kept to a minimum and voltage must not exceed predetermined limits. According to data, the overall losses in the distribution system range from 5 to 13 percent of the total power generated. While the significant rise in temperature and widespread emission of carbon dioxide as a result of the environment suffers when conventional vehicles are used excessively. Therefore, a different mode of transportation that relies on an electric field, such as battery-powered transportation outweigh the negative effects on the environment that the conventional mode of transportation causes.

Furthermore, EVs [1] the purpose of using EVs is not achieved with the charged EVs power sources. The impact of EVs on the electrical distribution system is investigated utilizing various EV scenarios and charge management approaches.

EVCS[2] integration in to the distribution scheme increases the network's overall load. The ascent of these EVs can accurately modelled and distributed by system, the formation of EVCS may be studied. EVCS in a distribution system has an impact on the load profile during the charging process. Based on the uncertainty around the number of EVs to be charged, the best position for EVCS in the IEEE 33 bus radial networks has been discussed. Following the best DG[3] distribution in the distribution system, the bus with the greatest number of EVs in the system will be treated as an EVCS.

These include the Genetic Algorithm (GA)[4], Particle Swarm Optimization (PSO)[5], Harmony Search Algorithm (HSA)[6], Cuckoo Search Algorithm (CSA)[7], Whale Optimization Algorithm (WOA)[8], Grey Wolf Optimization (GWO)[8], etc. The techniques that are currently popular for the best placement of DG based on artificial intelligence[9].

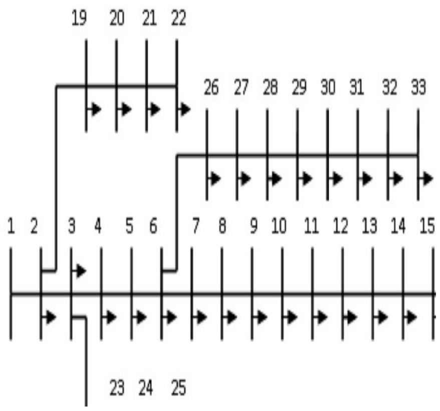

Fig.1. IEEE-33 bus radial distribution system

A search-based load flow method[10] is used to construct objective functions since it is quicker and more efficient. The distribution system's dependability is investigated. DG units have been properly introduced to eliminate active power losses from the distribution system, increasing the voltage and the voltage profile stability metric. Using DG units and EVCS together to increase the reliability of the distribution network. The outcomes of the simulation on test networks using the IEEE 33 bus standards to show the effectiveness of the suggested WHALE OPTIMISATION, HGWO and PSO.

The following steps are taken in order to finish the donations listed above: Section II and Section III provides the explanation and problem's mathematical formulations of two methods named as Gray Wolf Optimization and Particle Swarm Optimization along with the results respectively. Entire Whale Optimization parameter concepts and explantions are given in Section IV along with suggested optimization process. The key conclusions, comments, and methodology comparisons are presented in section V. Conclusions and future scope are provided in section VI.

II. GRAY WOLF OPTIMIZATION:-

In 2014 saw the initial introduction of GWO by Mirjalili. It draws inspiration from the way Grey Wolves hunt and behave in the wild. In a pack, they adhere to a rigid leadership structure. Alpha (α) wolves are the group's leaders. Two classifications exist for grey wolves. The other pack members are classified in the second group, while the alpha falls within the first. They help the leaders. They go by the moniker of beta (β) wolves. Additionally, wolves in the delta (δ) category are less important than wolves in the preceding two groups. Their objective is to yield to beta and alpha wolves while retaining power over omega wolves. The wolves with the lowest priority are known as the omegas (ω), as thus they have to submit to the lead grey wolves. The GWO approach has the following mathematical representations.

2.1 GREY WOLVES' SOCIAL HIERARCHY

The best possible answer in the mathematical description of the grey wolf hierarchy is referred to as alpha wolf. Therefore, delta is the third best option and beta wolf is the second most acceptable answer. The furthest solutions are represented by the omegas. In the GWO technique, alpha, beta, and delta direct the hunting process. The omegas should only obey the wolves with greater priority and take the same actions as them.

2.2 CAPTURING THE TARGET

When hunting, the grey wolves surround their victim. Two equations, (1) and (22), can be used to simulate the encirclement of grey wolves.

$\vec{K} = |\vec{C} \cdot \vec{P}_k(it) - \vec{P}(it)|$ ... 1

$\vec{P}(it+1) = \vec{P}_k(it) - \vec{D} \cdot \vec{K}$ ... 2

Where it is current iteration, $\vec{P}$ and $\vec{P}_k$ denote the position vector of a grey wolf and the prey respectively. $\vec{C}$ and $\vec{D}$ be a sign of coefficient vectors and are intended by the following equations

$\vec{D} = 2 \cdot \vec{a} r_1 - \vec{a}$ ... 3

$\vec{C} = 2 \cdot r_2$ ... 4

$\vec{a} = 2(1 - \frac{it}{Max\ iter})$ ... 5

Here r_1 and r_2 are random numbers between 0 and 1. $\vec{a}$ Component is decreased linearly from 2 to 0 over the course of the iterations

Throughout all rounds, the value of −→a decreases proportionately from two to zero.

2.3 GREY WOLF HUNTING MECHANISM

Mathematically to simulate the hunting behavior of grey wolves, assume that α, β and δ have better information concerning about the potential position of the prey. So the first three best are saved for compelled to update their positions according to their best positions.

Because they are better at spotting the position of the prey, the alphas, betas, and deltas frequently direct the hunting process. The position of the ideal mediator must be followed by the remaining exploration mediators, who must then make any necessary changes.

2.4 THE GREY WOLVES ATTACKING PROCESS

A is a number in the interval [−2a, 2a]. When |A| exceeds unity, the wolves will strike their victim. Exploration is the process of identifying the prey, whereas exploitation is the capacity to assault the target. The population is driven away from the target by A's unpredictable values. The wolves will leave their victim if |A| is bigger than 1

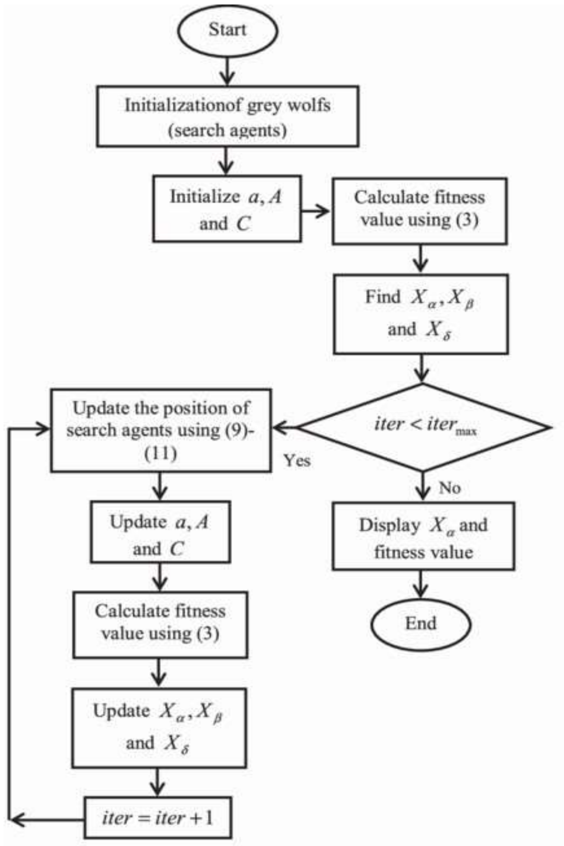

Fig.2. Flow chart of Gray Wolf Optimization

The graphical representation of voltage at each bus in Gray Wolf Optimization using conventional source (Thermal) is shown in below fig 3 .The voltages is in within limits (0.9-1.05).

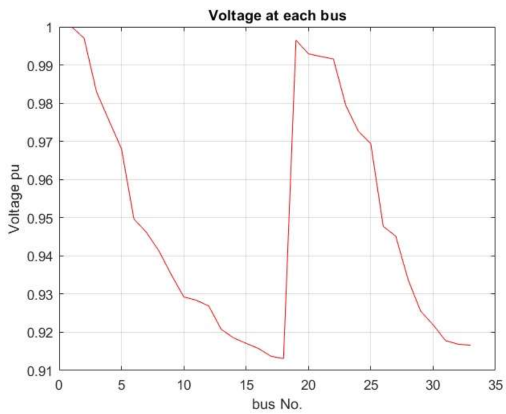

Fig.3. Voltage at each bus using Whale Optimization for conventional source

The maximum number of possible vehicles in electric vehicle charging station using Gray Wolf

Optimization technique with 0.5 SoC and 0.8 SoC using conventional sources(Thermal) are shown in below figures 4 and 5 respectively.

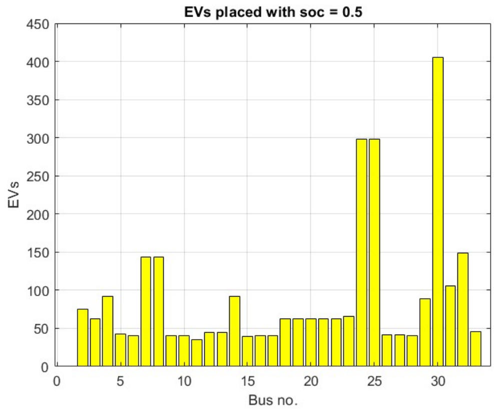

Fig.4. Placement of Electrical Vehicles using HGWO with conventional source.

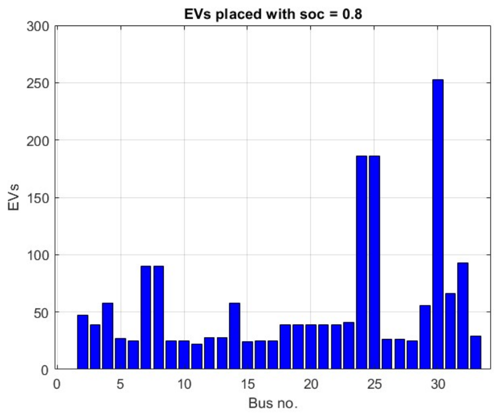

Fig.5. Placement of Electrical Vehicles using HGWO with conventional source

The graphical representation of voltage at each bus in Gray Wolf Optimization is shown in below fig 6 .The voltages is in within limits (0.9-1.05).

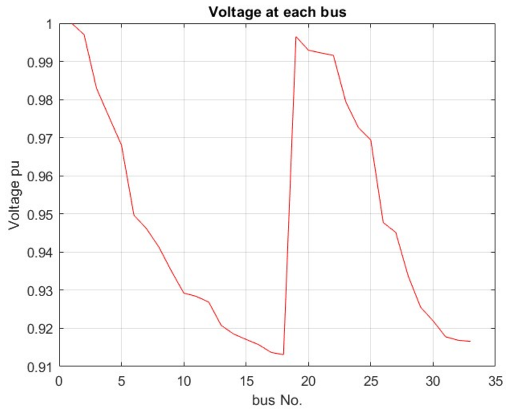

Fig.6. Voltage at each bus using Whale Optimization for renewable source.

The maximum number of possible vehicles in electric vehicle charging station using Gray Wolf Optimization technique with 0.5 SoC and 0.8 SoC using renewable sources(solar) are shown in below figures 7 and 8 respectively.

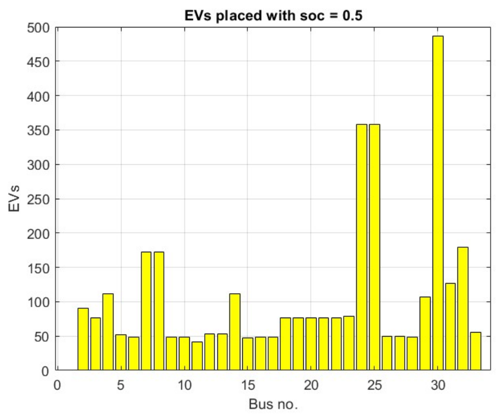

Fig.7. Placement of Electrical Vehicles using HGWO with renewable source.

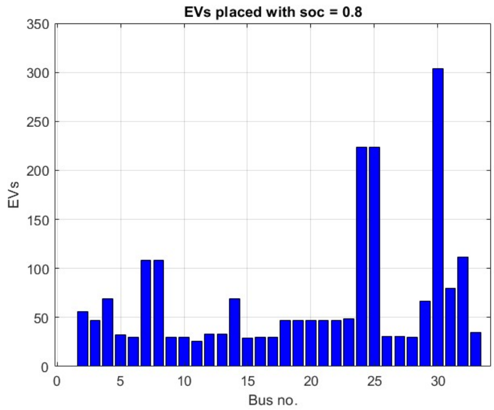

Fig.8. Placement of Electrical Vehicles using HGWO with renewable source.

III. PARTICLE SWARM OPTIMISATION:-

The PSO was developed in 1995 by Kennedy and Eberhart as a nature-inspired optimisation technique . PSO finds the global ideal via swarm-based exploration. Its inspiration comes from the way birds behave. The particles are extracted and dispersed over the exploration region in an attempt to find the best population to address the problem. Particles are created in a multidimensional exploration field, and each one changes its position according to its own and its neighbours' prior knowledge. Particles are also guided by the best place that they have attained in relation to their neighbours. The PSO has the advantages of being easy to use and not requiring a lot of parameter adjustments.

The allocation of DG for a balanced distribution system is the subject of this section. To do that, it is necessary to state the objective functions, DG limitations, voltage limits, and load flow solution method.

3.1.OBJECTIVE FUNCTION

The objective function for the balanced system is

$$\min(P_{LOSS}) = \sum_{K=1}^{Nbr} I_K^2 R_K \qquad \ldots \quad (6)$$

Where k is the bus number, I is the branch current, R is the branch resistance, and N is the number of branches.The limitations are,

Voltage Restrictions

$$0.95 \le V_{K(pu)} \le 1.05 \qquad \ldots \quad (7)$$

DG limitations

$$60 \le P_{DG} \le 300 \qquad \ldots \quad (8)$$

Limitation On The Power Balance

$$P^{sub} + \sum_{J=1}^{N_{bus}} P_{DG}(K) = \sum_{j=1}^{Nbr} P_{loss}^{j}(k, k+1) + \sum_{k=1}^{Nbus} P_{D,K} + P^{k}{}_{EVCS} \qquad \ldots \quad (9)$$

$$Q^{sub} + \sum_{J=1}^{N_{bus}} Q_{DG}(K) = \sum_{j=1}^{Nbr} Q_{loss}^{j}(k, k+1) + \sum_{k=1}^{Nbus} Q_{D,K} + Q^{k}{}_{EVCS} \qquad \ldots \quad (10)$$

Where P_{DK} and Q_{DK} are the total real and reactive power injected by DGs at the k^{th} bus, and P_{sub} and Q_{sub}, respectively, are the real and reactive power supplied by the electric substation. P^{k}_{EVCS} is the charging station load at the k^{th} bus, N bus is the number of buses in the distribution network, and P^{j} loss and Q^{j} loss represent the actual and reactive power loss in the j^{th} branch, respectively.

3.2 INDEX VECTOR METHOD :

It is employed to locate DG in the best possible way. Each bus's IV value is determined as

$$IV(k) = \frac{1}{V_K^2} + \frac{I_q(i)}{I_{p(i)}} + \frac{Q_{eff}(k)}{Q_{total}(k)} \qquad \ldots \quad (11)$$

V_K is the voltage at bus number k. The I^{th} branch's imaginary and actual current values are designated as $I_q(i)$ and $I_p(i)$. The reactive load of the K^{th} bus is $Q_{eff}(k)$. The system's overall reactive load is Q_{total}.

i. Conduct load flow study on the system in question. Then determine the IV values for every bus.

ii. Convert voltage values to V_k/0.95 units.Sort the values by decreasing value.

Graphical representation of voltages at each bus in Partical Swarm Optimization using conventional source are shown below figure 9.

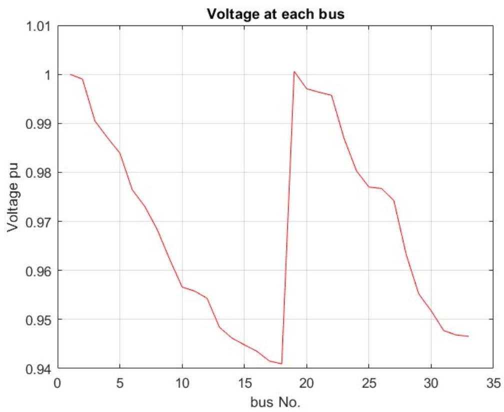

Fig.9. Voltage at each bus using PSO for conventional source.

The maximum number of vehicles possible in electric vehicle charging station using particle swarm optimization are shown in below Figures 10 and 11 with 0.8 soc and 0.5soc using conventional source(Thermal).

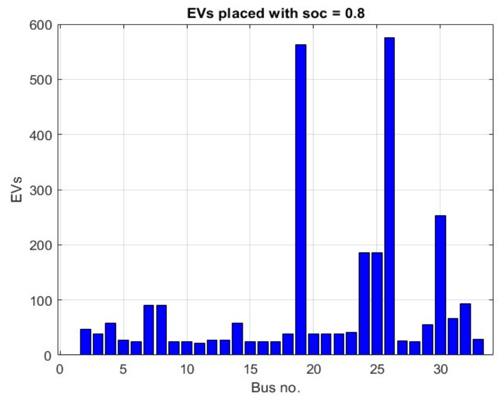

Fig.10. Number of vehicles possible with 0.8 SoC with conventional source.

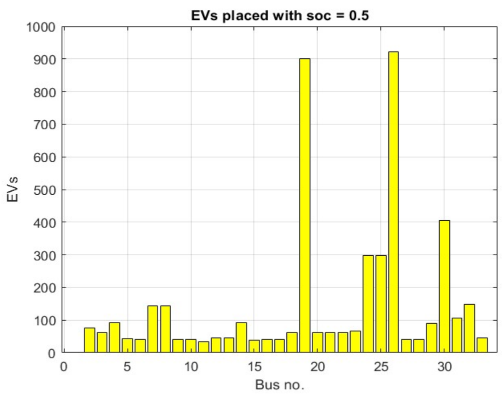

Fig.11. Number of vehicles possible with 0.5 SoC with conventional source.

Graphical representation of voltages at each bus in Partical Swarm Optimization using renewable source(Solar) are shown below figure 12.

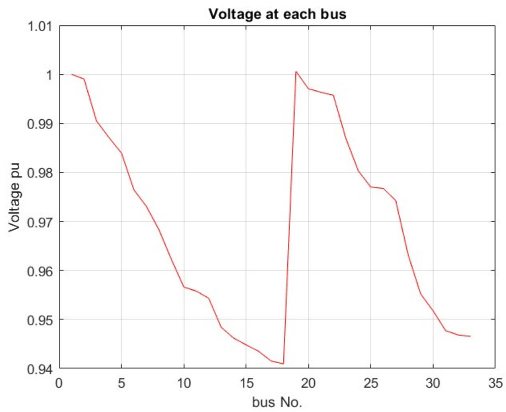

Fig.12. Voltage at each bus using PSO for renewable source

The maximum number of vehicles possible in electric vehicle charging station using particle swarm optimization are shown in below Figures 13 and 14 with 0.8 soc and 0.5soc using renewable sources(Solar).

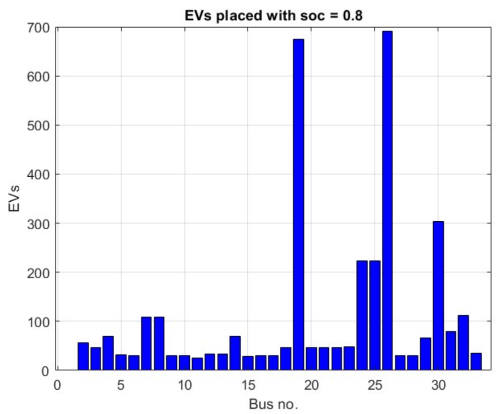

Fig.13. Number of vehicles possible with 0.8 SoC with renewable source.

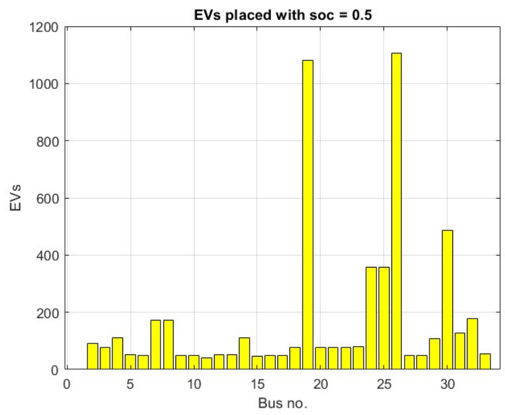

Fig.14. Number of vehicles possible with 0.5 SoC with renewable source.

IV. WHALE OPTIMISATION:-

In 2016, Mirjalili and Lewis proposed the Whales optimisation algorithm, a novel swarm intelligence optimisation method. They discovered that whales use a distinctive hunting technique known as bubble-net hunting by monitoring whales social behaviour. Three steps of the whale optimisation algorithm circling hunting, bubble-net attacking, and prey hunting simulate whale hunting.

Whales initially look for prey. When it is discovered, they swim about the prey while producing recognisable bubbles in a circle or 9-shaped pattern. They managed to capture their target and assault it in this fashion. Based on this behaviour of humpback whales, we first search the needed site and encircle it .

STATE OF CHARGE (SoC):

State of Charge (SoC) is the level of charge of an electric battery relative to its capacity. The units of SoC are percentage points (0% = empty, 100%=full).

4.1 IMPLEMENTATION OF WORK

Optimisation of Whales To cut down on power losses, the algorithm suggests putting DG in the distribution system.

4.1.1. Looking For And Surrounding Prey

Utilising Eqs(12) and (13) can demonstrate the search for food (also known as prey).

$$D = |C.X_{rand} - X| \quad \ldots \quad (12)$$

$$X(t+1) = X_{rand} - A.D \quad \ldots \quad (13)$$

where variables ‘A’ and ‘C’ are coefficient vectors denoted as

$$A = 2.a.r - a \quad \ldots \quad (14)$$

$$C = 2.r \quad \ldots \quad (15)$$

where 'a' is linearly decreasing from 2 to 0 and 'r' is the random integer between [0, 1].

$$D = |C.X^*(t) - X(t)| \quad \ldots \quad (16)$$

$$X(t+1) = X^*(t) - A.D \quad \ldots \quad (17)$$

Eqs. (12) and (13) are applied if A is 1. This indicates that the whale is still looking for prey (food); this process is known as the seeking prey mechanism. Eqs. (16) and (17) are utilised if A is 1, which indicates that the whale has already looked for its prey and must now attack it. This procedure is known as surrounding the prey by shrinking mechanism. Where ‘t’ is the current iteration, ‘X’ denotes the position vector, and ‘X*’ denotes the position vector's best value to date.

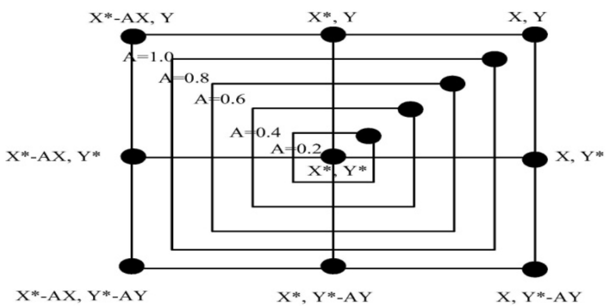

Fig.15. Bubble net searching mechanism in WOA.

4.1.2. Spirally Updating Position

Position update is represented by Eq. (18) in a spiral.

$$X(t+1) = \begin{cases} X^*(t) - A.D & if \ \ p < 0.5 \\ D.e^{bl}.\cos(2.pie.l) + X^*(t) & if \ \ p \geq 0.5 \end{cases} \quad \ldots(18)$$

'p' is a random number between [0, 1], The spiral form is described by 'l' being between [1, 1] and 'b' being constant.

A flowchart of the suggested method is shown in Fig. 10, whereas Fig. 9 depicts the bubble net searching mechanism in WOA.

4.1.3. Identifying The Issue

The major goal of the recommended approach is to identify the ideal location and size of DGs that minimises the multi objective function while taking into account a variety of distribution system restrictions.

The single line diagram of the straightforward radial distribution system depicted in Fig. 3 is taken into consideration in order to arrive at the equations to compute power flow in the distribution network, where p is the sending end node and p + 1 is the receiving end node.

4.2 CALCULATION OF POWER FLOW

Using the following set of equations, Eqs. (19) and (20) obtained from the single line diagram seen in Fig. 11, real and reactive power flows are determined.

$$P_{p+1} = P_p - P_{L_{(p+1)}} - R_{p,p+1} * \frac{(P_p^2 + Q_p^2)}{|V_p|^2} \quad \ldots \ (19)$$

The flow chart of whale optimization technique shown in the figure 16 below.

This flow chart algorithm shows the procedure of the process of whale optimization.

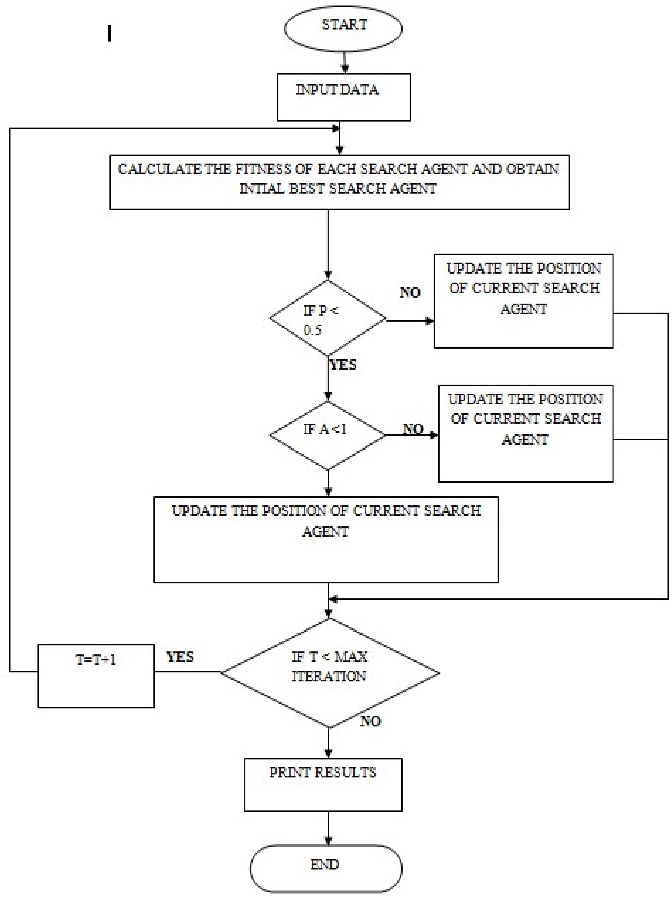

Fig.16. Flow Chart of Whale Optimization Algorithm

$$Q_{p+1} = Q_p - Q_{L_{(p+1)}} - X_{p,p+1} * \frac{(P_p^2 + Q_p^2)}{|V_p|^2} \ \ldots \ (20)$$

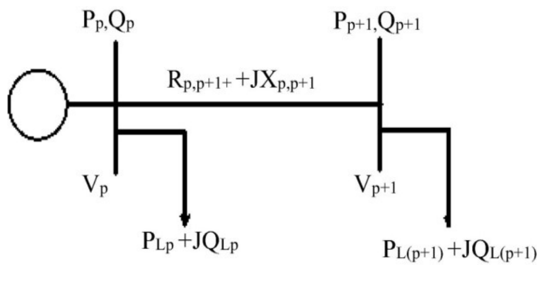

Fig.17. Simple Radial Distribution Network

Eq (21) used to calculating the line voltages,

$$|V_{p+1}{}^2| = |V_p{}^2| - 2(R_{p,p+1}.P_p + X_{p,p+1}.Q_p) + (R^2{}_{p,p+1} + X^2{}_{p,p+1}) * \frac{(P_p^2+Q_p^2)}{|V_p|^2} \quad \dots (21)$$

Real power loss calculated by eq (22),

$$P_{LOSS_{(p,p+1)}} = R_{p,p+1} * \frac{(P_p^2+Q_p^2)}{|V_p|^2} \quad \dots (22)$$

The system's overall power loss is computed by adding together all of the line losses, as given in Eq. (23).

$$P_{total_{loss}} = \sum_{p=1}^{n-1} P_{LOSS_{(p,p+1)}} \quad \dots (23)$$

The definition of power loss in a line with DG is

$$P_{DG,LOSS_{(p,p+1)}} = R_{p,p+1} * \frac{(P_{p,DG}^2+Q_{p,DG}^2)}{|V_p|^2} \quad \dots (24)$$

Eq. (25) is used to compute the system's overall power loss with DG.

$$P_{total_{loss\ with\ DG}} = \sum_{p=1}^{n-1} P_{LOSS\ with\ DG_{(p,p+1)}} \dots (25)$$

4.2.1. Reduction of Power Loss

Total power loss will decrease after the DG is installed in the network in the best possible way. The ratio of total power loss with DG to total power loss without DG is known as the power loss index, and it is defined as follows:

$$F_1 = min \frac{P_{total_{loss\ with\ DG}}}{P_{total_{loss\ without\ DG}}} \quad \dots (26)$$

4.2.2. Cumulative Voltage Deviation Index

The definition of voltage deviation index is

$$F_2 = min \frac{CVD_{with\ DG}}{CVD_{without\ DG}} \quad \dots (27)$$

Where

$$CVD = \begin{Bmatrix} 0 & 0.95 \le V_i \le 1.05 \\ |1 - V_i| & else \end{Bmatrix} \quad \dots (28)$$

4.2.3. Operational Cost Reduction

Minimising operational costs is one of the goals. The first part of the cost equation is the cost of the real power that is delivered from the substation, and the other two are the costs of the real and reactive powers that are supplied from DGs.

Real power costs for substations may be decreased by reducing power losses in the system, and costs for power provided by DGs can be decreased by drawing less power from them, hence overall operating costs can be decreased by applying the calculation in Eq. (29).

$$F_3 = min \frac{TOC_{with\ DG}}{TOC_{without\ DG}} \quad \dots (29)$$

Where

$$TOC = K_i P_{loss} + \sum K_p P_{dg} + \sum K_q Q_{dg} \quad \dots (30)$$

4.2.4. *Voltage Stability Index*

Voltage stability index is used to identify the bus with the greatest risk of voltage collapse and is defined as

$$F_4 = min \frac{1}{SI(n)} \quad \dots (31)$$

Where,

$$SI(n) = |V_m|^4 - 4(P_n(n)R_n + Q_n(n)X_n)|V_m|^2 - 4((P_n(n)R_n + Q_n(n)X_n)^2 \quad \dots (32)$$

4.3. OBJECTIVE PURPOSE

The major goal is to reduce the number of goals, including power loss reduction, voltage profile improvement, and operational cost reduction. Eq. (22) provides the mathematical formulation of the objective function.

$$OF = \min(\alpha_1 F_1 + \alpha_2 F_2 + \alpha_3 F_3 + \alpha_4 F_4) \quad \dots (33)$$

where a represents the weighting factors, which are stated asthe following restrictions

$$\sum_{i=1}^{4} \alpha_i = 1 < \alpha_i \epsilon [0,1] \quad \dots (34)$$

The power balance equation

$$P_{SUBSTATION} + \sum P_{DG} = P_{load} + \sum P_{loss} \quad \dots (35)$$

$$Q_{SUBSTATION} + \sum Q_{DG} = Q_{load} + \sum Q_{\text{loss}} \quad \dots (36)$$

Limits on bus voltage

$$|V_{min}| \leq |V_i| \leq |V_{max}| \quad \dots (37)$$

Limits on DG sizing

$$P_{DG\,min} \leq P_{DG\,i} \leq P_{DG\,max} \quad \dots (38)$$

$$Q_{DG\,min} \leq Q_{DG\,i} \leq Q_{DG\,max} \quad \dots (39)$$

The WOA-based strategy involves the following stages to position DGs in the network for multiple purposes optimally:

- Initialise line impedance and load power as input in step 1.
- Utilise the Forward-Backward sweep method to compute the overall power loss, operational costs, and bus voltages in step 2.
- Establish the initial number of search agents to be optimised in step 3.
- If the search agents travel outside the bounds, then insert the restrictions to bring them back inside the border. Initialise the counter in step 4.
- Determine the first best agent by using Eq. (13) to calculate the fitness function for each search agent in step 5.
- Using Equations (3) and (4), update a, A, C, l, and p for each search agent. l and p are arbitrary numbers in step 6.
- Continue to Step 8 if (p 0.5); otherwise, continue to Step 10, in step 7.
- If |A| is not 1, use Eq. (2) to update the location of the current search agent in step 8.
- If |A| is 1, then use Eq. (6) to update the position of the search agent and compute a new one in step 9.
- Update the location of the current search agent using Eq. (7) in step 10.
- Should the counter reach its maximum value, move on to Step 12. Go to Step 5 if not in step 11
- Print the outcomes in step 12.

Graphical representation of voltages at each bus in whale optimization using conventional source(Thermal) are shown below.

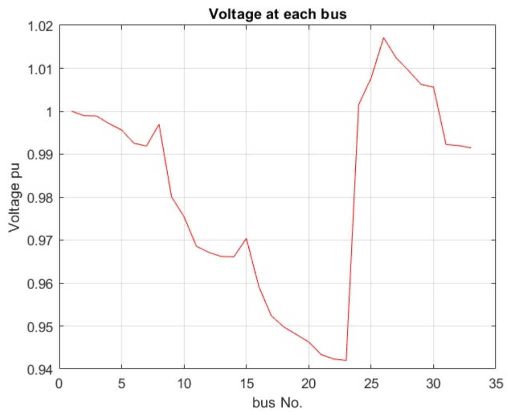

Figure.18. Voltage at each bus using WOA for conventional source.

The maximum number of vehicles possible in electric vehicle charging station using whalw optimization are shown in below with 0.8 soc and 0.5soc respectively.

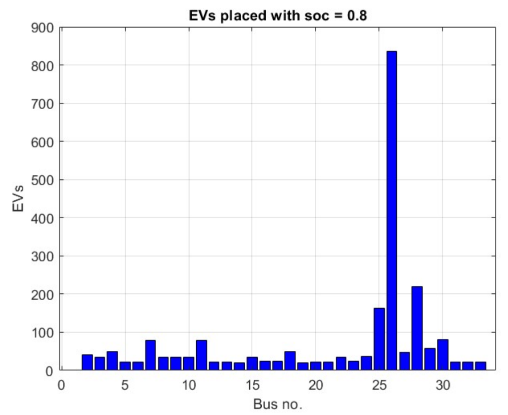

Fig.19. EVs placed with soc=0.8 using WOA with conventional source.

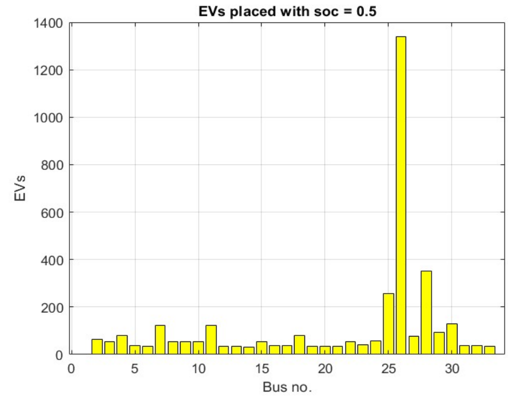

Fig.20. EVs placed with soc=0.5 in WOA with conventional source.

Graphical representation of Voltages at each bus in Whale Optimization using Renewable Source(Solar) are shown below.

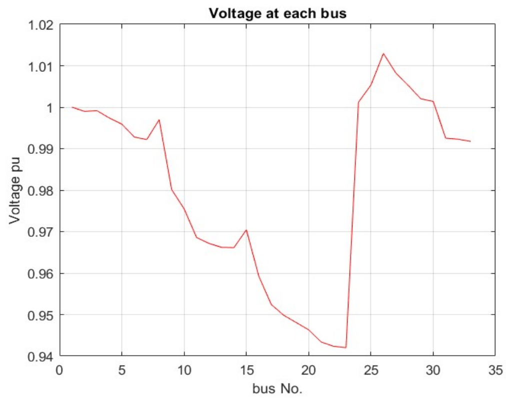

Fig.21. Voltage at each bus using WOA for renewable source.

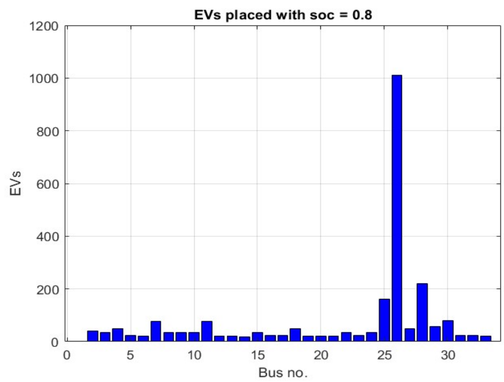

Fig.22. EVs placed with soc=0.8 using WOA with renewable source.

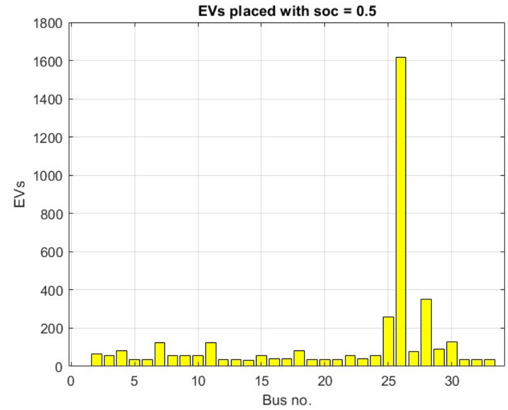

Fig. 23. EVs placed with soc=0.5 in WOA with renewable source.

From above graphical representations, we can abserve the increment of number of electric vehicles possible by using whale optimization and also we can achieve the minimization of active power losses by comparing with other optimizations, those are listed in tabular columns.

V.TESTS AND RESULTS:-

The comparison of active power losses of the Gray Wolf Optimization, Particle Swarm Optimizatio And Whale Optimizations by renewable sources shown.

TABLE.I. ACTIVE POWER LOSSES IN CONVENTIONAL ENERGY

Optimization Technique / Ratings	HGWO	Particle Swarm Optimization	Whale Optimization
Rated Voltage(Volts)	240	240	240
Rated Current(Amps)	13	13	13
No.Of Charging Hrs	7.5	7.5	7.5
Active Power Loss At 0.5 Soc(Kw)	781.32	389.47	320.06
Active Power Loss At 0.8 Soc(Kw)	320.62	100.41	78.09
Total Losses(Kw)	206.65	92.38	67.41
Max No.Of Vehicles	420	906	1310

above tabular column concludes that the whale optimization technique is most better than the other two optimization techniques.

We can see the decrement of power losses using whle optimization technique when compared to the other optimization techniques.

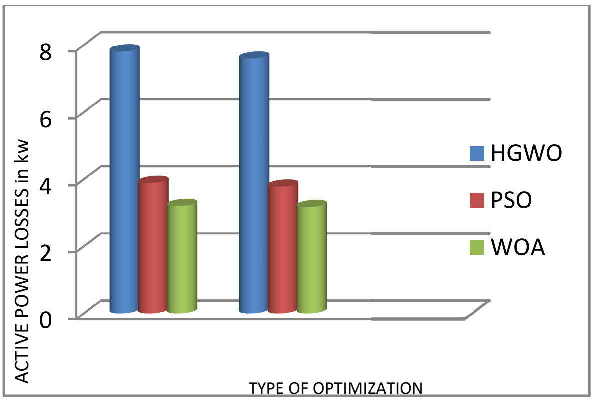

Fig.24. Graphical comparison of power losses

The pictorial representation of comparison of total power losses between gray wolf optimization, particle swarm optimization and whale optimization are given above

TABLE.II. ACTIVE POWER LOSSES (RENEWABLE ENERGY).

Optimization Technique / Ratings	HGWO	Particle Swarm Optimization	Whale Optimization
Rated Voltage(Volts)	240	240	240
Rated Current(Amps)	13	13	13
No. Of Charging Hrs	7.5	7.5	7.5
Active Power Loss At 0.5 Soc(Kw)	734.45	365.88	318.05
Active Power Loss At 0.8 Soc(Kw)	310.98	94.54	76.06
Total Losses(Kw)	198.86	92.43	64.32
Max No .Of Vehicles	490	1090	1650

The comparision of active power losses between the gray wolf optimization,particle swarm optimization and whale optimizations by renewable sources are shown in the above table II.

VI. CONCLUSION AND FUTURE SCOPE

This paper suggests using WOA to determine the best location and size for DGs and EVCS in a radial distribution system. Power loss reduction, operational cost reduction, and voltage profile improvement are among the several goals of the optimization problem.

On a 33-bus test system, the proposed approach is evaluated in two scenarios: case 1 is conventional(Thermal), and case 2 is renewable(solar). The recommended algorithm's findings are compared to those from other well-known optimization algorithms like HGWO and PSO, and it is discovered that it is successful for multiple objectives and many constraints.

The WOA has the slow converagence and unable to easy localization, in order to improve these we can refer advanced whale optimization technique.

REFERENCES

[1] Mohd Bilal, M.Rizwan, Ibrahim Alsaidan and Fahad M.Almasoudi, ‘‘AI-Based approach for optimal placement of EVCS and DG with reliability analysis, ’’in IEEE Access.,vol. 9, pp. 154204-154224,2021,doi:10.1109/ACCESS.2021.3125135.

[2] M. Usman et al., “A Coordinated Charging Scheduling of Electric Vehicles Considering Optimal Charging Time for Network Power Loss Minimization,” Energies 2021, doi: 10.3390/en14175336. Journal of Emerging Technologies and Innovative Research (JETIR) www.jetir.org f531 , “A Coordinated Charging Scheduling of Electric Vehicles Considering Optimal Charging Time for Network Energies, vol. 14, no. 17, p. 5336, Aug

[3] G. Gangil, S. K. Goyal and M. Srivastava, "Optimal Placement of DG for Power Losses Minimization in Radial Distribution System using Backward Forward Sweep Algorithm," 2020 IEEE International Conference on Advances and Developments in Electrical and Electronics Engineering (ICADEE), 2020, pp. 1-6, doi: 10.1109/ICADEE51157.2020.9368941.

[4] V. Miranda, J.V. Ranito, and L.M. Proenca, “Genetic Algorithms in Optimal Multistage

Distribution Network Planning", Transactions on Power Systems, Vol. 9, No. 4, pp. 1927-1933, 1994

[5] D.B. Prakash, C. Lakshminarayana, ''Multiple DG Placements in Distribution System for Power Loss Reduction Using PSO Algorithm, Procedia Technology'', Volume 25,2016,Pages 785-792,ISSN 2212-0173.

[6] K. Nekooei, M. M. Farsangi, H. Nezamabadi-pour and k.Y. Lee, "An Improved Multi-Objective Harmony Search for Optimal Placement of DGs in Distribution Systems," in IEEE Transactions on Smart Grid, vol. 4, no. 1, pp. 557-567, March 2013, doi: 10.1109/TSG.2012.2237420

[7] R. Priyadarshini, S. Kori and C. M. Rekha,''Cuckoo search algorithm based multiple dg placement and voltage profile improvement in a radial distribution system'', 2017 Second International Conference on Electrical, Computer and Communication Technologies (ICECCT), 2017, pp. 1-6, doi: 10.1109/ICECCT.2017.8118018

[8] .Seyedali Mirjalili, Andrew Lewis,The Whale Optimization Algorithm,Advances in Engineering Software,Volume 95,2016,Pages 51-67,ISSN 0965-9978,https://doi.org/10.1016/j.advengsoft.2016.01.008.

[9] R. Sanjay, T. Jayabarathi, T. Raghunathan, V. Ramesh and N. Mithulananthan, "Optimal Allocation of Distributed Generation Using Hybrid Grey Wolf Optimizer," in IEEE Access, vol. 5, pp. 14807-14818, 2017, doi: 10.1109/ACCESS.2017.2726586.

[10] Antoniol, Giuliano & Di Penta, Massimiliano & Harman, Mark. (2005). Search-based techniques applied to optimization of project planning for a massive maintenance project. IEEE International Conference on Software Maintenance, ICSM. 2005. 240- 249. 10.1109/ICSM.2005.79.

.

[11] G. Gangil, S. K. Goyal and M. Srivastava, "Optimal Placement of DG for Power Losses Minimization in Radial Distribution System using Backward Forward Sweep Algorithm," 2020 IEEE International Conference on Advances and Developments in Electrical and Electronics Engineering (ICADEE), 2020, pp. 1-6, doi: 10.1109/ICADEE51157.2020.936894

[12] H. Mehrjerdi and E. Rakhshani, ''Vehicle-to-grid technology for cost reduction and uncertainty management integrated with solar power,'' J. Cleaner Prod., vol. 229, pp. 463– 469, Aug. 2019, doi: 10.1016/j.jclepro.2019.05.023.

[13] P. Papadopoulos, S. Skarvelis-Kazakos, I. Grau, L. M. Cipcigan, and N. Jenkins, ''Electric vehicles' impact on British distribution networks,'' IET Electr. Syst. Transp., vol. 2, no. 3, p. 91, Oct. 2012, doi: 10.1049/iet-est.2011.0023.

[14] M. Etezadi-Amoli, K. Choma, and J. Stefani, ''Rapid-charge electricvehicle stations,'' IEEE Trans. Power Del., vol. 25, no. 3, pp. 1883–1887, Jul. 2010, doi: 10.1109/TPWRD.2010.2047874

[15] J. Y. Yong, V. K. Ramachandaramurthy, K. M. Tan, and N. Mithulananthan, ''Bi-directional electric vehicle fast charging station with novel reactive power compensation for voltage regulation,'' Int. J. Elect. Power Energy Syst., vol. 64, pp. 300–310, Jan. 2015, doi: 10.1016/j.ijepes.2014. 07.025

[16] M. S. K. Reddy and K. Selvajyothi, ''Optimal placement of electric vehicle charging station for unbalanced radial distribution systems,'' Energy Sour., A, Recovery, Utilization, Environ. Effects, vol. 2020, pp. 1–15, Feb. 2020, doi: 10.1080/15567036.2020.1731017.

[17] D. Singh, D. Singh, and K. S. Verma, ''GA based energy loss minimization approach for optimal sizing & placement of distributed generation,'' Int. J. Knowl.-Based Intell. Eng. Syst., vol. 12, no. 2, pp. 147–156, May 2008, doi: 10.3233/KES-2008-12206.

[18] F. Ahmad, M. Khalid, and B. K. Panigrahi, ''An enhanced approach to optimally place the solar powered electric vehicle charging station in distribution network,'' J. Energy Storage, vol. 42, Oct. 2021, Art. no. 103090, doi: 10.1016/j.est.2021.103090

[19] M. A. Tolba, H. Rezk, M. Al-Dhaifallah, and A. A. Eisa, ''Heuristic optimization techniques for connecting renewable distributed generators on distribution grids,'' Neural Comput. Appl., vol. 32, no. 17, pp. 14195–14225, Sep. 2020, doi: 10.1007/s00521-020-04812-y.

[20] NeuroQuantology |December 2022 | Volume 20 | Issue 16 | Page 4194-4202| doi: 10.48047/NQ.2022.20.16.NQ880426 G.Rishitha, P.Rizwan, Y.Manasa Optimization Of Vehicle-To-Grid (V2G) System And Its Energy Management For Renewable Power Integration

[21] Naik, Megavath Sai Kishor, Y. Manasa, and P. Rizwan. "Advanced Controller-Based Grid-Connected Wind PV Cogeneration using Ann And FO-PID." *Journal of Optoelectronics Laser* 41.11 (2022): 246-258.