International Journal of Power Electronics and Drive System (IJPEDS)
Vol. 16, No. 3, September 2025, pp. 1840~1851
ISSN: 2088-8694, DOI: 10.11591/ijpeds.v16.i3.pp1840-1851

Optimal placement of recloser for the improvement of reliability indices in radial distribution system using hybrid PSO-firefly algorithm

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Article Info

Article history:

Received Nov 12, 2024
Revised May 20, 2025
Accepted Jun 3, 2025

Keywords:

Energy-not-supplied
Firefly-particle swarm algorithm
Radial distribution system
Recloser
Sectionalizer

ABSTRACT

Electricity outages are frequently caused due to problems in the electric distribution system (EDS). The method presented in this research describes a comprehensive dual-phased design to enhance the electric network efficiency and reliability. A hybrid particle-firefly optimization method is applied in the first phase to allocate reclosers and sectionalizer in an optimal accessible path. Furthermore, in the second phase, the medium distribution voltage systems that comprise five main circuit breakers and one power source are taken into consideration, as well as automatic load shift to an alternative power supply and the secondary circuit breaker shut down under normal conditions. The authors provide a streamlined technique based on swapping out loads to determine the reduction value of the anticipated energy not-supplied (ENS) and cost of energy not-supplied (CENS) to customers after installing a sectionalizer and recloser in the APO 132/33 kV radial distribution network. The optimized CENS with the protective device of the distribution system is tremendously reduced compared to the CENS of the conventional state, which has no protective scheme.

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1. INTRODUCTION

The quality of electrical energy a country produced is a key factor in determining its development index. Thus, electric utilities applied new methods to increase the reliability and efficiency of power systems [1]. The majority of faults usually have an impact on the power distribution network. The customers are continuously interrupted by either permanent or temporary faults. Electric utilities suffer significant economic losses due to the frequent power outages. These distribution system outages are primarily caused by poor weather, poor infrastructure, birds, lightning, and human error. Modern distribution systems therefore provide the consistent delivery of high power quality to customers. When considering the distribution system, the time and failures occurrence might be avoided by inserting protective devices such as switches, fuses, fault indicators, reclosers, and sectionalizer in different feeder segments. Thus, at the expense of higher expenditure, the systematic placement of these preventive devices boosts system reliability [2]. A High-reliability power supply ensures minimal disruptions in the customers' access to electricity. Moreover, reliability is often defined as a system's lifetime capacity to perform well in operating conditions. The reliability of any power system can be measured using a variety of reliability indices [3], including the system average interruption frequency index (SAIFI), system average interruption duration index (SAIDI), average service availability index (ASAI), customer average interruption frequency index (CAIFI), average energy not served (AENS), average service unavailability index (ASUI), and customer average interruption duration index (CAIDI). An isolation of the system's faulty component by a protective device in a distribution network prevents interruptions in the upstream system portions [4]. However, until the fault is fixed, the consumers linked to the downstream portion experience continuous interruption. When switching off the faulty feeder part from the downstream supply, the healthy downstream feeder sections can be powered up if an alternative source is available. The overall performance of reliability is improved when the outage duration of healthy downstream feeder portions is reduced [5]. Distributed generation (DG) resources, which are included in contemporary distribution networks, can provide an alternative supply and operate in islanding mode [6]. Therefore, the DG capacity needs to be high enough to exceed the island's demand load [7]-[9]. The deployment of protective devices is made more difficult by the bidirectional flow of electricity since a feeder section may be fed from either upstream or downstream [10], [11]. Many studies have been conducted so far with an emphasis on the ideal placement of protective equipment in a distribution system. Researchers [12]-[15] show early studies that helped determine where the protective equipment should be placed in a radial distribution system (RDS). A method for sectionalizing switches that takes into account maintenance costs, system outages, and investment costs has been suggested in [12], [13], [16].

Moreover, the simulated annealing (SA) process has been used to provide a solution to this problem. Additionally, this problem has been solved using the SA method. For the best placement of the switches in an RDS, an alternate power supply source potentially to adjacent feeders has been proposed in [13]. For the best switch placement, the direct search technique has been suggested in [17]. Meneses and Mantovani [18] suggested a new model for assessing the effects of the DG islanded distribution system. Also, the paper developed a new model to identify the concession made between dependability and operating expense for the 135-bus system. Through the application of the ideal configuration of protection devices, a novel method has been suggested by Ray *et al.* [19] to improve the dependability characteristic of an RDS. Pombo *et al.* [20] proposed a novel method that deals with reliability, equipment cost, and DG unavailability to determine the best location for automatic control DG-enhanced switches in an RDS. Two distinct models have been put up by Velasquez *et al.* [21] to improve the DG reliability of an RDS. The first model is used to arrange reclosers in the RDS optimally, while the second model is used to run the DG in island mode. A novel method has been suggested by Issicaba *et al.* [22] for assessing how long-term load shedding affects reliability indices of a DG augmented RDS. The success rate of the islanding procedure has been increased through the application of an advanced under-frequency load shedding method. Alam *et al.* [23] present a broad, unique concept for the ideal placement of switching equipment in an RDS. This formulation is valid for systems without DG units; hence, it cannot manage the bidirectional power flow.

The aforementioned research has made a substantial contribution to the RDS's ideal placement of protective equipment. Nevertheless, it might not be easy to position the sectionalizer and recloser units at the feeder end of the substation network. So, it is necessary to create a new model that can handle circumstances in which sectionalizer and recloser units are present at any bus (not only the terminal bus). The innovative model presented in this study was created exclusively for the ideal positioning of reclosers in a substation network to minimize cost of energy not supplied (CENS) and energy not supplied (ENS). The following list provides an overview of the paper's major contributions:

a) To address the optimal placement concerns of reclosers in a number of zones and islands of a radial distribution system, including DG, using an analytical model.
b) The proposed optimization accommodates the placement(s) of protective devices linked at any node(s) of the distribution framework, not just the end node.
c) A proposed objective function is applied to optimize the profitability of the substation to reduce CENS, ENS, and additional system costs.

2. FIREFLY MODEL

Firefly algorithm is an optimization solution that was developed from the inspiration of the flashing attributes of certain winged insects called fireflies. They illuminate the flashlights to draw mates or preys. The flashlight is also used to pre-warn the fireflies about potential threats. The algorithm was first developed by Cham *et al.* [24] as a metaheuristic algorithm which can be used in solving diverse stochastic problems.

The impact of brightness I, irradiated by firefly m, on firefly n, is directly proportional to the brightness of firefly m and inversely proportional to the square of the distance between them [25], [26]. The attractiveness between firefly m, and firefly n, is given by (1).

$$I_r = \frac{I_m}{r_{mn}^2} \tag{1}$$

Where: I_r = is the attractiveness between the two fireflies; I_m= is the brightness of a firefly m; and r = is the distance between the two fireflies.

For k number of fireflies, with solution, x_m, for firefly m, there is a relationship between the brightness I of the firefly m, and the objective function $f(x_m)$. The brightness I, indicates the position of the objective function $f(x_m)$, of any firefly. Therefore, the brightness I, of any firefly is given by (2).

$$I_m = f(x_m) \tag{2}$$

Since there is a variation in the attractiveness of fireflies, the brighter fireflies tend to attract the less bright ones to them. The degree of attractiveness of each firefly is denoted by "τ". Nevertheless, the degree of attractiveness τ, is inversely proportional to the distance between the fireflies. Attractiveness is given by (3).

$$\tau_r = \tau_0 e^{-\gamma r^2} \tag{3}$$

Where τ_0 is the attractiveness of the firefly at distance r = 0 and γ is the media light absorption coefficient.

The movement of a less attractive firefly m, at position x_m, to a brighter firefly n at position x_n, is described and represented by (4).

$$x_m(t+1) = x_m(t) + \tau_0 e^{-\gamma r^2}(x_m - x_n) + \sigma\varepsilon_m \tag{4}$$

Where $\tau_0 e^{-\gamma r^2}(x_m - x_n)$is a factor determined by the attraction of firefly at x_n and $\sigma\varepsilon_m$ is a randomization parameter.

2.1. Firefly algorithm

The firefly algorithm is carried out applying the following procedures:

- Step 1: Initialize the firefly algorithm.
- Step 2: Increase the counter iteration i = i +1.
- Step 3: Apply the fitness function from (5) to determine the firefly's fitness in each iteration, and relate the same firefly to light intensity.
- Step 4: Arrange the fireflies according to their light intensities, and then in each iteration, choose the best firefly.
- Step 5: Adjust the perception of the intensity of light of all other fireflies with respect to their distance of separation.
- Step 6: Vary the position of the fireflies with reference to attraction, which is subject to control parameters and their corresponding light intensities.
- Step 7: If the convergence criteria are satisfied, go to step 8 else, go back to step 2.
- Step 8: Analyze firefly particle outcomes of the highest light intensity.

The maximum objective flow problem is evaluated as (5).

$$\begin{aligned} &Minimize\ P(x,w) \\ &Subject\ to: T(x,w) = 0 \\ &Y(x,w) \le 0 \end{aligned} \tag{5}$$

Where P(x) is the fitness function, which represents the amount of energy not served by the system. T(x,w) represents the set of equality nonlinear constraints, while Y(x,w) depicts the inequality nonlinear constraints. The vector x represents the dependent variables, while the vector w denotes the control variables. In this research work, the control variables include injected reactive power, which compensates for voltage shoot or sag, and the number of nodes where protective devices will be installed in the system. These control variables are optimized by the firefly algorithm to minimize the energy not served and, consequently, the cost of energy not served by the APO 132 kV/33 kV distribution system.

2.2. Particle swarm optimization model (PSO)

PSO is an optimization technique that was developed from the characteristic movements of animals such as fish and birds, which are modeled by Foqha *et al.* [25]. In particle swarm optimization, the coordinates of an individual particle represent the possible solution related to two vectors, which are the position $X_i = [x_{i1}, x_{i2}, \dots x_{iN}]$ and velocity $V_i = [v_{i1}, v_{i2}, \dots v_{iN}]$. For every search space, there are two vectors related to each particle. A swarm comprises many particles that depict possible solutions, which are explored until an optimal solution is found. The position and the velocity vector of the particle are updated accordingly, as shown in (6) and (7).

$$V_i^{k+1} = wV_i^k + c_1 r_1 \left(pbest_i^k + x_i^k\right) + c_2 r_2 \left(gbest^k - x_i^k\right) \quad (6)$$

$$x_i^{k+1} = x_i^k + V_i^{k+1} \quad (7)$$

Where c_1 and c_2 are two constants positive variable, r_1 and r_2 are two generated randomly numbers with a variable of [0,1], w is the weight inertia, $pbest_i^k$ is the particle best position *i*, generated based on historical experience: $pbest_i^k = [x_{i1}^{pbest}, x_{i2}^{pbest}, \dots x_{iN}^{pbest}]$, $gbest^k$ is the particle best position based on the entire experience of the swarm: $gbest^k = [x_1^{gbest}, x_2^{gbest}, \dots x_N^{gbest}]$ and K is the iteration index. The objective function the energy not supplied (ENS). The objective is to optimally place protective devices in order to minimize ENS by the system to the customers and the optimization model is presented in (8).

$$\begin{aligned} &Minimize\ F(x, w) \\ &Subject\ to: P(x, w) = 0 \\ &R(x, w) \le 0 \end{aligned} \quad (8)$$

The coordinate optimization of overcurrent sectionalizer is calculated as (11).

$$Min\ F = \sum_{j=1}^{n} W_j T_k \quad (11)$$

$$T_{op} = TMS_i \left(\frac{\propto}{\left(\frac{I_{Fj}}{I_{Pj}}\right)^k - 1} \right) \quad (12)$$

$$\propto = 0.14\ and\ k = 0.02$$

$$PSM = \frac{I_{Fj}}{I_{Pj}} \quad (13)$$

$$T_{op} = TMS_i \left(\frac{\propto}{(PSM)^k - 1} \right) \quad (14)$$

$$T_{op} = a\rho(TMS_i) \quad (15)$$

Where, as in (16).

$$a\rho = \frac{\alpha}{(PSM)^k - 1} \quad (16)$$

Hence, the objective function can be formulated as (17).

$$Min\ F = \sum_{i=1}^{n} a\rho(TMS_i) \quad (17)$$

Constraint, as in (18).

$$TMS_i^{min} \le TMS_i \le TMS_i^{max} \quad (18)$$

Where the parameters W_j and Tj are the weight and operating time of the sectionalizer and recloser. ∝ and k are steady parameters, which is 0.14 and 0.02, respectively. TMS_i and I_{pi} are the time multiplier setting and pickup current of the itch sectionalizer while I_{fi} is the fault current flowing through the sectionalizer. PSM is the plug setting multiplier, and I_{Pi} is the primary or main pickup current.

2.3. Hybrid firefly-PSO algorithm

By combining the FA and PSO, the hybrid firefly-PSO algorithm aims to take advantage of both the global search capabilities of PSO and the local refinement capabilities of FA, making it a powerful tool for solving complex and high-dimensional optimization problems. The below are description of how the hybridization works:

- Initialization: The initial population is created by using a combination of random positions and velocities from the PSO framework, with fireflies initialized at random locations in the search space. Each particle represents a potential solution for the optimization problem (e.g., optimal network configuration, placement of sectionalizer/reclosers, transformer settings).
- Movement and attraction: Each particle in the swarm moves based on both the principles of PSO (i.e., velocity update using personal and social bests) and the principles of FA (i.e., fireflies move towards brighter particles). This dual mechanism allows the algorithm to balance exploration (global search) and exploitation (local search).
- Dynamic adjustment: The hybrid algorithm can dynamically adjust the influence of each component PSO or FA based on the problem's complexity. For example, the Firefly component might dominate early on to explore the search space more widely, while PSO can refine solutions in the later stages to focus on local optimality. Each firefly (solution) moves towards a brighter (better) firefly based on the objective function. This allows fireflies to fine-tune sectionalizer and recloser positions for minimal outage time.

2.4. Coordination and placement of the protective devices

The protective devices used in the protective scheme are the auto recloser and sectionalizer. Due to unavailability of current breaking capacity of sectionalizer, they were integrated with reclosers in their operation. Therefore, all nodes where the protective schemes are installed have the two devices. The distance between each node with an installed protective scheme was averaged at 4.8 km, as the optimally effective distance between two installed sectionalizer in a circuit is between 3.22 km and 4.83 km. The reclosers' number of operation was set to 3, meaning that the reclosers trip three times, open two times, and reclose two times, but the fourth trip takes it into the lockout phase, which may signify a permanent fault on the line. Reclosers do not have a standard for setting; rather, their settings depend on the mode and area of application. The first trip was set to clear transient faults resulting from lightning, which usually last for about 0.05 seconds. the first trip's dead time was set to 0.5 seconds to allow dissipation of ionized gases before reclosing. This is done to avoid a recurrent fault due to the ionized gases. The second trip of the reclosers was set to a dead time of 10 seconds, which is now longer than the first. This is to cater for temporary faults that are not caused by lightning but other factors like tree branches. The third trip of the reclosers was set to lockout. If the auto recloser did not complete the count after a duration of 30 seconds, it means the fault has been cleared and both the auto reclosers and the sectionalizer reset to their initial state of counting. In other words, if the span between the recloser trips is equal to or more than 30 seconds, the sectionalizer restarts counting. Since the sectionalizer was set to trip after two counts, the total accumulated time is given by the sum of the first reclosing time and the second trip time. Mathematically expressed as (19).

$$TAT = R1 + F2 \tag{19}$$

Where TAT is the Total Accumulation Time, R1 is the duration of trip of the recloser, F2 is also referred to as the first burn out period where the fuses on the faulted segment are allowed to burn off in order to put out the fault. Therefore, the total accumulated time was set below 30 second.

2.5. Coordination details of reclosers and sectionalizing switches

The operation of reclosers normally associated with tripping relays. These mechanisms might be either electromechanical, hydraulic, or electronic. Multiple reclosers are used in the recloser method, and they are spaced apart by customizable intervals of 15 or 30 seconds [27]. Hydraulic reclosers, generally performed two seconds delay between reclose and trip, were meant to work in tandem with hydraulic sectionalizing switches at beginning. Electronic sectionalizing switches are better suited for installation right after a feeder breaker has counted retention durations of two minutes. It uses a 4-shot sequence, with the first one or two operations being a rapid trip to clear a fault and the final two or three operations being a delayed trip to cause the fuse to blow, assuming the fault is in fact downstream of a fuse. Typically, the recloser sequences are designated [2-2] or [1-3], where the first number represents the number of quick trips and the second number represents the number of slow or time-delayed travels. The recloser trips on a rapid path curve when Loc2 experiences a fault (T1). The recloser closes after a short delay (R1). The recloser travels once again on a quick trip curve as the fault continues (T2). The recloser shuts after a little interval (R2). In order to enable any downstream fuses to blow up, the recloser is then act as a slow curve. The recloser trips again if no fuse fixes the problem (T3). Since all trips when a tiny wire branch line is subjected to fault current are made quickly or instantly, the risk of conductor burn down is eliminated. A [2-2] recloser and a 3 shot sectionalizing switch are used in the circuit shown in Figure 1.

If the fault was just transient, it would go off after the first trip (T1), assuming that the period until the reclose (R1) is long enough to give the transitory fault enough time to extinguish and go off. Regardless of the fault current levels, this plan would function and coordinate effectively. The increased count retention time of the electronic sectionalizing switches enables longer reclose times (R1) while preserving count, allowing the system to operate in high fault current locations where fuse saving coordination is not possible due to fuse and breaker speeds. As a result, the method of employing a breaker set to a [2-2] sequence and a 2-shot sectionalizing switch is referred to as an electronic fuse scheme [27].

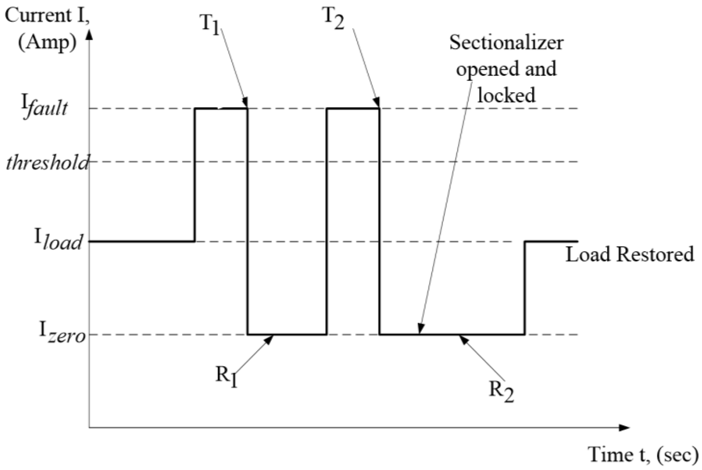

Figure 1. Sequence comprising a [2-2] recloser and a two-shot sectionalizing switch

3. RESULT AND DISCUSSION

The APO 132 kV/33 kV distribution system was evaluated over the period of ten years from 2009 to 2018 to get the profile of effect of interruptions on the energy not supplied and its impact on the economy. Figure 2 shows the electrical model network of APO 132/33 kV Substation, and Table 1 shows the location and number of sectionalizer and reclosers in the network. The result shows that if the recloser in bus H1 cannot interrupt the fault current due to malfunction, the recloser backup in bus H2, H3, H21, and H23 will take effect. Therefore, the sectionalizer in APO T3 also operates with reclosing function in Bus H2, H3, H21, H23, and opens the line. Also, the same approach occurs for sectionalizer in APO T4.

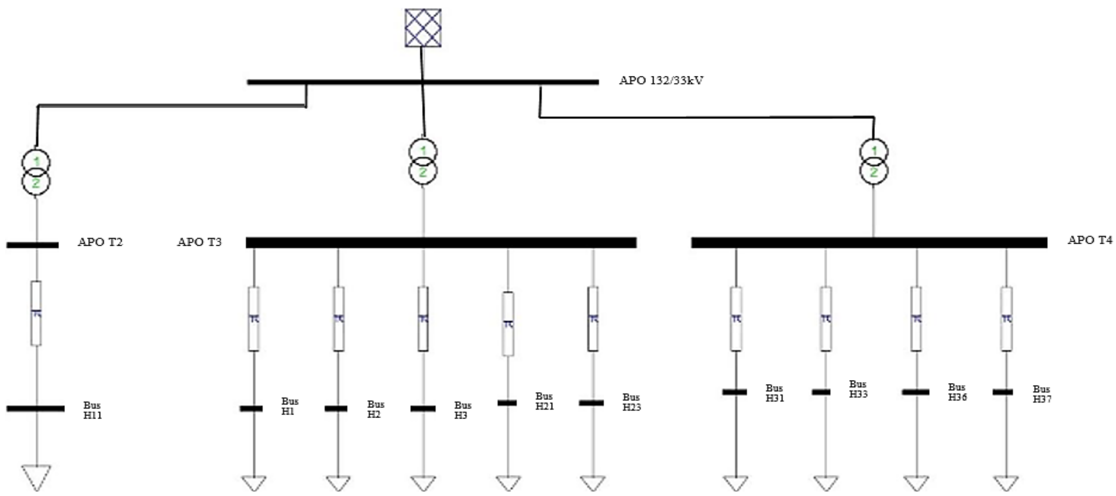

Figure 2. The electrical model network of APO 132/33 kV substation

Table 2 presents the results of the average energy not supplied to each customer in the distribution network for each year. Results from Table 2 shows that an average customer lacked energy supply most in the year 2009, with about 57.33 kWh of energy not supplied throughout the year due to forced failures. The average energy not supplied in year 2009 is considerably high as there is a difference of approximately 5 kWh of its AENS and that of the 2011 which is next to it on the log. This imply that the system was either characterized by more interruptions or more duration of interruptions or combination of both in year 2009 than in any other year. There was a significant reduction of AENS by approximately 10.7 kWh from 2009 to 2010 but increased again in year 2011 by about 6.2 kWh. This result from the total number of failures and/or the duration of outages experienced in those years irrespective of the number of customers served.

Table 3 presents the results of energy not supplied (ENS) by the APO 132 kV/33 kV distribution system. The distribution system had the most energy not supplied in year 2009 with 3.2814 GWh of energy. This accounts for about 12.5% of ENS over the ten years period of study. The least energy not supplied by the system was recorded in year 2018 with 2.1221 GWh of energy. Energy not supplied reduced fairly from 2012 to 2018, though in a random manner. This could be as a result of reduced duration of outage in those years as compared to years with high value of ENS. Table 3 shows that there is an increase in number of customers served by the system for consecutive years but this has no corresponding effect on the energy not served by the system. This shows that ENS is directly affected by the total duration of interruptions in a year but not the number of customers served that year. With every unit of energy not supplied, there is a corresponding cost consequence on the distribution system operator and the customers served. But the economic consequence of energy not supplied on utility operator alone was considered in this work. From Table 3, it can be seen that the cost of energy not supplied was highest in 2009 with the utility operator losing 79,7378 million Naira while the cost of energy not supplied was minimum in year 2018 with the utility operator losing 51,5663 million Naira. From Table 3, it can be deduced that there is a direct proportionality between ENS and CENS. Table 4 shows the ENS of the distribution system when auto reclosers and sectionalizes are installed on the feeders. The table shows a drastic reduction in the amount of energy not served when compared with the values without protective devices as shown in Table 4.

Table 1. Location and number of sectionalizer and reclosers

Device name	Device number	Device location
Recloser	10	H1, H2, H3, H21, H23, H31, H33, H36, H37, and H11
Sectionalized	3	APO T2, APO T3 and APO T4

Table 2. Average energy not supplied (AENS)

Year	AENS = (kWh/customer)
2009	57.3279
2010	46.6487
2011	52.4266
2012	51.3678
2013	48.7848
2014	41.9827
2015	37.0348
2016	38.5904
2017	42.6359
2018	36.3543

Table 3. Energy not supplied (ENS)

Years	ENS (GWh/year)	CENS (Million Naira)
2009	3.2814	79.7378
2010	2.6841	65.2241
2011	3.0354	73.7601
2012	2.98	72.414
2013	2.8383	68.9719
2014	2.4446	59.4031
2015	2.1582	52.4443
2016	2.2494	54.6613
2017	2.4859	60.4081
2018	2.1221	51.5663

Table 4. Energy not supplied (ENS) and cost of energy not supplied (CENS) with protective scheme using hybrid firefly-particle swarm optimization

Year	ENS with optimized protective scheme (GWh/year)	CENS with optimized protective scheme (Million Naira)
2009	0.3059	7.4326
2010	0.2787	6.7728
2011	0.294	7.1435
2012	0.2883	7.0047
2013	0.2783	6.7639
2014	0.2389	5.8055
2015	0.2373	5.7656
2016	0.2437	5.9215
2017	0.2563	6.2284
2018	0.237	5.7595

Figure 3 shows the distribution of energy not supplied in the distribution system over the ten years study period. The maximum value of energy not served was recorded in year 2009 with a value of 0.3059 GWh, followed by 2011 which has an energy value of 0.294 GWh. The least value of energy not served was obtained in year 2018, recording a value of 0.237 GWh. Cost evaluation was conducted on the system's energy not served. This project work also assumes a uniform tariff on a unit energy for the ten years period as there is a somewhat ambiguous economic instability in Nigeria for that period of time which is beyond the scope of this research. Therefore, the tariff charged by the Abuja Distribution Company is used for the ten years period. The tariff used in this work is ₦ 24/ kWh. Cost analysis was carried out on the distribution system when protective devices were installed on the faulty feeders. Optimization of cost was also carried out using the hybrid firefly-particle swarm optimization (HFPSO) technique. The CENS presented here are strictly those resulting from forced system failures. Figure 4 shows the amount (in million Naira) the cost of energy not served as a result of forced failures, when protective devices are installed on the faulty feeders, and the cost is optimized using the hybrid firefly-particle swarm optimization technique. The maximum monetary loss from unsupplied energy by the distribution system was obtained in year 2009 `recording about 7.4 million Naira loss while the lowest was obtained in year 2018, with approximately 5.7 million Naira loss. The CENS highlights the cost of ENS when the protective devices have been installed along the line of the feeders. However, it is imperial to put into consideration the cost of having these protective devices installed along the feeders else there would be a lack of thorough costing analysis when contemplating the implementation of protective scheme.

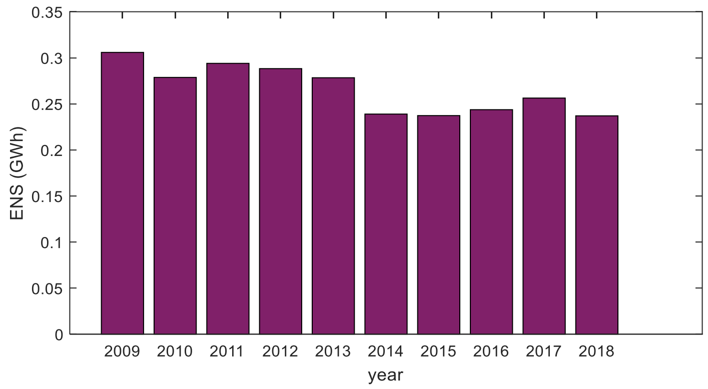

Figure 3. ENS using hybrid firefly-PSO

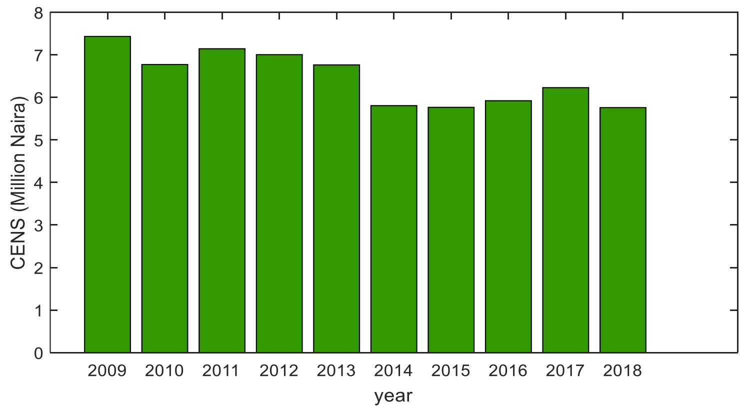

Figure 4. CENS using hybrid firefly-PSO

4. CONCLUSION

The purpose of this research was to apply hybridized firefly-particle swarm algorithm to evaluate EENS reduction in an MV distribution system following the installation of a sectionizer. The algorithm does not need complex computations, this technique is modified for use in the current power networks. The proposed approach enables the placement of sectionalizer in the most effective location for radial and linked various types of distribution systems. The value of EENS to consumers is our optimization criterion since it is the most significant index in Nigeria. The total average active loads of transformer substations that are disconnected during a fault for the duration of the service period are taken for consideration, which is based on national energy guidelines for distribution system operation and maintenance. The findings of this study are summarized as:

– A streamlined analytical procedure that considers the total average active loads of transformer substations disconnected after the fault for the service duration was presented for assessing the value of EENS to consumers.
– For radial and interconnected types of distribution systems, the best location of a single sectionalizer was determined using the proposed approach. An algorithm for calculating EENS and CENS for customers was developed for APO substation. The algorithm is applied in order to reduce the EENS and CENS in an MV distribution network after the installation of a sectionalizer.
– The proposed algorithm is flexible for two and more sectionalizer.

The optimized CENS with protective device of the distribution system is tremendously reduce compared to the CENS of the conventional state which has no protective scheme.

ACKNOWLEDGMENT

The authors acknowledge the support received from the Department of Electrical and Electronic Engineering, University of Abuja.

FUNDING INFORMATION

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

AUTHOR CONTRIBUTIONS STATEMENT

This journal uses the Contributor Roles Taxonomy (CRediT) to recognize individual author contributions, reduce authorship disputes, and facilitate collaboration.

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C : **C**onceptualization
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Fo : **Fo**rmal analysis
I : **I**nvestigation
R : **R**esources
D : **D**ata Curation
O : Writing - **O**riginal Draft
E : Writing - Review & **E**diting
Vi : **Vi**sualization
Su : **Su**pervision
P : **P**roject administration
Fu : **Fu**nding acquisition

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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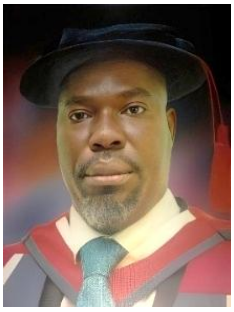

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