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To: "Dr. Sujono Sujono" <sujono@budiluhur.ac.id>

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**Sujono <sujono@budiluhur.ac.id>**

# [JAREE] Article Review Request

**Dr. Vita Lystianingrum** <vita@ee.its.ac.id> Wed, Nov 20, 2024 at 12:18 PM
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Cc: vita@ee.its.ac.id

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The editorial board of JAREE (Journal on Advanced Research in Electrical Engineering) believes that you would serve as an excellent reviewer of the manuscript, "Optimization Protection Coordination by Optimizing Time Dial Settings at PT. Pupuk Sriwidjaja Palembang Using Grey Wolf Method,". The submission's abstract is inserted below, and I hope that you will consider undertaking this important task for us. The manuscript has passed our plagiarism checking mechanism.

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JAREE (Journal on Advanced Research in Electrical Engineering)

"Optimization Protection Coordination by Optimizing Time Dial Settings at PT. Pupuk Sriwidjaja Palembang Using Grey Wolf Method"

Abstract

Overcurrent Rele (OCR) is an important component in the electric power protection system. One of the parameters that must be set on the OCR is the Pickup Current (Ip) and Time Dial Setting (TDS). To achieve optimum relay coordination by setting the time dial, several optimisation methods have been used such as Genetic Algorithm (GA), Particle Swarm Optimisation (PSO), Fire Fly Algorithm (FA) and Grasshopper Optimisation Algorithm (GOA).
In this study, the TDS setting was determined through Using the Grey Wolf Optimisation (GWO) method. The GWO algorithm was able to determine the optimum value of the TDS setting for each OCR process. This is validated by the results of tests conducted using the ETAP application. The primary and secondary relays are able to coordinate effectively to secure three-phase faults that occur on each bus.
Furthermore, GWO demonstrated a superior convergence rate in compared to GOA, therefore enhancing its capacity to identify a more optimal TDS setting value. Furthermore, the objective function of GWO is more effective than that of GOA, thereby enhancing its ability to function in a more optimal manner. The results of this test demonstrate that the GWO algorithm is a reliable method for directly identifying the optimal TDS setting value for

determining relay coordination settings.
Keywords—Protection Coordination Overcurrent Rele ( OCR ), Short Circuit Maximum ( IscMax ), Time Dial Setting ( TDS ), Grey Wolf Optimization ( GWO ).

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Thank you for considering this request.

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# PAPER TO REVIEW

# Optimization Protection Coordination by Optimizing Time Dial Settings at PT. Pupuk Sriwidjaja Palembang Using Grey Wolf Method

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**Overcurrent Rele (OCR) is an important component in the electric power protection system. One of the parameters that must be set on the OCR is the Pickup Current (Ip) and Time Dial Setting (TDS). To achieve optimum relay coordination by setting the time dial, several optimisation methods have been used such as Genetic Algorithm (GA), Particle Swarm Optimisation (PSO), Fire Fly Algorithm (FA) and Grasshopper Optimisation Algorithm (GOA).**

**In this study, the TDS setting was determined through Using the Grey Wolf Optimisation (GWO) method. The GWO algorithm was able to determine the optimum value of the TDS setting for each OCR process. This is validated by the results of tests conducted using the ETAP application. The primary and secondary relays are able to coordinate effectively to secure three-phase faults that occur on each bus.**

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***Keywords—****Protection Coordination Overcurrent Rele ( OCR ), Short Circuit Maximum ( $Isc_{Max}$ ), Time Dial Setting ( TDS ), Grey Wolf Optimization ( GWO ).*

## I. INTRODUCTION

The one of the essential components in an electrical system is OCR. OCR is designed as a protection device that responds as quickly as possible to open the circuit breaker when an abnormal current occurs. In programming the coordination of an OCR, there are two types of parameters setting: the first one is Pickup Current (Ip) and the second ones is Time Dial Setting (TDS) [1]. The Ip setting for each relay can be determined by first finding the minimum short-circuit current (Isc Min) and full load amps (FLA) [2]. In order to ascertain the TDS value, it is first necessary to identify the IP value and the type of relay used, as the inverse curve characteristics of different types of relay from different manufacturers vary considerably. [3].

The characteristics of the OCR can be observed on the Time Current Curve (TCC). This Inverse Time-Current graph is used to represent the relay's operational graph. To avoid malfunctions in the primary relay, It is recommended that a secondary relay be provided as a backup to maintain System safety. This can be achieved by adjustment of the time delay of the primary relay and the time delay of the secondary relay. in accordance with the regulations in force [4]. The time delay, the Current Time Interval (CTI) may be set between 0.2 and 0.4 seconds for ensuring the selectivity of the relay coordination [5].

The optimisation of the co-ordination of relays is becoming an increasingly popular method for obtaining the most optimal TDS settings. The application of this optimization method is expected to improve the performance of relays during faults. In previous studies, A number of optimisation algorithms have been implemented, for example the Particle Swarm Optimization (PSO), Genetic Algorithm (GA) and the Firefly Algorithm (FA) [6], Particle Swarm Optimization ( PSO ) [7], Fire Fly algorithm ( FA ) [8] and Grasshopper Optimization Algorithm (GOA) [9].

In this study, the process of finding the TDS value is conducted using the Grey Wolf Optimization (GWO) method. GWO's starting point will be an initial population, commonly referred to as agents, that will be applied to each case study [10]. GWO is implemented to obtain the most optimal relay parameter settings and serves as a solution for finding relay coordination settings using MATLAB.

This journal is divided into several sections: I. Introduction, II. Power System Protection, specifically Relay Coordination, III. Grey Wolf Optimization Algorithm, IV. Analysis of Research Results, and V. Conclusion

## II. ELECTRICAL POWER SYSTEM PROTECTION

Electrical faults can occur anywhere, at any time. These failures must be anticipated with a reliable protection system. Power system protection is designed to minimise damage to electrical components in the event of faults [11]. Coordinated relay protection is expected For improvement the reliability, selectivity and reliability of the protection system [12].

### *A. Overcurrent Relay*

The one of the essential components in a protection system is OCR. The OCR can detect anomalies in the flow of electricity through the electrical system. Based on its curve type, OCRs are categorized into three types: Instantaneous , Inverse and Definite Time.

*1) Setting Parameters OCR Inverse Time Current*

The inverse time, current overcurrent relay operates in a similar way, where an increase in the amount of current flowing through the relay leads to reduced relay operating time. This type of inverse time current OCR includes several curve types: Very Inverse, Long Time Inverse , Ultra Inverse, Standard Inverse and Extremely Inverse [11].

In order to set the inverse time current OCR, it is necessary to enter a number of parameters, including the pickup current and the time dial setting.

According to British Standard 142, the determination of the Pick Up Current (Ip) for overload following by criteria:

$$1.05FLA < Ip < 1.4FLA \tag{1}$$

To determine the limits of the Pick Up Current (Ip) as protection during a short circuit, the following by criteria:

$$1.06\ FLA < Ip < 0.8I_{SC\ MIN} \tag{2}$$

Based on the formulas from equations 1 and 2, it can be determined that the Pick Up Current (Ip) serves as the set point for the current at which the circuit breaker must trip if the flowing current exceeds this set point. Full Load Amperage (FLA) represents the maximum current of the load under normal conditions, and ISC MIN refers to the short circuit between phases (Isc for 2 phases) during the steady state duration (30 cycles) [13].

In addition to the Ip setting, the OCR also requires a TAP setting so that it can operate when the Ip setting is exceeded. The following formula is used to calculate TAP:

$$TAP = \frac{Ip}{Primer\ CT} \tag{3}$$

TAP is the tapping value from the transformer, while the Primary CT refers to the ratio value of the primary side of the transformer.

The OCR requires the TDS to add the $I_P$ setting. Calculation of TDS, The following formula can be used by The values of all coefficients are being entered k, α and β in accordance with the inverse curve being used:

$$Top = \frac{k\ x\ TDS}{\left[(\frac{I}{Ip})^{\alpha}-1\right] x\ \beta} \tag{4}$$

TABLE I INVERSE CURVE COEFICIENT

| Curve Type | Coefficient | | |
|---|---|---|---|
| | k | α | β |
| *Ultra Inverse* | 315.2 | 2.5 | 1 |
| *Long Time Inverse* | 120 | 1 | 13.33 |
| *Extremely Inverse* | 80 | 2 | 0.808 |
| *Very Inverse* | 13.5 | 1 | 1.5 |
| *Standard Inverse* | 0.14 | 0.02 | 2.97 |

*2) Coordination Time Interval ( CTI )*

Time difference operation between primary and secondary relay is CTI. According to the recommendations from IEEE Std 242-2001, the CTI settings can be seen in table:

TABLE II COORDINATION TIME INTERVAL ( CTI )

| **Component** | **Time ( s )** | |
|---|---|---|
| | **Electro mecanical** | **Static** |
| *Relay overtravel* | 0.1 | 0 |
| *Circuit breaker for opening time* | 0.08 | 0.08 |
| *Tolerance of relay and setting errors* | 0.12 | 0.12 |
| Total of CTI | 0.3 | 0.2 |

*B. Problem Statement*

Several issues in relay protection coordination reles are divided into three parts: control variables, constraints, and objective functions.

*1) Control Variables*

In this research, the control variable is TDS value. The method of the GWO algorithm is used to obtain the most optimal TDS value. The TDS configuration is carried out to achieve the most optimal and reliable relay settings.

*2) Constrain*

In application, all relay setting values must meet the following predetermined constraints:

$$Top_{Min} \leq Top_i \leq Top_{Max} \tag{5}$$

$$TDS_{\ Min} \leq TDS_{\ i} \leq TDS_{\ Max} \tag{6}$$

$$Ip_{\ Min} \leq Ip_{\ i} \leq Ip_{Max} \tag{7}$$

The aforementioned equations illustrate that $TopMax$, $Topi$, and $TopMin$ represent the maximum, actual, and minimum operational time relay, respectively. $TDSMax$, $TDSi$, and $TDSMin$ represent the maximum, actual, and minimum time dial setting relay, respectively. Additionally, the minimum, actual, and maximum pickup current of the relay, represented by $IpMin$, $Ipi$, and $IpMax$, respectively, are also of interest.

To ensure continued reliability of the protection system, it is essential that the timing between primary and backup relay satisfies following constraint :

$$Top_{bacukup} - Top_{Promer} \geq \text{CTI} \tag{8}$$

*3) Objective Function*

The objective function (OF) represents the total operating time of the relays installed in the system. The objective is to minimise the duration of relay operation in order to safeguard areas that are not impacted by the fault. This allows them to continue their normal operations.

$$OF = \sum_{i=1}^{n} Top_i \tag{9}$$

OF represents the objective function, while $T_{op}$ represents the relay operating time, according to the formula above.

## III. GREY WOLF OPTIMIZATION ( GWO )

The wolf is a social animal that lives in groups comprising more than a dozen individuals. These groups have a rigid hierarchical structure. Grey Wolf Optimization algorithm is composed of four distinct levels of wolves, designated as alpha (α), beta (β), delta (δ), and omega (ω), respectively. The alpha wolf is the primary decision-maker within the group, responsible for guiding the collective's actions. The Beta and Delta wolves support the Alpha, while the omega wolf serves as a representative for the remaining wolves. Influenced by the three previous wolves, the fourth wolf, called the Omega Wolf, obeys their commands. It is this hierarchical structure that the grey wolf uses for hunting and foraging. The alpha, beta, and delta wolves are the most proximate to the prey, while the omega wolf follows them in order to search for, track, and encircle their target. Once the circle has reached a sufficiently small size, the omega wolf initiates an attack and proceeds to consume the prey [14].

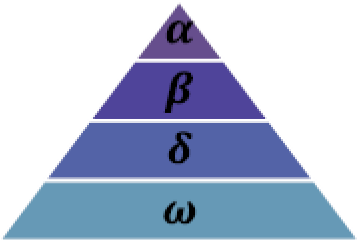



Fig. 1. Hierarki Grey Wolf Optimization

### A. Searching for Prey

The hunt for the grey wolf begins with the search for prey., and their behaviour can be described through the application of a mathematical formula:

$$D = | C.Xp(t) – X(t) | \quad (10)$$

$$X (t+1) = Xp(t) – A.D \quad (11)$$

In this context, D represents the distance between the wolves and the target. In this model, where the variable $t$ represents the current iteration, $Xp(t)$ denotes the position of the prey, the position vector of the wolf is denoted by $X(t)$, and the updated vector of the next generation of wolves is denoted by $X(t+1)$. Coefficients A and C, defined in Eqs. 12 and 13 respectively, are :

$$A = 2ar1 – a \quad (12)$$

$$C = 2r2 \quad (13)$$

$$a = 2 (1-t/T) \quad (14)$$

The random vectors r1 and r2 are defined on the interval [0,1] and during the iteration process, demonstrate a linear decrease from 2 to 0. The range of values for A is given by the interval [-2, 2]. The range for C is [0, 2].

### B. Encircling the Prey

In accordance with the alpha wolf's guidance, Beta and Delta wolves approaching prey. Initially, the distance between the wolves is calculated using equations (15) to (20). Subsequently, equation (21) is employed to ascertain the manner in which the brown wolves hu.

$$D\alpha = | C1.X_{\alpha} (t) – X(t) | \quad (15)$$

$$D\beta = | C2.X_{\beta}(t) – X(t) | \quad (16)$$

$$D\delta = | C3.X_{\delta}(t) – X(t) | \quad (17)$$

$$X1 = X_{\alpha} – A1.D_{\alpha} \quad (18)$$

$$X2 = X_{\beta} – A2.D_{\beta} \quad (19)$$

$$X3 = X_{\delta} – A2.D_{\delta} \quad (20)$$

$$X (t+1) = (X +X2+X3)/3 \quad (21)$$

In accordance with the aforementioned equations, the variable $X_{\alpha}$ represents the location of the alpha wolf, $X_{\beta}$ signifies the position of the beta wolf, and $X_{\delta}$ denotes the location of the delta wolf. The random vectors C1, C2, and C3 are derived from the alpha, beta, and delta wolves, respectively, and their values range between [0,2].

### C. Attacking the Prey

Once the prey has stopped moving, the target will be attacked by a group of grey wolves. By reducing the value of a from 2 to 0 during the iteration process, this process can be simulated. If |A| >1, the grey wolves will move away from the target and perform a global search; if |A|<1, the grey wolves will start attacking their prey.

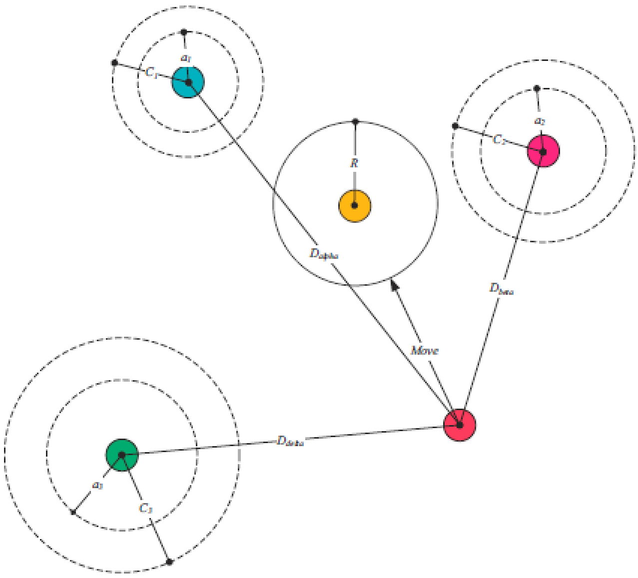


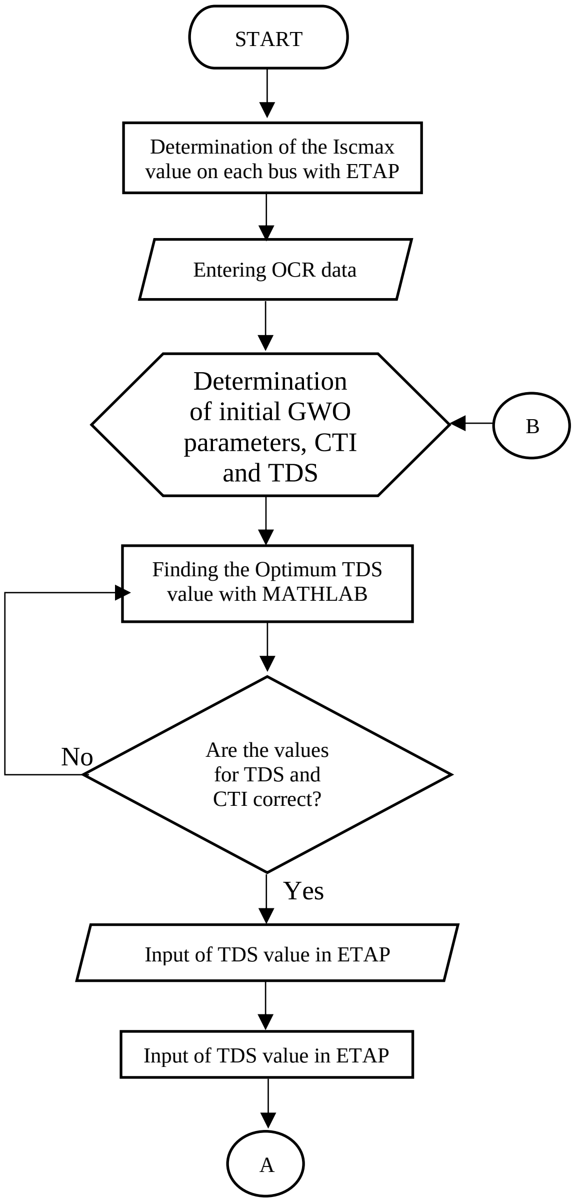

Fig. 2. Wolves Attack the Prey

### D. Application of GWO

One of the popular new algorithms is GWO. GWO was the brainchild of Seyedali Mirjalili, whose inspiration was the grey wolf. The proposed method will mimic the social hierarchy and behaviour of the grey wolf. GWO has demonstrated highly competitive results compared to other metaheuristic algorithms such as Particle Swarm Optimization (PSO), Differential Evolution (DE), , Gravitational Search Algorithm (GSA) Evolutionary Programming (EP), and Evolution Strategy (ES). The results show that GWO has superior exploitation capabilities, can perform exploration, avoids local optima, and achieves convergence. Thus, GWO proves its capability of high performance [15].

In application, this algorithm has been used for optimal reactive power dispatch problems, with results showing that GWO can effectively and efficiently solve the issue with minimal deviation [16]. GWO has also been used to solve both single-objective and multi-objective optimal power flow problems, demonstrating high performance [17]. Additionally, GWO has been used to find the gain of a PID controller for a quadruped robot, showing that GWO is faster and more efficient than PSO and GA algorithms in finding global and local optimization [18]. Based on GWO's optimization capabilities from previous research, this study will use the GWO algorithm to find the optimal TDS value to be applied in protection systems, allowing for quick identification of optimal protection settings through a reliable coordination system.

### *E. GWO Flowchart for Protection System*



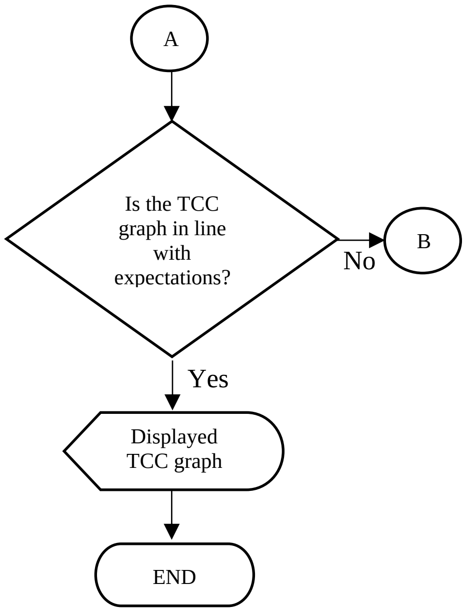




Fig. 3. Flowchart of GWO Application for Protection coordination

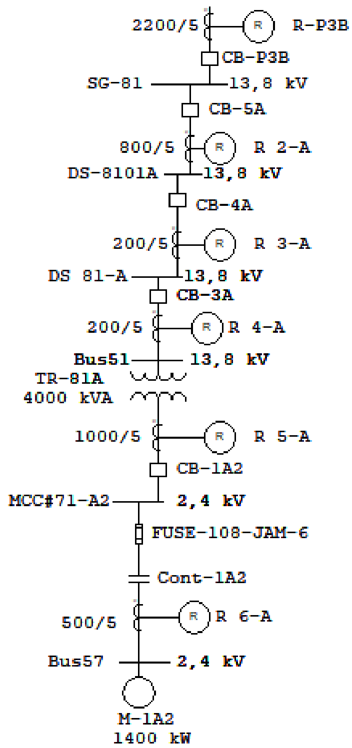



Fig. 4. *Single Line Diagram (SLD) of the Electrical System*

The application of GWO in protection systems is very helpful in finding the optimal coordination settings for relay protection. To determine the TDS value, all initial parameters of GWO need to be included.

The search for TDS is performed using the GWO algorithm in MATLAB. The TDS values generated by the GWO algorithm are then applied to the OCR in the Single Line Diagram (SLD) of the system using the ETAP application. To validate the accuracy of the applied OCR settings, it is necessary to check the TCC curve using the ETAP application.

## IV. Simulation Results And Disccusion

The TDS values generated by GWO are simulated on a radial type SLD in an industrial plant as shown in Figure 4. The Single Line Diagram consists of 6 buses and 6 OCRs. The OCR setting parameters are adjusted according to Table III. Using these setting parameters, GWO will determine the Time Dial Setting for each OCR using MATLAB programming.

This simulation evaluates the performance of the GWO algorithm compared to the GOA algorithm, both of which are subjected to the same type of disturbance. The two methods are compared with the same OCR and load parameter settings. Furthermore, the number of agents and the number of algorithm iterations are identical.

Table III. OCR Setting Data

| Rele ID | kV | $I_{scmax}$ Prim (A) | $I_{scmax}$ Sek (A) | FLA (A) | Ip (A) |
|---|---|---|---|---|---|
| R P3B | 13.8 | 26022 | 0 | 2108.6 | 2640 |
| R 2-A | 13.8 | 30573 | 26022 | 669.3 | 800 |
| R 3-A | 13.8 | 31644 | 30573 | 167.3 | 200 |
| R 4-A | 13.8 | 31644 | 3164 | 167.3 | 200 |
| R 5-A | 2.4 | 16686 | 2902 | 962.3 | 1200 |
| R 6-A | 2.4 | 18225 | 16686 | 387.2 | 500 |

### A. *Simulation of GWO and GOA Algorithms*

The reliability of these two algorithms can be seen from the convergence curves of the two algorithms. From Figure 6 we can see that GWO has a better convergence than GOA in finding the optimum Time Dial relay setting. GWO can reach the steady state at the 8th iteration while GOA reaches the steady state at the 252th iteration.

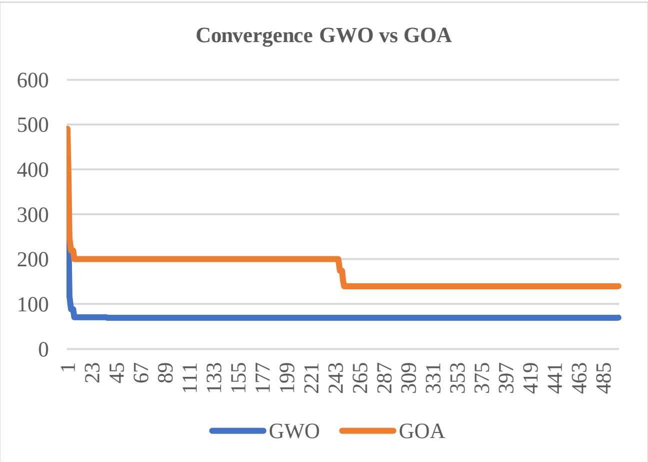



Fig 5. Comparison of convergence curves with 150 agents

The GWO and GOA simulations were conducted with an identical number of agents, specifically 150 and 500 iterations, respectively. The optimal TDS value generated by GWO is then applied to ETAP for the purpose of validating the reliability and effectiveness of the GWO algorithm in identifying the optimal TDS setting value on OCR. An examination of the inverse time-current curve (TCC) enables the determination of whether the OCR is performing in accordance with expectations.

Table IV. GWO vs GOA Optimisation Results

| ID Relay | Curve type | GWO | | GOA | |
|---|---|---|---|---|---|
| | | TDS | OF | TDS | OF |
| R 6A | UI | 1,0150 | 70,0251 | 1,0100 | 70,1283 |
| R 5A | VI | 1,0150 | | 1,0100 | |
| R 4A | EI | 1,1223 | | 1,1382 | |
| R 3A | UI | 2,7144 | | 3,0000 | |
| R 2A | SI | 1,4330 | | 1,5388 | |
| R P3B | UI | 1,0100 | | 1,0100 | |

Table IV demonstates that the objective function (OF) of GOA is greater than that of GWO. This demonstrates that the GWO algorithm is more effective than the GOA algorithm.

Table V. CTI Optimisation Results of the GWO Algorithm

| Location Fault | Protection | | Top ( S ) | | CTI (S) |
|---|---|---|---|---|---|
| | Prim. | Sec. | Prim. | Sec. | |
| BUS57 | R 6A | R 5A | 0,179 | 0,522 | 0,3430 |
| MCC71 | R 5A | R 4A | 0,522 | 0,53 | 0,0080 |
| BUS51 | R 4A | R 3A | 0,278 | 0,478 | 0,2000 |
| DS 81-A | R 3A | R 2A | 0,478 | 0,679 | 0,2010 |
| DS-8101A | R 2A | R P3B | 0,679 | 1,02 | 0,3410 |
| SG-81 | R P3B | | 1,02 | | 0,0000 |

In order to ascertain the reliability of the TDS optimisation settings generated by the GWO algorithm, it is possible to observe the TCC curve through ETAP by triggering a three-phase short circuit fault on each bus. The following section will examine the efficacy of the primary and backup relays in maintaining the reliability of the electrical system. The following failures were tested and found to exist:

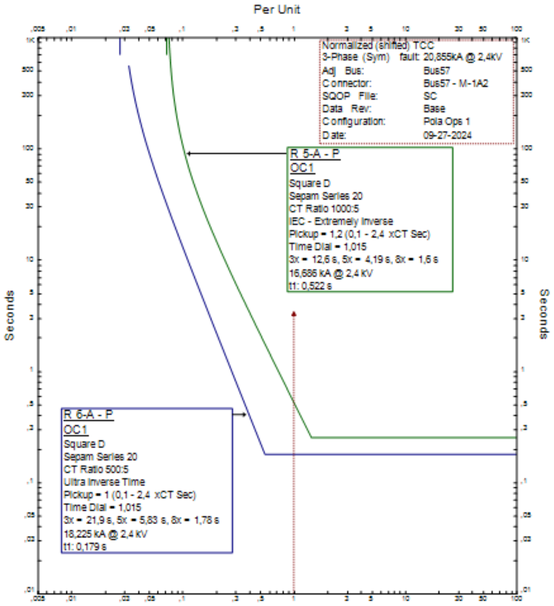



Fig 6. Three-phase short-circuit fault detected on bus 57

The TDS settings generated by the GWO algorithm from Table IV have been successfully implemented in relay 6A, which serves as the primary relay, and relay 5A, which serves as the secondary relay. The implementation of this configuration is intended to ensure the continued reliability of the protection system in the event of a maximum short circuit occurring on bus 57. Relay 6A works for 0.179s while relay 5A as a backup relay works for 0.522s. The implementation of relay coordination has proven to be an effective and selective method for securing areas that are not affected by interference, with a CTI of 0.343s..

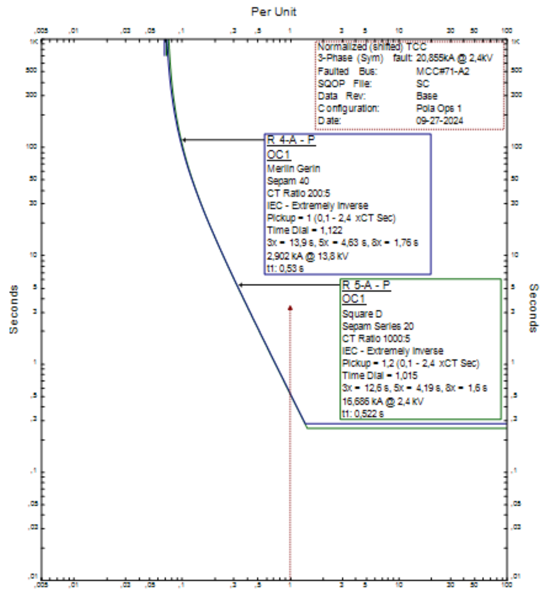



Fig 7. Three-phase short-circuit fault detected on MCC71

The TDS settings generated by the GWO algorithm from Table IV have been successfully applied to maintain the reliability of the protection system when a maximum short circuit occurs at MCC71. The settings have been implemented for relay 5A, which is the primary relay, and relay 4A, which is the secondary relay. Relay 5A works for 0.522s while relay 4A as a backup relay works for 0.530s. This relay coordination has worked effectively and selectively. This is because the two relays work at different voltage levels.

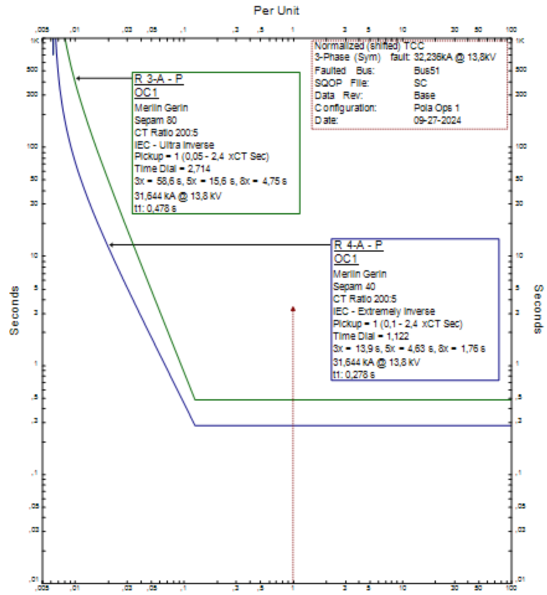



Fig 8. Three-phase short-circuit fault detected on Bus 51

The TDS settings generated by the GWO algorithm from Table IV have been successfully implemented in relay 4A, which has been designated as the primary relay, and relay 3A, which has been designated as the secondary relay. This configuration ensures the reliability of protection system in case of maximum short-circuit on bus 51. Relay 4A is operational for a duration of 0.278 seconds, while relay 3A which serves as a backup relay is operational for a duration of 0.478 seconds. The aforementioned relay coordination, with a CTI of 0.2 seconds, has been demonstrated to be an efficacious and selective method of securing unaffected areas.

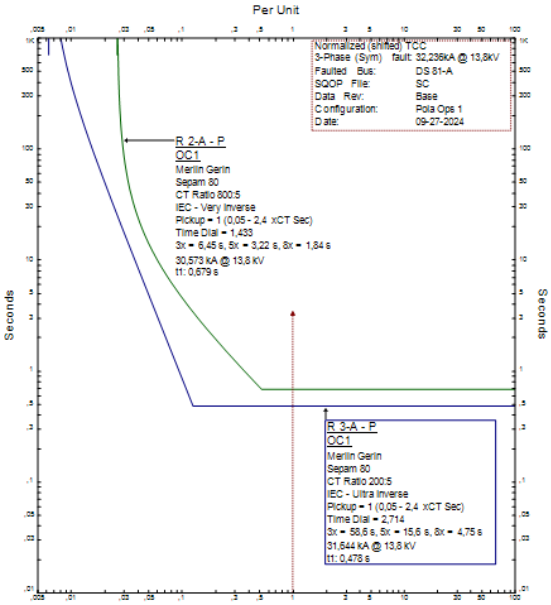



Fig 9. Three-phase short-circuit fault detected on Bus DS 81A

The TDS settings generated by the GWO algorithm from Table IV were successfully applied to maintain the reliability of the protection system when a maximum short circuit occurred at bus 51. Relay 3A was designated as the primary relay, while relay 2A was designated as the secondary relay. Relay 3A works for 0.478s while relay 2A as a backup relay works for 0.679s. The implementation of relay coordination has proven to be an effective and selective method for securing areas that are not affected by interference, with a CTI of 0.201s.

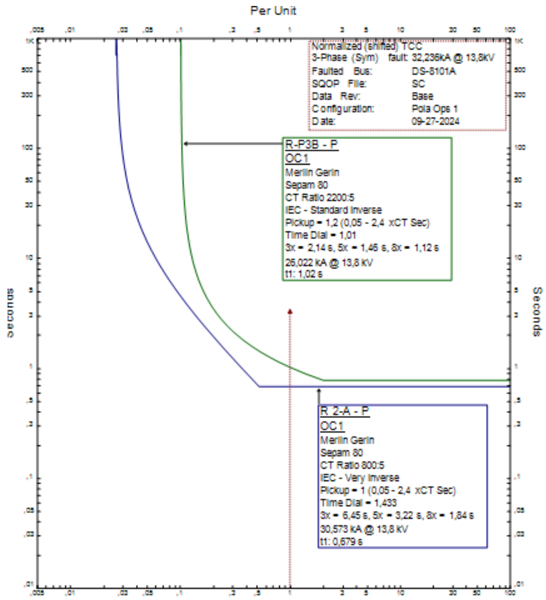



Fig. 10. Three-phase short-circuit fault detected on DS 8101A

The TDS settings generated by the GWO algorithm from Table IV have been successfully implemented in Relay 2A, which has been designated as the primary relay, and in Relay P3B, which has been designated as the secondary relay. This configuration ensures the reliability of the protection system in the event of a maximum short circuit on the DS8101A bus. Relay 2A is operational for 0.679 seconds, while relay P3B which serves as a backup relay is operational for 1.02 seconds. With a CTI of 0.341s, the coordination of the above relays has proved to be an effective and selective method of securing interference-free areas..

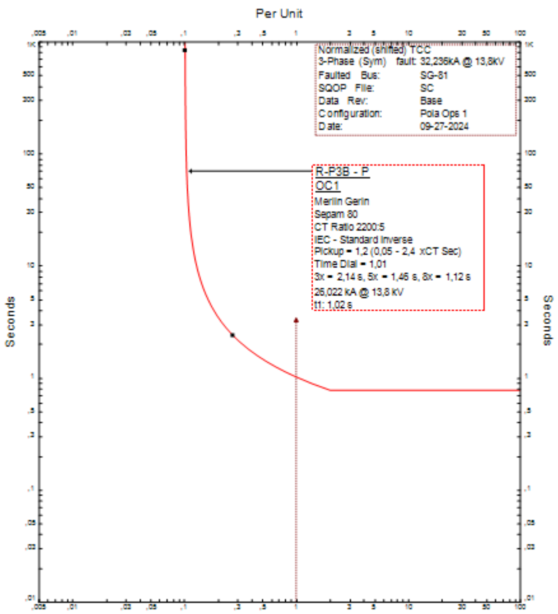



Fig. 11. Three-phase short-circuit fault detected on Bus SG 81

The TDS settings generated by the GWO algorithm from Table IV were used to determine that P3B is primary without backup. This is due to the occurrence of the disturbance on the bus in closest proximity to the source.

## V. Conclusion

The GWO algorithm has been demonstrated to be effective in identifying the optimal Time Dial parameter setting value of OCR. The OCR has been shown to provide effective protection against three-phase short circuit faults on each bus tested using the ETAP application. The primary and secondary relays have been observed to operate in a selective and effective manner, ensuring the secure isolation of unaffected areas.

In addition, the GWO algorithm demonstrates superior convergence properties in comparison to GOA. This demonstrates that the GWO algorithm is more reliable and faster at identifying the optimal TDS value than the GOA algorithm.

Furthermore, the objective function of GOA is more extensive than the one observed in GWO. This demonstrates that GWO is more effective than GOA in identifying the optimal TDS setting value.

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# REVIEW COMMENTS

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## REVIEWER COMMENTS

**PAPER ID: 430**

| No | Comment (for Reviewer) | Reply to Comment / Change Description (for Author) | Page No. |
|---|---|---|---|
| 1) | This paper discusses the optimization of over current relays using the Grey Wolf Optimizer (GWO) method. The writing structure of the paper is well presented so that it is easy to follow by the reader. To further clarify the contributions that have been mentioned and improve the readability of this paper, the following points and suggestions need to be considered carefully: | | |
| 2) | In the abstract, it is mentioned that many methods such as GA, PSO, FA, and GOA have been used in TDS optimization of OCR. However, for result validation, the proposed GWO algorithm is only compared with GOA. Is there any special reason why it is not also compared with the results from GA, PSO, and FA so that it is more complete and detailed how the advantages of the proposed GWO? | | |
| 3) | In the introduction: | | |

| | | | |
|---|---|---|---|
| | - The literature study is still only about the basic theory that will be used, but it does not reflect what distinguishes this publication paper from previous ones. An explanation should be added that represents the difference.<br>- The introduction also does not clearly state the contribution of this publication paper. | | |
| 4) | In the paper, it is mentioned that the optimization objective is to minimize the duration of relay operation to protect the unaffected area. However, the mathematical statement in equation 9 does not reflect this objective. | | |
| 5) | In the flowchart section:<br>- The flowchart of the GWO algorithm for the protection system does not reflect how the GWO algorithm works to achieve the objectives set in the optimization.<br>- The flowchart should explain the algorithm, it is general, so it should not state the name of the software used such as mathlab or the like. | | |
| 6) | In general optimization, there are constraints that must be met. In this paper, there is an explanation of the constraints used in optimization presented in the problem section. However, in the results and analysis, there is no discussion that explains the compliance with the constraints set. Are the optimization results obtained really obedient to the existing constraints? This needs to be explained. | | |

| | | | |
|---|---|---|---|
| 7) | The conclusion should clearly state the superiority of the proposed algorithm. What is the superiority in terms of? | | |
| 8) | Consistency in writing equations must be maintained, including:<br>- There are some multiplication writings that use “x” and some without “x”.<br>- The writing of multiplication between constants and variables or between variables, some use spaces and some without spaces, some use “.” but some without “.”.<br>- Some equations are italicized and some are not.<br>- The writing in subscribt form needs to be considered and must be consistent. | | |
| 9) | The quality of the images, especially images in figure 6 to 11, are of such low resolution that they are difficult to read. We suggest improving the quality of the images so that they are clearer and easier to read. | | |

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