

# MAINTENANCE AND OPERATION STUDY ON DISTRIBUTION SUBSTATION AT PT. PLN (Persero) ULP GUNUNGSITOLI

By :  
Amir  
Universitas Pelita Nusantara  
Email:  
[emailpenulis@gmail.com](mailto:emailpenulis@gmail.com)

## *Abstract*

Maintenance and operation of distribution substations are crucial factors in maintaining the proper performance of the electricity distribution system. Distribution substations play a crucial role in distributing electricity from the main substation to power users. Distribution substation maintenance involves a series of routine inspections, cleaning and replacing damaged components, routine testing and maintenance, and periodic condition monitoring of the distribution substation. Routine inspections are conducted to detect possible damage or wear on distribution substation components. Cleaning is performed to remove dirt and living plants that can interfere with the performance of the distribution system. Replacing damaged components or components that have exceeded their service life is crucial to maintain the proper functioning of distribution substation components. Routine testing and maintenance are conducted to ensure optimal performance of distribution substation components, and condition monitoring helps detect problems in the distribution system. Operation of distribution substations involves controlling the switching on and off of substations according to consumer demand. Prompt and efficient handling of disturbances is essential to restore power supply as quickly as possible. Periodic monitoring of network conditions and loads can help optimize power usage and prevent overloading.

*Keywords: Maintenance, routine testing and maintenance, condition monitoring*

## **Introduction**

### **1.1 Background**

The electrical distribution system plays a crucial role in providing a stable and reliable electricity supply to consumers. One of the most important components of the distribution system is the distribution substation. A distribution substation is an electrical installation containing circuit breakers, connectors, safety devices, and distribution transformers to distribute electricity to consumers according to their needs. The distribution substation serves as the point of electricity distribution from the main substation to the end customer or consumer. Proper maintenance and operation of distribution substations are key factors in maintaining a stable electricity supply. Routine and regular maintenance carried out periodically is necessary to ensure that components in the distribution substation function properly

and are not damaged. Furthermore, proper operation of the distribution substation allows for efficient power management and the ability to handle any disruptions quickly and accurately.

### **1.2 Formulation of the problem**

In the context of maintenance and operation of distribution substations, there are several problem formulations in writing, including:

- a. What are the problems frequently encountered in maintaining and operating distribution substations?
- b. How does ineffective maintenance impact the performance and reliability of components in distribution substations?
- c. How to optimize maintenance and replacement of spare parts on distribution substation components to extend the service life of the

equipment and reduce the risk of disruption?

### **1.3 Research purposes**

- a. Explains the importance of carrying out maintenance and operation on distribution substations.
- b. Understand the process and working principles of distribution substations.
- c. Increase safety awareness of electric current.
- d. Introducing the latest technology and innovation equipment that can be used in carrying out maintenance and operations at distribution substations.

## **1. Theoretical basis**

An electrical distribution system is the infrastructure used to deliver electrical power from main power plants or substations to power users or end consumers. The primary purpose of an electrical distribution system is to deliver electrical energy safely, reliably, and efficiently to locations requiring electrical power, or end consumers. The electrical distribution system is also part of the electric power system that connects large power sources *with* a series of services to end consumers. The electrical distribution system consists of several components and devices that work together to ensure the efficient distribution of electrical power. The electricity distribution system is designed to ensure a secure and efficient electricity supply. Proper maintenance, such as routine maintenance, preventative maintenance, and repairs, is also carried out to maintain the performance and reliability of components in the electricity distribution system. A reliable and efficient electricity distribution system ensures that electricity can be effectively distributed to various consumer sectors, including households, businesses, and industry.

## **2. Research methods**

### **3.1 Types and Approaches of Research**

The type of research used by the author is qualitative research. Qualitative research aims to describe in detail or to understand and explain something in depth through subjective interpretation, both from an individual perspective and from the perspective of the group involved. The author chose this type of qualitative research because the author obtained research data by going into the field and coordinating directly with supervisors and technicians on duty when carrying out maintenance and operation at the distribution substation. This study uses a descriptive approach, namely wanting to find complete and correct answers about the process during maintenance and operation at the distribution substation. This qualitative research approach aims to obtain answers to the problems stated in the problem formulation in chapter I so that the author can later review and present them during the presentation at the final exam.

### **3.2 Location and Time of Research**

Conducting research requires a location. The author chose PT. PLN (Persero) ULP Gunungsitoli for the research, located at Jl. Gomo No. 21, Gunungsitoli District, Pasar Village, Gunungsitoli City, North Sumatra Province. The research period was from May 2023 to July 2023.

### **3.3 Data collection technique**

In conducting this research, the author employed several data collection techniques. These techniques were very helpful in completing this final assignment. These include:

- a. Direct Observation

Conduct direct observations in the field by paying attention to activities when technicians (officers) carry out maintenance and operations at distribution substations.

b. Interview

Conduct interviews with existing supervisors and technicians (officers) to find out their views on the importance of carrying out maintenance and operation at a distribution substation and what obstacles are often encountered

when carrying out these activities or tasks.

c. Documentation

Documenting when the technician (officer) carries out maintenance and operations on the distribution substation.

**3. Research Results and Discussion**

In this discussion and findings, the author will explain what he obtained during his research. The following is the data the author obtained before and after maintenance was carried out on the distribution substation at PT. PLN (Persero) ULP Gunungsitoli:

No.	Feeder		Total Power (VA)	
	Beginning	End	Before	After
1.	GS 157	GS 158	63,580	95,370
2.	GS 157	GS 156	63,580	95,370

Tabel 4. 1 Jumlah Daya Sebelum dan Setelah Dilakukannya Pemeliharaan

Here is the calculation.

Formula  $I = P / (V \times 1.73)$

Where I: Current (A)  
P: Power (VA)

V: Voltage (V) = 400 Volt low voltage (depending on the number of customers)

In the case of a distribution substation maintained with feeder no. GS 157 having a transformer capacity of 100 KVA = 100,000 VA, then the NH Fuse installed in each phase is:

$$I = 100,000 / (400 \times 1.73)$$

$$I = 100,000 / 692$$

$$I = 144.5 \text{ A/Phase}$$

After obtaining the current for each phase, the next step is to calculate the total power before and after maintenance. The current values above are used as the benchmark because the damaged component I found during maintenance on a distribution substation at PT. PLN (Persero) ULP Gunungsitoli was the NH Fuse. The following is a calculation to obtain the total power before and after maintenance:

Formula,  $P = I \times V$

Where, P=Power (VA)

I=Current (Amperes)

voltage (volts), in this case the total voltage is 220 Volts. Because it is appropriate for its users, namely customer homes located along the GS 157 distribution substation feeder.

So,  $P = 144.5 \text{ A} \times 220 \text{ V}$   
 $= 31,790 \text{ VA/Phase}$

With a total power of 31,790 VA/Phase, the total power that should be in GS 157 is  $31,790 \text{ VA} \times 3 \text{ (Phase)} = 95,370 \text{ VA}$ . Now, because the problem during the maintenance was that one of the NH Fuses experienced a decrease in function due to age, the total power before the maintenance was carried out was:  $95,370 \text{ VA} - 31,790 \text{ VA} = 63,580 \text{ VA}$ .

With the results obtained above, the author can find out how many houses are supplied with electricity from GS 157 with the users being houses with an average meter used being a prepaid meter with a power of 1,300, as follows:

Total 1-phase power divided by the average power of the customer meter:  
 $= 31,790 : 1,300$

= 24.4 or rounded up 24 houses/phase x 3 = 72 houses. So, GS 157 supplies electricity to a total of 72 customer homes.

After the materials and work tools have been prepared, the next step is to carry out maintenance on the distribution substation. Before arriving at the location, officers will conduct a briefing conducted by the field supervisor or supervisor and the K3 (Occupational Health and Safety) supervisor. During the briefing, officers will be instructed to continue to work together while carrying out their duties and assist each other. Specifically, the officers will be checked from head to toe by the K3 supervisor. The K3 officer will inspect each officer, from helmets and clothing to rubber shoes. This is to protect officers during maintenance.

Next, we departed for the location to perform maintenance on the distribution

substation. The next step is the maintenance process at the distribution substation at PT. PLN (Persero) ULP Gunungsitoli. The maintenance process is as follows:

- a. After assessing the condition of the distribution substation and identifying the problems, the next step is to perform maintenance and repairs. First, remove the FCO from the LBS using a telescopic hot stick. This is to stop the induced charge from the transformer from transmitting current. The FCO is also removed to prevent feedback that could potentially cause customers to use the generator. After removing the FCO, turn off the main switch (hafboom switch) in the PHB-TR box.



Gambar 4. 1 Pelepasan FCO Dari LBS Menggunakan Telescopic Hot Stick

- b. After removing the FCO from the LBS and turning off the main switch located inside the PHB-TR box, the current from the transmission line through the JTM to the distribution transformer will automatically be cut off. The next step is to replace any damaged components.
- c. Remove the cable ring that attaches the JTR cable to the PHB-TR, then cut the cable connected to the JTM cable using cable cutting pliers. After removing the damaged JTR cable, prepare a new JTR cable and cut it into three pieces the same length as the damaged cable.

Gambar 4. 2 Pelepasan Cincin Kabel JTR Yang Ada Didalam Kotak PHB-TR

- d. Strip the cable skin at each end using a utility knife, then attach a cable lug to one end of each cable and press it using pliers. The other end doesn't need a cable lug, as you'll be attaching a bimetallic joint to connect the JTR and JTM cables, which receive their current from the distribution transformer.
- e. After the end of the cable and the cable lug are pressed, then reinstall the cable into the PHB-TR box in the order, namely RS T. After inserting the end of the cable with the cable lug into the PHB-TR box, then reinstall the cable ring to tie the cable.



Gambar 4. 3 Penggantian dan Pemasangan Kembali Kabel JTR Yang Rusak Dengan Kabel JTR Yang Baru

- f. Next, connect the end of the cable with the bimetal joint to the end of the JTM cable. The officer will climb the power pole using a climbing rope to disconnect the old cable and connect the new one. Connect the two cables by inserting each end into the bimetal joint and then pressing it using a pair of pliers. After pressing each end of the cable and ensuring that both types of cables are connected, the next step is to replace the other damaged component, the NH Fuse.
- g. After the replacement of the damaged cable is complete, the next step is to replace the damaged NH Fuse (which has decreased function). Replace the NH Fuse by opening and removing the NH Fuse from its holder. Then replace the NH Fuse with a new one according to the old size. The size of the NH Fuse replaced in the PHB-TR distribution substation of PT. PLN (Persero)

ULP Gunungsitoli which is being maintained is 150 A.



Gambar 4. 4 Setelah NH Fuse Yang Baru Di Pasang Kembali

- h. After replacing all degraded or damaged components, reactivate the power supply. To reactivate the power supply, first reinsert the FCO into the LBS, then activate the main switch located inside the PHB-TR box of the maintained distribution substation.
- i. Once everything is reactivated, an officer will check one of the homes to ensure the power is flowing and operating normally. At the end of this maintenance, electricity will be restored to every customer and operating normally.

After completing maintenance on the distribution substation by replacing components that have experienced decreased function and damage due to age, the next step is to operate the distribution substation at PT. PLN (Persero) ULP Gunungsitoli that has been maintained.

#### 4. Closing

##### 5.1 Conclusion

1. In carrying out maintenance and operation of distribution substations, especially distribution substations at PT. PLN (Persero) ULP Gunungsitoli, there are several problems that are often faced and encountered in the field, including:
  - a. Unfavorable weather: This is a common problem encountered during

maintenance and operation of distribution substations. Therefore, officers and technicians always prepare everything when performing maintenance and operation at distribution substations. For example, they prepare raincoats, boots, and rubber gloves. This ensures that even in unfavorable weather, they can still carry out maintenance with minimal risk.

- b. Components that are not on standby or not yet available: this problem sometimes occurs when carrying out maintenance, damaged components in a distribution substation must be ordered first and result in the performance of the distribution substation becoming ineffective or even not operating until the components are available or arrive.
2. The impact of ineffective maintenance on a distribution substation, especially the distribution substation at PT. PLN (Persero) ULP Gunungsitoli, includes:

- a. There is a decrease in the function of the distribution substation components.
  - b. Due to this decline in function, electricity distribution to customers is not optimal and makes customers dissatisfied and unhappy with PLN's performance.
- 3 Ways to optimize maintenance at a distribution substation to extend the service life of components and to reduce the risk of disruptions include:
- a. Create a maintenance schedule at each distribution substation point, for example twice a month.
  - b. Conduct routine inspections along the electrical lines, especially along the distribution lines.

## 5.2 Suggestion

After the author wrote this research, the author provided several suggestions to various parties, including:

- 1. To PLN:
  - a. When performing maintenance on a distribution substation, ensure that all components that need to be replaced are present to prevent long-term power outages.
  - b. When operating, ensure that all components are installed properly and correctly, so that unwanted things do not happen.
  - c. Establish a routine inspection and maintenance schedule to monitor the condition of each distribution substation, for example, at least two or three times a month, or

even more. This ensures that each distribution substation consistently performs well and avoids major disruptions.

### 2. To the Public:

- a. Everyone should always be safe when leaving the house. This includes always wearing footwear. This not only protects our feet from sharp objects, but also protects us from current leaks in the grounding of distribution substations or power poles.
- b. Before cutting down any trees near power lines, such as banana or coconut trees, report it to the state electricity company (PLN) first. This will ensure the safety of the PLN and the public.
- c. Use the electricity as best as possible and always top up your credit if you use a prepaid meter and pay every month if you use a postpaid meter so that the community and PLN remain in good relations.

## BIBLIOGRAPHY

- Hadiarin, Zeni Firda, 2016, Bandung, *LKP Distribution Transformer Maintenance of PT. PLN APJ Bandung*, 11-38.
- Makangiras, Ofriadi, 2016, Manado, Polytechnic, *Final Report on Distribution Substation Maintenance*, 4:1-20.
- PLN, Book 4, 2010, PT. PLN Persero, *Construction Standards for Distribution Substations and Electrical Power Distribution Substations*, Directors of PT. PLN, 7-14.

Saputra, Hengky Firmansyah, 2013, Bandung, *Journal of Distribution Substation Maintenance and Operation Studies*, 7:1-58.

Silaen, Warcit H., 2019, Medan, *Distribution Transformer Maintenance LPK PT. PLN*

*(Persero) ULP South Medan* , 18-22.

Telaumbanua, Wedi Mei, 2023, *Field Practice Report of PT. PLN (Persero) UP3 NIAS (Customer Service Implementation Unit) at ULP Gunungsitoli Distribution Substation Maintenance*, 8:1-36.