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RTU Control in GH Manembo by SCADA 20 KV Distribution Network Minahasa Systems

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ABSTRACT
In the Minahasa Electrical System, disturbance handling can be done quickly by using a remote protection control system that is capable of monitoring, control and data acquisition in real time. SCADA (Supervisory Control And Data Acquisition) becomes a solution in disturbance handling because it has a protection system that works in real time that can be controlled remotely. But in fact, the SCADA System based customized Remote Terminal Unit (RTU) in the Manembo-Nembo Substation sometimes cannot be controlled by the Master Terminal Unit (MTU) on the SCADA System.

The research objectives were thus to determine what causes the disturbance and find a way out to minimize the frequency of disturbances to increase the reliability of an electrical energy distribution system.

The test results show that remote control failure is caused by poor signal from the communication provider at the remote station location and the reliability of communication equipment such as GSM modems in capturing signals affects the failure rate of the remote control. The remote control trend after system reparation is increase from 94.83% with a calculation of 2089 executions in April rising to 95.29% in May 2020 with 2672 successes from 2804 executions.

General Terms
RTU, MTU, SCADA

Keywords
Distribution Network, Modem, Substation Manembo-nembo

1. INTRODUCTION
An electric power system is never free from various kinds of disturbances and of course a protection system is needed to detect these disturbances quickly and precisely. This is intended to maintain a quality supply of electrical energy. In the electric power system, disturbances are most commonly found in distribution systems where the main problem is how to solve the disturbance quickly. In the Minahasa Electrical System, reliability in electrical system plays a crucial role in handling of disturbances faster, using a remote protection control system that can be operated at a fast time (real time).

SCADA (Supervisory Control And Data Acquisition) becomes a solution in disturbance handling because it has a protection system that works in real time that can be controlled remotely. However, the SCADA system implementation also has deficiency, for example, a Remote Station that cannot be controlled by the control center or Master Station.

Then an analysis and maintenance of the SCADA system will be carried out for controlling the 20KV distribution network in order to obtain a way out of the problems that occur in the SCADA system to increase the reliability electrical system.

2. LITERATURE REVIEW

2.1 Electric Power System
The electric power system generally consists of three main parts which are the power plant, transmission lines and distribution systems. Power plant will produce electricity such as PLTA, PLTU, PLTG and PLTD then channeled through transmission lines, after that the electricity reaches the substation (GI) to reduce the voltage in distribution voltage.

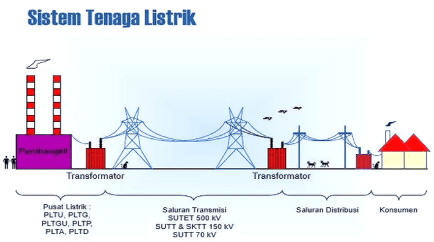

Figure 1. Electric Power System

The voltage distribution system is classified into 2 major parts, consist of primary distribution (20kV) and secondary distribution (380 / 220V). The 20kV distribution network is known as the Medium Voltage Distribution System and the 380 / 220V distribution network is known as the secondary distribution network or called the 380 / 220V Low Voltage Network, hereinafter supplied to consumers.

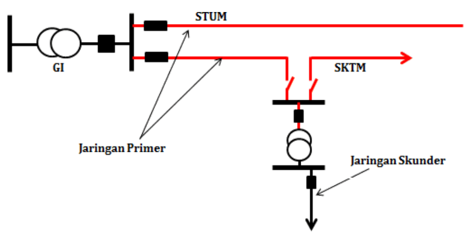

Figure 2. Primary and Secondary Networks

The primary distribution network configuration in a distribution network system determines the quality of service that will be obtained, especially regarding the continuity of its service. The primary network configuration consists of 4 types distribution network : radial pattern distribution network, loop pattern distribution network, grid pattern distribution network and spindle pattern distribution network.

2.1.1 Radial Pattern Distribution Network

The distribution system with the Radial pattern is the simplest and most economical distribution system. In this system there are several feeders that supply several substations by radial.

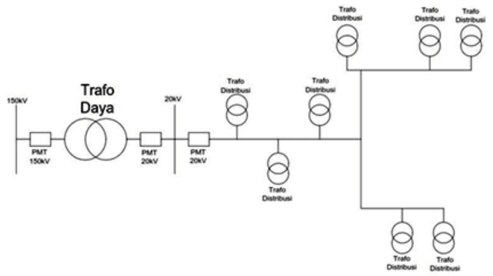

Figure 3. Pattern Radial Network

2.1.2 Loop Pattern Distribution Network

In this system, there are two sources and filling direction, one of which can be used as a backup for higher service reliability. Loop pattern distribution network is commonly used in general and industrial networks.

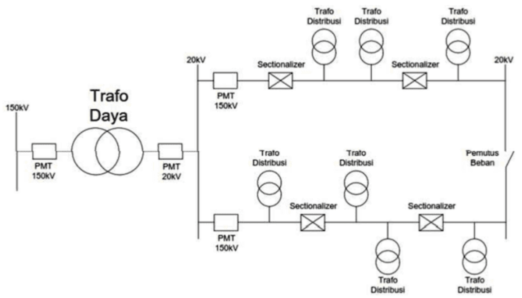

Figure 4. Pattern Loop Network

2.1.3 Grid Pattern Distribution Network

This network is a combination development of radial and loop networks. The continuity of power supply in this network is guaranteed because the load points have more alternative feeders that support each other. [1,10]

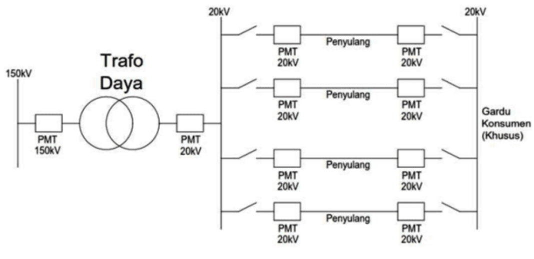

Figure 5. Pattern Grid Network

2.1.4 Spindle Pattern Distribution Network

This system is widely used for electricity supply in urban areas (especially big cities). It has high reliability because one express feeder / feeder is provided without load from the substation to the substation. Usually at each feeder there is a middle point which functions as a manufer point in case of disturbance on the network.

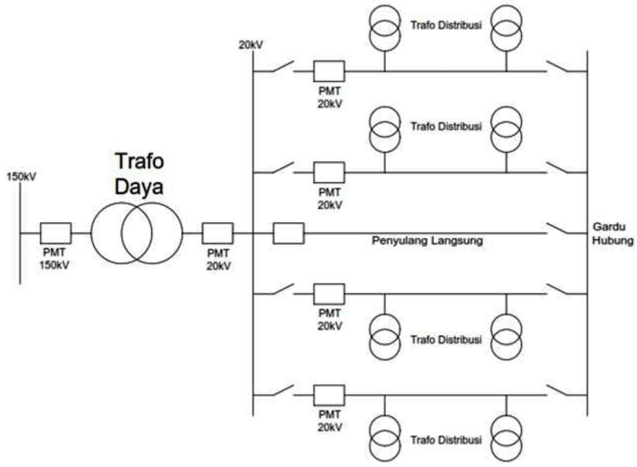

Figure 6. Pattern Spindle Network

2.2 SCADA system

SCADA (supervisory control and data acquisition) is a system that can monitor and control an equipment or system remotely in real time. SCADA functions from data retrieval at the substation or distribution substation, processing the information received, to the reactions that result from processing information.

SCADA is a control system that streamlines the operation of the electricity network, because with the SCADA system the network can be monitored, controlled and maneuvered remotely. The main purpose of operating the system is to maintain the normal state for as long as possible. In case of disruption, the operator must act quickly to restore the system to normal, while in emergency situations the dispatcher must be able to take appropriate action, so that recovery can be carried out smoothly and quickly.

SCADA-based control aims to help operators obtain the optimum operating system and control of the electric power system. In managing a distribution network system, the length of time for interruption recovery is an important criterion used to assess the performance of the network operating system and outage services. For this, the control system is equipped with a SCADA set. This device is used as a means to monitor and control the power system centrally from the control centers.

Figure 7. SCADA UP2D Suluttenggo

2.2.1 SCADA Function

The main functions of the SCADA system can be grouped into three parts as follows :

- Telemetering

Send information in the form of measurements of electrical quantities at a certain time, such as: voltage, current, frequency. The monitoring performed by the dispatcher includes displaying real power in MW, reactive power in Mvar, voltage in KV, and current in Ampere. Thus the dispatcher can centrally monitor all the information needed.

- Telesignaling
Send a signal that states the status of an equipment or device. The information sent is in the form of the status of the voltage breaker, the separator, the presence or absence of an alarm, and other signals. Telesignal can be a condition of a single equipment, it can also be a grouping of a number of conditions. The telesignal can be expressed single (single indication) or double (double indication).

Equipment status is expressed by means of multiple indications. Single indication of alarm.

- Remote Control
The dispatcher can carry out the command to open or close the electrical power system equipment remotely, by simply pressing one of the open / close command buttons on the dispatcher. [6,8]

The SCADA system has 3 main components, namely: the Control Center (Master Station), the Remote Station or controlled device (keypoint) and the communication line that connects the Control Center and Remote Station.

2.2.2 Scada System In Distribution Network

The SCADA system which is applied in the electric power distribution system is designed to monitor the activity of equipment at the Substation or Switching Substation and control operations, so that the condition of the Electric Power network can be monitored in real time. In addition to these functions the SCADA system also functions to carry out remote control commands.

With the SCADA system, the Dispatcher can get data quickly at any time (real time) if needed, besides that SCADA can quickly alert the Dispatcher if there is a disturbance in the system, so that the disturbance can be easily and quickly resolved or normalized. The supervisory control function refers to remote operation of equipment, such as switching circuit breakers, sending a return signal indicating or indicating that the desired operation has been effective.

3. METHODOLOGY

This research use a field survey method to determine the real condition of the object discussed, the required data, and other important information related to the problem of what causes the failure of RTU control by MTU on the Minahasa Distribution Network System, then conducts evaluation and analysis.

4. FLOW CHART SISTEM

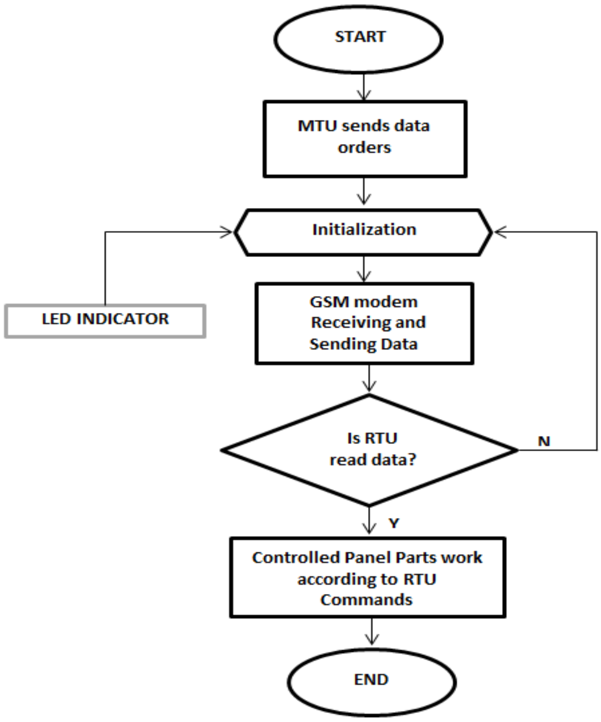

Figure 8. Flow Chart of SCADA System For RTU Control

System Block Diagram Description:

1. Turn on the system
2. The SCADA Master Terminal Unit (MTU) sends data commands to the keypoint.
3. Then the SCADA system is initialized and processed by the modem to receive and send data to the Remote Terminal Unit (RTU).
4. If the RTU cannot be controlled (reads the data sent by MTU) then an analysis and repairs will be carried out whether the problem is eating, electric or telecommunications.
5. If the RTU can receive data sent by MTU, it means that the RTU is working as desired.
6. Standby system.

5. RESULTS AND DISCUSSION

Reliability indicators of a SCADA system is based on the functions of the SCADA system in the form of telemetering, telesignaling and telecontrol can work properly without disturbances.

Telemetering is the transmission of variable values measured using telecommunications techniques. Tele-signaling is monitoring the status of operational equipment within a certain distance using telecommu-nication techniques such as alarm conditions, switch positions or valve positions. Telecontrol is control of remote operational equipment with information transmission using telecommunication techniques.

5.1 Remote Control (RTU) Data Trend in April 2020

The trend of remote control every day for 30 days in April 2020 shows that the percentage of total remote control success reached 94.83% with a calculation of 2089 successful executions from 2203 executions and 114 failures for more details, can be seen in table 1.

Table 1. Remote Control Trend for April 2020

Date	Execution			%SUCCESS	%FAILED
	SUCCESS	FAILED	TOTAL		
1-Apr	27	3	30	90.00%	10.00%
2-Apr	40	0	40	100.00%	0.00%
3-Apr	63	7	70	90.00%	10.00%
4-Apr	37	1	38	97.37%	2.63%
5-Apr	56	2	58	96.55%	3.45%
6-Apr	70	5	75	93.33%	6.67%
7-Apr	31	3	34	91.18%	8.82%
8-Apr	57	5	62	91.94%	8.06%
9-Apr	99	5	104	95.19%	4.81%
10-Apr	94	5	99	94.95%	5.05%
11-Apr	109	7	116	93.97%	6.03%
12-Apr	115	3	118	97.46%	2.54%
13-Apr	58	7	65	89.23%	10.77%
14-Apr	53	1	54	98.15%	1.85%
15-Apr	53	2	55	96.36%	3.64%
16-Apr	32	1	33	96.97%	3.03%
17-Apr	21	0	21	100.00%	0.00%
18-Apr	66	2	68	97.06%	2.94%
19-Apr	47	0	47	100.00%	0.00%
20-Apr	62	3	65	95.38%	4.62%
21-Apr	25	1	26	96.15%	3.85%
22-Apr	62	7	69	89.86%	10.14%
23-Apr	104	4	108	96.30%	3.70%
24-Apr	134	7	141	95.04%	4.96%
25-Apr	62	3	65	95.38%	4.62%
26-Apr	71	4	75	94.67%	5.33%
27-Apr	102	4	106	96.23%	3.77%
28-Apr	87	7	94	92.55%	7.45%
29-Apr	91	4	95	95.79%	4.21%
30-Apr	161	11	172	93.60%	6.40%
TOTAL	2089	114	2203	94.83%	5.17%

Data Source : PLN UP2D Suluttenggo

Substation, Connecting Substation, LBS (Load Break Switch) and Recloser are equipment that can be SCADA and become a keypoint so that they can be controlled via the master station. In each of these equipment, a place has been provided to integrate the SCADA system using several types of communication tools such as GSM modems, radio data and fiber optics, but the most commonly used communication tools are GSM modems because of the affordable investment value and relatively easy maintenance.

Remote control failure can be classified into three, which are mechanical failure, electrical failure and communication failure. Mechanical failure is a remote control failure caused by the mechanical components contained in the keypoint not working properly.

Electrical failure is a remote control failure caused by the wiring of the device, either due to wrong wiring or because the cable used is not good.

Communication failure is a remote control failure caused by a communication network such as a GSM modem that cannot properly receive data sent by the master station due to poor network.

Based on field experience and direct interviews with resource person at PLN UP2D Suluttenggo, remote control failure is most often caused by network disturbances, where the network from the provider used in the GSM modem is not work properly and could cause disturbance in sending data from the master station and vice versa. Another factor that also affects remote control failure is the reliability of the GSM modem to pick up signals from the GSM provider.

For the GH Manembo-Nembo keypoint located in the city of Bitung, North Sulawesi, there are 3 sets of cubicles with details of 3 Incoming PMTs namely SJ-2 / Charli, SJ-4 / SKTM and SJ-3 / Beta and 3 Outgoing PMT Fruits namely Klabat Department, SI-4 and Department of Outer Cities.

5.2 SCADA Failed Indicator in GH Manembo

In Figure 9. you can see the indication of the disturbance in GH Manembo, namely "Inverter State = Failed" and "Incoming SJ 2 / Charli = Failed". With the initial assumption of setting up the modem and inverter.

Based on the previous incident, there is an indication that the modem is the cause of the disturbance indication that appears in the SCADA system, therefore the first step is to check whether the modem is still functioning properly or not.

At this stage, check the condition of the modem, whether it needs to be reset or maybe replaced with a new modem. What needs to be considered is whether the modem gets an IP when trying to connect to the master, and the results can be seen in Figure 10

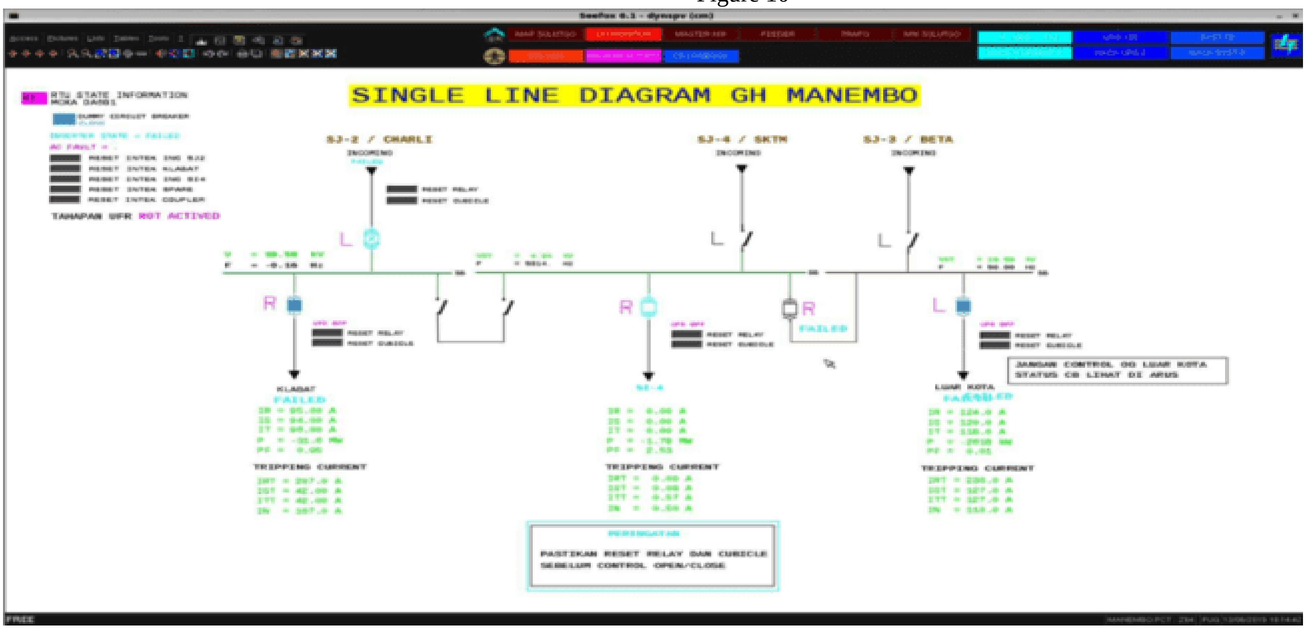

Figure 9. Display in GH SCADA Manembo (PLN UP2D Suluttenggo)

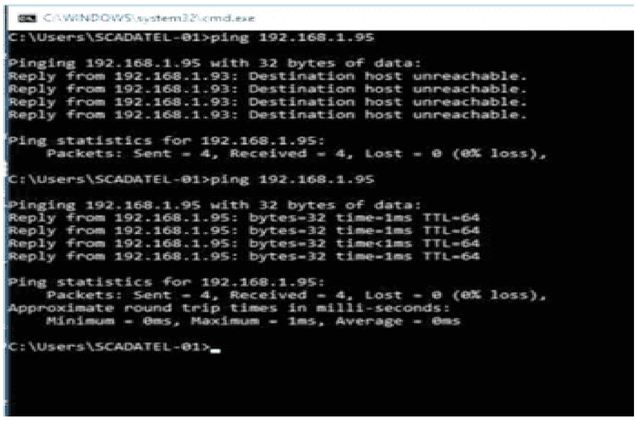

Figure 10. Testing the IP Address of the Master Station

From Figure 10, it can be seen that the modem managed to get the IP from the master station which indicates that the modem is in good condition and there is no need to take action on the modem.

Because the SCADA display shows “Inverter State = Failed”, you check the inverter device, and the first thing to do is restart the inverter. (Figure 11).

Figure 11. GH Manembo Inverter Device

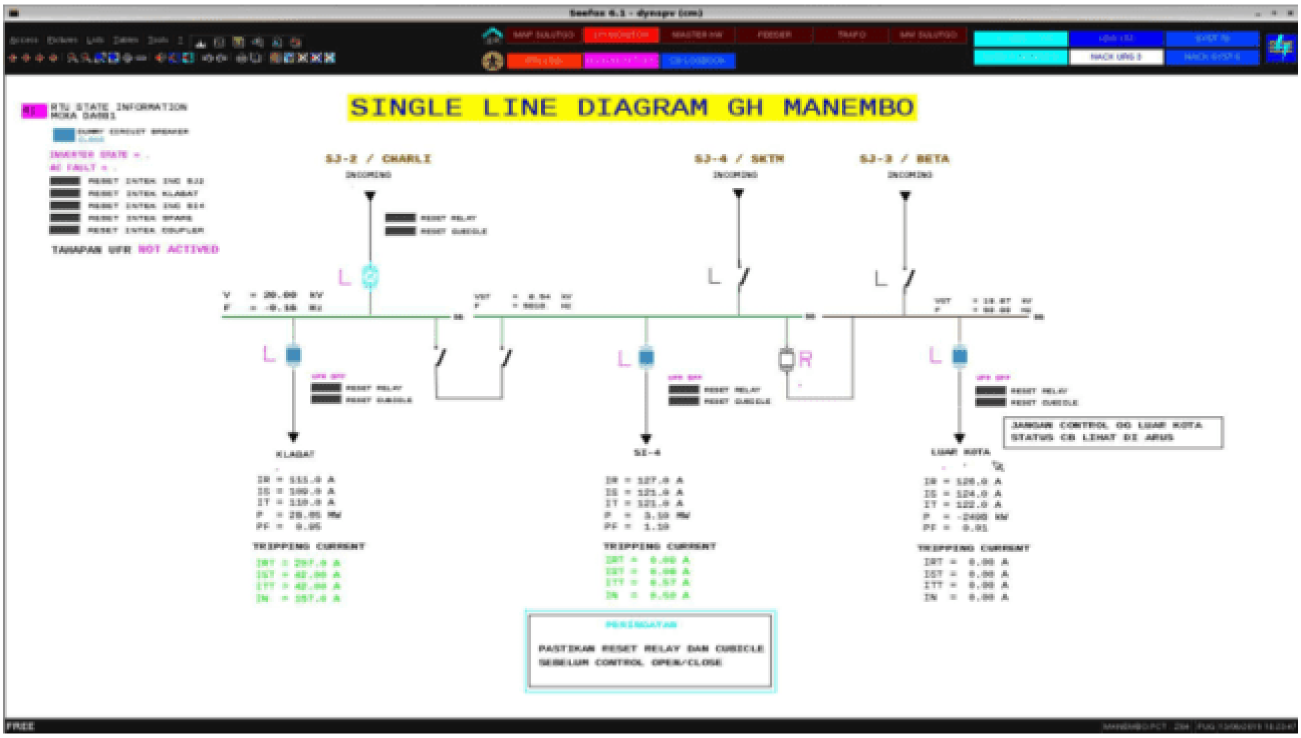

Figure 12. Views on the GH SCADA Manembo After Repair (PLN UP2D Suluttenggo)

After restarting the inverter device, then check the indication on the SCADA display whether it has returned to normal or not.

After repairing, the disturbance indication from the SCADA display has disappeared (Figure 12).

5.3 Remote Control Data Trend May 2020

After carrying out a series of maintenance during April 2020, it can be seen that the percentage of total remote control success in May 2020 has increased from the previous month, where in April 2020 the percentage of total remote control success was 94.83%, increasing to 95.29% in May 2019 with 2672 Successful execution of 2804 times and failing totaling 132 which can be seen in table 2.

Table 2. Remote Control Trends in May 2020

Date	Execution			%SUCCESS	%FAILED
	SUCCESS	FAILED	TOTAL		
1-May	106	13	119	89.08%	10.92%
2-May	84	8	92	91.30%	8.70%
3-May	117	7	124	94.35%	5.65%
4-May	94	2	96	97.92%	2.08%
5-May	32	1	33	96.97%	3.03%
6-May	82	3	85	96.47%	3.53%
7-May	72	3	75	96.00%	4.00%
8-May	59	1	60	98.33%	1.67%
9-May	142	4	146	97.26%	2.74%
10-May	78	5	83	93.98%	6.02%
11-May	103	7	110	93.64%	6.36%
12-May	79	3	82	96.34%	3.66%
13-May	61	2	63	96.83%	3.17%
14-May	186	3	189	98.41%	1.59%
15-May	96	2	98	97.96%	2.04%
16-May	149	10	159	93.71%	6.29%
17-May	65	3	68	95.59%	4.41%
18-May	80	2	82	97.56%	2.44%
19-May	41	2	43	95.35%	4.65%
20-May	42	2	44	95.45%	4.55%
21-May	33	5	38	86.84%	13.16%
22-May	119	5	124	95.97%	4.03%
23-May	115	4	119	96.64%	3.36%
24-May	53	1	54	98.15%	1.85%
25-May	87	6	93	93.55%	6.45%
26-May	84	2	86	97.67%	2.33%
27-May	72	4	76	94.74%	5.26%
28-May	99	5	104	95.19%	4.81%
29-May	122	5	127	96.06%	3.94%
30-May	62	8	70	88.57%	11.43%
31-May	58	4	62	93.55%	6.45%
TOTAL	2672	132	2804	95.29%	4.71%

Data source : PLN UP2D Suluttenggo

A significant difference in the number of Remote Controls for several days a month occurs in accordance with the control needs, in this case the intended need is for maintenance or repairs that require control for voltage control in the 20kV voltage distribution system in the Minahasa Electrical System.

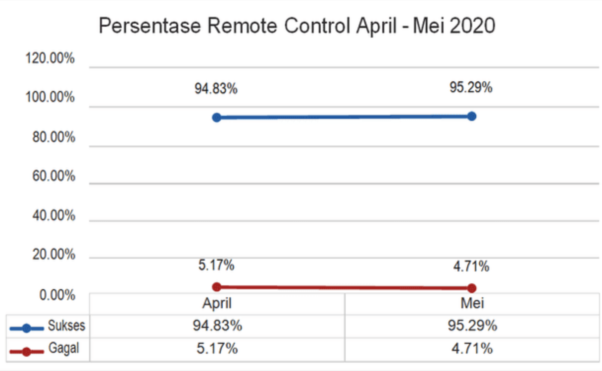

Figure 13. Percentage Graph Remote Control

PLN currently does not have standardization to determine what the value of the Remote Control reliability percentage, but it is determined by each implementing unit at PLN based on the performance targets that have been previously agreed by the executing unit leader.

6. CONCLUSION

From the data obtained and the analysis, it can be concluded that the Remote Terminal Unit (RTU) functions to collect status data and measurements of electric power equipment, then sends the data and measurements to the Master Station (control center) after being asked by the Master. Besides, the RTU functions to carry out orders from the master station.

Remote control failure is caused by poor signal from the communication provider at several remote station locations. The reliability of communication equipment such as GSM modems in capturing signals also affects the failure rate of the remote control.

The remote control trend after improving the percentage of remote control success has increased from 94.83% with a calculation of 2089 executions in April rising to 95.29% in May 2020 with 2672 successes from 2804 executions.

7. THANK-YOU NOTE

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