

Economic Research of Electricity Losses in PLN Due to Theft Differences with Methods Changing MCB and Influencing Measurement in kWh Meter

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Abstract— Today, there were many cases of theft or infringement of electricity in various ways. This was caused PLN to suffer losses due to the theft of electricity amounting to Rp 1.5 trillion per year. Electrical theft focused on kWh meter there were various kinds, such as by changing the side of the MCB and adding a needle on the kWh meter. The objective of this study were found out the recorded kWh ratio if the installation was installed normally with a modified installation by changing on the MCB side, adding a needle, and comparing the economic value that PLN should had obtained when the kWh meter was installed normally and the kWh meter was changed. The method used in the research for normal measurement as much as 6 times the rotation of the disk and used 5 variations of load ; the measurement by changing the MCB and adding the needle was the same as the normal measurement, only when changing the MCB changes 2 A to 4 A, and when adding the needle, the disk was plugged with a needle. The result showed that the average of error difference between kWh meter that was installed normally with that has been changed on the side of MCB is 0, and kWh meter installed with normal that has been changed add needle equal to -44.1586. The difference in total cost of electricity for one month for normal kWh meter with which has been changed on the MCB side was Rp. 165.914.-, and for the normal kWh meter difference with the added needle of Rp. 58.610.-

Index Terms— kWh Meter, Theft, Error, Usage fee.

I. INTRODUCTION

The single phase kWh meter serves to measure energy consumption by ensuring the effect of action torque in the rotary disk on a shaft proportional to the effective power. The torque is proportional to the angular velocity operated by the simultaneous. The steady state of angular density will be proportional to the effective power, so rotation of the disk will indicate energy consumption. The effect of torque is assumed not to be affected by braking and disk angle velocity.

The disk is placed in a magnetic trajectory slit corresponding to the magnetic force line formed by two coils, where one of the coils is connected parallel and the other is connected series. The effect of torque is caused by the interaction between the gap field and the eddy current induced by the coil on the kWh meter disk. (Bardi & Bureau, 1986)

Electric theft mode is divided into four. The first is replacing the Miniature Circuit Breaker (MCB) which is an electric meter so that the electrical power used is

higher than it should be. The second is to outsmart the kWh meter (electric meter) by lowering the jumper wire between terminals 1 and 3 so that the electricity usage recorded on the meter becomes less than the actual usage. Third is a combination of violations of the first and second type, namely changing the electrical power as well as outsmart the meter. Fourth, it is done by street vendors and roadside stalls, by making electricity connections from Public Street Lighting (Augustine, 2016)

This study aims to analyze the comparison between kWh meter recorded when installed correctly with kWh meter recorded with theft mode, so it is known how many kWh lost is stolen when kWh meter is changed by unscrupulous electric thieves. It is hoped that PLN can easily identify the household customers who commit electricity theft after the known percentage of kWh is lost by analyzing the change of usage of kWh recorded every month.

II. METHOD

In this study used a test object with some treatment, including:

1. kWh meters are properly installed.
2. kWh meter with installation replace MCB
3. kWh meters are properly installed, but the rotation setter is provided with a needle (affects the measurement).

The series of tests used in this study fit the following picture:

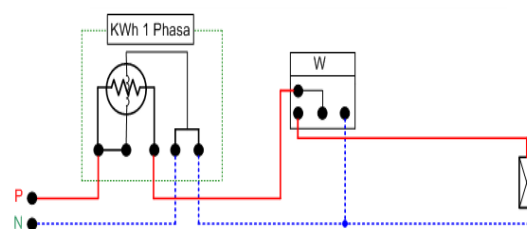


Figure 1. Testing circuit of single phase analog kWh meter.

A. Research Methods Normally

The method of research conducted to conduct economic analysis on the mode of electricity theft by changing the MCB and adding needles in PT. PLN can be seen in Figure 2

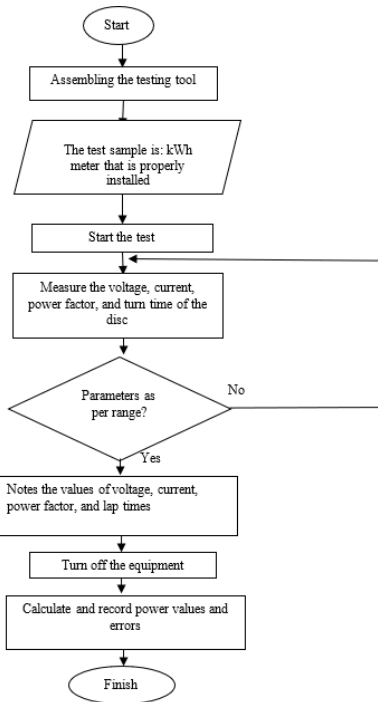


Figure 2. Flow Chart of Normal Research Method

B. Research Methods by Changing MCB

Tests conducted by the method of changing the MCB can be seen in Figure 3

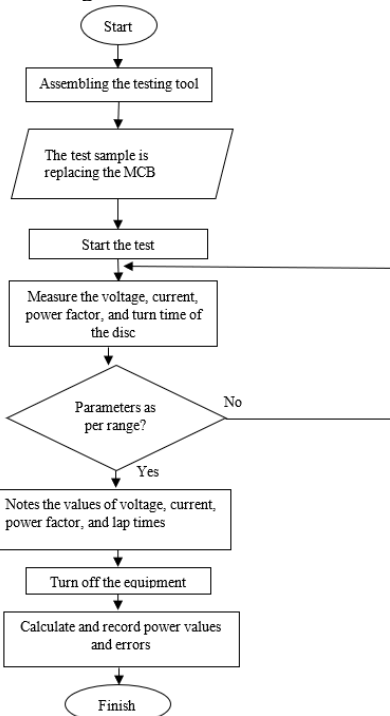


Figure 3. Flow Chart of Research Method Changing MCB

C. Research Methods by Adding Needles

Tests performed by the method of adding needles can be seen in Figure 4. The methods in Figures 1 through 3 are performed on certain loads of 40 watts, 80 watts, 120 watts, 220 watts, and 600 watts. The value of the load is based on assumption points of household consumption load pattern. Meanwhile, the value of daily energy

consumption (Wh) is calculated by calculating the graph area. The value of daily energy consumption has been obtained, then calculated monthly energy consumption by assuming the same daily consumption value and one month as much as 30 days so that the value of electricity consumption is obtained. The graph of the assumption of consumption patterns of household expenses can be seen in Figure 5 below.

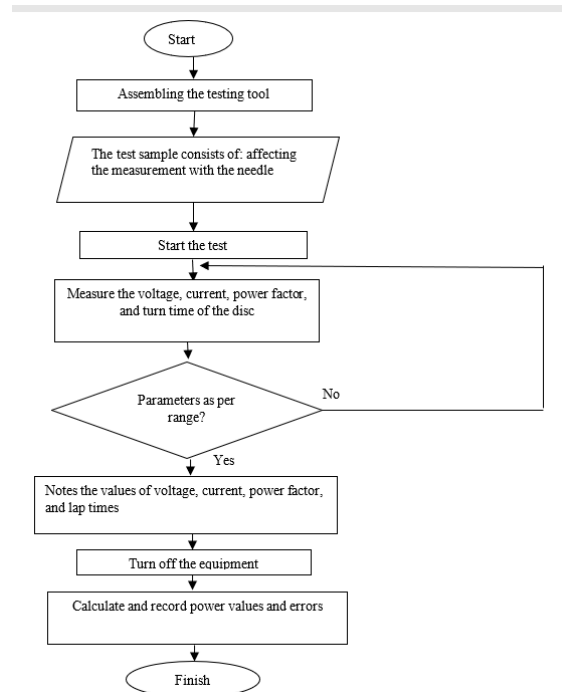


Figure 4. Flow Chart of Research Method Adding a Needle

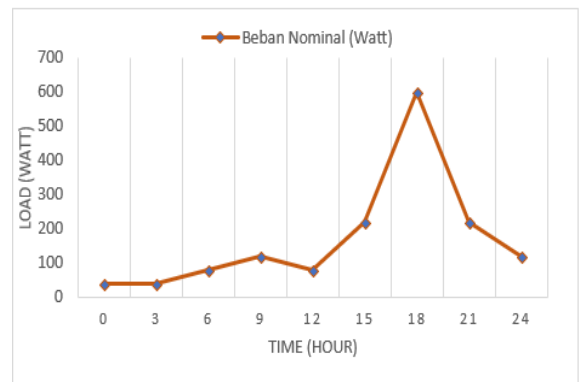


Figure 5. Assumption Chart of Household Consumption Pattern

D. Analysis of Test Result

At this stage analysis of test results that have been done are among others:

1. Analyze the effect of the recorded kWh if the installation is installed normally with the modified kwh meter on the mcb side.
2. Analyze the effect of recorded kWh if the installation is installed normally with a modified kWh meter by adding a needle.
3. Analyze the cost of electricity usage for the condition of the installed kWh meter normal, the modified kWh meter on the mcb side and by adding the needle.

III. RESULT AND DISCUSSION

A. Comparison of Error Values on Installed KWh Meters Normal in All Load Variations

The comparison of the error values in question is a recapitulation of the error results of all previously calculated load variations. This comparison aims to determine the effect of load variation on the measurement error value. The graph of the error value comparison is given in Figure 6.

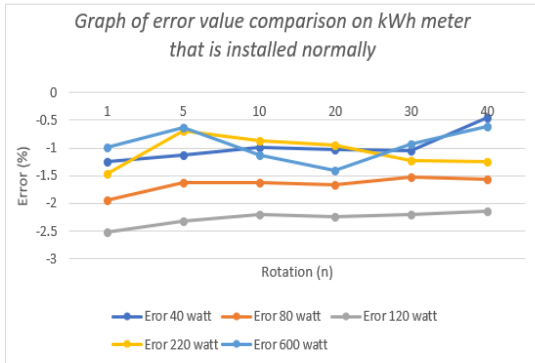


Figure 6. Graph of error value comparison on kWh meter that is installed normally in all load variations. Source: Calculation Result

Based on the data, it can be observed that the average error measurement value that occurs at a 40-watt load is -0.9087, when the 80 watts load is -6.6508, when the 120 watts load is -2.2650, when the 220 watts load is -1.0753, and when the 600 watt load is -0.9804. In Figure 4.1 shows the value of errors on all loads tend to fluctuate and not affected by the size of the load. In the data, for the order of error values from the largest to the smallest is at 120 watts, 80 watts, 220 watts, 600 watts, and 40 watts.

B. Comparison of Error Values on KWh Meters that have been altered on the MCB side

The comparison of the error values in question is a recapitulation of the error results of all previously calculated load variations. This comparison aims to determine the effect of load variation on the measurement error value. The graph of error value comparison is given in Figure 7.

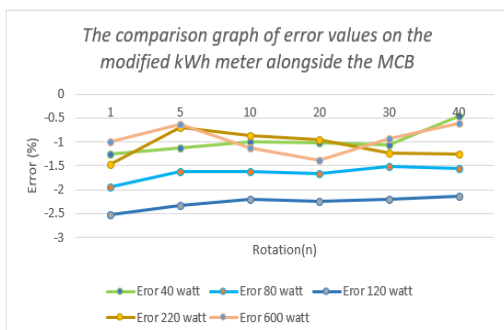


Figure 7. The comparison graph of error values on the modified kWh meter alongside the MCB in all load variations. Source: Calculation Result

Based on the data, it can be observed that the average error measurement value occurring at a 40 watt load is -0.9087, when the 80 watts load is -6.6508, when the 120

watts load is -2.2650, when the 220 watts load is -1.0753, and when 600 watt load of -0.9804. In Figure 4.2 shows the value of errors on all loads tend to fluctuate and not affected the size of the load. In the data, for the order of error values from the largest to the smallest is at 120 watts, 80 watts, 220 watts, 600 watts, and 40 watts.

C. Comparison of Error Values on KWh Meters that Have Been Modified By Adding Needles

The comparison of the error values in question is a recapitulation of the error results of all previously calculated load variations. This comparison aims to determine the effect of load variation on the measurement error value. The graph of error value comparison is given in Figure 8.

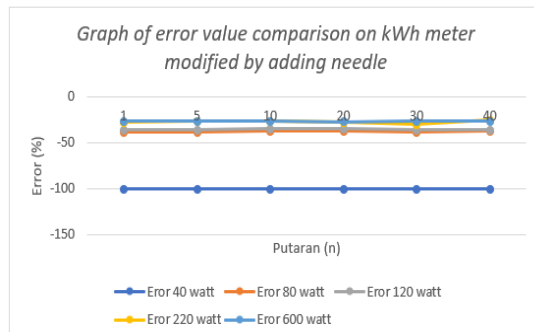


Figure 8. Graph of error value comparison on kWh meter modified by adding needle all load variations. Source: Calculation Result

Based on the data, it can be observed that the average error measurement value that occurs at a 40-watt load is -100, when the 80 watts load is -37.9950, when the 120 watts load is -35.672-, when the 220 watts load is -27.4107, and when the 600 watts load is 26.6355. In Figure 4.3 shows the error value of all loads tend to be inversely proportional to the load value. In the data, for the order of error values from the largest to the smallest is at a load of 40 watts, 80 watts, 120 watts, 220 watts, and 600 watts.

D. Comparison of Listed Value of KWh

The data that have been obtained from the calculation of errors on kWh installed or normal that has been changed is displayed in table 4.4.1 to table 4.4.2 for comparison purposes. This comparison aims to determine the difference in the value of errors recorded on the kWh meter as a power consumption meter.

The comparison is made by comparing the error values between the normal installed kWh meters with the modified ones for the theft mode ie the recorded kWh ratio if the installation is installed normally with the installation being changed on the MCB side, and the kWh ratio recorded if the installation is installed normally with kWh meter which has been changed by adding a needle. The effect of changing kWh meters is given on the graph.

From the data in Table 1. it can be observed that the average value of recorded errors on the installed kWh is normal at -1.3840 and at the modified kWh on the mcb side for an average value of error equal to -1.3840. The average error margin is 0. For the graph of figure 9. shows the error value of the installed kWh meter is the same as the modified kWh meter on the mcb side.

TABLE I
COMPARISON OF KWH METER ERROR INSTALLED NORMALLY WITH MODIFIED ON SIDE OF MCB.

| Load (watt) | Normal Error (%) | Error modified MCB (%) | Error Difference (%) |
|-------------|------------------|------------------------|----------------------|
| 40 | -0.9087 | -0.9087 | 0 |
| 80 | -1.6508 | -1.6508 | 0 |
| 120 | -2.2650 | -2.2650 | 0 |
| 220 | -1.0753 | -1.0753 | 0 |
| 600 | -0.9484 | -0.9484 | 0 |
| Median | -1.3840 | -1.3840 | 0 |

Source: Calculation Research

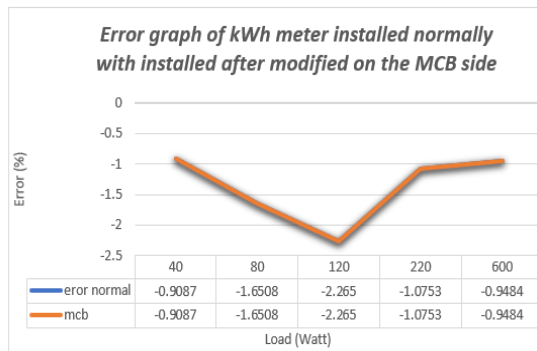


Figure 9. Error graph of kWh meter installed normally with installed after modified on the MCB side. Source: Calculation Result

TABLE 2
COMPARISON OF ERROR VALUE KWH METER INSTALLED NORMALLY WITH THE VALUE ALREADY CHANGED BY ADDING NEEDLES.

| Load (watt) | Normal Error (%) | Error Added Needle(%) | Error Difference (%) |
|-------------|------------------|-----------------------|----------------------|
| 40 | -0.9807 | -100 | -99.0193 |
| 80 | -1.6508 | -37.995 | -36.3442 |
| 120 | -2.2650 | -35.672 | -33.407 |
| 220 | -1.0753 | -27.4107 | -26.3354 |
| 600 | -0.9484 | -26.6355 | -25.6871 |
| Median | -1.3840 | -45.54264 | -44.1586 |

Source: Calculation Result

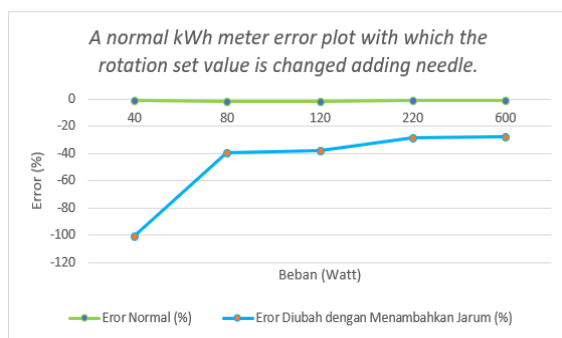


Figure 10. A normal kWh meter error plot with which the rotation set value is changed adding needle. Source: Calculation Result

From the data in Table 2. it can be observed that the average value of errors recorded on the installed kWh is normal at -1.3840 and at the kWh the added value of MCB is -45.54264. The average error margin is -44.1586, with the largest margin at 40 watt load, ie -99.0193 and the smallest margin at 600 watt load, which is -25.6871. In the graph of Figure 10. shows when the error values on the installed kWh meters are normally smaller than the

kWh which values have been changed by adding the needle.

E. Cost Comparison of Electricity Usage

This comparison aims to determine the difference in the cost of electricity consumption between the installed kWh meters normally, the modified kWh meter on the MCB side, and the modified kWh meter by adding the needle. Calculation on the cost of electricity usage is based on equation 2.12, where the basic electricity tariff is Rp 1,352 per kWh (900 VA RTM) and the basic electricity tariff is Rp 415 per kWh (540 VA), then the load is used in accordance with data assumptions of power consumption per day according to graphic picture 3.4 and one month is assumed 30 days. The cost of electricity is given in Table 3.

TABLE 3
ELECTRICITY CHARGE DURING ONE MONTH

| Condition | Total usage of 1 month (kWh) | Total cost, 1 month (Rupiah) |
|-----------------------|------------------------------|------------------------------|
| Normal | 129.9498 | 227.865,90 |
| Changed on Side MCB | 129.9498 | 61.951,13 |
| Changed Adding Needle | 86.598711 | 169.255,14 |

Source: Calculation Result

Based on table 3 on the cost of electricity usage for one month, it is known that the total electricity usage for one month for normal kWh meter condition is 129.9498 kWh, for the modified kWh meter on the mcb side of 129.9498, and for the modified kWh meter by adding a needle of 85.5987kWh. while at the total cost of electricity usage for one month for normal condition of kWh meter is Rp. 227.865.-, for kWh meter already on the mcb side of Rp. 61.951.-, and for the modified kWh meter by adding a needle of Rp. 169.255.-.

IV. CONCLUSION

1. The modified kWh meter on the MCB side produces a measurement error of -1.3840, while the normal installed kWh meter produces a measurement error of -1.3840. So the error difference is 0.
2. kWh meter added needle generates a measurement error of -45.5426, while the normal installed kWh meter produces a measurement error of -1.3840. So the error difference is -44.1586.
3. Based on the calculation of the cost of electricity usage for one month for kWh meter installed normally is Rp. 227,865, -, while for kWh meter which is changed beside MCB equal to Rp. 61,951, -, and for kWh meter added needle of Rp. 169.255, So the difference between the calculation of the cost of electricity consumption between kWh meter installed with normal kWh meter is changed on the MCB side of Rp. 165,914, while the kWh meter installed with normal kWh meter is changed by adding a needle of Rp. 58.610,

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