

Analysis of Impact Harmonics Variable Frequency Drive to Power Quality and Power Losses at Coal Mill Area Substation 448 Indarung 5 PT. Semen Padang

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Abstract - Non-linear loads were a source of harmonic current for electricity utilities. The high level of harmonics is very influential on the increasing of losses in electric power and power factors. The quality of electric power is determined by the parameters of losses and power factors that occur in the transformer due to harmonic distortion. The aims of study are determined the effect of harmonic distortion on power losses and power factor at Indarung 5 substation 448 coal mill area. In this research the kind of loads were eleven motors that controlled by VFD used for cooling fan. The harmonic produced by VFD was measured at three points. The harmonic from measurement result and calculated according to the IEEE std 519 – 2014. The analysis showed that the highest THD_i on the incoming feeder to substation 448 was 10.51% with a allowable limit of 12% and the highest THD_i on the primary side of the transformer was 27.68% where the allowable limit of 8%. The highest THD_i on the secondary side was 28.59% with a allowable limit of 8%. The true power factor on the secondary side phase R, S and T were 0.90 - 0.93. Total losses on incoming to SS 448 was 3,506.94 kWh, primary side was 2,034.62 kWh and secondary side was 2,128.73 kWh.

Key word : Harmonics, non linear load, Current Total Harmonic Distortion, power losses, power factor.

1. Introduction

Electricity growth of a country is twice the economic growth. With economic growth, people's purchasing power has also increased. Increased purchasing power is characterized by the increasing number of non-linear load owned by a factory. On the other hand, with the growing development of the use of electronic technology in power systems will manage the harmonics in power system. This non-linear load will be affected in power quality, because this non-linear load is the main source of harmonic interference. A high level of harmonics in an electric power system is undesirable because it can cause losses [1]. Harmonization is a very important thing to learn because if it is not immediately addressed, the bad effects will be even greater and have a negative impact on the performance of electrical equipment [1].

2. Methodology

This research starts from literature study, calculating, after obtaining the results of the data calculation, then conducting discussion and analysis, making a resume, conclusions, suggestions and finish.

3. Result and Analysis

3.1. Effect of harmonics to Power Factor

This section shows the effect of total harmonic distortion on power factor.

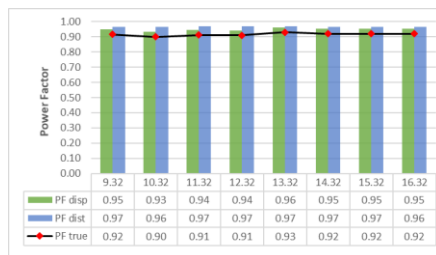


Figure 3.1 Power factor graph secondary side phase R

From Figure 3.1 above it could be seen that the secondary side phase R the true power factor was low than power factor displacement because the true power factor distorted by harmonics. From 8 hours took the measurement that the true power factor reaches the limit value of the power factor permitted by PLN which is 0.85. Based on the figure 3.1 power factor secondary side phase R at 9.32 am the displacement power factor was 0.95, distortion power factor was 0.97 and true power factor was 0.92. At 10.32 am the displacement power factor was 0.93, distortion power factor was 0.96 and true power factor was 0.90. At 11.32 am the displacement power factor was 0.94, distortion power factor was 0.97 and true power factor was 0.91. At 12.32 pm the displacement power factor was 0.94, distortion power factor was 0.97 and true power factor was 0.91. At 13.32 pm the displacement power factor was 0.96, distortion power factor was 0.97 and true power factor was 0.93. At 14.32 pm the

displacement power factor was 0.95, distortion power factor was 0.97 and true power factor was 0.92. At 15.32 pm the displacement power factor was 0.95, distortion power factor was 0.97 and true power factor was 0.92. At 16.32 pm the displacement power factor was 0.95, distortion power factor was 0.96 and true power factor was 0.92.

3.2. Losses

3.1. Table of transformer losses due to harmonics at 3 points measurement.

Measurement Point	Copper Losses (kWh)	Eddy Current Losses (kWh)	Hysteresis Losses (kWh)	Total Losses (kWh)
Incoming	2,509.06	994.65	3.23	3,506.94
Primary side	1,491.06	542.11	1.45	2,034.62
Secondary Side	1,568.81	539.20	20.72	2,128.73

Total losses on incoming to SS 448 was 3,506.94 kWh, primary side was 2,034.62 kWh and secondary side was 2,128.73 kWh.

4. Conclusion

After measuring and analyzing the harmonics produced by variable frequency drives at substation 448, the following conclusions can be drawn: The cases in phase R, phase S and phase T of secondary side Transformer 2 on that moment had true power factor ranged 0.90 - 0.93. Based on the analysis results total losses on primary side TR2 was 3,506.94 kW, on secondary side was 2,034.62 kW and on incoming side was 2,128.73 kW.

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