Determination analysis of the power losses of transformers with continuously transpored conductors (CTC) based fuzzy logic

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Determination Analaysis of The Power Losses of Transformers with Continuously Transpored Conductors (CTC) Based Fuzzy Logic

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Abstract. Electric motive force which flows into the iron core continuously on a plate – plate iron isolated may cause heat posed by current eddy (eddy current). No water loss occurs due to detainees on the circuit at the the flow of current load because this loss happened on the entanglement of the transformer is made of copper. Continuously Transposed Conductors (CTC) consist of a number of enameled rectangular wires (5-84 strands) made into an assembly. Each strand is transposed in turn to each position in the cable and is then covered with layers of insulation paper. Continuously Transposed Conductors are used in winding wires for medium and ultra high power transformers. CTC is manufactured by OFHC copper and indeed, is able to supply polyester roped. CTC which has been designed to reduce production cost, oil pocket and improve cooling efficiency. Hardened type CTC (CPR1, CPR2, and CPR3: BS1432) and Self-bonding CTC which can be used to improve mechanical and electrical strength are also available. This analysis is performed using the methods of fuzzy logic in taking account of the resources.

INTRODUCTION

A transformer is an electrical equipment included in the classifica-tion of the machine static electricity and serves to transmit power/electrical power from high voltage to low voltage or vice versa, with the same frequency. In operation, the power transformer is generally neutral on the point of in grounding, in accordance with the need for security or protection systems.

For example, 150/70 kV transformer grounding directly in the neutral side of the 150 kV, and 70/20 kV transformer in grounding with prisoners in the neutral side of the 20 kV. A transformer that has been produced in advance by testing according to the standard that has been set. Basis of a transformer, if there is an electric current which flows back and forth circling the nucleus iron then the iron core that will be turned into a magnet and if the magnets are surrounded by an entanglement of then on both ends of such entanglement will happen difference voltage surrounds magnets, so will develop Electric Motive Force (EMF).

In the presence of Electric Motive Force (EMF) that flows to the iron core continuously then the slab-slabs irons that can give rise to isolated heat caused by eddy currents (eddy current). One is done by giving the voltage on the transformer in an open circuit to find out loss-loss copper in may on the iron core.

While no loss incurred as a result of prisoners on the circuit at the flow of current load because this loss happened on the entanglement of the transformer is made of copper so no loss is often referred to as loss of copper.

With the description then the author will discuss about Analysis Determination of the Power Losses Transformers with Continuously Transposed Conductors (CTC) Based Fuzzy Logic. The Purpose of research is knowing the magnitude of loss-loss of copper with no power, and knowing the difference losses by using conductors type Continously Transposed Conductor (CTC) and other types of conductors. In order not to deviate from the specified subject matter then the author will limit the problem as follows, Discuss on loss-loss copper on transformer

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with no power. Tranformator Conductors used are Continuously Transposed Conductor (CTC) on the side of the High Voltage (HV). Transformer power transformer is used. Loss-loss tolerance Limit of copper used is 15%.

METHODS

Research methodology used in the preparation of this, among other things: a study of literature on short circuit test of the transformer, the transformer on a survey of historical data, data analysis.

THE POWER TRANSFORMER

The power transformer is an electrical appliance that can move and change the electric energy from one or more electric circuits to electrical circuit to another, through a coupling of magnet and based on the principle of induction-electromagnetism.

A transformer is used extensively, both in the field of electricity nor electronics.Power transformer serving as instruments of power at low voltage loads. If a transformer provide a non linear load, then the current harmonic distortion which would arise would interfere with performance on the side of the transformer low voltage.

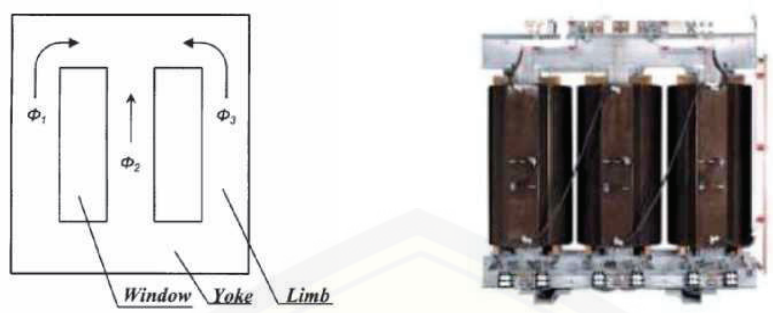
FIGURE 1. Power Transformer

In the standard IEC 60076-1, a power transformer is a transformer power is defined as part of the static apparatus with two or more windings with electromagnetic induction, changing the system of alternating voltage and current into another system of voltage and current usually has different values and at the same frequency for the purpose of the transmission of electric power.

PARTS OF THE TRANSFORMER

a. Iron core serves to ease the path of flux, caused by an electric current through the coil. The iron core is made of a thin slab of iron isolated slab, to reduce the heat (as iron loss loss) incurred by eddy currents.
b. Transformer Coil wire coil is some insulated will form a coil. The coil that was isolated to the iron core as well as against other coils with insulating solids such as cardboard, pertinax and others.

Generally on the transformer primary coil and there is a secondary coil. When the primary coil is connected to the voltage/current back and forth on the coil flux occurred. This flux will induce a voltage, and when it is on the secondary circuit is closed then it will generate a current in the coil. So the coil as a means of transforming the current voltage.



(a) The iron core transformer (b) Coil transformer

FIGURE 2. Part of the Transformer

POWER LOSS

Loss of electric power is divided into 2 parts, namely the loss of electric power technical and non technical loss. Non technical loss of electric power will lead to a decrease in the efficiency of the electric power system, which means lower corporate profit gains, in other words increase power loss may affect the income on the part of the Manager.

Losses in Transformer

Transformer loss ranges between 20 to 25% of the total loss of tissue, loss-loss transformer is distinguished into 2 parts, namely without the burden of loss and loss no water. Loss-loss without a load consisting of all loss-loss arising because the primary circuit voltage is given, and the secondary circuit in the State open.

State Transformer no-Load

When a transformer primary coil is connected to the voltage source V1, while the secondary coil in an open primary currents will flow then Io sinusoidal-shaped.

Assuming N1 that has custody of the pure reactive primary, the current (Io) will be left 90 ° and V1 and shown in Fig. 3 current Io raises flux (^) that one of phase and also sinusoidal shape.

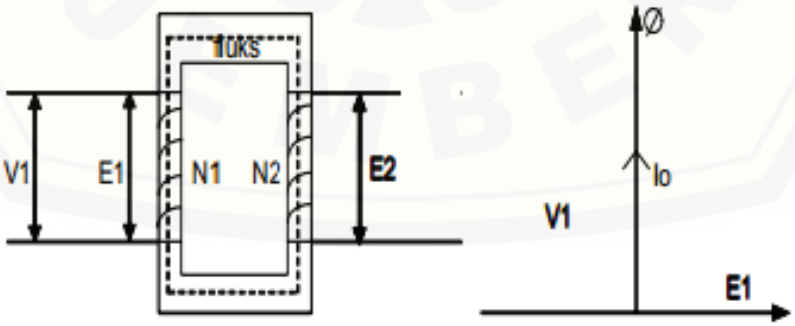


FIGURE 3. Series of transformer core

Primary current Io at the time flowing the secondary coil is not burdened also called current amplifier consisting of two components:

Current magnetization (Im), currents that arise because of an iron core and resulting flux.

A current loss of iron (Ic), which resulted in a flow of power lost due to loss of histerisys and loss-loss currents of the navel. One of phase IC with V1, so the results of multiplication (Ic xV1) is a lost power in Watts.

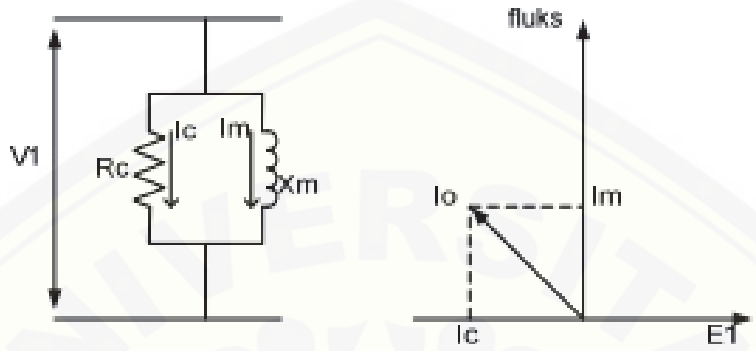


FIGURE 4. Transformer circuit without a load

Loss of Copper

Copper loss is the loss incurred as a result of current flowing out of the load on the wire entanglement. The value of the copper loss obtained by experimenting a short hyphen.

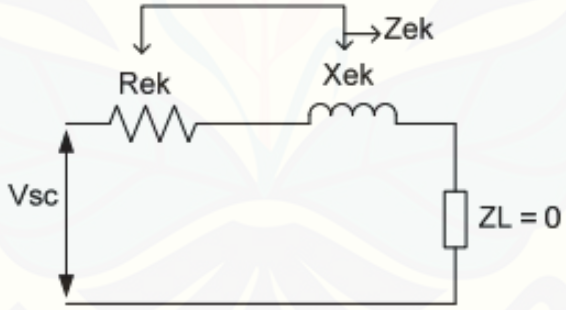


FIGURE 5. Short circuit equivalent

Copper loss magnitude is always changing depending on the given load, this loss reaches the maximum value at the moment of peak loads.

RESULT AND ANALYSIS

The author does a data retrieval is performed using Fuzzy Logic, where there are particular to the capacity of the transformer will be tested, and to see the value of the copper load losses can be by:

1) Testing a loss-loss iron core (No-load transformer losses)

2) Testing loss-loss entanglement (Load transformer losses) from there will test two of the transformer with the same capacity but getting the losses are different, from those results will look for the best investment value from the two aforementioned transformers.

Input Data

The data is drawn from the case study on power transformer that has a value of different copper losses. In this case to determine the losses in power transformers using Continously Transposed Conductor (CTC), there are several factors that must be considered among others capacity in a transformer, a good capacity averages around 300 MVA, and reached 500 MVA. In addition, there is a major factor to reduce losses in a transformer power conductor on the transformer must have a small cross-sectional area of about 5 mm, and a maximum of 7.5 mm. Another factor to reduce the copper losses, that is, pay attention to the amount of use of a conductor in one coil, among others, ranging from 27 to 30.

In the process of the reduction of copper losses using fuzzy rule 4 as follows: [R1] If large Transformer Capacity and large cross-sectional area and the number of the conductor a lot then the output either; [R1] If the capacity of the transformer are and the cross-sectional area are and the number of conductors are then output medium; [r1] if the small transformer capacity and the small cross-sectional area and number of conductor a little then the output is not very good.

The next step, determine the criteria for the process of making the system of fuzzy, Method = Mamdani, And Method = Min, Or Method = Max, Min = Implications, Aggregasi = Max, and Defuzifikasi = Centroid.

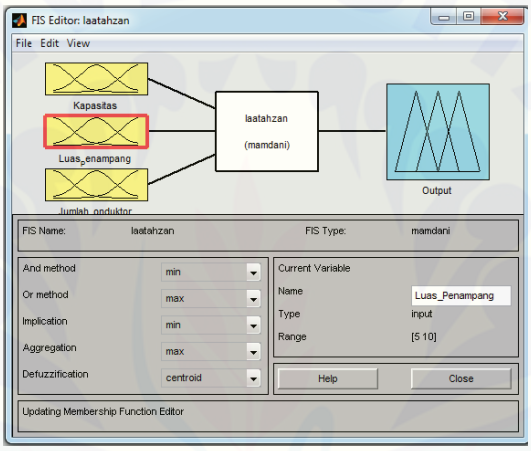


FIGURE 6. Fuzzy system

Variable Capacity

For the present variables used transformer capacity curve-shaped trapmf (for fuzzy set low and high), and the curve shape trimf (fuzzy set to medium).

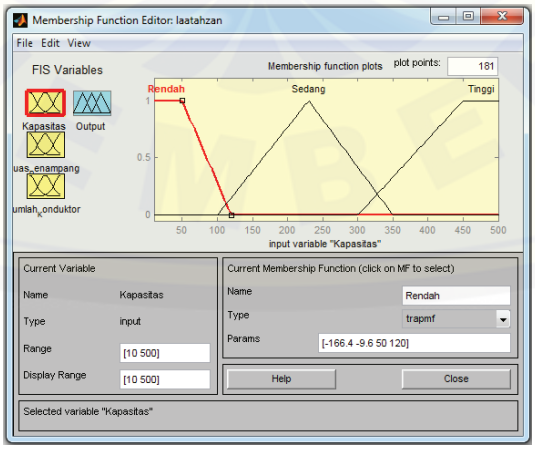
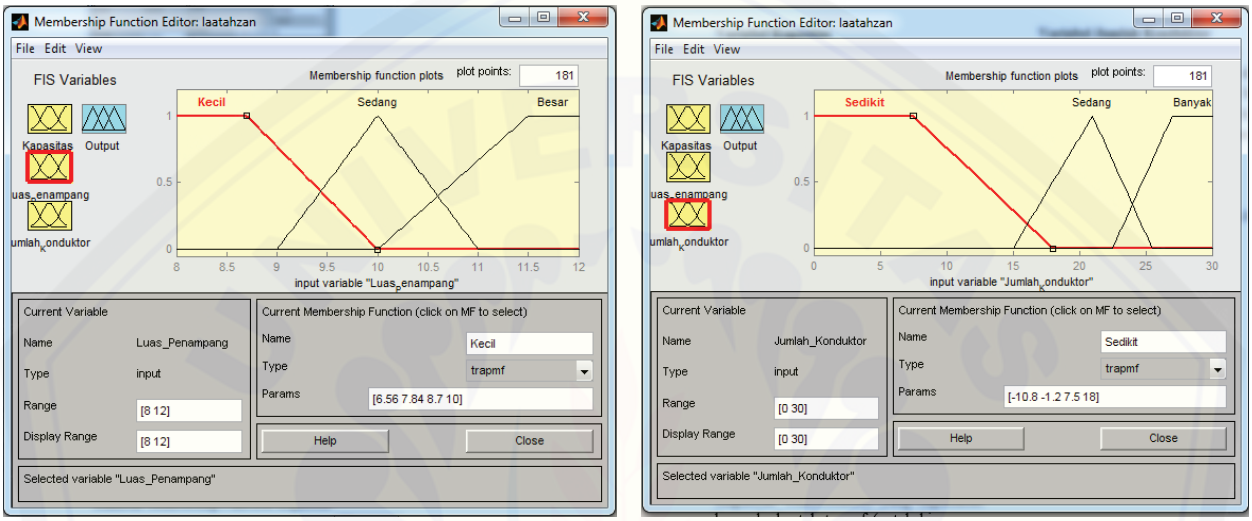


FIGURE 7. Membership function capacity

Variable cross-sectional area and variable number of conductors

For the present variables cross-sectional area used the curve-shaped trapmf (for small and big fuzzy set), and the curve shape trimf (fuzzy set to medium) show in Fig. 8 (a).

To present a variable number of conductors used the curve-shaped trapmf (to set a little fuzzy and a lot), and the curve shape trimf (fuzzy set to medium) show in Fig. 8 (b).



(a) Membership function wide conductor (b) Membership function total of conductors

Figure 8. variable cross-sectional area and variable number of conductors

Variable Output

For the present variables output trapmf-shaped curve that is used (for a set of fuzzy is good and not good), and the curve shape trimf (fuzzy set to medium).

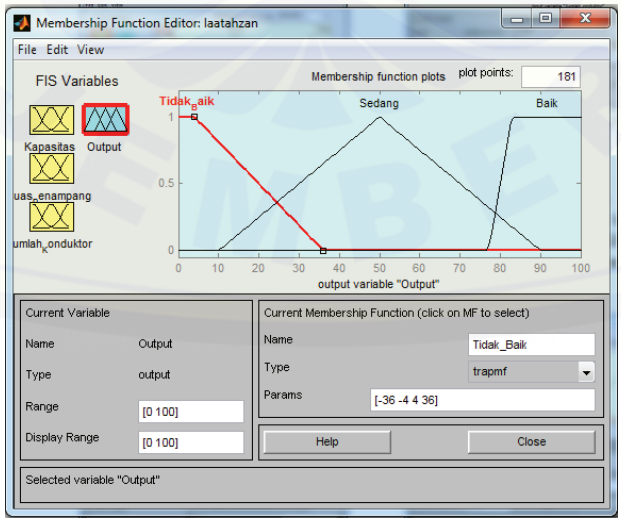


Figure 9. Membership function output

The Application of Fuzzy Operator

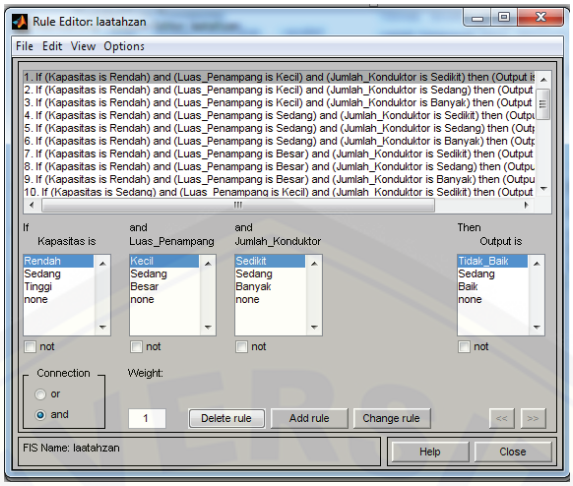


FIGURE 10. Rule editor

Table 1. Rule Editor

No	MVA	Wide Conductor	Total Conductor	Out
1	Low	Small	Little	G
2	Low	Small	Medium	G
3	Low	Small	A lot	G
4	Low	Medium	Little	NG
5	Low	Medium	Medium	M
6	Low	Medium	A lot	M
7	Low	Big	Little	NG
8	Low	Big	Medium	NG
9	Low	Big	A lot	NG
10	Medium	Small	Little	M
11	Medium	Small	Medium	G
12	Medium	Small	A lot	G
13	Medium	Medium	Little	M
14	Medium	Medium	Medium	M
15	Medium	Medium	A lot	M
16	Medium	Big	Little	NG
17	Medium	Big	Medium	NG
18	Medium	Big	A lot	NG
19	High	Small	Little	NG
20	High	Small	Medium	G
21	High	Small	A lot	G
22	High	Medium	Little	NG
23	High	Medium	Medium	M
24	High	Medium	A lot	M
25	High	Big	Little	NG
26	High	Big	Medium	NG
27	High	Big	A lot	NG

Note: G (Good), NG (Not Good), M (Medium)

The results of the deployment and composition of all output can be seen in Fig 11.

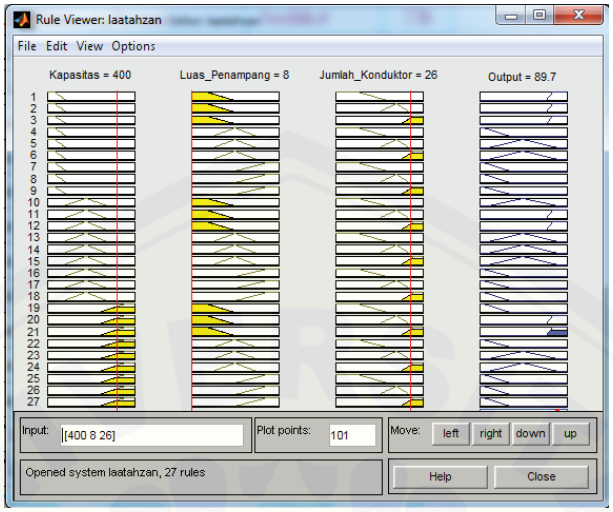


FIGURE 11. Output rule

Based on the above Image obtained the result that if has a value of 400 MVA capacity, and on the conductor cross-sectional area has a value of 8 mm, and the number of conductors in one coil have a value of as much as 26 pieces. Then results in getting is of 89.7.

Based on the results, then the transformer is said to be good and can reduce loss-loss due to copper with a small cross-sectional area and is owned by Continuously Transposed Conductor (CTC) can give a great power thus reducing loss-loss copper overburdened.

To see the relevance of the fourth variable in the form of a surface can be seen in Fig.12.

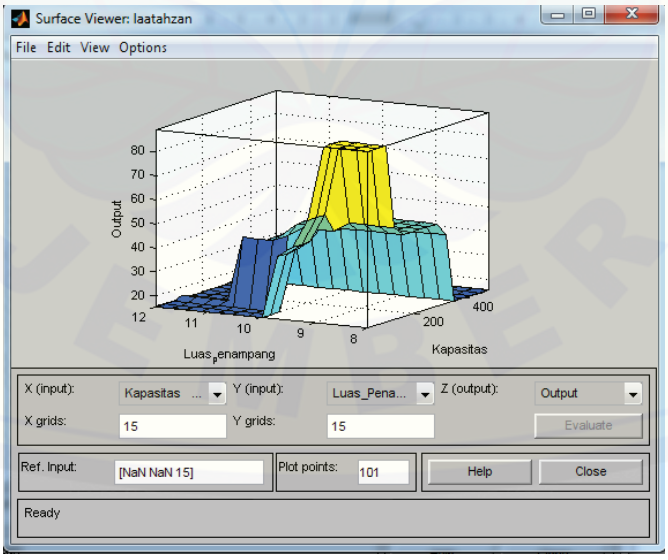


FIGURE 12. Surface viewer

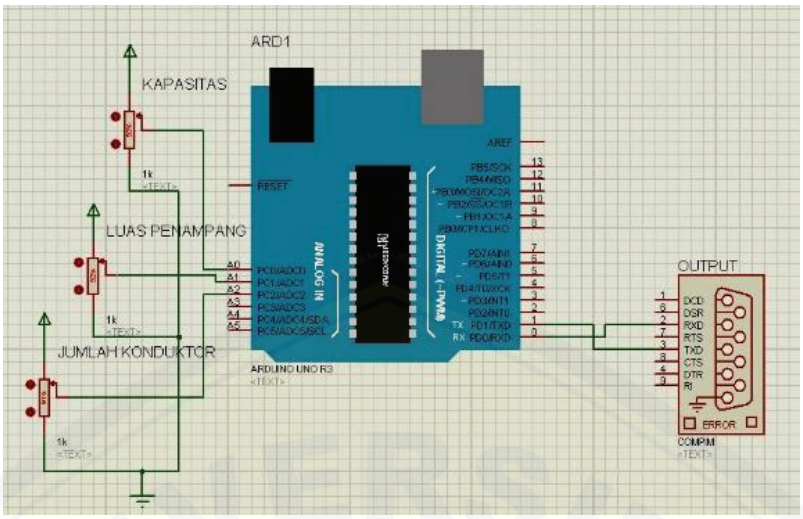


FIGURE 13. Series analysis the use of CTC

CONCLUSION

The forward chaining method implemented in this system works by tracking the symptoms that match between the symptoms of the rule and the symptoms are selected by the user. If forward chaining finds a rule with premises/ conditions/ symptoms that contained in the rule is worth the same as the symptoms of the selected user, so Then-part of that rule will be executed for the conclusion/ diagnosis. This system uses a validation through case testing by way of comparing the results of diagnostic systems and the results of diagnostic by human experts. There are 36 data from some of the symptoms of diseases and pests that are used as data case, where 32 data shows the same diagnosis results between this system and diagnosis results by a human expert. 4 data cases yield a different diagnosis. The difference in the results of the diagnoses is caused by the rule base in this system. Forward chaining methods do not find the rule corresponding to the symptoms that are chosen by the user. The complexity of the rule in this knowledge base is very influential in generating conclusions diagnosis. Increasing complex rule which was built, then the system will yield an accurate diagnosis. So, it can be concluded that this diagnostic system can be used to diagnose diseases and pests based on symptoms chosen by the user with an accurate percentage 88% is derived from the 32 data cases yield the same diagnosis between the results of diagnostic system and the results of the diagnosis by human experts. So, this system diagnosis can be used to help farmers for increase knowledge and skills about diseases, pests, and how to control them.

From the description of the data, as well as of the results of calculation and analysis of loss-loss of copper, then it can be concluded that:

1. Continuously Transposed Conductor (CTC) is good because it has a conductor cross-sectional area is small.
2. In the use of Continuously Transposed Conductor (CTC) should be used on a transformer with a large capacity.
3. Continuously Transposed Conductor (CTC) can be used to reduce loss-loss copper overburdened power transformer on.

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