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IMPROVEMENT OF CALCULATION SETTINGS FOR RELAY PROTECTION

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ABSTRACT

The active energy development, the formation energy of Ukraine evaluation equipment in emergency operation carried out at a cost of damages. Analysis of accidents and their consequences in the modern sense of power should not only be subject to technical feasibility, but also possible legal liability.

KEYWORDS: relay protection calculation settings, current transformer.

INTRODUCTION

Causes of accidents can be divided into the following groups:

1. Natural and external causes are atmospheric and naturalphenomenon, consumers of electrical system with interference of irrelevant persons in work of electrical system.
2. Gaps in the system are error design, defective installation and possible available defects established equipment (false of factory-manufacturer, transported company or ounting team), conditions of operation (eg weather conditions or aging).
3. Gaps in operation are operating errors expressed in wrong operational management, mistakes to service or repair.
4. Unexplained reasons are related to imperfection of system and its operation.

Natural and external causes cannot be causes irregular action of relay protection (RP), so special attention should be paid to the study of the last three reasons.

Measuring devices of most RP responsive to current or various combinations in the protected accession. The specified level of current protection and isolation of circuits from high voltage implemented using electromagnetic high current transformers (CT).

Constantly growing in the course of technical progress requirements for devices RP and pressure transmitters' power for their speed, sensitivity and selectivity causes necessarily to grow CT requirements [1, 2].

Improving of electronic components RP causes transition to new technologies. The vast majority of manufacturers cease production of electromechanical relays and devices then switch to digital elements. Main performance microprocessor protection is significantly higher than the microelectronic, and especially for electromechanical. The power consumed by them are ten times less (hardware error is only 2.5%), the rate of return of measuring high enough and is in the range 0,96□0,97.

However, the sufficiently broad of operating devices RP with electromechanical elements points that their entire lifespan is about 25 years, and more than 2 times the average set by the specifications. For example, lifetime of magnetic electric relay is limited of 6 years and microelectronic is 10 years. Similarly, restrictions exist for other nodes RP, eg for mounting wires, contactors, control cables. In turn, the technical data on the RP device with digital microelectronic elements has an average usage of a specified term of 12 years. CT average lifetime is about 25 years and can be renewed.

MATERIALS AND METHODS

The transition to the new technology does not change the basic principles of RP, but extends its functionality, further simplifies operation and significantly reduces cost. The examples of calculations for the current operation inserts for different relaying show opportunity for further improvement RP settings (fig.). Thus, the primary current operation of overcurrent protection is according to [3, 4]

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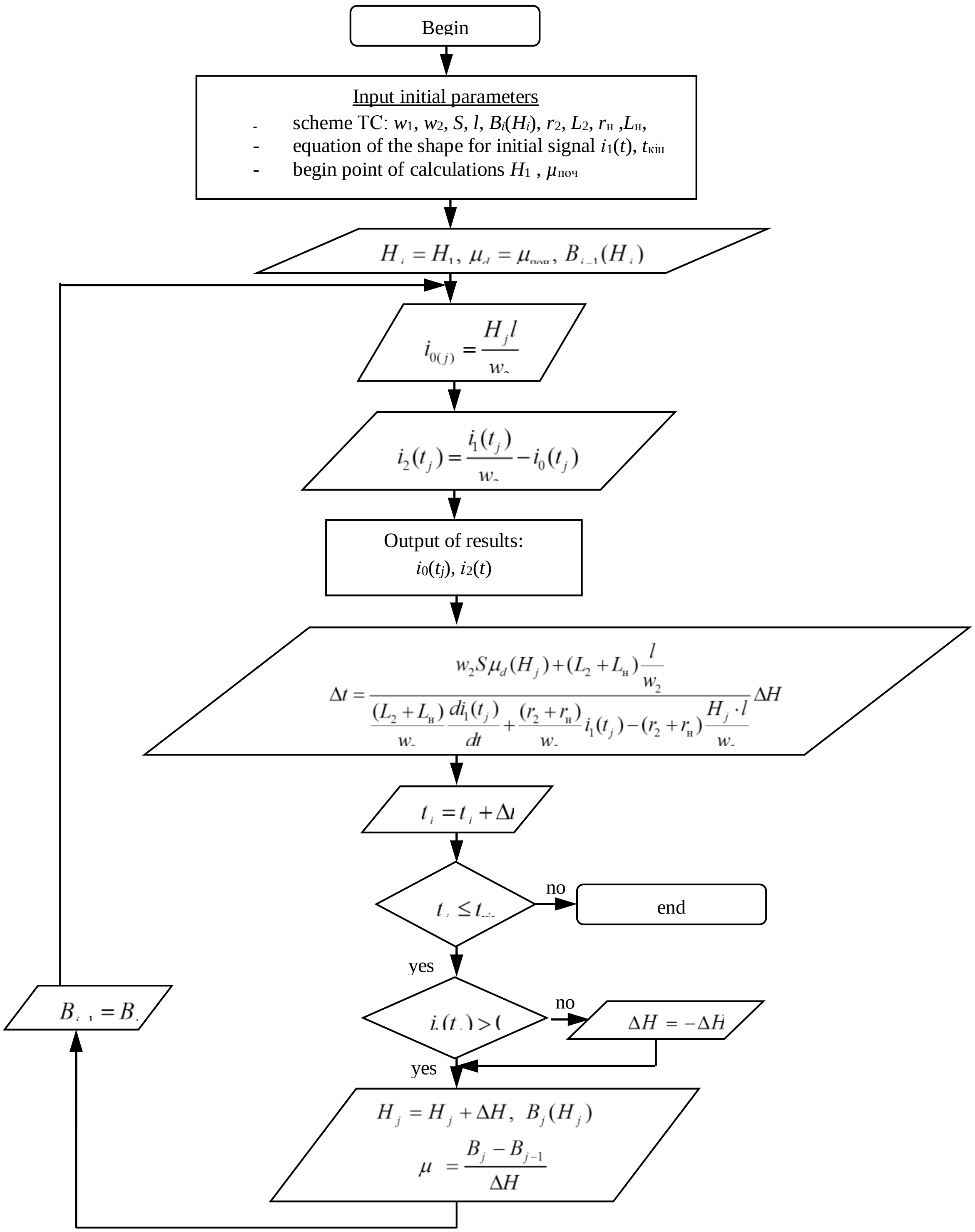

Figure: Optimized iterative calculation

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$$I_{C.3.} = \frac{K_{н} \cdot K_{сам}}{K_{в}} I_{PМакс}$$

where K_H – safety coefficient, assumed to be 1.2-1.4;

$K_{сам}$ – coefficient of self-start;

K_B – coefficient of relay return;

$I_{РБМакс}$ – the maximum operating current that flows through the line with all the possible overload it.

Further protection is determined by the sensitivity and the need for elected methods for providing it.

Safety factor takes into account measurement error will be made by part of the RP measurement. Its value depends on the type of protection, circuit protection, and other factors, conducted by the manufacturer.

Note, for modern microprocessor protection K_H is closer to 1 than for similar electromechanical relays.

To find the current secondary current operation of the relay circuit must consider coefficient of accession K_{CX} and transformation n_T:

$$I'_{C.3.} = K_{CX} \frac{I_{C.3.}}{n_T}$$

Coefficient of responsible for the transformation circuit current in the primary and secondary is 1 only on the condition and connection CT relay circuit complete and incomplete "stars". Note that in this case there is no consideration of the electrical connection secondary circuits of CT.

Calculating the maximum possible threshold current operation provided no errors in excess of 10% (corresponding to 1.1 denominator), use the following expression [5, 6]:

$$I_{сз} = \frac{K_{роз} I_{ном}}{1{,}1},$$

where $K_{роз}$ – calculated multiplicity of current circuit in which overcurrent error does not exceed the allowable values.

Similarly, the amount of current operation lowered compared to the calculations, which take into account the real total error of CT.

Technical improvements devices of RP leads to higher use of CT accuracy class 3R and 6R instead of 5P and 10R, one has to take into account for the calculation of the limit of the maximum possible current operation.

Differential protection as per complicated by two CT [7, 8]. Selecting of settings for transverse differential protection line is made with respect of current unbalance:

$$I_{C.3.} = K_H I_{нб\max}.$$

While

$$I_{нб\max} = I'_{нб\max} + I''_{нб\max},$$

where $I'_{нб\max}$ – current unbalance of errors of CT is equal to:

$$I'_{нб\max} = K_{а} \cdot K_{одн} \cdot f_i \cdot \frac{I_{К3\max}}{2},$$

where $I_{К3\max}$ – current of short circuit;

$K_{а}$ – coefficient that takes into account the presence of aperiodic component in the current short circuit;

$K_{одн}$ – uniformity coefficient of CT, taking into account the CT difference characteristics (0,5 on both CT and currents flowing close 1 for the rest cases);

f_i – CT error, generally defined accuracy and CT is set to the maximum error as CT curves are elected by a 10% margin of error.

$I''_{нб\max}$ – unbalance current, which is due to different resistance parallel lines.

As uniformity coefficient takes only two values, current unbalance of CT error is designed in a classic way for differential protection will vary by 2 times. Methods for more accurate calculation of ratios in the technical literature are given.

Accuracy of CT also meets a fixed value that ignores the real conditions of current relay protection circuits. Unbalance currents for two other CT are determined separately and taken to select insert larger value.

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RESULTS AND DISCUSSION

The current definition of imperfection inserts relaying in most cases does not result in incorrect operation, but leads to the usage of more expensive RP and CT. For problems related to low and medium voltage would be optimal adjustment of the above parameters by continuous refinement.

For nets of high and very high voltage, short circuit currents where transient different form of sine wave, that include forced Aperiodic components, using the above method leads to significant errors. For such systems is recommended to calculate the transition process in the secondary circuits CT [1, 8].

Another issue is the presence of residual magnetic induction in CT. It is common in conditions of CT with low multiplicity of short circuit or when installing automatic recloser.

According to IEC 60044-6 [3] provides additional requirements for CT with considering aperiodic component of current, CT are classified according to their magnetic structures (closed or open-circuited). So with the installation of automatic recloser, it is supposed the installation of TS with open magnetic circuit in economic feasibility. However, standard data do not give an exhaustive approach to valuation errors in transient conditions.

There are few statistical researches, where the consideration of amplitude and frequency aperiodic current component damage and residual induction of CT. Thus, according to the paper [7] 30% of CT were fixed at the presence of residual induction, which is 70% of the saturation induction. Aperiodic component is observed in approximately 70% of cases. Worst options when coincides maximum of aperiodic component and residual induction, it is relatively rare phenomenon.

For most practical problems no need to calculate the secondary current for any period of time. That is the notion of the estimated time during which the short circuit will be detected.

Calculation of transient convenient carries by optimized algorithm [8, 10]. Where, i_2, i'_1, i_0 is according instantaneous current of secondary and primary windings, the magnetization of the magnetic;

L_0 is nonlinear magnetization inductance CT;
L_2 and r_2 is scattering inductance and resistance of the secondary winding;
L_n and r_n is inductance and resistance of the load.
Note that all input values for calculations CT provided either by the manufacturer or determined experimentally to take into operation.
One important advantage of said algorithm should include: subject to presentation of the input current in the form of function $i_1(t)$ provides the possibility of making the algorithm previously calculated derivative $\frac{i_1(t)}{dt}$. The estimated amount of time intervals corresponding to a given accuracy of calculation time interval corresponds to the period of constant permeability, which agreed with the cycles of CT core reversal. The magnetization of the magnetic characteristics can be represented or magnetization curve, or family hysteresis loops. Input signals can be presented and discretely be obtained experimentally.

In calculating the secondary current range is recommended to use the experimentally obtained characteristics of CT and RP or nameplate by manufacturers.

CONCLUSION

The advantages of the proposed method should include: a significant increase in the accuracy of the selection elements by switching from the universal to the individual characteristics. Calculation of inserts for CT and RP by different manufacturers, taking into account the real characteristics of CT and RP (operating conditions, aging equipment). Perform equipment selection should do not only by the technical criteria but also the economic criteria; monitoring and forecasting of future working current state of relay protection circuits.

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