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FUZZY CONTROL OF CIRCUIT BREAKERS IN POWER TRANSFORMER CENTERS

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ABSTRACT: Transformer outages resulting from malfunctions by automatic maneuvers should be reflected to the system as soon as possible. Disruptions resulting from interruptions and losses should be minimized. In this study, Fuzzy Logic Control of Cutters in Transformer Centers has been provided. Since the energy parameters of the controlled electricity distribution line has been able to monitored continuously, energy consumption has been controlled. The fault conditions of all the elements in the substation are immediately determined and immediate intervention is possible. Human errors have been minimized by the control of breakers in the substation with fuzzy logic.

Keywords: Power Transformers, Transformer Breakers, Fuzzy Logic, Fuzzy Control.

1. INTRODUCTION

The advancement of technology, the more common power quality problems are becoming more important. The short or long-term changes in the power supply voltage result in huge financial losses for the industrialists who want to continuously increase their production [1, 2]. For the industrialist, power quality is an important issue in terms of continuous operation of the process and in order not to damage the devices. The harmonics in the transformer centers go up to a level that will deactivate sensitive devices or cause them to malfunction. For industrial users, it is important to minimize these risks and losses caused by risks and to keep energy consumption at the optimum level. Such events should be repeated frequently and the power quality improved. The biggest benefit to the consumer is the electricity distribution system under control and monitored; the most efficient and efficient use of existing energy is to eliminate risks in terms of life and property security [3, 4]. In all electrical facilities where electric energy is produced, transmitted, distributed and consumed, the distribution and transmission system is controlled and the energy parameters are monitored and the system is monitored. By means of this study, the automatic maneuvers and the interruption of the breakers in the substation with fuzzy logic have been reflected to the system as soon as possible.

2. CIRCUIT BREAKERS IN TRANSFORMER CENTERS

Circuit breakers are an absolutely essential part of any electrical system. Used in conjunction with proper grounding, they can safeguard against electrocution. Circuit breakers also protect appliances, wiring and property against fire hazards and other damage resulting from abnormal current flow, short circuiting, overloading, and heat build-up. Circuit breakers in transformer centers is shown in Figure 1.

Figure 1. Circuit breakers in transformer centers.

There are many types of circuit breaker designs and they can be classified on the basis of voltage (high, medium and low) or other characteristics like their arc quenching media and operating mechanism. The winding short-circuit protection relays are used for large power alternators and transformers. An isolation fault is used to prevent short circuits between the phase windings of the alternators or the short circuits between their windings of a phase. In the case of a winding or winding short circuit failure in a winding, the relay is energized since the vector is zero. The relay opens the breaker. The winding short-circuit protection relay is used to protect the system against short circuits between the short-windings formed between the phase windings of large power transformers and alternators or the short-circuits between a phase's own windings. When there is no winding short circuit fault, the vector sum of the voltages is zero in the secondary connected coils in the wattmetric relay, there is no voltage. When the winding short circuit occurs, this balance is disturbed and the position of the contacts is changed by pulling the pallet. In the case of short circuit faults that occur in the energy transmission lines forming the interconnected network, the protection relay distance relay which detects and disables the defective part is the relay. A short circuit protection relay is used in large power transformers to avoid short circuits between the phase windings of transformers or the windings of a phase due to an isolation fault. The star connected and neutral point of the alternators and transformers is the relay phase earth leakage protection relay which is used to protect the power transformer in a phase-earth fault that occurs in the circuit fed by the secondary winding which is grounded. The transformer is used to protect the line against the short circuit of the feeder-ground and to protect the transformer output hat against the short circuit of the earth. In large power transformers, phase earth leakage protection relay is used in order to protect the system during phase-earth leakage between phase windings and earth.

3. FUZZY LOGIC CONCEPT

Fuzzy logic is based on fuzzy set and sub set. In a classical approach, an entity is a member of the coop or is not. When expressed mathematically, "1" is the value when the element is a member of the conglomerate, and "0" when the element is not a member of the conglomerate. Fuzzy logic is the extension of classical cluster representation. Each entity in the fuzzy entity set has a membership level. Contrary to classical clusters, the membership grades of fuzzy clusters can change in infinite number of intervals (0,1). These are a whole bunch of grades of membership that are continuous and unbroken. Binary variables such as cold-warm, fast-slow, light-dark in sharp clusters are likened to the real world by being softened by flexible qualifiers such as a little cold, a little warm, a little darkness in the fuzzy logic. Once fuzzy variables are defined and membership functions are assigned to them. There are some rules that are used in defining fuzzy clusters. In principle, the number of fuzzy sets assigned to each variable is usually a single number. This provides the presence of a centre point to prevent numerical oscillation between adjacent values. Second, the number of fuzzy sets is usually between 3 and 9. To describe causal relations, we must be able to distinguish one subset from the other by the use of linguistic variables. The greater the number of sub-clusters, the more difficult it becomes. It is easy to distinguish between short, medium and long variable values. But with a lot of data, this situation becomes more difficult. The linguistic descriptions of the subclasses can be interpreted. At the same time, each fuzzy set must sum up the compound sets. This overlay provides a continuous control area for the fuzzy controller. Once the blur sets have been defined and assigned their membership functions, the rules must be written for each combination of the control variable. These rules will relate input variables to output variables using ‘If-Then’ expressions in decision-making. The condition ‘If’ is a prelude to the result of each rule. In general, each rule is shown in ‘If’ (prefix) ‘Then’ (result) style.

4. TRANSFORMER CIRCUIT BREAKERS CONTROL BY FUZZY LOGIC

Fuzzy system for circuit breakers control is given in Figure 2.

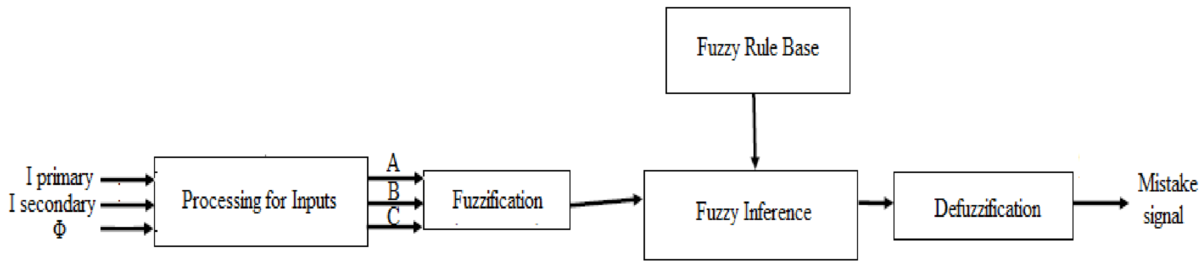

Figure 2. Fuzzy system for circuit breakers control**.**

The Fuzzy Control System is designed to monitor transformer fault information, to see the location of the breaker and the reason for opening the breaker opened under various fault conditions. Abbreviations and explanations of fuzzy expressions is given in Table 1.

Table 1. Abbreviations and explanations of fuzzy expressions.

Fuzzy parametre	Fuzzy Abbreviation	Fuzzy variable	Fuzzy Abbreviation
Over Voltage	OV	Short	S
Over Current	OC	Very short	VS
Voltage Imbalance	VI	Very long	VL
Current Imbalance	CI	Long	L
Temperature	T	Normal	N
Over Voltage Medium	OVM	Medium	M
Over Current Low	OCL	Low	l
Temperature High	TH	High	H

Fuzzy logic rule table is given in Table 2.

Table 2. Fuzzy logic rule table.

OV	OC	T	VI	CI	OVL	Output
OVl	OCI	Tl	X	X	X	VL
OVl	OCI	TM	X	X	X	VL
OVl	OCM	TH	X	X	X	N
OVl	OCH	TI	X	X	X	L
OVM	OCH	TH	X	X	X	VS
OVH	OCI	TI	X	X	X	L
OVl	OCM	X	X	X	X	L
OVl	X	TI	X	X	X	VL
X	OCI	TI	X	X	X	VL
OVl	X	X	X	X	X	L
X	OCM	X	X	X	X	N
X	X	X	VII	CII	OVI	VL
X	X	X	VII	CII	OVM	VL
X	X	X	VII	CII	OVH	L
X	X	X	VII	CIM	OVI	VL
X	X	X	VII	CIM	OVM	L
X	X	X	VII	CIM	OVH	N
X	X	X	VII	CIH	OVI	L
X	X	X	VIM	CIM	X	N
X	X	X	VII	X	OVI	VL
X	X	X	X	CII	OVI	VL
X	X	X	VII	X	X	L

Instantaneous values of current, instantaneous values of voltage, overcurrent information, earth leakage information, current transformer ratios, voltage transformer ratios, active power information, reactive power information, power factor, the value of the fault current that opens the system, when the system is turned on due to malfunction, and oscillographic diagrams of fault currents that open the system must be known. In the system monitored from the computer in the center, the remote control of the circuit breaker is also made from the same center. With the MC20 R reclosing microprocessor relay, the open circuit breaker is closed again to energize the line after the time set to the system with the breaker opened at the center. In order to decrease the rule base, two different results are produced by dividing 6 different input values and the smaller of the produced results is used as the final result. Created software in Matlab Program is given in Figure 3.

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>> If OV is OVI and OC is OCI and T is TI then Output is VL else
>> If OV is OVI and OC is OCI and T is TM then Output is VL else
>> If OV is OVI and OC is OCM and T is TH then Output is N else
>> If OV is OVI and OC is OCH and T is TI then Output is L else
>> If OV is OVM and OC is OCH and T is TH then Output is VS else
>> If OV is OVH and OC is OCI and T is TI then Output is L else
>> If OV is OVI and OC is OCM then Output is L else
>> If OV is OVI and T is TI then Output is VL else
>> If OC is OCI and T is TI then Output is VL else
>> If OV is OVI then Output is L else
>> If OC is OCM then Output is N else
>> If VI is VII and CI is CII and OVL is OVI then Output is VL else
>> If VI is VII and CI is CII and OVL is OVM then Output is VL else
>> If VI is VII and CI is CII and OVL is OVH then Output is L else
>> If VI is VII and CI is CIM and OVL is OVI then Output is VL else
>> If VI is VII and CI is CIM and OVL is OVM then Output is L else
>> If VI is VII and CI is CIM and OVL is OVH then Output is N else
>> If VI is VII and CI is CIH and OVL is OVI then Output is L else
>> If VI is VIM and CI is CIM then Output is N else
>> If VI is VII and OVL is OVI then Output is VL else
>> If CI is CII and OVL is OVI then Output is VL else
>> If VI is VII then Output is L
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Figure 3. Created software in Matlab Program.

This system is designed to protect the substations against faults, and has designed a fuzzy control system which will cut the energy in case of over voltage, over current, temperature, voltage imbalance, current unbalance and low voltage. As with most protection relays, if the system detects an error, it waits for a certain period of time and the power is cut off if the error is not corrected. The time to wait to de-energize the substation is critical. This needs to be determined by experts. In this study, waiting time for many different combinations is produced as turbidity. Due to the rule base created by the experts, the waiting period according to the error type and degree is calculated flexibly. Thus, the waiting time can be adjusted optimally according to the type and condition of the fault. In addition, the results of the simulation and the results of the experimental study show the reliability of the system. The classic system is 3 seconds with constant standstill, regardless of fault difference. The more flexible stop time is between 0 seconds and 4.5 seconds compared to the error type which is performed. The software is developed to adapt the system according to the parameters in the transformer central system.

6. CONCLUSIONS

By controlling the breakers in the substation with fuzzy logic, automatic maneuvers and interruptions resulting from the fault are reflected to the system as soon as possible. In this way, disruptions and losses resulting from the interruption are minimized. Since energy parameters of the controlled electricity distribution line can be monitored continuously, energy consumption is controlled. As the fault conditions of all the equipment in the system can be monitored from the system immediately, the intervention was interrupted without losing time. Fuzzy logic control system created by the human error, as well as a very small number of personnel was kept under control.

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