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IMPROVING TRANSFORMER PROTECTION

Azamov Saidikrom Saidmurodovich
Teacher of the Department of Electro mechanics and Electro technology of Electrical Engineering, Andizhan Institute of Mechanical Engineering, Uzbekistan

Uzakov Rahmonjon
Teacher of the Department of Electro mechanics and Electro technology of Electrical Engineering, Andizhan Institute of Mechanical Engineering, Uzbekistan

ABSTRACT
Power transformers play an important role in the power system. These electricity transformers are the main subject to internal short circuits, external short circuits and abnormal operating conditions as well. In this article, we shall discuss some protection challenges to power transformers and methods to improve the transformer protection.
KEYWORDS: *Power transformer, power system, protection challenges, operating conditions*

INTRODUCTION

Today, due to the use of electricity productivity is increased hundreds of times. Modern machines, automated assembly and assembly shops, networks and entire enterprises created new industries (electrometallurgy, electrolysis, electric welding, processing of materials using high frequency current and etc.) has developed rapidly. The reason is the widespread use of electricity for various purposes has the following advantages over other energies:

- Most natural energy to generate electricity sources, primarily fuel and water accessibility;
- For long distances without spending a lot of electricity quality transmission capability;
- Different location and power of electricity the possibility of easy distribution among consumers;
- Conversion of electrical energy into other types of energy: thermal, mechanical, light, high frequency, magnetic pulse, hydraulic pulse, chemical and ease and high efficiency of conversion to other energy. The electricity in power plants produced using power generators. Power generation at such stations takes place in two stages: first the source energy is converted into mechanical energy through the movement of the turbine, and then that turbine by moving the rotor of the electric generator, the mechanical energy is converted into electrical energy converted. Electricity using thermal energy or the internal energy of the atom at power generating stations, the energy is tripled becomes initially, the energy of the combustible material is converted into heat energy and the heat energy in the primary turbines is converted into mechanical energy and an electric generator converts mechanical energy into electrical energy.

MATERIALS AND METHODS

A set of power plants, substations, power transmission lines, and thermal power plants connected by a common mode of operation and the continuity of production and distribution of electricity and heat is called an energy system. An electrical system consisting of generators, distribution devices, power grid-substations, power transmitters and power receivers is part of the power system. A substation is an electrical device that serves to convert or distribute electricity and consists of transformers, other devices that convert energy from one type to another, distribution devices, control devices, and ancillary structures. Depending on the function of the substation transformer (voltage

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converter); current converters (AC to DC converters) and distribution substations. Small (up to 400 V secondary) transformers and distribution substations in industrial and municipal networks are called transformer substations. According to the design of power transmission lines, they are divided into overhead transmission lines and underground cable transmission lines. The power plants that connect to the system during peak hours are called peak stations. Hydropower plants that do not have enough water for long-term operation are often used as peak stations. Because consumers in different districts have different peak load times, the maximum load when these districts are combined into a single system will be smaller than the sum of the maximum loads when individual consumers or districts operate separately. when power plants are integrated into a common power system, there is no need to have a backup generator at each station. Different power plants operate differently, in some cases on a mandatory basis. For example, condensing thermal power plants can operate at full capacity throughout the year, while thermal power plants generate more electricity during the cold season, which consumes a lot of heat. Hydropower plants with large reservoirs can produce the energy they need when the consumer needs it, while hydropower plants without large reservoirs produce less energy during periods of water scarcity (especially in winter) and flooding. time (in plain rivers — in the spring, and in mountain rivers, the melting time of mountain ice is in the summer) increases the production of electricity. The combination of power plants with different operating modes allows increasing the load on other stations, which can increase power generation when the operating mode of one station is forced out of order. In this regard, power transformers play an important role in the power system. These power transformers are the main subject to internal short circuits, external short circuits and abnormal operating conditions as well. There are some protection challenges to power transformers and methods to improve the transformer protection.

RESULTS AND DISCUSSIONS

As far as we have observed that there are numerous challenges to the protection of power transformers and a variety of methods to improve the protection power transformers as well. *Remanence* in a current transformer might cause misoperation of phase-differential protection as the compromised current transformer performance. Heavy through-faults, sympathetic inrush and recovery inrush all cause high current. This combined with high remnant flux can create a security issue. IEEE current transformer performance calculations support the use of dual-slope differential characteristics to promote secure differential protection operation when challenged with unequal current transformer performance.

Traditionally, second harmonic current upon transformer energization has been used as a means to prevent phase-differential misoperation. Certain transformers might not exhibit sufficient second harmonic current, causing a dependability problem if the restraint is set too low. The use of second and forth harmonics for inrush detection enhances reliability during energizing inrush situations.

Overexcitation can be occured from abnormal operation of the utility system or the plant's excitation control. Traditionally, when overexcitation occurs from system voltage rise, the phase-differential protection has been blocked from using fifth harmonic restraint. Blocking might cause an undesired non-operation of the phase-differential-protection if an internal fault occurs while the transformer is overexcited, which causes a delay in tripping and severe damage to the transformer. An adaptive, phase-differential technique modifies the pick-up value and overcomes this challenge.

Overexcitation protection should be employed to protect properly against heating effects, insulation deterioration and subsequent faults. Proper overexcitation protection includes thermal-memory reset.

On resistance-grounded power transformers, phase-differential protection sensitivity for ground faults near the neutral is decreased. Ground-differential protection increases sensitivity gained.

Remanence is magnetization left behind in a ferromagnetic material (such as iron) after an external magnetic field is removed. Remanence in current transformer performance occurs because interrupting high currents with DC offset present may cause current transformer performance to saturate below the secondary voltage rating. As an example, a 1000:5, C400 ct could saturate with 200 V in the secondary circuit below the Class C definition accuracy of ±10% at 20 times rated current.

The tendency for a current transformer performance to saturate is increased by other factors, working alone and in combination:

• High system X/R ratio increases the time constant of the current transformer performance saturation period

• CT secondary circuit burden causes high current transformer performance secondary voltage

• High primary fault or through-fault current causes high secondary current transformer performance voltage

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We sometimes observe that there are many technical papers on the subject of modeling the behavior of iron-core current transformers used for protective relaying purposes. One of the difficulties in using an elaborate model is obtaining the parameters for a particular case to implement that model. For example, the excitation current in the region below the knee-point is a complex combination of magnetizing, hysteresis and eddy-current components; the parameters are usually not known for a particular case. The IEEE Power System Relaying Committee (PSRC) developed a simplified model for ct saturation that includes the major parameters that should be considered [4]. The simplified model is based on the fact that, if the excitation current waveform reaches into the saturated region, the part of the waveform below the knee-point region has negligible effect. This simplifies the solution greatly and makes this a good analysis tool for dimensioning current transformer performances.
A protection engineer uses this analysis tool to do the following:

• Examine a particular relay differential-element characteristic

• Develop settings for pickup, slopes and slope-change breakpoint

• Maximize security for external through-faults

• Maintain dependability for internal faults

CONCLUSION

As a brief conclusion, we can say that, power transformers are the main subject to internal short circuits, external short circuits and abnormal operating conditions as well. As we have discussed above mentioned that there are protection challenges to power transformers and methods to be improved the transformer protection.

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