Original Article

Protection of Distribution Networks

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ABSTRACT

With the increasing dependence on electrical power generation resources, achieve a good level of reliability, quality and safety, along with cost-efficient day to day for consumers is more important Another necessary thing that should take into consideration the safety of electric power. One of the first requirements of each feeding system is that such a system be designed well and in the next step be to good maintenance until the number of errors that might occur, it is limited. In this article, we try to have a variety of errors found in the distribution system should be evaluated and appropriate with such a solution provides dynamic protection of these errors as much as possible to a minimum of time.

Keywords: Protection, Distribution Networks.

Introduction

In connection with the distribution system, there are also a lot of tools to help estimate the conditions of safety, reliability and quality are about feeding operation. The most important of these tools are protective systems. These systems to fix errors and equipment failures, limitation of distribution systems, the systems are installed. The most important causes of the occurrence of an error in the distribution network are: lightning, insulation, vandalism and destruction of the branches of the trees and the animals that make the connection in the electrical circuits are. Most of the errors are transient and often described with no loss of power, or maximum with the shortest time off the circuit, will be relieved, while lasting longer to output errors to. To avoid downtime, you need all the circuits and

electrical equipment, protection and reliability suitable to be installed. Protective relays, the first tools that are part of the whole circuit damaged outside to other parts of the system are still in continuity is preserved. This is ultimately an electric energy update service with the integration of more and better quality nutrition will last.

A protective system requirement

Any kind of protective arrangement in each power system should be the basic principles of the following consideration:
1. Reliability: the ability of protection system to function properly. This principle itself has two elements: trust, which represents the correct performance during the occurrence of an error in the system

and security, the ability to avoid incorrect operation when the occurrence of error.

2-Speed: minimum time in error handling function to avoid equipment damage.

3-Selection flexibility: continued the process of feeding the necessary minimum cut through to separate the network error.

4-maximum protection with minimum cost: cost possible.

Since the supply of all the above points simultaneously, virtually impossible, you must establish a balance between the above tips and optimum protection system will be designed.

Protective areas

The general philosophy of the use of relays, divided into separate areas of the system that is able to separately about the protection and the error event of the network to be isolated, so the remainder of the system if possible to be able to continue their work to continue. Generally, a power system can be divided into several distinct areas in terms of protection for this add-on. These areas include: generators, transformers, the group consists of generators and transformers, motors, Shane and lines. Figure 1 protective area with several different system shows. Considering that in some places, these areas will overlap with each other, if the overlap, an error occur over a series of protection should operate. This overlap can be found through the protective relay connection to the appropriate current transformers, as shown in Figure 2, acquired.
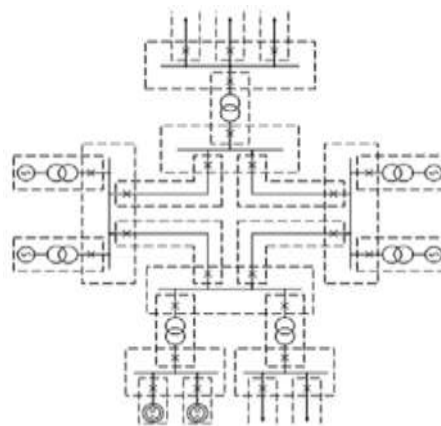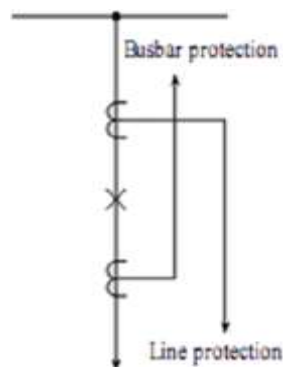

Figure 1. protective areas

Figure 2. Conservation areas of overlap

The primary and backup protection

All elements of the power system must be properly put up about the protection

relays only act when the occurrence of the error. Some of the relays only against errors that are in the scope of protection occurs, react, this type of protection, called the initial protection. On the other hand, some relays can also be what error in a special protective and out of it and the neighboring areas, usually recognize and reveal themselves. The relays can be used as a backup for the first type of use and line relay protection created the latter. It is important that any error will be separated from the network even if the original protection associated with it does not respond. So, if all the elements of a power system must have both a primary and backup protection type.

Primary protection

The primary protection system should be when an error is encountered in any of the elements, to be enabled. Therefore, each primary protection system is a protective zone of one or several elements of the power system, such as electric cars, lines formed with Shane on the covers. As we will see later, an element of the power system can have a variety of security tools is the primary type of protection. Of course, this does not mean that all these tools against a specific error of her to react. In addition to this basic protection that should be noted in any part of the equipment should be in place are not necessarily the same system or part of a particular element to be installed, but in some cases this can be done through the next or previous post admits.

Backup protection

The purpose of backup protection is that if for whatever reason, home protection than their error does not react, Act and be part of the circuit outside the damaged. To achieve this goal, the relay corresponding to the critical elements that are backup

protection can make a similar detector element relay primary protection or similar, but disappointed the relays in addition to this component should also be a tool of the time delay to their performance to the delay and the time required for the performance of the primary protection will be achieved. A relay can be simultaneously several backup protection equipment is part of the backup system. In fact, a relay in many times, for the element of primary protection system is considered. However, the task of protecting the backup of an element no longer has simultaneously.

The protection direction

One of the important features of some types of protection, taking advantage of the method of determining the direction of pass circuit. With the help of this feature, so the relay when the resulting stream of error in the direction opposite the direction of the primary relay function is set to on it can be necessary to open the damaged sections and keys of the entire circuit to be led. In this case, the protection using the direction, of the opening to prevent unnecessary keys, resulting in safety and reliability of electric power supply source improves, in the charts using protection, protection for them, usually with a special relay under the arrow signs show that for every stream in order to function specifies the relay.

Add stream protection

On electric power systems, high flow levels, usually as a result of the occurrence of an error in the system are visible. These streams, the basis for determining the presence of error conditions, and the incidence in the system and activate the protective tools, depending on the complexity of the required accuracy, are designed for a variety of applications, the.

Most types of protection, thermal, magnetic keys, CD keys or miniature fuse feeders and are high current relay. The first two types of functional structure are simple and low-voltage equipment in protection is used. Fuses are also often at low voltages and in particular for the protection of lines and distribution transformers are handled. Add relay flow, most are protection type and power system with high flow heads and have a job. This should not be the only relays as a means of protection against overload system about the operation because it was basically put high flow protection for unusual circumstances and when an error occurs in the system, can be designed. But in any case, the selected relays, usually with respect to both current and overload error type is set to be added.

Add flow direction protection

Flow direction in the absence of added protection being used so that error flows in both directions in the protection system, the flow and they take advantage of the large non-flow protection allows unwanted cut-point would have to follow. These conditions may be circular, as well as systems in power systems with a few (like dispersed production sources) has come. How to use high flow directional relays in the situation shown in Figure 3.
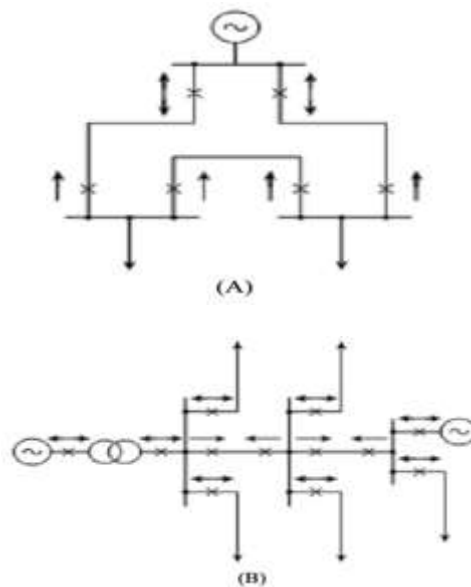

Figure 3. Flow direction add relay application (A) Ring system (B) The feeding system with multiple

Differential protection
Differential protection once the vector difference of two or more of the same, a lot of electrical size preset to be more. Almost all relays all types of relays can be used in

a differential protection enabled. In fact, what is more important in this field, not the structure of the relay, but how to get it

in the circuit? Although the differential relay in many applications are kind of a stream, but it can be simply as they also search the cursor measurement voltage difference which of course works in this case is identical with the type of stream as well, because in this mode the signal operated, in fact through the voltage that can be applied to a parallel resistance, change comes. Figure 4.a simple example of a makeup show differential. In this

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figure, the secondary current transformers (CT) have been connected to each other and also add a relay coil current is connected to them. Although the current I1 and I2 may have with each other are not equal, but if the CTs has the proportions of converter and its connections are appropriate, sometimes in normal circumstances or when an error occurs on the outside of the protected range is given, the secondary flows only from CT pass and will not pass any stream of relay. But if an error occurred in the interval between the two occur during short circuit CT of both side to side point the current connection will be the secondary flow of the total differential relay woes. In all cases, the flow in differential relay with the flow vector difference element or component has been compiled and protected it will be out, be appropriate. If the password of the current differential relay of more regulatory limit, it will sometimes act relay.
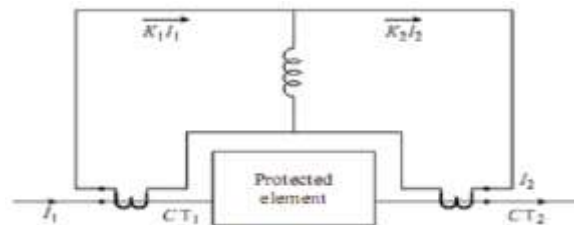

Figure 4. Current balances in terms of differential relays are

Distance protection

Basically, any error that occurs in a power system circuits must be overcome quickly, but from the other direction these errors may cause an outage of consumers, a loss of stability in the system and equipment failures are. Distance protection requirements for reliability and speed are necessary for the protection of these circuits and provide so much power, the system can be used. Distance protection, has this ability is among various sectors occurred in the errors of the system, based on the measured impedance, making the distinction. Basically, this is meant to be seen by the relay error stream compared with the size of the voltage at the installation location is to relay the impedance is calculated to place the error line. For the system-2-5 a relay located for the designation of A point $Z = V/I$ of the line current and voltage. The value of the impedance of Z when the F1 error occurrence against ZAF1 and for the F2 error against (ZAB + ZB2) will be.
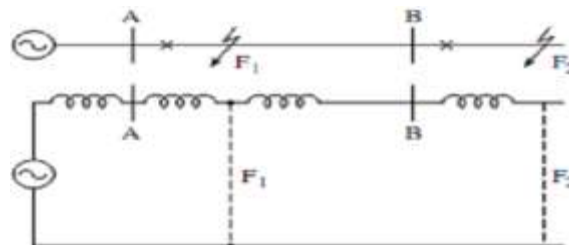

Figure 5. Error occurred in various parts of a power system

Digital protection

The first research in the field of digital protection began in the 1960s, a period in which the numerical computer replacement instead of the common tools in the analysis of power systems will become increasingly accepted. At the beginning of the short connection time,

broadcasting issues and the sustainability of using new applications were resolved for satisfactory. Taking advantage of the software for power system protection, the next step was that as a result of the development of new hardware in the field, along with the protective and done mathematical algorithm. However, in the beginning due to the problems caused by long response times required, use suitable protection for the computer so it doesn't hit. With the 16-bit microprocessors coming into existence in the 1970's mobile computers, faster and more economical were made, and the same applies to the implementation of the algorithm in the design of relays and protection could be built. Protective tools made by this technology today, can be read in the name of digital protection.

Characteristics of digital relay

In terms of digital relay based on the typical types of technical relay, which previously were superior overall rates, have many relays are as follows:

1. Reliability: in effect benefiting from the improper functioning of digital relay will be reduced so much. 2. Diagnosis and assessment: digital relay has the ability Guide, assessment and diagnosis that is visible in the form of a continuous circuit includes a memory test and part is analogue input. Error in event mode, the relay is usually either strongly or that acts on the basis of the apparent chaos circuit gives a chance to recover. 3. Create a list of events or information turbulences: whenever a protective function to be carried out, or one of the entries in the hardware error or any irritation occur these relays can provide a list of the events occurred. In addition to information related to the entropy can also be combined in a number of analog channels to all incoming and outgoing information

relays, are production. 4. The integrity of the digital systems in various parts of the technology of communication, all measurement and controls can be used in a digital system brought together to be able to post if safer and much faster action does. Now to create the communication among the diverse elements of the system of optical fiber used to make the communication problems when using metal conductors come, especially to be avoided. 5. Adaptive protection: according to the abilities of a digital system in the planning and communication, digital relays can provide adaptive protection. This feature enables the relay has a set of network based on different working conditions to be enjoyed. In this way a proper set and promptly relays can be practical and in these circumstances, the most critical of the arrangement based on the relay could not be set because in some scenarios, this type of set up, good results does not change much. Relay adjustment algorithms are usually written with the low level language because the response time must be very short and with high level languages such as Pascal or FORTRAN may not be necessary to obtain speed.

Digital relay function hierarchy

Generally digital relay performance hierarchy is as follows:
1. Get current and voltage signals in the input 2. Carrying out the process of signal processing on the input data to the following goals:
* Error detection
* Remove the DC component
* The classification errors
* Error detection to
* Spark error classification (especially for the connect keys again)
* CT saturation detection

Integrated protection

Since the application of the first electromechanical relays high current in power system protection, a century has passed. Most recently in the protective relay protection principles to the process of the first three decades of the last century that were formed, such as the high current relay, direction, distance and differential protection (differential) which can be seen in Figure 6.
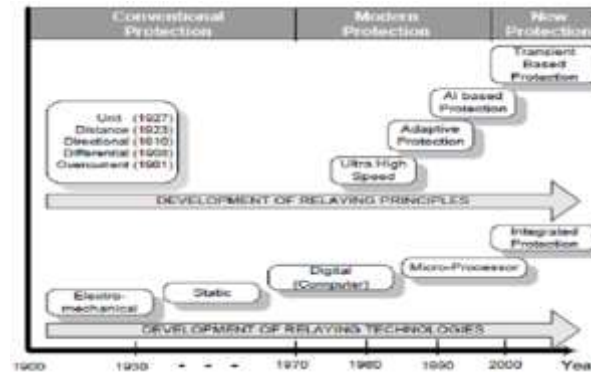

Figure 6. The protective principles of progress and the relay in the passing of time

This can be based on the principles of protection of signal sensing-frequencies, are for troubleshooting. To follow the progress of technology, the protective equipment of semiconductor integrated circuit to electromechanical and microprocessor technology, the deformation was found. Today, numerical relays and relay a digital alternative to the old microprocessors in all spheres have been power protection system. However, many of the same principles of protection will continue to play an important role. In the late 1960s, rock the central mail system uses a velour protection based on a central computer system is suggested. This concept fits with the concept of integrated protection in that it implements protection not only to check the power per unit, but part of the networks also control. However the idea was not practical because the telecommunication technology and

software – not available to hardware from such an idea they support. So the protection was limited to the backup protection integrated and remained as a secondary role.

In the late 1970s, with the development of power network, the need for constantly quick fixes to improve the stability of power system error, it is important to make the techniques to increase the speed of response on the relay. This leads to the progress of the super high speed relay based on transient mode of the mobile Jammer was created after the error for the protection of the used transmission lines. Due to the limitations of digital processing technology at the time, on the basis of these principles, protection relays, they develop. Progress in the 80's and 90's new tools for advanced power system protection, particularly protection and protective techniques based on Adaptive artificial intelligence they provide. As a result, the performance of protective relaying improved protective principles of customary law, but failed to add a new. In recent years, more advances in microprocessor technology and created a converter, respectively. This has caused a lot of diagnostic techniques that were impractical in the past to be practical. Studies have shown that the high frequency transient state created after the error can be detected and techniques and new rules to add protection. Now a significant effort to

research in the field of high frequency transient scenarios is dedicated.

At the same time with a significant growth in signal processing and telecommunications accessibility initiatives is a new opportunity to review the concept of integrated protection is provided. Research suggests that the information obtained from various plants and their components can be used to reach the new principles and protective designs used. In this respect it has been determined that a new security techniques based on transient scenarios not only have the ability to protect any plants but also can be used to deliver new integrated protection schemes of new technologies in power that used to be equipped with telecommunications.

With the advancement of digital technology, the increasing role of protective clothing for a different device (line, transformer generators) can be summed up in a protective device such as a relay or a numerical differential line spacing may be a role as the main protection and the role of large flow and direction have as backup protection. However, the phrase is an integrated protection for the integrity of the protective equipment used in a protective relay for mail is [24].

Classification of errors

Special significance of the errors of classification systems for protection is important. Identify the type of algorithm for fault location finder can be considered as a prerequisite and without notice of the type of error do not need to spend time and do more calculations to determine the location of the error. Including the benefits of classification errors can be used to carry items such as improving the characteristic impedance relay distance area, the ability to open and close and facilitate the trip is automatically noted. Due to the urgency of cases raised, many research on the type of error detection

algorithms is that the majority of them related to the transmission lines because the first transmission systems compared with distribution systems be transferred to more definitive on this system and each type is far more damage causes coming second to protect transmission lines, usually of the impedance relay used and the correct operation of the relays Correct information is dependent on the type of error, but in the distribution systems of high current relay mainly used for the proper functioning of these relays do not need to know the type of error.

Different methods of classification error

A variety of methods in order to classify the errors there are in General include:

1. on the basis of samples taken from the voltage and current: these methods are sensitive to transient modes, these transient modes may include severe changes in the system is weak. These methods are also in high impedance error detection to face the problem.

2. According to the sine wave shape includes:

A) Become Clark

B) Stream Notral

In this way the flow of error before, such as the flow of time and the dc component flows, will be ignore. As well as in its two phase error detection and face a problem to the ground.

3. Colman filters:

In this way, by comparing the statistical behavior of current and voltage, or in terms of before and after the error classification action does. This method is dependent on the parameters of the line and is in need of large calculations in each phase.

4. Wavelet transform

5. on the basis of the waves of mobile phones: This method is based on the extraction of the mobile Jammer works after the error. The disadvantages of this method include:

1- The need for high sampling

2- Sensitive to noise

3- Having trouble passing some synergy, such as the distinction between the lightning modes, disconnect and plug the line, etc.

4- Having trouble detecting high impedance error.

6. Using neural networks:

The disadvantages of this method include:

1- High number of samples required under various conditions and non-error conditions such as network errors

2- Specific method to determine the structure of the network.

3- Possibility to converge to a local minimum.

The benefits of this approach include:

1. High information processing capabilities

2. Fix problems such as the complexity of the system and the lack of sufficient information from the system parameters

3. Fast response error in classification

7. The use of fuzzy logic

8. Based on pattern recognition

In the case of fault classification using Wavelet transform in various ways of transmission, provided that some of them are as follows: in the reference [3] of the wavelet transform with Haar mother Wavelet is used. In the reference [4] the seventh level of details coefficients of wavelet transform and neural network in the reference is used [5] second-level details of the courier values, and the third and fourth Wavelet transformation of wavelet network use. in the reference [6] various methods of classification error in Transmission lines have been compared with each other.

Classification of errors in distribution network

With the expansion of cities and their industrialization, the amount of the transitional power distribution networks are far more and the same applies to the need to classify algorithms error on these networks in order to expedite and facilitate the necessary recovery time and locate the error

is made. In the case of an error in the classification of different methods of distribution network has been proposed. In the reference [7] decision tree-based approach employed in this way a variety of errors that only the four categories (LG, LLG, LL, LLL) and in the case of defective phase which does not give the reference information in [8] the cause-and-effect of the combined network and fuzzy logic used in this method requires having a lot of information (including bass lines and voltage and current) to identify the type of error and also as a reference Before the error types are divided into four categories, the only. In the reference [9] using Wavelet transform and neural networks with their map is the organizer (SOM) has classified the types of errors, in which current and voltages measured at 10 in the reference [10] cycle uses of the method based on fuzzy logic used in which of the symmetrical component angles information flow measured at the post, will take interest in reference [11] converted from S in order to classify the quality of disorders can take advantage Has been taken.

Conclusion

As was mentioned to guarantee performance of a given range in distribution network, in order to maintain the safety and strength of the individual sections, network equipment and protective systems, a power the entire network had been appropriate coordination is essential. To minimize downtime, the automatic function is also damaged parts of the separation with maximum speed, is required. The proper balance to achieve between business needs and the financial resources available should be the economic costs and benefits arising from the protection of the system. In addition to easing the cost of distributed energy must also have the abundant attention

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