

Investigating The Effect of Switching and tripping on Flashover and Breakdown in Circuit Breaker

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Abstract

The need for electrical power is increasing rapidly. The power is transmitted over long distance that made it establish to use high voltage .this need to created circuit breaker. Are an essential part of power system and it plays a major role in study and control. Circuit breaker use SF6 gas circuit breaker as insulation medium. The paper interested in study the SF6 gas circuit breaker; characteristics and advantages and how to deal with it, The paper interested in investigating the effect of switching, tripping on flashover and breakdown on SF6 gas circuit breaker. It shows the main factors which that effected in the SF6 gas circuit breaker performance and which caused faults flashover and tripping. The factors that caused faults may be from the circuit breaker itself or may be related with any part from circuit breaker such as transmission line location.

Keywords: SF6 gas circuit breaker, circuit breaker, transmission line, location and moisture.

Introduction

The circuit breaker is electrical switching devices used to manage and protect the power system. Circuit breakers are available in different types each type have special features that make it used in substation [1].

In the current era, the electrical energy has become important part for life. Modern energy system consists of large power network, which includes large complex electrical components power systems. When any fault occurred caused many problem in these components and caused large losses so it is necessary to maintain the integrity of electrical circuits in the system.

Under normal operating conditions when problems (overvoltage, overcurrent) occur the circuit breaker open and stop the flow of current to prevent any fault current to protect the equipment [2].

Literature review

After the discovery the electricity, which widely spread in all fields of Life, many of studies and research have focused on the circuit breakers and discussed several topics related it. Circuit breakers that is formed the main control for electricity so it is important point that is interested by experts and power engineers.

Improvement the life style and increasing the demand to electricity lead to need use high voltage circuit breaker to cover all demands in electricity [10]. The circuit breakers with high voltage are formed the most common type in the current era, it used for large numbers from application in many fields and it available in many types such as SF6, CO2, bulk oil, air blast , vacuum and minimum oil. Each type have many of the characteristics and features which giving it ability to work in specific applications [11].

Many researches interested in studying the high voltage circuit breaker such as SF6 and vacuum. Each type have many of features and characteristics, whether positive or negative the structure for it and physical and chemical properties effect in these performances related to SF6 circuit breaker.

SF6 gas circuit breaker, is high voltage circuit breaker have many of excellent features and characteristics that make it used in large application in the current life, it is strongly characterized by high isolation makes it safer when using in the application. The high insulation related to heavy gas which including in the structures in SF6 components. It have other advantages such a good conductor of heat and having excellent temperature stability.

Although the SF6 circuit breakers have many features in need to use it in correct way to save it and to protect the

environment work from gas risks. The gas is very heavy so when it spared in the environment , it will cased many problems and damage, so it need to use it in careful way to avoid the adversity [12].

This paper is completed for the studies in SF6 gas circuit breaker that related to study and back for many references from books, papers, internet which lead to arrive the main idea for this research. The paper interested in study the SF6 circuit breaker high voltage and investigating the effect of switching and tripping on flashover and breakdown in it.

Research importance

Because of the large expansion in the use and high demand of electricity. The problems have appeared and the electricity companies have complained from power failures. This establish the need to take care to prevent the circuit from damages by breakers.

The power failures is dangers for station staff life and for equipment and neighboring tools. That make the studying circuit breakers and analysis is important step. Showing the effect of switching and tripping on flashover and breakdown helping in learning how provide reliability method in the power system.

In this paper, the study and analysis have shown the effect of switching and tripping on flashover and breakdown in SF6 circuit breaker. The study interested in evaluate and investigate different cases related to circuit breaker .

Research aims

The research interested in achieving many aims after completed the circuit breaker study. It aim to study and analysis the effect of switching and tripping on flashover and breakdown in SF6 circuit breaker, investigating and analysis the change in the electrical difference that occur in many cases in circuit breakers and recognize these cases to know the dangers arising from these changes, recognize the dangers and problems that can get when using SF6 circuit breaker and show how to avoid each problems, identify the protection and public safety methods when using SF6 circuit breaker and evaluate and investigate different cases related to breaker-flashover safeguard systems and methods.

The important stages for the study analysis

The section contain more details for information that need to apply the practical part from the study. The main Factors that affected in the performance for the SF6 gas circuit breaker:

Transmission Line Fault

The power system network contains set of components that operating as a one unit, so when the fault occurred in one part the all the network will be effected by the problems , so the circuit breaker disconnect the current to protect the power system network. Transmission line is important part in the power system network, it support the path for transferring the electrical power in the load and generation. The range for voltage level which allow transferring the power in transmission line, it ranging between 69kV and 765kV.

The location on transmission line is important part in the system power analysis. So when selecting the volte location for transmission line many of studies is applied the idea before any practical steps. The study show case related to location for transmission line which reflect to how the trip on occurred on sf6 gas circuit breaker as a result of fault in transmission line. In this case the location for it was main reason for this fault when the trunk toward outside the path toward the transmission line at circuit zone

Dew point rate

The wetness effected in the gas components which reducing the dielectric level for the circuit breaker sf6 gas. SF6 gas is stable and it have high isolation level but the when increasing the wetness in SF6 gas and exceed the safely limit, SF6 gas became unstable and less insulation that is effected in pressure and temperature gas, the water drops On the surface of the container which containing gas lead to decrease the break down voltage value. Despite the excellent qualities in SF6 gas circuit breaker and its resistance to environmental conditions, the weather conditions from moisture and temperature are effected in the SF6 circuit breaker. The moisture is the most weather conditions influence the breaker because it changed in chemical characteristics of sf6 gas in the

circuit breaker. The study show case related to moisture caused short circuit and trip on sf6 gas circuit breaker.

Result

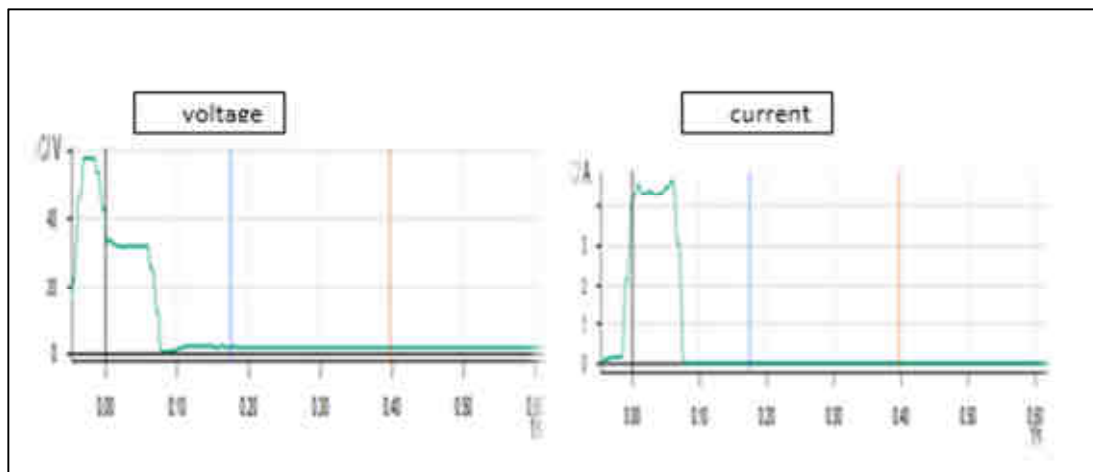
case1

This part from the paper have been shown failure case occurred in One of the power stations and caused to trip on in the circuit breaker to protect the power system network from the Danger, it show how the location effect in performance for SF6 gas circuit breaker and sometimes caused to problems in the power system network.

An actual fault occurred on 380KV on specific substation because a truck entered the circuit zone. Auto Recloser succeeded to reclose the breaker from the substation side only but it tripped again. There was no interruption.

The faults in phase 3 is clear; when the fault occurred the current value was increased and the voltage value was decreased to arrive to zero when the circuit breaker trip on. When compare current and voltage value in phase 3 with phase 1 and 2 can see problem in phase 3; the table below show compare between 3 phases in current value.

Figure 1. SF6 gas circuit breaker 380kv



The fault occurred because a truck entered the circuit zone, which made short circuit between Ph3 and ground. A truck entered the circuit zone of the station causing a short circuit between Ph3 and ground. The breakers of the station tripped accordingly and cleared the fault. This problem lead to trip on circuit breaker, the figures bellow show the current and voltage in three phase explain the SF6 gas 380KV circuit breaker when the problem occurred in the power station.

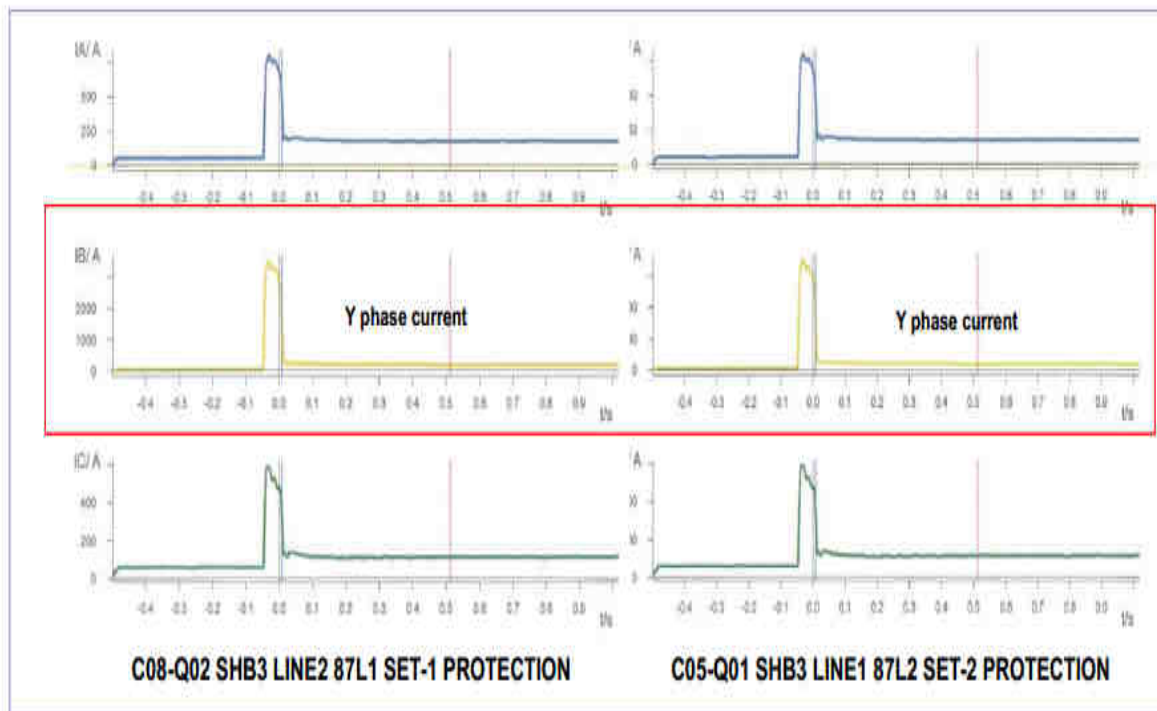
Table1: Current range value for ph1, ph2 and ph3

Phase 1	Phase 2	Phase 3
0.00	0.00	1
0.05	0.10	2
0.10	0.15	3

case2

The reasons that caused faults in the circuit breaker behaviour are Multiple and different, so that the Failures cases that happened in the power circuit network are numerous and varied cases include transmission line, circuit breaker, and power station and so on. The following case refers to trip on flashover occurred in SF6 gas 380KV circuit breaker which result from increase in fault ppmv value is exceeding the allowable limit that caused problem in moisture percentage in circuit breaker .

Figure 2. case2 analysis



The value of current in phase2 increased in unusual case , the value 0, 1000 and 2000 that unusual when compare it with other phase. The last figures show problem in phase 2 because it give the highest current value , the table show the secondary current values for ph1, ph2 and ph3 which show the problem in phase 2.

Table2: Current range value for ph1, ph2 and ph3

Phase 1	Phase 2	Phase 3
0	0	0
250	1000	200
500	2000	400

Conclusion

After the study in sf6 gas circuit breaker, there are the main conclusion for the study such as : Sf6 gas circuit breaker is effective circuit breaker used in a large area in the power system network, which provide power with high voltage level, Sf6 gas circuit breaker has excellent physical and chemical characteristics that makes it capable of working in high efficiently, Sf6 gas is high isolation gas because it heavy and inert gas, chemical properties of the gas make it have effective isolation ability, the main object for circuit breaker is protect the power system network and cut of the electrical power when any fault occurred in the network, in the normal stage for the circuit breaker , it trip on when faults occurred the power system network to protect the electrical system from the damage but in other up normal stage , the circuit breaker not trip on when the error occurred that caused to damage and fire in the electrical system, transmission line is effective part in the power system network need to follow and monitor it to avoid the faults and problems in the electrical system, the wetness is effected in the performance for the circuit breaker and it caused reducing in isolation ability because it change the chemical composition of the gas inside the circuit breaker and Provide the maintenance for the circuit breaker and other power system network is more important thing to save the electrical system and avoid the faults and problems before occurred.

After this result there are some important recommendations which must take it such as: Raise awareness of public safety ways to avoid the faults in the electrical system and provide safely environments, the need to deal with faults and problems in early time to avoid destruction and fires, take the protection ways and method to save the power system network from damages, follow and monitor the circuit breaker and the power system in consciously, maintenance the circuit breaker and test the gas insulation in periodically and expansion in sf6 gas circuit breaker references and researches, also dissemination in general to allow the students and people to understand it in easy way.

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Table 3. SF6 gas circuit breaker 380kv

main features for SF6 gas circuit breaker		
Related voltage		420KV
Rated Impulse withstand voltage		1425KV
Rated Power frequency withstand voltage		630KV
Rated switching impulse withstand volt.		1050 KV
Rated frequency		60HZ
Rated normal current (Feeder)		3150A
Rated normal current (Bus)		3150A
Rated short-time withstand current		40 KA
Rated duration of short current		1 s
Circuit breaker	Rated short-circuit breaking current	40 KA
	First-pole-to-clear factor	1.3
	Rated operating duty	O-t-CO-t'-CO
	Rated out-of-phase breaking current	10 KA
	Rated transient recovery voltage for terminal faults	620 KV
SF6 abs. pressure at+20 C	Circuit-breaker	6.5 bar
	Isolator ,Bus	3.8 bar
Wight of SF6 filling		1170Kg
Wight with SF6 filling		42.0 t
Ambiet air temperature		-5.....+40 °C
Standard :IEC-publ,58,19,517;VDE 0670		

Figure 3: fault current flow diagram-case2

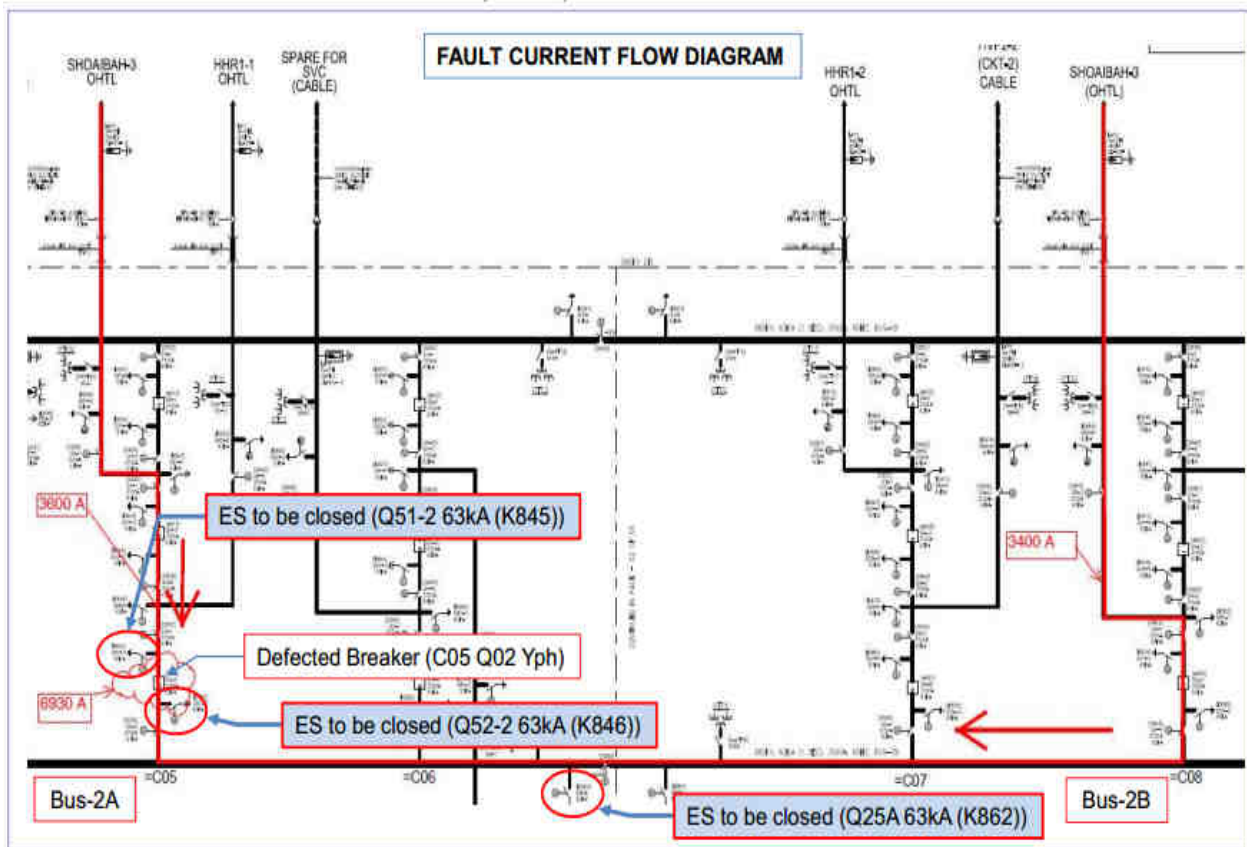


Figure 1: Power Station (problem voltage Transmission Line):

