Review of Study the Solid State Devices use for Improve the Power Quality in Power System

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***Abstract*—In power system, Maintain the power quality is the most important factor. As we know that voltage drop/sag during short-circuit faults in system are one of the major power quality problems so for that voltage drop/sag mitigation at point of common coupling is proposed using solid state fault current limiter. The proposed Solid state fault current limiter is tested on express distribution feeder. In present scenario increased demand of electricity has raised short circuit level of power system. Proposed Solid state fault current limiter also limit fault current significantly and thus reduced short circuit level and electromagnetic stress in associated equipment's. So in this paper our main aim is to find out optimized way to increase the power quality and maintain it.**

Keywords— Express Feeder fault;Solid state fault current limiter;Power quality; reliability.

I. INTRODUCTION

Electricity is one of the important and indespensible resources. However, in under development countries like India people are facing problems related to power quality and reliability of power supply and load shading due to low maintenance in distribution substations in small cities and vilages. In this Power Quality is considered an important aspect for reliable supply to consumers at rated magnitudes within limited variation limits. Poor power quality may led malfunction or failure of control, monitoring and protective equipment's. Most of power quality issues are harmonic,Voltage imbalance, transient overvoltage, swell, voltage sag and interruption etc., that may can cause huge financial losses. voltage drop/sag is becoming significant problem to distribution companies. IEEE standard define voltage sag as a decrease inrms voltage from 90% to 10% of nominal value for a timegreater than 0.5cycles of the power frequency but less than or equal to one minute [5]. Above sensitive loads are mainly process plants, electronic equipments and automatic control systems. It is observed by distribution companies that voltage sags are caused by the malfunctioning or failure of above sensitive loads for radial feeders [1]-[3], which leads to financial losses. During fault voltage sag is proportional to the short circuit current value. Most exposed radial feeders are required to mitigate expect voltage sag at point of common coupling by limiting fault current.This paper investigates, the voltage sag mitigation at point of common coupling using [6].The proposed SSFCL is implemented is on a practical express distribution feeder,at various symmetrical /unsymmetrical faults [7].The voltage sag is expressed in RMS value. The performance of SSFCL after implementing it to practical express distribution feeder, In this paper, the impact of SSFCL on prospective current, peak fault current after offset and voltage mitigation are investigate for test system and results are analyzed.

II. COVENTIONAL POWER IMPROVEMENT SCHEMES

1. GROUNDING AND BONDING INTEGRITY

The grounding and bonding is not correctly configured and thus poor system performance becomes the result. Grounding is one of the important part in electrical system. It is necessary to separate out the functions of grounded conductor from the grounding system of equipment. Also the grounding helps to protect the electrical system from super-imposed voltages caused due to lightning and prevents static charge. The safety ground should be a low impedance path from the equipment to the grounding electrode. This lets fault currents high enough to clear the circuit interrupters in the system preventing faulty conditions. Grounding conductor limits voltage potential inside the equipment with respect to grounded parts. Neutral and ground parts should be bonded together. Proper grounding and bonding minimizes costly disturbances. A sufficient degree of reliability can be increased.

2. PROPER WIRING

An overall device inspection is mandatory to make sure of proper wiring within a facility. The entire electrical system should be checked so as to find whether if any wire is loose, missing or improper connections at panels, receptacles and equipment. As per the article 300 National Electrical Code cover wiring methods should be followed to ensure safe and reliable operation. There are different types of easily available circuit testers that can be used to check for improper conditions such as reversed polarity, open neutral or floating grounds.

3. POWER DISTURBANCES

Voltage fluctuations and noise are common type of power disturbances present in an electrical system. These disturbances are present in number of forms including sags, swells, transients, over voltages, harmonics, under voltages, frequency variations, high frequency noise, etc. Due to these, it draws current which is non-linear to the voltage waveform. This non-linear current can cause high neutral current, overheated neutral conductors, overheated transformers, breaker tripping, etc. Loads such as solid-state controls for adjustable speed motors, computers and switched mode power supplies are sources of non-linear currents. Thus the equipment should be able to withstand voltage disturbances in the "no interruption" region. When the voltage disturbance is in the "no-damage" region, the equipment may not operate properly, but should recover when voltage returns to its normal position. If voltages reach to "prohibited region," connected equipment may be permanently damaged. Expensive equipment should be protected from voltage disturbances in the prohibited region.

4. POWER CONDITIONING EQUIPMENT

Some types of power enhancement devices are manufactured to protect equipment from power disturbances. These devices plays an important role to develop an effective power quality. Transient Voltage Surge Suppressors mostly provide the simplest and less expensive way to improve the power quality. These transient spikes to a level that is safe for the electronic load. Voltage regulators maintain output voltage at nominal voltage under all but the most severe input voltage variations.

5. MOTOR-GENERATORS SET

It consists of an electric motor driving that is a generator with coupling through a mechanical shaft. This solution provides complete decoupling from incoming disturbances such as voltage transients, surges and sags. Motor-Generators can cause short periods of power loss, but will not protect against sustained outages without the addition of an additional motor powered by an alternate fuel source. So, reliable electronic system performance in the industrial environment requires an initial inspection of the wiring and grounding system.. Once the integrity of the wiring is established, power conditioning products can be effectively applied to protect critical equipment and processes. This effective power quality will result in the best return on power quality investment.

III. PROPOSED SOLID STATE FAULT CURRENT LIMITER

A Fault Current Limiter (FCL) is used to limit the prospective fault current and connected in series with a circuit. FCL provides very low impedance during normal operating condition and high impedance under fault conditions [6] [8].In this paper solid state fault current limiter (SSFCL) is proposed. Proposed SSFCL have three branches connected in parallel namely surge arrester, thyristor branch 1 and thyristor branch 2.Each thyristor branch consists of two thyristor connected in inversely parallel and thyristor branch 2 have current limiting impedance (reactor) connected in series with it [6] [9].Thyristor branch 1 is normally closed and conducts current during normal operation. Nevertheless, when the magnitude of the current exceeds a pre-set level, the thyristor branch 1 will open the circuit instantly interrupts the current flow and thyristor branch 2 facilitate path to above fault current [6].A surge arrester (designed for high energy absorption) is also placed in parallel with these two branches [8] to protect the system from voltage surge during this transition.

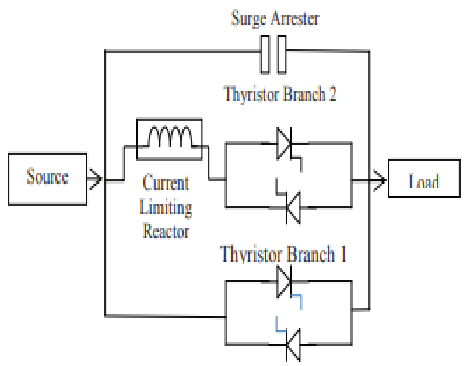

Fig. 1. Basic Arrangement Of Solid-State FCL[6]

Proposed SSFCL have two blocks such as solid state fault current limiter and control system block. Fault current limiter block have thyristor branch, current limiting reactor and surge arrester. To generate firing signals to turn on the thyristors control block is used.

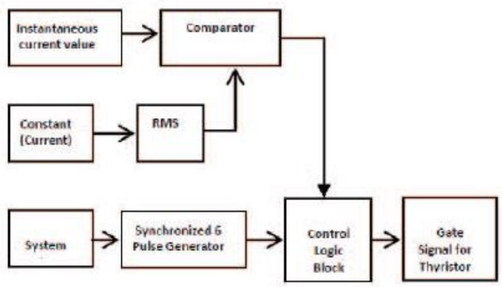

Fig. 2. Control block diagram of SSFCL[10]

The operation of SSFCL is initiated by fault current and need to be detected promptly before it becomes harmful to other equipment's. The SSFCL control strategies block is shown in figure (4). In the operation of SSFCL, system current is detected and regularly compared root mean square value of current with instantaneous current value, if the value of system current exceeds normal system current value the output from the comparator generate switching signals for the thyristor branch having series impedance with it to limit the fault current and mitigating the voltage sag [6] [9].

IV. TEST SYSTEM

To verify the performance of proposed SSFCL, an express feeder is considered. and test system parameters are mentioned below. Total time, solver, relative tolerance error and absolute tolerance error are taken 0.2 second, ode23t, 10-4 and 0.1 Respectively.

1. TEST SYSTEM PARAMETERS

a. Source 10MVA, 33KV, X/R=10,50 HZ
b.Transformer T1 5MVA, 33/11KV, %Z=7.15,X/R=10, Dyn11
c.Transformer T2 750KVA, 11/.433KV, %Z=5,X/R=6, Dyn11
d.Load 190KW, 130KVAR

V. RESULTS AND DISCUSSIONS

The test system is taken under LG fault (with and without using SSFCL) that are phase A to ground (LG) . The above fault are applied on the secondary side of the transformer (11/.433 KV). The fault timings are taken from t = 0.045 to t = 0.125 seconds. The impact of proposed SSFCL at feeder on prospective, fault current after offset and voltage mitigation.

TABLE 1. PROSPECTIVE CURRENT THROUGH BUS2 UNDER DIFFERENT FAULT.[10]

Fault	Phase	Without SSFCL	With SSFCL	%Reduction
LG	A	233.5	37	84%
	B	16	14	13%
	C	244.5	44	82%

TABLE 2. PEAK FAULT CURRENT AFTER OFFSET THROUGH BUS2 UNDER DIFFERENT FAULTS AT BUS4[10]

Fault	Phase	Without SSFCL	With SSFCL	%Reduction
LG	A	163	14	91%
	B	16	14	13%
	C	127	25	80%

TABLE 3. VOLTAGE AT BUS 2 UNDER DIFFERENT FAULTS AT BUS4 WITH AND WITHOUT SSFCL[10]

Fault	Phase	Without SSFCL	With SSFCL	%Reduction
LG	A	10.2	10.8	6%
	B	10.2	10.7	6%
	C	7.8	10.6	36%

As mentioned in the above Table I that in three phase fault condition, all three phases experiences high current flowing through the lines and phase C had highest reduction, phase C got the second best and phase A next. It is also clear that proposed SSFCL have very good reduction for LG fault. Thus the reduction in first peak of fault current reduces the cost of switchgear protection system and solid-state based FCL have better coordination with switchgear protection system. As shown in the Table II fault current after offset element have also high magnitude of current but implementation of SSFCL on feeder has also reduced it to safe level. Thus proposed SSFCL is also reliable and has abilities to confine the sub transient and transient part of fault

VI. CONCLUSION

Proposed SSFCL used for voltage sag mitigation analysis on the express feeder. During fault condition, proportional relationship between voltage sag and fault current makes SSFCL an effective approach for limiting fault current and improved voltage quality of point of common coupling (PCC), it may mitigate the voltage sag, SSFCL offer advantages to the electricity supply industry, technically and economically. SSFCL detects the fault current and activates the control circuit that sends firing signal to thyristor switches to divert the fault current through limiting reactor. Results of Table 1, 2 and 3 shows that proposed SSFCL effectively limits the current during fault incident and in this way it helps to mitigate the voltage sag from other bus during the fault. And hence it helps to improve the power quality of system.

VII. ACKNOWLEDGMENT

The authors would like to thanks to Prof. S. M. Waingankar HOD Electrical Department SSPM's COE Kankavli for technical support.

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