Superconducting Fault Current Limiters for the Power System Application

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ABSTRACT
As load demand increases day by day, new generating facilities are introduced. Power System face many problems related to safety, reliability due to the occurrence of short circuit fault current. To prevent power grid from fault currents Superconducting Fault current limiter is introduced. This paper provides the way to design SFCL in power grid which is based on the principle of superconductivity which totally loses its resistance to fault current below specific critical temperature. In this paper resistive type SFCL is studied for matlab simulation.

Keywords—Fault Current, SFCL, Superconductivity, Short circuit current.

I. INTRODUCTION
As the supply capacity unceasingly increases, in recent years, structure of grid and reliability of system gradually enhances. Due to this enhancement system face many problems and faulty short circuit currents are rapidly increases [5]. Because of these safety issues power grid is threatened seriously.

The traditional methods to limit short circuit current are much expensive, some measures are two separate buses, disconnect the switch, electromagnetic ring off [6]. These measures can minimize fault current up to some extent but this will degrade the system reliability. Fault current is pressing issue in today’s date.

To limit this short circuit current and decreasing the impact of fault current superconducting fault current limiter is installed. However, much research work is carried out on superconducting material and superconducting technology.

II. GENERAL PRINCIPLE OF SFCL
The device made up of superconducting material which totally loses resistance to excessive amount of current below certain specific temperature. Normally superconductor does not activate up to certain current density but if current rises certain critical value, within few milliseconds superconductor immediately reduces fault current and short circuiting of equipment is prevented [3]. The current limiter will operate very sharply to certain operating states.

Superconducting fault current limiters are basically classified according to their work principle: Composite type, quench type and non- quench type [8]. Further these types are classified as,

- Quench Type
- Non-Quench Type
- Composite Type

Inductive
Active
Combination of Both
Resistive
Bridge

Magnetic shielded type
Saturated Iron Core

Hybrid type

Fig. 1 classification of SFCL

Basically SFCL works, when it is operated below critical parameters with zero resistance are, Tc (Temperature)
Ic (Current)
Hc (Magnetic Field)

Any of the above parameter will increase, then there is transition of superconductor from zero resistance
to finite value. Hence it is used to limit fault current. In this paper we are using resistive type SFCL [2].

Some features of resistive SFCL are, limit current in first fault current cycle, having low maintenance, self activating, having low impedance when it is in normal condition, environment friendly etc [4].

Fig. 2 Resistive type SFCL

III. PROPOSED METHOD

Resistive SFCL model

Here consider the power system is of 100MVA connected with three phase synchronous machine. It is connected to 200Km long transmission line with 154kV through transformer. This voltage is stepped down near substation from 154 kV up to 22.9 kV. 10 MVA wind farm is connected, induction type wind turbine with rating of 2 MVA. This model is developed in simulink. There are certain parameters to be considered while developing single phase SFCL model are,
a) minimum impedance – 0.01 Ohms, maximum impedance – 20 Ohms,
b) Triggering current – 550 Ampere,
c) Response time – 2 msec.
d) working voltage – 22.9 kV,
e) recovery time – 12 msec.

The matlab model is developed in further work according to values mentioned above.

At first it will calculate RMS value of current; both values of current are compared in lookup table. If RMS current is more than triggering current, then resistance will increase within response time. As soon as current will falls down the triggering value, system waits up to recovery time and then there is transition to normal state.[7]

IV. CONCLUSION

By installing SFCL at locations of power grid to limit the fault current, it will not affect DG sources. Also resistive type SFCL is more advantageous for the purpose which is based on superconducting principle. This paper concludes uses of SFCL to minimize fault current in smart grid. To find optimum location of SFCL in smart grid is carried out further, as multiple installation of SFCL is not economical and efficient.

REFERENCES


