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# PERFORMANCE EVALUATION OF SFCL-A REVIEW

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**Abstract:** This paper is showing review of Superconducting fault current limiter which have ability to reduce fault current effectively. With the increasing population the consumption of electrical power is also increased widely so thus the probability of occurrence of fault in system also increases because of which a very high current flows through the system which is responsible for the generation of large mechanical forces which may affect the mechanical integration of the power system hardware, transformer and other related equipment which may get overheated due to this large current. To eliminate this overheating due to large current this Superconducting fault current limiter is introduced which increases the reliability of power system. The SFCL which is used here have capability of reducing the fault current within the first cycle which increases the transient stability of the power system.

**Keywords:** Fault Current Limitation, Superconducting, Fault Current Limiter (SFCL).

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## INTRODUCTION

With the growing electricity demand, there are several new generation, transmission and distribution system technology and connected system that are launched to cope up with the increasing demand but with the advent of technology there are certain drawbacks that are shown by the new technology devices increasing fault current is one out of that short coming. There are several facts devices like SSC, SSSC, and UPFC etc that came into existence for the smooth and uninterrupted functioning of the power system. Under normal operation a fault current limiter inserts negligible impedance into the networkWhen a fault occurs the limiter‘s impedance rises rapidly, reducing the current flowing through it.The demand for usage of renewable energy and meshing of power grid is also increased widely which put new challenges like changing load flows in the system, more distributed generation and higher loads which is responsible for the generation of increasing fault current in the system. The SFCL protects the grid operating system during circuit feedbacks and fault events from damaging peak currents. It also averts damage to power system by ahead of schedule upgrading, facilitate grid expansion and enables cost efficient grid stabilization and optimization.

A. Types of FCL

There are different types of FCL. Few of them are mentioned below

1. Resistive: Superconductor quenches under excessive fault current reverting to a normal conductor, inserting resistance.
2. Shielded core: Induced current in the Superconducting tube shields the iron core until excessive current causes quench.
3. Pre-saturated Core: Iron core driven into saturation by superconducting DC winding. Fault current opposes the saturation and increased impedance switched into the circuit.

SFCL

SFCL is formed by connecting four superconducting coils in a series-parallel configuration so the total inductance is minimized. One set of coils is used for each phase of the device, and limiting is accomplished by quenching the coils.

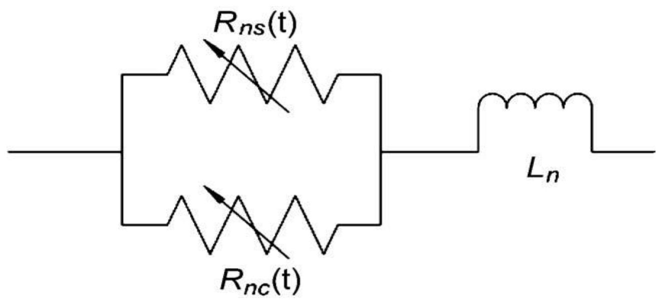


**Figure 1 Resistive Type SFCL 1**

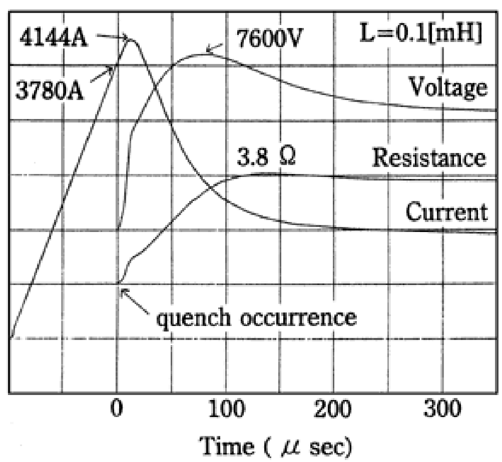


**Figure 2: Current limiting characteristic**

A conventional shunt resistor should be connected in parallel to the superconducting resistor in order to offer an alternative path to the current during the fault and to reduce the joule heating and consequently the recovery time [4].

Fault current flowing through parallel circuit with less impedance and as soon as fault current increases the impedance increases to greater extent [5].SFCL can provide the effective damping for low-frequency oscillations such as power system stabilizer (PSS) or a dynamic reactive compensator [6].The total resistance of parallel connections become zero because the value of $Rnc_{(t)}$ becomes zero in steady-state condition and in faulty condition it increases to infinity.

Advantages of SFCL:

- SFCL is ultrafast and is reacting in 1-2 milliseconds.
- It is automatic that means it does not require external trigger and is self-recovering.

- It is wear free and requires service for cooling only.
- It provide the main advantage to avoid changing the ratings of multiple protective devices

Applications

- The FCL protects the entire bus.
- The FCL protects an individual circuit on the bus.
- The two buses are tied, yet a faulted bus receives the full fault current of only one transformer.
- Power cables

SUBPART OF CIRCUIT USED IN PROJECT

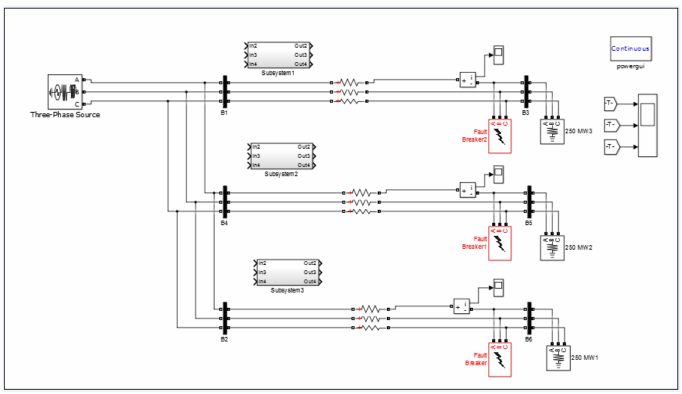

**Figure 3: SFCL**

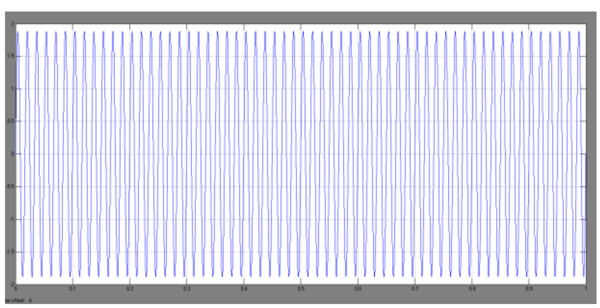

**Figure 4: OUTPUT of SFCL**

After looking it just imagine SFCL characteristics, it shows zero or negligible resistance during normal operating conditions .SFCL shows very high resistance when there is fault current (very high current). According to the structure and quantity of material used to make SFCL this value of current varies for ex. , let consider that for SFCL 100A be the breakdown current i.e. it increase resistance state from low to high when current exceeds 100A. (This condition is taken into consideration that the value of line current is less than 100A.) Now here three input switch is used, that switched from terminal one to terminal three depend upon the value of input terminal two. If the value of input terminal two is negative your switch takes input value from (terminal-3) i.e. indirectly resistance of SFCL. If value of terminal two is positive i.e. SFCL exceeds breakdown current value. Now SFCL switches to high resistance (resister + inductor) value. Here step signal acts as a resister and transportation delay acts as an inductor. Combination of it gives time constant (L/R).This time constant (transportation delay block) responsible to delay in current value in output side with respect to input side. Consider the fault occurs for 1-2 seconds, then we can adjust current value using this transportation delay block i.e. indirectly SFCL offering high resistance during this time, whatever output value of switch it will further multiply with value of branch current. Hence we can limit the value of current during fault time.

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