Surge current protection using superconductor.
Fault Current

- The short ckt current can exceed by a factor of 100 of the nominal current.
- Produce mechanical and thermal stress proportional to square of the current.
- Fault current limiter is used to limit this current, it must possess:
  - Zero impedance (at normal operation)
  - High Impedance (at faults)
  - Provide detection and recovery of the fault instaneously (16ms)
Superconductor fault current limiter

- Superconductor used because of their sharp transition from zero resistance at normal currents to finite resistance at higher current densities (above critical temp).
- Type of Superconductor: Low Temperature ($c \leq 23k$), High Temp ($c \leq 70$) $C=\text{critical temp}$
Types of Superconductor

- Low Temp: Low AC losses. Very high current carrying capacity, hotspots formation..
- High Temp: Poor heat conductor, no hot spots. Examples: BSCCO, YBCO compounds.
- SFCL types includes Resistive SFCL, Inductive SFCL.
Resistive SFCL

- Superconductor connected in series with the line to be protected.
- To keep it superconducting, it is usually immersed in a coolant that is chilled by a refrigerator.
- In case of a fault the inrush of current and magnetic field take the superconductor into the transition region, thereby the increasing resistance limits the fault current.
- The behavior of resistive fault current limiter is largely determined by the length of the superconductor and the type of material used for it.
Superconductors are strongly dependent on direction of an applied external magnetic field. The resistance of a superconductor can change by several orders of magnitude by applying a magnetic field.
Shielded Core SFCL

- The shielded core fault current limiter basically a shorted transformer
- The device’s primary coil is normal conducting and connected in series to the line to be protected, while the secondary side is superconducting and shorted