



## Fault current limiter using a series impedance combined with bus sectionalizing circuit breaker

Hamid Javadi \*

Electrical Engineering Department, Power and Water University of Technology, P.O. Box 16765-1679, Tehran, Iran

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### ABSTRACT

The necessity and procedure for application of series fault current limiter (FCL) composed to bus sectionalizing in power network of IRAN have been discussed. In this regard, all of the high voltage substations in the power network of IRAN were evaluated in point of view of the fault current amplitude. The short circuit analysis of the power network was done based on the actual and future network specifications which have been designed and published by Iran Generation Transmission & Distribution Company in 2005. The overall results of this analysis and the detail data of using FCL together bus sectionalizing for two of the most important high voltage substations of Iran are presented. This method allows decreasing of 27% in fault current amplitude. The economical observation shows this method can be profitable if high voltage substation contains more than four feeders.

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### 1. Introduction

At the beginning, generating units were separated from each other. But by increasing the electrical demand and in order to increase the system stability and reliability, they gradually became interconnected and more generating units, substations, parallel transmission lines, series and parallel capacitors were installed. One of the problems related to the growth of the transmission and distribution of electrical energy system is the fast increase in the short circuit level that may cause the following effects:

1. Overheating the series devices in the fault route.
2. Increase transient and recovery voltages produced by cutting off the increased current which can damage insulations of power system.
3. Producing very high mechanical forces in the transformers, generators, and reactors.
4. Power system stability can be lost depending on the fault current amplitude as well as its clearing time.
5. Because of the growth in the fault current amplitude it is possible that the circuit breakers installed in the past cannot interrupt the fault current and it is needed to replace that an extra investment in time and money will be needed. To avoid these extra costs we may have restriction in paralleling the power transformers to reduce system interconnectivity and this also reduce transmission capacity and system reliability.

6. Decreasing in reliability of electrical network.

There are generally three solutions to remove those effects:

1. To design power network in a way that probability of occurring a fault be low enough.
2. Using applicable strategies in order to minimize the network damage when a fault occurs.
3. Using fault current limiter depending short circuit current level of each desired bus of power system.

Nowadays a combination of above solutions can be used to design optimum and reliable network. But since the consumption of electrical energy is increasing (especially in advancing countries) and every day our life are becoming more dependent to this kind of energy, the electrical networks develop and it is impossible to remove completely short circuit faults. Also design power apparatuses based on increasing short circuit currents is not commercially reasonable. In this regard from the beginning of the 1970, fault current reduction became an important researching aspect in the world. A commonly used technique for reduction fault current is based on insertion of high impedance in the power system just after fault occurrence. There are different techniques for preparing and inserting this high impedance in system. These techniques can be classified as follows:

- FCL with a fuses and fast mechanical switch (multi-short or multi-divided commutating elements) [1–3].
- FCL with super-conducting coils [4–6].

\* Tel.: +98 21 73932529; fax: +98 2173932501.

E-mail address: [javadi@pwut.ac.ir](mailto:javadi@pwut.ac.ir)