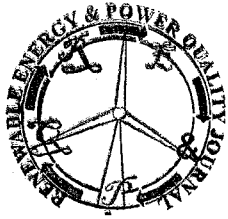


## Improving Profitability of the Network Distribution by protecting Power Transformers with a Current Limiting Technology Device



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**Abstract.** This paper presents the improvement of the profitability of the Network Distribution, when power transformers are protected only with Fault Current Limiting Technologies (FCLT). In assessing the total benefits of the Network Distributions from normal to post-fault conditions, we will compare two kinds of profitability taking in account the impact of Circuit Breakers (CBs) and FCL used separately as protection devices during the life span of power transformers. This study will be performed using MATLAB/SIMULINK as software and it was concluded that the FCL perfectly improves the profitability of the Network Distribution.

### Key words

MATLAB/SIMULINK, FCL, CBs, Total benefits, Profitability.

### 1. Introduction

In distribution network, one of the major targets is to protect the equipments, as well as the consumers. Under normal condition, the protection devices used in the circuit to protect the different equipments should not have a big disadvantage such as power loss, the voltage drop into the network distribution. The need of customer's power quality is very important with the aim to protect their expensive equipments. During the normal conditions in the power system, a fault current limiter as well as CBs should not appear totally in the circuit because of the voltage drop and unforeseen breaking action. Therefore, during the fault condition of the network distribution, there is power loss and when the protection device comes to secure the expensive equipments in the circuit, the level of current under post fault condition voltage obtained at the primary side should not be so high for limiting the power loss under this condition. [1], [2], [3], [4], [5].

In this paper, we have studied the comparison between two types of profitability for two network distributions of which one includes CBs as protection device of power transformers and another one includes FCL for accomplishing the same action. By evaluating the Total Benefits Costs during the normal and fault operation, also we have evaluated the lifecycle cost after the lifetime of power transformer with conventional copper. The results are presented using MATLAB/SIMULINK.

### 2. CBs and FCL in two different Networks Distribution as protection devices

We considered two types of Network Distributions containing each the source, the line, two power transformers to be protected and the load characterizing the utility. In Figures 1 and 2 below are presented these Networks just stated above with their components respectively. As said above, the first Network uses the CBs as protection device for breaking the three phase system under fault operation and the second uses the FCL for limiting the fault current under abnormal operation of the three phase system.

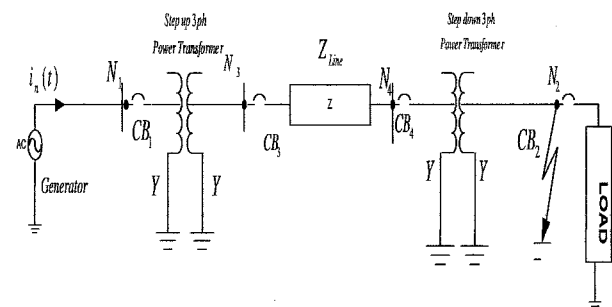


Figure 1: Network Distribution with CBs

The FCL used for limiting the short circuit current under fault condition is a Thyristor Controlled Series Reactor (TCSR) which is presented in Figure 3 below. The current under normal operation is expressed below by the equation 1:

$$i_{abc}(t) = I_{max} \times [\sin(\omega t + \theta_{abc} + \eta - \phi_{abc})] \quad (1),$$

In which

$\theta_{abc}$  is the source voltage angle for each phase

$\eta$  is the firing angle of the Thyristors

$\phi_{abc}$  is the total impedance angle under normal condition for each phase