Grounding System Modelling and Its Impact on Computational Refunding Analysis for Equipment Damages

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Abstract. This paper is aimed at presenting the computational results of the influence of the grounding systems representation in the refunding request analysis of equipment damages due to distribution system disturbances. The assessments include representation of grounding systems with linear and nonlinear parameters to produce a better representation of the overall electrical system at abnormal operating conditions. The model is included in a existing computational programme to deal with the subject of establishing a relationship between system occurrences, dielectric and thermal impacts on equipments and their withstand capabilities. This paper proposed grounding representation is based on a non-linear approach combining method already published in the literature. The methodology is then implemented in a computational tool facility to deal with the mentioned subject and the new software version is then used to evaluate practical situations. Comparisons between results derived from a typical distribution disturbance using simple ground modelling and the new proposition are carried out so as to highlight the importance of a more realistic modelling for the overall electrical complex.

Key words

Power quality, refunding request for damages, grounding systems, case studies.

1. Introduction

The changes occurred on the power system at the last years associated with the population knowledge about its consumer rights as well the rising use of devices more sensible to the power quality deviation [1] reveal that researches about "Refunding Request for Damages" (RRD) have been greatly increasing in the whole world.

Actuality, the occurrence of natural phenomenon and the operation of protection devices may affect several industrial, commercial and residential consumers' equipment [2]. This situation may jeopardize the physical appliance integrity and these concerns are especially true for new technology devices [3], [4], [5]. This situation has provoked an appreciable growth of compensation demands for electrical equipment supposedly damaged because of a non-ideal voltage supply from the utility. The question becomes more relevant when one considers the amount of financial resources involved in the matter.

Thus, it is important the development of mechanisms to establish a systematized procedure, based in science and technology, which yields to an impartial decision about the judgments. In this way there are different possibilities to analyse and provide a final report about a given occurrence. One of this consists in using a computational strategy to evaluate the relationship between typical distribution system disturbances and their propagation up to the end consumer.

Aiming at accomplishing this goal arises the matter of obtaining a software to simulate a given abnormal operating condition, its impact on consumer equipments so as to provide means to answer the request under analysis. To achieve such tool it becomes necessary to implement computational models that are appropriate to represent the power grids from any busbar until the end user and that is capable of reproducing disturbances and correctly model consumer equipments. This development has been fully described in [6]. This reference points out the final product called by APR software. The computational base utilized is the ATP (Alternative Transients Program) linked to other facilities developed throughout the MODELS routine. Although the advances offered by this product, it is still presented as a tool worthy of further improvements to match the power network and consumer needs.

When establishing the relationship between causes and effects, the ground systems modelling arise as a critical aspect. As a matter of fact, its representation has a great influence on the results. The literature and the experience have shown that some disturbances which would be considered to a wide range of RRD's applications may be associated with currents circulating throughout the grounding systems. Therefore, this can cause potential differences between distinct grounding systems, and also, between neutral point and remote earths. This is the situation that occurs, for example, during the incidence of lightning strikes and asymmetric faults.

Thus, a correct representation of the grounding systems cannot be ignored or treated as elementary models, such as a simple equivalent resistance. The inclusion of such effects must be priority to a strategy, pondering the consistency between simplicity and objectivity, so that the influence of these factors can be properly represented in order to match the simulation results with those from the reality.

In this way, this paper aims to present a summary of existing proposals for grounding systems modelling and a strategy towards the evaluation of the disturbance responses with different models. The studies to be described are associated with a real case of a refunding request for damages Thus this paper involves representations of earth systems with the linear and nonlinear parameters. Besides the evaluation of the