## Formulation, computation and improvement of steady state security margins in power systems. Part I: theoretical framework

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Abstract-

A steady state security margin for a particular operational point can be defined as the distance from this initial point to the secure operational limits of the system. Four of the most used steady state security margins are the power flow feasibility margin, the contingency feasibility margin, the load margin to voltage collapse, and the total transfer capability between system areas. A comprehensive literature survey has shown that these security margins have been studied separately. This fact has suggested to the authors the possibility of researching a common analysis framework valid for all of them. This is the first part of a two-part paper. In part I, a novel mathematical formulation valid to address the study of any steady state security margin is proposed. The developed general approach is presented in three steps: (a) formulation, (b) computation, and (c) improvement of security margins. In part II, the performance of the proposed approach when used to compute and improve the aforementioned steady security margins is illustrated through its application to the Spanish power system. Results denote that this approach can be a useful tool to solve a variety of practical situations in modern real power systems.

Index Terms- Steady state analysis; Security margins; Power flow feasibility; Contingency analysis; Voltage collapse; Total transfer capability

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