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Security-constrained optimal power and natural-gas flow

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Abstract— Continuous liberalization and interconnection of energy markets worldwide has raised concerns about the inherent interdependency between primary energy supply and electric systems. With the growing interaction among energy carriers, limitations on the fuel delivery are becoming increasingly relevant to the operation of power systems. This paper contributes with a novel formulation of a mixed-integer linear programing (MILP) security-constrained optimal power and gas flow. To this end, an iterative methodology, based on development of linear sensitivity factors, determines the stabilized post-contingency condition of the integrated network. The proposed model allows system operators not only to perform security analysis but also to adjust in advance state variables of the integrated system optimally and fast, so that n-1 contingencies do not result in violations. Case studies integrate the IEEE 24-bus system and a modified Belgian high-calorific gas network for analyzing the performance of the formulation and solution methodology.

Index Terms— security constrained, optimal power flow, security analysis, natural gas networks, integrated energy systems.

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