Computer & Operations Research. Volume: Number: Pages: -. December 2013

A trilevel programming approach for electric grid defense planning

N. Alguacil, A.R. Delgadillo, J.M. Arroyo

Abstract— This paper addresses the allocation of defensive or hardening resources in an electric power grid to mitigate the vulnerability against multiple contingencies. This planning problem is characterized by a defender-attacker-defender model which is formulated as a trilevel programming problem. In the upper level, the system planner identifies the components to be defended or hardened in order to reduce the damage associated with plausible outages. In the middle level, the disruptive agent determines the set of out-of-service components so that the damage in the system is maximized. Finally, in the lower level, the system operator minimizes the damage caused by the outages selected by the disruptive agent by means of an optimal operation of the power system. We propose a novel two-stage solution approach that attains optimality with moderate computational effort. The original trilevel program is first transformed into an equivalent bilevel program, which is subsequently solved by an efficient implicit enumeration algorithm. Numerical results show the effectiveness of the proposed methodology

Index Terms— Electric grid defense planning, multiple contingencies, trilevel programming, vulnerability mitigation.

Citation:
Alguacil, N.; Delgadillo, A.R.; Arroyo, J.M.; "A trilevel programming approach for electric grid defense planning", Computer & Operations Research, vol., no., pp.-. December, 2013.