International Journal of Electrical Power & Energy Systems, vol.100, pp.10-18, September, 2018.

A novel efficient method for multiyear multiobjective dynamic transmission system planning

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Abstract-

The unbundling of the electricity sector in several activities, some of them provided in a regulated way and some others under competition, poses a number of challenging problems namely because in several areas there are conflicting objectives associated to different stakeholders. These different views and objectives paved the way to the development of new multiobjective tools able to represent this new paradigm. In this scope, this paper presents a multiobjective (MO) formulation for the Transmission Expansion Planning (TEP) problem using a new solution approach that combines concepts of evolutionary computation and multi agent population algorithms. The new proposed tool is termed as Multi-Population and Multiobjective Evolutionary Particle Swarm Optimization - MEPSO-II. The TEP problem is handled in a realistic way preserving the holistic view over the entire planning horizon and the true grid behavior because it considers the multi-stage nature of the problem and we use an AC Optimal Power Flow (AC-OPF) model to gain insight on the operation conditions of the network. The multi objective formulation considers the total system cost, on one side, and the Expected Power Not Supplied (EPNS), on the other. The total system cost comprises the investment cost in new equipment and the operation costs while the EPNS takes into account the uncertainties related to the non– ideal behavior of system components using a non-chronological Monte Carlo simulation. Numerical simulations are conducted using the IEEE 24 and the 118 Bus Test Systems in order to compare the proposed MO tool against other algorithms through performance evaluation indices. Although being a higher time-consuming tool, the MEPSO-II enables improving the Pareto-Front and therefore it gives more insight to transmission network planners when compared with other consolidated algorithms described in the literature.

Index Terms- AC optimal power flow; Expected power not supplied; MEPSO-II; Monte Carlo simulation; Multiobjective transmission expansion planning; Uncertainties

Citation:
Tomé Saraiva, J.P.; Vilaça, P. "A novel efficient method for multiyear multiobjective dynamic transmission system planning", International Journal of Electrical Power & Energy Systems, vol.100, pp.10-18, September, 2018.