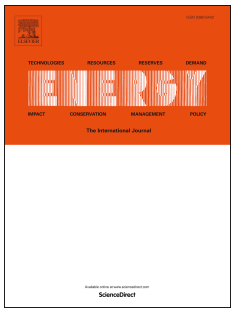
Accepted Manuscript



A sequential planning approach for Distributed Generation and natural gas networks

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PII: S0360-5442(17)30510-8

DOI: 10.1016/j.energy.2017.03.118

Reference: EGY 10585

To appear in: *Energy*

Received Date: 23 September 2016

Revised Date: 21 March 2017

Accepted Date: 24 March 2017

Please cite this article as: Odetayo B, MacCormack J, Rosehart WD, Zareipour H, A sequential planning approach for Distributed Generation and natural gas networks, *Energy* (2017), doi: 10.1016/j.energy.2017.03.118.

A Sequential Planning Approach for Distributed Generation and Natural gas Networks

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Abstract

The increasing integration of natural gas-fired distributed power generators at the distribution level of the electric power system presents reliability concerns. We present a comprehensive long-term planning model of natural gas distribution pipelines, natural gas-fired distributed power generators, and capacitor banks. The planning problem is modeled as a chance constrained mixed integer nonlinear optimization problem. Chance constrained programming affords the planner to simultaneously ensure a desired system reliability level while accommodating the risk of uncertain electricity demand. The objective of the planning problem is the minimization of the fixed and operating costs of both natural gas and electricity systems over a planning period of ten years. We solve this problem using a sequential planning approach. The outputs of the planning model are the best location and size of the natural gas-fired generators and the capacitor banks. The minimum acceptable reliability level in our model is set to 96%. We illustrate our approach using a simple radial distribution test system. We show that an energy system with desired reliability can be attained while accommodating the uncertainties of electricity demand in the long-term plan. In addition, we show a relationship between the expansion plans and the reliability policies of a distribution utility.

Keywords: Distributed generation, chance constrained optimization, integrated planning, natural gas distribution network.