

Accepted Manuscript

Impact of Replacing Thermal Power Plants by Renewable Energy on the Power System

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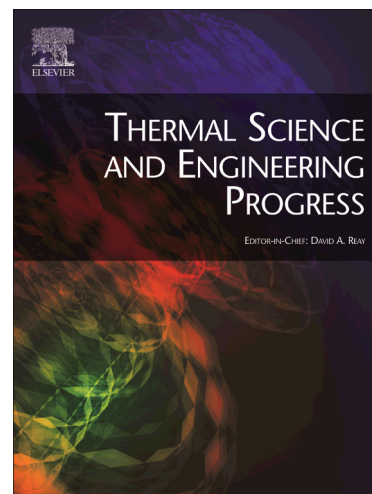
PII: S2451-9049(17)30484-5
DOI: <https://doi.org/10.1016/j.tsep.2018.02.002>
Reference: TSEP 130

To appear in: *Thermal Science and Engineering Progress*

Received Date: 19 November 2017
Revised Date: 31 January 2018
Accepted Date: 3 February 2018

Please cite this article as: I.A. Nassar, M.M. Abdella, Impact of Replacing Thermal Power Plants by Renewable Energy on the Power System, *Thermal Science and Engineering Progress* (2018), doi: <https://doi.org/10.1016/j.tsep.2018.02.002>

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Impact of Replacing Thermal Power Plants by Renewable Energy on the Power System

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Abstract

The Egyptian Electricity Holding Company (EEHC) has paid great attention to renewable energy sources; wind power (WP) and photovoltaic (PV). The EEHC Strategy aims at increasing the proportion of power totally generated from Renewable Energy Sources (RES) to 20% by 2022. With increasing such amount of RES in the Egyptian electricity system, some of the on-line thermal power plants will be shut down and replaced by WP and PV. Thus the thermal reserve will be reduced making the available online thermal power plants fewer to share the regulation burden. The power system inertia will be reduced, the frequency deviation will be greater after system disturbance and more oscillation will occur. Therefore, this paper studies the impacts of increasing the renewable energy sources on the frequency control of the Egyptian power system by investigating different scenarios of increasing the RES to 20% after occurring sudden variations in generation. Also the impact of RES on environmental improvement is presented by calculating the expected annual CO₂ emission reductions (ER), certified emission reduction (CER) and the amount of fuel saving. The model was created by using DigSILENT power factory software.

Index Terms— thermal power plants, wind, photovoltaic, inertia, oscillation, primary control.

1 INTRODUCTION

The Egyptian Electricity Holding Company (EEHC) has paid great attention to renewable energy sources (RES) since it is a global perspective for being positive in terms of environmental improvement, reducing the harmful emissions and overcoming the depletion of petroleum resources [1, 2]. The available renewable energy sources were evaluated and its technologies were provided to take advantage of what is available from renewable energy sources. The EEHC Strategy aims at increasing the proportion of power totally generated from renewable energy sources (WP and PV) to 20% by 2022 [3- 6]. In this way, it is a big challenge for the Egyptian power system to increase the integration of the RES, while maintaining the security level of supply. System stability is an example of challenge. Disconnecting the thermal power plants and replacing them with inertia by WP and PV, while the total power of the system is constant, makes more oscillation and large deviation of system frequency after system disturbance, the very thing that causes system stability reduction [7]. Shutting down the thermal power plant will reduce the primary control reserve, since thermal power plants contribute in the primary control. Therefore, a different method is required to simulate the scheduling of power plant [8, 9]. In Egypt, wind farms are built in urban areas far away from load center

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