

Coupling of Wind Farms with Nuclear Power Plants

Mohamad Abd-Alraheim Badr ,Mohamed Kareem AlAshery, Walid EI-Khattam,

Abstract

Countries in the Arab region are planning to meet their increasing electricity demands by increasing both nuclear and Renewable Energy (RE) contributions in electricity generation. In the planning phase of siting both new Wind Farms (WFs) and Nuclear Power Plants (NPPs), many benefits and challenges exist. An important aspect taken into consideration during the NPP siting is the existence of ultimate heat sink which is sea water in most cases. That is why most NPPs are sited on sea coasts. On the other hand, during WF siting, the main influential aspect is the existence of good wind resources. Many coastal areas around the world fulfill this requirement for WF siting. Coupling both NPPs and WFs in one site or nearby has many benefits and obstacles as well. This coupling can help in the geographical distribution of WFs along the countries territories by installing WFs at or near to the NPP area. This geographical distribution will make use of the low density population area around NPPs and smoothen the WFs output power injected into the grid. Due to wind speed fluctuations, the value of the output of WFs power is less than their installed capacity. Thus, WFs capacity credit is evaluated to find out the corresponding value of the thermal power plants to be installed in the grid in order to satisfy the required system reliability.

In this paper, the implementation aspects of NPP and WF coupling/adjacency will be discussed in detail. Based on international experience and literature reviews, the benefits and obstacles of this coupling/adjacency are studied and evaluated. Various case studies are carried out to verify the coupling/adjacency concept. The benefits of WF geographical distribution are examined on two candidate sites in Egypt. The WF capacity credit is calculated by implementing the PJM method using actual three-year hourly wind data. The obtained results are evaluated to study their applicability in the Egyptian environment and their applicability for countries in the Gulf region. Finally, both the coupling idea and the capacity credit values can be used to help decision makers in the planning phase as well as in the selection of WT characteristics as discussed in this paper.

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