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Highlights.

- Proposing a multiple-radius OPF model for the power systems under the penetration of off-shore WFs.
- Introducing a weighted IGDT technique which considers the geographical location of WFs.
- Considering VSC-HVDC to connect off-shore WFs to the grid.

Abstract Increasing the penetration of renewable energies creates various operational and even security challenges for power systems, due to the variability of their output power and inability to provide system inertia. These issues are even more inevitable in power systems which are connected to off-shore wind farms (WFs) in different locations, creating more complexity in decision making process. This paper, proposes a decision making model to increase the robustness of optimal power flow in presence of off-shore WFs. Information gap decision theory (IGDT) is used as a decision making tool for dealing with the uncertainty radius of multiple WFs, by definition of weighting factors for the uncertainty of each WF. Voltage source converter (VSC)-based high voltage DC (HVDC) transmission links are considered to connect the off-shore WFs to the main AC grid. The proposed optimization model, which includes both AC transmission and HVDC systems constraints, is implemented on the IEEE 118-bus standard test system and solved by general algebraic modeling system (GAMS) optimization software. The simulation results show the economic effect of location factor in definition of uncertainty for WFs.

Keywords Off-shore wind farmInformation gap decision theory (IGDT)Voltage source converter HVDC (VSC-HVDC)Optimal power flow (OPF)Uncertainty