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Demand-supply balancing in energy systems with high photovoltaic penetration, using flexibility of nuclear power plants

Abstract-

Energy transition requires scaling up the supply of low emissions electricity from renewable energy sources (RESs) and acceleration of deployment of dispatchable sources of low emissions electricity such as hydro and nuclear. Power output from RESs, particularly photovoltaic (PV) generation, can vary periodically and irregularly, depending on weather conditions. At high PV penetration levels, this peculiarity of the technology can not only cause voltage and power flow fluctuations in the local distribution grids, but also violate the demand-supply balance of a whole energy system, resulting in issues with frequency control and difficulty of demand supply management. This study is primarily focused on demand and supply balancing of an energy system with high PV penetration levels, assuming a significant share of nuclear power plants (NPPs), as well as thermal power plants (TPPs) and a strong transmission system. The potential benefits of flexible nuclear operations in an energy system are analyzed. It is demonstrated that nuclear power plants’ flexibility can reduce the share of environmentally unfriendly thermal power units and substantially reduce the restrictions for renewable energy. The IEEE 9-bus test system is used for the case study.

Index Terms- nuclear energy; flexible operation; renewable energy integration; demand-supply balancing; transmission power system; nuclear terrorism

Citation: