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STRATEGIC PLACEMENT OF RENEWABLE INTEGRATED EV CHARGING INFRASTRUCTURE IN RADIAL DISTRIBUTION NETWORK

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Abstract

The increasing adoption of Electric Vehicles (EVs) necessitates the expansion of EV Charging Stations (EVCS), exerting an impact on the electrical grid by introducing generation-demand imbalances, higher Energy Loss (EL), and decreased reliability. This paper proposes a method for strategically placing EVCS in conjunction with Photovoltaic (PV) and Wind Distributed Generation (WDG) to achieve optimal planning for minimizing EL and enhancing the reliability indices. The suggested method has been evaluated using the IEEE 33 bus Radial Distribution Network (RDN). The IEEE 33 bus RDN has been divided into three areas, each featuring an EVCS, PV, and WDG to effectively implement enhanced charging services and improve the power system parameters. The analysis was performed by utilizing the Backward Forward Sweep Power Flow (BFSPF) approach, considering the variable parameters of the electrical network. The Symbiotic Organisms Search (SOS) tool has been applied to tackle the issues, which have been formulated as an optimization problem. The results have been compared with Whale Optimization Algorithm (WOA), Grey Wolf Optimizer (GWO), and Particle Swarm Optimization (PSO) to validate the optimal planning. The proposed SOS-based optimization approach was benchmarked against GWO, WOA, and PSO algorithms through a performance ranking evaluation across multiple independent runs, consistently achieving the first rank in objective function minimization and convergence efficiency. The results indicate that the proper allocation of EVCS in combination with PV and WDG significantly lowers network losses and enhances reliability. The findings demonstrate the superior optimization of SOS, highlighting its viability for sustainable EVCS deployment with renewables.

Key words: distributed generation, electric vehicle charging stations, optimization, radial distribution network, reliability.

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