General Introduction With the growing demand for electrical power driven by population growth, industrial development, and economic expansion, the need for reliable power supply has become increasingly crucial.The research aims to provide valuable insights into the interplay between DG penetration levels, DG types, and system reliability, ultimately contributing to the development of more resilient and efficient distribution networks.The study will consider different types of DG units, including those injecting real power (e.g., photovoltaic, battery, fuel cell) and those injecting both real and reactive power (e.g., synchronous generators, wind power).By employing meta-heuristic optimization techniques, such as Particle Swarm Optimization (PSO) and Gravitational Search Algorithm (GSA), the optimal sizing and siting of DG units will be determined while considering various operational constraints and objectives, including power loss minimization and voltage profile improvement.This thesis aims to investigate the optimal allocation of multiple DG units in radial distribution systems and analyze their impact on system reliability indicators, such as Total Energy Not Supplied (TENS), Average Energy Not .(Supplied (AENS), and Average System Interruption Duration Index (ASIDI