# An Agent-based Model for Resilient Power Distribution System Restoration in Dynamic Environments

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## ABSTRACT

Power system restoration is a complex process due to: (1) the dynamic restoration needs arising from completed restoration tasks and new outage events, and (2) complex interactions among various stakeholders (e.g., customers, restoration managers, and crew). This study proposed an agent-based modelling (ABM) framework that can simulate the complex restoration process in dynamic environments by capturing the micro-behaviors and interactions of multiple restoration agents. Four types of agents were considered in the proposed ABM, i.e., restoration manager, crew, utility poles, and critical facilities. Each agent had their own attributes (e.g., utility pole failure probability) and interactions with one another (e.g., crew assignment made by restoration managers) which resulted in higher-level restoration outcomes. The proposed ABM was tested in three real-world storm-induced power outage events with different levels of severity in Connecticut. Two sets of simulation experiments were conducted to quantify the effects of: (1) decision-making frequency and (2) risk attitude of restoration managers. The goal was to identify effective restoration strategies that could reduce the negative social impacts associated with power outages. Results showed that more frequent decision making and risk averse restoration managers could substantially reduce the social impacts of power outages. However, the magnitude of the effects varied across power outage events with different severity levels. The proposed ABM provided a useful tool for utility companies to quantitatively assess the potential restoration outcomes and make informed restoration decisions.