Abstract

Con Edison's underground electric infrastructure includes approximately 27,000 network transformers that step down voltages from distribution levels to magnitudes that can be utilized by customers. Most of these units are located in vaults underneath city streets. The safe and reliable operation of these underground network transformers is one of the company's primary responsibilities as it ensures public safety as well as reliability of service.

An initial investigative study was conducted in order to examine potential drivers of corrosion failure, which is known to be the primary cause of failure for underground network transformers. In this study, several factors, including exposure to salt volume (indicated by primary street designation), presence of a submersible network protector, presence of an anode, and transformer age, were proven to be proxies for transformer health. These parameters with the exception of transformer age, were previously understood to be indicators of high atmospheric moisture inside the vault however their effects had been quantified. Since moisture helps to accelerate the corrosion process, especially when combined with elevated temperatures, salt concentration, pollutants, and other conditions inside the vault, it was hypothesized that quantification of the impact of these factors could be used to mitigate failure due to corrosion.

This study represents a novel approach for quantifying parameters that are understood to impact corrosion but which have never been analyzed in relation to

underground network transformers. The analytical approach developed in this study involved first visualizing data to identify high level trends. Visualization was followed by a formal analysis which included hypothesis testing and factorial design to confirm the statistical significance of the aforementioned parameters on transformer corrosion. Testing revealed that three parameters: primary street designation, submersible network protectors, and presence of an anode were statistically significant proxies for transformer health. Based on their established effects, these parameters were used to develop a discriminant model that could be used to predict transformers that are at risk of imminent failure. The model developed in this study correctly classifies 68% of transformer units at risk of failure and could be useful for planning modifications to transformer inspection cycles or even for facilitating the removal of units to prevent catastrophic in-service failure.