Industry Host: Con Edison

Problem Title: Preemptive Corrosion Detection and Prevention of Network Transformers

Challenge:

Create a corrosion detection and prevention system for utility workers to quickly assess the condition of network transformers and reduce replacement costs.

Background:

28,000 network transformers exist in the service territory, each of which is inspected on an 8-year cycle, with 65% of failed devices exhibiting corrosion upon inspection. Network transformers (located in underground vaults throughout the service territory), are responsible for stepping down distribution voltages (4 or 13 kV) to service levels for customers (120/208/265/460 V). These devices are continuously exposed to debris, are often submerged for prolonged periods of time after rain events, and are impossible to fully inspect in constrained vault environments without a costly removal. On average approximately 4% of the total network transformer population fails per year and are removed from service.

The extent of corrosion related damage is difficult to detect, leading to unexpected and premature failures that pose potential safety risks, in addition to incurring high replacement costs for the company. Corrosion detection and prevention outside of existing cathodic protection practices are desirable. Cathodic protection systems only provide a degree of corrosion protection to the unit when the magnesium anode and transformer cathode (zinc) are in the same electrolyte environment, as is the case during complete submergence after a weather event. During periods between weather events, transformers are more often surrounded by locally corrosive dirt and debris – a situation remediable only through power washing and vault flushing operations. In almost all cases, however, transformer vaults are not cleaned of debris due to operational constraints, and corrosion remains continuous.

Boundaries & Considerations:

- Network transformers are constructed with carbon steel enclosures coated with a zinc primer and then a two-part epoxy topcoat.
- Each network transformer is paired with a network protector device capable of disconnecting/reconnecting it to the network.
- Local dirt and debris are suspected of causing the majority of corrosion while remaining difficult to address through vault flushing.
- Transformers are installed with cathodic protection anodes (magnesium strapped to the neutral), to reduce corrosion rates during submerged conditions.
- Pressure, temperature and oil are monitored remotely to identify immediate inspection need/repair work.
- Measuring the extent of the corrosive damage and not just that some corrosion has occurred is important.