



## Nasonville Substation Fire \_\_\_\_\_ (November 2023)

### Background

During a thunderstorm on Tuesday, August 23, 2022, at 6:23 p.m., Rhode Island Energy's ("RIE") Nasonville Substation, located at 445 Douglas Turnpike in Burrillville, Rhode Island, had a fire within the substation. Initial reports from Pascoag Utility District ("PUD" or "Pascoag") to the Rhode Island Division of Public Utilities and Carriers ("Division") indicated that the fire was believed to have been caused by a lightning strike. However, subsequent investigation determined that the event was triggered by a tree that fell onto the 41-feeder wires between the Nasonville substation and the Pascoag substation which, in turn, led to a dielectric failure between the rosette-to-stab connection on the 41-feeder breaker, C-phase terminal to the switchgear bus, that is located inside the relay switchgear building within the Nasonville Substation. The incident caused 4,700 PUD and 4,617 RIE customers to lose power. There were no injuries reported related to the outage or fire.

The dielectric failure happened due to a tree falling across the 41-feeder three-phase wires resulting in a significant through fault current and, subsequently, cycling of a recloser which cleared the tree fault. Nasonville Substation differential relaying operated in response to the switch gear bus fault. The differential relaying at the Nasonville substation attempted to de-energize. The differential relaying was designed to open all 15kV breakers, close the 115kV grounding switch (which will create a 115kV fault and cause the West Farnum circuit breakers to open), and then have the three-phase gang motor operated air-break switch at Nasonville open to isolate the substation. However, the grounding switch failed to close, and the three-phase gang motor operated air-break switch opened under load (causing the contact arms to flash, resulting in significant damage to them), which caused a fault since the switch was not designed to open under load. This fault is what caused the West Farnum circuit breakers to open. The 15kV fault did not cause the West Farnum circuit breakers to operate.

Both PUD and RIE personnel responded to the situation immediately [with over fifty (50) RIE personnel mobilized], working together to restore service through re-routing electricity around Nasonville, deployment of contracted emergency generation, replacement of the failed switchgear, feeder transfers, solar power, a new battery storage system at Pascoag, onsite generation, and roll-on generation (which was run during the peak loading periods of each day). During restoration, while transferring loads, a splice failed on a primary wire located on Smithfield Road in Woonsocket, resulting in the wire falling to the ground, prompting a separate recloser to de-energize that circuit. Restoration efforts also experienced high and low voltage issues that required adjustments to equipment to correct.

Fortunately, through a prior agreement in place with National Grid, RIE was able to expeditiously obtain mobile switchgear and mobile substation cables by 9:00 a.m. the next morning. Temporary equipment (including a mobile relay station) was installed at the Nasonville Substation while tests of the Nasonville Substation transformer were performed. While most customer service was restored within hours, the duration of the event was from Tuesday, August 23, 2022, at 6:23 p.m., to Saturday, August 27, 2022, at 7:00 p.m., when 100% of the load served by the Nasonville Substation had been transferred back to the Nasonville transformer and the temporary mobile relay station. (The decommissioning of the "roll-on" generation occurred on Wednesday, September 1, 2022.)

Even though power was eventually restored to all customers by temporary means on August 24, 2022, by 1:26 a.m., there were capacity limitations and the need for additional localized generation and conservation measures. Per RIE's request, one 4-6 megavolt ampere ("MVA") large commercial customer agreed to shut down for the first two days after this incident. PUD cooperated fully with Rhode Island Energy and utilized their one (1) megawatt ("MW") generator and nine (9) megawatt hours ("MWhs") of energy storage equipment to provide load relief during peak load periods while the system was in its reconfigured state. This required very close coordination between RIE and PUD during the event. Eleanor Slater Hospital, Zambarano Unit, also cooperated with RIE with their deployment of 750 Kilowatt ("kW") of emergency backup generation.

## **Division Observations**

RIE's parent company had only recently purchased (May 25, 2022) the distribution system in Rhode Island. RIE did an excellent job responding to this incident, as did PUD (with the cooperation of National Grid—Massachusetts). Customer services were restored in a matter of hours due to the utilities planning for these scenarios and excellent communication skills, both with each other and with their largest customers and State regulators. The success in arranging for several large customers to either reduce their demands during this emergency, or provide distributed generation back to the utilities, is particularly noteworthy. Both the utilities and their customers are to be commended for their response to this emergency.

This substation fire resulted in 9,317 customers, including a hospital, losing electricity; however, most customers were restored in a short number of hours. Some customers were asked to stay offline for an extended time because their loads were too high, and others were asked to operate their backup generators. Restoration efforts were complicated by solar farms back-feeding electricity to the grid unpredictably, fluctuating loads, roll-on generation, and high and low voltages that took additional manpower to correct. Some customers reported voltages as low as 96 volts.

The best "root cause" analysis RIE has is that a dielectric failure on the C-phase rosette terminal within the Nasonville substation is to blame for this incident because the damage was so extensive; however, an absolute firm "root cause" cannot be definitively identified. A tree fault, caused by a tree located outside of the utility easement, but falling onto the power lines, should not have created a fault condition that caused substation equipment to fail. RIE confirmed, as did the prior National Grid switchgear analysis, that this switchgear was in "good condition" and had many years of remaining life. However, RIE also explained that Federal Pacific electrical equipment designs, such as this one, have **not** been known to be the most robust. Nasonville Substation was the **only** substation in Rhode Island to have the Federal Pacific plug in connections. We would note, however, that this specific electrical equipment design had been in place for many years and was probably installed before issues with this type of Federal Pacific electrical equipment design were identified. Considering that Nasonville Substation is the **only** station in Rhode Island to have the Federal Pacific plug-in connections, this failure would appear to be an isolated incident not likely to reoccur with any other substations in Rhode Island.