Town of Red Springs, NC

Power Surge Event Investigation Report

April 1, 2026

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I hereby certify this document was prepared by me or under my direct supervision. I also certify I am a duly registered professional engineer under the laws of the State of North Carolina, License No. 037457.

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Introduction

On January 21, 2026, Monty Montsinger, PE and Robert Beadle, PE, PMP from RGrid Power PLLC conducted a site visit to the Town of Red Springs, NC to meet with Town staff and review the Town's electrical utility system. In addition to looking at the system firsthand to assess the voltage conversion and Long-Range Plan update, RGrid Power also investigated the underlying causes of the April 7, 2025, voltage surge event to determine additional measures that may be taken to prevent future similar events and improve system operations.

On-Site Summary

The consensus presented by Town staff when interviewed was that the power surge was caused by a 24.9 kV line contacting a 4.16 kV line where they cross in close proximity, and that this was due to a high wind event causing motion of the conductors (RGrid Power confirmed the wind event with local weather history data. See Photo 1).

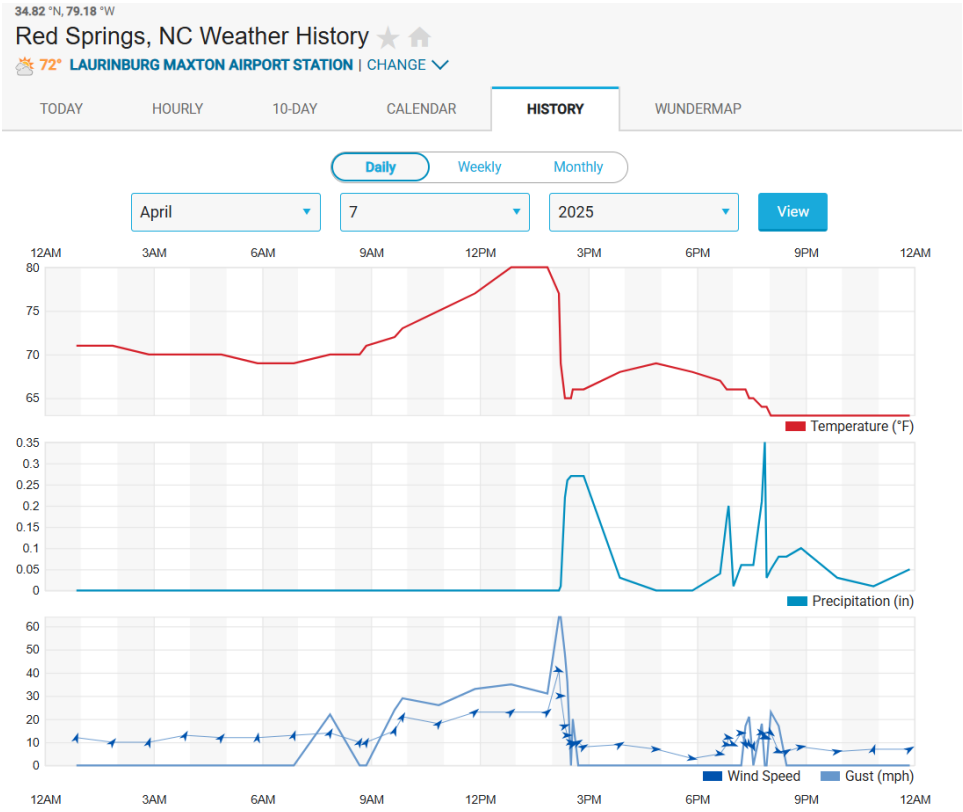

Photo 1: April 7, 2025 Weather History – WeatherUnderground.com

RGrid Power staff went to the origin of the surge event, an area in the middle of town where feeders of different voltages (4.16/2.4 kV and 24.9/14.4 kV) cross (See photos 2, 3, and 4 below).

The Town staff advised that immediate post-event action was taken by increasing the spacing between these feeders. This is apparent from a comparison of the pole just outside

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the Universal Pawn Shop between Photo 2 and Photo 3 below. Although this does decrease the probability of a repeat occurrence of a contact event, it may not eliminate the possibility that it could happen again given an extreme weather event.

Photo 2: Line crossing prior to additional line spacing

Photo 3: Increased feeder spacing

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It also appears that the April 7, 2025, voltage surge may not have been the only time that the feeders have made contact. Photo 4 (below) shows two different conductor splices that could correspond to other past contact event(s). The fact that the splices are different, and are in slightly different points in the feeder with sections of normal conductor between them is an indication that this may have happened at separate times.

Photo 4: Conductor splices

The feeders with differing voltages also run together along poles in other locations, with the 4.16 kV feeder below the 24.9 kV feeder providing residential service throughout the area. If the higher voltage conductor sags low enough during an extreme weather/high loading event to contact the lower conductor, a similar voltage surge event is likely to occur. This could even be caused by heavy ice loading during a winter storm. Voltage conversion that reduces the number of conductors and results in only one feeder voltage through town minimizes locations where conductors of different voltages are in close enough proximity to cause similar voltage surges.

RGrid Power reviewed the Town's circuit phases compared to a list of meters that were replaced due to damage from the surge event. In this comparison, the center phase of the feeder on 3rd Ave. listed more meters than the other two phases. This information generally corroborated the origin of the voltage surge to the conductor crossing. No data was reviewed from the power supplier (Duke Energy) as relay targets were not recorded for the time of the 2025 voltage surge. This was apparently due to Duke's equipment being offline.

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There are multiple contributing factors as to why some areas were affected more than others including where and how long the circuits contacted each other, grounding and bonding along the circuit and at the service locations, and various conditions at the connected equipment.

The Town staff's diagnosis of the problem and corrective action immediately following the April 2025 surge event appears to have been appropriate. RGrid Power recommends additional measures to further improve system reliability and operations.

Recommendations:

1.) **Test relays in the Highway 71 Substation**- Town staff indicated that the Duke Energy breaker operated during the surge event, while the Town of Red Springs feeder protection device did not. It is possible that the Duke Energy electronic relay operated faster than the Town's electromechanical relay, but we also observed that the Town's relay had not been tested since 2005. Although the Town's system is well below the NERC Bulk Electric System threshold for required 5-year testing, a 5-year testing cycle is generally accepted as 'good utility practice' making sure that relays are in working condition and drive the protective device to operate during fault conditions. Electromechanical relays are generally reliable, but sometimes the springs or other mechanical components become weaker with age and stop working within specified tolerances or require adjustment to perform as specified. RGrid Power recommends that the Town establish and fund a regular testing program, which can be done for a reasonable annual cost. Regular testing often identifies and corrects problems before they cause unnecessary or prolonged outages. Replacement of older protective relays or equipment can also result in faster and better coordinated clearing of fault events on the electric system which may reduce or prevent damage to equipment when these abnormal conditions occur.

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Photo 5: Electromechanical relay at Highway 71 Substation

2.) **Review relay settings**-A possibility for the Duke Energy operation ahead of the Town's device may be due to an issue with relay coordination. The settings in the Town's electromechanical relays were obtained by visual observation and the settings for the Duke Energy recloser were provided by ElectriCities. Initial review shows the Duke recloser's ground curves operating before the Red Springs relay for faults under 4,000 amps (TCC Plot and Duke settings attached). A system sectionalizing and coordination study is recommended, which will identify any potential coordination problems throughout the system which can then be corrected. This will likely result in fewer and shorter outages over time (i.e. Better overall reliability).

3.) **Install surge protection**-One of the effects of the voltage surge involved a high voltage condition and damage to equipment downline from the line contact. Due to the existing protective settings/design and the type of fault, the protective devices did not operate to quickly clear the fault, and the high voltage condition continued down the 4 kV feeder into residential services. In addition to increasing clearances between the conductors which are operated at different voltages, surge arresters may also be installed to mitigate the effects of this type of event as well as other overvoltage conditions which often occur due to lightning strikes. Surge arresters come in various voltages and types (line or substation) and create a path to ground during high voltage conditions. Substation class arresters are recommended to be installed where 23kV distribution and 4kV distribution cross or share the same pole line (see photo below). This equipment can be added to the existing distribution line without much difficulty. The idea is to make sure that the voltage surge goes straight to ground rather than proceeding down the feeder and damaging equipment and services. This is not a

particularly expensive piece of equipment, is usually readily available, and can be added to existing poles without difficulty.

Photo 6: Substation class surge arrester example

4.) **Review system grounding –** RGrid Power has not evaluated the Town's system grounding, since this involves several steps which time did not permit for this summary report. However, the recommended protection enhancements all rely upon the system neutral and grounding system to be functioning as intended. This requires pole grounds and ground rods throughout the system to be properly bonded and to be of low enough resistance to allow all the devices to function according to design and specifications. RGrid Power recommends that the Town conduct a review of existing grounding conditions and installation practices. This will identify if any corrective actions are needed to improve fault detection and isolation.

5.) **Voltage conversion**- The proposed voltage conversion for the remaining 4.16 kV portions of the distribution system is recommended. In addition to the loss savings and other benefits that the Town would see from voltage conversion, if the Town feeders were all upgraded to 24.9/14.4 KV, an unintentional contact event between different circuits or phase conductors could still result in an outage. However, during the voltage conversion design process, potential conflict areas can be eliminated, especially with the removal of additional 4.16 kV circuits, which would free up valuable space on the Town's poles as well as replacing some of the oldest equipment on the system. The likelihood of events like the April 2025 event will be greatly reduced. Together with the other recommended measures in this report, the Town will improve overall reliability and reduce the likelihood of future similar outages.

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6.) **Customer Owned Equipment** – Damaged customer owned equipment seemed to be in areas with older equipment installed. Improvements at the customer level would also mitigate the risk of damage due to voltage surge events. Updating this equipment to current standards and meeting current code requirements, especially for grounding and bonding, would reduce but not eliminate the risk of damage. There are too many individual conditions across all the affected consumers to include specific recommendations in this report. This would need to be done on a case-by-case basis. A periodic review of the customer services and meters is recommended to identify any services which do not meet current standards or which have degraded or damaged equipment.

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