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July 28, 2025

Via Electronic Filing
Matthew L. Homsher Secretary
Pennsylvania Public Utility Commission
400 North Street
Harrisburg, PA 17120

RE: Petition of the Borough of Royersford, Pennsylvania for Emergency Order
Docket No. P-2025-XXXXXXX

Dear Secretary Homsher:

Enclosed for electronic filing, please find the Borough of Royersford's Petition for Emergency Order, in the above-referenced matter. Copies to be served in accordance with the attached Certificate of Service.

Sincerely,

Carl R. Shultz

Carl R. Shultz

CRS/jls
Enclosure

cc: Certificate of Service (w/enc)
Rodney Bender, PA PUC (w/enc) (rodbender@pa.gov)

CERTIFICATE OF SERVICE

I hereby certify that on this day, I served a copy of the Petition of the Borough of Royersford for Emergency Order Regarding Dangerous Railroad Crossings upon the persons listed below in the manner indicated in accordance with the requirements of 52 Pa. Code Section 1.54.

Via Electronic Mail

Norfolk Southern Corporation
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Enola, PA 17025
Attn: Alicia Ruscitto
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Office of Consumer Advocate
555 Walnut Street
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PECO
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Attn: Engineering Department
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Allison Kaster, Esq.
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Pennsylvania Public Utility Commission
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Dated: July 28, 2025

/s/ *Carl R. Shultz*

Carl R. Shultz, Esq.

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF THE BOROUGH OF ROYERSFORD, PENNSYLVANIA FOR EMERGENCY ORDER	:	Docket No. _____

PETITION OF THE BOROUGH OF ROYERSFORD
FOR EMERGENCY ORDER
REGARDING DANGEROUS RAILROAD CROSSINGS

Pursuant to 52 Pa. Code §§ 3.1–3.3, the Borough of Royersford, Pennsylvania ("Borough") files this Petition for Emergency Order ("Petition") seeking the issuance of *ex parte* emergency relief by the Pennsylvania Public Utility Commission ("Commission") ordering the immediate repair of two railroad grade crossings within the Borough that are "an immediate danger to the safety and welfare of the public."[1] The crossing gates and warning lights at these railroad crossings have increasingly malfunctioned over a period of years and with enough frequency to pose a serious risk of harm to the public. These railroad crossings are part of the Norfolk Southern Corporation ("NS") railroad system and share a right-of-way ("ROW") with a PECO Energy Company ("PECO") owned transmission line, and both NS and PECO have identified the transmission line as a factor in the malfunctions, due to induced voltage. As further discussed below, **the need for emergency relief is immediate and the Borough respectfully requests that the Commission expeditiously order NS and PECO to alter or improve the railroad crossings as soon as possible because these crossings pose an immediate danger to the safety and welfare of the public.**

[1] 66 Pa. C.S. § 2702(f); 52 Pa. Code § 3.361(a).

In support of this Petition, the Borough avers as follows:

I. INTRODUCTION AND BACKGROUND

1. The name and address of the Complainant are:

Borough of Royersford
c/o Brant & Associates, LLC
572 West Main Street
P.O. Box 26865
Trappe, PA 19426

2. The name, address, and contact information for Complainant's counsel are:

Carl Shultz, Esq.
Renardo Hicks, Esq.
Eckert Seamans Cherin & Mellott, LLC
213 Market Street, 8th Floor
Harrisburg, PA 17101
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Stephen Pemberton, Esq.
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3. This petition concerns two defective railroad crossings within the Borough that are part of the "Harrisburg Line" owned and operated by NS.

4. The NS Harrisburg Line (and predecessor railroad line built by the Reading Railroad) have been present in Royersford for almost two centuries. Multiple NS-operated freight trains pass through Royersford each day.[2]

5. Alongside the NS ROW in the area in question is a "220-60" transmission line ("Transmission Line") owned and operated by PECO.

[2] For a depiction of the speed and length of the trains that pass through the area, *see* The Crusader Railfan, *NS trains at Royersford, PA 8/24/24*, YouTube (Dec. 19, 2024), https://www.youtube.com/watch?v=BP3cTKKAdSc.

6. The first railroad crossing is located at Main Street, which is depicted in a Google Street View screen capture below:

7. In an alternate view of the Main Street railroad crossing, the Transmission Line is visible in this same area:

8. The second railroad crossing is located at Arch Street, which is depicted in a Google Street View screen capture below:

9. In an alternate view of the Arch Street railroad crossing, the Transmission Line is visible in this same area:

10. Starting around 2017, the railroad crossing warning devices at these locations—including crossing gates and automatic crossing signals—would occasionally malfunction and activate without any train being present in the area.

11. NS investigated the issue and commissioned National Signal Technology to issue a report on July 14, 2023 entitled "Norfolk Southern CP Cromby Electrical Interference Continued Investigation Report 2023." The National Signal Technology report is attached hereto as **Exhibit A**.

12. The National Signal Technology report concluded that: (1) "electrical interference has been an ongoing issue" since the commissioning of the Transmission Line; (2) there was presently "inadequate mitigation" of the Transmission Line in the railroad ROW; and (3) that both PECO and NS "must work together to mitigate this interference to an acceptable level."[3]

13. Despite the conclusions of the National Signal Technology report, NS and PECO did not make significant progress on resolving the issue. In fact, beginning in August 2024, the railroad crossing warning devices began to malfunction with increasing frequency.

14. According to the Royersford Police Department, there were at least 27 malfunction incidents from January 2024 to August 2024. Attached hereto as **Exhibit B** is a log prepared by the Royersford Police Department documenting such incidents.

15. In the year 2025, the issue persists; there have been numerous errant crossing activations this year, as evidenced by the "Incident Frequency Report" also authored by the Royersford Police Department and attached hereto as **Exhibit C**.

16. When a malfunction occurs and the crossing warning devices activate erroneously, the activation can last multiple hours, which causes great inconvenience for local residents and first

[3] Exhibit A at 14.

responders. This contrasts with the normal crossing equipment activation sequence, in which the warning devices only activate for as long as it takes a train to pass through the area.

17. As a result of the frequent false crossing equipment activations, some drivers have resorted to driving around the crossing gates and through the defective crossing—despite activation of the warning equipment and despite the potential (or actual) presence of an approaching train.

18. At a meeting with Borough officials on April 23, 2025, NS identified the Transmission Line as a potential cause of the crossing equipment malfunctions.

19. On June 17, 2025, the Borough attended a meeting with NS, PECO, members of the Commission, and State Senator Katie Muth.

20. At this meeting, PECO gave a presentation discussing potential induction interference from its Transmission Line on the railroad and, by extension, the crossing equipment. The presentation concluded that "[a] partnership between PECO and NS" is required to study the induction effects on the railroad and provide options for remedial measures. PECO's presentation is attached hereto as **Exhibit D**.

21. On July 3, 2025, the Borough attended a meeting with representatives from the Commission, Senator Muth, and Representative Joseph Ciresi. The outcome of the meeting was that the Borough resolved to file an action against NS and PECO to ensure the expeditious resolution of this matter.

22. Through this Petition, the Borough is requesting that the Commission find that the Main Street and Arch Street grade crossings are inadequate and dangerous to the safety and welfare of the public and further require that NS, PECO, and any other responsible party (including any non-carrier public utility) alter and/or improve said crossings as soon as possible.[4]

[4] 66 Pa. C.S. § 2702(f); 52 Pa. Code § 3.361(a).

II. LEGAL STANDARDS

23. Section 3.3 of the Commission's regulations authorizes the issuance of *ex parte* Emergency Orders.[5]

24. A petition emergency relief must be supported by a verified statement of facts that establish the existence of an emergency, including facts to support that: (1) the petitioner's right to relief is clear; (2) the need for relief is immediate; (3) the injury would be irreparable if relief is not granted; and (4) the relief requested in not injurious to the public interest.[6]

25. An emergency is defined by the Commission's regulations as "[a] situation which presents a clear and present danger to life or property or which is uncontested and requires action prior to the next scheduled public meeting."[7]

26. Section 2702(f) of the Public Utility Code provides as follows:

> Upon the commission's finding of an immediate danger to the safety and welfare of the public at any such crossing, the commission shall order the crossing to be immediately altered, improved, or suspended. Thereafter hearing shall be held and costs shall be allocated in the manner prescribed in this part.[8]

27. The Commission's regulations likewise provide that when a complaint is made under Section 2702 of the Public Utility Code alleging that "a crossing is dangerous or inadequate and requires reconstruction, relocation, alteration or abolition," the "public utilities, owners of the railroad right-of-way and municipal corporations concerned and, if applicable, the Department of Transportation, will be made parties respondent."[9]

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5 52 Pa. Code § 3.3.
6 *Id.* § 3.2(b).
7 *Id.* § 3.1.
8 66 Pa. C.S. § 2702(f).
9 52 Pa. Code § 3.361(a).

28. The Commission "possesses exclusive authority" to determine and order which parties should perform railroad crossing repairs and which parties will maintain the crossing in the future, "*all to effectuate the prevention of accidents and promote public safety*."[10]

III. BASIS FOR EMERGENCY RELIEF

29. This Petition, including the facts recited herein and exhibits attached hereto, presents a sufficient basis for the issuance of emergency relief by the Commission.

30. There is no question that an "emergency" exists, because the malfunctioning crossing warning equipment has indisputably created "[a] situation which presents a clear and present danger to life or property" of the individuals seeking to traverse the crossings.[11] The existence and frequency of the dangerous situation is uncontested by both NS and PECO, and to avoid the possibility of irreparable harm, this emergency requires action prior to the next scheduled public meeting of the Commission.[12]

A. Right to Relief

31. The Borough's right to relief is clear and immediate: it has an obligation to ensure the safety of its residents and passers-through, and must ensure the provision of effective, timely emergency services—all of which is imminently threatened by the long-standing, inconvenient, and dangerous situation at the Main and Arch Street railroad crossings.

32. The Borough has met its burden of proof to demonstrate that NS and PECO are responsible and/or accountable for the defective railroad crossings at issue because: (1) in communications with the Borough, and amongst themselves, both parties have acknowledged the

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[10] *See Knox Twp. vs. Buffalo & Pittsburgh Railroad Inc*, PUC Docket No. C-2019-3009358, Opinion and Order issued Apr. 20, 2023, at *5 (emphasis added); *see also Seybert v. Consol. Rail. Corp.*, PUC Docket Nos. C-00981956 et al, Opinion and Order issued Aug. 31, 2000 ("the paramount consideration in proceedings of this nature is the promotion and enhancement of the safety of the public and the prevention of accidents").

[11] 52 Pa. Code § 3.1.

[12] *Id.*

ongoing issue with crossing equipment malfunctions and the likely source (Transmission Line); and (2) both parties acknowledge that they must work together to rectify the problem.[13]

33. Further, by failing to ensure proper function of the crossing equipment, NS is failing to abide by Section 33.21(b) of the Commission's regulations, which prohibits the railroad from "remov[ing] the protection afforded by . . . crossing gates, . . . automatic crossing signals, or any other protection against accidents" or "substitut[ing] or alter[ing] any existing form of protection at crossings, at grade, of the tracks of a carrier across a public highway, or the tracks of another carrier."[14]

34. The instances of malfunctioning crossing equipment at the Main and Arch Street crossings over a period of years is a *prima facie* example of conditions that are "danger[ous] to the safety and welfare of the public" per Section 2702.[15]

B. Need for Immediate Relief

35. The Borough is not satisfied with the current progress towards remedying this issue and apparent lack of urgency by both NS and PECO—given the years of malfunctions—and the Borough is only interested in ensuring that the crossings are returned to a safe, operational state as soon as possible. **Every day that passes without a proper, speedy resolution of this problem is another day that the residents, visitors, and first responders of the Borough risk being severely injured or killed by an accident involving an NS train at one of these defective crossings.**

36. In an emergency such as this, where time is of the essence to prevent a serious accident due to malfunctioning crossing equipment, the Commission is empowered "to take quick

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13 *See Knox Township*, Opinion and Order issued Apr. 20, 2023, at *5; Exhibits A, D.

14 52 Pa. Code § 33.21(b).

15 *See S.E. Pa. Transp. Auth. v. Pa. Pub. Util. Comm'n*, 592 A.2d 797, 800 n.2 (Pa. Commw. Ct. 1991) ("Because railroad-highway crossings are constructed not only for the convenience of the traveling public but also for the safety of the public, *see, e.g.*, *Borough of Bridgewater v. Pa. Pub. Util. Comm'n*, 123 A.2d 266 (Pa. Super. 1956), the applicable standard in railroad-highway crossing cases is 'the prevention of accidents and the promotion of safety of the public.' *Pa. Railroad Co. v. Pa. Pub. Util. Comm'n*, 35 A.2d 588, 590 (Pa. Super. 1944)."

action to protect the public safety" and may invoke long-established authority "to direct that immediate repairs be made to the pertinent crossing[s], with the allocation of costs to be determined later, subsequent to hearing."[16]

37. Therefore, the Borough requests that the Commission expeditiously issue an emergency order finding that the Main Street and Arch Street grade crossings are inadequate and dangerous to the safety and welfare of the public and immediately requiring NS and PECO to alter and/or improve said crossings as soon as possible.[17]

C. The Injury would be Irreparable if Relief is Not Granted

38. Although the malfunctioning crossing equipment causes multiple problems, the high likelihood of irreparable injury is tied to the possibility of a severe collision between a train and vehicle (or pedestrian) at the Main or Arch Street crossings.

39. Vehicle versus train accidents at grade crossings are a common occurrence, including multiple accidents involving NS trains within the Commonwealth of Pennsylvania.[18]

40. Because of the size of trains and the speed at which they pass through Royersford—in addition to the fact that members of the public have resorted to bypassing the warning equipment at these railroad crossings—the likelihood of irreparable injury here is high.

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16 *Hill v. Reading Blue Mountain and Northern Railroad Company*, PUC Docket No. C-2012-2303046, Opinion and Order issued Jan. 10, 2013, at *4 (citing *Re: Baltimore and Ohio Railroad Company*, Docket No. I-810345 (Order entered September 17, 1982)).

17 66 Pa. C.S. § 2702(f); 52 Pa. Code § 3.361(a).

18 *See, e.g.*, Brendan King, *Truck collides with train in Lancaster County*, FOX 43 (June 10, 2025), https://www.fox43.com/article/news/local/lancaster-county/2-injured-truck-collides-train-lancaster-county/521-73d9bd35-16d8-4c5f-9349-73f83474c95d; Rachael Lardani, *Pickup Truck Pulling Trailer Collides with Train in Lancaster County*, WGAL (June 6, 2025), https://www.wgal.com/article/pennsylvania-train-pickup-truck-crash-penn-twp-lancaster-co/64956491; *Fatal Crash Involving Vehicle and Norfolk Southern Train in Palmyra*, CBS 21 (Nov. 30, 2021), https://local21news.com/news/local/fatal-crash-involving-vehicle-and-train-in-palmyra.

D. The Relief Requested is Not Injurious to the Public Interest

41. The Commission's function in ensuring the proper operation and protection of railroad crossings is "to effectuate the prevention of accidents and promote public safety."[19]

42. The public interest would be duly served and protected by the Commission's issuance of an emergency order requiring the immediate repair of the Main and Arch Street railroad crossings—which are currently a daily danger to the safety and welfare of the public—for the purpose of preventing accidents and promoting public safety.

IV. CONCLUSION

Pursuant to 52 Pa. Code § 3.2 and based upon the foregoing, the Borough's Petition for Emergency Order should be granted. The Borough has demonstrated that the dangerous conditions at the Main and Arch Street railroad crossings qualify as an emergency situation. As the protector of its residents and other visitors to the Borough from unsafe railroad crossings, the Borough's right to relief is clear. The need for relief is immediate, given the lack of progress on a permanent solution and the number of trains that pass through the area each day. There is a high likelihood that the injury would be irreparable if an accident between a train and vehicle or pedestrian occurred. Finally, the relief requested is in the public interest, because the Commission's regulation of railroad crossings is to protect public safety and prevent accidents.

WHEREFORE, the Borough respectfully requests that the Commission:

a. Issue an *ex parte* Emergency Order finding that the Main Street and Arch Street grade crossings are inadequate and dangerous to the safety and welfare of the public and immediately requiring NS and PECO to alter and/or improve said crossings as soon as possible;

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[19] *See Knox Township*, Opinion and Order issued Apr. 20, 2023, at *5.

b. Close the affected crossings to rail traffic pending resolution;

c. To the extent that the affected crossing remain open to rail traffic, the Commission should (1) Issue a stop and protect order, where all trains are stopped and a safety check is performed at each stop before each crossing; (2) Direct that an emergency response team to be available within a certain time frame in the event of malfunctions, as the current response time is unacceptable; and (3) Implement of a traffic control plan, at the expense of NS

d. Compel NS to adhere to Federal Railroad Administration (FRA) standards in connection with the repair and operation of these crossings;

e. Allocate all cost for all of the above activities to NS and PECO; and

f. Grant any other relief in the public interest and as the Commission deems just and proper.

Respectfully submitted,

/s/ Carl R. Shultz

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Counsel for the Borough of Royersford

Date: July 28, 2025

VERIFICATION

I, Anil Dham, am Council President of the Borough of Royersford, Pennsylvania ("Borough"), and I hereby state that the facts set forth in the foregoing Petition for Emergency Order are true and correct to the best of my knowledge, information, and belief, and that I expect the Borough to be able to prove the same at a hearing held in this matter. I understand that the statements herein are made subject to the penalties of 18 Pa. C.S. § 4904 (relating to unsworn falsification to authorities).

Dated: 7/21/20

Anil Dham, Council President

Borough of Royersford, Pennsylvania

BEFORE THE
PENNSYLVANIA PUBLIC UTILITY COMMISSION

PETITION OF THE BOROUGH OF ROYERSFORD, PENNSYLVANIA FOR EMERGENCY ORDER	:	Docket No. _____

EMERGENCY ORDER

AND NOW, this ___ day of ____ 2025, upon consideration of the Petition for Emergency Order filed by the Borough of Royersford, Pennsylvania ("Borough"), it is hereby ordered that the Petition is GRANTED.

The Norfolk Southern Corporation ("NS") and PECO Energy Company ("PECO") are hereby ORDERED to immediately repair and ensure the proper function of the grade crossing warning equipment located at the Main Street and Arch Street railroad crossings within the Borough. It is further Ordered that:

a. The Main Street and Arch Street grade crossings identified by Petitioner are currently inadequate and dangerous to the safety and welfare of the public and immediately require NS and PECO to collaborate in the alteration and improvement of said crossings as soon as possible;

b. Until the Main Street and Arch Street crossings are fully functional and operational those crossings shall be closed to rail traffic pending full resolution. NS shall close the affected crossings to rail traffic pending repair, testing and certification by the Commission's Rail Safety and Motor Carrier Compliance Section

c. To the extent that affected crossings remain open to rail traffic, (1) NS is hereby ordered to Stop and Protect at each crossing, where all trains are stopped and a safety

check is performed at each stop before each crossing; (2) NS shall make available an emergency response team within a reasonable time frame to be determined by the Commission's Rail Safety and Motor Carrier Compliance Section in the event of malfunctions; and (3) NS shall implement a traffic control plan, at the expense of NS;

d. NS is required to comply with Federal Railroad Administration (FRA) standards in connection with the repair and operation of these crossings;

e. All costs for the above activities shall be allocated to NS and PECO in proportion to the work required by each to repair and ensure the proper function of the grade crossing warning equipment located at the Main Street and Arch Street railroad crossings within the Borough.

EXHIBIT A

Norfolk Southern
CP Cromby

Electrical Interference Continued Investigation Report 2023

National Signal Technology

Prepared by: Chris Ausefski

Revision 01
July 14, 2023

Reviewed by: Aaron Connor

Table of Contents

Table of Figures

1. Executive Summary

1.1. Introduction

NST had previously performed an investigation for NS regarding electrical interference and compatibility issues in the area of CP Cromby on the Harrisburg line in 2019. In June of 2023, NST was contacted by NS, stating that they had experienced persistent issues since the installation of the PSOe track circuits in 2018 and requested assistance is diagnosing and mitigating the issues.

NS stated that they had not only experienced failed track circuit equipment boards, but also had now uncovered a situation where a PSOe track circuit failed to show occupied under a broken rail condition.

In an effort to remedy these conditions, NST traveled to the site to investigate various possible mitigation methods to alleviate the issues of the failing equipment.

1.2. Summary of Work Performed

NST was joined by representatives from NS C&S department as well as Siemens in a joint effort to mitigate the issues. Mitigation work started at the point the 2019 investigation had left off, removing impedance bonds in the area to uncover the underlying conditions of electrical interference in the area.

Currents were again found to be in the 60A range on the rails. Impedance bonds in the area that paralleled the 230kV transmission line were removed. This removed any additional conduction interference on the rails and left only the underlying magnetic induction from the overhead transmission lines on the rails. Removal of the impedance bonds between the rails and across the insulated joints revealed a few underlying issues that were masked by the presence of the impedance bonds.

At least four failed insulated joints were uncovered. The failed insulated joints created a condition that allowed rail to rail imbalances to climb to significant levels, damaging track circuit equipment. In a scenario that is discussed in section 4.2, a single train axle shunting two adjoining track circuits together could cause a rapid spike in rail-to-rail potential, damaging track circuit equipment. 60 Hz high power track filters were installed between the rails to mitigate this phenomenon, and post mitigation measurements noted a maximum of $7V_{RMS}$ rail-to-rail in this scenario.

The Power System and Railroad Electromagnetic Compatibility Handbook [1] was utilized in assessing the observed onsite measurements as it references relevant AREMA limits. With the isolation of track circuits to their minimum effective lengths through removal of the impedance bonds across the insulated joints, the minimum steady state induction numbers could be measured. This revealed three scenarios. The first being that railway workers touching a given track on the right of way were below the 5 mA_{RMS} limits [1] for touch potential in all but six cases measured out of forty-seven. Second, that railway workers could be exposed to voltages across the insulated joints at values in excess of the 50 V_{RMS} limit [1] in areas where two long track circuits met. This was found to be exacerbated in areas with failed insulated joints. Lastly, voltages inside the signaling houses were hazardous to workers without PPE.

1.3. Conclusions

The conclusions of this field effort can be summarized in three areas. Human exposure under nominal conditions, signaling equipment exposure under nominal conditions, and human exposure under fault conditions.

After all work was completed, human exposure under nominal conditions was found to be generally of an acceptable level for workers outside of the signal equipment houses. Railway workers standing on top of the ballast are provided a significant isolation from ground. This made rail-to-ground current measurements for human analogs of 500Ω and 1000Ω to be generally below the limit of 5 mA_{RMS} which is the acceptable level identified by AREMA. The impedance bonds converted this potential difference into a current flow through the rails. Removing the bonds significantly reduced the hazard of track and signaling workers being exposed to high current while working with the running rails. Prior to removing the bonds, current measured through the rail was as high as 60 A_{RMS} to 70 A_{RMS} as measured during testing in 2019. After the bond removal, these levels greatly improved since currents through the rails were found to be only at a maximum of approximately 4 A_{RMS} in the middle of the track circuits, and would drop to zero at the signal wire interface points. Removal of the impedance bonds does however result in an increased voltage potential across insulating joints. Most measurements were acceptable, however the voltage level across insulating joints is in excess of the 50 V_{RMS} limit [1] in three areas, and will likely require additional mitigation to bring it to an acceptable level. With high voltage potentials present, signaling workers inside of the signaling houses are exposed to the voltage levels without the benefit of the high resistance to ground plane provided by ballast. Signaling houses in the area are all constructed of conductive metals which are electrically bonded to ground. This creates a high level shock hazard of working with bare conductors within the signaling house. A mandatory insulating glove policy is suggested as part of this report for workers handing bare conductors (track leads) within the signaling houses.

Signaling equipment exposure under nominal conditions was found to be significantly reduced after all work was completed. With the repair of insulating joints, removal of high levels of conducting currents on the rails, and installation of 60 Hz high power track filters; equipment was found to be exposed to transient voltage spikes of only approximately 7 V_{RMS}. Additionally, removal of the power frequency impedance bonds allows for the use of DC track circuits.

Human exposure under fault conditions will likely exceed the specified acceptable level of 650 V_{RMS} [1]. Both the previous mitigation scheme of impedance bonds and the currently implemented isolation scheme, could result in touch potential levels that will most likely be significantly greater than the accepted level of 650V_{RMS} during a fault on the overhead transmission lines. In order to mitigate this hazard, NST simulations show that a single or multiple counterpoise wire installation will likely be required to reduce magnetically induced potentials to an acceptable level.

1.4. References

[1] "Power System and Railroad Electromagnetic Compatibility Handbook" Revised First Edition, November 2006

[2] "United States - Maps - U.S. Energy Information Administration (EIA)". Eia.Gov, 2019. https://www.eia.gov/state/maps.php.

[3] "A phase-selective signal solution for inductive interference on non-electrified railroads" March 1991

2. General test descriptions

This section gives a brief description and objective for each test or data set that was collected as part of this investigation. During follow up measurements, the Fluke 117 DMM was substituted for the DEWESoft data acquisition unit in the interest of time. The test configuration which was used to profile the rails including rail to ground, rail to rail, and frequency spectrum measurements is shown in Figure 1.

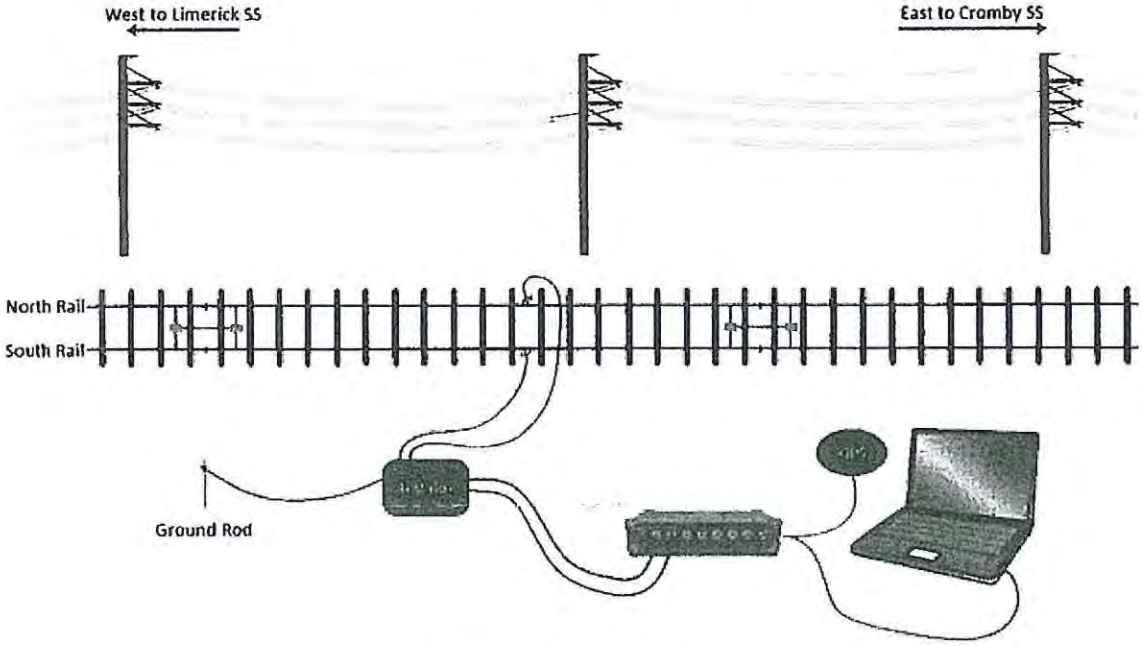

Figure 1: Rail Profile Test Setup

2.1. Test instrumentation

The main test equipment components necessary for this investigation and are listed below:

- DEWESoft SIRIUSi Data Acquisition Unit.
- Laptop (Running DEWESoft X software)
- Fluke i-3000S Flex-36/ Flex-24 current clamp (Rogowski coil)
- Fluke 376 True RMS Clamp Meter
- Rail clamps
- Ground rod
- Fluke 117 Digital Multimeter
- Touch potential test box

2.2. Rail to ground voltage (each rail)

Measuring the rail to ground voltage identifies the potential between the rails and the earth in close proximity. In addition to high impedance rail voltage measurements, touch potential for humans was also tested with the same setup. The test box shown in Figure 1 between the data acquisition unit and the rail connections allows measurements to be made with a series connected 500Ω or 1000Ω resistor in addition

to the high impedance measurement from rail to ground. The ground reference is a temporary ground rod driven about one foot into the ballast. The voltage across the resistor is measured and current through the resistor is calculated in order to identify the human touch potential. The measured current values are compared against known levels to make an assessment on personnel hazards.

2.3. Rail to rail voltage

Measuring the rail-to-rail voltage identifies if there are any unbalanced sections. The impedance bonds that were previously installed were balancing the rails, so the rail-to-rail measurements were relatively low with them in place. Measurements made after the removal of the impedance bonds reveals rail-to-rail imbalance due to the effects of magnetic induction from the overhead transmission lines. The signaling equipment is subject to the rail-to-rail imbalance which can cause damage if the imbalance is too great.

2.4. Across IJ Voltage

Measuring the voltage across the insulated joints serves two purposes. One, it quantifies the relative waveforms of the voltages to be additive, indicating they are from the same inductive source. Two, it serves to compare the measurement against the AREMA limit of $50V_{RMS}$. Excessive voltage across insulating joints can cause premature electrical failure of the joint as well as damage to signaling equipment when staggered joints are shunted by a train axle.

2.5. Current through the track filter

Identifying current through the 60Hz track filters installed serves to show the level of rail-to-rail imbalance that exists. Two rails, roughly experiencing the same conditions, should have less than 2A of current dissipated through the track filter. Excessive current points to an issue with insulating joints.

2.6. Test Support Personnel

The tests were performed by National Signal Technology engineer Chris Ausefski. Garrett Bedell coordinated all NS resources and facilitated the investigation. NS maintainers provided support for the investigation. Siemens was represented onsite by Frank. We would like to express our thanks to all involved without whose complete cooperation this investigation could not have been completed in the short duration required.

3. Test Site Information

3.1. Conditions of Impedance Bonds

The impedance bonds were initially installed to resolve inductive issues that started at the commissioning of the 230kV line in the railroad right of way. This was confirmed by the inductive interference mitigation report [3] which was provided after the completeion of testing. The impedance bonds were installed in a "drain bond" configuration as shown in Figure 2. The issue with this particular form of mitigation is that it trades induced voltage for conducted current. The trade-off to conducted current does not eliminate the hazard to railway workers or signaling equipment. Hazards exist with both conducted currents and induced voltage electrical energies on the railroad, and this was evidenced by the numerous equipment failures experienced over the years.

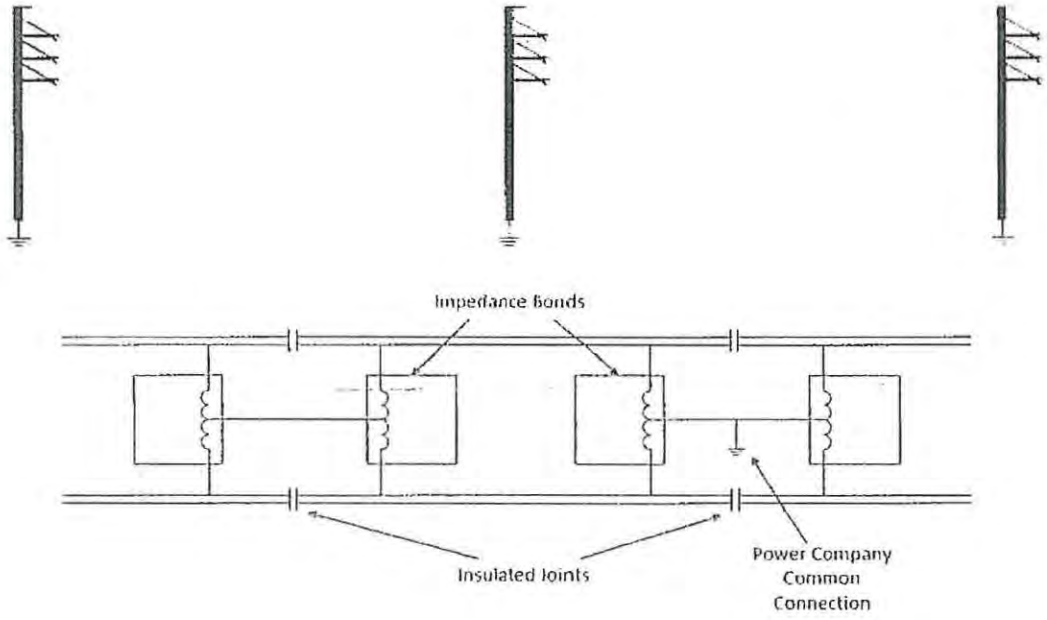

Figure 2: Impedance Bond Configuration

The observed state of the impedance bonds upon arrival indicated that various configurations were explored in an attempt to resolve issues with the signaling equipment in the area. Some impedance bonds had been completely disconnected. Some had been removed from their power company grounding connections. Others had new ground rods connected in parallel with the existing power company connections.

4. Actions Taken

4.1. Reconfiguring impedance bonds

An initial onsite assessment was taken upon arrival. The various impedance bond configurations were noted, and the decision was made to simplify the mitigation scheme to segment the track circuit blocks electrically and quantify the underlying issues in each section. Working from the outside in, all track circuit equipment was removed from the block being modified. Impedance bond connections to the rail were then removed. Voltage potentials and currents were measured prior to reconnection of the track circuit equipment to prevent damage due to large rail-to-rail imbalance that may have been present.

4.2. Issues uncovered

During the process of bond removal, several issues were uncovered that were masked by the presence of the impedance bonds. The first, and most critical, issue that was uncovered were several failed insulating joints. These failed insulating joints caused excessive rail-to-rail potentials in a steady state condition due to induced voltage effects on uneven lengths of rail. These levels were approximately 10V rail-to-rail in the affected blocks. However, when a train axle would either enter or exit the block, and a single axle was bridging two adjoining blocks together due to staggered insulated joints, this voltage could reach excessively high levels. These levels were calculated to be in excess of 80V. This high potential difference across the track circuit equipment caused the failure of crossing track cards in the area, and visible sparking could be seen from the train axle leaving the block. This issue was primarily mitigated through replacement of the failed insulating joints. However, the phenomena of the bridged track circuit was still present, albeit on a lower level of $50V_{RMS}$. In order to mitigate this hazard to the equipment, high power 60 Hz track filters were installed between the rails at both ends of each track section isolated by insulated joints. The addition of these filters resulted in the potential experienced by the track circuit equipment to be greatly reduced by balancing the induced voltage rail-to-rail. The level was measured to be a maximum of 7V rail-to-rail, and a current of 7A was dissipated through the track filter. The filters help prevent the large voltage spikes experienced when a train axle bridges two adjoining blocks when traversing an insulated joint.

Another issue uncovered was an improperly wired signal repeater location masked by the impedance bonds. With the bonds in place, the signal was able to travel from the opposite track block into the proper track block to permit operation. However, with the removal of the bonds, it became evident that the positive leads were reversed from east to west. This issue was corrected.

4.3. Touch Potential

Touch potentials were measured near insulating joints, post modification, though the seven-mile investigation area. High impedance voltage measurements were made followed by touch potential measurements. A 500Ω and a 1000Ω resistor was placed between the rail and ground to represent worst case impedance of the human body. The current measured through the resistor represents the potential current that could flow through the human body. It is important to keep in mind that this testing used a ground rod driven into the ballast for a ground reference which is a better path that what would exist for personnel standing on top of the ballast with insulated shoes. The results for human touch potential testing as part of this investigation can be found in Table 1. Figure 3 shows human reactions to various levels of current as identified in Section 7 of the Power System and Railroad Electromagnetic Compatibility Handbook [1]. The table is shaded from the lowest measured values (green) to the highest measured values (red). Overall, the touch potentials from rail-to-ground remained moderate (under 5 mA) throughout the track section from Cromby to Limerick. Six of the forty seven measurements exceeded

touch potential limits for rail-to-ground, which are highlighted in red. Three measurement locations had voltages exceeding 50 V_{RMS}.

Table 1: Touch Potential Measurements

Lat	Lon	Track	Direction	Length	North Rail to Ground 1MΩ	South Rail to Ground 1MΩ	Rail to Rail 1MΩ	North Rail Across IJ 1kΩ	South Rail Across IJ 1kΩ	Rail to Rail 1kΩ	Rail to Rail 500Ω	North Rail Across IJ 1kΩ mA	South Rail Across IJ 1kΩ mA	North Rail to Ground 1kΩ mA	North Rail to Ground 500Ω mA	South Rail to Ground 1kΩ mA	South Rail to Ground 500Ω mA	Rail to Rail 1kΩ mA	Rail to Rail 500Ω mA
40.22869	-75.5926	Main 1	E	2860	2.006	2.36	3.563	5.7	6.3	3.545	3.513	5.7	6.3	1.731	3.45	1.8	3.67	3.545	7.026
40.22869	-75.5926	Main 2	E	2860	3.108	3.67	3.882	6.1	7.1	3.893	3.862	6.1	7.1	1.905	3.772	1.978	3.976	3.893	7.724
40.22467	-75.591331	Main 1	M	2860	2.183	2.455	1.903			1.913	1.882	0	0	0.932	1.85	0.97	1.93	1.913	3.764
40.22467	-75.591331	Main 2	M	2860	3.508	3.836	1.912			1.896	1.906	0	0	0.847	1.892	0.975	1.932	1.896	3.812
40.22187	-75.588401	Main 1	W	2860	12.23	11.73	0.902	16.9	16.97	0.891	0.893	16.9	16.97	0.4369	0.8736	0.4584	0.9228	0.891	1.786
40.22187	-75.588401	Main 2	W	2860	9.77	9.85	0.671	15	15	0.669	0.667	15	15	0.3289	0.6592	0.3427	0.6812	0.669	1.334
40.22187	-75.588401	Main 1	E	3170	5.378	5.541	1.02	16.9	16.97	1.001	1.004	16.9	16.97	0.5003	0.9946	0.5134	1.036	1.001	2.008
40.22187	-75.588401	Main 2	E	2930	4.647	4.519	0.87	15	15	0.862	0.856	15	15	0.3954	0.8516	0.4403	0.879	0.862	1.712
40.21484	-75.583143	Main 2	W	2930	18.87	18.91	2.534	44.4	44.3	2.53	2.505	44.4	44.3	1.244	2.486	1.315	2.556	2.53	5.01
40.21484	-75.583143	Main 2	E	6780	25.75	25.67	0.3227	44.4	44.3	0.3184	0.3135	44.4	44.3	0.158	0.311	0.1721	0.3268	0.3184	0.627
40.21414	-75.582886	Main 1	W	3170	21.33	21.34	1.905	42.4	42.6	1.901	1.902	42.4	42.6	0.933	1.872	0.973	1.946	1.901	3.804
40.21414	-75.582886	Main 1	E	6780	21.48	21.67	0.4066	42.4	42.6	0.3974	0.4036	42.4	42.6	0.1941	0.399	0.2122	0.4178	0.3974	0.8072
40.20656	-75.578164	Main 1	M	6780	1.34	1.251	0.2566			0.2581	0.2508	0	0	0.1844	0.3048	0.1442	0.2532	0.2581	0.5016
40.20656	-75.578164	Main 2	M	6780	0.88	0.891	0.3753			0.379	0.3772	0	0	0.1891	0.378	0.2039	0.3884	0.379	0.7544
40.20966	-75.567673	Main 1	W	6780	23.97	24.17	0.854	58.1	58.3	0.853	0.843	58.1	58.3	0.4107	0.8346	0.4432	0.869	0.853	1.686
40.20966	-75.567673	Main 1	E	6920	31.9	31.83	0.4139	58.1	58.3	0.42	0.4201	58.1	58.3	0.2014	0.3994	0.2256	0.4286	0.42	0.8402
40.20966	-75.567673	Main 2	W	6780	27.32	27.72	0.764	82.1	82.5	0.758	0.753	82.1	82.5	0.3727	0.7436	0.3893	0.77	0.758	1.506
40.20966	-75.567673	Main 2	E	6920	51.79	52.25	0.673	82.1	82.5	0.678	0.676	82.1	82.5	0.277	0.6052	0.3977	0.7304	0.678	1.352
40.20481	-75.554668	Main 1	M	6920	10.74	10.63	0.2874			0.2868	0.2804	0	0	0.1533	0.2904	0.1445	0.2822	0.2868	0.5608
40.20481	-75.554668	Main 2	M	6920	9.01	10.44	1.528			1.515	1.512	0	0	0.717	1.476	0.825	1.6	1.515	3.024
40.19905	-75.551582	Main 1	W	6920	25.18	25.25	0.4641	43.5	43.6	0.4436	0.4413	43.5	43.6	1.177	1.276	1.178	1.27	0.4436	0.8826
40.19905	-75.551582	Main 1	E	5500	18.41	18.54	1.177	43.5	43.6	1.171	1.167	43.5	43.6	0.973	1.374	1.067	1.524	1.171	2.334
40.19905	-75.551582	Main 2	W	6920	5.955	4.636	2.179	6.6	2.6	2.165	2.16	6.6	2.6	1.739	2.29	0.955	2.044	2.165	4.32
40.19905	-75.551582	Main 2	E	5160	3.746	2.212	2.926	6.6	2.6	2.915	2.913	6.6	2.6	1.495	2.918	1.423	2.892	2.915	5.826
40.18593	-75.544613	Main 2	W	5160	41.3	42.08	1.755	54.6	55.6	1.749	1.741	54.6	55.6	2.59	3.198	1.42	3.734	1.749	3.482
40.18593	-75.544613	Main 2	E	3060	13.4	13.38	0.5291	54.6	55.6	0.4546	0.4631	54.6	55.6	2.559	2.838	2.563	2.872	0.4546	0.9262
40.18506	-75.544146	Main 1	W	5500	23.14	23.29	1.315	34.1	34.4	1.268	1.318	34.1	34.4	1.883	2.174	2.032	2.434	1.268	2.636
40.18506	-75.544146	Main 1	E	3060	11.02	11.12	1.051	34.1	34.4	1.032	1.032	34.1	34.4	0.953	1.27	1.064	1.46	1.032	2.064
40.17853	-75.539365	Main 1	W	3060	11.32	11.5	1.878	21.9	22.1	1.893	1.812	21.9	22.1	1.832	2.5	1.949	2.614	1.893	3.624
40.17853	-75.539365	Main 1	E	2560	10.86	11.01	1.549	21.9	22.1	1.53	1.514	21.9	22.1	1.703	2.19	1.818	2.38	1.53	3.028
40.17853	-75.539365	Main 2	W	3060	15.19	15.26	1.188	25.8	25.9	1.185	1.074	25.8	25.9	2.253	2.592	2.368	2.802	1.185	2.148
40.17853	-75.539365	Main 2	E	2560	11.07	10.99	2.889	25.8	25.9	1.989	1.975	25.8	25.9	1.877	2.6	1.899	2.678	1.989	3.95
40.17374	-75.532411	Main 1	W	2560	9.9	10.15	1.239	16	15.9	1.215	1.089	16	15.9	0.656	1.18	0.782	1.354	1.215	2.178
40.17374	-75.532411	Main 1	E	780	6.05	5.8	1.308	16	15.9	1.311	1.339	16	15.9	0.749	1.384	0.66	1.302	1.311	2.678
40.17374	-75.532411	Main 2	W	2560	11.48	11.73	1.335	17.2	16.6	1.318	1.331	17.2	16.6	1.052	1.486	1.25	1.808	1.318	2.667
40.17374	-75.532411	Main 2	E	780	5.83	5.052	1.536	17.2	16.6	1.526	1.511	17.2	16.6	1.049	1.774	0.68	1.376	1.526	3.027
40.17313	-75.531148	OS	M	780	0.695	0.5114	1.198			1.174	1.17	0	0	0.584	1.162	0.5888	1.1928	1.174	2.34
40.17243	-75.530235	Main 1	W	780	7.26	7.37	1.1	41.2	39.3	1.083	1.087	41.2	39.3	0.5308	1.0648	0.569	1.1194	1.083	2.174
40.17243	-75.530235	Main 1	E	6840	34.12	32.08	2.766	41.2	39.3	2.771	2.733	41.2	39.3	1.62	3.004	1.185	2.636	2.771	5.466
40.17243	-75.530235	Main 2	W	780	7.17	6.91	1.41	49	48.8	1.383	1.399	49	48.8	0.705	1.372	0.69	1.392	1.383	2.798
40.17243	-75.530235	Main 2	E	6840	42.13	42	0.1366	49	48.8	0.1352	0.1355	49	48.8	0.4805	0.5462	0.345	0.2816	0.1352	0.271
40.16838	-75.52618	Main 1	M	6840	7.62	5.76	2.365			2.327	2.338	0	0	1.199	2.348	1.169	2.332	2.327	4.676
40.15572	-75.525169	Main 1	W	6840	11.84	12.52	1.676	15.2	15.7	1.773	1.658	15.2	15.7	0.835	1.758	0.928	1.76	1.773	3.316
40.15572	-75.525169	Main 1	E	2930	3.924	3.839	0.4252	15.2	15.7	0.4232	0.4054	15.2	15.7	0.2423	0.456	0.2255	0.4774	0.4232	0.9308
40.15262	-75.526747	Main 1	M	2930	1.738	1.486	0.4704			0.4598	0.478	0	0	0.2397	0.4528	0.4217	0.466	0.4598	0.956
40.14946	-75.52346	Main 1	W	2930	2.958	2.717	0.4516	4.1	4.1	0.4963	0.5054	4.1	4.1	0.2347	0.4884	0.2214	0.5032	0.4963	1.0108
40.14946	-75.52346	Main 1	E		3.943	4.014	0.0852	4.1	4.1	0.3906	0.0569	4.1	4.1	0.2191	0.0854	0.3906	0.1138	0.3906	0.1138

Threshold of Sensation This varies with skin chemistry; a few individuals may be able to discern 1/2 milliampere, while others are unable to discern levels up to 3 milliamperes.	1 milliampere (0.001 ampere)
Mild Shock may start---not painful	**2 milliamperes**
Muscular Contraction, But Can Let Go If not grasping an object, involuntary muscle contraction can cause the body to jerk away from the object.	**2 to 10 milliamperes**
Painful Shock may start	**4 milliamperes**
GFCI Breaker Will Trip	**5 milliamperes**
Inability to Let Go (If grasping an object) The let-go current level is generally greater for larger persons; with adult males running in the upper portion of this range, and children running in the lower portion; the let-go current for infants may be as low as 3 milliamperes. Painful shock. *Serious burns may begin, if contact time is long enough.*	**6 to 25 milliamperes** @ 60 cycles a-c, 99.5% of women can let go with 6 ma; 99.5% of men can let go with 9 ma. (for direct current: 41 ma & 62 ma respectively)
Threshold of Unconsciousness and Possible Asphyxia Difficulty in breathing begins in the early portion of this range; at the end of the range, breathing is very difficult and suffocation may have begun.	**20 to 50 milliamperes**
Fibrillation and Asphyxia may begin Fibrillation of the heart interrupts or reduces blood flow and exacerbates breathing difficulties and reduces brain function.	**40 to 100 milliamperes**
Electric Toothbrush Will Operate (10 Watts)	**90 milliamperes**
Fibrillation to Cardiac Arrest Above 200 ma, chest muscles may clamp heart and stop it during duration of shock, thus preventing fibrillation	**100 milliamperes to 1-4 amperes**
Severe Burns and Hemorrhage Severe muscle contractions occur. Depending upon contact pressure and moisture content of flesh at contact point, heat will turn moisture into steam causing an explosive expulsion of enough material to break contact.	**200-300 milliamperes**
40 Watt Light Bulb Will Operate	**350 milliamperes**

Figure 3: Reactions to Various Levels of Current

4.4. Simulation Analysis

It does not appear that the original study [3] which identified impedance bonds as the mitigation for induced voltage on the rails did not consider fault conditions of the overhead transmission lines which can have significant impacts on the observed inductive interference. All field measurements and analysis up until this point has only considered steady state conditions. In order to discuss the entire scope of steady state and fault condition hazards, a simulation of the induced magnetic fields into the running rails was performed to assess the potentials that could exist under different conditions.

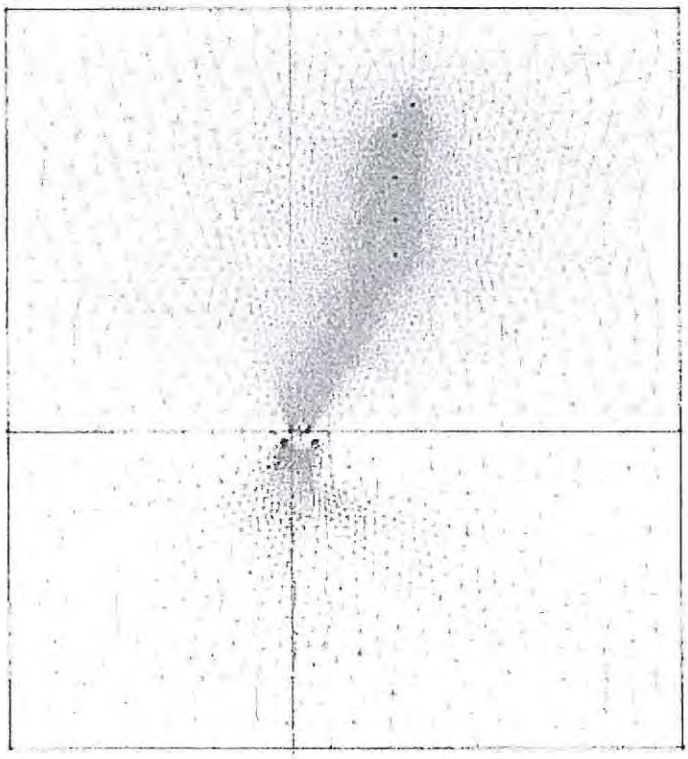

Figure 4: Magnetic Field Simulation

The simulation was built utilizing software which considers the electrical and physical characteristics of both the transmission line and running rails. Figure 4 graphically shows a cross-section of the running rails along the x-axis with counterpoise wires below the rails. The three phase transmission lines are vertically stacked with a shield wire on top which accounts for the majority of the power poles currently in the right of way. The simulation did not consider the other less utilized transmission line configurations in the right of way such as the delta configuration. An aerial counterpoise is also shown below the phase conductors. The conductors are then electrically connected and configured in the simulation with all other attributes considered to determine the magnetic induction graphically shown in green. The simulation data and configuration were first validated against field measurements with predictable results within 10% considering a steady state. Then, different conditions were configured to determine the worst-case scenarios including rail-to-rail, rail-to-ground, and across an insulated joint. Touch potentials were modeled in different nominal loading cases and fault conditions of the transmission line. No voltages should exceed $650V_{RMS}$ during a fault and steady state voltages across an insulated joint should not exceed $50V_{RMS}$ [1]. Simulated values were calculated as shown in Table 2. Different counterpoise wire configurations were also simulated to introduce demonstrate possible mitigation schemes with the aerial counterpoise being most effective placed between the rails and lowest phase conductor.

Table 2: Simulated Voltage Potentials

	Full Loading Nominal				Fault Conditions			
	N Rail	S Rail	R to R	IJ	N Rail	S Rail	R to R	IJ
No Counterpoise	70.6	73.3	2.7	146.6	604.1	616.8	37.5	1233.6
Aerial Counterpoise	12.6	14.7	2.4	29.5	392.9	377.1	36.5	785.8
Aerial and Underground Counterpoise	6.2	8.6	2.4	17.1	139.7	131.1	36.2	279.3

4.5. Possible Mitigations

There are two configurations to be discussed in terms of effectively dealing with induced voltage from the transmission lines including the result of the original study which recommended the use of impedance bonds and the current configuration which utilizes high power track filters. Both railroad-controlled mitigation configurations of grounded impedance bonds and isolated sections with track filters do not independently provide sufficient mitigation to meet the referenced limits [1]. The fundamental issue with both mitigations is that they are trying to deal with the already induced energy rather than trying to reduce the source of the energy. Neither of these mitigation techniques should not be utilized as the only solution to the induced voltage issue, however independently each has its own benefits.

4.5.1. Impedance Bonds

- Advantages
  - Rail-rail balance
  - Low rail-to-ground potential
- Dis-Advantages
  - High current flowing through the running rails
  - Need to use AC track circuit
  - Likely to have continued equipment failure
  - Connections to the transmission line ground need repaired

4.5.2. 60Hz high power track filter

- Advantages
  - Rail-rail balance
  - Low rail current
  - Can use DC coded track circuits
- Dis-Advantages
  - High rail-to-ground touch potential in signal houses
  - High touch potential across IJ
  - Potential equipment failure with failed IJ or 60Hz filter

4.5.3. 60Hz filter and counterpoise

Although the simulations show that an aerial counterpoise could greatly reduce the level of induced voltage, it should be implemented in conjunction with isolated sections utilizing track filters

- Advantages
  - Rail-rail balance
  - Low rail current
  - Can use DC coded track circuits
  - Acceptable rail-to-ground touch potential [1] in signal houses based on simulations
  - Acceptable touch potential [1] across IJ based on simulations
- Dis-Advantages
  - Requires the cooperation of the transmission line owner/operator

5. Conclusion

As was originally detailed in the 1991 study [3], electrical interference has been an ongoing issue at CP Cromby since the commissioning of the 230 kV transmission line. It is clear that the original mitigation scheme solved some issues while creating others. While previously deemed acceptable, 70-110A_{RMS} of current running on the rails that cannot be shut off is not desirable. Any disturbance of the electrical configuration of the rails, given broken equipment or servicing, places the workers and equipment at risk. Over the years, the grounding connections of the impedance bonds have degraded, and many pieces of equipment have been lost to electrical damage. The best mitigation scheme moving forward to combat magnetic induction is believed to be the installation of a counterpoise.

The counterpoise serves to be a sacrificial conductor to purposely induce a current and create a destructive interference current, and thusly a magnetic field, in the earth. In this way, the problem is passively mitigated in a way that reduces the effects of the source of the emission rather than trying to dissipate the energy after it has already been induced into the rails. The preliminary simulation analysis investigated two possible counterpoise configurations for consideration including both an aerial and underground. The feasibility of these mitigations should be discussed with the transmission line operator/owner. However, preliminary simulations show a possible steady state reduction of approximately 80%-90% of magnetic induction. Either railroad-controlled mitigation configurations of isolated sections with track filters or grounded impedance bonds do not provide sufficient mitigation to meet AREMA standards.

The ongoing issue of operation for the CP Cromby area stems from inadequate mitigation of the transmission line in the railroad right of way. Further mitigation beyond drain bonds and track filters needs to be implemented in order for the hazards to equipment and personnel to be acceptable on an ongoing basis. Both the transmission line operator and the railroad must work together to mitigate this interference to an acceptable level to both parties. Similar measurements of rail-to-rail voltage, rail-to-ground voltage, voltage across insulated joints, and current through the rail should be made with any modifications performed to the existing configuration to properly assess any hazards to workers and signaling equipment.

In the interim, some immediate actions are recommended including:

- Evaluation of insulated joint conditions in the area.
  - Any failed insulated joints in the area need to be replaced in order to reduce the effect of induced magnetic fields from the overhead transmission lines.
  - Insulated joints must be maintained in the area since a failure of a joint can lead to elevated potentials posing a hazard to both workers and signaling equipment.
- Installation of 60Hz filters in remaining track blocks.
  - All track blocks in the area containing overhead transmission lines should have high power 60 Hz filters installed near the insulated joints at either end of the block.
  - The filters must be maintained as they provide rail-to-rail balance. A failure or removal of the filter can result in equipment failure.
- Implement maintenance procedures.
  - Work performed in signaling houses should require insulating gloves to prevent the hazard of high potential between track leads and any ground reference.
  - Track work performed in the area during degraded ground isolation conditions such as rain should require insulating gloves while working on the running rails.

- Types of work performed on the running rails should be evaluated and safeguards should be implemented for personal and equipment safety. For example, shunts could be installed from rail-to-rail when servicing insulated joints or track filters to reduce the rail to-rail imbalance.

EXHIBIT B

Report Date / Time	PD Case #	Assigned Name / Case Role Type	Location&Address / Loc. Type	Agency Incident / Actual CFS Type		
08/08/2024 07:59	2024-02341	ROYERSFORD, PD (PRIMARY) (OFFICER)	ARCH ST/2ND AVE RYFD, ROYERSFORD BORO, PA	FIRE POLICE NEEDED	1108-0759	349
08/08/2024 07:17	2024-02340	ROYERSFORD, PD (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	FIRE POLICE NEEDED	0717-0742	25
08/06/2024 20:09	2024-02326	NORCINI, JOSEPH LOUIS (PRIMARY) (OFFICER) ONEILL, JAMES P (SECONDARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	5425 HWY 31, IN 47129 (BUSINESS) 6 S CHURCH ST, SPRING CITY, PA 19475 (GOVERNMENT) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	2009-0237	628
08/03/2024 23:34	2024-02287	ROYERSFORD, PD (SECONDARY) (OFFICER) WAKELEY, DAVID (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	TRAFFIC HAZARD	2334-0005	71
07/22/2024 06:44	2024-02144	ROYERSFORD, PD (PRIMARY) (OFFICER)	LL(-75:32:22.6702,40:10:43.1782): @RR & ARCH ST RYFD, PA	SIGNALS SIGNS OUT	0644-0646	2
07/22/2024 05:58	2024-02143	WAKELEY, DAVID (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	0558-0708	150
07/22/2024 05:32	2024-02142	WAKELEY, DAVID (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	0532-0554	22
07/17/2024 23:10	2024-02090	SMYTHE, MARK (PRIMARY) (OFFICER)	1200 PEACHTREE ST NE, ATLANTA, GA 30309 (COMMERCIAL) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	2310-2330	20
07/17/2024 20:16	2024-02089	ROYERSFORD, PD (SECONDARY) (OFFICER) SOUDERS, ROBERT (PRIMARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	2016-2248	232
07/17/2024 15:04	2024-02088	NORCINI, JOSEPH LOUIS (PRIMARY) (OFFICER) ONEILL, JAMES P (SECONDARY) (OFFICER)	738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:22.6702,40:10:43.1782): @RR & ARCH ST RYFD, PA	SIGNALS SIGNS OUT	1504-1626	122
07/14/2024 01:01	2024-02044	SMYTHE, MARK (PRIMARY) (OFFICER)	1200 PEACHTREE ST NE, ATLANTA, GA 30309 (COMMERCIAL) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	0101-0108	7
06/30/2024 18:11	2024-01888	ONEILL, JAMES P (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	147 MAIN ST, ROYERSFORD BORO, PA	SIGNALS SIGNS OUT	1811-0433	1022
06/30/2024 18:03	2024-01887	ONEILL, JAMES P (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1803-1808	5
06/30/2024 16:33	2024-01886	EGER, ZACCHAEUS (PRIMARY) (OFFICER) ONEILL, JAMES P (SECONDARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1633-1639	6
06/06/2024 16:57	2024-01655	HAVRILAK, RAYMOND JOHN (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	ARCH ST/DIAMOND PL RYFD, ROYERSFORD BORO, PA	SIGNALS SIGNS OUT	1657-0439	1182
06/06/2024 16:32	2024-01653	DEEGAN, KEVIN (SECONDARY) (OFFICER) HAVRILAK, RAYMOND JOHN (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	MAIN ST/1ST AVE RYFD, ROYERSFORD BORO, PA	SIGNALS SIGNS OUT	1632-1847	215
04/06/2024 07:49	2024-01011	EGER, ZACCHAEUS (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT - 10+ malfunctions noted	0749-1632	883

04/06/2024 07:10	2024-01010	EGER, ZACCHAEUS (PRIMARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	0710-0726	16
04/02/2024 15:10	2024-00971	HAVRILAK, RAYMOND JOHN (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1510-1515	5
02/17/2024 09:09	2024-00521	ROYERSFORD, PD (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	0909-0926	17
02/13/2024 10:57	2024-00466	FENNELLY, SCOT (PRIMARY) (SUPERIOR OFFICERS)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1057-1125	68
02/09/2024 10:10	2024-00406	SMYTHE, MARK (PRIMARY) (OFFICER)	1ST AVE/MAIN ST RYFD, ROYERSFORD BORO, PA	SIGNALS SIGNS OUT	1010-1022	12
01/22/2024 15:11	2024-00214	EGER, ZACCHAEUS (PRIMARY) (OFFICER) NORCINI, JOSEPH LOUIS (SECONDARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1511-1727	216
01/22/2024 11:20	2024-00212	NORCINI, JOSEPH LOUIS (PRIMARY) (OFFICER)		SIGNALS SIGNS OUT	1120-1124	4
01/22/2024 10:19	2024-00211	NORCINI, JOSEPH LOUIS (SECONDARY) (OFFICER) ROYERSFORD, PD (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1019-1022	3
01/10/2024 11:41	2024-00092	ROYERSFORD, PD (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT	1141-1144	0
01/06/2024 04:59	2024-00044	OBERHOLTZER, JOSEPH P (PRIMARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	SIGNALS SIGNS OUT	0459-0503	4
						88.15 hrs total

EXHIBIT C

ROYERSFORD POLICE DEPARTMENT

Incident Frequency Report

By Agency Code

From Date: 1/1/2025 To Date: 6/27/2025

Report Date: 6/27/2025 Criteria: TRAFFIC HAZARD,SIGNALS SIGNS OUT,

Local Agency Code SIGNALS SIGNS OUT				Total Number 16
Date / Time	**Incident Number**	**CFS Code**	**Address**	**Disposition**
1/5/2025 3:19:47 PM	2025-00028	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: TRAIN GATE STUCK DOWN REPORT. UNFOUNDED				
1/18/2025 3:21:30 PM	2025-00144	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note:				
1/19/2025 4:29:04 PM	2025-00150	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: I HAD COUNTY CONTACT NORFOLK SOUTHERN. THE GATES REMAINED DOWN FOR APPROXIMATELY 30 MINUTES AND THEN CAME BACK UP.				
1/19/2025 7:18:37 PM	2025-00152	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	NO REPORT/NO FURTHER ACTION
Disposition Note: RR GATES STUCK MULTIPLE TIMES				
1/27/2025 3:50:55 PM	2025-00211	6612	MAIN ST/1ST AVE RYFD, ROYERSFORD BORO, PA	CLOSED
Disposition Note: LIGHTS WERE OPERATING AS DESIGNED. NO ISSUE.				
1/28/2025 4:05:04 PM	2025-00222	6612	S 5TH AVE/SPRING ST RYFD, ROYERSFORD BORO, PA	CLOSED
Disposition Note:				
3/3/2025 1:40:21 AM	2025-00512	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: LIGHTS ON RR ARM OUT				
3/21/2025 4:13:54 PM	2025-00739	6612	2ND AVE/MAIN ST RYFD, ROYERSFORD BORO, PA	CLOSED
Disposition Note:				
4/5/2025 5:11:29 PM	2025-00938	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: RR GATES STUCK DOWN				
4/16/2025 1:37:11 PM	2025-01067	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note:				
5/2/2025 1:42:11 PM	2025-01295	6612	LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	CLOSED
Disposition Note:				
5/6/2025 9:44:32 AM	2025-01339	6612	MAIN ST/2ND AVE RYFD, ROYERSFORD BORO, PA	NO REPORT/NO FURTHER ACTION
Disposition Note: ON A MEDICAL CALL, GATES WENT BACK UP PRIOR TO RESPONDING.				
5/12/2025 1:16:20 PM	2025-01439	6612	MAIN ST/N LEWIS RD RYFD, ROYERSFORD BORO, PA	CLOSED
Disposition Note:				
5/30/2025 11:40:18 PM	2025-01652	6612	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: ARMS DOWN				

5/31/2025 10:31:49 PM	2025-01666	6612	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: RR CROSSING ARMS GOING UP AND DOWN EVERY FEW MINUTES WITH NO TRAIN COMING. SEVERAL TIMES OVER 15 MINUTE PERIOD.				
6/26/2025 6:10:08 PM	2025-02010	6612	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	PENDING
Disposition Note: TRAIN ARMS STUCK DOWN				

Local Agency Code				**Total Number**
TRAFFIC HAZARD				**11**
Date / Time	**Incident Number**	**CFS Code**	**Address**	**Disposition**
2/3/2025 4:27:00 AM	2025-00271	6335	N 6TH AVE/ MAIN ST, PA	CLOSED
Disposition Note: ICE ON ROADWAY				
2/17/2025 7:58:31 AM	2025-00370	6335	250 2ND AVE, ROYERSFORD BORO, PA	CLOSED
Disposition Note: CRAIG KEEFER PUBLIC WORKS NOTIFIED.				
3/11/2025 8:43:53 AM	2025-00602	6335	447 N 5TH AVE, ROYERSFORD BORO, PA	CLOSED
Disposition Note:				
3/18/2025 3:20:34 PM	2025-00692	6335	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note: CROSSING ARMS DOWN - LATER WENT UP ON OWN				
3/28/2025 11:17:53 AM	2025-00826	6335	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	CLOSED
Disposition Note:				
5/3/2025 3:47:45 PM	2025-01314	6335	S LEWIS RD/WASHINGTON ST RYFD, ROYERSFORD BORO, PA	CLOSED
Disposition Note:				
5/7/2025 1:04:30 PM	2025-01355	6335	21 2ND AVE, ROYERSFORD BORO, PA	CLOSED
Disposition Note: OIL IN ROADWAY				
6/3/2025 10:15:23 AM	2025-01696	6335	302 SPRING ST, ROYERSFORD BORO, PA	CLOSED
Disposition Note:				
6/19/2025 5:20:54 PM	2025-01934	6335	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	PENDING
Disposition Note: 1720-2357 HOURS				
6/26/2025 7:33:55 PM	2025-02012	6335	LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	NO REPORT/NO FURTHER ACTION
Disposition Note: REF 2025-02010				
6/27/2025 10:56:14 AM	2025-02022	6335	LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	PENDING
Disposition Note: RR XINGS STUCK DOWN AGAIN				

Report Date / Time	PD Case #	Person Name (Type)	Assigned Name / Case Role Type	Location&Address / Loc. Type	Agency Incident / Actual CFS Type
06/28/2025 21:21	2025-02047	NORFOLK SOUTHERN (OWNER)	DEEGAN, KEVIN (PRIMARY) (OFFICER) FENNELLY, SCOT (SECONDARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
06/27/2025 10:56	2025-02022	NORFOLK SOUTHERN(OWNER)	NORCINI, JOSEPH LOUIS (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	4600 DEERPATH RD, HARRISBURG, PA (BUSINESS) LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	TRAFFIC HAZARD
06/26/2025 19:33	2025-02012	NORFOLK SOUTHERN (OWNER)	NORCINI, JOSEPH LOUIS (SECONDARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER) WOOD, THOMAS (PRIMARY) (OFFICER)	LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	TRAFFIC HAZARD
06/26/2025 18:10	2025-02010	NORFOLK SOUTHERN(CONTACT)	ROYERSFORD, PD (PRIMARY) (OFFICER) SLATTERY, MICHAEL (SECONDARY) (OFFICER) WOOD, THOMAS (SECONDARY) (OFFICER)	4600 DEERPATH RD, HARRISBURG, PA (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
06/20/2025 16:00	2025-01944	NORFOLK SOUTHERN (OWNER)	ROYERSFORD, PD (SECONDARY) (OFFICER) WOOD, THOMAS (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	POLICE INFORMATION
06/19/2025 17:20	2025-01934	NORFOLK SOUTHERN CORP. (RAILWAY)(CONTACT)	EGER, ZACCHAEUS (SECONDARY) (OFFICER) HAVRILAK, RAYMOND JOHN (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	TRAFFIC HAZARD
6/18/2025 18:07	2025-01914	NORFOLK SOUTHER (OWNER)	EGER, ZACCHAEUS (SECONDARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	TRAFFIC HAZARD
05/31/2025 22:31	2025-01666	NORFOLK SOUTHERN RAILROAD(OWNER)	ROYERSFORD, PD (SECONDARY) (OFFICER) SLATTERY, MICHAEL (PRIMARY) (OFFICER)	110 FRANBKLIN RD SE, ROANOKE, VA 24004- (BUSINESS) 3 COMMERCIAL PL, NORFOLK, VA 2351024004 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
05/30/2025 23:40	2025-01652	NORFOLK SOUTHERN CORP. (RAILWAY)(CONTACT) ROYERSFORD BOROUGH PUBLIC WORKS DEPT.(CONTACT)	EGER, ZACCHAEUS (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 434 CHESTNUT ST, ROYERSFORD 19468 (OTHER) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT

05/06/2025 09:44	2025-01339	NORFOLK SOUTHERN (OWNER)	NORCINI, JOSEPH LOUIS (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
05/02/2025 13:42	2025-01295	NORFOLK SOUTHERN CORP. (RAILWAY)(BUSINESS)	FENNELLY, SCOT (PRIMARY) (OFFICER) NORCINI, JOSEPH LOUIS (SECONDARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:22.6703,40:10:43.1781): @RR & ARCH ST RYFD, PA	SIGNALS SIGNS OUT
04/16/2025 13:37	2025-01067	NORFOLK SOUTHERN (OWNER)	ONEILL, JAMES P (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
04/09/2025 17:11	2025-00982	NORFOLK SOUTHERN RAILROAD(CONTACT)	NORCINI, JOSEPH LOUIS (PRIMARY) (OFFICER)	110 FRANBKLIN RD SE, ROANOKE, VA 24004- (BUSINESS) 3 COMMERCIAL PL, NORFOLK, VA 2351024004 (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	POLICE INFORMATION
04/05/2025 17:11	2025-00938	NORFOLK SOUTHERN RAILWAY(CONTACT)	NORCINI, JOSEPH LOUIS (SECONDARY) (OFFICER) ONEILL, JAMES P (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
03/28/2025 11:17	2025-00826	BROGNA, MARIA ROSE(CONTACT)	ONEILL, JAMES P (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	1386 JUNIPER ST, POTTSTOWN, PA 19464 (HOME) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	TRAFFIC HAZARD
03/21/2025 16:13	2025-00739	NORFOLK SOUTHERN (OWNER)	HAVRILAK, RAYMOND JOHN (PRIMARY) (OFFICER)	LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	TRAFFIC HAZARD
03/18/2025 15:20	2025-00692	NORFOLK SOUTHERN CORP. (RAILWAY)(CONTACT)	EGER, ZACCHAEUS (PRIMARY) (OFFICER)	3 COMMERCIAL PL, NORFOLK, VA 23510 (BUSINESS) 738 NICOLLS ST, READING, PA 19604 (BUSINESS) LL(-75:32:35.3106,40:10:59.1272): @RR & MAIN ST RYFD, PA	TRAFFIC HAZARD
03/03/2025 01:40	2025-00512	NORFOLK SOUTHERN(OWNER)	DEEGAN, KEVIN (PRIMARY) (OFFICER)	4600 DEERPATH RD, HARRISBURG, PA (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
01/19/2025 19:18	2025-00152	NORFOLK SOUTHERN(OWNER)	DEEGAN, KEVIN (PRIMARY) (OFFICER) ROYERSFORD, PD (SECONDARY) (OFFICER)	4600 DEERPATH RD, HARRISBURG, PA (BUSINESS) LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
01/19/2025 16:29	2025-00150	NORFOLK SOUTHERN (OWNER)	TAYLOR, DAVID (PRIMARY) (DETECTIVE)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT

01/18/2025 15:21	2025-00144	NORFOLK SOUTHERN (OWNER)	ONEILL, JAMES P (PRIMARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT
01/05/2025 15:19	2025-00028	NORFOLK SOUTHERN (OWNER)	TAYLOR, DAVID (PRIMARY) (DETECTIVE) WOOD, THOMAS (SECONDARY) (OFFICER)	LL(-75:32:35.3107,40:10:59.1272): @RR & MAIN ST RYFD, PA	SIGNALS SIGNS OUT

22 Incidents

EXHIBIT D

Background

- PECO's 220-60 transmission line that runs along the Norfolk Southern (NS) Right Of Way (ROW) in Royersford was installed in 1984. The circuit is operated at 230 kV and has been in continuous service for 41 years.
- In 2008, all railroads including NS were mandated by the Federal government to install Positive Train Control system (PTC) on their system by 12/31/2018.
- In 2017, NS installed a PTC system on this corridor.
- After the installation of the new PTC system, NS began experiencing traffic gate mis-operations at the two crossings in Royersford.
  - PTC equipment failures defaults to a fail-safe traffic gate activation. Fail-safe traffic gate activation can last for extended periods of time inconveniencing local vehicle traffic.
  - Typical Equipment failures:
    - Circuit board failures
    - Blown fuses

Looking north on Main Street at NS crossing

peco
AN EXELON COMPANY

June 17, 2025

Norfolk Southern Grade Crossing Signal Issue

peco
AN EXELON COMPANY

→ Arrival has their own police department

→ (emerg. responder 911 like)
- same priority
- call signal

→ call: chain of command

→ emerg. # on sign:
- goes to central dispatch
- go third call list

→ electric vehicles
added layer & complication with voltage

Previous Actions Taken

- In 2019, NS began working with National Signal Technology Inc and Siemens to mitigate the issues (as identified in Norfolk Southern CP Cromby Electrical Interference Report 2023.)
  - Impendence bonds were removed from the system to remove the induction interference safety issue on the rails and help identify any underlying conditions of electrical interference.
    - At least four failed insulated joints were identified, which created a condition that caused damage to track control equipment.
  - 60 Hz high power track filters were also installed to mitigate an unsafe induction condition on the track rails (outside of signal equipment houses).
  - As a result of removing the impedance bonds, conditions inside signal equipment houses worsened and identified as outside acceptable limits.
- In 2023, NS hired National Signal Technology, Inc. to investigate the malfunctioning NS RR Crossing controls in Royersford, PA and provide a report assessing the issue and recommending mitigation measures.

→ like 85 signal failures

- In January 2024, NS approached PECO Transmission and Substation (T&S) Engineering for assistance in investigating the inductance issue.
  - PECO T&S Engineering confirmed a PECO-owned 230kV transmission line parallels the NS RR tracks for several miles.
- In March 2024, PECO T&S Engineering hired a consultant, Power Engineers, to review the NS investigative report from National Signal Technology, Inc. and provide feedback on behalf of PECO.
- In May 2024, PECO T&S Engineering provided the results of that consultant review back to NS including PECO's consultant's recommendations for how the investigation and associated results/recommendations might be improved utilizing industry-accepted best practice for analysis software.
  - PECO T&S Engineering did not hear back from NS after providing this information.

XX

peco
AN EXELON COMPANY

→ can you go back to the vendor & see if it can record

→ Brent Killian - PUC

- barriers
- signage

→ Trouble tickets - if called in by the public or does it get recorded? not in a user friendly data... → easier to do

→ damage due to flooding → too much work on tracks

Site Visit Description/Background

- On May 30, 2025, PECO and NS met on site at the two railroad grade crossings in Royersford PA. The conditions were dry and sunny with few clouds and low humidity. Temperature was 77°F.
- NS informed PECO they only have two crossing gates between PECO's Cromby and Limerick substations. Crossing gates are located near the intersection of (1) Arch Street and 2nd Avenue and (2) Main Street and 2nd Avenue (127 Main Street).
- NS informed PECO that they had approximately 12 gate mis-operations last year. Of the 12, they consider 6 to be due to PECO transmission line induction.
- NS reported that induction issues tend to occur on hot summer days (August) and cold winter nights.
- NS report that over the last couple of years, it has removed all their impedance bonds in this area.
- NS is using isolation joints to reduce induction. They have isolation joints located every mile in this area due to induction challenges.
- NS has also started using 60 HZ shunts to minimize induction issues. They may help with the crossing mis-operation.
- The last event occurred mid-May at the Main Street crossing. The event may have caused one of their control boards to fail. NS believes the issue was due to a train sitting idle on the tracks too long.
- NS explained to PECO that their railroad grade signaling is triggered when the train is within a set distance from the crossing, called a "block". A signal is sent along one track. When the train enters the specified zone the signal travels through the axle to the other track which signals the gate to close. If the signaling system sees any error, it defaults to closed.

May 30th:

dual track issue

peco AN EXELON COMPANY

Tickets on both crossing:

→ 5/30: 11:40pm trouble ticket

12:03pm : 5/31

track maintenance also occurring

— training for first responders

where the in

@Arch, only voltage measurement not?

Measurements from May 30 Site Visit

Arch Street and 2nd Ave Crossing Isolation Joint Measurement (40.178718, -75.539519)

→ 3,065 AV (amps)

- **Relay House location for crossing (40.178525, -75.539486)**
- PECO Power Quality tested voltage across isolated joint at track 2. Track 1 was active
- Volage across isolation joint = 27 volts (15 v to ground on one side; 17 volts on the other side)
- Measured the same voltage at the relay house.
- Located near PECO transmission structure 6-1
- Power Quality considered the 34 kV recloser located near Arch Street may contribute to the issue
  - They called the DOC and opened the recloser near the site. No change to voltage on rails-No issue.

NS days: they measured 70 volts

→ 1mi. west & Main St.

Main street and 2nd Ave Crossing Isolation Joint Measurement (40.183109, -75.543131)

- **Relay House location for crossing (40.185456, -75.544512)**
- PECO Power Quality tested voltage across isolated joint at track 1. Track 2 was active
- Volage across isolation joint = 37 volts.
- Measured 21 amps – track 1 west bound to ground
- Isolation joint located near PECO transmission structure 5-5
- Two of four 10 amp fuses were blown in the CSX relay house. They were replaced. The cause of the blown fuses was undetermined at the time.

→ CSX had to change all fuses

Findings (continued)

Measured voltage between 220-60 structures and ground

- Using a screwdriving as a ground rod
  - Structure 5-4 = 0.2V
  - Structure 5-5 = 6.9 V
  - Structure 5-6 = 0.44 V
  - Structure 5-7 = .03 V
- Using a temp 8' ground rod
  - Structure 5-5 =13.0 V — where blown fuses were at
  - NS shed@Main St =8.0 V
  - NS shed@Arch St =0.4 V (NS 588601K crossing inventory number)
  - Structure 6-1 =.04 V
  - Structure 6-4 =.9 to .05V
  - Structure 6-5 =5.0 V (transmission conductors cross tracks on span)
  - N/S sign 3/1 =0.9V

Isolated Joint near Arch Street Crossing and 60 hz Shunt

Conclusions

→ 1/3 of the capacity

- Most of the readings were negligible. (but not
  - One area of interest was the voltage and current in the vicinity of NS' relay shed near the Main Street crossing.
  - Transmission pole 5-5, which is located approximately 25' from the relay shed, measured 13 V to ground. 21 amps, 4 blown fuses
  - Additionally, the isolation joint in this area measure 37 volts and 21 amps (track1, west bound to ground).
  - Two of the 10A fuses in the relay shed were blown and had to be replaced.
- No other issues were identified during this walkdown.
- It should be noted that the line was not heavily loaded at the time of the walkdown.
  - The 220-60 line loading at the time of inspection was carrying 1135 amps (5/30, 1:30 pm).
  - The summer normal line rating of the 220-60 line is 3065 amps.
  - The potential exists that during high demand periods (humid hot summer day or cold winter days) the line will be carrying more load and the induction on the railroad may increase.

Suggested Next Steps

- It is recommended an expert be hired to study induction effects on railroads to guide us through any mitigations.
  - This study should attempt to identify the root cause and should quantify the worst induced voltages/currents on the railroad. These results should guide us towards remedial measures to limit the induced voltages. The work should include analysis that will quantify the effectiveness of the remedial measures.

- A partnership between PECO and NS will be required to complete this study as we are proposing to:
  (a) Perform measurements at Limerick and Cromby substations;
  (b) Perform measurements at a few towers in the vicinity of the two crossings (existing data captured on 5/30 may be sufficient);
  (c) Perform measurements on the rails and switching housing (existing data captured on 5/30 may be sufficient);
  (d) Construct an integrated model of the Limerick/Cromby line with the railroad; and
  (e) Perform analysis of what happens during:
    a. Normal operating conditions;
    b. High loading conditions of the line; and
    c. Analysis during various faults in the system, mainly along the line.

- We expect that there may be several options of remedial measures.