IDA Restoration- The Transmission Engineering Efforts

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OUTLINES

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C. Relay Impact Study & Challenges
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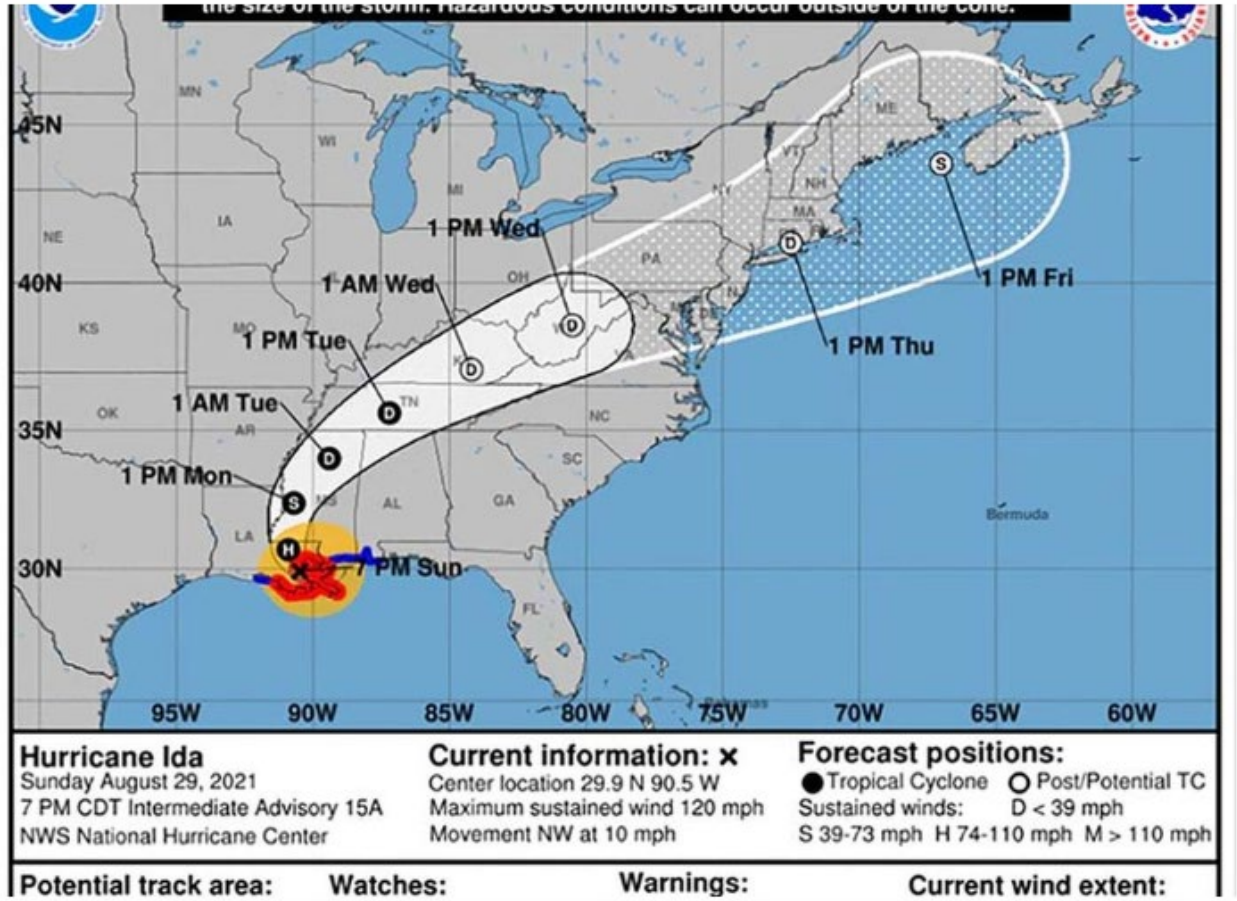
Introduction



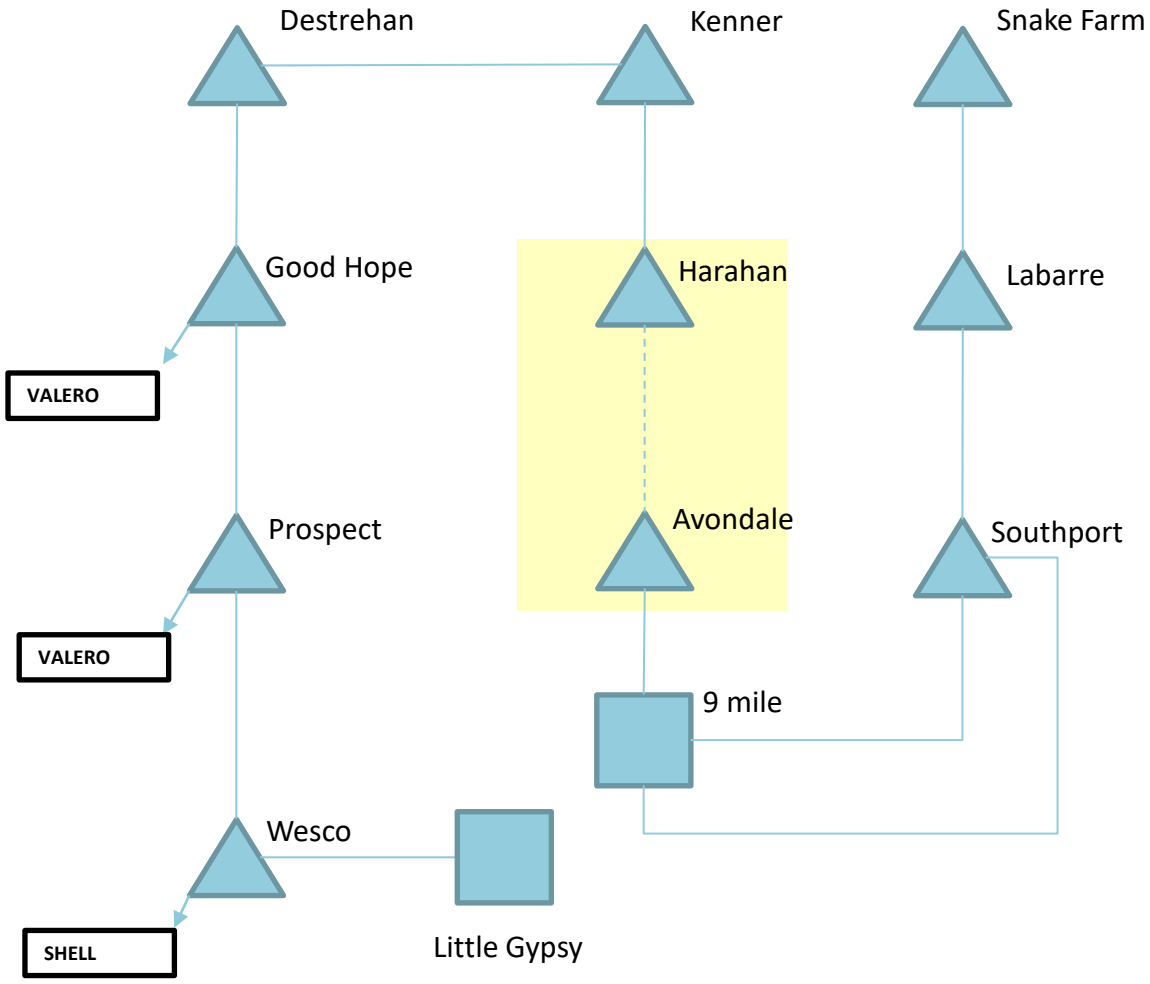
Hurricane Ida made landfall Aug. 29 at 11:55 CDT as an extremely dangerous Category 4 hurricane near Port Fourchon, Louisiana, with maximum sustained winds of 150 mph and gusts recorded reaching 172 mph in the area.

Ida's historic intensity caused severe damage to the Entergy distribution and transmission systems resulting in a peak of 948,000 outages in Louisiana and Mississippi.

Introduction

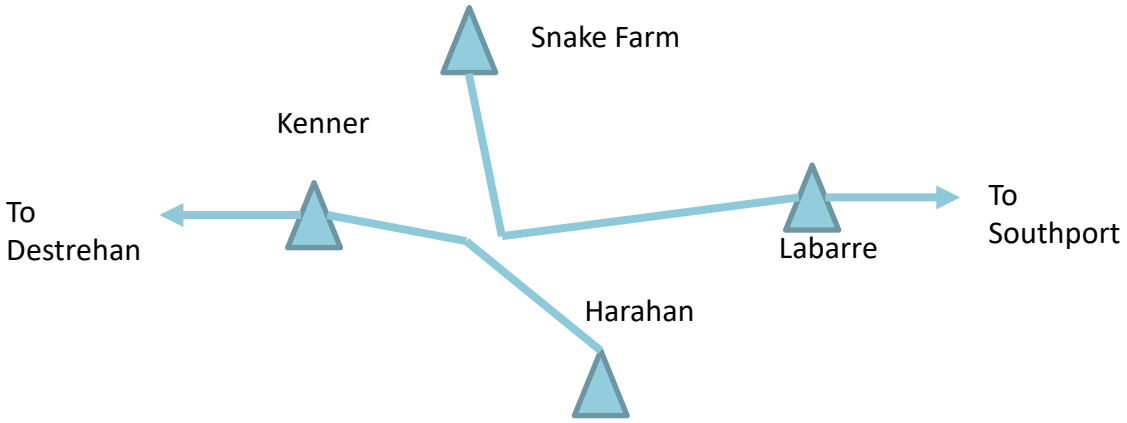
Transmission Damages
520 structures damaged
226 substations out
211 line branches out

Introduction

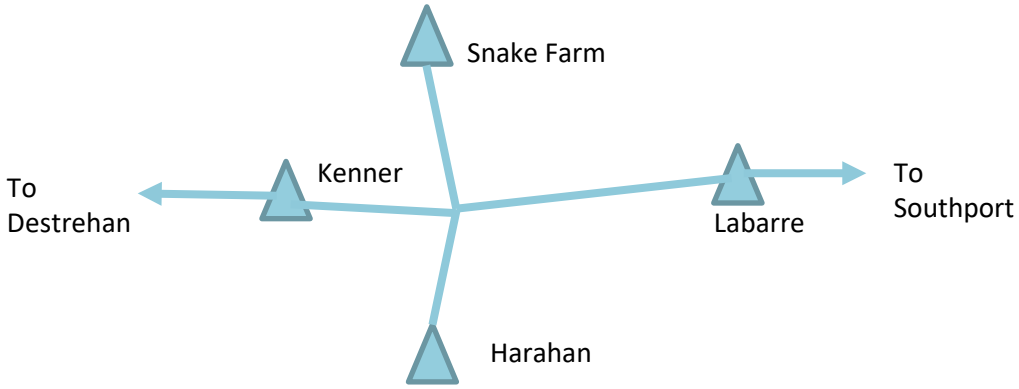


The high winds of Hurricane Ida resulted in the catastrophic failure of a transmission line river crossing tower. With the Harahan to Avondale 230kV line out of service, multiple key industrials in South Louisiana are left radially sourced from Little Gypsy.

Project Summary



Post-IDA Network

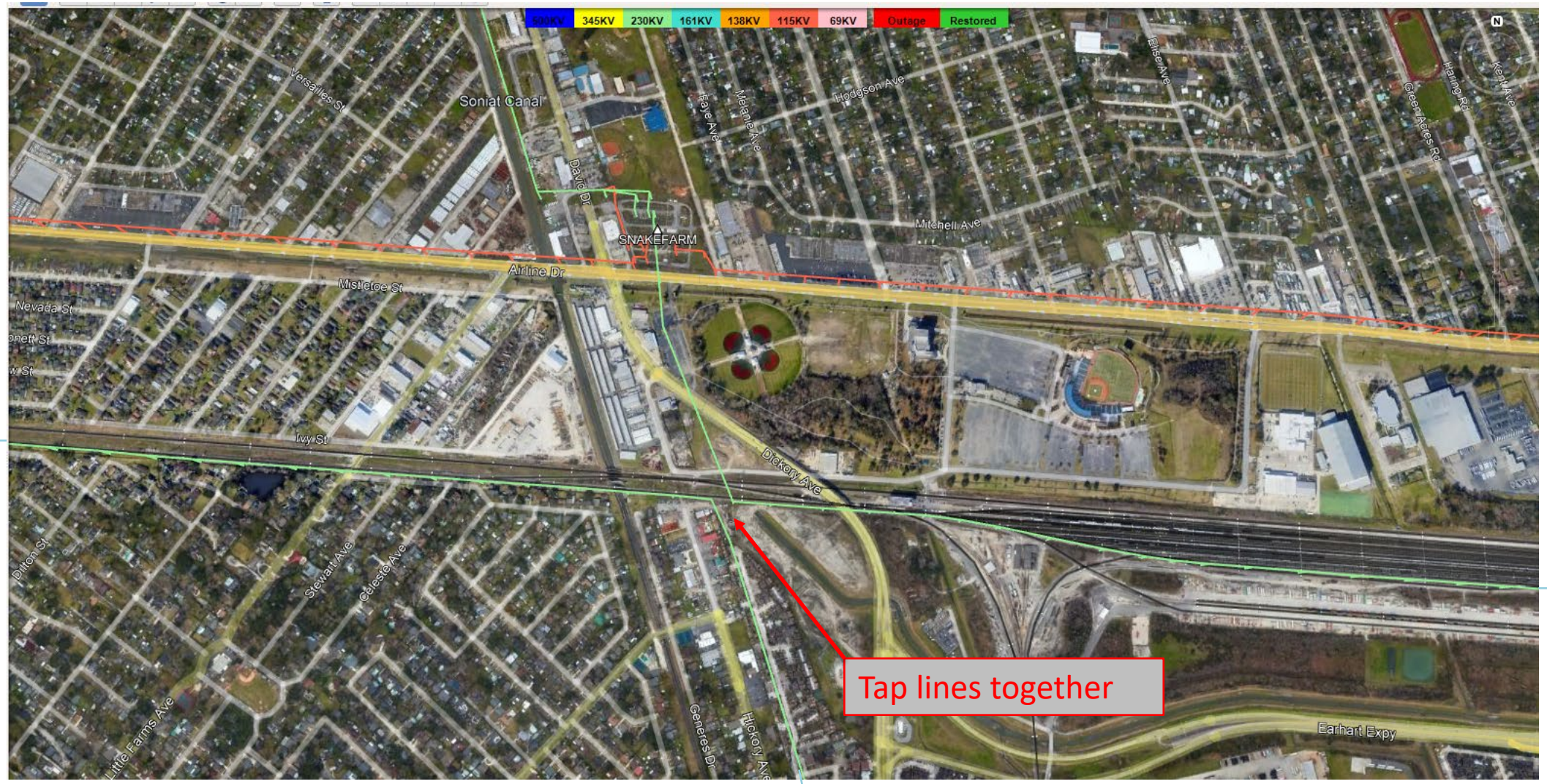


Proposed Network

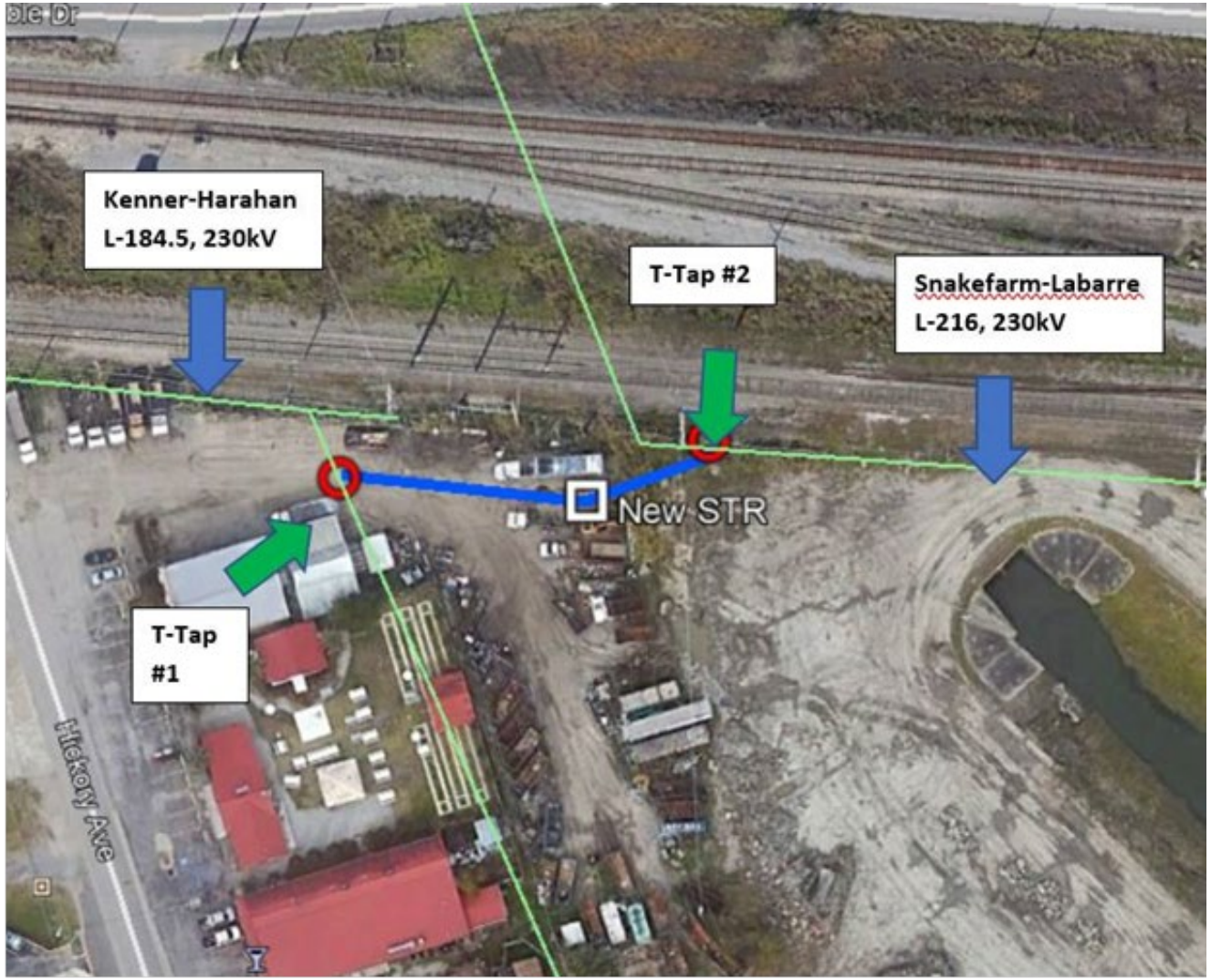
Proposed Solution

The team determined that the best solution for eliminating the radial would be to tie the Snake Farm to Labarre 230kV line to the Destrehan to Harahan 230kV line creating a 3-terminal line with Harahan acting as a tap.

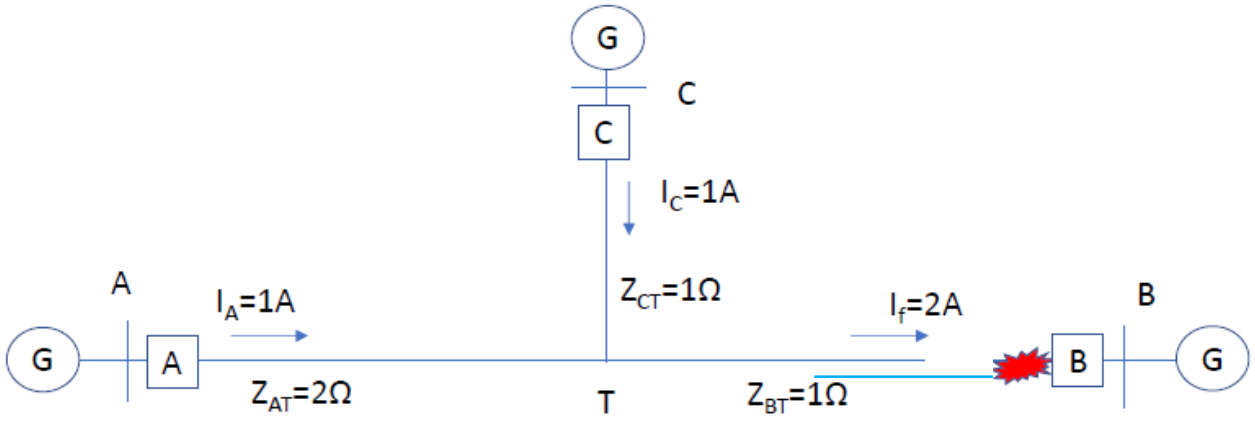
Project Summary: Point of Tapping the Two Lines



Project Summary: Proposed Transmission Line work

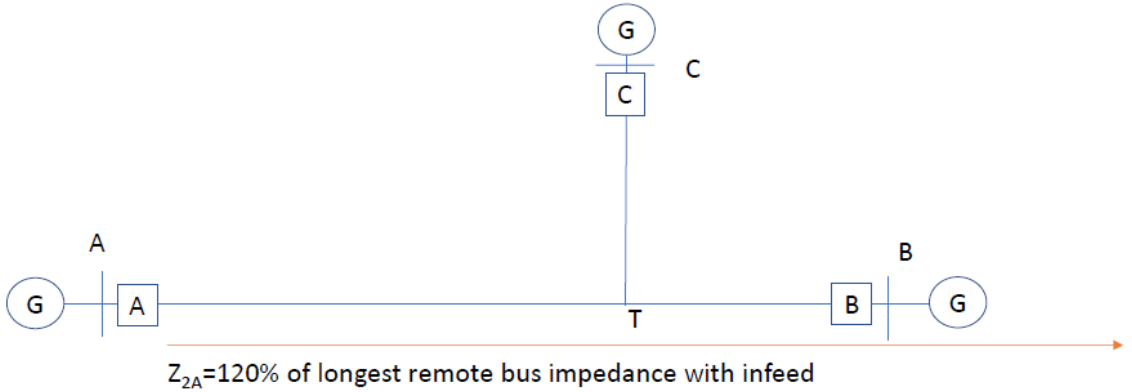


Relay Impact Study: Protection Challenges



Distance (21) Protection: Apparent impedance issue due to infeed

Relay Impact Study: Protection Challenges

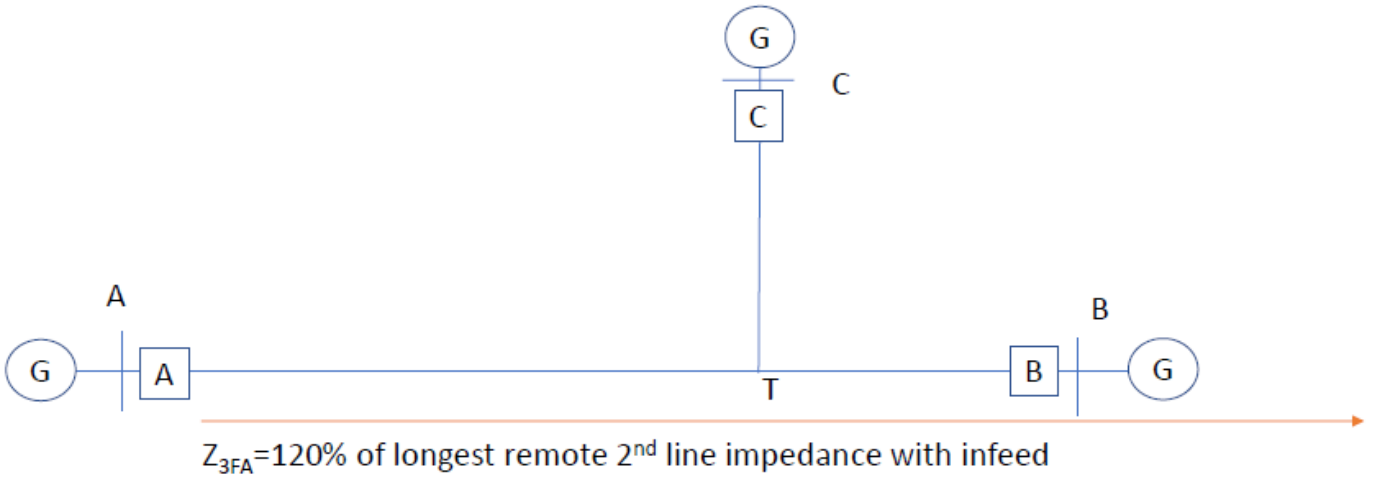


Z_{2A}=120% of longest remote bus impedance with infeed

Miscoordination from overreaching during contingency conditions (no infeed)
Violation of NERC loading compliance due to high reach
Limitation of relay range

Distance (21) Protection: Limitation to set overreaching elements

Relay Impact Study: Protection Challenges

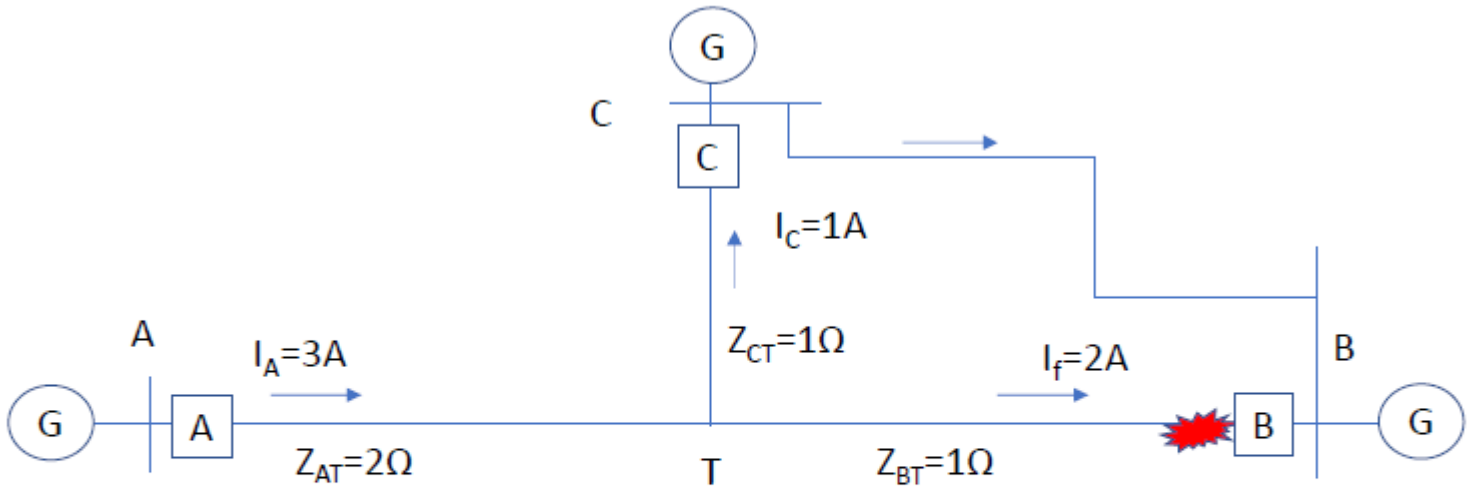


Z_{3FA}=120% of longest remote 2nd line impedance with infeed

Violation of NERC loading compliance due to high reach
Limitation of relay range

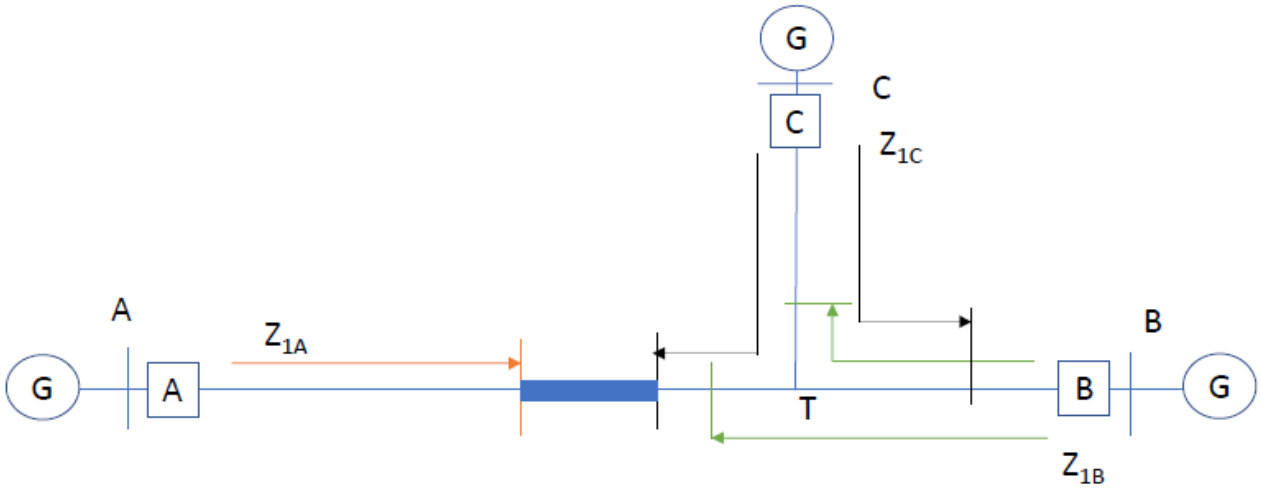
Distance (21) Protection: Limitation to set overreaching elements

Relay Impact Study: Protection Challenges



Distance (21) Protection: Apparent impedance issue due to outfeed

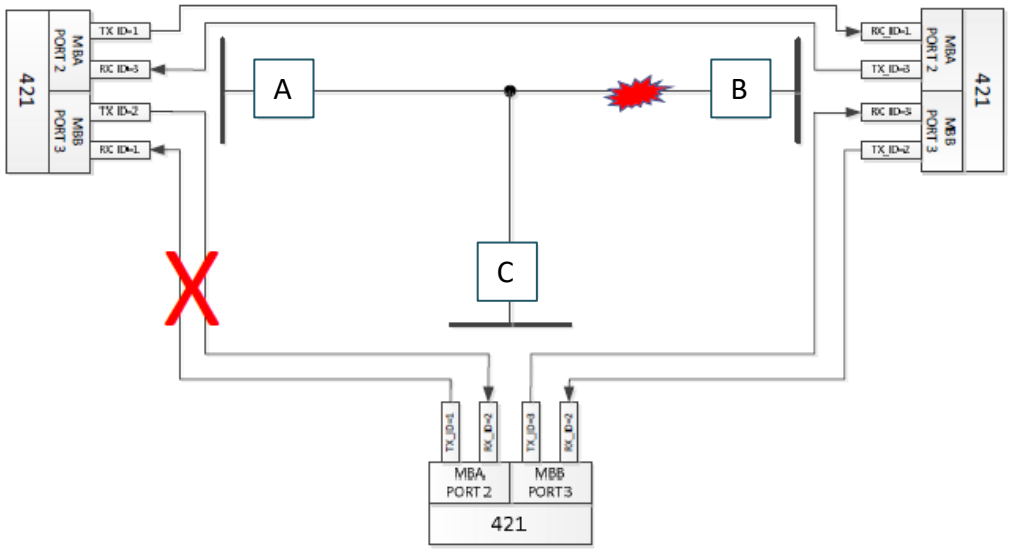
Relay Impact Study: Protection Challenges



Distance (21) Protection: Limitation to set underreaching elements

Relay Impact Study: Protection Challenges

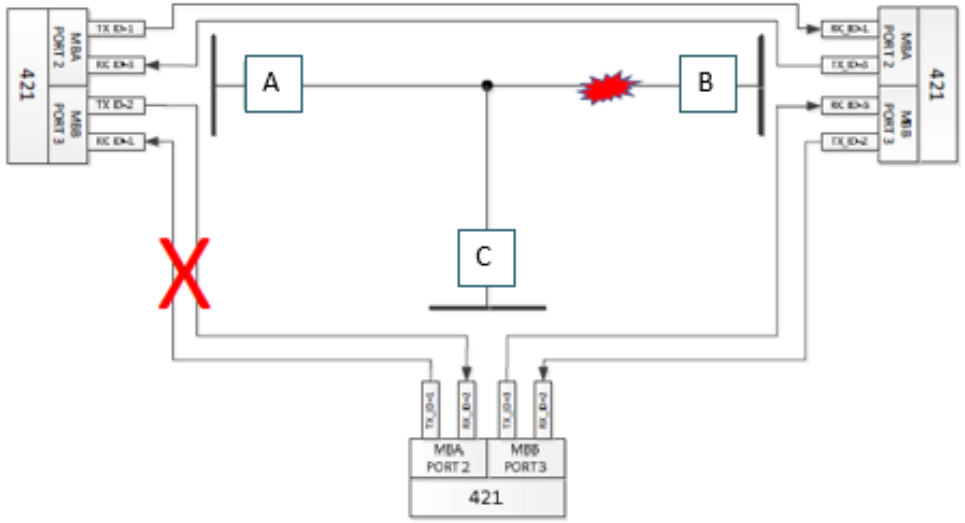
1. The built-in POTT is configured for two-terminal line protection.
2. POTT scheme failure due to communication loss.
3. Weak infeed condition.



POTT Scheme

Implementation: Solutions

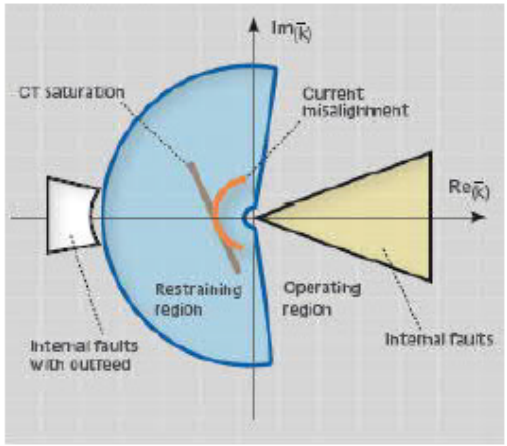
1. Deployed new line differential protection panels.
2. Set Z1 (underreach element) to 80% of the minimum remote end without infeed.
3. POTT scheme with customized pass-through mirror bit.



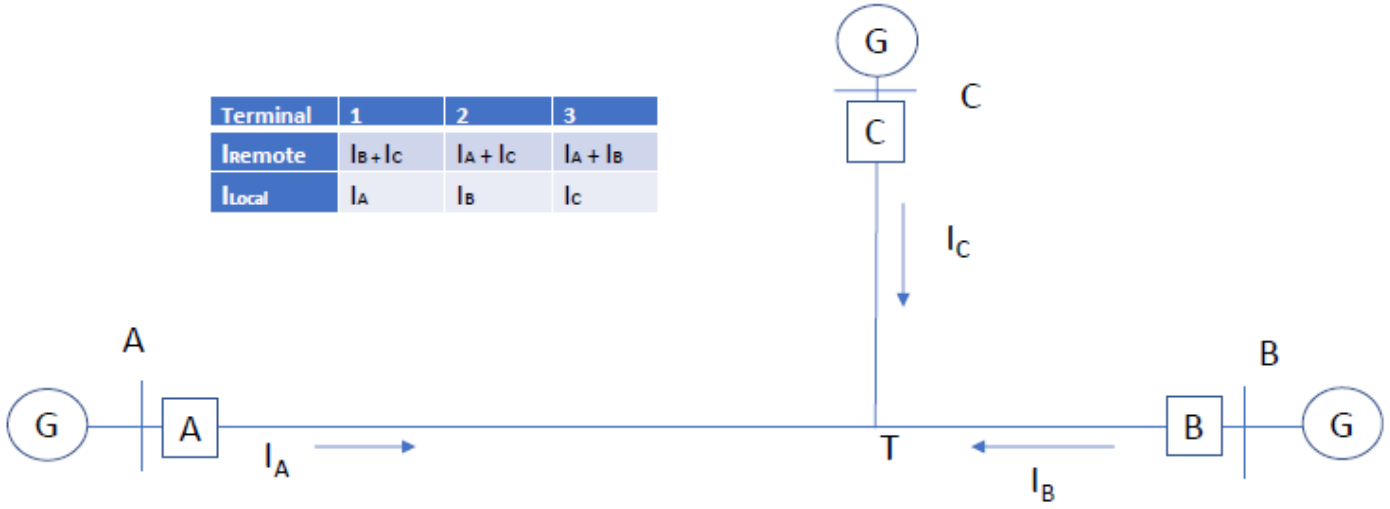
POTT Scheme

Implementation: Solutions

4. Line differential scheme to cover all internal faults (irrespective of tap faults, weak infeed).



Terminal	1	2	3
I_{Remote}	$I_B + I_C$	$I_A + I_C$	$I_A + I_B$
I_{Local}	I_A	I_B	I_C



Implementation: Solutions

5. Customized Z2 supervision in case of both 87 and POTT schemes failure.

TRIP= ……+Z2T * PSV31+…….

PSV31= (POTT Failure) AND (87 Failure)

Implementation: Testing

- **Single-ended Element Test:**
  I. Calculated V/I simulated in Power System Simulator.
  II. Ensure individual protection function and alarm pickup.
- **End-to-End Test**
  I. V/I from fault analysis software simulated in Power System Simulator.
  II. Ensure comm. channel integrity.
  III. Ensure POTT coordination, and differential functionality.

Conclusions

- Successful implementation within a week.
- Ensured N-2 transmission reliability for the area.
- Ensured N-1 relay coordination.
- Ensured NERC compliances.
- The implemented solution performed as intended for more than one year until the restoration of the original network (re-construction of Harahan-Avondale line).
- Saved 22k customers from outage during a fault event on 01-04-2022.

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Questions