



Sub Regional RTEP Committee South

August 29, 2017



Baseline Reliability and Supplemental Project First Review





Dominion Transmission Zone Supplemental Project

Supplemental Project: Bremo 138-115kV Transformer #8 Replacement

Problem Statement:

- Bremo 138-115kV 192 MVA transformer #8 needs to be replaced as a result of Dominion's ongoing transformer health assessment (THA) process. This process considers design characteristics, past electrical test results, dissolved gas-in-oil test results, age, ongoing maintenance issues, and past failures of similar designed transformers.
- The current configuration for this transformer consists of a group of three single-phase 26.67 MVA transformers in parallel with a single three-phase 112 MVA transformer for a total capacity of 192 MVA. This transformer feeds Dominion Energy Line #8 which serves as a critical tie between Dominion Energy and APCO.
- For the three single-phase transformers (3x138-115-13.2 kV 26.667 MVA)
 - Manufactured by Westinghouse in 1950
 - Drivers for replacement: age & increased trend of combustible gas generation
- For the single three-phase transformer (1x138-115-13.2 kV 112 MVA)
 - Manufactured by McGraw-Edison in 1975
 - Drivers for replacement: age, previous remanufacturing following failure in 1997 & reduced BIL ratings

Potential Solution:

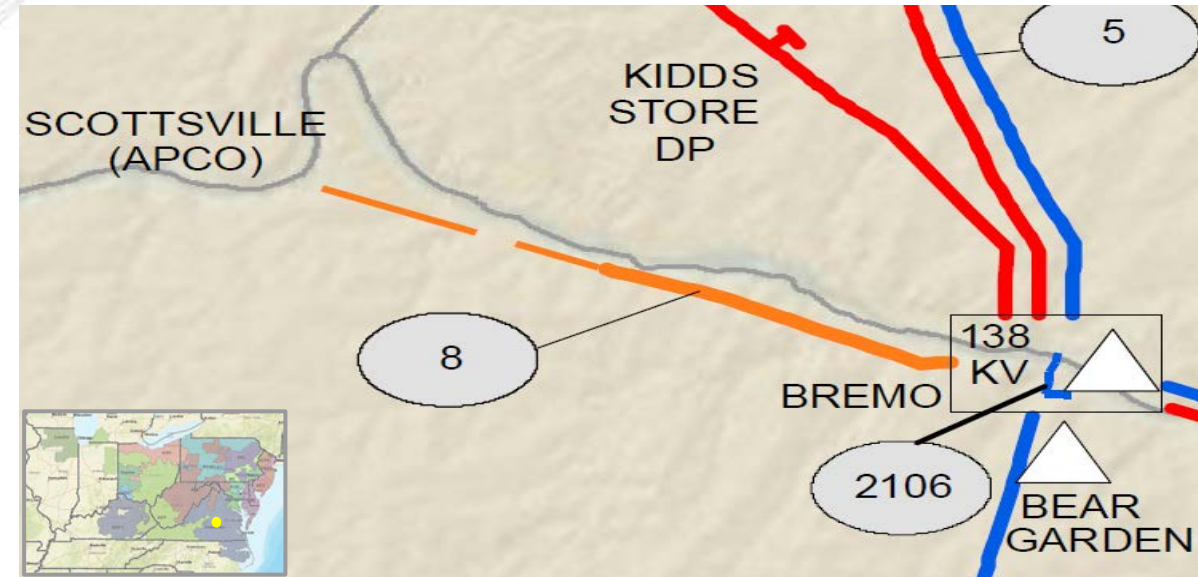
- Replace the current transformers that make up Bremo Transformer #8 with three single-phase units for a total capacity of 225 MVA. A spare 75 MVA transformer is also to be installed.

Alternatives: No feasible alternatives

Estimated Project Cost: \$7 M

Possible IS Date: 7/31/2018

Project Status: Engineering





Dominion Transmission Zone Supplemental Project

Supplemental Project: Basin 230-115kV Transformer #6 Replacement

Problem Statement:

- Basin 230-115kV 224 MVA transformer #6 needs to be replaced as a result of Dominion's ongoing transformer health assessment (THA) process. This process considers design characteristics, past electrical test results, dissolved gas-in-oil test results, age, ongoing maintenance issues, and past failures of similar designed transformers.
- There is no fault interrupting device on the high side of the transformer. A transformer fault trips three adjacent 230kV breakers to clear the entire bus and temporarily interrupts the network and tapped load.
- This transformer was manufactured by North American in 1989.
- Drivers for replacement: age, increased trend of combustible gas generation, reduced BIL ratings, and transformers previously manufactured by Federal Pacific/North American are considered highly suspect due to previous transformer failures

Potential Solution:

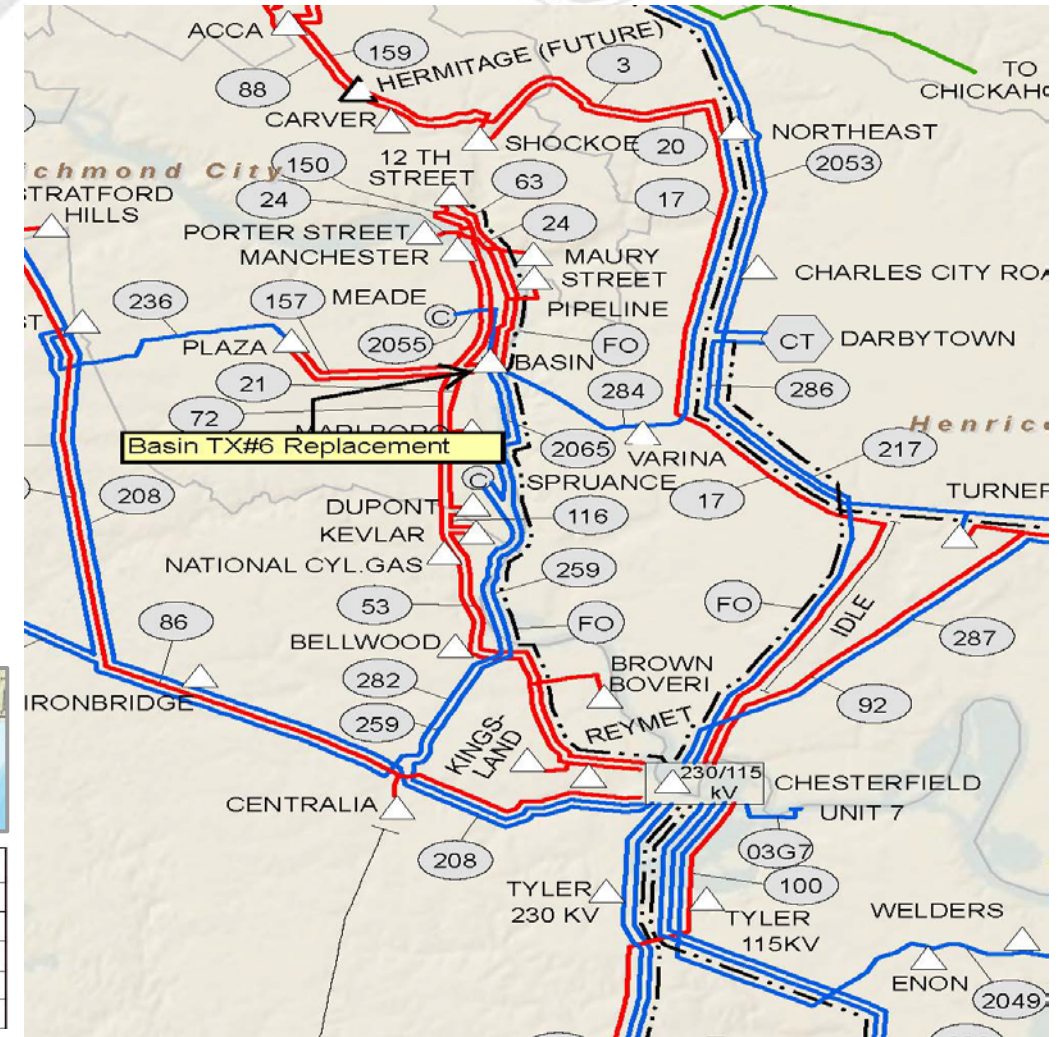
- Replace Basin transformer #6 with a 224 MVA transformer. Install a 230kV breaker on high side of transformer and replace high side switch.

Alternatives: No feasible alternatives

Estimated Project Cost: \$3.2 M

Possible IS Date: 05/30/2018

Project Status: Engineering



COLOR	VOLTAGE	TRANSMISSION LINE NUMBER
Green	500 KV.	500 thru 599
Blue	230 KV.	200 thru 299 & 2000 thru 2099
Red	115 KV.	1 thru 199
Orange	138 KV.	AS NOTED
Cyan	69 KV.	AS NOTED



Dominion Transmission Zone Supplemental Project

Supplemental Project: Pendleton Substation – New 115kV Circuit Switcher

Problem Statement:

- No high side interrupting device on Pendleton 115/34.5kV Transformer #1. There is a motor operated switch and a ground switch.

Potential Solution:

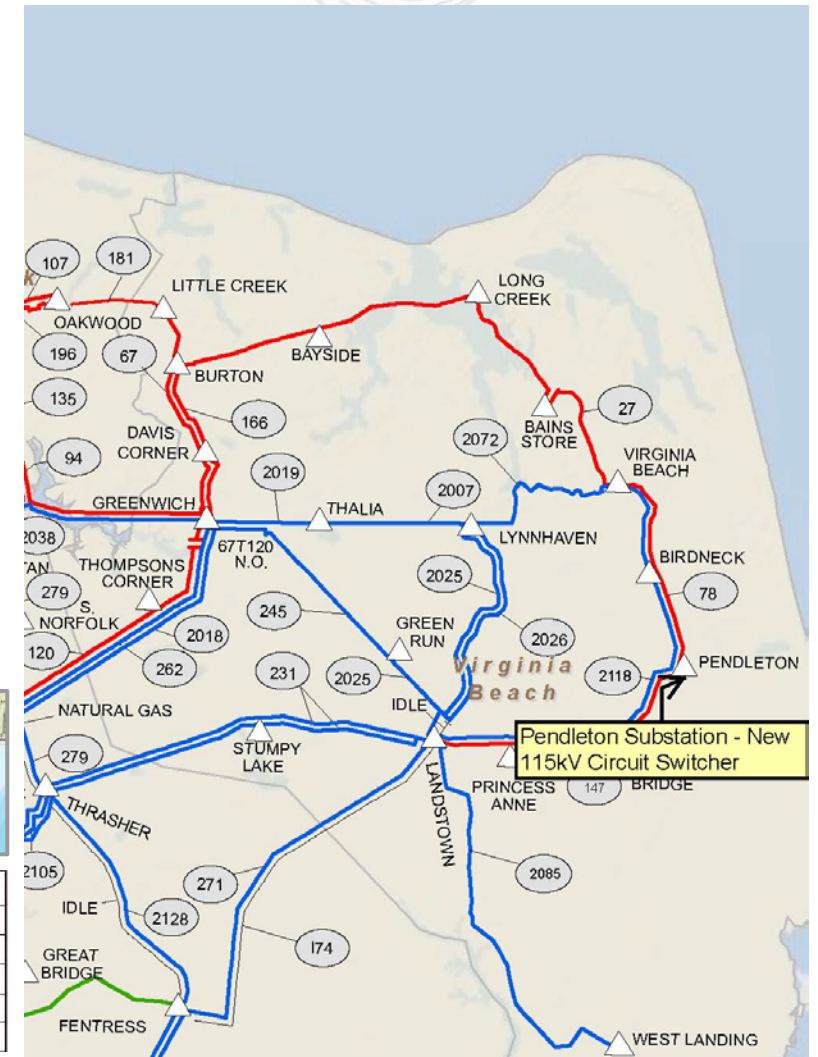
- Remove the ground switch, install a 115kV circuit switcher on TX#1 high side.

Alternatives: No feasible alternatives

Estimated Project Cost: \$1.6 M

Possible IS Date: 05/31/2018

Project Status: Engineering



COLOR	VOLTAGE	TRANSMISSION LINE NUMBER
Green	500 KV.	500 thru 599
Blue	230 KV.	200 thru 299 & 2000 thru 2099
Red	115 KV.	1 thru 199
Orange	138 KV.	AS NOTED
Cyan	69 KV.	AS NOTED



Baseline Reliability and Supplemental Project Second Review





Dominion Transmission Zone Baseline Project

Baseline Project: New 230-115kV Switching Station to Serve Windsor DP (REC)

Problem Statement: DOM “End of Life Criteria”

Date Project Last Presented: 6/9/2017 SRRTEP

- 115kV Line #139 Everetts to Windsor has 336 ACSR conductor constructed on wood H-frames in the 1951 timeframe. Line #139 serves one delivery point Windsor DP (Roanoke EC). This line needs to be rebuilt to current standards or provide another source for Windsor DP based on Dominion’s “End of Life” criteria.
- Permanent MW load loss for removal of this line is 10 MW.

Recommended Solution:

- Build a new 230-115kV switching station connecting to 230kV network Line #2014 (Earleys – Everetts). Purchase land and install three single phase 30 MVA 230-115kV transformers (and a spare) with a high and low side breaker. Provide a 115kV source from the new station to serve Windsor DP. Remove Line #139 19.5 miles (15.5 miles Everetts – Windsor, 1.1 mile Windsor to idle line, 2.9 miles idle line). **(b2900)**

Estimated Project Cost: \$11.5 M

Alternatives:

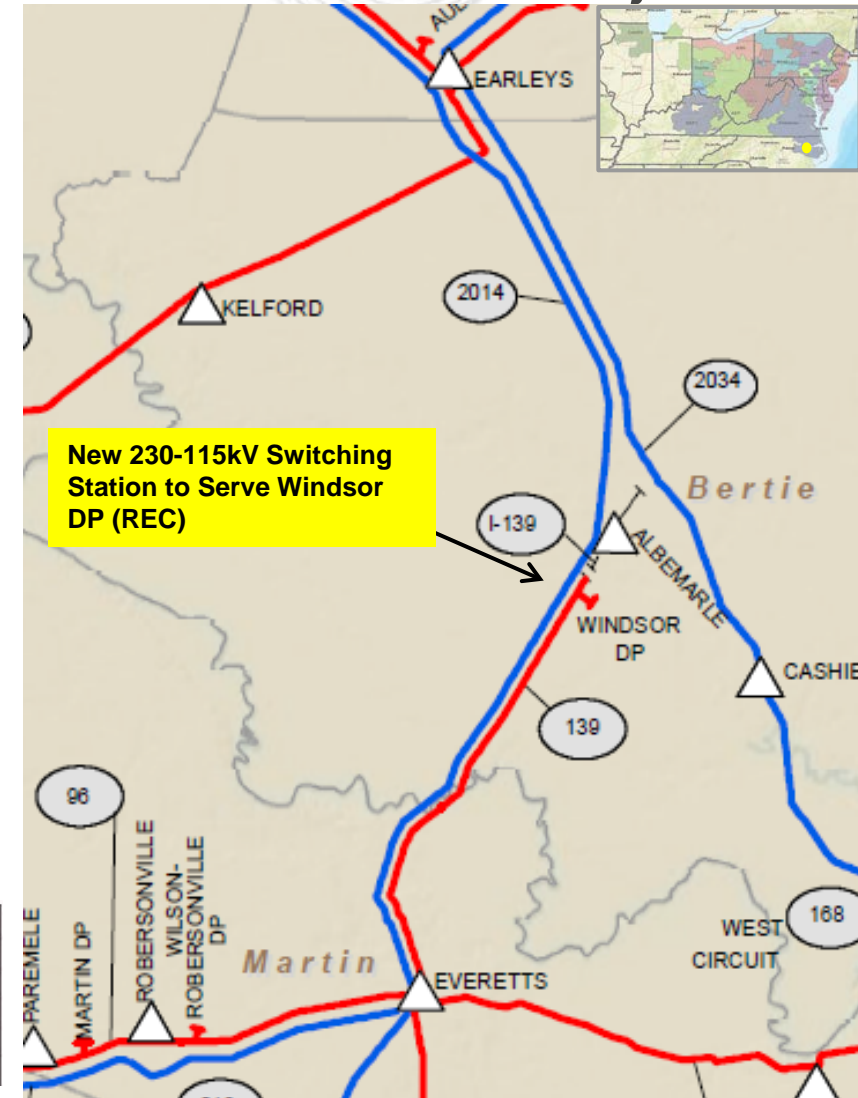
- Rebuild 115kV Line #139 from Everetts to Windsor, 15.5 miles, with single circuit steel structures. The conductor used (636 ACSR) will be at current standards with a summer emergency rating of 262 MVA at 115kV.

Estimated Project Cost: \$20 M

Projected IS Date: 12/30/2022

Project Status: Conceptual

COLOR	VOLTAGE	TRANSMISSION LINE NUMBER
Green	500 KV.	500 thru 599
Blue	230 KV.	200 thru 299 & 2000 thru 2099
Red	115 KV.	1 thru 199
Orange	138 KV.	AS NOTED
Cyan	69 KV.	AS NOTED





Dominion Transmission Zone Baseline Project

Baseline Project: Line #101 Rebuild Mackeys to Creswell (End of Life Criteria)

Problem Statement: DOM “End of Life Criteria”

Date Project Last Presented: 4/25/2017 & 6/9/2017 SR RTEP

- 115kV Line #101 from Mackeys to Creswell (14 miles) was constructed on wood H-frames in the 1970-1975 timeframe. The conductor has broken stranding consistent across entire line. The existing summer emergency rating of this line is 152 MVA. Current conductor used is 545.6 ACAR (15/7).
- This line needs to be rebuilt to current standards based on Dominion’s “End of Life” criteria.
- Permanent MW load loss for removal of this line is 21 MW.
- The MW-mile for line #101 is 518 MW-mile based on the Winter 2025/26 projection. Dominion’s 700 MW-mile radial line criteria would be violated if 8 MW or more of new load were added in the future.

Recommended Solution:

- Rebuild Line #101 from Mackeys to Creswell, 14 miles, with double circuit steel structures. Install one circuit with provisions for a second circuit. Provisions for a future second circuit would allow networking of the line (Mackeys – Creswell) if the 700 MW-mile level was exceeded. The conductor used will be at current standards (636 ACSR) with a summer emergency rating of 262 MVA at 115kV. Additional right-of-way is required for the temporary line. **(b2876)**

Estimated Project Cost: \$40 M

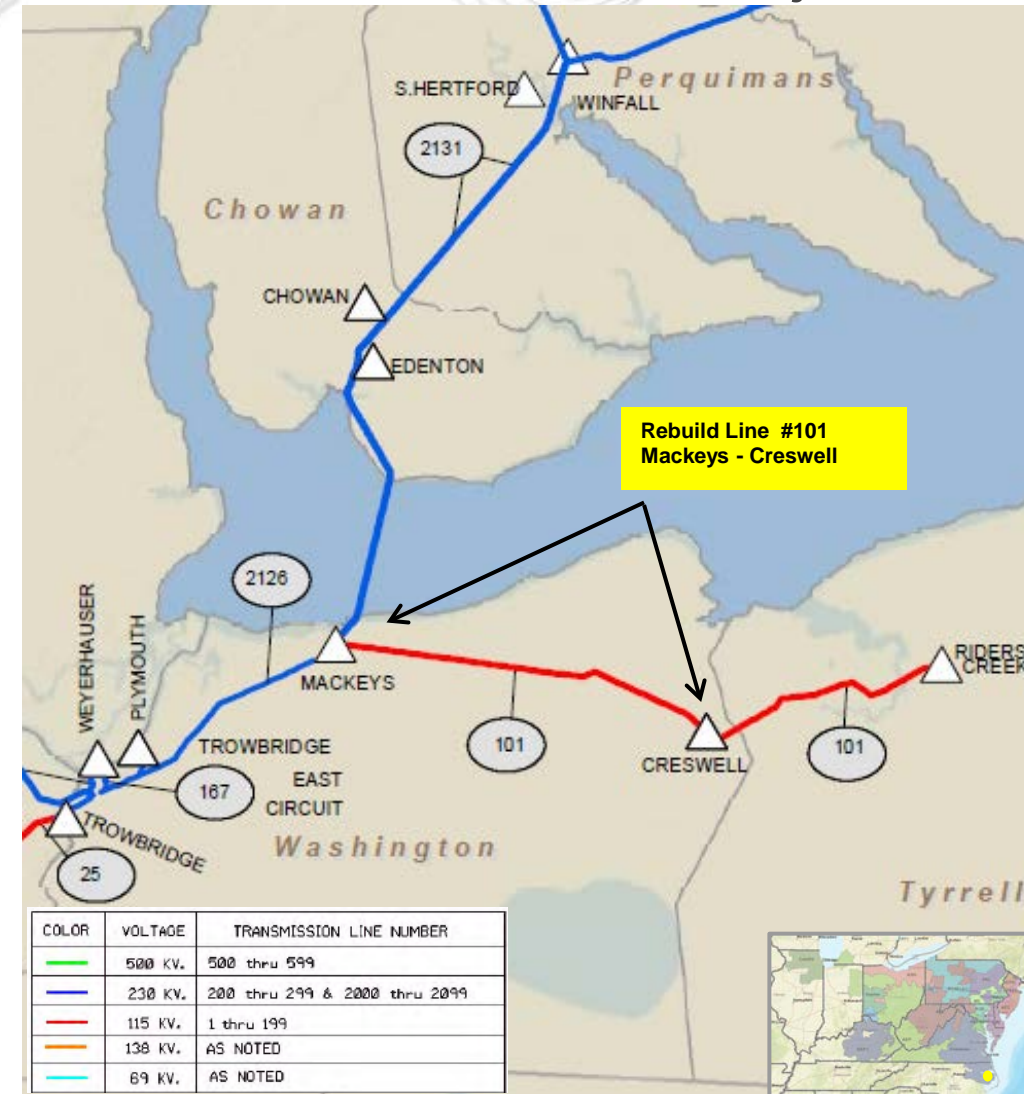
Alternatives:

- Rebuild line #101 from Mackeys to Creswell, 14 miles, with single circuit structures. The conductor used will be at current standards (636 ACSR) with a summer emergency rating of 262 MVA at 115kV.
- Additional right-of-way is required for the temporary line. This alternative would not address the future 700MW-mile violation.

Estimated Project Cost: \$26 M

Projected IS Date: 12/30/2022

Project Status: Conceptual





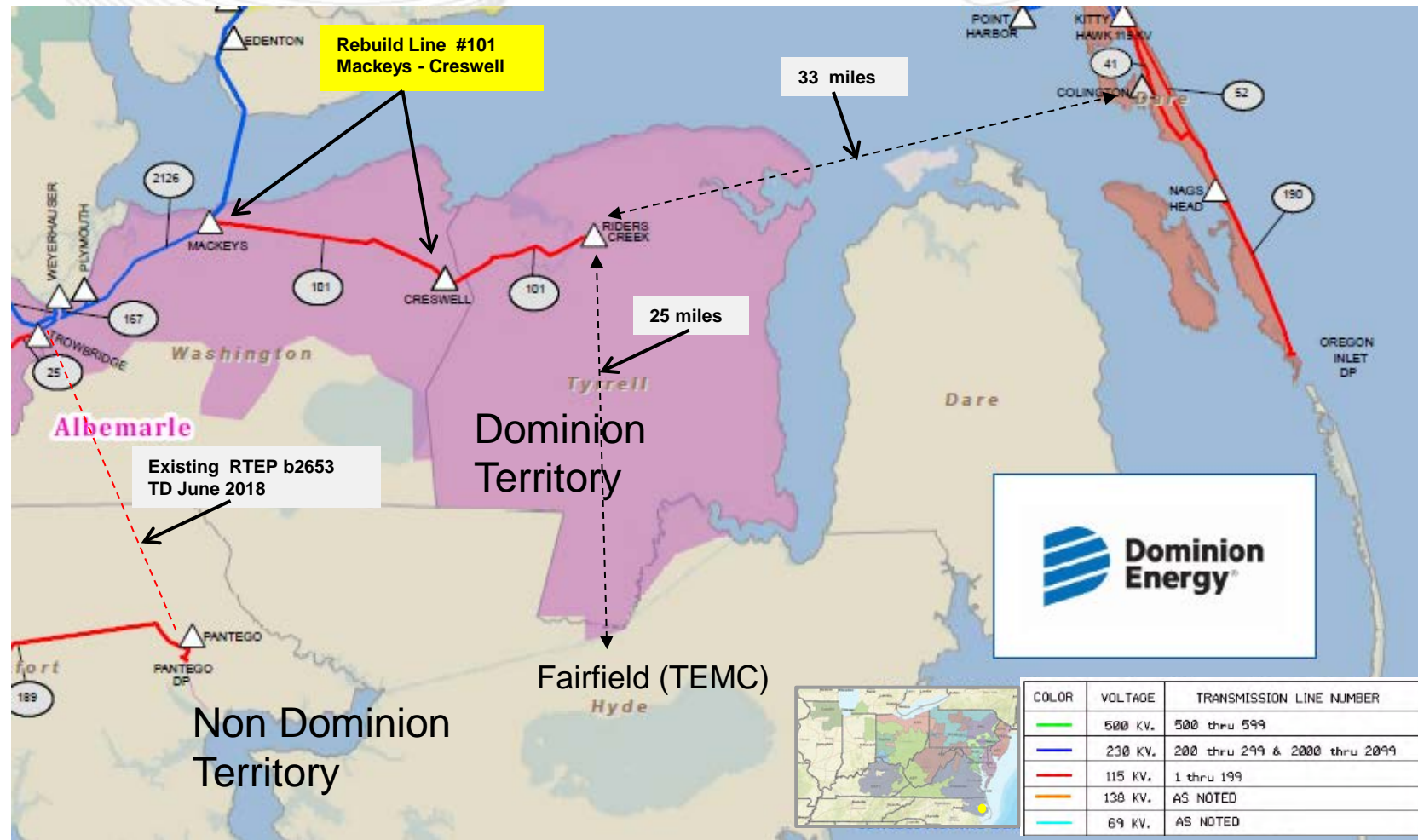
Dominion Transmission Zone Baseline Project

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Baseline Project: Line #101 Rebuild Mackeys to Creswell (End of Life Criteria)

Supporting Project Information:

- Radial Line #101 is located in an isolated area with no distribution ties
- Riders Creek to TEMC's Fairfield route was reviewed in 2013 by NRG
- Obtaining right-of-way to network Line #101 to a different source is restricted by wetlands and significant natural heritage areas to the south as well as very long water crossings to the north and to the east
- Riders Creek to Fairfield preliminary route is 25 miles and could become 50 miles if federal and state regulatory agencies are unwilling to approve routing
- Riders Creek to Colington – previous studies have shown this option resulted in voltage collapse for a tower line outage of the two 230kV lines from Shawboro to Kitty Hawk
- Any option to a different source, assuming right-of-way could be obtained, would be much greater than the preferred option cost





Dominion Transmission Zone Baseline Project

Continued from previous slide...

Baseline Project: Line #101 Rebuild Mackeys to Creswell (End of Life Criteria)

Project Comparison Information:

	PREFERRED	ALTERNATE
	Build as double circuit / One circuit Initially	Build single circuit steel H-frame
COST	\$40M	\$26M
STRUCTURE TYPE (material, labor, foundation)	Double circuit designed single steel poles with anchor bolts / foundation	Single circuit direct buried steel H-frames
LIFE OF ASSET	50+ years	
ADDITIONAL ROW NEEDED FOR TEMPORARY LINE	Additional 25' (\$1M) --- 125' ROW total	
COST DIFFERENCE	The \$14M cost difference of the preferred compared with the alternate solution is due to the structure type which increases the material, labor and foundation costs.	
COST TO CREATE 2ND CIRCUIT IN THE FUTURE TO RESOLVE MW-MILE CRITERIA	\$8.4 M for second circuit conductor Total Cost \$40M + \$8.4 M = \$48.4M	1) BEST CASE - Obtain additional 55' of ROW (125+55=180' total) and build 2nd line - \$ 23.5M Total Cost \$26M + \$23.5M = \$49.5M*
NOTE: Expected to occur with additional 8MW of load		2) WORST CASE - Wreck NEW line, build temporary line and rebuild with double circuit steel poles (same as Preferred Option except wrecking a NEW line). Uses the 125' ROW (no additional ROW) - \$47.4M Total Cost \$ 26M + \$47.4M = \$73.4M

Notes:

* assumes additional 55' of ROW can be obtained in the future @ \$143,000 per mile – Potential in the future for higher cost and challenging to obtain all ROW



Dominion Transmission Zone Supplemental Project

Supplemental Project: Brunswick 115-69kV Transformer #2 Upgrade

Date Project Last Presented: 6/9/2017 SRRTEP

Problem Statement:

- Brunswick 115-69kV 22 MVA transformer #2 needs to be replaced as a result of Dominion's ongoing transformer health assessment (THA) process. This process considers design characteristics, past electrical test results, dissolved gas-in-oil test results, age, ongoing maintenance issues, and past failures of similar designed transformers.
- This transformer was manufactured in 1951 by Westinghouse.
- Drivers for replacement are: age, elevated (moderate) combustible gas, and the emergency spare is not available. This project upgrades Brunswick transformer #2 to the same size as Brunswick transformer #1 so that for the loss of either transformer, the remaining transformer can carry all load at the substation.

Selected Solution:

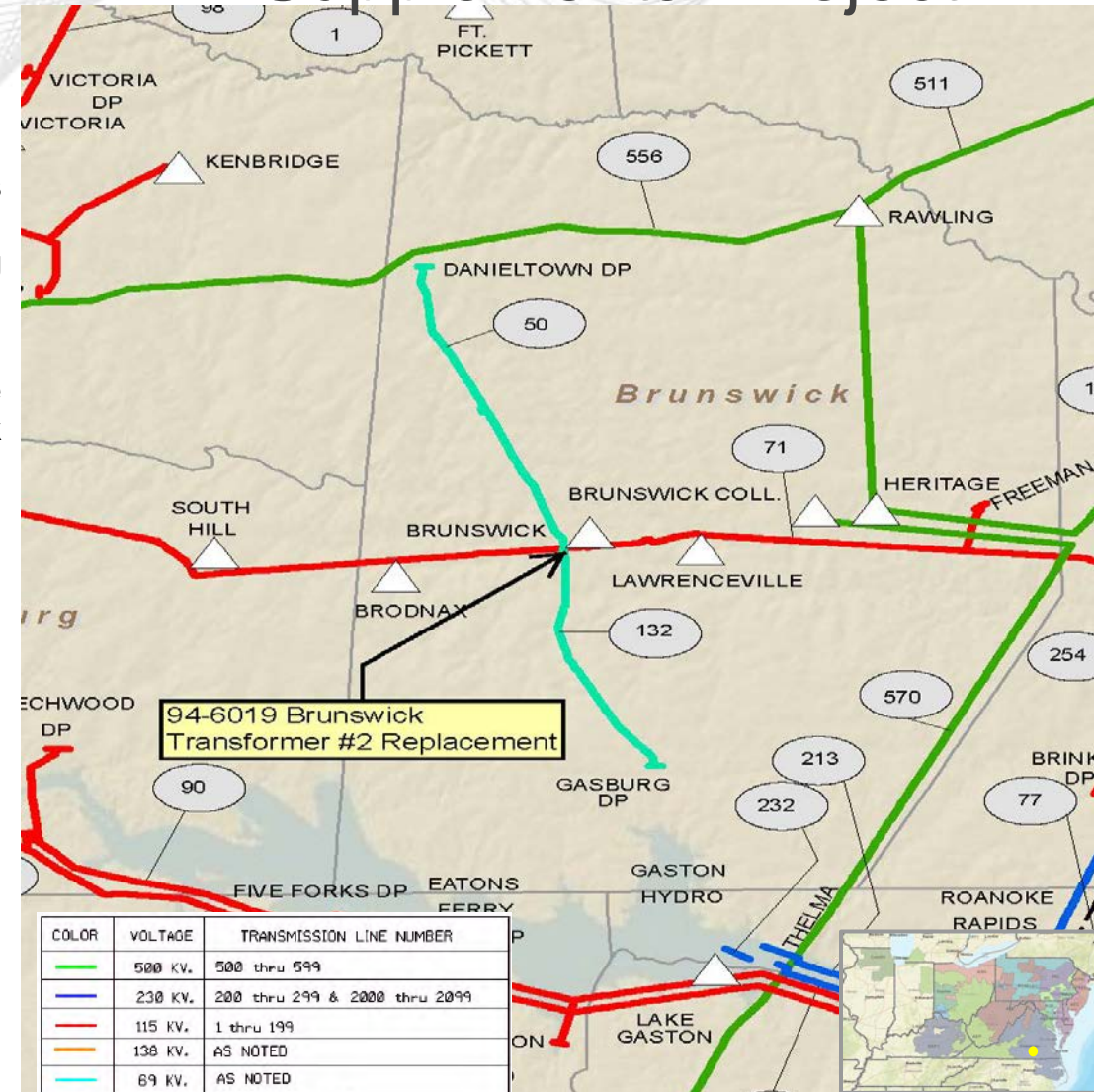
- Replace Brunswick transformer #2 with a 30 MVA transformer.
- Expand station and relocate A frame structure to accommodate replacement transformer.
- Expand control house to move transformer controls inside the control house. (s1353)

Alternatives: No feasible alternatives

Estimated Project Cost: \$2.9 M

Projected IS Date: 06/15/2018

Project Status: Engineering



Supplemental Project: Tarboro 230-115kV Transformer #3 Upgrade

Date Project Last Presented: 6/9/2017 SRRTEP

Problem Statement:

- Tarboro 230-115kV 112 MVA transformer #3 needs to be replaced as a result of Dominion's ongoing transformer health assessment (THA) process. This process considers design characteristics, past electrical test results, dissolved gas-in-oil test results, age, ongoing maintenance issues, and past failures of similar designed transformers.
- This transformer was manufactured in 1972 by Westinghouse. It was remanufactured in 2003 following failures in 1975, 1994 & 2002.
- Drivers for replacement are – age, previous remanufacture following failures, increased trend of combustible gas generation, and reduced BIL.

Selected Solution:

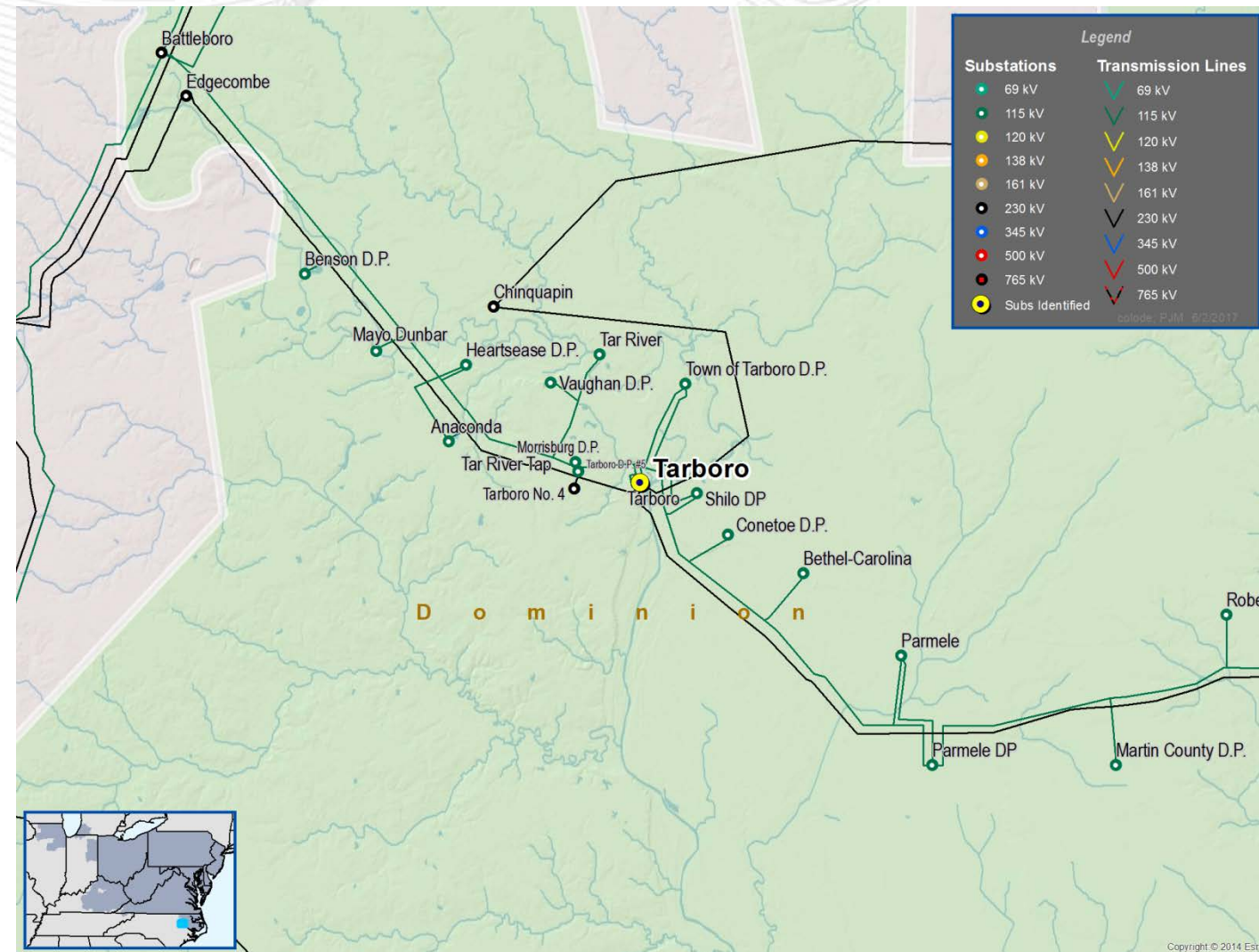
- Replace Tarboro transformer #3 with a 168 MVA transformer. (**s1356**)

Alternatives: No feasible alternatives

Estimated Project Cost: \$2.9 M

Projected IS Date: 12/29/2017

Project Status: Engineering



Supplemental Project: Tarboro 230-115kV Transformer #4 Upgrade

Date Project Last Presented: 6/9/2017 SRRTEP

Problem Statement:

- Tarboro 230-115kV 112 MVA transformer #4 needs to be replaced as a result of Dominion's ongoing transformer health assessment (THA) process. This process considers design characteristics, past electrical test results, dissolved gas-in-oil test results, age, ongoing maintenance issues, and past failures of similar designed transformers.
- This transformer was manufactured in 1974 by McGraw Edison.
- Drivers for replacement are – age, reduced BIL, transformers previously manufactured by McGraw Edison are considered suspect due to previous transformer failures.

Selected Solution:

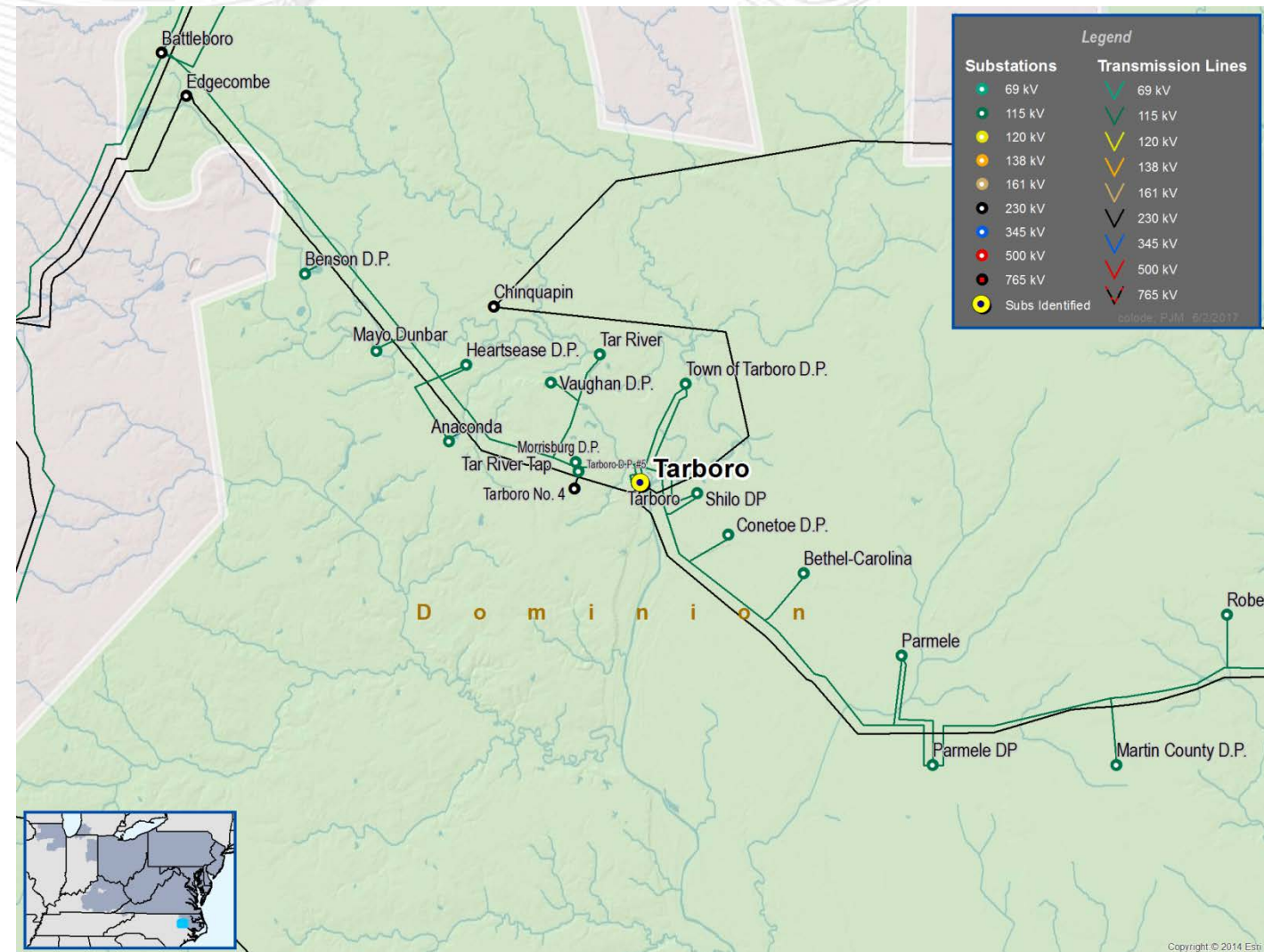
- Replace Tarboro transformer #4 with a 168 MVA transformer. (**s1357**)

Alternatives: No feasible alternatives

Estimated Project Cost: \$2.9 M

Projected IS Date: 12/30/2019

Project Status: Engineering



Questions?

Email: RTEP@pjm.com



Revision History

08/23/2017 – V1 – Original version posted to PJM.com.

08/24/2017 – V2 – Removed redundant term “ACAR” from slide 8 and resized text boxes on drawing on slide 9.

09/15/2017 – V3 – Updated slide 3 to correctly identify Bremono TX#8 as 138kV-115kV and provided additional THA driver information. Updated slide 4 to provide additional Basin TX#6 THA driver information. Updated slide 11 to provide additional Brunswick TX#2 THA driver information. Updated slide 13 to correct the ISD for Tarboro TX#4 to 12/30/2019.