Sub Regional RTEP Committee
South

October 30, 2017

Baseline Reliability and Supplemental Projects
First Preliminary Review

Dominion: Baseline Violation
115 kV Line #43 Staunton to Harrisonburg End of Life

Problem Statement: DOM "End of Life Criteria"

- 115kV Line #43 is approximately 22.8 miles long and was constructed on wood H-frame structures in 1958 from Staunton to Harrisonburg. This line has ACSR conductor and 3/8" steel static. This line serves Peach Grove DP, North River DP, Weyers Cave and Verona substations which encompasses 7,693 customers including 3,214 fed by Co-op. It has an existing summer emergency rating of 147 MVA between Harrisonburg and Verona. Between Verona and Staunton it has a rating of 168 MVA.
- Industry guidelines indicate equipment life for wood structures is 35-55 years, conductor and connectors are 40-60 years, and porcelain insulators are 50 years.
- Permanent MW load loss for removal of this line would be in excess of 58 MW. This line needs to be rebuilt to current standards based on Dominion's "End of Life" criteria.

Potential Solution:

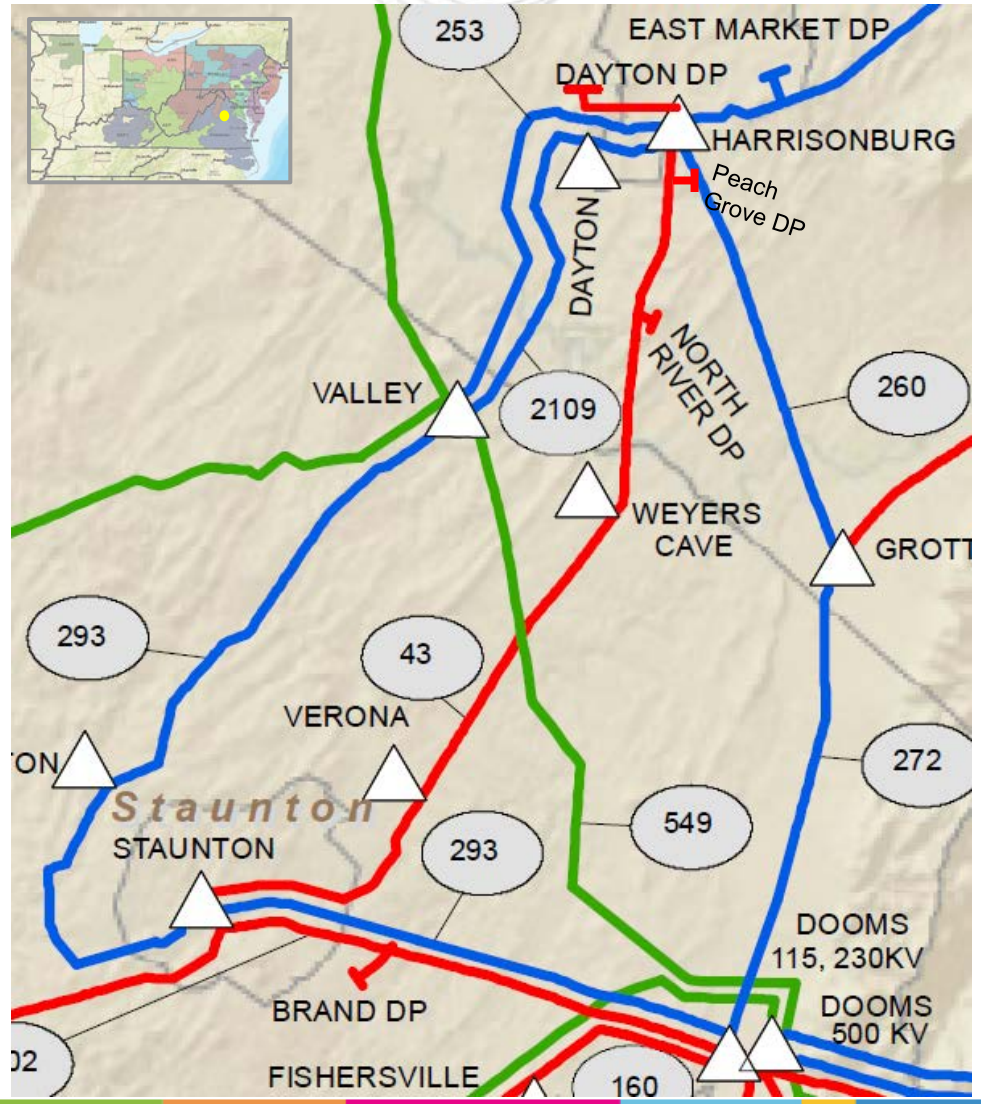
- Rebuild 115kV Line #43 between Staunton and Harrisonburg (22.8 miles) to current standards with a summer emergency rating of 261 MVA at 115kV.

Alternatives: Same as the potential solution with higher capacity conductor (393 MVA) at an estimated project cost of $41.3 M.

Estimated Project Cost: $37.5 M

Possible In-service Date: 10/31/2022

Project Status: Conceptual



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

Dominion: Baseline Violation
115kV Line #29 Fredericksburg to Aquia Harbor End of Life

Problem Statement: DOM "End of Life Criteria"

- Total line length of 115kV Line #29 is 24.4 miles and runs between Fredericksburg Substation and Possum Point Power Station. The proposed rebuild segment of the 115kV Line #29 between Fredericksburg and Aquia Harbor is approximately 12 miles long and was constructed on wood H-frame structures in 1957. Existing conductor in the proposed rebuild segment is a combination of 1109 ACAR, 2-721 ACAR and 795 ACSR with a summer rating of 239 MVA. The remaining 12 miles of Line #29 is on a common 230kV lattice structure with Line #252 (with the exception of the tap to Quantico) with a summer conductor rating of 361 MVA at 115kV.
- This line provides service to Quantico Substation with a total of 440 customers including the Quantico USMC Base. Quantico Substation is connected to Line #29 with a 1.7 mile 115kV tap off the main line.
- Rebuilding this 12 mile segment of Line #29 to current 230kV standards (with continued operation at 115kV) would be consistent with the Company's practice of containing or converting 115kV load in the Northern Virginia area and would support the future conversion of the entire Line #29 to 230kV with the remaining 12 miles already installed on 230kV structures.

Potential Solution:

- Rebuild Line #29 segment between Fredericksburg and Aquia Harbor to current 230kV standards (operating at 115kV) utilizing steel H-frame structures with 2-636 ACSR to provide a normal continuous summer rating of 524 MVA at 115kV (1047 MVA at 230kV).

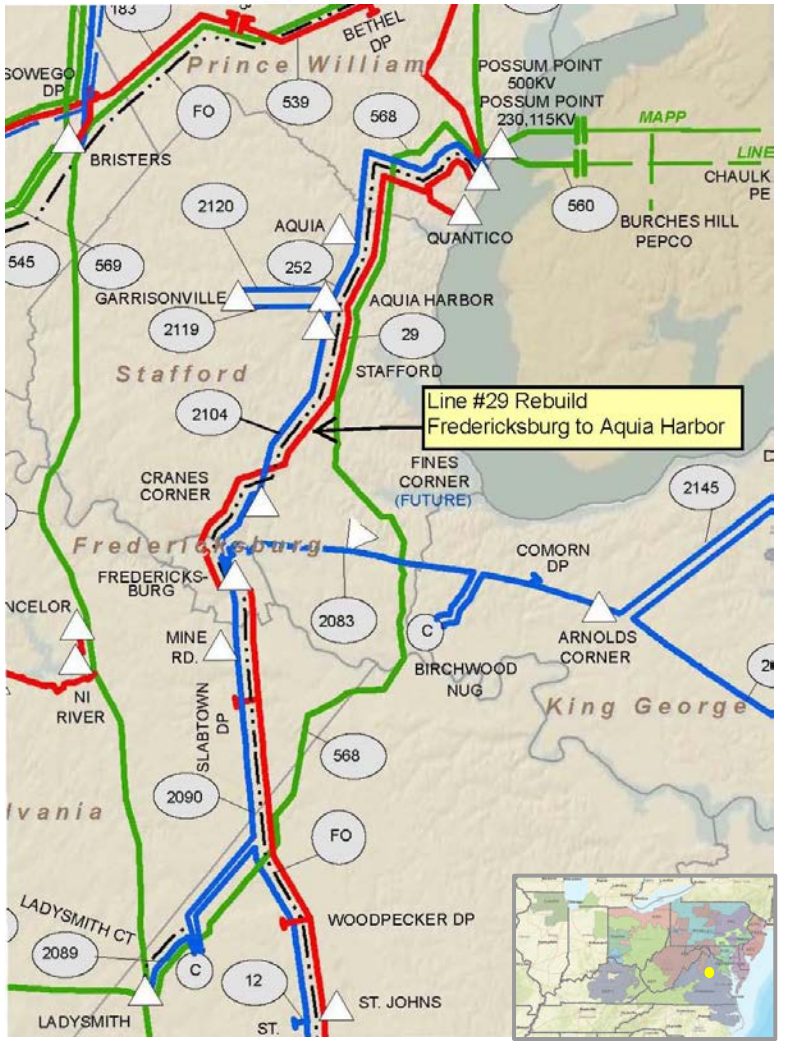
Alternatives: Convert 1.7 mile tap line to Quantico to 230kV, connect the tap to Line #252 and retire Line #29. This alternative would require the installation of a new 230kV switching station at the tap point and conversion/relocation of Quantico Substation. This alternative would be more costly ($20M) and would be subject to ROW and land acquisition due to space constraints at Quantico USMC Base. This alternative would also eliminate a network transmission line to a high load growth area in Northern Virginia.

Estimated Project Cost: $12.5 M

Possible In-service Date: 12/31/2022

Project Status: Conceptual

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



Dominion: Supplemental Project
Carver Substation – New 115kV Circuit Switcher

Problem Statement:

- The existing protection scheme on Carver 115/13.2kV transformer #6 requires momentarily opening the Line #3 breaker and the associated 115kV bus while a motor operated switch is opened to isolate the transformer.

Potential Solution:

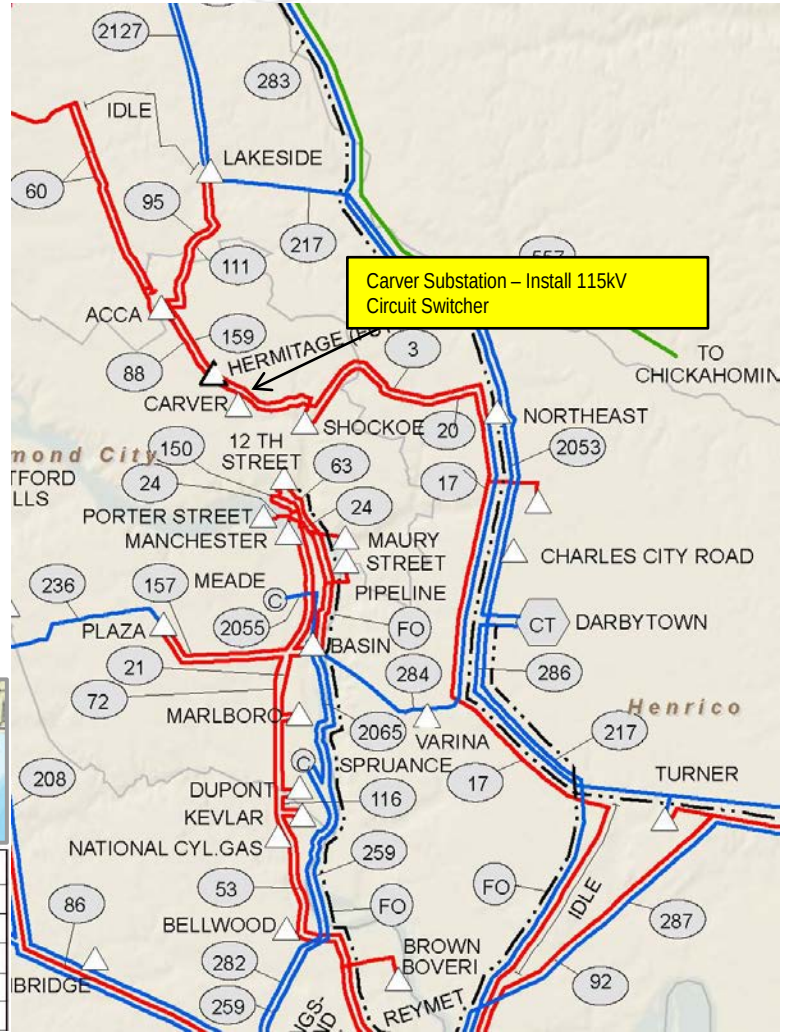
- Install a 115kV circuit switcher on the high side of transformer #6 to provide transformer protection and eliminate the need to open the Carver Line #3 breaker and 115kV bus during this event.

Alternatives: No feasible alternatives

Estimated Project Cost: $275,000

Possible In-service Date: 11/16/2017

Project Status: Engineering



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

Dominion: Supplemental Project
Kitty Hawk 230-115kV Transformer #7 Replacement

Problem Statement:

- Kitty Hawk 230-115kV 168 MVA transformer #7 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 1987 by North American.
- Drivers for replacement are age, reduced BIL ratings and transformers previously manufactured by North American are considered highly suspect due to previous transformer failures.

Potential Solution:

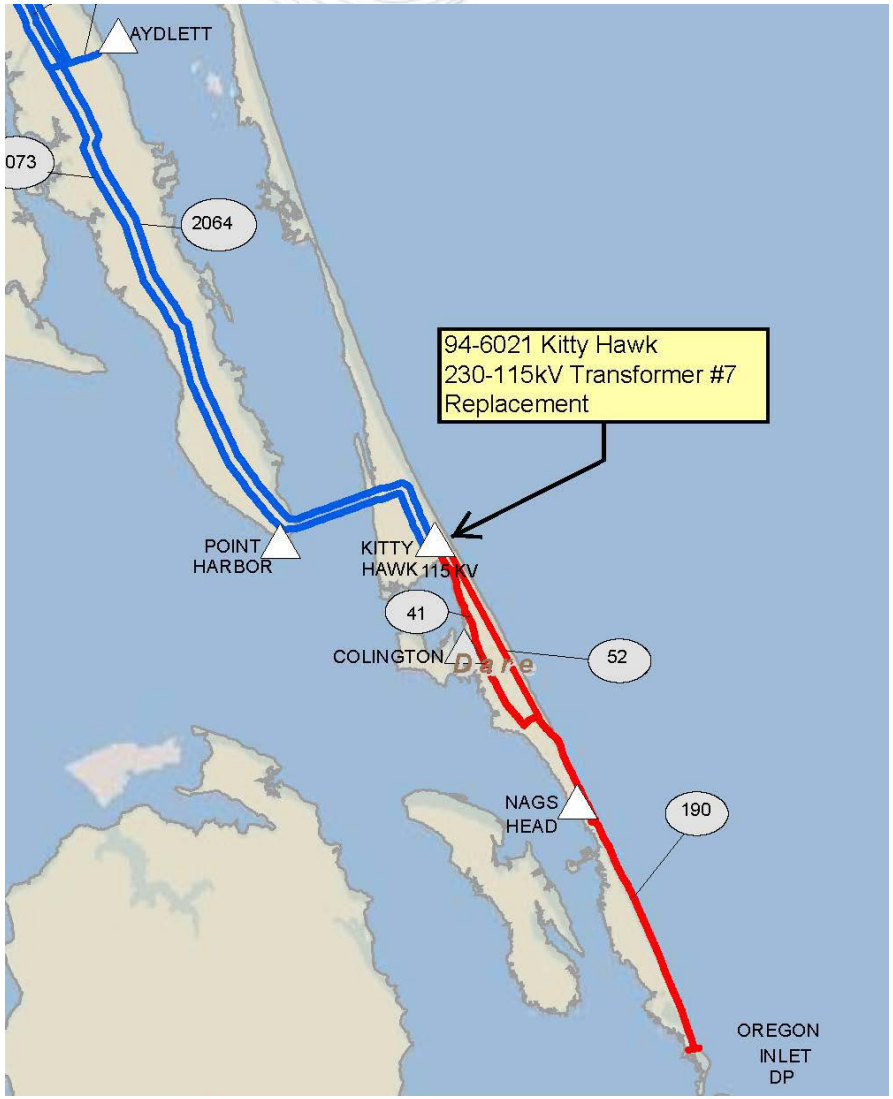
- Replace Kitty Hawk transformer #7 with a 168 MVA transformer.

Alternatives: No feasible alternatives

Estimated Project Cost: $3.0 M

Possible In-service Date: 12/15/2017

Project Status: Engineering



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

Dominion: Supplemental
Lines #93 & #140 Wave Trap & Line Terminal Equipment Replacement

Problem Statement:

- 115kV Line #93 and 115kV Line #140 wave traps and associated line terminal equipment at Southampton substation need to be replaced due to age.

Potential Solution:

- Replace one 115kV breaker and #93 & #140 line relays at Southampton. Replace existing Line #93 & Line #140 1200A wave traps at Southampton with 2000A wave traps. 115kV Line #93 Southampton – Watkins Corner segment summer emergency rating will be increased from 239MVA to 287MVA. 115kV Line #140 Hansom DP – Southampton segment summer emergency rating will be increased from 239MVA to 287MVA.

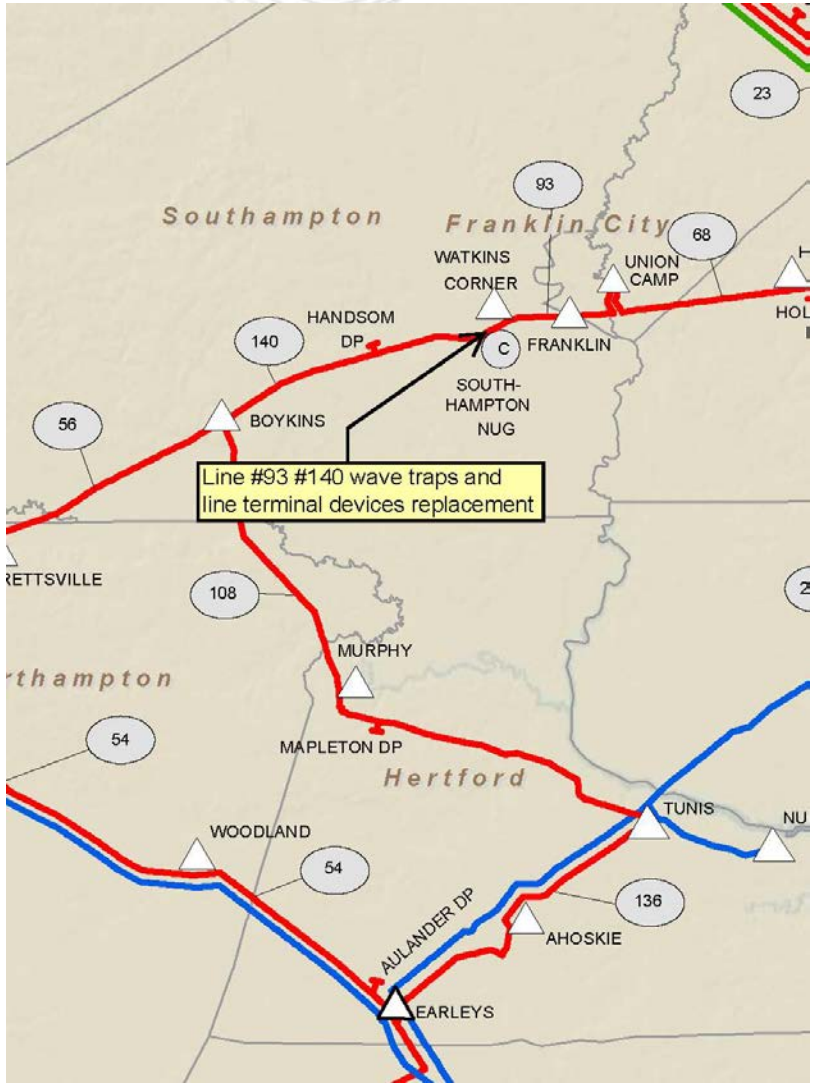
Alternatives: No feasible alternatives

Estimated Project Cost: $1.0 M

Possible In-service Date: 11/15/2017

Project Status: Under Construction

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



Baseline Reliability and Supplemental Projects
Second Review

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

Date Project Last Presented: 8/29/2017 SRRTEP

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

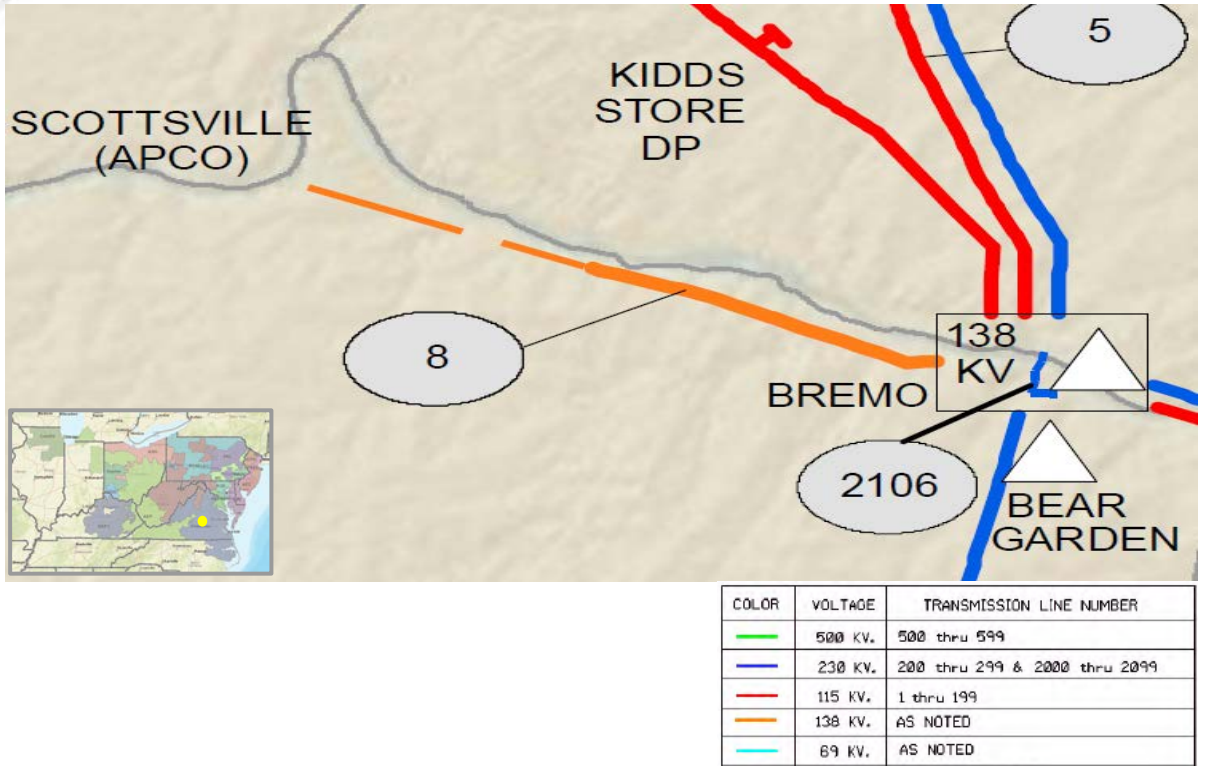
Selected Solution:

- 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. (s1374)

Estimated Project Cost: $7 M

Projected In-service Date: 7/31/2018

Project Status: Engineering



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

Date Project Last Presented: 8/29/2017 SRRTEP

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.

Selected Solution:

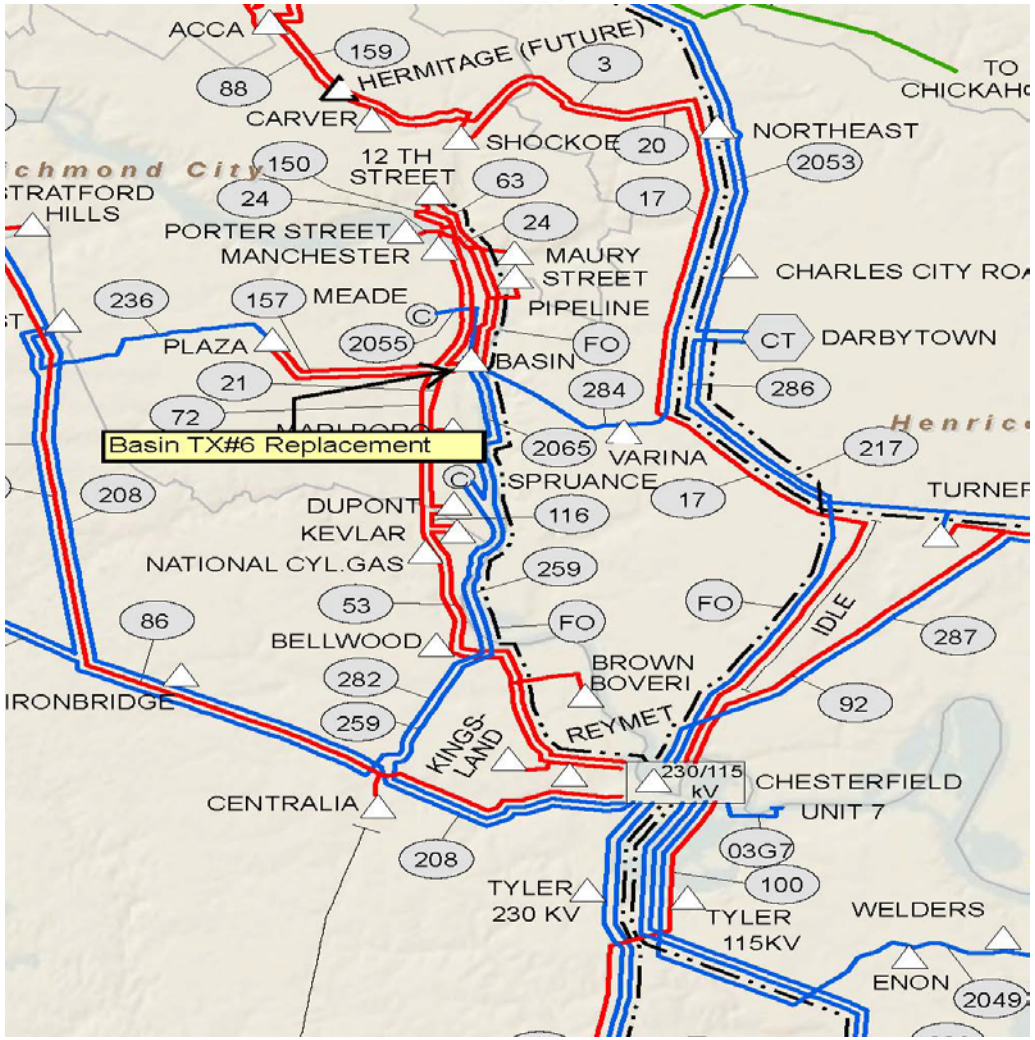
- Replace Basin transformer #6 with a 224 MVA transformer. Install a 230kV breaker on high side of transformer and replace high side switch. (s1375)

Estimated Project Cost: $3.2 M

Projected In-service Date: 5/30/2018

Project Status: Engineering

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



Dominion: Supplemental
Pendleton Substation – New 115kV Circuit Switcher

Date Project Last Presented: 8/29/2017 SRRTEP

Problem Statement:

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

Selected Solution:

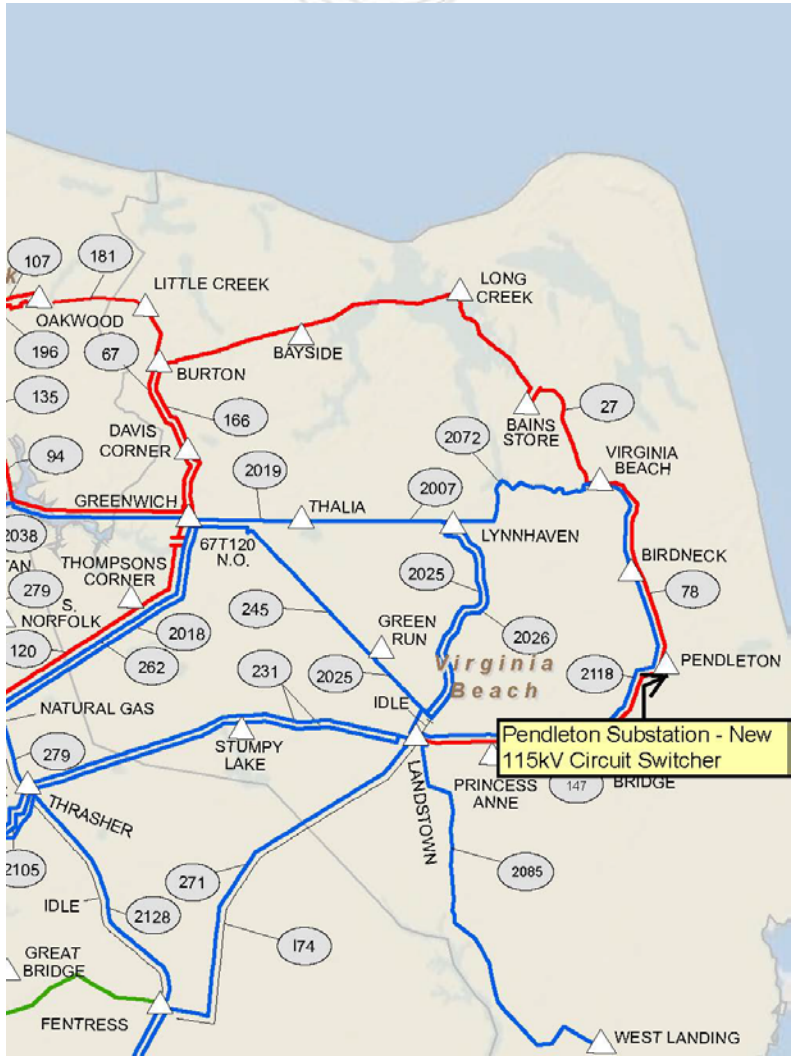
- Remove the ground switch, install a 115kV circuit switcher on TX#1 high side. (s1376)

Estimated Project Cost: $1.6 M

Projected In-service Date: 5/31/2018

Project Status: Engineering

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



Next Steps

Upcoming SRRTEP-South Meetings

South	Start	End
12/18/2017	8:30	11:30
1/30/2018	8:30	11:30
3/27/2018	8:30	11:30
5/30/2018	8:30	11:30
7/27/2018	8:30	11:30
9/28/2018	8:30	11:30
11/29/2018	8:30	11:30

Questions?

or

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Revision History

10/25/2017 – Original version posted to PJM.com