Surry – Skiffes Creek – Whealton

Modeling and Alternatives Analysis Review

TOPICS

- Project Purpose, Need, Timeline
- NERC Criteria Review
- NHRLA Load Data
- Power Flow Modeling – Background and Examples
- Generation Retirements – Basecase
- Alternatives Analysis – 2015 & 2016
- Load Shed Summary and Consequences

Proposed Project is :

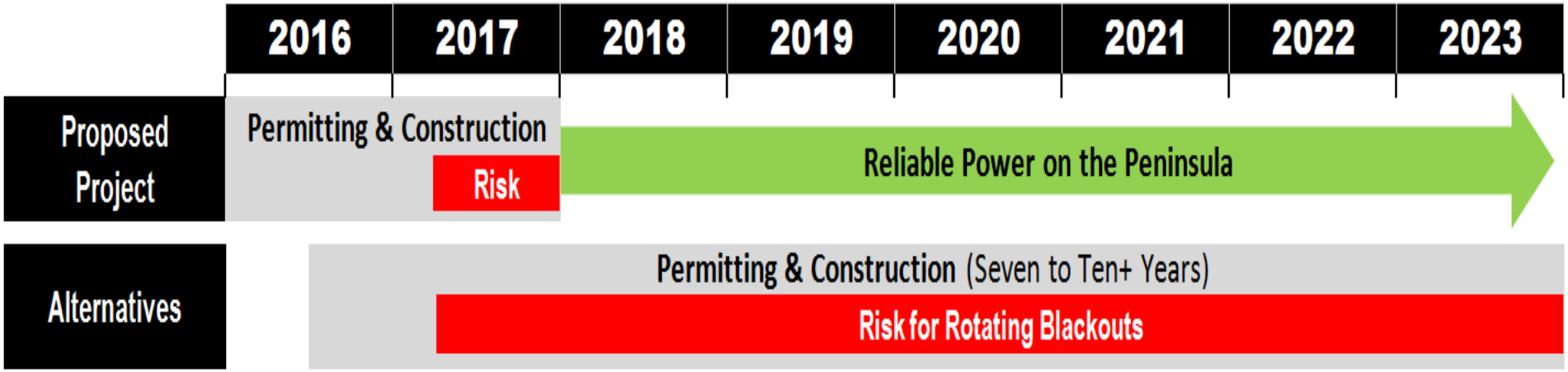
- ✓ ***Needed Based on Latest Load Forecast***
- ✓ ***Recently Validated by PJM***
- ✓ ***Still the Optimum Long-term Solution***

PROJECT PURPOSE AND NEED

USACE Preliminary Alternatives Conclusions White Paper
RE: NAO-2012-0080/13-V0408
October 1, 2015

(1) Basic: To continue providing the North Hampton Roads Load Area (NHRLA) with reliable, cost effective, bulk electrical service consistent with mandatory North American Electric Reliability Corporation (NERC) Reliability Standards for transmission facilities and planning criteria.

(2) Overall: Provide sustainable electrical capacity into the NHRLA in a manner that addresses future load growth deficiencies, replaces aging infrastructure, complies with Federal regulations, including MATS, and maintains compliance with NERC Reliability Standards.



MANDATED COMPLIANCE WITH NERC RELIABILITY STANDARDS

Category A Criteria (Normal)	Established in NERC Reliability Standard TPL-001-0, require that, for all facilities in service (transmission lines, transformers, etc.) and no contingencies (normal system or "n'), equipment **thermal ratings and system voltage limits must be maintained** and that the system is stable.	**Examples**:
Category B Criteria (N-1)	Established in NERC Reliability Standard TPL-002-0, impose **similar requirements with one facility removed from service**, referred to as "n-1." These criteria ensure that the system operates to remain reliable upon the instantaneous outage of any one system element.	**Line 209 Lockout** Winter Storm January 2016
Category C Criteria (N-1-1)	Established in NERC Reliability Standard TPL-003-0, require the system to be stable and equipment thermal ratings and system voltage limits **maintained for multiple system events, including second contingencies involving the loss of one system element followed by system readjustments and then the loss of a second system element** (referred to as "n-1-1"). Category C criteria also include the loss of two circuits on a single tower line or a single faulted system element followed by a stuck breaker (referred to as "n-2"), for which the criteria do not allow adjustment of generation patterns.	**James River Bridge Line** Straightline wind July 2009 (N-2)
Category D Criteria (Extreme)	Established in NERC Reliability Standard TPL-004-0, require **evaluation of extreme events resulting in two or more (multiple) elements** removed from services or cascading out of service, such as loss of a line with three or more circuits and loss of all lines in a common right-of-way.	**Surry Switchyard** Tornado April 2011

NHRLA – LOAD DATA

NHRLA Peak Summer Load (MW)				
	Summer 2012	Summer 2013	Summer 2014	Summer 2015
Northern Neck	475	449	466	463
Yorktown	1367	1350	1300	1430
Actual	1842	1799	1766	1893

- ***Peak load, while relevant, is not the only applicable criteria that must be considered***
- ***<u>Power flow modeling studies</u> must be conducted to evaluate whether an alternative meets NERC Reliability Standards at all points in the system under all contingencies***

PERI "military bases and a DOE laboratory, have collectively decreased their energy usage by 14.8 %"

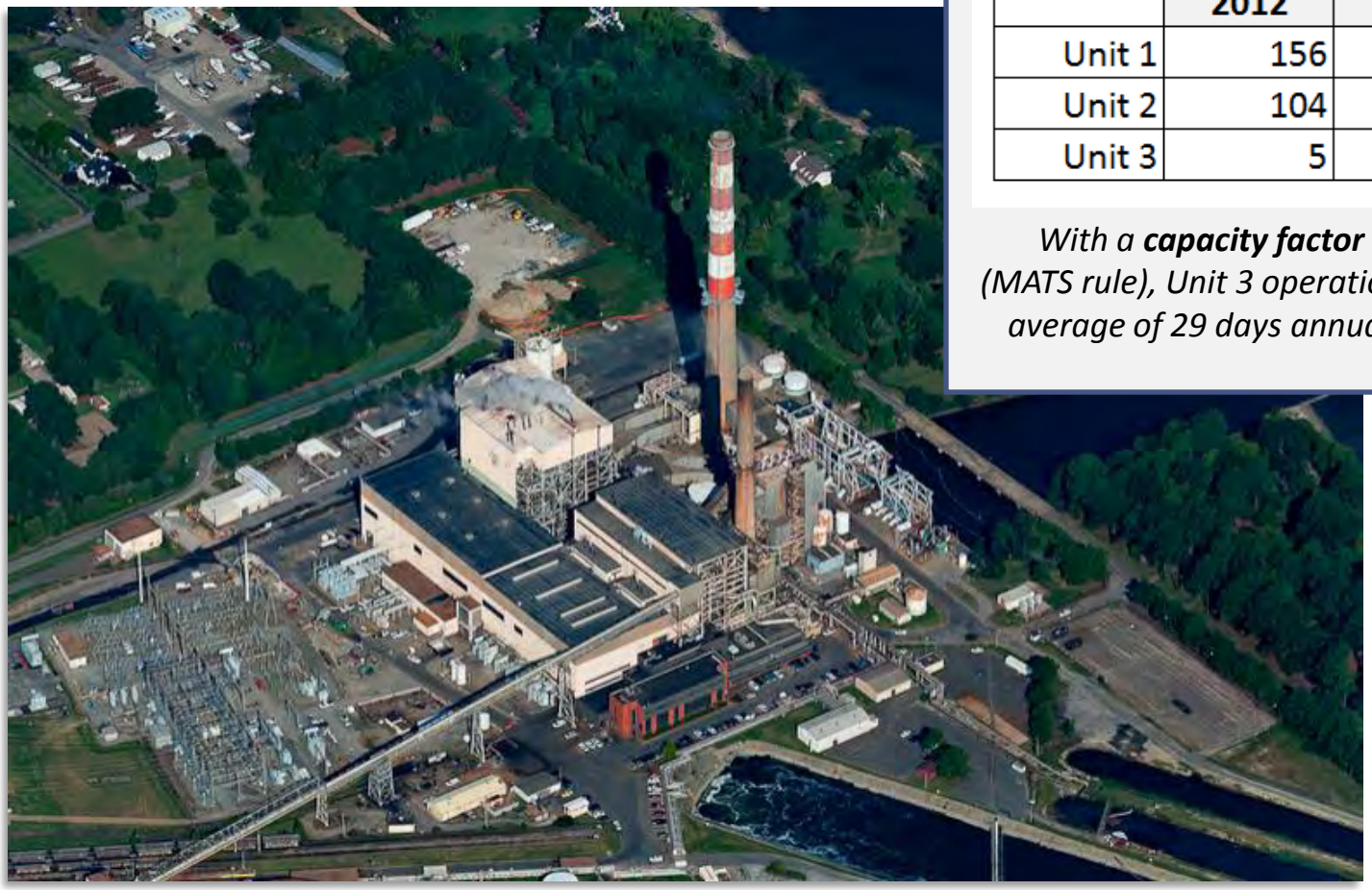
- PERI references all energy source consumption from electricity, to natural gas, fuels (gas and diesel) and LNG
- Reliability in NHRLA is not tied to energy consumption but to peak electrical demand, which continues to grow
- Six Federal facilities in the NHRLA region (Camp Peary, Cheatham Annex, Coast Guard Station Yorktown, Yorktown Naval Weapons Station, Fort Eustis and Langley Air Force Base) experienced ***actual peak electrical demand increases*** between 2013 and 2015

Total Customers	2011	2012	2013	2014	2015
Total NHRLA	283,534	285,461	286,495	288,254	290,985

New Customers	2012	2013	2014	2015	Total
Total NHRLA	1,926	1,033	1,758	2,730	7,447

% Growth	2012	2013	2014	2015	Annual
Total NHRLA	0.68%	0.36%	0.61%	0.95%	0.64%

YORKTOWN POWER STATION



© Scott Keating

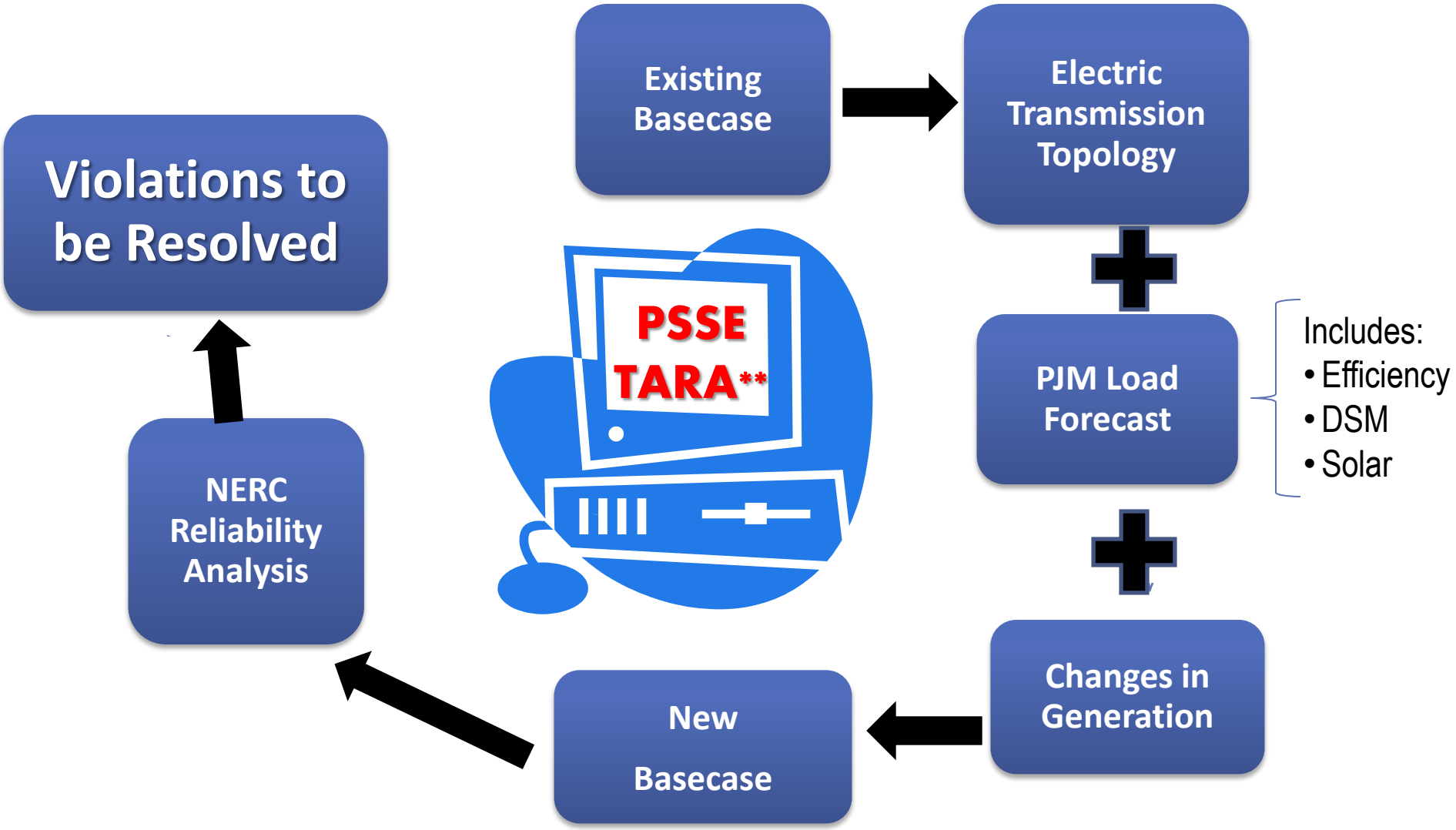
Yorktown Power Station
Days at 100% Capacity

	2012	2013	2014
Unit 1	156	97	112
Unit 2	104	117	122
Unit 3	5	5	8

*With a **capacity factor limitation of 8%** (MATS rule), Unit 3 operations are limited to an average of 29 days annually at full capacity*

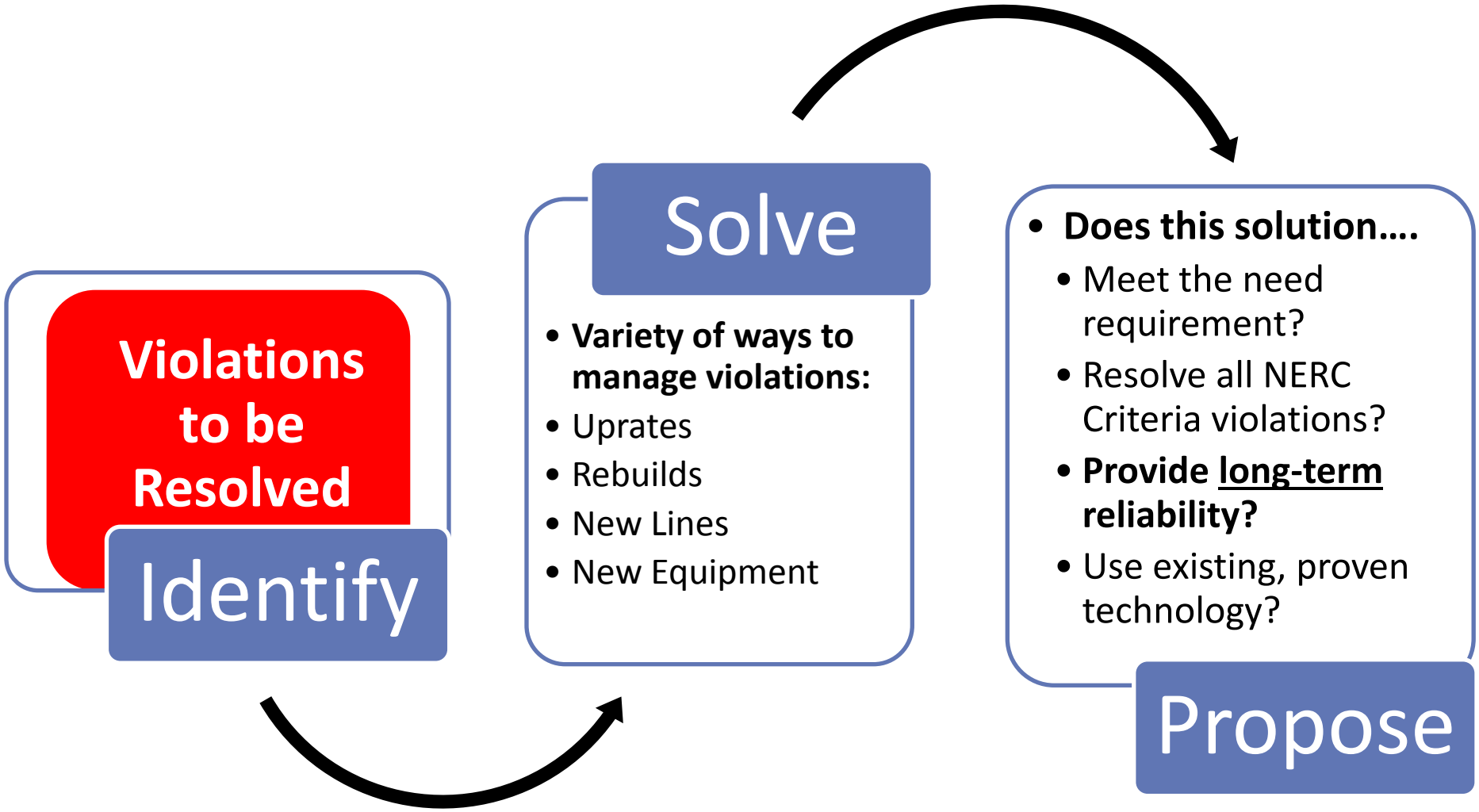
MODELING REQUIRED FOR SYSTEM RELIABILITY

Annual Transmission Planning Process



**Over 50,000 scenarios studied

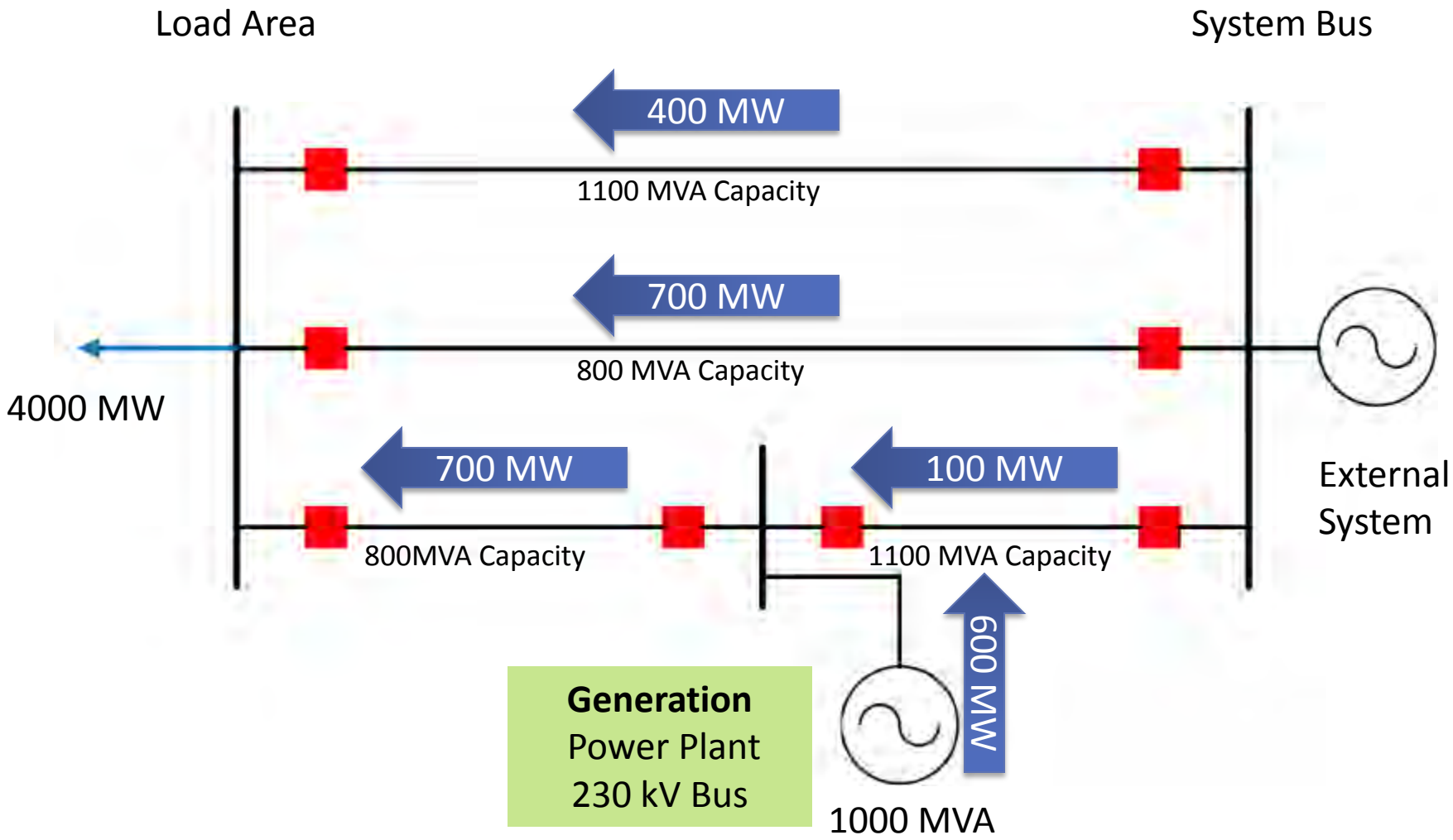
MODELING REQUIRED FOR SYSTEM RELIABILITY



Let's look at few modeling examples . . .

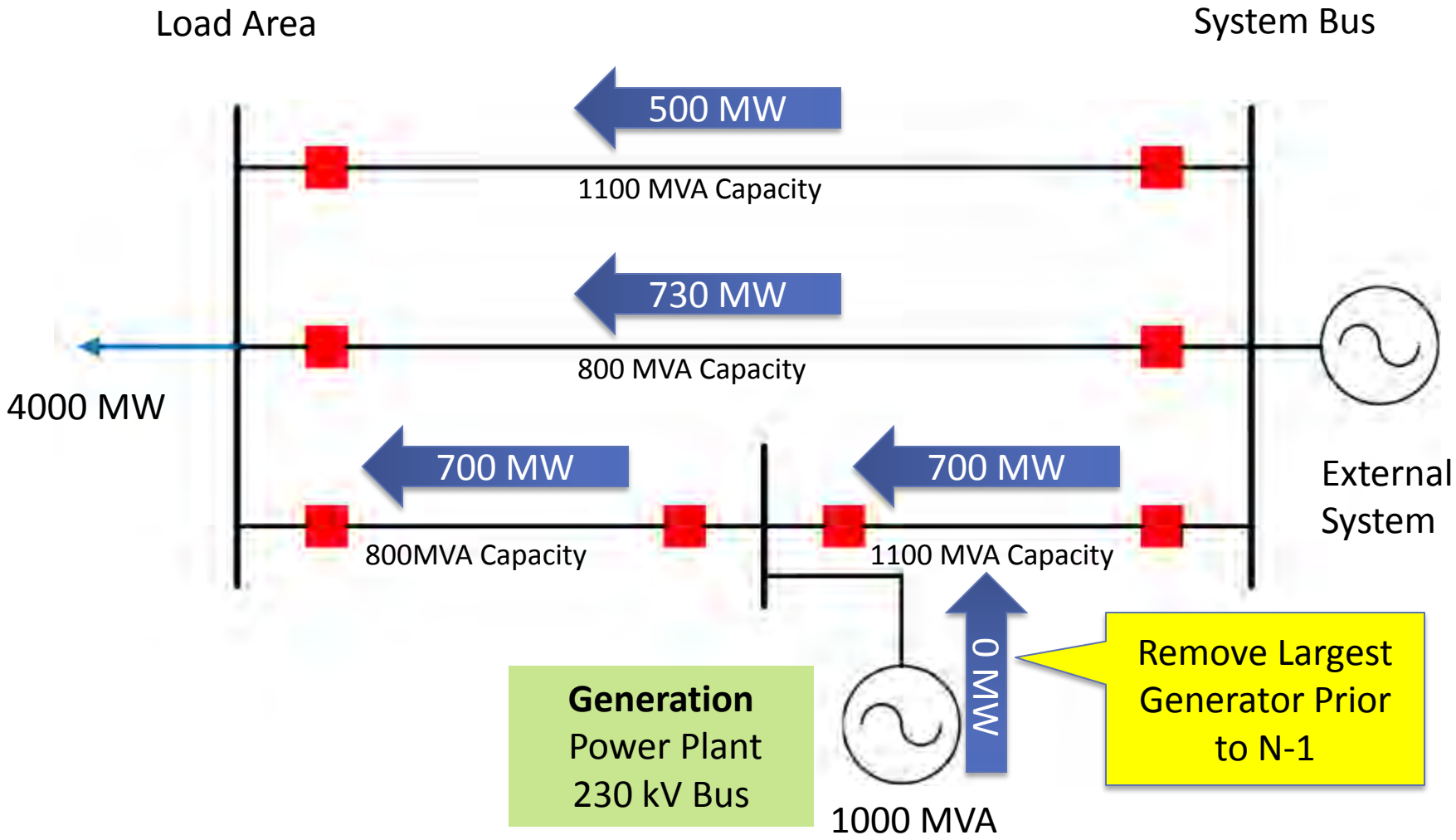
Example – Power Flow System

Base System (N-0)



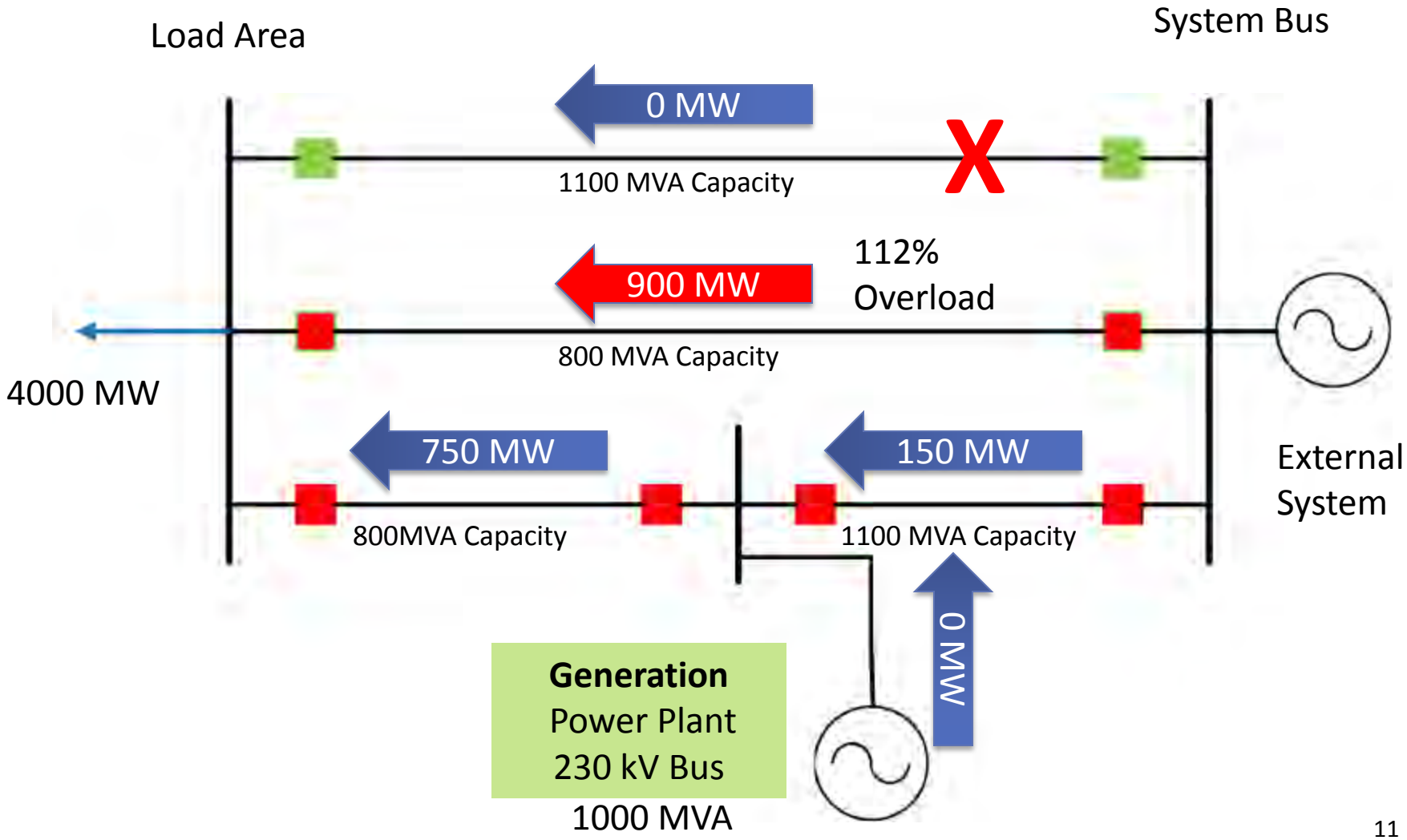
Example – Power Flow System

Critical System Conditions N-0

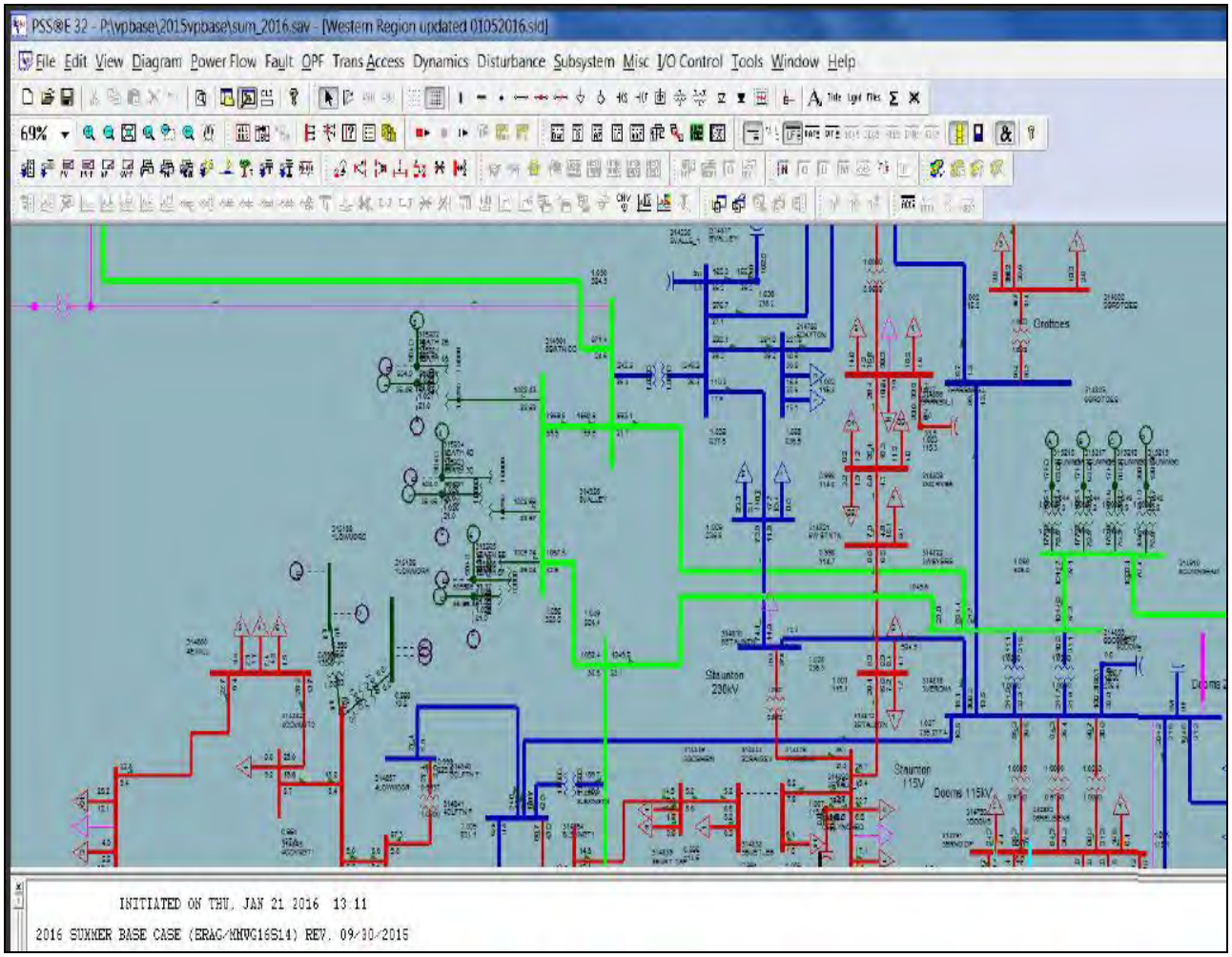


Example – Power Flow System

Critical System Conditions, N-1

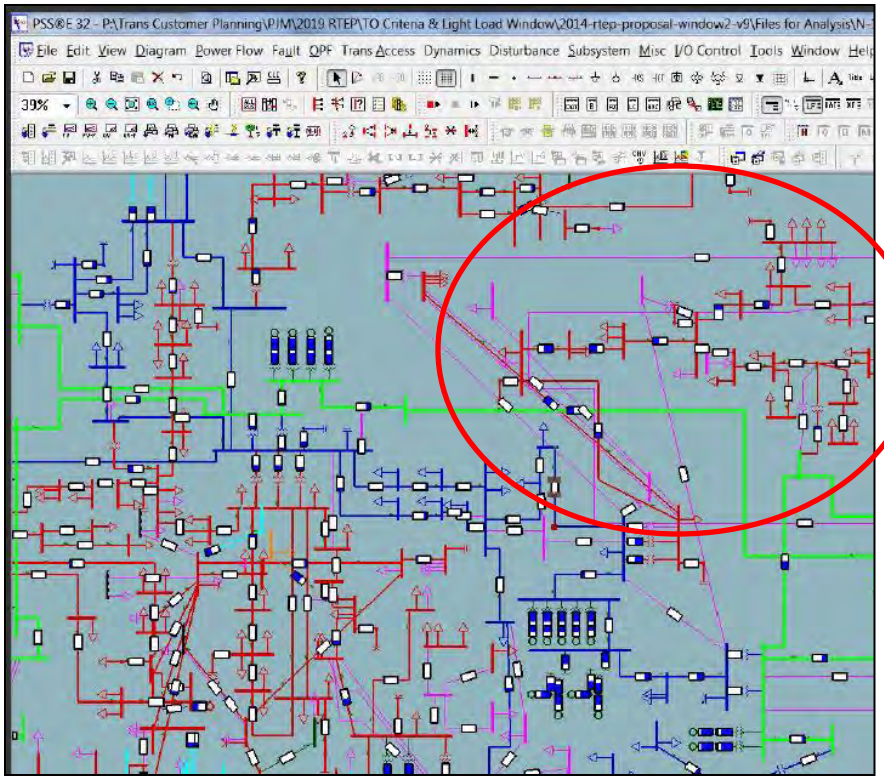


MODELING REQUIRED FOR SYSTEM RELIABILITY

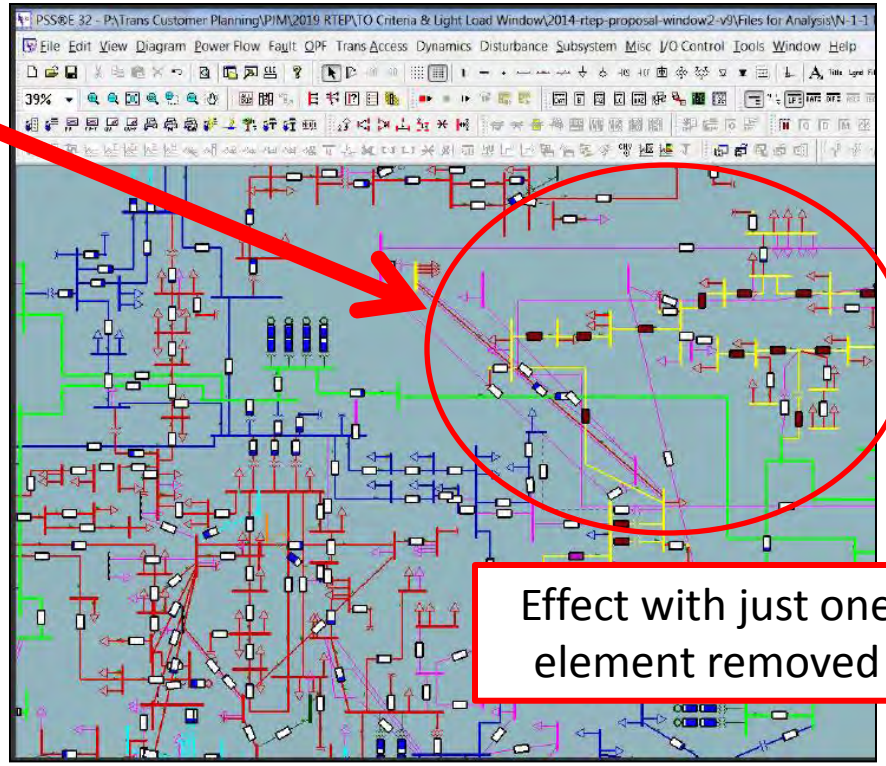


- Multiple power-flow models are created to analyze how a power system would operate under various conditions
- Evaluates up to 50,000 scenarios, can take hours or days to “solve”

MODELING REQUIRED FOR SYSTEM RELIABILITY



Example –
PSSE Contingency Study



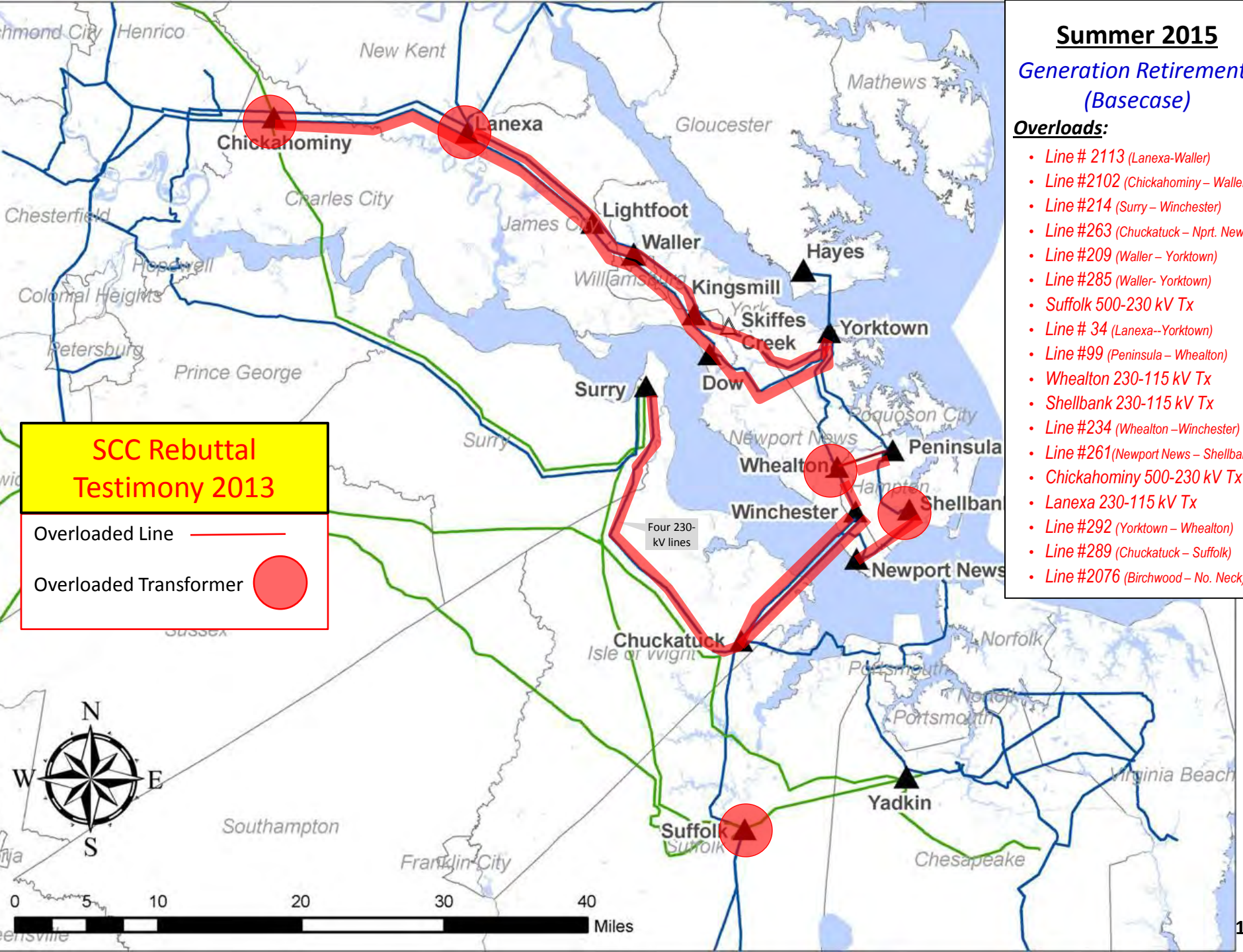
Effect with just one element removed

Alternatives Analysis

Existing As-Is Basecase

Electric Transmission Alternatives

- Modeling Analysis conducted in 2013, using the 2013 Load Forecast
- Modeling Analysis conducted in 2016, using the 2016 Load Forecast


Summer 2015
Generation Retirements (Basecase)
Overloads:
Line # 2113 (Lanexa-Waller)
Line #2102 (Chickahominy – Waller)
Line #214 (Surry – Winchester)
Line #263 (Chuckatuck – Nprt. News)
Line #209 (Waller – Yorktown)
Line #285 (Waller- Yorktown)
Suffolk 500-230 kV Tx
Line # 34 (Lanexa--Yorktown)
Line #99 (Peninsula – Whealton)
Whealton 230-115 kV Tx
Shellbank 230-115 kV Tx
Line #234 (Whealton –Winchester)
Line #261(Newport News – Shellbank)
Chickahominy 500-230 kV Tx
Lanexa 230-115 kV Tx
Line #292 (Yorktown – Whealton)
Line #289 (Chuckatuck – Suffolk)
Line #2076 (Birchwood – No. Neck)
SCC Rebuttal Testimony 2013
Overloaded Line
Overloaded Transformer
Four 230-kV lines
Chickahominy
Lanexa
Lightfoot
Waller
Hayes
Kingsmill
Skiffes Creek
Yorktown
Dow
Surry
Peninsula
Whealton
Winchester
Shellbank
Newport News
Chuckatuck
Yadkin
Suffolk
Henrico
New Kent
Mathews
Gloucester
Charles City
Chesterfield
Colonial Heights
Petersburg
Prince George
Surry
Poquoson City
Hampton
Norfolk
Portsmouth
Virginia Beach
Chesapeake
Southampton
Franklin City
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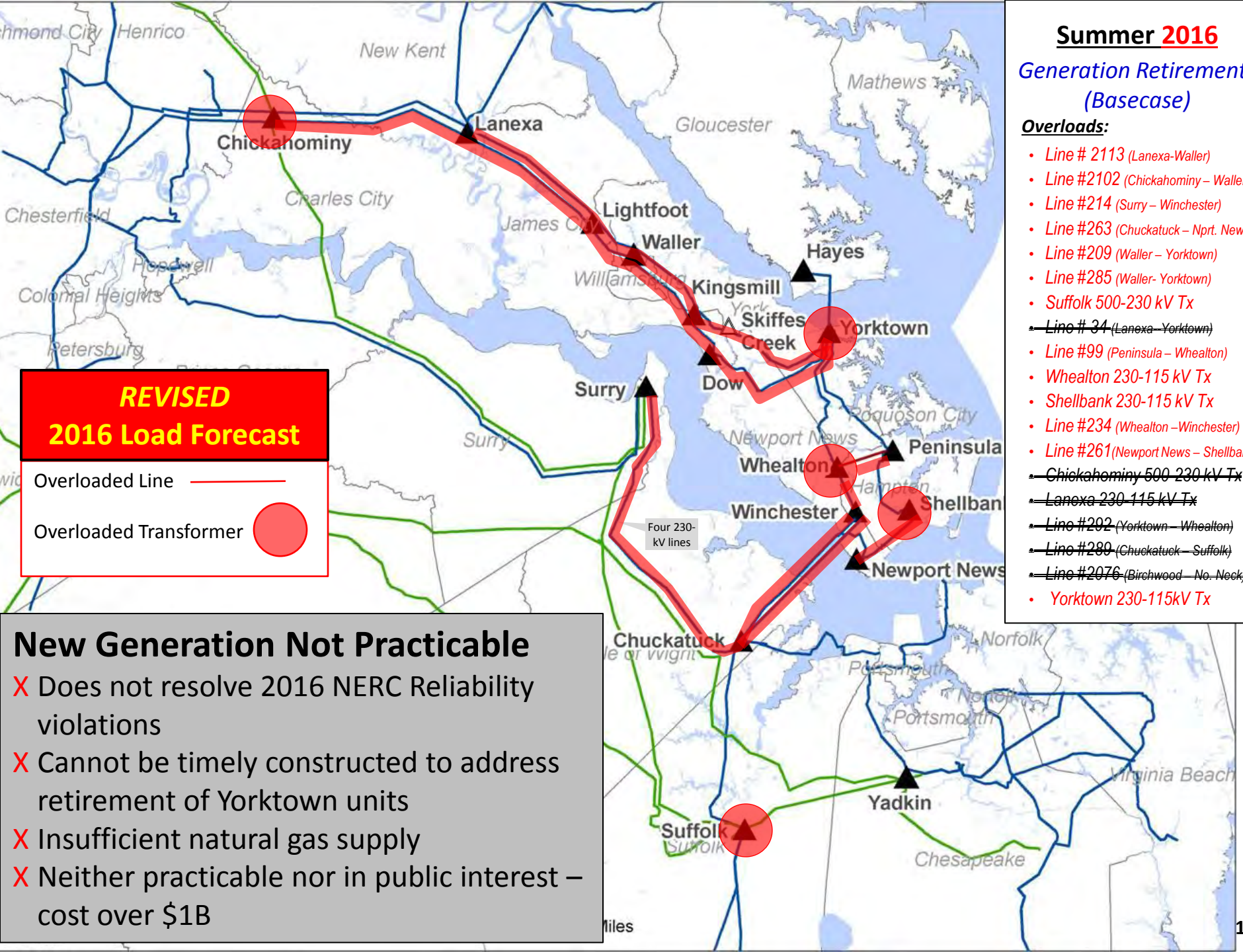
Miles



Summer 2016

Generation Retirements (Basecase)

Overloads:

- *Line # 2113 (Lanexa-Waller)*
- *Line #2102 (Chickahominy – Waller)*
- *Line #214 (Surry – Winchester)*
- *Line #263 (Chuckatuck – Nprt. News)*
- *Line #209 (Waller – Yorktown)*
- *Line #285 (Waller- Yorktown)*
- *Suffolk 500-230 kV Tx*
- ~~*Line # 34 (Lanexa - Yorktown)*~~
- *Line #99 (Peninsula – Whealton)*
- *Whealton 230-115 kV Tx*
- *Shellbank 230-115 kV Tx*
- *Line #234 (Whealton –Winchester)*
- *Line #261(Newport News – Shellbank)*
- ~~*Chickahominy 500-230 kV Tx*~~
- ~~*Lanexa 230-115 kV Tx*~~
- ~~*Line #292 (Yorktown – Whealton)*~~
- ~~*Line #289 (Chuckatuck – Suffolk)*~~
- ~~*Line #2076 (Birchwood – No. Neck)*~~
- *Yorktown 230-115kV Tx*

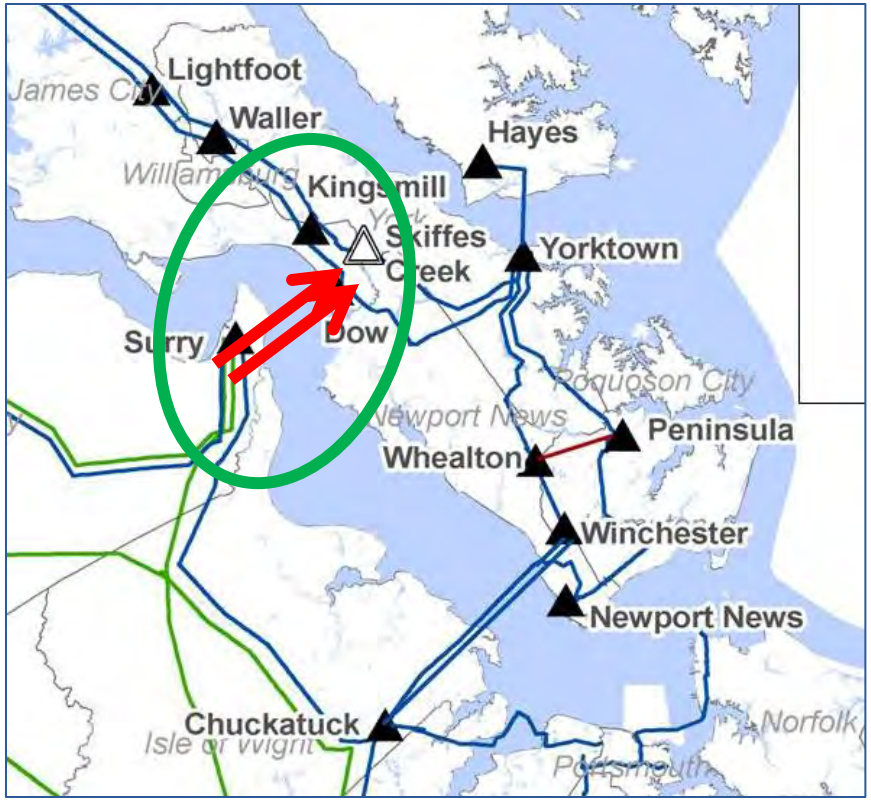
New Generation Not Practicable

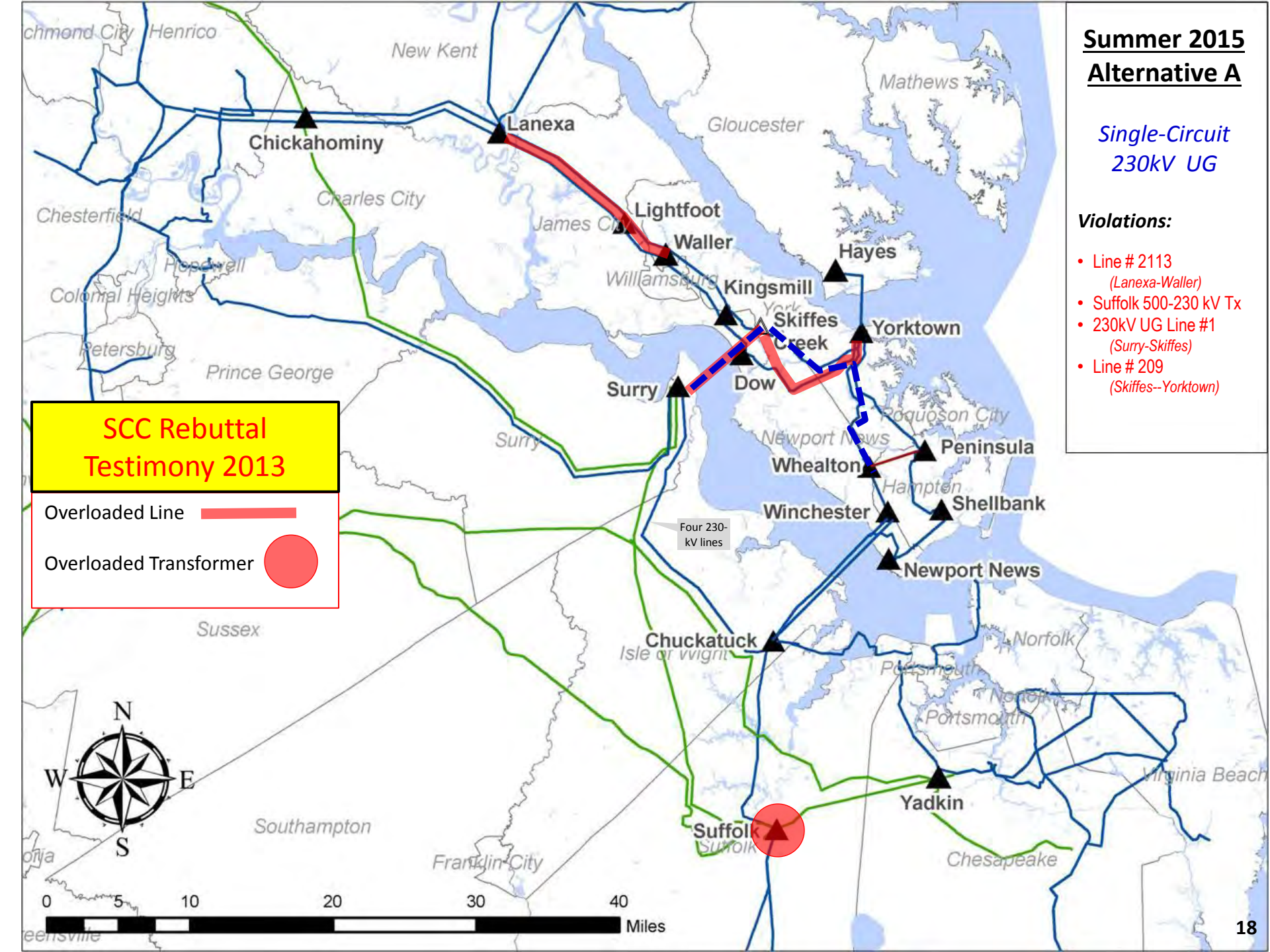
- X Does not resolve 2016 NERC Reliability violations
- X Cannot be timely constructed to address retirement of Yorktown units
- X Insufficient natural gas supply
- X Neither practicable nor in public interest – cost over $1B

Alternatives A and B - - 230kV UNDERGROUND

Potential Adverse Environmental Impacts:

- Water quality impacts include turbidity, and release of contaminants
- Direct impacts to subaqueous bottom
- Direct impacts likely to oyster lease
- Potential impacts to the Atlantic sturgeon
- Potential visual effects from onshore towers and transition stations (0.8 mi from Carter's Grove)
- 7 archaeological sites within the ROW
- 6 underwater archeological sites which may be directly impacted
- 84 houses within 500’ of the ROW
- Existing gas line located within the river in the vicinity of the project




Summer 2015
Alternative A
Single-Circuit
230kV UG
Violations:
• Line # 2113
(Lanexa-Waller)
• Suffolk 500-230 kV Tx
• 230kV UG Line #1
(Surry-Skiffes)
• Line # 209
(Skiffes--Yorktown)
SCC Rebuttal
Testimony 2013
Overloaded Line
Overloaded Transformer
Four 230-kV lines
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Norfolk
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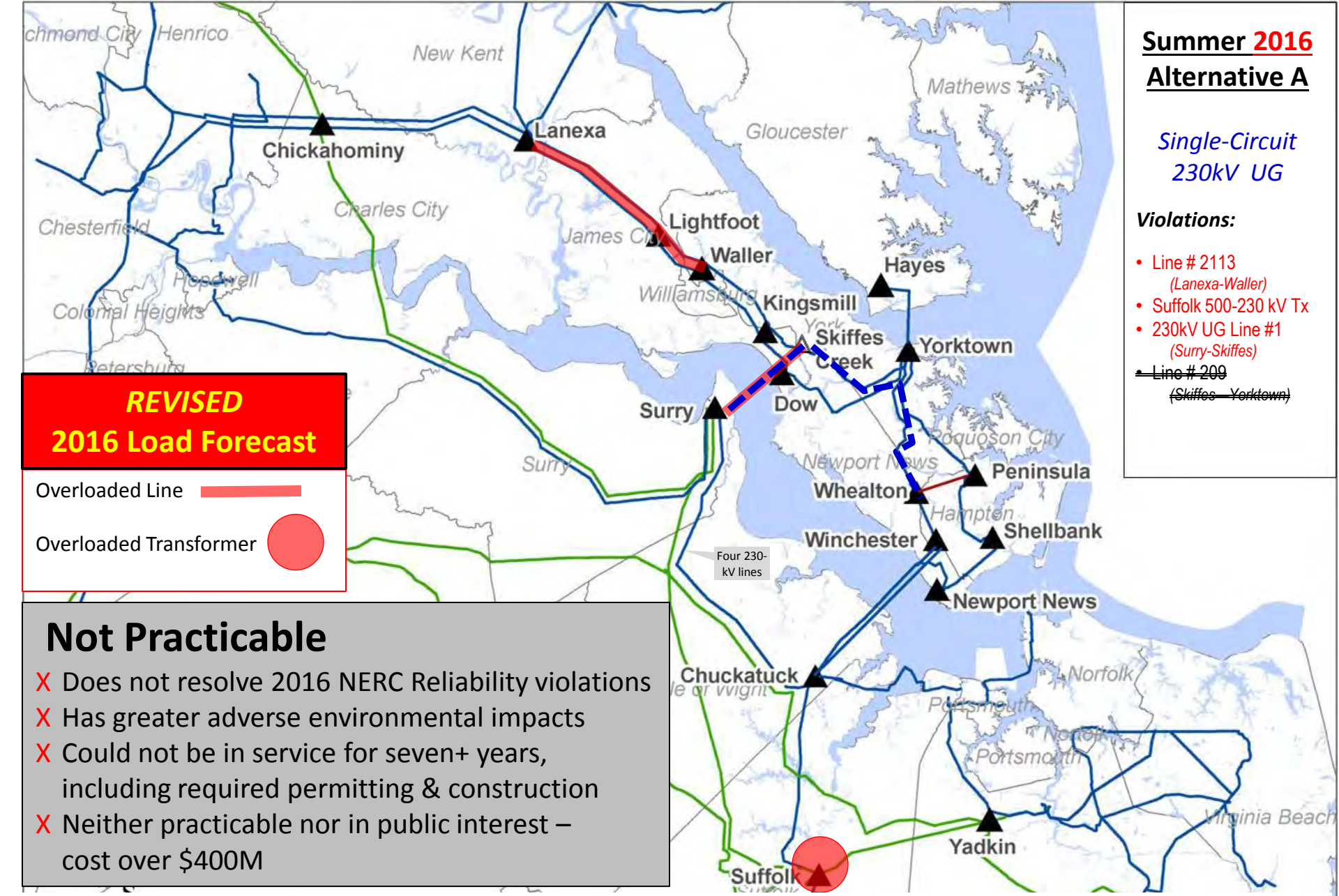
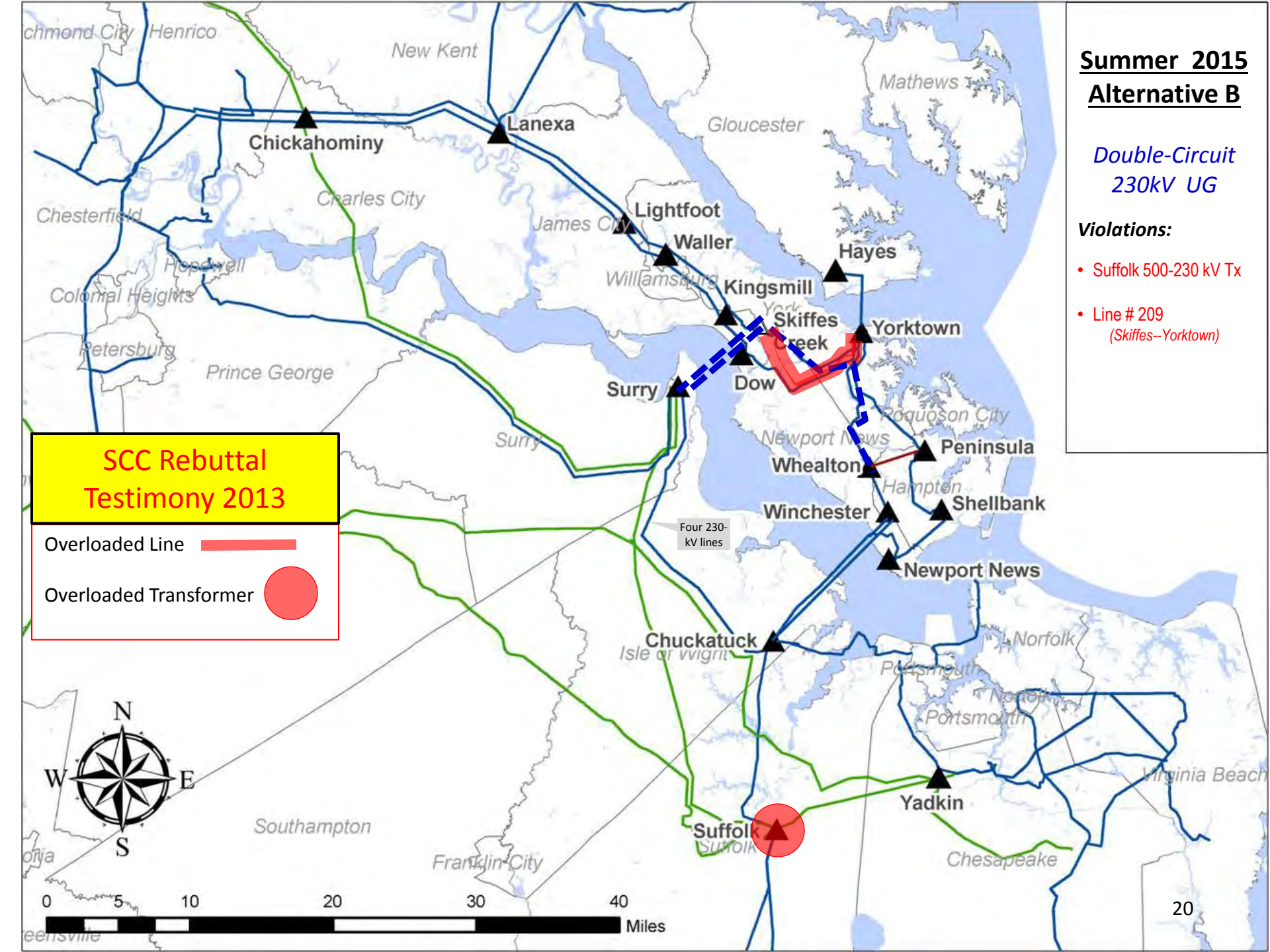

Summer 2016
Alternative A
Single-Circuit
230kV UG
Violations:
• Line # 2113
(Lanexa-Waller)
• Suffolk 500-230 kV Tx
• 230kV UG Line #1
(Surry-Skiffes)
• ~~Line # 209~~
~~(Skiffes – Yorktown)~~
REVISED
2016 Load Forecast
Overloaded Line
Overloaded Transformer
Not Practicable
X Does not resolve 2016 NERC Reliability violations
X Has greater adverse environmental impacts
X Could not be in service for seven+ years, including required permitting & construction
X Neither practicable nor in public interest – cost over $400M
Chickahominy
Lanexa
Lightfoot
Waller
Hayes
Kingsmill
Skiffes Creek
Yorktown
Surry
Dow
Peninsula
Whealton
Shellbank
Winchester
Four 230-kV lines
Newport News
Chuckatuck
Yadkin
Suffolk
New Kent
Mathews
Gloucester
Charles City
James City
Chesterfield
Colonial Heights
Williamsburg
Poquoson City
Hampton
Norfolk
Portsmouth
Virginia Beach
2016
2017
2018
2019
2020
2021
2022
2023
Alternative A
Permitting & Construction (Seven+ Years)
Risk for Rotating Blackouts


Summer 2015
Alternative B
Double-Circuit
230kV UG
Violations:
• Suffolk 500-230 kV Tx
• Line # 209
(Skiffes--Yorktown)
SCC Rebuttal
Testimony 2013
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Overloaded Transformer
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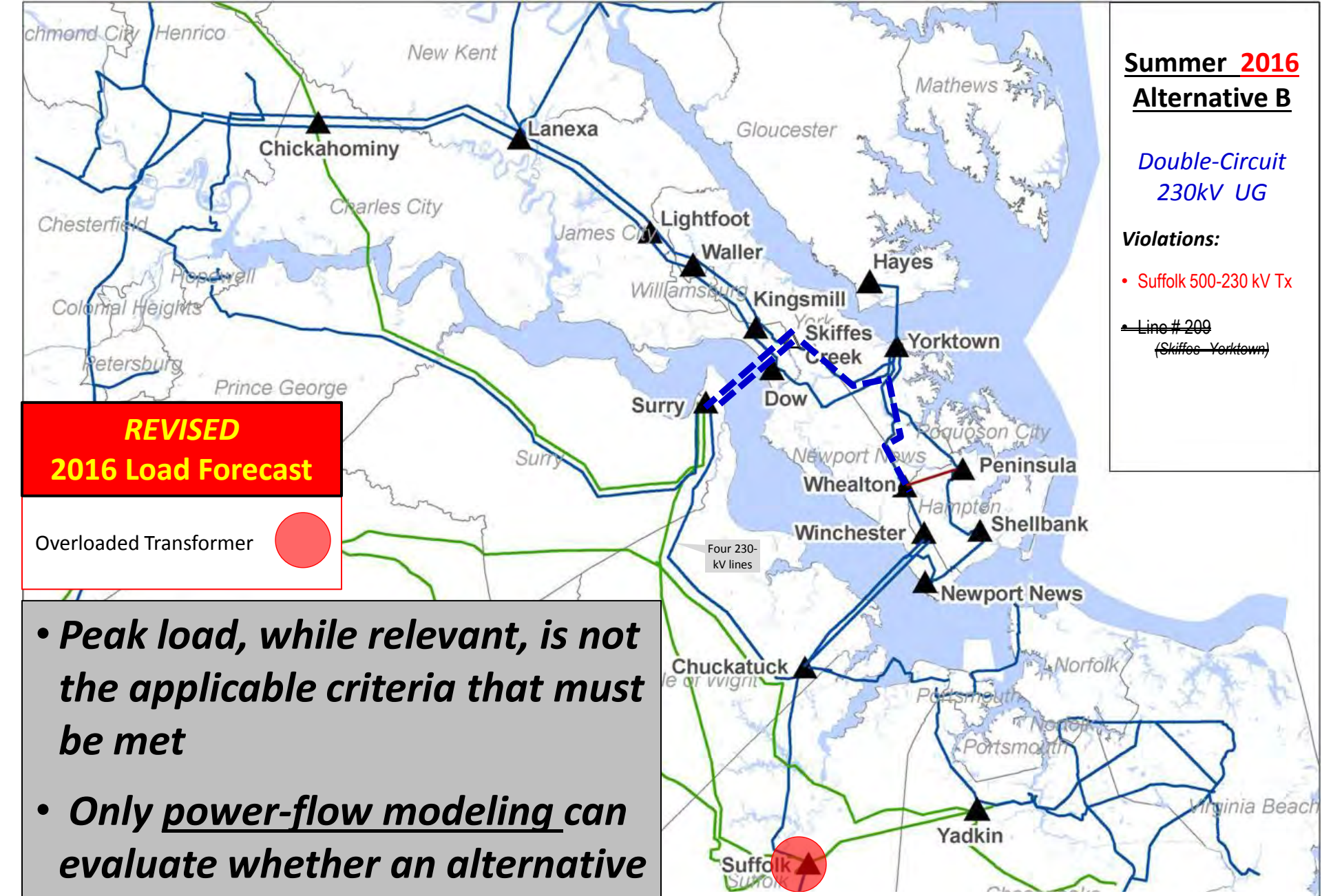


- ***Peak load, while relevant, is not the applicable criteria that must be met***
- ***Only power-flow modeling can evaluate whether an alternative meets NERC Reliability Standards at all points in the***

SUMMARY OF UNDERGROUND LIMITATIONS

Electric Capacity

- Underwater 230 kV, even double circuit, cannot solve the identified NERC violations; significant additional facilities, impacts and would add significant cost without meeting project purpose or need
- Examples:
  - Existing underwater 500 kV Vancouver line has less than 50% of the capacity required to resolve the identified NERC violations
  - The first 500kV XLPE transmission line installed in a duct bank and vault system in North America is under construction (3.7-miles/underground) in California; line has less capacity and XPLE is not suitable for underwater construction

Adverse Environmental Impacts Under James River & on BASF Property

230 kV underground would require:

- 400 foot-wide ROW to hold 18 cables in 6 pipes in drilled tunnels 15 feet below surface
- 18 underwater splice tunnels, each 900 feet long, 4 feet wide, 15 feet below surface with jack-up splice platform
- Excavation of 36,000 cubic yards of riverbed sediment

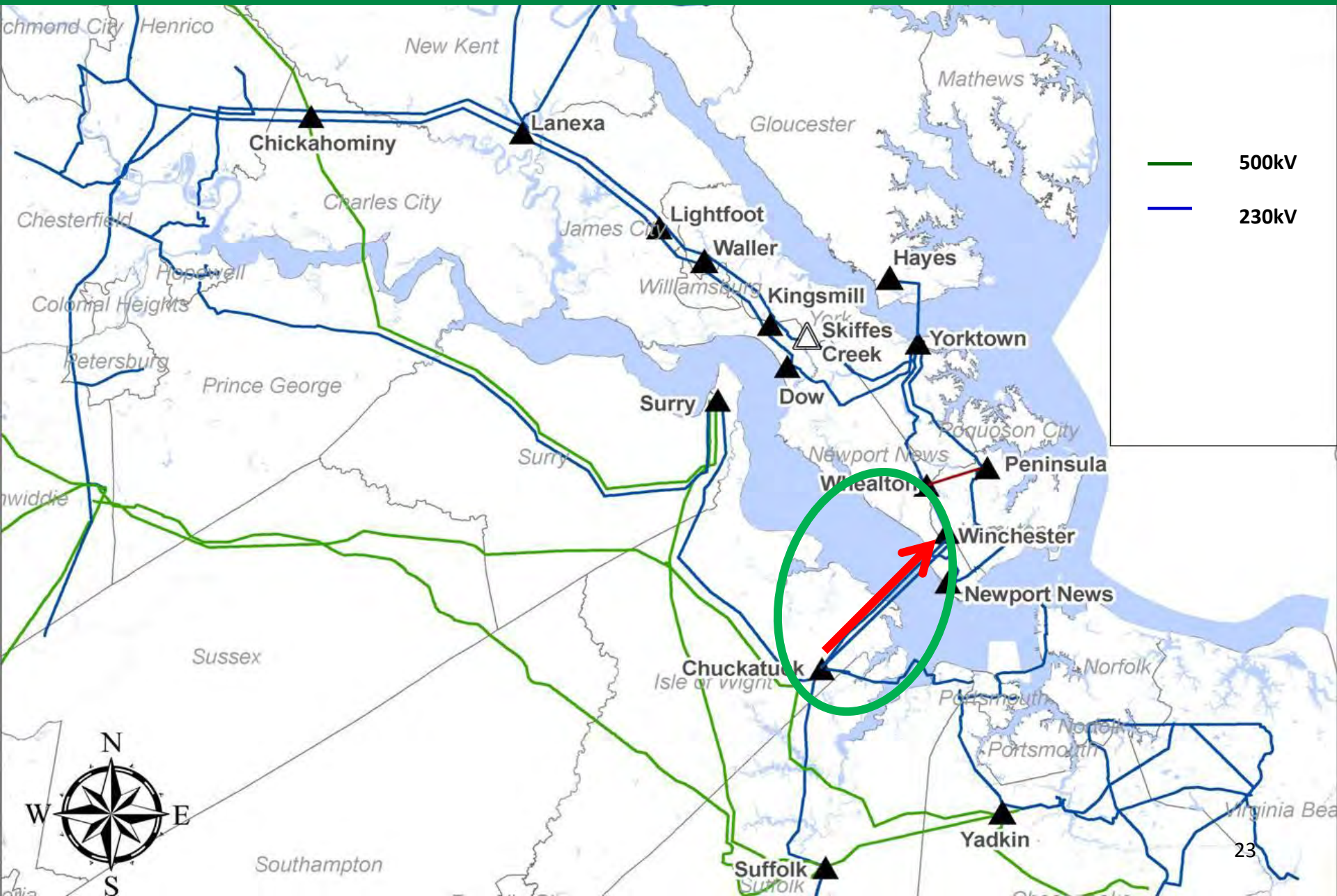
Vancouver-type 500 kV line would require:

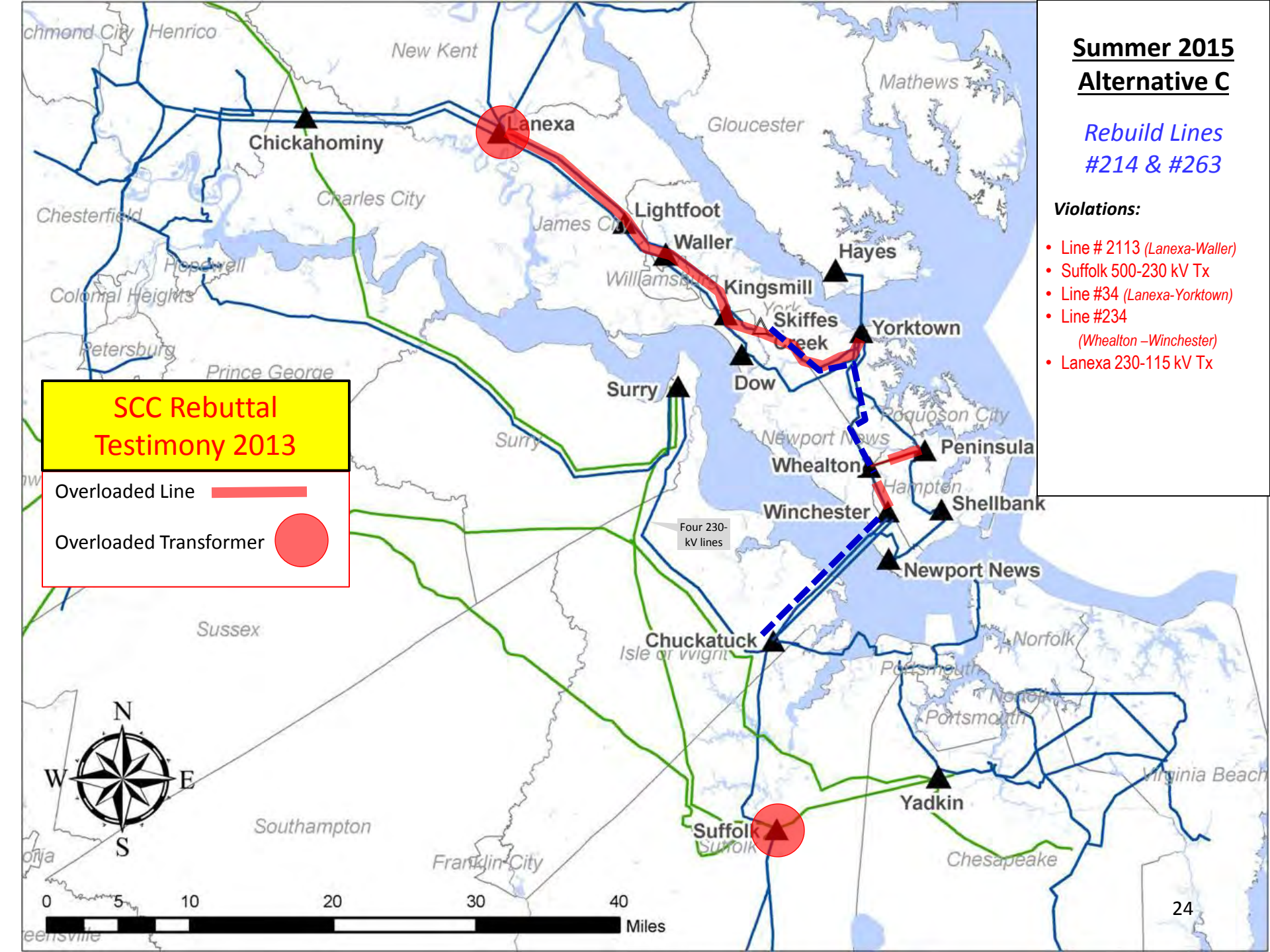
- 1.5 mile-wide ROW for spacing between cables to reach even 50% of needed capacity
- Scarce, specialized vessels drawing too much water to navigate James River

Reliability

- Dominion has piloted the use of XLPE. Problems on underground transmission lines are more difficult to locate, requiring longer service restoration than overhead

Alternative C - - 214/263 230 KV LINE REBUILD




Summer 2015
Alternative C
Rebuild Lines
#214 & #263
Violations:
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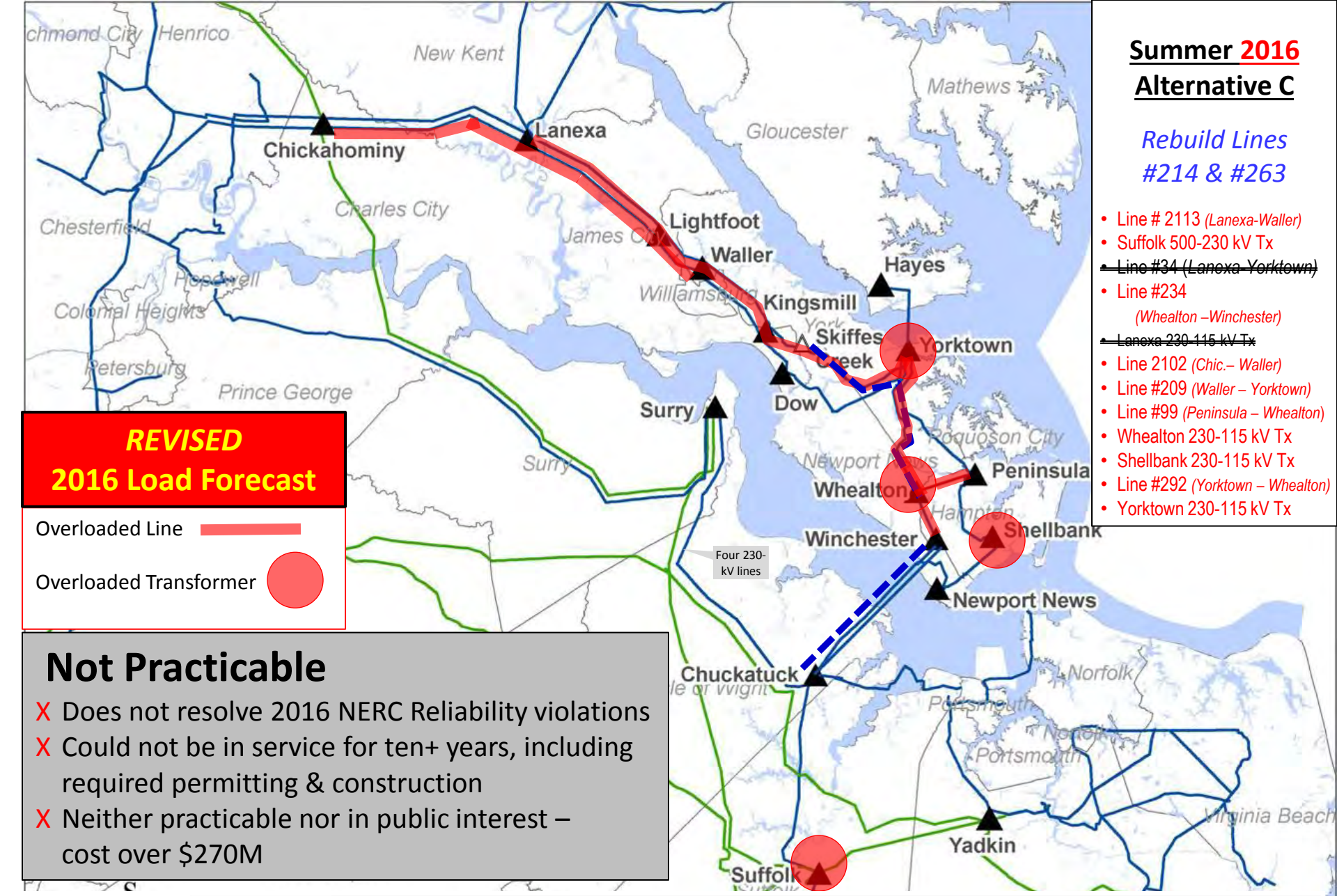
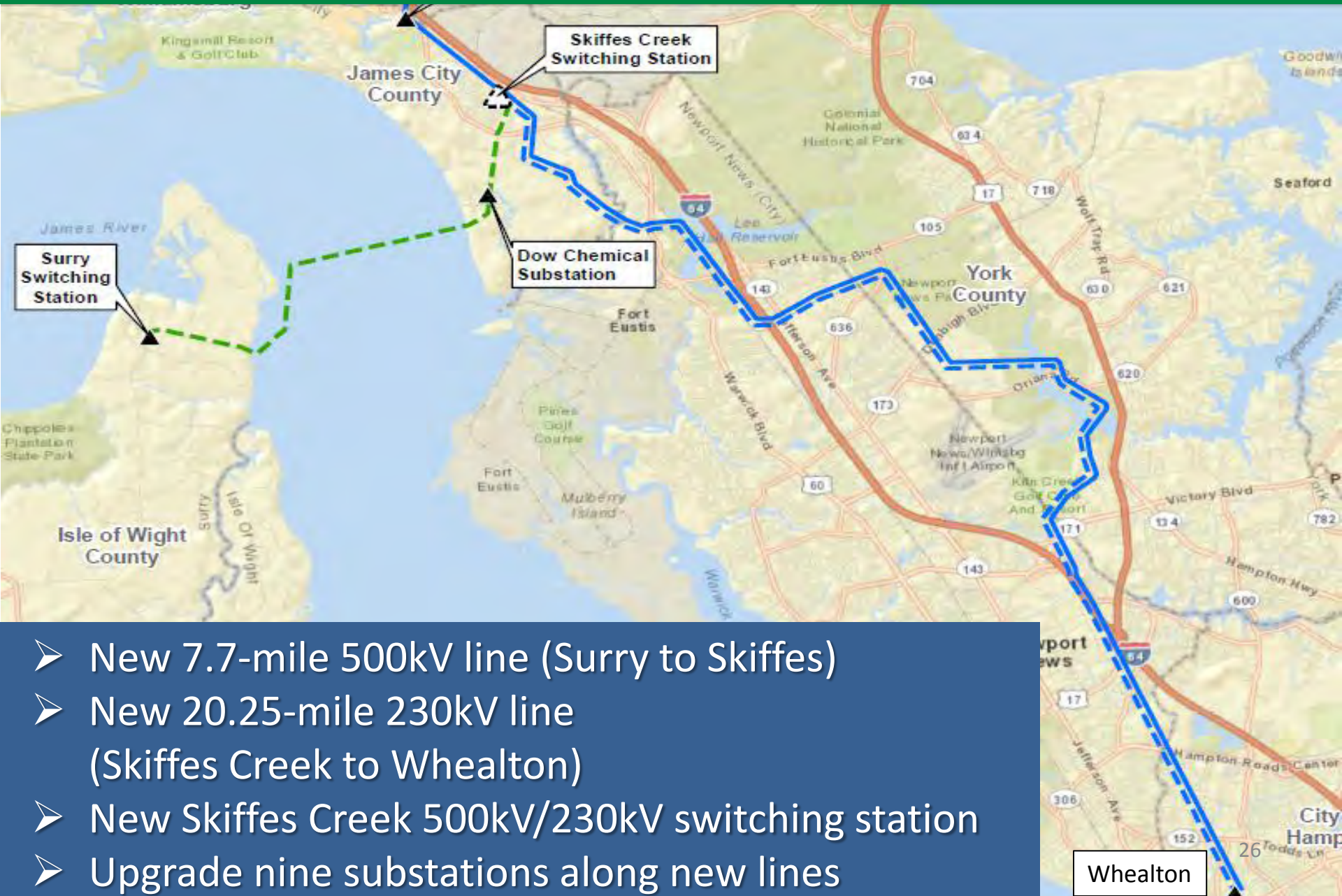


Not Practicable

- X Does not resolve 2016 NERC Reliability violations
- X Could not be in service for ten+ years, including required permitting & construction
- X Neither practicable nor in public interest – cost over $270M

	2016	2017	2018	2019	2020	2021	2022	2023+
Alternative C	Permitting & Construction (Ten+ Years)							
	Risk for Rotating Blackouts							

PROPOSED SURRY - SKIFFES CREEK - WHEALTON



- New 7.7-mile 500kV line (Surry to Skiffes)
- New 20.25-mile 230kV line (Skiffes Creek to Whealton)
- New Skiffes Creek 500kV/230kV switching station
- Upgrade nine substations along new lines

Proposed Project Summer 2016

Surry - Skiffes Creek 500 kV
&
Skiffes Creek - Whealton 230kV
&
Skiffes Creek Switching Station

No Violations

SCC Rebuttal Testimony 2013

REVISED
2016 Load Forecast

- ✓ **Practicable**
- ✓ **Reasonable**
- ✓ **Prudent & Feasible**

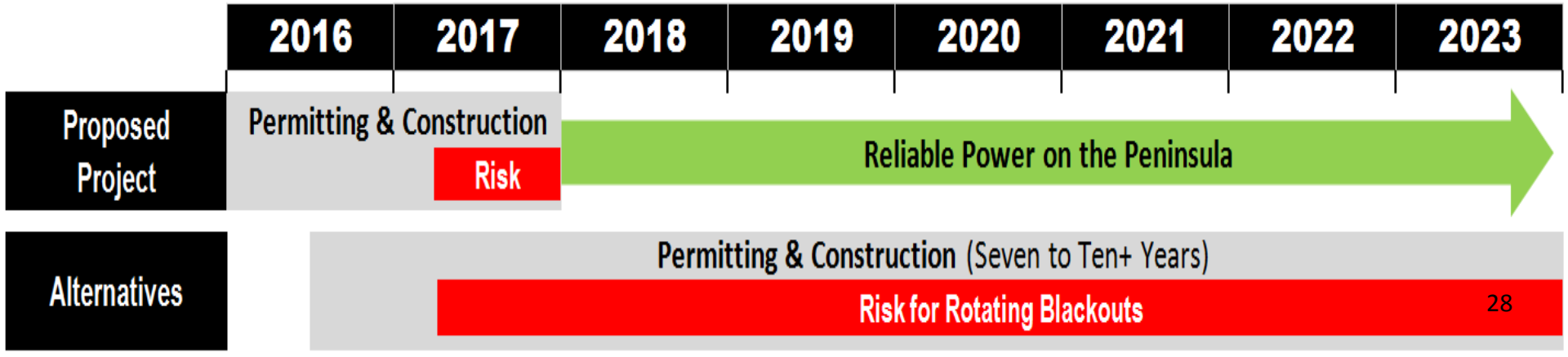
2016	2017	2018	2019	2020	2021	2022	2023
Proposed Project	Permitting & Construction	Risk	Reliable Power on the Peninsula				

CONSEQUENCES OF FAILING TO ENERGIZE PROJECT

Reliability risks without Skiffes Creek in service by 2017

Under certain conditions, system load can exceed limits which create the possibility of rolling blackouts

Blackouts could occur with or without advanced warning depending on the circumstances



POTENTIAL OUTAGES FOR 50% OF CUSTOMERS

Stantec Alternatives Analysis – January 2015

- The amount of load to be shed on a pre-contingency basis is estimated to be between 220 MW and 240 MW or approximately 20-25% of the total number of customer in this load area
- Should planned or unplanned outage occur during different times of the year, then additional days that require planned blackouts may increase
- Should one of the identified critical contingencies actually occur, it will be necessary to load shed an additional 30% of customers demand
- Therefore, the potential exists that up to 50% of the customers in this load area could be without electricity for days or even weeks until the event which caused the failure could be fixed

Friday, January 22, 2016

22:42

DPAGER@DOM.COM: From: From: EROC_ Williamsburg - Kingsmill Substation Transformer #2 and Penninman Substation Transformer #1 is out affecting 5,892 customers including Anhueser Busch Brewery. **Cause transmission line 209 is locked out.** ROC is currently exploring switching options.

THIRD-PARTY VALIDATION

FERC COMMENTS ON REQUESTS FOR EPA ADMINISTRATIVE ORDERS (Issued December 2, 2015)

Based on our review of Dominion's submission and attachments, we find that the loss of Dominion's Yorktown Unit Nos. 1 and 2 prior to the completion of the Skiffes Creek Project might result in violations of NERC Reliability Standards in the absence of load shedding. Accordingly, in our view, Dominion's Yorktown Unit Nos. 1 and 2 are needed during the administrative order period, as requested by Dominion, to maintain electric reliability and to avoid possible NERC Reliability Standard violations.

pjm

2750 Monroe Blvd
Audubon, PA 19403-2497

Steven R. Herling
Vice President, Planning

January 25, 2016

Colonel Jason E. Kelly
District Commander, Army Corps of Engineers
803 Front Street
Norfolk, Va. 23510

Subject: Skiffes Creek Project

Dear Colonel Kelly,

PJM is a regional transmission organization ("RTO") that ensures the reliability of the electric transmission system under its functional control. PJM coordinates the movement of wholesale electricity in the PJM Region, which consists of all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. In its role as an RTO, PJM is responsible for planning and operating the bulk electric transmission system and administering the wholesale electricity market in the PJM region. As part of its ongoing responsibilities as an RTO, PJM prepares a Regional Transmission Expansion Plan ("RTEP") to analyze the electric supply needs of the customers in the PJM region.

During the development of the 2012 RTEP, PJM identified numerous grid reliability criteria violations in the Virginia Electric and Power transmission system. The reliability criteria violations were driven by the scheduled deactivation of generators at the Dominion Yorktown facility in York County Virginia. PJM identified the Skiffes Creek project as the preferred and most effective solution to address the expected reliability problems. PJM's subsequent RTEP restudies continue to validate the need for the project. Based on recently updated analysis, the reliability criteria violations are expected to occur immediately following the retirement of the Yorktown generators. The project continues to be needed even considering the updated load forecasts in the recently released 2016 PJM Load Forecast Report. Mandatory reliability standards, approved by the Federal Energy Regulatory Commission require PJM to implement a solution to address the reliability criteria violations. The current Skiffes Creek 500 kV project is the most effective and efficient solution to address the reliability criteria violations.

Sincerely,

Steven R. Herling

Cc: Ronnie Bailey - Dominion
Steve Chafin - Dominion
Scott Miller – Dominion
Randy Steffey – USACE
William Walker – USCE

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