

# Transmission Expansion Advisory Committee

October 9, 2014

# Stage 1A 10-Year ARR Analysis

## Final Stage 1A 10-Year ARR Analysis

- On an annual basis PJM conducts a simultaneous feasibility analysis test for stage 1A ARRs which shall access the simultaneous feasibility for a 10-year period.
- 10-year analysis on 2014/15 Stage 1A ARRs resulted in violations on both internal and M2M facilities.
- Already approved planned upgrades were identified for all violations either within the PJM or MISO planning processes.



# 2014/2015 Final Stage 1A 10-Year ARR Results

Facility Name	Facility Type	Upgrade expected to fix infeasibility	Expected ISD
0622 Byron-Cherry Valley 345 kV I/o 0621 Byron-Cherry Valley 345 kV	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
12205-151 Woodstock 138 kV I/o Cherry Valley-Silver Lake 345 kV	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
15623-Belvidere 138 I/o Cherry Valley-Silver Lake 345	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
6101-Hennepin 138 I/o Oglesby Tap 138 sub	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
6101-Hennepin 138 I/o Princetp 138 Sub	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Athenia 230 KV ATH-CLIK I/o CedarGrove-Clifton-Athenia.B-2228	Internal	PJM RTEP: B1304.1 Convert the existing 'D1304' and 'G1307' 138 kV circuits between Roseland - Kearny- Hudson to 230 kV operation. B1304.3: Build second 230 kV underground cable from Bergen to Athenia	2015
Beaver Channel-Albany 161 I/o Rock Creek-Salem 345	Flowgate	MISO MVP 3127: Dubuque to Cardinal	2024
Breed-Wheatland 345 kV line I/o Rockport-Jefferson 765 kV line	Flowgate	MISO MVP 2202: Brookston to Greentown 765	2018
Burr Oak-Plymouth 138 kV I/o Burr Oak-Leesburg 345 kV	Flowgate	MISO MVP 3203: Burr Oak to Hiple	2019
CEDARGRO230 KV CED-CLIK I/o CedarGrove-Clifton-Athenia.B-2228	Internal	PJM RTEP: B1304.1 Convert the existing 'D1304' and 'G1307' 138 kV circuits between Roseland - Kearny- Hudson to 230 kV operation. B1304.3: Build second 230 kV underground cable from Bergen to Athenia	2015
Cordova-Nelson 345 (flo) Quad Cities-H471 345	Flowgate	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Cordova-Nelson 345 kV (15503) I/o H471-Nelson 345 kV (15504)	Flowgate	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Dixon-McGirr Rd 138 kV I/o Nelson-Electric Jct 345 kV	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Galesburg 161/138 Xfm #2 flo Electric Jct.-Nelson B 345	Flowgate	MISO: Transformer upgrades	2016
Kewanee-Edwards 138 kV I/o Nelson-Electric Jct 345 kV	Flowgate	MISO MVP 1203: Brookings, SD - SE Twin Cities 345 kV	2015
Kewanee-Edwards 138kV (flo) Duck Crk-Tazewell 345kV	Flowgate	MISO MVP 1203: Brookings, SD - SE Twin Cities 345 kV	2015
MarengoTap-PlsntValley(12204-2)138kV I/o ChryVly-SilverLake(15616)345kV	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Monticello_East_Winamac_138_flo_Schahfer_Burr_Oak_345	Flowgate	MISO MVP 3203: Reynolds to Burr Oak to Hiple 345 kV	2019
Monticello-East Winamac 138 kV I/o Rockport-Jefferson 765 kV	Flowgate	MISO MVP 3203: Reynolds to Burr Oak to Hiple 345 kV	2019
Nelson 345/138 TR82 I/o Nelson-Electric Jct 345	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Nelson-Electric Jct (15502) I/o Cherry Val-Silver Lake (15616)	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Nelson-Electric Junction (15502) I/o Byron-Cherry Valley (0621)	Internal	PJM RTEP B2141: New Byron-Wayne 345 kV circuit	2017
Oak_Grove_Galesburg_flo_Nelson_ElectricJct	Flowgate	MISO MVP 3022: Fargo-Oak Grove 345 kV Line	2016
Oakgrove_Galesburg_161_FLO_Cordova_Nelson_345	Flowgate	MISO MVP 3022: Fargo-Oak Grove 345 kV Line	2016
OAKGROVE_GALESBURG161_flo_STERLING_STL_NELSON345	Flowgate	MISO MVP 3022: Fargo-Oak Grove 345 kV Line	2016
Pleasant Prairie-Zion EC 345 kV I/o Pleasant Prairie-Zion 345 kV	Flowgate	MISO MVP 2844: Pleasant Prairie-Zion Energy Center 345 kV line	2014
Rantoul RantJct_138_flo_NChmpgn_Mahmet_Rsng_138	Flowgate	MISO MVP 2237, 3169: Pawnee-Pana-Mt. Zion-Kansas-Sugar Creek 345 kV	2016
Rising 345/138 XFMR 1 (flo) Clinton - Brokaw 345kV	Flowgate	MISO MVP 2237, 3169: Pawnee-Pana-Mt. Zion-Kansas-Sugar Creek 345 kV	2016

# Interregional Planning Update

- 2014 Scenario Analysis - update
  - Scenario A - Update rollup case - complete
  - Scenario B - Severe Heat and Drought - complete
  - Scenario A – August 26 complete - complete
  - Stakeholder WebEx – September 9, 10AM - complete
  - Scenario B - September 19 case completion - complete
    - Analysis in progress – anticipated completion this month
  - November 17 week - Stakeholder WebEx on results

- Beyond 2014 discussions
  - Summer and Winter case builds and analysis
  - Ongoing review of potential scope
    - Production Cost Analysis
    - DOE Congestion Report Support
    - Synergies between Planning Coordinator MOD standard activities and EIPC model building
      - NERC meeting scheduled 9/22 - complete
      - NERC meeting scheduled 11/18-19 (DE & case creation)

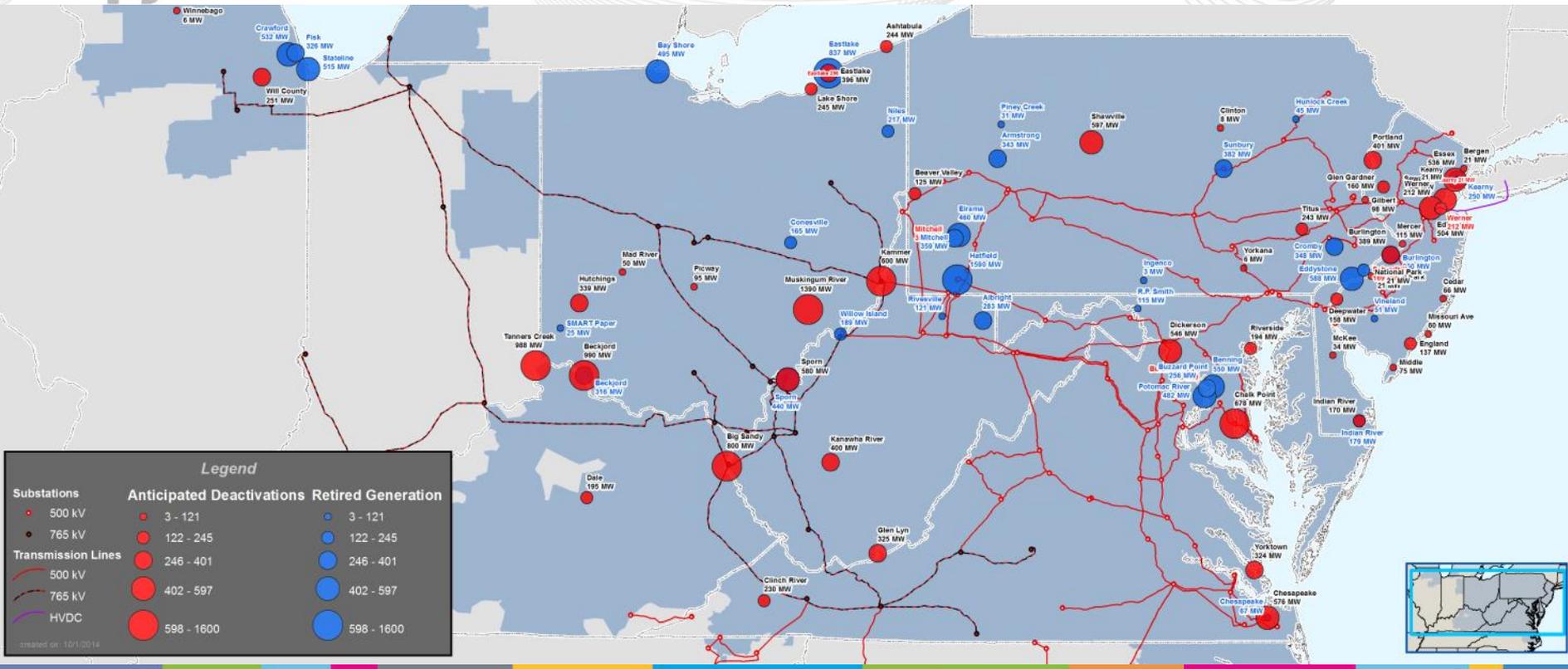


# Interregional Planning Studies (not including JCM)

- NCTPC - update
  - Study requested by NCUC
  - Reliability analysis – complete – wrapping up and reporting
  - Economic data checkout for NC complete - analysis under way
  - 2014 target completion
- PJM/MISO IPSAC
  - Process and metrics review:
    - 9/11 and 10/2 meetings held. 10/24 scheduled at MISO
  - “Quick hit review” – scope in development
    - Northeast Protocol Activities – reviewing possibilities for end of year IPSAC WebEx

# Generation Deactivation Notification (Retirements) Update

Unit(s)	Transmission Zone	Requested Deactivation Date	PJM Reliability Status
Will County Unit 3 (251MWs)	ComEd	4/15/2015	Reliability analysis complete. No impacts identified.
East Lake 1, 2, & 3 and Lake Shore 18 (641MWs total)	ATSI	Requested change in deactivation date to April 15, 2015	No additional reinforcements identified
Kinsley Landfill (1.4MWs)	PSEG	12/31/2014	Reliability analysis underway
Walter C Beckjord GT 1,-4 (47 MWs each, total 188MWs)	DEOK	12/25/2014	Reliability analysis underway
Winnebago Landfill (6.4MWs)	ComEd	12/2/2014	Reliability analysis underway



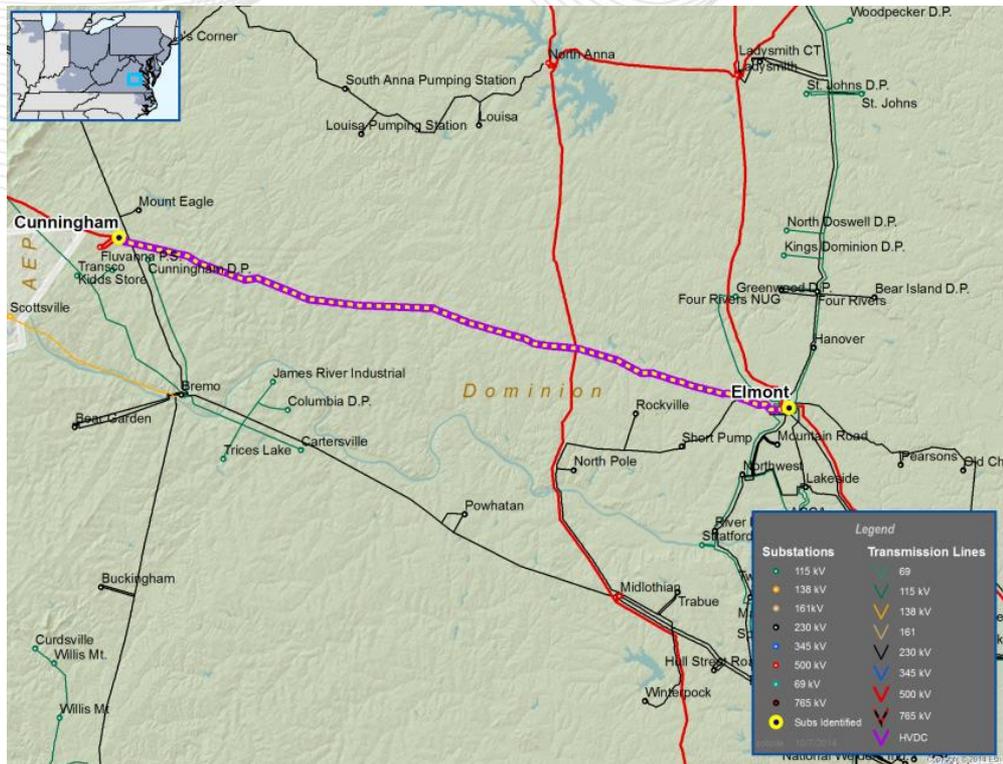
# 2014 Baseline RTEP Status & Timeline

- Organization of PJM States, Inc. (OPSI)
- OPSI requested PJM Interconnection staff to perform analyses of the potential impacts of U.S. EPA's proposed 111(d) Carbon rule.
- OPSI's request outlined base case, regional compliance case, regional compliance case scenarios and state-by-state compliance case modeling assumptions.
  - <http://www.pjm.com/~media/documents/reports/20140905-opsi-data-request-for-section-111d-modeling.ashx>

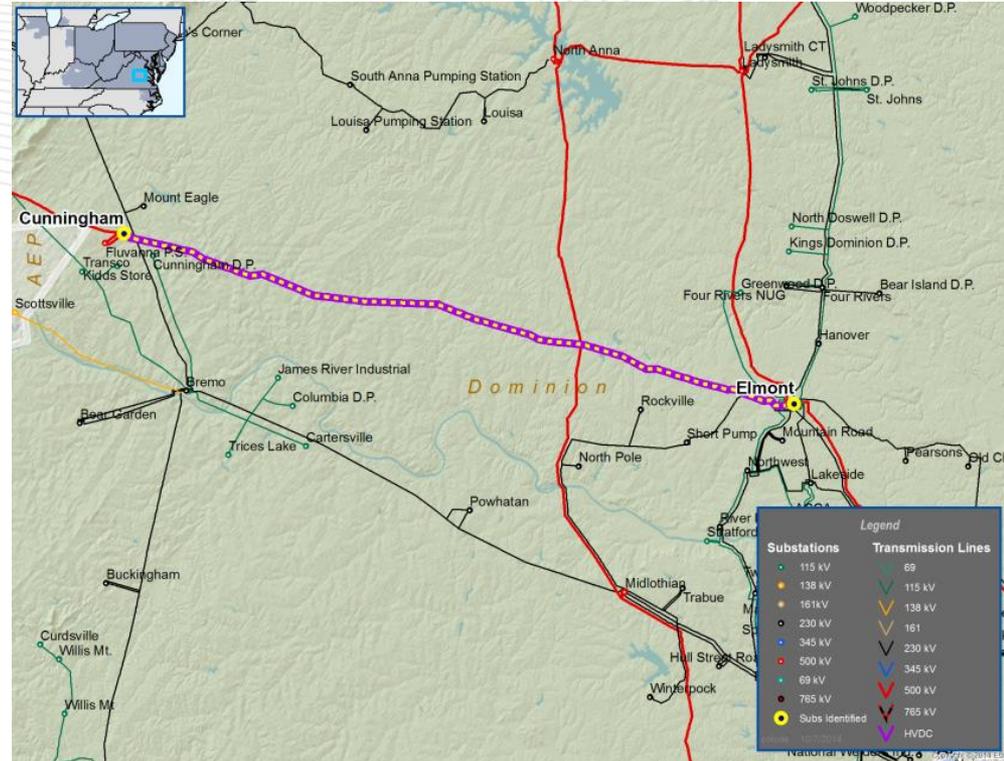
- Illinois Commerce Commission (ICC) request for a Nuclear At-Risk Study
- Illinois House of Representatives adopted House Resolution 1146, which urges the Illinois Commerce Commission (ICC) to prepare a report examining the State's and grid operators' ability to expand transmissions to allow Illinois to transport clean electricity to other parts of the nation, as well as any legislative impediments, and the impact on residential, commercial, and industrial electric rates from the premature closure of Illinois' nuclear power plants

# Reliability Analysis Update

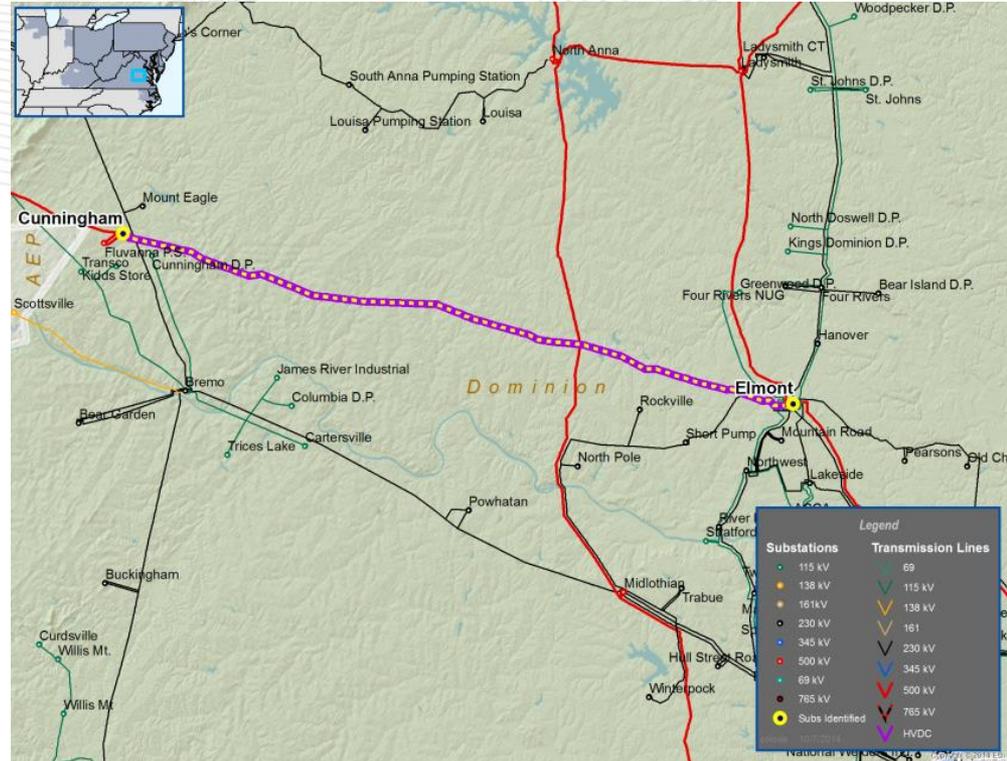
- Dominion 500 kV assessment by third party
  - Initiated by Dominion
  - Evaluate the condition of the 500 kV system in Dominion
    - Physical infrastructure evaluation
    - Power flow simulation
- Assessment Result
  - Facility list ranked by priority



- Dominion End of Life Criteria Violation on the Cunningham to Elmont 500 kV Line
- Third party evaluation:
  - Confirmed the Cunningham to Elmont 500 kV is nearing or has reached its End of Life
  - Performed a Risk Assessment
- Preliminary Power Flow Assessments without the line result in Criteria violations:
- Category B Violations:
  - For loss of Mt Storm - Valley 500 kV Line: the Edinburg - Strasburg 138 kV Overloads
- Category C1 Violations:
  - Loss of Mt Storm 500 kV Bus: the Edinburg - Strasburg 138 kV Overloads
  - Loss of Valley 500 kV Bus: low voltage in the Harrisonburg - Valley - Dooms area
  - Loss of Dooms 230 kV Bus: Staunton 230-115 kV Tx overload
- Category C2 Violations:
  - Breaker failure 539T55: the Edinburg - the Strasburg 138 kV Overloads
  - Loss of breaker 548T549: low voltage in the Lexington-Bath County-Dooms area



- Criteria Violations Continued
- Category C3 Violations:
  - Loss of Mt Storm-Valley 500 kV Line plus and other 230kV or 500 kV Line in western area: – the Strasburg 138 kV Overloads
  - Loss of Mt Storm-Valley 500 kV Line and Dooms - Charlottesville 230kV Line: – the and Barracks Rd - Crozet 230kV Line Overloads
  - Loss of Mt Storm-Valley 500 kV Line and Dooms - Charlottesville 230kV Line #1: – the Barracks Rd - Crozet 230kV Line Overloads
  - Loss of Mt Storm-Valley 500 kV Line and Dooms - Charlottesville 230kV Line #2: – the Charlottesville -Proffit 230kV Line Overloads
- Potential for other violations
- Next Steps: PJM to validate the reliability analysis and review the end of life condition assessment report
- Preliminary Recommended Solution: Rebuild the Elmont to Cunningham 500 kV line as a PJM baseline upgrade
- Estimated Cost: \$106.1 M
- Projected In Service Date: June 2018



# Current Year + 8 (2022) Analysis

- Updated 2019 RTEP base case to reflect 2022 load forecast
- 2014 RTEP approved upgrades not included
- Performed generator deliverability and common mode outage examining single and tower contingencies
- Performed load deliverability for LDAs where  $CETL < 150\% CETO$  in 2018
  - BGE, CLEV, DEOK, DPL South, PEPCO, PSEG, PS North and SWMAAC
- Extrapolated results out through year 2029



# 15 Year Reliability Analysis Result Using 2022 Case

15 Year Result Using 2022 Case - Single Contingency							
Fr Bus	Fr Name	To Bus	To Name	CKT	KVs	Areas	100% Year
232004	MILF_230	232001	COOLSPGS	1	230/230	DPL	2022
314074	6POSSUM	314057	6LAKERD	1	230/230	Dominion	2029
314228	6MESSER	314225	6CHARCTY	1	230/230	Dominion	2022
314072	6PL_VIEW	314004	6ASHBURN	1	230/230	Dominion	2023
314074	6POSSUM	314096	6WOODB_A	1	230/230	Dominion	2026
314287	6CHSTF_B	314228	6MESSER	1	230/230	Dominion	2022
248005	06KYGER	242528	05SPORN	2	345/345	OVEC/AEP	2022
223983	CHALK230	292453	T133TAP1	1	230/230	PEPCO	2022
223983	CHALK230	292453	T133TAP1	2	230/230	PEPCO	2022
219110	GLOUCSTR_2	219755	CUTHBERT_4	2	230/230	PSEG	2029
213519	CONOWG01	231006	COLOR_PE	1	230/230	PECO/DPL	2029
231004	RL_230	232002	CEDAR_CK	1	230/230	DPL	2022
243217	05DEQUIN	243878	05MEADOW	1	345/345	AEP	2027
243217	05DEQUIN	243878	05MEADOW	2	345/345	AEP	2027



# 15 Year Reliability Analysis Result Using 2022 Case

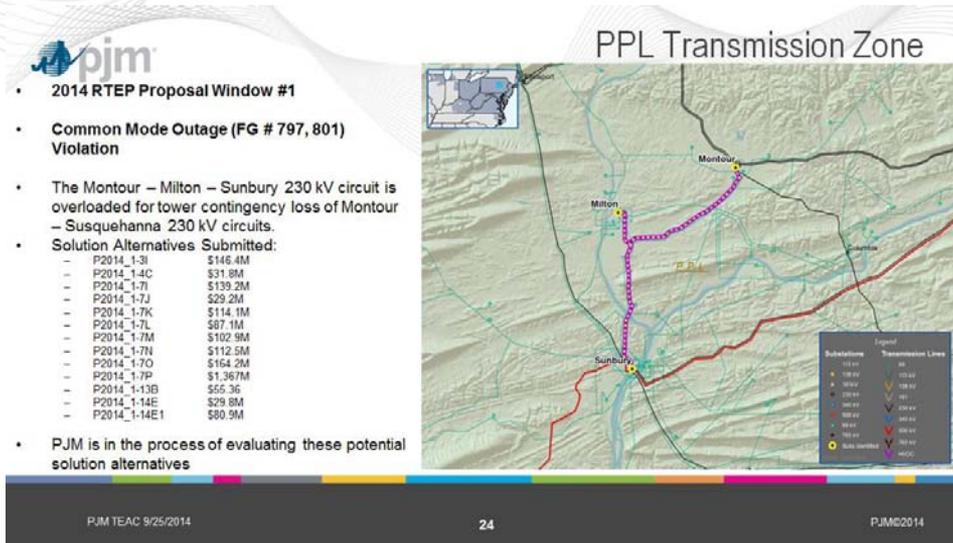
15 Year Results Using 2022 Case - Tower Contingency							
Fr Bus	Fr Name	To Bus	To Name	CKT	KVs	Areas	100% Year
208034	MILT	208109	SUNB	1	230/230	PPL	2022
208040	MONT	208034	MILT	1	230/230	PPL	2022
206305	28RAR RVR	218331	KILMER I	1	230/230	JCPL/PSEG	2028
206298	28WILLIAMS	206292	28FRENEAU	1	230/230	JCPL	2029
206322	28PARLIN	206298	28WILLIAMS	1	230/230	JCPL	2028
206314	28RED OAKA	206305	28RAR RVR	1	230/230	JCPL	2028

# 2014 RTEP Proposal Window 1

- Overall Status

- 22 baseline reliability projects recommended at the 9/25/2014 TEAC and will be taken to the PJM Board in November 2014 for approval
  - All are Transmission Owner Upgrades
- Several retirement and FSA generation related issues were reviewed but solutions will not be recommended for approval unless the status of the deactivation or FSA generation changes

- Analytical update
- Network upgrade update for FSA generation in the PPL zone
  - New generation interconnection network upgrades recently established for generation in the Y2 queue
  - The new upgrade is more cost efficient than the previous Y2 upgrades
  - Cost allocated to queued generation
- Preliminary Result:
  - With the new upgrade assumption, the remaining flowages (FG #797, 801) are no longer violations in 2019
  - The B2282 - Frackville – Siegfried 230 kV rebuild is no longer needed for failed reliability criteria in 2018



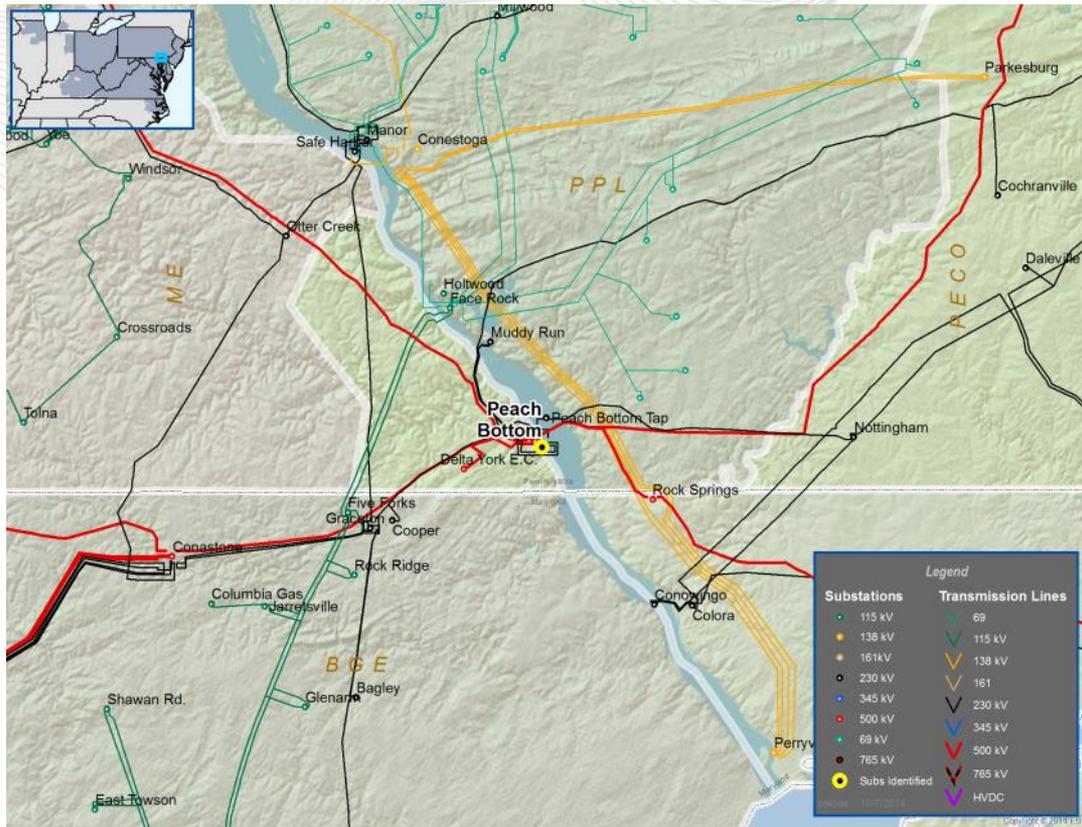
- Next Steps for the Montour – Milton – Sunbury area in the PPL Zone
  - Determine if any new or existing violations exist in the PPL zone due to the new assumption
  - Determine if the B2282 baseline reliability project should be cancelled

# 2014 RTEP Proposal Window 2

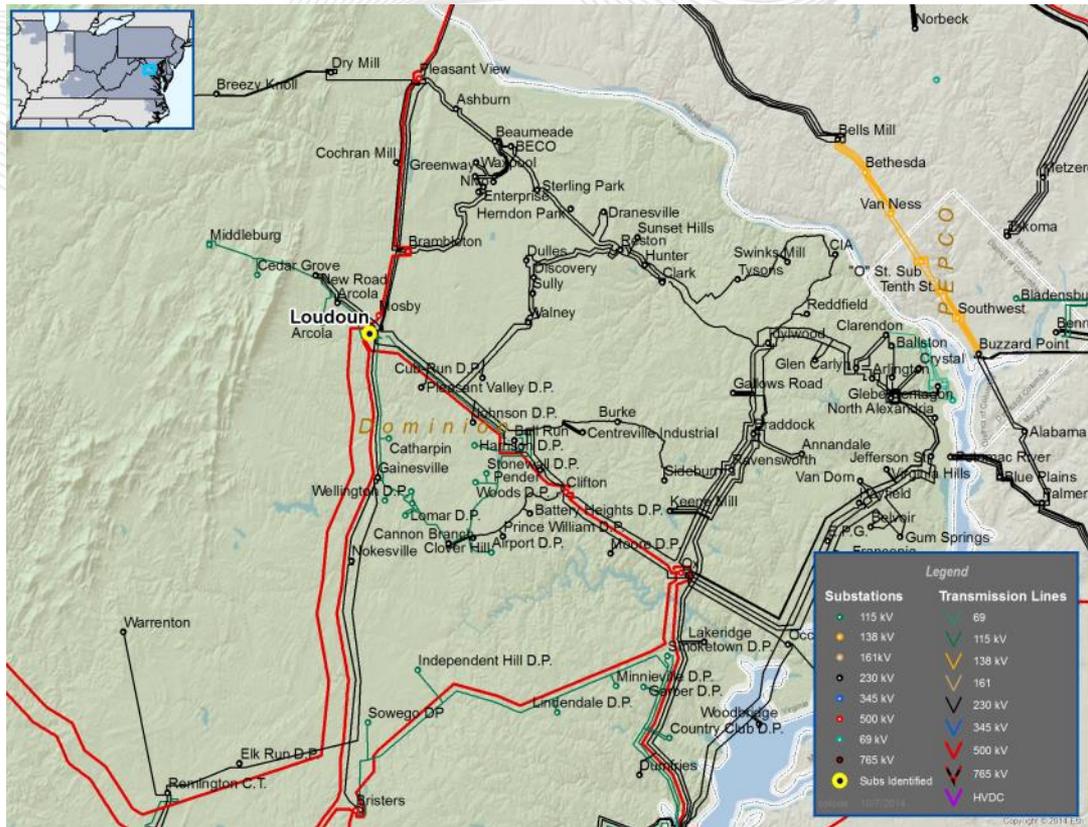
- Anticipated scope: 2018 Light Load Reliability Criteria, Transmission Owner Criteria, Basecase and N-1-1 Voltage
- Status:
  - Completing the quality control check and preparing files for posting.
  - This window will have several power flow models plus supporting files compared to 1 power flow for the previous 2014 RTEP Proposal Window #1.
  - Target Proposal Window #2 opening by the end of next Week

# Short Circuit Upgrades

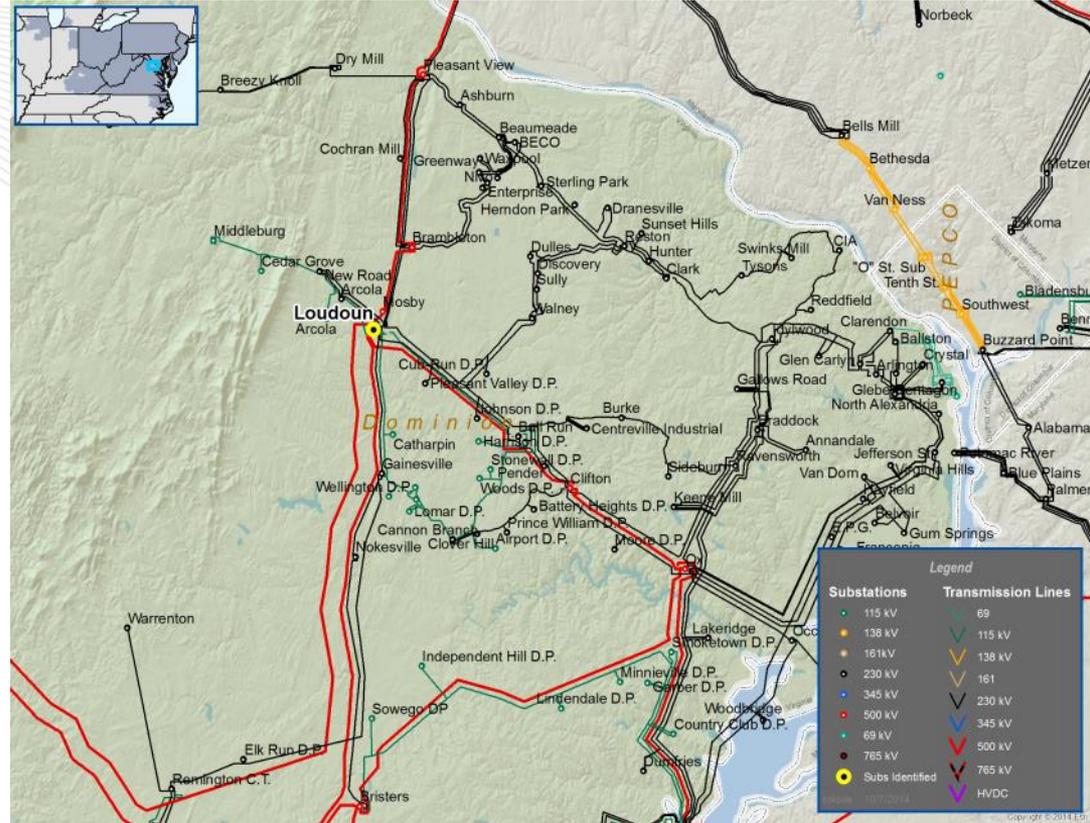
- The Peach Bottom 500kV breaker '#225' is overstressed
- Proposed Solution: Replace the Peach Bottom 500kV breaker '#225' with a 63 kA breaker (B2572)
- Estimated Project Cost: \$1.5M
- Required IS Date: 6/1/2019



- The Loudoun 230kV breaker '203052' is overstressed
- Proposed Solution: Replace the Loudoun 230kV breaker '203052' with a 63kA breaker (B1698.7)
- Estimated Project Cost: \$313K
- Required IS Date: 6/1/2016



- The Loudoun 500kV breakers 'H2T502' and 'H2T584' are overstressed
- Proposed Solution: Replace the Loudoun 500kV breakers 'H2T502' and 'H2T584' with 50kA breakers (B2542 and B2543)
- Estimated Project Cost: \$790K per breaker
- Required IS Date: 6/1/2019



# Light Load Analysis

- ComEd: Four 138KV branches are overloaded
- AEP: One 765/345KV transformer is overloaded
- EKPC: High voltage violations are identified at six 161kV buses
- PenElec: One high voltage issue around Farmers Valley new 345/230 kV substation
- PSEG: One high voltage issue around Mercer 230 kV substation
  
- All of the above reliability issues will be posted with the 2014 RTEP Proposal Window #2
- There are no issues in any other PJM zone for the 2018 Light Load Study

# Winter Peak Study Update

- Analytical Update
  - Included the recommended proposals from Window #1 and re-ran the assessment
  - Compared the results of the 2019 winter study with the 2018 Light Load Reliability Analysis preliminary results

## – ComEd

Fr Bus	Name	To Bus	Name	CKT	KVs	Comments
293710	O29	272097	NELSON ;RT	1	138/138	This facility is also in the 2019 Light Load Reliability Criteria

## – AEP

Fr Bus	Name	To Bus	Name	CKT	KVs
242576	05CAPITO	242783	05RUTLED	1	138/138
242593	05CHEM 2	242576	05CAPITO	1	138/138
243664	05HAZARD	243693	05HAZRD2	1	161/138

## – ATSI

Fr Bus	Name	To Bus	Name	CKT	KVs
239070	02RICHLD	238521	02NAOMI	1	138/138

## – PEPCO

Fr Bus	Name	To Bus	Name	CKT	KVs
223949	BML 138	224079	BETH T7	1	138/138

## – DPL

Fr Bus	Name	To Bus	Name	CKT	KVs	Comments
232247	DUP-SFRD	232249	LAUREL	1	69/69	There are several recently submitted supplemental projects in this area. PJM expects most/all of these potential issues to be resolved.
232227	EASTN_69	232232	TRAPPETP	1	69/69	
232244	GREENWD	232245	BRIDGEVL	1	69/69	
232215	KENT	232813	VAUGHN	1	69/69	
231803	MOTIVA	231214	REYBD_69	1	138/69	
232233	PRESTON	232234	TODD	1	69/69	
231214	REYBD_69	231128	REYBOLD	1	69/138	
232000	STEELE	232004	MILF_230	1	230/230	
232821	TANYARD	232233	PRESTON	1	69/69	
232815	WELLS	232217	HARRNGTN	1	69/69	
232267	WORCR_69	232832	OCEANPIN	1	69/69	

- Next Steps
  - Consider additional winter analysis scenarios

# Artificial Island Update

- **Permitting constructability comparison**
  - Compare the permitting challenges of the Southern Delaware Crossing alternatives to the AI – Red Lion 500 kV alternatives
  - Nearing completion
- **Discussion with the Nuclear Regulatory Commission (NRC)**

- Supplemental Responses
  - Supplemental responses received
  - Redacted versions posted to PJM.com
  - PJM is coordinating three party meetings between PJM, the proposing entity and a FERC Administrative Law Judge (ALJ)
    - The letter from PJM to the FERC ALJ is posted to PJM.com
  - <http://www.pjm.com/planning/rtep-development/expansion-plan-process/ferc-order-1000/rtep-proposal-windows/closed-artificial-island-proposals.aspx>

- **PJM Simulation**
  - Validated the performance of the TCSC under several failure and outage mode scenarios
    - Critical pre-contingency outage conditions
    - Critical faults
    - Assumed combinations of failure modes and outage conditions

# TCSC Outage and Failure Mode Evaluation

	TCSC on 5023	TCSC on 5024	SVC at New Freedom	Stability	line outage in pre-contingency	Note	
Assume TCSC Outage - simulate as open circuit	outage	outage	in	unstable	Two line outages	N-2-1 Beyond criteria	
	outage	in	in	stable		N-1-1	
	in	outage	in	stable		N-1-1	
Assume TCSC Failure - simulate as 0% compensation	failure	failure	in	unstable	One line outage	N-1-3 Beyond criteria	
				unstable			
	failure	in	in	stable		N-1-3 Beyond criteria	
				stable		N-1-2 Beyond criteria	
	in	failure	in	stable		N-1-2 Beyond criteria	
				stable		N-1-2 Beyond criteria	
	failure	failure	in	stable		no line outage	N-3 Beyond criteria
	failure	in	in	stable		no line outage	N-2 for two un-related elements - Beyond criteria
in	failure	in	stable	no line outage	N-2 for two un-related elements - Beyond criteria		
Assume SVC outage	in	in	outage	stable	no line outage	N-1-1	
	in	in	outage	unstable	One line outage	N-2-1 Beyond the criteria	
	in	in	outage	unstable		N-2-1 Beyond the criteria	

- Discussion of TCSC technology and applications with vendors
- Constructability Report is in-progress
- Evaluation of Sub Synchronous Resonance (SSR)

# RTEP Next Steps

- Open 2014 RTEP Proposal Window #2
- Recommend all final recommendations reviewed at the 9/25/2014 TEAC to the PJM Board in November 2014
- Open a 120 Day Proposal Window in November 2014
  - Long term reliability, energy market efficiency, capacity market efficiency

Questions?

Email: [RTEP@pjm.com](mailto:RTEP@pjm.com)

- **Revision History**

- Version 1: Original version posted to the PJM TEAC on 10/8/2014
- Version 2: Slide 4 updated to show Byron-Wayne Expected ISD=2017