PJM Retirement Study Update
Analysis of January 2012 FirstEnergy Deactivation Notifications

03/13/2012
PJM Retirement Study

Retirement Units considered in this study:

- Armstrong 1: (172 MW in 2013 RTEP case)
- Armstrong 2: (171 MW in 2013 RTEP case)
- Ashtabula 5: (244 MW in 2013 RTEP case)
- Bay Shore 2: (138 MW in 2013 RTEP case)
- Bay Shore 3: (142 MW in 2013 RTEP case)
- Bay Shore 4: (215 MW in 2013 RTEP case)
- Eastlake 1: (132 MW in 2013 RTEP case)
- Eastlake 2: (132 MW in 2013 RTEP case)
- Eastlake 3: (132 MW in 2013 RTEP case)
- Eastlake 4: (240 MW in 2013 RTEP case)
- Eastlake 5: (597 MW in 2013 RTEP case)
- Lake Shore: (245 MW in 2013 RTEP case)
- RP Smith 3: (28 MW in 2013 RTEP case)
- RP Smith 4: (87 MW in 2013 RTEP case)

- Requested retirement date: September 1, 2012
- Study case: 2013 RTEP case

Studies:

- **N-1 Common Mode Voltage Study (for tower, bus, stuck breaker contingencies)**
  1. The Calphalon 138 kV bus voltage magnitude drops to 0.9198 pu (0.92 pu limit) for the loss of the Bowling Green Tap 138 kV bus and Brim TE 69 138 kV bus and the loss of the Woodville Tap – Lemoyne 138 kV line and Maclean TE 69 138 kV – Lemoyne 138 kV line.
  2. The Maclean TE 69 138 kV bus voltage magnitude drops to 0.9167 pu (0.92 pu limit) for the loss of the Bowling Green Tap 138 kV bus and Brim TE 69 138 kV bus and the loss of the Woodville Tap – Lemoyne 138 kV line and Maclean TE 69 138 kV – Lemoyne 138 kV line.
  3. The Walbridge Coatings Tap 138 kV bus voltage magnitude drops to 0.9179 pu (0.92 pu limit) for the loss of the Bowling Green Tap 138 kV bus and Brim TE 69 138 kV bus and the loss of the Woodville Tap – Lemoyne 138 kV line and Maclean TE 69 138 kV – Lemoyne 138 kV line.

- **N-1-1 Thermal and Voltage Study**

  **AP Area (Thermal):**
  1. The Allegheny Ludlum 4 Jct.-All Dam 6 Tap 138 kV line loads to 142.8% of its emergency rating (116 MVA) for the loss of the Butler - Kars City 138 kV line followed by the loss of the Kiski Valley - Garretts Run Junction 138 kV line.
2. The Allegheny Ludlum 4 Jct - Springdale 138 kV line loads to 122.3% of its emergency rating (309 MVA) for the loss of the Cabot – Woodland 138 kV line followed by the loss of the Shaffers Corner - Springdale 138 kV line.

3. The Allegheny Ludlum 4 Jct-Brackenridge Jct. 138 kV line loads to 116.5% of its emergency rating (261 MVA) for the loss of the Cabot – Woodland 138 kV line followed by the loss of the Shaffers Corner - Springdale 138 kV line.

4. The Allegheny Ludlum 4 Jct - Springdale 138 kV line loads to 129.8% of its emergency rating (297 MVA) for the loss of the Cabot – Woodland 138 kV line followed by the loss of the Shaffers Corner - Springdale 138 kV line.

5. The Allegheny Ludlum 4 Junction - Springdale 138 kV line loads to 116.5% of its emergency rating (261 MVA) for the loss of the Cabot – Woodland 138 kV line followed by the loss of the Shaffers Corner - Springdale 138 kV line.

6. The All Dam 6 Tap - Kittanning 138 kV line loads to 147.5% of its emergency rating (116 MVA) for the loss of the Butler - Karns City 138 kV line followed by the loss of the Kiski Valley - Garretts Run Junction 138 kV line.

7. The Marlowe-Bedington 138 kV line loads to 113.9% of its emergency rating (295 MVA) for the loss of the Marlowe - Bedington 138 kV line followed by the Bedington - Harmony Junction 138 kV line.

ATSI Area (Thermal):

7. The West Canton – Dale 138 kV line loads to 102.8% of its emergency rating (255 MVA) for the loss of the Sammis - Star 345 kV line followed by the Star - South Canton 345 kV line.

8. The Eber - Liquid Air 138 kV line loads to 109.9% of its emergency rating (192 MVA) for the loss of the Allen Junction 345 kV – Allen Junction 138 kV transformer along with the loss of the Allen Junction 138 kV bus followed by the loss of the Bayshore 345 kV - Bayshore 138 kV transformer.

9. The Babb – Evans 138 kV line loads to 105.1% of its emergency rating (223 MVA) for the loss of the Star - South Canton - Hanna- Juniper 345 kV line

10. The Barberton - Star 138 kV line loads to 124.5% of its normal rating (176 MVA) for the loss of the Barberton – Star #2 138 kV line

11. The Barberton - Star 138 kV line loads to 117.4% of its emergency rating (229 MVA) for the loss of the Star - Wadsworth 138 kV line followed by the loss of the Barberton – Star #2 138 kV line.

12. The Barberton – Star #2 138 kV line loads to 104.5% of its normal rating (208 MVA) for the loss of the Barberton – Star 138 kV line.

13. The Barberton - Star #2 138 kV line loads to 104.5% of its emergency rating (256 MVA) for the loss of the Star - Wadsworth 138 kV line followed by the loss of the Barberton - Star #2 138 kV line.

14. The Brush - Hickory Q-21 138 kV line loads to 103.3% of its emergency rating (146 MVA) for the loss of the Juniper- Star 345 kV line followed by the Hanna – Juniper 345 kV line.

15. The Brush - West Akron 138 kV line loads to 110.5% of its emergency rating (146 MVA) for the loss of the Juniper- Star 345 kV line followed by the Hanna- Juniper 345 kV line.

16. The East Akron - Hayes-Lembrnz 138 kV line loads to 106.2% of its emergency rating (281 MVA) for the loss of the Star - South Canton 345 kV line followed by the Hanna- Juniper 345 kV line.

17. The East Akron - West Ravenna 138 kV line loads to 107% of its emergency rating (225 MVA) for the loss of the Hanna - East Akron 138 kV line followed by the Hanna- Juniper 345 kV line.
18. The Evans - Goodyear T&R Co. Tap 138 kV loads to 100.2% of its emergency rating (281 MVA) for the loss of the Star - South Canton 345 kV line followed by the loss of the Hanna – Juniper 345 kV line.
19. The Goodyear T&R Co. Tap- Hayes-Lemmerz 138 kV line loads to 105.2% of its emergency rating (281 MVA) for the loss of the Star - South Canton 345 kV line followed by the loss of the Hanna- Juniper 345 kV line.
20. The Hanna 345 kV – Hanna 138 kV transformer loads to 101% of its emergency rating (680 MVA) for the loss of the Hanna 345 kV- Hanna 138kV #2 transformer followed by the loss of the Hanna – Juniper 345 kV line.
21. The Hanna 345 kV – Hanna 138 kV #2 transformer loads to 100.9% of its emergency rating (681 MVA) for the loss of the Hanna 345 kV- Hanna 138kV transformer followed by the loss of the Hanna – Juniper 345 kV line.

PN Area (Thermal):
22. The Erie South 230/115 kV transformer loads to 116.0% of its emergency rating (306 MVA) for the loss of the Erie South (East) 230/115 kV transformer #6 followed by the loss of the Erie West - Fairview East 115 kV line.
23. The Erie South (East) 230/115 kV transformer #6 loads to 107.0% of its emergency rating (321 MVA) for the loss of the Erie South 230/115 kV transformer followed by the Erie West - Fairview East 115 kV line.

AEP Area (Thermal):
24. The West Canton – Dale 138 kV line loads to 102.8% of its emergency rating (255 MVA) for the loss of the Sammis - Star 345 kV line followed by the loss of the Star - South Canton 345 kV line.
25. The Miles - West Canton 138 kV line loads to 114.2% of its emergency rating (250 MVA) for the loss of the Northeast Canton – Wagenhals 138 kV line followed by the loss of the Promway - South Canton 138 kV line.
26. The 05Necant – 05Wagenh 138 kV line loads to 119.6% of its emergency rating (255 MVA) for the loss of the Promway - South Canton 138 kV line followed by the loss of the Negley - Reedurban 138 kV line.
27. The 05Necant – 05PackRd 138 kV line loads to 104.8% of its emergency rating (255 MVA) for the loss of the Promway - South Canton 138 kV line followed by the loss of the Negley - Torrey 138 kV line.
28. The 05Reedur – 05Negley 138 kV line loads to 103.6% of its emergency rating (335 MVA) for the loss of the Northeast Canton - Wagenhals 138 kV line followed by the loss of the Promway - South Canton 138 kV line.
29. The 05Secant – 05Sunny 138 kV line loads to 100.1% of its normal rating (296 MVA) for the loss of the South Canton - Torrey 138 kV line.
30. The 05Sunny – 05Warner 138 kV line loads to 111.6% of its normal rating (205 MVA) for the loss single contingencies the loss of the South Canton 345/138 kV transformer.
31. The 05Torrey – 05Scante 138 kV line loads to 102.1% of its normal rating (364 MVA) for the loss single contingencies South Canton 345/138 kV transformer.
32. The 05Torrey – 05Negley 138 kV line loads to 107.1% of its emergency rating (335 MVA) for the loss of the Northeast Canton – Wagenhals 138 kV line followed by the loss of the Promway - South Canton 138 kV line.
33. The Torrey – Warner 138 kV line loads to 111.6% of its normal rating (205 MVA) for the loss of the South Canton - Torrey 138 kV line.

Generator Deliverability Study

ATSI facilities overloaded:
1. The Avon – Crestwood Tap Q-1 138 kV line loads to 107.36% of its emergency rating (315 MVA) for the Loss of the Avon - Admiral Q-3 138 kV line, the Lorain Q-2-Johnson 138 kV line, the Crystal Q-2138 kV – Crystal 13.8 kV transformer, the Crystal Q-1 138 kV – Crystal 13.8 kV transformer, the Crystal Q-2 - Fowles Q-2 138 kV line, the Avon - Crestwood Tap Q-3 138 kV line, the Darwin Q-3 138 kV – Darwin 13.8 kV transformer, the Tap Q-3 - Fowles Q-3 138 kV line along with the loss of the Crestwood Tap Q-3 138 kV bus, Darwin Q-3 138 kV bus, the Dawson Q-3 138 kV bus, the Lorain Q-2 138 kV bus, the Crystal Q-2 138 kV bus, the Crestwood Q-3 138 kV bus. The Darwin Q-1 – Darwin 13.8 kV transformer is closed.
2. The Galion – Gen. Motors Corp Cpc Group 138 kV line loads to 100.54% of its emergency rating (242 MVA) for the loss of the Brookside – Howard 138 kV line, and the Brookside – Milliron 138 kV line.
3. The Galion – Leaside 138 kV line loads to 111.26% of its emergency rating (193 MVA) for the loss of the Galion - Gen. Motors Corp Cpc Group 138 kV line, the Ontario - Gen. Motors Corp Cpc Group 138 kV line, the Ontario – Cairns 138 kV line, the Armco Back Up Tap – Cairns 138 kV line, the Longview - Armco Back Up Tap 138 kV line, and the Galion 138/69 kV transformer, along with the loss of the Gen. Motors Corp Cpc Group 138 kV bus, the Ontario 138 kV bus, the Cairns 138 kV bus.
4. The Galion – Leaside 138 kV line loads to 107.49% of its emergency rating (193 MVA) for the loss of the Armco Steel 138 kV bus, the Armco Steel Tap 138 kV bus, the Longview 138 kV bus, and the Cairns 138 kV bus.
5. The Gen. Motors Corp Cpc Group – Ontario 38 kV line loads to 107.06% of its emergency rating (225 MVA) for the loss of the Brookside – Howard 138 kV line, and the Brookside – Milliron 138 kV line.
6. The Hanna 345/138 kV transformer loads to 104.94% of its emergency rating (680 MVA) for the loss of the Hanna – Juniper 345 kV line, and the Hanna 345/138 kV transformer.
7. The 02Ky-Hs – Ottawa TE 138 kV line loads to 115.0% of its emergency rating (289 MVA) for the loss of the Ottawa TE - West Fremont TE 69 138 kv line, and the West Fremont TE 69 138 kV - West Fremont TE 69 kV transformer, along with the loss of the West Fremont TE 69 kV bus. The Clyde TE - Flat Rock tap OE 69 kV line is closed.
8. The Kelsey-Hayes – Ottawa TE 138 kV line loads to 113.99% of its emergency rating (289 MVA) for the loss of the Ottawa TE - West Fremont TE 69 138 kV line, and the West Fremont TE 69 138 kV - West Fremont TE 69 kV transformer, along with the loss of the West Fremont TE 69 kV bus, the Green Springs TE 69 kV bus.
the WHIRLP72 bus and the Clyde TE 69 kV bus. The Clyde TE - Flat Rock tap OE 69 kV line is closed.

9. The Kelsey-Hayes – Ottawa TE 138 kV line loads to 109.4% of its emergency rating (289 MVA) for the loss of the Ottawa TE - West Fremont TE 69 138 kV line.

10. The Lakeview – Greenfield 138 kV line loads to 127.47% of its emergency rating (316 MVA) for the loss of the Beaver - Davis-Besse 345kV line.

11. The Ontario – Cairns 138 kV line loads to 100.35% of its emergency rating (208 MVA) for the loss of the Brookside – Howard 138 kV line, and the Brookside – Milliron 138 kV line.

12. The Ottawa TE – Lakeview 138 kV line loads to 128.05% of its emergency rating (375 MVA) for the loss of the Beaver - Davis-Besse 345kV line.

13. The Richland– Naomi 138 kV line loads to 103.44% of its emergency rating (166 MVA) for the loss of the Richland - Richland J 138 kV line.

14. The Ashtabula 345/138 kV transformer loads to 104.97% of its emergency rating (370 MVA) for the loss of the Perry – Eastlake 345 kV line, and the Eastlake – Juniper 345 kV line.

15. The Ashtabula 345/138 kV transformer loads to 100.47% of its emergency rating (370 MVA) for the loss of the Perry – Inland 345 kV line, and the Eastlake – Perry 345 kV line.

16. The 02Star 345/138 kV transformer #1 loads to 100.89% of its emergency rating (393 MVA) for the loss of the Star 345/138 kV transformer #2 and #3.

17. The Star – Barberton 138 kV line #1 loads to 106.29% of its emergency rating (229 MVA) for the loss of the Star – Barberton 138 kV #2. The Star – Tusc 138 kV line, and the Tusc – Urban 138 kV line.

18. The Star – Barberton 138 kV line #1 loads to 102.84% of its emergency rating (229 MVA) for the loss of the Star – Barberton 138 kV #2. The Star – Tusc 138 kV line, and the Tusc – Urban 138 kV line.

19. The Star – Barberton 138 kV line #2 loads to 103.24% of its emergency rating (256 MVA) for the loss of the Stat – Barberton 138 kV line, and the Star - Cloverdale 138 kV line.

20. The West Fremont TE 69– Kelsey-Hayes 138 kV line loads to 115.66% of its emergency rating (289 MVA) for the loss of the Ottawa TE - West Fremont TE 69 138 kV line, and the West Fremont TE 69 138 kV - West Fremont TE 69 kV transformer, along with the loss of the West Fremont TE 69 kV bus. The Clyde TE - Flat Rock tap OE 69 kV line is closed.

21. The West Fremont TE 69– Kelsey-Hayes 138 kV line loads to 114.65% of its emergency rating (289 MVA) for the loss of the Ottawa TE - West Fremont TE 69 138 kV line, and the West Fremont TE 69 138 kV - West Fremont TE 69 kV transformer, along with the loss of the West Fremont TE 69 kV bus, the Green Springs TE 69 kV bus, the WHIRLP72 bus and the Clyde TE 69 kV bus. The Clyde TE - Flat Rock tap OE 69 kV line is closed.

22. The West Fremont TE 69– Kelsey-Hayes 138 kV line loads to 110.06% of its emergency rating (289 MVA) for the loss of the Ottawa TE – West Fremont TE 69 138 kV line.

23. The West Fremont TE 69– Ottawa TE 138 kV line loads to 111.99% of its emergency rating (289 MVA) for the loss of the Kelsey-Hayes – West Fremont TE 69 138 kV line.
AP facilities overloaded:
24. The Cabot Junction – Karns City 138 kV line loads to 120.0% of its emergency rating (182 MVA) for the tower contingency ‘53’.
**AEP facilities overloaded:**

1. The Kammer – West Bellaire 345 kV line loads to 145.79% of its emergency rating (971 MVA) for the loss of the Kammer – South Canton 765 kV line, the Kammer 765/500 kV transformer, South Canton 765/345 kV transformer, and the Kammer - 502 Junction 500 kV line, and the South Canton 345/138 kV transformer.

2. The Kammer – West Bellaire 345 kV line loads to 101.51% of its emergency rating (971 MVA) for the loss of the South Canton 765/345 kV transformer.

3. The Prep Plant Tap – Ohio Central 138 kV line loads to 107.34% of its emergency rating (446 MVA) for the loss of the Galion – Ohio Central 345 kV line, the Ohio Central - Muskingum River 345 kV line, Muskingum River 345/138 kV transformers #A, Muskingum River 345/138 kV transformers #B, and Ohio Central 345/138 kV transformer.

4. The Prep Plant Tap – Ohio Central 138 kV line loads to 101.5% of its emergency rating (446 MVA) for the loss of the Galion – Ohio Central 345 kV line, the Ohio Central - Muskingum River 345 kV line, and the Ohio Central 345/138 kV transformer.

5. The Lincoln – Anthony Tap 138 kV line loads to 101.1% of its emergency rating (201 MVA) for the loss of the Convoy - Robison Park 345 kV line, the Robison Park – Argenta 345 kV line, and the Robison Park 345/138 kV transformer #5.

6. The Madison – Cross Street 138 kV line loads to 100.6% of its emergency rating (167 MVA) for the loss of the Desoto – Fall Creek 345 kV line, and the Desoto 345/138 kV transformer.

7. The Conesville East – Prep Plant Tap 138 kV line loads to 107.34% of its emergency rating (446 MVA) for the loss of the Galion – Ohio Central 345 kV line, the Ohio Central - Muskingum River 345 kV line, Muskingum River 345/138 kV transformers #A, Muskingum River 345/138 kV transformers #B, and Ohio Central 345/138 kV transformer.

8. The Conesville East – Prep Plant Tap 138 kV line loads to 101.5% of its emergency rating (446 MVA) for the loss of the Galion – Ohio Central 345 kV line, the Ohio Central - Muskingum River 345 kV line, and the Ohio Central 345/138 kV transformer.

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**Load Deliverability Study**

1. **ATSI LDA:**
   - Voltage collapse is observed for basecase/non-contingency conditions.
   - The (AEP-ATSI) South Canton - Star 345 kV line loads to 136.0% of its summer normal/summer emergency ratings (1001/1383 MVA) for the loss of the Sammis - Star 345 kV line.

2. **AP LDA & PJMWest LDA:**
- No violations identified.