Special Planning Committee: CETO/CETL
Education

Transmission Planning
Special Planning Committee
November 3rd, 2017
What is the Load Deliverability test?

- Ensures that within accepted probabilities, emergency power can be delivered to each PJM LDA (Load/Locational Deliverability Area) from the aggregate of capacity resources available to PJM regardless of economics.
  - **Capacity Emergency Transfer Objective (CETO):** The required amount of emergency import capability into a defined area
  - **Capacity Emergency Transfer Limit (CETL):** The actual ability to import emergency assistance into that area
- Reliability requirement: CETL > CETO
- Examined annually for RTEP and RPM
What is the Load Deliverability test?

**Test** – Transmission system’s capability to deliver energy from aggregate of all capacity resources to an electrical area experiencing a capacity deficiency.
What is an LDA?

- Predefined regions in the PJM system that have greater than 1,500 MW of load.
- **22 Zonal LDAs**
  - Each of the 19 PJM transmission owner zones, except RECO
  - 3 partial zones: PSEG North, Delmarva South and Cleveland
- **5 Global LDAs:** Comprised of geographical combinations of various Zonal LDAs
  - Eastern Mid-Atlantic Area – Comprises all load and generation connected 500 kV and lower in PECO, PSE&G, JCP&L, Delmarva, AE, and RECO.
  - Southern Mid-Atlantic Area – Comprises all load and generation connected 500 kV and lower in BG&E and PEPCO.
  - Western Mid-Atlantic Area – Comprises all load and generation connected 500 kV and lower in Penelec, Met-Ed and PP&L.
  - Mid-Atlantic Region – Comprises all load and generation connected 500 kV and lower in Penelec, Met-Ed, PP&L, BG&E, PEPCO, PECO, PSE&G, JCP&L, Delmarva, AE and RECO.
  - Western Region – Comprises all load and generation connected 765 kV and lower in ComEd, ATSI, AEP, Dayton, DEOK, Duquesne, AP and EKPC.
What is an LDA?
What is an LDA?
CETO/CETL Basics

- **CETO**
  - Uses the PRISM Model
  - Primary driver is generation reserves in the LDA - function of generation, load, demand resources (DR) and energy efficiency programs (EE) in the LDA

- **CETL**
  - Uses a power flow model
  - Primary drivers are network topology, load, generation
  - Limit can be thermal or voltage
Cases set up at CETO (Thermal & Voltage)

Load deliverability analyses at CETO (Thermal & Voltage)

CETL calculations (Thermal & Voltage)

Reasons for CETL value change

- Topology changes
- Load model changes (load shift)
- Adding or withdrawing generators (depending on the location)
- Changes in forced outage of the generators.
- Start with summer peak case: 50/50 diversified load case
- Uniform cases are set up for each individual LDA (27) using the CETO values provided by the Resource Adequacy Department
- LDA load levels: 90/10-DR-EE vs 50/50-EE
- Par Settings – Consistent with operations
- Different setup procedure for thermal and voltage cases
27 thermal & 27 voltage cases created from uniform cases

Thermal cases
- Average generation output from 10,000 discrete samples (Monte Carlo simulation)
- Valid generation samples must be close to generation outage target (+/- 2%)

Voltage cases
- Discrete generator outages
- Generators are ranked according to $\text{EFORD}^{(1/P_{\text{max}})}$
- Select generators in rank order till the next selected generator would exceed outage target
Study Scope

- All PJM transmission lines and transformers are monitored for thermal violations
- All PJM single contingencies are evaluated
- Transfers from PJM generation outside the LDA to generation inside the LDA are studied
- System adjustments are allowed
  - Optimal generation redispatch for PJM generators outside LDA
    - Generators outside the study area shouldn’t exceed the PJM average availability
    - Output of nuclear units can be increased but not decreased
  - Internal PJM PAR adjustments are considered

Load Deliverability Facility

- Any overloaded facility whose OTDF is ≥ 5% is automatically considered a violation
- Any overloaded facility whose OTDF is < 5% may be considered to be a violation
- CETL = LDA MW import level at which Load Deliverability Facility thermal overload(s) occurs
Thermal Analysis

- **NERC Category B / “n-1” Violation**
- **CETL < CETO**

- **Load Deliverability Violation**
  - The South Canton - Star 345kV line is overloaded for the loss of the Sammis - Star 345kV Line.

- **Reconduct the AEP portion of South Canton – Star 345kV with 954 ACSR and upgrade terminal equipment at South Canton. (B1812)**

- **Estimated Project Cost: $0.8M**

- **Expected IS date: 6/1/2016**
Study Scope

- Thermal analysis
  - First perform thermal analysis on voltage case to attempt to resolve any thermal issues
- Voltage analysis
  - Monitor all PJM substations for voltage violations
    - Voltage magnitude
    - Voltage drop
  - Contingencies in the study area plus the surrounding TOs are evaluated
  - Transfers from PJM generation outside the LDA to generation inside the LDA are studied

Load Deliverability Facility

- Any substation with a voltage violation where one of the transmission facilities connected to the substation has an OTDF ≥ 5% is automatically considered a violation
- Any substation with a voltage violation where one of the transmission facilities connected to the substation has an OTDF < 5% may be considered a violation
- CETL = LDA MW import level at which Load Deliverability Facility substation voltage violation(s) occurs
### Voltage Analysis

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<th>kV</th>
<th>Area</th>
<th>ContVolt</th>
<th>BaseVolt</th>
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### Diagram

- **Sending Area**
- **Receiving Area**
- **Transmission Lines**
- **Power Transfer**
- **Interface**
- **Voltage Collapse Transfer Limit**
- **Low Voltage Transfer Limit**
- **Incremental Transfer**
- **Low Voltage Limit**
Summary Of Load Deliverability Test

- Reliability test of transmission capability
  - CETO is the MW import objective
  - CETL is the MW import capability
  - CETL > CETO
- Examined annually for both RTEP and RPM
- Considers both thermal and voltage analyses
- Load Deliverability Facilities are selected based on OTDF and interaction between PJM and Transmission Owners
Load Deliverability in PJM Manuals

- PJM Manual 14B: PJM Region Transmission Planning Process
  - Section 2.3.9: Load Deliverability Analysis
  - Attachment C.4 and C.5 Load Deliverability Procedure CETO and CETL
  - [http://www.pjm.com/~media/documents/manuals/m14b.ashx](http://www.pjm.com/~media/documents/manuals/m14b.ashx)
Appendix: Recent Modifications To Load Deliverability Test
Termination of ConEd Wheel Agreements

❖ Before termination
  ▪ Specific rules under JOA for setting PSEG-NYISO PARs in the load deliverability test.
    ✓ 1,000 MW into PJM at Waldwick
    ✓ 600 MW out to NYISO at Linden & Hudson
  ▪ Non-firm emergency assistance assumed available subject to transmission limits

❖ Transition period
  ▪ A multi-month period beginning in late 2016 in which PJM investigated, developed and refined new load deliverability test assumptions with regard to assistance from NYISO

❖ After termination
  ▪ PJM has aligned the PSEG-NYISO PAR settings in all planning studies to be consistent with new protocols established by PJM Ops
  ▪ Non-firm emergency assistance is not assumed to be available in planning studies