Criteria That Applies to Transmission Owners

FERC 715 Filing - general

- Created Annual Transmission Planning and Evaluation Report, to inform potential transmission customers, State regulatory authorities and the public of potentially available transmission capacity and known constraints as required under section **213(b)** of the Federal Power Act, as added **by** the Energy Policy Act of **1992.**
- Provide FERC information with which to analyze filings involving, or requests for, transmission services under the Federal Power Act.

FERC 715 Filing - general

- Consists of six parts that include power system data and planning guidelines
- Must be submitted by or for the owner of any network transmission facilities above 100 kV
- Filing is submitted by PJM for member TOs
- Considered CEII information
- Required annually by April 1
- All projects driven by criteria in the FERC 715 filing become baseline RTEP projects

FERC 715 Filing - specifics

- Part 1
  - contact information and certification from transmission owner
- Part 2
  - power flow data for TO’s system in electronic format
  - PJM submits this data for member TOs since PJM is RTO
  - considered CEII information
- Part 3
  - maps and diagrams used by TO for planning purposes
  - TO submits a single line diagram of its bulk power facilities
  - considered CEII information

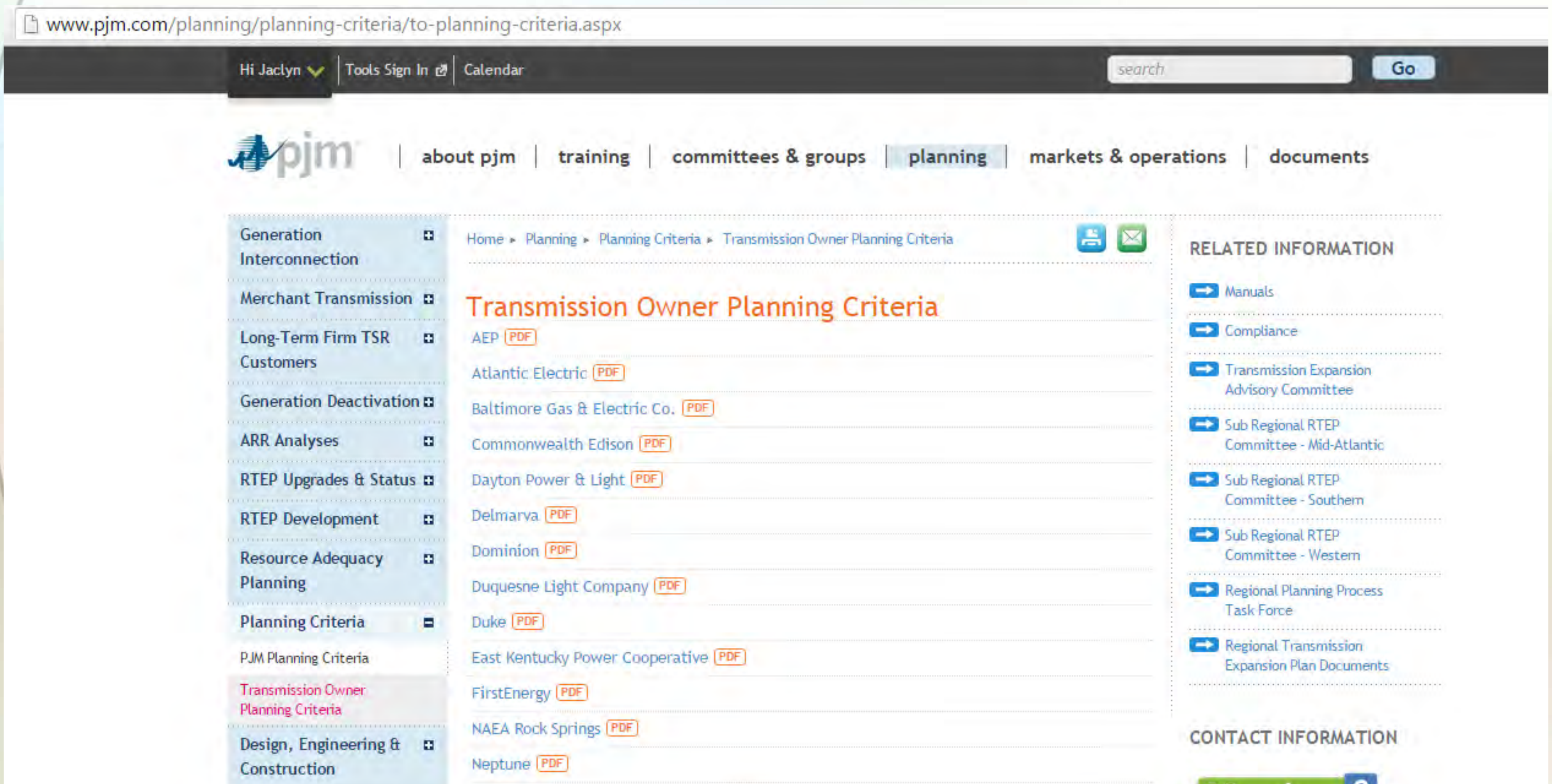
FERC 715 Filing - specifics

- Part 4
  - Description of the reliability criteria used to assess and test the strength and limits of its transmission system
  - Includes regional (NERC, RFC, PJM) and local (TO) standards
  - If a utility subscribes, through its interconnection or pooling agreements with others, to criteria that are more detailed than the NERC and regional entity standards, then it must also submit these additional criteria.
    - Commission expects that each transmitting utility will have additional detailed criteria
    - Example, each utility generally sets its own voltage limit criteria on its bulk system as well as its lower voltage system, since NERC and the regional entities generally do not. Each transmitting utility must submit all such additional criteria.

FERC 715 Filing - specifics

- Part 4
  - Criteria will be those which the utility uses to determine available transmission capacity needed to meet potential transmission requests as well as its own native load
  - Criteria described in sufficient detail to allow others to use the criteria when performing their own planning or screening studies and to better understand the process of determining available transmission capacity.
  - Studies to test TO's facilities for compliance with regional criteria (NERC, RFC, PJM) are performed annually by PJM as part of the RTEP process
  - Studies to test member TO's facilities for compliance with local (TO) criteria are performed annually by member TO, with results provided to PJM when requested as part of the RTEP process
  - Member TO submits this part to PJM, then PJM submits filing to FERC
  - In subsequent years, respondents need only identify and file changed criteria

FERC Form 715 – Part 4 (available on PJM website)



FERC Form 715 (part 4) example

ATLANTIC CITY ELECTRIC

FERC Form 715 (Part 4) - Transmission Planning Study Guidelines

Transmission Reliability Guidelines

1. General Overview

The reliability guidelines used to plan the transmission system of Atlantic City Electric are the criteria by which the ability of the transmission system to serve the future load is determined. In addition to load growth, any significant changes to the generation capacity on Atlantic Electric's or neighboring utility systems must also be included in any evaluation.

2. Transmission Criteria

The Atlantic City Electric service territory is governed by the reliability standards established by the North American Electric Reliability Corporation (NERC), Reliability*First* (RF), PJM Interconnections, LLC (PJM), and the legacy Mid-Atlantic Area Council (MAAC) organizations. The exact planning requirements of these regulated institutions can be found on their websites and external publications. Atlantic City Electric will adhere to any requirements directed by these agencies in order to meet their established reliability planning criteria.

NERC, PJM Criteria

In addition to these external organizations, Atlantic City Electric also has its own internal planning criteria which will meet or exceed the strict standards above. The following criteria will be used for all transmission facilities (69kV and above) within the Atlantic City Electric zone:

TO Criteria

Thermal Requirements (Based on a 50/50 Load Forecast)

- For normal system conditions with no line, transformer, or generation unit out of service, all transmission facilities should not exceed their normal (continuous) rating.
- For a contingency loss of any one facility (line, transformer, or generator), the system should not exceed its emergency (4 hour) rating.

FERC 715 Filing - specifics

- Part 5
  - Description of how reliability of the transmission owner’s facilities is evaluated (assessment practices)
  - Member TO submits this part to PJM, then PJM submits filing to FERC
  - PJM performs assessment for NERC criteria and most of PJM’s criteria (as outlined in PJM Manual 14B)

FERC 715 Filing - specifics

- Part 5, BGE
  - Plans and operates its bulk power transmission system under the functional control of the PJM RTO
  - Transmission planning assessment processes are consistent with the PJM planning process and the Reliability First assessment practices
- Part 5, PEPCO
  - Adheres to the NERC Reliability Standards criteria, ReliabilityFirst Standards criteria, PJM Planning criteria and its own PEPCO Transmission Planning Criteria
  - Transmission planning assessment and practices are consistent with the assessment practices of PJM RTO
  - All transmission service requests into, through, and out of Pepco’s service territory is administered by the PJM RTO

FERC 715 Filing - specifics

- Part 5, DPL
  - Follows the planning criteria for the North American Electric Reliability Corporation (NERC), Reliability*First* (RF), PJM Interconnections, LLC (PJM), as well as internal criteria
  - Plans for single and some double contingency conditions per the criteria.
  - System must not exceed the appropriate normal and emergency limits to meet the reliability criteria
  - Off cost generation operation and other system adjustments may be acceptable as temporary measures to meet the reliability criteria
  - Transmission analysis, depending on the particular study conditions, assumes operating conditions for DPL's system as well as the neighboring utilities' systems in order to study any constraints within DPL's system and potential problems to neighboring
  - utility systems
- Part 5, ACE
  - Follows the planning criteria for the North American Electric Reliability Corporation (NERC), Reliability*First* (RF), PJM Interconnections, LLC (PJM), as well as internal criteria
  - Plans for single and some double contingency conditions per the criteria
  - System must not exceed the appropriate normal and emergency limits to meet the reliability criteria. Off cost generation operation and other system adjustments may be acceptable as temporary measures to meet the reliability criteria
  - Transmission analysis, depending on the particular study conditions, assumes operating conditions for AE's system as well as the neighboring utilities' systems in order to study any constraints within AE's system and potential problems to neighboring utility systems

FERC 715 Filing - specifics

- Part 5, PECO
  - PECO performs assessment for some portions of PJM's criteria in PJM Manual 14B and local criteria that exceeds PJM criteria
    - PECO follows the planning criteria for the North American Electric Reliability Council (NERC), ReliabilityFirst (RF), PJM Interconnections, LLC (PJM), as well as PECO criteria
    - PECO, plans and operates its bulk power transmission assets under the direction of PJM so as to avoid, or minimize, any system limitations which might be imposed upon other members of the PJM Interconnection or surrounding entities under a variety of system configurations
    - PECO works with PJM in studying the ability of its system to deliver generation to its load substations without violating reliability criteria
    - The system is designed to operate such that no single contingency shall cause a thermal overload nor will it cause a state of instability or exceed voltage reliability criteria
    - Following remedial action subsequent to the occurrence of a first contingency, the system is designed to withstand a second contingency such that reliability parameters remain within applicable limits

FERC 715 Filing - specifics

- Part 5, ComEd
  - ComEd performs assessment for some portions of PJM's criteria in PJM Manual 14B and local criteria that exceeds PJM criteria
    - ComEd follows the planning criteria for the North American Electric Reliability Council (NERC), ReliabilityFirst (RF), PJM Interconnections, LLC (PJM), as well as ComEd criteria
    - ComEd, plans and operates its bulk power transmission assets under the direction of PJM so as to avoid, or minimize, any system limitations which might be imposed upon other members of the PJM Interconnection or surrounding entities under a variety of system configurations
    - ComEd works with PJM in studying the ability of its system to deliver generation to its load substations without violating reliability criteria
    - The system is designed to operate such that no single contingency shall cause a thermal overload nor will it cause a state of instability or exceed voltage reliability criteria
    - Following remedial action subsequent to the occurrence of a first contingency, the system is designed to withstand a second contingency such that reliability parameters remain within applicable limits

FERC 715 Filing - specifics

- Part 5, ComEd
  - Adequacy evaluated for the next ten years
    - Forecast situations where transmission system does not meet ComEd planning criteria
    - Develop mitigation plan (operator action, reinforcement)
    - Reinforcement planning over 6 year period required for sufficient time to implement mitigation plans
    - Reinforcement plans to ten years for long range planning purposes and property acquisition
  - Process for applying planning criteria
    - Power flow case development
    - Testing for adequacy (thermal, voltage, stability)
    - Identification of operating steps
      - Timely, safe, reliability impact, allowable per any criteria, failure cause cascade?
    - Development of reinforcement plans
      - upgrades to existing equipment to increase their rated capability or new facilities such as transmission lines, transformers, breakers, or capacitors
      - Ultimately, the decision on a particular reinforcement depends on the level of risk that can be prudently accepted while always meeting applicable planning criteria

FERC 715 Filing - specifics

- Part 6
  - evaluation of TO's system performance measured against its criteria using its assessment practices
  - PJM submits this part for member TO since PJM is RTO
- PJM submits annual RTEP report for part 6
  - Typically 3 parts (RTEP in review, input data and process scope, baseline and market efficiency results)
  - Part 1
    - Executive summary of baseline, market efficiency and operational performance studies.
    - Generation fleet changes driven by deactivation and new natural gas plants.
    - Scenarios and interregional studies that have provided insights on public policy impacts
    - NERC, regional and Transmission Owner (TO) reliability criteria expansion
    - RTEP process enhancements that were completed or initiated

FERC 715 Filing - specifics

- Part 2
  - Input Data and Study Processes, focuses on input parameters (load forecasts, generation and topology, for example) and study methodologies (deliverability, for example) which were key to conducting PJM's 2015 RTEP process cycle of studies.
  - NERC planning criteria and summarizes the changes underway to comply with FERC approval of NERC Planning Standard TPL-001-4

- Part 3
  - Results from studies that year
  - Recommendations and approvals associated with specific upgrades (e.g. Artificial Island) and RTEP process window evaluations
  - RTEP process analysis that led to PJM Board approval of immediate need system enhancements to address operational performance issues, generator deactivations and transmission owner criteria violations
  - Evaluation, recommendation and approval of system enhancements arising out of the Long-Term Proposal Window to address market efficiency study long-term congestion issues
  - Scenario studies conducted to assess the impacts of public policy, particularly that associated with generation at risk of deactivation driven by environmental regulations
  - Interregional planning activities including initiatives with Eastern Interconnection Planning Collaborative (EIPC) and Midcontinent Independent System
  - Subregional summaries of RTEP projects approved by the PJM Board

NERC Planning Criteria

- Defines minimum transmission system performance requirements for BES facilities throughout U.S.
  - identifies system conditions that must be maintained in steady state and transient time periods with and without contingency events
- Example requirement
  - At peak load, the outage of a transmission circuit shall not cause applicable facility ratings to be exceeded on any other facility
- Example remedy
  - Increase ratings on a 230 kV transmission circuit by replacing the conductor

PJM Planning Criteria

- Defines minimum transmission system performance requirements for any facility under PJM control
  - must meet or exceed NERC standards for BES facilities
- Example requirement
  - The outage of a transmission circuit shall not cause applicable facility ratings to be exceeded on any other facility under a probable generation dispatch (generator deliverability test)
- Example remedy
  - Increase ratings on a 230 kV transmission circuit by replacing the conductor

PJM Planning Criteria

- PJM criteria exceeds NERC standards
  - Includes criteria for non-BES facilities under PJM control as stated in PJM Manual 14B, attachment D
    - N-1 single outage of line, transformer or generator
    - Maintenance criteria (N-1 during facility maintenance)
  - Includes generator and load deliverability tests applied to all facilities under PJM control
    - Generator deliverability test is performed to ensure that the aggregate amount of generation in any sub-area of the system can be delivered to the rest of the system
    - Load deliverability test is performed to ensure that power can be delivered to any sub-area of the system during times of higher than expected load levels and higher than expected generation outages

PECO TO Planning Criteria

- Defines minimum transmission system performance requirements for PECO's facilities
  - Must meet or exceed PJM criteria
- PECO exceeds PJM criteria as follows:
    - Normal (0.98pu) voltage limit on sub-500 kV facilities (exceeds 0.95pu for PJM)
    - Emergency (0.95pu) voltage limit on sub-500 kV facilities (exceeds 0.92pu for PJM)
    - Maximum contingency voltage change of 5-7% depending on voltage level of facility (exceeds 5-10% depending on voltage level of facility for PJM)
    - Include all open circuit breaker contingencies (in addition to CBs on network lines where opening the CB results in load served radially from other end of line)
    - Monitoring 69 kV facilities for capacitor bank and shunt reactor contingencies (in addition to monitoring BES facilities)
    - Include 69 kV bus outage, faulted circuit breaker and tower outage contingencies (in addition to line, transformer and generator contingencies)
- Example remedy
  - Increase the ratings on a 69 kV circuit by replacing the conductor

Distribution Load Forecasts

- Forecast Development
  - The weather adjusted peak load for the most recent year for each circuit and substation, along with identified changes [new business or load transfers], are used to project future peak loads
- Timeframe
  - Future peak loads are projected out:
    - 2 years for circuits
    - 5 years for substations
      - Forecasted distribution substation peak loads are provided to Transmission Planning for use in basecase development
- Reason for Different Timeframes
  - Considering the long lead time for a substation project, particularly if a new site is needed, early identification of the need for a substation project is required
  - Provides additional time to evaluate substation options
- Use of Peak Load Data
  - Peak loads are compared to allowable ratings
  - Relief projects are developed when peak loads are forecasted to exceed allowable ratings by more than that permitted by distribution planning guidelines

Weather Variances

- Peak loads are used as the basis for future planning forecasts
- Distribution substation and circuit peak loads are weather corrected to account for variances in peak loads due to weather
- Individual weather correction factors, based on cooling degrees and the type of customers served, are applied to each circuit or substation
  - Cooling degrees measure the operating level of air conditioning equipment on a hot day
    - Number of **degrees** that a **day's** average temperature is above 65º Fahrenheit and people start to use air conditioning to cool their buildings (e.g. avg temp one day 80, the CCD would be 15)
  - Response to temperature varies by type of customer
    - Industrial customers - none
    - Commercial customers - moderate
    - Residential customers – high
- PECO is typically a summer peaking system
  - A few winter circuit peaks occur and are addressed on a case by case basis versus a system wide weather correction

Distribution Substation Design Criteria

- Distribution Substation
  - Nearly all PECO transmission voltage supplied substations consist or two or more transformers
    - Supply voltages can be: 69, 138 or 230 kV
- Design Criteria
  - Most transmission voltage substations are designed as multi-transformer, non-mobile ready, substations
  - Allowable loading is normally limited by loss of highest rated transformer [N-1 Design Criteria]
    - Long term emergency rating [typically 2 weeks or longer] of remaining transformer[s] is used to determine substation allowable rating
- Relief Options
  - Permanent load transfers to other substations
  - Making the substation mobile ready and adding a distribution automation transfer scheme to temporarily transfer load to other substations to provide time to install a mobile transformer
  - Installing an additional substation transformer
  - Building new substation

PECO Ten Year Plan

- Each year, PECO performs a study to identify potential future transmission problems and develop solutions to those problems
- Multiple scenarios for future system conditions are modeled, with each scenario representing a variation of assumptions from the "base" case
  - Assumptions that may be varied in each scenario include:
    - generation dispatch (location and amount of future generation resources used to serve PJM load that will impact flows on PECO system, accounting for new development and potential retirements)
    - Load (aggregate amount as well as development at specific sites)
    - Transmission (addition of regional transmission lines that will impact flows on PECO system)

PECO Ten Year Plan (cont.)

- PECO’s system is tested to identify potential reliability criteria violations under each scenario
- Potential violations are prioritized based on magnitude of problem or number of scenarios under which problem occurs
- Solutions are developed to address issues on individual facilities or groups of facilities
- Study results related to major problem areas and potential projects of significant scope are presented at a challenge meeting, which offers opportunity for others outside Transmission Planning to provide comments and suggestions

ComEd TO Planning Criteria

- Defines minimum transmission system performance requirements for ComEd's facilities
  - Must meet or exceed PJM criteria
- ComEd exceeds PJM criteria as follows:
  - 90/10 load level for all P1 (single element) and P2-1 (open circuit breaker) contingencies
  - 90/10 load level for non-simultaneous loss of two underground cables (Chicago Business District only)
  - Voltage Stability criteria has minimum voltage collapse points for various contingencies. For example:
    - P1-1 through P1-5 (single contingency) @ 90/10 peak load + 500 MW
  - Dynamic Voltage Recovery Criteria is more conservative and has more data points. For example:
    - Return to 0.9 pu 0.5 seconds after fault is cleared
  - Angular Stability Criteria includes the following:
    - Three-phase fault on any single transmission or generation element with delayed clearing due to a stuck breaker or other device
    - Three-phase fault on all transmission lines on a multiple circuit tower with normal clearing
    - Three-phase fault on any transmission or generation element with a maintenance outage

BGE TO Planning Criteria

- Defines minimum transmission system performance requirements for BGE's facilities
  - Must meet or exceed PJM criteria
- BGE exceeds PJM criteria as follows:
  - Tighter operating and voltage drop criteria for certain transmission voltages
    - For example, 34.5 kV normal voltage operating limits are 0.95-1.04 PU
  - Restriction on common mode failures on radial supplies which serves 30,000 or more customers that restoration would take more than four hours
    - PJM currently only restricts a load drop off radial circuits to be no more than 300 MW
  - Additional stability requirements
    - Tests of three-phase faults at a point 80% of the circuit impedance away from the station under study with delayed (zone two) clearing.

ACE/DPL/Pepco TO Planning Criteria

- Defines minimum transmission system performance requirements for ACE/DPL/Pepco facilities
  - Must meet or exceed PJM criteria (applies to all Transmission Facilities including 69kV for ACE/DPL)
- ACE exceeds PJM criteria as follows:
  - 90/10 load level for all single contingencies
  - 90/10 load level for contingency loss of any one facility and the discrete outage of one generator
  - Emergency (0.94pu) voltage limit on 138/69kV kV facilities (exceeds 0.92pu for PJM)
  - Less probable contingency analysis (e.g. sudden loss of entire generating capability of any station, sudden loss of all lines of one voltage emanating from a substation, sudden loss of all lines on a single right-of-way, sudden dropping of a large load or a major load center)
- DPL exceeds PJM criteria as follows:
  - In addition to those listed above;
  - Emergency (.94pu) voltage limit on 138 kV facilities (exceeds 0.92pu for PJM)

ACE/DPL/Pepco TO Planning Criteria (cont.)

- Pepco exceeds PJM criteria as follows:
  - In addition to those listed above;
  - The loss of any double-circuit line or the combination of facilities resulting from a line fault and a stuck breaker, in addition to normal scheduled outages shall not exceed the applicable short time emergency rating of the facility

TO Supplemental Criteria

- TOs also recommend projects that do not violate PJM Planning Criteria or the TO's filed FERC 715 criteria, but are instead needed to maintain local reliability. Drivers for such projects include but are not limited to:
  - Proactively addressing the age and condition of transmission facilities (considers factors such as physical condition obtained from inspections, asset health index reports, material obsolescence, age, etc. to determine the potential risk associated with continued operation of the facility);
  - Incorporating new load into the system, including transmission facilities that are necessary to support new distribution load in addition to the interconnection of wholesale and major customers;
  - Enhancing system resiliency and reliability through system improvements such as undergrounding lines, reconfiguring supplies and adding breakers to minimize the adverse impact of outages;
  - Increasing operational performance of the local system through collaboration with PHI's real time system operations department assessments;

Replacement Criteria

- TO criteria that does exist is generic
  - Considers condition of facility
    - Service life industry expectations
    - Performance history
    - Maintenance expense
    - Assessment
  - Reliability Impact
    - NERC standard, Region criteria, PJM criteria, local TO criteria, operational performance
    - Market efficiency
    - Stage 1A ARR sufficiency
    - Public policy
  - Replacement or alternative
    - Effectiveness of alternative
    - Constructability
    - Cost