Attachment H: Power System Modeling Data

Power System Modeling Data

Accurate power system modeling data is a key component of quality power system analysis. PJM System Planning uses a variety of models and analytical techniques to create and maintain the models used for the RTEP. The indented use of this Attachment is to supplement existing documentation by PJM and other entities that govern modeling data quality requirements. PJM will continue to follow the data quality guidelines and standards set forth by NERC as part of the MOD standards and the Multiregional Modeling Working Group (MMWG) Procedural Manual.

Load Flow Analysis Models

Basecase creation is a collaborative process between PJM and its members. From a technical standpoint PJM follows the regulations set forth in the MMWG Procedural Manual. In addition to this guide, PJM focuses on the logistics and transfer of information between PJM and its Transmission owners.

Annual Updates

Annually, in approximately the 4th Quarter of each year, PJM will request from each TO:

- Current year + 5 summer peak network model
  - Network model updates to the current year + 5 base case to update the case that will make the case a current year + 5 base case in the 1st Quarter of the following year
  - Complete NERC category B and C contingency file updates that correspond to the updated network model
  - Any other significant changes such as new load or block load additions

Additionally, PJM will request from each TO:

- Network models for additional years and demand levels in the near term (years 1 through 5) and longer term (beyond 5 years) that are in the analysis scope for that particular RTEP cycle.
  - Complete NERC category B and C contingency file updates that correspond to the updated network model
  - Any other significant changes such as new load or block load additions
- Maximum credible disturbance (NERC Category D) contingencies

PJM requires that Transmission Owners provide within 4 weeks of receiving the initial draft network model:

- Updates to the case and contingency files that have been reviewed for correctness and compatibility with the final version of the basecase under development
- Behind the Meter information
- Specific information regarding generator capability

- Verification that all baseline, network and supplemental upgrades are included in the case update along with a written description the case modifications.
- Notification of any changes to tie lines whether they are internal to PJM or ties to external companies.

Load Flow Modeling Requirements

In addition to the guidelines set forth by NERC and the MMWG procedural manual, PJM uses several specific procedures in setting up the base case so that it is the best starting point for the annual RTEP analysis.

Interchange

The PJM net interchange of is determined by the firm interchange that is represented in the PJM OASIS system.

Generator Reactive Capability

Annually, PJM models the generator reactive capability (GCAP) of each PJM generator based on data coordinated with PJM operations.

Interconnection Projects With Interconnection Service Agreements (ISAs)

Transmission owner are responsible for adding any queue projects that have signed their ISA into the basecase as well as verifying the accuracy of queue projects that have not yet signed their ISA including the interconnection, ratings and associated upgrades.

Real and Reactive Load

Each PJM TO is responsible to model the real and reactive load profile in their zone. PJM will ultimately scale the load in the base case to the values reported in the latest annual PJM load forecast report. Real loads will be scaled uniformly in each zone to meet the PJM load forecast plus any Demand Response (DR), Energy Efficiency (EE), or Behind the Meter generation as necessary. Reactive load in each area will be scaled at a constant power factor along with the real load.

Voltage Schedules

The setting of voltage schedules is crucial to the robustness of cases. PJM allows transmission owners to supply generator voltage schedule data. If the data is provided correctly based on the MMWG procedure manual, PJM will use the default voltage schedules as defined in PJM Manual 03.

Submittal of Load Flow Data

Acceptable Data Formats

- For TOs that use PSS/E, cases should be provided back to PJM in ".SAV" format in a version of PSS/E that is readable by the current version of PSS/E that PJM is using.
- For TOs that use PSLF or other modeling software, cases shall be provided back to PJM in ".RAW" format in a version of PSS/E that is readable by the current version of PSS/E that PJM is using.

Timing

Transmission Owners must comply with the schedule dictating the timeliness of the case creation process which will be included in the initial email sent to kick off the process. This schedule will include a minimum of 3 weeks to provide updates to the case and corresponding files for the first iteration, and 2 weeks for the second iteration.

Load Flow Data Quality

Transmission owners must provide data that has been shown to pass all of the testing included in the MMWG data checker. In addition to the requirements of the MMWG data checker, Transmission Owners must also provide unique bus names for each winding of all transformers. Bus numbers must also be within the allocated bus number range for each company.

Modeling and naming of machines must also follow strict guidelines including Machines ID's which should not be named "H" or "L" except for the high/low pressure units which should be modeled on the same bus. Additionally multiple machines modeled on the same bus must have the same status, so offline machines should not be modeled on the same bus as machines which are online.

Short Circuit Data

Short Circuit data procedures are documented in PJM Manual 14B Attachment G.7 which references ANSI/IEEE 551. Together these procedures outline the data requirements which PJM follows in creating the short circuit cases used for analysis.

- PJM will request new TO short circuit models at approximately 2 year intervals.
- Short circuit models to be provided in Aspen ".olr" format, if possible.
    - At the time of this writing, CAPE and PSSE users can't accommodate this requirement.
- All the TO provided Aspen ".OLR" cases should have only their own TO area modeled as well as their tie lines. No outside areas should be sent with the case.
- All the area numbers in the TO provided cases should be consistent with MMWG designated area numbers. E.g. Area numbers such as 1, 2, 3, etc. are not acceptable.
- All the TO provided Aspen ".OLR" cases should have all TO circuit breakers rated above 100 kV modeled in the case.
- All generation owners must submit to PJM all their breaker data for breakers rated above 100 kV

- TOs must submit an excel sheet containing explanations for outaged equipment that is normally in-service
- TOs must submit an excel sheet containing explanations for out-of-service breakers that are normally in-service

Stability Data

The base case used for stability and dynamics is a combination of the Regional Transmission Expansion Plan (RTEP) case prepared by PJM Interconnection, the stability studies performed by the planning department stability group at PJM and the NERC case prepared by Powertech Labs for the Eastern Interconnection Reliability Assessment Group (ERAG) and the System Dynamics Database Working Group (SDDWG).

When preparing the base case for stability and dynamics, the NERC case provides the information for the areas outside PJM while the RTEP case provides the PJM information (e.g. load forecast, network configuration). When combining the NERC and the RTEP cases, care should be taken to preserve the ties between the PJM areas and the rest of the Eastern Interconnection.

All of the queue projects active in PJM queue process that have been studied must be included in the base case for stability and dynamics. In some instances, the RTEP model for the queue project may not be detailed enough for stability. In the event of this, the case must be updated to make sure that all of the components are modeled in detail in the stability and dynamics powerflow (e.g. generator step-up transformer, loads).

In addition to updating the power flow case with the latest network information, the dynamic models must also be updated to reflect the changes introduced by the RTEP case and the Stability and Dynamic studies performed by PJM. In this regard, the NERC dynamic data file from the SDDWG case is updated so that the dynamic models for the machines in the PJM areas are matched against the new powerflow information from the RTEP. Since most of these changes are updates to bus numbers and machine IDs it is recommended that a table showing a one-to-one correspondence for the machines in the PJM areas for both the NERC and RTEP cases be constructed. The dynamic model for each queue project must also be added to the NERC dynamic data file.

The resulting powerflow case, the dynamic data file and supporting files required for a complete stability and dynamics base case need also to be correlated and reviewed to determine inconsistencies as well as missing or questionable data. A base case is considered to be finished when after being reviewed, it initializes correctly after compiling and linking the models to the PSS/E main structure. A correct base case must also show no deviations from the initial conditions for any simulation setup with no disturbances applied to the system.

Stability and dynamics base cases:

Stability is assessed using two load conditions: summer peak load and light load. The summer peak case has the load profile of the RTEP summer peak case and corresponds to

the demand expected to be served in that year. The light load case represents 50% of the summer peak load scaled down with a fixed power factor.

Similar procedures may be followed to prepare the summer peak case and the light load case for stability and dynamics. For simplicity, it is recommended to first build the summer peak case and then update that case to reflect the second load condition (light load). This approach provides two cases that are uniform in bus numbers and network information. Updates to both cases, such as addition or removal of proposed lines or queue projects would be easy to handle due to the uniformity.

A complete base case (summer peak or light load) must include at least:

- A powerflow file: This file contains the network information and provides the initial conditions for the dynamic models.
- A dynamic data file: This file contains all the information necessary to simulate the dynamic response of the various system components.
- A gnet file: This file contains the information of those generators that do not have a dynamic model. Any generator listed in this file is considered as a negative MVA load.
- A conl file: This file indicates how loads will be modeled based on a combination of constant MVA, constant current and constant admittance.
- User defined models: All dynamic models external to PSS/E. These models must be compatible with the version of PSS/E for which the basecase is being created.

Light load dynamics base case:

After the powerflow case has been finalized and revised, the dynamic data file from the NERC must be updated to reflect the changes that were introduced by the addition of the PJM areas from the RTEP case. Since most of these changes are updates to bus numbers and machine IDs it is recommended that a table showing a one-to-one correspondence for the machines in the PJM areas for both the NERC and RTEP cases be constructed.

After the summer peak case has been finished, the PJM load is scaled down to a load representing 50% of the summer peak load. The areas outside PJM are updated with the light load case from the corresponding NERC case. Note that generation and shunt capacitors may be required to be turned off or disabled in order to achieve convergence of the power flow. In addition, all pumped storage hydro units are modeled in the pumping mode with their governors and power systems stabilizers deactivated or adjusted to reflect the appropriate operating condition.