PJM MOD-032 Steady State, Dynamics, and Short Circuit Modeling Data Requirements and Reporting Procedures Document

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Contents

1 Introduction

1.1 Purpose

MOD-032, according to the NERC standard, is to "establish consistent modeling data requirements and reporting procedures for development of planning horizon cases necessary to support analysis of the reliability of the interconnected transmission system." The purpose of this document is to establish the data requirements, schedules, and submission methods to ensure data owner compliance with the standard.

1.2 Background

The MOD-032 and MOD-033 standards are focused on system-level modeling and validation. MOD-032 replaces and consolidates MOD-010-0, MOD-011-0, MOD-012-0, MOD-013-0, MOD-014-0, and MOD-015-0.1. It requires various Functional Entities, as data owners, to submit data to their Transmission Planner(s) (TP) and Planning Coordinator(s) (PC). These data owners include Transmission Owners (TO), Load Serving Entities (LSE), and Generation Owners (GO). The data submitted is used to build steady state, dynamics, and short circuit models for various years and scenarios. MOD-033 is a new standard requiring every PC to put into place a process to validate the models for its area.

The latest version of the MOD-032 standard is available here:
http://www.nerc.com/pa/Stand/Reliability%20Standards/MOD-032-1.pdf

1.3 Process Overview

PJM is the TP and PC for its region and therefore must develop data requirements, reporting procedures, and schedules for the data owners in its area to provide data to build steady state, dynamics, and short circuit cases. MOD-032 Requirement 1.2.4 states that the data must be submitted at least every 13 months.

The basic process is outlined in Figure 1. PJM will reach out to individual data owners using a variety of methods. Methods are targeted to the specific Functional Entities and will include email, compliance bulletins, and announcements at PJM committee meetings. These announcements will include updated schedules and deadlines, an overview of expectations by Functional Entity, and links to this document. Any appreciable changes to this document will be presented at PJM's Planning Committee.

Data owners will provide data annually and in a timely fashion consistent with that year's required schedule. Upon submission, PJM will review the data and respond to the Functional Entity with any technical concerns. For any technical concerns, PJM will follow the procedure in MOD-032 Requirement 3. The Functional Entity will have 90 days to respond with model updates or a technical basis for maintaining the data as submitted.

PJM uses a feedback review process that gives Transmission Owners an opportunity to review the data after submission and review by PJM, but before the final approval by the NERC designee.

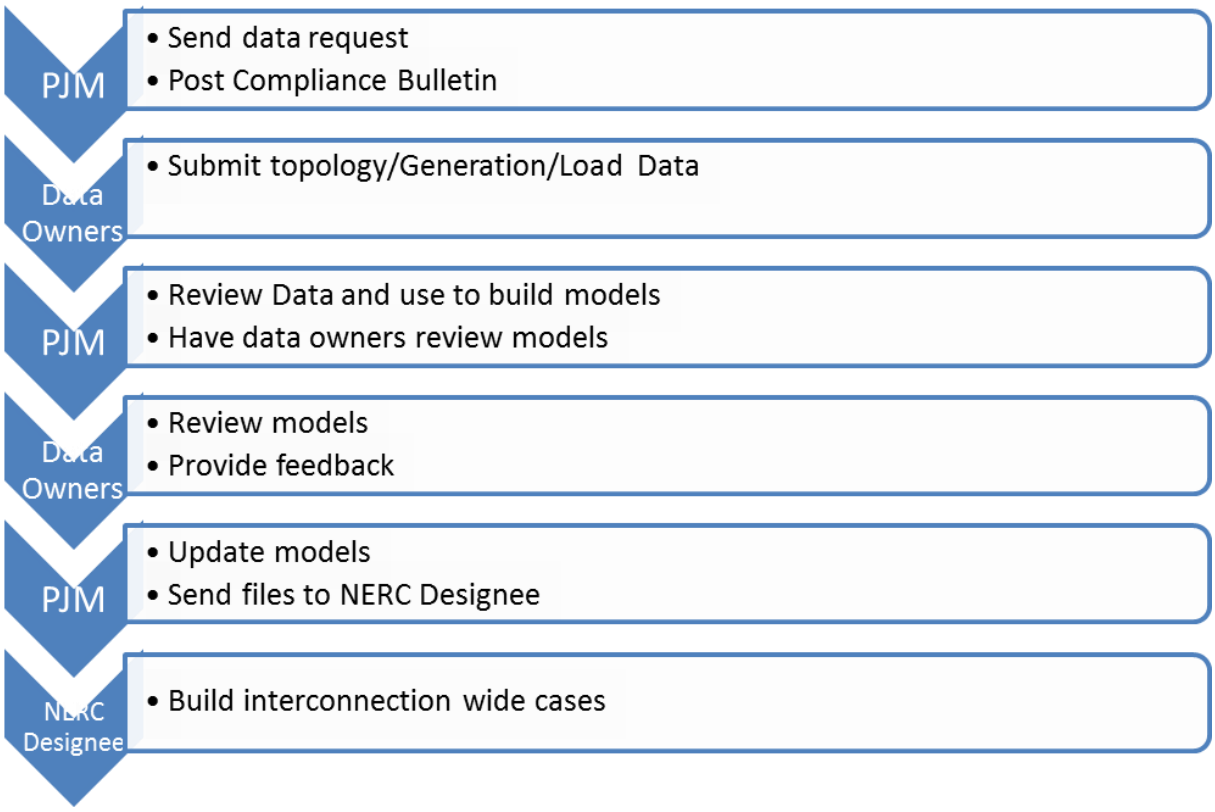

Figure 1

1.4 Specifications for posting of data requirements and reporting procedures

This document will be posted on the MOD-032 webpage on PJM.com available at the following url: http://pjm.com/planning/rtep-development/powerflow-cases/mod-032.aspx

This document and the data requirements and reporting procedures were developed by PJM staff to ensure compliance with MOD-032 requirement 1. PJM staff made monthly progress updates at PJM Planning Committee starting in October 2014. This document incorporates feedback provided from representatives from various functional entities including GOs and TOs.

PJM will communicate any updates of this document via various committee mailing lists and with in-person announcements from many committees including the Planning Committee, the Reliability Standards and Compliance Subcommittee, Nuclear Generation Owner User Group, and the System Operations Subcommittee. PJM's TOs, GOs, and LSEs regularly attend these meetings.

The version of this document posted on pjm.com is the latest version. Any major revisions to this document or the data requirements, reporting procedures, and schedules contained herein will be communicated via various PJM committees. In addition PJM will reach out directly to TOs, GOs, and LSEs with its current modeling contacts list. Also, a compliance bulletin will be posted.

1.5 Responsible Entities and expectations

Requirement 2 of MOD-032 requires GOs, TOs, and LSEs to submit steady state, dynamics, and short circuit data to their TPs and PCs according to the requirements, schedules, and submission methods set out in this document. A brief description of these entities and their responsibilities:

1.5.1 Load Serving Entity

LSEs, according to NERC, secure "energy and transmission service to serve the electrical demand and energy requirements of its end-use customers." With regard to MOD-032, they will submit their forecasted load for the years and scenarios being developed.

It is expected LSEs will coordinate with their respective interconnected TO(s) to submit aggregate demand for each scenario listed in section 2.1. For steady state model development, LSEs are expected to provide aggregate demand at the bus level as well as the location of future load additions. For dynamic modeling data, LSEs are expected to coordinate with TOs to provide load composition and characteristics.

1.5.2 Generator Owner

A Generation Owner (GO), according to NERC is an "entity that owns and maintains generating units." With regards to MOD-032, GOs are responsible for submitting modeling data for existing generating units. PJM asks that all generators with capacity in PJM markets or having machines over 20 MW submit data under MOD-032. PJM queue projects coming in service during the calendar year are asked to submit data under MOD-032 via the as-built data submitted to PJM's Queue Point tool as required by their agreements and milestones. That submittal will stand for one calendar year. So if a queue project submits its as built data to PJM's Queue Point as stipulated by its agreement in December 2018 they will not have to submit during the 2019 submission window since that window is within one calendar year of their Queue Point submission. After that window queue projects are expected to update and confirm their data as any other existing generator in Gen Model.

PJM expects GOs to be attentive to committee activities and PJM.com for MOD-032 compliance announcements. To submit MOD-032 data to PJM, GOs are required to establish a "My PJM" log in for pjm.com and use the "Gen Model" tool to annually provide and/or verify the accuracy of the data listed in Appendix 2: Generator Owner Data Sheet Requirements. This data will aid in building steady state, dynamics, and short circuit cases.

They will also have to provide dynamics data in the best format they have available. This could be word or excel document, pdf, dyr, etc.

1.5.3 Transmission Owner

A TO, according to NERC, is "The entity that owns and maintains transmission facilities." With regards to MOD-032, TOs are responsible to submit modeling data for their existing and future transmission assets.

The TOs are required to submit all data contained in MOD-032-1 attachment 1 which is included in Appendix 5: MOD-032-1 Attachment 1. TOs are expected to submit and coordinate tie data. They will also submit system topology information using the current Siemens Model On Demand production system at PJM such that each scenario listed in section 2.1 can be built. Once the cases are built using Model On Demand, TOs will be expected to review topology for accuracy and provide updates to correct the models. TOs will also be expected to provide data for short circuit case builds. TOs are expected to provide dynamics modeling information for any dynamics devices they own. Any TOs that serve external area load via their transmission system should coordinate with that company and include in its data submission.

Non-incumbent TOs that are awarded projects through PJM's FERC Order 1000 window process shall provide modeling data for their project via an idev. PJM will ensure that this idev is included in future case builds. Non-incumbent TOs will be asked to review models for accuracy and provide PJM feedback. Any questions and updates should be sent to MOD-032@pjm.com.

2 Deliverables

2.1 Load Flow

The load flow files developed for MOD-032 compliance are built using Siemens PTI PSS/E 33 and Model On Demand v9 software. Transmission Owners are given access to Model On Demand to upload project and profile files to aid in building the case years, seasons, and scenarios as defined by the NERC designee. Upon announcement of a change in the cases to be built, this section will be updated. The current case types and scenarios list developed by the Multiregional Modeling Working Group (MMWG) annually is:

- Year 1 Spring Light Load
- Year 1 Summer Peak
- Year 1 Winter Peak
- Year 2 Spring Light Load
- Year 2 Summer Peak
- Year 2 Winter Peak
- Year 5 Spring Light Load

- Year 5 Summer Peak
- Year 5 Shoulder Peak
- Year 5 Winter Peak
- Year 10 Summer Peak
- Year 10 Winter Peak

For each of these scenarios, the equipment and generation included in each should be in service by the following dates:

	Topological changes modeled if in-service on or before this date in the target model year
Summer Peak	**June 1st**
Winter Peak	**January 15th/(yyyy+1)**
Light Load	**April 1st**
Shoulder Peak	**July 15th**
Spring Peak	**April 15th**
Fall Peak	**October 15th**

- Note that "yyyy" = target model year

Summer Peak Load (yyyySUM) — is defined as the summer peak demand with load forecast defined in table B-1 of PJM's Load Forecast Report, developed by PJM's Resource Adequacy Planning Department. Topological modeling changes shall be incorporated into the model if they are to go into effect on or before June 1st. Summer interchange schedules should reflect transactions expected to be in place on June 1st. Planned summer maintenance of generation and transmission should be reflected in the operating year case.

Winter Peak Load (yyyyWIN) — is defined as the winter peak demand with load forecast defined in table B-2 of PJM's Load Forecast Report, developed by PJM's Resource Adequacy Planning Department. Topological modeling changes shall be incorporated into the model if they are to go into effect on or before January 15th of the following year (yyyy + 1). Winter interchange schedules should reflect transactions expected to be in place on January 15th. Planned winter maintenance of generation and transmission should be reflected in the operating year case.

Light Load (yyyySLL) — is defined as a typical early morning load level, modeling at or near minimum load conditions. Historically for PJM this is 50% of that year's summer peak load as defined in table B-1 of PJM's Load Forecast Report. Topological modeling changes shall be incorporated into the model if they are to go into effect on or before April 1st. Generation dispatch will be in line with PJM's historical dispatch during these scenarios. Planned spring maintenance of generation and transmission should be reflected in this case. Summer or appropriate equipment ratings should be used.

Shoulder Peak Load (Summer) (yyyySSH) — is defined as 70% to 80% of summer peak load conditions. Dispatchable and pumped storage hydro units should be modeled consistent with the peak hour of a typical summer day with run-of-river hydro on-line. Generation dispatch and interchange schedules should be commensurate with the experience of the PC during such load periods, not just including firm transactions. Summer or appropriate equipment ratings should be used.

2.2 Dynamics

The dynamics cases will use the topology developed for the load flow series of cases as outlined above. GOs will need to provide generator exciter, governor, power system stabilizer, and protection equipment updates annually. TOs with dynamic devices will also need to provide PJM with dynamics modeling data for the dynamic devices they own.

2.3 Short Circuit

PJM will develop Short Circuit models in Aspen using input from TOs and GOs. Model development will align with the current RTEP development schedule, submission methods, and level of modeling detail defined in PJM Manual 14B.

3 Procedure

3.1 Annual Schedules

The following schedules contain the overall annual timelines for case builds and the TO and GO schedule for submission of data. Data must be submitted at least once every 13 months.

Steady State

Task	Anticipated Annual Completion Month	Additional Comments
Kick off Conference Call	February	
Tie line update	May	
Interchange Update	May	
Build Cases to be submitted for Trial 1 in MOD	May	Cases assembled by PJM in MOD based on latest available base case and project file information and disseminated to TOs by PJM
Case updates to Trial 1	July	
Finalize Tie line and Interchange	June	

Case updates to Trial 2	August	
Case updates to Trial 3	September	
Post Final Cases	October	

Short Circuit

The short circuit schedule presented below keeps with the current RTEP development cycle. The schedule set out by the NERC designee makes this schedule subject to change. If the designee requests a case, PJM will request TOs to review and provide feedback on a 2 year and/or 5 year case based on the NERC designee request.

Two year case build

Task	Anticipated Annual Completion Month	Additional Comments
Send out draft case	August	
Send out Trial 1 case	October	
Receive updates	October/November	
Apply updates	–October/November	
Send out Trial 2 case	December	
Finalize Case	February	

Five year case build

Task	Anticipated Annual Completion Month	Additional Comments
Send out Trial 1 case (based on final year 2 case)	December/January	
Receive and apply updates	–January/February	
Finalize Case	February/March	

Generation Owners Data Submittal

Generation Owners are required to submit their data via the PJM tool "Gen Model." The required data to be submitted is listed in Appendix 2: Generator Owner Data Sheet Requirements. GOs are also required to submit excitation, governor, and power system stabilizer data via the Gen Model portal as well. The user guide for "Gen Model" can be accessed here: http://www.pjm.com/~/media/etools/planning-center/gen-model-user-guide.ashx

For each year, the GO has a window during which to submit data. For the first year, this window will be three months long. Each subsequent year the window will be two months. The reasoning for the initial three month window is twofold. One, the GO will have to complete the full form the first year. However, the GO submitter still must log into the web form and verify that the data is still accurate. In subsequent years only data that has changed will need to be updated in the form. Second, additional time to deal with any issues with the new process has been built in.

For new units coming into service, PJM will require generators to submit data starting the year the unit goes into service. To the extent that PJM tools will allow, Gen Model will be seeded with information submitted during generation queue study. The GO will have to verify the data each year the generator is active.

Year 1

Task	Anticipated Window	Additional Comments
Submit Information	May – July 2016	Additional time given for first years submittal

Year 2 – Beyond

Task	Anticipated Window	Additional Comments
Submit Information	April - June	

Transmission Owner Dynamics Data Submittal

PJM will maintain a list of dynamics model contacts at its TOs and will request data updates annually. In keeping with the dynamics schedule for the GOs above, this data will be requested to be provided in July. If there are no updates, PJM will need written confirmation. TOs will only be responsible for submitting data for devices they own.

Task	Anticipated Window	Additional Comments
Submit Information	July	

3.2 Auxiliary data

3.2.1 Ties

PJM will maintain a tie line database to be used in the creation of steady state and dynamics models. It will be distributed to the TOs at the beginning of each year's build cycle for updates. PJM will maintain data for intra-PJM ties between its TOs and Inter-PJM ties with other PCs.

1) Tie lines will only be included in steady state and dynamics models if they are included in the tie line database

2) The bus names and associated data in steady state and dynamics models should match those in the tie line database
3) Tie lines must be agreed upon by both TOs in order to be included
4) Tie line modeling should be consistent with the data requirements in Appendix 1: Detailed Data Requirements for Steady State
5) Include in service and out of commission dates for tie lines
6) Tie line database will be updated annually at the beginning of the case build cycle
7) TOs should only submit changes to the tie line database
8) Ties with an in-service/out-of-service date from 01/16/yyyy to 04/15/yyyy will be in-service/out-of-service in the spring model for the year yyyy.
9) Ties with an in-service/out-of-service date from 04/16/yyyy to 06/01/yyyy will be in-service/out-of-service in the summer model for the year yyyy.
10) Ties with an in-service/out-of-service date from 06/02/yyyy to 10/15/yyyy will be in-service/out-of-service in the fall model for the year yyyy.
11) Ties with an in-service/out-of-service date from 10/16/yyyy to 01/15/yyyy will be in-service/out-of-service in the winter model for the year yyyy.

3.2.2 Interchange

PJM will maintain an interchange spreadsheet for the creation of steady state and dynamics models. The spreadsheet will be based on confirmed transactions in PJM's Open Access Same-time Information System (OASIS) system for the model year of each case to be built. PJM will coordinate transaction source and sink with other PCs.

Given PJM's single area dispatch, interchange will be set for PJM as a whole for each case, generation will be dispatched, and then the case will be solved with area interchange control off. When solved, the interchanges for each of its TOs will be maintained with area interchange control turned on.

4 Power flow modeling requirements and guidelines

4.1 Data Format

Power Flow data for MOD-032 compliance will be uploaded via PJM's implementation of the Siemens/PTI software Model On Demand. Every Transmission Owner will have access to Model On Demand in order to upload project files and profile files to allow PJM to build the years and scenarios as defined by the NERC designee. A project (.prj) file will model future changes in transmission system topology, correct case modeling, and future generation projects. Profile files (.raw) model load profile and device settings on regulating equipment. Equipment ratings will be uploaded via comma separated value (.csv) format into Model On Demand.

Non-incumbent TOs that are awarded projects through PJM's FERC Order 1000 window process shall provide modeling data for their project via an idev compatible with PSS/e v33. PJM will ensure that this idev is included in future case builds. Non-incumbent TOs will be asked to review models for accuracy and provide PJM feedback. Any questions and updates should be sent to MOD-032@pjm.com.

4.2 Level of Detail

The minimum level of detail that must be uploaded to Model On Demand in order to be included in steady state cases for MOD-032 compliance is:

Included in Model On Demand base case or in project files

- Bulk Electric System and PJM Market Monitored facilities
  - Sub-BES facilities can be included at TO discretion
- All PJM Board approved Baseline projects
- All Supplemental projects presented at TEAC and SRRTEP
- Interconnection projects with an executed ISA and their network upgrades
  - PJM as RP will coordinate with TO's for project modeling

Included in Model On Demand profile files

- Load profile for each season
  - PJM will scale load based on its load forecast as described in section 2.1
  - It is expected that LSE's will coordinate with their TO to provide load profile data
- TOs that serve external area load via their transmission system should coordinate with that company and include in its data submissionSettings on equipment such as transformers, shunts, HVDC data, etc.
- Generation profile data will be provided via web interface by GOs. PJM will coordinate with TOs to ensure model compatibility

More in depth detail on individual equipment can be found in Appendix 1: Detailed Data Requirements for Steady State.

4.3 Data Checks

The MMWG has established a set of Power Flow Data Checks, defined in their manual. PJM will run the MMWG's data checking program to identify all errors according to the criteria defined by MMWG. All finalized power flow models shall be free of all such errors. The latest MMWG manual can be found at MMWG's website located here: https://rfirst.org/ProgramAreas/RAPA/ERAG/MMWG/Pages/MMWG.aspx

4.4 Model On Demand

PJM currently has Model On Demand v9.1.2.8 installed.

Each TO can have as many users as it deems necessary, with one person being that TOs administrator in charge of approving its areas projects. PJM then will have to accept each submission before the projects are included in case builds. For any user issues contact MOD@pjm.com.

5 Generation Owner Data Requirements and Guidelines

Generation Owners will be responsible for annually submitting data to PJM via its Gen Model portal. The data to be submitted can be found in Appendix 2: Generator Owner Data Sheet Requirements. Generation Owners will have to create a log in account for pjm.com and request access to Gen Model via their Company Account Manager (CAM). The user guide for Gen Model can be accessed at the following URL:
http://www.pjm.com/~/media/etools/planning-center/gen-model-user-guide.ashx

6 Dynamics Data Requirements and Guidelines

6.1 Dynamics Data Format

Dynamics data is to be submitted via Gen Model in any readable format. This would include Excel and Word documents, .pdf, .dyr, etc. PJM staff will use this data to update the dynamics models and produce the Siemens/PTI PSS/E .dyr file. Any changes year to year would require an update uploaded via Gen Model.

6.2 Dynamics modeling Level of Detail

6.2.1 Generators

Generation Owners must submit detailed dynamics data for:

- All generators with capacity in PJM markets or having machines over 20 MW submit

Generation Owners are required to provide the information for the following:

- Generator Model
- Excitation System
- Governor Model
- Power System Stabilizer Model
- Reactive Line Drop Compensation Model

6.2.2 Transmission Owner and Merchant Transmission Provider Owned Equipment

Transmission Owners and Merchant Transmission Provider owned equipment will be responsible to supply dynamics modeling information for any SVCs, FACTS devices, HVDC, and other dynamic reactive devices they own. PJM will coordinate with dynamics contacts

at its TOs in order for them to provide this information as appropriate for the schedule as determined by the NERC designee.

6.2.3 Dynamics Load Model Data

To meet TPL-001-4 R2.4.1 standard, PJM requires TOs develop and submit dynamic load models satisfying the following conditions:

- Submitted load models shall be under system peak load conditions
- Submitted load models shall represent dynamic behavior of loads
- Submitted load models shall consider dynamics of induction motor loads
- Submitted load models shall cover all load buses in TO's area
- Submitted load models shall be usable:
    - Model shall initialize without error
    - Model shall results in negligible transients for a no-disturbance
    - Model shall results in stable behavior for an stable disturbance

An aggregate System Load model which represents the overall dynamic behavior of the Load is acceptable.

For acceptable dynamic load model, please refer to section 6.3.2.

6.3 Accepted Dynamics Models

The following sections outline the dynamics models PJM will accept.

PJM follows the MMWG practice in regards to dynamic model requirements. The latest MMWG procedure manual can be found at the following URL: https://rfirst.org/reliability/easterninterconnectionreliabilityassessmentgroup/mmwg/Pages/default.aspx

6.3.1 Accepted Generator Models

Standard PSS/e models will be accepted including Generator, Excitor, Governer, and Power System Stabalizer with the exception of those in 6.4. Those must be converted.

6.3.2 Accepted Dynamics Load Models

Standard PSS/e models will be accepted.

6.3.3 Accepted Synchronous Condenser and Dynamic Device Models

6.3.4 Accepted FACTS Device Models

Includes HVDC/TCSC/STATCOM/SVC/ETC. Standard PSS/e models will be accepted.

6.3.5 Accepted Protection Equipment Models

6.3.6 Accepted Wind models

Standard PSS/e models will be accepted.

6.4 Converting Legacy Models

PJM requires the following legacy models to be converted prior to submission:

From Legacy Model	To Updated model
IEEET1	ESDC1A
IEEET2	ESDC2A
IEEET3	ESST2A
IEEEX1	ESDC1A
IEEEX2	ESDC2A
IEEEX3	ESST2A
GAST2A	GGOV1
GASTWD	GGOV1
WESGOV	GGOV1
GFT8WD	GGOV1

6.5 Dynamics Data Checks

PJM follows the MMWG practice in regards to dynamic data checks. The latest MMWG procedure manual can be found at the following URL:
https://rfirst.org/reliability/easterninterconnectionreliabilityassessmentgroup/mmwg/Pages/default.aspx

6.6 Dynamics Initialization and Checking Procedure

PJM follows the MMWG practice in regards to dynamic initialization and Checking Procedure. The latest MMWG procedure manual can be found at the following URL:
https://rfirst.org/reliability/easterninterconnectionreliabilityassessmentgroup/mmwg/Pages/default.aspx

6.7 Dynamics Case Acceptance Criteria

PJM follows the MMWG practice in regards to dynamics case acceptance criteria. The latest MMWG procedure manual can be found at the following URL:
https://rfirst.org/reliability/easterninterconnectionreliabilityassessmentgroup/mmwg/Pages/default.aspx

7 Short Circuit Data Requirements and Guidelines

7.1 Short Circuit Data Format

PJM uses Aspen Oneliner V12.5 as its short circuit modeling and analysis software which uses .olr format. For TOs using Aspen, data shall be submitted either via .olr or change file (.chf) format. For TOs using Electrocon's Cape software, changes will be accepted in .dxt format.

7.2 Short Circuit Level of Detail

Included in MOD base case or in project files

- Bulk Electric System and PJM Market Monitored facilities
    - Sub-BES facilities can be included at TO discretion
- All PJM Board approved Baseline projects
- All Supplemental projects presented at TEAC
- Interconnection projects with an executed ISA and their network upgrades
    - PJM as RP will coordinate with TOs for project modeling

7.3 Short Circuit Submittal Procedure

PJM will maintain short circuit modeling contacts with each of its TOs. PJM will send out the previous year's short circuit case and will ask for updates in the data formats outlined above to be emailed back according to that year's model build schedule. An anticipated short circuit build schedule is included in section 3.1.

Appendix 1: Detailed Data Requirements for Steady State

Steady State

Power Flow data is to be submitted via PJM's Model On Demand portal and include all BES and PJM Market Monitored facilities. It is left to the discretion of the TO to model additional sub-BES model details.

1) Bus
    a. Data provider: Transmission Owner
    b. Data Submission: Model On Demand
    c. Data Requirements
        i. Bus Voltage: All buses are required to have a non-zero nominal voltage. The nominal voltages of buses connected by lines, reactors or series caps should be the same.
        ii. Bus Names: All BES bus names and voltages should be unique for BES facilities
        iii. Bus Area, Zone, and Owner: All buses in PJM's models must have area, zone, and owner fields completed
        iv. Bus Numbers: Transmission Owners will be required to follow the bus number guidelines for their area as outlined in Appendix 4: Transmission Owner Bus Range Allocation.
2) Aggregate Demand (aka Load)
    a. Data provider: Load Serving Entities via Transmission Owners
        i. The demand is the load aggregated at each bus identified by the TO as a load bus. The LSE is responsible to provide this information, usually by coordinating with the TO.
    b. Data Submission: Model On Demand
        i. Load profiles will be uploaded via Bus/Load/Generation profiles. For more information, see PJM's Model On Demand Procedure Manual
        ii. A different BLG profile will be required for each scenario (Year/Season) being built
    c. Data Requirements
        i. Bus number, load ID, Area and Zone number
        ii. Real and reactive power
        iii. In-service status
        iv. Conformity status
3) Generating Units
    a. Data Provider: Generator Owner

b. Data Submission: Generator Data Portal
c. Data Requirements: See Appendix 2: Generator Owner Data Sheet Requirements for full Generation data requirements. This section is solely for Steady State Generator Requirements
    i. Plant Name
    ii. Unit Number
    iii. EIA Plant Code
    iv. Pmax Summer Net (MW)
    v. Pmin Summer Net (MW)
    vi. Qmax Summer Net (MVAr)
    vii. Qmin Summer Net (MVAr)
    viii. Pmax Winter Net (MW)
    ix. Pmin Winter Net (MW)
    x. Qmax Winter Net (MVAr)
    xi. Qmin Winter Net (MVAr)
    xii. Name Plate MVA
    xiii. GSU 2 Winding
        1.
    xiv. GSU 3 Winding
        1.

a. Data Provider: Transmission Owner
b. Data Submission: Model On Demand
c. Data Requirements:
    i. Bus Number
    ii. Machine ID

a. Data Provider: Resource Planner
b. Data Submission: Model On Demand
c. Data Requirements: The Recourse Planner will be responsible for providing the modeling data for future units
    i. Bus Number
    ii. Machine ID
    iii. Pmax Summer Net (MW)
    iv. Pmin Summer Net (MW)
    v. Qmax Summer Net (MVAr)
    vi. Qmin Summer Net (MVAr)
    vii. Pmax Winter Net (MW)
    viii. Pmin Winter Net (MW)
    ix. Qmax Winter Net (MVAr)

x. Qmin Winter Net (MVAr)
xi. Name Plate MVA

4) AC Transmission Line
   a. Data Provider: Transmission Owner
   b. Data Submission: Model On Demand
      i. Ratings sets for different seasons will be uploaded via Model On Demand. For more information, see PJM's Model On Demand Procedure Manual
   c. Data Requirements
      i. From bus – To bus – Ckt id
      ii. Impedance data: Line R, X, and B in p.u.
         1. For Zero impedance lines, start circuit ID with Z and use R = 0.0000, X=0.0001, and B= 0.0000
      iii. In-service status
      iv. Ratings:
         1. Rate A: Normal Rating
         2. Rate B: Short Term Emergency
         3. Rate C: Not required
5) DC Transmission Systems
   a. Data Provider: Transmission Owner
   b. Data Submission: Model On Demand
   c. Data Requirements
6) Transformer
   a. Data Provider: Transmission Owner
   b. Data Submission: Model On Demand
   c. Data Requirements:
      i. From Bus – To Bus – Ckt id
      ii. Nominal voltages of Windings
      iii. Impedance data: Specified R and X
      iv. Tap ratios
      v. Min and Max Tap position limits
      vi. Number of tap positions
      vii. Regulated bus
      viii. Ratings
         1. Rate A: Normal Rating
         2. Rate B: Short Term Emergency
      ix. In Service Status
7) Reactive Compensation

a. Data Provider: Transmission Owner
b. Data Submission: Model On Demand
c. Data Requirements:
    i. Fixed Shunts
        1. G-Shunt (MW)
        2. B-Shunt (MVAr)
        3. In-service Status
    ii. Switched Shunts
        1. Voltage Limits (Vhi and Vlow)
        2. Mode of Operation (Fixed, Discrete, Continuous)
        3. Regulated Bus (If not fixed)
        4. Binit (MVAr)
        5. Steps and Step Sizes (MVAr)

8) Static Var Systems
    a. Data Provider: Transmission Owner
    b. Data Submission: Model On Demand
    c. Data Requirements

Appendix 2: Generator Owner Data Sheet Requirements

All data in this section is to be provided by Generator Owners via PJM.com's MOD-032 Generator Data Sheet. This data is to be completed for each plant the company owns.

General Information Sheet

General Information (All Generators)

1. TO Area
2. Plant Name
3. Number of units at plant
4. Company Name
5. Name of Individual completing data
6. Email of Individual completing data
7. Phone of Individual completing data
8. EIA Plant Code
9. Commercial Operation Year

Location (All Generators)

1. State
2. County
3. City
4. Zip Code

Generator Capability (All Generators)

Note: Summer and Winter values are needed for all generator capability parameters

1. Name Plate (MVA)
2. Unit Maximum (MW)
3. Unit Minimum (MW)
4. Total Gross Energy(MW)
5. Auxiliary Load (MW)
    a. Auxiliary Load is related to the operations of the plant (e.g. fans, pumps, etc.)
    b. Load will have to be designated as
        i. Low voltage side of the GSU
        ii. High voltage side of the GSU
        iii. Location other than the two options above
6. Auxiliary load (MVAR)
    a. Auxiliary Load is related to the operations of the plant (e.g. fans, pumps, etc.
7. Station Load (MW)

   a. Station load is necessary to support facility of the plant
   b. Load will have to be designated as
      i. Low voltage side of the GSU
      ii. High voltage side of the GSU
      iii. Location other than the two options above
8. Station Load (MVAR)
   a. Station load is necessary to support facility of the plant

Total Reactive Power Capability at Max Gross Energy Output (All Generators)
Note Summer and Winter values are needed for all reactive power capability at max gross energy output parameters

1. Leading (MVAR) - Under excited
2. Lagging (MVAR) – Overexcited

Synchronous Generator Sheet

1. Machine ID
   a. (e.g. ST, CT, CT1, CT2, ST2, etc.)
   b. Multiple Machines can be entered, 1 at a time
2. Prime Mover Code
3. Energy Source Code
4. MVA Base (MVA)
5. Terminal Voltage (kV)
6. Nominal Power Factor
7. Unit maximum net capacity output (unit CIR) (MW)
   a. Unit Gross Energy Output (MW)
   b. Summer and Winter Values
8. Unit reactive power capability at max gross energy output – leading (MVAR)
   a. Summer and Winter Values
9. Unit reactive power capability at max gross energy output – lagging (MVAR)
   a. Summer and Winter Values
10. Unit auxiliary load at max gross energy power output (MW and MVAR)
    a. Summer and Winter Values
11. Where is the auxiliary load being connected?
    a. Low voltage side of the GSU
    b. High voltage side of the GSU
    c. Location other than the two options above
12. Any additional comments on the capability (Aux Load)

Generator Parameters
Note: All reactance and resistance values in PU on Machine MVA Base

1. Combined turbine-generator-exciter inertia, H (kWs/kVA)
    a. 1 < H < 10
2. Speed damping coefficient, D (PU)
    a. O ≤ D < 3

Generator Saturation

1. Generator Saturation at 1.0 PU voltage, S (PU)
    a. 0 < S1.0
2. Generator saturation at 1.2 PU voltage, S (PU)
    a. S1.0 < S1.2

Unsaturated Reactances

1. Direct axis synchronous reactance, Xd(i) (PU)
    a. xd < 2.5
2. Direct axis transient reactance, X'd(i) (PU)
    a. x' < 0.5 x xd
3. Direct axis sub-transient reactance, X''d(i) (PU)
    a. x"d < x'd
4. Quadrature axis synchronous reactance, Xq(i) (PU)
    a. xq < xd
5. Quadrature axis transient reactance, X'q(i) (PU)
    a. x'q < xq
6. Quadrature axis sub-transient reactance, X''q(i) (PU)
    a. x"q < x'q
7. Stator leakage reactance, Xl
8. Negative sequence reactance, X2(i)
9. Zero sequence reactance, X0(i)

Saturated Reactances

1. Saturated sub-transient reactance, X''d(v) (PU)
    a. X"d(v) < X"d(i)
2. Negative sequence reactance, X2(v) (PU)
3. Zero sequence reactance, X0(v) (PU)

Resistances

1. DC armature resistance, Ra (Ohms)
2. Positive sequence resistance, R1 (PU)
3. Negative sequence resistance, R2 (PU)
4. Zero sequence resistance, R0 (PU)

Time Constraints

1. Direct axis transient open circuit, T-do (sec)
    a. 1. < T(’do < 10.)
2. Direct axis sub-transient open circuit, T’’do (sec)
    a. 0.01667 < T"do < 0.2
3. Quadrature axis transient open circuit, T’qo (sec)
    a. 0.2 ≤ T’qo ≤ 1.5
4. Quadrature axis sub-transient open circuit, T’’qo (sec)

a. $0.01667 \leq T"qo \leq 0.2$

5. Armature three phase short circuit, Ta3 (sec)
    a. $0.025 \leq Ta \leq 0.1$

Control Systems

1. Exciter
    - IEEET1 - 1968 IEEE type 1 excitation system model.
    - IEEET2 - 1968 IEEE type 2 excitation system model.
    - IEEET3 - 1968 IEEE type 3 excitation system model.
    - IEEET4 - 1968 IEEE type 4 excitation system model.
    - IEEEX1 - 1979 IEEE type 1 excitation system model and 1981 IEEE type DC1 model.
    - IEEEX2 - 1979 IEEE type 2 excitation system model.
    - IEEEX2A - 1979 IEEE type 2A excitation system model.
    - IEEEX3 - 1979 IEEE type 3 excitation system model.
    - IEEEX4 - 1979 IEEE type 4 excitation system, 1981 IEEE type DC3 and 1992 IEEE type DC3A models.
    - EXAC1 - 1981 IEEE type AC1 excitation system model.
    - EXAC2 - 1981 IEEE type AC2 excitation system model.
    - EXAC3 - 1981 IEEE type AC3 excitation system model.
    - EXAC4 - 1981 IEEE type AC4 excitation system model.
    - EXDC2 - 1981 IEEE type DC2 excitation system model.
    - EXST1 - 1981 IEEE type ST1 excitation system model.
    - EXST2 - 1981 IEEE type ST2 excitation system model.
    - EXST3 - 1981 IEEE type ST3 excitation system model.
    - ESAC1A - 1992 IEEE type AC1A excitation system model.
    - ESAC2A - 1992 IEEE type AC2A excitation system model.
    - ESAC3A - 1992 IEEE type AC3A excitation system model.
    - ESAC4A - 1992 IEEE type AC4A excitation system model.
    - ESAC5A - 1992 IEEE type AC5A excitation system model.
    - ESAC6A - 1992 IEEE type AC6A excitation system model.
    - ESDC1A - 1992 IEEE type DC1A excitation system model.
    - ESDC2A - 1992 IEEE type DC2A excitation system model.
    - ESST1A - 1992 IEEE type ST1A excitation system model.
    - ESST2A - 1992 IEEE type ST2A excitation system model.
    - ESST3A - 1992 IEEE type ST3A excitation system model.
    - UAC7B - 2005 AC7B Excitation System
    - UAC8B - 2005 AC8B Excitation System
    - UDC4B - 2005 DC4B Excitation System
    - UST6B - 2005 ST6B Excitation System
    - ESAC8B - Basler DECS model.
    - EXBAS - Basler static voltage regulator feeding dc or ac rotating exciter model.
    - SCRX - Bus or solid fed SCR bridge excitation system model.

- EX2000 - EX2000 Excitation System.
- URST5T - IEEE proposed type ST5B excitation system.
- ESST4B - IEEE type ST4B potential or compounded source-controlled rectifier exciter.
- IEET1A - 1968 IEEE Modified type 1 excitation system model.
- IEET1B - 1968 IEEE Modified type 1 excitation system model.
- IEEET5 - 1968 IEEE Modified type 4 excitation system model.
- IEEET5A - 1968 IEEE Modified type 4 excitation system model.
- EXST2A - 1981 IEEE Modified type ST2 excitation system model.
- EXAC1A - Modified type AC1 excitation system model.
- EXPIC1 - Proportional/integral excitation system model.
- SEXS - Simplified excitation system model.
- EXELI - Static PI transformer fed excitation system model.
- Other - Please specify. Submit block diagram and parameter list and .obj/.lib file
- N/A - Not applicable. Please specify reason

2. Governor
    - CRCMGV - Cross compound turbine-governor model.
    - DEGOV - Woodward diesel governor model.
    - DEGOV1 - Woodward diesel governor model.
    - GAST - Gas turbine-governor model.
    - GAST2A - Gas turbine-governor model.
    - GASTWD - Gas turbine-governor model.
    - GGOV1 - GE general purpose turbine-governor model.
    - HYGOV - Hydro turbine-governor model.
    - IEEEG1 - 1981 IEEE type 1 turbine-governor model.
    - IEEEG2 - 1981 IEEE type 2 turbine-governor model.
    - IEEEG3 - 1981 IEEE type 3 turbine-governor model.
    - IEESGO - 1973 IEEE standard turbine-governor model.
    - PIDGOV - Hydro turbine and governor model.
    - SHAF25 - Torsional-elastic shaft model for 25 masses.
    - TGOV1 - Steam turbine-governor model.
    - TGOV2 - Steam turbine-governor model with fast valving.
    - TGOV3 - Modified IEEE type 1 turbine-governor model with fast valving.
    - TGOV5 - Modified IEEE type 1 turbine-governor model with boiler controls.
    - WEHGOV - Woodward electronic hydro governor model.
    - WESGOV - Westinghouse digital governor for gas turbine.
    - WPIDHY - Woodward P.I.D. hydro governor model.
    - BBGOV1 - Brown-Boveri turbine-governor model.
    - HYGOV2 - Hydro turbine-governor model.
    - IVOGO - IVO turbine-governor model.
    - TURCZT - Czech hydro or steam turbine-governor model.
    - URCSCT - Combined cycle, single shaft turbine-governor model.

- URGS3T - WECC gas turbine governor model.
- WSHYDD - WECC double derivative hydro governor model.
- WSHYGP - WECC GP hydro governor plus turbine model.
- WSIEG1 - WECC modified 1981 IEEE type 1 turbine-governor model.
- Other - Please specify. Submit block diagram and parameter list and .obj/.lib file
- N/A - Not applicable. Please specify reason

3. Power System Stabilizer (PSS)
    - IEEEST - 1981 IEEE power system stabilizer model.
    - PSS2A - 1992 IEEE type PSS2A dual-input signal stabilizer model.
    - PSS2B - 2005 IEEE type PSS2B Dual-Input Stabilizer Model
    - PSS3A - 2005 IEEE type PSS3B Dual-Input Stabilizer Model
    - STAB2A - ASEA power sensitive stabilizer model.
    - IEE2ST - Dual-input signal power system stabilizer model.
    - ST2CUT - Dual-input signal power system stabilizer model.
    - STAB3 - Power sensitive stabilizer model.
    - STAB4 - Power sensitive stabilizer model.
    - PTIST1 - PTI microprocessor-based stabilizer model.
    - PTIST3 - PTI microprocessor-based stabilizer model.
    - STAB1 - Speed sensitive stabilizer model.
    - STBSVC - WECC supplementary signal for static var system.
    - N/A - Not applicable. Please specify reason
4. Additional Information

Wind Farm Parameters

1. Specify manufacturer
2. Specify model
3. MW Value per turbine (nominal rating)
4. Number of wind turbines generators of the selected type
5. Prime Mover Code
6. Energy Source Code
7. MVA base (MVA)
8. Terminal voltage
9. Nominal power factor
10. Stator resistance, R1 (Ohms)
11. Saturated sub-transient reactance, X''d(v) (PU on MVA base)
12. Control Mode
    a. Power Factor
    b. Voltage control
    c. Other

13. Voltage relays
    a. Yes
        i. If yes, provide voltage relay settings
    b. No
14. Frequency relays
    a. Yes
        i. If yes, provide frequency relay settings
    b. No
15. Additional windfarm compensation
    a. Yes
        i. Type of reactive compensation (e.g. fixed shunts, switchable shunt bank, dynamic)
        ii. Enter details related to compensation (e.g. number of caps, size, steps, etc.)
    b. No

Inverter Based Parameters

1. Type of inverter based technology (e.g. solar, storage, etc.)
2. Prime Mover Code
3. Energy Source Code
4. Specify manufacturer of inverter
5. Specify model
6. MW Value per inverter (MW)
7. Total number of inverters
8. MVA Base per inverter (MVA)
9. Terminal Voltage (kV)
10. Nominal power factor
11. Nominal output current at full load per inverter (Amps)
12. Maximum fault current output from the inverter (Amps or PU)
13. How fast can the inverter be disconnected from the system subsequent to a fault (Cycles)

Dynamic modeling

14. Description of dynamic performance of the inverter during a fault. Please describe how the selected inverter will behave dynamically with respect to real power, reactive power and tripping points for voltage and frequency
    a. Example: Constant real and reactive power injection during a fault. No tripping allowed. Fluctuations in real and reactive power depending on system conditions. Please submit dynamic model for an accurate representation.

15. Is the inverter designed with Low Voltage Ride-Through (LVRT) capability?
    a. Yes
    b. No
16. Voltage Relays
    a. Yes
        i. If yes, provide voltage relay settings
    b. No
17. Frequency Relays
    a. Yes
        i. If yes, provide frequency relay settings
    b. No

Circuit Breaker Parameters

1. Substation Name
2. Breaker Name
3. Manufacturer
4. Model Number
5. Nameplate Interrupting Rating (kA or MVA)
6. Nameplate Interrupting Time (Cycles)
7. Nameplate K-factor
8. Operating Voltage (kV)
9. Nameplate Max Design kV (kV)
10. Contact Parting Time (Cycles)
11. Reclosing Time (Cycles)
12. Protective Equipment 1 (e.g. generator, line, transformer)
    a. Specify specific protective equipment name (e.g. Peach Bottom unit 2 Generator, TMI- Hosensack 500 kV Circuit 1 Line)
13. Protective Equipment 2 (e.g. generator, line, transformer)
    a. Specify specific protective equipment name (e.g. Peach Bottom unit 2 Generator, TMI- Hosensack 500 kV Circuit 1 Line)
14. Interrupting Medium (e.g. Gas, Oil, Air, etc.)

Main Transformers

Generator Step-Up (GSU) Transformer

1. MVA base (MVA)
2. Rating 1 (MVA)
3. Rating 2 (MVA)
4. Rating 3 (MVA)

Impedances (All values in PU on transformer MVA Base)

1. High-side to low-side (PU) (Two winding and three winding)
    a. R

   b. jX
   c. X/R
2. High-side to tertiary (Three winding only)
   a. R
   b. jX
   c. X/R
3. Low-side to tertiary (Three winding only)
   a. R
   b. jX
   c. X/R
4. Winding Voltages (kV)
   a. High side (kV) (Two winding and three winding)
   b. Low side (kV) (Two winding and three winding)
   c. Tertiary (Three winding only)
5. Winding Connection Types (Delta, Wye, Wye Gnd, etc.)
   a. High side (Two winding and three winding)
   b. Low side (Two winding and three winding)
   c. Tertiary (Three winding only)
   d. Tap Position (Two winding and three winding)
   e. Off-nominal turns ratio (Two winding and three winding)
   f. Number of taps (Two winding and three winding)
   g. Step size (Two winding and three winding)
   h. Any additional comments on the transformer (Two winding and three winding)
6. Grounding configuration (For GMD)
7. Core Type (For GMD)
8. K-Factor (For GMD)
9. Is this an autotransformer? (For GMD)
10. Winding 1 GIC Blocking Device Enabled (For GMD)

Appendix 3: Detailed Data Requirements for Short Circuit

1) Bus
    a. Data provider: Transmission Owner
    b. Data Submission: Email
    c. Data Requirements:
        i. Bus Voltage: All buses are required to have a non-zero nominal voltage. The nominal voltages of buses connected by lines, reactors or series caps should be the same.
        ii. Bus Names: All BES bus names and voltages should be unique for BES facilities
2) Generating Units

    Existing Units
    a. Data Provider: Generator Owner
    b. Data Submission: Generator Data Portal
    c. Data Requirements: See Appendix 2: Generator Owner Data Sheet Requirements for full Generation data requirements. This section is solely for Short Circuit
        i. Generator MVA Base
        ii. Generator saturated sub-transient reactance X''d(v) in p.u.
        iii. DC Armature resistance (Ra) in ohms
        iv. Negative sequence resistance (R2)
        v. Negative sequence saturated reactance (X2(v))

    Future Units
    a. Data Provider: Resource Planner
    b. Data Submission: Model On Demand
    c. Data Requirements: The Resource Planner will be responsible for providing the modeling data for future units
        i. Generator MVA Base
        ii. Generator saturated sub-transient reactance X''d(v) in p.u.
        iii. DC Armature resistance (Ra) in ohms
        iv. Negative sequence resistance (R2)
        v. Negative sequence saturated reactance (X2(v))
3) AC Transmission Line
    a. Data Provider: Transmission Owner
    b. Data Submission: Email
    c. Data Requirements
        i. From bus – To bus – Ckt id
        ii. Impedance data: Line R, X, and B in p.u.
            1. Line R, X, and B in p.u.

2. Positive, Negative, zero sequence data

iii. In-service status

4) DC Transmission Systems
   a. Data Provider: Transmission Owner
   b. Data Submission: Model On Demand
   c. Data Requirements
5) Transformer
   a. Data Provider: Transmission Owner
   b. Data Submission: Model On Demand
   c. Data Requirements:
      i. From Bus – To Bus – Ckt id
      ii. Nominal voltages of Windings
      iii. Impedance data: Specified R and X
         3. Positive, Negative, zero sequence data

6) Circuit Breakers
   a. Data Provider: Transmission Owners
   b. Data Submission: Email
   c. Data Requirements: For each BES circuit breaker the following data must be included in the data submittal:

1. Substation Name
2. Breaker Name
3. Manufacturer
4. Model Number
5. Nameplate Interrupting Rating (kA or MVA)
6. Nameplate Interrupting Time (Cycles)
7. Nameplate K-factor
8. Operating Voltage (kV)
9. Nameplate Max Design kV (kV)
10. Contact Parting Time (Cycles)
11. Reclosing Time (Cycles)
12. Protective Equipment 1 (e.g. generator, line, transformer)
    a. Specify specific protective equipment name (e.g. Peach Bottom unit 2 Generator, TMI- Hosensack 500 kV Circuit 1 Line)
13. Protective Equipment 2 (e.g. generator, line, transformer)
    a. Specify specific protective equipment name (e.g. Peach Bottom unit 2 Generator, TMI- Hosensack 500 kV Circuit 1 Line)
14. Interrupting Medium (e.g. Gas, Oil, Air, etc.)

Appendix 4: Transmission Owner Bus Range Allocations

Area Number	Area Name	Buses in Range	Model	Bus Range Assignment			Zone Numbers	Owner Numbers
201	AP	100	PJM Queue	235000	to	235099	1201-1205	201,255-258
201	AP	3000	TO topology	235000	to	237999	1201-1205	201,255-258
202	ATSI	100	PJM Queue	241900	to	241999	1230-1249	202
202	ATSI	3500	TO topology	238500	to	241999	1230-1249	202
205	AEP	199	PJM Queue	247500	to	247699	1250-1259, 1290-1299	204,205
205	AEP	5000	TO topology	242500	to	247499	1250-1259, 1290-1299	204,205
205	AEP	100	TO topology	270000	to	270099	1200	245,246
209	DAY	29	PJM Queue	253270	to	253299	1209	209
209	DAY	300	TO topology	253000	to	253299	1209	209
212	DEO&K	19	PJM Queue	252465	to	252484	1226	208
212	DEO&K	40	TO topology	249564	to	249603	1220-1229	208,250-253
212	DEO&K	255	TO topology	249980	to	250234	1220-1229	208,250-253
212	DEO&K	458	TO topology	251258	to	251715	1220-1229	208,250-253
212	DEO&K	57	TO topology	251792	to	251848	1220-1229	208,250-253
212	DEO&K	60	TO topology	251934	to	251993	1220-1229	208,250-253
212	DEO&K	462	TO topology	252038	to	252499	1220-1229	208,250-253
215	DLCO	49	PJM Queue	254250	to	254299	1215	203,215
215	DLCO	400	TO topology	253900	to	254299	1215	203,215
222	CE	449	PJM Queue	276150	to	276599	1270-1289	220-240
222	CE	6000	TO topology	270600	to	276599	1270-1289	220-240
225	PJM	400	TO topology	200000	to	200399	202 - 204, 1820-1833	269
226	PENELEC	100	PJM Queue	203900	to	203999	205 - 213	271
226	PENELEC	3500	TO topology	200500	to	203999	205 - 213	271
227	METED	100	PJM Queue	205900	to	205999	214 - 222	272
227	METED	1500	TO topology	204500	to	205999	214 - 222	272
228	JCP&L	300	PJM Queue	207400	to	207699	223 - 231	273
228	JCP&L	1500	TO topology	206200	to	207699	223 - 231	273
229	PPL		PJM Queue					
229	PPL	5000	TO topology	207900	to	212899	232 - 240	275,276,277
230	PECO	100	PJM Queue	216300	to	216399	241 - 249	279
230	PECO	3000	TO topology	213400	to	216399	241 - 249	279
231	PSE&G		PJM Queue					
231	PSE&G	3000	TO topology	216900	to	219899	250 - 258	281
232	BGE	200	PJM Queue	223199	to	223399	263	
232	BGE	3000	TO topology	220400	to	223399	259 - 267	283,284

233	PEPCO		PJM Queue					
233	PEPCO	3000	TO topology	223900	to	226899	268 -276	286,287
234	AE	399	PJM Queue	230000	to	230399	277 - 285	289,290
234	AE	3000	TO topology	227400	to	230399	277 - 285	289,290
235	DP&L	100	PJM Queue	233800	to	233899	286 - 294	292,293
235	DP&L	3000	TO topology	230900	to	233899	286 - 294	292,293
236	UGI	200	TO topology	234200	to	234399	295 - 297	295
237	RECO	99	PJM Queue	234700	to	234799	298 - 299	297
237	RECO	200	TO topology	234600	to	234799	298 - 299	297
345	DVP	300	PJM Queue	315300	to	315599	366	312
345	DVP	3,000	TO topology	313000	to	315999	350 - 374	312 - 314
320	EKPC	9	PJM Queue	342990	to	342999	1315 - 1324	340 - 341
320	EKPC	2,000	TO topology	341000	to	342999	1315 - 1324	340 - 341

Appendix 5: MOD-032-1 Attachment 1

Steady State

1) Each bus [TO]
    a. nominal voltage
    b. area, zone and owner
2) Aggregate Demand [LSE]
    a. real and reactive power*
    b. in-service status*
3) Generating Units [GO, RP (for future planned resources only)]
    a. real power capabilities - gross maximum and minimum values
    b. reactive power capabilities - maximum and minimum values at real power capabilities in 3a above
    c. station service auxiliary load for normal plant configuration (provide data in the same manner as that required for aggregate Demand under item 2, above).
    d. regulated bus* and voltage set point* (as typically provided by the TOP)
    e. machine MVA base
    f. generator step up transformer data (provide same data as that required for transformer under item 6, below)
    g. generator type (hydro, wind, fossil, solar, nuclear, etc)
    h. in-service status*
4) AC Transmission Line or Circuit [TO]
    a. impedance parameters (positive sequence)
    b. susceptance (line charging)
    c. ratings (normal and emergency)*
    d. in-service status*
5) DC Transmission systems [TO]
6) Transformer (voltage and phase-shifting) [TO]
    a. nominal voltages of windings
    b. impedance(s)
    c. tap ratios (voltage or phase angle)*
    d. minimum and maximum tap position limits
    e. number of tap positions (for both the ULTC and NLTC)
    f. regulated bus (for voltage regulating transformers)*
    g. ratings (normal and emergency)*
    h. in-service status*

7) Reactive compensation (shunt capacitors and reactors) [TO]
    a. admittances (MVars) of each capacitor and reactor
    b. regulated voltage band limits* (if mode of operation not fixed)
    c. mode of operation (fixed, discrete, continuous, etc.)
    d. regulated bus* (if mode of operation not fixed)
    e. in-service status*
8) Static Var Systems [TO]
    a. reactive limits
    b. voltage set point*
    c. fixed/switched shunt, if applicable
    d. in-service status*
9) Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]

Dynamics

1) Generator [GO, RP (for future planned resources only)]
2) Excitation System [GO, RP(for future planned resources only)]
3) Governor [GO, RP(for future planned resources only)]
4) Power System Stabilizer [GO, RP(for future planned resources only)]
5) Demand [LSE]
6) Wind Turbine Data [GO]
7) Photovoltaic systems [GO]
8) Static Var Systems and FACTS [GO, TO, LSE]
9) DC system models [TO]
10) Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]

Short Circuit

1) Provide for all applicable elements in column “steady-state” [GO, RP, TO]
    a. Positive Sequence Data
    b. Negative Sequence Data
    c. Zero Sequence Data
2) Mutual Line Impedance Data [TO]
3) Other information requested by the Planning Coordinator or Transmission Planner necessary for modeling purposes. [BA, GO, LSE, TO, TSP]