RARF QnA Session

December 13, 2007

Planning Data - Overall

- **This data is required to build accurate models of the ERCOT system. It is understandable that the information is difficult to interpret. Efforts made by the market Participants to submit data in the format requested by ERCOT is appreciated.**

Generator Aux Load and Private Network Load Characteristics

- **Split Large/Small by voltage.**
  - Large: connected to 2400/4160V or a higher voltage
  - Small: connected at voltage less than 2400/4160V
- **No Resistive Load for MVAR**
- **Give most information with a reasonable amount of effort**
  - Guesses and inaccuracies cause model to be inaccurate
- **Need the MW and MVAR load totals**
- **Private Networks should fill out Load Characteristics as well as Gen Aux Load**
- **Generators only need to fill out Gen Aux section**

Generation Auxiliary Load Characteristics:

--Large Motor, percent of total MW load

-Small Motor, percent of total MW load

-Resistive (Heating) Load, percent of total MW load

-Discharge Lighting, percent of total MW load

-Other, percent of total MW load

--Large Motor, percent of total MVAR load

-Small Motor, percent of total MVAR load

-Resistive (Heating) Load, percent of total MVAR load

-Discharge Lighting, percent of total MVAR load

-Other, percent of total MVAR load

Generator Aux Load and Private Network Load Characteristics

- **We also need to know what type of accuracy they are looking for when we provide this information. There is a considerable amount of effort that would be necessary to get better than plus and minus 5%.**
  - Please do your best at filling out this data with a reasonable amount of effort.
  - If the information is incorrect, the models and study results will be incorrect.

Generator Step-up Transformer

- **Tap changer typically applies to one side of the Transformer**
  - Leave other portion blank
- **What do we do if we have more than one step-up transformer per unit?**
  - Attach additional transformer information with the RARF submittal.
- **What do we do if we have multiple units for one step-up transformer?**
  - Enter the transformer information once, and put a reference in the “transformer name” row for the other units.

Step-Up Transformer Name (all data in 100MVA base) (if multiple transformers, attach supporting data)
Provide kV Base
High Voltage Limit (no-load)
Low Voltage Limit (no-load)
Series Resistance
Series Reactance
Shunt Magnetizing Conductance
Shunt Magnetizing Susceptance
Normal Rating MVA
Emergency Rating MVA
Loadshed Rating MVA
Load Tap Changer (Y/N)

Generator Step-up Transformer

- **Can you give some detail as to what you are looking for when you ask us to "Provide kV Base”?**
  - The KV Base is needed to identify the base voltage used in the per unit calculations associated with the transformer data.
  - Electrical systems are often modeled on a per unit basis. In order to make per unit calculations useful to ERCOT, the base for MVA and KV must be disclosed.
  - For the step-up transformer, ERCOT has requested that the MVA base is 100MVA. Even if the MVA base is given, the resource needs to provide the kV Base in the RARF.

Generator Step-up Transformer

- **In the Network Model Transformer Data section, what is needed in the Low Voltage Limit and High Voltage Limit fields?**
  - The High Voltage Limit and the Low Voltage Limits for the transformers should be the no-load ratings. On the EDS 4 RARF, these fields are labeled as:
    - High Voltage Limit (no-load tap)
    - Low Voltage Limit (no-load tap)
  - These should read:
    - High Voltage Limit (no-load)
    - Low Voltage Limit (no-load)
  - For example, the per-unit nominal voltage is 1.0, the no-load limits could be 1.1.

Generator Step-up Transformer

- **Where will the transformer names be found/listed/available on the RARF?**
  - Existing transformer names and PTI bus numbers can be found in the ERCOT Branch Data spreadsheet available in the Operations and System Planning secure area of the ERCOT website in the Operations Model data folder.
  - Existing REs should have and use the transformer names on their current GARF. The primary intent is that the name adheres to the naming conventions specified for that field in the GARF (and the RARF).
  - For new REs, the transformer name results can be obtained by one of several methods: The transmission operator dictates the name, the RE determines the name, the transmission and distribution service provider (TDSP) and RE work together to determine a name.

Generator Impedances

What is the MVA base that the following data is based on?
What is the kV base that the following data is based on?
Machine Impedance
Positive Sequence Z
Negative Sequence Z
Zero Sequence Z
Armature Z
Rotor Z
Mutual coupling Armature-Rotor Z
Direct Axis Subtransient reactance, X"di
Direct Axis Transient reactance, X'di

- **What is Armature Z? What is Rotor Z? What is Mutual coupling Armature-Rotor Z?**
  - The Armature impedance would also be the Stator impedance.
  - These three components (Armature, Rotor, and Mutual Coupling of Armature and Rotor) are used to calculate an equivalent impedance for the unit, Zeq.
- **Is Machine Impedance is the same as Positive Sequence?**
  - Machine Impedance (Z) row should be the Zeq if available.

Generator Impedances

- **Does ERCOT want the generator Zero Sequence impedance of just the generator windings, or do they want the generator and the neutral grounding transformer impedance in this blank?**
  - The impedance should include the machine impedance plus neutral grounding impedance (if any).
  - This section came from the Generation Data Forms Detailed Gen Info-by unit tab for Transient Stability Analysis. ERCOT is looking for generator impedances in R + jX form.

Generator Impedances

- **We need a better definition of what is being asked for in the Generation Details Section labeled as "Mutual coupling Armature-Rotor Z". This appears to be asking for the mutual inductance between the stator and the rotor in the generator.**
  - The three pieces of information – Armature, Rotor, Mutual Coupling – should be provided together.
  - Alternatively, the Zeq could be submitted in the first row of this section in lieu of the individual impedance components.
  - This section came from the Generation Data Forms Detailed Gen Info-by unit tab for Transient Stability Analysis. ERCOT is looking for the machine impedances in R + jX form.

PSSE Models

- **Will ERCOT be updating their site with all the new manufactures model sheets? Where can we get copies of the latest model sheets?**
  - PTI Dynamic Models can be found in the Generation Project Interconnection Information folder on the Operations and System Planning secure website at:

    http://www.ercot.com/tmaps/ListMaps.cfm?GroupID=50.
  - In addition, some models can be found on ERCOT.com at:

    http://www.ercot.com/gridinfo/generation/index.html
  - ERCOT's standard models are obtained from PSSE manuals
  - Non-standard models, typically new generator designs, will have to be generated and submitted by the resource

Reactive Capability Curve (D-Curve)

MW1 (lowest MW value of curve)

Lagging MVAR limit associated with MW1 output

Leading MVAR limit associated with MW1 output

MW2

Lagging MVAR limit associated with MW2 output

Leading MVAR limit associated with MW2 output

MW3

Lagging MVAR limit associated with MW3 output

Leading MVAR limit associated with MW3 output

MW4

Lagging MVAR limit associated with MW4 output

Leading MVAR limit associated with MW4 output

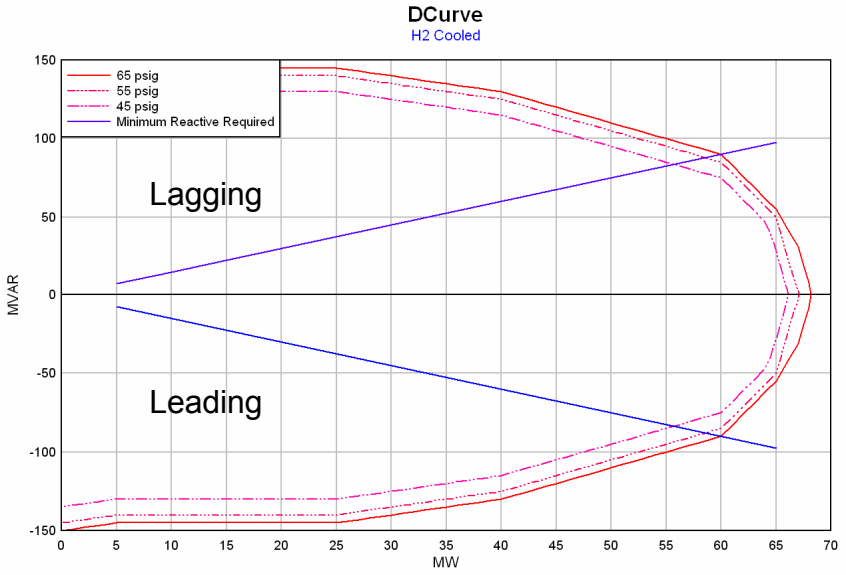
MW5- Unity Power Factor

If hydrogen cooled, indicate hydrogen pressure (psi) associated with your Reactive Curve submitted for ERCOT studies

- **Does ERCOT want the Manufacturer's power curve added as a separate tab to this document?**
  - Please include Capability Curve as a separate document.

Reactive Capability Curve (D-Curve)

Field Description	Unit #1
MW1 *(lowest MW value of curve – minimum operating MW output)*	18
Lagging MVAR limit associated with MW1 output	145
Leading MVAR limit associated with MW1 output	-145
MW2 *(midpoint (50%) between MW1 and MW5)*	38
Lagging MVAR limit associated with MW2 output	130
Leading MVAR limit associated with MW2 output	-130
MW3 *(seventy-fifth percentile (75%) between MW1 and MW5)*	48
Lagging MVAR limit associated with MW3 output	115
Leading MVAR limit associated with MW3 output	-115
MW4 *(between MW3 and MW 5 - breakpoint of curve)*	60
Lagging MVAR limit associated with MW4 output	80
Leading MVAR limit associated with MW4 output	-80
MW5- Unity Power Factor	68
If hydrogen cooled, indicate hydrogen pressure (psi) associated with your Reactive Curve submitted for ERCOT studies	65



Net Maximum VARs

- **What rating is used for "Net Maximum Leading Operating Capability (MVAR)" and "Net Maximum Lagging Operating Capability (MVAR)"?**
  - Please submit the Maximum Leading and Lagging Operating Capability in MVAR that the unit is able to provide – independent of MW.

Net Maximum Leading Operating Capability (MVAR)
Net Maximum Lagging Operating Capability (MVAR)

SubSynchronous Resonance

- **The section covering SubSync Resonance is asking for some information that is unavailable. We have mass and inertia information on the Generator rotor/exciter and we have this same type of information on the turbine but we do not have the individual turbine rotating component (LP, HP, IP etc.) or between the generator rotor and exciter rotating elements. Also, we do not have any information on damping or stiffness on any of these items. If this information is necessary, it will require performing a study by the original OEMs and will come at a considerable cost per unit.**
  - The studies using this information are not needed often right now, but will become more common as capacitor compensation is used in series on long transmission lines.
  - The studies focus on the units at either end of the lines compensated with the series capacitors to ensure the resonance from these lines won't excite critical frequencies in the machines in the area at the end of these lines.
  - Owners of theses units will be interested in these studies to prevent equipment damage. ERCOT will accept minimal information in these fields at this time, but as series compensation is installed on our grid, this information will become necessary and critical to system performance.

Generator Protection

- **Do we need to be including the alarms and operator's guides for manual trip times in this section or is it OK to omit any information based on the fact that these are not automatic trips?**
  - If there are no automatic trips, please enter N/A and use the comments section to the right to document why.

Instantaneous Undervoltage Trip (kV)
Time 1 (provide a time in seconds)
Undervoltage 1 (KV)
Time 2 (seconds)
Undervoltage 2 (KV)
Time 3 (seconds)
Undervoltage 3 (KV)
Instantaneous Overvoltage Trip (kV)
Time 1 (seconds)
Overvoltage 1 (KV)
Time 2 (seconds)
Overvoltage 2 (KV)
Time 3 (seconds)
Overvoltage 3 (KV)
Plant Frequency Protection
Instantaneous Underfrequency Trip (Hz)