Planning Center – Gen Model updates MOD-032 and TPL-007 compliance

May 2, 2019
<table>
<thead>
<tr>
<th>Product - Action Required</th>
<th>Deadline</th>
<th>Who May Be Affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submit generator data via Gen Model</td>
<td>6/14/2019</td>
<td>Generator Owners</td>
</tr>
</tbody>
</table>
Gen Model allows generator owners to upload required data for NERC’s MOD-032-1 and TPL-007-2 standards

- These standards establish consistent modeling data requirements and reporting procedures needed to develop planning horizon models
- These models are necessary to support reliability analyses of the transmission system
• Release 2019.4
  – Enhancements to Gen Model driven by user feedback and data deficiencies in previous versions
Redline version of MOD-032 Data Requirements and Procedures document available in 3/7/2019 Planning Committee meeting materials:


- Gen-model enhancements align with MOD-032 Requirements and Procedures document updates
Updated Gen Model screenshots
### Generator Data Forms

<table>
<thead>
<tr>
<th>Form</th>
<th>Form Status</th>
<th>Actions</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Information</td>
<td>Complete</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Synchronous Generator Parameters</td>
<td>Complete</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Wind Farm Parameters</td>
<td>Not Started</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Inverter-Based Parameters</td>
<td>Not Started</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Circuit Breakers and Relays</td>
<td>Not Started</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Main Transformer</td>
<td>Not Started</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Load Transformer</td>
<td>Not Started</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Attachment Line Data</td>
<td>Not Started</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Additional Data Files</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

**Warning:** Total Gross Energy (MWh) summer for overall plant does not match sum of Unit Gross Energy Output (MWh) summer. Please double check before submitting.
Gen Model Screenshots
Total Plant Generation Capability

Name Plate (MVA) *

Maximum Facility Output (MW) *

PJM's Tariff (http://www.pjm.com/directory/merged-tariffs/ont.pdf) defines MFO as: Maximum Facility Output. "Maximum Facility Output" shall mean the maximum (not nominal) net electrical power output in megawatts, specified in the Interconnection Service Agreement, after supply of any parasitic or host facility loads, that a Generation Interconnection Customer's Customer Facility is expected to produce, provided that the specified Maximum Facility Output shall not exceed the output of the proposed Customer Facility that Transmission Provider utilized in the System Impact Study. For plants without an ISA, enter the equivalent value from the applicable Interconnection Agreement. For plants without an Interconnection Agreement, enter nominal maximum seasonally independent net power output.
**Total Reactive Power Capability at Max Gross Energy Output**

<table>
<thead>
<tr>
<th></th>
<th>Summer</th>
<th>Winter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leading (Underexcited) (MVAR)</td>
<td>[Yellow]</td>
<td>[Yellow]</td>
</tr>
<tr>
<td>Lagging (Overexcited) (MVAR)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

- Leading (Underexcited) (MVAR) is now required to be \(\leq 0\)
Provide individual generator capability (All values requested here are for individual units)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e.g. ST, CT, CT1, CT2, ST2, etc.) *</td>
<td>List all the Machine IDs that these data corresponds (e.g. CT1, CT2)</td>
</tr>
<tr>
<td>Prime Mover Code *</td>
<td>Select From EIA-860 filing</td>
</tr>
<tr>
<td>Energy Source Code *</td>
<td>Select From EIA-860 filing</td>
</tr>
<tr>
<td>MVA Base *</td>
<td></td>
</tr>
<tr>
<td>Terminal Voltage (KV) *</td>
<td></td>
</tr>
<tr>
<td>Nominal Power Factor</td>
<td></td>
</tr>
<tr>
<td>Unit Maximum Net Capacity Output (Unit CIR) (MW)</td>
<td></td>
</tr>
</tbody>
</table>

PJM®2019
• Leading (Underexcited) (MVAR) is now required to be <=0
Generator Parameters (All reactances and resistance values in PU on Machine MVA Base at machine terminal voltage)

Combined Turbine-Generator-Exciter Inertia, H [kW/kVA]

Speed Damping Coefficient, D

Generator Saturation

Generator Saturation at 1.0 p.u. Voltage, S (1.0)

Generator Saturation at 1.2 p.u. Voltage, S (1.2)

Unsaturated Reactances

Direct Axis Synchronous, Xd(i)

Direct Axis Transient, X'd(i)

Direct Axis Sub-Transient, X'd'(i)

Quadrature Axis Synchronous, Xq(i)

Quadrature Axis Transient, Xq(i)

Quadrature Axis Sub-Transient, X'q(i)

Stator Leakage, Xl

Negative Sequence, X2(i)

Zero Sequence, X0(i)
**Gen Model Screenshots**

### Saturated Reactances

**Saturated Sub-Transient, X'd'(v)***

\[ X'd'(v) < X'd(v) \]

**Transient Reactance, Xd(v)***

\[ Xd(v) > X'd(v) \]

**Synchronous Reactance, Xd(v)***

\[ Xd(v) > X'd(v) \]

**Negative Sequence, X2(v)***

**Zero Sequence, X0(v)***

### Resistances

**DC Armature, Ra [Ohms]***

**Positive Sequence, R1***

**Negative Sequence, R2***

**Zero Sequence, R0***

### Time Constants

**Direct Axis Sub-Transient Open Circuit, T'do [sec]***

\[ t < T'do \times 1.2 \]

**Direct Axis Sub-Transient Open Circuit, T'do [sec]***

\[ 0.04 < T'do < 0.2 \]

**Quadrature Axis Sub-Transient Open Circuit, T'qo [sec]***

\[ T'qo <= T'do \]

**Quadrature Axis Sub-Transient Open Circuit, T'qo [sec]***

\[ T'qo <= T'qo \]

**Armature Three-Phase Short Circuit, Ta3 [sec]***

\[ \]
Stability Models
To submit multiple files at once, please place them into a zip file before uploading.

Generator Models, Relay Model & Frequency Relay Model

Excitation System Models

Prime Mover & Governor Models

Static Var Compensator (SVC) & Frequency Changer Models

Power System Stabilizer Models

Maximum Excitation Limiter Models

Minimum Excitation Limiter Models

Compensation Models

Other documents
• Same changes for Main and Load transformers
### Impedances

Select Transformer Windings *

<table>
<thead>
<tr>
<th>R</th>
<th>X</th>
<th>X/R</th>
</tr>
</thead>
</table>

Positive Sequence Impedances (All values in PU on Transformer MVA Base at nominal winding voltage specified below)

<table>
<thead>
<tr>
<th>R</th>
<th>X</th>
<th>X/R</th>
</tr>
</thead>
</table>

Zero Sequence Impedances (All values in PU on Transformer MVA Base at nominal winding voltage specified below)

<table>
<thead>
<tr>
<th>R</th>
<th>X</th>
<th>X/R</th>
</tr>
</thead>
</table>

#### DC Winding Resistance

- Transformer High Winding DC Resistance (ohms/phase) *
- Transformer Low Winding DC Resistance (ohms/phase)
- Transformer Tertiary Winding DC Resistance (ohms/phase)

#### Substation Grounding

- Substation grounding DC resistance (ohms) *

- Same changes for Main and Load transformers
### Windings

#### Winding Voltages (kV)

<table>
<thead>
<tr>
<th>Winding</th>
<th>Nominal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Side (kV)</td>
<td>[Field]</td>
</tr>
<tr>
<td>Low-Side (kV)</td>
<td>[Field]</td>
</tr>
</tbody>
</table>

- **High-Side (kV) at Tap Setting**: [Field]
  - If no tap changer on this winding enter nominal voltage.
- **Low-Side (kV) at Tap Setting**: [Field]
  - If no tap changer on this winding enter nominal voltage.

#### Winding Connection Types (Delta, Wye, Wye Gnd, etc)

<table>
<thead>
<tr>
<th>Connection Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Side</td>
<td>Select</td>
</tr>
<tr>
<td>Low-Side</td>
<td>Select</td>
</tr>
</tbody>
</table>

### Transformer Details

- **Tap Position**: [Field]
- **Off-Nominal Turns Ratio**: [Field]
- **Number of Taps**: [Field]
- **Step Size**: [Field]

### Additional Comments

- **Any Additional Comments on the Transformer?**: [Field]
Wind Farm Parameters

Machine Id *

Prime Mover Code *

Energy Source Code *

Specify Manufacturer *

Specify Model *

MW Value per Turbine (Nominal Rating) *

Number of Turbines *

MVA Base *

Terminal Voltage (KV) *

Nominal Power Factor *

Type 4 turbine *

Control Mode *
• Wind
• Inverter based
## Circuit Breaker and Relay Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substation Name</td>
<td></td>
</tr>
<tr>
<td>Breaker Name</td>
<td></td>
</tr>
<tr>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Model Number</td>
<td></td>
</tr>
<tr>
<td>Nameplate Interrupting Rating (kA or MVA)</td>
<td></td>
</tr>
<tr>
<td>Nameplate Rating Type</td>
<td>Select</td>
</tr>
<tr>
<td>Nameplate Interrupting Time (cycles)</td>
<td></td>
</tr>
<tr>
<td>Nameplate K-factor</td>
<td></td>
</tr>
<tr>
<td>Nameplate Max Design (kV)</td>
<td></td>
</tr>
<tr>
<td>Operating kV</td>
<td></td>
</tr>
</tbody>
</table>

- **Contact Parting Time (cycles)**
- **Protective Equipment 1 (i.e., generator, line, transformer)**
- **Protective Equipment 2 (i.e., generator, line, transformer)**
- **Interrupting Medium (i.e., Gas, Oil, Air, Etc)**
- **Reclosing Time One (seconds)**
- **Reclosing Time Two (seconds)**
- **Required to provide relay settings under PRC-024-2?**
- **PRC-024-2 Compliance Files**

*To submit multiple files at once, please place them into a Zip file before uploading.*