gentpj validation

Shawn Patterson
MVWG meeting
11-19-2010
Steady State - gentpj
Steady State - gensal

![Steady State Graph]

- **Unit 1 V-Curve (gensal)**
- **Field Current (pu)**
- **Armature Current (pu)**

**Legend**:
- Measured
- Model

Graph showing measurements and model predictions for Field Current and Armature Current.
Steady State - gentpj

![Graph showing field current and armature current relationship for Hills Creek Unit 1 V-Curve.

- **Measured** data points are represented by circles.
- **Model** data points are represented by plus signs.

The graph plots field current (pu) on the x-axis and armature current (pu) on the y-axis, with grid lines at intervals of 0.2 units.
Steady State - gensal

Field Current (pu)

Armature Current (pu)

Measured
Model
Steady State - gentpj

Field Current (pu)

Unit 13 V-Curve

Measured
Model
Steady State - gensal

![Graph showing measured and model data for a certain unit with the labels "Measured" and "Model" and the unit number "13". The graph plots Field Current (pu) against Armature Current (pu).]
Steady State Recap

- **gensal** does not adequately model field current compared to measurements
- **gentpj** provides very good simulation of field current compared to measurements
- OEL operation and reactive capability of machine models depend on accurate field current simulation
- **gentpj** better than **gensal**
Dynamics – Vt/Efd (offline)

Unit 1 Offline Generator Response (Vt/Efd)

Gain (dB)

Freq (Hz)

Phase (deg)

Freq (Hz)

S10 = 0.12  Xd = 0.99 pu
S12 = 0.48  Xpd = 0.33 pu
Tpd = 6 sec  Xppd = 0.299 pu
Tppd = 0.019 sec  Xi = 0.26 pu
Unit 2 Offline Generator Response (Vt/Efd)

Gain (dB):
- S10 = 0.12
- Xd = 0.999 pu
- S12 = 0.48
- Xpd = 0.33 pu
- Tpd = 6 sec
- Xppd = 0.299 pu
- Tppd = 0.019 sec
- XI = 0.24 pu

Phase (deg):
- Measured
- Model-gentpj
- Model-gensal

Freq (Hz):
- 10^2 to 10^1
Unit 3 Offline Generator Response (Vt/Efd)

- $S_{10} = 0.12$
- $X_d = 0.999$ pu
- $S_{12} = 0.48$
- $X_{pd} = 0.33$ pu
- $T_{pd} = 6$ sec
- $X_{ppd} = 0.299$ pu
- $T_{ppd} = 0.019$ sec
- $X_d = 0.24$ pu

Gain (dB) vs. Freq (Hz)

Phase (deg) vs. Freq (Hz)

- Red: Measured
- Blue: Model-gentpj
- Green: Model-gensal
Machine models only

Unit 1, offline step response, same Efd into both models

- $T_r = 0$
- $T_a = 0.0168$
- $T_c = 1.7$
- $T_e = 5.5$
- $T_b = 0.11$
- $K_a = 1$
- $K_e = 1$
- $K_r = 0$
- $T_p = 0$
Unit 4 Offline Generator Response (Vt/Efd) (gensal)

- **Gain (dB)**
  - $S_{10} = 0.088$
  - $S_{12} = 0.256$
  - $T_{pd} = 4$ sec
  - $T_{ppd} = 0.03$ sec
  - $X_{d} = 0.68$ pu
  - $X_{pd} = 0.319$ pu
  - $X_{ppd} = 0.248$ pu
  - $X_{l} = 0.1$ pu

- **Phase (deg)**
  - Measured
  - Model
Unit 4 Offline Generator Response (Vt/Efd) (gentpj)

- $S_{10} = 0.088$
- $X_d = 0.68$ pu
- $S_{12} = 0.256$
- $X_{pd} = 0.319$ pu
- $T_{pd} = 4$ sec
- $X_{ppd} = 0.248$ pu
- $T_{ppd} = 0.03$ sec
- $X_l = 0.1$ pu

Measured
Model

Gain (dB)
Phase (deg)
Closed Loop – offline - gentpj

Unit 1 Offline Step Response

Voltage (pu)

Time (sec)
Closed Loop – offline - gensal
Closed Loop – offline - gentpj

Unit 2 Offline Step Response

- Measured
- Model
Closed Loop – offline - gensal

Unit 2 Offline Step Response (gensal)

Measured
Model
Closed Loop – offline - gentpj
Closed Loop – offline - gensal

![Unit 1 Offline Step Response - gensal model](image)

- Measured
- Model
Closed Loop – Online, low load - gentpj

Unit 1 Online Step Response - LDC = 0%

Time (sec) vs Voltage (pu) graph showing measured and model responses.
Closed Loop – Online, low load - gensal

Unit 1 Online Step Response - LDC = 0% - gensal model
Closed Loop – Online, full load - gentpj

Unit 1 Online Step Response - PSS ON

- Blue: Measured
- Green: Model
Closed Loop – Online, full load - gensal

Unit 1 Online Step Response - PSS ON (gensal)

Voltage (pu)

Measured
Model

Time (sec)
Closed Loop – Online, full load - gentpj

Unit 1 Online Step Response - PSS OFF

- Measured
- Model

Voltage (pu)

Time (sec)
Closed Loop – Online, full load - gensal

Unit 1 Online Step Response - PSS OFF - gensal model

Measured
Model
Closed Loop – Online, full load - gensal

![Unit 2 Online Step Response - PSS ON](image)

- **Time (sec)**
- **Voltage (pu)**

- **Measured**
- **Model**
Closed Loop – Online, full load - gensal

Unit 2 Online Step Response - PSS ON (gensal model)

- Measured
- Model
Oscillations

Unit 4 Online Impulse Response with PSS OFF

- Measured
- gentpj
- gensal

Time (sec)

Power (MW)
Oscillations – with PSS

Parker Unit 2 Online Impulse Response with PSS ON

Measured

gentpj
gensal
Summary

• **gentpj** better than **gensal** in steady state
• **gentpj** and **gensal** are similar in staged dynamic tests
• **gentpj** models can provide slightly more damping than **gensal**
• WECC (then WSCC) program used **gentpf** model, which is the basis of **gentpj**
• **gensal** models should be replaced with **gentpj**