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GENTPJ Retirement Timeline

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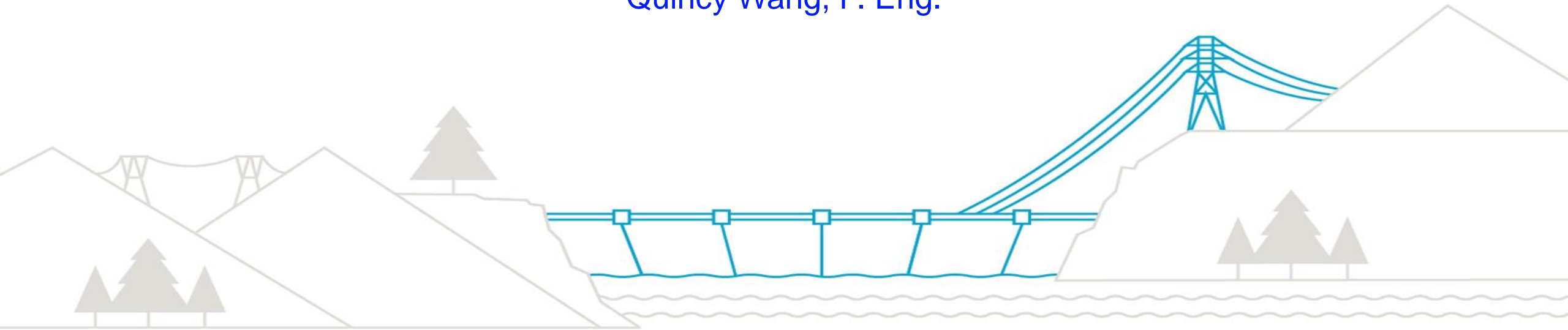
Outline

o Current Situation

o GENTPJ Model Review

o Options and Recommendation

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Current Situation

o WECC announced GENTPJ Retirement Plan Jan 27, 2022

o GENTPJ set to retire from WECC starting Jan 1, 2024

o Superseding model (GENQEC) approved Dec 3, 2020 in all major system study software used in North America

o GENTPJ model structure well understood by MVS May 2023

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Problem Statement

o Some entities are not ready to use GENQEC

o GENTPJ dynamic performance issue has not been widely seen and recognized

o GENTPJ is still being used to replace earlier models (GENSAL/GENROU)

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GENTPJ Model Review

- o Improvement on steady-state modeled field current accuracy

- o Saturation effect considered on all inductance terms except stator leakage

- o Dynamic performance issue independent from the accuracy improvement

- o Inherently not truly representing generator windings' electro-magnetic relations

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GENTPJ Model Major Timeline

- Aug 2006, GENTPF, GENSAL and GENROU approved by WECC

- Jan 2009, GENTPJ approved by WECC as GENTPF improvement in Saturation

- Jan 2011, GENTPJ set to replace retired GENSAL in WECC

- Nov 2016, GENTPJ recommended by NERC to replace GENSAL and GENROU

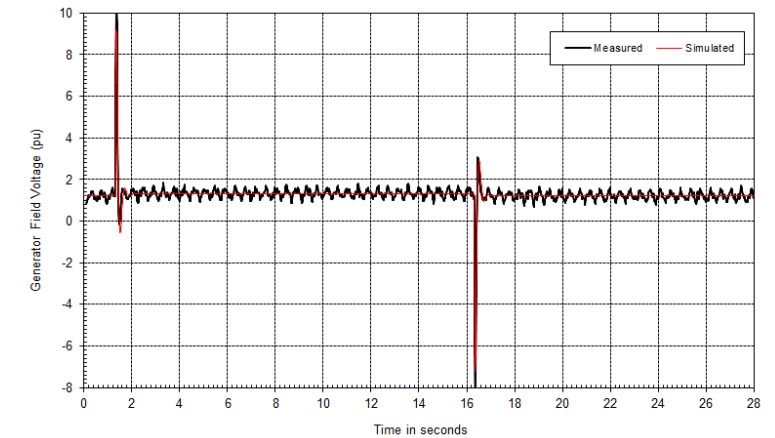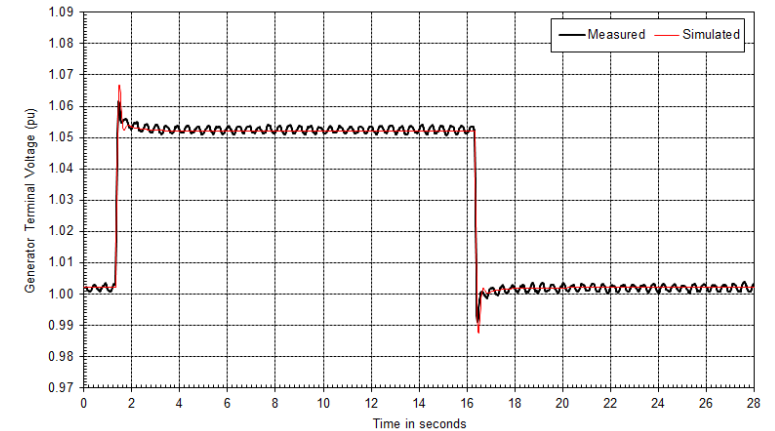- Jan 2022, GENTPJ and GENTPF unapproved by WECC, set to retire by Dec 31, 2023

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GENTPJ Model Review

2016 – 2017

GENTPJ Dynamic performance issue noticed

Measured and Simulated 5% AVR Voltage Reference Step Response
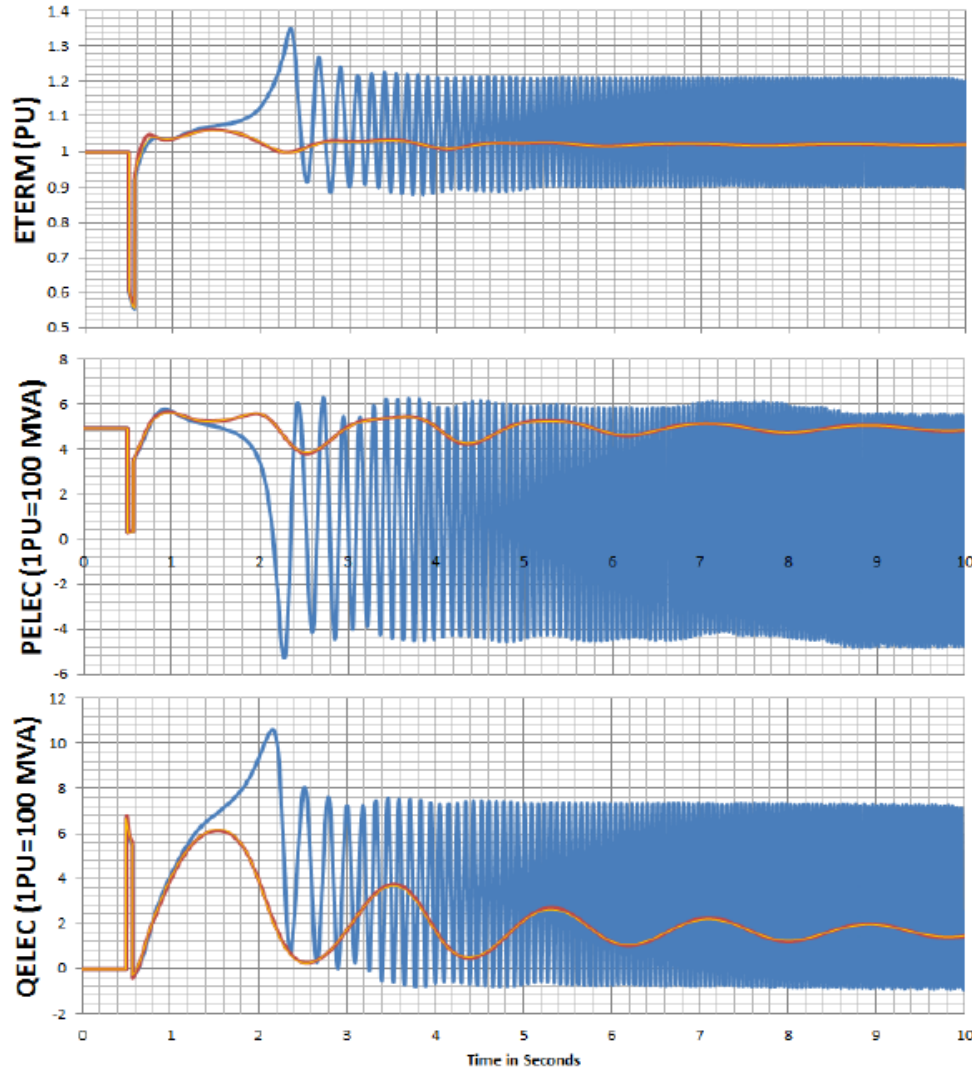

GENTPJ

GENSAL

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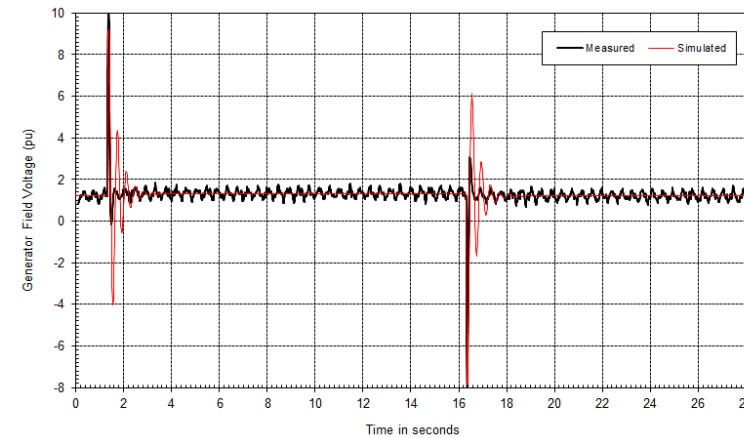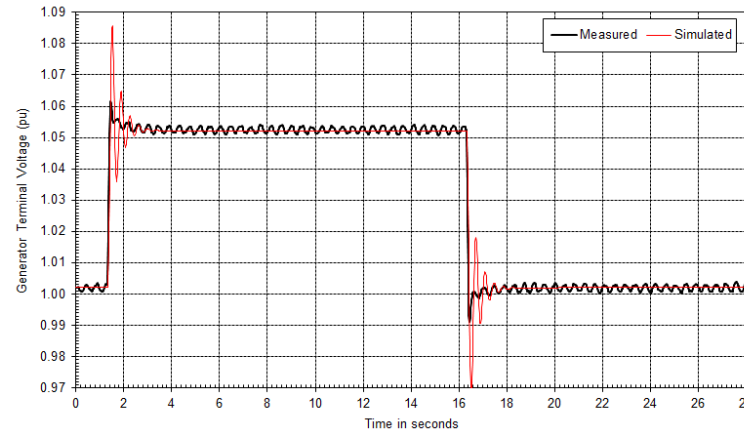
GENTPJ Model Review

2017, GENTPJ model dynamic performance issue confirmed by MVWG

- GENTPJ does not truly represent the electro-magnetic relations between the generator windings (in comparison with GENSAL/GENROU)

- GENTPJ exhibited slightly less damping than GENSAL/GENROU in simulation results

- Proposed to re-anoint GENSAL/GENROU at the time

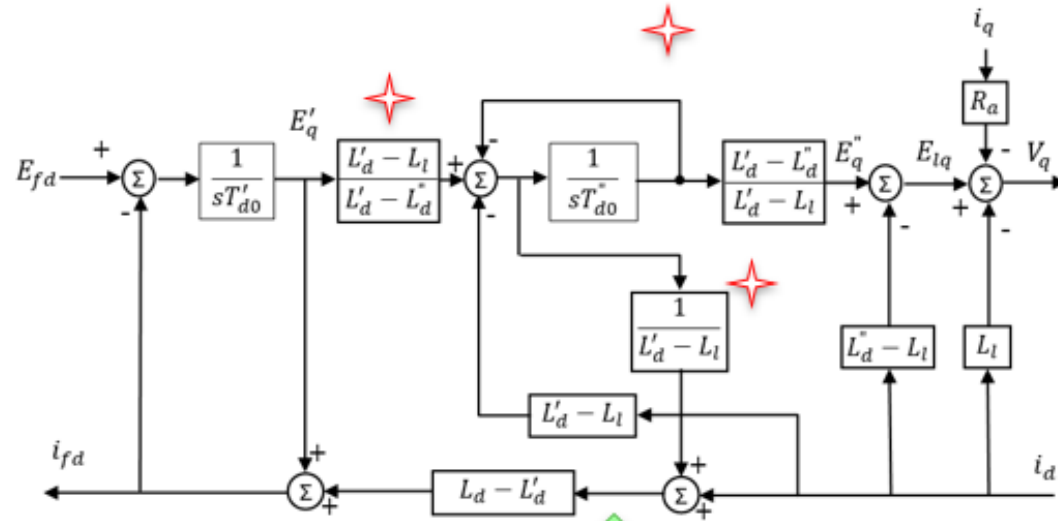- MVWG made a decision to develop a single new model as replacement

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GENTPJ Model Review

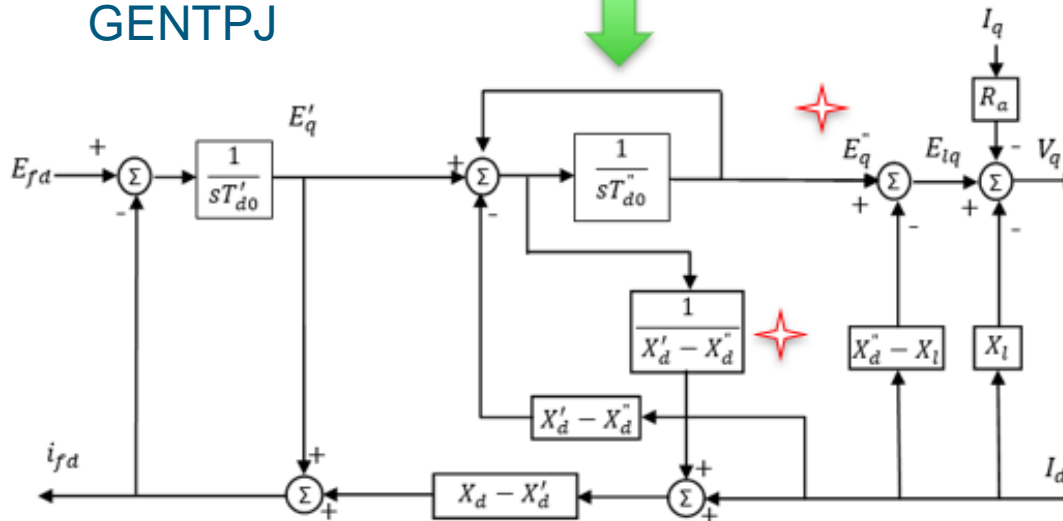*Source: Sam Li   Nov 2019 MVS Meeting representation*

Nov 2019, a typical transmission study in WECC system:

- Confirmed less damping of GENTPJ model

- Example: Critical Clearance Time (CCT) for stability

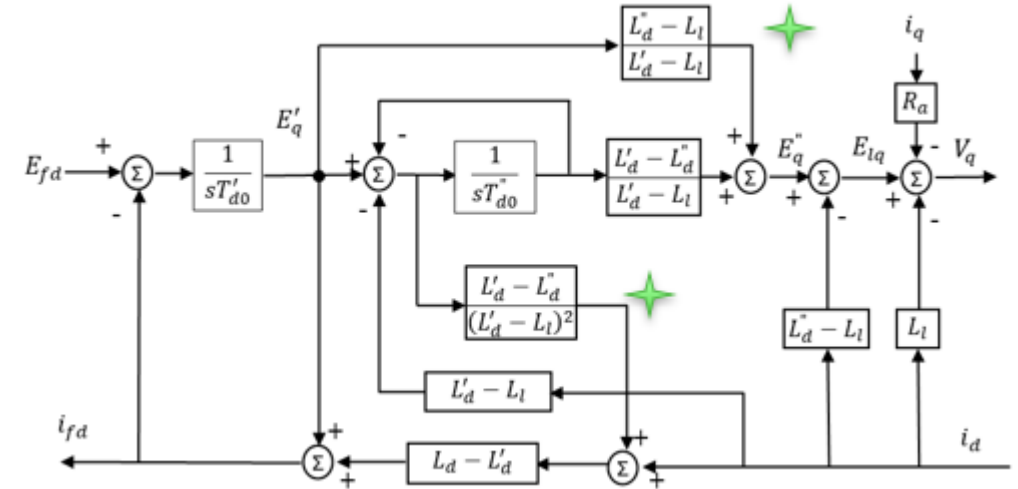 - GENTPJ   3.8 Cycles
  - GENROU 4.2 Cycles

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GENTPJ Model Review

GENSAL/GENROU/GENQEC

GENTPJ

May 2023, GENTPJ model basic structure was compared with other second-order models.

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GENTPJ Model Review

- In linear format, GENTPJ is modified from a common platform shared by GENSAL, GENROU, and GENQEC;

- Generator parameters validated using GENSAL and GENROU cannot be directly applied to GENTPJ model;

- GENTPJ has inherent inaccuracy in modeled dynamic performance;

- GENTPJ not suitable for standstill frequency response method described in IEEE Std-115;

- Retiring GENTPJ will benefit system study in the long run, especially in the areas of power plant modeling and generator model validation.

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GENQEC Readiness and Challenges

- GENTPJ's replacement, GENQEC has been implemented in newer versions of major system study software in North America since 2020.

- Some entities have started using GENQEC. Initial results have demonstrated agreement with the mathematic analysis and bench marking results.

- Initial results also show that GENQEC model works well with manufacturer-provided parameters used for GENSAL and GENROU models.

- Challenge in generator model validation practice associated with the newly introduced field current compensation factor Kw.

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Replacing GENTPJ with GENQEC

GENTPJ Retirement

- GENTPJ model may remain in WECC database for up to 10 years after official retirement

- The earlier the GENTPJ retirement, the less potential negative impact it will have on future study results

GENQEC Application

- Theoretical analysis well documented

- Initial results consistent with analysis

- Easy migration from GENSAL and GENROU to GENQEC

- Some entities have started using GENQEC with good results

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Solution Options

1. GENTPJ retire by end 2023 as planned

   • GENTPJ to be replaced by GENQEC starting Jan 2024

2. Delay GENTPJ retirement

   • Replacement of GENTPJ by GENQEC will also be postponed

3. GENTPJ retire by end 2023 with mitigation measure

   • Re-anoint GENSAL model

   • A grace period for migrating to GENQEC from GENSAL (and GENROU)

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Recommendation – Option 3

- Right decision made in early 2021 due to the deficiency of GENTPJ

- As a matter of fact, field current accuracy improvement of GENTPJ and GENQEC is only an anticipated future benefit for system study.

- In the interim after GENTPJ retirement, GENSAL (GENSAE) can be used as replacement of GENQEC for entities unable to use GENQEC.

- GENSAL has proven performance over decades of experience

- GENSAL is widely available to all entities and all system study software

- GENSAL is easy for future migration to GENQEC

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Thank You !

Thoughts?

Comments?

Ideas?

Questions?

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