



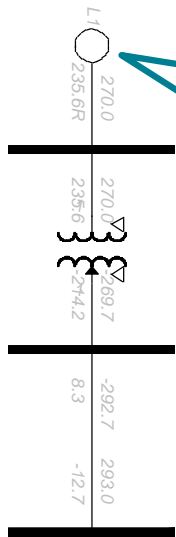
## Dynamic Models Overview

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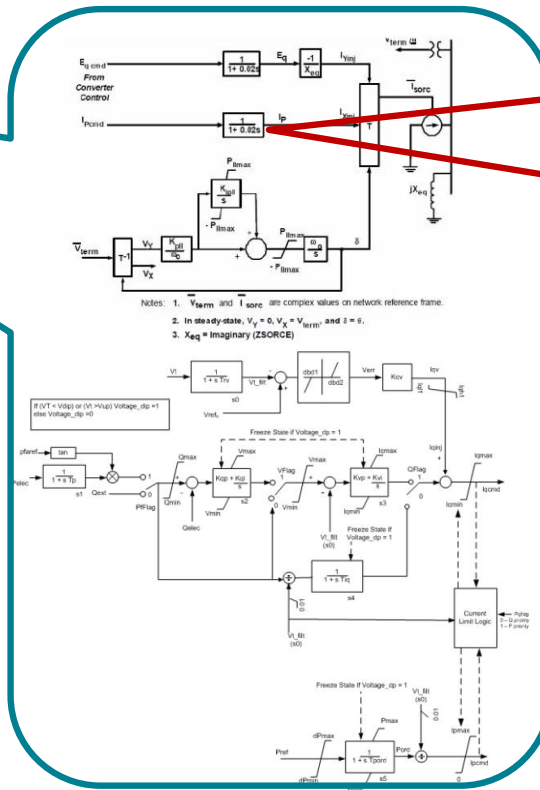
ERCOT ROS Meeting  
March 7, 2019

# Example: How Generators are modeled?

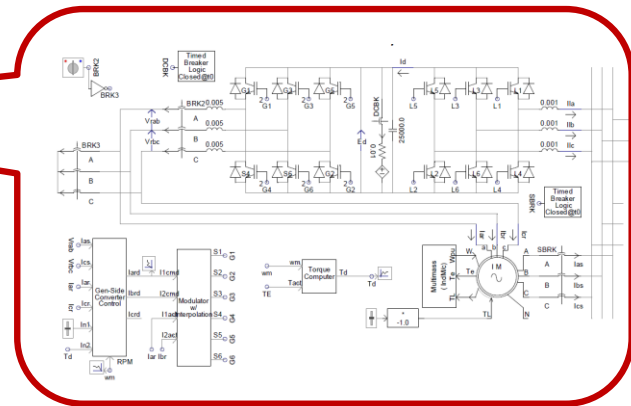
## Steady State



## (Electromechanical Transient)



## (Electromagnetic Transient)



- Time step of 10 ~ 50 us
- Simulation finished in 10 mins ~ hours
- Parameters: tens ~ hundreds, varies based on

- Time step of 1 ~ 4 ms
- Simulation finished in 1 ~ 10 mins
- Parameters: tens ~ hundreds, varies based on technology, vendor, and machine generation

# Dynamic Models in ERCOT

## Synchronous Generators

- Mature Technology
- Most projects use standard model library maintained by the simulation software vendor

## Inverter Based Resources

- Developing technology
- Most projects use user defined models that were developed by various entities (manufacturer, consultant, software vendor)
- More than 200 renewable projects with UDMs

## Why User Defined Models

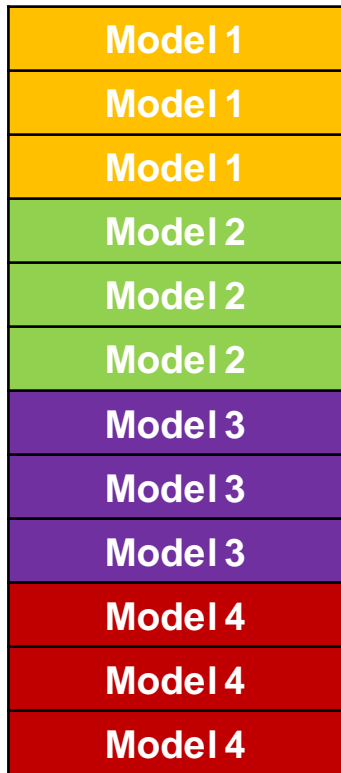
- ERCOT accepts dynamic models with model parameters that represent the dynamic behavior of the device.
  - Standard or UDM
- Why UDMs are provided to ERCOT?
  - Suggested by the vendor to accurately represent unique features that are not available in the limited standard model library
  - For special system condition, like weak grid

# Dynamic Model Challenges

- Many Identified dynamic model issues are listed in the ERCOT User Defined Model Submittal Guideline
  - [http://www.ercot.com/content/wcm/lists/168307/Dynamic\\_Model\\_Templates\\_v2.zip](http://www.ercot.com/content/wcm/lists/168307/Dynamic_Model_Templates_v2.zip)
- For examples:
  - Limited description of UDMs and difficult to fully understand the response of the models , unhelpful error messages
  - Inconsistent simulation time step requirements
  - Model and library changes/updates without clear distinction
  - Models with poor memory management
  - Models may not adhere to simulation software UDM requirements
  - Model with very restricted rule, like machine ID

# Potential Model Interference Issue

Every dynamic model is assigned a specific number of internal arrays



Good Models manages data only within its own array space



Bad Model 4 writes to Model 2 internal array space

An example of dynamic flat start simulation message below indicated possible erroneous array management and significantly affected the simulation results.

```
Model VTGDCAT Model Instance 38135103:  
Pickup timer started at TIME = -0.008, Voltage = 0.00  
Model VTGDCAT Model Instance 38135103:  
Pickup timer started at TIME = 0.004, Voltage = 0.00  
Model VTGDCAT Model Instance 38135103:  
Breaker timer started at TIME = 0.254  
Model VTGDCAT Model Instance 38135103:  
Breaker timer timed out at TIME = 0.354  
BUS 381351 DISCONNECTED AT TIME = 0.354
```

## DWG/ERCOT Work and Ongoing Efforts

- Better communication and awareness of the model issues and expectations
- Develop tools to detect model issues
- Work with the Resource Entities, developers, TSPs, and manufacturers to correct the model (lots of communication, very time consuming)
- However
  - Some model issues may not be possible to be identified by users (no access to the details of the UDMs)
  - Increasingly UDMs are developed by outside entities. Model quality is and will continue to be a challenge.

## Next Steps and Future Plan

- ERCOT is working with DWG to mitigate this challenge
  - Require UDMs to be vetted by the simulation software vendor to ensure model quality?
  - Require information/tests to demonstrate the quality of the model?
  - Better communication at early stage of FIS process?
- Others
  - How to ensure the UDM developers maintain good model quality and update/correct the models?
  - Work with the industry to continue to improve the development of the standard model library to reduce/eliminate the need of UDMs and NERC unacceptable model list