

# ERAG Multi-regional Modeling Working Group (MMWG) Current and Future Activities

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# Agenda

- Background
- Scope
- Annual Model Series Development
- ERAG Assessment Model Development
- Software Utilized
- Future Development
- Questions

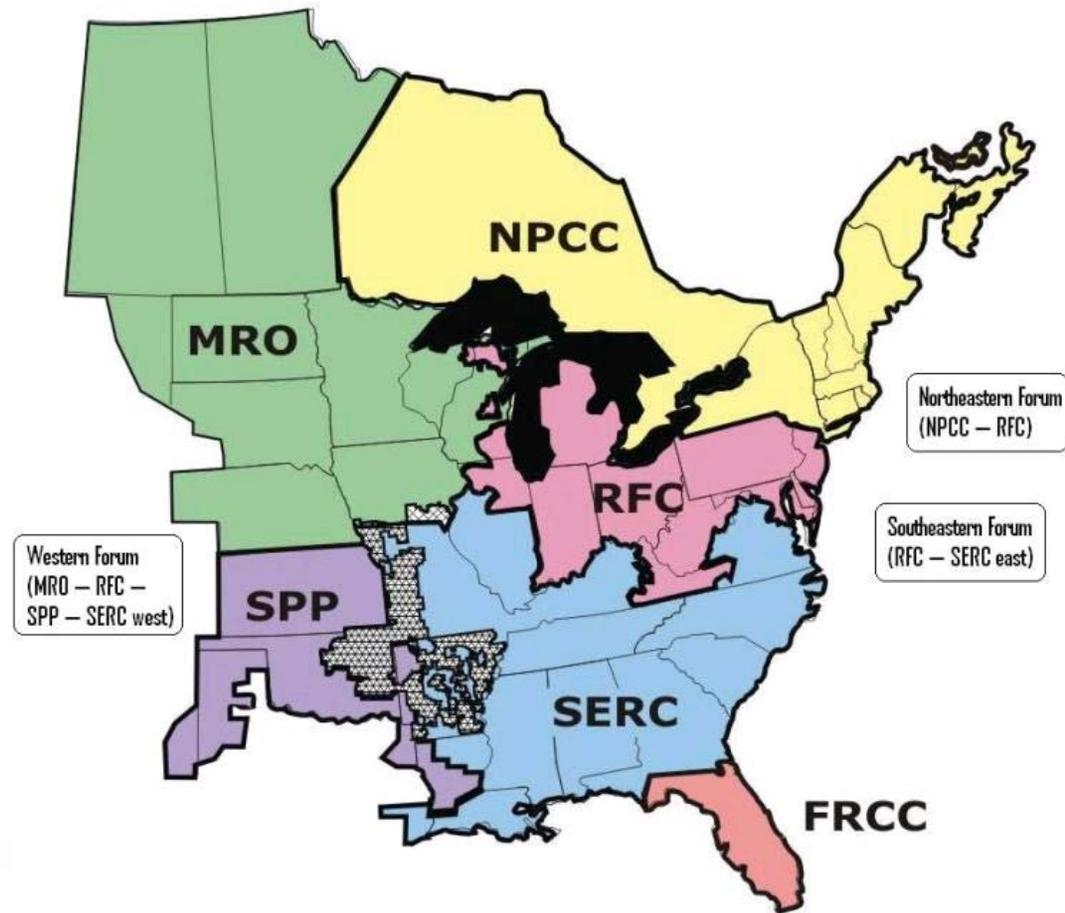


# Background

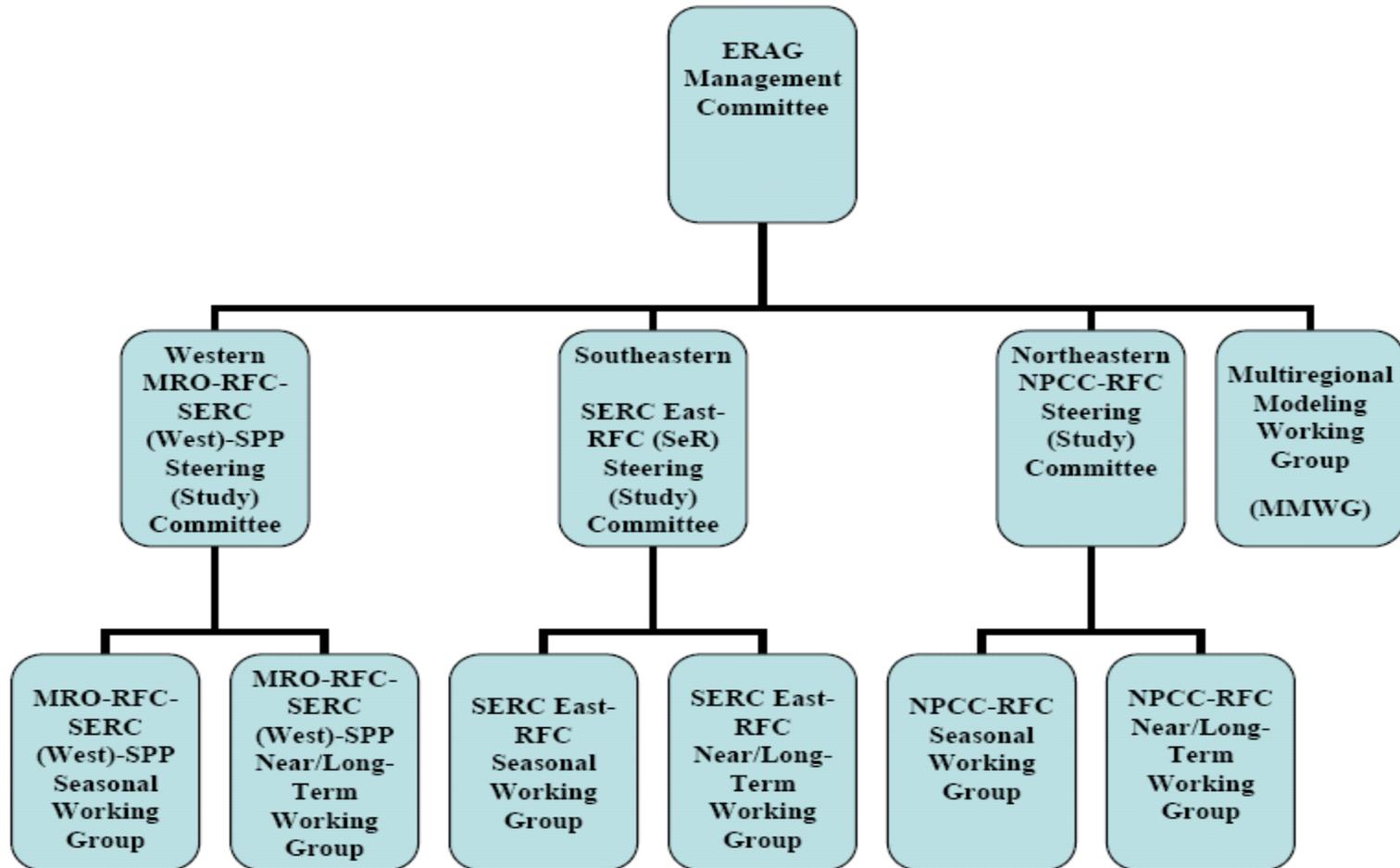
- Modeling your neighbors' systems is necessary to get valid results for internal studies of the interconnected transmission system
  - Loop flows
  - Reactive influences
- In the past, utilities had to gather models from each of their neighbors individually
- MMWG was formed to gather together models of all the systems and create a single model for the whole Eastern Interconnection
- Because of program limitations, the first models were very high level with lots of equivalents formed before the cases could be assembled
- A utility would replace the high level model of their system with a more detailed model for their analysis
- As the modeling software evolved the submitted model details was increased
- Now almost every company submits fully detailed models



# Eastern Interconnection Reliability Assessment Group (ERAG)



# Eastern Interconnection Reliability Assessment Group- Organization Chart



# Scope

- Annually review and recommend the list of power flow base cases and system dynamic simulation models.
- Develop and maintain a library of Power Flow and Dynamic base case models. The library of cases is maintained for the benefit of members of the ERAG.
- Maintain a Procedural Manual for use by the Regions in submitting power flow and system dynamic modeling data.
- Work with the Regions to coordinate and ensure the timely submission of the regional and member system data.
- Keep abreast of the modeling requirements of the Regions and member systems and adopt or develop improved modeling and data handling techniques as required.



# Annual Model Series Development

- List of Models



# MMWG Annual List of Base Case Models

## *2011 Series Model Selection*

<b>Year</b>	<b>Season</b>	<b>Power Flow Models</b>	<b>Dynamics</b>
2012	Light Load	X	X
2012	Spring	X	
2012	Summer	X	X
2012	Summer Shoulder	X	X
2012	Fall	X	
2012	Winter	X	X
2013	Spring	X	
2013	Summer	X	X
2013	Winter	X	
2017	Light Load	X	X
2017	Summer	X	X
2017	Winter	X	X
2021	Summer		
2022	Summer	X	



# Annual Model Series Development

- List of Models
- Tie Lines and Interchange Coordination



# Tie Line and Interchange Coordination

- Only the interregional tie lines are coordinated by MMWG and will appear in the final power flow models as populated.
- A tie line will not be represented in a particular power flow base case model unless both parties involved have agreed to include it.
- The Regional Coordinators should only submit tie line changes (additions, deletions, and changes) from the prior year's Master Tie Line Database to the Power Flow Coordinator.
- The schedule shall show net scheduled interchange for each Region and for each area within that Region.
- All interchanges must net to zero for all models.



# Annual Model Series Development

- List of Models
- Tie Lines and Interchange Coordination
- Regional Data Submission



# Data Submission

- Data submitted should be in accordance with Power Flow Modeling and System Dynamic Modeling Guidelines
- Each region performs an N-1 screening of its bulk electric system



# Annual Model Series Development

- List of Models
- Tie Lines and Interchange Coordination
- Regional Data Submission
- Data Check Resolution



# Data Checks

- Unrealistic P<sub>MAX</sub> and P<sub>MIN</sub>
- Unrealistic Q<sub>MAX</sub> and Q<sub>MIN</sub>
- P<sub>GEN</sub> outside range
- Reactive device regulating node voltage more than one bus away. Exceptions to include three winding transformers and zero impedance lines.
- Switch shunts with  $V_{HI} - V_{LOW} < 0.0005$
- Controlled Bus Checks (CNTB) - Errors shall be corrected and warnings should be reviewed.
- Transformers with voltage band  $< 1.95 * \text{step}$
- RAW read warnings produced by PSSE.
- Buses with duplicate bus names within the same control area. Duplicate bus names are defined as having the same twelve character name and six character voltage fields.
- Buses with blank voltage fields.
- Machines connected to a Code 1 bus.
- Code 2 buses with no machines modeled.
- Machines with  $M_{BASE} < P_{MAX}$  or  $M_{BASE} = 100$ . Exceptions shall be documented.
- Machines with zero or non-positive RMPCT.
- Machines with  $GENTAP > 1.1$  or  $< 0.9$ .
- Branches with Rate B  $<$  Rate A (Required) or Rate A = 0.0 and Rate B = 0.0 (Warning) for 100 kV and above. Exceptions to include circuit 99 and zero impedance branches.
- Three winding transformers with Rate B  $<$  Rate A (Required) or Rate A = 0.0 and Rate B = 0.0 (Warning).
- Transformers with  $R_{MAX} \leq R_{MIN}$  or  $V_{MAX} \leq V_{MIN}$ . Required for non-fixed tap transformers only.
- Transformers with  $R_{MAX} = 1.5$  and  $R_{MIN} = 0.51$ . Required for non-fixed tap transformers only.
- Transformers with  $V_{MAX} = 1.5$  and  $V_{MIN} = 0.51$ . Required for non-fixed tap transformers only.
- Transformers with  $R_{MAX}, R_{MIN}, V_{MAX}$  or  $V_{MIN} = 0$ . Required for non-fixed tap transformers only.
- Switched shunts with missing Block 1 steps.
- Branches with loading above 100% of Rate A or B for 100 kV and above.
- Bus voltages under 90% or above 110% for 100 kV and above.
- Branches with resistance  $>$  |reactance| for 100 kV and above. Exceptions shall be documented.
- Buses with owner numbers out of range.
- Buses with zone numbers out of range.
- Buses with numbers out of range.



# Annual Model Series Development

- List of Models
- Tie Lines and Interchange Coordination
- Regional Data Submission
- Data Check Resolution
- Final Power Flow Model Published
- Dynamic Data Submission
- Final Dynamic Model Published



# ERAG Assessment Model Development

- MMWG develops two models for ERAG Assessment Studies
  - Summer Assessment
  - Winter Assessment/ Near term study/ Long term study



# Software Utilized

- Siemens PTI- PSS/E
- GE -PSLF
- Powertech – Power Flow Database (PFDB)
- Powertech- Dynamic Database (SDDB)



# Power Flow Database (Powertech)

The screenshot shows the Powerflow Database application window. On the left is a navigation tree with a 'Case Components' callout pointing to the tree structure. Below the tree is a 'Series Data' callout pointing to a sub-section. At the bottom left is a 'Navigation Tree' callout. The main area is a 'Data View' callout pointing to a table of data. The table has columns: NAME, BASKV, IDE, GL, BL, and AF. The data includes various bus names and their associated parameters.

Series Name	NAME	BASKV	IDE	GL	BL	AF
	CHESTER	345	Load	0	0	10'
100002	ORRINGTN	345	Load	0	0	10'
100003	MAXCYS	345	Load	0	0	10'
100004	ORR SCAP	345	Load	0	0	10'
Case Name(s)		115	Load	0	0	10'
100014	PERC TAP	115	Load	0	0	10'
100015	ENFIELD	115	Load	0	0	10'
100016	UP5 115	115	Load	0	0	10'
100017	CHESTER	115	Generator	0	0	10'
100018	REBEL HI	115	Load	0	0	10'
100019	ELLSWORT	115	Generator	0	0	10'
100020	DEBLOIS	115	Load	0	0	10'
100021	EPPING 1	115	Load	0	0	10'
100022	HARRINGT	115	Load	0	0	10'
100023	WASH. CT	115	Generator	0	0	10'
100024	KEENE RD	115	Load	0	0	10'
100025	ELLSWORT	44	Load	0	0	10'
100026	LINCOLN	44	Load	0	0	10'

54601 Records



# Dynamic Database (Powertech)

The screenshot displays the Microsoft Access application window titled "All dynamics models existed in SDDB". The interface is divided into three main sections:

- Tree View:** A hierarchical list of models under "ALL Dynamics Models in SDDB". The "SPP" region is expanded, showing a list of bus models including "AES 1G 1", "GENROU", "IEEE1", "IEEE1", "AES 2G 1", "CONEMG 1", "CONEMG 2", "DUKE1 1", "DUKE2 1", "DUKE3 1", "HSL 6G 1", "HSL 7G 1", "HSL 7S 1", "HSL 8G 1", "HSL 9G 1", "HSL10G 1", "MSRG3G 1", "MSRG4G 1", "MSRG5G 1", "MSRG6G 1", "MSTN1G 1", "MSTN2G 1", "MSTN3G 1", "MSTN4G 1", and "ONE1&2 1".
- Parameter Form:** A form for the selected model "AES 1G". It contains various input fields for parameters such as bus voltage (IBUS, JBUS), time constants (T1-T7), gains (K1-K8), and region (SPP). The "Record" indicator shows "1 of 1".
- Block Diagram:** A detailed transfer function diagram. It starts with an input  $\Delta\omega$  and  $\text{SPEED}_{HP}$  entering a block  $\frac{K(1+sT_2)}{1+sT_1}$ . This is followed by a summing junction  $\Sigma$  with feedback from  $P_0$ . The signal then passes through a block  $\frac{1}{T_3}$  and a block  $\frac{1}{s}$  (integrator). The output  $U_0$  is limited by  $P_{MAX}$  and  $P_{MIN}$ . The signal then passes through a series of blocks  $\frac{1}{1+sT_4}$ ,  $\frac{1}{1+sT_5}$ ,  $\frac{1}{1+sT_6}$ , and  $\frac{1}{1+sT_7}$ . Each of these blocks is followed by a summing junction  $\Sigma$  with feedback from gains  $K_1$  through  $K_8$ .

# Database Pros

- Consistent Topological Information
- Centralized Storage System
- Reduced Effort to Coordinate Tie Lines and Interchange
- Consolidated Error Checking
- Reduction in Annual Model Development Cost



# Future Developments

- Data accuracy
- Data Submission
- Tracking Modeling Changes
- Industry Input



<http://erag.info/>

Questions?

