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Industry Technical Conference (MOD-010 through MOD-015) Informal Development

May 9, 2013

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- Introductions of panelists and overview
- Standards informal development background
- MOD-010 through MOD-015 standards, current practices, and associated recommendations
- Discussion of approaches
 - Modeling Data standard proposal
 - Validation Standard proposal
- Participant-focused discussion
- Review key points for forward action and consensus items

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Introduction of Panelists and Overview

Steven Noess, Standards Developer

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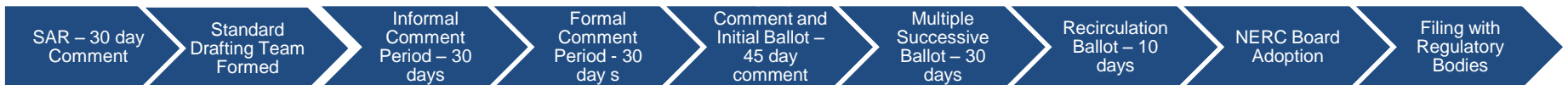
Development Process and Informal Efforts

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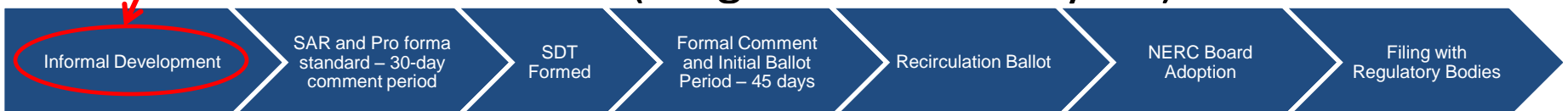
- August 2012 NERC Board of Trustees Meeting
 - FERC commissioners urged the industry to focus on creating a more efficient standards development process
 - NERC CEO focused on revamping the standards process for more efficiency and efficacy
 - NERC Board issued a resolution instructing the SPIG, MRC, SC, NERC staff and industry stakeholders to reform its standards program (November 2012)

Old Standards Process (1 to 3 years)

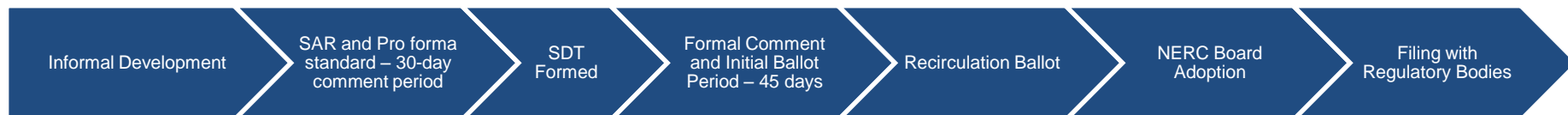


Resolving issues starts early

Revised Standards Process (Target: less than 1 year)



Revised Standards Process (Target: less than 1 year)



- Informal development - revised portion of the development process:
 - Ad-hoc group
 - Identify issues and possible solutions
 - Create pro forma Standard or proposed approaches
 - Create Standards Authorization Request (SAR)
- Post SAR and accompanying proposals
- Formal development (SDT formation through Filing)

- Three Separate Informal Efforts related to MOD standards:
 - MOD A: ATC/TTC/CBM (MOD-001, -004, -028, -029, and -030)
 - MOD B: Modeling Data (MOD-010 through MOD-015)
 - MOD C: Demand Data (MOD-016 through MOD-021)
- Emphasis on proposals to address outstanding FERC directives, mostly from FERC Order No. 693
- Outreach and Engagement:
 - Use industry subject matter experts
 - Work on issues related to consensus early
 - Maximize efficiency and use of resources during formal development
 - Support transition to formal development
 - Reduce breadth of issues requiring significant comment and resolution
 - Workshops and other opportunities for involvement

- Use Experts and Resources throughout project – pull in as needed
- Extended group members
 - Internal SMEs
 - Legal staff
 - ERO Compliance Operations
 - Standards Committee Member
 - Regional Entities
 - ERO Event Analysis
- Industry Experts
 - Researchers
 - Trades
 - FERC
 - NERC Committees
 - Standards Committee Member
 - Regional Entities

- Proposals include mechanisms to support “Results Based Standards” (RBS) format. Three types of RBS requirements:
 - Performance-based
 - Risk-based (preventive)
 - Capability-based
- Consider “Paragraph 81” (P81) criteria to ensure elimination of requirements that require responsible entities to conduct an activity or task that does little, if anything, to benefit or protect reliable operation of the Bulk Electric System (BES)
- Involving compliance and enforcement considerations early (e.g., concurrent Reliability Standard Audit Worksheet (RSAW) development, etc).

- FERC Directives remain outstanding
- August 14, 2003 and subsequent blackout recommendations
- IVGTF recommendations (April 2009)
- MVTF (MWG) whitepaper recommendations (Dec 2010)
- NERC SAMS whitepaper recommendations (Dec 2012)
- Status of Current Modeling Data Standards (Not all approved; “fill in the blank”)
- Why the MOD standards are necessary as standards and not as a data request:
 - Section 1600 data request not applicable outside of U.S.
 - Section 1600 data request not mandatory and no mechanism to compel participation without pursuing as federal action under section 215

- Directives Summary:
 - 1 Directive from FERC Order No. 890
 - 14 Directives from FERC Order No. 693
- FERC Order 890 Directive:
 - Paragraph 290: incorporate periodic review and modification of models, with certain criteria

- FERC Order 693 Directives:
 - Paragraph 1148: Require filing of all contingencies used in performing steady-state system operation and planning studies.
 - Paragraph 1152, 1181: address confidentiality issues
 - Paragraph 1154: include TOP as an applicable entity
 - Paragraphs 1155, 1162, 1184, 1199 : include PA/PC as an applicable entity “because (it) is the entity responsible for the coordination and integration of transmission facilities and resource plans, as well as one of the entities responsible for the integrity and consistency of the data.”
 - Paragraph 1178, 1183: add requirement to provide a list of the faults and disturbances used in performing dynamics system studies for system operation and planning, and require TSP to provide the lists

- FERC Order 693 Directives continued:
 - Paragraph 1197: permit entities to estimate dynamics data if they are unable to obtain unit specific data . . . But require that the results of these dynamics models be compared with actual disturbance data to verify accuracy
 - Paragraph 1210: require models be validated against actual system responses
 - Paragraph 1211: require actual system events be simulated and if model output is not within the accuracy required, the model shall be modified to achieve the necessary accuracy
 - Paragraph 1220: require actual system events be simulated and dynamics system model output be validated against actual system responses

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Current Approaches

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- Standards:
 - **MOD-010-0: Steady State Data (TO, GO, RP)**
 - MOD-011-0: Steady State Data (RRO)
 - **MOD-012-0: Dynamics Data (TO, GO, RP)**
 - MOD-013-1: Dynamics Data (RRO)
 - MOD-014-0: Steady State Models (RRO)
 - MOD-015-0.1: Dynamics Models (RRO)
- MOD-010 and MOD-012 approved by FERC (bolded above)
- MOD-011, MOD-013, MOD-014, and MOD-015 not approved due to “fill-in-the-blank” nature (applicable to “RRO”)

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Western Interconnection

Kent Bolton, WECC

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- 11 System Models per year
- Equipment Owners → Area Coordinators → WECC Staff
- WECC Staff – Model Builder
 - 2-Phase Process (Initial Submittals and Comments)
 - Includes Dynamics Data
 - PSLF → PSS/E

- Ongoing Process
- Multiple Software Programs
- Area Coordinator Role
- Dynamics Data with Each System Model

- Timeliness
- Adequate Review of Model
- Data Conversion
- Model Validation

- Current Standards
- Proposed Standards
 - 12 ACs → 29 PCs
 - TPs and PCs – added authority
 - GOs – specified submittal process

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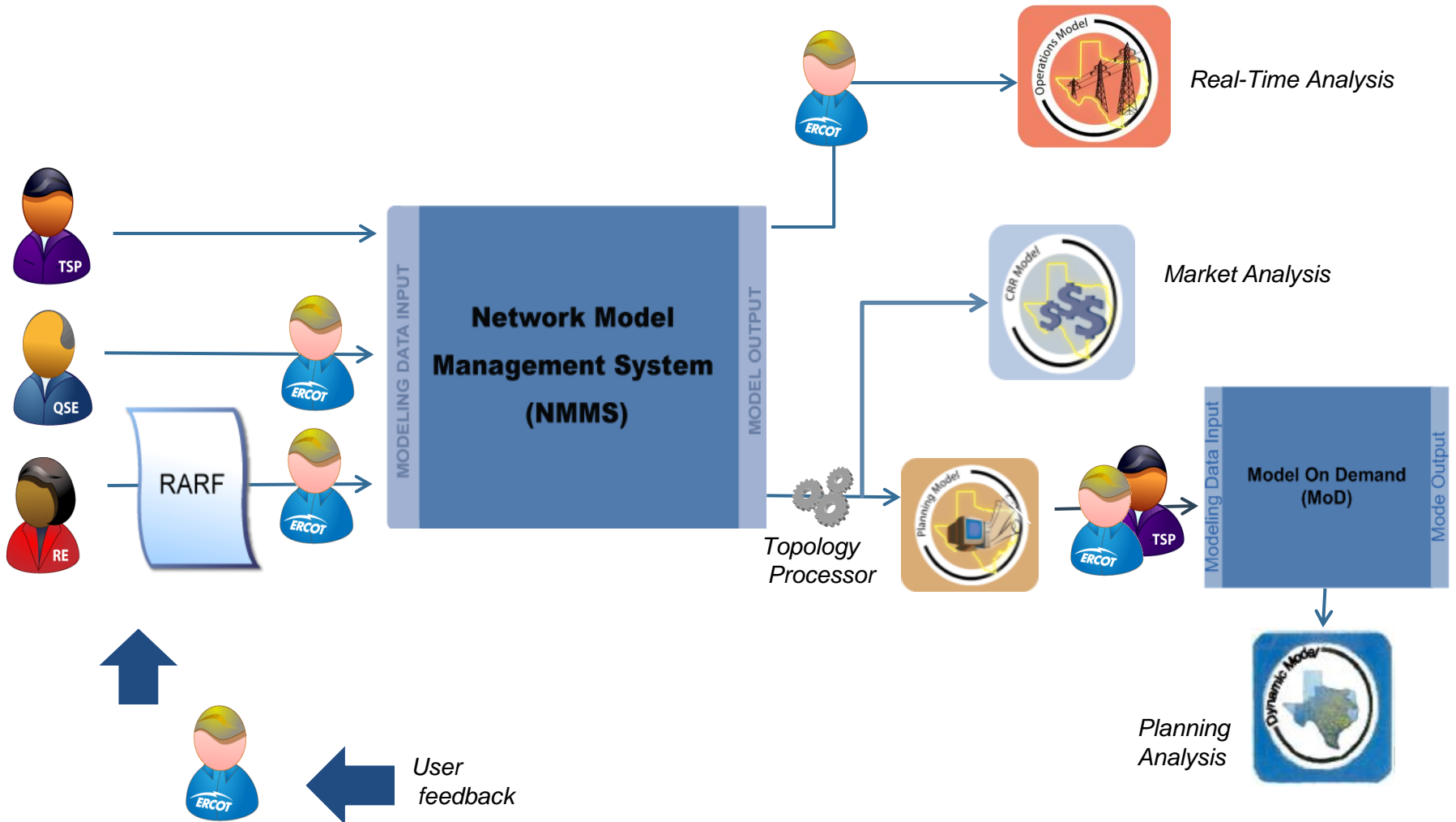
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Texas Interconnection

Jose Conto, ERCOT

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The Network Model Management System (NMMS) is an umbrella of applications to manage, process, prepare, validate, test, and provide consistent data to all the model-driven ERCOT operational, planning and market systems.

- NMMS serves as the single point of entry and maintenance for the network model topology.
- Built around the Siemens' Information Model Manager (IMM) and Model on Demand (MOD)
- Uses temporal based tracking methodologies to store the network models data changes.
- Utilizes Common Information Model (CIM) standards.

- Operation's steady state model is validated using the on-line State Estimator (SE) and SCADA tools. Process exists to check and resolve errors.
- Models entry in dynamic case are being verified as same as reported by data owners.
- Models are tested for compatibility and dynamic behavior during a no-disturbance test process.
- ERCOT working groups review models periodically and analyze post-event system response as requested.

- MOD Standards will strengthen current ERCOT process to collect data and develop network models suitable for system studies.
- Consolidated MOD Standards will give a clear set of requirements to data owners on the type of data needed to model and test reliably the power system.

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Eastern Interconnection

Adam Flink, MRO
MMWG Chairman

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Organization of Eastern Interconnection (EI) differs from WECC and ERCOT

- Six Regional Entities instead of one
- Some Planning Coordinator and RTO footprints cross Regional boundaries.
- Areas of EI that did not establish RTOs have individual utilities registered as Planning Coordinators.
 - 51 Planning Coordinators in the EI.
 - Number of Planning Coordinators per Region ranges from 1 to 21
 - Sizes of Planning Coordinator footprints vary greatly within EI

Eastern Interconnection Reliability Assessment Group (ERAG)



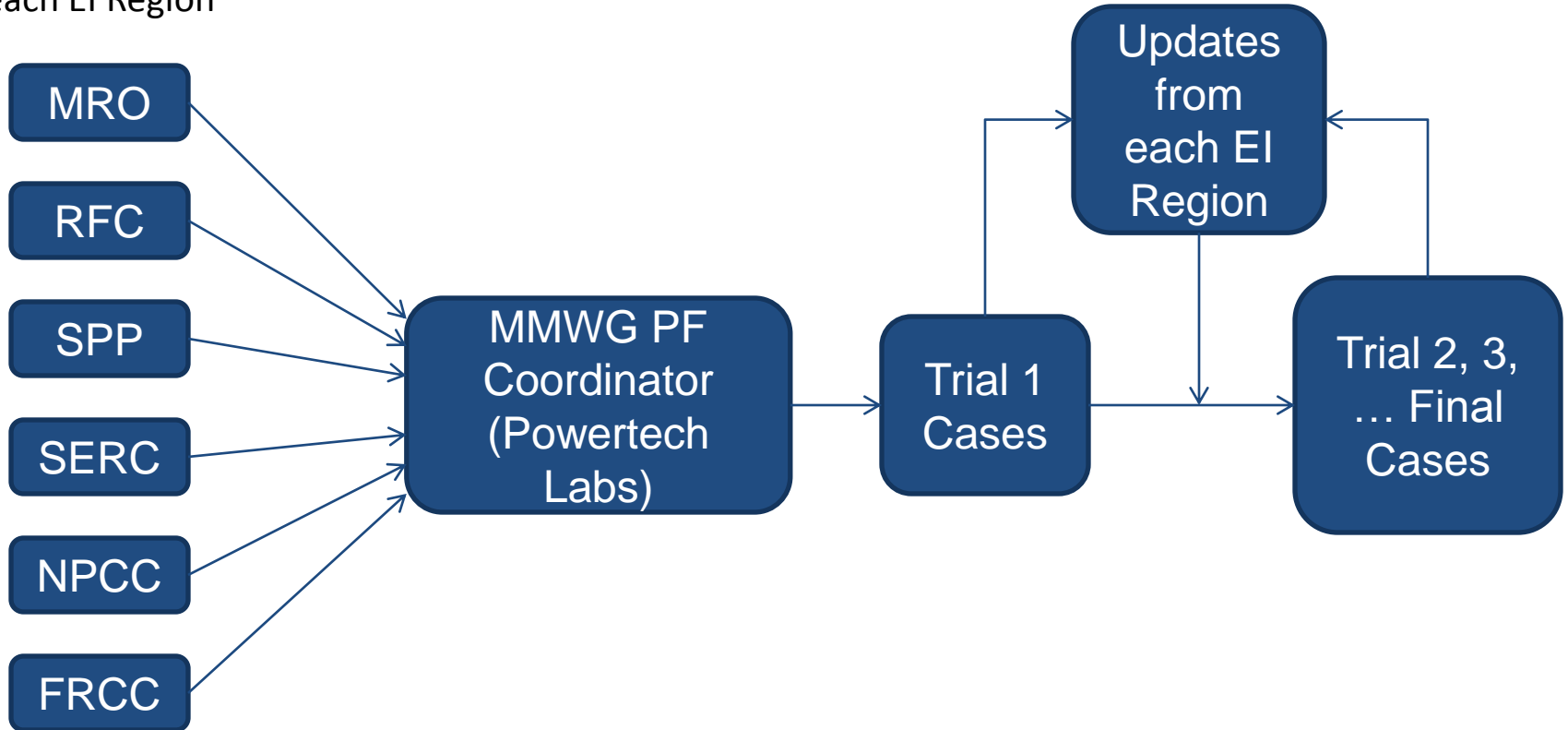
- **ERAG**

- Established by the six Regional Entities of the Eastern Interconnection in 2006
- ERAG Management Committee (MC) oversees all ERAG tasks
- Multi-Regional Modeling Working Group (MMWG) develops power flow and dynamic base case models
 - NERC transferred oversight of the MMWG to ERAG in 2006
- Steering Committee (SC) oversees three inter-regional study forums
 - Northeastern, NPCC – RFC
 - Southeastern (SeR), SERC east (VACAR, Central subregions) – RFC
 - Western, MRO - RFC - SERC west (Central, Delta, Gateway subregions) – SPP (MRSWS)

- **MMWG**
 - Made up of representatives from each region
 - Responsible for developing a library of solved power flow models and associated dynamics simulation models of the Eastern Interconnection.
 - Maintains a Procedural Manual containing:
 - Key procedures for the functioning of the MMWG
 - Model Data Requirements
 - Maintains a model building schedule
 - Contracts Power Flow Coordinator and Dynamic Coordinator to perform model building work

- Thirteen MMWG power flow cases are built by combining complete power flow cases from each region.
- Eight of the thirteen MMWG cases are dynamics compatible.

13 PF cases from
each EI Region



- MMWG Region Coordinators submit dynamics data to the MMWG Dynamics Coordinator (Powertech Labs)
- Dynamics Coordinator maintains all dynamics data in the System Dynamics Data Base (SDDB)
- Dynamics Coordinator exports DYRE files from SDDB for each of the eight associated power flow cases
- Dynamics Coordinator builds each dynamics case
 - Work with Region Coordinators to correct problems
 - Perform testing on each case as prescribed by the MMWG
- MMWG distributes finalized dynamics cases

- Current improvements to MMWG model building process
 - Power flow data checking
 - Power flow auditing
 - Dynamics data checking
 - Dynamics simulation based testing
 - Frequency response
 - Web based dynamics data base
 - Data submitters provide data directly to EI-wide data base
 - Data access controls
 - Change auditing and activity logging
 - Built-in data checking

Questions on Current Approaches?

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Event Recommendations

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- **NERC Recommendation 14:** “The regional reliability councils shall within one year establish and begin implementing criteria and procedures for validating data used in power flow models and dynamic simulations by benchmarking model data with actual system performance.”
- **Task Force Recommendation 24:** Improve quality of system modeling data and data exchange practices. “The Task Force supports these requirements strongly. The Task Force also recommends that FERC and appropriate authorities in Canada require all generators, regardless of ownership, to collect and submit generator data to NERC, using a regulator-approved template.”

- September 18, 2007 (MRO)
 - Develop efficient translation of telemetry data for model benchmarking
 - Initiate a dynamic model validation regime to benchmark models
 - “develop a standard/requirement regarding reporting electrical, dynamics and machine and plant protection characteristics of non-conventional (e.g., wind, solar, small hydro) generation data”
- September 8, 2011 (Pacific Southwest)
 - Recommendation 10: Benchmark WECC dynamic models against actual performance
 - Recommendation 16: Ensure consistencies in model parameters between planning and RTCA models

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Other Recommendations

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- IVGTF (Integration of Variable Generation Task Force) Special Report titled "Accommodating High Levels of Variable Generation" (April 2009)
 - Standard, valid, generic, non-confidential, and public power flow and stability models (variable generation) are needed and must be developed, enabling planners to maintain bulk power system reliability.
 - IVGTF Work Plan: Review the Modeling, Data and Analysis Standards (MOD) for improvements required to support simulation of power systems with high amounts of variable generation.

- Improve and Strengthen MOD-010 through MOD-015
- Standardization of functional requirements, including data exchange formats
 - Standardized Component Models
- Industry should make periodic model validation and benchmarking an integral part of off-line study model maintenance
- Industry should validate operational planning (offline) models by comparing them with models developed from real-time data

- Reduce the quantity of the MOD standards
- Add short circuit data to MOD standards
- Add to the Requirement to Supply Data and Models:
 - Identify responsibility to provide and receive data (who provides what data to whom)
 - Provision for acceptability of data
 - Require specification and use of standard format
 - Consider how to deal with new technology
 - Shareability

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Proposed Approach

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- Consolidation into single modeling standard for data collection for steady-state, dynamics, and short circuit
- Attachment approach for data requirements
- Separate standard for validation (ties-in to FERC Directives from Order No. 693)

- Proposed single modeling standard to combine and replace MOD-010 through MOD-015
 - Requirement R1: provide steady-state, dynamics, and short circuit data to Planning Coordinator(s) and Transmission Planner(s) according to the data requirements specified in Attachment 1 and other criteria.
 - Attachment 1: Specifies a three column detailed matrix of data requirements for steady-state, dynamics, and short-circuit data

- Proposed single standard (R2):
 - Requirement R2: Provides a requirement for entities that submit data to provide correct data
 - Covers data sufficiency, usability, consistency, and accuracy
 - Tool for PC or TP in collecting data
 - Does not obligate a process to check/confirm data
 - Uses format similar to MOD-26-1 requirements (*see, e.g., MOD-26-1, Requirement R3*)

- Proposed single standard (R3):
 - Requirement R3: To facilitate creation of interconnection-specific models, a requirement for Planning Coordinator to submit data collected under Requirement R1 according to a (proposed) NERC list of modeling organizations (which are the organizations that currently exist)
 - Intended to create clear expectation that each Planning Coordinator will provide the data they collect under Requirement R1 according to an interconnection-specific process
 - Recognizes the differences among interconnections in model building process, but creates obligation for PC to provide the data in a manner that accounts for those differences.
 - Replaces MOD-014 and MOD-015

Questions on Data?

- Why a separate standard for Validation?
 - Harder to get consensus on validation approaches
 - Relationship with the data standard
- Validation standard
 - Not duplicate other standards like MOD-025, -026, -027
 - Focus on what PC could reasonably do
 - Interconnection-wide phenomena outside PC's purview
- How prescriptive should the standard be?
 - Focus on results
 - Leave judgment to the PC
 - Added some information in the guidance section at the bottom of the standard

- How close is close enough for a validation?
 - For load flow comparison to EMS case – should flows on major lines be within 10%?
 - Or be within 10% or within 100 MW whichever is larger; make it specific to voltage level?
 - Or as FERC directive states - The maximum discrepancy between the actual system performance and the model should be small enough that decisions made by planning entities based on output from the model would be consistent with the decisions of operating entities based on actual system response.
 - Empower the judgment of the PC?

- Validation of dynamic load models?
 - Validate the magnitude/percent of the induction motors used in load models on a regular basis but no less than every two years. The validation can be made using End Use surveys, actual load shapes at substations, or customer load data. The comparison of the magnitude/percent shall be made on an aggregate company or power flow zone level at a minimum but may also be made on a bus by bus, load pocket, or smaller area basis as deemed appropriate by the PC.
 - There's still too much unknown about the dynamic behavior of the loads to require some kind of validation. I think this falls into the good utility practice but not into the standards arena yet.

- What system condition should be used to validate power flow models?
 - Peak load condition?
 - Stressed condition that gives unexpected results?
 - NERC reportable event?
 - Local event?

- What system condition should be used to validate dynamics models?
 - NERC reportable event?
 - Significant system disturbance?
 - Dynamic local event?

- R1. Each Planning Coordinator must validate the data used for steady state and dynamic analyses (the data submitted under MOD-TBD-01 (the single modeling data standard)) for its planning area against actual system responses as follows:
 - 1.1 Validate its portion of the system in the power flow model by comparing it to a state estimator case to check for discrepancies that the Planning Coordinator determines are large or unexplained at least once every 24 calendar months and through simulation of a local event, if any.

- Guidance section:
 - For the validation in part 1.1 the state estimator case should be taken as close to system peak as possible. However, other snapshots of the system could be utilized if deemed to be more appropriate by the Planning Coordinator. While the requirement specifies “once every 24 calendar months,” entities are encouraged to perform the comparison on a more frequent basis.
 - In performing the comparison required in Part 1.1, the PC should consider, among other considerations:
 - System load;
 - Transmission topology and parameters;
 - Voltage at major buses; and
 - Flows on major transmission elements.

- Guidance section:
 - The validation in 1.1 would include consideration of the load distribution and load power factors used in its power flow models.
 - The validation may be made using metered load data if state estimator cases are not available.
 - The comparison of system load distribution and load power factors shall be made on an aggregate company or power flow zone level at a minimum but may also be made on a bus by bus, load pocket (e.g., within a Balancing Authority), or smaller area basis as deemed appropriate by the Planning Coordinator.

- R1:
 - 1.2 Validate its portion of the system in the dynamic models through simulation of a dynamic local event, if any. Complete the simulation within 12 calendar months of the system event.

- Guidance:
 - The validation required in part 1.2 should include simulations which are to be compared with actual system data and may include comparisons of:
 - Voltages oscillations at major buses
 - System frequency (for events with frequency excursions)
 - Real and reactive power oscillations on generating units and major inter-area ties

- R1:
 - 1.3 Correct the model for accuracy in coordination with the data owner when the Planning Coordinator determines the discrepancy between actual system response and expected system performance is too large.

- What if the PC cannot match an event with the model?
- In the guidance section of the standard:
 - However, for some disturbances, the data in the PC's area may not be what is causing the simulations to not match actual responses. These situations should be reported to the ERO.

- R2. Each Reliability Coordinator shall provide data to its Planning Coordinator within 30 calendar days of receiving written notification from its Planning Coordinator requesting data necessary to perform validation under Requirement 1, such as, but not limited to, Real-time data necessary for actual system response validation.

Questions on Validation?

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Participant-focused Discussion

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Key Points for Forward Action and Consensus Items

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- Upcoming MOD B Webinars and Workshops
 - June 18, 2013—Salt Lake City, UT: Industry Technical Conference (details TBD)
 - June 25, 2013—Location TBD (DC/Baltimore/VA area) Industry Technical Conference
- Key Dates (for planning purposes; subject to change)
 - May/June 2013 – Posting of the SAR for 30 day comment
 - July/August 2013 – Initial ballot posting: Pro-forma Standard and RSAW for 45 day comment
 - October 2013 – Recirculation Ballot
 - November 2013 – Board of Trustees Adoption
 - December 2013 – File with FERC

- Email list for information distribution specific to MOD B effort
 - To be added to the list, contact Steven Noess, steven.noess@nerc.net
- MOD B Web site:
http://www.nerc.com/filez/standards/MOD_B_Informal_Development_Project-RF.html
- Attend technical conferences (details to follow):
 - June 18, 2013: Salt Lake City, UT
 - June 25, 2013: Location TBD



Questions and Answers