Standard Development Timeline

This section is maintained by the drafting team during the development of the standard and will be removed when the standard becomes effective.

Development Steps Completed

1. SAR and supporting package posted for comment (~~Dates of posting TBD~~July 2013).
2. First posting for 45-day comment period and concurrent ballot (July 2013).
3. Second posting for a 45-day comment period and concurrent ballot (October 2013).

Description of Current Draft

This is the ~~first~~ second posting of this standard for a 45-day formal comment period and ~~initial~~ ballot. Several directives remain outstanding (including from FERC Order No. 693) that relate to MOD-010 through MOD-015. This standard and Standard MOD-032-1 ~~seek to~~ address the outstanding directives while simultaneously incorporating recommendations for improvement from the NERC Planning Committee's System Analysis and Modeling Subcommittee (SAMS).

Anticipated Actions	Anticipated Date
Post SAR	July 2013
45-day Formal Comment Period with Parallel ~~Initial~~ Ballot	July 2013
Additional 45-day Formal Comment Period with Parallel Ballot	October 2013
~~Recirculation~~ Final ballot	~~September~~ December 2013
BOT adoption	~~November~~ December 2013

~~Effective Dates~~

~~In those jurisdictions where regulatory approval is required, this standard shall become effective on the first day of the twelfth calendar quarter after applicable regulatory approval or as otherwise made effective pursuant to the laws applicable to such ERO governmental authorities. In those jurisdictions where no regulatory approval is required, this standard shall become effective on the first day of the twelfth calendar quarter after Board of Trustees approval.~~

Version History

Version	Date	Action	Change Tracking
1	TBD	Developed as a new standard for system validation to address outstanding directives from FERC Order No. 693 and recommendations from several other sources.	

Definitions of Terms Used in Standard

None

When this standard has received ballot approval, the text boxes will be moved to the Application Guidelines Section of the Standard.

A. Introduction

1. **Title: Steady-State and Dynamic System Model Validation**

2. **Number: MOD-033-1**

3. **Purpose: To establish consistent validation requirements to facilitate the collection of accurate data and building of planning models to analyze the reliability of the interconnected transmission system.**

4. **Applicability:**

   4.1. Functional Entities:

   4.1.1 Planning Authority and Planning Coordinator~~s~~ (hereafter referred to as "Planning Coordinator")

   This proposed standard combines "Planning Authority" with "Planning Coordinator" in the list of applicable functional entities. The NERC Functional Model lists "Planning Coordinator" while the registration criteria list "Planning Authority," and they are not yet synchronized. Until that occurs, the proposed standard applies to both Planning Authority and Planning Coordinator.

   4.1.2 Reliability Coordinator~~s~~

   4.1.3 Transmission Operator~~s~~

5. **Effective Date:**

   MOD-033-1 shall become effective on the first day of the first calendar quarter that is 36 months after the date that the standard is approved by an applicable governmental authority or as otherwise provided for in a jurisdiction where approval by an applicable governmental authority is required for a standard to go into effect. Where approval by an applicable governmental authority is not required, the standard shall become effective on the first day of the first calendar quarter that is 36 months after the date the standard is adopted by the NERC Board of Trustees or as otherwise provided for in that jurisdiction.

~~5.~~6. **Background:**

   MOD-033-1 exists in conjunction with MOD-032-1, both of which are related to system-level modeling and validation. Standard MOD-032-1 is a consolidation and replacement of existing MOD-010-0, MOD~~-~~-011-0, MOD-012-0, MOD-013-1, MOD-014-0, and MOD-015-0.1, and it requires ~~a minimum level of~~ data submission by applicable data owners to their respective Transmission Planners and Planning Coordinators to support the ~~i~~Interconnection-wide case ~~model~~ building process in

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Comment [SN1]: The changes to the effective date language in the implementation plan are not material changes to the previously posted timelines. Rather, they are changes in effective date language format.

Formatted: Indent: Left: 0.65", Space Before: 0 pt, After: 6 pt their ~~i~~Interconnection. Standard MOD-033-1 is a new standard, and it requires each Planning Coordinator to implement a documented process to perform model validation within its planning area.

The transition and focus of responsibility upon the Planning Coordinator function in both standards are driven by several recommendations and FERC directives (to include several remaining directives from FERC Order No. 693), which are discussed in greater detail in the rationale sections of the standards. One of the most recent and significant set of recommendations came from the NERC Planning Committee's System Analysis and Modeling Subcommittee (SAMS). SAMS proposed several improvements to the modeling data standards, to include consolidation of the standards (that whitepaper is available from the December 2012 NERC ~~Planning~~ Planning Committee's agenda package, item 3.4, beginning on page 99, here: http://www.nerc.com/comm/PC/Agendas%20Highlights%20and%20Minutes%20DL/2012/2012_Dec_PC%20Agenda.pdf).

The focus of validation in this standard is not Interconnection-wide phenomena, but on the Planning Coordinator's portion of the existing system. The Reliability Standard requires Planning Coordinators to implement a documented data validation process for power flow and dynamics. For the dynamics validation, the target of validation is those events that the Planning Coordinator determines are dynamic local events. A dynamic local event could include such things as closing a transmission line near a generating plant. A dynamic local event is a disturbance on the power system that produces some measurable transient response, such as oscillations. It could involve one small area of the system or a generating plant oscillating against the rest of the grid. The rest of the grid should not have a significant effect. Oscillations involving large areas of the grid are not local events. However, a dynamic local event could also be a subset of a larger disturbance involving large areas of the grid.

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B. Requirements and Measures

Rationale for R1:

In FERC Order No. 693, paragraph 1210, the Commission directed inclusion of "a requirement that the models be validated against actual system responses." Furthermore, the Commission directs in paragraph 1211, "that actual system events be simulated and if the model output is not within the accuracy required, the model shall be modified to achieve the necessary accuracy." Paragraph 1220 similarly directs validation against actual system responses relative to dynamics system models. In FERC Order 890, paragraph 290, the Commission states that "the models should be updated and benchmarked to actual events." Requirement R1 addresses these directives.

Requirement R1 requires the ~~PC~~ Planning Coordinator to implement a documented data validation process to validate data in the Planning Coordinator's portion of the existing system ~~for~~in the ~~steady state~~steady-state and dynamic models to compare performance against expected behavior or response~~within its area~~, which is consistent with the Commission directives. The validation of the full ~~interconnection model~~Interconnection-wide cases is left up to the Electric Reliability Organization (ERO) or its designees, and is not addressed by this standard. The following items were chosen for the validation requirement:

A. Comparison of performance of the existing system in a planning power flow model to actual system behavior ~~state estimator snapshot~~; and

B. ~~Simulation of significant system disturbances and comparing the simulation results with the actual event results~~Comparison of the performance of the existing system in a planning dynamics model to actual system response.

Implementation of these validations will result in more accurate power flow and dynamic models. This, in turn, should result in better correlation between system flows and voltages seen in power flow studies and the actual values seen by system operators during outage conditions. Similar improvements should be expected for dynamics studies, such that the results will more closely match the actual responses of the power system to disturbances.

Validation of model data is a good utility practice, but it does not easily lend itself to Reliability Standards requirement language. Furthermore, it is challenging to determine specifications for thresholds of disturbances that should be validated and how they are determined. Therefore, this requirement focuses on the Planning Coordinator performing validation pursuant to the criteria listed without specifying the details of "how" it must validate, which is necessarily dependent upon facts and circumstances. Other validations are best left to guidance rather than standard requirements.

~~Part 1.3 supports confirming or correcting the model for accuracy in coordination with the data owner when the actual system response does not match expected system performance, which could be accomplished through use of MOD-032-1, Requirement R4, if necessary.~~

R1. Each Planning Coordinator ~~must~~shall implement a documented data validation process~~ to 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~~ that includes the following attributes~~, at a minimum, the following items~~: *[Violation Risk Factor: Medium] [Time Horizon: Long-term Planning]*

1.1. ~~Validate its~~Comparison of the performance of the Planning Coordinator's portion of the existing system in ~~the~~ a planning power flow model ~~by comparing it~~ to actual system behavior, represented by a state estimator case or other Real-time data sources, ~~to check for discrepancies that the Planning Coordinator determines are large or unexplained~~ at least once every 24 calendar months through simulation;~~.~~

1.2. ~~Validate its~~ Comparison of the performance of the Planning Coordinator's portion of the existing system in ~~the~~ a planning dynamic model~~s~~ to actual system response, ~~at least once every 24 calendar months~~ through simulation of a dynamic local event, at least once every ~~, unless the time between dynamic local events exceeds~~ 24 calendar months. If ~~the time between~~no dynamic local ~~events exceeds~~event occurs within the 24 calendar months, ~~validate its~~ use~~portion of the system in the dynamic models through simulation of~~ the next dynamic local event that occurs;~~.~~ ~~Complete the simulation within 12 calendar months of the local event.~~

~~1.2.~~**1.3.** Guidelines the Planning Coordinator will use to determine unacceptable differences in performance under Part 1.1 or 1.2; and

~~1.3.~~**1.4.** Guidelines to~~Coordinate with the data owner(s) to confirm or correct the model for accuracy~~resolve differences in performance identified under Part 1.3 ~~when the discrepancy between actual system response and expected system performance is too large, as determined by the Planning Coordinator~~.

M1. ~~Examples of evidence may include, but are not limited to, a documented validation process and~~ Each Planning Coordinator shall provide evidence that it has a documented validation process according to Requirement R1 as well as evidence that demonstrates the implementation of the required components of the process.

Rationale for R2:

The Planning Coordinator will need actual ~~real time~~ system behavior data in order to perform the validations required in R1. The Reliability Coordinator or Transmission Operator may have this data. Requirement R2 requires the Reliability Coordinator and Transmission Operator to supply actual system data, if it has the data, to any requesting Planning Coordinator for purposes of model validation under Requirement R1.

This could also include information the Reliability Coordinator or Transmission Operator has at a field site. For example, if a PMU or DFR is at generator site and it is recording the disturbance, the Reliability Coordinator or Transmission Operator would typically have that data.

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R2. Each Reliability Coordinator and Transmission Operator shall provide actual system behavior data (or a written response that it does not have the requested data) to any Planning Coordinator ~~that the Planning Coordinator requests to~~ performing validation under Requirement R1 within 30 calendar days of a written request, such as, but not limited to, state estimator case or other Real-time data (including disturbance data recordings) necessary for actual system response validation. *[Violation Risk Factor: Lower] [Time Horizon: Long-term Planning]*

M2. Each Reliability Coordinator and Transmission Operator shall provide evidence, such as email notices or postal receipts showing recipient and date that it has distributed the requested data or written response that it does not have the data, to any Planning Coordinator who has indicated a need for the data for validation purposes within 30 days of a written request in accordance with Requirement R2; or a statement by the Reliability Coordinator or Transmission Operator that it has not received notification regarding data necessary for validation by any Planning Coordinator.

C. Compliance

1. Compliance Monitoring Process

1.1. Compliance Enforcement Authority

~~1.1.~~ As defined in the NERC Rules of Procedure, "Compliance Enforcement Authority" means NERC or the Regional Entity in their respective roles of monitoring and enforcing compliance with the NERC Reliability Standards.

~~Regional Entity~~

1.2. Evidence Retention

~~1.2.~~

The following evidence retention periods identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the Compliance Enforcement Authority may ask an entity to provide other evidence to show that it was compliant for the full time period since the last audit.

The Applicable Entity shall keep data or evidence to show compliance with Requirements R1 through R2, and Measures M1 through M2, since the last audit, unless directed by its Compliance Enforcement Authority to retain specific evidence for a longer period of time as part of an investigation.

If an Applicable Entity is found non-compliant, it shall keep information related to the non-compliance until mitigation is complete and approved, or for the time specified above, whichever is longer.

The Compliance Enforcement Authority shall keep the last audit records and all requested and submitted subsequent audit records.~~The following evidence retention periods identify the period of time an entity is required to retain specific evidence to demonstrate compliance. For instances where the evidence retention period specified below is shorter than the time since the last audit, the CEA may ask an entity to provide other evidence to show that it was compliant for the full time period since the last audit.~~

~~The Responsible Entity shall keep data or evidence to show compliance as identified below unless directed by its CEA to retain specific evidence for a longer period of time as part of an investigation:~~

- ~~Each Responsible Entity shall retain evidence of each requirement in this standard for three calendar years.~~
- ~~If a Responsible Entity is found non-compliant, it shall keep information related to the non-compliance until mitigation is complete and approved or for the time specified above, whichever is longer.~~

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- ~~The CEA shall keep the last audit records and all requested and submitted subsequent audit records.~~

1.3. Compliance Monitoring and Assessment Processes:

Refer to the NERC Rules of Procedure for the Compliance Monitoring and Assessment processes.~~Compliance Audits~~

~~Self-Certifications~~

~~Spot Checking~~

~~Compliance Violation Investigations~~

~~Self-Reporting~~

~~Complaints Text~~

1.4. Additional Compliance Information

None

Table of Compliance Elements

R #	Time Horizon	VRF	Violation Severity Levels			
			Lower VSL	Moderate VSL	High VSL	Severe VSL
R1	**Long-term Planning**	**Medium**	The Planning Coordinator documented and implemented a process to validate data but did not address one of the four required topics under Requirement R1; ~~The Planning Coordinator did not validate its portion of the system in the power flow model as required by R1 but did validate in less than or equal to 28 calendar months;~~ OR The Planning Coordinator did not perform simulation as required by part 1.1 within 24 calendar	The Planning Coordinator documented and implemented a process to validate data but did not address ~~one~~ two of the ~~three~~ four required topics under Requirement R1; OR The Planning Coordinator did not perform simulation as required by part 1.1 within 24 calendar months but did perform the simulation in greater than 28 calendar months but less than or equal to 32 calendar months; OR	The Planning Coordinator documented and implemented a process to validate data but did not address three of the four required topics under Requirement R1;~~The Planning Coordinator documented and implemented a process to validate data but did not address two of the three required topics under Requirement R1;~~ OR The Planning Coordinator did not perform simulation as required by part 1.1 within 24 calendar	The Planning Coordinator did not have a validation process at all or did not document or implement any of the ~~three~~ four required topics under Requirement R1; OR The Planning Coordinator did not validate its portion of the system in the power flow model as required by ~~R1~~ part 1.1 within ~~or did validate but exceeded~~ 36 calendar months ~~between validation~~; OR The Planning Coordinator did not perform simulation as

			months but did perform the simulation within 28 calendar months; OR The Planning Coordinator did not ~~complete~~ perform simulation as ~~of the local event~~required by part 1.2 within ~~12~~ 24 calendar months (or the next dynamic local event in cases where there is more than 24 months between events) ~~in validating its portion of the system in the dynamic models as required by R1~~ but did ~~complete~~ perform the simulation ~~in less than or equal to 15 calendar months~~within 28 calendar months.	The Planning Coordinator did not perform simulation as required by part 1.2 within 24 calendar months (or the next dynamic local event in cases where there is more than 24 months between events) but did perform the simulation in greater than 28 calendar months but less than or equal to 32 calendar months. ~~The Planning Coordinator did not validate its portion of the system in the power flow model as required by R1 but did validate in greater than 28 calendar months but less than or equal to 32 calendar months;~~ ~~OR~~ ~~The Planning Coordinator did not~~	months but did perform the simulation in greater than 32 calendar months but less than or equal to 36 calendar months; OR The Planning Coordinator did not perform simulation as required by part 1.2 within 24 calendar months (or the next dynamic local event in cases where there is more than 24 months between events) but did perform the simulation in greater than 32 calendar months but less than or equal to 36 calendar months.~~The Planning Coordinator did not validate its portion of the system in the power flow model as required by R1 but did validate in greater than 32~~	required by part 1.2 within 36 calendar months (or the next dynamic local event in cases where there is more than 24 months between events)~~The Planning Coordinator did not complete simulation of the local event at all in validating its portion of the system in the dynamic models as required by R1 or did complete the simulation but exceeded 18 calendar months~~.

				~~complete simulation of the local event within 12 calendar months in validating its portion of the system in the dynamic models as required by R1 but did complete the simulation in greater than 15 calendar months but less than or equal to 18 calendar months.~~	~~calendar months but less than or equal to 36 calendar months;~~ ~~OR~~ ~~The Planning Coordinator did not complete simulation of the local event within 12 calendar months in validating its portion of the system in the dynamic models as required by R1 but did complete the simulation in greater than 18 calendar months but less than or equal to 21 calendar months.~~	
R2	**Long-term Planning**	**Lower**	The Reliability Coordinator or Transmission Operator did not provide requested actual system behavior data (or a written response that it does not have the requested data) to a requesting ~~planning coordinator~~ Planning	The Reliability Coordinator or Transmission Operator did not provide requested actual system behavior data (or a written response that it does not have the requested data) to a requesting Planning Coordinator~~planning~~	The Reliability Coordinator or Transmission Operator did not provide requested actual system behavior data (or a written response that it does not have the requested data) to a requesting Planning Coordinator~~planning~~	The Reliability Coordinator or Transmission Operator did not provide ~~any~~ requested actual system behavior data (or a written response that it does not have the requested data) to a requesting Planning Coordinator~~planning~~

			Coordinator within 30 calendar days of the written request, but did provide the data (or written response that it does not have the requested data) in less than or equal to 45 calendar days.	~~coordinator~~ within 30 calendar days of the written request, but did provide the data (or written response that it does not have the requested data) in greater than 45 ~~calednar~~ calendar days but less than or equal to 60 calendar days.	~~coordinator~~ within 30 calendar days of the written request, but did provide the data (or written response that it does not have the requested data) in greater than 60 calendar ~~calednar~~ days but less than or equal to 75 calendar days.	~~coordinator~~ within 75 calendar days; OR The Reliability Coordinator or Transmission Operator provided a written response that it does not have the requested data, but actually had the data. ~~The Reliability Coordinator or Transmission Operator did not provide requested actual system behavior data (or a written response that it does not have the requested data) to a requesting planning coordinator within 30 calendar days of the written request, but did provide the data (or written response that it does not have the requested data) in greater than 45 calednar days but less~~

						~~than or equal to 60 calendar days.~~

D. Regional Variances

None.

E. Interpretations

None.

F. Associated Documents

None.

Application Guidelines

Guidelines and Technical Basis

Requirement R1:

The requirement focuses on the results-based outcome of developing a process for and performing a validation, but does not prescribe a specific method or procedure for the validation outside of the criteria specified in the requirement. For further information on suggested validation procedures, see "Procedures for Validation of Powerflow and Dynamics Cases" produced by the NERC Model Working Group.

The specific process is left to the judgment of the Planning Coordinator, but the Planning Coordinator is ~~encouraged~~ required to develop and include in its process ~~criteria~~ guidelines for evaluating discrepancies between actual system behavior or response and expected system performance for determining whether the discrepancies are ~~too large or unexplained~~unacceptable.

For the validation in part 1.1 the state estimator case or other Real-time data should be taken as close to system peak as possible. However, other snapshots of the system could be ~~utilized~~ used 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 Planning Coordinator should consider, among other criteria:

1. System load;
2. Transmission topology and parameters;
3. Voltage at major buses; and
4. Flows on major transmission elements.

The validation in part 1.1 would include consideration of the load distribution and load power factors (as applicable) used in the 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.

The scope of dynamics model validation is intended to be limited, for purposes of part 1.2, to the Planning Coordinator's planning area, and the intended emphasis under the requirement is on local events or local phenomena, not the whole ~~i~~Interconnection.

The validation required in part 1.2 should include simulations ~~which~~ that 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

Application Guidelines

Part 1.3 requires guidelines for determining when discrepancies in the comparison of simulation results with actual system results are unacceptable. For the power flow comparison, this could include a guideline the Planning Coordinator will use that flows on 500 kV lines should be within 10% or 100 MW, whichever is larger. It could be different percentages or MW amounts for different voltage levels. Or the guideline for voltage comparisons could be that it must be within 1%. But the guidelines should be meaningful for the Planning Coordinator's system. Guidelines for the dynamic event comparison may be less precise. Regardless, the comparison should indicate that the conclusions drawn from the two results should be consistent. For example, the guideline could state that the simulation result will be plotted on the same graph as the actual system response. Then the two plots could be given a visual inspection to see if they look similar or not. Or a guideline could be defined such that the rise time of the transient response in the simulation should be within 20% of the rise time of the actual system response. As for the power flow guidelines, the dynamic comparison criteria should be meaningful for the Planning Coordinator's system.

The guidelines to resolve differences in Part 1.4 could ~~be accomplished in~~include direct coordination with the data owner, and, if necessary, through the provisions of MOD-032-1, Requirement R3~~4~~ (i.e., the validation performed under this requirement could identify technical concerns with the data). In other words, while this standard is focused on validation, results of the validation may identify data provided under the modeling data standard that needs to be corrected. If a model with estimated data or a generic model is used for a generator, and the model response does not match the actual response, then the estimated data should be corrected or a more detailed model should be requested from the data provider.

While the validation is focused on the Planning Coordinator's ~~PC's~~ planning area, the model ~~to be used~~ for the validation should be one that contains a wider area of the ~~i~~Interconnection than the PC's area. If the simulations can be made to match the actual system responses by reasonable changes to the data in the Planning Coordinator's area, then the Planning Coordinator ~~PC~~ should make those changes in coordination with the data provider. However, for some disturbances, the data in the Planning Coordinator's ~~PC's~~ area may not be what is causing the simulations to not match actual responses. These situations should be reported to the Electric Reliability Organization (ERO). ~~If a model with estimated data or a generic model is used for a generator and the model response does not match the actual response, then the estimated data should be corrected or a more detailed model should be requested from the data provider.~~ The guidelines the Planning Coordinator includes under Part 1.4 could cover these situations.