Standards Authorization Request Form

Request to propose a new or a revision to a Reliability Standard			
Title of Proposed Standard:	Modification of MOD-010 through MOD-015		
Date Submitted:	12/12/2012		
SAR Requester Information			
Name:	John Simonelli, Chair, on behalf of the System Analysis and Modeling Subcommittee		
Organization:	System Analysis and Modeling Subcommittee		
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SAR Type (Check as many as applicable)			
☐ New Standard		☒ Withdrawal of existing Standard	
☒ Revision to existing Standard		☐ Urgent Action	

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Purpose (Describe what the standard action will achieve in support of Bulk Electric System reliability):
This SAR proposes modifying the current standards MOD-010 through MOD-015 by combining them into a fewer number of standards. This project will resolve FERC Order No. 693 directives relating to MOD-10 through MOD-15. The combined standards should be improved and strengthened to include additional requirements for the supply of data and models that specify the responsible functional entities, criteria for acceptability, standard formatting, and shareability. Short circuit data requirements should also be added to support the latest draft of the TPL-001-2 standard.
Industry Need (What is the industry problem this request is trying to solve?):
Models are the foundation of virtually all power system studies. Calculation of operating limits, planning studies for assessment of new generation and load growth, and performance assessments of system integrity protection schemes are but some of the studies that depend on accurate mathematical representations of transmission, generation, and load. The current standards have several limitations in three broad categories that should be addressed:

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- Needed MOD standards are not approved
  - MOD-011, MOD-013, MOD-014 and MOD-015 were not approved by FERC Order No. 693 and remain in "pending" state due to their "fill-in-the-blank" nature, with requirements applicable to Regional Reliability Organizations (RROs).
  - Approved standards MOD-010 and MOD-012 refer to specific modeling needs and processes outlined in unapproved standards MOD-011 and MOD-013 respectively.
- Approved MOD standards require clarification
  - The approved MOD standards lack clear delineation of responsibilities for providing and receiving needed data and models.
  - The approved standards lack specificity. For example, the standards do not describe the quality and usability that the provided models must have for static and dynamic conditions.
- The MOD standards should be strengthened
  - Newer Reliability Standards such as TPL-001-2 require a level of modeling not supported by the approved MOD standards.
  - The approved standards do not support the increased modeling demands of new technologies (e.g., renewable resources).
  - The absence of cogent modeling standards makes it difficult to identify the source of emerging Interconnection-wide issues (such as declining frequency response), and to perform event analysis for large system disturbances.

Furthermore, the Power System Model Validation White Paper by the NERC Model Validation Task Force (MVTF) of the Transmission Issues Subcommittee (TIS) recommended that "The NERC MOD standards on powerflow and dynamics data (MOD-010 through MOD-015) should be improved and strengthened."

Brief Description (Provide a paragraph that describes the scope of this standard action.)

1. The quantity of MOD standards should be reduced by combining the existing standards MOD-010 through MOD-015 into a fewer number of standards (such as one for steady state and one for dynamics).
2. Short Circuit Data requirements should be added to support the latest draft of the TPL standard (TPL-001-2).
3. Additions should be made to the requirements to supply data and models.
   a. The correct functional entities that are responsible to provide data and models or receive them should be identified. References to the RRO as the applicable entity should be removed from any existing or new requirements.
   b. Criteria for acceptability should be identified for supplied data and models.
   c. A standard format should be specified for supplied data.

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d. New technology model requirements should be included. e. Shareability of proprietary models should be addressed.
Detailed Description (Provide a description of the proposed project with sufficient details for the standard drafting team to execute the SAR. Also provide a justification for the development or revision of the standard, including an assessment of the reliability and market interface impacts of implementing or not implementing the standard action.)
All devices and equipment attached to the electric grid must be modeled to accurately capture how that equipment performs under static and dynamic conditions. There have been issues with proprietary models and the ability to share across sectors. Many generator manufacturers, notably wind turbine manufacturers, wish to keep the dynamics properties of their equipment confidential. As most areas are experiencing a surge in wind penetration, obtaining accurate dynamics model data for wind farms is becoming increasingly difficult, if not impossible. Similar challenges are also associated with modeling of utility-grade photovoltaic installations. Generator Owners must provide accurate model data of their systems during the interconnection process. This information is critical to ensure that their power generating systems can be safely integrated into the electric grid. However, many of those accurate model datasets submitted for use in the interconnection process cannot be used for any other modeling endeavors due to non-disclosure agreements or pro forma tariff language concerning use of confidential information. These generator owners state that industry sensitive data is contained in their datasets and therefore cannot be divulged to anyone outside the interconnecting utility. This precludes use of those data and models in Interconnection-wide powerflow and dynamic analysis, which is crucial to understanding how the connecting equipment will interact with the rest of the system. Similar situations are arising with the models for wind turbines, photovoltaic inverters, and other power electronic devices. When a number of proprietary models are excluded from system analysis, the interconnection-wide model becomes incomplete, and the potential interaction of equipment and their control systems is unknown. As such, there is no way to analyze the potential operating conditions of the interconnection. Several improvements to MOD-010 through MOD-015 are outlined below. The standards development process will naturally need to consider parallel developments in other projects (such as Project 2007-09 Generator Verification) as well as requirements in other existing standards (such as IRO-010-1a and TOP-003-2). It may be desirable to move modeling requirements from other standards into the revised MOD standards. Furthermore, industry best practices and existing processes should be considered in the development of requirements, as many entities are successfully coordinating their efforts.

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1. *Reduce the quantity of MOD Standards* MOD-010 through MOD-015 should be combined into a fewer number of standards, such as one standard for steady state and one for dynamics. However, it may also be useful to develop separate standards for equipment data collection (for the purpose of building needed steady-state and dynamic models) and the construction and validation of solved cases. MOD-011 and MOD-013 could be eliminated, but needed requirements from these standards should be moved into MOD-010 and MOD-012 respectively (or a comparable standard or set of standards). MOD-010-0 clearly states that responsible entities (including Transmission Owners, Transmission Planners, Generator Owners, and Resource Planners) must provide the needed steady state data and models in accordance with requirements that are provided in MOD-011-0. If MOD-011-0 is eliminated, then MOD-011-0 R1.1 through R1.7 must be included in a revised MOD-010 (or comparable standard). Further, a revised MOD-010 must include requirements for Planning Coordinators and Reliability Coordinators to provide the needed data, models and assembled cases to the Regional Entities and ERO (upon request or on a schedule) to facilitate the development of Interconnection-wide steady-state modeling cases. MOD-012-0 contains requirements that responsible entities (including Transmission Owners, Transmission Planners, Generator Owners, and Resource Planners) shall provide appropriate equipment characteristics, system data, and dynamics system modeling and simulation data in compliance with the respective Interconnection-wide requirements and reporting procedures. Further, the standard requires that the responsible entities must have evidence that they complied with the Interconnection-wide requirements and reporting procedures. MOD-012-0 also states that the responsible entities (including Generator Owners) must provide the needed data and models in accordance with requirements that are provided in MOD-013. If MOD-013 is eliminated, then the specifics provided in MOD-013-1 R1.1, R1.2, R1.3, R1.4, and R1.5 must be included in MOD-012. Further, MOD-012 must include requirements for Planning Coordinators and Reliability Coordinators to provide the needed data, models and assembled cases to the Regional Entities and ERO (upon request or on a schedule) to facilitate the development of Interconnection-wide dynamics modeling cases. A revised MOD-012 (or comparable standard) should account for the current MOD-013-1 provision that allows for responsible entities to provide estimated or typical manufacturer dynamics data based upon

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criteria provided in the Interconnection-wide procedures.[1] A comparable provision should be included in a revised standard, but the requirements should be strengthened by specifying (and limiting) the instances when generic manufacturer data is accepted. For example, estimated or typical data could be accepted on a temporary basis, or upon documented agreement between entities when the impact is shown to be negligible; however, it is not possible to determine the impact without a sufficient model. A stronger, FERC-approved standard could ultimately resolve some of the issues associated with the use of generic manufacturer data for equipment, including wind turbines.

2. *Add Short Circuit Data to MOD Standards*

Short circuit analysis is required in the approved FAC-002-1 standard and the latest draft of the TPL-001-2 standard.[2] While the development of Interconnection-wide short-circuit modeling cases is not necessary and should not be required in a standard, the standards must require that neighboring entities share a sufficient level of short-circuit data to enable the studies required by the existing and future standards.

3. *Add to the Requirement to Supply Data and Models*

a. *Identify responsibility to provide and identify who is responsible to receive*

A model of the power system requires data that includes but is not limited to: loads, transmission lines, transformers, shunt devices, generators, stacking order for dispatching generators, and interchanges of power. Such data must be supplied by various functional entities as shown in the table below. This data must be supplied to Planning Coordinators, Transmission Planners, Transmission Operators, and Reliability Coordinators as applicable. The Planning Coordinator or Transmission Planner should be responsible for putting all of the data together in a power flow case with associated dynamics data. These assembled cases should then be supplied to the Regional Entities and ERO, who can then combine cases to develop an Interconnection-wide case.

[1] MOD-013-1 R1.2.1 states: "Estimated or typical manufacturer's dynamics data, based on units of similar design and characteristics, may be submitted when unit-specific dynamics data cannot be obtained. In no case shall other than unit-specific data be reported for generator units installed after 1990."

[2] See FAC-002-1 R1.1.4 and TPL-001-2 R2.3 & R2.8. See also page 209 in Project 2010-03 Modeling Data.

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Table 2: Data Responsibilities

Data	Responsible for Providing Data & Models	Delivers To
Load Forecast	LSE	PC, TP, TOP, RC
Transmission Data	TO	PC, TP, TOP, RC
Generator Data	GO	PC, TP, TOP, RC
a. Resource Projections b. Generation stacking order	RP	PC, TP, TOP, RC
Interchange	TSP, BA	PC, TP, TOP, RC
Complete cases/models	PC, TP	ERO, RE

b. ***Identify acceptability***

The present MOD standards provide little to no specification on whether a particular set of model data meets the requirements of the standards. The group recommends the following changes to the standards to identify acceptability:

- For powerflow models, the standards should specifically list all of the parameters which must be provided. For some parameters, it may be desirable to include established norms (for example, a typical range for transmission line impedance per mile at a given voltage). For these parameters, the data should either conform to established norms, or a statement attesting to unusual values should be provided. Data for new equipment should be tested in a standard library powerflow case by performing a solution to test convergence and reasonableness. Model data for a particular piece of equipment should be consistent across all applications that use that data. When available, the model data for the equipment should be from vendor-certified test reports or field tests. If a novel device is required to be represented by a user-written model, the standards should mandate that all of the equations describing the characteristics and logic of the model must be provided, along with any other descriptive information. Additionally, the data provided by asset owners needs to meet model validation standards such as MOD-026 and MOD-027 and any additional standards that arise from the work of the NERC Model Validation Working Group (MVWG).

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- For dynamics models, a standard, industry-recognized model name and a set of parameter values must be provided. If a standard, industry-recognized model is not available, the standards should specify that the asset owner must provide a block diagram, equations describing the characteristics of the model, values and names for all model parameters, and a list of all state variables. Furthermore, it should be required that, if a standard model is not available, the owner should develop the non-standard model in the format needed by the Transmission Planner or Planning Coordinator. The standards also need to specify that this information will be shared on an Interconnection-wide basis. Proprietary models with details hidden from the user ("black box" models) or those models that cannot be shared across the Interconnection are not acceptable.[3] Engineers performing power system studies need access to all of the model information in order to properly analyze the reliability and operating characteristics of the power system. To the extent practical, the revised MOD standards should include a list of specific data that is required. Preference should be given to IEEE standard models where such models are suitable representations of the equipment being modeled. Additionally, the data provided by asset owners needs to meet model validation standards such as MOD-026 and MOD-027 and any additional standards that arise from the work of the NERC MVWG.
- The standards must also specify that the asset owner will provide models with additional detail and specificity to any Planning Coordinator upon request for its own internal studies.

c. *Standard format*

The specification and use of a standard format or set of formats enables data to be exchanged easily between involved entities (e.g., PCs, TPs, TOPs, RCs, TOs, GOs, LSEs, RPs) and helps support the accurate development of steady state, short circuit, and dynamic base cases. Having a standard format allows the development and aggregation of base cases which cover large areas such as the four Interconnections in North America. Each vendor has their own data format, some of which are translatable between vendors. However, some translations are only useful for steady-state analysis. Dynamics data does not translate well between vendors.

The MOD standards should incorporate industry standard formats for all steady-state, short-circuit, and dynamics data, and the standard formats should be approved via the NERC standard development process. A translation of a specific vendor format to the common format is acceptable provided the resulting data has been validated.

[3] As noted in Section 1 and footnote 1, concessions could be considered for the acceptance of generic manufacturer data, if proven to be working and useful, based on whether it is used on a temporary basis or when the impact is shown to be negligible, for example.

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NERC should lead the development of test cases to validate the translation of the vendor format to the common format. If a specific vendor format is not translatable to the approved common format then it does not comply with the standard. Coding for generic block diagrams should be included. The NERC Model Validation Working Group also recommends standardizing data exchange formats. **d. *How to deal with new technology (require a user-written model if no standard model exists)*** Presently, models for new technology equipment are introduced in a non-uniform manner. Equipment manufacturers and other outside interests have internally created a proliferation of non-standard equipment models. These models thus lack sufficient input from the individuals who study reliability and operating characteristics of the power system. These models were inserted into production studies without vetting from recognized technical authorities such as the IEEE. Many of these models are proprietary and distributed as "black box" object code modules for specific simulation programs. Models for new technology must include information comparable to existing models in common use. Powerflow models need to include the equations describing the characteristics of the equipment being modeled. For dynamics, a block diagram is essential. Ideally, the industry should collaboratively develop model structures which include those elements that are of importance in power system studies. Such an effort would enable consistent development of useful models while simultaneously protecting manufacturer interests regarding confidential trade secrets of implementation details that are not relevant to power system studies. Equipment should not be allowed to connect to the grid if the models lack the information needed for performing appropriate reliability and operating characteristics assessments. All responsible entities including Transmission Owners and Generator Owners must be held accountable for providing the information needed to maintain power system reliability. **e. *Shareability (an issue tangential to the MOD standards)*** One of the problems identified in the *Power System Model Validation White Paper* is that there are legal and procedural issues that inhibit the gathering and distribution of model data among stakeholders. The report cites FERC CEII (critical energy infrastructure information) requirements and proprietary issues that result in claims of the need for confidentially. The report noted that in particular, Generator Owners of wind turbines are unable to provide unit specific data due to wind turbine manufacturer statements that the dynamics models of their equipment must be held confidential. This is particularly problematic in areas that are experiencing a surge in wind penetration.

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One possible approach to address proprietary model issues is for the Generator Owner to work with the vendor to develop a generic model that can be shared across the Interconnection. In such a case, the standard should specify that the Generator Owner is responsible for reviewing and submitting supporting simulations performed by the vendor that demonstrate and certify a provided generic model will accurately simulate the generator (or any other device in question) for system level studies. The Generator Owner must also arrange to give the proprietary model to the Transmission Planner, Planning Coordinator, and Reliability Coordinator for their sole use, using an NDA if necessary. Another approach is for NERC and/or FERC to hold a technical conference where wind turbine manufacturers will be asked to give explanations for keeping their models proprietary while NERC staff and members of NERC subcommittees describe why detailed models are required. Following such a technical conference, NERC and FERC could consider subsequent steps that could result in a FERC Notice of Inquiry or Notice of Proposed Rulemaking on the subject.

Reliability Functions		
The Standard will Apply to the Following Functions (Check each one that applies.)		
☐	Regional Reliability Organization	Conducts the regional activities related to planning and operations, and coordinates activities of Responsible Entities to secure the reliability of the Bulk Electric System within the region and adjacent regions.
☒	Reliability Coordinator	Responsible for the real-time operating reliability of its Reliability Coordinator Area in coordination with its neighboring Reliability Coordinator's wide area view.
☒	Balancing Authority	Integrates resource plans ahead of time, and maintains load-interchange-resource balance within a Balancing Authority Area and supports Interconnection frequency in real time.
☐	Interchange Authority	Ensures communication of interchange transactions for reliability evaluation purposes and coordinates implementation of valid and balanced interchange schedules between Balancing Authority Areas.
☒	Planning Coordinator	Assesses the longer-term reliability of its Planning Coordinator Area.
☒	Resource Planner	Develops a >one year plan for the resource adequacy of its specific loads within a Planning Coordinator area.

Reliability Functions		
☒	Transmission Planner	Develops a >one year plan for the reliability of the interconnected Bulk Electric System within its portion of the Planning Coordinator area.
☒	Transmission Service Provider	Administers the transmission tariff and provides transmission services under applicable transmission service agreements (e.g., the pro forma tariff).
☒	Transmission Owner	Owns and maintains transmission facilities.
☐	Transmission Operator	Ensures the real-time operating reliability of the transmission assets within a Transmission Operator Area.
☐	Distribution Provider	Delivers electrical energy to the End-use customer.
☒	Generator Owner	Owns and maintains generation facilities.
☐	Generator Operator	Operates generation unit(s) to provide real and Reactive Power.
☐	Purchasing-Selling Entity	Purchases or sells energy, capacity, and necessary reliability-related services as required.
☐	Market Operator	Interface point for reliability functions with commercial functions.
☒	Load-Serving Entity	Secures energy and transmission service (and reliability-related services) to serve the End-use Customer.

Reliability and Market Interface Principles	
Applicable Reliability Principles (Check all that apply).	
☒	1. Interconnected bulk power systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
☐	2. The frequency and voltage of interconnected bulk power systems shall be controlled within defined limits through the balancing of real and Reactive Power supply and demand.
☒	3. Information necessary for the planning and operation of interconnected bulk power systems shall be made available to those entities responsible for planning and operating the systems reliably.
☐	4. Plans for emergency operation and system restoration of interconnected bulk power systems shall be developed, coordinated, maintained and implemented.
☐	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk power systems.

Reliability and Market Interface Principles	
☐	6. Personnel responsible for planning and operating interconnected bulk power systems shall be trained, qualified, and have the responsibility and authority to implement actions.
☐	7. The security of the interconnected bulk power systems shall be assessed, monitored and maintained on a wide area basis.
☐	8. Bulk power systems shall be protected from malicious physical or cyber attacks.

Does the proposed Standard comply with all of the following Market Interface Principles?	Enter (yes/no)
1. A reliability standard shall not give any market participant an unfair competitive advantage.	Yes
2. A reliability standard shall neither mandate nor prohibit any specific market structure.	Yes
3. A reliability standard shall not preclude market solutions to achieving compliance with that standard.	Yes
4. A reliability standard shall not require the public disclosure of commercially sensitive information. All market participants shall have equal opportunity to access commercially non-sensitive information that is required for compliance with reliability standards.	Yes

Related Standards	
Standard No.	Explanation
IRO-010-1a	Identifies the high-level process that must be followed to ensure that RCs are provided with models. This standard could be considered for consolidation into revised MOD standards.
TOP-003-2	Identifies the high-level process that must be followed to ensure that BAs and TOPs are provided with models. This standard could be considered for consolidation into revised MOD standards.

Related SARs	
SAR ID	Explanation

Regional Variances	
Region	Explanation
ERCOT	
FRCC	
MRO	
NPCC	
RFC	
SERC	
SPP	
WECC	