

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

ERO Unacceptable Models List

Project 2022-02 Uniform Modeling Framework
for IBR

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RELIABILITY | RESILIENCE | SECURITY



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Overview/Introduction

FERC issued Order No. 901 on October 23, 2023, directing “NERC to develop new or modified Reliability Standards that require the use of approved industry generic library IBR models that accurately reflect the behavior of IBRs during steady state, short-circuit, and dynamic conditions when developing planning, operations, and interconnection-wide models. For example, the new or modified Reliability Standards could reference the NERC approved component model list, which defines the models that may be used, and those models that may not be used, for specific types of studies. This approved component model list includes WECC’s IBR models. Without requiring the use of approved industry generic library models, Bulk-Power System planners and operators may not be able to create system models that adequately predict IBR behaviors and subsequent impacts on the Bulk-Power System.”

Proposed Reliability Standard MOD-032-2 addresses the reliability issue identified by FERC in Order No. 901 in a manner that considers advancements in user written models since the issuance of Order No. 901, perspectives of planning entities across North America, and the historical practice of the ERO, which has been to maintain a use of unacceptable models, rather than acceptable models, due to the practical difficulties of keeping an acceptable model library up to date in a timely manner.

Reliability Standard MOD-032-2 requires the Planning Coordinator and Transmission Planner to include specifications addressing the use of standard library models, user-written models meeting certain minimum usability requirements to minimize the risk of non-convergence, or both. To minimize the use of models with known deficiencies, Transmission Planners and Planning Coordinators must also include provisions to require any entity submitted on the Unacceptable Model List to include a technical rationale supporting its use.

The Unacceptable Models List identifies models that are generally considered not acceptable for purposes of model submissions under the MOD-032, TOP-003, and IRO-010 Reliability Standards due to identified issues with usability or accuracy impacting the ability to develop planning or operational horizon cases necessary to support analysis of the reliability of the interconnected transmission system. However, it is recognized that the use of such models may be appropriate in some cases, such as where there is no feasible means for procuring an alternative model that may better represent the behavior of legacy equipment. Any use of such models must include a technical rationale supporting its use.

Disclaimers

Interconnection-wide modeling requirements may differ from the requirements of specialized studies dedicated to a particular technical objective. Thus, models deemed acceptable for planning purposes may be deemed unacceptable by a receiving entity for certain operations applications.

Updates to the Unacceptable Models List

Refer to the Supporting Document section of MOD-032.

Chapter 1: Unacceptable Models List

Models that have been identified as unacceptable are listed in Table 1 below. Revisions to this list may be made in accordance with the process described in the Supporting Document section of the MOD-032 standard.

Table 1: Unacceptable Model List		
Known Unacceptable Model Name	Model Description	Effective
Renewable Energy Models		
WT3G1, WT3G2, wt3g	Generic Type 3 WTG Generator/Converter Model - Doubly-fed induction generator	Effective Date of MOD-032-2
WT4G1, WT4G2, wt4g	Generic Type 4 WTG Generator/Converter Model - Variable speed generator with full converter	Effective Date of MOD-032-2
WT3E1, wt3e	Generic Type 3 WTG Electrical Control Model	Effective Date of MOD-032-2
WT4E1, WT4E2, wt4e	Generic Type 4 WTG Electrical Control Model	Effective Date of MOD-032-2
WT3T1, wt3t	Generic Type 3 WTG Turbine Model	Effective Date of MOD-032-2
WT3P1, wt3p	Generic Type 3 WTG Pitch Control Model	Effective Date of MOD-032-2
WT12A1, wt1p, wt2p	Generic Type 1 and 2 WTG Pitch Control Model	Effective Date of MOD-032-2
WT4E1, wt4t	Generic Type 4 WTG Power Converter Model	Effective Date of MOD-032-2
wt4p	Generic Type 4 Pitch Control Model	Effective Date of MOD-032-2
REECB1, REECBU1, reec_b	Generic Phase 2 PV Electrical Controls Model	Effective Date of MOD-032-2
Machine Models		
GENSAL, gensal	Salient Pole Generator Model (IEEE Std 1110 §5.3.1 Model 2.1)	Effective Date of MOD-032-2
GENCLS, gencs	Classical Generator Model (IEEE Std 1110 §5.4.2)	Effective Date of MOD-032-2
GENTRA	Transient Level Generator Model	Effective Date of MOD-032-2
Excitation System Models		
texs	General Purpose Transformer Fed Excitation System	Effective Date of MOD-032-2
SEXS, sexs	Simplified Excitation System	Effective Date of MOD-032-2
EX2000	GE EX2000 Excitation System	Effective Date of MOD-032-2
Turbine-Governor Models		
lm2500	LM 2500 Aero-Derivative Gas Turbine Governor Model	Effective Date of MOD-032-2
Known Unacceptable Model Name	Model Description	Effective

Table 1: Unacceptable Model List		
Im6000	LM 6000 Aero-Derivative Gas Turbine Governor Model	Effective Date of MOD-032-2
URGS3T, gast	WECC Gas Turbine Governor Model	Effective Date of MOD-032-2
GAST	Gas Turbine-Governor Model	Effective Date of MOD-032-2
GAST2A	Gas Turbine-Governor Model	Effective Date of MOD-032-2
GASTWD	Gas turbine-governor	Effective Date of MOD-032-2
IEEEG2	1981 IEEE Type 2 General Approx. Linear Ideal Hydro Model	Effective Date of MOD-032-2
WESGOV	Westinghouse Digital Governor Model for Gas Turbines	Effective Date of MOD-032-2
Load Models		
motorc	Phasor Model of Single-Phase Air-Conditioner Compressor Motor	Effective Date of MOD-032-2

Chapter 2: Unacceptable Models Technical Rationale

Table 2 below provides the technical rationale for each unacceptable model included on the current Unacceptable Models List.

The purpose of this list of unacceptable models is to develop and maintain a repository of models deemed acceptable by the ERO and industry stakeholders for use in developing interconnection-wide models developed by the MOD-032 Designee. The NERC System Analysis and Modeling Subcommittee (SAMS) initially developed this list, and it is now maintained and updated by ERO staff in accordance with MOD-032 Supporting Document. This list seeks to bring together multiple sources of data to ensure uniformity in the use of models across Interconnections. While models may be deemed 'obsolete' or 'deprecated' due to known issues, these models are not removed from the software vendor libraries for various reasons. However, these models should not be used to represent specific facilities within Interconnection-wide models. For additional information about this list, please contact NERC staff at advancedsystemanalyticsmodeling@nerc.net with any questions.

Table 2: Unacceptable Model List	
Known Unacceptable Model Name	Rationale For Inclusion
Renewable Energy Models	
WT3G1, WT3G2, wt3g	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
WT4G1, WT4G2, wt4g	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
WT3E1, wt3e	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
WT4E1, WT4E2, wt4e	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
WT3T1, wt3t	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
WT3P1, wt3p	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
WT12A1, wt1p, wt2p	Unable to represent common Type 1 wind pitch control logic.
WT4E1, wt4t	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
wt4p	Replaced by 2 nd Generation renewable models. 1 st Generation generic models have produced numerical instability for on-fault conditions for power electronics represented by this model
REECB1, REECBU1, reec_b	Inability to represent momentary cessation or other voltage dependent current logic common in the equipment the model was stated to represent.
Machine Models	

Table 2: Unacceptable Model List

Known Unacceptable Model Name	Rationale For Inclusion
GENSAL, gensal	Uses simplifying approximations for saturation as additive terms over exponential or quadratic curves. Further, ignores the q-axis saturation completely.
GENCLS, gencls	Does not allow for representation of excitation system and turbine/speed governor models
GENTRA	Simplified model that ignores sub transient effects, leading to numerical instability problems.
Excitation System Models	
texs	Simplified, early generation model considered obsolete. Refer to IEEE Std 421.5
SEXS, sexs	Simplified, early generation model considered obsolete. Refer to IEEE Std 421.5
EX2000	Field current limiter latch in the model is unable to represent the field equipment for simulation in power system software. Replace with AC7B or ex21br
Turbine-Governor Models	
Im2500	No supporting documentation implemented in software, proprietary model with no added model support.
Im6000	No supporting documentation implemented in software, proprietary model with no added model support.
URGS3T, gast	Simple representation of steam turbine-governor system with insufficient model capability for modern digital controllers.
GAST	Simple representation of steam turbine-governor system with insufficient model capability for modern digital controllers.
GAST2A	Simple representation of steam turbine-governor system with insufficient model capability and flexibility for modern digital controllers.
GASTWD	Simple representation of steam turbine-governor system with insufficient model capability and flexibility for modern digital controllers.
IEEEG2	Model uses an oversimplified governor model applicable only to first swing stability. Deprecated with other hydro governor models.
WESGOV	Simple representation of steam turbine-governor system with insufficient model capability and flexibility for modern digital controllers.
Load Models	
motorc	Experimental load model. Should not be used for generation resources

Additional References

The references below are provided for further reading and information about the models above. These references are:

- “IEEE Guide for Synchronous Generator Modeling Practices and Applications in Power System Stability Analyses,” IEEE Std 1110-2002.
- Undrill, J., “The gentpj model,” November 19, 2007 (updated June 19, 2012).
- “IEEE Recommended Practice for Excitation System Models for Power System Stability Studies,” IEEE Std 421.5-2005.
- “Computer Representation of Excitation Systems,” IEEE Transactions on Power Apparatus and Systems, Vol. PAS-87, No. 6, pp. 1460-1468, 1968 (Committee Report).
- “Excitation System Models for Power System Stability Studies,” IEEE Transactions on Power Apparatus and Systems, Vol. PAS-100, No. 2, pp. 494-509, 1981 (Committee Report).

- IEEE Task Force on Overall Plant Response, “Dynamic Models for Steam and Hydro Turbines in Power System Studies”, IEEE Trans. on PAS, Vol PAS-92, Nov-Dec 1973, pp. 1904-1915.
- Task Force on Turbine-Governor Modeling, “Dynamic Models for Turbine-Governors in Power System Studies,” IEEE Technical Report, PES-TR1, Jan. 2013.
- WECC M&VWG, “Composite Load Model for Dynamic Simulations” Ver 1.0, June 12, 2012.
- WECC M&VWG, “WECC Wind Power Plant Dynamic Modeling Guide,” November 2010.
- EPRI, “Specification of the Second Generation Generic Models for Wind Turbine Generators,” September 20, 2013. and WECC M&VWG, “Generic Solar Photovoltaic System Dynamic Simulation Model Specification,” September 2012.
- WECC, “Generic Static Var System Models for the Western Electricity Coordinating Council” April 18, 2011.
- W. I. Rowen, “Simplified Mathematical Representations of Heavy Duty Gas Turbines”, ASME Paper 83-GT-63 and ASME Journal of Engineering for Power, October 1983, pages 865-869. [GAST2A reference]
- Periera, L. et al, “A New Thermal Governing Approach in the WECC,” IEEE Transaction on Power System, Vol. 18, No. 2, pp. 819-829, May 2003.
- WECC M&VWG, “Cross-current Compensation Model Specification,” August 2015.
- EPRI, “Simple Model Specification for Battery Energy Storage System,” March 6, 2015.
- WECC M&VWG, “WECC Wind Power Plant Dynamic Modeling Guide,” April 2014.
- WECC M&VWG, “WECC PV Power Plant Dynamic Modeling Guide,” April 2014.
- EPRI, “Proposed Changes to the WECC WT3 Generic Model for Type 3 Wind Turbine Generators,” September 27, 2013.
- EPRI, “Proposed Changes to the WECC WT4 Generic Model for Type 4 Wind Turbine Generators,” January 23, 2013.
- Q. Wang, “GENQEC Generator Dynamic Model”, July, 2019.
<https://www.wecc.org/Administrative/GENQEC%20Model%20Specification.pdf>
- Q.Y. Wang, S. Wang, “A New High Accuracy Generator Dynamic Model”, 2018 IEEE PES Asia-Pacific Power and Energy Engineering Conference (APPEEC).

Chapter 3: Sample Submission Form

This form is a sample to explain what is deemed a full application to change a model designation in the Unacceptable Models List.

Section 1: Submitting Entity Information			
Name of Person submitting			
Organization(s)			
Sector (if known)			
Telephone		Email	

Section 2: Model Identifying Information	
Model Name	
Alternative Model Name(s) as implemented in software	
Equipment Model is stated to represent	
Indicate desired Action	<input type="checkbox"/> Add model to the Unacceptable Models List <input type="checkbox"/> Remove model from the Unacceptable Models List

Section 3: Technical Supporting Documentation and Description	
Description of model ability to meet small signal Disturbances	
Description of model ability to meet large signal Disturbances	
Please cite and link any industry approved documentation regarding this model's small and large signal disturbances	
Describe the technical document attachments that support the above questions	
Please identify any information in this application that may meet the criteria for Confidential Information, as defined in Section 1500 of the NERC Rules of Procedure	

Section 4: Process Tracking	
Date Submitted to ERO	
Model Status	<input type="checkbox"/> Submitted to the ERO <input type="checkbox"/> Assigned ERO Review team <input type="checkbox"/> Investigation and review by ERO and submitting entity <input type="checkbox"/> Remanded by NERC RSTC (or its successor) <input type="checkbox"/> Approved by the NERC RSTC (or its successor)
Date of Approval	
Date of Model Notice to Industry	

Attachments

If available, please include at least one report that uses Hardware-in-the-Loop, Software-in-the-Loop, or actual System response (e.g., in a commissioning test) to demonstrate the model's ability or inability to achieve its stated purpose. At least one attachment should detail the model's error boundaries to represent its stated equipment with the test description and procedure outlined in that report. Entities shall label any attachment that may meet the criteria for Confidential Information under NERC Rules of Procedure Section 1500, along with the basis for the designation (e.g., Confidential Business and Market Information, Critical Electric Infrastructure Information, etc.). If any of this information is not available to the supporting entity, please provide an explanation.

Chapter 4: Version History

Version	Date	Action	Change Tracking
1	August 2025	Draft 2 Posting for Project 2022-02	Initial Draft