

About Verification Report Requirement

ERCOT Transmission Planning 3/2025

Questions? Contact: dynamicmodels@ercot.com Please don't submit models to this email address.

Model Submission instructions are at the end of this document.

Verification Reports are different from MOD-026/027 studies and are required from all resources according to [Planning Guide](#) 5.5 and [Planning Guide](#) 6.2(5)(b) according to the following timeframes:

- New Resources (commissioning after 3/1/2021):
 - Submit initial report within 30 days of receiving Part 3 approval
 - Submit an updated report no earlier than 12 months and no later than 24 months after receiving Part 3 commissioning approval
- Existing Resources (commissioning before 3/1/2021):
 - By 3/1/2023 but not before 3/1/2022
- All resources (regardless of commissioning date)
 - A minimum of every ten years
 - Within 30 days of making a setting change at the plant

Verification reports should be uploaded to R100-RS and included with the following attachments per [Planning Guide](#) 6.2 and per the [DWG Procedure Manual](#):

- Dynamic Template (which contains your up-to-date PSS/E / TSAT model)
 - For user-defined models (UDM), also include library files for PSS/E version 33 and version 35 (.dll files), library files for TSAT (.dll and .tudm files) and a TSAT case (.pfb or .raw file and .dvr or .dat file). Two TSAT cases should be provided: One set up using bus numbers and another set up using equipment names. The case with equipment names should also have bus numbers set to match the PSS/E model. (A TSAT case is optional for generic models.)
 - Blank templates are downloadable from <https://www.ercot.com/services/rq/re>
- Model Quality Test (MQT) report for the dynamic (PSS/E) model if any changes were made to the model since the last submission. Synchronous (conventional) plants can usually submit their MOD-026/027 studies in lieu of a MQT report provided these studies meet the MQT goals.
- MQT simulation files (.raw or .sav and .dvr).
- PSCAD model (required for most IBRs; some pre-2015 IBRs that never before provided a PSCAD model are not required unless requested by ERCOT)
 - Model Quality Test report for the PSCAD model. It is recommended to overlay the PSCAD and PSS/E MQT plots. ERCOT will check for a match; overlaying the plots helps the RE catch any mismatch prior to submission.
 - PSCAD model Guideline checksheet. Blank checksheets are available in the Model Quality Guide downloadable from <https://www.ercot.com/services/rq/re>
- Generally, you should update both the dynamic and PSCAD models at the same time to ensure model consistency. However, if the PSCAD model is delayed then provide the dynamic model (PSS/E and TSAT) first with a time estimate for the PSCAD model.
- Helpful instructions are in the Model Quality Guide downloadable from <https://www.ercot.com/services/rq/re>

The goal of the Verification requirement is to ensure our models match actual equipment *settings*. This augments MOD-026/027 studies which check *measurements*. The Verification requirement focuses on tunable numerical settings. For example, *“The exciter model submitted to ERCOT has an integral gain of 5 and a time constant of 0.5 seconds. On 4/6/2022, plant personnel checked the Exciter settings using the equipment console and found that the settings matched. Below is a photograph of the console screen for evidence.”*

A typical Verification report would consist of the following:

- Brief description of how and when the actual parameters were checked for the plant. For example, a conventional plant report may read: *“On 4/6/2022, the plant personnel used Human Machine Interface (HMI) screens on the exciter, governor, and power system stabilizer control panels to read the tunable adjustment settings. A photograph below is provided for evidence.”* A renewable plant report may read: *“On 4/6/2022, the wind turbine manufacturer / OEM logged into the turbine firmware and power plant controllers and obtained a parameter dump. A partial screenshot is shown below for evidence.”*
- Include a table listing tunable model parameters from either the PSS/E model or the PSCAD model (whichever is more convenient). In one column, list the parameter value from the dynamic model that was submitted and in the next column, list the setting value from the actual equipment. If the values do not match, explain why. For example, *“Values are represented on different units of measure. This formula is used for the conversion....”* Or *“The following values were parameterization by the following procedure (curve fitting, statistical analysis, etc.) ...”*
- Reference to the dynamic model Template filename being verified. Dynamic model templates should be saved with the following naming convention, referenced in the report, and submitted together with the Verification report as a complete package. Include also any Model Quality Test reports required for model updates (for conventional facilities, MOD-026/027 studies may be submitted in lieu of an MQT report).
 - TURTLE_dyn_2023-12-31.xlsm ← Dynamic model template for Sitecode Turtle prepared 12/31/2023

Screenshots of actual equipment settings provide the best evidence. ERCOT also accepts attestations from the OEM, commissioning or delivery reports, or curve-fitting or response matching exercises¹, etc. If the unit has been in service for a while and the commissioning report is old, additional evidence may be necessary to ensure that the values have not changed since commissioning.

There are many parameters in each model. We require your engineering judgement which parameters are site-specific or commonly tuned. These must be identified and verified. Verification may be performed either on the PSS/E or PSCAD models. Note that PSS/E generic IBR models often have limited relation to actual equipment settings; ERCOT may request additional supporting evidence (OEM attestation or verification of the PSCAD model) if the verification appears insufficient.

¹ MOD-026/027 studies involve small-signal tests and are generally incapable of uniquely verifying more than a few model parameters. Additional tests or disturbance measurements involving large-signal / fast response tests would provide additional evidence.

Table 1 lists synchronous power plant parameters typically requiring verification; Table 2 lists parameters for inverter-based resources.

Table 1: Conventional (Synchronous Generator) Power Plant Verification

Parameters	Best Verification Method	Additional Notes
Inertia (H)	Commissioning / delivery reports.	Inertia should total all spinning masses. It is incorrect to only report the generator inertia. Inertia is typically 3-9 MW-s/MVA.
Generator Electrical Parameters	Verify if a reference is available (generator nameplate or delivery report).	These parameters generally do not change after delivery so ERCOT will currently not require verification if no reference is available.
Generator Saturation Parameters	Please confirm values through any means if any of the following occur: <ul style="list-style-type: none"> • S(1.0) outside range 0.03 – 0.18 • S(1.2) outside range 0.2 – 0.85 • S(1.2)/S(1.0) ratio outside range 2 – 8 	NERC has identified these ranges. Parameters falling outside these ranges should be confirmed as correct.
Protection Parameters	Engineer attestation or illustration confirming Voltage, Frequency, and V/Hz protection models match relay settings	Plant may have multiple relays (generator terminals, feeder / transformer protection). Verify the most limiting protection settings.
Exciter Gains	MOD-026 studies can be referenced however additional verification is recommended such as directly checking equipment settings, comparison with delivery / commissioning reports, etc.	
Exciter Self-Excite K_E param	Please confirm value if K_E is above 0 (except $K_E = 1$ for separately excited is okay) (No K_E confirmation needed if exciter model does not contain this parameter.)	NERC has identified this as possibly erroneous.
Governor Parameters	MOD-027 report or direct comparison with equipment settings.	
Power System Stabilizer Parameters	Directly checking equipment settings, delivery reports, commissioning tuning reports.	Note from NERC: “If $K_{s3} = 1$, then $K_{s1} > 0$, $V_{stmax} > 0$, $V_{stmin} < 0$, $T_{w4} = 0$, $T_7 = T_{w2}$, $T_6 > 0.033$, $T_8 = m \cdot T_9$, and the input signals should be generator speed and generator electrical power.” Models not conforming to this may need review.

Table 2: Inverter-Based Resource Verification

Parameters	Best Verification Method	Additional Notes
Protection Parameters	Most IBRs have protection built into the inverter / wind turbine. These settings can be verified directly by OEM documentation. If physical relays are present, an engineer should attest that the protection models match the relay settings.	Protection models should include the generator terminal protection. If other protection relays may trip for an external grid event (e.g. feeder overvoltage), please include these in the Misc. Model section of the model Template and verify these as well.
Inverter-Based Resource PSS/E or PSCAD Model	<p>First, create a table listing all model parameters that are <u>site-specific or commonly tuned</u>. The table should have two numerical columns: (1) model value in PSS/E or PSCAD, and (2) actual equipment value. Actual values are read from HMI screen or parameter dump obtained by OEM. Demonstrate a matching of all parameters that can be verified directly or using a mathematical formula. For parameters which cannot be directly matched:</p> <ul style="list-style-type: none"> • Provide OEM attestation indicating the parameters are correct, OR: • Use some other method to verify <p>Note that MOD-026/027 tests are generally not sufficient to fully verify an IBR model, especially the high-speed / large-signal / voltage-ride-through response.</p>	The RE can choose which model to verify – either PSS/E or PSCAD. ERCOT may request an OEM attestation if the verification method appears insufficient. Note that PSS/E generic models are not easily verifiable as they may have little overlap with actual equipment settings – for these, it is recommended to seek an OEM attestation or verify the PSCAD model instead.

Some model parameters may not have a 1:1 relationship with actual control equipment settings and may instead be generalizations of more complicated systems. These site-specific “non-1:1” parameters should be identified along with a qualitative explanation of their determination, such as by statistical or curve-fitting. Note that many models have a mix of 1:1 and non-1:1 parameters; the Verification report should identify each kind and directly verify the 1:1 parameters.

Can MOD-026/027 reports be used as Verification proof? Partly. These reports may be sufficient to verify exciter / governor models of conventional synchronous facilities. The reports are generally insufficient for verifying power system stabilizer models of conventional facilities. These reports are also generally insufficient for verifying the high-speed, large signal, or voltage-ride through response of inverter-based facilities. A good verification report of an IBR facility should use employ additional means to verify the model such as confirming actual parameter values, obtaining an OEM model attestation, commissioning reports, comparing high-speed measurements, or comparing large-signal model response against a trusted reference such as a verified PSCAD or original OEM-provided site-specific UDM dynamic model.

Gather all the documents (Verification Report, latest model, and any supporting evidence), compress the package into a zip file, and upload to RIOO-RS. If you encounter any problems using the RIOO system, please contact RIOO-HELP@ercot.com or your ERCOT Client Services Account Manager.

The latest dynamic model Template has a worksheet for completing your verification report. This can be submitted in lieu of a separate report, however you must still embed or attach supporting evidence. The latest Template can be found at: <https://www.ercot.com/services/rq/re>