

## Comment Report

**Project Name:** 2022-04 EMT Modeling | SAR  
Comment Period Start Date: 8/11/2022  
Comment Period End Date: 9/13/2022  
Associated Ballots:

There were 38 sets of responses, including comments from approximately 64 different people from approximately 45 companies representing 7 of the Industry Segments as shown in the table on the following pages.

## **Questions**

- 1. Do you agree with the proposed scope as described in the SAR? If you do not agree, or if you agree but have comments or suggestions for the project scope, please provide your recommendation and explanation.**
- 2. Provide any additional comments for the SAR drafting team to consider, if desired.**

Organization Name	Name	Segment(s)	Region	Group Name	Group Member Name	Group Member Organization	Group Member Segment(s)	Group Member Region
PPL - Louisville Gas and Electric Co.	Devin Shines	1,3,5,6	RF,SERC	PPL NERC Registered Affiliates	Brenda Truhe	PPL Electric Utilities Corporation	1	RF
					Charles Freibert	PPL - Louisville Gas and Electric Co.	3	SERC
					JULIE HOSTRANDER	PPL - Louisville Gas and Electric Co.	5	SERC
					Linn Oelker	PPL - Louisville Gas and Electric Co.	6	SERC
Entergy	Julie Hall	1,3,6		Entergy	Oliver Burke	Entergy - Entergy Services, Inc.	1	SERC
					Jamie Prater	Entergy	5	SERC
Duke Energy	Kim Thomas	1,3,5,6	FRCC,RF,SERC,Texas RE	Duke Energy	Laura Lee	Duke Energy	1	SERC
					Dale Goodwine	Duke Energy	5	SERC
					Greg Cecil	Duke Energy	6	RF
FirstEnergy - FirstEnergy Corporation	Mark Garza	1,3,4,5,6		FE Voter	Julie Severino	FirstEnergy - FirstEnergy Corporation	1	RF
					Aaron Ghodooshim	FirstEnergy - FirstEnergy Corporation	3	RF
					Robert Loy	FirstEnergy - FirstEnergy Solutions	5	RF
					Tricia Bynum	FirstEnergy - FirstEnergy Corporation	6	RF
					Mark Garza	FirstEnergy-FirstEnergy	4	RF
Pacific Gas and Electric Company	Michael Johnson	1,3,5	WECC	PG&E All Segments	Marco Rios	Pacific Gas and Electric Company	1	WECC

					Sandra Ellis	Pacific Gas and Electric Company	3	WECC
					James Mearns	Pacific Gas and Electric Company	5	WECC
Southern Company - Southern Company Services, Inc.	Pamela Hunter	1,3,5,6	SERC	Southern Company	Matt Carden	Southern Company - Southern Company Services, Inc.	1	SERC
					Joel Dembowski	Southern Company - Alabama Power Company	3	SERC
					Ron Carlsen	Southern Company - Southern Company Generation	6	SERC
					Jim Howell	Southern Company - Southern Company Services, Inc. - Gen	5	SERC
Southwest Power Pool, Inc. (RTO)	Shannon Mickens	2	MRO,SPP RE,WECC	SPP RTO	Shannon Mickens	Southwest Power Pool Inc.	2	MRO
					Matt Harward	Southwest Power Pool Inc	2	MRO
					Sunny Raheem	Southwest Power Pool Inc.	2	MRO
					Jonathan Hayes	Southwest Power Pool Inc.	2	MRO
					Doug Bowman	Southwest Power Pool Inc.	2	MRO

1. Do you agree with the proposed scope as described in the SAR? If you do not agree, or if you agree but have comments or suggestions for the project scope, please provide your recommendation and explanation.

Joe Gatten - Xcel Energy, Inc. - 1,3,5,6 - MRO,WECC

Answer No

Document Name

Comment

Xcel Energy supports EEI comments.

Likes 0

Dislikes 0

Response

Thomas Foltz - AEP - 3,5,6

Answer No

Document Name

Comment

AEP fundamentally agrees with the industry need as expressed in the SAR, and offers the following comments that we believe will improve the SAR and make the resulting project more effective.

AEP does not believe that FAC-002 is the preferable standard in which to insert model verification requirements. EMT model verification/validation will likely be an involved, multi-step process, and we believe the draft of MOD-026-2 would be a preferable framework on which to build for verification of pre-commissioning models.

Industry is still in the early stages of fully understanding EMT IBR modeling and how best to include it in IBR system impact studies. The cutting-edge nature of this topic and complexities involved, as well as the various protection and control details with which the modeling should be fitted, will necessitate that industry be provided technical guidance, references, and recommended practices on which to rely. This would ensure that appropriate EMT IBR models are developed for the resulting studies, and that the models are no more detailed or complex than are necessary to obtain improved accuracy.

As previously stated, EMT IBR modeling is an emerging field, and individuals with adequate expertise in the subject matter may be in short supply. Future implementation plans for resulting obligations driven by this project should take into account the time that will be needed to seek out individuals with this expertise as well as to increase their numbers. As an example, time will be needed to educate and train individuals who will be newly-tasked with the development of EMT IBR modeling, and properly applying the models in system studies.

Likes 0

Dislikes 0

Response

**Kim Thomas - Duke Energy - 1,3,5,6 - SERC,RF, Group Name Duke Energy**

**Answer** No

**Document Name**

**Comment**

Duke Energy Planning agrees the FAC-002 and MOD-032 Standards need to be updated for the EMT modeling and study but NOT the TPL-001 Standard. For the FAC-002 Standard, necessary EMT study during the system interconnection process could identify the potential issue within the local region of the interconnecting units. In order to perform the EMT study according to FAC-002 Standard, the MOD-032 Standard needs to be modified as well to reflect the data submission requirement for EMT models. But for TPL-001 Standard, an annually system wide effort for identifying needs and performing the EMT study is premature giving the industry experience, model availability, simulation execution times, and computational power required for large scale EMT studies.

Likes 0

Dislikes 0

**Response**

**David Jendras - Ameren - Ameren Services - 1,3,6**

**Answer** No

**Document Name**

**Comment**

Ameren agrees with and supports EEI comments.

Likes 0

Dislikes 0

**Response**

**Michael Jones - National Grid USA - 1,3,5**

**Answer** No

**Document Name**

**Comment**

It is recommended to develop a new TPL standard related to EMT planning assessments and not modifying TPL-001. This would provide the Standard Drafting Team flexibility in developing criteria and requirements for EMT planning assessments. The flexibility opened by this recommendation is in particular important since TPL-001 is already quite detailed and focuses on 'traditional' steady state, short circuit, and Stability transmission planning assessments and its associated performance criteria. It is recommended that any modifications to TPL-001 or preferably a new standard for EMT planning assessments should include process and criteria for conducting EMT studies only, while not making any changes to the Stability requirements

and performance criteria for positive sequence RMS simulations in the present TPL-001 standard. Further, it is important that any new standards or requirements related to EMT are not to be overly prescriptive and provide room for regional flexibility.

In accordance with the above proposal of establishing a new TPL standard for EMT planning assessments, it is proposed to re-word the project deliverables in the Detailed Description (p. 2) from: 'The proposed project will produce three deliverables – modifications to FAC-002, modifications to MOD-032 (or a new standard related to EMT model collection), and modifications to TPL- 001' to 'The proposed project will produce three deliverables – modifications to FAC-002, modifications to MOD- 032 (or a new standard related to EMT model collection and/or validation), and modifications to TPL-001 or preferably a new TPL standard related to EMT planning assessments, including performance criteria.' Similarly, it is proposed to refer to TPL-001 in the Purpose or Goal statement (p. 2) as 'TPL-001 or preferably a new standard for EMT planning assessments.'

EMT modeling should preferably allow for model interchangeability between existing (and future) EMT simulation platforms from different vendors. Please also evaluate how to best handle EMT model validation, via modifications to MOD-033 (if so, please add this standard to proposed scope in this SAR) or preferably in a new MOD standard combining model data collection and validation related for EMT.

Likes 0

Dislikes 0

## Response

**Lynn Goldstein - PNM Resources - Public Service Company of New Mexico - 1,3**

**Answer**

No

**Document Name**

**Comment**

Inclusion into any standard should provide a structured PSCAD/EMT model format (template) to enable Original Equipment Manufacturer (OEM) to camouflage proprietary algorithms and equipment in the PSCAD/EMT model while meeting Standard PSCAD Modeling Practices. (See <http://www.electranix.com/wp-content/uploads/2021/12/PSCAD-Model-Requirements-Rev.-11-Dec-2021.pdf>)

The current practice of allowing OEMs to create poorly written models and require NDAs because they don't want to "Black Box" models jeopardizes timelines for any kind of study or NERC compliance timeline. Negotiating NDAs is very inefficient because it usually restricts the utility from outsourcing work to third parties i.e. Eltranix and other consultants. This adds burdensome time to the study process in EMT/PSCAD.

### **FAC-002 Changes:**

The utility is concerned that the proposed changes to FAC-002 will greatly impact its interconnection study process which is a FERC regulated process. Currently utilities struggle to complete study work to get generators interconnected in a timely manner. Adding the additional burden of an EMT study and verification of EMT models would make it more difficult for utilities to complete studies.

Additional language providing engineering judgment when and how PSCAD models will be used in FAC-002 studies would help reduce the burden of this addition.

The proposed changes will create a gap with proposed revisions to MOD-026. MOD-026 also requires EMT models be provided to the TP. MOD-026 requires verified model be provided after commissioning and SAR proposing verified model by the end of trial operations. The SAR does recognize this gap and recommends it be addressed as part of the standard development process.

The SAR also discusses a requirement to re-study prior to commercial operations. This could have an impact on contractual obligations for interconnection and PPAs which set a specific a COD for generation. This could put the PC/TP in a difficult situation.

**MOD-032 Changes:**

Given the proprietary nature of EMT models it does not seem feasible to have a PC collect EMT modeling data. It would be difficult for a PC/TP to maintain these models similar to the way existing steady state and dynamic models are maintained and some utilities do not have the expertise needed to determine when EMT models and modeling data should be required.

The implementation plan for any changes to the standard should include a timeline for back filling data. This will be needed since it may take a significant amount of time to develop models for older facilities.

**TPL-001 Changes:**

The proposed inclusion of EMT studies in the annual Planning Assessment has the potential to significantly increase the time required to perform the assessment especially in the short term while entities are trying to figure out when and how often EMT studies are required. Overall the industry needs to have a better understanding of the benefits of an annual EMT assessment before making it a requirement.

Likes	0
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Dislikes	0
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**Response**

**Mark Gray - Edison Electric Institute - NA - Not Applicable - NA - Not Applicable**

<b>Answer</b>	No
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<b>Document Name</b>	
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**Comment**

While EEI agrees that in the future, EMT studies will need to be a part of Reliability Standards, the tools are not yet fully developed for most companies to conduct EMT studies at the level that would be required within the framework of TPL-001. What is needed are industry case studies and supporting guidance that would assist the industry in preparing and conducting these types of studies. While EMT studies are mentioned in existing NERC Reliability Guidelines and white papers, there is a lack of comprehensive guidance by NERC technical committees on how to effectively conduct regional EMT studies. It would be more effective to develop a NERC Task Force consisting of IBR OEMs, NERC, software developers, industry SMEs, and possibly national labs to develop guidance that support the development of expertise within the industry to support regional EMT BPS reliability models and studies. This should be done before EMT requirements are added to the TPL-001 Reliability Standard.

We support the portion of this SAR that focuses on interconnection studies for IBR, however, requirements should be limited to situations where the TP and PC agree EMT models are needed. Relative to GO requirements for the delivery of EMT models of newly interconnecting IBR facilities, we support new requirements that would obligate IBR GOs and developers to delivery suitable EMT models regardless of whether an EMT study was planned. As conventional resources are retired, conditions will change and EMT studies may be necessary in the future and having EMT models that represent those facilities will be important. We also support PC and TP requirements that would ensure the models supplied by the GO meet their planning needs.

Issues with the SAR regarding FAC-002 that should be change are as follows:

1. The obligation to supply EMT and positive sequence models that accurately represent the interconnected plant should be the sole responsibility of the interconnection owner (i.e., the GO). While we agree the TP and PC have an obligation to verify the information supplied is sufficient, validation that the information supplied matches the actual plant configuration, equipment and protection settings cannot be reliably validated by the TP or PC and should reside with the GO. Additionally, if at a later date the information supplied is found to be invalid, or otherwise in error, the GO should be obligated to remedy the issue upon request by the TP or PC.



2. EEI agrees that the TP and PC have an obligation to study the impact of interconnecting new or changed Facilities on the BES, however, such assessments have limitations. The TP and PC should retain the flexibility to decide whether an EMT study is needed based on existing system conditions and known or planned resource retirements. Such a study should not be required in all cases.
3. EEI recommends the addition of clarifying language in FAC-002 that makes GO obligations more explicit to ensure TPs and PCs have the information they need to conduct both interconnection studies and future impact studies.

Likes 0

Dislikes 0

**Response**

**Alison Mackellar - Constellation - 5,6**

**Answer**

No

**Document Name**

**Comment**

The Proposed SAR is broad in nature and does not address the regional requirements implemented by each Planning Coordinator in regards to collection of MOD-032 data.

Kimberly Turco on behalf of Constellation Segment 5 and 6

Likes 0

Dislikes 0

**Response**

**Kimberly Turco - Constellation - 5,6**

**Answer**

No

**Document Name**

**Comment**

The Proposed SAR is broad in nature and does not address the regional requirements implemented by each Planning Coordinator in regards to collection of MOD-032 data.

Kimberly Turco on behalf of Constellation Segment 5 and 6

Likes 0

Dislikes 0

## Response

### Isidoro Behar - Long Island Power Authority - 1

Answer

No

Document Name

Comment

We do not agree entirely with the proposed scope.

We generally agree with the proposed scope / description for FAC-002 enhancements. However, we do have some concerns:

- From a compliance perspective, we agree with having a requirement for a process to verify (i.e., sign off) that the models used in FAC-002 interconnection studies are a reasonable representation of the plant being commissioned prior to commercial operation. However, this should not be the sole compliance responsibility of the TP and PC. The Asset owner (which could be a TO, GO for example) should share in this compliance responsibility, and should be responsible for signing off on the reasonableness of the plant model. Note that as part of NERC Project 2020-06 Verification of Models and Data for Generators, the emphasis for model verification is on the TO and GO.
- For the statement “Proof of accuracy for EMT and positive sequence models should be provided for the type of phenomena these models will be used to assess, including large disturbances (faults), control behavior and interactions, etc.”, we don’t feel this should be a requirement within FAC-002. The SAR should strive to further clarify requirements for model accuracy and verification, in consideration of the appropriate project stage.
- We are not certain, from a compliance perspective, how “proof of accuracy” could be assured at the interconnection studies stage. As the SAR also states, “model verification should be conducted at the time of plant commissioning or during trial operations”. Plant commissioning would typically occur well after facility interconnection type studies. Benchmarking models during RTDS type testing or after actual system event(s) may be another realistic opportunity to ensure accuracy of the models.

Related to proposed MOD-032 enhancements:

- We agree that proposed enhancements could be made either from modifications to MOD-032 or by introducing a new NERC Standard specifically focused on gathering EMT models and modeling data for the purposes of reliability studies. In this regard, the efforts of NERC Project 2020-06 Verification of Models and Data for Generators should be leveraged.
- We would like to stress that models for EMT studies depend on what is being investigated. A model correctly configured to investigate a low-frequency control interaction differs greatly for one investigating a lightning transient or even a transmission switching surge. Some EMT studies need to be more geographically extensive, but the some studies require system parameters much different than the typical “nameplate” parameters. Equipment data appropriate at one frequency may be inaccurate another / higher frequency. In summary, a large amount of expertise is needed to know how to estimate the non-published parameters of system elements, and this is of greater importance with greater frequency of the relevant phenomena.
- We agree with the concept of, where applicable, replacing the term “dynamics” to differentiate between EMT and RMS fundamental frequency positive sequence models.
- We agree with the concept that models, including EMT, should be accurate and represent the equipment installed in the field. However, we are not sure from a compliance perspective how this can be achieved. Benchmarking models during RTDS testing, plant commissioning, trial operation or after actual system event(s) may be a more realistic opportunity to ensure accuracy of the models. In this regard, the efforts of NERC Project 2020-06 Verification of Models and Data for Generators should be leveraged.
- From a compliance perspective, we do not believe that EMT model quality should be solely assessed by the TP and PC to ensure models are accurate for use in reliability studies. This should also be the compliance responsibility of the of the Asset owner that is supplying EMT model data.

Related to proposed TPL-001 enhancements:

The perception of the SAR may be to underestimate certain aspects of EMT modeling, benchmarking and studies. These efforts are very complex, technically demanding and time consuming. Additionally, the appropriate models for EMT studies will depend on what is being investigated.

As such, we are not sure that adding EMT studies to the required annual NERC TPL-001 planning assessment (i.e., assessing near term & long term planning horizons) is meaningful. Performing targeted EMT studies as requirement for later stage interconnection studies might make more sense in the near term....perhaps guided by an entities' interconnection requirements that will likely be guided by IEEE-2800-2022. Performing EMT studies for the long term planning horizon would be overly speculative (immature models) and may not provide value from a reliability perspective.

We are not convinced that making very targeted EMT studies is needed for a wide area planning study like the annual NERC TPL-001 planning assessment – unless there is a valid wide area / regional reliability quantification that can be identified from an EMT study (perhaps SSR, inverter based resource control interaction, wide area impact of BPS faults, verification of ride through performance as some examples). The SAR might benefit from emphasizing such examples. Some of the potential study focus areas could be considered during later stage interconnection studies and should not need annual repetition unless the grid strength decreases such as by synchronous generator retirement(s).

If there will ultimately be a TPL-001 requirement to perform EMT assessments annually, there must be allowance for the use of past studies.

- In summary, we believe that EMT-related planning assessments should not be included as part of TPL-001 as that standard is already quite detailed and focuses on traditional transmission reliability criteria. Similar to how TPL-007 was developed to assess new concerns and assessments related to transmission reliability, EMT requirements, as appropriate, should be documented in a new standard. In this regard, the efforts of NERC Project 2020-06 Verification of Models and Data for Generators should be leveraged.
- As part of a new standard, we generally agree that the TP and PC can develop a process for determining when detailed studies using EMT models are required such that those studies are done in specific and limited scenarios where they are necessary. TPs and PCs shall then perform EMT studies for situations that meet the rationale.
- As part of a new standard, “stability” can be more clearly and accurately differentiated between studies using EMT models and studies using RMS fundamental frequency positive sequence models. The new standard can be used to ensure that stability criteria for inverter-based resources is clear, consistent, and appropriate for both EMT and RMS fundamental frequency positive sequence simulations.
- With regard to EMT assessments, we do not agree that the requirements should be enhanced to clearly state that the “TP and PC” shall develop corrective action plans when the instabilities are identified. Due to the complexities of potential inter actions and performance of inverter based resources, asset owners (such as TOs, GOs) must also be responsible for participating with the TP/PC in developing corrective action plans.

Likes 0

Dislikes 0

## Response

**Pamela Hunter - Southern Company - Southern Company Services, Inc. - 1,3,5,6 - SERC, Group Name Southern Company**

**Answer**

No

**Document Name**

**Comment**

Southern Company supports the EMT SAR Scope in part, with the following proposed modifications:

1. Southern Company does not support the portion of this EMT SAR Scope that proposes modifications to TPL-001 and MOD-032, specifically:

- TPL-001 enhancements:
  - Southern Company does not support the option of expanding TPL-001 to include EMT studies. Additional clarity needs to be included in the SAR that justifies the need to modify TPL-001 R2, R4, R5 and R6. The system stability criteria should not be any different for EMT simulations. We believe the requirements are correct, as written, unless the SAR clearly identifies the criteria that is missing, including technical justification.
  - A proposal to modify TPL-001 implies that there is a need to develop large-scale EMT models and perform system-wide EMT studies. We do not support the need to perform system-wide EMT studies. EMT studies should be limited to those areas where there is a reliability need, as determined by the TP and PC. It is extremely challenging, and unpractical, to develop and maintain large-scale EMT models; this requires the development of bounding parameters to determine the size of the power system network that needs to be modeled. Broadly requiring the development/maintenance of EMT models and performing EMT studies puts an unnecessary burden on the TP and PC. EMT modeling and analysis should be used when absolutely necessary for unique scenarios as determined by the TP and PC.
- MOD-032 enhancements – Southern Company does not support including MOD-032 within the scope of this SAR. In addition, Southern Company does not support modifications to MOD-032 to explicitly distinguish EMT models. Currently, as written, MOD-032 already allows the TP and PC to request modeling data from GOs and TOs, including modeling data necessary to conduct EMT studies (please review MOD-032 R1).
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2. We support the portion of this SAR that focuses on interconnection studies for inverter-based generation resources, however the following items are of significant concern, and should be addressed as follows:

- FAC-002 enhancements:
  - Southern Company does not support the obligation included in this SAR requiring the TP and PC to validate that the information supplied matches the actual plant configuration, equipment, and protection settings. This information cannot be reliably validated/verified by the TP or PC; therefore, this should not be the responsibility of the TP or PC. Validation of this information should be the responsibility of the interconnecting inverter-based resource (i.e., the GO). Also, please note that the latest draft of MOD-026-2 (under Project 2020-06), already places the responsibility to provide verified models on the GO. We recommend the inclusion of clarifying language that clearly addresses our concern.
  - We have concerns that the time needed to complete interconnection studies could increase significantly if EMT modeling/studies are mandated, and such studies may not be completed within the FERC mandated timelines. Increasing study complexity drives timing and cost, and there is no coordination or relief with mandated timelines for interconnection studies. We recommend the inclusion of clarifying language that clearly addresses our concern.
  - We have concerns regarding the need to perform EMT Studies. The TP and PC should maintain the flexibility to decide whether an EMT study is needed. Such a study should not be required in all cases, and it needs to be up to the TP/PC, based on modeling or reliability needs. We recommend the inclusion of clarifying language that clearly addresses our concern.
  - Page 3 - FAC-002 R1 states “The following shall be studied:” in respect to 1.1 through 1.4. How does the “as necessary” in R1.3 agree with the parent shall? We recommend the inclusion of clarifying language.

Likes	0
Dislikes	0
<b>Response</b>	
<b>Gail Elliott - International Transmission Company Holdings Corporation - NA - Not Applicable - MRO,RF</b>	
<b>Answer</b>	No
<b>Document Name</b>	
<b>Comment</b>	

ITC supports the comments submitted by EEI for this question

Likes 0

Dislikes 0

**Response**

**Alan Kloster - Evergy - 1,3,5,6 - MRO**

**Answer**

No

**Document Name**

**Comment**

Evergy supports and incorporates by reference the comments of the Edison Electric Institute (EEI) for question #1.

Likes 0

Dislikes 0

**Response**

**Mark Garza - FirstEnergy - FirstEnergy Corporation - 1,3,4,5,6, Group Name FE Voter**

**Answer**

No

**Document Name**

**Comment**

FirstEnergy supports EEI comments.

Likes 0

Dislikes 0

**Response**

**Donna Wood - Tri-State G and T Association, Inc. - 1,3,5**

**Answer**

No

**Document Name**

**Comment**

Tri-State Generation and Transmission supports the comments submitted by EEI.

Likes 0

Dislikes 0

**Response**

**Devin Shines - PPL - Louisville Gas and Electric Co. - 1,3,5,6 - SERC,RF, Group Name** PPL NERC Registered Affiliates

**Answer** No

**Document Name**

**Comment**

PPL NERC Registered Affiliates agree with the comments submitted by EEI.

Likes 0

Dislikes 0

**Response**

**Andrea Jessup - Bonneville Power Administration - 1,3,5,6 - WECC**

**Answer** No

**Document Name**

**Comment**

Although BPA is supportive of the effort to ensure that IBR resources are integrated reliably, BPA does not agree with the proposed scope of the SAR.

BPA has concerns about the quality of EMT modelling data available from developers during generator interconnection studies. Detailed manufacturer-specific EMT models, including actual protection and control models and settings, are required to verify disturbance ride-through capabilities. Data that represents equipment actually being installed is not available until after a developer chooses an EPC contractor if they decide to move forward with their project, which occurs after the interconnection study process is complete.

A better approach would be to require a project developer either to self-certify or seek a third party certification of the disturbance ride-through capabilities. The following is suggested:

- NERC IRPWG to develop disturbance ride-through requirements such as voltage change, phase change, instantaneous frequency, waveform distortion, phase imbalances, etc.
- Transmission Planners to adopt these requirements in their Generation Interconnection Standards.
- Transmission Planners require Generator Owners to provide evidence of certification as part of a generator interconnection checklist.
- NERC pursue Reliability Standards to address disturbance ride-through performance applicable to GOs, possibly through modifications to PRC-024.

BPA does not believe that TPL-001 is the appropriate Standard for EMT analysis or that EMT studies should be performed during annual planning assessments. Data requirements would be large and difficult to effectively manage for modeling, and there would be concerns with simulation computation time and solvability issues trying to conduct system wide EMT studies. Also, if IBR generation were to experience cessation or loss of synchronism, that loss of generation would need to be modelled back into stability and powerflow studies anyway to evaluate if it results in a transmission performance deficiency. That would be an iterative process. EMT studies would multiply the amount of studies and the time required for

Annual Assessment. Finally, if a performance deficiency were to occur in the study with regards to a generator or group of generators, the TP or PC would be required to develop a Corrective Action Plan (CAP). A transmission CAP would not necessarily be effective to resolve a transmission performance deficiency due to a generator performance deficiency. This places an undue burden on the TP or PC to develop a CAP and resolve an issue that ultimately should be the responsibility of, and would be most effectively dealt with, by the GO to meet standards for generator performance.

From the 2016 Blue Cut fire and 2017 Canyon 2 fire disturbance reports, the root cause of inverter based resource tripping seems to be momentary cessation and perceived low frequency due to distorted voltage waveform caused by the transmission line fault. The Canyon 2 fire disturbance report indicates no frequency related tripping occurred during the two Canyon 2 fire fault events. This is because the mitigating actions of the inverter manufacturer and affected GOs remediated the frequency related issues identified during the Blue Cut Fire disturbance. Therefore, the solution for the issues identified by the disturbance reports seems to be with the generator owner and/or manufacturers, and the best way to achieve the needed fixes is through performance requirements for the generator owners rather than additional EMT modeling requirements added to existing Standards for TPs and PCs which require significant resources, data gathering challenges, simulation computation time and solvability issues, and performance issues that are not transmission system related issues.

BPA does not believe it is appropriate to collect EMT model data through the MOD-32 data collection process. If models are needed to be collected a new Standard should be developed.

The current MOD-032 process to collect steady state and transient data is working well. MOD-032 data collection is for the powerflow, short-circuit, and dynamic studies. These models are a single-phase equivalent of a 3-phase network and the basic assumption of these studies is a balanced 3-phase network. EMT studies model each phase individually. It is a completely different model from everything else collected under MOD-032. There are completely different software tools for such studies as well. From a strictly modeling data perspective, MOD-032 is not a good fit for this purpose.

Also, MOD-032 requires the TP/PC perform an annual collection of the modeling data (R2) and submit it to the ERO (WECC for BPA) for incorporation into the regionally coordinated model (R4). If data is collected for an interconnection request, then neither of those would apply. That would be a one-time data collection effort for the interconnection study and these would not be passed to the ERO. Within WECC, there is no regionally coordinated EMT model. This would be a very large undertaking and is not realistic from both a data management and simulation standpoint. From a cadence and process perspective, MOD-032 is not a good fit for this purpose.

BPA does not support modifications to FAC-002 either. Instead, as stated in comments earlier:

A better approach would be to require a project developer either to self-certify or seek a third party certification of the disturbance ride-through capabilities. The following is suggested:

- NERC IRPWG to develop disturbance ride-through requirements such as voltage change, phase change, instantaneous frequency, waveform distortion, phase imbalances, etc.
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Likes 0

Dislikes 0

### Response

**Michelle Amarantos - APS - Arizona Public Service Co. - 1,3,5,6**

**Answer**

No

**Document Name**

**Comment**

AZPS supports the following comments submitted by EEI on behalf of their members:

EEI supports this SAR in part, but we disagree that MOD-032-1 needs to be revised. At the present time, PC and TP have all the tools they need to request and obtain EMT modeling data from GOs, TOs, etc. Among the data requirements identified in this Reliability Standard include dynamic modeling data (which includes EMT data, see R1). What may not be fully understood is that the requirements already exist as well as the obligations to supply this data upon request.

While EEI agrees that in the future EMT studies will need to be a part of this Reliability Standard, the tools are not yet fully developed, and most companies are ill prepared to conduct EMT studies at the level that would be required within the framework of TPL-001. What is needed is industry case studies and supporting guidance that would assist the industry in preparing and conducting these types of studies outside of associated compliance burdens. While EMT studies are mentioned in existing NERC Reliability Guidelines and white papers, there is a lack of concrete guidance by NERC technical committees on how to effectively conduct regional EMT studies. It would be more effective to develop a NERC Task Force consisting of IBR OEMs, NERC, software developers, industry SMEs, and possibly national labs to develop guidance that support the development of expertise within the industry to support regional EMT BPS reliability models and studies. This should be done before EMT requirements are added to TPL-001 Reliability Standard.

EEI supports the portion of this SAR that focuses on interconnection studies for IBR, however, requirements should be limited to situation where the TP and PC agree they are needed. Relative to GO requirements for the delivery of EMT models of newly interconnecting IBR facilities, we support new requirements that would clearly and unambiguously obligate IBR GOs and developers to delivery suitable EMT models regardless of whether an EMT study was planned because as conventional resources are retired, conditions will change and EMT studies may be necessary in the future. We also support PC and TP requirements that would ensure the models supplied by the GO meet their planning needs.

Issues with the SAR regarding FAC-002 that should be change are as follows:

- a. The obligation to supply EMT and positive sequence models that accurately represent the interconnected plant should be the sole responsibility of the interconnection owner (i.e., the GO). While we agree the TP and PC have an obligation to verify the information supplied is sufficient, validation that the information supplied matches the actual plant configuration, equipment and protection settings cannot be reliably validated by the TP or PC and should reside with the GO. Additionally, if at a later date the information supplied is found to be invalid, or otherwise in error, the GO should be obligated to remedy the issue upon request by the TP or PC.
- b. EEI agrees that the TP and PC have an obligation to study the impact of interconnecting new or changed Facilities on the BES, however, such assessments have limitations. The TP and PC should retain the flexibility to decide whether an EMT study is needed based on existing system conditions and known or planned resource retirements. Such a study should not be required in all cases.
- c. EEI recommends the addition of clarifying language in FAC-002 that makes GO obligations more explicit to ensure TPs and PCs have the information they need to conduct both interconnection studies and future impact studies.

Likes 0

Dislikes 0

**Response**

**Eric Shaw - Oncor Electric Delivery - 1 - Texas RE**

**Answer**

No

**Document Name**

**Comment**



While Oncor believes that there are benefits to performing EMT assessments, Oncor does not support a broad inclusion of EMT assessments in TPL-001. It may be better to have a separate and dedicated standard to cover the specific reliability needs to be addressed through EMT assessments.

Likes 0

Dislikes 0

### Response

**Stephen Stafford - Georgia Transmission Corporation - NA - Not Applicable - SERC**

**Answer**

No

**Document Name**

**Comment**

Prior to pursuing changes to standards, time should be allotted for the implementation and efficacy measurement of reliability guidelines.

Likes 0

Dislikes 0

### Response

**Marty Hostler - Northern California Power Agency - 3,4,5,6**

**Answer**

No

**Document Name**

**Comment**

No, more detail is required.

This proposal claims PCs and TPs lack accurate modeling data and that EMT models are needed for the interconnection process and long-term planning horizon studies. It also mentions getting EMT model data prior to commissioning.

What is to be done about the 1,000s of already installed Inverter Resources?

Likes 0

Dislikes 0

### Response

**Rachel Coyne - Texas Reliability Entity, Inc. - 10**

**Answer**

Yes

**Document Name****Comment**

Texas RE agrees with and supports the proposed SAR. Given recent events described in the Multiple Solar PV Disturbances in CAISO and Odessa Disturbance report, in which the need for detailed EMT modeling for ride-through assessments is described, these revisions are timely and necessary. This SAR is a step in improving BES stability.

Texas RE recommends the drafting team consider including technical rationale or guidance for the term “where necessary”.

Texas RE also recommends a provision to update models as needed to reflect operations.

Likes 0

Dislikes 0

**Response****Leonard Kula - Independent Electricity System Operator - 2****Answer**

Yes

**Document Name****Comment**

The IESO supports the NPCC RSC comments for this question.

Likes 0

Dislikes 0

**Response****Brendan Baszkiewicz - Eversource Energy - 1,3****Answer**

Yes

**Document Name****Comment**

The proposed project should produce three deliverables – modifications to FAC-002, modifications to MOD-032 (or a new standard related to EMT model collection and validation), and a new TPL standard related to EMT planning assessments. EMT-related planning assessments should not be included as part of TPL-001 as that standard is already quite detailed and focuses on traditional transmission reliability criteria. Similar to how TPL-007 was developed to assess new concerns and assessments related to transmission reliability, EMT requirements should be documented in a new TPL standard.

Likes 0

Dislikes 0

**Response**

**Michael Johnson - Pacific Gas and Electric Company - 1,3,5 - WECC, Group Name PG&E All Segments**

**Answer** Yes

**Document Name**

**Comment**

PG&E indicates agreement with the SAR, but also indicates;

1 - Although EMT modeling and studies are necessary in many cases, they are not always required from a transmission planning perspective. PG&E recommends that the SDT develop criteria defining which scenario(s) require EMT modeling and which do not.

2 - Furthermore, there are nuances to the *types* of EMT studies that may be performed, which the SDT should at least address in supplemental documents.

3 - Finally, corrective actions based on the results of EMT studies should also be acknowledged in the Standard (if their inclusion is agreed upon in the final version).

If the SDT does not feel it is appropriate for the Standard to dictate these criteria, they may also choose to assign this responsibility to the Planning Coordinators or Transmission Planners. The development of EMT modeling criteria may also be more appropriately suited for the Regional Entities to manage, based on the distribution of inverter-based resources within their region.

Likes 0

Dislikes 0

**Response**

**Justin Welty - NextEra Energy - Florida Power and Light Co. - 1,3,6**

**Answer** Yes

**Document Name**

**Comment**

Yes, the group agrees on the proposed scope. Comments are added under Question #2

Likes 0

Dislikes 0

**Response**

**Carl Pineault - Hydro-Québec Production - 1,5****Answer** Yes**Document Name****Comment**

The proposed project should produce three deliverables – modifications to FAC-002, modifications to MOD-032 (or a new standard related to EMT model collection and validation), and a new TPL standard related to EMT planning assessments. EMT-related planning assessments should not be included as part of TPL-001 as that standard is already quite detailed and focuses on traditional transmission reliability criteria. Similar to how TPL-007 was developed to assess new concerns and assessments related to transmission reliability, EMT requirements should be documented in a new TPL standard.

Likes 0

Dislikes 0

**Response****John Pearson - ISO New England, Inc. - 2****Answer** Yes**Document Name****Comment**

The scope as described is acceptable but with BES applicability of 20 MVA for a single generator and 75 MVA aggregate, the standards for data collection will not be applicable to enough generation such as a 50 MVA solar plant connected at 115 kV. To make this effort more meaningful, the BES definition must also be updated to account for inverter based generation.

Likes 0

Dislikes 0

**Response****Nicolas Turcotte - Hydro-Québec TransEnergie - 1****Answer** Yes**Document Name****Comment**

The proposed project should produce three deliverables – modifications to FAC-002, modifications to MOD-032 (or a new standard related to EMT model collection and validation), and a new TPL standard related to EMT planning assessments. EMT-related planning assessments should not be included as part of TPL-001 as that standard is already quite detailed and focuses on traditional transmission reliability criteria. Similar to how TPL-007 was developed to assess new concerns and assessments related to transmission reliability, EMT requirements should be documented in a new TPL standard.

Likes	0
Dislikes	0
<b>Response</b>	
<b>Dwanique Spiller - Berkshire Hathaway - NV Energy - 5</b>	
<b>Answer</b>	Yes
<b>Document Name</b>	
<b>Comment</b>	
After more deliberation, we would like to change our Yes to a NO. for Question 1.	
Likes	0
Dislikes	0
<b>Response</b>	
<b>Shannon Mickens - Southwest Power Pool, Inc. (RTO) - 2 - MRO,WECC, Group Name SPP RTO</b>	
<b>Answer</b>	Yes
<b>Document Name</b>	
<b>Comment</b>	
<p>SPP RTO recommends that the SAR drafting team consider including the OEM as an applicable entity to provide modeling data. Additionally, the drafting team may want to put some parameters around what is defined as real-code models provided by the OEM. At this point, it's not clear what real-code models are defined as in the cost section of the SAR.</p> <p>Furthermore, SPP recommends that the drafting team take into consideration the increase effort and timing requirements on the TPL assessment if there is an EMT study that's associated with it. From our perspective, this will create more work to be completed in less time. Moreover, we suggest the TPL time requirement be extended from 12 months to 18 months.</p>	
Likes	0
Dislikes	0
<b>Response</b>	
<b>Nazra Gladu - Manitoba Hydro - 1,3,5,6</b>	
<b>Answer</b>	Yes
<b>Document Name</b>	

**Comment**

Likes 0

Dislikes 0

**Response****Julie Hall - Entergy - 1,3,6, Group Name** Entergy**Answer**

Yes

**Document Name****Comment**

Likes 0

Dislikes 0

**Response****Teresa Krabe - Lower Colorado River Authority - 1,5****Answer**

Yes

**Document Name****Comment**

Likes 0

Dislikes 0

**Response****Israel Perez - Salt River Project - 1,3,5,6 - WECC****Answer**

Yes

**Document Name****Comment**

Likes 0

Dislikes 0

**Response**

**Daniel Gacek - Exelon - 1,3**

**Answer** Yes

**Document Name**

**Comment**

Likes 0

Dislikes 0

**Response**

**Charles Yeung - Southwest Power Pool, Inc. (RTO) - 2**

**Answer**

**Document Name**

**Comment**

The SRC believes the Standard Drafting Team (SDT) must address several issues prior to making EMT studies mandatory. First, the SRC agrees with the SAR's scope to the extent it indicates EMT modeling and studies *may* be needed in certain situations and, when needed, a new Standard should ensure the models contain accurate information. The existing TPL-001 allows PCs and TPs to perform EMT studies when deemed necessary due to Inverter-Based Resource (IBR) impacts in the study area. However, PCs and TPs find it difficult to obtain needed IBR data to perform those studies. Thus, the SRC believes NERC must first ensure data availability and quality before creating a standard requiring EMT studies. NERC also must consider the feasibility and capability of available engineering tools. At this point, software vendors cannot store all the IBR data needed to satisfy a mandatory requirement. Further, to create standards for a mandatory study that provides effective results, NERC must address the BES definition because many IBRs are less-than 50 MVA and connected at 115KV (such as solar) and should be included in studies.

The SRC also has concerns about a learning curve to determine when PCs and TPs should perform EMT studies because the industry does not have an established threshold for IBR penetration requiring a study. Because not all study areas have significant IBR penetration, a PC/TP could not technically determine when it must perform an EMT study.

Further, TPL-001 contains requirements for a core baseline study performed annually. PCs/TPs need not perform EMT studies every year and those studies usually apply to locally-focused areas (not interconnection-wide). Adding a requirement to perform EMT studies annually will make transmission planning studies longer and more burdensome. NERC should separate EMT requirements from core baseline study requirements to avoid confusion as currently done with GMD studies. Hence, if NERC follows through on requiring EMT studies, the SRC recommends modifying the SAR scope to propose creating a new standard to cover the topic instead of adding requirements to existing standards.

Because of these concerns, the SRC seeks a change to the scope to something more like FAC-002:

*TP and PC Conduct EMT Studies Where Necessary: Draft a new standard to include studies involving EMT models, where necessary, as part of the interconnection study process.*

The SRC also recommends having the project focus on data collection of the data PCs and TPs need to determine when to perform an EMT study.

With respect to data availability, Generator Owners often cannot get the equipment manufacturer to provide data for proprietary reasons. The SAR should make it clear data needed for EMT studies must be provided, with no exemption for commercial reasons. The requirement for a GO to provide data to support EMT models must also include existing generators. A study area may not currently require an EMT study but changes to the resource mix over time may create a need. Existing IBR resources in a study area will affect study results and equipment vintage should not affect whether the GO must provide data.

Part of the SDT's work should include addressing confidentiality by providing a mechanism for GOs to provide needed data to modelers while satisfying confidentiality requirements. Currently, PCs work with GOs and load customers under strict confidentiality requirements. If more authority or agreement is needed to make needed data available, NERC must resolve the issue.

The SRC believes the data requirements should remain in MOD-032, which already covers data requirements for planning study models.

Likes	0
Dislikes	0
<b>Response</b>	



2. Provide any additional comments for the SAR drafting team to consider, if desired.

Charles Yeung - Southwest Power Pool, Inc. (RTO) - 2

Answer

Document Name

Comment

Due to the increasing impact of IBRs, NERC must take a holistic approach to address the SRC's concerns about tools and timing concerns.

We suggest the EMT Modeling SDT coordinate EMT-related aspects of Project 2020-06 that eventually may become mandatory, with the coordination highlighted more prominently as part of the scope of this project (rather than mentioning it only at the SAR's end).

In addition, the SRC recommends the section, *Are there any related standards or SARs that should be assessed for impact as a result of this proposed project? If so, which standard(s) or project number(s)?*" (on page 6), be expanded to include **Project 2022-02: Modifications to TPL-001-5.1 and MOD-032-1** in addition to **Project 2020-06 Verification of Models and Data for Generators** as both Project 2022-04 and Project 2022-02 are intended to address aspects of how BPS-connected inverter-based resources are considered, modeled, and studied in planning assessments.

Likes 0

Dislikes 0

Response

Marty Hostler - Northern California Power Agency - 3,4,5,6

Answer

Document Name

Comment

One concern is, as a GO/GOP, our PC/TP pushes interconnection queue System Impact Studies down to us without any compensation or reimbursement. Even though generation developers are required to pay a study deposit to them upfront and reimburse them for expenses above the deposited amount as part interconnection study process; our expenses should be included.

FERC should ensure we are compensated/reimbursed for our expenses as there are an inordinate number of requests submitted to the queue and we spend a lot of time and money which we pay our study consultant.

Another concern is that there is a very limited number of people who know how to perform EMTP modelling and studies. A proposal such as this one is going to tax that limited supply of expertise and increase their rates to perform said studies; let alone create a big study backlog logjam.

Before this SAR is approved, FERC, NERC, and others who desire these models, should develop a process to provide entities the tools (software/hardware), training, and reimbursement for time and \$\$ spent to existing impacted GO and TOs that need to do studies to determine the impact of proposed generation on our existing Facilities.

We also need reimbursement for past studies as we have had an inordinate number of interconnection queue requests and have already spent a significant amount of time and money in order to complete said studies; the PCs and TPs are compensated by the developer proposing the interconnection. Why aren't the potential impacted entities reimbursed for their time, material, and consultant costs to study interconnection requests. This proposal is going to require us to spend more \$\$, time, with no training or tools needed to perform work proposed.

Likes 0

Dislikes 0

### Response

**Stephen Stafford - Georgia Transmission Corporation - NA - Not Applicable - SERC**

**Answer**

**Document Name**

**Comment**

GTC supports and agrees with the comments provided by Southern Company. Additional comments related to each standard are included below.

- MOD-032 Enhancements – GTC, in general, supports efforts to ensure GOs supply needed EMTP modeling data. It is not clear from the SAR if MOD-032 does not already provide sufficient authority for the PC to request this data.
- FAC-002 Enhancements
  - The obligation to validate that the information supplied matches the actual plant configuration, equipment and protection settings cannot be reliably validated by the TP or PC in the timeframe allotted by FERC for generation interconnection studies. This would require generator test data to be compared to the provided model. It would also require an actual system event to be modeled. These issues are already addressed in MOD-026, MOD-027, MOD-033.
  - Modifications to FAC-002, if pursued, should not be focused on R1, but rather on requirements focused on the GO & TO providing the necessary EMT data and details.
- TPL-001 Enhancements
  - As currently written, TPL-001 prescribes system performance requirements that must be met under prescribed system conditions. It does give a detailed prescription for the type of study/tool used to assess the performance requirement, nor is it necessary. This level of detail should be left to discretion of the TP & PC.
  - Unless there are specific performance requirements related to EMT studies that must be added to Table 1, the current language in TPL-001 will allow the PC & TP discretion to use EMT studies to evaluate the performance of BES.
  - There is no need to modify requirements R5 & R6 to state that the TP & PC shall develop corrective action plans; requirement R2.7 already clarifies when a corrective action plan is required.
  - Adding requirements to perform EMT studies to TPL-001 implies system wide EMT models will be required. This is impracticable and would be a significant and unnecessary burden on PCs and TPs. Interconnection studies are a more appropriate forum to address EMT analysis, not the annual Planning Assessment of a PC/TP area.

Likes 0

Dislikes 0

### Response

**Michelle Amarantos - APS - Arizona Public Service Co. - 1,3,5,6**

**Answer**

**Document Name**

**Comment**

AZPS supports the following comments submitted by EEI on behalf of their members:

Consistent with our comments above, we suggest the following guidance be considered, noting that the capability to do EMT modeling remains limited for many companies.

- Guidance is needed on what model quality checks are necessary.
- Guidance is needed on how to determine adequate parameterization of an EMT or positive sequence model.
- Guidance is needed on how model validation studies should be performed:
  - Who is responsible for validating disturbance event data against model response?
  - How is a model validated against a disturbance event?
  - What qualifies acceptable deviation from actual response versus the need for tuning or re-validation?

Likes 0

Dislikes 0

**Response**

**Devin Shines - PPL - Louisville Gas and Electric Co. - 1,3,5,6 - SERC,RF, Group Name PPL NERC Registered Affiliates**

**Answer**

**Document Name**

**Comment**

PPL NERC Registered Affiliates agree with the comments submitted by EEI.

Likes 0

Dislikes 0

**Response**

**Shannon Mickens - Southwest Power Pool, Inc. (RTO) - 2 - MRO,WECC, Group Name SPP RTO**

**Answer**

**Document Name**

**Comment**

SPP RTO recommends that the SAR drafting team include language in the SAR that suggests that the EMT SDT coordinates with the SDT drafting team of the 2020-06 Verification of Models and Data for Generators (MOD-026 and MOD-027). The concern is that the proposed MOD-026-2 includes the Planning Coordinator in the applicability section of the standard. It would be a good idea for these two drafting teams work together and ensure that

all requirements associated with EMT studies align with the modifications for FAC-002, MOD-032 and TPL-001 when it comes to studies being conducted by the TP and PC.

Likes 0

Dislikes 0

### Response

**Mark Garza - FirstEnergy - FirstEnergy Corporation - 1,3,4,5,6, Group Name FE Voter**

**Answer**

**Document Name**

**Comment**

FirstEnergy supports EEI comments.

Likes 0

Dislikes 0

### Response

**Elizabeth Davis - PJM Interconnection, L.L.C. - 2 - SERC,RF**

**Answer**

**Document Name**

**Comment**

In addition to supporting the IRC SRC comments, PJM is requesting the following additional comments for the SAR drafting team to consider:

Due to the amount of technical work associated with this Project, PJM is requesting additional information associated with the SAR in order to understand the scope of work and reliability need.

From a Planning perspective:

- The SAR states that “EMT models are not required in all instances and the TP and PC have the discretion to decide on as needed basis. This is already the case today. If the process of collecting, maintaining and validating EMT models is not mandatory, why the need for modification to the standards from their current state?
- PJM would like to indicate that the modeling effort will extend well beyond just collecting the initial EMT models. These models will generally be proprietary-based, which may impose challenges sharing them with an extended stakeholder base including consultants. Also, the effort will involve maintaining these models to remain valid for the EMT platforms to be used for such analysis as the versions evolve over time.
- For NERC TPL-001 enhancements: PJM would like to indicate that all dynamic studies should utilize models suitable to capture the proper (dynamic, not electromagnetic) time-domain analysis. The electromagnetic phenomena and other system performance assessments (Such as harmonics, power quality and resonance) are dealt with at an equipment/TO level and are not part of the current planning standard for system-wide

stability assessments. The new standard should be clear on which phenomena is being targeted from the change. Who conducts the studies and the performance criteria to which compliance will be measured could follow accordingly.

- From the SAR, NERC is implying that entities can have different criteria that may not be applied homogeneously and equally throughout. If the assessments are deemed necessary for the overall system stability and acceptable performance with inclusion of EMT models, why isn't this being considered to be through a centralized NERC std that is equally applied nationally?

- Can the highlighted study cases outlined in the SAR supporting paper provide guidance to (1) what enhancements are possible to the dynamic planning tools/models (PSS/E and PSLF) to potentially address the modeling deficiency? (2) can the dynamic studies and performance criteria enhanced (either alone or in addition to (1)) to allow PSS/E and PSLF analysis indicate need for additional EMT performance assessments?

The second bullet of NERC FAC-002 Enhancements on page 3, "Ensure Accurate Models are Provided and Verified Prior to Commercial Operation", requires the TP and PC to have a verification process between studied models and as-built models. PJM believes that the GO should provide the proof of accuracy for EMT and positive sequence models but it's not clear in the sentence. Also it's not clear if the proof of model accuracy should involve field tests or just comparison based on simulations is acceptable. If this model validation should involve field tests, alignment and coordination with the Project 2020-06 may be necessary

From a Modeling perspective:

The devices to be involved into EMT study are listed in the page 4 of NERC document '2022-04 EMT Modeling SAR\_082022.pdf'. It can be seen that EMT will be covered soon by MOD-026-2.

Study of lower voltage ride through ability during the recovery phase when a fault occurred at a wind farm or solar park is covered by MOD-026-1 and MOD-027-1, when plant capacity is greater than 100MVA. In future, this will be covered by MOD-026-2 where the plant capacity is greater than 20MVA on 100 kV and above as well as HVDC, Statcom, SVC, and other FACTS devices.

Regarding whether to modify MOD-032 to collect EMT models, PJM feels it is not necessary:

- MOD-032 R2 already allows for collection of dynamics models and data. Transient models are short-term, or fast response dynamic models. Thus, TPs & PCs already have the authority within MOD-032 to collect this data under the existing dynamic data collection language of R2 and R1.

However, PJM is questioning the need to collect this data annually, which applying MOD-032 would do. MOD-026-2 can be used to require a GO to submit an EMT model for a technical concern. Therefore, MOD-032 requirements may not need to apply at all.

From an Interconnection perspective:

Clarity on when to perform EMT needed: SAR states that EMT studies should be performed, "where necessary", as part of the interconnection study process. We believe that it should be better defined as to when it would be applicable to an interconnection request. "Where necessary" is too open and vague. Will there be criteria established by NERC? Or will it be the responsibility of the TP or PC to determine when an EMT study should be performed? (e.g. weak grid situation, low short circuit ratio, close proximity of 2 offshore wind etc..) If left to the individual TP, then it would not be performed consistently across zones.

System Wide EMT analysis is unfeasible: Due to the rigor of the analysis, performing EMT analysis across entire the PJM footprint is infeasible. If the responsibility of the TP, PJM would need to develop a methodology to identify potential study areas. PJM would need to develop a screening analysis to identify critical stress conditions and weak system locations and perform EMT studies on the identified subset. This screening analysis may differ from other ISOs so there would be some inconsistencies.

TO support for study: As the local TO is most familiar with the state of their transmission system, it may be prudent to have them to help make the assessment of which zones on their system would require an EMT study. They may even want to support performing the study.

Too early for an EMT study?: Requesting EMT model data up front in the application phase for a generator developer may be too premature as they will likely not yet have equipment specified. The integrity of any data collected would be in question. With many hundreds or possibly a thousand new interconnection requests in a study cycle, even if PJM were to receive the EMT model data, results from such a study could be very skewed

initially. Historically a small percentage of projects that enter the interconnection queue actually move through to commercial operation. Performing an EMT study too early in the life cycle of a generator could be time spent resulting in uncertain and unactionable results.

No way to open ISA with added scope: If the study is performed at a later stage when the Generator Owner has good quality data, it could be closer to the implementation phase and after the study phase. If the EMT study reveals that reinforcements are necessary to accommodate the generator at a later stage, it could be after their final agreement is signed and there is no mechanism in the Tariff by which we can open that ISA to add scope or cost for any mitigation to the responsible party.

Lacking experience: This would be an additional new type of study that PJM analysis engineers do not have experience performing. Either we would need extensive training for the existing employees, add new employees with the experience or rely on consultants to help support this effort. Even with consultants, we always need in-house expertise to review and validate results.

Delays in Interconnection Study cycles: Imposing EMT studies in the Interconnection Study process phase would result in a prolonged interconnection study cycle process as there would be more data to gather and verify, more coordination with the generator owner on the integrity of the data, more time and coordination to perform the study, more coordination required with the TO to verify study results, and more time to develop any mitigation plans. This would be similar to the dynamic analysis process where there is regularly a delay in getting final results (compared to Load Flow and Short Circuit results) due to the level of interaction required to gather the correct data, coordinate the study, review results with TOs and determine mitigations. This at a time where we just filed a process reform with FERC to speed up the interconnection study process. Introducing a new study with questionable results is not supportive of abbreviating the time a project developer needs to wait before moving to final agreement phase.

More Necessary Studies: Currently when a developer has equipment changes after an interconnection agreement is signed, a Necessary Study would be required to see the impact of the changes. With EMT studies being performed in addition to stability/load flow/short circuit, the need for Necessary Studies could double (need for both stability and EMT restudy). This will take additional time/resources and could delay the generator developer.

Likes 0

Dislikes 0

### Response

**Alan Kloster - Evergy - 1,3,5,6 - MRO**

**Answer**

**Document Name**

**Comment**

Evergy supports and incorporates by reference the comments of the Edison Electric Institute (EEI) for question #2.

Likes 0

Dislikes 0

### Response

**Gail Elliott - International Transmission Company Holdings Corporation - NA - Not Applicable - MRO,RF**

<b>Answer</b>	
<b>Document Name</b>	
<b>Comment</b>	
ITC supports the comments submitted by EEI for this question.	
Likes 0	
Dislikes 0	
<b>Response</b>	
<b>Pamela Hunter - Southern Company - Southern Company Services, Inc. - 1,3,5,6 - SERC, Group Name Southern Company</b>	
<b>Answer</b>	
<b>Document Name</b>	
<b>Comment</b>	
Consistent with the aforementioned comments, we recommend that the following be considered:	
<ul style="list-style-type: none"> <li>• We recommend that a NERC EMT modeling guideline (one that solely focuses on EMT modeling) be published and implemented before modifying standards so that industry has an opportunity to learn about EMT modeling, including understanding challenges and modeling complexities. The EMT guideline must be reviewed and approved by industry (e.g., TPs and PCs) and appropriate committees (e.g., RSTC) before considering an EMT SAR.</li> <li>• Page 1 – we do not support the development of a new NERC Reliability Standard to address EMT studies. While there is an increased need to perform EMT simulations to verify that inverter-based resources meet interconnection requirements, there is not enough justification to develop a Reliability Standard solely for this purpose. Furthermore, MOD-026 and MOD-027 standards are currently being revised to address the EMT data and model requirements.</li> </ul>	
Likes 0	
Dislikes 0	
<b>Response</b>	
<b>Isidoro Behar - Long Island Power Authority - 1</b>	
<b>Answer</b>	
<b>Document Name</b>	
<b>Comment</b>	

As stated on page 6 of the SAR (section covering “unique characteristics of the BES facilities..”), we agree and also recommend that Asset owners of BES facilities (GOs, TOs) should be required to provide EMT models, where applicable, and ensure model quality of the models submitted to the TP and PC.

A significant concern for adding or enhancing NERC standard requirements related to EMT models and studies is that entity compliance would be dependent on having EMT models that are not confidential and that can be shared. NERC might consider developing or enhancing specific requirements to emphasize that EMT models for use in interconnection studies (or possible TPL-001 studies / studies required by a new EMT standard) must not be proprietary, and that at a minimum the models must be shared with the TP/PC.

We recognize that EMT studies are critical for the reliable integration of non-synchronous resources. However, EMT studies require specialized technical expertise and require a longer time to perform than traditional studies. The aspects of EMT modeling and EMT studies to support the high penetration of IBRs will be greatly challenged by human resources (i.e., lack of detailed technical expertise or the right type of engineers who have the skills to address all of the issues evolving). Therefore, potential compliance requirements and process for EMT model verification/accuracy and compliance requirements for conducting EMT studies need to be well thought out. Based upon our discussions with colleagues, the consensus is that we must be careful to apply the industry’s very limited EMT expertise resources in the near-term, and in terms of EMT studies we should be studying the specific interconnection issues and areas of the system that really deserve the attention.

Likes 0

Dislikes 0

## Response

**Nicolas Turcotte - Hydro-Qu?bec TransEnergie - 1**

**Answer**

**Document Name**

**Comment**

The SDT should instead of modifying TPL-001 “which will differentiate stability portions from existing requirements, have a process for conducting EMT studies, and include appropriate stability criteria”, the SDT should make a new standard targeted just to EMT assessment. This should be a new standard to avoid crowding TPL-001 with multiple layers of assessment processes and, more importantly, criteria.

Consider requirements for model interchangeability between different EMT software packages. Required models should be usable in any of the EMT software packages (“EMTP-RV” from HydroQuebec, “PSCAD” from Manitoba Hydro, “eMT” from etap, “EMT” from DIgSILENT, etc.).

Also, consider if changes are needed to MOD-033 and if all EMT-related MOD standard changes and additions would be best captured in a single, new MOD standard.

Finally, the requirements should capture the necessity for periodic verification (ideally, field verification) of inverter parameters and settings since regular updates to inverter firmware should be expected. As inverter manufacturers add features to or correct security weaknesses in their code, they will issue new firmware to implement these which will be installed at many of the field installations of the equipment. The MOD standard should require actual, in the field firmware updates within 180-days to fix any known security vulnerabilities to protect the reliability and integrity of the transmission system.

We suggest that the TP/PC should be the entity that defines the EMT requirements.

Likes 0

Dislikes 0



**Response**

**Kimberly Turco - Constellation - 5,6**

**Answer**

**Document Name**

**Comment**

Constellation has no further comments.

Kimberly Turco on behalf of Constellation Segment 5 and 6

Likes 0

Dislikes 0

**Response**

**Alison Mackellar - Constellation - 5,6**

**Answer**

**Document Name**

**Comment**

Constellation has no further comments.

Kimberly Turco on behalf of Constellation Segment 5 and 6

Likes 0

Dislikes 0

**Response**

**John Pearson - ISO New England, Inc. - 2**

**Answer**

**Document Name**

**Comment**

For FAC-002, the SAR indicates that studies should be performed “where necessary.” This should be limited to studies for inverter based resources to address control interactions and ride-through. This limitation should also be applied to revisions to TPL-001. These limitations would then reduce the scope of data required under MOD-032 for transmission elements (for example, information related to transmission elements such as tower configurations would not be needed).

Likes 0

Dislikes 0

## Response

**Carl Pineault - Hydro-Quebec Production - 1,5**

**Answer**

**Document Name**

**Comment**

“The SDT should instead of modifying TPL-001 “which will differentiate stability portions from existing requirements, have a process for conducting EMT studies, and include appropriate stability criteria”, the SDT should make a new standard targeted just to EMT assessment. This should be a new standard to avoid crowding TPL-001 with multiple layers of assessment processes and, more importantly, criteria.

Consider requirements for model interchangeability between different EMT software packages. Required models should be usable in any of the EMT software packages (“EMTP-RV” from HydroQuebec, “PSCAD” from Manitoba Hydro, “eMT” from etap, “EMT” from DIgSILENT, etc.).

Also, consider if changes are needed to MOD-033 and if all EMT-related MOD standard changes and additions would be best captured in a single, new MOD standard.

Finally, the requirements should capture the necessity for periodic verification (ideally, field verification) of inverter parameters and settings since regular updates to inverter firmware should be expected. As inverter manufacturers add features to or correct security weaknesses in their code, they will issue new firmware to implement these which will be installed at many of the field installations of the equipment. The MOD standard should require actual, in the field firmware updates within 180-days to fix any known security vulnerabilities to protect the reliability and integrity of the transmission system.

We suggest that the TP/PC should be the entity that defines the EMT requirements.

Likes 0

Dislikes 0

## Response

**Mark Gray - Edison Electric Institute - NA - Not Applicable - NA - Not Applicable**

**Answer**

**Document Name**

**Comment**

Consistent with our comments above, we suggest the following guidance be considered, noting that the capability to do EMT modeling remains limited for many companies.

- Guidance is needed on what model quality checks are necessary.
- Guidance is needed on how to determine adequate parameterization of an EMT or positive sequence model.
- Guidance is needed on how model validation studies should be performed:
  - Who is responsible for validating disturbance event data against model response?

- How is a model validated against a disturbance event?
- What qualifies acceptable deviation from actual response versus the need for tuning or re-validation?

Likes 0

Dislikes 0

### Response

**Lynn Goldstein - PNM Resources - Public Service Company of New Mexico - 1,3**

**Answer**

**Document Name**

**Comment**

The industry needs guidance on how to conduct the EMT studies and needs to be provided specific details that deliver enough information to fully understand EMT Modeling.

Likes 0

Dislikes 0

### Response

**Justin Welty - NextEra Energy - Florida Power and Light Co. - 1,3,6**

**Answer**

**Document Name**

**Comment**

**FAC-002 Interconnection process:**

**TP and PC Conduct EMT Studies Where Necessary**

The standard needs to be more specific and to provide guidance for the TP/PC on suggested instances of when an EMT study is to be necessary. For example, should the TOP determine certain criteria during the initial Loadflow/Feasibility studies such as SCR, Loadflow instability to determine an EMT study need? The provided guidance could be added towards a technical rationale section which allows the TP/PC on making their own judgement.

**Clarify Requirements on Applicable Entities Providing Accurate Models**

Model accuracy, based on as built conditions, not generic models, should be a requirement between the GO/TOP, and should be clearly stated within the requirement. Any modifications in settings or equipment should be clearly communicated especially for EMT and Positive sequence models.

**MOD-032 – Data collection:**

**Explicit Inclusion of EMT Models:**

The standard should be specific and avoid using “where necessary” clauses. Validated and correct EMT models should be provided for every generator, including IBR models, we have in the system.

### Process for Collection of EMT Models and Modeling Data:

Accurate, based on as built data or modifications, EMT models should be provided on a regular basis. The standard should explicitly state this requirement and not as a need basis to avoid confusion about the TP/PC and the GOs obligations. It should be a part of the interconnection process to provide validated, correct models for all generation plants. For instance, if in the future the TOP sees the need to analyze a significant disturbance that occurred in real-time (e.g. losing a few hundred MWs of PVs), without the correct models and data, it would be more difficult to be able to analyze how and when the disturbance occurred. For doing reliability or TPL studies, models (EMT and positive sequence) should be available, especially if in the instance there is a large disturbance that could lead to an event analysis, investigation or audit.

Likes 0

Dislikes 0

### Response

**Michael Johnson - Pacific Gas and Electric Company - 1,3,5 - WECC, Group Name** PG&E All Segments

**Answer**

**Document Name**

**Comment**

PG&E has no additional comments.

Likes 0

Dislikes 0

### Response

**Julie Hall - Entergy - 1,3,6, Group Name** Entergy

**Answer**

**Document Name**

**Comment**

Creating EMT models for the entire transmission network would require significant time and effort. To create these models for all transmission lines, tower height, conductor spacing, line sag, among other parameters would be required. Besides modeling effort, TPL studies performed near inverter-based resources using EMT models on an annual basis will significantly increase the time to complete the TPL assessment given the modeling work, contingency development, screening analyses, and corrective action mitigation assessments that would be needed for the EMT study.

Also, prior to including EMT study requirements in TPL, NERC must have EMT modeling standards updated several years in advance to ensure that all existing inverter-based resources have had an EMT model submitted to the Transmission Planner and Planning Coordinator. The EMT models for many existing and in-service inverter-based resources have not been provided to the Transmission Planner despite requests to do so (given that no NERC requirement exists for EMT model submission).

In lieu of EMT studies in TPL, has NERC considered the usage of the 3rd generation of generic IBR positive sequence models developed by EPRI that capture the small signal and large signal oscillatory instabilities associated with IBRs connected at weak grid locations? These improved IBR positive

sequence models may be able to provide similar response to the EMT study results and allow the Transmission Planner to continue to use positive sequence dynamic tools for TPL-001.

Would EMT models be required for synchronous machines or only those machines (synchronous or non-synchronous) as required by the Transmission Planning or Planning Coordinator?

Likes 0

Dislikes 0

### Response

**Brendan Baszkiewicz - Eversource Energy - 1,3**

**Answer**

**Document Name**

**Comment**

Consider requirements for model interchangeability between different EMT software packages. Required models should be usable in any of the EMT software packages (“EMTP-RV” from HydroQuebec, “PSCAD” from Manitoba Hydro, “eMT” from etap, “EMT” from DIgSILENT, etc.).

Also, consider if changes are needed to MOD-033 and if all EMT-related MOD standard changes and additions would be best captured in a single, new MOD standard.

Finally, the requirements should capture the necessity for periodic verification (ideally, field verification) of inverter parameters and settings since regular updates to inverter firmware should be expected. As inverter manufacturers add features to or correct security weaknesses in their code, they will issue new firmware to implement these which will be installed at many of the field installations of the equipment. The MOD standard should require actual, in the field firmware updates within 180-days to fix any known security vulnerabilities to protect the reliability and integrity of the transmission system.

Likes 0

Dislikes 0

### Response

**David Jendras - Ameren - Ameren Services - 1,3,6**

**Answer**

**Document Name**

**Comment**

Ameren agrees with and supports EEI comments.

Likes 0

Dislikes 0

### Response

**Kim Thomas - Duke Energy - 1,3,5,6 - SERC,RF, Group Name Duke Energy**

**Answer**

**Document Name**

**Comment**

None.

Likes 0

Dislikes 0

**Response**

**Leonard Kula - Independent Electricity System Operator - 2**

**Answer**

**Document Name**

**Comment**

The IESO supports the NPCC RSC comments for the question.

Likes 0

Dislikes 0

**Response**

**Joe Gatten - Xcel Energy, Inc. - 1,3,5,6 - MRO,WECC**

**Answer**

**Document Name**

**Comment**

Xcel Energy supports EEI comments.

Likes 0

Dislikes 0

**Response**

**Nazra Gladu - Manitoba Hydro - 1,3,5,6**

<b>Answer</b>	
<b>Document Name</b>	
<b>Comment</b>	
	<p>On page 6, under the question “Are there any related standards or SARs that should be assessed for impact as a result of this proposed project? If so, which standard(s) or project number(s)?”, it is mentioned that there is a misalignment between this SAR and existing MOD-026 and MOD-027 standards. Manitoba Hydro would like to know if the SAR drafting team has considered any impact on the planning model validation standard MOD-033-02? With the increasing level of IBRs, it may not be possible to accurately capture the actual system response for a local dynamic event by solely considering the Positive sequence models, especially under unbalance system conditions. Does the SAR drafting team believe that MOD-033 needs to be revised to recommend the use of EMT models (if required) when validating dynamic behavior of the simulation models?</p>
Likes	0
Dislikes	0
<b>Response</b>	

**Ruida Shu – Northeast Power Coordinating Council, Inc.**

**Questions**

- 1. Do you agree with the proposed scope as described in the SAR? If you do not agree, or if you agree but have comments or suggestions for the project scope, please provide your recommendation and explanation.**

Yes

Comments:

The proposed project should produce three deliverables – modifications to FAC-002, modifications to MOD-032 (or a new standard related to EMT model collection and validation), and a new TPL standard related to EMT planning assessments. EMT-related planning assessments should not be included as part of TPL-001 as that standard is already quite detailed and focuses on traditional transmission reliability criteria. Similar to how TPL-007 was developed to assess new concerns and assessments related to transmission reliability, EMT requirements should be documented in a new TPL standard.

- 2. Provide any additional comments for the SAR drafting team to consider, if desired.**

Comments:

“The SDT should instead of modifying TPL-001 “which will differentiate stability portions from existing requirements, have a process for conducting EMT studies, and include appropriate stability criteria”, the SDT should make a new standard targeted just to EMT assessment. This should be a new standard to avoid crowding TPL-001 with multiple layers of assessment processes and, more importantly, criteria.”

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