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Standard Authorization Request Form

Title of Proposed Standard	Assess Transmission Future Needs and Develop Transmission Plans
Request Date	May 01, 2004

SAR Requestor Information	**SAR Type** (Put an 'x' in front of one of these selections)	
Name Paul Rocha	☒	New Standard
Primary Contact Paul Rocha	☐	Revision to existing Standard
Telephone (713) 207-2768 Fax	☐	Withdrawal of existing Standard
E-mail paul.rocha@centerpointenergy.com	☐	Urgent Action

Purpose/Industry Need (Provide one or two sentences)

To establish a standard for assessing and planning the transmission systems in North America. The transmission system must be assessed and planned to ensure that it performs its intended functions in providing reliable delivery of power for the future needs of customers.

Reliability Functions

The Standard will Apply to the Following Functions *(Check box for each one that applies by double clicking the grey boxes.)*		
☒	Reliability Authority	Ensures the reliability of the bulk transmission system within its Reliability Authority area. This is the highest reliability authority.
☐	Balancing Authority	Integrates resource plans ahead of time, and maintains load-interchange-resource balance within its metered boundary and supports system frequency in real time
☐	Interchange Authority	Authorizes valid and balanced Interchange Schedules
☒	Planning Authority	Plans the bulk electric system
☐	Resource Planner	Develops a long-term (>1year) plan for the resource adequacy of specific loads within a Planning Authority area.
☒	Transmission Planner	Develops a long-term (>1 year) plan for the reliability of transmission systems within its portion of the Planning Authority area.
☐	Transmission Service Provider	Provides transmission services to qualified market participants under applicable transmission service agreements
☒	Transmission Owner	Owns transmission facilities
☐	Transmission Operator	Operates and maintains the transmission facilities, and executes switching orders
☐	Distribution Provider	Provides and operates the “wires” between the transmission system and the customer
☐	Generator Owner	Owns and maintains generation unit(s)
☐	Generator Operator	Operates generation unit(s) and performs the functions of supplying energy and Interconnected Operations Services
☐	Purchasing-Selling Entity	The function of purchasing or selling energy, capacity and all necessary Interconnected Operations Services as required
☐	Market Operator	Integrates energy, capacity, balancing, and transmission resources to achieve an economic, reliability-constrained dispatch.
☒	Load-Serving Entity	Secures energy and transmission (and related generation services) to serve the end user

Reliability and Market Interface Principles

Applicable Reliability Principles *(Check boxes for all that apply by double clicking the grey boxes.)*	
☒	1. Interconnected bulk electric systems shall be planned and operated in a coordinated manner to perform reliably under normal and abnormal conditions as defined in the NERC Standards.
☐	2. The frequency and voltage of interconnected bulk electric systems shall be controlled within defined limits through the balancing of real and reactive power supply and demand.
☒	3. Information necessary for the planning and operation of interconnected bulk electric systems shall be made available to those entities responsible for planning and operating the systems reliably.
☐	4. Plans for emergency operation and system restoration of interconnected bulk electric systems shall be developed, coordinated, maintained and implemented.
☐	5. Facilities for communication, monitoring and control shall be provided, used and maintained for the reliability of interconnected bulk electric systems.
☐	6. Personnel responsible for planning and operating interconnected bulk electric systems shall be trained, qualified and have the responsibility and authority to implement actions.
☐	7. The security of the interconnected bulk electric systems shall be assessed, monitored and maintained on a wide area basis.

Does the proposed Standard comply with all of the following Market Interface Principles? *(Select 'yes' or 'no' from the drop-down box by double clicking the grey area.)*
1. The planning and operation of bulk electric systems shall recognize that reliability is an essential requirement of a robust North American economy. Yes
2. An Organization Standard shall not give any market participant an unfair competitive advantage.Yes
3. An Organization Standard shall neither mandate nor prohibit any specific market structure. Yes
4. An Organization Standard shall not preclude market solutions to achieving compliance with that Standard. Yes
5. An Organization Standard shall not require the public disclosure of commercially sensitive information. All market participants shall have equal opportunity to access commercially non-sensitive information that is required for compliance with reliability standards. Yes

Detailed Description (Provide enough detail so that an independent entity familiar with the industry could draft, modify, or withdraw a Standard based on this description.)

The Standard shall establish requirements for assessing the performance of planned bulk electric transmission systems and the requirements for documenting plans to remedy any inadequacies identified in the process of conducting such assessments.

The scope of such assessments and plans is for a future planning period (planning horizon) starting at one year and extending to five years or more.

The planning horizon must be long enough to permit timely implementation of viable solutions to remedy the potential inadequacies found. Planning horizons beyond 5 years may be needed to meet regulatory or legislative requirements, or may be based on the judgment of the Transmission Planner or Planning Authority.

The scope *does not* include the operating horizon less than one year. While the planning horizon is intended to provide sufficient time for facility additions, there is no intent to exclude appropriate operating procedures as options to correct potential transmission inadequacies. Such procedures should also be included in the Transmission Plan.

The Standard will consider the transition from the operating horizon to the planning horizon. In particular, the Standard will assure consistency between reliability requirements set forth in the Standards for Planning (for example, this Standard 500, “Assess Transmission Future Needs and Develop Transmission Plans”) and similar criteria required by other Standards (such as Standard 600, “Determine Facility Ratings, Operating Limits and Transfer Capabilities”), which also apply in operations.

In addition, the Standard shall explain the relationship between the reliability requirements for operations and those for planning, so that differences are better understood.

The Standard shall identify reliability performance requirements, but shall not specify *how* to achieve such performance requirements.

The applicable portions of the following existing NERC Planning Standards will be used as the starting point in drafting these requirements:

- I.A Transmission Systems
- I.B Reliability Assessment
- I.D Voltage Support & Reactive Power
- II.A System Data
- II.D Actual and Forecast Demands

The Standard shall require that system models be developed, maintained and shared in a manner consistent with the Functional Model and appropriate information-sharing policies. Included will be requirements that each Planning Authority and Transmission Planner document modeling assumptions, including the methodology used for incorporating planned generation assets (including transfers) in the model, as well as how such generation is dispatched. The Standard shall consider a requirement for Load Serving Entities (LSEs) to provide forecast resource data for input to the models.

While methodologies and assumptions must be documented, the Standard will *not* prescribe specific tools to be used in the performance assessment of the planned systems.

The Standard will identify the various planning functions that are responsible for compliance with the standard criteria. The assignment of compliance responsibility will be consistent with the Functional Model.

This Standard will *not* include requirements for:

- Resource Planning (i.e., assessing or ensuring the availability of adequate aggregate generation resources to serve aggregate load).
- Planning generation additions to remedy any aggregate generation resource inadequacies.
- Developing Transmission Plans to mitigate congestion due to economy transfers of generation resources.

However, the Standard should neither preclude nor require the consideration of generation or load (demand side management) as alternatives to transmission reinforcement/reconfiguration when developing solutions to potential transmission inadequacies.

While the Standard should start from and closely align with the existing Planning Standards I.A, I.B, I.D, II.A, and II.D, the system conditions to be studied or assessed may need to be better defined or clarified.

Examples of areas that should be considered for clarification in the Standard include:

- The Standard should clarify that the requirement to assess the performance at *all* demand levels does not mean that a multitude of transmission models need to be created for every possible demand level, only that a representative sample covering critical operating conditions needs to be modeled in accordance with regionally-defined criteria.
- The Standard should provide a clearer definition of "cascading outages", including what constitutes a cascading state. The Standard should also consider providing a clearer definition of "system stable". These definitions must be coordinated and consistent with definitions in other new Standards being drafted by NERC, such as Standards 200 and 600.
- The Standard should take into account the variability of generation, including unit maintenance outages, weather and time of day. Variability of load due to factors such as weather and time of day should also be considered.
- The Standard should continue to use deterministic criteria. The criteria embodied in Table 1 of existing Planning Standard I.A shall be used as a starting point. Following a review of the likelihood, duration, impact of events, and definition of applicable ratings (A/R) in existing Table I, a re-classification of Table I events should be considered, as necessary, for inclusion in the new Standard.

  Other changes should be considered for incorporation into the new Standard. Such changes could include:

  (1) Addition or deletion of categories/events/performance requirements.
  (2) Use of probabilistic planning methods.
  (3) Re-definition of categories (e.g., categories determined by event probability levels or ranges).
  (4) Differences in requirements for an event based on a range of event probabilities (for example, recognize that longer lines have a greater probability of outage than shorter lines).

(5) An alternative table, similar to Table I of existing Planning Standard I.A, except allowing for probabilistic planning criteria.
(6) Provision for a specific facility with an abnormal outage probability to have different performance requirements.

The list above is intended to be illustrative and not exhaustive or mutually exclusive. As allowed by the Standards Development Process, Regions may submit Regional Differences.

- Existing Planning Standard S1, S2, S3, S4 and Table I, Categories A, B, C, and D should be clarified on the issue of how a planned outage should be used in an assessment.

  The Standard should specify whether the planned outage requirement should be retained for Categories B and C. If retained, the requirement should be clarified in such a way that it can be practically implemented. In particular, the Transmission Planner should not be required to exhaustively test its system for every conceivable planned outage (including maintenance outages) in addition to every conceivable Category B and C contingency. The Standard should clarify that the planned outage requirement does not apply to Categories A and D.

- The Standard should address and rectify ambiguities in performance requirements, specifically cascading outages and applicable ratings (A/R). This applies to all Categories, especially Category C.
  For example, the Standard should clarify tests used for considering cascading, such as divergent power flow, post-contingency overload limits, voltage magnitudes, etc. The Standard should also clarify that different ratings may be applicable to different categories of events and perhaps different types of events within a category (specified by entities in accordance with Standard 600).

- The Standard should include requirements to ensure that the maximum available short circuit current does not exceed facility owner specifications.

- The Standard should also address requirements on reactive planning with specific reference to steady state and transient voltage stability criteria.

- The Standard should address requirements for reporting (perhaps to the Regions) on the progress or status of implementing the plans developed in accordance with the Standard. However, any such reporting requirements should be consistent with the Resource & Transmission Adequacy Task Force Recommendation #2, and should not impose undue burdens upon transmission entities

Related Standards

Standard No.	Explanation

Related SARs

SAR ID	Explanation
FACILITY_RATINGS_01_01	*"Determine Facility Ratings, Operating Limits and Transfer Capabilities".* The Planning Standard will use some data collected within the "Facility Ratings" SAR. The Draft "Facility Ratings" Standard, Section 603, establishes some guidelines for the planning function to set operating limits based on Table 1 of the existing Planning Standard I.A.
OPER_WITHN_LMTS_01_01	*"Operate Within Interconnection Reliability Operating Limits".* This Planning Standard needs to establish future planning criteria such that the bulk electric power system can be operated within operating limits.

Regional Differences

Region	Explanation
ECAR	
ERCOT	
FRCC	
MAAC	
MAIN	
MAPP	
NPCC	
SERC	
SPP	
WECC	

Related NERC Operating Policies or Planning Standards

ID	Explanation
Planning Std. I.A	Transmission Systems: Plan within ratings, avoid cascading outages, uncontrolled system separation, and voltage and transient instability.
Planning Std. I.B	Reliability Assessment
Planning Std. I.D	Voltage Support & Reactive Power
Planning Std. II.A	System Data
Planning Std. II.D	Actual & Forecast Demands

MAPP & MEC believe the following information supports our proposed new reclassification by demonstrating that the events that MAPP & MEC recommend for reclassification are the low probability Category C events. MAPP & MEC recognize that published outage data are subject to interpretation, potential inaccuracy, and change through time; however, we believe that MAPP & MEC operating experience with transmission element outages supports the statistical summary provided in the following table.

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345 kV Outage Data				
Contingency	Outage Rate, occ./year	Duration, hours	Probability	Relative Likelihood
Generator B1	9	81	0.08321918	1
Two generators C3	1.5	40.5	0.00693493	12
Bipolar DC line * (Similar to B4)	1.41	21	0.00338014	24
Line * B2	0.8065	18	0.00165719	50
Transformer B3	0.0642	157	0.00115062	72
Bipolar DC Line * + Generator (Sim. to 1 Pole DC line + gen. C3)	0.1478	16.68	0.00028143	296
Line * + Generator C3	0.0820	14.7	0.00013760	605
Generator + Transformer C3	0.0157	53.4	0.00009571	870
Common tower * C5	0.007	113	0.00009030	922
Breaker Failure- Insulation Breakdown C2 RECLASSIFY THIS EVENT	0.001423	163	0.00002647	3,144
Bipolar DC line *+Bipolar DC line * (Sim. to Two 1 Pole DC lines - C3) RECLASSIFY THIS EVENT	0.009532	10.5	0.00001143	7,281
Stuck breaker C6-C9 RECLASSIFY THIS EVENT	0.00635	4	0.00000290	28,696
Line * + Line * (independent) C3 RECLASSIFY THIS EVENT	0.00267	9	0.00000275	30,262
Line * + Transformer C3 RECLASSIFY THIS EVENT	0.0010	16.1	0.00000184	45,228
Two transformers C3 RECLASSIFY THIS EVENT	0.00014774	78.5	0.00000132	63,045
Bus Section** RECLASSIFY THIS EVENT	0.0023	4.7	0.00000123	67,438

* Per 100 mile-year.
** Based upon 230 kV data.

References

1. MAPP-CSRWG, "MAPP Bulk transmission system outage report", June 2001.

2. C. R. Heising, et al, "Final report on high voltage circuit breaker reliability data for use in substation and system studies – report on behalf of WG 13.06, in Proceedings of CIGRE Conference, Paris, 1994.

3. R. Billinton, A. A. Chowdhury, "Generating unit models using the Canadian Electricity database", CEA Transactions, Volume 23, 1984.

4. R. N. Allan, "Concepts of data for assessing the reliability of composite systems", IEEE Tutorial Course on Reliability Assessment of Composite Generation and Transmission Systems, Course Text 90EH0311-1-PWR.

BPA Data

Category	Contingencies	Outages per year	Source of Data
B1	Generator	4	NW Federal system is mostly hydro generation in remote locations and these outages are usually of little consequence to the power system. These outage data are based on three thermal plants located in load areas. Due to the small size of this sample, they may not be very useful. These outages average 109 hour duration.
B2	Transmission Circuit	0.97	BPA data for 225 lines 200-kV through 550-kV, 1985-2003 data (19 years), average length 50.5 miles, outages with duration greater than 1 minute only. Five hour average duration.
B3	Transformer	0.037	IEEE Paper 91 SM 442-4 PWRS, BPA autotransformers, winding voltages 115 to 550-kV. 28 day average duration.
B4	Single Pole DC Line	9	BPA data for PDCI, 845 miles (one line only). 8.99 outages per year with total annual outage time of 170 hours. Not including terminal outages. 19 hour average duration.
C1	Bus section	0.00733	BPA data for 115 stations with voltages between 230-kv through 500-kV, 17.8 years of data, resulting in 15 events.
C2	Breaker internal fault	0.00079	1994 CIGRE Brochure 83: data for 230 and 500-kV breakers: insulation breakdown.
C2	Breaker fails to open	0.00569	1994 CIGRE Brochure 83: data for 230 and 500-kV breakers: failure to open.
C3	Two Line Dependent	0.08700	BPA data for sustained multiple outages (greater than one minute) for its 500-kV lines, 1985-2003 data (19 years). Calculated for two lines with 50 mile common corridor length.
C3	Two Line Independent	0.00110	Calculated based on single contingency rate indicated above: 1 outage per year with duration of 5 hours
C3	Generator and Transformer	0.01400	Calculated based on single contingency outage rates indicated above: 0.037 outages per year of duration 28 days for transformers and 4 outages per year of duration 109 hours for generators.
C3	Line and Transformer	0.00290	Calculated based on single contingency outage rates indicated above: 1 outage per year of duration 5 hours for line and .037 outages per year of duration 28 days for transformer.
C3	Two Generator	0.45000	Calculated based on single contingency outage rate indicated above: 4 outages per year with duration 109 hours each. Small sample of data - may not be representive.

C3	Line and Generator	0.05500	Calculated based on single contingency outage rates indicated above: 1 outage per year of duration 5 hours for line and 4 outages per year of duration 109 hours for generator.
C4	Bipolar DC Line	0.35000	Calculated based on single contingency outage rate indicated above: 9 outages per year for duration of 19 hours
C5	2 circuits on multiple towerline	0.05100	BPA data for sustained multiple outages (greater than one minute) for its 500-kV double circuit lines, 1985-2003 data (19 years). Calculated for double circuit line with 50 mile length.
C6, C7, C8, C9	Protection failure	0.11969	BPA Data for 115 stations with voltages 230 through 500-kV, 17.8 years of data, resulted in 245 events of preotection failure.
C6	SLG Fault Generator with protection failure	0.47875	Generator single contingency outage rate from above multiplied by protection failure rate (0.11969)
C7	SLG Fault Transmission circuit with protection failure	0.11490	Transmission line single contingency outage rate from above multiplied by protection failure rate (0.11969)
C8	SLG Fault Transformer with protection failure	0.00443	Transformer single contingency outage rate from above multiplied by protection failure rate (0.11969)
C9	Bus section fault with protection failure	0.00088	Bus fault outage rate from above multiplied by protection failure rate (0.11969)

Data provided by Marv Landauer based on outage data collected by BPA.