2017 Regional Transmission Plan

Version 1.0

Document Revisions

Date	Version	Description	Author(s)
11/21/2017	1	Original draft	Sandeep Borkar
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Table of Contents

1. Executive Summary

The 2017 Regional Transmission Plan (RTP) is a result of a coordinated planning process performed by ERCOT with extensive review and input by NERC-registered Transmission Planners (TPs), Transmission Owners (TOs) and other stakeholders. The RTP addresses ERCOT System reliability and economic transmission needs for years 2019 through 2023. This report documents the results of the assessment, in part, to comply with the requirements of NERC Reliability Standards, ERCOT Protocols, and the ERCOT Planning Guide.

The reliability analysis was performed over a six-year planning horizon; years one through five representing the near-term horizon and year six representing the long-term horizon. The 2017 RTP assessed ERCOT's steady-state transmission needs under summer peak and off-peak conditions. In addition to the seasonal variations, the RTP also included various sensitivities to address uncertainty involved in the transmission planning process. The reliability analysis in the 2017 RTP included:

- Steady-state contingency analysis to identify criteria violations based on NERC Reliability Standards and ERCOT planning criteria
- Short-circuit analysis to identify over-dutied circuit breakers in the near-term planning horizon
- Cascading analysis to identify potential system cascading conditions

Following the reliability assessment, ERCOT planners in collaboration with TPs developed Corrective Action Plans to address the reliability criteria violations identified in this assessment. These plans included but were not limited to, upgrades or addition of new transmission facilities and new constraint management plans.

The majority of planned improvements identified in the 2017 RTP are 138-kV and 69-kV upgrades. Most of the projects identified as 345-kV upgrades consist of either the addition of a new 345/138-kV transformer or the upgrade of an existing 345/138-kV transformer. Many of these transformer projects were identified in previous RTP studies.

The 2017 RTP identified the following noteworthy reliability projects:

- New 345/138-kV transformer (fourth transformer) at the P.H. Robinson substation in Galveston County
- Extend the 345-kV line from Royse Substation along with addition of a new 345/138-kV transformer at a new station in Rockwall County
- New 345/138-kV transformer (second transformer) at the Ben Davis Substation in Dallas County
- Rebuild the existing Plano Tennyson Switch Substation in Collin County and add a new 345/138-kV transformer (second transformer)

In addition to these transmission projects, the 2017 RTP also included a review of a few placeholder projects such as improvements in North Garland area submitted by Garland Power & Light, and improvements to the Jones Creek/Freeport area in Brazoria County submitted by CenterPoint Energy. These Tier 1 transmission improvement projects were undergoing review through the Regional Planning Group process concurrent with the RTP analysis.

The 2017 RTP also included an economic assessment of the ERCOT transmission system for years 2020 and 2023. Through this assessment, ERCOT planners identified transmission congestion and tested various transmission upgrades to address this congestion in a cost-effective manner (as defined by ERCOT's economic planning criteria). Since the results from the ERCOT independent review of the South Plains Transmission Project were not available at the time of the RTP a placeholder project was put in place to model the improvements in the Panhandle export capacity. The topology used in the 2017 RTP included two 175-MVAr synchronous condensers at the Windmill Substation in Deaf Smith County based on the results of previous economic planning studies. Twelve economic transmission improvement projects were evaluated in the 2017 RTP. Four of the twelve solutions evaluated showed sufficient benefits to pass ERCOT economic planning criteria. Most noteworthy of these projects was the upgrade of the 138-kV lines between the Kendall Substation and Cico Substation in Kendall County.

Due to the timing of recent generation retirement announcements, the impact of the unavailability of over 4500 MW[1] of fossil fuel generation was not evaluated in the 2017 RTP. The magnitude and timing of these retirements may potentially affect the power flows and congestion across the system and will be evaluated in the 2018 RTP.

The project completion years stated in this 2017 RTP Report were chosen to address reliability and economic needs in a timely manner. The TOs are expected to meet these project completion dates, but lead-times necessary to implement projects based on factors such as availability of construction clearances, the time required to receive regulatory or governmental approvals, equipment availability, land acquisition and resource constraints may result in different project completion dates. The scope of projects identified in the RTP may change if further analyses by ERCOT or the TPs identify better alternatives or a need to modify any projects due to changes in expected generation, load forecasts, or other system conditions. Projects requiring Regional Planning Group (RPG) approval will be reviewed in future assessments (where sufficient lead-time exists), such as future Regional Transmission Plans, to ensure the identified system facilities are still needed.

The TOs will provide ERCOT additional details on project scope, project cost and an implementation schedule with completion date(s). This information from the TOs may be provided through further RPG review and/or Transmission Project Information Tracking (TPIT) updates in accordance with ERCOT Planning Guide Section 6.4.1.

[1] This included Notice of Suspension on Spencer, Barney Davis, Monticello, Big Brown, Sandow announced through October 2017.

2. 2017 Regional Transmission Plan

This report documents the 2017 Regional Transmission Plan (RTP) assessment performed by ERCOT System Planning. It is intended, in part, to satisfy ERCOT's requirements under NERC Reliability Standards, ERCOT Protocol Section 3.11 and ERCOT Planning Guide Sections 3 and 4.

The RTP study is conducted annually for the entire ERCOT System. The 2017 RTP analyzed the reliability needs of the ERCOT transmission system for the years 2019, 2020, 2022 and 2023. The 2017 RTP included steady-state analysis as required by NERC Standard TPL-001-4 for the Summer Peak conditions of years 2019 (year 2), 2020 (year 3) and 2022 (year 5) for the near-term planning horizon and Off-Peak conditions for 2020 (year 3) and short-circuit analysis for summer peak conditions of years 2020 (year 3) and 2022 (year 5). The 2017 RTP also included steady-state analyses for 2023 (year 6), representing the long-term planning horizon. The year six, or 2023, was selected based on the rationale that most of ERCOT transmission upgrades can be completed within five to six years from the date when the need is identified. In addition to the reliability needs, the 2017 RTP also included an evaluation of economic/efficiency needs of the ERCOT system for 2020 and 2023.

2.1. Stakeholder Involvement

The RTP is a collaborative process. ERCOT worked with NERC-registered Transmission Planners (TP), Transmission Owners (TO) and other stakeholders to develop the input assumptions and the scope of technical studies that define the RTP. These assumptions are described in the RTP Scope and Process document and were presented to the stakeholder community at Regional Planning Group (RPG) meetings. The RTP Scope and Process document and input assumptions can be found in Appendix A1 and A2. Stakeholders and the RPG community were provided routine updates on the input assumptions and supporting analysis performed for the 2017 RTP study in the monthly RPG meetings held from January to April of 2017. Feedback and comments from the RPG were incorporated into the RTP Scope and Process document.

The RPG is responsible for reviewing and providing comments on new transmission projects in the ERCOT Region. Per ERCOT Protocols Section 3.11.3, participation in the RPG is required of all Transmission Service Providers and is open to all Market Participants, consumers, other stakeholders and Public Utility Commission of Texas (PUCT) Staff.

ERCOT worked with TPs, TOs, and other stakeholders to study the existing system, identify system upgrades and new transmission projects to ensure continued system reliability and address projected system congestion.

2.2. Standards and Regulations

The RTP assessment was conducted based on NERC Reliability Standards, ERCOT Protocols, and the ERCOT Planning Guide.

NERC Reliability Standard: ERCOT performed its steady-state reliability assessment in accordance with NERC Reliability Standard TPL-001-4 "Transmission System Planning Performance

Requirements." A portion of the RTP assessment also addressed some requirements from the FAC-002[2] reliability standard and the IRO-017[3] reliability standard.

ERCOT Protocols: ERCOT Protocols Section 3.10.8.4 (3) requires ERCOT to identify additional Transmission Elements that have a high probability of providing significant added economic efficiency to the ERCOT market through the use of Dynamic Ratings and request such Dynamic Ratings from the associated ERCOT Transmission Service Provider (TSP). This report identifies such Transmission Elements as part of its economic analysis. ERCOT Protocols Section 3.11.5 specifies the economic planning criteria used to evaluate the cost-effectiveness of projects in the RTP.

ERCOT Planning Guide: The RTP assessment adheres to ERCOT Planning Guide Section 3.1.1.2, which provides guidelines regarding completion of the RTP. This section also requires that ERCOT complete and publish the final RTP report no later than December 31 each year. Additionally, ERCOT Planning Guide Section 4 and ERCOT Protocol Section 3.11.2 specify the transmission planning criteria to be used in the RTP assessment.

2.3. Confidentiality and Report Posting

The RTP report is shared with internal and external stakeholders. A redacted version of the RTP is created by removing at a minimum any confidential data such as the list of long-lead-time equipment. This report is shared with ERCOT stakeholders via MIS Secure area. In addition, a redacted "public" version of the RTP report is created by removing, at a minimum, any system criteria violation information. This report is shared with the general public via ERCOT public website. Additionally, ERCOT will distribute its planning assessment to any functional entity that has a reliability related need and submits a written request via ERCOT Client Services[4] for the information within 30 days of such a request.

[2] R4 from FAC-002
[3] R3 and R4 from IRO-017
[4] Email ClientServices@ercot.com or call 512-248-9300

3. 2017 Regional Transmission Plan Process

The RTP study process is described in Figure 1. The initial start cases to be used in the reliability analysis were prepared in the case-conditioning stage. The case-conditioning step in the 2017 RTP also included the use of a 'bounded-higher-of' methodology to determine appropriate weather zone load levels for the RTP study. The details of this methodology can be found in Planning Guide Section 3.1.7. Following case conditioning, reliability analysis was conducted on the base case to determine the Corrective Action Plans needed to meet ERCOT and NERC reliability requirements. In addition to the base case, the 2017 RTP also included sensitivity cases, short circuit analysis, cascade analysis and multiple element outage analysis as required by NERC Reliability Standard TPL-001-4. Economic analysis was then conducted to identify transmission projects that allow reliability criteria to be met at a lower total cost. The detailed scope, process and input assumptions used in conducting both reliability and economic analyses are available in Appendix A1 and A2.

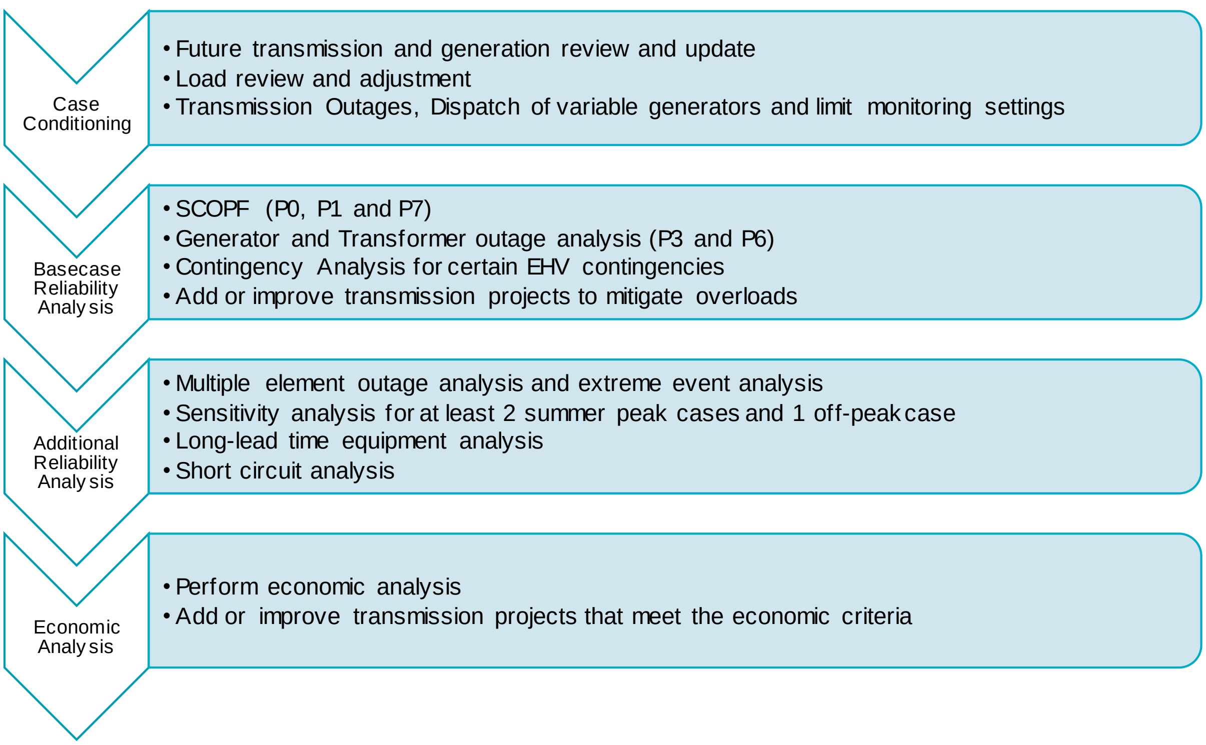


Figure 1: 2017 RTP Transmission Planning Process

ERCOT utilized the following software tools while performing the 2017 RTP:

- PSS/E version 33 was used to develop the conditioned cases and the AC reliability cases
- PowerWorld versions 19 with Security-Constrained Optimal Power Flow (SCOPF) and its SIMAUTO functionality were used to perform AC SCOPF analysis and to run generator and transformer outage analysis.
- TARA version 880e was used to screen critical contingencies while evaluating P3 (Generator outage) and P6-2 (Transformer outage) planning events.

- POM application suite including Physical and Operational Margin (POM suite) – Optimal Mitigation Measures (OPM) and Potential Cascading Modes (PCM) were used to perform load shed analysis, multiple element outage analysis, and cascade analysis.
- UPLAN version 10.2 was used to perform the security-constrained economic analysis.

3.1. Reliability Analysis

Reliability analysis in the 2017 RTP was focused on the steady-state portion of the NERC TPL standards and the ERCOT Planning Guide. The purpose of reliability analysis was to identify potential criteria violations and Corrective Action Plans that may be used to resolve them. The RTP analysis included the use of Security Constrained Optimal Power Flow (SCOPF) to identify unresolvable constraints. Loading and voltage levels at BES elements were monitored for all NERC Planning Events, including Extreme Events. ERCOT staff developed Corrective Action Plans in collaboration with TPs to mitigate criteria violations in accordance with the NERC and ERCOT performance requirements.

The 2017 RTP reliability analysis included the following studies:

- SCOPF: was used to perform basic Powerflow and Contingency Analysis (CA). The SCOPF used generation cost data and other system constraints to give an optimized generation dispatch and unit commitment while maintaining the reliability of the system. In this analysis, the software simulated the operation of Protection Systems and other automatic controls following the contingency event.
- Contingency Analysis: Certain contingency events listed in Table 1 of the NERC TPL standard do not allow system adjustments; such planning events were tested using basic CA routines in the power flow software. CA was used to test P2-2, P2-3, P2-4, P4, P5 and Extreme Event contingencies.
- Multiple Element Contingency Analysis: Planning events P3 and P6 involve a first and second level contingency analysis; such events were tested using multiple element contingency analysis. During this analysis, loss of elements due to first contingency was followed by acceptable system adjustments before testing the effect of the second contingency event. The list of acceptable system adjustments included system reconfiguration, changes in voltage schedule and re-dispatch of generation. Other contingency events such as P4, P5 and Extreme Events which involved simultaneous removal of multiple elements were also analyzed.
- Cascading analysis: Cascading analysis was conducted to test all Planning and Extreme Events where a facility could be loaded above its rating prior to allowed load shed. In this analysis, the software simulated the operation of Protection Systems and other automatic controls following the contingency event. These operations included tripping of generators and transmission elements which were loaded beyond their relay loadability limits. These contingencies were screened to detect potential cascade events for more detailed analysis.

- Short circuit analysis: Impact of system changes such as transmission additions and upgrades, and generation additions on fault levels were evaluated under pre-defined fault conditions via short circuit analysis in this RTP. The results of short-circuit analysis included the magnitude of short-circuit current and the source impedance associated with each fault; these results were communicated to the NERC Registered TOs and Generator Owners (GO). TOs and GOs completed a review of study results, acknowledged the findings and provided a list of over-dutied circuit breakers and Corrective Action Plans. In addition, TOs and GOs also confirmed the continued validity and implementation status of the Corrective Action Plans for over-dutied facilities identified in previous RTPs.
- Long-lead-time equipment analysis: Per Requirement 2.1.5 of TPL-001-4, the impact of the possible unavailability of major transmission equipment with a lead-time of one year or more was studied. The studies were performed with an initial condition of the identified long-lead-time equipment modeled as out of service, followed by P0, P1, and P2 contingency events. The list of long lead-time equipment was developed based on TO feedback. The results of such analysis were communicated to the appropriate TPs.
- Sensitivity Analysis: ERCOT selected the summer peak conditions of 2019 and 2022 and off-peak conditions of 2020 for sensitivity analyses as required by Requirement 2.1.4 of the NERC TPL-001-4 standard. ERCOT prepared the sensitivity cases by varying the following set of input assumptions: Turn all wind and hydro units in the study region offline and unavailable in the 2019 and 2022 summer peak cases, and high-wind, low-load conditions for the off-peak case.

  The sensitivity analyses were performed with all identified reliability solutions from the base case analysis to evaluate the effectiveness and robustness of the base case solutions under the stressed system conditions.

Corrective Action Plan Development

Per the ERCOT Planning Guide, reliability projects are those system improvements (projects) that are needed to meet NERC Reliability Standards or ERCOT planning criteria which could not otherwise be met by any re-dispatch of existing or planned generation. The software simulated the operation of Protection Systems and other automatic controls following the contingency event. These operations included the simulation of devices designed to provide steady-state voltage control. These devices included equipment such as load tap changing transformers, phase-shifting transformers, switched capacitors and inductors. A list of potential Corrective Action Plans, or reliability projects, along with the corresponding limiting elements and contingencies was communicated to the appropriate TP and/or TO. TPs and TOs reviewed the initial list of reliability driven projects for their technical feasibility and estimated the year of completion (taking into account necessary lead-times). In some cases, the TOs also provided project alternatives. In the instance that a project was not feasible in time, ERCOT designed a Constraint Management Plan to mitigate the criteria violations until the permanent Corrective Action Plan could be put in-service. Intermediate and final results were posted on the ERCOT MIS Secure website and presented to stakeholders at regularly scheduled RPG meetings in order to solicit comments and suggestions.

System Operating Limit (SOL) Identification

The ERCOT SOL Methodology was used to determine if additional SOLs were needed in the planning horizon. Per the criteria, a new SOL was identified if results of the reliability analysis of the base case resulted in any of the following:

- Voltage instability (resulting in uncontrolled voltage collapse);
- Cascading or uncontrolled separation or islanding;
- Events that required manual system adjustments (such as load shedding) in the planning horizon in order to prevent Cascading or transient, dynamic, or voltage instability.

3.2. Economic Analysis

ERCOT staff conducted an economic analysis to identify system improvements that would allow ERCOT to meet NERC Reliability Standards and ERCOT planning criteria at a lower total cost (total system variable production cost plus carrying-cost of new transmission projects) than the continued dispatch of higher cost generation.

To identify such efficiency-driven projects, ERCOT prepared a production cost model for years 2020 and 2023. This model included the ERCOT-developed load forecast, existing and planned generation (meeting the requirements of Planning Guide Section 6.9), and the conditioned topology with the newly identified reliability projects. The input information used in the start and final cases for economic analysis is provided as Appendix B. When applicable, pre-defined RAS's were modeled in the case to relieve congested portions of the network. The list of RAS's modeled in the economic analysis section is documented in Appendix A2. Following the production cost simulation, a list of all congested elements and binding contingencies was produced. In addition to the traditional production cost simulation, the 2017 RTP included sensitivities to address uncertainties in weather (Wind, Solar, and load profiles) based on the Economic Planning Whitepaper[5].

According to the economic planning criteria described in ERCOT Protocol Section 3.11.2 (5), ERCOT recommends economic projects if the annual production cost savings resulting from the project exceed the first-year annual revenue requirement for the project. Based on the recent review of current market conditions, the first-year annual revenue requirement for a project is assumed to be 15% of the total project cost.

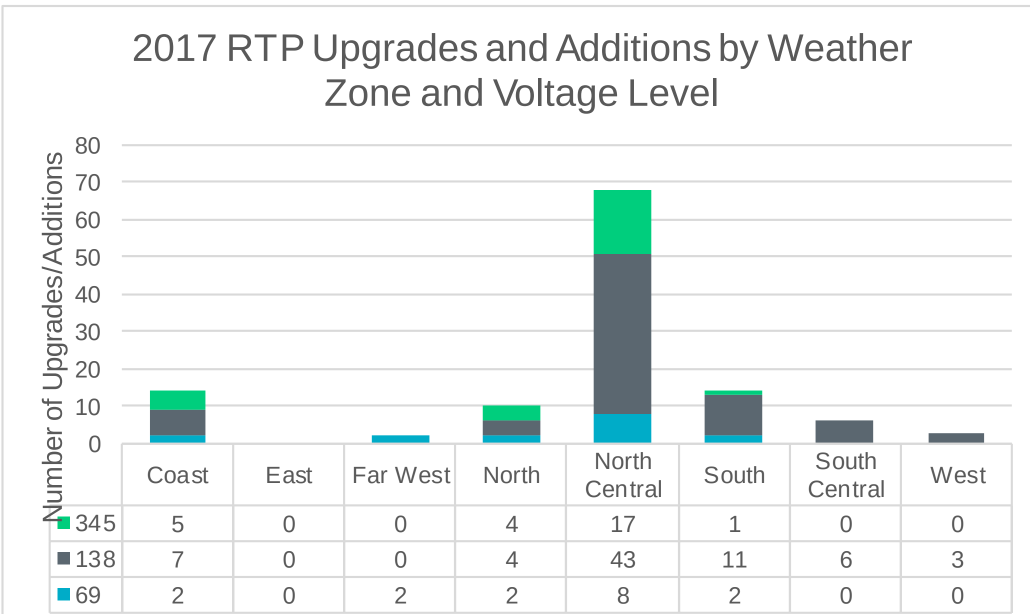
[5] http://www.ercot.com/content/wcm/key_documents_lists/108892/Whitepaper_Economic_Planning.pdf

4. Findings from Reliability Analysis

4.1. Reliability Projects and CMPs

The primary purpose of the 2017 RTP reliability analysis was to identify ERCOT reliability criteria violations and potential Corrective Action Plans to resolve them. ERCOT Corrective Action Plans were largely composed of reliability driven projects. Overall, the base reliability analysis identified a need for sixty Corrective Action Plans. The detailed list of criteria violations and resulting Corrective Action Plans or reliability projects can be found in Appendix C.

Figures 2 and 3 summarize the type of projects, their geographic locations, and voltage levels. Figure 4 summarizes a list of projects in the 2017 RTP that were not identified in previous ERCOT planning studies. A detailed map of the ERCOT system with project locations can be found in Appendix D.



	Coast	East	Far West	North	North Central	South	South Central	West
345	5	0	0	4	17	1	0	0
138	7	0	0	4	43	11	6	3
69	2	0	2	2	8	2	0	0

Figure 2: 2017 RTP upgrades and additions by weather zone and voltage level

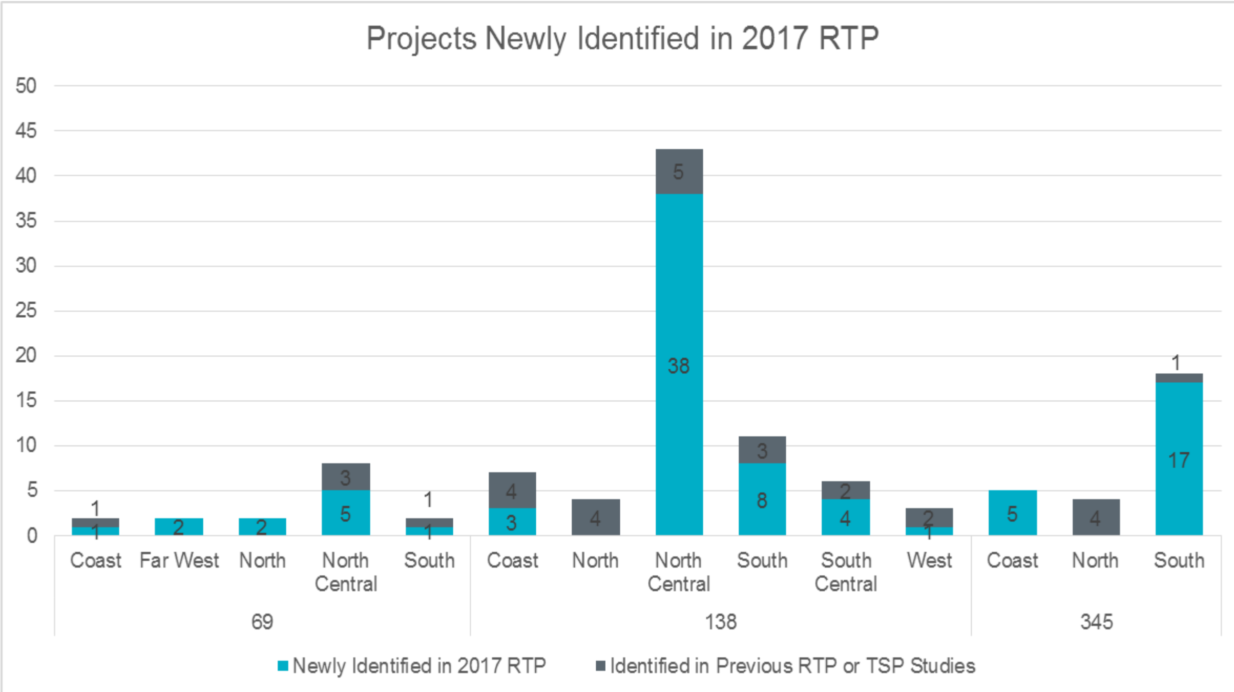
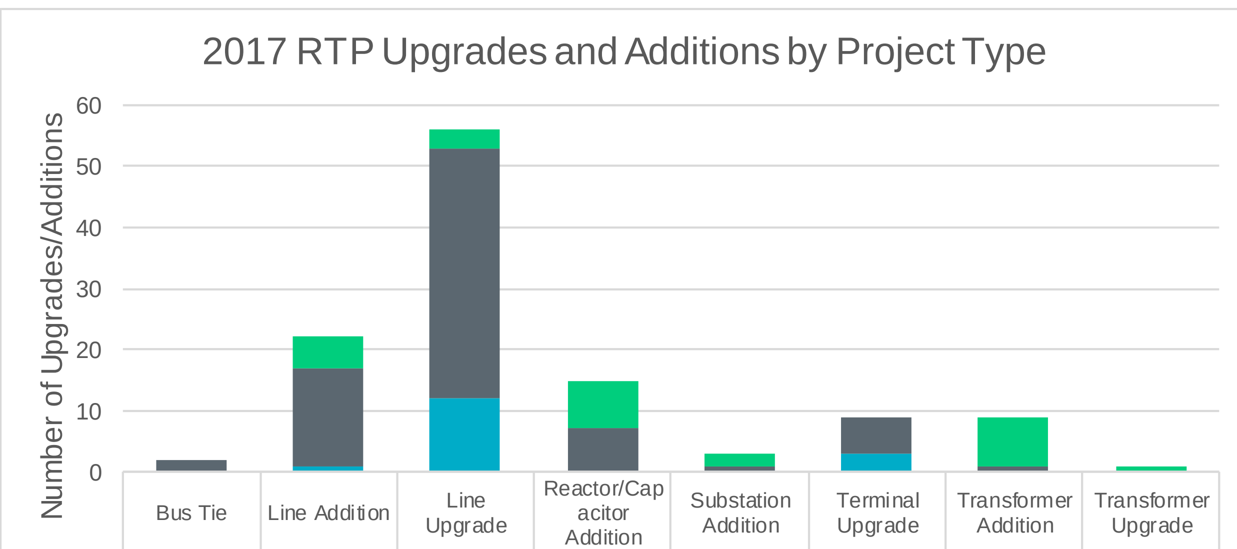


Figure 3: Projects newly identified in 2017 RTP



	Bus Tie	Line Addition	Line Upgrade	Reactor/Capacitor Addition	Substation Addition	Terminal Upgrade	Transformer Addition	Transformer Upgrade
345	0	5	3	8	2	0	8	1
138	2	16	41	7	1	6	1	0
69	0	1	12	0	0	3	0	0

Figure 4: 2017 RTP upgrades and additions by project type

The Corrective Action Plans identified in the 2017 RTP included transmission upgrades that may not be completed in time to meet systems performance requirements. ERCOT staff, in collaboration with the TP, identified nine potential Constraint Management Plans (CMPs) as placeholder mitigating actions. These potential CMPs can be further reviewed in the operations planning horizon by ERCOT and TOs. The list and details of the CMPs identified in the 2017 RTP can be found in Appendix E.

Many reliability criteria violations could be mitigated by adjusting the dispatch on DC ties connecting ERCOT with the electric grid in Mexico. ERCOT planning practices allow for DC tie dispatch changes under P3 and P6.2 conditions since they are considered to be manual system adjustments as prescribed in Table 1 of NERC TPL-001-4. However, there were some instances in 2019 when DC tie exports had to be reduced to mitigate criteria violations resulting from P1 planning events. Figure 5 below shows a breakdown of separate contingency events and the dc tie export capacity during the summer peak hour.

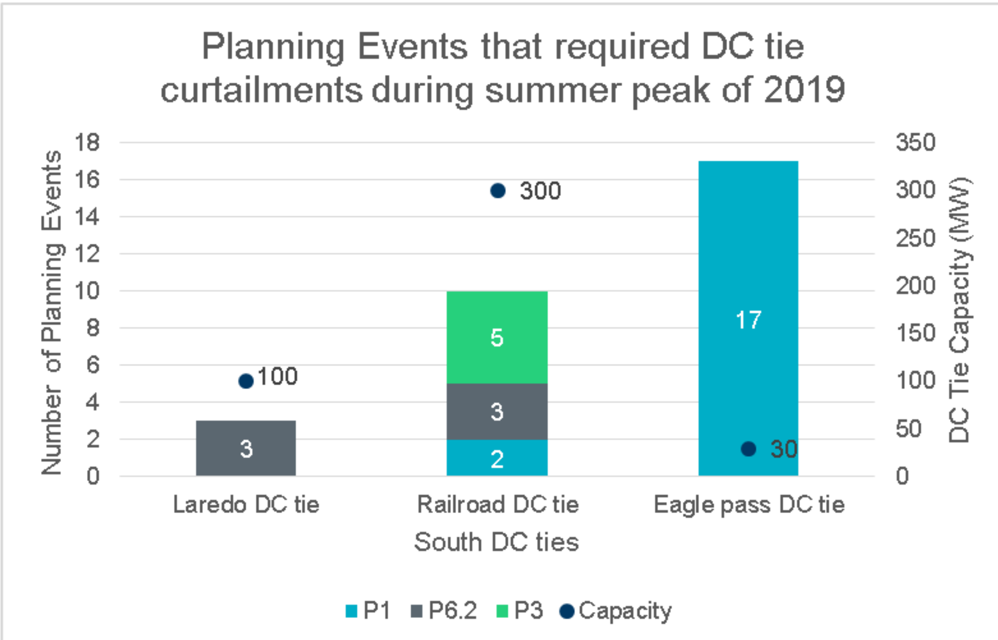


Figure 5: DC tie curtailments during 2019 summer peak

In addition to the above reliability analysis, a multiple-element outage analysis was conducted for contingencies where non-consequential loadshed was allowed as an acceptable Corrective Action Plan. This analysis consisted of 1) load shed analysis, which identified mitigation measures (such as transformer tap setting changes, switching actions, generator re-dispatch and load shed) to resolve any criteria violations resulting from such contingencies; and 2) cascade analysis, which identified any contingencies that could result in potential cascade events.

Several Planning Events and Extreme Events were screened for detailed analysis. However, a further investigation performed by ERCOT and affected TPs indicated that none of these events resulted in system-wide cascading conditions. Some events which caused power-flow convergence issues were also studied using dynamic/stability analysis in a separate assessment. The results of the multiple element outage analysis are documented in Appendix F. This appendix includes the list of critical contingencies identified as a result of this analysis and Corrective Action Plans or recommendations necessary to mitigate the impact of these contingencies. No new SOL's were identified in the 2017 RTP reliability analysis.

In addition to the above analysis, per the Planning Guide Section 3.1.1.2 (3), the 2017 RTP analysis also included development of a list of transmission facilities that are loaded above 95% of their applicable ratings under normal and contingency events (loss of single generating unit, transmission circuit, transformer or common tower outage). This list is attached to the report as Appendix G.

4.2. Sensitivity analysis

As indicated in Section 2.2, the impact of unavailability of wind and hydro generating units under summer peak conditions was evaluated in the 2019 and 2022 summer peak cases. For the 2019 off-peak conditions, ERCOT analyzed the system impact of the high-wind, low-load conditions.

The purpose of this portion of the study was to evaluate the effectiveness and robustness of the base case reliability projects under stressed system conditions. The sensitivity analysis identified the need for two additional upgrades and two CMPs in addition to acceptable mitigation actions such as voltage schedule changes, tap setting changes, and generation re-dispatch.

A detailed list of system deficiencies and transmission improvements identified in the 2017 sensitivity analysis is provided in Appendix H.

4.3. Short-circuit analysis

As indicated in Section 2.3, ERCOT conducted the short circuit analysis for the 2020 and 2022 summer peak base cases with all reliability projects identified in the 2017 RTP and shared the results with TOs and GOs. TOs and GOs reviewed the fault duty information to identify substations with over-dutied breakers along with Corrective Action Plans.

Table 1 provides a summary of the results of the short-circuit analysis. These results indicate that short-circuit currents tend to increase as additional transmission elements are added or upgraded over the years. Based on the review and comments provided by TOs and GOs, twenty-four buses were identified as having over-dutied breakers. The buses with over-dutied breakers and the resulting Corrective Action Plans can be found in Appendix I, which also contains the study cases and details of the results.

Table 1: Summary of Short Circuit Analysis

Magnitude of Fault Current	Number of buses (3-phase fault)		Number of buses (single-line to ground fault)	
	2020	2022	2020	2022
Below 40 kA	4037	4066	4291	4330
40 kA to 60 kA	424	455	187	205
More than 60 kA	26	25	9	11

4.4. Long lead-time equipment analysis

Upon ERCOT's request, the TOs provided a list of long-lead-time equipment based on their spare equipment strategy. All TO-provided, BES, long-lead-time equipment outages were studied to determine the impact of unavailability of such equipment for an extended period of time. This analysis was conducted on 2019, 2021, 2022 and 2023 summer peak conditions, along with 2020 off-peak conditions. Overall, twenty 345/138-kV transformers and four 345-kV reactors were identified as long-lead-time equipment. Impact of the unavailability of these devices were evaluated under P0, P1 and P2 contingencies. Criteria violations resulting from P0, P1, and P2 contingencies were shared with the respective TPs. The list of long-lead-time equipment and criteria violations are attached in Appendix J.

5. Economic Projects

The 2017 RTP economic analysis was performed using production cost simulation runs for the years 2020 and 2023. The input assumptions and starting congestion for both years are presented in Appendix B. Figure 6 shows the top constraints seen in years 2020 and 2023.

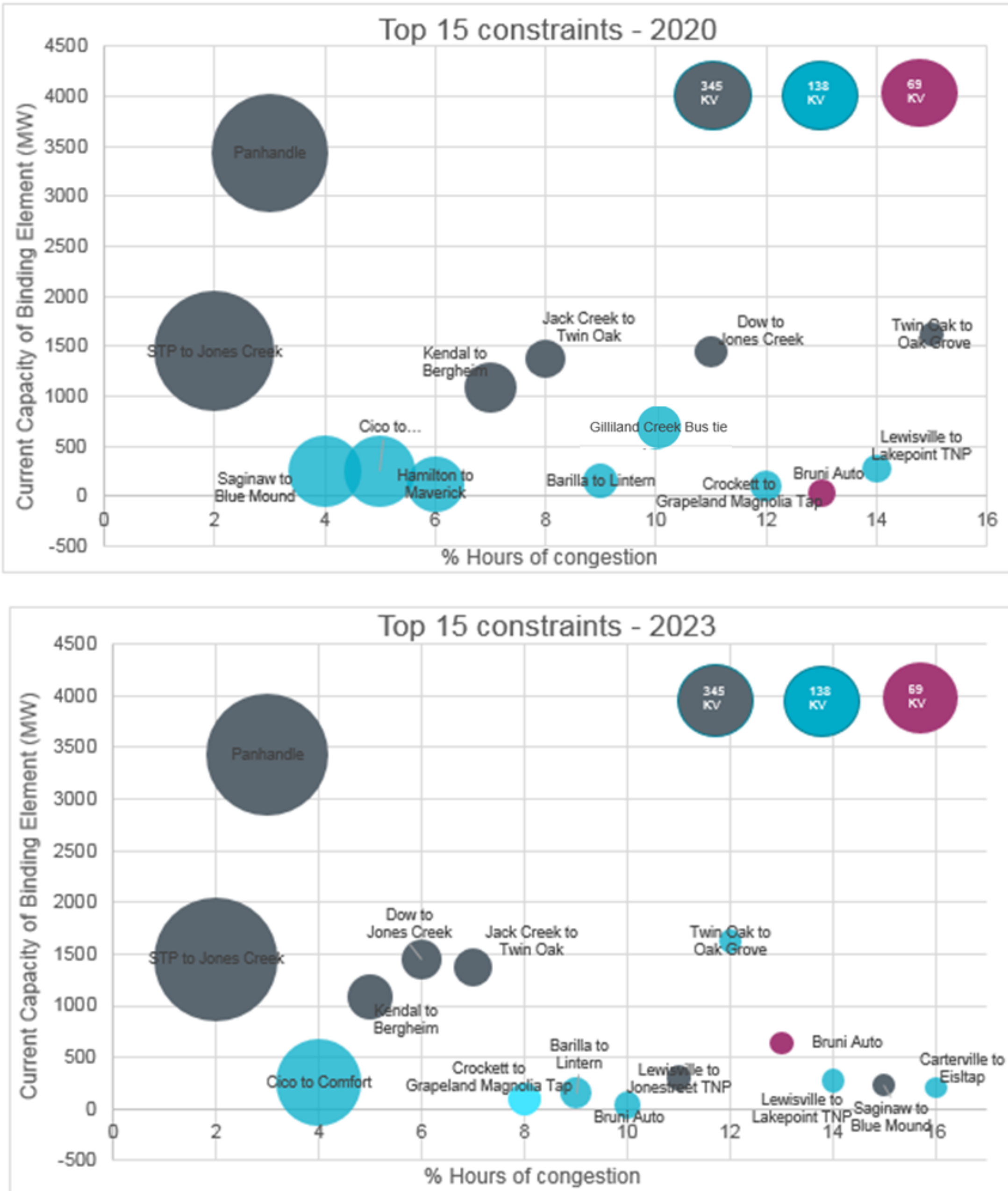


Figure 6: Top fifteen constraints in 2020 and 2023

The size of each bubble represents the relative congestion rent accumulated over the study period. As seen in the charts the Panhandle Interface in the North and 345-kV double-circuit lines from South Texas Project to Jones Creek in Coast weather zones exhibited a significant amount of congestion.

The Panhandle interface has seen consistent congestion over the past few planning assessment. This congestion is primarily driven by more wind generation connecting inside the Panhandle, a region that suffers from weak-grid conditions and resulting stability issues. The STP to Jones Creek congestion, in the planning studies, saw a big increase primarily driven by additional industrial loads projected for the Freeport region. Both of these constraints are currently being evaluated as part of ERCOT independent reviews at the RPG.

Since the South Plains Transmission Project is currently under review at the RPG, a placeholder option of two 175 MVA synchronous condensers at Windmill Station was modeled to represent the improvement in the Panhandle Interface export capacity. This option was seen to provide enough benefit to meet the economic criteria. Additionally, the Freeport Master Plan, a reliability project intended to serve increased loads in the Freeport region is also currently under review and may play a significant role in relieving congestion in the region. Economic benefits of this project were not evaluated in the 2017 RTP. Furthermore, due to the timing of the announcements, the impacts of the recent generation retirements were not evaluated in the 2017 RTP. The magnitude and timing of these retirements may potentially affect the power flows and congestion across the ERCOT region and will be investigated in future planning studies such as the 2018 RTP.

Twelve economic transmission improvement projects were evaluated in the 2017 RTP. Four of the twelve solutions evaluated showed sufficient benefits to pass the ERCOT economic planning criteria. Most noteworthy of these projects was the upgrade of the 138-kV lines between the Kendall Substation and Cico Substation in Kendall County. The list and details of the economic projects tested in the 2017 RTP can be found in Appendix K. The input data and final congestion tables from the 2017 RTP can be found in Appendix L.

In addition to the evaluation of economic projects, ERCOT, per the ERCOT Protocol Section 3.10.8.4 (3), identified additional Transmission Elements that have a high probability of providing significant added economic efficiency to the ERCOT market through the use of dynamic ratings. Dynamic ratings for the identified elements (listed in Appendix M) have been requested from the associated TPs.

6. Appendices

Index	Description	Document	Access
A1	RTP Scope and Process Document	Appendix_A1_2017_RTP_Scope_and_Process_Final.pdf <file included in public version>	Public
A2	Input assumptions for the 2017 RTP – addendum to the 2017 RTP Scope	Appendix_A2_2017_RTP_Input_Assumptions_public.xlsx <file included in public version>	Public
B	Economic analysis input information	Appendix_B_2017_RTP_Economics_Start_Case_Inputs_Annual_Contraints.zip <file available on MIS Secure>	MIS Secure
C	Reliability Driven Projects	Appendix_C_2017RTP_Reliability_Projects_public.xlsx <file included in public version>	MIS Secure
D	Project locations	Appendix_D_Project_Locations.pdf <file included in public version>	Public
E	Constraint Management Plans	Appendix_E_2017RTP_ConstraintManagementPlans.xlsx <file available on MIS Secure>	MIS Secure
F	Multiple element outage analysis	Appendix_F_2017_RTP_MultipleElementContingencyStudyReport.docx <file available on MIS Secure>	MIS Secure
G	Facilities loaded over 95%	Appendix_G_2017_RTP_95%_Overload_PG31123.xlsx <file available on MIS Secure>	MIS Secure
H	Sensitivity Analysis Results	Appendix_H_2017RTP_Sensitivity_Projects.xlsx <file available on MIS Secure>	MIS Secure
I	Short Circuit Analysis	Appendix_I_2017RTP_ShortCircuitStudyCases_DetailedResult.docx <file available on MIS Secure>	MIS Secure
J	Long lead-time equipment analysis	Appendix_J_2016RTP_LongLeadTimeEquipment.docx (File is ERCOT-Confidential)	ERCOT Confidential
K	Economic projects evaluated	Appendix_K_2017_RTP_Economic_Projects_public.xlsx <file included in public version>	MIS Secure
L	Annual Constraints from economic analysis	Appendix_L_2017_RTP_Econ_AnnualConstraints.zip <file available on MIS Secure>	MIS Secure
M	Transmission elements proposed to be dynamically rated	Appendix_M_2017RTP_DynRating_NP3_10_8_4.xlsx <file available on MIS Secure>	MIS Secure