Date: February 4, 2020
To: Board of Directors
From: Kenan Ögelman, Vice President of Commercial Operations
Subject: ERCOT determination regarding the development of policies, rules, guidelines, procedures, standards and/or criteria for the implementation of Real-Time Co-optimization

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: February 11, 2020
Item No.: 10.1.1

Issue:

Whether the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) should vote to: (a) approve Real-Time Co-optimization (RTC) Key Principles (KPs) developed by the RTC Task Force (RTCTF) and endorsed by the Technical Advisory Committee (TAC); (b) preclude consideration of policy principles set forth in KP8, Out of Scope and Post-RTC Review Items, in the development and implementation of RTC Nodal Protocol Revision Requests (NPRRs) and Other Binding Document Revision Requests (OBDRRs); and (c) direct ERCOT staff to develop and sponsor NPRRs and OBDRRs based on Board-approved KPs for the purpose of implementing RTC.

Background/History:

On January 17, 2019, the Public Utility Commission of Texas (Commission), while discussing PUC Project No. 48540, *Review of Real-Time Co-optimization in the ERCOT Market*, directed ERCOT to begin the process of implementing RTC.

On March 6, 2019, ERCOT hosted an RTC workshop to educate and engage stakeholders on the mechanics of RTC, and begin discussion on the policy principles to be decided by ERCOT and stakeholders. At the workshop, ERCOT staff highlighted some of the policy issues to be considered, and eventually detailed, for the creation of key policy principles that would be used to develop the appropriate NPRRs and OBDRRs—e.g., the creation of Ancillary Service demand curves based upon Operating Reserve Demand Curve (ORDC) principles decided by the Commission, Ancillary Service participation rules, Real-Time Settlement changes, and changes to the Reliability Unit Commitment (RUC) process. ERCOT staff further highlighted the need for a list of policy issues to be considered outside the scope for purposes of NPRR/OBDRR development for RTC implementation within the appropriate timeline and cost estimates. Finally, ERCOT staff proposed a governance process concerning development and approval of RTC policy principles (RTC KPs), and any dependencies on Commission policy principles (e.g., System-Wide Offer Cap (SWOC) and Value of Lost Load (VOLL)) that might be considered in parallel with RTC KP development.

On March 27, 2019, TAC approved the RTCTF Charter, and confirmed the first RTCTF

meeting for April 4, 2019. The RTCTF is a non-voting body that reports directly to TAC, provides recommendations to TAC for the development of RTC KPs, and is responsible for reviewing NPRRs and OBDRRs prepared by ERCOT for the implementation of RTC. The first phase and objective of RTCTF (Phase I) was to establish RTC KPs to define the scope of RTC implementation, and to be used for the development of NPRRs and OBDRRs. Throughout 2019 and into 2020, ERCOT and stakeholders worked to develop the following RTC KPs:

- KP1.1, Ancillary Service Demand Curves and Current Market Price Adders;
- KP1.2, System-Wide Offer Cap and Power Balance Penalty Price;
- KP1.3, Offering and Awarding Ancillary Services in Real-Time;
- KP1.4, Systems/Applications that Provide Input into the Real-Time Optimization Engine;
- KP1.5, Process for Deploying Ancillary Services;
- KP1.6, Ancillary Service Imbalance Settlement;
- KP2, Suite of Ancillary Service Products
- KP3, Reliability Unit Commitment;
- KP4, The Supplemental Ancillary Service Market Process
- KP5, Day-Ahead Market;
- KP6, Market-Facing Reports;
- KP7, Performance Monitoring; and
- KP8, RTC Out of Scope and Post-RTC Review Items.

A document containing descriptions of each KP, including development summaries and TAC voting records, is included as ***Attachment A***.

As of January 29, 2020, all RTC KPs have been endorsed by TAC, with the exception of KP8, RTC Out of Scope and Post-RTC Review Items. TAC did not vote to endorse KP8 because the policies contained in KP8 have been determined to be outside the scope, and not considered in the development of NPRRs and OBDRRs for RTC implementation.

The second and final objective of RTCTF (Phase II) is to review NPRRs and OBDRRs developed by ERCOT staff for the implementation of RTC KPs, as established in Phase I and approved by the Board.

Key Factors Influencing Issue:

The RTCTC Charter provides, in pertinent part:

> RTCTF shall establish the key policy principles for implementing RTC, and identify policy issues that are beyond the scope of the RTC project. RTCTF shall present key RTC policy principles, along with policy issues

beyond the scope of the RTC project, to TAC for ultimate consideration by the ERCOT Board of Directors (ERCOT Board). The ERCOT Board will instruct ERCOT staff to develop the Nodal Protocol Revision Requests (NPRRs) and applicable Other Binding Documents (OBDs) based upon the recommended key RTC policy principles.

TAC has endorsed KP1.1 - KP1.6, KP2, KP3, KP4, KP5, KP6 and KP7 for the development NPRRs and OBDRRs to implement RTC.

Additional information regarding the Commission's directive to implement an RTC design in the ERCOT market and the purpose and scope of the RTCTF can be found at the following links:

- PUC Project No. 41837, PUCT Review of Real-Time Co-optimization in the ERCOT Region
- PUC Project No. 48540, Review of Real-Time Co-optimization in the ERCOT Market
    - January 17, 2019 Open Meeting
        - Item No. 21, Memorandum by Chairman Walker
    - June 27, 2019 Open Meeting
        - Item No. 10, Memorandum by Chairman Walker
    - July 18, 2019 Open Meeting
        - ERCOT Letter to Commissioners
- RTCTF Charter

Conclusion/Recommendation:

ERCOT staff requests that the Board vote to: (a) approve the RTC KPs endorsed by TAC as the policy principles by which ERCOT NPRRs and OBDRRs will be developed for the implementation of RTC; (b) preclude consideration of policy principles set forth in KP8, Out of Scope and Post-RTC Review Items, in the development and implementation of RTC NPRRs and OBDRRs; and (c) direct ERCOT staff to develop and sponsor NPRRs and OBDRRs based on Board-approved KPs for the purpose of implementing RTC.

ELECTRIC RELIABILITY COUNCIL OF TEXAS, INC.
BOARD OF DIRECTORS RESOLUTION

WHEREAS, on January 17, 2019, the Public Utility Commission of Texas (Commission), while discussing PUC Project No. 48540, *Review of Real-Time Co-optimization in the ERCOT Market*, directed Electric Reliability Council of Texas, Inc. (ERCOT) to begin the process of implementing Real-Time Co-optimization (RTC);

WHEREAS, ERCOT staff and stakeholders, through the RTC Task Force (RTCTF), developed the following Key Principles (KPs) to be used for the development of Nodal Protocol Revision Requests (NPRRs) and Other Binding Document Revision Requests (OBDRRs) for the implementation of RTC: KP1.1, Ancillary Service Demand Curves and Current Market Price Adders; KP1.2, System-Wide Offer Cap and Power Balance Penalty Price; KP1.3, Offering and Awarding Ancillary Services in Real-Time; KP1.4, Systems/Applications that Provide Input into the Real-Time Optimization Engine; KP1.5, Process for Deploying Ancillary Services; KP1.6, Ancillary Service Imbalance; Settlement; KP2, Suite of Ancillary Service Products; KP3, Reliability Unit Commitment; KP4, The Supplemental Ancillary Service Market Process; KP5, Day-Ahead Market; KP6, Market-Facing Reports; KP7, Performance Monitoring; and KP8, RTC Out of Scope and Post-RTC Review Items;

WHEREAS, as of January 29, 2020, the following RTC KPs have been endorsed by the Technical Advisory Committee (TAC) to be used to develop NPRRs and OBDRRs for the implementation of RTC: KP1.1 - KP1.6; KP2; KP3; KP4; KP5; KP6; and KP7;

WHEREAS, ERCOT staff and TAC have determined that policies contained in KP8, RTC Out of Scope and Post-RTC Review Items, are outside the scope of what should be considered in the development of NPRRs and OBDRRs for RTC implementation; and

WHEREAS, after due consideration of the alternatives, the ERCOT Board of Directors (Board) deems it desirable and in the best interest of ERCOT to: (a) approve RTC KPs endorsed by TAC; (b) preclude consideration of policy principles set forth in KP8, Out of Scope and Post-RTC Review Items, in the development and implementation of RTC NPRRs and OBDRRs; and (c) direct ERCOT staff to develop and sponsor NPRRs and OBDRRs based on Board-approved KPs for the purpose of implementing RTC;

THEREFORE, BE IT RESOLVED, that (1) RTC KP1.1 - KP1.6, KP2, KP3, KP4, KP5, KP6 and KP7 are hereby approved; (2) consideration of policy principles set forth in KP8, Out of Scope and Post-RTC Review Items, in the development and implementation of RTC NPRRs and OBDRRs, is hereby precluded; and (3) ERCOT is hereby authorized and approved to develop and sponsor NPRRs and OBDRRs based on Board-approved KPs for the purpose of implementing RTC.

CORPORATE SECRETARY'S CERTIFICATE

I, Vickie G. Leady, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its February 11, 2020 meeting, the ERCOT Board passed a motion approving the above Resolution by _____.

IN WITNESS WHEREOF, I have hereunto set my hand this ___ day of February, 2020.

_____
Vickie G. Leady
Assistant Corporate Secretary

Attachment A

2705 West Lake Drive
Taylor, Texas 76574
(512) 248-6800
ercot.com

Real-Time Co-optimization (RTC) Key Principles

Matt Mereness
RTCTF Chair
02/11/2020

Table of Contents

Executive Summary

The objective of this document is to support the development of the scope and subsequent Nodal Protocol Revision Requests (NPRRs), Nodal Operating Guide Revisions (NOGRRs), and Other Binding Documents (OBDs) necessary to implement Real-Time Co-optimization (RTC) in the ERCOT market.

At the direction of the Public Utility Commission of Texas (PUC) in January 2019, Project No. 48540, *Review of Real-Time Co-Optimization in the ERCOT Market*, ERCOT staff and stakeholders initiated discussions to support the design and implementation of RTC. In March 2019, ERCOT's Technical Advisory Committee (TAC) adopted a charter creating the RTC Task Force (RTCTF). TAC instructed RTCTF to develop the policy principles necessary to support RTC implementation. In relevant part, the RTC charter provides:

> *RTCTF is responsible for developing the necessary policy principles to implement a [RTC] design in the ERCOT market that aligns with [PUC] Project No. 48540, Review of Real-Time Co-Optimization in the ERCOT Market. RTCTF is also responsible for reviewing draft Revision Requests (RRs) prepared by ERCOT to implement RTC policy principles.*
>
> *The first phase and objective (Phase I) of RTCTF is to: (a) establish the key policy principles that establish the scope of the RTC project and will be used to develop the ERCOT rules, and (b) identify policy issues that are beyond the scope of the RTC project. The second phase and objective (Phase II) of RTCTF is to review the draft RRs prepared by ERCOT for implementation of the policy principles established in Phase I.*

Included in this document are the key policy principles (i.e., Key Principles or KPs) developed by ERCOT staff and stakeholders to establish the scope of the RTC project. These Key Principles, upon direction from the ERCOT Board of Directors (Board), will be used by ERCOT staff to develop the NPRRs, NOGRRs, and OBDs required for RTC implementation.

Key Principle 1.1, Ancillary Service Demand Curves and Current Market Price Adders

Executive Summary	The pricing of reserves and energy with Real-Time Co-Optimization (RTC) will reflect the use of demand curves based on the Operating Reserve Demand Curve (ORDC) while continuing to adjust for defined out-of-market actions taken by ERCOT to maintain reliability.
Principle Description	The purpose of Key Principle 1.1, Ancillary Service Demand Curves (ASDCs) and Current Market Price Adders, is to make adjustments to pricing rules as follows: 1. ORDC price adders will be eliminated along with the associated Settlement. 2. An ASDC for each Ancillary Service (AS) product will be an input in determining Market Clearing Prices for Capacity (MCPCs) in Real-Time. 3. In aggregate, ASDCs will reflect the pricing outcomes expected under the 2020 shifted ORDC. 4. The process of the Reliability Deployment Price Adder for out-of-market actions will be expanded to also consider changes in MCPCs.
RTCTF Discussion	On 8/9/19, ERCOT staff presented material introducing KP1.1 subsections (1) through (5). On 8/27/19, the RTCTF discussed KP1.1 subsections (1) through (5) and reached consensus on subsections (1), (3), and (4). On 9/19/19, the RTCTF discussed subsection (4) and modified the details of the single aggregate ORDC for disaggregation into individual ASDCs. RTCTF also adopted Siddiqi proposal to subsection (5) defining the disaggregation of the ORDC into ASDCs, and RTCTF added language to ensure this functionality is implemented as parameters to allow flexibility for future changes. On 10/9/19, the RTCTF discussed and reached consensus on KP1.1 subsection (5). Also, ERCOT gave an overview on the concepts for principle (6). On 10/30/19, the RTCTF reviewed Luminant options for subsections (2), (6), and (7), and a subgroup of interested parties agreed to work on alternative language for the November 19, 2019 RTCTF meeting. On 11/19/19, RTCTF continued discussion on KP1.1 subsections (2), (6), and (7), and ERCOT Staff presented material introducing KP1.1 subsection (8) On 12/3/19, RTCTF reviewed Austin Energy's proposal for subsection (8) and after discussion proceeded with the original (8) proposal, now

	renumbered to (7) based on additional revisions agreed upon at RTCTF. RTCTF reached consensus on KP1.1 subsections (2), (6), and (7). On 12/19/19, RTCTF reached consensus on Luminant's proposal for subsection (8) related to reviewing RTC pricing outcomes with current ORDC.
TAC Action Requested	On 9/25/19, TAC vote to endorse KP1.1 subsections (1), (3), and (4) for purposes of informing the Board. On 10/23/19, TAC vote to endorse KP1.1 subsection (5) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP1.1 subsections (2), (6), (7), and (8) for purposes of informing the Board.
TAC Action Summary	On 9/25/19, TAC voted to endorse KP1.1 subsections (1), (3), and (4) for purposes of informing the Board. On 10/23/19, TAC voted to endorse KP1.1 subsection (5) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP1.1 subsections (2), (6), (7), and (8) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP1.1 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) The ORDC price adders and the associated process of determining those price adders in Real-Time are eliminated under Real-Time Co-optimization (RTC). Instead, the Real-Time market (RTM) optimization will use ASDCs as input and determine Market Clearing Prices for Capacity (MCPCs) for each of the individual AS products.

2) The existing process of having a pricing run to capture the effects of reliability deployments will continue, as will the existing reliability deployment triggers for executing that process. However, the pricing run will be modified to also co-optimize energy and AS. To account for the co-optimization in the pricing run and to preserve the existing market design of removing RUC and RMR capacity from the calculation of scarcity prices, the following modifications will be made to the inputs:

    a. AS offers from Reliability Unit Commitment (RUC) instructed Resources, including RMR Resources, will be removed for the pricing run.

    b. Energy Offers for RUC-instructed Resources, including RMR Resources, will be administratively set to $11,000/MWh for the pricing run. This EOC is still subject to mitigation for non-competitive constraints.

3) Real-Time AS Settlement will no longer include the Reliability Deployment Price Adder. Instead, the MCPCs for AS resulting from including the impacts of the pricing run will be used for Real-Time AS imbalance Settlement.

4) To reasonably reflect the current RTM pricing outcomes expected with the ORDC methodology changes being made starting in March, 2020, the following steps will be taken to develop a single aggregate ORDC for disaggregation into individual ASDCs:

   a. For all Security-Constrained Economic Dispatch (SCED) where the sum of RTOLCAP and RTOFFCAP is less than 10,000MW, use the historical RTOLCAP and RTOFFCAP values to calculate the composite LOLP and composite price with composite price defined as:

$$\left(0.5 * \left(1 - pnorm\left(RTOLCAP - X,\ 0.5 * 925,\ 0.707 * 1213\right)\right) + 0.5 * \left(1 - pnorm\left(RTOLCAP + RTOFFCAP - X,\ 925,\ 1213\right)\right)\right) * \left(VOLL - min\left(System\ Lambda,\ 250\right)\right)$$

   b. To account for lower reserve level areas where there are no historical observations, create a single point using the following assumptions:

      i. RTOFFCAP = 0, RTOLCAP = 2,000MW

      ii. Set System Lambda equal to the average of system lambda, with the historical values capped at $250/MWh, during SCED timestamps with less than or equal to 4,000MW of total reserves

   c. Using the results of (a) and (b) above, use regression methods to fit a curve to the average reserve pricing outcomes for the various MW reserve levels.

5) ERCOT will design and implement parameters to represent the disaggregation of ASDCs so that potential future changes in values and distribution will not require system changes. The following steps will be taken to disaggregate the single aggregate ORDC into individual ASDCs:

   a. Place Reg-Up requirement at the highest priced MWs on the aggregate ORDC;

   b. Place RRS requirement at the highest priced open MWs on the aggregate ORDC;

   c. Place ERCOT Contingency Reserve Service (ECRS) requirement at the highest priced open MWs on the aggregate ORDC;

   d. Place Non-Spinning Reserve (Non-Spin) requirement at the highest priced open MWs on the aggregate ORDC; and

   e. Fill remaining MWs on the aggregate ORDC priced at >= $0.01 as NSRS.

6) The Reliability Deployment Price Adder process will apply to both energy and AS, and the adder for each AS product will be the positive increase in MCPC between the dispatch and pricing run.

7) For Reg-Down, the ASDC will be a constant value equal to VOLL.

8) ERCOT will work with stakeholders prior to RTC go-live to develop a framework and reporting to periodically review RTC pricing outcomes relative to pricing outcomes that would have been realized through the ORDC for a reasonable period of time.

Key Principle 1.2, System-Wide Offer Cap and Power Balance Penalty Price

Executive Summary	The values of and interaction between System-Wide Offer Cap (SWOC), Value-of-Lost-Load (VOLL), and Power Balance Penalty Price (PBPP) must be evaluated as part of implementation of Real-Time Co-optimization (RTC). This key principle identifies which values are changing and which one are remaining the same.
Principle Description	The purpose of Key Principle 1.2, System-Wide Offer Cap and Power Balance Penalty Curve, is to identify the parameters to be used both before and after meeting the Peaker Net Margin (PNM) threshold with the Resource Adequacy cycle: 1. SWOC 2. VOLL 3. PBPP, currently represented as the Power Balance Penalty Curve (PBPC) Rules are also identified for the capping of prices under scarcity conditions and this key principle considers the interaction of SWOC between the Day-Ahead Market (DAM) and Real-Time Market (RTM).
RTCTF Discussion	On 8/9/19, ERCOT staff presented material introducing KP1.2 subsections (1) and (2). On 8/27/19, the RTCTF reached consensus on KP1.2 subsections (1) and (2). Also, ERCOT staff presented material introducing KP1.2 subsection (3). On 9/19/19, the RTCTF reviewed subsection (3) and discussed the ERCOT, Luminant, and Siddiqi options. RTCTF narrowed the options to Luminant proposal or Siddiqi proposal for consideration at the next RTCTF. On 10/9/19, the RTCTF reviewed subsection (3) and reached consensus that there is not a need to adjust Real-Time Market Clearing Prices for Capacity (MCPCs) when there is an ex post capping of energy prices as proposed in (3) and therefore removed (3) from further consideration (relocated to KP8 at the 10/30/19 RTCTF meeting based on TAC discussions). On 10/30/19, ERCOT Staff introduced concepts for the potential need for separate SWOC in DAM. On 11/19/19, the RTCTF reviewed subsection (3) and reached consensus to reference the Value of Lost Load (VOLL) rather than $9,000/MWh when describing the SWOC in DAM.

TAC Action Requested	On 9/25/19, TAC vote to endorse KP1.2 subsections (1) and (2) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP1.2 subsection (3) for purposes of informing the Board.
TAC Action Summary	On 9/25/19, TAC voted to endorse KP1.2 subsections (1) and (2) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP1.2 subsection (3) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP1.2 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) For the period of the annual Resource Adequacy cycle where the PNM threshold has not been met, the following parameters will be in effect for the RTM:
   a. SWOC will be equal to $2,000/MWh;
   b. VOLL and the maximum Ancillary Service Demand Curve (ASDC) value will be equal to $9,000/MWh;
   c. The energy price, exclusive of congestion costs, produced every execution of the RTM will be capped at $9,000/MWh; and
   d. PBPP will be equal to $11,000.01/MWh.
2) After the PNM threshold has been met, a process will be used to adjust the parameters for the RTM to be:
   a. SWOC will be equal to $2,000/MWh;
   b. VOLL and the maximum ASDC value will be equal to $2,000/MWh;
   c. The energy price, exclusive of congestion costs, produced every execution of the RTM will be capped at $2,000/MWh; and
   d. PBPP will be equal to $4,000.01/MWh.
3) For the Day-Ahead Market (DAM), the SWOC will be equal to VOLL.

Key Principle 1.3, Offering and Awarding Ancillary Services in Real-Time

Executive Summary	Real-Time Co-Optimization (RTC) will allow Qualified Scheduling Entities (QSEs) to offer and be awarded Ancillary Services (AS) in Real-Time.
Principle Description	The purpose of Key Principle 1.3, Offering and Awarding Ancillary Services in Real-Time is to outline the key mechanisms and timelines for submitted AS Offers, as well as those considered and awarded under RTC. Specifically, this principle addresses the following concepts: (a) AS Offer structure and timing; (b) QSE telemetry for updating available capacity from AS Offers; (c) Under-frequency relay (UFR) Load Resource scheduling for Responsive Reserve (RRS) UFR and ERCOT Contingency Reserve Service (ECRS); (d) On-Line hydro Generation Resource (hydro Generation Resources not operating in synchronous condenser fast-response mode) scheduling for RRS, Non-Spinning Reserve (Non-Spin), and ECRS; and (e) Constraints to be used for the RTC clearing process.
RTCTF Discussion	On 6/21/19, ERCOT provided a presentation and whitepaper discussing constraint formulation for RTC. There was specific discussion on KP1.3 subsections (1), (2), and (4). On 7/12/19, RTCTF discussed comments that ERCOT received, and ERCOT provided a presentation looking at telemetered ramp rates and constraints for Combined Cycle Generation Resources (CCGRs). On 8/9/19, South Texas Electric Cooperative Inc. (STEC) presented proposed changes to KP1.3, with a focus on the treatment of hydro Resources (subsection (3)). ERCOT also presented on a number of topics related to KP1.3, including discussion on subsections (5) through (9). On 8/27/19, ERCOT continued presentations on KP1.3, including subsection (9). ERCOT staff also presented material introducing KP1.3 subsections (10) through (13). On 9/19/19, RTCTF reviewed ERCOT's examples of AS deployment and re-procurement, including impacts to Load Resources. RTCTF reviewed Siddiqi proposal, but group consensus was to continue forward on ERCOT's proposal in subsection (8). RTCTF modified (9) to include Real-Time feedback to impacted QSEs with mitigated AS limits related to AS infeasibility.

	On 10/9/19, RTCTF discussed KP1.3 subsections (1) through (15) and reached consensus on subsections (1), (2), (3), (4)(a), (4)(b), (5), (6), (7) (8), (10), and (11). On 10/30/19 RTCTF discussed Exelon comments to subsection (4)(c-d) and agreed to move them to KP8. For subsection (12)(c), ERCOT discussed and plans to develop Protocols whereby the AS proxy offer price floors will be a separate configurable parameter that will be set by TAC as a single value for each AS product and product sub-category. For subsection (16) (AS Substitution), RTCTF reached consensus to remove this concept from KP1.3. RTCTF reached consensus on subsections (8)(c), (9), (12), and (13). On 11/19/19, RTCTF discussed Exelon comments to previously TAC-approved subsection (11) as well as the new subsection (15) proposed in Siddiqi comments. On 12/3/19, RTCTF discussed Siddiqi proposal on subsection (15) but this proposal was withdrawn after RTCTF discussion. RTCTF reached consensus on new subsection (11) language. On 12/19/19, RTCTF reached consensus on subsection (14) to address potential over-scheduling of AS Trades.
TAC Action Requested	On 10/23/19, TAC vote to endorse KP1.3 subsections (1), (2), (3), (4)(a), (4)(b), (5), (6), (7) (8), (10), and (11) for purposes of informing the Board. On 11/20/19, TAC vote to endorse KP1.3 subsections (8)(c), (9), (12), and (13) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP1.3 subsections (11) and (14) for purposes of informing the Board.
TAC Action Summary	On 10/23/19, TAC voted to endorse KP1.3 subsections (1), (2), (3), (4)(a), (4)(b), (5), (6), (7) (8), (10), and (11) for purposes of informing the Board. On 11/20/19, TAC voted to endorse KP1.3 subsections (8)(c), (9), (12), and (13) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP1.3 subsections (11) and (14) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP1.3 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) QSEs will have ability in Real-Time to indicate whether a Resource is temporarily unable to provide AS due to operational constraints.

2) UFR Load Resources will be able to self-provide RRS UFR and ECRS; the amount of which will based on Day-Ahead Market (DAM) and AS trades.

3) On-Line hydro Generation Resources not operating in Synchronous Condenser Fast-Response mode will be able to maintain RRS, Non-Spin, and ECRS on those Resources through modification of the Mitigated Offer Cap (MOC).

4) RTC will account for frequency responsive capacity of a CCGR when awarding AS that is required to be frequency responsive.

   a. In Real-Time, QSEs will supply data informing ERCOT systems, on the portion of the total CCGR MW output that is being provided from the CCGR's frequency responsive capacity, and, the high and low limits of the CCGR's frequency responsive capacity.

   b. Utilizing these additional Real-Time data provided by the QSE informing ERCOT systems of the CCGR's frequency responsive parameters, RTC will limit frequency responsive AS awards to be within the frequency responsive capability limits.

5) RTC will not change limitations on sub-categories of AS products (e.g., FRRS, FFR, and RRS and ECRS provided via UFR).

6) Off-Line Resources providing Non-Spin that are in startup due to a manual deployment of Non-Spin by ERCOT will continue to be eligible for being awarded Non-Spin for the first 25 minutes following the deployment. The eligible capacity will be based on the High Sustained Limit (HSL) of the Resource less its Base Point instruction.

7) Resources operating in quick-start mode that are in startup due to a deployment from ERCOT will continue to be eligible for being awarded ECRS and Non-Spin. The eligible capacity will be based on the HSL of the Resource less its base point instruction.

8) During each execution, RTC awards for energy (Base Points) and AS will be based on taking a fresh look at the pool of Resources available to provide energy and AS.

   a. Energy awards (Base Points) will be relative to Resource capability (limits, ramp rates).

   b. AS awards will be relative to Resource capability (limits, ramp rates, etc.) and the ASDCs irrespective of the quantity of AS already being deployed.

   c. All Resources providing FFR shall be considered during the RTC runs following an automatic deployment of FFR, including continued awarding of FFR and economic dispatch of the Resource up to the Resource's limits. The RTC runs will consider the Resource's energy and AS offers as well as the physical capabilities (e.g., HSL, ramp rates, etc.) of the Resource at the time of execution.

9) Within RTC, ERCOT operators will have the ability to manually reduce the amount of AS being awarded to Resources that, when deployed, may violate transmission constraints. ERCOT will notify QSE in Real-Time of any AS capability that has been

derated by ERCOT including unit's new AS limit in MW. ERCOT will exclude any such manually reduced AS amounts from the AS imbalance calculation.

10) RTC will utilize the AS Offer structure that will be in place with the implementation of Nodal Protocol Revision Request (NPRR) 863.

11) QSEs will have the ability to continuously update their AS Offers. SCED will use the most recently available AS Offer.

12) Proxy AS Offers will be created for Resources that do not have a valid AS offer curve for the entire operating range of the Resource for use in the Real-Time Market (RTM) and will be consistent with the following guidelines:

    a. The proxy offer will be a linked AS Offer across all AS products for which a Resource is qualified to provide. For Resources that are not Load Resources, the proxy offer MW will be equal to the Resource's telemetered HSL. For Load Resources, the proxy offer MW will be equal to the Resource's telemetered Maximum Power Consumption (MPC).

    b. For each AS, the price in the proxy AS Offer for that AS for the Resource will be set equal to:

        i. For Reg-Up and RRS, the maximum of a proxy offer price floor for that AS, the Resource's highest submitted offer price for that AS, the Resource highest price offer for ECRS (submitted or proxy), and the Resource's highest price offer for Non-Spin (submitted or proxy).

        ii. For ECRS, the maximum of a proxy offer price floor for ECRS, the Resource's highest submitted offer price for ECRS, and the Resource's highest price offer for Non-Spin (submitted or proxy).

        iii. For Non-Spin, the maximum of a proxy offer price floor for Non-Spin and the Resource's highest submitted offer price for Non-Spin.

        iv. For Reg-Down, the maximum of a proxy offer price floor for Reg-Down and the Resource's highest submitted offer price for Reg-Down.

    c. Each of the AS proxy offer price floors will be a separate configurable parameter that can be set equal to a defined $/MWh value.

    d. The system will be designed to allow different proxy offer price floors for instances in which the same AS can be provided by either Off-Line or On-Line Resources (i.e., the proxy offer price floor for an offline Non-Spin offer may be different than the proxy offer price floor for an online Non-Spin offer). It will also be designed to allow different proxy offer price floors for different subcategories of AS (i.e., the proxy offer price floor for a PFR-type RRS offer may be different than the proxy offer price floor for a UFR-type RRS offer).

    e. The RTC optimization will enforce various Resource specific AS constraints to ensure the AS awards are feasible, considering both QSE submitted AS offers and RTC created proxy AS Offers.

13) Proxy AS Offers will not be created for Resources for use in the DAM.

14) A behavioral rule will be created that QSEs shall not submit confirmed trades for AS sub-types in excess of their DAM self-arrangement quantity (including 0 or null).

a. QSEs will be notified at 1430 in the Day-Ahead if they have an overage.

b. If the overage is not resolved by the end of the Adjustment Period, QSEs with any overage will be charged the RT MCPC for those quantities.

c. If ERCOT exceeds the AS sub-type limits system-wide in Real-Time, no awards will be prorated.

Key Principle 1.4, Systems/Applications that Provide Input into the Real-Time Optimization Engine

Executive Summary	The current ERCOT systems and applications that provide input for the current Real-Time Market (RTM) optimization engine are not designed to accommodate Real-Time Co-optimization (RTC)–i.e., the awarding of Ancillary Services (AS) in Real-Time. Key Principle (KP) 1.4 addresses modifications to those systems and applications that will be necessary to accommodate RTC.
Principle Description	ERCOT's systems and applications that provide input for the current RTM optimization engine will be modified to account for RTC (e.g., the Resource Limit Calculator (RLC)). Real-Time information exchanged between Qualified Scheduling Entities (QSEs) and ERCOT will need to be reviewed and modified to accommodate such changes.
RTCTF Discussion	On 6/7/19, the RTCTF reached consensus on the subsection (1) of KP1.4. On 7/12/19, the RTCTF added "Telemetered" into the equations in KP1.4, subsection (1) for clarification with respect to Ramp Rates. On 8/9/19, the RTCTF reached consensus on KP1.4, subsection (2), and ERCOT introduced KP1.4, subsection (4). On 10/30/19, the RTCTF reviewed subsections (3)-(6) with minor edits, and agreed to a telemetry-focused WebEx for review prior to the November 19, 2019 RTCTF meeting. On 11/19/19, the RTCTF reviewed subsections (3)-(6) and discussed comments submitted by Luminant that expand the telemetry of ramp rates to each AS product and sub-product as well as minor edits by ERCOT, and stakeholders suggested the content contained in subsections (3)-(5) be consolidated into a table. On 12/3/19, RTCTF reviewed ERCOT redlines to consolidate subsections (3)-(5) into a single subsection (3) for increased transparency. RTCTF reached consensus on subsections (3) and (4).
TAC Action Requested	On 7/24/19, TAC vote to endorse KP1.4, subsection (1) for purposes of informing the Board. On 8/28/19, TAC vote to endorse KP1.4, subsection (2)(a)-(d) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP1.4, subsections (3) and (4) for purposes of informing the Board.
TAC Action Summary	On 7/24/19, TAC endorsed KP1.4, subsection (1) for purposes of informing the Board.

	On 8/28/19, TAC endorsed KP1.4, subsection (2)(a)-(d) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP1.4, subsections (3) and (4) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP1.4 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) Under RTC, for Resources that are being economically dispatched by ERCOT, the current practice of pre-reserving portions of their capacity to provide Ancillary Services (AS) through telemetry from the Resource's QSE will be discontinued. AS awards will now be an output of RTC.
    a) Because of this, RLC calculated Resource Limits of High Ancillary Service Limits (HASLs) and Low Ancillary Service Limits (LASLs) will be discontinued.
    b) With the HASL and LASL calculations being discontinued, the method for calculating dispatch limits needs to be modified. High Sustained Limits (HSLs), Low Sustained Limits (LSLs), and telemetered ramp rates will be used directly to calculate High Dispatch Limits (HDLs) and Low Dispatch Limits (LDLs), per the formulas:

        HDL=Min(HSL,TelemMW+NormalTelemeteredRampRateUp*5)

        LDL=Max(LSL,TelemMW-NormalTelemeteredRampRateDn*5)
2) Under RTC, the following will occur:
    a) HASL and LASL calculations will be discontinued;
    b) AS will be a Resource specific award (and an output of RTC);
    c) AS will be awarded only to Resources that are qualified to provide the service; and
    d) Regulation instructions will be Generation Resource specific.

        Furthermore, the following modifications to Real-Time telemetered information provided from/to QSEs via RLC will be necessary:

        1) For Generation Resources, AS-related (i) responsibility and schedule telemetry, and (ii) Regulation Up/Down participation factor telemetry from QSEs will be discontinued;
        2) New telemetry for QSEs to track (i) Resource-specific AS awards, and (ii) Generation Resource-specific Regulation Up/Down instructions from Load Frequency Control (LFC);
3) For each Resource, QSEs will continue to send Up and Down Normal Ramp Rates that represent the 5-minute ramping capability of the Resource. In addition, there

will be new telemetry to be submitted by QSEs to inform ERCOT of the current physical capability of a qualified Resource to provide AS. These telemetry points will be calculated and updated by the QSE every 2 seconds and will be used as additional limits on AS awards below what could be awarded given the Resource's other constraints such as HSL, HDL, LDL, and LSL. The table below describes the existing and new telemetry points required for each AS product or sub-product, the unit of measure for the telemetry point, and a comment describing what the telemetry point is and how it will be used.

Product or sub-product	Telemetry Unit	Comment
Energy (up)	MW/minute	5-minute blended Normal Up Ramp Rate that reflects the current ability of Resource to follow a Base Point instruction. Determines HDL. This is an existing telemetry point.
Energy (down)	MW/minute	5-minute blended Normal Down Ramp Rate that reflects the current ability of Resource to follow a Base Point instruction. Determines LDL. This is an existing telemetry point.
Regulation Up	MW/minute	5-minute blended ramp rate that reflects the current capability of the Resource to provide Regulation Up. In addition to HDL, limits amount of Regulation Up that SCED can award to the Resource.
Regulation Down	MW/minute	5-minute blended ramp rate that reflects the current capability of the Resource to provide Regulation Down. In addition to LDL, limits the amount of Regulation Down that SCED can award to the Resource.
RRS-PFR	MW	Reflects the current capability to provide RRS from PFR via Governor response. In addition to available headroom and 20% of HSL, limits the amount of RRS-PFR that SCED can award to the Resource.
RRS-FFR	MW	Reflected the current capability to provide Fast Frequency Response. In

		addition to HSL, limits the amount of RRS-FFR that SCED can award to the Resource.
RRS-UFR	MW	Reflects the current capability to provide RRS via UFR. In addition to available headroom, limits the amount of RRS-UFR that SCED can award to the Resource.
ECRS	MW/minute	10-minute blended ramp rate that reflects the current capability of the Resource to provide ECRS. In addition to HSL, limits the amount of ECRS that SCED can award the Resource. This value will be the ten-minute output change capability of the Resource divided by ten (positive change for Resources injecting into the grid and negative change for Resources withdrawing from the grid).
Non-Spin	MW/minute	30-minute blended ramp rate that reflects the current capability of the Resource to provide Non-Spin. In addition to HSL, limits the amount of Non-Spin that SCED can award the Resource. This value will be the 30-minute output change capability of the Resource divided by 30 (positive change for Resources injecting into the grid and negative change for Resources withdrawing from the grid).

4) Under RTC, the following changes will be made to Resource Statuses provided by QSEs for their Resources.

   a) The following changes will be made for Resources that are not Load Resources:

      1) A new status of ONSC will be created for Resources that are on-line operating as a synchronous condenser. This status will be for both Current Operating Plans (COP) and Real-Time telemetry. Resources with this status will be eligible to provide RRS and ECRS and will count towards Physical Responsive Capability (PRC).

      2) A new status of ONHOLD will be created for Resources that are on-line but are temporarily not available for being awarded AS or economically dispatched by ERCOT. This status will only be used for Real-Time telemetry.

Resources with this status will have their Base Point set equal to the telemetered MW output of the Resource, will not be eligible to provide AS, and will not count towards PRC.

3) All Resources Statuses that are specific to a particular AS product will be eliminated. These statuses are ONREG, ONOSREG, ONDSRREG, FRRUP, ONRR, ONECRS, ONFFRRRS, and OFFNS.

b) The following changes will be made for Load Resources:

1) A new status of ONL will be created for Resources that are On-Line and are available for economic dispatch and/or for providing AS. Economic dispatch is only applicable to Controllable Load Resources (CLRs) that are qualified to participate in Security-Constrained Economic Dispatch (SCED) and have a valid Energy Bid in Real-Time.

2) All Resources Statuses that are specific to a particular AS product or being a CLR will be eliminated. These statuses are ONRGL, FRRSUP, FRRSDN, ONCLR, ONRL, ONECL, and ONFRRRSL.

Key Principle 1.5, Process for Deploying Ancillary Services

Executive Summary	To implement Real-Time Co-optimization (RTC), certain processes for deploying Ancillary Services (AS) will need to be modified to accommodate the awarding of AS in Real-Time. This RTC principle looks at the ERCOT systems, ERCOT to Qualified Scheduling Entity (QSE) communications, QSE to ERCOT communications, and other processes in place that play a role in the sending of Dispatch instructions and deployment of AS.
Principle Description	To implement RTC, certain processes for deploying Ancillary Services (AS) will need to be modified to accommodate AS awards in Real-Time.
RTCTF Discussion	On 6/7/19, the RTCTF reached consensus on a number of the principle concepts under KP1.5. However, alternatives were proposed for concepts 3 and 6. In both cases, the alternatives relate to the issue of whether Regulation Service instructions from ERCOT should be Resource-specific or maintain the current practice of instructing QSEs at the portfolio level. On 6/21/19, Shams Siddiqi presented modified alternative language for (3) and (6). On 7/12/19, Shams Siddiqi presented modified alternative language for (3) and removed alternative for (6). Both ERCOT and Shams presented a brief position for their alternatives, but without resolution at RTCTF. Alternatives for (3) will be going to 7/24/19 TAC, with consensus on (1)-(2), and (4)-(6). On 8/9/19, RTCTF made a minor edit to subsection (8) and reached consensus on subsections (7) through (13). On 10/30/19, ERCOT initiated discussion and presented material regarding subsections (14) through (16). On 11/19/19, RTCF reviewed subsections (14)-(16) and proposed edits to subsections (14) and (16). On 12/3/19, RTCTF reviewed and reached consensus on subsections (14)-(16)
TAC Action Requested	On 7/24/19, TAC vote to endorse KP1.5, subsections (1)-(6), with specific direction on which alternative language for (3) for purposes of informing the Board. On 8/28/19, TAC vote to endorse KP1.5, subsections (7)-(13) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP1.5, subsections (14)-(16) for purposes of informing the Board.

TAC Action Summary	On 7/24/19, TAC voted to endorse KP1.5, subsections (1)-(6), including alternative 1 for (3), for purposes of informing the Board. On 8/28/19, TAC voted to endorse KP1.5, subsections (7)-(13) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP1.5, subsections (14)-(16) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP1.5 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) The AS manager application will be modified to obtain Resource-specific AS responsibility/award information as an output from RTC (i.e., it will no longer be driven by Real-Time telemetry and Current Operating Plan (COP) information provided by Qualified Scheduling Entities (QSEs)).
2) Under the current process, energy for immediate dispatch and Locational Marginal Prices (LMPs) from Security-Constrained Economic Dispatch (SCED) are binding; this process will remain in place with RTC. Thus, RTC awards for AS products, energy, dispatch, and their respective prices (e.g., LMPs, Market Clearing Prices for Capacity (MCPCs)) will be immediately binding as applicable to various AS products (e.g., Regulation Up Service (Reg-Up) and Regulation Down Service (Reg-Down)).
3) Regulations Service instructions from ERCOT will become Resource specific (i.e., no longer QSE portfolio level; participation factors will be removed).
4) Load Frequency Control (LFC) will be modified to address more frequent awards of Regulation Service to qualified Resources; upon the receipt of new Base Points and AS awards from RTC, LFC will reset Regulation Service instructions to zero.
5) Updated Desired Base Points (UDBP) will be replaced by Updated Desired Set Point (UDSP)—UDSP will be a single value that is the sum of two components: Base Ramp and Resource-specific Regulation Service instruction. Base Ramp will be a four minute ramp similar to UDBP, except that the starting point of the Base Ramp will be the expected output of the Resource using the previous Base Point and the last Resource-specific Regulation instruction from LFC before new Base Points were input to LFC (i.e., the expected output based on these two components). For Resources that are not providing Regulation Service, the Regulation instruction component will be zero. LFC will then determine the Resource-specific instruction and add it to the Base Ramp.

   LFC will send UDSP every four seconds for all Resources receiving a Base Point from RTC and will continue to do so as new RTC results become available. The UDSP ramp may be temporarily halted for Resources that have Base Points directionally opposite a significant frequency deviation.

6) The calculated system level regulation requirement will be distributed as Regulation Service Instructions to each Resource proportionate to their Regulation Service awards. Issued Resource-specific Regulation Service instructions will respect Resource limits (i.e., HSL, LSL, and ramp rates) by considering UDSP and Resource-specific Regulation Service instructions. Remaining un-deployed system level regulation will be distributed to Resources with Regulation Service awards that have un-deployed Regulation Service award capacity.

7) Operational procedures for deploying Offline Non-spin and RRS from Load Resources remain the same

8) For manual deployment of Generation Resources carrying RRS with the Resource on Synchronous Condenser Fast Response Mode or carrying RRS as FFR capable Resources excluding NCLR, LFC will send energy deployment instructions.

9) The existing process for QSEs to update telemetered AS schedules following manual deployment for Generation Resources and Controllable Load Resources will be removed under RTC.

10) Under scarcity conditions, energy to be served is given priority and smaller amounts of each Ancillary Service will be procured. This will result in scarcity prices being set by the demand curves and reflected in energy prices and MCPCs.

11) The administrative price floor for Non-Spin will be replaced by prices determined from awarded offers and the ASDC for Non-Spin.

12) RTC will continue to have the ability for the Real-Time co-optimization (i.e., RTC) to be executed off-cycle, manually or automatically, between regularly scheduled 5-minute executions.

13) The processes and procedures during a SCED/RTC failure will remain the same: emergency base points and held prices (SPPs, Meter prices and MCPCs) through the 15 minute recovery period.

14) In Emergency Base Points, RTC systems will consider the AS awards from the most recent SCED execution. Non-AS awarded capacity will be utilized ahead of AS awarded capacity and, if necessary, Non-Spin capacity will be utilized before ECRS and ECRS will be utilized before Regulation Service and RRS capacity.

15) No new Settlement calculations will be needed to address the case where there is a SCED failure.

16) Under RTC Fast Responding Regulation Service (FRRS) will not be needed as a subset of Regulation Ancillary Service and will be removed. Energy Storage Resources (ESRs) will be required to qualify and provide the same Regulation Service as other Resources providing Regulation Service.

Key Principle 1.6, Ancillary Service Imbalance Settlement

Executive Summary	The current Real-Time Ancillary Service (AS) imbalance Settlement process is driven by Operating Reserve Demand Curve (ORDC) prices and MW amounts; it does not consider that under Real-Time Co-Optimization (RTC), AS will be awarded in Real-Time. Because the ORDC process will be removed, and AS will be awarded in Real-Time, the AS imbalance Settlement process will be modified.
Principle Description	The Real-Time AS imbalance Settlement process for the ORDC will be replaced with a new process for RTC.
RTCTF Discussion	On 6/7/19, the RTCTF reached consensus on principle concepts 1 through 4 for KP1.6. Subsequent discussion at 6/21/19 and 7/12/19 but no issues identified and no changes to language. On 11/19/19, ERCOT Staff presented material to introduce KP1.6 subsection (5), and noted the Credit Work Group will review at its November 22, 2019 meeting. On 12/3/19, RTCTF reached consensus on subsection (5)
TAC Action Requested	On 7/24/19, TAC vote to endorse KP1.6, subsections (1)-(4) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP 1.6, subsection (5) for purposes of informing the Board.
TAC Action Summary	On 7/24/19, TAC endorsed subsections (1)-(4). On 1/29/20, TAC voted to endorse KP 1.6, subsection (5) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP1.6 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) The new AS imbalance Settlement process will not create new sources of uplift or Make-Whole Charges/Payments for Load Serving Entities (LSEs).
2) AS imbalance calculations will be created for each AS product in the Real-Time Market (RTM).
3) 15-minute Settlement of non-zero net AS imbalance amounts will be charged/paid to Qualified Scheduling Entities (QSEs) on a Load Ratio Share (LRS) basis. Where the amount cleared in DAM plus corresponding AS trades is equal to the

corresponding RTM award MW amount, there will be no LRS-based charge/payment.

4) Under RTC, a QSE's RTM AS Obligation shall equal the RTM LRS multiplied by sum of all RTM AS awards (i.e., there will be no portfolio self-arrangement for the RTM).

5) Under RTC, the following revision will be made credit exposure calculations to account for the RTC AS activity:

   a. Updates will be made to the Real-Time Liability Completed and Not Settled (RTLCNS) component of Estimated Aggregate Liability (EAL) calculation to include RTC AS activity.

   b. Updates will be made to the Real-Time Liability Estimates (RTL) component of the EAL to include RTC AS activity (these components will flow into RTLCNS).

   c. Updates will be made to the Minimum Current Exposure (MCE) component of Total Potential Exposure (TPE) calculation to include RTC AS activity.

Key Principle 2, Suite of Ancillary Service Products

Executive Summary	This Key Principle focuses on the suite of Ancillary Service (AS) products to identify any changes that are needed with the implementation of Real-Time Co-Optimization (RTC)
Principle Description	The purpose of Key Principle 2, Suite of Ancillary Service Products, is answer the following questions: 1. What are the AS products under RTC and what type of Resources can provide them? 2. Under the RTC framework, should the definition of any of the existing AS be changed? 3. With the last two questions in mind, do the AS qualification processes need to be modified?
RTCTF Discussion	On 9/19/19, ERCOT staff presented material introducing KP2 subsections (1) through (6). On 10/9/19, RTCTF discussed subsections (1)-(6) and debated the appropriate sustained MW qualification (hour vs 15-minutes) for Regulation Service and RRS. On 10/30/19, RTCTF reached consensus on subsections (1)-(6) with a 15-minute qualification for Regulation Service and RRS.
TAC Action Requested	On 11/20/19, TAC vote to endorse KP2 subsections (1)-(6) for purposes of informing the Board.
TAC Action Summary	On 11/20/19, TAC voted to endorse KP2 subsections (1)-(6) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP2 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) The set of AS products under RTC will be the products finalized with the approval NPRR863.
2) For all AS, the qualification process will determine for each Resource the maximum MW amount the Resource is qualified to provide. ERCOT will limit awards to no more than the qualified quantity.
3) Regulation Service

a) Continue with current qualification methodology. Existing Regulation Ancillary Service qualification tests can continue under RTC and ERCOT suggests currently qualified Resources qualification status to carry-over into RTC.

b) MW qualified to provide Regulation Service excluding Fast Responding Regulation Service (FRRS) will be limited to how much Resources can sustain for 15 minutes.

4) Responsive Reserve (RRS)

a) For a Generation Resource or Controllable Load Resource, continue with current qualification methodology and include the provision to sustain the qualified MW for 15 minutes.

b) For a Generation Resource operating in synchronous condenser fast-response mode, continue with current qualification methodology.

c) For a Load Resource controlled by high set UFR set at 59.7 Hz, continue with current qualification methodology.

d) For a Resource providing Fast Frequency Response (FFR) including under-frequency relay Controlled Load Resources, ERCOT deployment signal and high-speed site-level data to verify the 15-cycle response along with the sustained 15-minute output.

i) A Resource must be able to sustain for full 15 minutes its output, equal or greater than the amount requested for FFR qualification.

ii) A Resource must demonstrate its capability to provide full response in 15 cycles or faster when system frequency falls below 59.85 Hz.

iii) High-speed recorder capability must be demonstrated.

5) Non-Spinning Reserve (Non-Spin)

a) For Off-Line Non-Spin, continue with current qualification methodology.

b) All SCED-dispatchable Resources are qualified to provide On-Line Non-Spin based on their 30 minute blended ramp rate.

6) ERCOT Contingency Reserve Service (ECRS)

a) Off-Line ECRS can only be provided by Resources that have met the Quick Start Generation Resources (QSGR) qualification.

b) All SCED-dispatchable Resources are qualified to provide On-Line ECRS based on their 10-minute blended ramp rate.

c) For ECRS from a Load Resource other than a Controllable Load Resource, the same qualification process used today to test manual deployment of Load Resources for RRS, excluding requirements for under-frequency relay response will be used.

Key Principle 3, Reliability Unit Commitment

Executive Summary	The Reliability Unit Commitment (RUC) process is designed to study forecasted conditions on the grid and determine whether there is sufficient Resource capability planned to be available to reliably meet those conditions in Real-Time. If there is not sufficient Resource capability planned to be available, RUC may recommend the commitment of additional Resources. With the implementation Real-Time Co-optimization (RTC), this objective remains the same. However, to better project Real-Time conditions on the grid and determine the potential need for Resource commitments, RUC will be modified to be consistent with how energy and Ancillary Services (AS) will be awarded in Real-Time. In the same way that there will be flexibility in Real-Time to move AS among qualified Resources, the RUC optimization engine will also look at moving AS among qualified Resources to meet the forecasted conditions on the grid to align with Real-Time and deliver more effective reliability solutions. The RUC Settlement process will be adjusted to consider Real-Time AS Revenues in the Make-Whole and clawback Settlements. The RUC Capacity-Short Charge will be adjusted to consider AS Supply Responsibility amounts not covered with qualified AS capability.
Principle Description	To better project Real-Time conditions on the grid and determine the potential need for Resource commitments, RUC will be modified to be consistent with how energy and AS will be awarded in the Real-Time Market (RTM). To facilitate this change under RTC, RUC will review Resources scheduled to be available to determine whether additional Resource commitments are needed to meet the Load forecast and minimum AS requirements, and resolve transmission congestion per defined penalty curves and factors. RUC Settlements will be adjusted to consider Real-Time AS award revenue and to accommodate changes in the RUC engine.
RTCTF Discussion	On 6/7/19, the RTCTF considered principle concepts 1 through 9. There was discussion on a number of the principles and alternatives were proposed for concepts 2 and 6. RTCTF discussed all the principle concepts coming back to RTCTF for review at the next meeting. On 6/21/19, ERCOT gave an overview on the concepts for subsections (10), (11), and (12). On 7/12/19, Shams Siddiqi removed Alternative for (6). Shams Siddiqi and ERCOT made presentations on (2). After further discussion ERCOT agreed to provide RUC AS Demand Curve capability, and (2) was updated to reflect the agreement. No additional feedback on subsections (10) through (12).

	On 8/9/19, RTCTF agreed that there was consensus on subsections (10) through (12). On 10/9/19, ERCOT gave an overview on the concepts for subsections (13) through (18). On 10/30/19, RTCTF reviewed the concepts in (13) through (18) as part of the KP1.1 RUC / Reliability Deployment pricing discussion. On 11/19/19, RTCTF continued its review of the concepts in (13) through (18) as part of the KP1.1 RUC / Reliability Deployment pricing discussion. On 12/3/19, RTCTF reached consensus on subsections (13)-(20).
TAC Action Requested	On 7/24/19, TAC vote to endorse KP3, subsections (1) through (9) for purposes of informing the Board. On 8/28/19, TAC vote to endorse KP3, subsections (10) through (12) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP3, subsections (13) through (20) for purposes of informing the Board.
TAC Action Summary	On 7/24/19, TAC voted to endorse KP3, subsections (1) through (9) for purposes of informing the Board. On 8/28/19, TAC voted to endorse KP3, subsections (10) through (12) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP3, subsections (13) through (20) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP3 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) RUC will continue to ensure adequate capacity for Real-Time to meet energy and AS needs, and resolve transmission constraints; since it is designed to distribute AS across all available Resources, it has the additional flexibility for resolving transmission constraints as well as AS needs and should result in fewer RUC commitments for congestion.
2) RUC will be built with the capability to use RUC Ancillary Service Demand Curves (ASDCs). RUC will attempt to solve for a Resource commitment that meets the Load forecast and AS Plan considering Resources' COPs and using defined penalty curves. The values of these curves will be determined at a future date.
3) Modifications will be made to the existing set of data elements provided by Qualified Scheduling Entities (QSEs) in their COPs to accommodate changes to RUC optimization.

4) QSEs will have a mechanism in their COPs to indicate, for each hour, the physical ability/inability of a Resource to provide AS (i.e., the Resource Status).

5) The amount of AS that can be provided by a Resource will be constrained by its qualifications and capabilities.

6) Proxy AS Offers will be used in RUC in determining a co-optimized solution where AS Offers have not been submitted.

7) In addition to online qualified Resources, the RUC engine will consider a COP Resource Status of OFFQS (Off-Line but available for SCED deployment) for a Resource that is qualified for ERCOT Contingency Reserve Service (ECRS), as being able to provide ECRS.

8) In addition to online qualified Resources, the RUC engine will consider a COP Resource Status of OFF (Off-Line but available for commitment in the DAM and RUC) for a Resource that is qualified for Non-Spinning Reserve (Non-Spin), as being able to provide Non-Spin.

9) The current process under which ERCOT Operators review recommendations from the RUC optimization and make commitment instruction decisions will remain in place. This process includes:

    a. ERCOT Operators will give Market Participants ample time to respond to postings of capacity shortages for future hours; and

    b. If a generation commitment is recommended by RUC for a future hour, ERCOT Operators will delay any Dispatch Instruction until the next RUC process would not have sufficient lead time to commit the Resource for the same future hour thus giving QSEs a chance to self-commit.

10) Revenues from Real-Time AS awards will be used to offset the RUC Guarantee for the RUC Make-Whole Payment.

11) Revenues from Real-Time AS awards will be included as revenues in the RUC Clawback Charge.

12) The Capacity-Short Charge will be adjusted to allocate RUC Make-Whole Costs to QSEs that are short in either energy capacity or AS capacity.

    a. QSEs with AS Supply Responsibility greater than their AS capability will be allocated a portion of RUC Make-Whole costs.

    b. QSEs with an overall shortage in energy plus AS Supply Responsibility will be allocated a portion of the RUC Make-Whole costs.

    c. AS capability for Capacity Short Charge Settlement purposes will be based on AS Offers validated against COP information.

13) The RUC engine will use the same proxy methodology for AS as Real-Time.

14) The RUC engine will use the same scaling for AS offers as energy offers.

15) RUC will use new information contained in the COP to determine how much capability for each AS product each Resource will be capable of providing.

16) The Energy Offer Floor for RUC-instructed Resources which have not opted out of RUC settlement will be $1,500/MWh for the dispatch run.

17) All RUC-instructed Resources will have their Energy Offer Curve administratively set to a value just below the Power Balance Penalty Price (i.e., $11,000/MWh) in the pricing run only. This EOC is still subject to mitigation for non-competitive constraints.

18) The AS Offer Floors for RUC-instructed Resources which have not opted out of RUC Settlement will be $1,500/MWh for the dispatch run.

19) AS Offers for RUC-instructed Resources which have not opted out of RUC Settlement will be removed for the pricing run.

20) RTC will not affect the ability for QSEs to opt out of RUC Settlement.

Key Principle 4, The Supplemental Ancillary Service Market Process

Executive Summary	This Real-Time Co-Optimization (RTC) principle proposes the elimination of the Supplemental Ancillary Service Market (SASM) process.
Principle Description	The current SASM process will be eliminated; an updated Reliability Unit Commitment (RUC) process will be used to ensure sufficient capacity is projected to be available in Real-Time to meet the Load forecast and Ancillary Service Plan, and resolve transmission congestion.
RTCTF Discussion	On 6/7/19, the RTCTF reached consensus on KP4. On 7/12/19, additional language was added into "Principle Concept for Voting" section. There was consensus for the change.
TAC Action Requested	On 7/24/19, TAC vote to endorse KP4 for purposes of informing the Board.
TAC Action Summary	On 7/24/19, TAC voted to endorse KP4 for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP4 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) This Real-Time Co-Optimization (RTC) principle proposes the elimination of the Supplemental Ancillary Service Market (SASM) process.

Key Principle 5, Day-Ahead Market

Executive Summary	This Key Principle identifies what changes are needed to the Day-Ahead Market (DAM) in order to bring Day-Ahead Ancillary Service (AS) procurement into alignment with implementation of Real-Time Co-optimization (RTC).
Principle Description	The purpose of Key Principle 5, Day-Ahead Market, is to identify any necessary changes to DAM with the implementation of RTC: 1. Potential use of Ancillary Service Demand Curves (ASDCs) in the DAM optimization. 2. Changes to the DAM AS insufficiency process 3. Updates to the AS Obligation quantities for settlement based on actual DAM AS quantities procured, if different from the AS Plan quantities. 4. Virtual Offers for AS in the DAM.
RTCTF Discussion	On 8/27/19, ERCOT staff presented material introducing KP5 subsections (1) through (6). On 9/19/19, Morgan Stanley proposed virtual AS offers in the DAM, and the concept will be discussed further at future RTCTF meetings. On 10/9/19, RTCTF discussed KP5 subsections (1) through (7) and reached consensus on KP5 subsections (1) through (6). On 10/30/19, RTCTF reached consensus on KP5 subsection (7). On 12/3/19, RTCTF reached consensus on KP5 subsection (7)(j). On 12/19/19, RTCTF reached consensus on KP5 subsections (2)(a) and (7)(b).
TAC Action Requested	On 10/23/19, TAC vote to endorse KP5 subsections (1) through (6) for purposes of informing the Board. On 11/20/19, TAC vote to endorse KP5 subsection (7) for purposes of informing the Board. On 1/29/20, TAC vote to endorse KP5 subsections (2)(a), (7)(b), and (7)(j) for purposes of informing the Board.
TAC Action Summary	On 10/23/19, TAC voted to endorse KP5 subsections (1) through (6) for purposes of informing the Board. On 11/20/19, TAC voted to endorse KP5 subsection (7) for purposes of informing the Board. On 1/29/20, TAC voted to endorse KP5 subsections (2)(a), (7)(b), and (7)(j) for purposes of informing the Board.

Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP5 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) ASDCs will be added to the DAM optimization, and will be used as an input affecting the AS quantity procured and the Market Clearing Price for Capacity (MCPC).
2) The same ASDCs that are used in Real-Time will be used in DAM.
    a. In some cases, negative self-arranged quantities may necessitate shifting the DAM ASDC to the right, as they are treated by DAM as bids at the highest price on each corresponding ASDC.
3) The current DAM AS insufficiency process will be eliminated by removing:
    a. The process of reopening submission window for more offers;
    b. The AS penalty costs; and
    c. The current pricing run used when AS Offers are insufficient to meet the AS Plan.
4) AS Obligation quantities posted by 06:00 in the Day-Ahead will become an advisory-only number based on the AS Plan.
    a. They will be used to validate self-arranged AS transactions. This validation will include any AS subtype limitations, e.g., Responsive Reserve (RRS) being provided via Under Frequency Relay (UFR).
5) Minimum AS Obligation quantity will be 0.1 MW.
6) After DAM is published, updated AS Obligation quantities will be calculated and published based on the actual DAM AS requirement. These quantities may differ from the 06:00 posting, and are the quantities that will be used for DAM Settlement.
    a. “DAM AS requirement” here means the sum of the DAM AS awards plus any self-arrangement.
    b. In the event that a QSE’s self-arranged quantity exceeds the final AS Obligation, the remainder will be paid to the QSE at the DAM MCPC. Self-arranged AS transactions will not be allowed to be submitted or updated after DAM.
7) AS Virtual Offers
    a. Allow one part, unlinked offers of AS that do not represent an offer from a physical Resource from Qualified Scheduling Entities (QSEs). The general purpose of adding this new transaction is convergence bidding, in contrast to conventional Resource-specific AS Offers.
    b. If awarded, the QSE will be paid the DAM price for the capacity times the quantity awarded. The awarded QSE will pay the Real-Time price times the quantity awarded.

c. This proposal does not change the quantity of capacity purchased for each AS. ERCOT will attempt to procure the quantity from its AS Plan from Resource-specific offers as well as virtual offers against respective ASDCs.

d. Virtual offers can only be submitted for:

   i. Conventional Regulation (not Fast Frequency Response Service);

   ii. RRS – Primary Frequency Response type;

   iii. ECRS – dispatchable; and

   iv. Non-Spin.

e. The capability to self-arrange AS in excess of a QSE's AS Obligation will no longer be needed and can be removed.

f. Virtual AS Offers will automatically expire at the close of the DAM.

g. The QSE will have the award included in the calculation of the QSE's position regarding any RUC Capacity-Short Charge.

h. The credit calculation for Real-Time Liability Estimate (RTLE) will also need to be modified to include this capacity in a fashion similar to the DAM energy short calculations.

i. The DAM credit exposure calculations will be modified to validate the virtual AS Offers against the available credit limit, similar to how DAM Energy-Only Offers are treated (evaluating the potential DAM/RT price risk). This will take the form of the 90th percentile of any positive hourly difference between the RT MCPC and the DAM MCPC over the previous 30 days.

j. The Default Uplift Invoice Process will include virtual AS awards to the QSE when calculating the Maximum MWh Activity for the Counter-Party that represents the QSE.

Key Principle 6, Market-Facing Reports

Executive Summary	This Key Principle identifies changes to market-facing reports that will be necessary for the market for implementation of Real-Time Co-optimization (RTC).
Principle Description	The purpose of Key Principle 6, Market-Facing Reports, is to identify any necessary changes to market-facing reports with the implementation of RTC: 1. Existing reports that will be discontinued 2. Existing reports that will be modified 3. New reports that will be created Additional display and user interface changes are also described in this Key Principle.
RTCTF Discussion	On 11/19/19, ERCOT Staff provided a presentation to introduce KP6 subsections (1) and (2) and an Excel file containing an initial list of reports with indications of whether each report would be modified, removed, created, or not changed. ERCOT requested that stakeholders review and provide feedback on the list. On 12/3/19, RTCTF continued its review of potential reporting changes needed under RTC. On 12/19/19, RTCTF reached consensus on KP6 subsections (1) and (2), with additional discussion requested on the report inventory Excel file at the next RTCTF meeting. On 1/22/19, RTCTF continued discussion on the report inventory. Floyd Trefny proposed and presented on the concept of two new 60-day disclosure reports to capture counts of offer curve updates. Luminant presented on their concerns with these proposed new reports. After discussion, there was no consensus reached, but neither was there opposition to creating these two reports. This decision will be presented to the January 29, 2020 TAC meeting.
TAC Action Requested	On 1/29/20, TAC vote to endorse KP6 (with or without the additional two 60-day disclosure reports) for purposes of informing the Board.
TAC Action Summary	On 1/29/20, TAC voted to endorse KP6 (with the additional two 60-day disclosure reports) for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP6 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) As necessary, existing market-facing reports and user interfaces will be removed or modified and new market-facing reports and user interfaces will be created to implement RTC and achieve the key principles developed by the RTCTF.

2) The list of reports and user interfaces contained in the appendix of this document will be used to guide the development of Protocol language for RTC.

APPENDIX: LIST OF REPORTS AND USER INTERFACES

New Reports/Interfaces

2-Day Ancillary Services Reports (RTM)
48-Hour Highest Price AS Offer Selected (RTM)
60-Day DAM Disclosure Reports - AS Offers (Not Associated with a Resource)
60-Day SCED Disclosure Reports - Generation Resource Updates to Offer Curves for AS and potentially Energy Offers if later approved
60-Day SCED Disclosure Reports - Load Resource Updates to Offer Curves for AS and potentially Energy Bids if later approved
7-Day Event Trigger Posting - AS MCPC Greater than 50xFIP (RTM)
Aggregated Ancillary Service Offer Curve (SCED)
AS Obligation and Responsibility (RTM)
Daily RUC Hourly AS Capability
DAM Ancillary Service Demand Curves
Historical RTM Clearing Prices for Capacity
Hourly RUC Hourly AS Capability
RTD Indicative RTC MCPC
RTM Ancillary Service Demand Curves
RUC Ancillary Service Demand Curves
SCED Clearing Prices for Capacity
Website- RTM MCPCs display
Weekly RUC Hourly AS Capability

Deleted Reports/Interfaces

60-Day SASM Disclosure Reports - Gen AS Offer Awards
60-Day SASM Disclosure Reports - Gen AS Offers
60-Day SASM Disclosure Reports - Load AS Offer Awards
60-Day SASM Disclosure Reports - Load AS Offers
Hourly RUC Ancillary Service Demand Curves
IMM Software Real-Time Co-Optimization Input Files
LOLP Distribution by Season and TOD Block
Monthly Summary of Ancillary Service Supply Responsibility Failure
Monthly Summary of Resource AS Supply Insufficiency at 1430
Resource AS Supply Insufficiency at 1430

SASM Aggregated Ancillary Service Offer Curve
SASM MCPC by Ancillary Service Type
Total Ancillary Service Procured in SASM
UI- Get SASM ID List
Weekly RUC Ancillary Service Demand Curves

Changed Reports/Interfaces with Notes on Changes

2-Day DAM and SCED Energy Curves Reports	SCED Energy Offers Report should be posted for each SCED interval
2-Day Real Time Gen and Load Data Reports	HASL columns need to be removed from Gen summary report
48-Hour Highest Price AS Offer Selected (DAM)	Remove SASM from market column population
60-Day Current Operating Plan	COP information will change and report will need to change to contain new information.
60-Day SCED Disclosure Reports - DSR Load data	Update to include SCED interval level data.
60-Day SCED Disclosure Reports - Gen Resource data	Update to include SCED interval level data. HASL column needs to be removed. Include AS Offer information for each interval and update for changes in Resource telemetry
60-Day SCED Disclosure Reports - HDL&LDL manual overrides	Update to include SCED interval level data.
60-Day SCED Disclosure Reports - Load Resource data	Update to include SCED interval level data. HASL column needs to be removed. Include AS Offer information for each interval and update for changes in Resource telemetry
60-Day SCED Disclosure Reports - QSE Self-Arranged AS	Update to include SCED interval level data. Change to self-provision concept
60-Day SCED Disclosure Reports - SMNE Gen Resource (Settlement Metered Net Energy for Generation Resources)	Update to include SCED interval level data.
7-Day Event Trigger Posting - AS MCPC Greater than 50xFIP (DAM)	Remove SASM from market column population
7-Day Event Trigger Posting - LMP Exceeds 50xFIP (RTM)	Updated to include SCED interval level data, for the applicable intervals.
AS Obligation and Responsibility (DAM)	Responsibility will change to simply be DAM award
CLREDP Acceptable Performance Criteria and PRC Variables	Will need to be updated due to AS award changes
Complete Current Operating Plan Data	COP information will change and report will need to change to contain new information.

Controllable Load Resource Base Point Deviation Charge for Over-Consumption Variables	Will need to be updated due to AS award changes
Controllable Load Resource Base Point Deviation Charge for Under-Consumption Variables	Will need to be updated due to AS award changes
ERCOT Fundamentals Training Manual	This references AS awards in DAM being physically binding. More will need to be added about how AS works in RTM.
ERCOT Market Information List	Add new reports. Remove old reports.
ERCOT Summary Dispute Report	New settlement SUB TYPE needs to be added
Historical Real-Time ORDC and Reliability Deployment Price Adders and Reserves	Remove ORDC related data. Keep Reliability Deployment related data.
Historical Real-Time ORDC and Reliability Deployment Prices for 15-minute Settlement Interval	Remove ORDC related data. Keep Reliability Deployment related data.
Market Submission Validation Rules	Update to consider new RTC submission/validation rules
Monthly Generation Resource Energy Deployment Performance Report	Will need to be modified if GREDP metric is modified
Monthly Non-Spin CLR Performance Report	Need to change to reflect on how AS is awarded in RTM
Monthly Non-Spin Generation Performance Report	Need to change to reflect on how AS is awarded in RTM
QSE Ancillary Services Capacity Monitor	Will need to be updated to the concept of AS award vs. responsibility
Real-Time ORDC and Reliability Deployment Price Adders and Reserves by SCED Interval	Remove ORDC related data. Keep Reliability Deployment related data.
Real-Time ORDC and Reliability Deployment Prices for 15-minute Settlement Interval	Remove ORDC related data. Keep Reliability Deployment related data.
Responsive Reserve Performance QSE Summary Report for Non CLRs	Need to change to reflect on how AS is awarded and deployed in RTM
Responsive Reserve Performance Report for Generators and CLRs	Need to change to reflect on how AS is awarded and deployed in RTM
RTD Indicative ORDC and Reliability Deployment Price Adders and Reserves	Remove ORDC related data. Keep Reliability Deployment related data.
RTM Price Corrections	Update to include RTC MCPC
Short-Term System Adequacy Report	Construct likely the same but calculations will likely change as new COP statuses likely added and old COP statuses removed

System-Wide Offer Cap	Update to consider RTC SWCAPs and potentially new SWCAP for DAM
UI- Ancillary Service Obligations Notification	Remove SASM
UI- Ancillary Service Offer Awards	Remove SASM
UI- Ancillary Service Offers	changes to validation interface
UI- Ancillary Service Trades	Adjust to consider RTC trade rules
UI- AwardedAS	Remove SASM
UI- Confirmed and Unconfirmed Ancillary Service Trades	Adjust to consider RTC trade rules
UI- Confirmed Trades	Adjust to consider RTC trade rules
UI- Current Operating Plan (COP) Submissions/Retrievals	COP information will change and report will need to change to contain new information.
UI- Market MCPCs	Remove SASM
UI- Real-Time LMPs for Latest SCED Run Display	Remove ORDC related data
UI- RTD Indicative LMPs by Load Zones or Hubs Display	Remove ORDC related data
UI- Unconfirmed Ancillary Service Trades	Adjust to consider RTC trade rules
UI- Unconfirmed Trades	Adjust to consider RTC trade rules
Website- Capacity Available to SCED	HASL needs to be removed
Website- System Ancillary Service Capacity Monitor	Will need to be updated to the concept of AS award vs. responsibility

Key Principle 7, Performance Monitoring

Executive Summary	This Key Principle identifies changes to performance monitoring that will be necessary to reflect the implementation of Real-Time Co-optimization (RTC).
Principle Description	The purpose of Key Principle 7, Performance Monitoring, is to identify any necessary changes to performance monitoring with the implementation of RTC: 1. Changes to Generation/Controllable Load Resource Energy Deployment Performance (GREDP/CLREDP) formulation. 2. Performance metrics related to a release of a Resource's High Ancillary Service Limit (HASL) through a change in AS Schedule. 3. Removal of the concept of AS Responsibility in Real-Time and associated Settlements.
RTCTF Discussion	On 10/30/19, ERCOT Staff presented language to introduce KP7 subsection (1). On 11/19/19, ERCOT Staff presented language to introduce KP7 subsections (2) and (3). On 12/3/19, RTCTF continued its review of KP7 subsections (2) and (3) and introduced subsection (4). On 12/19/19, RTCTF reached consensus on KP7, and acknowledged that performance monitoring during the transition into RTC will be addressed in a later phase of the project and include the stakeholders.
TAC Action Requested	On 1/29/20, TAC vote to endorse KP7 for purposes of informing the Board.
TAC Action Summary	On 1/29/20, TAC voted to endorse KP7 for purposes of informing the Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP7 as endorsed by TAC.
Board Action Summary	

Proposed Principle Language

1) Generation Resource Energy Deployment Performance (GREDP) and Controllable Load Resource Energy Deployment Performance (CLREDP) calculations will updated to account changes made to deployments instructions from ERCOT. The “ABP” and “ARI” components of the GREDP and CLREDP calculations will be replaced with an Average Set Point (ASP) component, where ASP is equal to the

time-weighted average of the Updated Desired Set Point (UDSP), which is sum of a linearly ramped Base Point (Base Ramp) and Regulation Service instruction that the Resource should have produced during a five-minute clock interval.

2) Currently, ERCOT measures a QSE's total telemetered Ancillary Service (AS) Responsibilities and total AS Responsibilities submitted in Current Operating Plans (COPs) against its total AS Obligation in order to identify any non-compliance with the Qualified Scheduling Entity (QSE) meeting its obligation. With RTC, the concept of an AS Obligation based on Day-Ahead Market (DAM) awards, AS self-arrangement, and AS trades is no longer relevant. As such, related compliance requirements and associated reporting will be removed.

3) With RTC, the updating on AS Schedules following a deployment instruction for the purpose of adjusting High Ancillary Service Limits (HASLs) is no longer relevant. As such, the compliance requirement and associated reporting will be removed.

4) In line with the changes for GREDP and CLREDP, the Aggregate Adjusted Base Point (AABP) calculation used in the Base Point Deviation (BPD) Settlement will replace the sum of the Average Base Point (AVGBP) and the Average Regulation Instruction (AVGREG) with the Average Set Point (ASP) component.

Key Principle 8, RTC Out of Scope and Post-RTC Review Items

Executive Summary	This document captures design concepts that were considered during the development of Real-Time Co-Optimization (RTC) Principles, but deemed to be outside the scope of the initial implementation of RTC. This document will be maintained by ERCOT to record decisions/actions taken by the Public Utility Commission of Texas (PUCT) and/or Technical Advisory Committee (TAC), and included in the final package of RTC Principles that may eventually be presented to TAC and the ERCOT Board.
Board Action Requested	On 2/11/20, ERCOT Board vote to approve KP8.
Board Action Summary	

RTC Out of Scope and Post-RTC Review Items

Concept	**History/Rationale for Deeming Concept Beyond the Scope of RTC**

Day-Ahead Market (DAM) Enhancement to Introduce Willing Buyer, Willing Seller	July 18, 2019, PUCT Open Meeting
	• To avoid disruption to the RTC delivery timeline, Commissioners directed ERCOT and parties to consider DAM enhancements independently of RTC.
	• *See:*
	  ○ July 17, 2019 ERCOT Letter on RTC Timeline: http://interchange.puc.texas.gov/Search/Documents?controlNumber=48540&itemNumber=62
	  ○ July 18, 2010 PUCT Open Meeting: http://www.adminmonitor.com/tx/puct/open_meeting/20190718/ (Item No. 24)

Maintaining Participation Factors for Regulation Deployments (KP1.5)	Alternative concept (re: deployment of Regulation Services) considered with respect to KP 1.5 July 24, 2019, TAC Meeting • TAC voted to not pursue this alternative concept. The vote was unanimous with the exception of one abstention (Independent Power Marketer segment). • *See:*

	○ TAC Meeting materials and meeting minutes: http://www.ercot.com/calendar/2019/7/24/163996-TAC
Price Adjustments for Reg-Up, RRS, ECRS, and Non-Spin (KP 1.2)	ERCOT initially proposed and RTCTF discussed the AS price adjustment in KP 1.2 that "For instances in which the energy price, exclusive of congestion costs, has been reduced to ensure that the final value does not exceed VOLL, the MCPCs for Reg-Up, RRS, ECRS, and Non-Spin will be adjusted by the same $/MWh amount with a floor on the final MCPCs of $0/MWh the highest cleared offer price for that AS from a resource awarded that AS responsibility." RTCTF also discussed the Crescent Power Inc. proposal to remove the AS price adjustment. At the October 9, 2019 RTCTF there was consensus to remove the AS price adjustment from KP 1.2, with some discussion regarding the infrequency of these events based on current market conditions and recognition that this could be revisited in the future if this becomes a pricing issue. At the October 23, 2019 TAC meeting: • TAC was informed that the RTCTF decided not to pursue this proposal. • Austin Energy recommended this proposal be captured in KP 8 with a commitment to reconsider following RTC operational experience to determine whether such pricing adjustments are necessary to ensure resource indifference to providing energy or ancillary services under prevailing market conditions.
Energy Offer Curve updates in Real-Time and Make-Whole Considerations for Resources **Exelon comments (KP1.3) (4)(c) and (4)(d)**	• Energy Offer Curve updates in Real-Time: At the October 30,, 2019 meeting a majority of RTCTF participants were in favor of changing the Energy Offer Curve submission window from being hour-ahead to being allowed in Real-Time between RTC/SCED runs. Since this change would apply to and benefit current energy market, MPs will sponsor an NPRR for consideration and upon approval would trigger an impact analysis for the cost and timing of the necessary changes. This would define the functionality and value of this concept while mitigating delays to RTC program for this scope item. • Make-whole considerations for Resources: The goal for each iteration of designing RTC is to provide the optimal solution to meet system demand and AS; as well as, optimal results for every Resource. Should sub-

	optimal results occur, every effort will be made to find a technical solution. As a last resort, a Make Whole will be considered for costs, including lost opportunity costs when a unit is not fully co-optimized.
AS Substitution **Crescent Power comments (KP1.3)**	Crescent Power proposal at the October 30, 2019 meeting to add AS substitution to KP1.3 which would substitute higher value AS with lower offer for lower value AS in RTC SCED (i.e. Substitute lower offer priced ECRS for Non-Spin; lower offer priced RRS or RUS for ECRS and Non-Spin).