The Reliability and Markets (R&M) Committee is expected to consider R&M Committee Agenda Item 5:

Recommendation regarding Real-Time Market Price Correction – Generic Transmission Constraint (GTC) Calculation Error

at its meeting on April 17, 2023.

The Board of Directors is expected to hear the R&M Committee's recommendation on this matter at the Board meeting on April 18, 2023.

Attached are the Board and Committee materials in relation to these agenda items.

Item 5: Recommendation regarding Real-Time Market Price Correction – Generic Transmission Constraint (GTC) Calculation Error

Kenan Ögelman
Vice President, Commercial Operations

Reliability and Markets Committee Meeting

ERCOT Public
April 17, 2023

# Reliability and Markets Committee Request

Why this is being presented today:

ERCOT staff requests that the Reliability and Markets Committee recommend approval of, and the ERCOT Board of Directors (Board) approve, the proposed correction of Real-Time Market prices for certain Settlement Intervals on Operating Day February 5, 2023 (Board Decision Template Attachments A through F).

Background on the Impacted GTC

- On February 7, 2023, ERCOT discovered an error related to the value of the Valley Export GTC (VALEXP) flow that was being passed to the Real-Time Market (RTM) for Operating Days February 5 and 6, 2023.

- The VALEXP definition (interface constraint) consists of six transmission lines in the region (three 345 kV transmission lines and three 138 kV transmission lines).

- The constraint represents a stability limit for transient voltage instability associated with large power exports out of the Greater Valley area.

- Limits on the amount of power that can flow across this interface constraint are highly dependent on transmission outage conditions with limits for the GTC ranging between 145 and 705 MW.

Real-Time Systems for Managing Congestion

- A typical thermal constraint is non-directional, meaning flow on the transmission element must be managed in either direction.
  - The Transmission Constraint Manager (TCM) sends the absolute value of the flow to the Security-Constrained Economic Dispatch (SCED) engine and the sign of the shift factors are adjusted to account for direction.

- GTCs and the associated phenomenon that result in these transmission limitations are directional in nature.
  - The constraint should only be limiting when the flow is in a specific direction and signs of the shift factors are not adjusted.

- However, TCM was not designed to recognize this distinction in constraint type when providing flow information and was sending the absolute value for GTCs.
  - There has been a dependency on these constraints being deactivated from consideration in SCED before the flow reversed direction.

Station A

Thermal constraint: managed in both directions

GTC: managed in a single direction

Station B
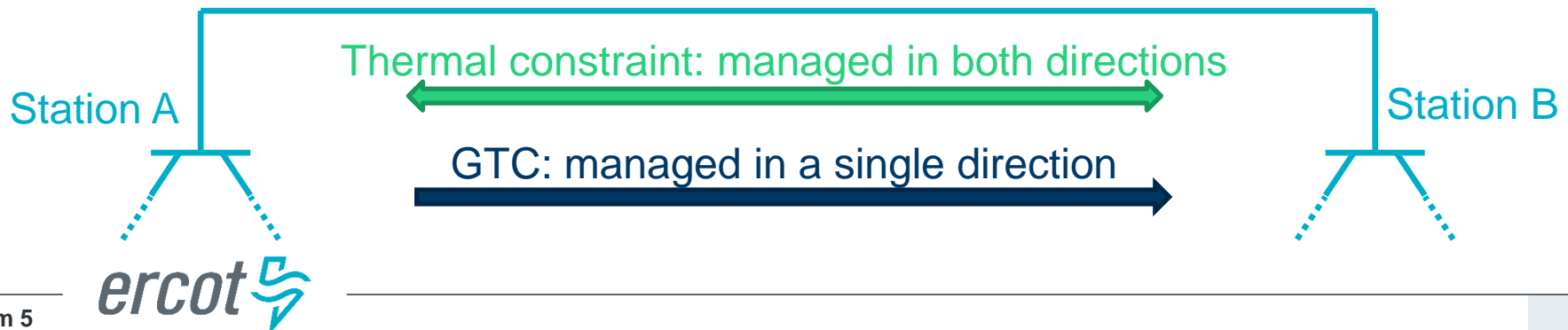
Appearance and Identification of the Error

- On the given Operating Days, there were specific outages that resulted in the limits for the VALEXP GTC being on the lower end of the possible range. This lower limit combined with wind conditions in the region resulted in increased potential for the constraint flow to change directions prior to it being deactivated from consideration in SCED.

- For certain intervals on these days, the misalignment between constraint shift factors and constraint flow for the GTC resulted in incorrect congestion management including incorrect prices in Real-Time.

- This same error had previously resulted in a correction of Real-Time prices for the morning of December 12, 2021. The initial solution of enhanced internal procedures without a software change did not prove sufficient to fully mitigate the issue.
  - The error was associated with existing functionality and was not a result of a recent software change.

- Upon learning of the issue, ERCOT issued an Operations Message on the afternoon of February 7, 2023, noting that there was an investigation of SCED prices underway.

Analysis of Impacts and the Criteria for Board Review

- Upon completion of the investigation, an updated message was provided on the afternoon of February 8, 2023. ERCOT found that both Operating Days met the initial criteria for price correction, according to Protocol Section 6.3(5).

- However, because the initial deadline for February 5, 2023, had passed, further analysis was performed and it was determined that the Settlements impact met the criteria for seeking review by the Board, as specified in Protocol Section 6.3(7)(b).

  - Protocol Section 6.3(7)(b) defines the two possible criteria for seeking Board review as the impact to any single Counter Party RTM Settlement Statement being:

    i. 2% and also greater than $20,000; or

    ii. 20% and also greater than $2,000

Operating Day	Counter-Parties meeting criteria in Protocol Section 6.3(7)(b)(i)	Counter-Parties meeting criteria in Protocol Section 6.3(7)(b)(ii)
02/05/2023	2	3

Communication of Board Review and Software Corrections

- ERCOT issued Market Notice M-A022123-01 on February 21, 2023, notifying Market Participants that ERCOT would seek correction of Real-Time prices for February 5, 2023, in accordance with Protocol Section 6.3(7)(a).

- A fix was implemented on March 2, 2023, that allows TCM to pass a negative flow to SCED for GTCs, ensuring that the flow is managed in the correct direction and that shift factors and flow information for the constraint are in alignment for the SCED engine.
  - The flow for all thermal constraints are still passed as an absolute value.

Estimated Settlement Impacts

Operating Day	Increase in Statement Charges Due to ERCOT	
2/5/2023	$83,356	2.1%

A positive value in this table represents an increase in statement charge amount due to ERCOT.

The percent amount is the absolute value of the percent of impact to the previously settled net amount due to/from ERCOT.

Operating Day	Absolute Value Impact to Counter-Parties		
	Maximum Amount	**Maximum Percentage for Criteria (i)***	**Maximum Percentage for Criteria (ii)****
2/5/2023	$60,156	16.5%	33.1%

* The maximum of percentage change to any single Counter party with impact more than $20,000.

** The maximum of percentage change to any single Counter party with impact more than $2,000.

Date: April 11, 2023
To: Board of Directors
From: Bob Flexon, Reliability and Markets (R&M) Committee Chair
Subject: Real-Time Market Price Correction – Generic Transmission Constraint
               (GTC) Calculation Error

Issue for the ERCOT Board of Directors

ERCOT Board of Directors Meeting Date: April 18, 2023
Item No.: 10.2

Issue:
Pursuant to paragraph (7) of Protocol Section 6.3, Adjustment Period and Real-Time Operations Timeline, whether the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) should approve price corrections for Real-Time Locational Marginal Prices (RTLMPs), Real-Time Settlement Point Prices (RTSPPs), Real-Time Price for Energy Metered for Resources (RTRMPRs), and Real-Time Price for Energy Metered for Settlement Only Generators (RTESOGPRs) for certain Settlement Intervals on Operating Day (OD) February 5, 2023, that were affected by a software calculation error for the flow on the Valley Export (VALEXP) GTC.

Background/History:
ERCOT staff has identified the need to correct prices in the Real-Time Market (RTM) for certain Settlement Intervals on OD February 5, 2023. The impacted prices include:

- RTLMPs;
- RTSPPs;
- RTRMPRs; and
- RTESOGPRs

The ERCOT Protocols require ERCOT to correct prices when invalid prices are identified in an otherwise valid market solution. If ERCOT determines that prices are erroneous, ERCOT must correct the prices before they are final. Prices are final at 1600 on the second Business Day following the OD. However, if ERCOT determines that prices are erroneous and need correction after they are final, then ERCOT shall seek Board review of such prices provided that, within 30 days of the OD, ERCOT notifies Market Participants of the need for correction and that ERCOT intends to seek Board approval of the correction.

The Board may review and change prices if the impact of the price correction is determined to be significant, as defined in the Protocols, and the Board finds that such prices should be corrected for an OD. The Board may rely on the following reasons to find that prices should be corrected:

- <u>Data Input Error</u>: Missing, incomplete, stale, or incorrect versions of one or more data elements input to the market applications may result in an invalid market solution and/or prices.

- <u>Data Output Error</u>: These include: (i) incorrect or incomplete data transfer, (ii) price recalculation error in post-processing, and (iii) Base Points inconsistent with prices due to the Emergency Base Point flag remaining activated even when the Security-Constrained Economic Dispatch (SCED) solution is valid.

- <u>Hardware/Software Error</u>: These include unpredicted hardware or software failures, planned market system or database outages, planned application or database upgrades, software implementation errors, and failure of the market run to complete.

- <u>Inconsistency with the Protocols or Public Utility Commission of Texas (PUCT) Substantive Rules</u>: Pricing errors may occur when specific circumstances result in prices that are in conflict with such Protocol language or the PUCT Substantive Rules.

See ERCOT Protocol Sections 6.3(4) – (7).

At 21:20 on February 5, 2023, the VALEXP GTC began binding on a flow opposite the direction defined by the VALEXP GTC methodology, resulting in incorrect congestion management including incorrect prices in Real-Time.

The Transmission Constraint Manager (TCM) was passing the absolute value of the flow on the GTC to the SCED engine. This software behavior is specifically designed for thermal constraints due to the flow on thermal constraints needing to be managed in both directions. This bidirectional constraint management works by taking the absolute value of the flow and then adjusting the sign of the shift factors for all the Resources being dispatched by SCED to account for the direction.

GTCs are distinct from thermal constraints and directional in nature, meaning that they should only be managed and bind in the direction for which they are defined. Historically, there has been a dependency on GTCs being deactivated from consideration in SCED before the flow reverses direction to avoid this error in congestion management and prices.

On the impacted OD, there were specific outages that resulted in the limit for the VALEXP GTC being on the lower end of its possible range. This lower limit combined with wind conditions in the region resulted in increased potential for the constraint flow to change directions prior to it being deactivated from consideration in SCED. This in turn led to the erroneous congestion management and prices for February 5, 2023.

This same error in functionality had previously resulted in a correction of Real-Time prices for the morning of December 12, 2021. At that time, the measures put in place

to mitigate the issue were enhancements to procedures to ensure that GTCs would be deactivated from consideration in SCED prior to the flow changing direction. Given the circumstances of grid conditions on the impacted OD, those measures did not prove to be sufficient.

A change to the software was implemented on March 2, 2023, that allows TCM to pass a negative flow to SCED for GTCs, ensuring that the flow is managed in the correct direction and that Resource shift factors and flow information for all constraints are in alignment for the SCED engine.

On February 7, 2023, ERCOT notified Market Participants of the data error that impacted RTM prices on OD February 5, 2023, and its intent to seek Board review of RTM prices for February 5, 2023. *See* Market Notice M-A022123-01.

Accordingly, ERCOT staff requests that the Board:

(a) Review RTLMPs, RTSPPs, RTRMPRs, and RTESOGPRs for OD February 5, 2023;

(b) Make a determination as to whether such prices should be corrected; and

(c) Direct/authorize ERCOT to correct the impacted RTLMPs, RTSPPs, RTRMPRs, and RTESOGPRs for OD February 5, 2023.

Attached hereto are document containing corrected RTLMPs, RTSPPs, RTRMPRs, and RTESOGPRs for OD February 5, 2023, as follows:

- ***Attachment A*** - Corrected Electrical Bus Locational Marginal Prices (EBLMPs)
- ***Attachment B*** - Corrected Settlement Point Locational Marginal Prices (LMPs)
- ***Attachment C*** - Corrected RTSPPs
- ***Attachment D*** - Corrected RTRMPRs
- ***Attachment E*** - Corrected Settlement Only Generator LMPs
- ***Attachment F*** - Corrected RTESOGPRs

Relevant Protocol Sections:

6.3 Adjustment Period and Real-Time Operations Timeline

(4) ERCOT shall correct prices for an Operating Day when accurate prices can be determined, the impact of the price correction is determined to be significant, and one of the following conditions has been met: a market solution is determined to be invalid, invalid prices are identified in an otherwise valid market solution, the Base Points received by Market Participants are inconsistent with the Base Points of a valid market solution, or the Security-Constrained Economic Dispatch (SCED) process experiences a failure as described in Section 6.5.9.2,

Failure of the SCED Process. The following are some reasons that may cause these conditions:

(a)   Data Input error: Missing, incomplete, stale, or incorrect versions of one or more data elements input to the market applications may result in an invalid market solution and/or prices.

(b)   Data Output error: These include: incorrect or incomplete data transfer, price recalculation error in post-processing, and Base Points inconsistent with prices due to the Emergency Base Point flag remaining activated even when the SCED solution is valid.

(c)   Hardware/Software error: These include unpredicted hardware or software failures, planned market system or database outages, planned application or database upgrades, software implementation errors, and failure of the market run to complete.

(d)   Inconsistency with the Protocols or Public Utility Commission of Texas (PUCT) Substantive Rules: Pricing errors may occur when specific circumstances result in prices that are in conflict with such Protocol language or the PUCT Substantive Rules.

(7)   All Real-Time LMPs, Real-Time Settlement Point Prices, Real-Time prices for energy metered, Real-Time On-Line Reliability Deployment Price Adders, Real-Time On-Line Reliability Deployment Prices, Real-Time Reserve Prices for On-Line Reserves, Real-Time Reserve Prices for Off-Line Reserves, Real-Time On-Line Reserve Price Adders, Real-Time Off-Line Reserve Price Adders and SASM MCPCs are final at 1600 of the second Business Day after the Operating Day.

(a)   However, after Real-Time LMPs, Real Time Settlement Point Prices, Real-Time prices for energy metered, Real-Time On-Line Reliability Deployment Price Adders, Real-Time On-Line Reliability Deployment Prices, Real-Time Reserve Prices for On-Line Reserves, Real-Time Reserve Prices for Off-Line Reserves, Real-Time On-Line Reserve Price Adders, Real-Time Off-Line Reserve Price Adders and SASM MCPCs are final, if ERCOT determines that prices qualify for a price correction pursuant to paragraph (4) above and that ERCOT will seek ERCOT Board review of such prices, it shall notify Market Participants and describe the need for such correction as soon as practicable but no later than 30 days after the Operating Day. Failure to notify Market Participants within this timeline precludes the ERCOT Board from reviewing such prices.

However, nothing in this section shall be understood to limit or otherwise inhibit any of the following:

(i) ERCOT's duty to inform the PUCT of potential or actual violations of the ERCOT Protocols or PUCT Rules and its right to request that the PUCT authorize correction of any prices that may have been affected by such potential or actual violations;

(ii) The PUCT's authority to order price corrections when permitted to do so under other law; or

(iii) ERCOT's authority to grant relief to a Market Participant pursuant to the timelines specified in Section 20, Alternative Dispute Resolution Procedure.

(b) Before seeking ERCOT Board review of prices, ERCOT will determine if the impact of the price correction is significant, as that term is used in paragraph (4) above, by calculating the potential changes to the Real-Time Market (RTM) Settlement Statement(s) of any Counter-Party on a given Operating Day. ERCOT shall seek ERCOT Board review of prices if the change in RTM Settlement Statement(s) would result in the absolute value impact to any single Counter-Party, based on the sum of all original RTM Settlement Statement amounts of Market Participants assigned to the Counter-Party, to be greater than:

(i) 2% and also greater than $20,000; or

(ii) 20% and also greater than $2,000.

(c) The ERCOT Board may review and change Real-Time LMPs, Real-Time Settlement Point Prices, Real-Time prices for energy metered, Real-Time On-Line Reliability Deployment Price Adders, Real-Time On-Line Reliability Deployment Prices, Real-Time Reserve Prices for On-Line Reserves, Real-Time Reserve Prices for Off-Line Reserves, Real-Time On-Line Reserve Price Adders, Real-Time Off-Line Reserve Price Adders and SASM MCPCs if ERCOT gave timely notice to Market Participants and the ERCOT Board finds that such prices should be corrected for an Operating Day.

(d) In review of Real-Time LMPs, Real Time Settlement Point Prices, Real-Time prices for energy metered, Real-Time On-Line Reliability Deployment Price Adders, Real-Time On-Line Reliability Deployment Prices, Real-Time Reserve Prices for On-Line Reserves, Real-Time Reserve Prices for Off-Line Reserves, Real-Time On-Line Reserve Price Adders, Real-Time Off-Line Reserve Price Adders and SASM MCPCs,

the ERCOT Board may rely on the same reasons identified in paragraph (4) above to find that the prices should be corrected for an Operating Day.

Key Factors Influencing Issue:
- Due to incorrect flow data on the VALEXP GTC, RTORDPAs, RTRDPs, RTSPPs, and RTRMPRs on OD February 5, 2023, were incorrect and cannot be corrected by ERCOT without authorization from the Board.
- Analysis of the potential price correction impact for the RTM for February 5, 2023, show that this OD meets the criteria for "significance" set forth in Protocol Section 6.3(7)(b). The analysis indicates that the largest dollar impact to a Counter-Party is approximately $60K, and the largest percentage impact to a Counter-Party is approximately 33%.

Conclusion/Recommendation:
ERCOT staff recommends, and the R&M Committee is expected to recommend, that the Board find that RTLMPs, RTSPPs, RTESOGPRs, and RTRMPRs for certain Settlement Intervals on OD February 5, 2023, should be corrected, and direct ERCOT to correct impacted RTM prices for OD at issue.

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

WHEREAS, paragraph (7) of Protocol Section 6.3, Adjustment Period and Real-Time Operations Timeline, authorizes the Board of Directors (Board) of Electric Reliability Council of Texas, Inc. (ERCOT) to approve a price correction for certain prices if ERCOT has determined that such prices have been significantly affected by an error;

WHEREAS, pursuant to paragraph (7) of Protocol Section 6.3, ERCOT staff gave timely notice to Market Participants that Real-Time Locational Marginal Prices (RTLMPs), Real-Time Settlement Point Prices (RTSPPs), Real-Time Prices for Energy Metered for Resources (RTRMPRs), and Real-Time Prices for Energy Metered for Settlement Only Generators (RTESOGPRs) for certain Settlement Intervals on Operating Day (OD) February 5, 2023 were incorrect; that a price correction for each of those Settlement Intervals met the criteria for "significance" in Protocol Section 6.3(7)(b); and ERCOT staff would be seeking Board review of such prices; and

WHEREAS, after due consideration of the alternatives, the Board deems it desirable and in the best interest of ERCOT to correct RTLMPs, RTSPPs, RTRMPRs, and RTESOGPRs for certain Settlement Intervals on OD February 5, 2021, that were affected by a software calculation error;

THEREFORE, BE IT RESOLVED, that the Board hereby (1) determines that RTLMPs, RTSPPs, RTRMPRs, and RTESOGPRs for certain Settlement Intervals on OD February 5, 2021, were affected by a software calculation error, and (2) directs ERCOT staff to implement the appropriate price corrections pursuant to Protocol Section 6.3.

CORPORATE SECRETARY'S CERTIFICATE

I, Jonathan M. Levine, Assistant Corporate Secretary of ERCOT, do hereby certify that, at its April 18, 2023 meeting, the Board passed a motion approving the above Resolution by _____.

IN WITNESS WHEREOF, I have hereunto set my hand this ___ day of April, 2023.

_____
Jonathan M. Levine
Assistant Corporate Secretary