CME Group

SOFR PA & Discounting Transition for Cleared Swaps

Methodologies for Transition

AUGUST 2020

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CME Group

Contents

1. Overview

CME Group has worked with market participants and industry groups to develop a plan for transitioning the discounting and Price Alignment (PA) for cleared USD interest rate swaps (IRS) products from daily Effective Federal Funds Rate (EFFR) to Secured Overnight Financing Rate (SOFR). This transition will occur at close of business (COB) on October 16, 2020 (the Transition Date), pending regulatory approval.

This document summarizes certain of the processes and methodologies relating to the transition process and is provided for informational purposes only and shall not be binding on CME or any person. Details of the applicable binding rules and legal documentation relating to the transition process are summarized in this document. Firms wishing to participate in the transition in any capacity should review the applicable CME Rulebook provisions and relevant rules and legal documentation in addition to this document.

1.1. Scope

Table: Product Scope

Curreny	*CME Cleared Instrument Types*	*Index*	*Current Discounting and PAA*	*New Discounting and PAA*	*Transition Date*
USD	All Cleared OTC products: Fixed/Float Swaps, OIS Swaps, FRAs, Basis Swaps, Zero-coupon swaps, Swaptions	USD-LIBOR-BBA 1M,3M, 6M,..., USD-Federal Funds	*EFFR*	*SOFR*	**October 16, 2020**
USD	OIS Swaps, Basis Swaps	Any Swap referencing USD-SOFR-OIS-COMPOUND	*SOFR*	*SOFR*	**No Impact**
MXN	Fixed/Float Swaps	MXN-TIIE-Banxico-28D	EFFR	SOFR	TBD
BRL	Zero Coupon Swaps	BRL-CDI-1D	EFFR		
KRW	Fixed/Float Swaps	KRW-CD-KSDA-Bloomberg-3M	EFFR		
INR	OIS Swaps	INR-FBIL-MIBOR-OIS-COMPOUND-1D	EFFR		
CLP	Fixed/Float Swaps	CLP-TNA-1D	EFFR		
COP	OIS Swaps	COP-IBR-OIS-COMPOUND-1D	EFFR		
CNY	Fixed/Float Swaps	CNY-CNREPOFIX=CFXS-Reuters-1W	EFFR		

The table above summarizes the product scope for the transition. Please also note that:

- *Cleared USD IRS products*: USD IRS, OIS, FRAs, Basis, ZCS and Swaptions[1] are in scope for the transition. Note that swaps referencing SOFR index are excluded from the transition as these swaps are already utilizing the SOFR rate for discounting and price alignment (PA) computations.
- *MXN Swaps and Non-deliverable IRS (NDIRS)*: Cleared MXN and NDIRS swaps denominated in BRL, KRW, INR, CLP, COP and CNY will continue to use EFFR rate for discounting and PA computations. CME will continue to work with market practitioners to evaluate a future date for transitioning these swaps that contain a USD funding component, taking into consideration potential impacts on adjacent FX forward and cross-currency swap markets. Fees for NDIRS swaps, which are always denoted in USD, will continue to be discounted using EFFR rate post October 19, 2020.
- *Cleared Swaptions*: Swaptions volatility surface settlement will utilize SOFR rate for discounting beginning October 19, 2020.

1.2. Transition Process

Changing the discounting and PA computations impacts the Mark-to-Market (MTM) of swaps products as well as the discounting risk profile. CME will run additional processes that will help reduce the transition impacts on market participants that includes:

Cash Adjustment: Changing discounting curve impacts the net present value (NPV) of cleared swaps products. To neutralize the value transfer from the change to SOFR discounting, CME will process a **mandatory** cash adjustment that is equal and opposite to the NPV change on each trade in all accounts.

Re-Hedging Process With the change in discounting curve, the discounting risk will be transferred from EFFR curve to SOFR curve.

To mitigate both the potential re-hedging costs and to reduce the valuation sensitivity to the closing curve marks on the Transition Date, CME will book a series of **mandatory** EFFR/SOFR basis swaps at the position account level (Basis Swaps). Such Basis Swaps will (approximately) restore participants' positions to their original discounting risk profiles and will be booked at closing curve levels ($0 NPV) as of the Transition Date (the Re-hedging Process).

CME will allow participants to choose the mandatory Basis Swaps as either float vs float SOFR/EFFR basis swaps or pairs of fixed-float OIS referencing EFFR and SOFR respectively with the fixed rates set at par replicating the basis exposure.

SOFR Basis Swap Auction: Certain market participants have indicated their preference to unwind the re-hedging Basis Swap trades arising from the Re-hedging Process. CME will

[1] Uncleared swaptions contracts that exercise into CME cleared swaps subject to the discounting transition prior to the Transition Date will be subject to the transition. CME recognizes that the Transition may create ambiguities with respect to the exercise of legacy uncleared swaption contracts that expire after the date of the Transition and which anticipate EFFR PA/discounting for the resulting cleared interest rate swap on exercise. While this remains an issue for market participants and cannot be resolved directly by central counterparties, which are not counterparties to the uncleared swaptions, we encourage the industry to resolve these ambiguities by agreeing to a set of industry protocols and practices to address the issue, in line with the recommendations of the ARRC published in May 2020. See ARRC Recommendations for Swaptions Impacted by the CCP Discounting Transition to SOFR, available at https://www.newyorkfed.org/medialibrary/Microsites/arrc/files/2020/ARRC-swaptions-recommendations.pdf

facilitate a **voluntary** auction to help market participants liquidate these mandatory re-hedging Basis Swaps on Monday October 19, 2020 following the transition (the SOFR Basis Swap Auction).

1.3. Transition Timeline

June 29, 2020

CME distributed the "CME SOFR Discounting Transition Election File" to IRS Clearing Members pre-populated with CUST position accounts (the Client Election File):

- The Client Election File contained all active IRS client clearing accounts for clearing member firms, with an indication of accounts that contain USD exposure
- The elections are independent of one another. If no action is taken, the default elections will apply, i.e. the account will receive float vs float SOFR/EFFR basis swaps and will not participate in the CME SOFR Basis Swap Auction
- Clearing Members are responsible for facilitating client elections for choice of re-hedging Basis Swaps to be booked and participation in CME SOFR Basis Swap Auction, leveraging this file, and returning the updated Client Election File to CME Client Services (Onboarding_Clearing@cmegroup.com)
- Members may choose to send the client elections to CME as they are received or return the Client Election File only after all clients have provided their elections (**preferred process**).

The consolidated election file, across all IRS accounts, will be referenced during the re-hedging process and when determining the net auction exposure.

August 3, 2020

CME distributed the final "CME SOFR Basis Swap Auction Participation Agreement" to IRS Clearing Members: This is a legal agreement between CME and the underlying client (account holder / controller) that is required for participation in the SOFR Basis Swap Auction (Auction Participation Agreement). The Auction Participation Agreement provides that:

- Contracts that result from the auction are binding;
- All re-hedging Basis Swaps received for the participant's position account will be submitted to the auction (i.e. no partials); and
- a "Maximum Loss Limit" that each client could incur as a result of the auction will be applied

Clearing Members are responsible for distributing the Auction Participation Agreement to all customers that receive the "CME SOFR Discounting Transition Election File." Clearing Members will not be required to sign the Auction Participation Agreement but must ensure that participating clients comply with any requirements issued by CME. If a client would like to participate in the SOFR Basis Swap Auction, CME must receive a signed Auction Participation Agreement ***and*** corresponding Client Election File in respect of that client.

October 2, 2020 (Client Election Deadline) **IRS Clearing Members (or Clients) provide the completed Client Election File and signed Auction Participation Agreement to CME Client Services at** *Onboarding_Clearing@cmegroup.com*

- CME will begin consolidating the client elections and reconcile auction elections vs. a signed Auction Participation Agreement in each case
- CME will reach out to clearing members and clients directly if breaks are found

October 9, 2020 (CME/Clearing Member Review Period) **Clearing Members (or Clients) provide the consolidated Client Election File to CME Client Services at** *Onboarding_Clearing@cmegroup.com*

- CME will finalize the consolidated list of client elections to use as an input to the 'Re-hedging Process' on Transition Date and the CME SOFR Basis Swap Auction on October 19, 2020

October 16, 2020 **Standard end-of-day valuation cycle:** CME will conduct an end-of-day standard valuation cycle using EFFR discounting. Upon completion of this initial cycle, CME will then compute the NPV of the positions under SOFR discounting.

Cash Adjustment: CME will provide a report showing the cash adjustment at the trade level for each position account to neutralize the value transfer from the change to SOFR discounting (equal and opposite to the NPV change on each trade in all accounts).

Re-Hedging Process: CME will book a series of mandatory EFFR/SOFR basis swaps (Basis Swaps) at pre-defined anchor points for each position account.

October 19, 2020 **Discounting Convention:** Market begins to quote swaps based on SOFR discounting.

SOFR Basis Swap Auction: CME will facilitate an auction for participants looking to unwind the assigned re-hedging Basis Swaps.

Variation Cycle: CME will run a standard valuation cycle under SOFR discounting. Settlement variation will be computed using top-day valuation under SOFR discounting and the previous day's SOFR discounted NPV computed on Friday, October 16, 2020.

2. Cash Adjustment Methodology

Changing the discounting and PA computations impacts the MTM of all in-scope swap products. The valuation change driven by the change of discounting from EFFR to SOFR can be derived as:

$$Valuation\ Change = Adjusted\ NPV_{SOFR\ discounting} - Adjusted\ NPV_{EFFR\ discounting}$$

Cash adjustmentwill neutralize the changes in MTM driven by the change of the discounting curve (the Cash Adjustment). The cash adjustment amount will be computed as

$$Cash\ Offset = -Valuation\ Change = Adjusted\ NPV_{EFFR\ discounting} - Adjusted\ NPV_{SOFR\ discounting}$$

2.1. Cash Adjustment for Cleared Swaps

Current Curve Generation Process: CME currently generates USD curves based on the break-even rates / prices / break-even spreads for the below instruments:

- **LIBOR 3M Index:** Eurodollar Futures (with convexity adjustments) at the short-end followed by LIBOR fixed-float swaps;
- **LIBOR 1M Index:** LIBOR 1M – 3M Basis Swaps;
- **LIBOR 6M Index:** LIBOR 3M – 6M Basis Swaps;
- **EFFR Index:** OIS swaps at the short-end followed by EFFR – LIBOR basis swaps; and
- **SOFR Index:** SR3/SR1 Futures (with convexity adjustments) at the short-end followed by SOFR – EFFR basis swaps.

Curves are currently bootstrapped using Log cubic spline interpolation.

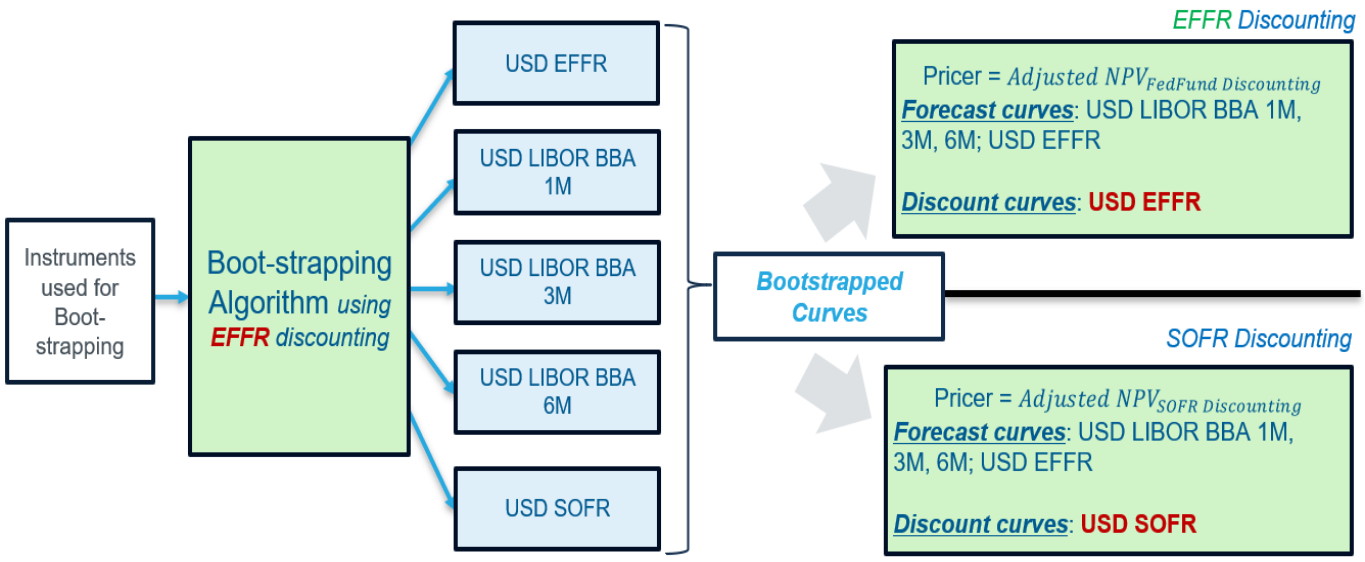
On October 16, 2020, market participants will quote break-even rates / prices / break-even spreads for USD swaps assuming EFFR discounting. For cash adjustment calculations, NPV under SOFR discounting will be computed by holding the undiscounted value of the future cashflows unchanged (i.e. the projected forward cash flows for each curve remain unchanged).

As shown in the formula and graph below, the cash adjustment amount will be entirely attributed to the difference in the discounting rates between the two curves (i.e. EFFR and SOFR).

$$Cash\ Adjustment = \sum_i Undiscounted\ NetCashflow_i\ * (DF_i^{EFFR} - DF_i^{SOFR})$$

where DF_i^{EFFR} and DF_i^{SOFR} are discount factors between October 16, 2020 and the future cash flow payment date i based on EFFR curve and SOFR curve respectively.

Figure: Illustration of curve generation for cash adjustment calculations



2.2. Cash Adjustment Methodology for Cleared Swaptions

CME will also provide cash adjustment for any cleared Swaptions as of COB October 16, 2020.

Current Process: CME currently follows the below process to derive prices for cleared swaption trades:

(i) For each pre-defined expiry/tenor point and moneyness[2]:

a. Sources prices and implied normal volatilities for OTM Swaptions from Clearing Members on a daily basis; Data is collected for pre-defined moneyness points defined in absolute measure i.e. $ATM\ forward - Strike$;

b. Blends the implied normal volatilities across different Clearing Members: $\sigma(t, T, ATMF, M)$ is the blended implied normal volatility for expiry t, underlying tenor T, ATM forward $ATMF$, and moneyness M; and

c. CME blended Swaption price is then derived using the blended normal volatility and ATM forwards obtained from CME end-of-day USD curves under EFFR discounting.

(ii) CME Modified SABR (MSABR) parameters are calibrated to these blended prices to construct the whole volatility surface across all expiry/tenor points and all moneyness.

(iii) The above volatility MSABR parameters and interest rate curve with EFFR as discounting curve are then used for pricing the cleared Swaption trades.

[2] Length of time between valuation date and expiry of a swaption is the time to expiry; tenor of a swaption is the length of the underlying Swap; and moneyness of a swaption is the difference between the strike and the at-the-money forward rate.

On October 16, 2020, CME will derive the Swaptions prices under SOFR discounting as follows:

(i) For each pre-defined expiry / tenor point and moneyness:
   a. Compute the ATM forwards ($ATMF_{SOFR}$ and $ATMF_{EFFR}$) for the standard Swaption under SOFR and EFFR discounting, respectively, utilizing the curves as mentioned in the previous section;
   b. Define the new blended normal volatility using the original blended normal volatility from step (i)b of the current process described in previous sub-section and by leveraging sticky moneyness terms:

$$\sigma_{new}(t, T, ATMF_{SOFR}, M) = \sigma(t, T, ATMF_{EFFR}, M)$$

   c. CME blended Swaption price is then derived based on the new normal volatility from above and ATM forward from CME curves under SOFR discounting.

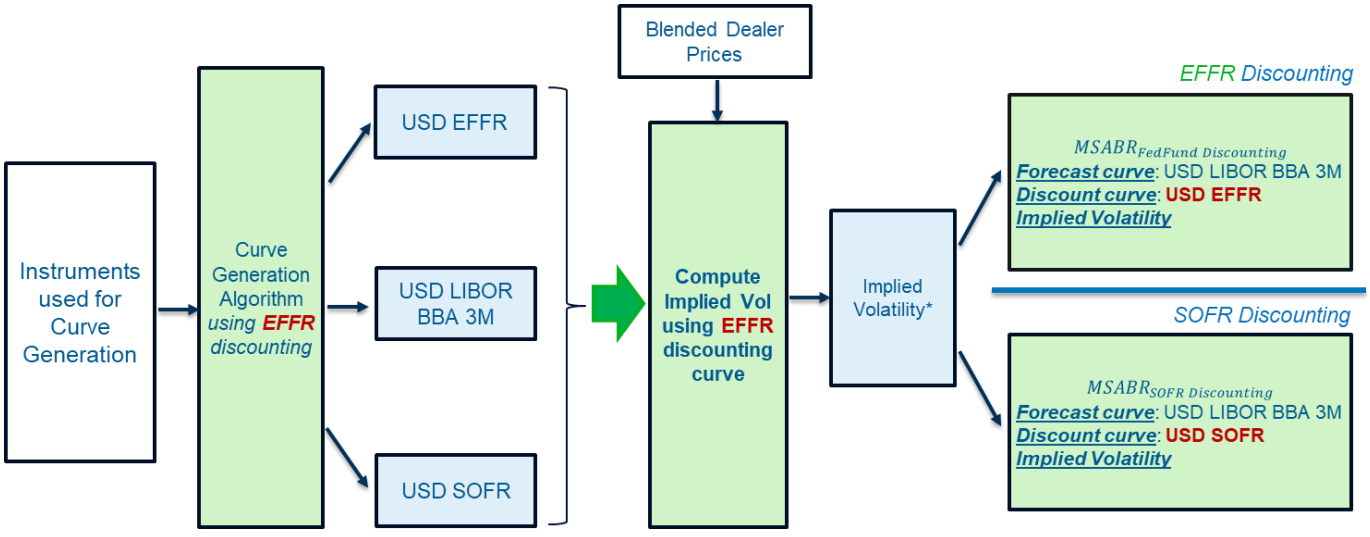
(ii) CME MSABR parameters are calibrated to these blended prices to construct the whole volatility surface across all expiry / tenor points and all moneyness.

(iii) The above volatility MSABR parameters and interest rate curve with SOFR as discounting curve are then used for pricing the cleared Swaption trades.

Like the cash adjustment for swaps, the cash adjustment for Swaptions will be computed as:

$$Adjusted\ NPV\ (MSABR_{EFFR\ Discounting}) - Adjusted\ NPV\ (MSABR_{SOFR\ Discounting})$$

Figure: Illustration of cash adjustment calculations for cleared Swaptions trade



*assuming sticky moneyness

2.3. Price Alignment Transition

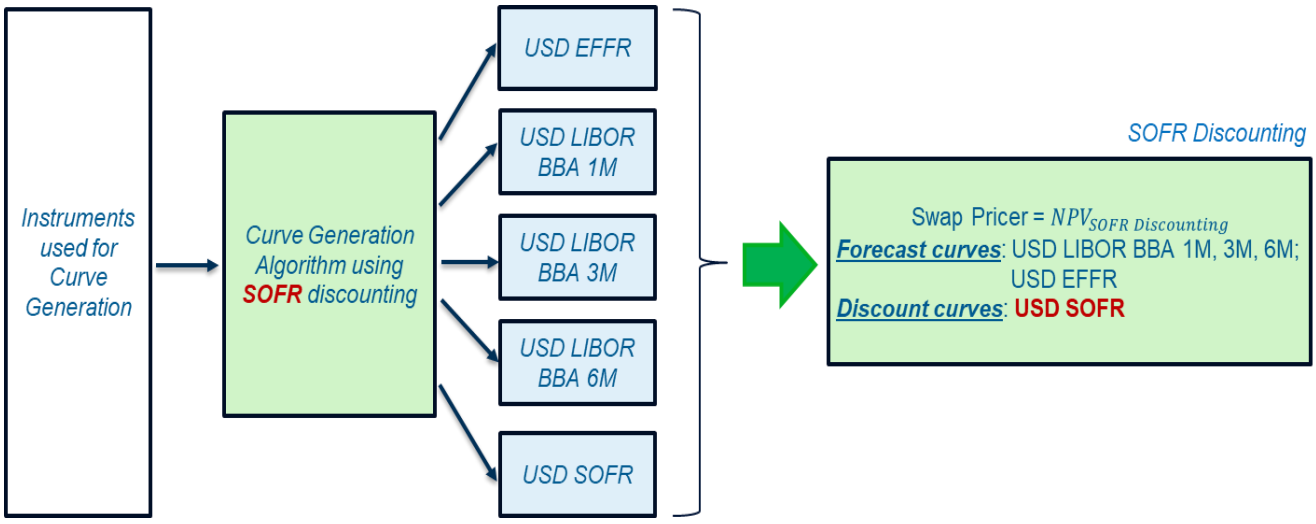
Consistent with the discounting transition, the overnight rate used for calculating the PA amount will also be updated as highlighted below:

- **October 15, 2020** — **PA Rate:** EFFR — **PA Amount:** *-Adj EFFR* $NPV_{(previous\ Bus.\ day)}$ *x EFFR x (Days / 360)*
- **October 16, 2020** — **PA Rate:** EFFR — **PA Amount:** *-Adj EFFR* $NPV_{(previous\ Bus.\ day)}$ *x EFFR x (Days / 360)*
- **October 19, 2020** — **PA Rate:** SOFR — **PA Amount:** *-Adj SOFR* $NPV_{(previous\ Bus.\ day)}$ *x SOFR x (Days / 360)*
- **Going Forward** — **PA Rate:** SOFR — **PA Amount:** *-Adj SOFR* $NPV_{(previous\ Bus.\ day)}$ *x SOFR x (Days / 360)*

2.4. Curve Construction Post Transition

From October 19, 2020 onwards, market participants will be quoting break-even rates / NPV for USD swaps assuming SOFR discounting. CME will use the same instruments listed above to construct the end-of-day USD curves.

Figure: Illustration of curve generation after transition



For cleared Swaptions, CME will follow the same blending process as highlighted under Current Process in section 2.2. Note that the CME forward rates used for blending will be implied from the curves as illustrated here based on SOFR discounting.

2.5. Settlement Variation & Cash Adjustment Processing

As noted above, when switching the discounting curve used for USD swaps, there will be a resultant gain or loss for each cleared swap. The purpose of the cash adjustment is to neutralize this value transfer through processing an amount that is equal and opposite to the NPV change on each trade across all accounts. The example below illustrates how CME will effect the transition through settlement variation and cash adjustment where "T" represents the Transition Date (October 16th).

Example: Discounting Transition Cash Flows

	Date	Current NPV	Prior NPV	VM	Adjustment	Total Cash
1	T – 1 *(Thursday)*	$100 (EFFR)				
2	T *(Friday)*	$125 (EFFR)	$100 (EFFR)	$25		$25
Processing Approach:						
	T + 1 *(Monday)*	$140 (SOFR)	$125 (EFFR Friday)	$15	-$1	$14

- As shown in **Row 2**, on the Transition Date, CME will run a standard end-of-day cycle valuing all USD swaps under EFFR discounting. The current Adj NPV of this trade is $125. To calculate the settlement variation that will be banked Monday morning, subtract the prior day's Adj NPV of $100 from $125, resulting in a movement of $25.
- On the Monday following the transition, CME will begin valuing all USD swaps under SOFR discounting.
    - Clients can reconcile settlement variation calculations as Adj NPV-SOFR (Monday) minus Adj NPV-Fed Funds (Friday) plus the cash adjustment of -$1, resulting in a cash movement of $14 to be banked on Tuesday morning **shown above.**
    - CME will process settlement variation as Adj NPV-SOFR (Monday) minus Adj NPV-SOFR (Friday) resulting in a cash movement of $14.

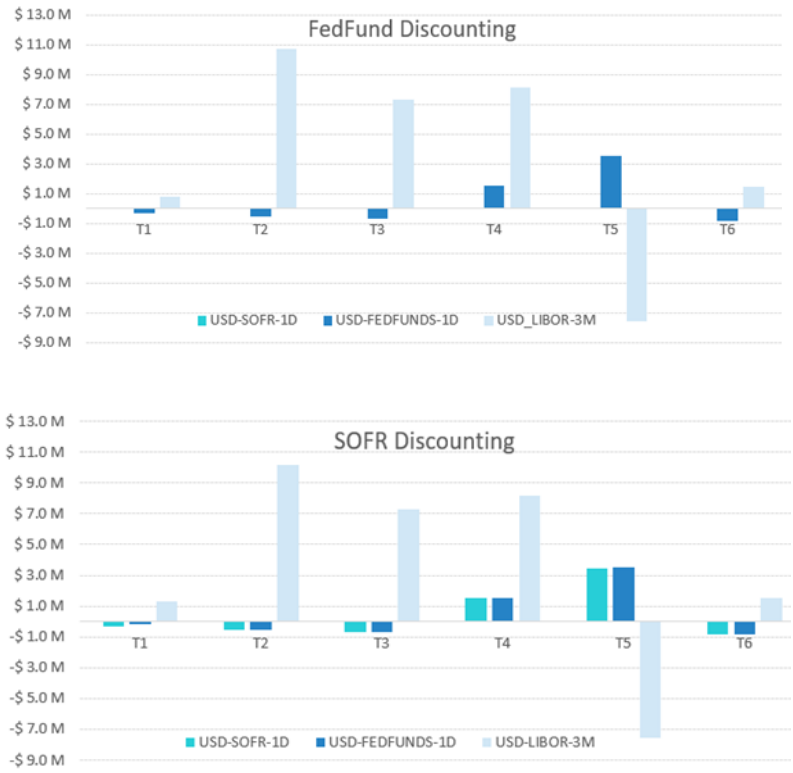
Please note that CME will produce a new **"IRS Discounting Transition Report"** on the Transition Date showing the revised NPVs under the new discounting methodology as well as the cash adjustment at the trade level for each position account. The purpose of this report is to:

(i) Isolate the impacts of the discounting transition for each USD IRS trade cleared at CME; and
(ii) Provide participants ability to reconcile settlement variation on Monday by referencing the cash adjustment amount and prior-day EFFR NPV

3. Re-Hedging Process Methodology

Transitioning to SOFR discounting will effectively move the discounting risk of all CME cleared portfolios from EFFR curve to SOFR curve at closing curve levels on October 16, 2020. The below chart shows the risk differences of a sample portfolio between EFFR discounting and SOFR discounting:

Figure: Delta Ladders represented in par space



Note that changing the discounting curve adds discounting exposure on the SOFR curve. The process of adding the mandatory EFFR-SOFR Basis Swap packages using the same timestamp for the curves as for the cash adjustment will assist the market participants in the following ways:

(i) Reduce the sensitivity of cash adjustment to closing marks

(ii) Serve as a hedge to market changes in the SOFR-EFFR basis

(iii) Restore participants' positions to their original discounting risk profiles at the macro-level (as close as practicable)

(iv) Reduce the re-hedging costs for managing the additional added discounting risk

3.1. Re-Hedging Basis Swaps

EFFR-SOFR Basis Swaps will be booked to the account of USD IRS product position holders for key maturity tenors of 2Y, 5Y, 10Y, 15Y, 20Y and 30Y to revert the added discounting risk on SOFR curve back to EFFR curve (as closely as practicable). The maturity tenors were chosen based on below considerations:

(i) Liquidity observed in the swaps market
(ii) Choosing six tenors provides a good hedging mechanism at macro-level
(iii) Controlling the impacts on capital costs driven by gross notionals (e.g. increasing the number of maturity tenors may increase the gross notionals added to each account)
(iv) Providing for a number of maturity tenors that are manageable, as certain customers might want to trade out of the re-hedging Basis Swaps

Some clients have indicated operational concerns regarding booking re-hedging Basis Swaps as EFFR-SOFR basis swaps. To help address this concern, CME will allow market participants to choose re-hedging Basis Swaps as either EFFR-SOFR basis swaps (i.e. default option) or pairs of fixed-float swaps referencing EFFR and SOFR respectively. The basis swaps will be booked at the break-even spread and the fixed rate for the fixed-float swaps will also be booked at par based on the end-of-day curves on the Transition Date based on SOFR discounting. The curves used for pricing are the same as the ones used for computing the NPV under SOFR discounting on the Transition Date. In this case, the difference of the fixed rates of the two fixed-float swaps equals the spread on the SOFR leg for the corresponding basis swaps. The default basis swaps and the alternative fixed-float swaps will have the same cashflows.

The swap spread and the fixed rate will both be rounded to 7 decimals. To ensure the cashflows are exact, the fixed rate for the SOFR swaps will be derived as:

$$Fixed\ Rate_{SOFR} = Fixed\ Rate_{EFFR} - Spread_{(EFFR-SOFR)}$$

Basis Swaps will have the below key attributes:

Table: Basis Swap attributes

Index: USD-SOFR-OIS-COMPOUND vs USD-Federal Funds-H.15-OIS-COMPOUND	
Start Date: October 21, 2020	**Maturity Date:** + {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}
Roll Convention: 21	**Day Count:** Act/360
Cal Period Frequency: 3M	**Cal Period Adj Calendar:** USNY
Payment Frequency: 3M	**Payment Calendar:** USNY
Payment Offset: 2D	**Payment Related to:** End Period
Spread: On SOFR Leg	**Comp Method:** Spread Exclusive
Fixing Date Calendar: SOFR Leg - USGS; EFFR Leg - USNY	
Fixing Index Tenor: 1D	**Fixing Date Offset:** 0D
Fixing Date Type: Business	**Fixing Date Business Date Convention:** Preceding

The fixed-float Basis Swaps will have the same specifics for the SOFR and EFFR leg as referenced above. The fixed leg of swap will also follow similar conventions (where applicable).

3.2. Mechanism for Computing Notional for Re-Hedging Basis Swaps

CME will add the re-hedging Basis Swaps at each position account level. The notional values for each of the Basis Swaps will be computed by following these steps:

I. Compute the par quotes based on SOFR discounting for each of instruments used in curve generation

II. Compute Discounting Delta sensitivity for the position account to each of the instrument used for generating SOFR curves – Delta ladder is computed by bumping the instrument quotes

III. Compute Discounting Delta sensitivity for the re-hedging Basis Swaps to each of the instruments used for generating SOFR curves - Delta ladder is computed by bumping the instrument quotes

IV. Bucket the Delta sensitivity from Step II and Step III to 6 benchmark tenors corresponding to the re-hedging Basis Swaps

V. Compute the notional and direction of the re-hedging Basis Swaps using matrix inversion

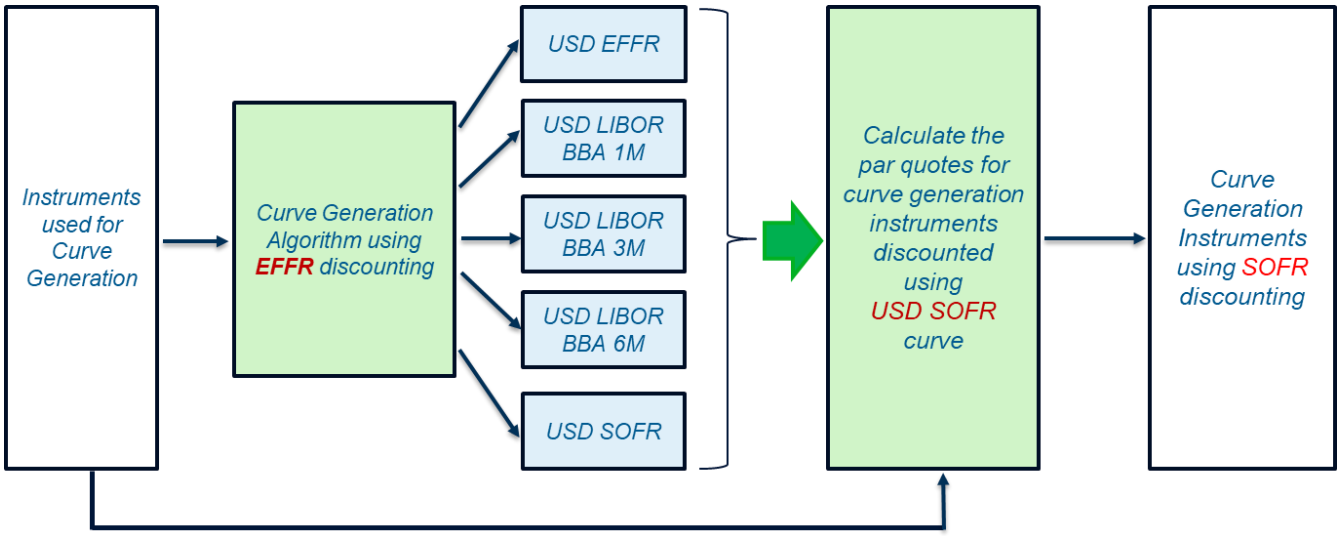
As highlighted earlier, any trade referencing SOFR index in the position account will not be included in the Transition process as CME already utilizes SOFR discounting for SOFR index referenced swaps. The following sections capture the details for each of the above steps.

3.2.1. Par quotes based on SOFR discounting for each of instruments used in curve generation

Input par quotes as of October 16, 2020 are based on EFFR discounting. CME will imply the par quotes[3] based on SOFR discounting by utilizing the same curves as used for SOFR NPV generation on the Transition Date (i.e. assuming the undiscounted value of cashflows/forwards remain unchanged). Par quotes based on SOFR discounting are implied for each of the instruments used for generating LIBOR 1M, LIBOR 3M, LIBOR 6M, EFFR and SOFR curves. The implied quotes for each of the swaps will be rounded to 7 decimals consistent with the market quoting standard. Note that the prices for futures will remain unchanged as the quotes are independent of discounting.

Figure: Generate par quotes based on SOFR discounting

[3] The par quotes are computed using the Log cubic spline curve interpolator consistent with the interpolation mechanism used for settlement variation computations.



3.2.2. Discounting Delta sensitivity for the position account to each of the instruments used for generating SOFR curve

The first step to compute the Discounting Delta sensitivity is to generate bumped curves.

CME will bump the implied par quotes (from the above step) for each of the instruments used for SOFR curve construction independently by $+x\ bps, where\ x \in \{1, -1\}$. For each of the bumped values, CME will regenerate the curve[4] and recalibrate the CME MSABR model assuming SOFR discounting for use of cleared Swaptions trades.

CME is currently using the first SR1 and eight SR3 instruments followed by EFFR-SOFR basis swaps to generate the SOFR curve. The spread for EFFR-SOFR basis instruments is defined on the SOFR leg. The table below shows the instruments which will be used as of the Transition Date, October 16, 2020:

[4] Log Linear interpolation with Flat forward extrapolation will be used for curve generation and repricing of trades.

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Table: Illustration for bumps applied to each Instrument on SOFR curve as of October 16, 2020

Instrument	Period Code	Start Date	End Date	Bumps for + 1bps	Bumps for - 1bps
SR1 Futures	202010	10/1/2020	10/31/2020	Imply the price shock such that the change in forward Rate is +1bps	Imply the price shock such that the change in forward Rate is -1bps
SR3 Futures	202009	9/16/2020	12/16/2020		
	202012	12/16/2020	3/17/2021	Price - 0.01: SOFR Rates will go up	Price + 0.01: SOFR Rates will go down
	202103	3/17/2021	6/16/2021		
	202106	6/16/2021	9/15/2021		
	202109	9/15/2021	12/15/2021		
	202112	12/15/2021	3/16/2022		
	202203	3/16/2022	6/15/2022		
	202206	6/15/2022	9/21/2022		
EFFR - SOFR Basis	3Y	10/20/2020	10/20/2023	Breakeven Spread - 1bps (Spread Shrinking): SOFR rates will go up	Breakeven Spread + 1bps (Spread Widening): SOFR rates will go down
	4Y	10/20/2020	10/20/2024		
	5Y	10/20/2020	10/20/2025		
	7Y	10/20/2020	10/20/2027		
	10Y	10/20/2020	10/20/2030		
	12Y	10/20/2020	10/20/2032		
	15Y	10/20/2020	10/20/2035		
	20Y	10/20/2020	10/20/2040		
	25Y	10/20/2020	10/20/2045		
	30Y	10/20/2020	10/20/2050		
	40Y	10/20/2020	10/20/2060		
	50Y	10/20/2020	10/20/2070		

SR1 202010 and SR3 202009 contract will have accrual start date before the Transition Date. The Price shocks for these contracts will be determined by bumping the forward rate for the unknown accrual section by $+x\ bps$, where $x \in \{1, -1\}$.

For SR1 202010 contract, the bumped price for $+x$ bps movement will be computed as:

$$SR1_{+x\ bps} = SR1\ Price\ -\ x \times 0.01 \times \frac{d_{remaining\ calendar\ days\ in\ the\ month}}{d_{calendar\ days\ in\ the\ month}}$$

where $d_{remaining\ calendar\ days\ in\ the\ month} = 16$ and $d_{calendar\ days\ in\ the\ month} = 31$ as of October 16, 2020.

For SR3 202009 contract, the bumped price for $+x\ bps$ movement will be computed as:

$$SR3_{+xbps} = 100 - 100 \times \frac{360}{d} \times \left[\left(\prod_{t \in T_1} \left(1 + SOFR\ fixing_t \times \frac{(t_{next} - t)}{360} \right) \right) \times \prod_{t \in T_2} \left(1 + (SOFR\ Forecast + 0.0001 \times x) \times \frac{(t_{next} - t)}{360} \right) \right) - 1 \right]$$

where:

- $d = 91$ (# of calendar days in 202009 contract)
- T_1 is the set of all business days between September 16, 2020 and October 15, 2020 (inclusive on both ends)

- T_2 is the set of all business days between October 16, 2020 and December 15, 2020 (inclusive on both ends)
- $SOFR\ fixing_t$ is the observed SOFR fixing rate for day t
- $SOFR\ Forecast$ is derived assuming constant daily forwards based on USGS calendar from the input SR3 price as

$$\prod_{t\in T_2}\left(1+SOFR\ Forecast\times\frac{(t_{next}-\ t)}{360}\right)=\frac{\left(1-\frac{SR3}{100}\right)\times\frac{d}{360}+1}{\prod_{t\in T_1}\left(1+\ SOFR\ fixing_t\times\frac{(t_{next}-\ t)}{360}\right)}$$

- t_{next} is the next business day of t.

By picking $x\in\{1,-1\}$, the above formulas generate the new par quotes that can be used to produce the bumped curves.

The second step to compute the Discounting Delta sensitivity is to price all trades using the bumped curves under SOFR discounting. Assume for some position account (PAcct), the following two values indicate the aggregated price of all its trades using the bumped curves when bumping the SOFR curve generation instrument I_s up or down by 1 bps[5]:

$$Price_{s,up}^{PAcct}, Price_{s,down}^{PAcct}$$

where $s\in\{1,2,\dots,S\}$ and $\{I_1,I_2,\dots,I_S\}$ is the set of curve generation instruments for SOFR curve.

The Delta sensitivity of this position account to the SOFR curve generation instrument I_s is computed as:

$$Delta_s^{PAcct}=\frac{Price_{s,up}^{PAcct}-\ Price_{s,down}^{PAcct}}{2}$$

Discounting Delta ladder for the position account will be a vector of length $\boldsymbol{S}$.

3.2.3. Delta sensitivity for re-hedging Basis Swaps to each of the instruments used for re-hedging process

Like 3.2.2, the delta sensitivity will also be computed for each of the re-hedging Basis Swaps. The re-hedging Basis Swaps will have an effective date set to October 21, 2020 and with key maturity tenors $k\in$ {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}. CME will use the swap attributes as highlighted earlier and set the direction as payer on the EFFR leg and direction as receiver on the SOFR leg for each of these swaps. Also, the notional will be set to 1 million USD. CME will compute the par spread for each re-hedging Basis Swap based on SOFR discounting by utilizing the same curve as used for SOFR NPV generation on the Transition Date. The re-hedging Basis Swap will have the par spread as the input spread making the NPV $0 on the Transition Date.

Assume the Delta ladder for re-hedging Basis Swap of tenor k is $\{Delta_s^k\}$, where $s\ \in\ \{1,2,\dots,S\}$ and $k\in$ {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}.

[5] For SR1 and SR3 futures, the bumped curves are generated using the price bumps of futures calculated in the formula above. A up bump actually means a reduction in the futures price.

3.2.4. Bucket the delta sensitivity from 3.2.2 and 3.2.3 to 6 key tenor corresponding to the re-hedging Basis Swaps

Using the steps below, CME will linearly bucket the resulting Delta ladders from 3.2.2 and 3.3.3 to the 6 maturity tenor points.

(i) For each of the instruments I_s on the SOFR curves, convert the tenor to τ_s denoting the number of calendar days between October 16, 2020 and the maturity of the swap adjusted for USNY business day based on convention "following".

(ii) For each of the key tenors $b \in$ {2yr, 5yr, 10yr, 15yr, 20yr, 30yr} (the same as the re-hedging key tenors), convert the tenor to τ_b , the number of calendar days between October 16, 2020 and the date calculated by adding tenor b to October 16, 2020 + 2 USGS business days. The maturity date is adjusted for USGS business day based on convention "following". For example, τ_b for b =2yr is the number of calendar days between October 16, 2020 and October 20, 2022.

(iii) Compute the linear interpolation weights $w_{s,b}$ for each instrument I_s and each key tenor b:

- $w_{s,b} = 1$, if $\tau_b = 2$yr and $\tau_s \leq \tau_b$
- $w_{s,b} = 1$, if $\tau_b = 30$y and $\tau_s \geq \tau_b$
- $w_{s,b} = 0$, if $\tau_s \geq \tau_{b_{next}}$
- $w_{s,b} = 0$, if $\tau_s \leq \tau_{b_{prev}}$
- $w_{s,b} = \frac{\tau_{b_{next}} - \tau_s}{\tau_{b_{next}} - \tau_b}$, if $\tau_s > \tau_b \ and \ \tau_s < \tau_{b_{next}}$
- $w_{s,b} = \frac{\tau_s - \tau_{b_{prev}}}{\tau_b - \tau_{b_{prev}}}$, if $\tau_s \leq \tau_b \ and \ \tau_s > \tau_{b_{prev}}$

where b_{next} and b_{prev} indicates the next or previous tenor of b in list {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}.

(iv) Using the weights defined above and the formulas below, CME will bucket the Delta ladder $\{Delta_s^{PAcct}\}$ for position account PAcct and Delta ladder $\{Delta_s^k\}$ for all re-hedging Basis Swaps,

$$BDL_b^{PAcct} = [w_{1,b}, w_{2,b}, \dots, w_{S,b}] \times \begin{bmatrix} Delta_1^{PAcct} \\ \dots \\ Delta_S^{PAcct} \end{bmatrix}$$

$$BDL_b^k = [w_{1,b}, w_{2,b}, \dots, w_{S,b}] \times \begin{bmatrix} Delta_1^k \\ \dots \\ Delta_S^k \end{bmatrix}$$

where $\boldsymbol{b} \in$ {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}, $\boldsymbol{s} \in \{\mathbf{1}, \mathbf{2}, \dots, \boldsymbol{S}\}$ and $\boldsymbol{k} \in$ {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}.

Note that bucketed portfolio Delta will be provided as a csv file, the format for which is highlighted in Section 5.2. Also, the bucketed Delta for key tenor re-hedging Basis Swaps will be provided, the format for which is highlighted in Section 5.4. These two files can be used directly as an input to 3.2.5. below to compute the notional for the re-hedging Basis Swaps.

3.2.5. Compute the notional and direction of the re-hedging Basis Swaps using matrix inversion

Assume N_k is the notional for the EFFR/SOFR trades at key tenor $k \in$ {2yr, 5yr, 10yr, 15yr, 20yr, 30yr}. The notional will be computed as:

$$\left[N_{2yr}, N_{5yr}, \dots, N_{30yr}\right] = 1{,}000{,}000 \times \left[BDL_{2yr}^{PAcct}, BDL_{5yr}^{PAcct}, \dots, BDL_{30yr}^{PAcct}\right] \times \begin{bmatrix} BDL_{2yr}^{2yr} & \cdots & BDL_{30yr}^{2yr} \\ \vdots & \ddots & \vdots \\ BDL_{2yr}^{30yr} & \cdots & BDL_{30yr}^{30yr} \end{bmatrix}^{-1}$$

The notional and the direction for the re-hedging Basis Swap k will be adjusted to ensure it is a hedge to the risk on the SOFR curve for the position account as highlighted below:

(i) $N_k > 0$: If the N_k for the re-hedging Basis Swap at key tenor k is positive, the direction of the discounting risk re-hedging Basis Swap from 3.2.3 will be flipped (i.e. change the trade direction of the SOFR leg to payer and EFFR leg to receiver). Notional was the swap will be set to N_k.

(ii) $N_k < 0$: If N_k for the re-hedging Basis Swap at key tenor k is negative, $-N_k$ will be used as the notional instead. This will ensure that the re-hedging Basis Swaps hedges SOFR risk of the position account. The direction of the re-hedging Basis Swap from 3.2.3 is unchanged.

Notional values from above will be rounded to the nearest integer with the minimum notional set to $10,000. To ensure there is a balanced book post the rounding of notional, for each key tenor k CME will:

(i) Compute the total notional N_{pay}^k of all re-hedging Basis Swaps across all position accounts that are receiving EFFR leg and paying SOFR leg and the notional N_{rec}^k of all re-hedging Basis Swaps across all position accounts that are receiving SOFR leg and paying EFFR leg.

(ii) If $N_{pay}^k \geq N_{rec}^k$, pick all the position accounts that contain re-hedging Basis Swaps at tenor k receiving SOFR leg and paying EFFR leg; If $N_{pay}^k < N_{rec}^k$, pick all the position accounts that contain re-hedging Basis Swaps at tenor k receiving EFFR leg and paying SOFR leg.

(iii) Increase the notional based on pro-rata share basis to ensure a balanced book for tenor k. This will be done for each tenor k re-hedging Basis Swap in each account.

For Clients electing to receive a pair of fixed-float OIS swaps in place of an EFFR-SOFR basis swap, the relevant EFFR-SOFR basis swaps will be converted to a pair of fixed-float OIS swaps using following conventions: For each key tenor k , the notional for fixed-float OIS swap for tenor k will be same as the notional of EFFR-SOFR basis swap for tenor k. Also, the direction for the EFFR(SOFR) OIS Fixed Float swap for tenor k will have the direction of the Float leg consistent with the direction of EFFR(SOFR) leg in the EFFR-SOFR basis swaps for tenor k respectively. The fixed rate for these pair of OIS swaps will be determined as described in Section 3.1.

The re-hedging Basis Swap at key tenor k is added to the position account based on the rounded notional. Note that the re-hedging Basis Swap at key tenor k will not be added if the rounded notional value is 0 for that swap.

4. SOFR Basis Swap Auction

CME Group will conduct an auction to help market participants wishing to liquidate Basis Swaps arising from the mandatory Re-Hedging Process on Monday, **October 19, 2020** (the "Auction Date"), subject to regulatory approvals. Each Basis Swap holder that wishes to

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

participate in the SOFR Basis Swap Auction shall be subject to the applicable rules, policies and procedures of CME, as such rules are established and modified from time to time and any additional requirements for participation determined by CME. Further details on the SOFR Basis Swap Auction process are set out in the CME SOFR Basis Swap Auction Protocol which is available at [https://www.cmegroup.com/trading/interest-rates/files/sofr-basis-swap-auction-protocol.pdf]. In the event of any inconsistency between this document and the SOFR Basis Swap Auction Protocol, the SOFR Basis Swap Auction Protocol shall prevail.

During the SOFR Basis Swap Auction process, CME will net down gross payer and receiver Basis Swap discounting risks across participant firms and will facilitate the auction of the residual risk exposures by soliciting bids from a range of auction bidding participants to close out the Basis Swaps at a single fill price for each of the relevant Swap Tenors of Basis Swaps (the "Auction Clearing Price"). CME will determine the Auction Clearing Price based on the bids submitted by the invited bidders in accordance with the terms of the CME SOFR Basis Swap Protocol. If the auction process is successful, CME will close out the Basis Swaps of each participant at the Auction Clearing Price and allocate new basis swap cleared trades to the successful bidder(s) in accordance with the CME SOFR Basis Swap Auction Protocol (New Basis Swap Cleared Trades). The New Basis Swap Cleared Trades resulting from the SOFR Basis Swap Auction shall be binding on the auction winner(s).

4.1. Required pre-Auction processes

Participating Firms' Clearing Member: Responsible for facilitating auction participation election for each position account leveraging the "CME SOFR Discounting Transition Election" file (the Client Election File) by **October 2nd, 2020**. As part of this, Clearing Members must:

- Agree the Participating Accounts with the Participant; and
- Confirm the Participating Accounts to CME and the participation of the Participant in the SOFR Basis Swap Auction by providing confirmation to CME of the Participating Accounts listed in the Client Election File by no later than **October 9th, 2020**.

Participating Firms: Participants wishing to participate in the auction are responsible for signing the "CME SOFR Basis Swap Auction Participation Agreement" (the Auction Participation Agreement) and returning to CME by **October 2nd, 2020**. CME has made the Auction Participation Agreement available to Clearing Members to send to clients that are interested in participating in the Auction.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

CME Group

CME: Responsible for setting the Maximum Loss Limit, as set out in the Auction Participation Agreement. This mechanism is designed to protect auction participants from liquidating their Basis Swaps under adverse market conditions. This limit (stated in terms of basis points of gross discounting risk) specifies the maximum possible loss the individual position account may incur as a result of participating in the auction. This loss, in dollar terms, is the greatest acceptable difference in value between the NPV of all re-hedging Basis Swaps as of the close of business on Friday, October 16th 2020 (i.e. $0 NPV) and the Auction Clearing Price determined by the auction process on the morning of Monday, October 19th 2020.

If the clearing price of the auction results in a cost greater than this Maximum Loss Limit, then the auction will not execute.

The maximum auction charge for each Position Account (PAcct) in $ terms will be derived as:

$$Maximum\ auction\ charge_{PAcct} = Gross\ Discounting\ DV01_{PAcct} * CME\ defined\ Maximum\ Loss\ Limit$$

where $Gross\ Discounting\ DV01$ is computed as the gross of the delta values bucketed to the 6 tenor points on the SOFR curve for the position account on the Transition Date Oct 16, 2020 (as highlighted in section 3.2.4).

Note that CME will provide Trade Level Delta Report bucketed to the 6 tenors as highlighted in Section 5.2

The hypothetical example below illustrates the computation of the maximum auction costs for a hypothetical position account:

Assume:

- CME-defined Maximum Loss Limit is 2 bps (example only)
- Portfolio Delta sensitivities to SOFR curve bucketed to the 6 tenor points as of October 16th are as below:

Key Tenors	2Y	5Y	10Y	15Y	20Y	30Y
Portfolio Delta Ladder	$ (70,000)	$ 290,000	$ 31,000	$ 660,000	$ (1,190,000)	$ (642,000)

Then the maximum auction charge for this position account will be:

Gross Discounting DV01 * 2 = $2,883,000 * 2 = $5,766,000.

The Maximum Loss Limit is expressly stated in the Auction Participation Agreement. The Maximum Loss Limit has been determined by CME based on prevailing liquidity prior to the Auction Participation Agreement being made available to participants. Each position account electing to participate in the auction will receive a copy of the Auction Participation Agreement, which must be signed and returned to CME.

4.2. Mechanism

Eligible Bidders: CME will invite CME IRS Clearing Members and/or other active market participants in the SOFR/Fed Funds market to bid in the SOFR Basis Swap Auction (each, an Auction Bidder). Bidding in the auction is voluntary. All invited Auction Bidders will be required to accept the CME SOFR Basis Swap Auction

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

Bidder Terms (the Auction Bidder Terms) and participate in a dry run for operational testing purposes, described in more detail below.

Market participants wishing to submit bids for the Auction Portfolio (described in detail below) in the CME SOFR Basis Swap Auction should register for participation as an Auction Bidder by the following process:

- Auction Bidders must:
  - notify CME of their intention to participate as an Auction Bidder by **September 4th, 2020**;
  - notify their respective IRS Clearing Members, where the Auction Bidder is not an IRS Clearing Member, of the intention to submit auction bids for the Auction Portfolio in the SOFR Basis Swap Auction; and
  - return a signed copy of the Auction Bidder Terms back to CME by **October 2nd, 2020**.
- Where the Auction Bidder is not an IRS Clearing Member, the IRS Clearing Member must, as applicable:
  - agree the participation of the Auction Bidder; and
  - confirm the participation of the Auction Bidder to CME by no later than **October 9th, 2020**.

Portfolio to Auction: CME will first net down payer and receiver re-hedging Basis Swaps for the six tenor points (2Y, 5Y, 10Y, 15Y, 20Y and 30Y) across all position accounts of participants electing to participate in the auction, thus determining the aggregate portfolio of such participant's Basis Swaps to be auctioned off (the "Auction Portfolio"). In addition, to hide the portfolio's direction, CME will create a mirror image portfolio, containing the same positions (equal in size) but in the opposite direction (together, the "Auction Portfolios"). The Auction Bidders will be asked to bid on both Auction Portfolios, although only bids for the Auction Portfolio representing the actual net risk (across all tenors)) will determine the Auction Clearing Price for the Basis Swaps. Masking of the direction of the Auction Portfolio is necessary to protect the Auction Winner(s) and the participating customers in case the auction is not executed. The total portfolio size will be communicated to Auction Bidders at the onset of the auction irrespective of the auction style.

- IRS Trade Register (2): One for each side of the net risk
- IRS Trade Register (2): One for each portfolio
- IRS Cash Flow Report (2): Projected cash flows for each Basis Swap within the two portfolios
- Clearing Confirmed Messages (12): Full Basis Swap economics in FpML that may be used to load trades directly into Auction Bidder firm's risk applications
- Market Data files as of COB 10/16 settlement run

Auction Style: Single auction inclusive of all 6 tenor points will run on the morning of Monday, October 19, 2020. Running a single auction allows Auction Bidders to consider offsetting risk when providing prices.

Under this approach, considering the Maximum Loss Limit, the auction will be an all-or-none execution event – there is no possibility for participants to receive a partial fill of their positions from the auction.

The auction format will be determined by CME based on the size of the portfolio being auctioned:

- **Winner-takes-all:** The best price wins the entire Auction Portfolio (If the Gross Discounting DV01 of Auction Portfolio is within the acceptable size by a single dealer, as determined by CME)
- **Dutch-style:** The Auction Portfolio may be divided into any number of slices and the firms may bid on any of these slices. Execution price is determined based on the bid filling the last clearing size to liquidate the

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

Auction Portfolio (If the Gross Discounting DV01 of Auction Portfolio is beyond the acceptable size by a single dealer, as determined by CME)

- Portfolio divided into equally proportioned "vertical slices" across all six tenor points, these "slices" represent the minimum portfolio bidding size
- Each bidder submits bid (stated in terms of $ bid/ask) at either the minimum bidding size, or its multiples
- The auction price is determined by CME based on the last clearing size of the portfolio, e.g. sufficient bids to liquidate the portfolio, all winning bidders get filled at the same (clearing) price

An Example of Dutch-style auction execution:

If the Auction Portfolio has $2M Net DV01, then it will be divided into four equal slices (25% of portfolio) for the below bid submission and allocation size. In the below table, the auction clearing price is corresponding to submission from 4th Bidder which represents the last clearing size of the portfolio.

Bidder	Submission	Allocation	Premium Received
1	**$375,000**	$500k DV01 "Slice"	$500,000
2	**$450,000**	$500k DV01 "Slice"	$500,000
3	**$475,000**	$500k DV01 "Slice"	$500,000
4	**$500,000**	$500k DV01 "Slice"	$500,000
5	**$550,000**	N/A	-
6	**$625,000**	N/A	-

Final auction cost will be:
$500,000 x 4 Slices = **$2,000,000**

Included Bid	Excluded Bid	Auction Clearing Price

Irrespective of the auction style, if the Auction Clearing Price of the portfolio results in a cost of liquidation greater than the Maximum Loss Limit for any of the participant position accounts, the entire auction will not be executed.

To help facilitate Auction Bidders obtaining necessary credit lines with IRS Clearing Members, CME will communicate the auction style during the week of October 12th. This information will be provided and should be kept confidential by Auction Bidders in accordance with the Auction Bidder Terms/NDA. However, CME does not intend to disclose the size or direction of the Auction Portfolio in advance of the auction.

Auction Venue: The bidding in the SOFR Basis Swap Auction (including the distribution of the details of the Auction Portfolio and market data reports, and auction-related communications) will be facilitated on the CME Auction Platform [6] (https://cme.auctionplatformservices.com). Auction Bidders must ensure they have all required credentials and operational capability to use the CME Auction Platform prior to the Auction. In the event of experiencing any operational issues with the CME Auction Platform, an Auction Bidder must contact CME immediately.

Auction Process: CME will open the auction window on the CME Auction Portal between 9-10am ET on Monday (October 19, 2020) and provide eligible bidders with the total absolute size of the net risk for two portfolios being auctioned, one representing the actual net risk and one representing the equal and opposite risk (across all tenors).

[6] Additional information about the CME Auction Platform can be found in Section 3 of the Appendix.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

Auction Bidders will be asked to provide NPV-based Auction Bid submissions in USD terms for the Auction Portfolios. Such submissions should reflect the relevant portfolio's NPV as of the time of bidding (i.e. incorporate mark-to-market gains or losses of the portfolio from the previous settlement cycle, COB October 16th), plus any hedging and other costs.

- The quotes represent the price at which Auction Bidders are willing to enter into all 6 EFFR-SOFR Basis Swaps at.
- This protects participants if the auction were not executed (e.g. the auction charges exceed the Maximum Loss Limit.)
- Auction Bidders must have the ability to provide prices for either the entire portfolio, or a vertical slice if run as a Dutch-style auction

Submission of an Auction Bid is voluntary and an Auction Bidder may choose not to submit an Auction Bid. CME will determine the winner of the Auction in its absolute and sole discretion.

The actual direction of the portfolio will only be disclosed to winners, if the auction is executed.

Auction Results and Cost Allocation: Immediately after the auction window closes, CME will execute the auction if the following condition is satisfied:

$$Auction\ Charge \leq\ Aggregated\ Auction\ Charge\ Threshold$$

where the $Aggregated\ Auction\ Charge\ Threshold$ is defined as the sum of the Maximum Loss Limit across all position accounts participating in the auction.

If the auction is executed ,CME intends to notify the Auction Winner(s) of the Auction Clearing Price as soon as reasonably practicable of the auction's closing. Participants, and their respective Clearing Members will be notified of the results as soon as practicable. CME will also publish a Clearing Advisory to communicate to the broader marketplace whether the auction was executed, and if executed, the fill level of the auction in basis points of the gross discounting DV01.

CME will allocate the auction charge to individual participating position accounts (based on pro-rata share of Gross Discounting DV01) and book offsetting trades. Auction cost for a position account is calculated as:

$$Auction\ Cost_{Position\ Account} = -Auction\ Charge \times \frac{Gross\ Discounting\ DV01_{Position\ Account}}{\sum_i Gross\ Discounting\ DV01_i}$$

where $i \in$ {all position accounts participating in the auction}.

The auction cost will be assigned to the offsetting swap with the shortest tenor in the form of an upfront fee. This upfront fee will bank the morning of Tuesday, October 20th.

Offsetting swaps will be booked into participant's accounts auto-netted against the original re-hedging Basis Swaps. The original and offsetting swaps will be Terminated as part of the EOD clearing cycle on October 19th. Winners of the auction will similarly see their swaps populate in their accounts on the trade register generated as part of the October 19th EOD clearing cycle.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

Auction Winner(s) will see their New Basis Swap Cleared Trades posted to their nominated accounts as part of the October 19th clearing cycle. The associated bid value will also settle the morning of Tuesday, October 20th, in the form of an upfront fee on the New Basis Swap Cleared Trades.

The New Basis Swap Cleared Trades resulting from the SOFR Basis Swap Auction shall be binding on the Auction Winner and the relevant IRS Clearing Member, absent manifest error. New Basis Swap Cleared Trades shall comprise cleared contracts subject to the Rulebook and shall be cleared at the Clearing House.

Auction Dry-run(s): CME will hold up to two "dry-runs" of the auction procedure for the purposes of operational testing. The first, which is mandatory for all Auction Bidders, will be held on September 21st. If CME elects to hold a second dry-run for additional testing, this will be held on September 28th. During these dry-runs, CME and the Auction Bidders will go through the entire bidding process:

- CME will upload hypothetical portfolio reports and market data to the CME Auction Platform,
- the Auction Bidders will be asked to bid on the two (mirror) portfolios, and
- the auction would be "mock" awarded.

The dry-runs will be used to test operational aspects of the auction and ensure that the Auction Bidders have proper access to the CME Auction Platform and are familiar with the bidding process.

SDR Reporting**:** CME Clearing will report (i) the original Basis Swaps, booked as part of the re-hedging process within the Transition at close-of-business on October 16th 2020, and (ii) the offsetting basis swaps, resulting from the CME SOFR Basis Swap Auction, to CME Swap Data Repository via CFTC's Part 45 (End of Day) swap reporting.

Auction Specification Summary

Auction Date	October 19th, between 9am and 10am ET
Auction Venue	CME Auction Platform (https://cme.auctionplatformservices.com)
Auction Participation	Voluntary
Auction Styles (one of the two)	1) Winner-takes-all, or 2) Dutch-style, as determined by CME in its sole and absolute discretion
Number of Auction Portfolios	Two. One represents real exposures, the other represents a mirror image
Number of Swap Trades in each Auction Portfolio	Six SOFR basis trades in the following tenors: 2Y, 5Y, 10Y, 15Y, 20Y, 30Y
Total Portfolio Size	Revealed during auction
Bidders	Select CME IRS Clearing Members and non-members
Bidding Convention	NPV-based submission
Bidding Format	2-way bidding (i.e. the real direction not known)

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

Execution	Entire Portfolio or None
Awarded Amount	Up to the largest size for which an Auction Bidder submitted a bid
Tie Procedure	Equally among Auction Winners with the same bid

4.3. Illustration of Settlement Variation and Auction cost allocation

The below example helps illustrate the settlement variation and auction cost for a hypothetical set of position accounts under different auction selection and auction outcome.

Assumption: In the below example to illustrate the settlement variation CME assumed that only the EFFR-SOFR basis levels are changing. For ease of illustration, all the other rates used in pricing of a portfolio are kept static between COB October 16, 2020 and COB October 19, 2020.

Market Data: The table below illustrates the prices for each of the SOFR curve construction instruments for three time stamps: (i) COB October 16, 2020; (ii) auction time at 10 am ET October 19, 2020; and (iii) COB October 19, 2020. The basis between EFFR-SOFR is assumed to move by 2 bps between COB October 16, 2020 and auction time 10 am ET October 19, 2020, and by 4 bps between COB October 16, 2020 and COB October 19, 2020.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

CME Group

Table: Changes in each of the SOFR instrument prices from COB Oct 16 to COB Oct 19, 2020

Instrument		COB Oct 16	10AM EST Oct 19	Change in EFFR - SOFR in bps (10AM EST Oct 19 - COB Oct 16)	COB Oct 19	Change in EFFR - SOFR in bps (COB Oct 19 - COB Oct 16)
SR1 Futures: 202010	Futures Price	99.8	99.808	2.0	99.816	4.0
SR3 Futures: 202009		99.6	99.61	2.0	99.625	4.0
SR3 Futures: 202012		99.6	99.62	2.0	99.64	4.0
SR3 Futures: 202103		99.8	99.82	2.0	99.84	4.0
SR3 Futures: 202106		99.75	99.77	2.0	99.79	4.0
SR3 Futures: 202109		99.65	99.67	2.0	99.69	4.0
SR3 Futures: 202112		99.5	99.52	2.0	99.54	4.0
SR3 Futures: 202203		99.45	99.47	2.0	99.49	4.0
SR3 Futures: 202206		99.4	99.42	2.0	99.44	4.0
EFFR - SOFR Basis: 3Y	EFFR - SOFR Basis	1.875	3.875	2.0	5.875	4.0
EFFR - SOFR Basis: 4Y		2.7524	4.7524	2.0	6.7524	4.0
EFFR - SOFR Basis: 5Y		3.6526	5.6526	2.0	7.6526	4.0
EFFR - SOFR Basis: 7Y		4.2632	6.2632	2.0	8.2632	4.0
EFFR - SOFR Basis: 10Y		4.2632	6.2632	2.0	8.2632	4.0
EFFR - SOFR Basis: 12Y		4.5102	6.5102	2.0	8.5102	4.0
EFFR - SOFR Basis: 15Y		4.6871	6.6871	2.0	8.6871	4.0
EFFR - SOFR Basis: 20Y		5.0241	7.0241	2.0	9.0241	4.0
EFFR - SOFR Basis: 25Y		5.6233	7.6233	2.0	9.6233	4.0
EFFR - SOFR Basis: 30Y		5.8277	7.8277	2.0	9.8277	4.0
EFFR - SOFR Basis: 40Y		6.152	8.152	2.0	10.152	4.0
EFFR - SOFR Basis: 50Y		6.5706	8.5706	2.0	10.5706	4.0

Risk Profile pre and post Re-hedging Process: The table below illustrates Delta sensitivities to SOFR curve construction instruments (left table) and the bucketed Delta sensitivities to the 6 key tenors corresponding to the re-hedging Basis Swaps (lower right table) for Position Account 1 as of COB October 16, 2020. As noted in the table below, the Delta ladder is hedged at the macro-level (i.e. the 6 bucketed tenor points). Negative sensitivity to the instrument indicates the portfolio will incur a loss if the EFFR-SOFR basis was to narrow.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

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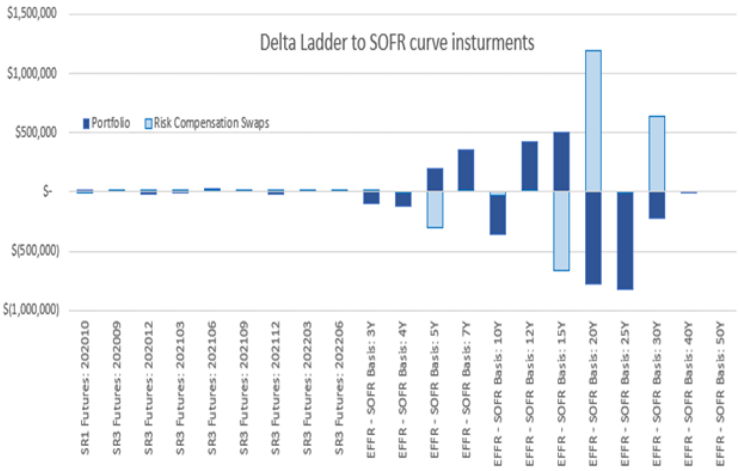
Table: SOFR sensitivity for Position Account 1 as of COB October 16, 2020

Delta Ladder: COB Oct 16	Portfolio	Re-Hedging Swaps
SR1 Futures: 202010	$2,000	$(109)
SR3 Futures: 202009	$2,500	$3,945
SR3 Futures: 202012	$(15,000)	$9,159
SR3 Futures: 202103	$(7,400)	$9,137
SR3 Futures: 202106	$22,500	$9,119
SR3 Futures: 202109	$12,500	$9,088
SR3 Futures: 202112	$(14,000)	$9,052
SR3 Futures: 202203	$18,000	$9,035
SR3 Futures: 202206	$8,000	$9,021
EFFR - SOFR Basis: 3Y	$(100,000)	$17,278
EFFR - SOFR Basis: 4Y	$(125,000)	$(24)
EFFR - SOFR Basis: 5Y	$200,000	$(298,990)
EFFR - SOFR Basis: 7Y	$350,000	$190
EFFR - SOFR Basis: 10Y	$(360,000)	$(31,936)
EFFR - SOFR Basis: 12Y	$420,000	$125
EFFR - SOFR Basis: 15Y	$500,000	$(668,188)
EFFR - SOFR Basis: 20Y	$(780,000)	$1,190,118
EFFR - SOFR Basis: 25Y	$(820,000)	$(235)
EFFR - SOFR Basis: 30Y	$(220,000)	$642,118
EFFR - SOFR Basis: 40Y	$(12,000)	$0
EFFR - SOFR Basis: 50Y	$-	$-
Net Delta	**$(917,900)**	**$917,900**



Bucketed Delta Ladder COB Oct 16	Portfolio	Re-Hedging Swaps
EFFR - SOFR Basis: 2Y	$(78,930)	$78,930
EFFR - SOFR Basis: 5Y	$293,107	$(293,107)
EFFR - SOFR Basis: 10Y	$31,785	$(31,785)
EFFR - SOFR Basis: 15Y	$668,138	$(668,138)
EFFR - SOFR Basis: 20Y	$(1,190,000)	$1,190,000
EFFR - SOFR Basis: 30Y	$(642,000)	$642,000
Net Delta	**$(917,900)**	**$917,900**

Gross Bucketed Delta on SOFR curve for the above position account is $2,903,960.

Settlement Variation under different scenarios for Position Account 1: Based on the changes in SOFR instrument prices, the above account will realize settlement variation based on the auction selection and outcome:

- **Case I**: Retains re-hedging Basis Swaps;
- **Case II:** Elects to unwind re-hedging Basis Swaps under CME facilitated SOFR Basis Swap Auction and auction charge is below aggregated maximum auction charges;
- **Case III:** Elects to unwind re-hedging Basis Swaps under CME facilitated SOFR Basis Swap Auction and auction charge is above aggregated maximum auction charges.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

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Table: Settlement Variation Illustration under different scenarios

	Time	NPV Portfolio COB Oct 16 - I	NPV Re-Hedging Swaps - II	I + II	Variation Margin from COB Oct 16
	COB Oct 16	$100,000,000	$-	$100,000,000	N/A
Case I	10 AM ET - CME Auction Time Oct 19	$98,164,200	$1,835,800	$100,000,000	N/A
	COB Oct 19	$96,328,400	$3,671,600	$100,000,000	$-
Case II	10 AM ET - CME Auction Time Oct 19	$98,164,200	N/A	$98,164,200	N/A
	COB Oct 19	$96,328,400	N/A	$96,328,400	$(3,671,600)
Case III	10 AM ET - CME Auction Time Oct 19	$98,164,200	$1,835,800	$100,000,000	N/A
	COB Oct 19	$96,328,400	$3,671,600	$100,000,000	$-

In Case II, the client could be subject to an additional cost for auction with the maximum cost being (Gross Discounting DV01 * X), where Gross Discounting DV01 is $2,903,960 and X is the CME defined Maximum Loss Limit.

The settlement variation for the portfolio is dependent on the exposure and the market movements across all the risk factors. In the above example, it is assumed that only EFFR-SOFR spread changes. There could be additional settlement variation (increase or decrease) based on changes to other instruments used in curve generation. Also, the settlement variation for a portfolio with the reverse directions (flip risk profile) would be gaining $3,671,000 in case II, however, the maximum auction cost for the account will remain the same.

Auction Cost Allocation: In the case the auction is executed, the auction cost will be allocated to each of the position accounts based on pro-rata share of Gross Discounting DV01 calculated on COB Oct 16, 2020.

Assume:

- CME-defined Maximum Loss Limit is 2 bps (example only); and
- Three position accounts elected to participate in the auction and the position account 1 and 2 are perfectly offsetting each other.

The table below highlights the bucketed sensitivity (DV01) to SOFR curve, Gross Discounting DV01, Max Auction charges for each of the position accounts participating in CME auction.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

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Table: Bucketed Delta ladder for the 3 position accounts elected to participate in auction

Bucketed Delta Ladder COB Oct 16, 2020	EFFR - SOFR Basis: 2Y	EFFR - SOFR Basis: 5Y	EFFR - SOFR Basis: 10Y	EFFR - SOFR Basis: 15Y	EFFR - SOFR Basis: 20Y	EFFR - SOFR Basis: 30Y
Position Account 1	$(78,930)	$293,107	$31,785	$668,138	$(1,190,000)	$(642,000)
Position Account 2	$78,930	$(293,107)	$(31,785)	$(668,138)	$1,190,000	$642,000
Position Account 3	$44,981	$(184,511)	$(31,007)	$(444,490)	$-	$-

Gross DV01	Max Auction Charge
$2,903,960	$5,807,920
$2,903,960	$5,807,920
$704,989	$1,409,977

Aggregated Auction Threshold	$13,025,817

The table below presents the re-hedging trade notional for each Position Accounts. In the below example, positive notional refers to the basis swap with SOFR leg as receiver and negative notional refers to the basis swaps with SOFR leg as payer.

Table: Re-hedging Basis Swap Notional added to the above 3 position accounts

Notional for Re-hedging Swaps	EFFR - SOFR Basis: 2Y	EFFR - SOFR Basis: 5Y	EFFR - SOFR Basis: 10Y	EFFR - SOFR Basis: 15Y	EFFR - SOFR Basis: 20Y	EFFR - SOFR Basis: 30Y
Position Account 1	$422,938,989	$(611,228,615)	$(33,950,787)	$(488,571,646)	$678,016,940	$262,731,775
Position Account 2	$(422,938,989)	$611,228,615	$33,950,787	$488,571,646	$(678,016,940)	$(262,731,775)
Position Account 3	$(240,978,315)	$383,384,198	$32,515,868	$325,008,559	$-	$-

The auction portfolio will be based on netted notional across the above Position Accounts. In this case it will be the same as that of Position Account 3 as the risks for Position Account 1 and 2 are offsetting. CME will run an auction on the netted notional as highlighted below:

Table: Notional for the Auction portfolio

	EFFR - SOFR Basis: 2Y	EFFR - SOFR Basis: 5Y	EFFR - SOFR Basis: 10Y	EFFR - SOFR Basis: 15Y	EFFR - SOFR Basis: 20Y	EFFR - SOFR Basis: 30Y
Auction portfolio 1	$(240,978,315)	$383,384,198	$32,515,868	$325,008,559	$-	$-
Auction portfolio 2	$240,978,315	$(383,384,198)	$(32,515,868)	$(325,008,559)	$-	$-

Assume: Auction charge for the above is $1M.

The auction charge is lower than the total aggregated auction threshold of $13,025,817. The auction will be executed and the costs will be allocated to each of the three position accounts pro-rata based on the Gross Discounting DV01. The table below shows the auction cost allocated to each of the position accounts and the comparison to the CME-defined Maximum loss limit.

Further detail regarding the Auction can be found at CME's SOFR Basis Swap Auction Protocol on our website here

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Table: Auction Cost Allocation

Account	Auction Cost Allocation	Maximum Auction Cost based the CME-defined Loss Limit
Position Account 1	$(445,878)	$(5,807,920)
Position Account 2	$(445,878)	$(5,807,920)
Position Account 3	$(108,245)	$(1,409,977)

5. Appendix

5.1. IRS Discounting Transition Report

This report will summarize the cash adjustment activity and change in NPVs on the Transition Date.

- Publication Time: 9:00 pm ET on the Transition Date
- File Name = IRSDIS_XXX_YYYYMMDD_EOD.csv
  "XXX" = Firm ID
- Location: firm specific sFTP sites

Table: Column Headers & Description

Column Header	Description
Value Date	Business Date
Position Account ID	Position Account
Cleared Trade ID	CME Trade ID
Platform ID	SEF/Platform ID
Client ID	Client ID
REG_TRADE_ID	USI
Firm ID	3 digit clearing firm ID
Origin	HOUS or CUST
PRODUCT_TYPE	Type of SWAP
Currency	3-digit currency code
NPV_NEW_DISC	NPV under SOFR discounting
NPV_PRIOR_DISC	NPV under EFFR discounting
NPV_ADJ_NEW_DISC	ADJ NPV under SOFR discounting

NPV_ADJ_PRIOR_DISC	ADJ NPV under EFFR discounting
NPV_ADJ_DIFF	New ADJ NPV minus Prior Adj NPV
FX_RATE	1
OFFSET_ADJ_AMT	Cash adjustment amount Prior ADJ NPV minus new ADJ NPV

5.2. Trade-Level Discounting Delta Report

This report provides Bucketed Discounting Delta sensitivity to SOFR instruments for each of the trades in the position account. The report allows firms to tie back the impact of each trade to the re-hedging process.

- Publication SLA: 9:00 pm ET on the Transition Date
- File Name: *IRSDLT_XXX_YYYYMMDD_EOD.csv*
  "XXX" = Firm ID
- Location: Firm specific sFTP folder

Table: Column Headers & Description

Column Header	Description
Value Date	Business Date
Position Account ID	Position Account
CME Swap Indicator	Swap Identifier
Cleared Trade ID	CME Trade ID
Platform ID	SEF/Platform ID
Client ID	Client ID
REG_TRADE_ID	USI
Origin	HOUS or CUST
Firm ID	3 digit clearing firm ID
Currency	3-digit currency code
Curve Name	USD_SOFR_1D_MULTI
2Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 2 yr tenor
5Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 5 yr tenor
10Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 10 yr tenor
15Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 15 yr tenor
20Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 20 yr tenor
30Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 30 yr tenor

5.3. Template of Trade Register for Re-Hedging Basis Swaps

This report provides swap details for each of the re-hedging Basis Swaps as well as the two fixed-float swaps at key maturity tenors of 2Y, 5Y, 10Y, 15Y, 20Y and 30Y. The column headers will match the existing Trade Register as sent out to clearing firm today. Cleared Trade ID will be a unique value for each of the Basis Swaps with "dummy" account and clearing firm values.

- Publication SLA: 9:00 pm ET on the Transition Date
- File Name: *IRSTR_RISKCOMP_YYYYMMDD_EOD.csv*
- Location: pub/IRS sFTP folder

5.4. Re-Hedging Basis Swap Sensitivity (Delta) Report

This report provides Bucketed Discounting Delta sensitivity to SOFR instruments for each of the re-hedging Basis Swap trades as highlighted in the *IRSTR_RISKCOMP_YYYYMMDD_EOD.csv* file. The report allows firms to tie back the impact of each trade to the re-hedging process.

- Publication SLA: 9:00 pm ET on the Transition Date
- File Name: *IRSDLT_RISKCOMP_YYYYMMDD_EOD.csv*
- Location: pub/IRS sFTP folder

Table: Column Headers & Description

Column Header	Description
Value Date	Business Date
Position Account ID	Position Account
CME Swap Indicator	Swap Identifier
Cleared Trade ID	CME Trade ID
Platform ID	SEF/Platform ID
Client ID	Client ID
REG_TRADE_ID	USI
Origin	HOUS or CUST
Firm ID	3 digit clearing firm ID
Currency	3-digit currency code
Curve Name	USD_SOFR_1D_MULTI
2Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 2 yr tenor
5Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 5 yr tenor
10Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 10 yr tenor
15Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 15 yr tenor
20Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 20 yr tenor
30Y	Bucketed Discounting Delta Sensitivity to SOFR curve at 30 yr tenor

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