Financial Benchmarks India Pvt. Ltd.

Valuation Methodology for
(A): State Development Loans (State Government Securities) [SDL(SGS)]
(B): SDL(SGS) ZCYC

August 15, 2025

Version-5

I. Introduction

1. In 2018, RBI, in modification of its direction on valuation of investments dated July 1, 2015, advised that FBIL may publish the prices/YTM of all SDL(SGS)s based on the actual/ observed prices in the market.
2. It is a well-known fact that extreme illiquidity and lack of depth mark the secondary market of SDL(SGS)s, which normally trade without any particular credit differentiation among the issuer states. The average number of SDL(SGS)s that trade on any business day is very small compared to the aggregate number of outstanding SDL(SGS)s.
3. An empirically tested fact is that while a statistically significant difference between the traded prices/YTM of SDL(SGS)s on the NDS-OM [i.e., NDS-OM 'Normal' trades] and the prices/YTM of the over-the-counter (OTCR) trades in the same SDL(SGS)s that are reported on NDS-OM for settlement on the same day has been observed on a number of days, particularly when the number of trades in an SDL(SGS) is high, the difference in volume- weighted average YTM of these two types of trades is less than 5 basis points, which is small. Hence, for the purpose of this methodology, no distinction has been made between "Normal' and 'OTCR' trades in SDL(SGS).
4. Also, there is no empirical evidence for according to different treatment to prices/YTM of proprietary trades in SDL(SGS)s on any business day, and the prices/YTM of CSGL (Constituent) trades in the same/similar SDL(SGS)s on that day.
5. Keeping the foregoing in view and also the requirement that the prices/YTM of all SDL(SGS)s for valuation purposes are required to be based on the

actual/observed prices in the market, a framework in this regard has been formulated having the following elements: (a) On any business day, the secondary market prices/YTM of SDL(SGS)s and the auction prices/YTM of SDL(SGS)s, as available, will be used for their valuation. However, the secondary market trades that are referred to the Dispute Resolution Committee (DRC) of the Fixed Income Money Market and Derivatives Association of India (FIMMDA) and the reversed trades when they occur, will be excluded, (b) Interpolation/ extrapolation technique will be used in respect of the remaining SDL(SGS)s which do not trade on that day, and (c) Consistency/market alignment check, as applicable, will be applied in respect of all traded prices/YTM.

6. The methodology seeks to strike a judicious and prudent balance between two opposing considerations: Since the number of actual/observed prices in respect of SDL(SGS)s are very small, the opportunity cost of not including any actual/observed price is high (consequence of the so-called Type 1 error). However, sufficient care has been exercised, by way of the imposition of a set of objective criteria, to make sure that (i) off-market data are excluded, and (ii) no incentive for market manipulation is provided (reducing the possibility of the so-called Type 2 error).

7. Calculation of SDL Valuation is done by FBIL in-house.

II. Assumptions, Definitions and Main Rules

1. All transaction level data on NDS-OM will be obtained from Clearing Corporation of India Limited. All transactions with T+1 settlement only will be considered. All SDL(SGS)s will be identified by their respective International Securities Identification Number (ISIN). For the purpose of this methodology document, the term 'SDL(SGS)' means a state development loan identified by its ISIN. The SDL(SGS)s will be grouped according to the calendar year of their maturity (hereinafter referred to as 'maturity-bucket'). In other words, the differences in the residual maturities of SDL(SGS)s in any maturity-bucket will be in the range of 0-12 months. For the purpose of grouping SDL(SGS)s in different maturity-buckets, no distinction will be made between the issuer

states. The SDL(SGS)s in a maturity-bucket will be arranged in the increasing order of their residual maturities.

2. Due to lack of adequate transactions level data for SDL(SGS)s with residual maturities ≤ 12months, the valuation of ISINs with maturities ≤ 12 months will be done using the FBIL- published T-Bills benchmark rates plus a spread, as described in this document.
3. The YTM of the primary issuances and of the secondary trades of all SDL(SGS)s in any maturity-bucket will be treated as similar for their aggregation and statistical treatment required for the purpose of this methodology (except for trades in SDL(SGS)s with residual maturities ≤ 12 months). This approach is based on the assumed homogeneity of the YTM of the trades in respect of SDL(SGS)s in any maturity-bucket.
4. Valuation of SDL(SGS)s will be based on the transaction-level data obtained from the NDS- OM platform and the auction/OMO (Open Market Operation - sale and purchase) data released by RBI from time to time.
5. The YTM of all SDL(SGS) secondary trades of ₹5 crores and above, on the NDS OM Regular/NDS-OM Odd Lot/ NDS-OM Reported Regular/NDS-OM Reported Odd lot segments of NDS OM platform will be included as input data.
6. Traded SDL(SGS)s in any maturity-bucket (except for SDL(SGS)s with residual maturities ≤12 months) will be valued at their traded YTM. For the purpose of valuation of non-traded SDL(SGS)s in a maturity-bucket which do not trade on any business day, it will be assumed that their YTM have moved, since the last business day, in line with those of the traded SDL(SGS)s of that maturity-bucket. Hence, the YTM of a non-traded SDL(SGS) will be estimated by way of algebraic addition to its traded/estimated YTM (hereinafter referred to as 'published YTM') on the previous day an appropriate measure of the average change in the YTM of traded SDL(SGS)s belonging to the same maturity-bucket on that day. This approach makes it necessary to apply this methodology, with few necessary changes, to calculate/estimate YTM of all SDL(SGS)s on a sufficient number of successive days prior to the date of the coming into effect of this methodology, since, as noted in the foregoing, the average number of daily trades in all SDL(SGS)s is very small compared to the total number of outstanding SDL(SGS)s. This way of calibrating the valuation model will ensure that the YTM of the non-traded SDL(SGS)s on the start date and thereafter are

estimated inconformity with this methodology. The steps used for model calibration are described in the Section V below.

7. Traded YTM of an SDL(SGS) belonging to any maturity-bucket means the Volume- weighted Average YTM (VWAY) of the trades in that SDL(SGS). Before the calculation of VWAY, each SDL(SGS) trade in a maturity-bucket will be subjected to a consistency and market alignment check, which aims at determining if its ΔYTM is consistent with the ΔYTM of other trades in the same maturity-bucket and also with its last published YTM. If the total number of trades in a maturity-bucket is 5 or more, the check carried out by applying a Standard Deviation (SD) criterion, the details of which are in the paragraph 8 below. In case the total number of trades in a maturity- bucket is less than five, the check is done by way of applying a set of conditions, the details of which are in the paragraphs 10 and 11.

8. Consistency and market-alignment check, if the total number of trades in a maturity- bucket is five or more:
    a. The difference (ΔYTM) between the YTM of trades in each SDL(SGS) in the maturity- bucket and the published YTM of that SDL(SGS) on the previous business day will be calculated.
    b. The volume-weighted average difference (VWAYΔ) in respect of all ΔYTM in the maturity-bucket will be calculated and their sample standard deviation will be obtained.
    c. Any trade the ΔYTM for which falls outside (+/-) one standard deviation (SD) from the mean will be identified as an outlier trade. In case SD is < 10 basis points, it will be set equal to 10 basis points. In other words, SD will have a floor of 10 basis points. However, there will be no cap on SD.
    d. Using the volume and YTM of the surviving trades, Volume Weighted Average Yield (VWAY) will be calculated for each traded SDL(SGS) (ISIN).
    e. VWAYΔ will be re-calculated using the surviving trades. This will be the Market Yield Movement (MYM) of the maturity-bucket (Refer to the paragraph 1 of Section IV below).

Table 1: Illustrative example for outlier detection: Traded data for maturity- bucket 2024 as on 29.01.2021

SDL (SGS)	Trades	ISIN No	ISIN Description	Previous day's YTM (%)	YTM (%) of trades	Volume in ₹ crores	ΔYTM	Volume Weighted Average ΔYTM	SD of ΔYTM	Applicable SD	Check Result
Security 1 (S1)	Trade 1 (T1)	IN202013014 1	09.41 KL SDL (SGS) 2024	5.23	5.56	5.00	0.33	0.25	0.07	**0.07 as it is <0.10. 0.10 will be used for calculation of +/- 1SD**	Accepted
S1	T2	IN202013014 1	09.41 KL SDL (SGS) 2024	5.23	5.54	5.00	0.31				Accepted
S2	T1	IN222014007 2	08.94 MH SDL (SGS) 2024	5.22	5.5	25.00	0.28				Accepted
S2	T2	IN222014007 2	08.94 MH SDL (SGS) 2024	5.22	5.45	25.00	0.23				Accepted
S3	T1	IN102020028 4	5.41 AP SDL (SGS) 2024	5.17	5.3	5.00	0.13				Outlier
S4	T1	IN152014005 5	8.43 GJ SDL (SGS) 2024	5.24	5.5	15	0.26				Accepted
S4	T2	IN152014005 5	8.43 GJ SDL (SGS) 2024	5.24	5.45	15	0.21				Accepted
				VWAYΔ (-/+) 1SD = 0.15 & 0.35							

Note: The outlier identification procedure, as above, will not be applied to the first three rolling maturity-buckets ≤ 12 months.

9. For each maturity-bucket with total number of trades at 5 or above, excluding the maturity bucket ≤ 12 months, VWAYΔ or MYM will be calculated taking into account the YTM of the surviving trades, following the above-mentioned steps. Also, the volume and number of trade-weighted average [WAYΔμ] of all such VWAYΔ in respect of all the traded maturity- buckets will be calculated, excluding the first three (up to 3-month, 6-month and 12-month) rolling maturity – buckets ≤12-months.
10. Consistency and market alignment check, if the total number of trades in a maturity- bucket is less than five:

If the total number of SDL(SGS) trades in a maturity-bucket is less than 5 (viz. 1, 2, 3 and 4 trades) the steps, as below, will be followed:

a. ∆YTM of each trade will be calculated.
b. The trades, the ∆YTM of which fall outside (+/-) 10 basis points of WAY∆μ (as described in the paragraph 9 above) will be identified as outliers.
c. In case the number of trades in any SDL(SGS) is more than one and any one of them passes the check, as above, the remaining trades will not be subjected to the check.

Table 2: Illustrative example for ∆YTM check: Traded data as on 29.01.2021

SDL (SGS)	**Trades**	**ISIN No**	**ISIN Description**	**Maturity - Bucket**	**Volume in ₹ crores**	**YTM (%)**	**Previous day's YTM (%)**	**∆YTM**
Security 1 (S1)	Trade 1 (T1)	IN1020150075	07.98 AP SDL(SGS) 2025	2025	5	5.61	5.52	0.09
S1	T2	IN1020150075	07.98 AP SDL(SGS) 2025	2025	5	5.56	5.52	0.04
S2	T1	IN2020150099	07.99 KL SDL(SGS) 2025	2025	10	5.6	5.59	0.01
S2	T2	IN2020150099	07.99 KL SDL(SGS) 2025	2025	10	5.56	5.59	-0.03
S3	T1	IN1520160178	07.14 GJ SDL(SGS) 2027	2027	20	6.12	5.98	**0.14**
S4	T1	IN3320170068	07.19 UP SDL(SGS) 2027	2027	92.56	6.08	6.08	0
S5	T1	IN1520170094	07.25 GJ SDL(SGS) 2027 23 Aug	2027	5	6.22	6.08	**0.14**
S6	T1	IN3320170084	07.27 UP SDL(SGS) 2027	2027	95	6.08	6.08	0
		WAY∆μ						**0.01**
		WAY∆μ - 10bps						-0.09
		WAY∆μ +10bps						0.11

Trade S3-T1 and S5-T1 will be identified as an outlier as their ∆YTMs are outside the range: (-) 9 basis points to (+) 11 basis points.

11. In case there is no maturity bucket with >= 5 trades on a particular day, the below mentioned process will be adopted to remove outliers for effecting the above consistency and market alignment check:
    a. Calculate the yield changes (∆YTM) with respect to previous day's published YTM for each ISIN traded on that day.
    b. Calculate the volume weighted average yield change [VWAY∆μ] of all the ∆YTMs of all the traded maturity buckets.
    c. Any trade, the ∆YTM for which falls outside (+/-) 10 basis points of VWAY∆μ, will be identified as an outlier.

12. VWAY∆ will be re-calculated using the surviving trades. This will be the Market Yield Movement (MYM) of the maturity-bucket (Refer to paragraph 1 of Section IV below).
13. Using the volume and YTM of surviving trades (even if a single trade in an SDL(SGS) survives) the Volume-Weighted Average Yield (VWAY) will be calculated for each SDL(SGS).
14. Traded YTM of an SDL(SGS) that does not pass the checks described in the paragraphs 8 to 11 above will not be used further for the valuation exercise of the day. However, the data in this regard will be preserved for possible use during the next seven calendar days for the purpose to applying the check, as in the paragraph 11(b) above.

15. Treatment of Auction Data (Reissuance/New issuance/OMO (sales/purchase)):

a. On the day of auctions, the weighted average yield (WAY) published by RBI of the auctioned SDL(SGS) will be included in the traded data set for the calculation of YTM of the auctioned SDL(SGS) and MYM of different maturity-buckets:

YTM:

b. In case the auction involves the reissuance of an existing SDL(SGS), both the pre- and post-auction trades of ₹5 crores and above will be taken into account.
c. All the traded YTMs will be subjected to the consistency and market alignment checks, as described in paragraphs 8, 10 and 11 above. However, WAY will not be subjected to the consistency and market alignment checks.
d. In case there is no pre- or post-auction trades, or when the SDL(SGS) has traded but all the trades are rejected due to application of the consistency and market alignment check, WAY will be taken as the YTM of the SDL(SGS) concerned.
e. If the total number of trades in an auctioned SDL(SGS) is less than 5 (1, 2, 3, and 4), the simple average of the VWAY of the surviving trades (after applying the consistency and market alignment check in para 10 above) and the WAY will be calculated and used as the VWAY for that SDL(SGS).
f. If the total number of trades in an auctioned SDL(SGS) is 5 or more, the VWAY of the surviving trades (after applying the consistency and market alignment check in para 8 above) will be calculated and used as the VWAY for that SDL(SGS).

MYM:

g. In the case of a new SDL(SGS) being auctioned, its ∆YTM is calculated by subtracting the average of the previous day's published YTM of the SDL(SGS)s of the maturity- bucket to which the newly auctioned SDL(SGS) belongs, from its traded YTM.
h. If an auction results in a new maturity-bucket, then the ∆YTM is calculated by subtracting the average of the previous day's published YTM of the SDL(SGS)s of the closest maturity-bucket/s from its traded YTM.
i. For the purpose of calculation of MYM in respect of the maturity-bucket, which contains an SDL(SGS) that has been auctioned on the day, the auction will be Regarded as equivalent to a single trade with a volume of ₹5 crores with YTM equal to its WAY.

III. Calculation of Market YTM Movement (MYM) on the Start Day and thereafter for Valuation Purposes

1. MYM for a maturity-bucket on any business day will be calculated using the difference between the YTM of traded SDL(SGS)s in that maturity-bucket and their published YTM on the previous day as described below:
    a. Difference between the day's YTM of a traded SDL(SGS) in that maturity-bucket and its published YTM on the previous day (∆YTM) = Traded YTM of the day - (minus) previous day's published YTM, as described in the paragraph 8 under Section II.
    b. Market YTM Movement (MYM)for a maturity-bucket = Volume-weighted average of ∆YTM of all the traded SDL(SGS) of the maturity-bucket

Table 5: Illustrative calculation of MYM

Description of SDL(SGS) (ISIN)	**Maturity - bucket**	**Previous day's Published YTM (%)**	**Today's Traded YTM (%)**	**Volume (₹ in crores)**	**∆YTM**	**VWAY∆**
8.05 GUJ SDL(SGS) 2028	2028	8.01	8.01	10	0	
8.28 TN SDL (SGS) 2028	2028	8.08				
8.28 TN SDL(SGS) 2028 MAR	2028	8.05				**-0.01**
8.00 KL SDL(SGS)	2028	8.05	8	5	-0.05	
8.05 TN SDL(SGS) 2028 APR	2028	8.02	8.01	147.5	-0.01	
MYM	**-0.01**					

2. In case there are no trades in a maturity bucket, the following interpolation approach will be used:
    a. The maturity bucket with no trade has traded maturity buckets on both sides: MYM of a maturity-bucket with no trade = Weighted Average (Volume and Trades) change (WA∆) of the MYM of the two closest traded maturity-buckets, one on each side.
    b. The maturity bucket with no trade has traded maturity bucket only on one side:

MYM of a maturity-bucket with no trade = Weighted Average (Volume and Trades) change (VTWA∆) of the MYM of all traded maturity-buckets, excepting the first three rolling six-month buckets.

Table 6: Illustrative calculation for MYM Interpolation

Maturity - bucket	No. of Traded SDL (SGS)s	Volume in ₹ crores	MYM (%) of the maturity-bucket	Volume-weighted average MYM (%)
2022	2	50	-0.02	
2023	6	240	**-0.08**	
2024				**-0.06**
2025				
2026	8	95	**-0.01**	
2027	18	142	-0.1	

Table 7: Illustrative calculation for MYM interpolation/extrapolation (based on data from Jan 29, 2021, valuation sheet)

Maturity- bucket	MYM (%)	Volume- weighted average MYM (%)	Applicable MYM for interpolation/extrapolation
Up to 28 Apr 2021	N.A.		
Up to 28 Jul 2021	N.A.		
Up to 28 Jan 2022	N.A.		
2022		0.01	VTWA∆ of all maturity groups
2023		0.01	VTWA∆ of all maturity groups
2024	0.25		
2025	0.02		
2026		0.02	WA∆ of two closest maturity groups
2027	0.02		
2028	-0.01		
2029	0.01		
2030	-0.01		
2031	0		
2032	0.02		
2033	0.01		
2035	-0.01		
2036		-0.01	WA∆ of two closest maturity groups
2037		-0.01	WA∆ of two closest maturity groups
2038		-0.01	WA∆ of two closest maturity groups
2039		-0.01	WA∆ of two closest maturity groups
2040	-0.01		WA∆ of two closest maturity groups
2041		-0.02	WA∆ of two closest maturity groups
2043		-0.02	WA∆ of two closest maturity groups
2044		-0.02	WA∆ of two closest maturity groups

2049		-0.02	WA∆ of two closest maturity groups
2050	-0.02		
2051		0.01	VTWA∆ of all maturity groups
2054		0.01	VTWA∆ of all maturity groups
2055		0.01	VTWA∆ of all maturity groups
2059		0.01	VTWA∆ of all maturity groups
2060		0.01	VTWA∆ of all maturity groups
Weighted Average change (Trade and Volume)	**0.01**	**(2022 to 2060)**	Excluding the first three rolling maturity buckets

3. If an auctioned SDL(SGS) belongs to a maturity-bucket with no other SDL(SGS), then its ∆YTM will be calculated as follows:
   ∆YTM = Traded YTM (subsequent to the auction) post – (minus) the mean of the previous day's published YTM of the closest maturity-buckets on both side in the maturity ladder or the previous day's published YTM of the closest maturity group on one side in the maturity ladder, as the case may be.

IV. Valuation of SDL(SGS)s in Each Maturity-Bucket

1. Valuation of traded SDL(SGS)s will be done on the basis of their traded YTM, as calculated in conformity with the relevant paragraphs under Section II and Section III.
2. Valuation of non-traded SDL(SGS)s will be done on the basis of their estimated YTM. MYMof the maturity-bucket will be used to derive/estimate the Model YTM of the non-traded SDL(SGS) of that maturity-bucket, applying the following formula:
   Model YTM = SDL(SGS)'s published YTM of previous day + MYM of the maturity-bucket

Table 8: Illustrative calculation/ estimation of YTM

SDL(SGS)	Maturity - bucket	Previous Day's Published YTM (%)	Day's Traded YTM (%)	Volume (₹ in crores)	MYM	Traded / estimated YTM (%) for Valuation
8.52% ANDHRA SDL(SGS) 2028	2028	8.49	8.47	10.00	-0.02	**8.47**
8.42% ANDHRA SDL(SGS) 2028	2028	8.38				8.35

8.56% ANDHRA SDL(SGS) 2028	2028	8.42				8.39
8.54% ASSAM SDL(SGS) 2028	2028	8.52	8.48	25.00	-0.04	**8.48**
8.42% ASSAM SDL(SGS) 2028	2028	8.43				8.40
Volume-weighted average MYM of the maturity-bucket					**-0.03**	

3. On a daily basis, the YTM of SDL(SGS)s that were not traded in the previous 7 calendar days, will be calculated using the following steps.
   a. The average of published YTM of SDL(SGS)s in a maturity-bucket, which traded at least once during the previous last 7 days are applied to the non-traded SDL(SGS)s in that maturity-bucket during that period.
   b. If a maturity-bucket does not contain any traded SDL(SGS), the simple mean of the VWAY of the two adjacent maturity-buckets are applied to the SDL(SGS)s in the non- traded maturity-buckets.
   c. Simple mean of the VWAY of the nearest maturity-bucket is applied to the nontraded maturity-buckets at the extreme ends of the maturity ladder.

V. Steps for Calibrating the Valuation Model

1. The realignment process will be done for a look-back period of 7 calendar days. This will be done using a process described in the following paragraphs.
2. The process, the start date for which will be 7 calendar days prior to the commencement date of the revised methodology, begins by calculating/ estimating the YTM in respect of all the outstanding SDLs(SGS). These are arranged and grouped into maturity-buckets, subject to the provisions of paragraph 3 below.
3. YTM of all the outstanding SDLs (SGS) as on the start date is calculated /estimated through the following steps:
   a. Traded SDL(SGS): Volume-weighted average yield (VWAY) is calculated for all traded SDL(SGS)s in each maturity-bucket.

b. Non-traded SDL(SGS): YTM of non-traded SDL(SGS)s in a maturity-bucket, if any, are set equal to the mean VWAY of traded SDL(SGS)s in that maturity- bucket.
c. Non-traded maturity-buckets: If there is no traded SDL(SGS) in a maturity-bucket, its VWAY is set equal to the mean VWAY of the two closest maturity-buckets on both sides of the maturity ladder.
d. Other maturity buckets: The VWAY of the closest maturity bucket is applied.

4. The realignment process for SDL(SGS)s with residual maturities ≤ 12 months will not be required, as the valuation of ISINs with residual maturities ≤ 12 months will be based on FBIL T-Bill benchmark rate and a spread, as described in the section VI. below.
5. Auctioned SDL(SGS)s has been/will be added to the list and redeemed SDL(SGS)s have been/will be removed from the list of outstanding SDL(SGS)s on a daily basis.
6. Thereafter, from the next business day onwards (after the start date) the YTM of traded SDL(SGS)s are subjected to the consistency and market alignment test, based on which MYM of different maturity-buckets are calculated.
7. Traded SDLs (SGS) are valued at the VWAY of the surviving trades. Non-traded SDLs (SGS) in a maturity-bucket is valued by adding the MYM of the maturity-bucket to their YTM of the previous day.

VI. Valuation of ISINs with maturity up to and including 12-months:

As stated in the paragraph 2 of section II, the valuation of ISINs with residual maturities ≤12 months will be done using the FBIL published T-Bills benchmark rate and a spread as detailed below:

a. The entire set of ISINs with residual maturities ≤ 12 months is divided into first three rolling time-buckets-
   i. 0.01 to 0.25 years or 3-month
   ii. 0.26 to 0.50 years or 6-month
   iii. 0.51 to 1.00 years or 12-month

b. Respective FBIL T-Bill benchmark rate plus a spread will be applied to each of the all the three sub-sets of ISINs to arrive at the final YTM.
c. FBIL T-Bill benchmark rates published daily on the FBIL's website for various tenors i.e., 3-month, 6-month and 12-month will be used.

Spread Calculation Process:

d. All traded SDL(SGS)s with residual maturities ≤ 12 months are divided into two categories: 0.5 year (6 months) and 1 year (12-months).
    i. 0.50 year – traded data for residual maturities ranging between 0.26 and 0.50 year will be considered for spread calculation.
    ii. 1.00 year – traded data for residual maturities ranging between 0.76 and 1.00 year will be considered for spread calculation.
e. A volume-weighted average rate is computed each day for all the traded SDL(SGS)s in each of the two categories mentioned above.
f. A spread between the published FBIL T-Bill benchmark rates and YTM of SDL(SGS)s with residual maturities ≤ 12 months that are traded is computed on each business day.
g. A 20-trading day moving average of the above spread will be calculated each business day. The spread thus calculated for 6 months will be added to the day's 3-month and 6-month FBIL-published T-Bill benchmark rates and the spread calculated for 12 months will be added to the 12-month FBIL-published T-Bill benchmark rate of the day
h. The final rates arrived at for the aforesaid maturities will be uniformly applied to all the ISINs in the respective maturity buckets.
i. SDL(SGS) traded data for residual maturities ≤ 12 months will not be used for valuation purpose.
j. The spread will be calculated on a 20-trading day moving average basis. If there are no trades in the last 20 trading days, the spread for the previous day will be repeated.
k. If the average spread comes to be a negative number, apply zero as the spread for that day.
l. Since the valuation of SDL(SGS)s with residual maturities ≤ 12 months is based on T-Bill benchmark rates, so no realignment is required for this maturity bucket,

as traded data for this category of SDL(SGS)s will not be used for their valuation.

VII. Computation of spread of SDL(SGS) over G-sec:

Post realignment and after the YTMs are calculated for all the outstanding ISINs, a spread will be calculated with G-Sec YTM for each half year maturity bucket beyond one year, like1.5, 2, 2.5, 3, …, etc. The G-Sec YTM chosen is the highest YTM in a half-yearly maturity bucket selected for computation of spreads between SDL(SGS) YTMs and G-Sec YTM for that maturity bucket.

All the SDL(SGS) ISINs having negative spread over the G-sec in the relevant maturity bucket will be identified and will go through a further fallback procedure in a water-fall approach. Under this waterfall method, the option b) is applied only when the criteria in a) is not met:

a) Lowest positive spread (SDL(SGS) –(minus) G-Sec) of the ISIN from same maturity bucket

Illustration:

Date	Description	Maturity	Resi Mat	Resi Mat round off	YTM	G-Sec YTM	Spread	Lowest of positive Maturity Bucket Spread	New YTM based on SDL(SGS) Gsec Spread
27-Nov-20	6.74 TN SDL(SGS) 2050	10-Jun-50	29.54	29.50	6.58	6.59	-0.01	-	6.59
27-Nov-20	6.69 TN SDL(SGS) 2050	17-Jun-50	29.56	29.50	6.58	6.59	-0.01	-	6.59

b) Lower of the two - lowest positive spreads (SDL(SGS) –(minus) G-Sec) of the ISIN of the preceding and succeeding maturity buckets.

Illustration:

Date	Description	Maturity	Resi Mat	Resi Mat round off	YTM	G-Sec YTM	Spread
31-Aug-20	8.38 TS SDL(SGS) 2049	13-Mar-49	28.54	28.5	6.74	6.79	-0.04

Preceding Tenor	Succeeding Tenor	Lowest positive of the Preceding Spread	Lowest positive of the Succeeding Spread	Lowest of the two spreads	New YTM based on SDL(SGS) GSec Spread	
23		0.06		0.06	6.85	Nearest maturity buckets 23.5, 29, 29.5, 34, 34.5, 39 and 39.5 were not taken as they have no matching g-sec

Note: This spread is applied to current day's GSec i.e., same ISIN as used in the spread calculation.

c) No adjustment will be carried out in the SDL(SGS) YTMs in a maturity bucket, if G- secs for that maturity is not available. (e.g.: 2037 and 2038 outstanding G-Secs are not available, hence, the final YTMs of the SDL(SGS) ISINs with in 2037 and 2038 maturity will not be adjusted)

VIII. Valuation of UDAY/DISCOM Bonds:

UDAY/ DISCOM bonds issued by the various State Governments are currently valued at a spread of 50 basis points to the par YTM of the G-Sec of equivalent residual maturity. These securities trade very sparingly. Hence, their traded price/YTM are not recognised for the purpose of new valuation methodology. Like SDL(SGS)s, UDAY/DISCOM bonds will also be grouped into maturity-buckets following the provisions of the paragraph 2 of Section II above. However, the maturity-buckets for UDAY/DISCOM bonds with residual maturity up to and including 12 months will be as per the provisions of the paragraph 4 of Section V above. A UDAY/DISCOM bond belonging to a particular maturity-bucket will be valued at the average of the published YTMs of the SDL(SGS)s of that maturity-bucket, as per the steps below:

1. Following this methodology, FBIL will calculate for the purpose of publication on each business day, a YTM curve in respect of SDL(SGS)s in all maturity-buckets. The YTM for a maturity-bucket will be the simple mean of all the published YTMs of all the SDL(SGS)s in that maturity-bucket.

2. UDAY/DISCOM bonds belonging to a maturity-bucket will be valued at the YTM of that maturity-bucket.

   A. **Illustrative example**: (Rates as on Feb 28, 2019)

Maturity Buckets	Average Published YTM of SDL(SGS) (%)	YTM for UDAY/DISCOM bonds (%)
1	6.6561	6.6561
2	6.9569	6.9569
3	7.0658	7.0658
4	6.9785	6.9785
5	7.059	7.059
2020	7.2037	7.2037
2021	7.2246	7.2246
2022	7.6149	7.6149
2023	7.8103	7.8103
2024	8.0608	8.0608
2025	8.2004	8.2004
2026	8.1684	8.1684
2027	8.3531	8.3531
2028	8.3708	8.3708
2029	8.4053	8.4053
2030	8.3729	8.3729
2031	8.3434	8.3434
2032	8.6931	8.6931

   B. **Illustrative example**: Price and YTM for UDAY/DISCOM bonds in Maturity-bucket 2028

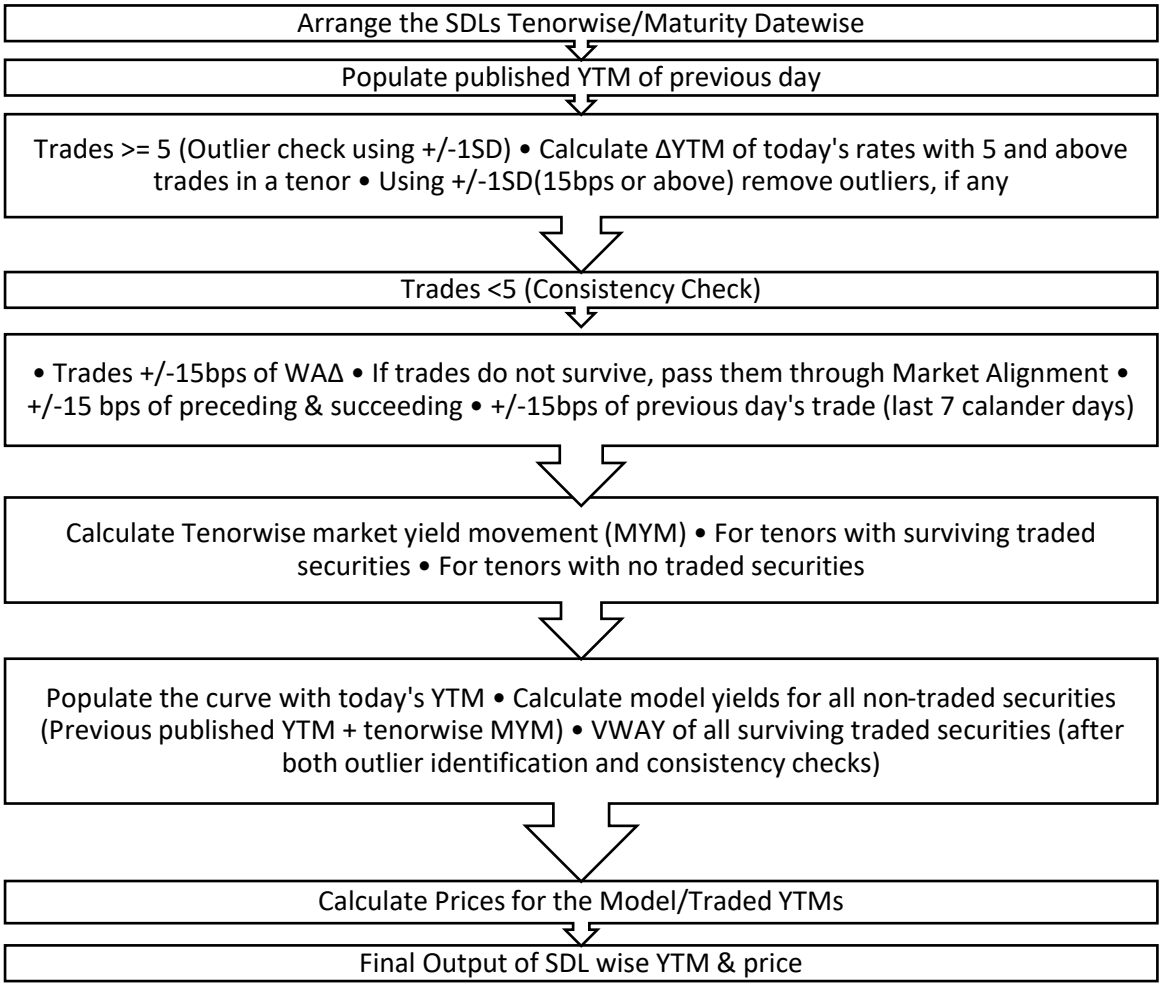
Security Description	Maturity- Bucket	Price (₹)	YTM (%)
07.68 TN UDAY 2028	2028	95.6970	8.3708
07.69 TN UDAY 2028	2028	95.7592	8.3708
07.70 TN UDAY 2028	2028	95.8215	8.3708
07.71 TN UDAY 2028	2028	95.8837	8.3708
07.72 TN UDAY 2028	2028	95.9459	8.3708
10.03 RJ SDL(SGS) SPL 2028	2028	110.8033	8.3708
07.23 AP UDAY 2028	2028	92.5441	8.3708
07.34 AP UDAY 2028	2028	93.2614	8.3708
07.35 AP UDAY 2028	2028	93.3266	8.3708
07.37 AP UDAY 2028	2028	93.4570	8.3708
08.61 UP SDL(SGS) SPL 2028DEC	2028	101.5617	8.3708

IX. Miscellaneous:

1. The price/YTM of all the SDL(SGS)s and UDAY/DISCOM bonds will be published on all Mumbai business days, excluding Saturdays, Sundays and Mumbai holidays by 7 PM.
2. The securities with residual maturity less than six months will be treated as money market instruments and their prices will be calculated accordingly.
3. If on a particular business day, if there is no SDL(SGS) trade or SDL(SGS) auction, or if the traded YTM do not fulfil the conditions for being used for valuation, the previous day's published YTM will be repeated.
4. The prices of SDL(SGS)/UDAY/DISCOM bonds will be derived from their YTM and will be published up to **four decimal places.**
5. **Error Re-fix:** The following error materiality threshold will be used for error re-fix if any:

Residual Maturity	Bucket	Error Materiality Threshold in basis points
1-5 Years	Bucket 1	5
>5-15 Years	Bucket 2	3
> 15 Years	Bucket 3	2

Flowchart of SDL(SGS) Valuation Methodology for maturities above 12 months:


Arrange the SDLs Tenorwise/Maturity Datewise
Populate published YTM of previous day
Trades >= 5 (Outlier check using +/-1SD) • Calculate ΔYTM of today's rates with 5 and above trades in a tenor • Using +/-1SD(15bps or above) remove outliers, if any
Trades <5 (Consistency Check)
• Trades +/-15bps of WAΔ • If trades do not survive, pass them through Market Alignment • +/-15 bps of preceding & succeeding • +/-15bps of previous day's trade (last 7 calander days)
Calculate Tenorwise market yield movement (MYM) • For tenors with surviving traded securities • For tenors with no traded securities
Populate the curve with today's YTM • Calculate model yields for all non-traded securities (Previous published YTM + tenorwise MYM) • VWAY of all surviving traded securities (after both outlier identification and consistency checks)
Calculate Prices for the Model/Traded YTMs
Final Output of SDL wise YTM & price

(B): FBIL SDL(SGS) ZCYC Methodology

July 7, 2022

Version – 1

Introduction

1. The Reserve Bank of India in its Statement of Development and Regulatory Policy announced on August 7, 2019, indicated that FBIL will develop ZCYC on SDL(SGS) for widening the bond market. A ZCYC on SDL(SGS) would also facilitate stripping of SDL(SGS). Accordingly, FBIL started examining various approaches for the development of ZCYC on SDL(SGS). It is an acknowledged fact that the SDL(SGS) market in India lacks depth and liquidity and very few SDL(SGS) ISINs are traded on any given day. It is also observed that there are wide variations in the yield (YTM) of ISINs with equal or similar residual maturity. It makes the task of developing a ZCYC on SDL(SGS) a challenging one.
2. Notwithstanding this insufficient liquidity in the SDL(SGS) market, the preferred methodology for SDL(SGS)-ZCYC construction approach should be, following the IOSCO principles, based on prices, rates, indices or values that have been formed by the competitive forces of supply and demand. Accordingly, it was decided by FBIL to use as much secondary market (traded) data as possible for construction of SDL(SGS)- ZCYC.
3. Further, it was decided that the broad methodology for construction of SDL(SGS)-ZCYC would be on the similar line as it is followed for construction of G-Sec ZCYC. Thus, the same bootstrapping technique followed by Cubic Spline based smooth curve construction methodology would be adopted for building SDL(SGS)-ZCYC.
4. The extant methodology for valuation of individual SDL(SGS) ISINs would continue and it is quite likely that difference between the prices of individual ISINs based on ZCYC and their valuations as published by FBIL will occur, especially in the cases of ISINs that are not traded on the day of ZCYC publication.

5. Computation Methodology:

5.1. Input data set:

The input data used in the construction of ZCYC are divided into two segments:

i. Residual Maturity upto 12 months.

ii. Residual Maturity above 12 months.

5.2. Residual Maturity up to 12 months (1- year):

- The input points for maturities up to and including 12 months: As the SDL(SGS)s with residual maturity upto and including 12 months do not trade very often, for construction of ZCYC, the T-Bill rates published by FBIL are used as inputs for this segment. Along with the T-Bill rate a spread is added.
- FBIL 7-day T-Bill rate is used as the first input point. This point is the anchor for spot rate. No spread will be applied to the 7-day T-Bill rate as it is used as an overnight rate.
- The next three input points are: 3-Month FBIL T-Bill rate, 6-Month FBIL T-Bill rate and 12-Month FBIL T-Bill rate plus a spread.
- Spread calculation: The spread is intended to capture the difference between the T-Bill and traded SDL(SGS) YTM for the relevant maturity on a particular day.
    - The traded SDL(SGS)s are divided into two categories below 6-Months and above 6-Months. The SDL(SGS)s above ₹5 Crores trades and residual maturity upto and including 12-Months are taken.
    - ISINs having residual maturity from 0.26 to 0.50 years are grouped under 6-month category and from 0.76 to 1.00 years under 12-month category.
    - The spread between the T-Bills and the SDL(SGS) for the 6-month and 12-month maturities are computed for the last 20 trading days. The spread is calculated on a moving average basis.
    - Spread is calculated as the difference between the traded SDL(SGS) and FBIL published T-Bill rates.
    - A volume weighted average of the spread is calculated for last 20 trading days.
    - The spread calculated for 6-Month T-Bill is applied to the 3-Month and 6-Month T-Bill rates and the spread calculated for 12-Month is applied to the 12-Month T-Bill rate.
    - In case the spread is negative, it is treated as equal to zero in order to be consistent with the empirically observed fact that SDL(SGS) YTM are higher than T-Bill rate of the same maturity.
    - In the event of no spread is available in the last 20 trading days (look- back period), the last calculated spread will be repeated.

5.3. Maturities above 12 months and upto 14 years:

The data to be used for maturities above 12 months and upto 14 years will be drawn from the data set that are prepared for the purpose of SDL(SGS) valuation. For this purpose, the below-mentioned steps will be followed in a 'waterfall' sequence for each tenor:

- Select maximum number of traded ISINs plus auctioned ISINs from among those which pass outlier test or consistency check[1], as the case may be, subject to the condition that the time distance between any two adjacent ISINs is not less than 0.25-year/3 months.
- If there are more than one ISIN with exactly identical maturity date[2], select the one with highest [Volume × Number of trades]
- If [Volume × Number of trades] is identical for two or more ISINs, then select the one with the lowest YTM.
- If YTM is identical for two or more ISINs, select anyone of them.
- For the construction of ZCYC, the entire SDL(SGS) curve is divided into following segments:
    - Up to and including 1 year.
    - Above 1 year - at least one input point per half year (two input points should have a distance of 3 months and if this criterion qualifies, more input points in a maturity can be considered).
    - The segments start from 1.25 years as 1 year input point is chosen using the T-Bill's plus spread criteria. The minimum gap between two input points is maintained at 0.25 years.

- [1]As outlined in the SDL(SGS) Methodology document.
- [2]Usually, SDL(SGS)s of several States with identical tenors are auctioned on the same day. Hence, their redemption dates become identical

    - The last input point [nearest 14-year maturity (≤14.00 years' residual maturity)] is compulsorily the last outstanding ISIN. If there are more than

one ISINs with same maturity in the very last segment, choose the one that is mostly traded.

- The segment will be 1.5, 2.0, 2.5, 3.0, 3.5, …, up to 14 years. (The last maturity input point may vary depending on the issue of SDL(SGS))
- There are few segments with no outstanding ISINs, those are excluded from the input segment.

- Each segment will have at least 1 traded ISIN. If it is not possible to have traded ISINs in each of the segment, proxies may be used. The proxy ISIN in a segment is one or more ISINs used as inputs in the previous day's ZCYC for that segment. The published YTMs for the day (as per the SDL(SGS) methodology) of these selected ISINs is used as input.
- If there were two ISINs traded on the previous day and used in the SDL(SGS) valuation, the one with the higher product (No. of trades * Volume) is used as input for proxy.

Various scenarios for selection of input points both traded or proxy data are given below:

Selection of input points in a maturity segment	**Proxy Calculation**
Single ISIN traded	No proxy required
No ISIN traded while single ISIN traded on the previous day.	The ISIN with higher product will be used.
No ISIN traded today while two ISIN traded on the previous day.	The ISIN with higher product will be used.
No ISIN traded today or on the previous day.	Use the ISIN used as proxy on the previous day as the input today

- Repeat the ISIN till a new ISIN in a segment is traded. (In case of SDL(SGS), a 20-trading day look back period does not work as it is observed that ISINs in a particular maturity bucket may not trade for consecutive months).

Illustration: The below table indicates the last traded date for certain ISINs that were used as input point in the January 31, 2020 model run.

Model Run Date	ISIN DESCRIPTION	Valuation date status	Last Traded
31-Jan-20	07.59 TN SDL(SGS) 2031	Not Traded	09-Jan-20
31-Jan-20	07.22 PN SDL(SGS) 2032	Not Traded	28-Jan-20
31-Jan-20	07.48 KL SDL(SGS) 2032	Not Traded	27-Jan-20
31-Jan-20	07.19 AP SDL(SGS) 2034	Not Traded	24-Jan-20

6. Publication of SDL(SGS) ZCYC:

- The SDL(SGS)-ZCYC will be published for the tenors, starting from 0.25 years and going up to and including 14 years (56 time points with three months' interval between two adjacent time-points or tenors).
- The SDL(SGS) Zero Coupon Yields will be published up to two decimal places in semi- annual as well as annual formats.
- A SDL(SGS) Par Yield Curve will be generated from the SDL(SGS) ZCYC using a standard methodology.
- SDL(SGS) Par Yield Curve will also be published upto two decimal places in semi-annual as well as annual formats.
- Any change in the SDL(SGS) methodology will reflect changes in the SDL(SGS) ZCYC methodology, as the input points used in the computation of SDL(SGS) ZCYC are obtained from the published SDL(SGS) Valuation prices/YTMs.

• The SDL(SGS) ZCYC methodology will be reviewed annually along with the SDL(SGS) valuation methodology.

X. Data Quality Assurance & Disclaimer:

While FBIL makes all reasonable efforts to ensure the accuracy of the benchmarks, it makes no warranty, representation or undertaking, expressed or implied by law or otherwise, in relation to the benchmarks, and expressly disclaim, to the fullest extent permitted by applicable law, all liability in any form whatsoever with respect to any errors or omissions, or losses caused by disruptions in the service or late publication of the Rates and other benchmarks or inaccuracy thereof or otherwise arising from the use of or reliance on the Rates and other benchmarks and contents in its website.

Annexure I

Illustration of Realignment of securities

Note: Securities in red font have been recalibrated to Bucket/Tenor average YTM

Valuation Date: 15-01-2025 (Before Realignment)									
ISIN	**Description**	**Maturity Date**	**Maturity Bucket**	**PREV DAY PYTM (A)**	**MYM of Maturity Bucket(B)**	**Model YTM (A+B)**	**TENOR Average YTM (C)**	**Last Traded Date**	**PUBLISHED YTM (A+B)**
IN2920170148	08.07 RJ SDL 2028	31-Jan-28	2028	7.0564	-0.0142	7.0423	7.0603	08-01-2025	7.0423
IN2920170189	08.44 RJ SDL 2028	07-Mar-28	2028	7.0564	-0.0142	7.0423	7.0603	08-01-2025	7.0423
IN2920170197	08.28 RJ SDL 2028MAR	14-Mar-28	2028	7.0564	-0.0142	7.0423	7.0603	08-01-2025	7.0423
IN2920180105	08.44 RJ SDL 2028JUN	27-Jun-28	2028	7.1381	-0.0142	7.124	7.0603	08-01-2025	7.124
IN1920190098	07.23 KA SDL 2028	06-Nov-28	2028	7.0647	-0.0142	7.0506	7.0603	10-01-2025	7.0506

Valuation Date:16-01-2025 (After Realignment)									
ISIN	**Description**	**Maturity Date**	**Maturity Bucket**	**PREV DAY PYTM(A)**	**MYM of Maturity Bucket (B)**	**Model YTM (A+B)**	**Tenor Average YTM (C)**	**Last Traded Date**	**Published YTM (C)**
IN2920170148	08.07 RJ SDL 2028	31-Jan-28	2028	7.0423	-0.0608	6.9815	7.0089	08-01-2025	7.0089
IN2920170189	08.44 RJ SDL 2028	07-Mar-28	2028	7.0423	-0.0608	6.9815	7.0089	08-01-2025	7.0089
IN2920170197	08.28 RJ SDL 2028MAR	14-Mar-28	2028	7.0423	-0.0608	6.9815	7.0089	08-01-2025	7.0089
IN2920180105	08.44 RJ SDL 2028JUN	27-Jun-28	2028	7.124	-0.0608	7.0632	7.0089	08-01-2025	7.0089
IN1920190098	07.23 KA SDL 2028	06-Nov-28	2028	7.0506	-0.0608	6.9898	7.0089	10-01-2025	6.9898

Illustration for spread calculation (20-Day Moving Average):

Trade Date	ISIN	Security Description	Redemption Date	Residual Maturity (year)	No. of Trades	FV in ₹ crores	Traded VWAY	6M T-bill Rate	T-Bill Rate	Spread (bps)
05-Jan-21	IN1620110016	08.36 HARYANA SDL(SGS) 2021	08-Apr-21	0.26	1	5	3.15	3.23	3.33	-18
07-Jan-21	IN2920180048	08.15 RAJASTHAN SDL(SGS) 2021	23-May-21	0.38	1	5	3.37	3.32	3.42	-5
Volume Weighted Average Spread										0

Trade Date	ISIN	Security Description	Redemption Date	Residual Maturity (year)	No. of Trades	FV in ₹ crores	Traded VWAY	12M T-bill Rate	T-Bill Rate	Spread (bps)
05-Jan-21	IN3520180024	08.11 CHHATISGARH SDL(SGS) 2021	31-Oct-21	0.82	1	50	3.6	3.43	3.6	0
05-Jan-21	IN1920190122	06.10 KARNATAKA SDL(SGS) 2021	11-Dec-21	0.93	1	100	3.6	3.43	3.6	0
05-Jan-21	IN1220180179	07.90 ASSAM SDL(SGS) 2021	12-Dec-21	0.93	1	75	3.6	3.43	3.6	0
06-Jan-21	IN1520160129	07.03 GUJARAT SDL(SGS) 2021	26-Oct-21	0.8	1	25	3.6	3.45	3.62	-2
12-Jan-21	IN3520180040	07.90 CHHATISGARH SDL(SGS) 2021	28-Nov-21	0.88	1	20	3.8	3.49	3.67	13
12-Jan-21	IN2220110083	08.72 MAHARASHTRA SDL(SGS) 2022	11-Jan-22	0.99	1	50	3.95	3.49	3.67	28
13-Jan-21	IN2020110051	09.03 KERALA SDL(SGS) 2021	07-Dec-21	0.9	1	5	4.2	3.56	3.74	46
14-Jan-21	IN2020110051	09.03 KERALA SDL(SGS) 2021	07-Dec-21	0.89	1	5	4.01	3.57	3.76	26
14-Jan-21	IN3420110154	08.75 WEST BENGAL SDL(SGS) 2022	11-Jan-22	0.99	1	20	4.05	3.57	3.76	29
15-Jan-21	IN3420110154	08.75 WEST BENGAL SDL(SGS) 2022	11-Jan-22	0.98	1	5	4.05	3.56	3.74	31
19-Jan-21	IN1920190122	06.10 KARNATAKA SDL(SGS) 2021	11-Dec-21	0.89	2	200	3.85	3.54	3.72	13
21-Jan-21	IN1920190122	06.10 KARNATAKA SDL(SGS) 2021	11-Dec-21	0.89	1	75	3.85	3.58	3.77	8

21-Jan-21	IN1220180187	07.73 ASSAM SDL(SGS) 2021	19-Dec-21	0.91	1	100	3.85	3.58	3.77	8
21-Jan-21	IN1220180195	07.86 ASSAM SDL(SGS) 2022	02-Jan-22	0.94	1	25	4	3.58	3.77	23
22-Jan-21	IN3320110114	09.02 UTTAR PRADESH SDL(SGS) 2021	07-Dec-21	0.87	2	20	3.98	3.58	3.77	21
22-Jan-21	IN3420110139	09.04 WEST BENGAL SDL(SGS) 2021	07-Dec-21	0.87	2	20	3.98	3.58	3.77	21
28-Jan-21	IN2220110083	08.72 MAHARASHTRA SDL(SGS) 2022	11-Jan-22	0.95	1	25	4	3.65	3.84	16
Volume Weighted Average Spread										16

Annexure-2

Glossary of Terms:

- **OMO**: Open Market Operations are the market operations conducted by the Reserve Bank of India by way of sale/ purchase of G-Secs to/ from the market with an objective to adjust the rupee liquidity conditions in the market on a durable basis.
- **NDS-OM**: Negotiated Dealing System-Order Marching (NDS-OM) is an order driven electronic system, where the participants can trade anonymously, in the secondary market, by placing their orders on the system or accepting the orders already placed by other participants. NDS-OM is operated by the Clearing Corporation of India (CCIL), on behalf of Reserve Bank of India.
- **YTM**: Yield to Maturity (YTM) is the expected rate of return on a bond if it is held until its maturity. The price of a bond is simply the sum of the present values of all its remaining cash flows, up to maturity. The present value is calculated by discounting each cash flow at a rate; this rate is the YTM.
- **ISIN**: International Securities Identification Number is a 12-digit alphanumeric code that uniquely identifies a specific security. Hence, no two securities will have the same ISIN. The organization that allocates ISINs, in any particular country, is the National Numbering Agency (NNA) for the country.
- **UDAY/DISCOM**: These are bonds issued by State Governments as special securities under “Ujjwal Discom Assurance Yojna (UDAY) Scheme for Operational and Financial Turnaround of Power Distribution Companies (DISCOMs).

Annexure-3

Modifications in the SDL(SGS) Methodology Document

Para No.	Existing Version-4	New Version-5
3	**IV. Valuation of SDL(SGS)s in Each Maturity-Bucket** On a daily basis, the YTM of SDL(SGS)s that were not traded in the previous one month, will be calculated using the following steps. a) The average of published YTM of SDL(SGS)s in a maturity-bucket, which traded at least once during the previous last One month are applied to the non-traded SDL(SGS)s in that maturity-bucket during that period.	**IV. Valuation of SDL(SGS)s in Each Maturity-Bucket** On a daily basis, the YTM of SDL(SGS)s that were not traded in the previous one month, will be calculated using the following steps. a) The average of published YTM of SDL(SGS)s in a maturity-bucket, which traded at least once during the previous last One month are applied to the non-traded SDL(SGS)s in that maturity-bucket during that period.
1	**I. Steps for Calibrating the Valuation Model** The realignment process will be done for a look-back period of one month.	**V. Steps for Calibrating the Valuation Model** The realignment process will be done for a look-back period of 7 Days.
	Annexure I Illustration of realignment- 30 days	**Annexure I** Illustration of realignment- 7 days

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