ESTIMATION OF RUPEE FORWARD PREMIA AND MIFOR CURVE[1]

Methodology Document

FBIL US DOLLAR / RUPEE FORWARD PREMIA AND MIFOR (MUMBAI INTER-BANK FORWARD OUTRIGHT RATE) CURVE will be computed daily as per the following methodology:

1. Inter-bank Forex SWAP (SPOT and FORWARD Pairs) trades expiring in the month-end upto 12 month ends, that are reported to CCIL upto 3 PM each working day are taken for estimation of US Dollar / Rupee Term Forward premia (%). Only CASH – TOM pairs are taken for the estimation of Overnight US dollar/Rupee Forward premium (%).
2. The transactions which are considered for inclusion in computation basket should be initiated on both the first and second legs by the same party and with the same dollar amount on both the sides. The first leg is settled on the Spot Settlement date and the second leg is settled on the respective month-end forward settlement date. In addition to the above matching criteria, the transaction pairs are identified by a common indicator, the Reference number, with the flag indicating the first leg and the second leg of that US Dollar / Rupee swap pair (***Annexure-1***). Only transactions of US$1 million and above are considered for estimation of the Rates.
3. For each pair, the annualized US dollar/Rupee forward premium (%) is computed upto four decimal places as per the equations (1) and (2) below.

$$\textit{Annualised O/N Forward Premia} = \left[\frac{T_t - C_t}{C_t}\right] \times \left[\frac{365}{T_{Value\ Date} - C_{Value\ Date}}\right] \times 100 \quad \ldots(1)$$

where,
C_t *is the Cash Rate;*
T_t *is the Tom Rate;*
$C_{Value\ Date}$ *is the Cash Settlement Date and*
$T_{Value\ Date}$ *is the Tom Settlement Date.*

$$\textit{Annualised Month End Forward Premia} = \left[\frac{F_t - S_t}{S_t}\right] \times \left[\frac{365}{F_{Value\ Date} - S_{Value\ Date}}\right] \times 100 \quad \ldots(2)$$

where,
F_t *is the Forward Rate;*
S_t *is the Spot Rate;*
$F_{Value\ Date}$ *is the Forward Settlement Date and*

[1] Prepared by Dr. Golaka C Nath for FBIL OC.

$S_{Value\ Date}$ *is the Spot Settlement Date.*

4. For each pair, the US dollar amount is multiplied by the annualized US dollar/Rupee forward premium (%), as calculated in step 3 above.
5. The volume-weighted average annualized Forward Premium (%) of the transactions along with standard deviations are computed for tenors like overnight, 1-month, 2-month, etc.
6. Any annualized forward premium (%) outside the range of +/-3SD are excluded from further computation.
7. After exclusion of outliers, the volume-weighted average annualized premium (%) for each tenor is computed subject to the threshold criteria that at least total of 3 trades and aggregate volume of US$ 25 million are available for that tenor.
8. Necessary steps are taken for roll-over 2 business days prior to the last business day of the month.
9. Fallback mechanism (***Annexure-2***) for calculation of month end Forward premia for various tenors which do not satisfy the threshold criteria detailed in Sl. 7 is as follows:
    a. Interpolation/Extrapolation will be carried out if there are a minimum of 3 traded tenors, at least one of which should be 3 months or less and at least one of which should be more than 6 months. The forward premia (%) for tenors that do not satisfy the threshold criteria are calculated by way of interpolation between two closest tenors available (traded/calculated) beginning with the lowest tenor, but excluding the overnight tenor (***Scenario 1***). The forward premia (%) for the remaining tenors will be calculated by way of extrapolation (***Scenario 2***), beginning from the nearest tenor available (traded/calculated). In case the spread of the Forward Premia rate computed for a tenor using either interpolation/extrapolation varies by more than (+/-) 10 bps compared to the previous day's Month-End Forward Premia (%), then the current day's Month-end Forward Premia (%) for that Tenor will be recomputed as the previous day's month-end forward premia plus the average spread of the two most liquid traded tenors of the day (on the basis of Value-USD Million) (***Scenario 3***).

b. In case there are 3 or more traded tenors, but the criteria of less than or equal to 3 months and higher than 6 months, as in ***(a.)*** above, are not met, then the month-end forward premia (%) in respect of the remaining tenor(s) will be calculated using previous day's month-end forward premia (%) of that tenor plus the average spread of the two closest tenors available (traded/calculated). The month-end forward premia (%) for the extreme tenor(s) are calculated first using the nearest available spread, if necessary, and then in respect of the remaining missing tenor(s), the month-end forward premia (%) are calculated, moving from the shorter to the longer tenor(s) (***Scenario 4***).

c. In case the month-end forward premia (%) can be calculated on the basis of traded data for only two tenors, then the month-end forward premia (%) for the remaining tenors will be computed using previous day's month-end forward premia (%) for the respective tenors plus the average spread of two closest tenors available (traded/calculated). As in ***(b.)*** above, the month-end forward premia (%) for the extreme tenor(s) are calculated first using the nearest available spread, if necessary, and then in respect of the remaining missing tenor(s), the month-end forward premia (%) are calculated, moving from the shorter to the longer tenor(s) (***Scenario 5***).

d. In case month-end forward premium (%) can be calculated on the basis of traded data for only one tenor, then the previous day's month-end forward premia (%) are used/repeated for the remaining tenors (***Scenario 6***).

e. In case month-end forward premium (%) cannot be calculated based on traded data even for any one tenor, then the previous day's month-end forward premia (%) for all the tenors will be used/repeated.

10. In case of missing tenors, the US Dollar/Rupee forward premia in the rupee terms for the tenor is computed from the calculated month end US Dollar/Rupee forward premia (%) by using the CCIL SPOT US dollar/Rupee rate computed up to 3:00 PM, using the equation (3) below:

$$\textbf{Rupee Forward Premia} = FP_M \times S_t \times \left(\frac{N}{36500}\right) \qquad \textbf{...(3)}$$

where,

FP_M is the Month End Forward Premia Rate(%) for the relevant tenor
S_t is the applicable Spot Rate
N is the number of calendar days from Spot settlement date to the month end settlement date

11. The computation process of US dollar/Rupee forward premia (%) also takes into account the observed jump in the US dollar/Rupee swap points and forward premium, both in the rupee terms as also in percentage terms, during financial year ends [between the last working day of March and the first working day of April], commonly known as the 'year-end-turn'.
    a. Traded data on US dollar/Rupee forward premium/swap points for the period between the last working day of March and the first working day of April are derived from the forward-on-forward swaps with the first leg value date on the last working day of March and the second leg value date on the first working day of April. (For example, in 2017-18, the first leg value date was March 31, 2017 and that for the second leg was April 3, 2017). This is hereinafter referred to as the 'year-end-turn'.
    b. The volume-weighted average annualized forward premia (%) as also the premia in the rupee terms are calculated on the basis of the traded forward-to-forward swaps, as described in a. above, provided the swaps are of value US$ 1 million or above. After elimination of outliers (by applying a +/- 3 STD criterion to the volume-weighted average forward premium (%), the final volume- weighted average forward premium in rupee terms is calculated, provided there are at least 3 forward-to-forward swap trades and their aggregate value is at least US$25 million.
    c. The weighted average forward premium in the rupee terms, as calculated in b. above, is added to the month-end US dollar/Rupee forward premium in the rupee terms (traded/calculated) for the month of March to obtain the first working day of new financial year forward premium in the rupee terms. In case there are no such traded forward-to-forward swaps, as in b. above, on any day, the year-end-turn of the previous day will be repeated. This will be allowed for a maximum of two consecutive days. Beyond that, the process will follow the equation (4) below. The forward premia in the rupee terms for end of March, and including the year-end-turn will be computed from June of every calendar year through March

of the next calendar year (till one business day prior to the rollover date for March-end). This is done because it will not be possible to calculate the YET using formula 3 if 12M month end point falls in March or April of next financial year. Year End Turn premia (Rupee and Rate percentage) calculation is shown in ***Annexure-3***.

$$\boldsymbol{Premia_{YET} = Premia_{Mar} + \left\{[Premia_{Apr} - Premia_{Mar}] - \left[\left(\frac{Premia_{May} - Premia_{Apr}}{Date_{May} - Date_{Apr}}\right) \times (Date_{Apr} - Date_{YET})\right]\right\}} \quad \textbf{...(4)}$$

Where

$Premia_{YET}$ *is the rupee premia for the year end turn date (first business day of April)*
$Date_{YET}$ *is the year end turn date (first business day of April)*
$Premia_{Mar}$ *is the month end rupee premia for March with value date of* $Date_{Mar}$
$Premia_{Apr}$ *is the month end rupee premia for April with value date of* $Date_{Apr}$
$Premia_{May}$ *is the month end rupee premia for May with value date of* $Date_{May}$.

12. Using the month-end annualized forward premia (%) and incorporating INR financial "Year-End Turn", the rolling forward premia (%) are computed for all tenors, ranging from 1 month to 12 months, using interpolation/extrapolation method as per the equation (5) and equation (6) below except on Mumbai holidays:

$$\boldsymbol{M\ Month\ Rolling\ Forward\ Premia}\ (\%) = \boldsymbol{FP_M} + \frac{[(\boldsymbol{N - Days_M}) \times (\boldsymbol{FP_{M+1} - FP_M})]}{\boldsymbol{Days_{M+1} - Days_M}} \ldots (\mathbf{5})$$

where,
FP_M *is the weighted average forward premia rate for M month end,*
FP_{M+1} *is the weighted average forward premia rate for the following month end (M+1),*
N is the number of calendar days from Spot settlement date using modified following day convention taking into account Mumbai and New York holidays till M month Rolling Forward Settlement Date.
$Days_M$ *is the day difference between the settlement dates of spot and the M month end forward,*
$Days_{M+1}$*is the day difference between the settlement dates of spot and the M+1 month end forward.*

$$\mathbf{12}\ \boldsymbol{Month\ Rolling\ Forward\ Premia}\ (\%) = \boldsymbol{FP_{12M}} + \frac{[(\boldsymbol{12M - Days_{12M}}) \times (\boldsymbol{FP_{12M} - FP_{11M}})]}{\boldsymbol{Days_{12M} - Days_{11M}}} \quad \textbf{...(6)}$$

where,

FP_{12M} *is the 12 month weighted average 12M month end forward premia rate,*
FP_{11M} *is the 11 months weighted average 11M month end forward forward premia rate,*
$12M$ *is the number of calendar days from Spot settlement date using modified following day convention taking into account Mumbai and New York holidays till 12M month Rolling Forward Settlement Date*
$Days_{12M}$ *is the day difference between the settlement dates of spot and the 12month end forward,*
$Days_{11M}$ *is the day difference between the settlement dates of spot and the 11month end forward.*

To illustrate the computation of the 1M Rolling Forward Premium (%) as on January 04, 2016, we use the following details and apply Equation (5*)*:

Variables	Rate	Settlement Date	Day Difference
Spot	66.47	06-01-16	
1-Month Weighted Average Forward Premia Rate	6.27%	29-01-16	23
2-Month Weighted Average Forward Premia Rate	6.36%	29-02-16	54
One Month Calendar Date		08-02-16[2]	33

$$1M\ Rolling\ Forward\ Premia\ (\%) = 6.27 + \frac{[(33-23)\times(6.36-6.27)]}{54-23} = 6.29$$

Illustration of 12M Rolling Forward extrapolated from 11M and 12M is given in ***Annexure-4***.

13. From the rolling forward premia (%), the US dollar/Rupee forward premia in the rupee terms for each tenor are computed using the CCIL SPOT US dollar/Rupee rate computed up to 3:00 PM, using the equation (7) below:

$$\boldsymbol{Rupee\ Forward\ Premia = FP_M \times S_t \times \left(\frac{N}{36500}\right)} \qquad \boldsymbol{\ldots(7)}$$

w*here,*
FP_M *is the Rolling Forward Premia Rate(%) for the relevant tenor*
S_t *is the applicable Spot Rate*
N *is the number of calendar days from Spot settlement date using modified following day convention till Forward Settlement date.*

[2] 06-Feb-2016 and 07-Feb-2016 are Saturday and Sunday (Holidays).

14. If Rolling Forwards are traded for any of these 12 tenors with fulfilment of minimum threshold criteria as defined in Sl. 7 of this document, then the said traded Rolling Forward Premia (% and Rupee) would replace the calculated Rolling Forward Premia (%) and Rupee Premia for those tenors.
15. If Month-end Forward premia is repeated for any Tenor as detailed in Sl. 9 (d) and Sl. 9 (e) in this document due to lack of meeting threshold criteria, Rolling Forward premia will also be repeated for the said Tenor. In a scenario where only 1 Tenor is traded and the Month-end Forward Premia is repeated for the remaining Tenors, then the Rolling Forward Premia (% and Rupee) for that traded Tenor is calculated using the method as stated in Sl. 12 and Sl. 13, while the Rolling Forward (% and Rupee Premia) is repeated for the remaining Tenors (**Annexure-5).**
16. For the Overnight US Dollar/Rupee forward premium (%), the volume-weighted average CASH US Dollar /Rupee exchange rate reported up to 12.00 Noon will be used.
17. The computed/traded rolling US dollar/Rupee forward premia (%) and the rolling US dollar/Rupee forward premia (in Rupee terms) for all tenors from Overnight up to and including 12 months along with the US dollar/Rupee forward premium in the rupee terms for end-March plus the year-end-turn will be disseminated by **4:15 PM**.
18. MIFOR rates for Overnight, 1 month, 2 months, 3 months, 6 months and 12 months are estimated using the computed US dollar/Rupee forward premia (%) and the US dollar LIBOR for the respective tenors using the equation (8) below. If it is a holiday in the US, the previous day's LIBOR will be used for this purpose.

$$\boldsymbol{MIFOR} = \left[\left(1 + \boldsymbol{LIBOR} \times \frac{N}{36000}\right) \times \left(1 + \boldsymbol{Rolling\ Forward\ Rate} \times \frac{N}{36500}\right) - 1\right] \times \frac{36500}{N} \quad \ldots (8)$$

Where

N is the number of calendar days from Spot settlement date using modified following day convention taking into account Mumbai and New York holidays till Forward Settlement Date.

N is the number of calendar days from Cash settlement date using modified following day convention in case of overnight MIFOR

19. In case of New York Holiday, Overnight Forward premia will not be computed.
20. The MIFOR for various tenors ranging from Overnight up to and including 12 months will be disseminated on each working day around 5:00 PM (as shown in **Annexure-6**) subject to availability of LIBOR. The time of release of MIFOR will shift to 6.00 PM when the LIBOR release is delayed due to Day Light Savings.

21. In case Rolling Forwards (% and Rupee premia) are repeated, MIFOR would be computed using the said repeated Rolling Forwards but with the day's LIBOR for the respective Tenor.
22. All computations are rounded off at each stage to 4 decimal places.
23. An illustration of the computation of Rolling Forward Premia is depicted in **Annexure – 7.**

Reference:

METHODOLOGY FOR COMPUTATION OF BENCHMARK FORWARD PREMIA AND MIFOR CURVE by Golaka C Nath, Sahana Rajaram and Manoel Pacheco

Annexure-1

Data Sample												
Trade Date	**Value Date**	**Trade Type**	**Buy Currency**	**Buy Amount**	**Exchange Rate**	**Sell Currency**	**Sell Amount**	**Common Reference**	**Premia (a)**	**Trade (b)**	**USD Amount (c)**	**Weighted Amount (d)=(a) x (c)**
04-01-16	06/01/16	SPOT	INR	662300000	66.2300	USD	10000000	XX009F				
04-01-16	29/01/16	FORWARD	USD	10000000	66.4905	INR	664905000	XX009S	6.24	1	10000000	62419172
04-01-16	06/01/16	SPOT	USD	5000000	66.2100	INR	331050000	XX094F				
04-01-16	29/01/16	FORWARD	INR	332357500	66.4715	USD	5000000	XX094S	6.27	1	5000000	31338856

$$\textit{Annualised Month End Forward Premia}\ (\%) = \left[\frac{66.4905 - 66.2300}{66.2300}\right] \times \left[\frac{365}{29/01/16 - 06/01/16}\right] \times 100 = 6.24$$

Annexure-2

Scenario 1: *Criteria Accepted- Interpolation/Extrapolation for missing tenor points*

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	Month end Forward Settlement Date	31-05-17	30-06-17	31-07-17	31-08-17	29-09-17	31-10-17	30-11-17	29-12-17	31-01-18	28-02-18	28-03-18	27-04-18
3	02-05-17	5.10	BLANK	4.99	4.96	4.93	BLANK	4.89	4.87	4.88	BLANK	BLANK	4.79

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	Month end Forward Settlement Date	31-05-17	30-06-17	31-07-17	31-08-17	29-09-17	31-10-17	30-11-17	29-12-17	31-01-18	28-02-18	28-03-18	27-04-18
3			=C3+(E3-C3)/(E2-C2)*(D2-C2)				=G3+(I3-G3)/(I2-G2)*(H2-G2)				=K3+(N3-K3)/(N2-K2)*(L2-K2)	=K3+(N3-K3)/(N2-K2)*(M2-K2)	
	02-05-17	5.10	5.05	4.99	4.96	4.93	4.91	4.89	4.87	4.88	4.85	4.82	4.79

Scenario 2: Criteria Accepted- Interpolation/Extrapolation for missing tenor points

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	Month end Forward Settlement Date	31-05-17	30-06-17	31-07-17	31-08-17	29-09-17	31-10-17	30-11-17	29-12-17	31-01-18	28-02-18	28-03-18	27-04-18
3	03-05-17	BLANK	BLANK	5.07	BLANK	BLANK	4.93	BLANK	BLANK	BLANK	4.86	BLANK	BLANK

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	Month end Forward Settlement Date	31-05-17	30-06-17	31-07-17	31-08-17	29-09-17	31-10-17	30-11-17	29-12-17	31-01-18	28-02-18	28-03-18	27-04-18
3		=E3-((H3-E3)/(H2-E2))*(E2-C2)	=E3-((H3-E3)/(H2-E2))*(E2-D2)		=E3+(H3-E3)/(H2-E2)*(F2-E2)	=E3+(H3-E3)/(H2-E2)*(G2-E2)		=H3+(L3-H3)/(L2-H2)*(I2-H2)	=H3+(L3-H3)/(L2-H2)*(J2-H2)	=H3+(L3-H3)/(L2-H2)*(K2-H2)		=L3+((L3-H3)/(L2-H2))*(M2-L2)	=L3+((L3-H3)/(L2-H2))*(N2-L2)
	03-05-17	5.16	5.12	5.07	5.02	4.98	4.93	4.91	4.90	4.88	4.86	4.84	4.83

Scenario 3: Adjustment to Interpolation/Extrapolation for calculated tenor points in case of Spread Greater than +/-10 bps

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	**Date**	**1 M**	**2 M**	**3 M**	**4 M**	**5 M**	**6 M**	**7 M**	**8 M**	**9 M**	**10 M**	**11 M**	**12 M**
2	**Month end Forward Settlement Date**	**31-05-17**	**30-06-17**	**31-07-17**	**31-08-17**	**29-09-17**	**31-10-17**	**30-11-17**	**29-12-17**	**31-01-18**	**28-02-18**	**28-03-18**	**27-04-18**
3	11-05-17	5.00	5.08	4.99	4.96	4.93	4.76	4.89	4.87	4.88	4.95	4.81	4.79
4	12-05-17	5.11	**BLANK**	4.98	4.96	4.92	**BLANK**	4.85	4.82	4.8	**BLANK**	**BLANK**	4.76
5													
6													
7	**Date**	**1 M**	**2 M**	**3 M**	**4 M**	**5 M**	**6 M**	**7 M**	**8 M**	**9 M**	**10 M**	**11 M**	**12 M**
8	**Month end Forward Settlement Date**	**31-05-17**	**30-06-17**	**31-07-17**	**31-08-17**	**29-09-17**	**31-10-17**	**30-11-17**	**29-12-17**	**31-01-18**	**28-02-18**	**28-03-18**	**27-04-18**
			=C4+((E4-C4)/(E2-C2))*(D2-E2)				=G4+((I4-G4)/(I2-G2))*(H2-G2)				=K4+((M4-K4)/(M2-K2))*(L2-K2)	=K4+((N4-K4)/(N2-K2))*(M2-K2)	
9	12-05-17	5.11	**=5.05**	4.98	4.96	4.92	**=4.88**	4.85	4.82	4.80	**=4.79**	**=4.77**	4.76
10	Spread Over Previous Day	11	-3	-1	0	-1	12	-4	-5	-8	-16	-4	-3
11	Value (USD Mn.)	**250**		**115**	80	50		85	110	25			50
12	Recomputed Forward Premia(%) – 12-05-17	5.11	5.05	4.98	4.96	4.92	=H3+((C9-C3)+(E9-E3))/2 **4.81**	4.85	4.82	4.80	=L3+((C9-C3)+(E9-E3))/2 **5.00**	4.77	4.76

Scenario 4: Criteria Rejected with >=3 Traded Tenor Points- Previous Day Plus Adjacent Tenor Spread for missing tenor points

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	05-05-17	5.41	5.33	5.27	5.25	5.22	5.17	5.13	5.13	5.10	5.04	5.03	5.01
3	08-05-17	BLANK	BLANK	BLANK	5.29	5.26	5.21	5.19	5.16	5.14	5.11	5.09	5.07

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	05-05-17	5.41	5.33	5.27	5.25	5.22	5.17	5.13	5.13	5.10	5.04	5.03	5.01
3		=C2+(F3-F2)	=D2+((C3-C2)+(F3-F2)/2)	=E2+((D3-D2)+(F3-F2)/2)									
	08-05-17	5.45	5.37	5.31	5.29	5.26	5.21	5.19	5.16	5.14	5.11	5.09	5.07

Scenario 5: Criteria Rejected with 2 Traded Tenor Points - Previous Day Plus Adjacent Tenor Spread for missing tenor points

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	15-05-17	5.36	5.30	5.28	5.26	5.21	5.18	5.18	5.18	5.16	5.12	5.10	5.09
3	16-05-17	5.31	BLANK	BLANK	BLANK	5.19	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	15-05-17	5.36	5.30	5.28	5.26	5.21	5.18	5.18	5.18	5.16	5.12	5.10	5.09
3			=D2+(((C3-C2)+(G3-G2))/2)	=E2+(((D3-D2)+(G3-G2))/2)	=F2+(((E3-E2)+(G3-G2))/2)		=H2+(((G3-G2)+(N3-N2))/2)	=I2+(((H3-H2)+(N3-N2))/2)	=J2+(((I3-I2)+(N3-N2))/2)	=K2+(((J3-J2)+(N3-N2))/2)	=L2+(((K3-K2)+(N3-N2))/2)	=M2+(((L3-L2)+(N3-N2))/2)	=N2+(G3-G2)
	16-05-17	5.31	5.27	5.25	5.24	5.19	5.16	5.16	5.16	5.14	5.10	5.08	5.07

Scenario 6: Criteria Rejected with 1 Traded Tenor Point - Previous Day Rate for missing tenor points

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	17-05-17	5.28	5.24	5.20	5.17	5.14	5.09	5.08	5.08	5.07	5.04	5.02	4.99
3	18-05-17	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	BLANK	5.01

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Date	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
2	17-05-17	5.28	5.24	5.20	5.17	5.14	5.09	5.08	5.08	5.07	5.04	5.02	4.99
3		=C2	=D2	=E2	=F2	=G2	=H2	=I2	=J2	=K2	=L2	=M2	
	18-05-17	5.28	5.24	5.20	5.17	5.14	5.09	5.08	5.08	5.07	5.04	5.02	5.01

Annexure-3

3-A: In Case Year End Turn (YET) is Traded												
Value Date Spot	**Value Date March**	**Value Date April**	**Value Date May**	**FBD April**	**Spot Rate**	**March Rupee / %**	**April Rupee / %**	**May Rupee / %**	**Interpolated Premia on 03-04-17**	**Traded YET**	**Traded Premia on 03-04-2017**	**Applicable Premia on 03-04-17**
$Date_{Spot}$	$Date_{March}$	$Date_{April}$	$Date_{May}$	$Date_{FBD\ April}$		$Premia_{March}$	$Premia_{April}$	$Premia_{May}$				$Premia_{FBD\ April}$
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	0.4545	0.7510	1.0162	-	0.081	0.5355	**0.5355**
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	4.7300%	5.0900%	4.9200%	-	14.5200%	5.2730%	**5.2693%**

$$Premia_{FBD\ April}\ (Rupees) = \text{Premia}_{\text{March}} + \text{Traded YET}$$

$$= 0.4545 + 0.0810$$

$$= \mathbf{0.5355}$$

$$Premia_{FBD\ April}\ (\%) = \left[\left\{\left[1 + \left(\text{Premia}_{\text{March}}\% \times \frac{Date_{March} - Date_{Spot}}{365}\right)\right] \times \left[1 + \left(\text{Traded YET}\ \% \times \frac{\text{Date}_{\text{FBDApril}} - \text{Date}_{\text{March}}}{365}\right)\right]\right\} - 1\right] \times \left[\frac{365}{Date_{FBD\ April} - Date_{Spot}}\right] \times 100$$

$$= \left[\left\{\left[1 + \left(4.7300\% \times \frac{31/03/17 - 07/02/17}{365}\right)\right] \times \left[1 + \left(14.5200\% \times \frac{03/04/17 - 31/03/17}{365}\right)\right]\right\} - 1\right] \times \left[\frac{365}{03/04/17 - 07/02/17}\right] \times 100$$

$$= \mathbf{5.2693}\%$$

3-B: In Case Year End Turn (YET) is NOT Traded												
Value Date Spot	**Value Date March**	**Value Date April**	**Value Date May**	**FBD April**	**Spot Rate**	**March Rupee / %**	**April Rupee / %**	**May Rupee / %**	**Interpolated Premia on 03-04-17**	**Traded YET**	**Traded Premia on 03-04-2017**	**Applicable Premia on 03-04-17**
$Date_{Spot}$	$Date_{March}$	$Date_{April}$	$Date_{May}$	$Date_{FBD\ April}$		$Premia_{March}$	$Premia_{April}$	$Premia_{May}$				$Premia_{FBD\ April}$
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	0.4545	0.7510	1.0162	0.5501	-	-	**0.5501**
07/02/17	31/03/17	28/04/17	31/05/17	03/04/17	67.3626	4.7300%	5.0900%	4.9200%	5.4193	-	-	**5.4193%**

$$Premia_{FBD\ April}\ (Rupees) = Premia_{March} + \left\{\left[Premia_{April} - Premia_{March}\right] - \left[\left(\frac{Premia_{May} - Premia_{April}}{Date_{May} - Date_{April}}\right) \times \left(Date_{Apr} - \text{FBD}_{\text{April}}\right)\right]\right\}$$

$$= 0.4545 + \left\{[0.7510 - 0.4545] - \left[\left(\frac{1.0162 - 0.7510}{31/05/17 - 28/04/17}\right) \times (28/04/17 - 03/04/17)\right]\right\}$$

$$= \mathbf{0.5501}$$

$$Premia_{FBD\ April}\ (\%) = \left(\frac{Premia_{FBD\ April}\ (Rupees)}{Spot\ Rate}\right) \times \left(\frac{365}{\text{Date}_{\text{FBD April}} - Date_{spot}}\right) \times 100$$

$$= \left(\frac{0.5501}{67.3626}\right) \times \left(\frac{365}{03/04/17 - 07/02/17}\right) \times 100$$

$$= \mathbf{5.4193\%}$$

Annexure-4

Computation of Rolling Forwards for 12M for Spot Settlement Date of 15-Nov-2017								
	ROLLING MONTH		ROLL1	ROLL2	ROLL3	ROLL4		ROLL5
	MONTH END	M1	M2	M3	M4	M5	YET	M6
SPOT SD	FORWARDS	0.72%	0.82%	0.96%	1.18%	1.26%	1.34%[3]	1.41%
15-Nov-17	M E DATES	30-Nov-17	28-Dec-17	29-Jan-18	26-Feb-18	31-Mar-18	4-Apr-18	30-Apr-18
	ROLLING DATES		15-Dec-17	15-Jan-18	15-Feb-18	15-Mar-18		15-Apr-18
	Days $(ME_t - ME_{t-1})$		28	32	28	33		26
	Days $(RL_t - ME_{t-1})$		15	18	17	17		11
	ROLL FORWARD		0.77%	0.90%	1.09%	1.22%		1.37%
	ROLLING MONTH	ROLL6	ROLL7	ROLL8	ROLL9	ROLL10	ROLL11	ROLL12
	MONTH END	M7	M8	M9	M10	M11	M12	
	FORWARDS	1.58%	1.69%	1.76%	1.85%	1.92%	1.97%	
	M E DATES	29-May-18	30-Jun-18	31-Jul-18	27-Aug-18	29-Sep-18	30-Oct-18	
	ROLLING DATES	15-May-18	15-Jun-18	15-Jul-18	15-Aug-18	15-Sep-18	15-Oct-18	15-Nov-18[4]
	Days $(ME_t - ME_{t-1})$	29	32	31	27	33	31	31
	Days $(RL_t - ME_{t-1})$	15	17	15	15	19	16	16
	ROLL FORWARD	1.50%	1.64%	1.72%	1.81%	1.89%	1.95%	2.00%

[3] YET is trading at 0.08% which is added to March month end forward premia to give the forward premia for 04-Apr-2018.

[4] 12M Rolling Forward for 15-Nov-2018 is calculated using extrapolation of 11M and 12M (29-Sep-2018 and 30-Oct-2018) as 15-Nov-2018 falls outside 12M month end date.

Annexure-5

Illustration of Rolling Rate Computation in case only one Month End Tenor is Traded - Rolling 6M is Interpolated														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		**Spot Date**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**
2	**Month End Dates**		28-02-18	28-03-18	27-04-18	31-05-18	29-06-18	31-07-18	31-08-18	28-09-18	31-10-18	30-11-18	31-12-18	31-01-19
3	**Rolling Dates**	12-02-18	12-03-18	12-04-18	14-05-18	12-06-18	12-07-18	13-08-18	12-09-18	12-10-18	13-11-18	12-12-18	14-01-19	12-02-19
4	**Month End Premia (T-1)**	09-02-18	4.7065	4.7501	5.1013	4.8218	4.7302	4.6291	4.5733	4.5375	4.4953	4.457	4.4173	4.3925
5	**Month End Premia (T)**	12-02-18	=C4	=D4	=E4	=F4	=G4		=I4	=J4	=K4	=L4	=M4	=N4
			4.7065	**4.7501**	**5.1013**	**4.8218**	**4.7302**	**4.6381**	**4.5733**	**4.5375**	**4.4953**	**4.457**	**4.4173**	**4.3925**
6	**Rolling Premia (T-1)**	09-02-18	4.7707	5.0071	4.6196	4.4597	4.4559	4.334	4.2278	4.1879	4.1533	4.1188	4.0774	4.0999
7	**Rolling Premia (T)**		=C6	=D6	=E6	=F6	=G6	**=(H5+(((I5-H5)/(I2-H2))*(H3-H2))**	=I6	=J6	=K6	=L6	=M6	=N6
		12-02-18	**4.7707**	**5.0071**	**4.6196**	**4.4597**	**4.4559**	**4.6109**	**4.2278**	**4.1879**	**4.1533**	**4.1188**	**4.0774**	**4.0999**

Illustration of Rolling Rate Computation in case only one Month End Tenor is Traded - Rolling 12M is Extrapolated														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		**Spot Date**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**
2	**Month End Dates**		28-02-18	28-03-18	27-04-18	31-05-18	29-06-18	31-07-18	31-08-18	28-09-18	31-10-18	30-11-18	31-12-18	31-01-19
3	**Rolling Dates**	12-02-18	12-03-18	12-04-18	14-05-18	12-06-18	12-07-18	13-08-18	12-09-18	12-10-18	13-11-18	12-12-18	14-01-19	12-02-19
4	**Month End Premia (T-1)**	09-02-18	4.7065	4.7501	5.1013	4.8218	4.7302	4.6291	4.5733	4.5375	4.4953	4.457	4.4173	4.3925
5	**Month End Premia (T)**	12-02-18	=C4	=D4	=E4	=F4	=G4	=H4	=I4	=J4	=K4	=L4	=M4	
			4.7065	**4.7501**	**5.1013**	**4.8218**	**4.7302**	**4.6291**	**4.5733**	**4.5375**	**4.4953**	**4.457**	**4.4173**	**4.3800**
6	**Rolling Premia (T-1)**	09-02-18	4.7707	5.0071	4.6196	4.4597	4.4559	4.334	4.2278	4.1879	4.1533	4.1188	4.0774	4.0999
7	**Rolling Premia (T)**	12-02-18	=C6	=D6	=E6	=F6	=G6	=H6	=I6	=J6	=K6	=L6	=M6	**=N5+(((N5-M5))/(N2-M2))*(N3-N2)**
			4.7707	**5.0071**	**4.6196**	**4.4597**	**4.4559**	**4.334**	**4.2278**	**4.1879**	**4.1533**	**4.1188**	**4.0774**	**4.3829**

Illustration of Rolling Rate Computation in case only one Month End Tenor is Traded - Rolling 12M is Interpolated														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		**Spot Date**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**
2	**Month End Dates**		30-11-16	30-12-16	31-01-17	28-02-17	31-03-17	28-04-17	31-05-17	30-06-17	31-07-17	31-08-17	29-09-17	31-10-17
3	**Rolling Dates**	28-10-16	28-11-16	28-12-16	30-01-17	28-02-17	29-03-17	28-04-17	30-05-17	28-06-17	28-07-17	28-08-17	28-09-17	30-10-17
4	**Month End Premia (T-1)**	27-10-16	4.7065	4.7501	5.1013	4.8218	4.7302	4.6291	4.5733	4.5375	4.4953	4.457	4.4173	4.3925
5	**Month End Premia (T)**	28-10-16	=C4	=D4	=E4	=F4	=G4	=H4	=I4	=J4	=K4	=L4	=M4	
			4.7065	**4.7501**	**5.1013**	**4.8218**	**4.7302**	**4.6291**	**4.5733**	**4.5375**	**4.4953**	**4.457**	**4.4173**	**4.3800**
6	**Rolling Premia (T-1)**	27-10-16	4.7707	5.0071	4.6196	4.4597	4.4559	4.334	4.2278	4.1879	4.1533	4.1188	4.0774	4.0999
7	**Rolling Premia (T)**	28-10-16	=C6	=D6	=E6	=F6	=G6	=H6	=I6	=J6	=K6	=L6	=M6	**=M5+(((N5-M5))/(N2-M2))*(N3-M2)**
			4.7707	**5.0071**	**4.6196**	**4.4597**	**4.4559**	**4.334**	**4.2278**	**4.1879**	**4.1533**	**4.1188**	**4.0774**	**4.3812**

Annexure-6

FORMAT FOR WEBSITE DISPLAY

a) FBIL Forward Premia Curve

Trade Date	Time	Tenor	Settlement Date	USD/INR Premia (%)	USD/INR Premia (Rs.)
dd-mmm-yyyy	4:15:00 PM	O/N	dd-mmm-yyyy	4.6473	0.0082
dd-mmm-yyyy	4:15:00 PM	1M	dd-mmm-yyyy	4.7707	0.2367
dd-mmm-yyyy	4:15:00 PM	2M	dd-mmm-yyyy	5.0071	0.5147
dd-mmm-yyyy	4:15:00 PM	3M	dd-mmm-yyyy	4.6196	0.7368
dd-mmm-yyyy	4:15:00 PM	4M	dd-mmm-yyyy	4.4597	0.9484
dd-mmm-yyyy	4:15:00 PM	5M	dd-mmm-yyyy	4.4559	0.9556
dd-mmm-yyyy	4:15:00 PM	6M	dd-mmm-yyyy	4.3340	1.1746
dd-mmm-yyyy	4:15:00 PM	7M	dd-mmm-yyyy	4.2278	1.5884
dd-mmm-yyyy	4:15:00 PM	8M	dd-mmm-yyyy	4.1879	1.8035
dd-mmm-yyyy	4:15:00 PM	9M	dd-mmm-yyyy	4.1533	2.0094
dd-mmm-yyyy	4:15:00 PM	10M	dd-mmm-yyyy	4.1188	2.2117
dd-mmm-yyyy	4:15:00 PM	11M	dd-mmm-yyyy	4.0774	2.4135
dd-mmm-yyyy	4:15:00 PM	12M	dd-mmm-yyyy	4.0999	2.6520
dd-mmm-yyyy	4:15:00 PM	FBD April	dd-mmm-yyyy	5.8274	0.3408
dd-mmm-yyyy	4:15:00 PM	Spot	dd-mmm-yyyy		64.6853

b) FBIL MIFOR Curve

Trade Date	Time	Tenor	Settlement Date	FBIL MIFOR (%)
dd-mmm-yyyy	5:00:00 PM	O/N	dd-mmm-yyyy	6.1151
dd-mmm-yyyy	5:00:00 PM	1M	dd-mmm-yyyy	6.4477
dd-mmm-yyyy	5:00:00 PM	2M	dd-mmm-yyyy	6.8353
dd-mmm-yyyy	5:00:00 PM	3M	dd-mmm-yyyy	6.6543
dd-mmm-yyyy	5:00:00 PM	6M	dd-mmm-yyyy	6.5463
dd-mmm-yyyy	5:00:00 PM	12M	dd-mmm-yyyy	6.7062

Annexure – 7

Sample of Forward Premia Calculations

a. Computation of Month End Forward Rates for 29-01-2018

From the trades for the day, we computed the Month End Forwards for all Tenors where minimum trade criteria were met. For the trading date 29-01-2018, the Spot settlement falls on 31-Jan-2017 (not holiday) while the forward is on month end dates subject to adjustment of holidays. We calculated the weighted average forward rates for the Tenors. The next step is to calculate the Year End Turn (YET) as the last Business day of March is on 28-Mar-2018 while the first business day of April is 02-Apr-2018 that falls between the 2M and 3M tenors. Here, we have shown the data upto 5M as the same is required for YET computation.

Table 1 – Trades executed on 29-01-2018 till 3.00PM

Pair No.	Trade Date	Spot Sett. Date	Fwd. Sett. Date	Spot Rate	Forward Rate	Amount	Premia %	Weighted Premia %	Rupee Premia	Weighted Rupee Premia	Tenor
1	29-01-18	31-01-18	28-02-18	63.5250	63.7330	30000000	4.2683	128049000	0.2080	6240000	1M
2	29-01-18	31-01-18	28-02-18	63.5250	63.7330	30000000	4.2683	128049000	0.2080	6240000	1M
3	29-01-18	31-01-18	28-02-18	63.5375	63.7450	5000000	4.2572	21286000	0.2075	1037500	1M
4	29-01-18	31-01-18	28-02-18	63.5375	63.7450	5000000	4.2572	21286000	0.2075	1037500	1M
5	29-01-18	31-01-18	28-02-18	63.5450	63.7525	5000000	4.2567	21283500	0.2075	1037500	1M
6	29-01-18	31-01-18	28-02-18	63.5450	63.7525	5000000	4.2567	21283500	0.2075	1037500	1M
7	29-01-18	31-01-18	28-02-18	63.5200	63.7290	5000000	4.2891	21445500	0.2090	1045000	1M
8	29-01-18	31-01-18	28-02-18	63.5200	63.7290	5000000	4.2891	21445500	0.2090	1045000	1M
9	29-01-18	31-01-18	28-02-18	63.5300	63.7390	2000000	4.2885	8577000	0.2090	418000	1M
10	29-01-18	31-01-18	28-02-18	63.5300	63.7390	2000000	4.2885	8577000	0.2090	418000	1M
11	29-01-18	31-01-18	28-02-18	63.5000	63.7075	15000000	4.2597	63895500	0.2075	3112500	1M
					WAR =	**109000000**		**465177500**		**22668500**	
					WAPremia%	**4.2677**			**WA Rupee**	**0.2080**	
						(465177500 /109000000)				**(22668500 /109000000)**	
12	29-01-18	31-01-18	28-03-18	63.5100	63.9360	15000000	4.3719	65578500	0.4260	6390000	2M
13	29-01-18	31-01-18	28-03-18	63.5100	63.9360	15000000	4.3719	65578500	0.4260	6390000	2M

14	29-01-18	31-01-18	28-03-18	63.5305	63.9565	5000000	4.3705	21852500	0.4260	2130000	2M
15	29-01-18	31-01-18	28-03-18	63.5315	63.9565	5000000	4.3602	21801000	0.4250	2125000	2M
16	29-01-18	31-01-18	28-03-18	63.5305	63.9555	5000000	4.3603	21801500	0.4250	2125000	2M
17	29-01-18	31-01-18	28-03-18	63.5295	63.9555	5000000	4.3706	21853000	0.4260	2130000	2M
18	29-01-18	31-01-18	28-03-18	63.5315	63.9575	5000000	4.3704	21852000	0.4260	2130000	2M
19	29-01-18	31-01-18	28-03-18	63.5540	63.9750	10000000	4.3176	43176000	0.4210	4210000	2M
20	29-01-18	31-01-18	28-03-18	63.5300	63.9650	1700000	4.4629	7586930	0.4350	739500	2M
						66700000		**291079930**		**28369500**	
					WAPremia%	**4.3640**			**WA Rupee**	**0.4253**	
21	29-01-18	31-01-18	27-04-18	63.5200	64.2300	25000000	4.7440	118600000	0.7100	17750000	3M
22	29-01-18	31-01-18	27-04-18	63.5200	64.2300	25000000	4.7440	118600000	0.7100	17750000	3M
23	29-01-18	31-01-18	27-04-18	63.5225	64.2255	20000000	4.6970	93940000	0.7030	14060000	3M
24	29-01-18	31-01-18	27-04-18	63.5225	64.2255	20000000	4.6970	93940000	0.7030	14060000	3M
25	29-01-18	31-01-18	27-04-18	63.5200	64.2230	15000000	4.6972	70458000	0.7030	10545000	3M
26	29-01-18	31-01-18	27-04-18	63.5200	64.2230	15000000	4.6972	70458000	0.7030	10545000	3M
27	29-01-18	31-01-18	27-04-18	63.5250	64.2375	25000000	4.7603	119007500	0.7125	17812500	3M
28	29-01-18	31-01-18	27-04-18	63.5250	64.2375	25000000	4.7603	119007500	0.7125	17812500	3M
29	29-01-18	31-01-18	27-04-18	63.5300	64.2325	5000000	4.6931	23465500	0.7025	3512500	3M
30	29-01-18	31-01-18	27-04-18	63.5300	64.2325	30000000	4.6931	140793000	0.7025	21075000	3M
31	29-01-18	31-01-18	27-04-18	63.5300	64.2325	30000000	4.6931	140793000	0.7025	21075000	3M
32	29-01-18	31-01-18	27-04-18	63.5295	64.2320	5000000	4.6932	23466000	0.7025	3512500	3M
33	29-01-18	31-01-18	27-04-18	63.5155	64.2225	5000000	4.7243	23621500	0.7070	3535000	3M
34	29-01-18	31-01-18	27-04-18	63.5155	64.2225	10000000	4.7243	47243000	0.7070	7070000	3M
						255000000		**1203393000**		**180115000**	
					W.A. Premia%	**4.7192**			**WA Rupee**	**0.7063**	
35	29-01-18	31-01-18	31-05-18	63.5100	64.4700	2000000	4.5977	9195400	0.9600	1920000	4M
36	29-01-18	31-01-18	31-05-18	63.5100	64.4700	2000000	4.5977	9195400	0.9600	1920000	4M
37	29-01-18	31-01-18	29-06-18	63.5300	64.7125	5000000	4.5596	22798000	1.1825	5912500	5M
38	29-01-18	31-01-18	29-06-18	63.5300	64.7125	25000000	4.5596	113990000	1.1825	29562500	5M
39	29-01-18	31-01-18	29-06-18	63.5500	64.7350	10000000	4.5678	45678000	1.1850	11850000	5M

40	29-01-18	31-01-18	29-06-18	63.5500	64.7350	10000000	4.5678	45678000	1.1850	11850000	5M
41	29-01-18	31-01-18	29-06-18	63.5175	64.7000	5000000	4.5605	22802500	1.1825	5912500	5M
						55000000		**250946500**		**65087500**	
					W.A. Premia%	**4.5627**			**WA Rupee**	**1.1834**	

The Annualized month end forward premia is computed using the following equation:

$$\textbf{\textit{Annualised Month End Forward Premia}} = \left[\frac{F_t - S_t}{S_t}\right] \times \left[\frac{365}{F_{Value\ Date} - S_{Value\ Date}}\right] \times 100$$

where,
F_t *is the Forward Rate;*
S_t *is the Spot Rate;*
$F_{Value\ Date}$ *is the Forward Settlement Date and*
$S_{Value\ Date}$ *is the Spot Settlement Date.*

For example the month end forward premia % for the Pair No. 1 is computed as ((63.7330 (FP)-63.5250(SP))/ 63.5250(SP))*(365/(28/Feb/18-31/Jan/18)) = 4.2683. The Rupee premia for Pair No 1 is calculated as: 63.7330-63.5250 = 0.2080. The traded premia for 4M (as in the Table -1) is not computed as it fails to meet the minimum criteria of at least 3 trades and the same will be computed using Fallback mechanism.

The Weighted average premia in % and in Rupees (month end) for all the traded tenors is given below.

Trade Date	Tenor	WAR	WRUP
29-01-2018	CT	4.1905	0.0073
29-01-2018	1M	4.2677	0.208
29-01-2018	2M	4.3640	0.4253
29-01-2018	3M	4.7192	0.7063
29-01-2018	4M	FAIL	FAIL
29-01-2018	5M	4.5627	1.1834
29-01-2018	6M	4.5048	1.4193
29-01-2018	7M	FAIL	FAIL
29-01-2018	8M	FAIL	FAIL
29-01-2018	9M	FAIL	FAIL
29-01-2018	10M	FAIL	FAIL
29-01-2018	11M	4.4027	2.5599
29-01-2018	12M	4.3649	2.773
29-01-2018	FWD_FWD	FAIL	FAIL

As the criteria for interpolation is met i.e. Minimum 3 traded tenors, with 1 traded tenor upto 3M and 1 traded tenor beyond 6 M, the missing tenors are calculated using interpolation as per the following equation. Example is given for M4.

$$\textbf{Month End Forward Premia}\ (\%)FP_4 = FP_3 + \frac{[(FP_5 - FP_3)]}{Days_5 - Days_3} \times (Days_4 - Days_3)$$

Table – 2 Month End Forwards using interpolation for Missing Tenors on 29-01-2018

	Spot Settlement Date↓	CT	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Month End Settlement Dates	Forward Date=>		28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019
WAR % (T-1)	30-Jan-2018	4.3154	4.1823	4.3287	4.3983	4.7465	4.6791	4.6217	4.5583	4.4999	4.474	4.4481	4.4346	4.4207
WAR % (T)	31-Jan-2018	4.1905	4.2677	4.364	4.7192	4.6347	4.5627	4.5048	4.4841	4.4654	4.4434	4.4234	4.4027	4.3649
Spread (T)-(T-1)	31-Jan-2018		8.54	3.53	32.09	11.18	11.64	11.69	7.42	3.45	3.06	2.47	3.19	5.58
Value (USD Mn)	31-Jan-2018		109	66.7	**255**		55	160					**194**	50
WAR % After Adj.	31-Jan-2018	4.1905	**4.2677**	**4.364**	**4.7192**	**4.8910**	**4.5627**	**4.5048**	**4.4841**	**4.4654**	**4.4434**	**4.4234**	**4.4027**	**4.3649**
WRUP (Rs.) (T)	31-Jan-2018	0.0073	**0.208**	**0.4253**	**0.7063**	**1.0219**	**1.1834**	**1.4193**	**1.6551**	**1.8659**	**2.112**	**2.3336**	**2.5599**	**2.773**
TRADED/CALC.		TRADED	TRADED	TRADED	TRADED	CALC.	TRADED	TRADED	CALC.	CALC.	CALC.	CALC.	TRADED	TRADED
Weighted Average Spot Rate = 63.5503														

For example, the 4M rate is computed as 4.7192+((4.5627-4.7192)/(29/Jun/2018-27/Apr/2018)) * (31/May/2018- 27/April/2018) =4.6347. Since the spread of the Forward Premia rate computed for a tenor using interpolation varies by more than (+/-) 10 bps compared to the previous day's Month-End Forward Premia (%), for 4M, the 4M rate is recomputed by adding to the previous day's 4M forward premia, the average spread of the two most liquid traded tenors of the day (i.e. 3M and 11M). The rate is computed as 4.7465+(((4.7192-4.3983)+(4.4027-4.4346))/2) = 4.8910. The month rupee premia for 4M is computed as 4.8910*63.5503*((31/May/2018- 31/Jan/2018)/36500) = 1.0219.

Computation of YET Rates for 29-01-2018:

Since the YET is relevant here as Last Business Day (LBD) of March falls on 28-Mar-2018 and First Business Day (FBD) falls on 02-Apr-2018, Forward X Forward trade for the above period is to be considered for YET computation. However, since minimum threshold criteria for trades in Forward X Forward was not observed, the YET has to be computed from March/April/May month end forwards. The applicable Forward Rate for 02-Apr-2018 would be computed after finding out the Rupee premia relevant for 02-Apr-2018 using the formula:

$$Premia_{YET} = Premia_{Mar} + \left\{\left[Premia_{Apr} - Premia_{Mar}\right] - \left[\left(\frac{Premia_{May} - Premia_{Apr}}{Date_{May} - Date_{Apr}}\right) \times \left(Date_{Apr} - Date_{YET}\right)\right]\right\}$$

Table 3: Computation of YET Rate % and Rupee										
Spot Settlement	**Value Date March**	**Value Date April**	**Value Date May**	**Year End Turn Date**	**March Rupee**	**April Rupee**	**May Rupee**	**Interpolated Rupee Premia on FBD April**	**Traded Rupee Premia on FBD April**	**Applicable Rupee Premia on FBD April**
31-Jan-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	0.4253	0.7063	1.0219	0.4742		0.4742
Spot Settlement	Value Date March	Value Date April	Value Date May	Year End Turn Date	March %	April %	May %	Interpolated % Premia on FBD April	Traded % Premia on FBD April	Applicable % Premia on FBD April
31-Jan-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	4.3640	4.7192	4.891	4.4649		4.4649

Interpolated YET Rs.	0.0489	(0.7063-0.4253)-[{(1.0219-0.7063)/(31/May/2018-27/Apr/2018)}*(27/Apr/2018-02/Apr/2018)]
Rupee Premia on FBD April	**0.4742**	**0.4253+0.0489**
Implied Premia % on FBD April	**4.4649**	**(0.4742/63.5503)*(365/(02/04/2018-31/01/2018))*100**

This Implied Premia % as on FBD of April (02-Apr-2018) will be used for computation of all Rolling Rates during 02-Apr-2018 to 27-Apr-2018. For example, Rolling Forward for 17-Apr-2018 will be computed interpolation between 4.4649% and 4.7192%.

Computation of Rolling Forward Rates for 29-01-2018:

Rolling Forward Premia (RFP) (%) is computed using the equation: $$\boldsymbol{RFP_{15-03-18\ on\ 15-01-18}} = \boldsymbol{FP_{28-02-18}} + \frac{[(\mathbf{15-03-18})-(\mathbf{28-02-18})\times(\boldsymbol{FP_{28-03-18}-FP_{28-02-18}})]}{((\mathbf{28-03-18})-(\mathbf{28-02-18}))}$$

Table – 4: Computation of Rolling Forwards for trade date 29-Jan-2018															
	Spot Sett. Date	**CT**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**	**FBD**
Month End Settlement Dates			28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019	02-Apr-2018
Rolling Settlement Dates	31-Jan-2018		28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019	
Month End Forward Premia (%)	31-Jan-2018	4.1905	4.2677	4.364	4.7192	4.891	4.5627	4.5048	4.4841	4.4654	4.4434	4.4234	4.4027	4.3649	4.4649
Rolling Forward Premia (%)	31-Jan-2018	4.1905	4.2677	4.364	4.7192	4.891	4.5627	4.5048	4.4841	4.4654	4.4434	4.4234	4.4027	4.3649	
Month End Forward Premia (Rs.)	31-Jan-2018	0.0073	0.208	0.4253	0.7063	1.0219	1.1834	1.4193	1.6551	1.8659	2.112	2.3336	2.5599	2.773	0.4742
Rolling Forward	31-Jan-2018	0.0073	0.2081	0.4255	0.7066	1.0219	1.1837	1.4196	1.6551	1.8659	2.112	2.3336	2.5603	2.7739	

Premia (Rs.)																
Weighted Average Spot Rate: 63.5503																

For example, Rolling Forward Rate for 1M (as on trade date of 29-Jan-2018) is computed as 4.2677+((4.364-4.2677)/(28/Mar/2018 - 28/Feb/2018))*(28/Feb/2018 - 28/Feb/2018) =4.2677.

In case the Rolling date of a Tenor falls on any day between the FBD April Date and the April Month End Date, for example the Rolling Date is April 16, 2018 then the Rolling Rate would be calculated as follows:

$$\boldsymbol{RFP_{16-04-18\ on\ 15-01-18}} = \boldsymbol{FP_{02-04-2018}} + \frac{[(\mathbf{16-04-18}) - (\mathbf{02-04-18}) \times (\boldsymbol{FP_{27-04-18}} - \boldsymbol{FP_{02-04-18}})]}{((\mathbf{27-04-18}) - (\mathbf{02-04-18}))}$$

The Rolling Rupee Premia is calculated from the computed Rolling Premia % using the following equation:

$$\boldsymbol{Rupee\ Forward\ Premia} = \boldsymbol{FP_M} \times \boldsymbol{S_t} \times \left(\frac{\boldsymbol{N}}{\mathbf{36500}}\right)$$

where,
FP_M *is the Rolling Forward Premia Rate(%) for the relevant tenor*
S_t *is the applicable Spot Rate*
N *is the number of calendar days from Spot settlement date using modified following day convention till Forward Settlement date.*

In case of 1M, the rolling rupee premia is calculated as (4.2677/100)*63.5503*((28/Feb/2018-31/Jan/2018)/365) =0.2081.

b. Computation of Month End Forward Rates for 12-02-2018

In section (a) of this Annexure we have shown the calculation of the Month end rates and Rolling Forward Premia in case the criteria of atleast 3 trades, with 1 trade within 3M, 1 trade beyond 6M is met for which we use interpolation to calculate the missing tenors to arrive at the Month end rates for that day. However, in case the above criteria is not met then we use Previous day plus average of nearby tenor spreads to arrive at the missing tenors. For 12-02-2018 we obtained traded Month rates for only 2 Tenors i.e. 3M and 12M, due to which the nearby tenor average spread criteria was adopted. The computation of the missing month-end rates is shown below.

Computation of Month-end Rates for 12-02-2018

The Weighted average premia in % and in Rupees (month end) for all the traded tenors is given below.

Trade Date	Tenor	WAR	WRUP
12-02-2018	CT	**4.5181**	**0.0159**
12-02-2018	1M	FAIL	FAIL
12-02-2018	2M	FAIL	FAIL
12-02-2018	3M	**5.1039**	**0.6382**
12-02-2018	4M	FAIL	FAIL
12-02-2018	5M	FAIL	FAIL
12-02-2018	6M	FAIL	FAIL
12-02-2018	7M	FAIL	FAIL
12-02-2018	8M	FAIL	FAIL
12-02-2018	9M	FAIL	FAIL
12-02-2018	10M	FAIL	FAIL
12-02-2018	11M	FAIL	FAIL
12-02-2018	12M	**4.4279**	**2.7292**
12-02-2018	FWD_FWD	FAIL	FAIL

As the criteria for interpolation is not met and only 2 Traded Tenors are there, we calculate the missing tenors as shown in the following table.

Table – 5 Month End Forwards using interpolation for Missing Tenors on 12-02-2018

	Spot Settlement Date↓	CT	1M	2M	3M	4M	5M	6M	7M	8M	9M	10M	11M	12M
Month End Settlement Dates	Forward Date=>	14-Feb-2018	28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019
WAR % (T-1)	14-Feb-2018	4.5226	4.6611	4.7666	5.0622	4.9274	4.8124	4.6856	4.5627	4.5347	4.5017	4.4717	4.4407	4.4096
WAR % (T)	15-Feb-2018	**4.5181**	**4.7028**	**4.8083**	**5.1039**	**4.9574**	**4.8366**	**4.7069**	**4.5825**	**4.5538**	**4.5204**	**4.4902**	**4.4591**	**4.4279**
WRUP (Rs.) (T)	15-Feb-2018	**0.0159**	**0.1077**	**0.3472**	**0.6382**	**0.9167**	**1.1414**	**1.376**	**1.5898**	**1.8044**	**2.0539**	**2.2774**	**2.5051**	**2.7292**
Weighted Average Spot Rate = 64.2797														

The missing tenors are computed using the following equations:

$$\textbf{Month End Forward Premia}\ (\%)\ FP_1 = FP_{1(Prev)} + \left(FP_3 - FP_{3(Prev)}\right)$$

In case of 1M which is not traded, the Month end rate is computed as: 4.6611+(5.1039-5.0622) = 4.7028

$$\textbf{Month End Forward Premia}\ (\%)\ FP_4 = FP_{4(Prev)} + \frac{\left[\left(FP_{12} - FP_{12(Prev)}\right) + \left(FP_3 - FP_{3(Prev)}\right)\right]}{2}$$

The 4M rate is computed as 4.9274+(((4.4279-4.4096)+(5.1039-5.0622))/2) =4.9574. The month end rupee premia for 4M is computed as 4.9574*64.2797*((31/May/2018- 15/Feb/2018)/36500) = 0.9167.

Computation of YET Rates for 12-02-2018:

Since the YET is relevant here as Last Business Day (LBD) of March falls on 28-Mar-2018 and First Business Day (FBD) falls on 02-Apr-2018, Forward X Forward trade for the above period is to be considered for YET computation. However, since minimum threshold criteria for trades in Forward X Forward was not observed, the YET has to be computed from March/April/May month end forwards. The applicable Forward Rate for 02-Apr-2018 would be computed after finding out the Rupee premia relevant for 02-Apr-2018 using the formula:

$$Premia_{YET} = Premia_{Mar} + \left\{\left[Premia_{Apr} - Premia_{Mar}\right] - \left[\left(\frac{Premia_{May} - Premia_{Apr}}{Date_{May} - Date_{Apr}}\right) \times \left(Date_{Apr} - Date_{YET}\right)\right]\right\}$$

Table 6: Computation of YET Rate % and Rupee										
Spot Settlement	**Value Date March**	**Value Date April**	**Value Date May**	**Year End Turn Date**	**March Rupee**	**April Rupee**	**May Rupee**	**Interpolated Rupee Premia on FBD April**	**Traded Rupee Premia on FBD April**	**Applicable Rupee Premia on FBD April**
15-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	0.3472	0.6382	0.9167	0.4334		0.4334
Spot Settlement	**Value Date March**	**Value Date April**	**Value Date May**	**Year End Turn Date**	**March %**	**April %**	**May %**	**Interpolated % Premia on FBD April**	**Traded % Premia on FBD April**	**Applicable % Premia on FBD April**
15-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	02-Apr-2018	4.8083	5.1039	4.9574	5.3500		5.3500

Interpolated YET Rs.	0.0862	(0.6382-0.3472)-[{(0.9167-0.6382)/(31/May/2018-27/Apr/2018)}*(27/Apr/2018-02/Apr/2018)]
Rupee Premia on FBD April	**0.4334**	**0.3472+0.0862**
Implied Premia % on FBD April	**5.3500**	**(0.4334/64.2797)*(365/(02/04/2018-15/02/2018))*100**

Computation of Rolling Forward Rates for 12-02-2018:

Rolling Forward Premia (RFP) (%) is computed using the equation: $$RFP_{15-03-18\ on\ 15-01-18} = FP_{28-02-18} + \frac{[(15-03-18)-(28-02-18)\times(FP_{28-03-18}-FP_{28-02-18})]}{((28-03-18)-(28-02-18))}$$

Table – 7: Computation of Rolling Forwards for trade date 12-Feb-2018															
	Spot Sett. Date	**CT**	**1M**	**2M**	**3M**	**4M**	**5M**	**6M**	**7M**	**8M**	**9M**	**10M**	**11M**	**12M**	**FBD**
Month End Settlement Dates			28-Feb-2018	28-Mar-2018	27-Apr-2018	31-May-2018	29-Jun-2018	31-Jul-2018	31-Aug-2018	28-Sep-2018	31-Oct-2018	30-Nov-2018	31-Dec-2018	31-Jan-2019	02-Apr-2018
Rolling Settlement Dates	15-Feb-2018		15-Mar-2018	16-Apr-2018	15-May-2018	15-Jun-2018	16-Jul-2018	16-Aug-2018	17-Sep-2018	15-Oct-2018	15-Nov-2018	17-Dec-2018	15-Jan-2019	15-Feb-2019	

Month End Forward Premia (%)	15-Feb-2018	4.5181	4.7028	4.8083	5.1039	4.9574	4.8366	4.7069	4.5825	4.5538	4.5204	4.4902	4.4591	4.4279	5.35
Rolling Forward Premia (%)	15-Feb-2018	4.5181	4.7593	5.2122	5.0263	4.8949	4.7677	4.6427	4.5651	4.5366	4.5053	4.4731	4.444	4.4128	
Month End Forward Premia (Rs.)	15-Feb-2018	0.0159	0.1077	0.3472	0.6382	0.9167	1.1414	1.376	1.5898	1.8044	2.0539	2.2774	2.5051	2.7292	0.4334
Rolling Forward Premia (Rs.)	15-Feb-2018	0.0159	0.2347	0.5507	0.7878	1.0344	1.2678	1.4881	1.7205	1.9334	2.166	2.4026	2.614	2.8365	
Weighted Average Spot Rate: 64.2797															

For example, Rolling Forward Rate for 1M (as on trade date of 12-Feb-2018) is computed as 4.7028+((4.8083-4.7028)/(28/Mar/2018-28/Feb/2018))*(15/Mar/2018-28/Feb/2018) =4.7593.

In case the Rolling date of a Tenor falls on any day between the FBD April Date and the April Month End Date, for example the Rolling Date for 2M which is April 16, 2018 then the Rolling Rate would consider the FBD rate and would be calculated as follows:

$$\boldsymbol{RFP_{16-04-18\ on\ 15-02-18}} = \boldsymbol{FP_{02-04-2018}} + \frac{[(\mathbf{16-04-18}) - (\mathbf{02-04-18}) \times (\boldsymbol{FP_{27-04-18}} - \boldsymbol{FP_{02-04-18}})]}{((\mathbf{27-04-18}) - (\mathbf{02-04-18}))}$$

i.e. Rolling rate of 2M for the day would be :- 5.35+(((5.1039-5.35)/(27/Apr/2018-02/Apr/2018))*(16/Apr/2018-02/Apr/2018)) = 5.2122
The Rolling Rupee Premia is calculated from the computed Rolling Premia % using the following equation:

$$\boldsymbol{Rupee\ Forward\ Premia} = \boldsymbol{FP_M} \times \boldsymbol{S_t} \times \left(\frac{\boldsymbol{N}}{\mathbf{36500}}\right)$$

where,
FP_M is the Rolling Forward Premia Rate(%) for the relevant tenor
S_t is the applicable Spot Rate
N is the number of calendar days from Spot settlement date using modified following day convention till Forward Settlement date.

In case of 2M, the rolling rupee premia is calculated as (5.2122/100)*64.2797*((16/Apr/2018-15/Feb2018)/365) = 0.5507.