Guide To Daily Reference Rates

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Contents

1. Introduction 4
2. Features 4
2.1 New Rate Calculation Methods 4
2.2 Storage of Historical Rates 5
2.2.1 Relational Gateway Storage 5
2.3 Enhanced Rate Fixing 5
2.4 Updates to the NI Summary Positions 5
3. Set Up 6
3.1 Rates 6
3.2 Permissions 7
3.3 IR Type 7
3.4 Rate Imports 7
4. Rates & Storage 7
5. Rate Updates & Fixing 8
5.1 ScheduleFixingrate.cl 9
5.2 MakeHistoricRates.cl 9
6. Deal Capture 10
6.1 Pricing Deals 10
6.2 Back Valued Deals 11
6.3 Forward Value Dated Deals 12
6.4 Sales of Holding Deals 12
6.5 Rate Information in the Relational Gateway 12
6.6 Daily Accruals in the Relational Gateway 12
7. Calculations & Processes 12
7.1 Observation periods 12
7.1.1 Period Start 12
7.1.2 Running 13
7.2 Lockout/lag periods 13
7.3 Date Adjustment Methodologies 13
7.4 Observation Start Date 13
7.5 Observation End Date (Fixing Date) 14
7.6 SOFR Rate Derivation 14
7.6.1 Extract Rates 14

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7.6.2 Derivation of Observation Rates 15
7.7 Period Start 15
7.8 Running 15
7.9 Setting of Lag Day Rates 15
7.10 Calculate Rate 15
7.10.1 Average 15
7.10.2 Compound 16
7.10.3 Compound Average 17

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1. Introduction

As a result of market changes, the Libor term reference rates are being replaced by daily overnight reference rates. The major financial markets have already started publishing these and this list will grow in size over time. The direct replacement for Libor terms (1, 3,6 and 12 months) will not be covered within this document. Below are the equivalents daily reference rates already recognized.

SOFR	- USD	Secured Overnight Financing Rate
SONIA	– GBP	Sterling Overnight Index Average
€STR or ESTR	– EUR	Euro short-term rate
SARON	– CHF	Swiss Average Rate Overnight
TONAR	– JPY	*Tokyo Overnight Average Rate*

New features have been added to Siena to handle these overnight rates to compensate for daily volatility; these features are described in more detail in sections 2 & 7. At this stage, the reference rates mentioned above will only apply to the operation of the following deal types: -

- Floating Rate Notes

2. Features

Additional functionality has been added to Siena in a number of areas to handle daily overnight reference rates. These include: -

- Handling for observation and lockout/lag periods:
- New Rate Calculation Methods
- Storage of Historical Rates
- Enhanced rate fixing and rate storage processes
- Updates to the NI Summary Positions
- Daily rates and accruals

2.1 New Rate Calculation Methods

There are three calculation methods that are used in conjunction with the observation boundaries described in the previous section.

These methods are: -

- Average: Using a simple average as a basis
- Compounding: Daily compounding of rates
- Compounding Averages: A hybrid of the above

A description of the formulas and their application is given in section 7 of this document.

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2.2 Storage of Historical Rates

Daily reference rates are stored in the operations configuration function under the Historic Rate table. A script can be run via the Siena scheduler to update this table each day. The scheduler and script are described in more detail in section 5.

Daily reference rates for non-working days are defaulted for calculation purposes from the previous working day or for any day where rates are not available.

2.2.1 Relational Gateway Storage

Historical rates are also stored in the Relational Gateway.

2.3 Enhanced Rate Fixing

The ScheduleFixingrate.cl script has been enhanced to handle the fixing for daily reference rates. The scheduler and script are described in more detail in section 5.

2.4 Updates to the NI Summary Positions

For deals using daily reference rates, accrual updates will be calculated using the latest calculated rate for the daily monthly and total profit figures. This differs from term rates where these figures accumulate on a daily basis.

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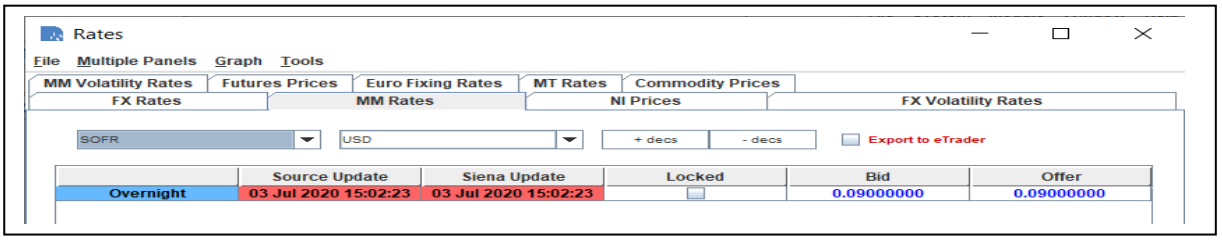
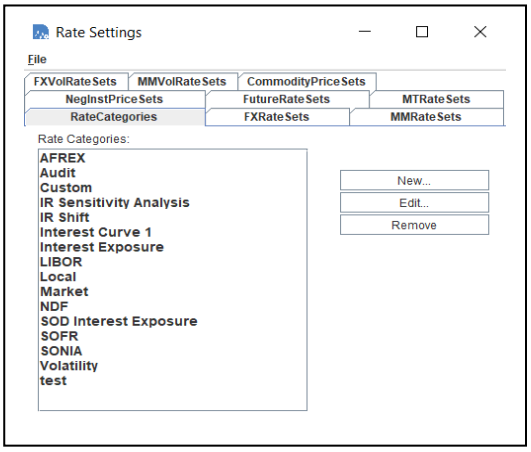
3. Set Up

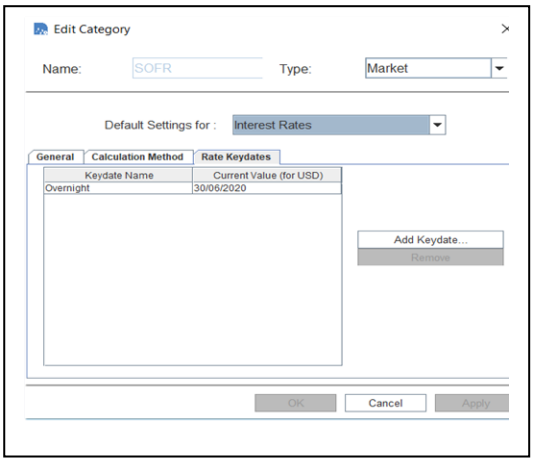


3.1 Rates

Daily reference rates will need to be set up using the Rate Settings function from the Siena Tool bar.



Users should add the new Rate Category e.g. SOFR, SONIA etc and hit Edit.



These daily reference rates should be set up as Interest Rates and only require a single frequency "Overnight"

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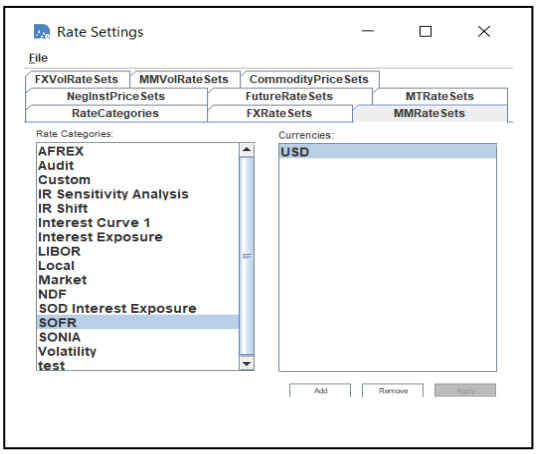


Under the MM Rate Sets, users must select the currency for the daily reference rate.

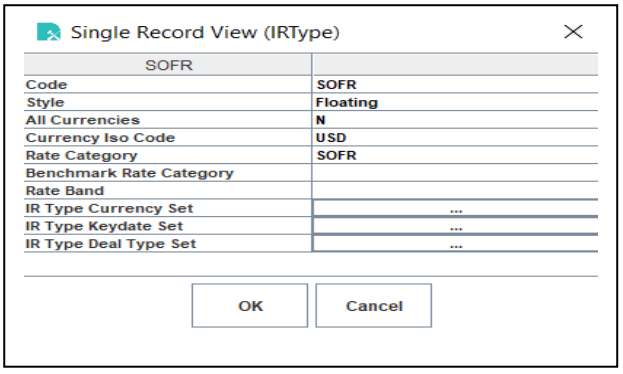
3.2 Permissions

For each daily reference rate set up, users need to define permissions and operators so that they appear within the rates maintenance screen.

These permissions are found under the Rate and Rate Settings resource.

3.3 IR Type

The daily reference rates need to be defined to the IR Type table within Operations Configurations from the main Siena Tool bar.



Users will enter details of the daily reference rate to include a code, style =" Floating", Currency and the Rate Category as defined in section 3.1

Once the IR Type has been defined the code will be selectable within the deal capture UI.

3.4 Rate Imports

Daily reference rates can be imported through any of the standard Siena rate import functions.

4. Rates & Storage

Daily reference rates are stored within the Historic rate table within Siena Operations configuration.

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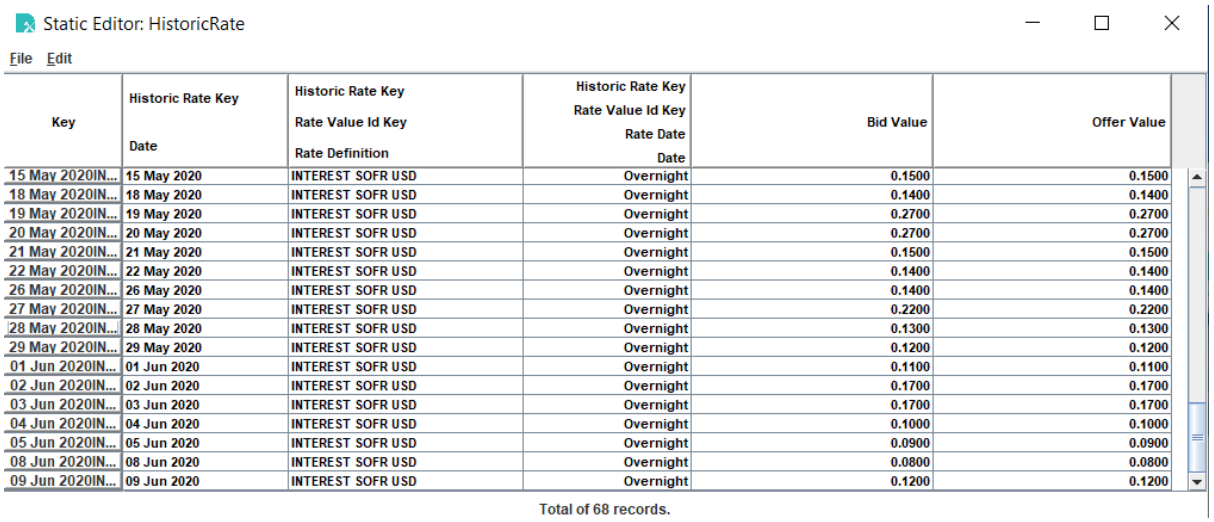

Static Editor: HistoricRate

File Edit

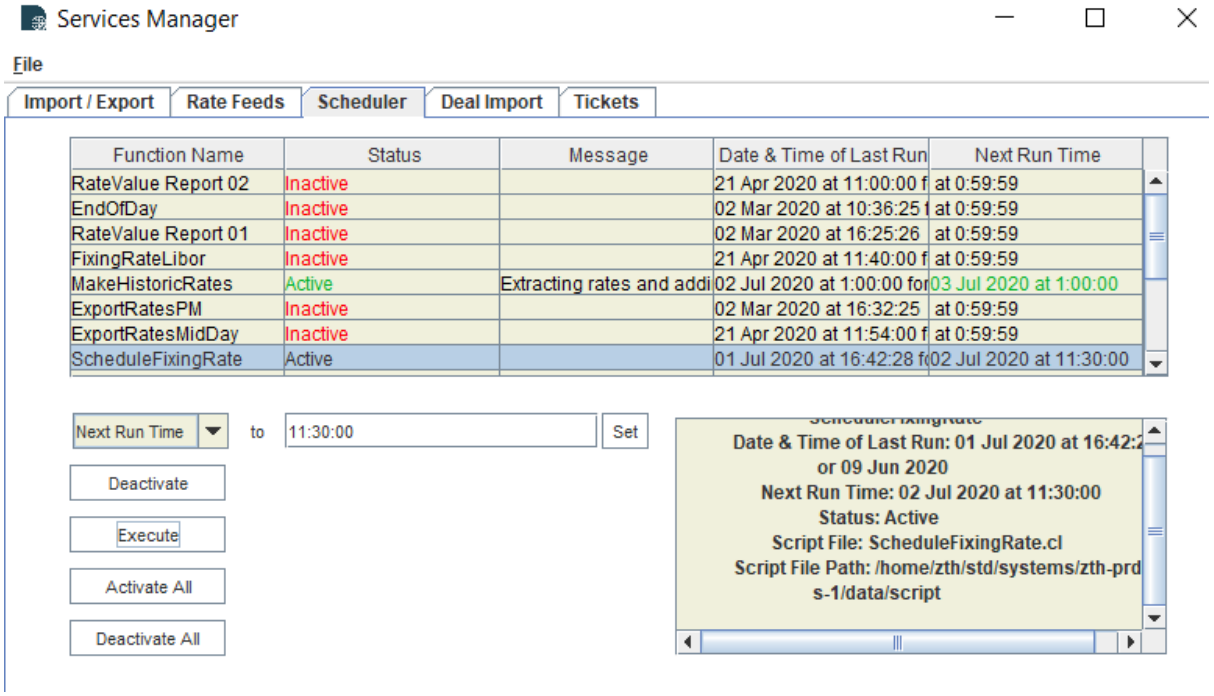
Key	Historic Rate Key Date	Historic Rate Key Rate Value Id Key Rate Definition	Historic Rate Key Rate Value Id Key Rate Date Date	Bid Value	Offer Value
15 May 2020IN...	15 May 2020	INTEREST SOFR USD	Overnight	0.1500	0.1500
18 May 2020IN...	18 May 2020	INTEREST SOFR USD	Overnight	0.1400	0.1400
19 May 2020IN...	19 May 2020	INTEREST SOFR USD	Overnight	0.2700	0.2700
20 May 2020IN...	20 May 2020	INTEREST SOFR USD	Overnight	0.2700	0.2700
21 May 2020IN...	21 May 2020	INTEREST SOFR USD	Overnight	0.1500	0.1500
22 May 2020IN...	22 May 2020	INTEREST SOFR USD	Overnight	0.1400	0.1400
26 May 2020IN...	26 May 2020	INTEREST SOFR USD	Overnight	0.1400	0.1400
27 May 2020IN...	27 May 2020	INTEREST SOFR USD	Overnight	0.2200	0.2200
28 May 2020IN...	28 May 2020	INTEREST SOFR USD	Overnight	0.1300	0.1300
29 May 2020IN...	29 May 2020	INTEREST SOFR USD	Overnight	0.1200	0.1200
01 Jun 2020IN...	01 Jun 2020	INTEREST SOFR USD	Overnight	0.1100	0.1100
02 Jun 2020IN...	02 Jun 2020	INTEREST SOFR USD	Overnight	0.1700	0.1700
03 Jun 2020IN...	03 Jun 2020	INTEREST SOFR USD	Overnight	0.1700	0.1700
04 Jun 2020IN...	04 Jun 2020	INTEREST SOFR USD	Overnight	0.1000	0.1000
05 Jun 2020IN...	05 Jun 2020	INTEREST SOFR USD	Overnight	0.0900	0.0900
08 Jun 2020IN...	08 Jun 2020	INTEREST SOFR USD	Overnight	0.0800	0.0800
09 Jun 2020IN...	09 Jun 2020	INTEREST SOFR USD	Overnight	0.1200	0.1200

Total of 68 records.

These rates are updated via script called MakeHistoricRates.cl. This script can be run manually or via the Siena scheduler.

There is also an option to load historic rates via the Siena Static Data loader – this is covered in other documentation.

5. Rate Updates & Fixing



There are two scripts that are required for daily reference rate processing: -

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- MakeHistoricRates.cl: this updates the Historic Rate Table in the Siena Operations Configuration.
- ScheduleFixingrate.cl: this applies the current daily rate to all deals where daily fixing is due.

Both scripts can be found in the …….\data\script directory

5.1 ScheduleFixingrate.cl

To add additional daily reference rates to be fixed, users need to add the Rate Category name to the script in double quotes as in the example below. Ensure that the file is saved after any edits.

run ScheduleFixingRate irtypes="SOFR","SONIA";

Other rate categories should also be added if still required, e.g. LIBOR.

5.2 MakeHistoricRates.cl

To add additional daily reference rates to be added to the Historic rate table, users need to add another *MakeHistoricRates* command node for the Rate Category as in the example below. Ensure that the file is saved after any edits.

run TablePorter porter="com.eurobase.siena.migrator.commands.MakeHistoricRates"
rateType="INTEREST"
rateCategory="SOFR"
rateInstrument="USD"
rateInstrumentType="Currency"
tenor="O/N"
daysToKeep="";

run TablePorter porter="com.eurobase.siena.migrator.commands.MakeHistoricRates"

rateType="INTEREST"

rateCategory="SONIA"

rateInstrument="GBP"

rateInstrumentType="Currency"

tenor="O/N"

daysToKeep="";

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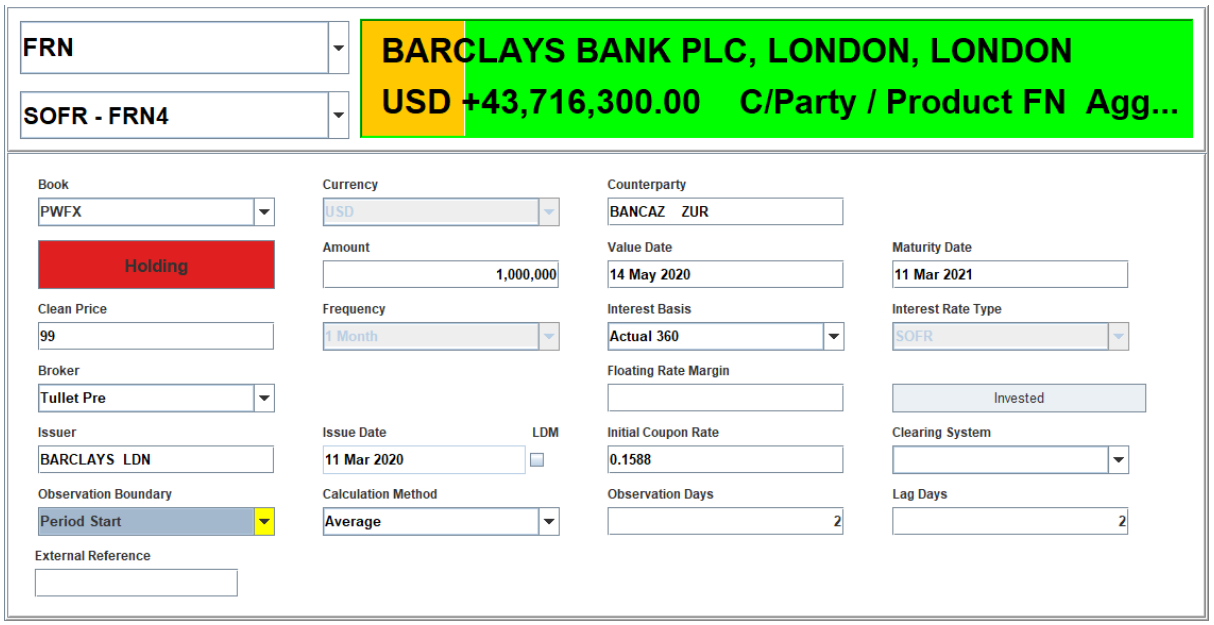
6. Deal Capture



For FRNs the following fields will only become visible if one of the Interest Rate Types listed in section 1 are selected in the Interest Rate Type drop-down.

- Observation Boundary
- Calculation Method
- Observation Days
- Lag Days

Within the Observation Boundary users can select (see sections 7.1.1 & 7.1.2 for more information): -

- Period Start
- Running

Within the Calculation methods users can select (See section 7 for more information) : -

- Average
- Compounding
- Compounding Averages

6.1 Pricing Deals

Users can define the Initial Coupon price that will be applied for initial pricing. If the initial coupon price is not known, users can use the default button in the right-hand static helper panel when the mouse is on the Initial Coupon field; this will then populate the field. Users will need to ensure that all daily rates are up to date before doing this. Furthermore, this field will update with the latest reference rate up to the start date of the deal.

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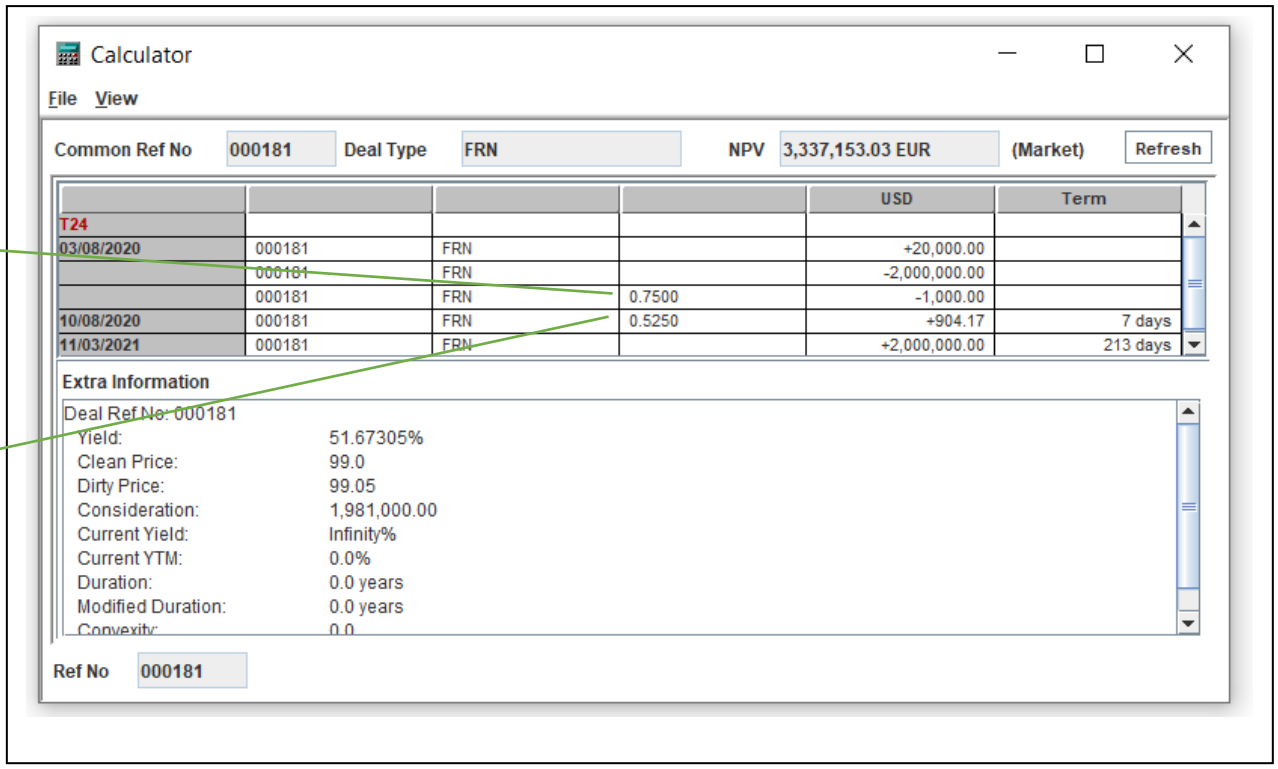
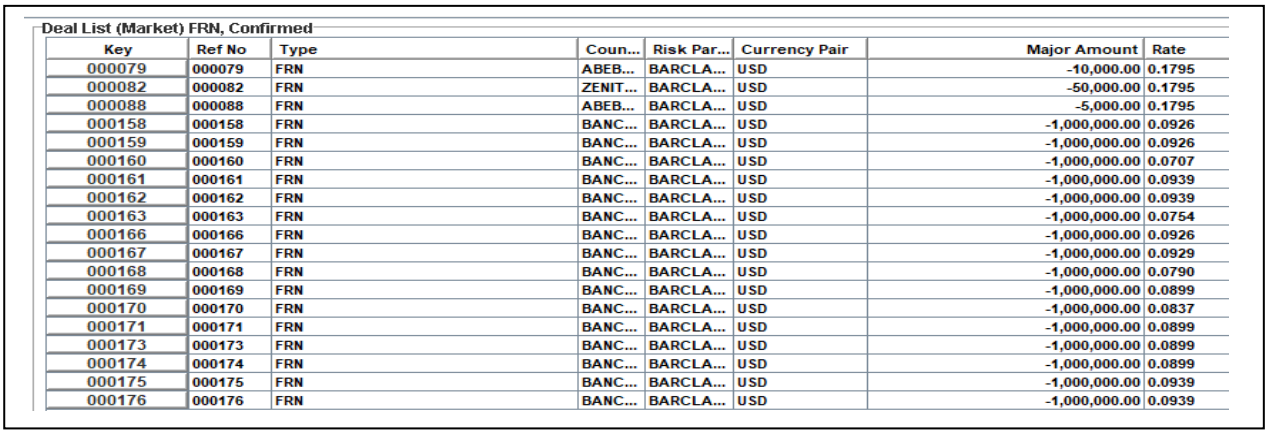


The deal calculator will show the rate at which the interest was purchased in [1] and the current rate of interest in [2]



Key	Ref No	Type	Coun...	Risk Par...	Currency Pair	Major Amount	Rate
000079	000079	FRN	ABEB...	BARCLA...	USD	-10,000.00	0.1795
000082	000082	FRN	ZENIT...	BARCLA...	USD	-50,000.00	0.1795
000088	000088	FRN	ABEB...	BARCLA...	USD	-5,000.00	0.1795
000158	000158	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0926
000159	000159	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0926
000160	000160	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0707
000161	000161	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0939
000162	000162	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0939
000163	000163	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0754
000166	000166	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0926
000167	000167	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0929
000168	000168	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0790
000169	000169	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0899
000170	000170	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0837
000171	000171	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0899
000173	000173	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0899
000174	000174	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0899
000175	000175	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0939
000176	000176	FRN	BANC...	BARCLA...	USD	-1,000,000.00	0.0939

The Deal list blotter will also show the current rate of interest that applies to deals in the Rate column.

6.2 Back Valued Deals

For deals that are back-valued, dated within the current coupon cycle, users will have to calculate the interest rates for the back-valued period and apply them directly to the deal legs for the back-valued period. The system will only calculate interest rates where deals are valued dated today or for a future date.

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6.3 Forward Value Dated Deals

For a forward dated holding deal, if users enter an initial coupon rate and an optional floating rate margin, this will be used to compute the purchased interest element. The rate fixing process will start to assign an interest rate when the observation period has started.

For sell of holding deals, if the sell is forward dated, the system will calculate and reprice the deal each day up to the value date of the sell. Users can override this rate in the deal legs if they need to.

6.4 Sales of Holding Deals

A sell transaction of a holding deal will use the prevailing calculated rate as the parent deal by default.

6.5 Rate Information in the Relational Gateway

Daily calculated deal reference rates are updated in the Relational Gateway. These can be found in the <DealLegsInfo> table under the "Rate" column. The rate value will correspond to the deal leg as can be see in in the Siena Deal Legs function for each deal.

6.6 Daily Accruals in the Relational Gateway

The system automatically generates daily accrual values to the <GLMovementPending> table when the Cashflow Server or GL Server is deployed.

7. Calculations & Processes

7.1 Observation periods

Overnight rates can be volatile and so rates that are applied to deals are based upon a number of sequential rates over a period. The period is defined using an observation boundary type and observation days. There are two types of boundary: -

- Period Start
- Running

7.1.1 Period Start

The Period Start boundary refers to the construction of the **first rate** that is set in a given interest or coupon period and every period thereafter. If a user selects this, they would also have to define a number of observation days to determine the number of sequential rates that need to be included within the rate calculation.

Observation days are counted backward from the first rate date in a given interest or coupon period. They are counted in calendar days and not in business days. The default observation days is set to 0; defaults can be reset in the Fundamental Deal Type table in the Switches for a deal type.

Example if the 1st rate date in a coupon or interest cycle is the 7th of July 2020, and a user enters 7 in the observation days, the system will need to extract rates from and including the 1st July 2020.

Once the rate set is assembled, the system will apply a calculation method to set the first rate.

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7.1.2 Running

The running boundary is similar to the Period Start boundary except that it extends beyond the first rate date. The observation days defined lock down a number of sequential rates however at each business EOD rollover the system will move the observation set on by a day.

Example, using 7 observation days (Running), if the 1st Rate date in a coupon or interest cycle is the 7th of July 2020, the system will need to extract rates from and including the 1st July 2020. If the system is rolled over to the 8th of July, the extract rates will be assembled from (and including) the 2nd July 2020 to the 8th July 2020. This will continue everyday within a coupon/interest period unless lockdown lags are defined – these are described in the next section.

Once the rate set is assembled, the system will apply a calculation method to set the daily rate.

7.2 Lockout/lag periods

Lockout/lag periods are a set number of days prior to an interest settlement date when the reference rate underpinning the rate calculation is locked. For example, if 3 days is set into the lag period, the reference rate 3 days before settlement is locked and applied for the remaining days up to settlement. If there are intervening non-working days, the lag days will be forced to a previous working day. Note it is only the reference rate that is locked as there will be an overriding calculation method used to calculate the interest rate to the deal.

Observation days and lag periods can be applied to the same deal. There is no requirement to match the lag days in number with observation days.

7.3 Date Adjustment Methodologies

Calendar Days	date – day count (e.g. observation days)
Business Days	"day count" valid business days prior to date. E.g. date = Monday, day count = 2, adjusted date is previous Thursday (Thurs and Fri being valid business days)
First Business Day	date – day count. If this is not a valid business day, then get the previous valid business day

7.4 Observation Start Date

Observation Start Date defines the date of the beginning of the daily rate observation period.

Observation Start Date is derived using the Observation Days as the day count and the Calendar Days adjustment methodology.

The day count is calculated as Observation Days – 1 as the observation includes the start date of the observation period.

E.g.

Observation Days = 2, Start Date = 13/01/02, End Date = 13/03/20, Frequency = 1M

Interest Date	**Observation Start Date**

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13/01/20	12/01/20 (13/01/20 – 1)
13/02/20	12/02/20 (13/02/20 – 1)
13/03/20	(none)

The application of the observation days can be calendar days (as above) or as business days, skipping holidays and weekends. This is a properties file configuration.

7.5 Observation End Date (Fixing Date)

As many of the daily reference rates are fixed in arrears, the fixing date of an interest event is based on the end date of the fixing period and any corresponding lag days defined to the deal.

Observation End Date is derived using the Lag Days as the day count and the *First Business Day* adjustment methodology

E.g.

Lag Days = 2, Start Date = 13/01/02, End Date = 13/03/20, Frequency = 1M

Interest Date	**Observation End Date**
13/01/20	11/02/20 (13/02/20 – 2)
13/02/20	11/03/20 (13/03/20 – 2)
13/03/20	(none)

The application of the lag days can be first business date (as above) or calendar days. This is a properties file configuration.

7.6 SOFR Rate Derivation

The methodology can be broken down into 4 discrete steps:

7.6.1 Extract Rates

Daily reference rates come from the Historic Rates table. The rates used are defined by the observation period, which has an observation start date and an observation end date.

An Observation Day of 1, means each derived daily rate in the period is made up of only one rate from the observation period (see Derivation of Observation Rates, below).

As with Lag Days, the application of Observation Days can be calendar days (as above) or as valid business days.

Observation End Date = Fixing Date (see above)

E.g.

Observation Days = 3, Lag Days = 2, Start Date = 13/01/02, End Date = 13/03/20, Frequency = 1M

Interest Date	**Start Date**	**End Date**	**Observation Start**	**Observation End (Fixing Date)**
13/01/20	13/01/20	13/02/20	11/01/20 (13/01/20 – 2)	11/02/20 (13/02/20 – 2)
13/02/20	13/02/20	13/03/20	11/02/20 (13/02/20 – 2)	11/03/20 (13/03/20 – 2)
13/03/20	(none)	(none)	(none)	(none)

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The rates extracted from the Historic Rates table are rates from the Observation Start Date to the Observation End Date, inclusive. Any dates that are missing rates, due to holidays or weekends, take the value of the preceding valid rate.

7.6.2 Derivation of Observation Rates

Once the Historic Rates have been extracted, the Period Start or Running Boundary rules need to be applied.

7.7 Period Start

The rate for the Start Date is the average of the rates within the Observation Days.

For rates after the start date, the value is just taken from the single rate for the date.

E.g. Extracted Historic Rates

Observation Days = 3

13/01/20 (Observation Start Date)	**14/01/20**	**15/01/20 (Start Date)**	**16/01/20**	**17/01/20**
5	5.1	5.2	5.3	5.4

15/01/20 (Start Date)	**16/01/20**	**17/01/20**
= (5+5.1+5.2) /3 = 5.1	5.3	5.4

7.8 Running

Each rate from Start Date to Observation End Date is the average of the rates with the previous Observation Days.

15/01/20 (Start Date)	**16/01/20**	**17/01/20**
= (5+5.1+5.2) /3 = 5.1	= (5.1 + 5.2 + 5.3) / 3 = 5.2	= (5.2 + 5.3 + 5.4) / 3 = 5.3

7.9 Setting of Lag Day Rates

If Lag Days are defined, the last rate is then copied to the days with the lag period (i.e. the days from Observation End Date to End Date). E.g.

13/02/20 (Observation End Date)	**14/02/20**	**15/02/20 (End Date)**
5	5	5

7.10 Calculate Rate

Once all of the daily rates from Start Date to End Date have been derived, then the Calculation Method can be applied:

7.10.1 Average

This is simply the sum of all of the rates divided by the number of rates, e.g.

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$$rate = \frac{\sum_{d=1}^{n} r_d}{n}$$

Where:

$$n = (End\ Date - Start\ Date) + 1$$

7.10.2 Compound

Calculate the Interest Factor for each day and multiply them together – this gives the Interest Factor for the whole period. From this, the straight-through rate for the period can be derived.

An Interest Factor for a day is calculated as:

$$IF_d = 1 + \frac{r_d}{IB}$$

Where:

IB is the interest basis, e.g. 365.

r_d is the rate for the single date

The total Interest Factor is calculated as a product of all the daily Interest Factors:

$$IF_{total} = \prod_{d=1}^{n} IF_d$$

This total Interest Factor is then used to derive the equivalent rate for the period:

$$rate = \frac{(IF_{total} - 1) \times IB}{n}$$

Example:

The End Date is set to 18/01/20 just to keep the number of dates to a manageable size for this example.

IB = 365

	15/01/20 (Start Date)	**16/01/20**	**17/01/20**	**18/01/20 (End Date)**
r_d	5	5.1	5.2	5.3
IF_d	IF_1 = 1 + 5 / 365	IF_2 = 1 + 5.1 / 365	IF_3 = 1 + 5.2 / 365	IF_4 = 1 + 5.3 / 365
	1.000136986	1.000139726	1.000142466	1.000145205

$$IF_{total} = IF_1 \times IF_2 \times IF_3 \times IF_4$$

$$IF_{total} = 1.000564503$$

$$rate = \frac{(1.000564503 - 1) \times 365}{4}$$

$$rate = 5.151089897$$

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7.10.3 Compound Average

Compound Average is the same as average, but before the compound calculation starts, the daily rates are recalculated as the running average. E.g.

Original Rates:

15/01/20 (Start Date)	16/01/20	17/01/20
= 5.1	5.3	5.4

Average Rates:

15/01/20 (Start Date)	16/01/20	17/01/20
= 5.1 / 1	= (5.1 + 5.3) / 2 = 5.2	= (5.1 + 5.3 + 5.4) / 3 = 5.2667

These average rates are then compounded as above.

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