

Ancillary Services and Intra-Day Power Trading Markets

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- Ancillary Services are defined, under Regulation (2)(1)(b) of the CERC (Indian Electricity Grid Code), Regulations, 2010 (IEGC) as follows :
 - “in relation to power system (or grid) operation, the services necessary to support the power system (or grid) operation in maintaining power quality, reliability and security of the grid, e.g. active power support for load following, reactive power support, black start, etc;”*
- The IEGC, under Regulation 2.3.2 (g) also made operation of Ancillary Services as an exclusive function of Regional Load Despatch Centers (RLDCs).

Balancing of Power System in Real Time

Challenges for Power Systems Operation :-

- Secure and Reliable grid operation
- Renewable energy integration
- Frequency support
- Utilization of un-dispatched surplus and congestion management

Deliverable for Power System Operation:-

- Maintaining load – generation balance (frequency control)
- Primary Control- Primary frequency control is triggered automatically
- Secondary Control - Secondary frequency control is triggered within tens of seconds, also automatically, called Automatic Generation Control (AGC)
- Tertiary Control- Tertiary frequency control is triggered within a few minutes, it involves manually adjust by power grid operator

Maintaining voltage and reactive power support

Maintaining generation and transmission reserves

Current Ancillary Services-Reserves Regulation Ancillary Services (RRAS)

- Launched on 18th April, 2016.
- Participants – All Regional Entity whose tariff is determined or adopted by Commission for the full capacity e.g. CGPL, ISGS Stations etc
- Nodal Agency –NLDC is responsible for implementation of Ancillary services through RLDCs at inter state level

Merit Order Stack

- Separate Stack for Regulation UP and Down Services
 - URS capacities of ISGS
 - Variable cost of Generation
 - Time Block wise; Region wise
 - Factoring in ramp up / down rate, transmission constraint
- **No** commitment charges payable to RRAS providers

Triggering Events

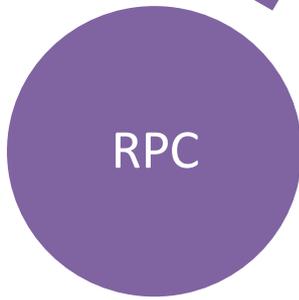
- Extreme Weather condition
- Generation / transmission line outage
- Trend of load / frequency
- Abnormal events such as outages etc.

Current Ancillary Services- RRAS: Roles

- Publish Fixed charge, Variable Charge and any other statutory charges for MoD – Monthly Basis
- Preparation of RRAS providers Energy / Deviation Accounts on Weekly Basis



- Prepare separate stacks for Reg UP and Reg Down, based on VC
- Despatch & Withdrawal instruction through RLDCs by Nodal Agency
- Incorporation on instruction in schedules of RRAS provider by RLDC



Regulation Up
RRAS provider paid at their fixed & variable charges with markup (50 Paisa at Present)

Regulation Down
RRAS provider shall pay 75 % of variable charges to Pool Fund

Fixed Charge, Variable charge and any other statutory charge

RRAS : Challenges

- Inadequacy of available reserves during high demand period
 - Only 67 power stations fall under RRAS
 - Need to expand base
 - Technology agnostic
- Clear distinction need to be drawn between “Balancing AS” or meeting demand
- Need to define adequacy in terms of flexibility
 - Ramp limited resource or Energy Limited Resource
- Performance monitoring of AS
- Gate closure time – passive approach
- Minimum threshold quantum for Ancillary Services

CERC's discussion paper on Ancillary Services

- In September 2018, the Central Electricity Regulatory Commission (CERC) published a discussion paper on “Re-designing Ancillary Services Mechanism in India”.
- Paper proposes to transform the existing administered ancillary services mechanism in India to a market-based one.
- Challenges for Power Systems Operation :-
 - Secure and Reliable grid operation
 - Renewable energy integration
 - Frequency support
 - Utilization of un-despatched surplus and congestion management
- Requirement to Introduce
 - Greater coverage and more efficient outcome in terms of price discovery and grid balancing.
 - Adequate reserves capacity
 - Gate Closure for Scheduling Process
 - Minimum threshold quantum for Ancillary Services

CERC's discussion paper on Ancillary Services

- Proposed Principles for Proposed Ancillary Market Design
 - Competitive and Market Based
 - Transparent
 - Level playing field – Participative for all types of technology
 - Fit for the future- Agile
- Introduction of Market based mechanism for **Tertiary Ancillary Services viz.**,
 - Slow Spinning Reserve (already synchronized and come up within 15-30 Minutes)
 - Slow Non Synchronized Spinning Reserve (Not Synchronized but can come up in 15-30 Minutes)

CERC's discussion paper on Ancillary Services

D a y A h e a d	Offers by Qualified Resources	<ul style="list-style-type: none"> • Joint Co-Optimization of Energy and Reserves Services by Power Exchanges on Day Ahead Basis, with objective of Total Cost Minimization
	Notice by POSOCO	<ul style="list-style-type: none"> • All selected suppliers in the Day Ahead Market are notified by POSOCO for provision of Reserves
	Change in Operating Reserve Schedule	<ul style="list-style-type: none"> • Any Resource may change the schedule with due notification (to POSOCO) at least 90 minutes prior to time block for which the resource is scheduled to provide reserve, or before gate closure
I n t r a D a y	Supplemental Resource Evaluation	<ul style="list-style-type: none"> • POSOCO to reassess the need for reserves in real time (90 Min Prior to Real Time)
	Real Time Resource Selection	<ul style="list-style-type: none"> • Mechanism to be synchronised with RTM (Real Time Market) whenever it commence operation
	Obligation to make resources available	<ul style="list-style-type: none"> • All Operating Reserves selected by POSOCO to remain available to activate for at least four time blocks from activation time

CERC's discussion paper on Ancillary Services

- Offer by Qualified Resources
 - There shall be a Day Ahead Market where the generators would bid simultaneously in Day Ahead Energy Market and Day Ahead Ancillary Services Market and the two shall be cleared simultaneously.
 - Resources capable of providing Tertiary Services in Day Ahead Commitment, shall submit Availability bids for each hour of next day in Day Ahead Market where these will be co-optimized with Energy Bids.
 - The demand curve in Day Ahead Energy Market will be formed by aggregation of demand bids in the market, while the demand curve for each type of ancillary service shall be put forth by the NLDC/RLDCs.
 - Co-Optimization process will be run by Power Exchanges on DAY AHEAD basis
 - In this process, —JOINT cost of provision of Energy and Reserves on a Day Ahead Basis is Minimized (Or alternatively Maximization of Social Welfare from Joint Provision of Energy and Reserves in Day Ahead Market)
- Notice by POSOCO
 - All selected suppliers in the Day Ahead Market are notified by POSOCO for provision of Reserves

CERC's discussion paper on Ancillary Services

- Change in Operating Reserve Schedule
 - Any Resource may change the schedule with due notification (to POSOCO) at least 90 minutes prior to time block for which the resource is scheduled to provide reserve, or before gate closure
 - If supplier selected in DAM is not able to supply reserve services in real time, then it shall have to buy back the un-served quantum at real time prices
 - The charges for ancillary services shall be recovered through DSM pool
- Certain conditions may lead to a change in real time availability of resources and hence the resources designated to provide Ancillary Services shall be finally selected through a Real Time Market
- Suppliers will be selected in real time based on their response rates, their applicable operating limit, and their Energy Bid through a co-optimized Real-Time commitment and dispatch process that minimizes the total cost of Energy and Tertiary Reserves

CERC's discussion paper on Ancillary Services

Bid by Suppliers:-

- Bided quantum shall be in each type of Reserve Service
- Offers Price shall be separate for Energy and AS in the Day Ahead Market, and only Energy Price offer in Real Time Market, AS Price in Real Time will be set at Rs.0 / MWh i.e., both the energy and AS price can't be altered from that submitted earlier

Buyers Shall be RLDC's (POSOCO)

- Based on Demand Curves for Reserves – which are different for different congestion zones

Price

- Price would be calculated as the cost of the marginal resource providing the ancillary service
 - If that generator's variable fuel and maintenance cost was Rs 4.0/kWh and market price is ₹ 5.0/kWh, the generator must get at least Rs 1.0/kWh plus some maintenance cost for remaining available for reserve
- Uniform market clearing price would be discovered for each block of time for all type of reserve services in the market

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NLDC can initiate resource evaluation at any instant. The resource that is not able to demonstrate the offer parameters shall be barred from participating in these markets for a period of three years after it has failed three successive tests

CERC's discussion paper on Ancillary Services

Day Ahead Settlement

Total Demand: **590 MW**

Reserve: **25 MW** , to be determined by POSOCO

Day Ahead Position		Gen. Offered at 0 ₹ (MW)	Incremental Energy (MW)	Generation (MW)	Spinning Reserve (MW)	Incremental Energy Price Offer (₹/MWh)	DA Spinning Reserve Availability offer (₹/MWh)	Energy Schedule (MW)	Reserve Schedule (MW)
Fully Dispatched	Unit 1	50	150	200	10	2500	100	200	
Held Back for Reserve	Unit 2	50	150	200	10	3500	200	195	5
Econ. Despatch	Unit 3	50	150	200	10	4500	300	145	10
Tech Min	Unit 4	50	150	200	10	5500	400	50	10

The last two columns show the market clearing volumes of **Energy** and **Reserves** through Joint Optimization model

Energy Clearing Price :- With 590 MW Load, Marginal Generator is Unit 3, Hence Energy Price shall be calculated at ₹ 4500/MWh (as 200 MW is served at ₹0) 13

Reserves Clearing Price :- With 25 MW Reserves Demand, Marginal Provider for Reserves is **Unit 2**, through optimization model, & the opportunity cost for Unit 2 shall be ₹ (4500-3500) + ₹ 200= ₹ 1200/MWh. Thus Reserves Cost shall be calculated at ₹ 1200/MWh

CERC's discussion paper on Ancillary Services

Real Time Scenario Settlement

Total Demand: **510 MW (minus 80)**

Reserve: **15 MW (minus 10)**, to be determined by POSOCO

Day Ahead Position		Gen. Offered at 0 ₹ (MW)	Incremental Energy (MW)	Generation (MW)	Spinning Reserve (MW)	Incremental Energy Price Offer (₹/MWh)	Real Time Spinning Reserve Availability offer (MW)	Energy Schedule (MW)	Reserve Schedule (MW)
Fully Disp	Unit 1	50	150	200	10	2500	0	0	0
Held Back for Reserve	Unit 2	50	150	200	10	3500	0	200	5, 0
Econ. Despatch	Unit 3	50	150	200	10	4500	300, 0	145, 60	10, 5
Tech Min	Unit 4	50	150	200	10	5500	400, 0	50, 50	10, 10

The last two columns show the market clearing volumes of Energy and Reserves through Joint Optimization model with constraints

Energy Clearing Price :- Marginal Generator is Unit 3, Hence Energy Price shall be calculated at **₹ 4500/MWh** (as 200 MW is served at ₹0)

Reserves Clearing Price :- With **510 MW** Demand and **15 MW** Reserve, Marginal Provider for Reserves will be **Unit 3, through optimization model**, & the opportunity cost for Unit 3 shall be ₹ (4500-4500) + ₹ 0 = ₹ 0/MWh. Thus, there shall be no additional cost payable to Unit 3 and it shall buyback 5 MW at RT Reserve Price which is ₹ 0 here for AS support (incidentally) and will buyback (145-60) at Real Time Market Clearing Price i.e., **₹ 4500**

CERC's discussion paper on Ancillary Services

Real Time Scenario Settlement

Total Demand: **950 MW (plus 440 as compared to 510 on day ahead basis)**

Reserve: **35 MW (plus 10)**, to be determined by POSOCO

Day Ahead Position		Gen. Offered at 0 ₹ (MW)	Incremental Energy (MW)	Generation (MW)	Spinning Reserve (MW)	Incremental Energy Price Offer (₹/MWh)	Real Time Spinning Reserve Availability offer (₹/MWh)	Energy Schedule (MW)	Reserve Schedule (MW)
Fully Disp	Unit 1	50	150	200	10	2500	0	0	
Held Back for Reserve	Unit 2	50	150	200	10	3500	0	195	5
Econ. Despatch	Unit 3	50	150	200	10	4500	300, 0	145, 190	10, 10
Tech Min	Unit 4	50	150	200	10	5500	400, 0	50, 190	10, 10
-	Unit 5 (New)	50	150	200	10	6500	0	175	10

Energy Clearing Price :- Marginal Generator is Unit 5, Hence RT Energy Price shall be calculated at **₹ 6500/MWh** (as 250 MW is served at ₹0)

Reserves Clearing Price :- With **950 MW** Demand, Marginal Provider for Reserves is **Unit 2 through optimization model**, & the opportunity cost for Unit 2 shall be ₹ (6500-3500) + ₹ 0 = ₹ 3000/MWh.

- **Unit 1 & 2** shall be paid as per initial discovered price of ₹ 4500/MWh as there is no change in their schedule in Real Time
- **Unit 3 & 4** shall get amount at ₹ 6500 for additional 45 MW & 140 MW respectively & will provide reserves at initial DA reserves price i.e., ₹1200/MWh as there is no change in their reserve schedule
- **Unit 5** shall be compensated at ₹ 6500 for entire 175 MW and shall provide reserves at Real Time reserve price of ₹3000/MWh (6500-3500)

Real Time Market

2. Real Time Electricity Markets in India (1/3)

CERC has issued a ***Discussion Paper on Re-designing Real Time Electricity Markets in India*** on 25.07.2018. Summary of the proposal is as under:

1. **Issues in present market design:** The volume traded under intra-day market is at a very miniscule level of less than 1% due to:

- The price discovery methodology viz., continuous trading based on pay as you bid principle
- Absence of gate closure
- The original beneficiaries (discoms) have the right to recall contracted generation at any time from the fourth time block ahead. This often leads to sub-optimal utilization.
- Substantial growth in RE generation -issues related to its integration
- Alternatively, the DISCOMs themselves can sell the surplus power from their contracted generation sources in the real time market and earn the revenue in full.

2. Real Time Electricity Markets in India (2/3)

Proposed Real-time Market (RTM) design:

- Double sided closed auctions with uniform market clearing price.
- Energy hour for delivery in four fifteen minute blocks in each hour.
- Energy trade for the first hour (00.00 Hrs. to 01.00 Hrs.) of the day starts at 22.30 Hrs. of the previous day and is repeated every hour thereafter.
- To ensure firmness of such bids and offers, the gate for schedule revision will close before the start of the auction.
- Revenue over and above the regulated variable cost shall be shared in the ratio of 50:50.
- Transmission Corridor Allocation and Congestion Management: POSOCO to declare in advance the transmission corridor margin available for real-time transaction.

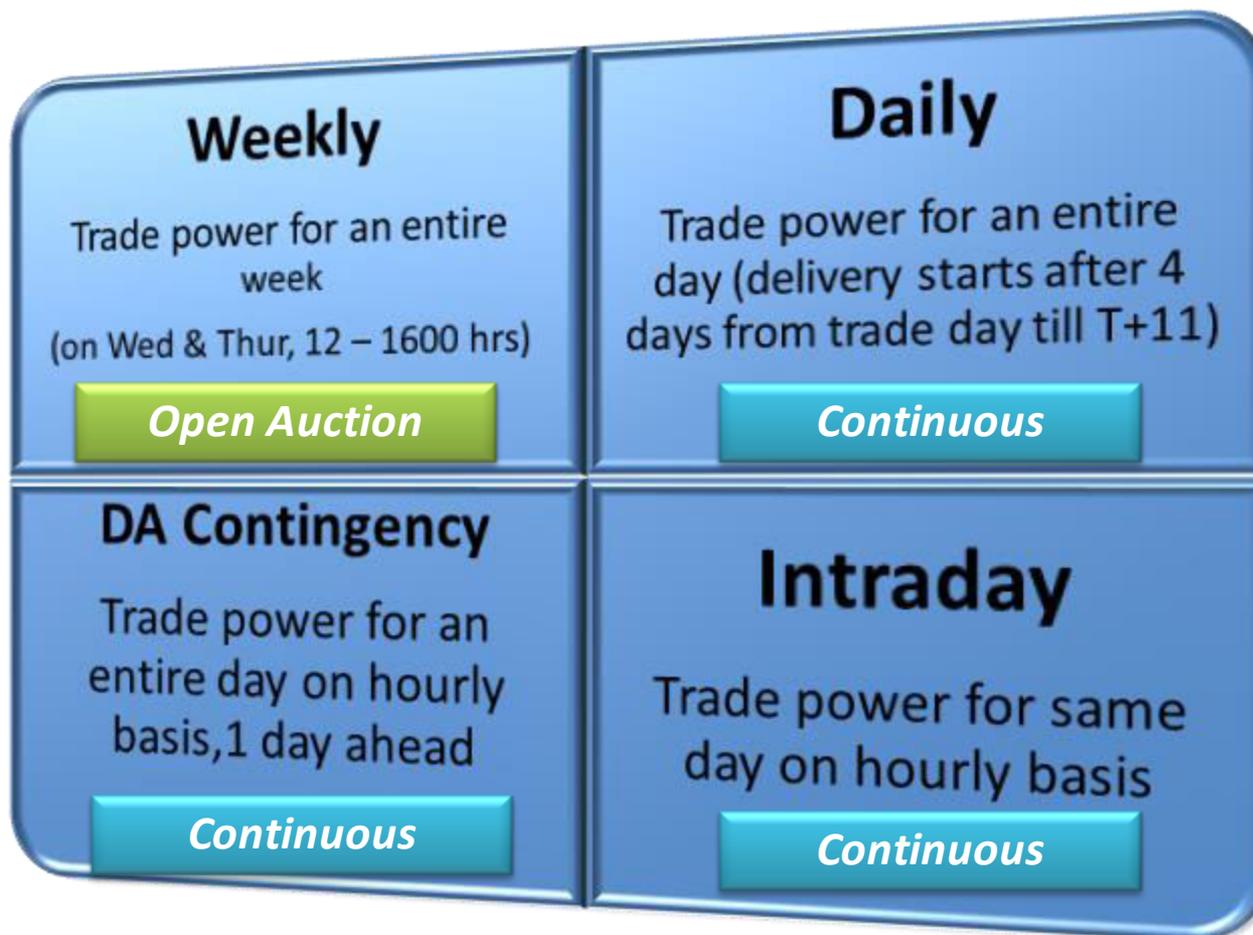
Benefits to DISCOM (3/3)

- Liquidity in the proposed RTM will increase because of the design change in the form of auction and gate closure.
- Resource optimization across regions to take advantage of cheap resources.
- Access to larger pool of generation resources to meet contingent requirement in real time as against the existing bilateral resources.
- Prices discovered in such real time market are likely to be more efficient than the cost of procurement of power from the bilateral arrangement under the right to recall;
- Net gains shall be shared with the discoms in the ratio of 50:50;
- Alternatively, the discoms themselves can sell the surplus power from their contracted generation sources in the real time market and earn the revenue in full.

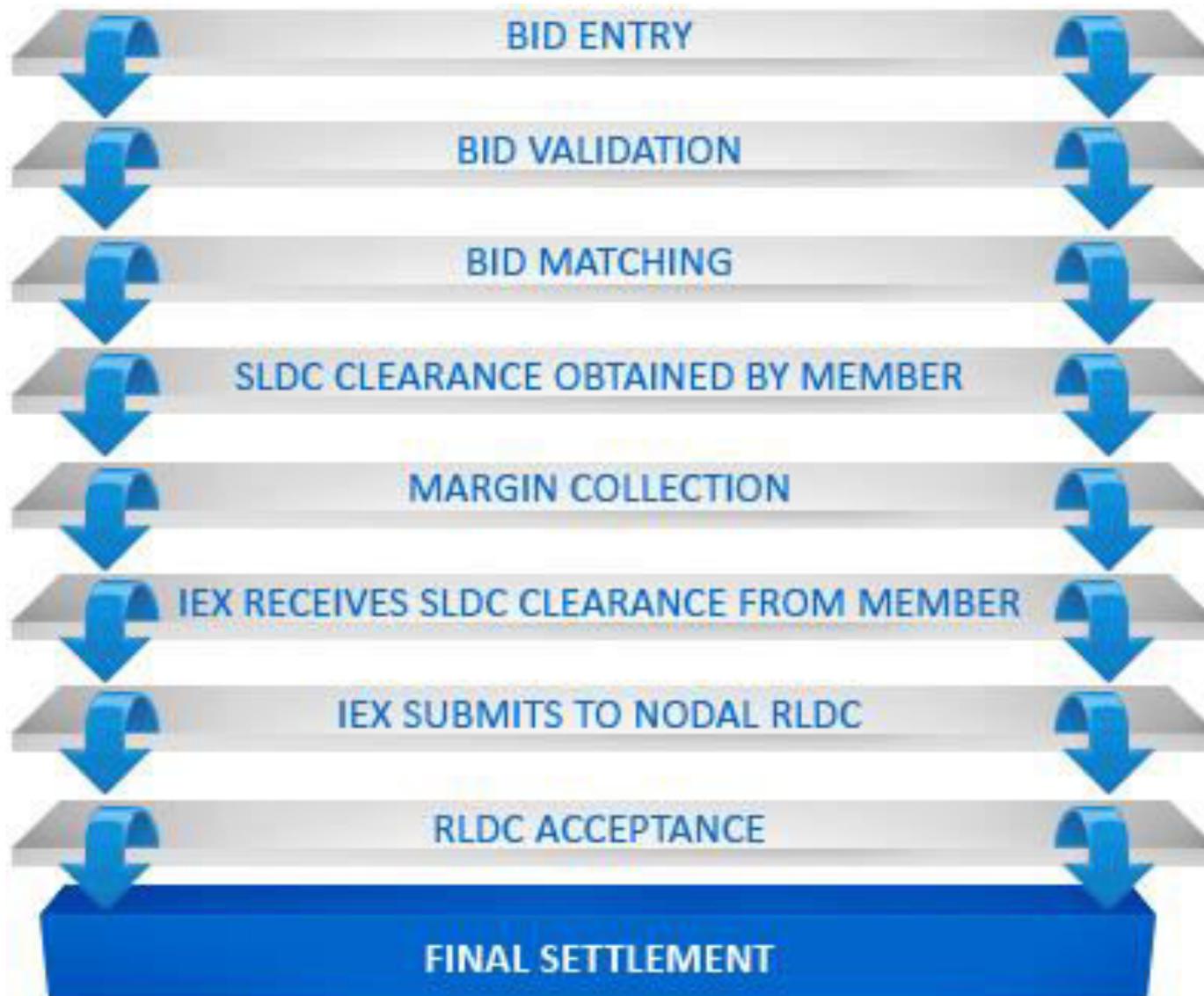


Intra Day Market

TAM Market Segments



Market Place Functionality (TAM)



Contract Characteristics

TERM AHEAD MARKET

Contract Characteristic
Delivery
Auction Type
Contracts
Trade Availability
Financial Settlement

Day Ahead Market
Next day
Closed Auction
15 min
All Days
Pay-In- D-1; Pay Out – D+1

Intraday Contracts
0400-2400 Hrs same day
Continuous trading
Hourly
All days
Pay in: T+1 Pay out: T+1

Day Ahead Contingency
For next day
Continuous trading
Hourly
All Days; 1500-2300
Pay in: T+1 Pay out: T+2

Daily Contracts
From T+2 day to next T+9 days
Continuous trading
Block of Hours (Fixed)
All Days; 1200-1500
Pay-In- D-1; Pay Out – D+1

Weekly Contracts
For next week
Open Auction
Block of Hours (Fixed)
Wed & Thurs; 1200-1600
Pay-In- D-1; Pay Out – D+1

Open/Closed Auction

Orders accumulated during call phase (no matching)

Orders matched after call period

Orders are used for calculation common price i.e. Equilibrium Price.

All successful orders matched at Equilibrium Price.

Continuous Trading

Price-time priority based continuous matching

The highest Buy order & lowest Sell order gets the priority

If the prices are same then priority is given to the time of the order received.

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