S K Soonee

Founder, CEO, Grid-India (formerly POSOCO)

FIEEE, FINAE, LFIE(I)

International Member NAE US, Retired CPES GOI

Distinguished Member CIGRE, Distinguished Alumnus IIT KGP

How the transaction is settled ? Hand’s on exercise…

- An exercise for 10 mins , involve every one …
- Start with simple two meters , supplier, consumer
- Keep building the complexity
- Multiple supplier, multiple consumer, multiple rates etc
- Let’s try suggesting the settlement using meter reading
- Prove that meters don’t understand the transaction
- Show why schedules are important and relate to Finance
- The basic concept of deviation, accounting, pricing

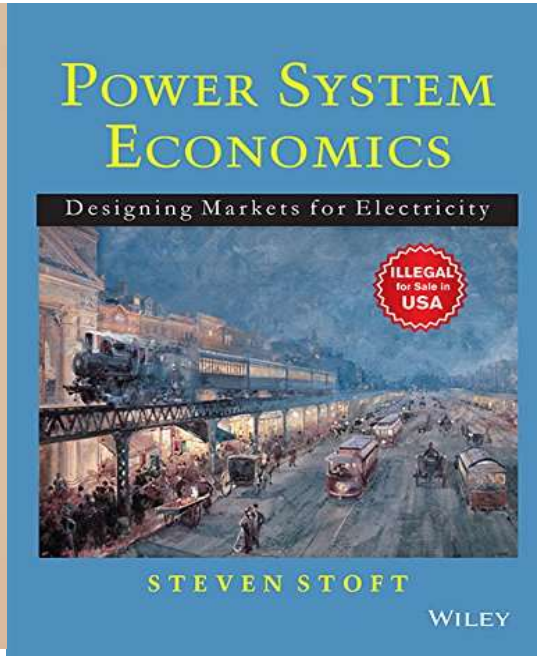
"…In a competitive market the real time prices are true marginal cost prices, and the forward prices are just estimates…"

- **Steven Stoft**

Power System Economics: Chapter-

The Two-Settlement System

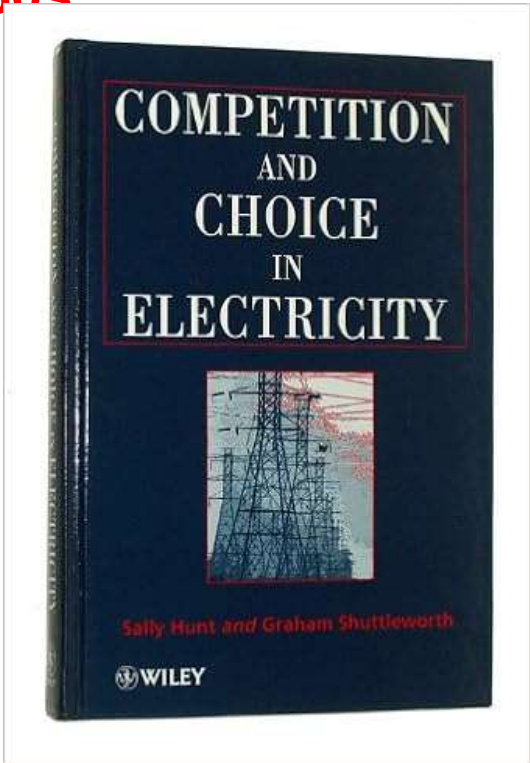
- http://stoft.com/metaPage/lib/Stoft-2002-PSE-Ch-1-3,4,5,6.pdf



Sally Hunt: Energy expert

https://regulationbodyofknowledge.org/wp-content/uploads/2013/03/Hunt_Making_Competition_Work.pdf

Who helped mastermind electricity privatisation in Britain in the 1980s



https://www.independent.co.uk/news/obituaries/sally-hunt-energy-expert-who-helped-mastermind-electricity-privatisation-in-britain-in-the-1980s-2136934.html

Contents

- Ontology rather than epistemology of Deviation settlement mechanism .
- Electricity at Core of Indian Economy
- Key Principles of Electricity Market
- Fundamental Questions
- Sequencing – Markets Products & Services as LEGO sets
- Market Development in Indian Context – Products and Services
- Imbalances and Evolution of Design of Rate Vector
- System Balancing in India
- CERC DSM Regulations, 2024

History – Evolution of UI/ DSM in India –Literature survey

- https://www.researchgate.net/publication/318264288_Some_aspects_of_improving_Quality_of_Electricity_Production
- https://www.researchgate.net/publication/348295567_An_ode_to_the_Unscheduled_Interchange_Mechanism_in_India_2005
- https://www.researchgate.net/publication/228583289_Significance_of_Unscheduled_Interchange_Mechanism_in_the_Indian_Electricity_Supply_Industry

History – Evolution of UI/ DSM in India –Literature survey

- https://www.researchgate.net/publication/366390752_Transition_From_Administered_To_Market_Linked_Imbalance_Handling_Mechanism_in_Indian_Power_System

- https://www.researchgate.net/publication/361181805_Active_and_Passive_Balancing_Paradigms_in_Indian_Electricity_Grid_-_CIGRE_2022_Kyoto_Symposium_Japan

- http://www.cercind.gov.in/2018/Reports/ASB.pdf
- http://www.cercind.gov.in/2018/Reports/50%20Hz_Committee1.pdf

Understanding Electric Power Systems…Complex in Nature…

- Electricity as a commodity
  - Fungible (Homogenous) Cancels each other
  - Follows Cournot's behavior ,Quality Hz
- Schedules :: Commitments :: Contracts
- Exact delivery/withdrawal- a coincidence
- Meters do not recognize Contract / Trade
- Delivery to the 'whole'
- Withdrawal from the 'whole'
- ~99% of Bulk Settlement -without meter

"Power system is a complex system, everything interacts with everything, Nobody is in full control and Nobody knows the whole thing."

Six networks describing Industry.

Jack Casazza Frank Delea

1. The ***physical*** network
2. The ***fuel/energy*** network
3. The ***regulatory*** network
4. The ***business*** network
5. The ***money*** network
6. The ***information/ control*** network

Accounting and settlement cuts across all these six networks

Fundamental questions

“Who”
pays to
“Whom”
for
“What”
and
How much ?

Who **Approves** ?

How is it **Scheduled** ?

How is it **Measured** ?

Who keeps the **Accounts** ?

How is it **Settled** ?

How is **Transparency** ensured ?

How is **Trust** built in the whole System ?

Settlement
Single ?
Two part ?
Multipart ?
Gross or Net ?
Period ?
Cycle ?

https://forumofregulators.gov.in/Data/Reports/I.pdf

Life is like accounting, everything must be balanced

Inadvertent Interchange - Imbalances

http://regulationbodyofknowledge.org/wp-content/uploads/2013/03/Hunt_Making_Competition_Work.pdf

"The right price for imbalances is a market-based price. A market-based price for imbalance energy is incentive-compatible...

Source: Sally Hunt Making Competition Work in Electricity' Chapter – Trading Arrangements Section – Imbalances

*"Inadvertent Interchange consisted of three components. The first component, the —**Energy Component**, represented the value of the energy included in the Inadvertent Interchange and is represented in the energy price. The second component, the —**Transmission Component**, represents the reliability value of the transmission congestion and in present markets this is also included in the energy price. The third component, the —**Frequency Control Component**, represents the value of the response and underlying reserves used to deliver the balancing energy necessary to offset unscheduled energy"*

Source: NERC Joint Inadvertent Interchange Task Force (JIITF) *White Paper, Recommendations for the Wholesale Electric Industry of North America, May 2002*


Recommendations for the Wholesale Electric Industry of North America:
Inadvertent Interchange
Draft 6d
May 10, 2002
A White Paper Prepared by the
Joint Inadvertent Interchange Task Force
For Consideration by the:
Resources Subcommittee
Market Interface Committee
Compliance Committee

http://www.naesb.org/pdf/weq_mos012403w5.pdf

Scheduling - contract

- Long term
- Medium term
- Short term – Bilateral
- Short term – Collective
- Through Trader
- Through Power Exchange
- Through OTC platform
- Ancillary by LDCs
- SCED redispatch by LDCs

Scheduling – Modes

• One -One	Basic Bilateral no loss
• One-Pool-One	Bilateral with Loss
• One –Pool	Ancillary up/down
• Many-Pool -Many	Collective PX/ SCED
• Many –Pool	Ancillary
• Many-Pool-One	Ancillary with Loss
• Pool-Pool	Inter Regional
• One- Pool- Many	Aggregator (future)
• Many-Pool-Many	Aggregator (future)
• Pool- Pool-Pool	Cross Border AS (future)

A good accountant is a good poet. He appreciates the true value of things. -Robert Frost

Indian Power Market Lego Set –Sequencing Matters

SOONEE

ISSUES GALORE

SCHEDULING
DEVIATION
METERING
JURISDICTION
ACCOU
CONTROL AREA
LOSS
SETTLEMENT
TREATMENT
ANCILLARY
ANCILLARY
TRANSMISSION
PRICING
OPEN ACCESS
OPEN
ACCESS
CAPACITY
DERIVATIVE
SHORT TERM
ENERGY
CAPACITY MARKET
EXCHANGES
OTC
BILATERAL
COUPLING
COUILATION
SHORT TERAL

Evolution of Indian Electricity Market

2025: Derivatives

2024: Indian Carbon Market

2023: Market based TRAS

2022: Green Open Access, OTC Platform

2021: Integrated DAM

2020: Real Time Market

2019: SCED

2018: AGC

2017: Reserves

2016: Ancillary Services

2015: 24 x 7 Market

2015: RE Framework

2014: Deviation Settlement

2012: Sub-Hourly Market

2011: Transmission Pricing (POC)

2010: Power Market, REC

2009: Connectivity, LTA, MTOA

2009: Trading License

2009: Congestion Management

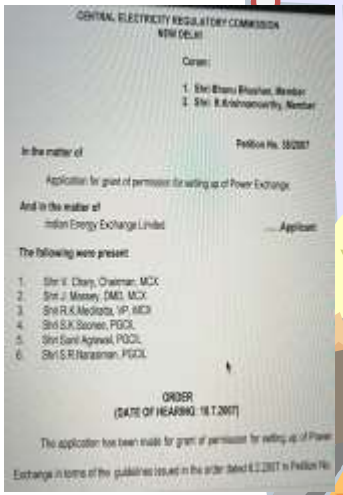
2009: Imbalance (UI)

2008: Power Exchange

2004: Open Access

2002-03: ABT

Policy Level
- Electricity Act, 2003
- National Electricity Policy
- Tariff Policy (2006, 2016)


CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

Coram:

1. Shri Bhanu Bhushan, Member
2. Shri R.Krishnamoorthy, Member

In the matter of

Petition No. 55/2007

Application for grant of permission for setting up of Power Exchange

And in the matter of

Indian Energy Exchange Limited ....Applicant

The following were present:

1. Shri V. Dhar, Chairman, MCX
2. Shri J. Massey, DMD, MCX
3. Shri R.K.Mediratta, VP, IIECI
4. Shri S.K.Soonee, POSOCO
5. Shri Sunil Agrawal, PGCIL
6. Shri S.R.Narasimhan, PGCIL

ORDER
(DATE OF HEARING: 16.7.2007)

The application has been made for grant of permission for setting up of Power Exchange in terms of the guidelines issued in the order dated 6.2.2007 in Petition No.

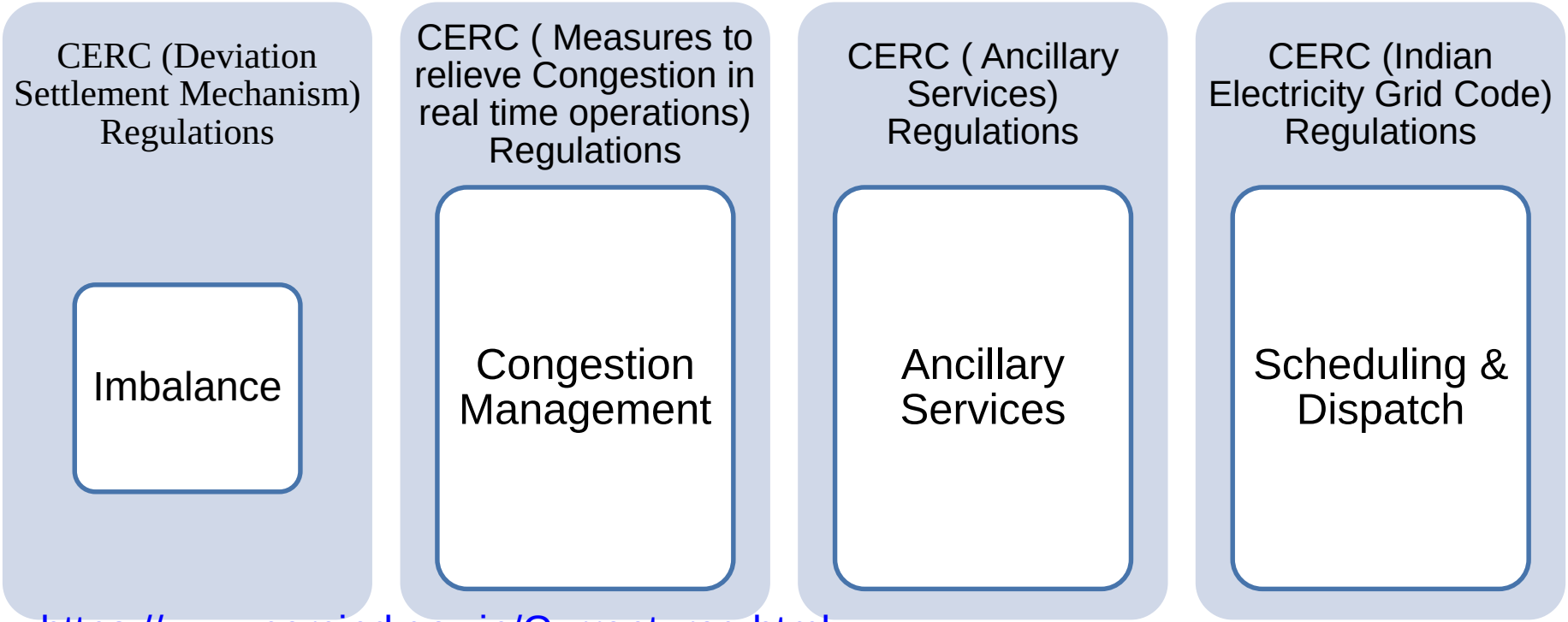

IN THE MATTER OF:

Parties Present:

Future…
- Market for Resource Adequacy
- Financial Products
- Demand Response

Market to complement and not compromise reliability ....

The 4 basic Pillars of Market Design



https://www.cercind.gov.in/Current_reg.html

Scheduling vs Despatch: What's the Difference?

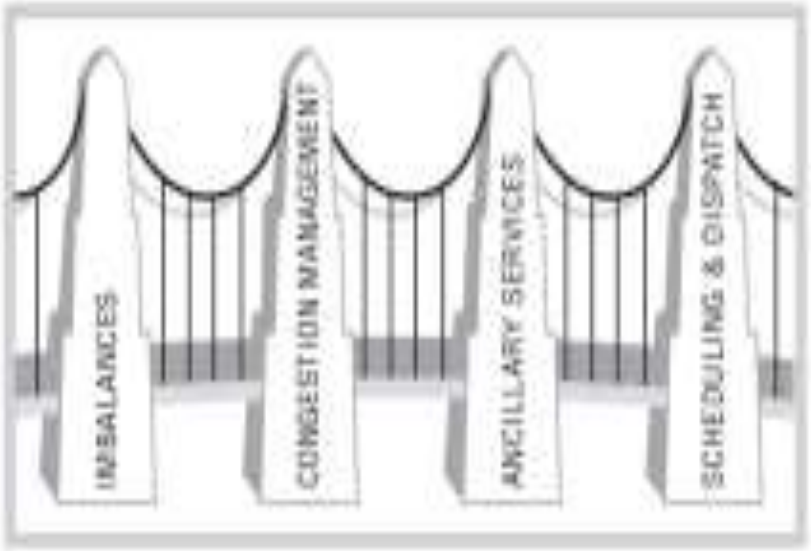
Aspect	Scheduling (Commercial)	Despatch (Operational)
Nature	Bilateral contract between two parties based on agreements	Centralized system-level control, focussed on execution
Timing	Planned hours or days ahead ex-ante	Real-time
Objective	Planning and commitment to meet forecasted demand	Adjusting to actual demand ensuring grid security, frequency and voltage control as per grid needs
Decision Maker	Generator and buyer	System operator post gate closure
Flexibility	Limited post-agreement changes	Highly adaptive to system conditions
Authority	Mutually negotiated Financial settlement, contractual balance ensures fair resource allocation	System-wide, single-entry

Scheduling is about setting expectations!

Despatch is about meeting realities!!

Each process building on each other to ensure a reliable power supply

Indian Electricity Market…Some Numbers



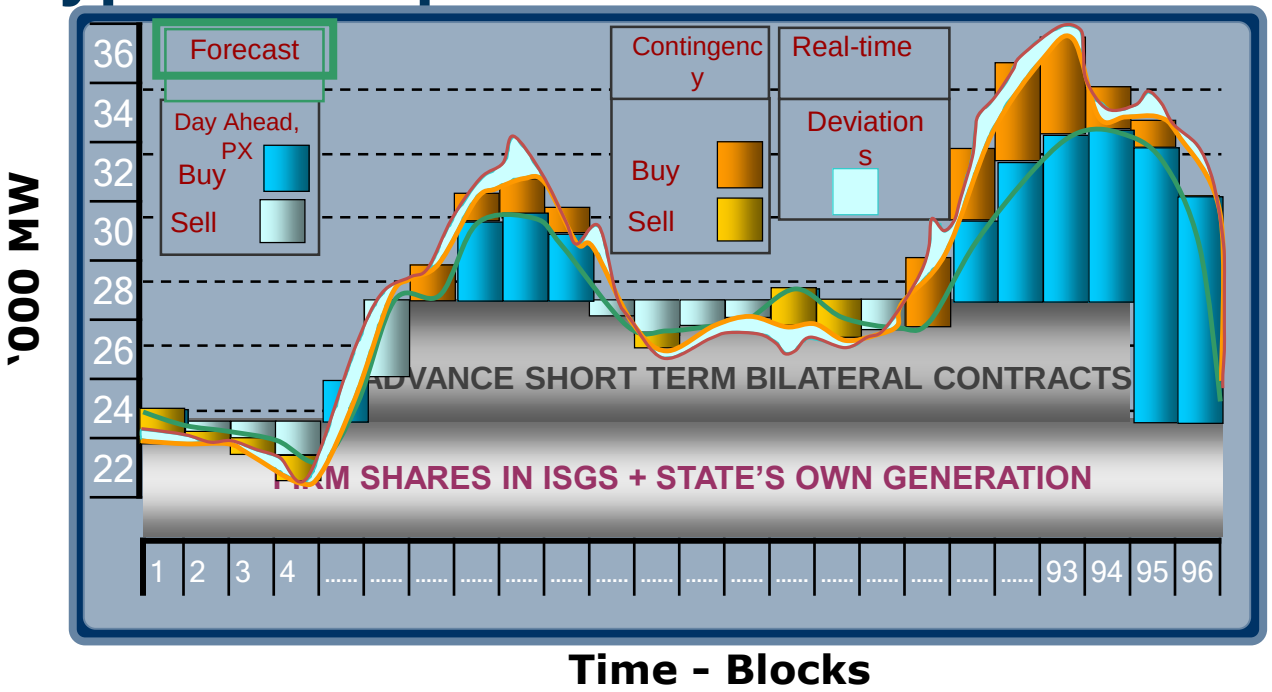
Foundation pillars- Base - Accounting and Settlement

Appx Volume in ₹ Crore /Year

- Deviation charge handled ~ 30,000
- Residual transfer to PSDF ~1000
- ST Transmission Charge ~ 5000
- LT Transmission charge ~ 50000
- Ancillary RRAS charge ~2000
- SCED optimization savings ~1000
- AGC SRAS charge(SCADA)~100
- Congestion charge ~10
- Congestion revenue PX ~ 100
- Reactive charge ~ 50
- Fixed charge to ISGS ~ 100 K
- Fuel charge ISGS ~ 100 K
- Value of Market trade ~ 50 K

Source: “Competition and Choice in Electricity” by Sally Hunt
https://openlibrary.org/books/OL804750M/Competition_and_choice_in_electricity

A Typical Despatch

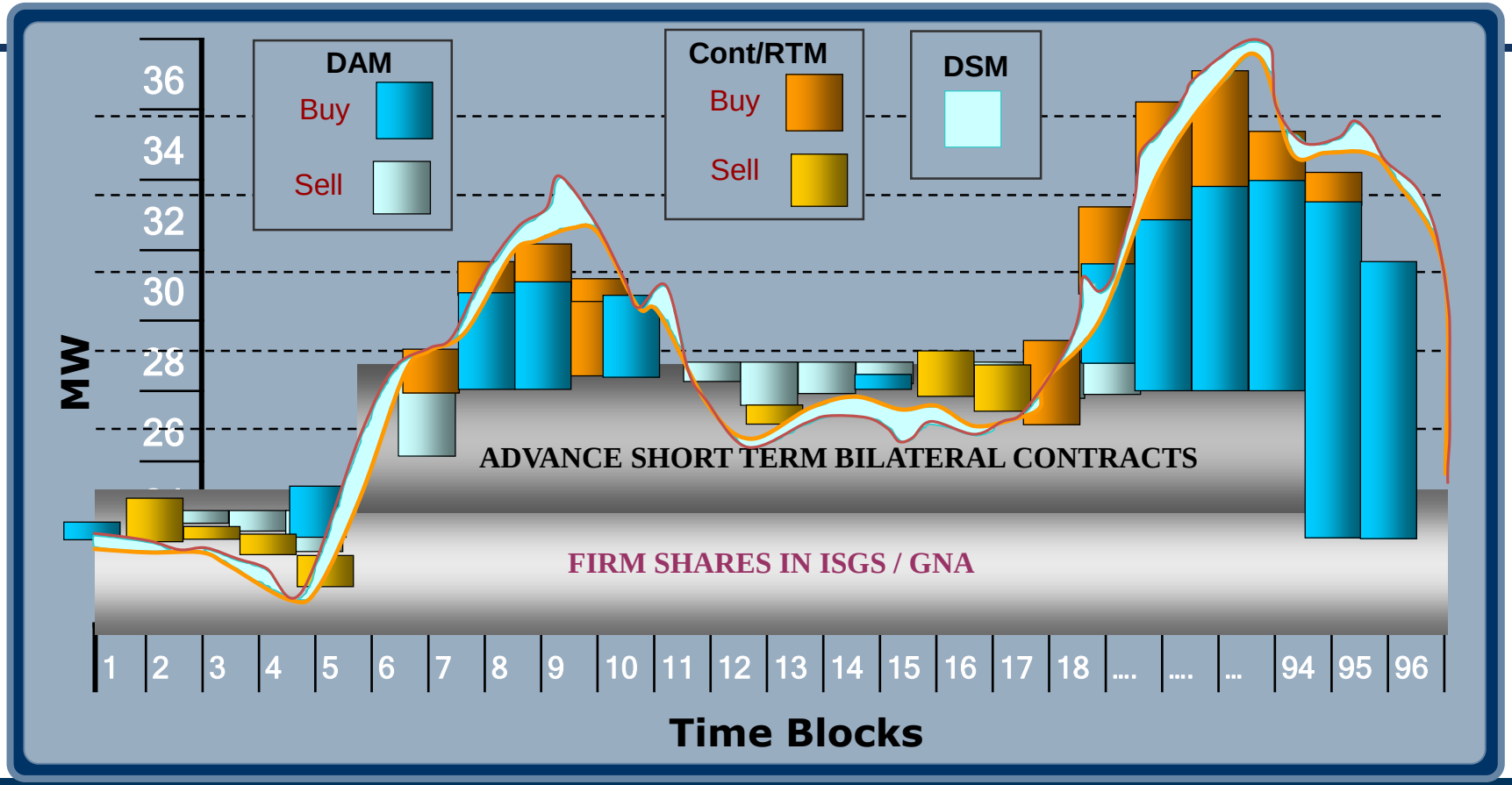


Coordinated Multilateral Model in India

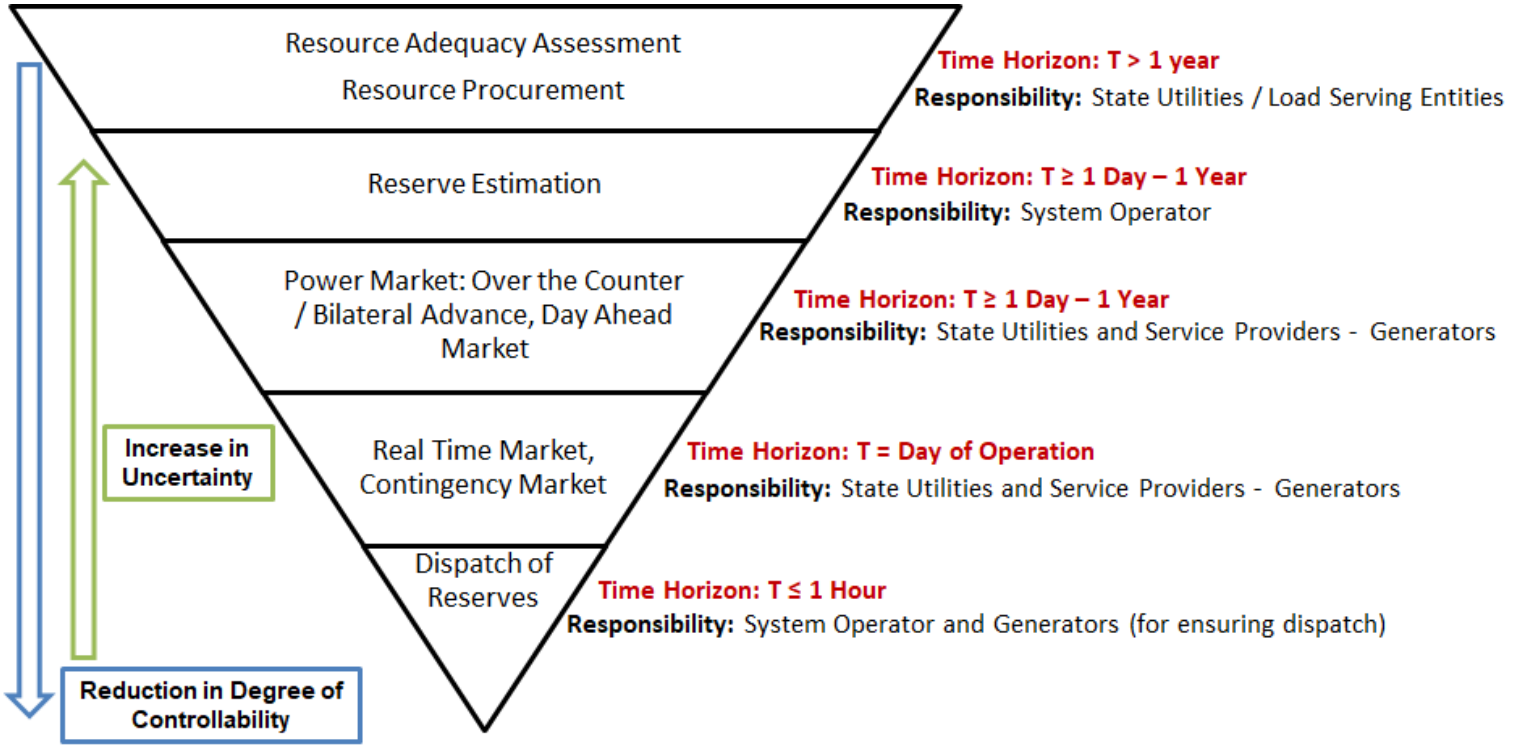
Balancing Supply and Demand

Handling Surplus and Deficit

A Typical Despatch

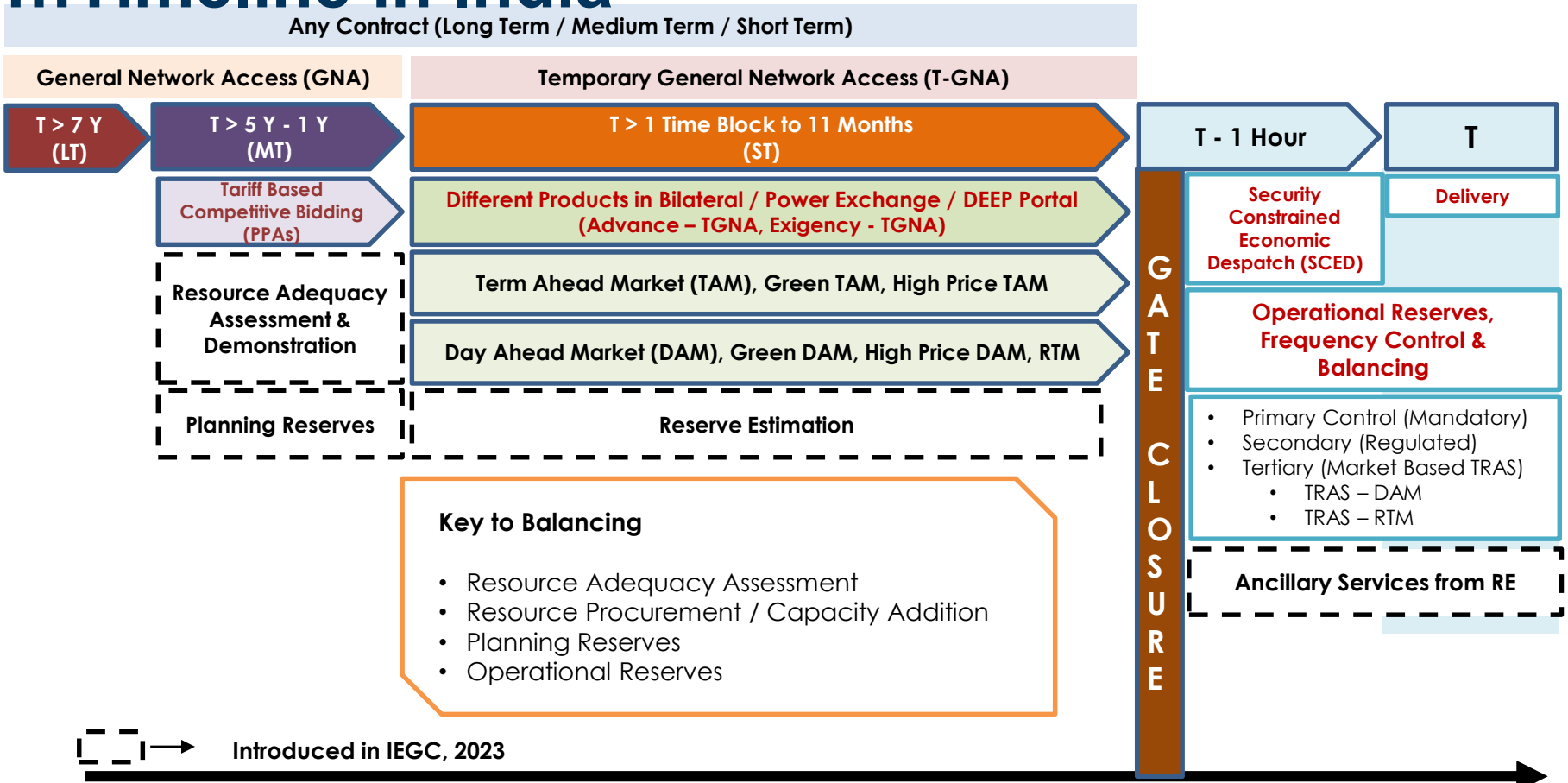


Portfolio Management and Balancing …Responsibility Matrix

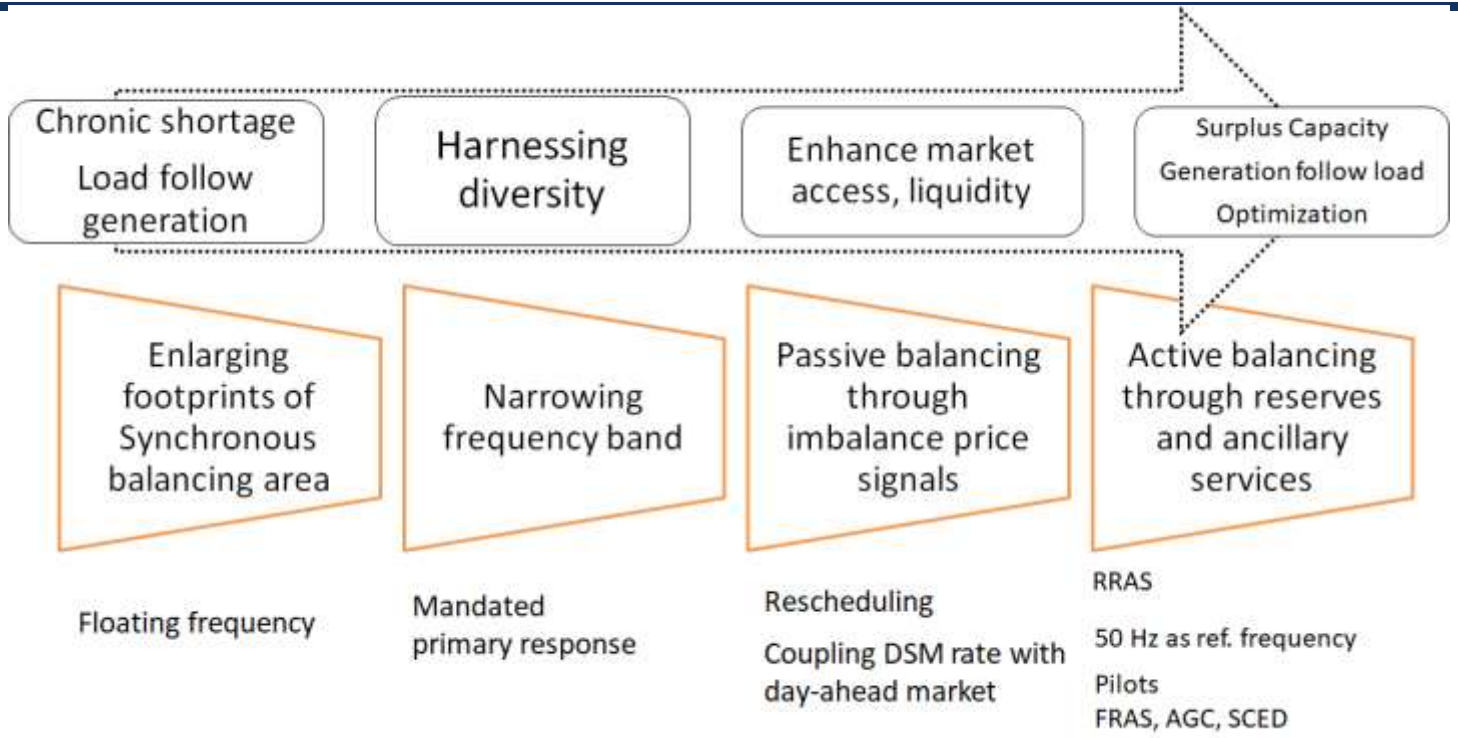


Trade-off between Uncertainty and Controllability

Portfolio Management and Balancing …Timeline in India

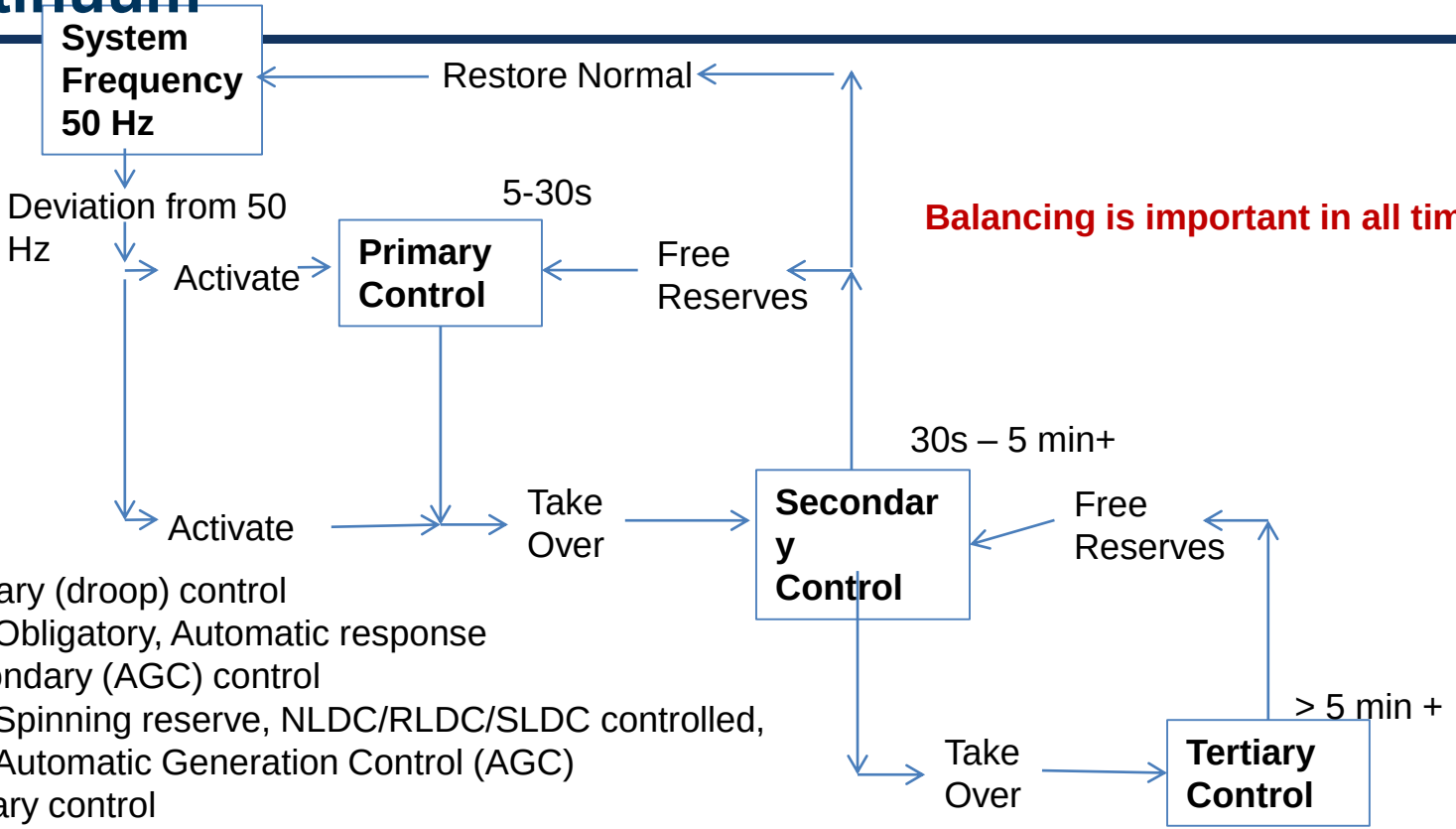


Balancing Paradigms Shift



Reference: Hirth, Lion & Ziegenhagen, Inka, 2015. "Balancing power and variable renewables: Three links," Renewable and Sustainable Energy Reviews, Elsevier, vol. 50(C), pages 1035-1051. https://www.neon-energie.de/Hirth-Ziegenhagen-2015-Balancing-Power-Variable-Renewables-Links.pdf

System Balancing and Frequency Control …Continuum

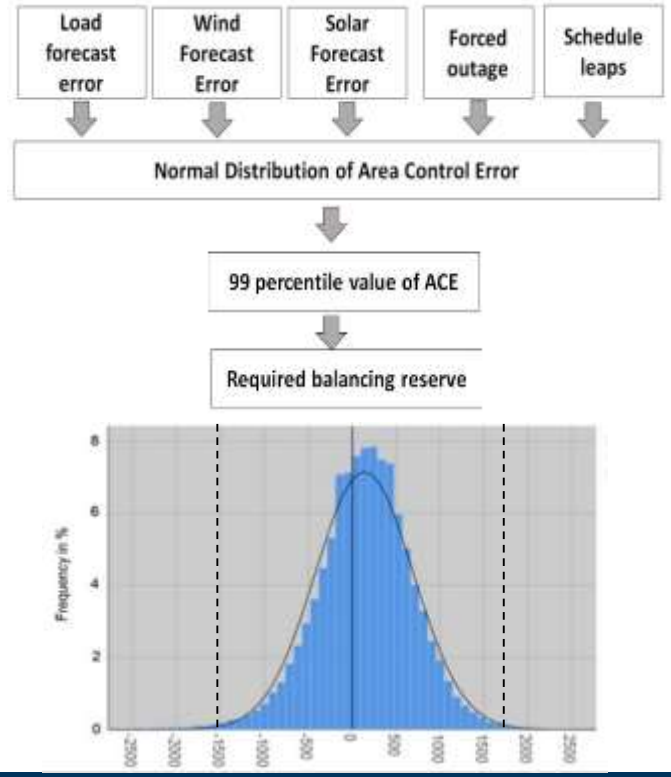


- Primary (droop) control
  - Obligatory, Automatic response
- Secondary (AGC) control
  - Spinning reserve, NLDC/RLDC/SLDC controlled,
  - Automatic Generation Control (AGC)
- Tertiary control
  - Tertiary Reserve and response from State, Manual

Reserve Estimation and Procurement

Basis of Estimation

- Nodal Agency (NLDC) estimates quantum of requirement of SRAS and TRAS at the regional level in coordination with RLDCs and SLDCs and publishes on its website
  - after factoring in the reserves for each state control area
  - based on methodology as specified in the Grid Code
- Requirement of quantum of SRAS and TRAS to re-assessed on day-ahead basis



Planning for Reserves

Year- Ahead	Resource Adequacy/LGBR
Three Day - Ahead	Operational planning/ Unit Commitment

Procurement of Reserves

Day- Ahead	Day Ahead Procurement (DAM - AS)
Intra - Ahead	Incremental Procurement (RTM - AS)

Balancing Reserves Dimensioning (2025-26) …All – India level

Type of reserve	Inter-state level (MW)	Intra state level (MW)	Total All India level (MW)
Secondary	6672	4957	11630
Tertiary	6672	10637	17310
Total	**13344**	**15595**	**28940**

- All India reserves capture diversity benefit at regional level
- Reference contingency for 2024-25 (**7000 MW** (for Solar hours) / **4500 MW** (for non- Solar hours)) published on NLDC website

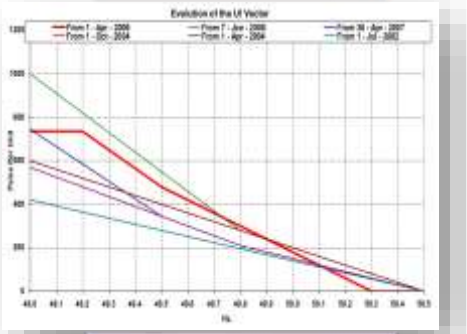
Grid-india.in/en/download/reserves-requirement-of-sras-and-tras-for-2025-26/?wpdmdl=60648

Table 1: Evolution of Deviation Price (erstwhile UI) Vector

Period	Operational Frequency Band	Ceiling Rate (paise/kWh)	Benchmarking of Ceiling Rate	Slope (paise/kWh)	Step size
1st July 2002 – 31st March 2004	49.0 Hz – 50.5 Hz	420	DG set	5.6	0.02 Hz
1st April 2004 – 30th Sept 2004	49.0 Hz – 50.5 Hz	600	DG set	8	
1st October 2004 – 29th April 2007	49.0 Hz – 50.5 Hz	570	DG set	9	
30th April 2007- 6th Jan 2008	49.0 Hz – 50.5 Hz	745	Domestic Naphtha (Liquid Fuel)	6 (50.5-49.8) 9 (49.8-49.5) 16 (49.5-49.0)	
7th Jan 2008 – 31st March 2009	49.0 Hz – 50.5 Hz	1000	Combined cycle plants -Naphtha/RLNG	8 (50.5-49.8) 18 (49.8-49.0)	
1st April 2009 – 2nd May 2010	49.2 Hz – 50.3 Hz	735	RLNG based generating station with variation in fuel prices of around 5%	12 (50.3-49.8) 17 (49.8-49.2)	
3rd May 2010 to 16th Sep 2012	49.5 Hz – 50.2 Hz	873	Gas/liquid fuel based thermal generating stations of NTPC & NEEPCO	15.5(50.2-49.7) 47 (49.7-49.5)	
17th Sep 2012 to 16th Feb 2014	49.7 Hz – 50.2 Hz	900	Highest cost of generation is 896.02 Paise/kWh @Auraiya CCGT Station	16.5 (50.2-50.0) 28.5 (50.0-49.8) 28.12 (49.8-49.5)	
17th Feb 2014 onwards	49.90 Hz - 50.05 Hz	824	Highest cost of generation is 8.24 Rs/kWh @ Auraiya Gas Power Station	20.84 (49.70 - 50.00) 35.60 (50.01 - 50.05)	0.01 Hz

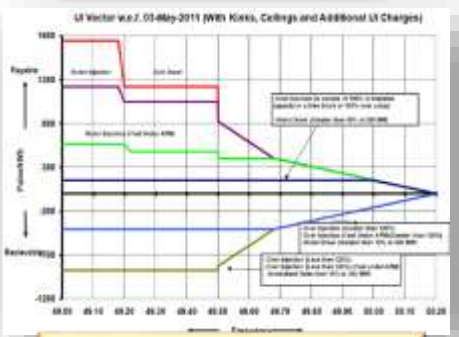
Evolution of Imbalance Handling Mechanism

2002-2010

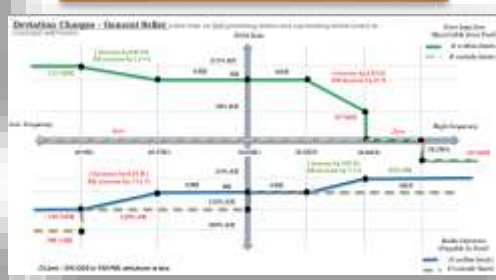


2010-2011

2011-2012

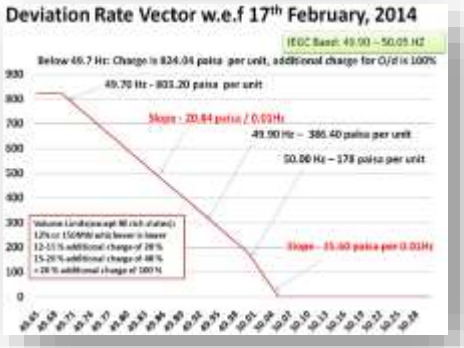


2024 onwards

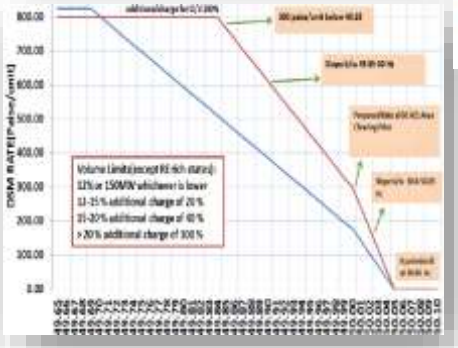


2012-2014

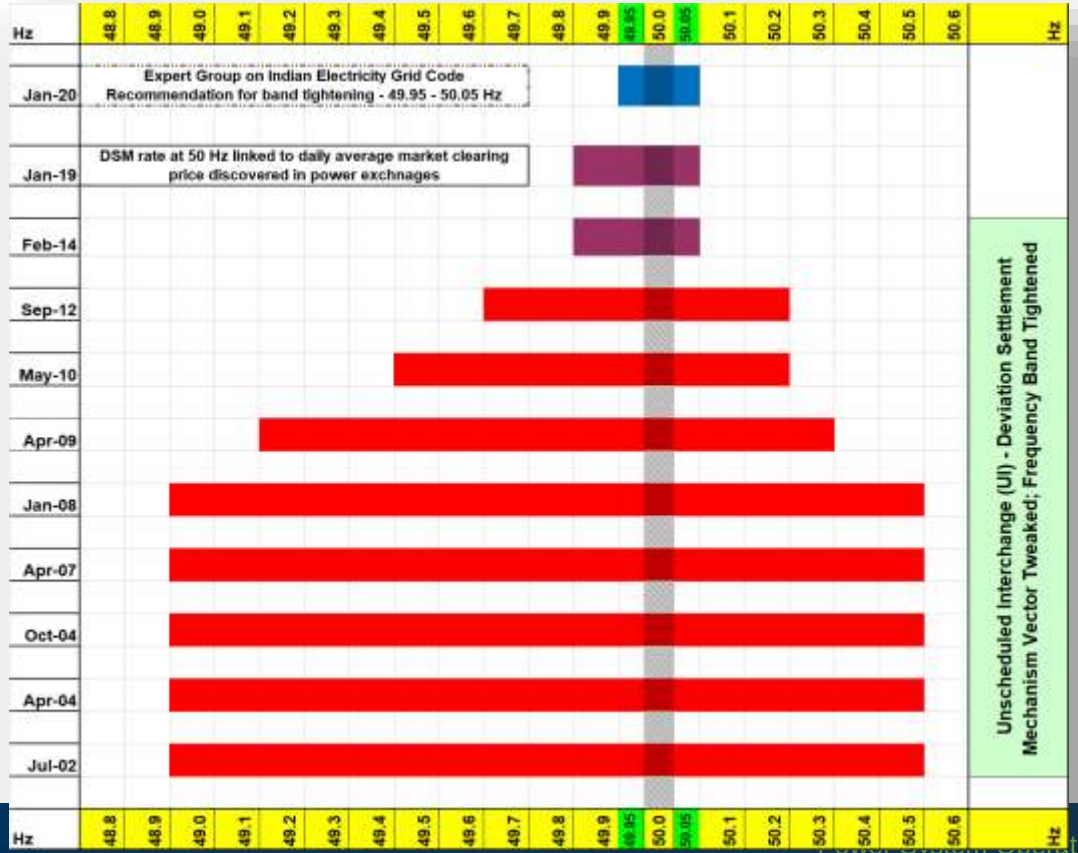
2014-2019

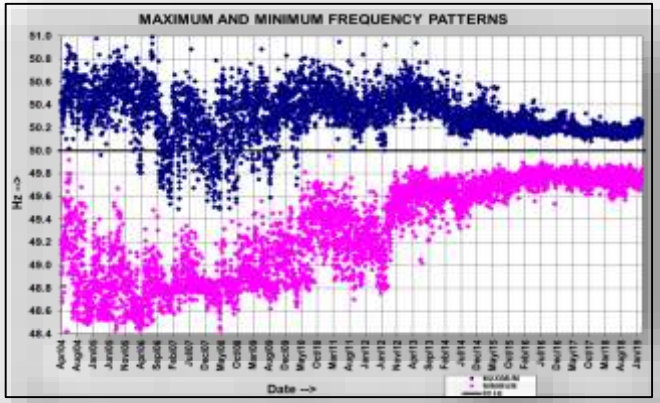


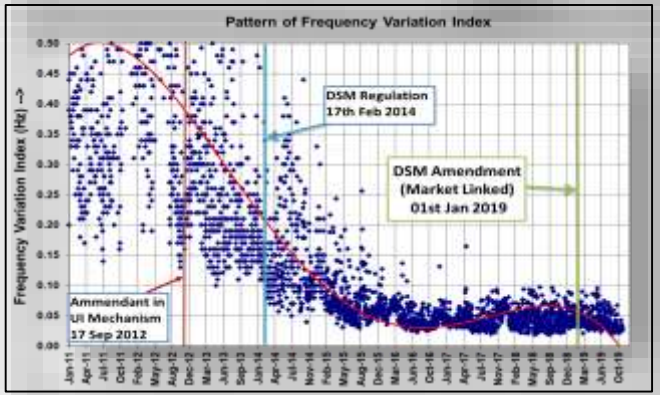
2019-2024



Frequency Band Tightening over the years







Pre-Market Linked Imbalance Pricing (till ‘18)

- Pros
  - Real Time Imbalance Pricing
  - Promotes Efficiency and Merit Order Despatch
  - Perfect Information
  - Known ex ante to everyone
  - Provides a negative feedback for automatic correction
  - Facilitates achieving marginal cost despatch
  - Diffusion of market power and choice to buyers & sellers
  - Hysteresis to disincentive possible misuse
  - Simple to calculate
  - No post facto adjustment
  - Discourages advertent deviations
  - Highest priority in payment

- Cons
  - Regulated Price Vector
  - Not Factoring Value of Lost Load (VOLL)
  - Interplay of Prices in various market segments
  - Not Factoring Time value of Electricity
  - Not Factoring Geographical Location and Transmission Congestion
  - Inadequate Market Opportunities for Balancing
  - Absence of Gate Closure

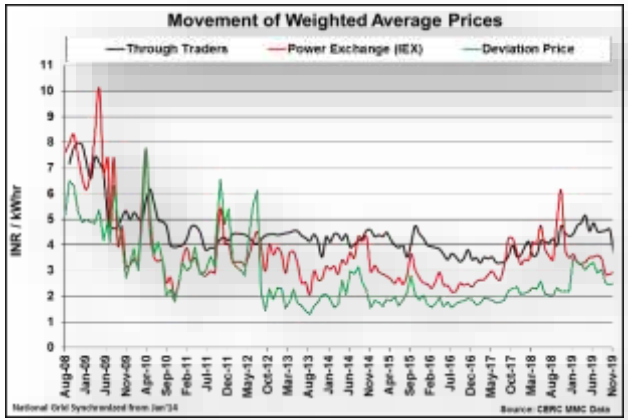
Central Commission Expert Group to Review of the principles of Deviation Settlement Mechanism (DSM) – 2017

http://www.cercind.gov.in/2018/Reports/ASB.pdf

Drivers for Transition to Market linked Imbalance Pricing

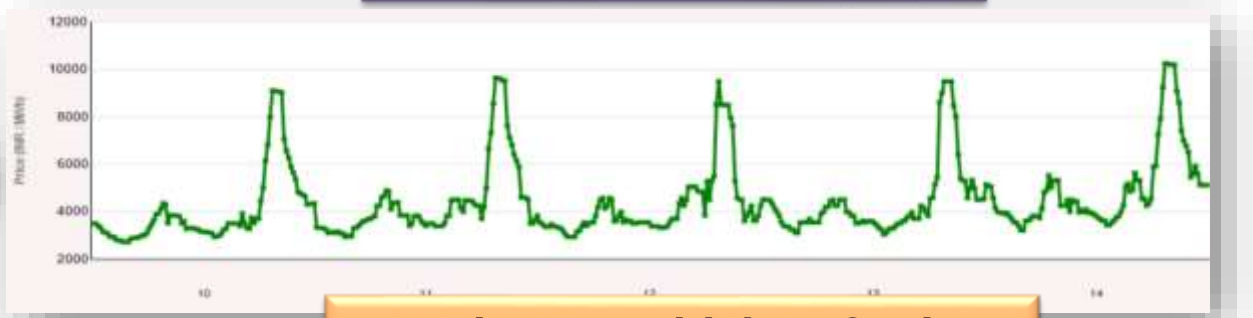
Various Factors affecting Deviation Rate

Interplay of Prices in Different Market Segments



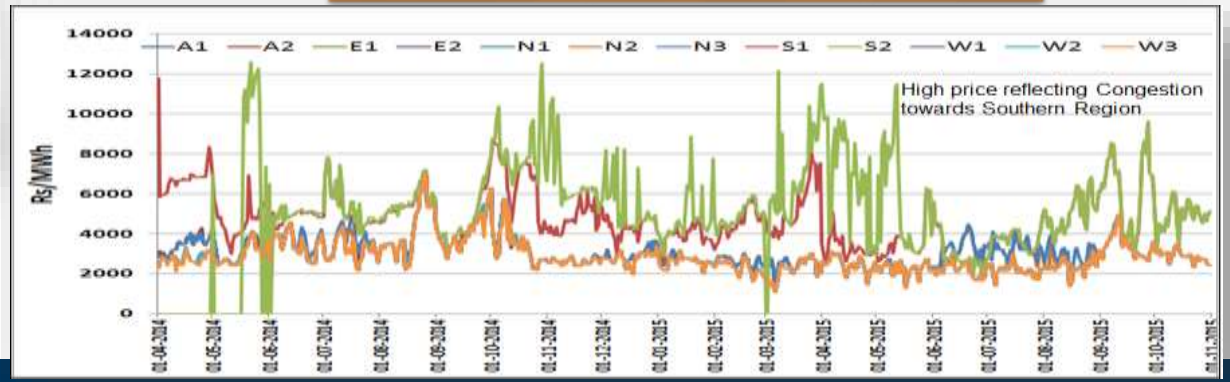
Source: CERC MMC Report

Time Sensitivity of Prices



Source: IEX

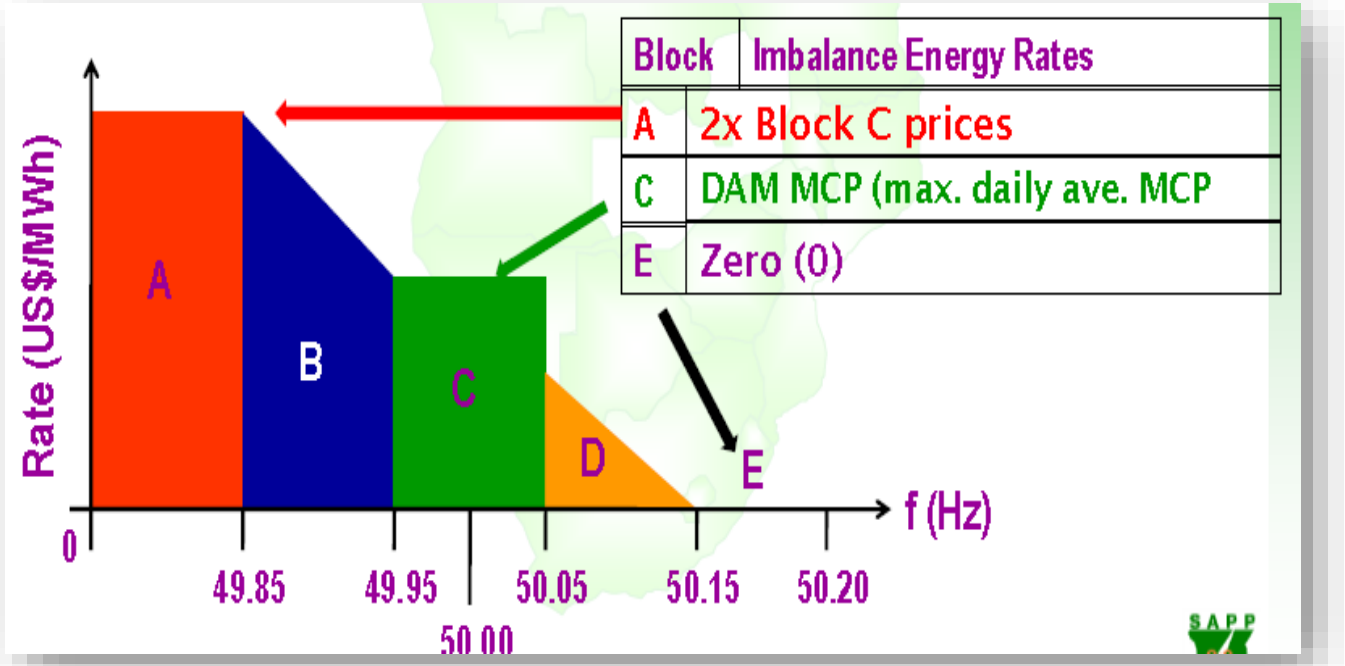
Location Sensitivity of Prices



Source: IEX

International Experience

South African Power Pool (SAPP)



Proposed SAPP Imbalance Energy Rates Calculation

SAPP is reviewing the energy imbalance charges prices in order to link them to market prices.

Source: https://sari-energy.org/wp-content/uploads/2016/03/Session-3-Mr-Musara-BETA-SAPP.pdf

Weakness and the strengths of the present DSM mechanism

- Real Time Imbalance Pricing
- Promotes Efficiency and Merit Order Despatch
- Perfect Information
- Known ex ante to everyone
- Provides a negative feedback for correction
- Facilitates achieving marginal cost despatch
- Diffusion of market power and choice
- Simple to calculate
- No post facto adjustment
- Discourages advertent deviations
- Highest priority in payment
- Hysteresis - disincentive possible misuse

The features lacking in the present mechanism are as follows:

- SMP linked Price Vector
- Factoring Value of Lost Load (VOLL)
- Interplay of Prices in various segments
- Time value of Electricity
- Geographical Location

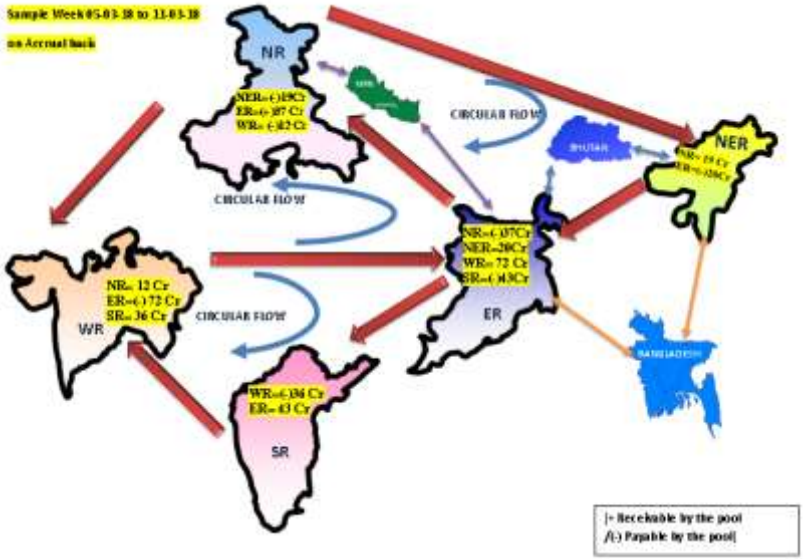
Transmission Congestion

Sufficiency of Funds for Ancillary Services through Differential DSM Rates

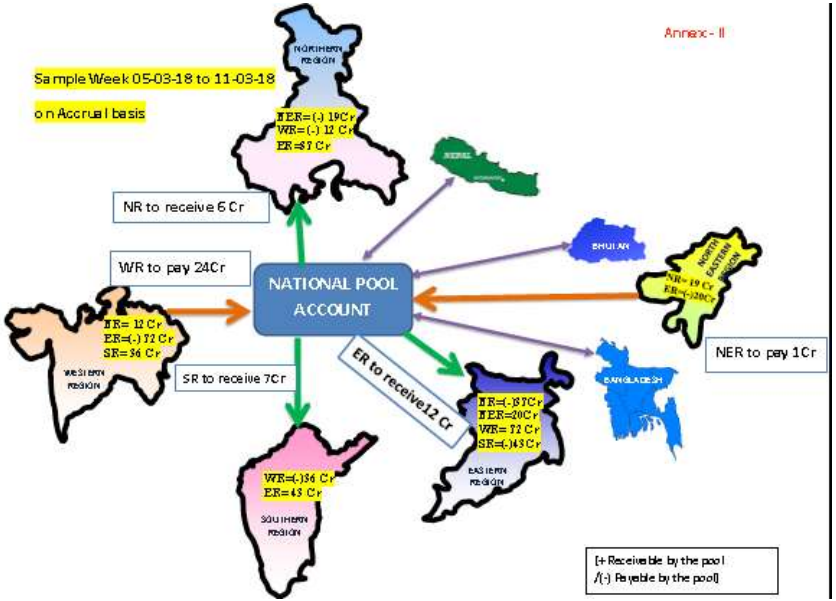
- Worldwide, the system balancing costs
  - ~ 1-2% of the energy costs
- Annual Cost of power procurement in India
  - ~ ₹ 500,000 Crore
- Expected All-India Ancillary Services Costs
  - ~ ₹ 5000-10000 Crore in the medium to long term
- Grid-India scheduling & despatch of ISGS covers
  - ~ 45 % of India's generation
- Grid-India would need
  - ~ ₹ 2000-5000 Crores annually for ancillary services
- Need to ensure regulatory pool account to have sufficient funds
  - Differential DSM rates would be needed to capture this aspect

Need for a National Deviation Pool Account

Circular Flow of Funds amongst DSM Accounts Pan-India



Flow of Funds amongst DSM Accounts Pan-India and Proposed National Pool Account



There is a need of national pool account to avoid transfer of fund to deficit region from surplus region while making payment to the recipients of Deviation Pool Account.

NERC Joint Inadvertent Interchange Task Force (JIITF)

White Paper, Recommendations for the Wholesale Electric Industry America, May 2002

Inadvertent Interchange consisted of three components.

—The first component, the Energy Component, represented the value of the energy included in the Inadvertent Interchange and is represented in the energy price.

—The second component, the Transmission Component represents the reliability value of the transmission congestion and in present markets this is also included in the energy price.

—The third component, the Frequency Control Component, represents the value of the response and underlying reserves used to deliver the balancing energy necessary to offset unscheduled energy....

The proposed standard addressing frequency control contribution will have incentives and penalties that will reward good control and penalize poor control. The incentives and penalties need to be sufficient to promote good performance....

...Zero UI/ Deviation is a coincidence rather than expectation....

Steven Stoft : Power System Economics-
Power Supply and Demand -The Two- Settlement System

“ Because frequency indicates the discrepancies between supply and demand, frequency is the right guide for interconnection-wide price adjustment. When frequency is high price should be reduced; when frequency is low price should be raised. This is the classical adjustment process for keeping supply equal to demand.”

“ In a competitive market the real time prices are true marginal cost prices, and the forward prices are just estimates”

Arthur Berger & F.C Schweppe: Real time pricing to assist in load frequency control

IEEE Transactions on Power Systems, Vol.4, No. 3, August 1989

"A key feature of this pricing scheme is that the independent power plants can themselves monitor the frequency deviations and thus no real time signal needs to be sent by the electric utility. This eliminates the problem of how the utility could compute and transmit the price faster than the time scale to be controlled "

Howard F. Illian
Defining Good and Bad Inadvertent Jan 2002

“A market requires an a priori determination of

Good and Bad Inadvertent.”

Sally Hunt & Graham Shuttleworth _Competition & Choice in Electricity‘

- The market for imbalances competes with longer- term transactions as a means for trading electricity.
- The imbalances must be settled as if they were instantaneous spot transactions i.e. sales of electricity arranged at (infinitesimally) short notice for immediate delivery.
- There must be some pricing rules for imbalances...These pricing rules become central to the character of the whole electricity market
- The main tool available to the Market Operator to encourage efficiency is the price charged or paid for imbalances between contracts and actual flows.
- If these imbalances are priced at punitive rates, generators may be reluctant to offer any flexibility of output. The task of maintaining system security would then be rendered difficult, if not impossible.

LDK Consultants – Report – January 2013
Recommendations for Imbalance Settlement

- Gross model for energy imbalance settlement.
- Single Imbalance price.
- Average price of accepted bids in system imbalance direction but long term aim to move o a marginal price.
- Weight activated reserve bids by reservation fee.
- Remove Transmission constraint resolving bids, make TSO pay for them.
- Non Delivery Rule for high price Offers and low price accepted Bids.
- RES to be exposed to imbalance settlement on an equal basis to other system users.

Imbalance Rate Design Considerations

- Prices available for use as a reference for DSM
- Size of Market Segments proposed to be linked
- Multiple Power Exchange Prices
- Unconstrained Market Clearing Price or Area Clearing Price
- Granularity/periodicity of prices to be linked
- Frequency Band
- Point of linking DSM Vector and DAM prices
- Slope of the DSM Rate Vector along with the Ceiling and Floor
- Volume limits & Cap Rates
- Single or Dual Imbalance Pricing: Different rates for drawl/injection
- Establishment of truly inadvertent deviations

Deficit in DAS Pool

- In case of deficit in the Deviation and Ancillary Service Pool Account of a region, the surplus amount available in the Deviation and Ancillary Service Pool Accounts of other regions shall be used for settlement of payment
- in case the surplus amount in the Deviation and Ancillary Service Pool Accounts of all other regions is not sufficient to meet such deficit, the balance amount shall be recovered from the drawee DICs
  (i) for the period from the date of effect of these regulations till 31.03.2026, in the ratio of [50% in proportion to their drawal at the regional periphery] and [50% in proportion to their GNA]; and
  (ii) from 01.04.2026, in the ratio of the shortfall of reserves allocated by NLDC to such DICs

Provided further that the NLDC shall prepare, with the approval of the Commission, a detailed procedure for recovery of charges in case of deficit in the Deviation and Ancillary Service Pool Accounts, and for the methodology of computation of shortfall of reserves and allocation of deficit amongst DICs.

Payment security

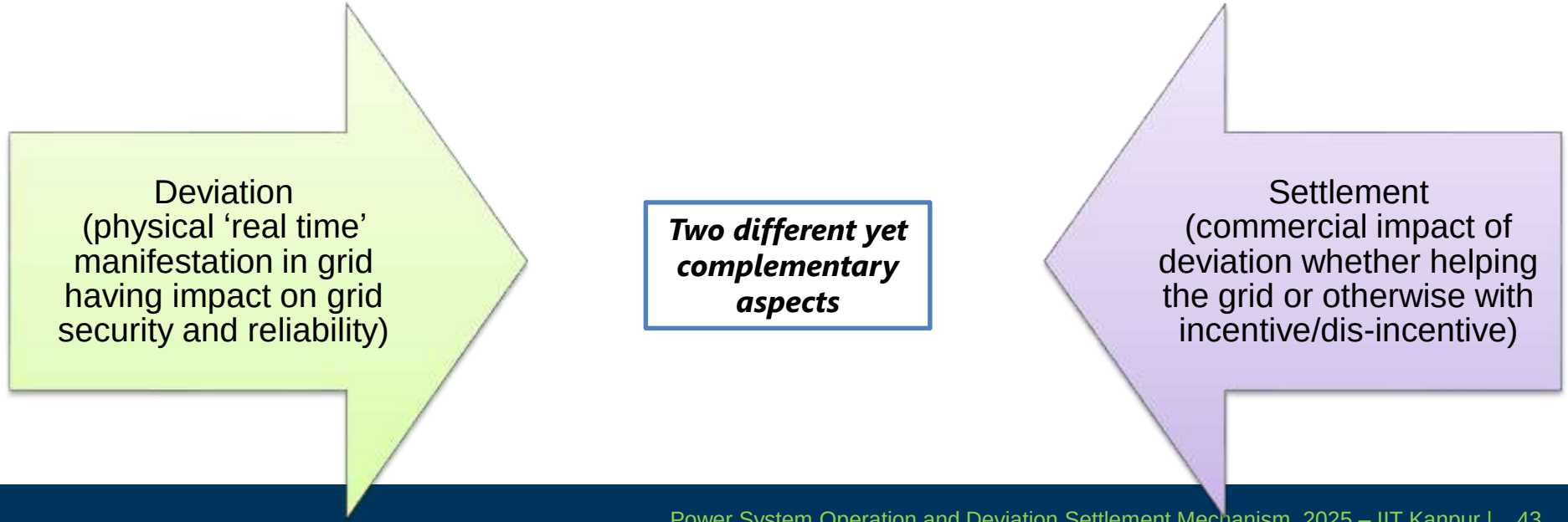
- The defaulting regional entity will have open a Letter of Credit (LC) equal to 110% of their average payable weekly liability for deviations in the previous financial year in favour of the concerned Regional Load Despatch Centre within a fortnight from the start of the current financial year.

  E.g: If any entity defaulted for one week in 2022-23, then they have to open LC equivalent to 110% of their average payable weekly liability by 1st April 2023 for the FY 2023-24

- RLDC shall be entitled to encash LC if the payment is not received within 10 days of issue of statement by RPC & fresh LC shall be recoup within 3 days of encashment.

‘Deviation’ and ‘Settlement’ – Need for Integrated Approach

- DSM, per-se, does not balance the system;
- DSM is simply an ex-post mechanism for defraying the costs of balancing
- At the same time incentivizing good contracting and portfolio management behaviour on the part of grid entities.



DSM is an Integral part of Grid Code

Commercial Mechanism

- Part of Commercial Mechanism in Grid Code since 2000
- Part of Terms and Conditions of Tariff Regulations for some period

Standalone Regulations

- First time in 2009
- Limitations in revisions of tariff on dynamic basis
- Enabling provisions related to UI/DSM have been suitably incorporated in the Grid Code for past two decades

- **Grid Code is the foundation on which the entire electricity market edifice stands**
- **Essential building blocks like Resource Adequacy, Reserves (primary, secondary and tertiary both at inter state and intra state level) and compliance monitoring incorporated in Grid Code in 2023**

Implications on the Grid Security and Behaviour

Collectively Distributed Responsibility

- To maintain Integrated Grid Security and Reliability
- Clean Energy Transition

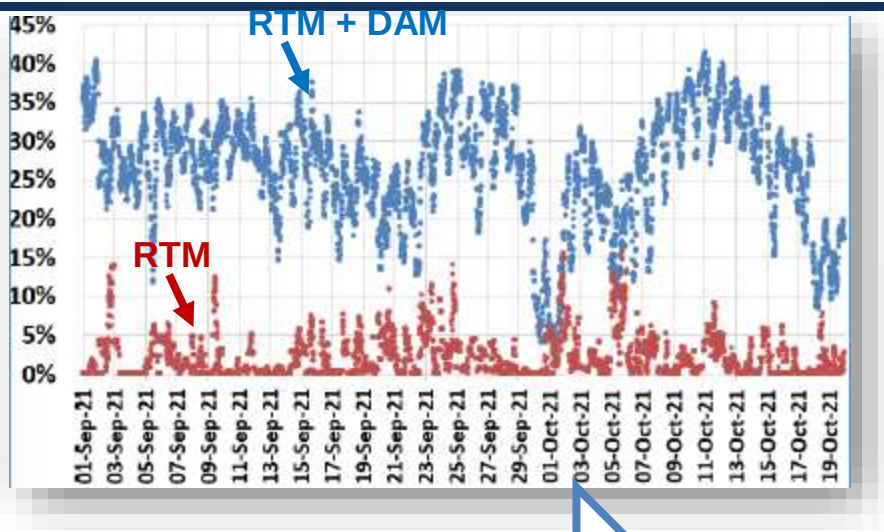
Delinkage of deviation with frequency

- Would lead to deterioration of the primary response
- Case Study of Maharashtra – Imbalance Pricing delinked with frequency a non-starter
- Would delay intra-state ABT implementation pan-India
- Would be impacted with uncertainty of Ancillary Services Despatch

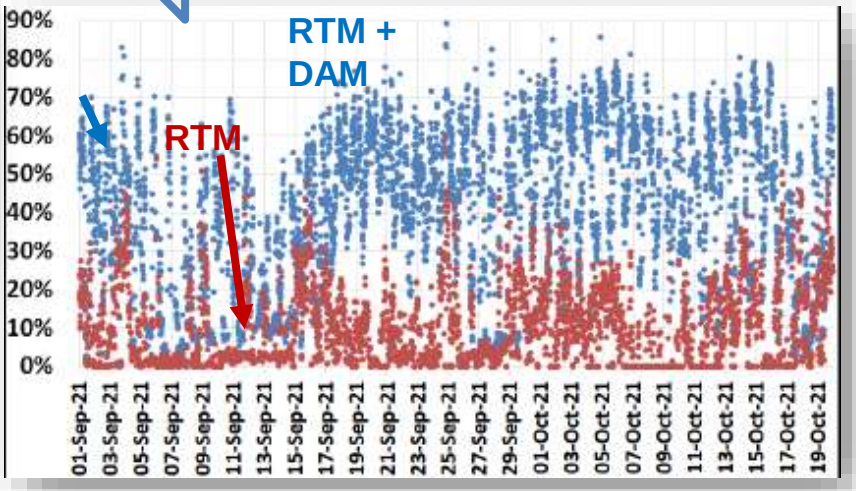
Resource Adequacy in all time horizons

- Need for systematic resource adequacy framework for balancing
- Energy markets don’t bring adequacy
- Globally, capacity adequacy studies are conducted by the perspective planners
- Need to publish rolling 7-10 yearly adequacy statement
  - Generation (basket of resources) & Transmission on a rolling basis.
  - Need to consider reasonable reserve margins to take care of contingencies
- Determination of resource adequacy guidelines for each region is important
  - LoLP (Loss of Load Probability), VoLL (Value of Lost Load) and Optimal Reserve Margin.
  - These provisions need to be strengthened through the National Electricity Policy and the Indian Electricity Grid Code and implementation enforced through the SERCs.

Need for Metrics for Measuring Portfolio Management Diligence



State "X" meeting upto 40 % of its demand from RTM and DAM



State "Y" having upto 90 % portion of its drawal schedule from RTM and DAM

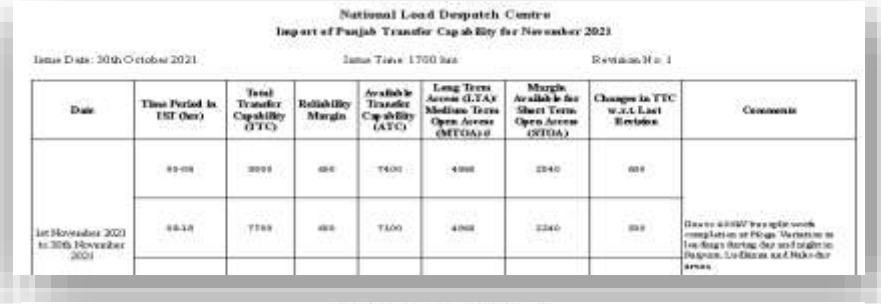
Threat to Grid Security, High Probability of Deviations, Resource Adequacy, Maintaining Reserves at State level

Need for Declaration of Transfer Capability by State Control Areas

- Need for assessment of transfer capability on a state-wise basis in advance.
- Many states have started declaring the TTC/ATC; others also to do so.
- Need to configure each state as a bid area in Power Exchanges

National Load Despatch Centre, New Delhi
Import Capability between SS for November 2021

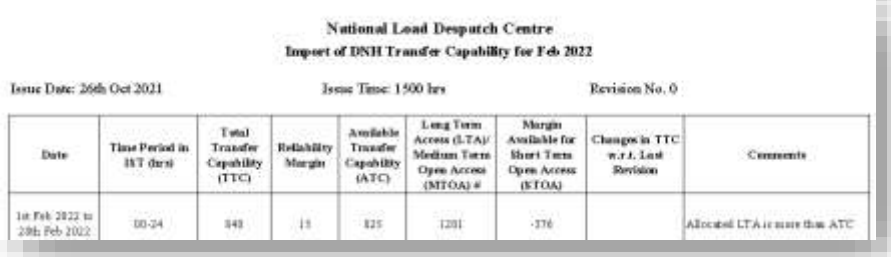
Date	Time Period in IST (hrs)	Total Transfer Capability (TTC)	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA)	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Comments
1st November 2021	00-24	3300	80	3220	2596	614		
2nd November 2021	00-24	3300	80	3220	2374	836		
3rd November 2021 to 4th November 2021	00-24	3300	80	3220	2671	539		
5th November 2021	00 - 08	3300	80			539		
	08 -24	3000		2800		239		
6th November 2021	00-24	3300	80	3220	2714	506		
	00-09	3300		3220		484		



National Load Despatch Centre
Import of Punjab Transfer Capability for November 2021

Issue Date: 30th October 2021 Issue Time: 1700 hrs Revision No: 1

Date	Time Period in IST (hrs)	Total Transfer Capability (TTC)	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Comments
1st November 2021 to 30th November 2021	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



National Load Despatch Centre
Import of DNH Transfer Capability for Feb 2022

Issue Date: 26th Oct 2021 Issue Time: 1500 hrs Revision No. 0

Date	Time Period in IST (hrs)	Total Transfer Capability (TTC)	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Comments
1st Feb 2022 to 28th Feb 2022	00-24	840	15	825	1201	-376		Allocated LTA is more than ATC

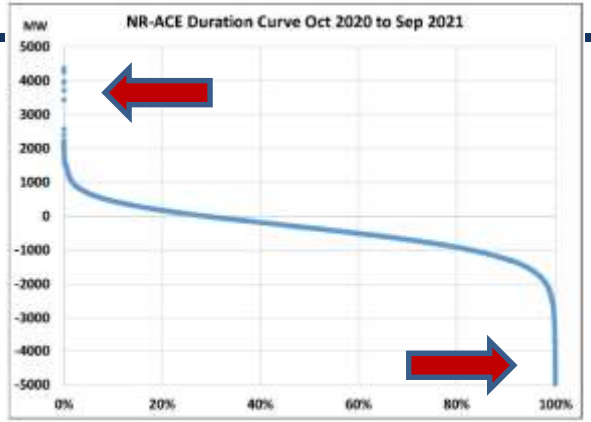
National Load Despatch Centre
Import of Gujarat Transfer Capability for Nov 2021

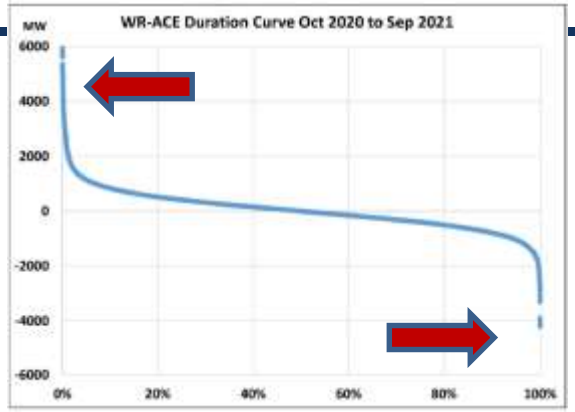
Issue Date: 12th Nov 2021 Issue Time: 2100 hrs Revision No. 2

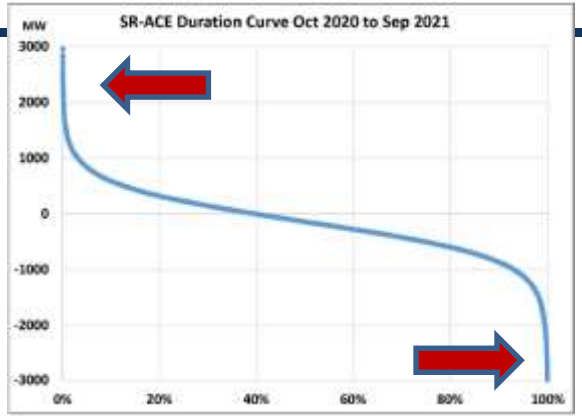
With SSP Generation

Date	Time Period in IST (hrs)	Total Transfer Capability (TTC)	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Comments
01st Nov to 30th Nov'21	00-09	10230	330	9900	9661.516	1016		

Need for Monitoring and Tight Control of Area Control Error (ACE)







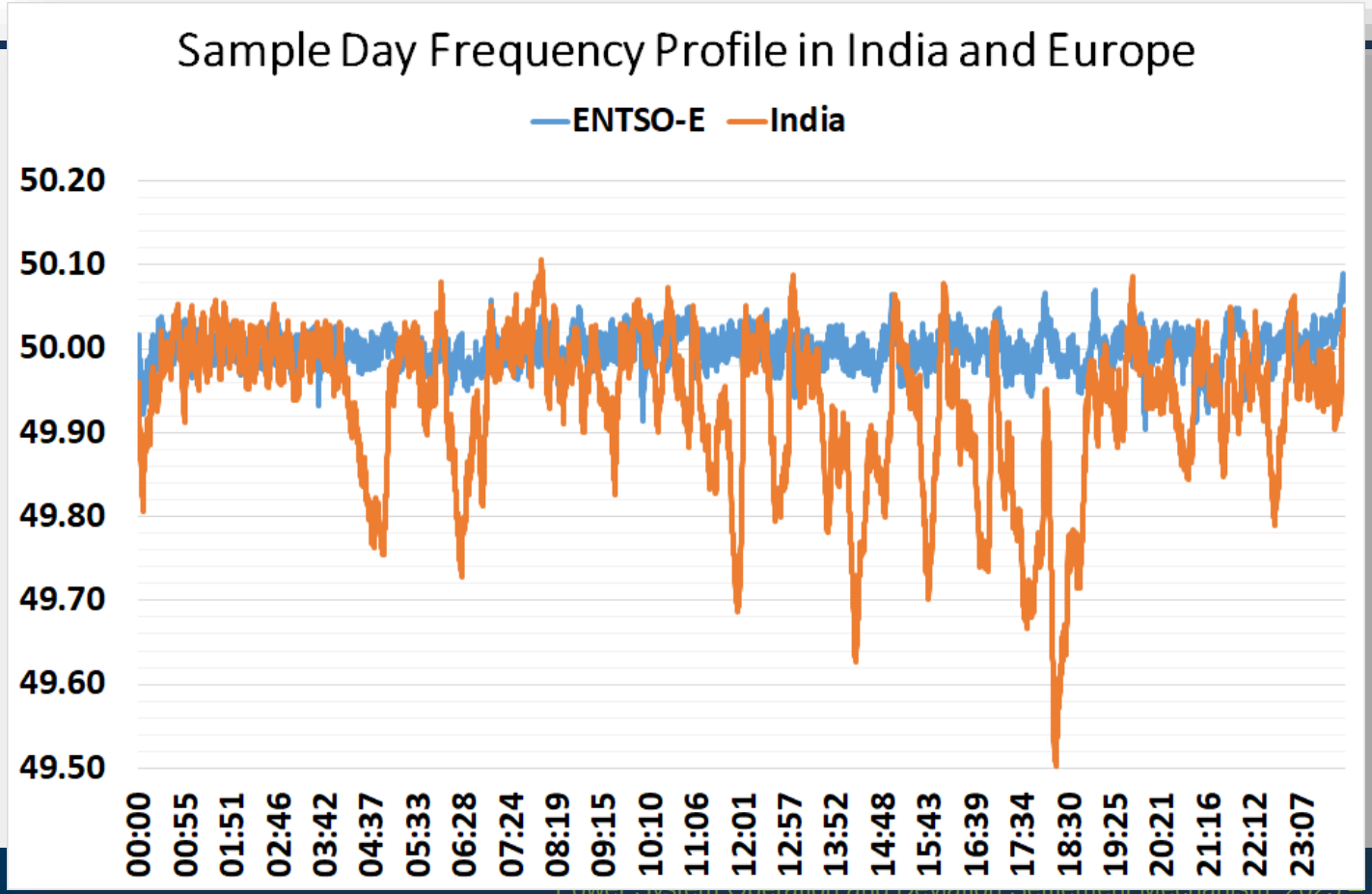
Region	Range of ACE (+ve and -ve) MW
NR	4500 to (-) 5000
WR	6000 to (-) 4000
SR	3000 to (-) 3000
ER	3000 to (-) 2000
NER	700 to (-) 800

Distribution curve of ACE of a control area for assessment of reserves as per draft IEGC recommended by CERC Expert Group

- **Impact on Frequency, Skewed Load Generation Balance leading to Grid Security and Reliability Issues**

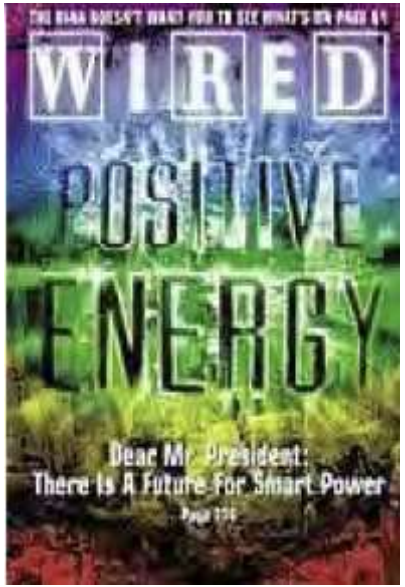
There is a need for a paradigm change from monitoring of simple deviations to monitoring of "Area Control Error (ACE)".

Frequency Profile…Long way to go…



Embrace Change to Power Progress…

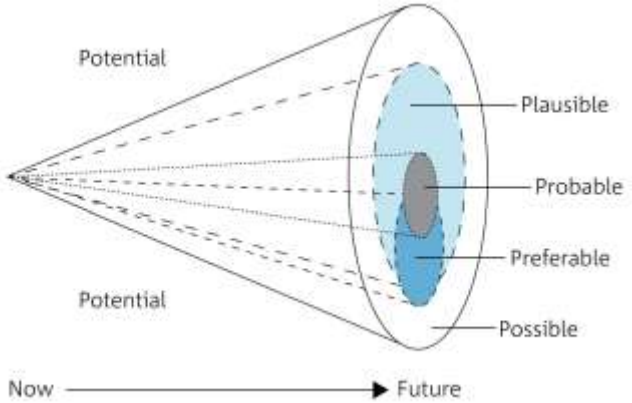
“Every node in the power network of the future will be awake, responsive, adaptive, price smart, eco-sensitive, real-time, flexible, humming - and interconnected with everything else.”



-- The Energy Web, Wired Magazine, July 2001
http://www.wired.com/wired/archive/9.07/juice.html

Thank You!

Difficult to see. Always in motion is the future.
– Yoda, Jedi master in Star Wars



The Future Cone

sksoonee@gmail.com

Voros J (2003) A generic foresight process framework. Foresight, 5(3): 10-21.
Hancock T, Bezold C (1994) Possible futures, preferable futures. The Healthcare Forum journal, 37(2): 23-29.

CERC DSM REGULATIONS, 2024 SECTION I:

General Seller

DSM Rate for General Seller (other than an Run-of-river hydroelectricity (RoR) generating station and a generating station based on municipal solid waste)

Reference Charge Rate (RR) : means

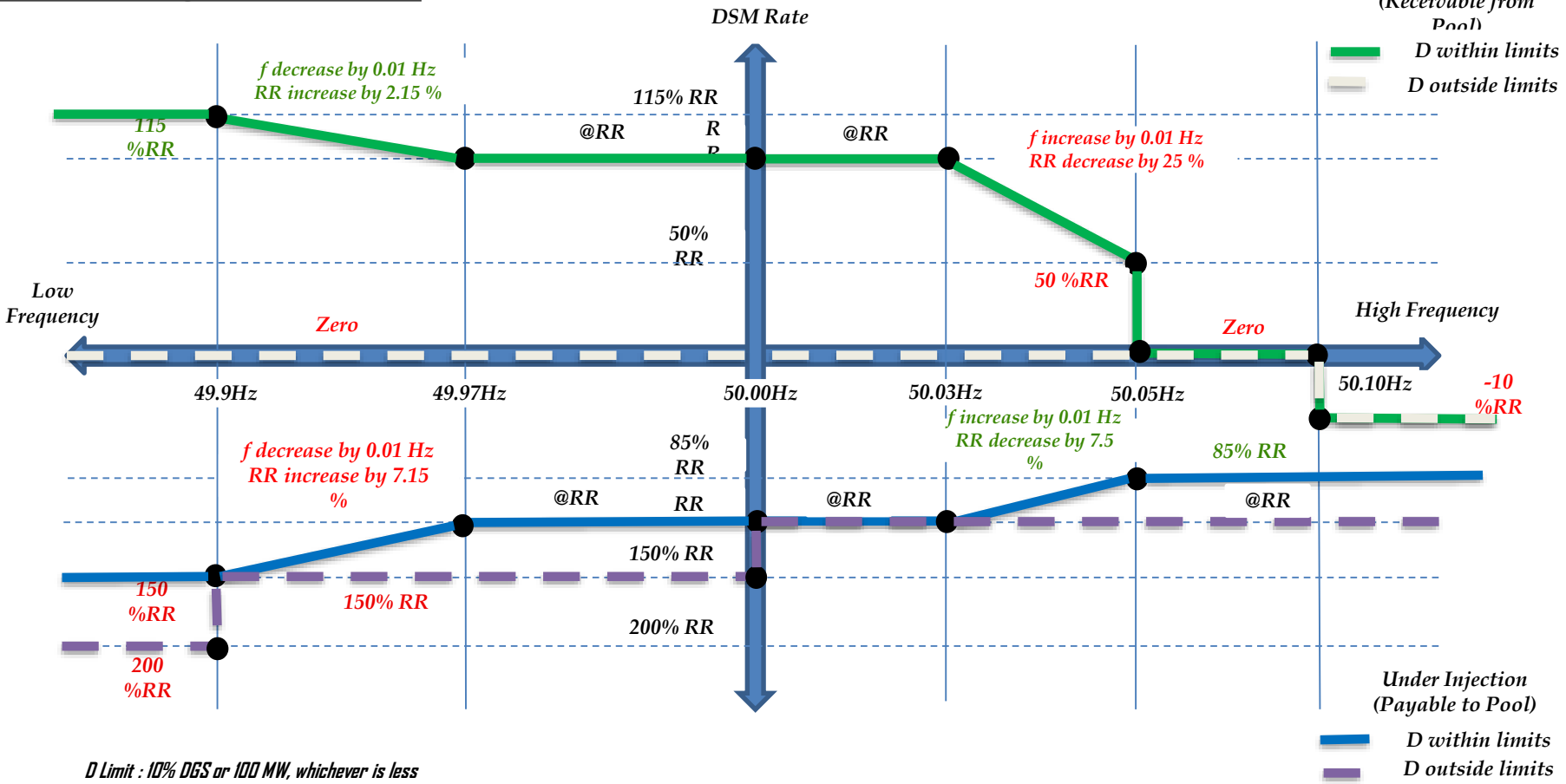
(i) in respect of a general seller whose tariff is determined or adopted or approved under Section 62 (Appropriate Commission (CERC) determines the tariff) or Section 63(Determination of tariff by bidding process) or Section 86(1)(b) (Appropriate Commission (SERC) determines the tariff) of the Act , Rs/ kWh energy charge as determined or adopted or approved by the Appropriate Commission, or

(ii) in respect of a general seller whose tariff is not determined or adopted or approved under Section 62 or Section 63 or Section 86(1) (b) of the Act, and selling power through power exchange(s), the price as discovered in the power exchange for the respective transaction; or

(iii) in case of captive consumption of a captive generating plant based on resources other than renewable energy sources, the weighted average ACP of the Integrated-Day Ahead Market segments of all the Power Exchanges for the respective time block; or

(iv) in case of multiple contracts or transactions including captive consumption, the weighted average of the reference rates of all such contracts or transactions.

Deviation Charges - General Seller (other than an RoR generating station and a generating station based on municipal solid waste)



D Limit : 10% DGS or 100 MW, whichever is less

Deviation Charges for General Seller

1. In case of forced outage or partial outage of a seller, the charges for deviation shall be @ the **reference charge rate** for a maximum duration of eight time blocks or until the revision of its schedule, whichever is earlier.
2. For a Seller whose bids are cleared in the HP-DAM, the '**reference charge rate**' for deviation by way of 'under-injection' for the quantum of power sold through HP- DAM shall be equal to the weighted **average ACP of the HP-DAM** Market segments of all the Power Exchanges for that time block;

CERC DSM REGULATIONS, 2024 SECTION II

WS Seller

DSM Rate for WS Seller

Contract Rate (CR) : means

(i) in respect of a WS seller or a MSW Seller or such other entity as applicable, whose tariff is determined or adopted or approved under Section 62 or Section 63 or Section 86(1)(b) of the Act, Rs/kWh tariff as determined or adopted or approved by the Appropriate Commission; or

(ii) in respect of a WS seller or a MSW Seller or such other entity as applicable, whose tariff is not determined or adopted or approved under Section 62 or Section 63 or Section 86(1)(b) of the Act, and selling power through power exchange(s), the price as discovered in the Power Exchange for the respective transaction; or

(iii) in case of captive consumption of a captive generating plant based on renewable energy sources, the weighted average ACP of the Integrated-Day Ahead Market segments of all Power Exchanges for the respective time block;

(iv) in case of multiple contracts or transactions including captive consumption, the weighted average of the contract rates of all such contracts or transactions, as the case may be

Deviation Calculation for WS Seller

a) For the period from the date of commencement of these regulations to 31.03.2026

a) Deviation-WS seller (DWS) (in MWh) = [(Actual Injection in MWh) – (Scheduled generation in MWh)];

b) Deviation-WS seller (DWS) (in %) =

$$\frac{100 \times [(\text{Actual Injection in MWh}) - (\text{Scheduled generation in MWh})]}{[(\text{Available Capacity})]}$$

b) For the period from **01.04.2026 onwards**

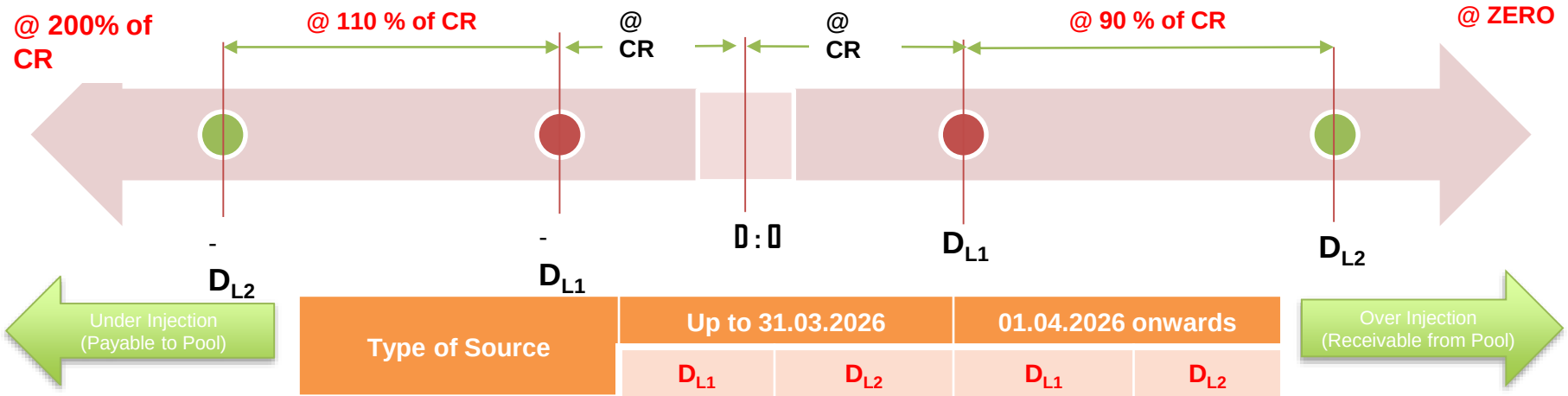
a) Deviation-WS seller (DWS) (in MWh) = [(Actual Injection in MWh) – (Scheduled generation in MWh)];

b) Deviation-WS seller (DWS) (in %) =

$$\frac{100 * \textbf{[(Actual Injection in MWh) – (Scheduled generation in MWh)]}}{\textbf{[(X\% of Available Capacity) + (100−X) \% of Scheduled Generation)}}$$

Provided 'X' shall be stipulated by the Commission through separate order(s) after public consultation.

Deviation Charges for WS Seller



Type of Source	Up to 31.03.2026		01.04.2026 onwards	
	D_{L1}	D_{L2}	D_{L1}	D_{L2}
solar or a hybrid of wind – solar resources	10%	15%	5%	10%
wind resource	15%	20%	10%	15%

WS sellers at a pooling station through QCA

In case of aggregation of WS sellers at a pooling station through QCA,

(a) the contract rate for the purpose of deviation shall be equal to the weighted average of the contract rates of all individual WS seller(s) opting for aggregation at the pooling station;

(b) Available Capacity shall be equal to the cumulative capacity rating of wind turbines or solar inverters that are capable of generating power in a given time block;

(c) de-pooling of deviation charges for WS seller(s) connected to the pooling station shall be as per the methodology mutually agreed upon between the QCA and such individual WS seller(s).

CERC DSM REGULATIONS, 2024 SECTION III

ESS

Deviation Charges for Standalone Energy Storage System (ESS)

1. **Standalone Energy Storage System (ESS)** applicable as per **General Seller (other than an RoR generating station and a generating station based on municipal solid waste)**

Provided that in the charging mode, deviation by way of over drawal shall be treated as under injection and deviation by way of under drawal shall be treated as over injection and the charges for deviation shall be settled accordingly.

2. **Standalone ESS being pumped hydro storage plant :** the charges for deviation including the formula for computation of Deviation shall be the same as applicable to a **WS seller being a generating station based on solar resources**, for the period from the date of commencement of these regulations to 31.03.2026.

Deviation Charges for WS Seller with ESS

Charges for Deviation including the formula for computation of Deviation, in respect of a WS Seller with ESS connected at the same interconnection point shall be the same

(i) as applicable to a WS seller of respective category during the period solar or wind or hybrid generating station is injecting power,

(ii) as applicable to a standalone ESS, when only ESS is injecting power, and

(iii) as applicable to a standalone ESS for drawl by ESS based on drawal schedule from the grid.

Note : Each generator and ESS shall be metered with Special Energy Meter (SEM) so that individual actual injection/drawal can be captured.

CERC DSM REGULATIONS, 2024 SECTION IV

BUYER

DSM Rate for Buyer

Normal Rate of Charges for Deviation (NR) : means

(A)	(B)	(C)
the **weighted average ACP** (in Paise /kWh) of the Integrated-**Day Ahead Market segments of all the Power Exchanges**	the **weighted average ACP** (in Paise /kWh) of the **Real Time Market segments of all the Power Exchanges**	the **sum** of: (a) 1/3 [**Weighted average ACP (in paise/kWh)** of the **Integrated-Day Ahead Market segments** of all the Power Exchanges]; (b) 1/3 [**Weighted average ACP (in paise/kWh)** of the **Real-Time Market** segments of all the Power Exchanges]; and (c) 1/3 [**Ancillary Service Charge (in paise/kWh)** computed based on the total quantum of Ancillary Services (SRAS UP and TRAS UP) deployed and the net charges payable to the Ancillary Service Providers for all the Regions]:

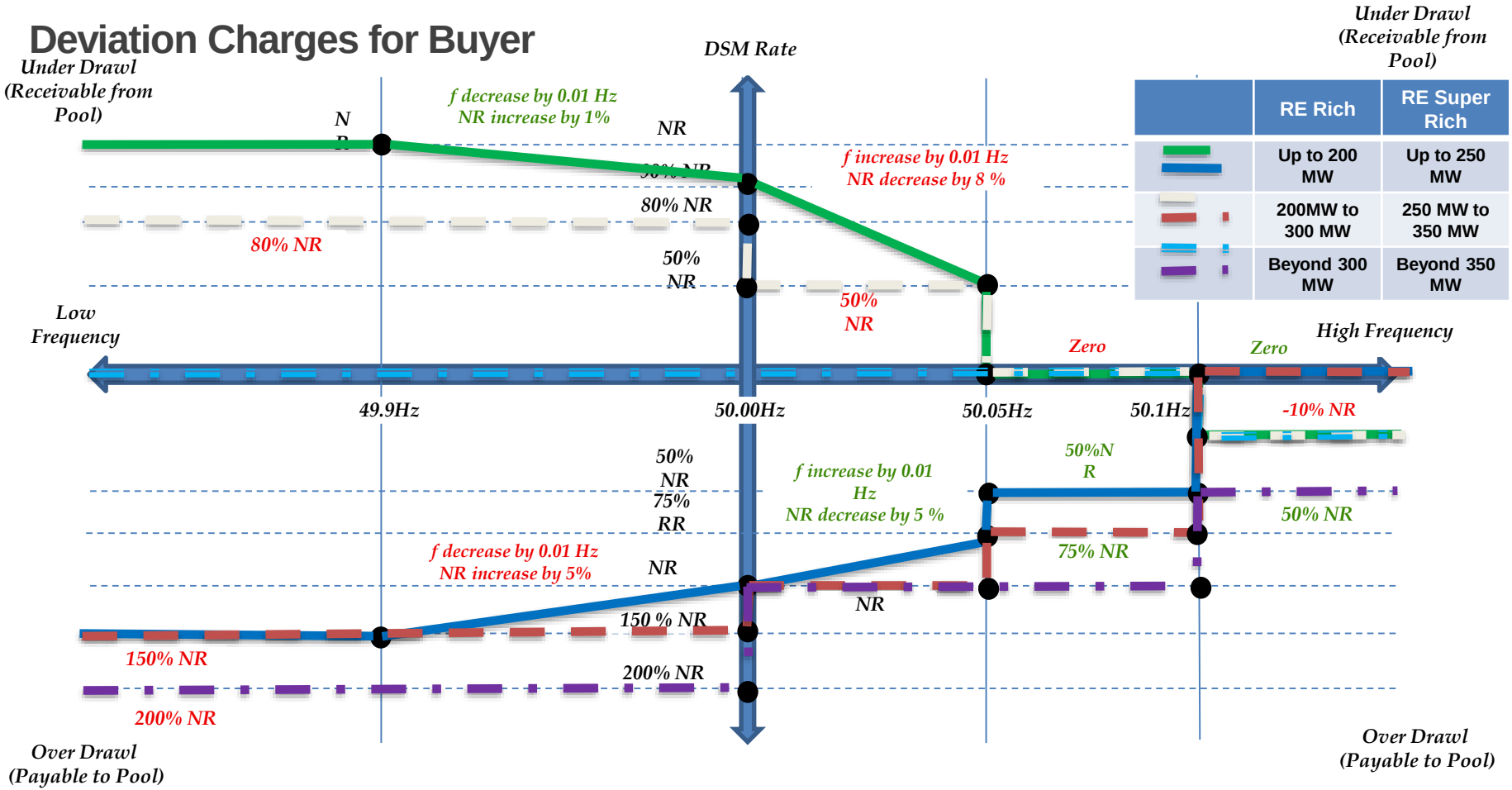
Provided that in case of non- availability of ACP for any time block on a given day, ACP for the corresponding time block of the last available day shall be considered

Definitions

(v) ‘Renewable Rich State’ or ‘RE-rich State’ means a State whose combined installed capacity of solar and wind generating stations under the control area of the State is **1000 MW or more but less than 5000 MW**;

(w) **‘Renewable Super Rich State’ or ‘RE Super-rich State’** means a State whose combined installed capacity of solar and wind generating stations under the control area of the State is **5000 MW or more**;

Deviation Charges for Buyer



	RE Rich	RE Super Rich
	Up to 200 MW	Up to 250 MW
	200MW to 300 MW	250 MW to 350 MW
	Beyond 300 MW	Beyond 350 MW

Deviation Charges for Buyer

- In case of a State having net injection at the regional periphery, the deviation charges for such State shall be as applicable to a **buyer**.

CERC DSM REGULATIONS, 2024 SECTION V

Inter-regional, Infirm & Start Up

Inter-Regional

- The inter-regional deviation caused by way of over drawal or under drawal or over injection
- or under-injection shall be computed notionally @ **normal rate of charges for deviation.**

Infirm Power

- (a) The charges for deviation for injection of infirm power shall be **zero**:
- Provided that if infirm power is **scheduled after trial run** as specified in the Grid Code, the charges for deviation over the scheduled infirm power shall be as applicable for a **general seller or WS seller**, as the case may be.

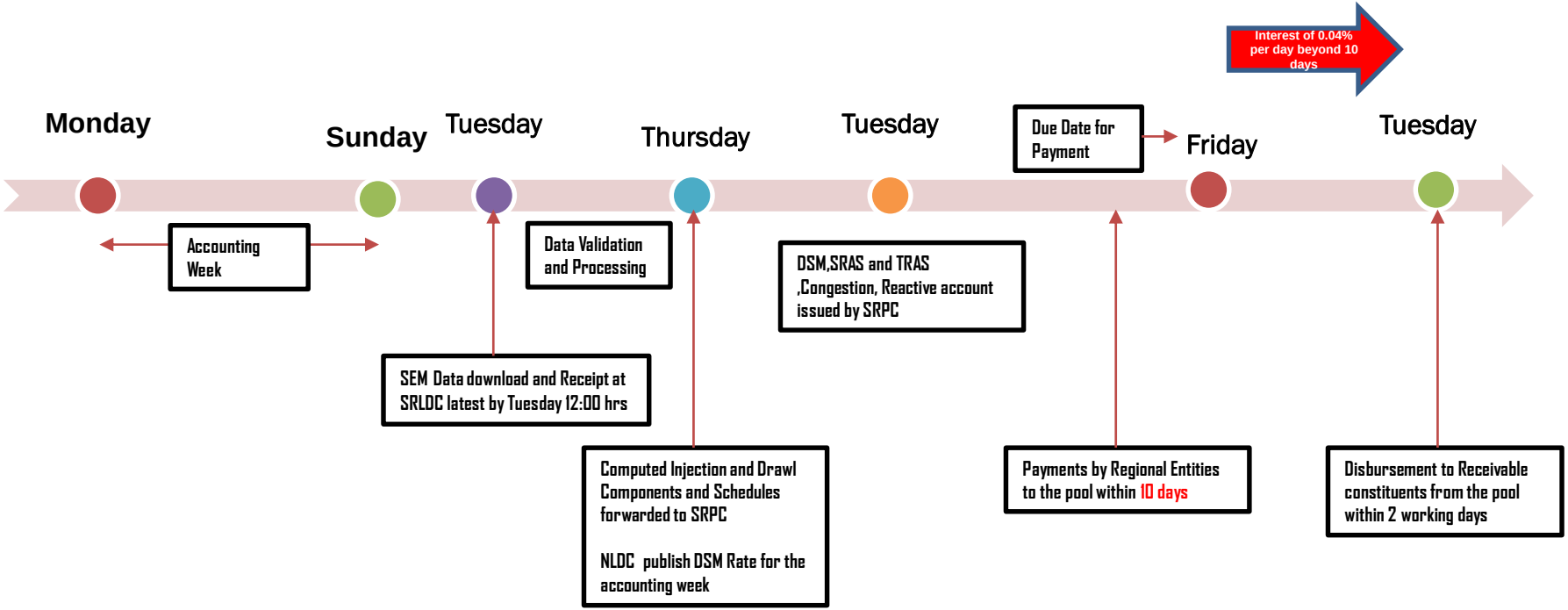
Startup Power

- The charges for deviation for **drawal of start-up power before the COD** of a generating unit or for drawal of power to run the auxiliaries during the shut-down of a generating station shall be **payable at the reference charge rate or contract rate** or in the absence of reference charge rate or contract rate, the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block, as the case may be.

CERC DSM REGULATIONS, 2024 SECTION VI

Accounting and settlement

Timeline for accounting and settlement



Accounting and settlement

- There shall be a Deviation and Ancillary Service Pool Account to be maintained and operated by the Regional Load Despatch Centre for the respective region:
- Provided that the National Load Despatch Centre (NLDC) shall formulate detailed procedure for implementation, maintenance and operation of the **National Deviation and Ancillary Services Pool account** after due consultation with stakeholders within 1 (one) year from the date of commencement