



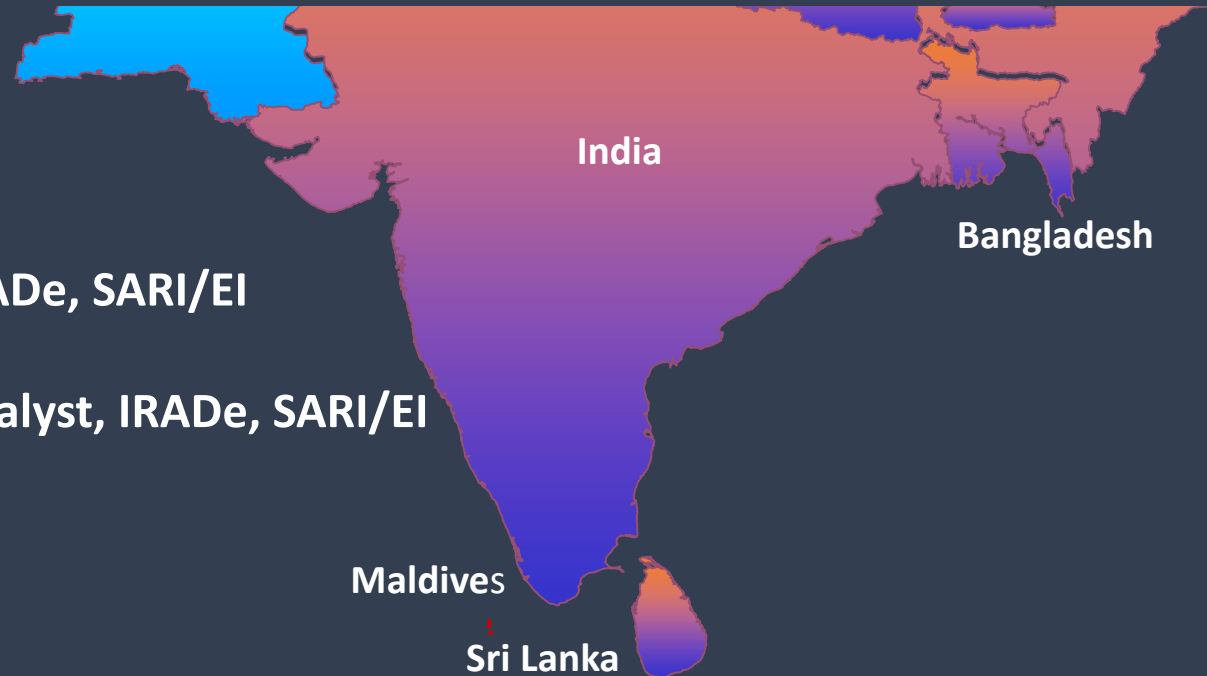
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Integrated Research and
IRADe Action for Development

Review & Key activities of South Asian Regional Power Exchange- Mock Exercise (SARPEX)



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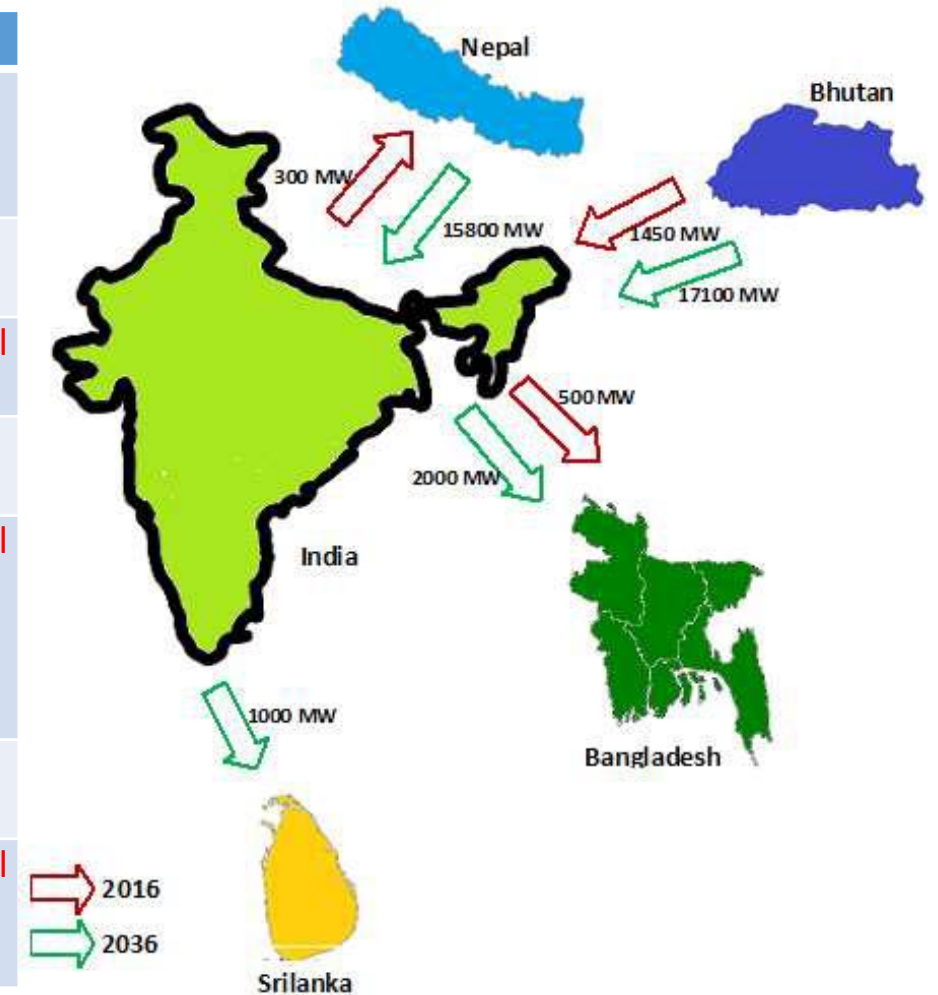


Content

- Power trading scenario in South Asian Region
- Recent guidelines, orders and agreements related to CBET
- SARPEX feasibility and Desirability analysis- Focus on BBIN
- Market Design and Mode of operation
- Country governments stakeholder
- Progress Update- Key Activities undertaken

Existing and Future envisaged Power trade in South Asian countries

Country	Contracts quantum and duration	Type
Bhutan → India (1450 MW)	Contract with PTC for Chukka (336 MW), Kurichhu (60 MW) Hydro Projects (Long Term)	G to G
	Contract with PTC for Tala (1040 MW) Hydro Project (Long Term)	G to G
	Contract with TPTCL for Dagachhu (126 MW) Hydro Project (Long Term)	Commercial
India → Bangladesh (600 MW)	BPDB Long-term contract with NVVNL for 250 MW	G to G
	BPDB Medium-term contract with PTC for 250 MW	Commercial
	Tripura – Comilla 100 MW contract	G to G
India → Nepal (250 MW)	NEA Bilateral contracts / Treaties to the tune of 237 MW	G to G
	NEA Past contracts with PTC (2011-2015) during December-April months for ~20-30 MW	Commercial



Commercial Mechanisms of Price Discovery in Power Trading is well established now in all the BBIN countries

RECENT INITIATIVES – GUIDELINES FOR CROSS BORDER TRADING BY MOP, INDIA



Key Policy developments in Cross Border Trading

Inter-Governmental Agreement between Bhutan and India on development of JV Hydropower Projects

SAARC Inter-Governmental Framework Agreement (IGFA) on Energy Cooperation

Ministry of Power, India Guidelines on Cross Border Electricity Trade

Apr, 2014

Sep, 2014

Nov, 2014

Oct, 2015

Nov, 2016

Feb, 2017

Power Trade Agreement between India and Nepal

Sub-Regional Cooperation between Bangladesh, Bhutan, India and Nepal (BBIN)

Center Electricity Regulatory Commission, India draft notification on CBET

Trading through the Power Exchanges

- The following products are permitted
 - Term Ahead Contracts (Upto 11 days ahead)
 - Intra Day Contracts / Contingency Contracts
- Subject to
 - Approval from the Designated Authority
 - traded volumes to be regulated and reviewed from time-to-time by the Designated Authority
- Cross border trade to be extended to other categories of contracts based on review by MoP and CERC, India

**Primary or the core Product of Power Exchanges i.e. the Day Ahead Market (DAM)
Spot is still not in the list of products to be offered through Exchanges**

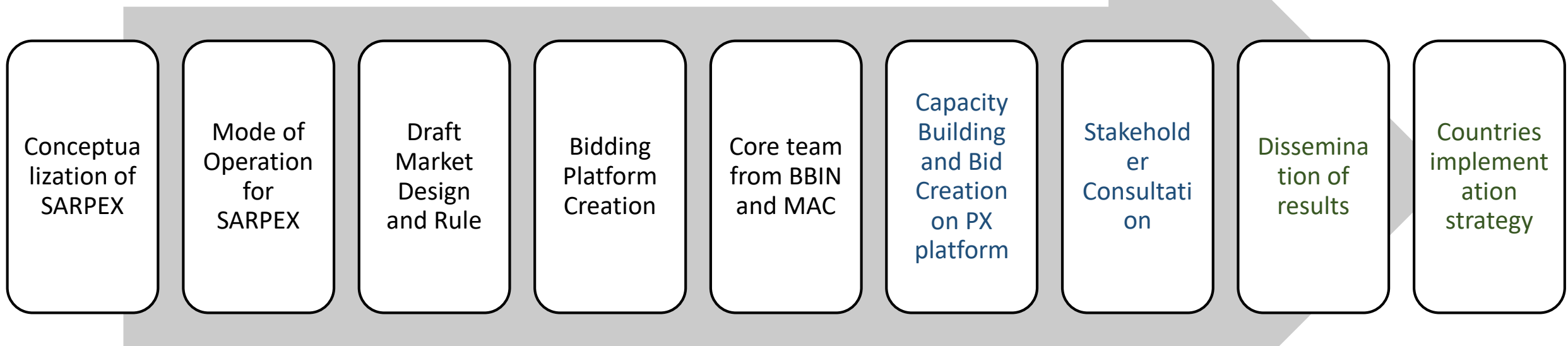
Objective of SARPEX- Activities under Mock Exercise

Objective and Outcome of SARPEX

- A trading platform mimicking a regional Energy Exchange for the SA Region.
- The mock exchange will provide an answer to various key questions, related to feasibility and desirability and possible volume in the regional market, the impact of regional market on domestic energy markets.
- The mock exercise results will provide the desired inputs for the decision makers in selecting a suitable option for market design. This will also give clarity about the identity of the buyers and sellers in such a Regional Exchange.
- Additionally, the mock exercise will also develop/provide:
 - Develop a draft set of market design and rules of a SA regional electricity market.
 - Prepare a detailed report based on the analysis of the pilot market data to ascertain the desirability and the feasibility of a SARPEX, and
 - To build the capacity of relevant officials from the SA countries on the functions of a power exchange which is critical irrespective to the option finally selected.



SARPEX- Mock Exercise activities



← Completed activities →

← Ongoing activities →

← Will be initiated after completion of bidding →

Completed activities

Ongoing activities

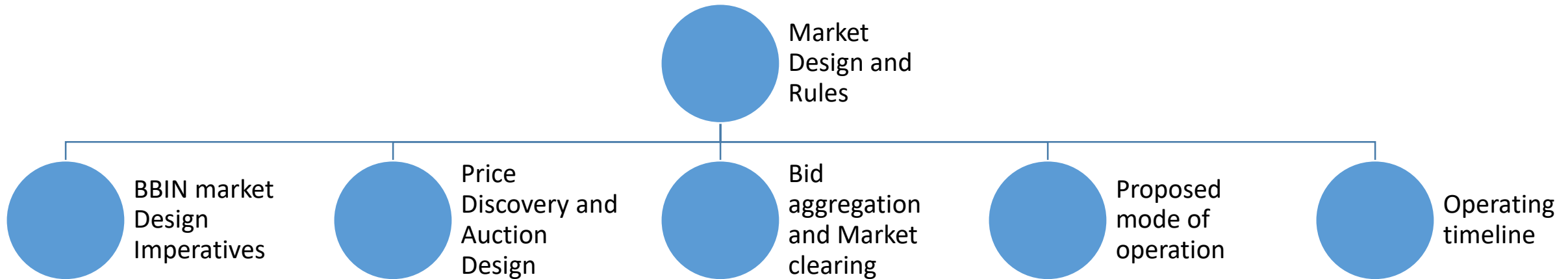
Will be initiated after completion of bidding

Market Design and Mode of Operation



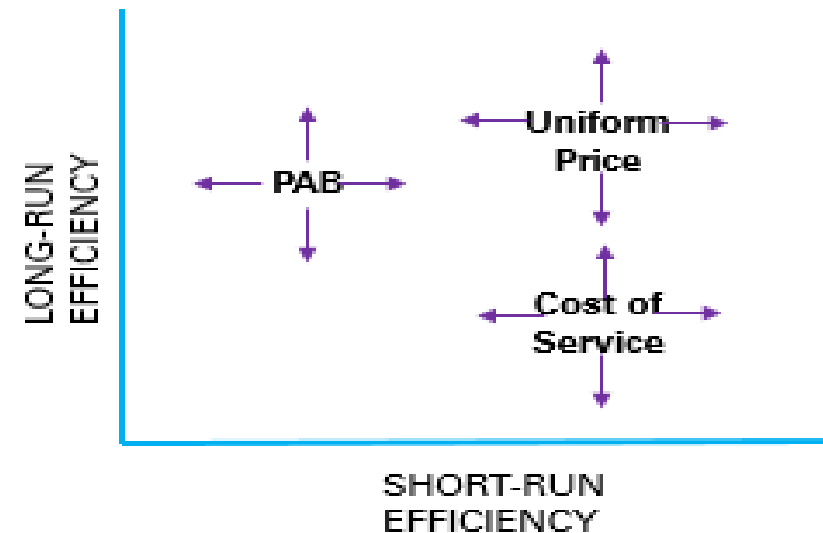
MARKET DESIGN AND RULE FOR SARPEX

- An efficient market design for Power Exchanges may optimize the Social Welfare is fundamental to developing and sustaining integration of the SARPEX countries.
- Harmonisation of the market rules across the SARPEX countries through an appropriate market design will likely lead to efficient utilization of available resources and infrastructure.



BBIN Market Design Imperative

- Power Exchanges use the Market Clearing mechanism to determine an efficient price and volume to clear the market.
- This mechanism uses an algorithm that aggregates bids and arrives at a Market Clearing Price (MCP) and Market Clearing Volume (MCV).
- In a Uniform Price auction, the sellers have an incentive to bid their marginal cost of generation or the forgone opportunity to sell in another market, since irrespective of what they bid a uniform price will be paid to all.
- Similarly, the buyers bid their marginal utility based on the financial constraints or willingness-to-pay.
- The underlying assumption in this case is that suppliers/buyers will be unable to affect the eventual market clearing price, owing to the large number of participants, leaving no incentive to bid above the marginal cost.

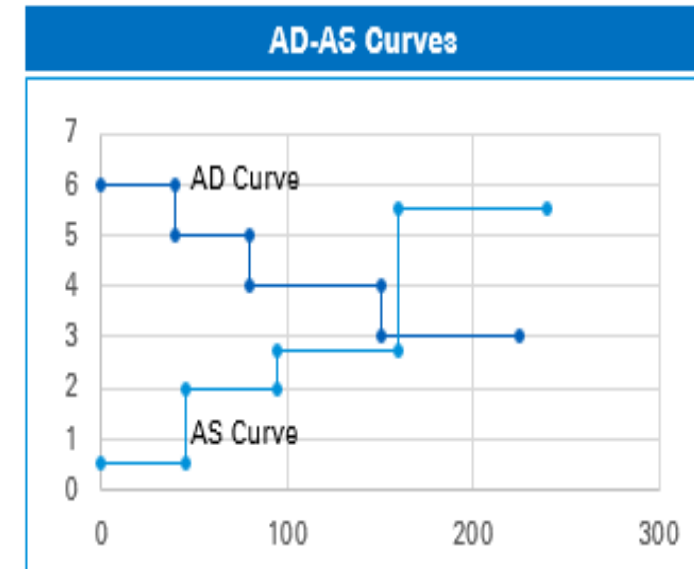


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Bid Aggregation and Market Clearing

- The AD and AS curves are obtained by stacking buy bids & sell bids, placed every 15 minutes.
- The intersection point of the curves so obtained, is called the equilibrium price.
- Similarly, the buyers bid their marginal utility based on the financial constraints or willingness-to-pay.
- The underlying assumption in this case is that suppliers/buyers will be unable to affect the eventual market clearing price, owing to the large number of participants, leaving no incentive to bid above the marginal cost.

Sample Bids for a time period			
Bids		Offers	
Price	Quantity	Price	Quantity
6	40	0.5	45
5	40	2.0	50
4	70	2.75	65
3	75	5.5	80

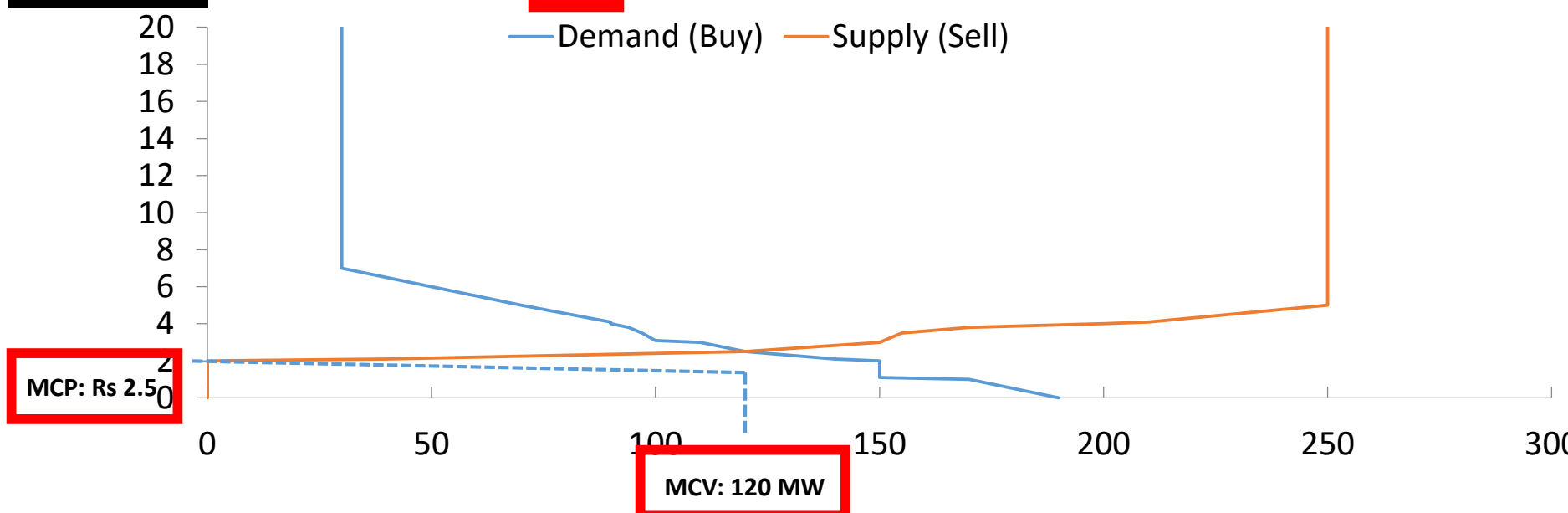


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Matching: Model Price Calculation algorithm (Example for a sample 15-min- single bids)

Price Tick	0	1	1.1	2	2.1	2.5	3	3.1	3.5	3.8	4	4.1	5	7	9	12	14	17	19	20
Portfolio A	20	20	20	20	20	20	20	10	7	4	0	0	0	0	0	0	0	0	0	0
Portfolio B	60	60	60	60	50	40	40	40	40	40	40	40	20	20	20	20	20	20	20	20
Portfolio C	70	70	70	70	70	60	50	50	50	50	50	50	50	10	10	10	10	10	10	10
Portfolio D	40	20	0	0	-40	-60	-80	-81	-85	-100	-120	-120	-120	-120	-120	-120	-120	-120	-120	-120
Portfolio E	0	0	0	0	0	-40	-50	-50	-50	-50	-60	-60	-90	-90	-90	-90	-90	-90	-90	-90
Portfolio F	0	0	0	0	0	-20	-20	-20	-20	-20	-20	-30	-40	-40	-40	-40	-40	-40	-40	-40

Total Buy, MW	190	170	150	150	140	120	110	100	97	94	90	90	70	30	30	30	30	30	30	30
Total Sell, MW	0	0	0	0	-40	-120	150	-151	-155	-170	-200	-210	-250	-250	-250	-250	-250	-250	-250	-250
Net Transaction, MW	190	170	150	150	100	0	-40	-51	-58	-76	-110	-120	-180	-220	-220	-220	-220	-220	-220	-220



Operating Rules for SARPEX

Participation Pre-Requisites

- In SARPEX, all trades are expected to be through the Indian Grid; while the operational control of respective grids of Countries is within their own jurisdiction.
- Thus, provision of NOC to allow access to the Indian Grid in absence of standardized Open Access Regulations

Scheduling

- Unlike Bilateral Contracts, where delivery points are mutually agreed by counter parties, the delivery points are pre-determined in Exchange in order to have a uniform price for all the buy and sale transactions
- The interconnection of the cross-border transmission line and the inter-state transmission network of India (International periphery) may be the delivery point for buy or sale of power by Member Countries

Operating Rules for SARPEX

Deviation Settlement

- Deviation is the mismatch in scheduled and actual injection / drawl of power to / from the grid. Inadvertent deviations from schedule may pose threats to the grid stability and security
- Nodal Agency to be responsible for overall settlement of deviations at the International Periphery and penalties would be as per the applicable DSM rates of CERC
- Deviation settlement may be pro-rated in the case of multi Nodal Agency involvement for different transaction types

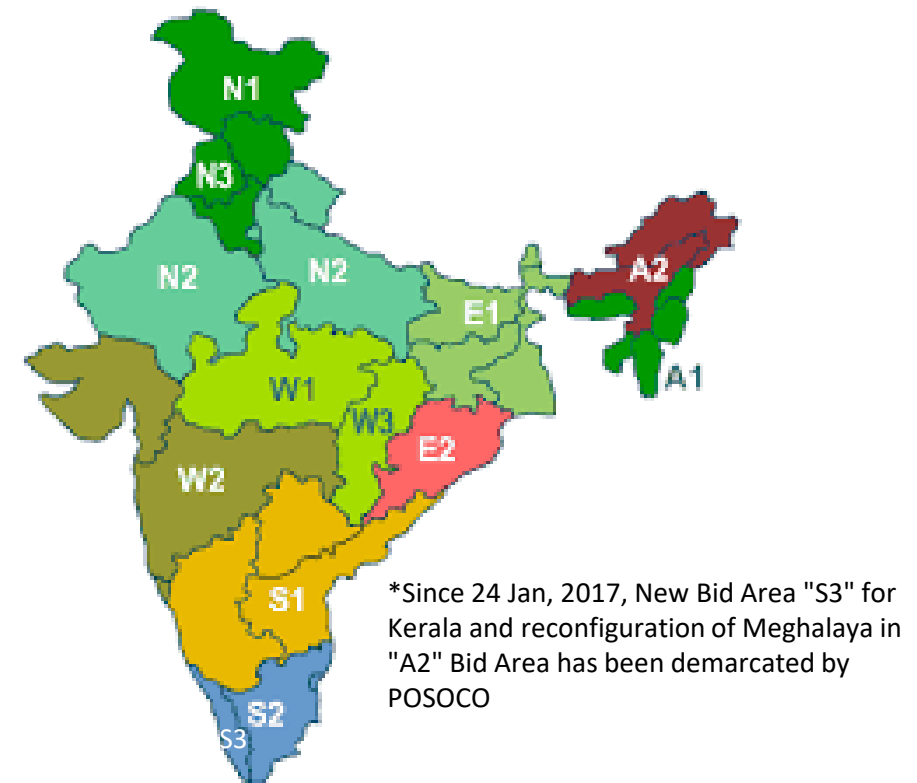
Transmission Charges & Losses

- Currently, all the Me for estimation and application of transmission charges and losses on the entities using the grid
 - In case of cross border bilateral contracts, the charges are levied in accordance with the MOU / contractual terms
 - The POC injection and drawal charges and losses for various interconnection points of cross-border transmission lines in the Indian grid are already in place

Key considerations in the formation of Bid Areas

- Bid areas determine the prices paid or charged by buyers or sellers in any specific geography in keeping with the grid constraints
- In case of transmission constraints, separate markets are formed in the congested areas which requires creation of separate bid areas (market splitting principle)
- Other factors for creation of a separate Bid area may be economic, political or technical, network topography in nature

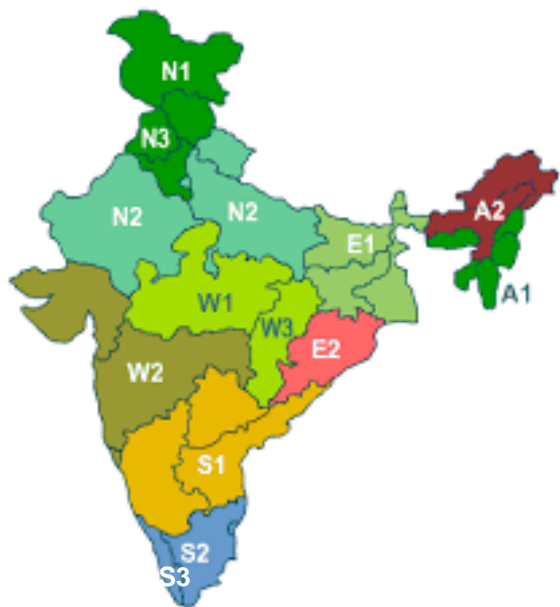
Existing Bid Area definitions in India*



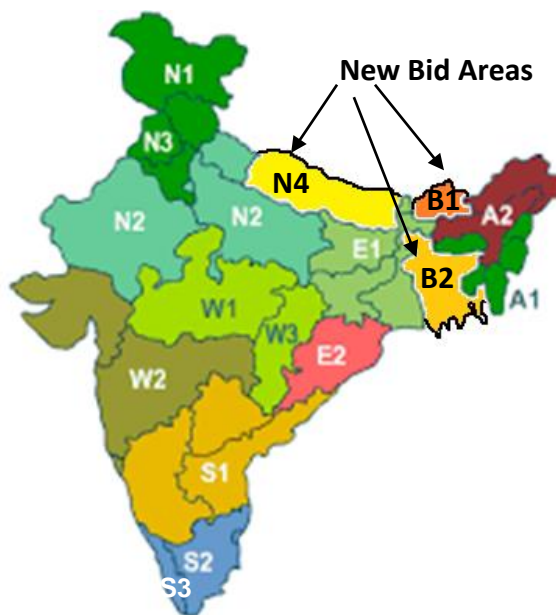
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SARPEX Bid Areas

Retaining the Indian Bid Areas



Additional Areas for each new country



- Creation of individual bid areas for each country may be desired due to the following
 - Differences in the Sovereign Laws, Power Sector Structure, Grid operation related processes and procedures
 - Perceived constraints in the cross border transmission lines
 - Settlement of Deviations from schedules
 - Alignment of time differences
 - Settlement of currency related issues

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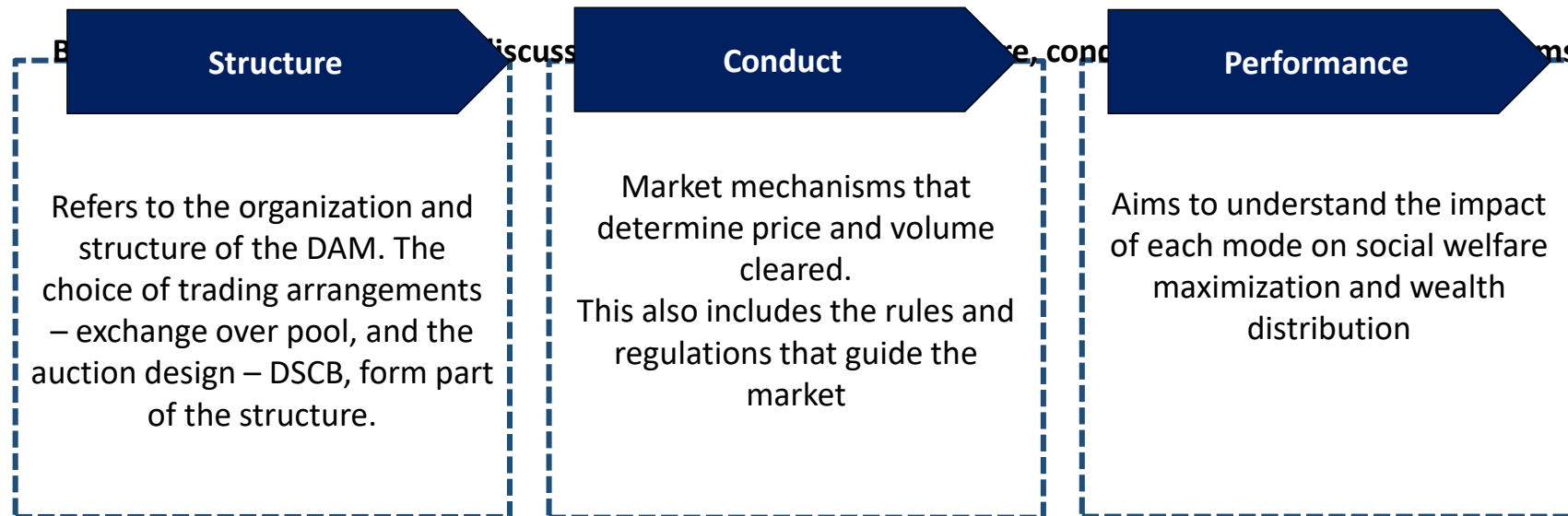
PROPOSED MODES OF OPERATION FOR SARPEX

OPTION 1 – UNIFIED MODE

The bids from the Indian participants and BBN countries' participants would be cleared simultaneously. India is already having power exchanges and the same platform may be utilized for same.

OPTION 2 – SEQUENTIAL MODE (RESIDUAL MODE)

The bids from the Indian participants and BBN countries will be cleared in a sequential manner.



UNIFIED MODE

Structure:

- BBN introduced as new bidding areas
- Trading on a 15-minute intervals
- DSCB Auction model
- Price discovery through Uniform Market Clearing Price mechanism

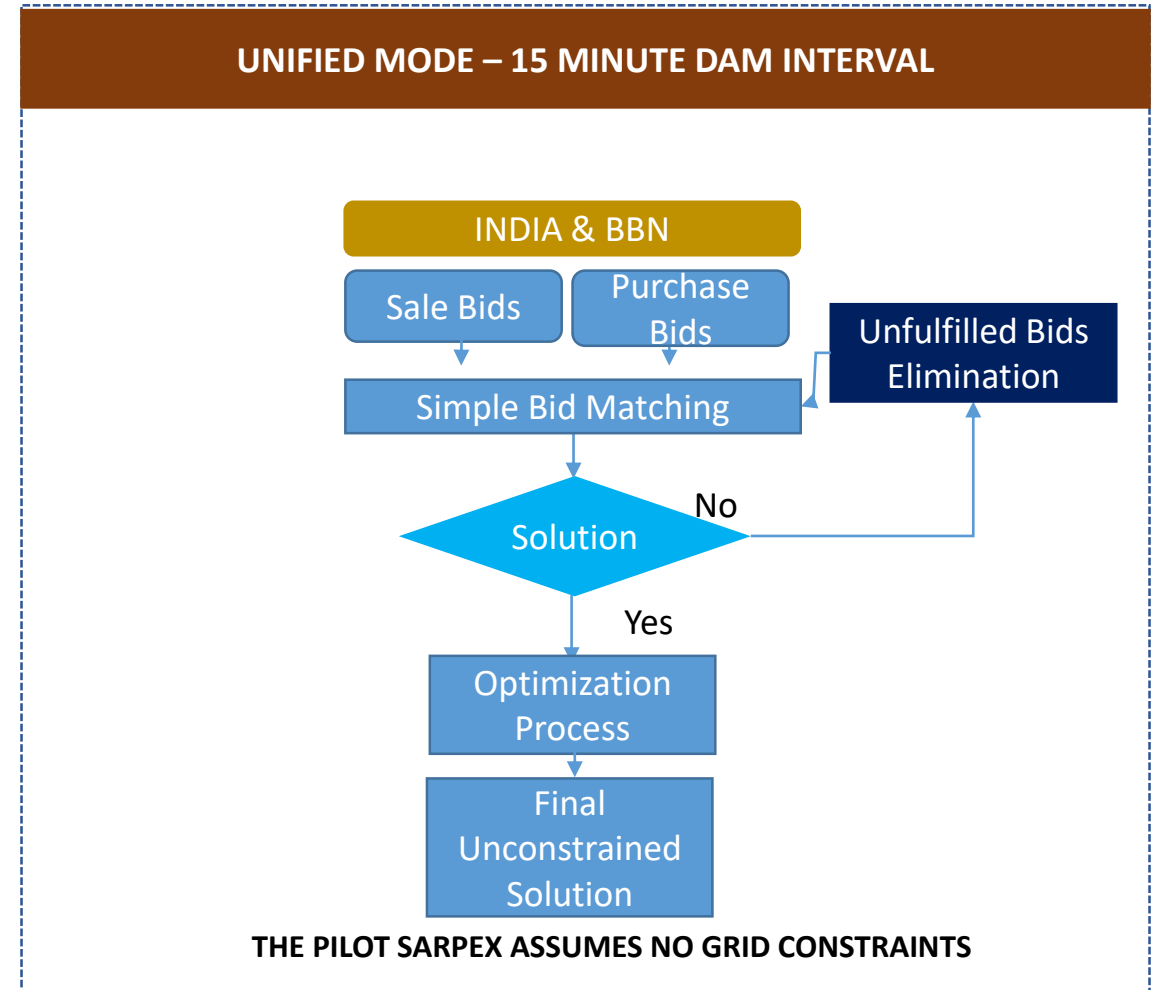
Conduct:

- Uniform Pricing
- Step-wise algorithm
- Extrapolation method in case of non-convergence of curves

Performance:

- The total SW of the Indian and BBN's market changes
- There may be a redistribution of the SW in terms of consumer surplus and producer surpluses for India and BBN

SARPEX's CLEARING ALGORITHM



SEQUENTIAL (RESIDUAL) MODE

Structure:

- Same as Unified Mode

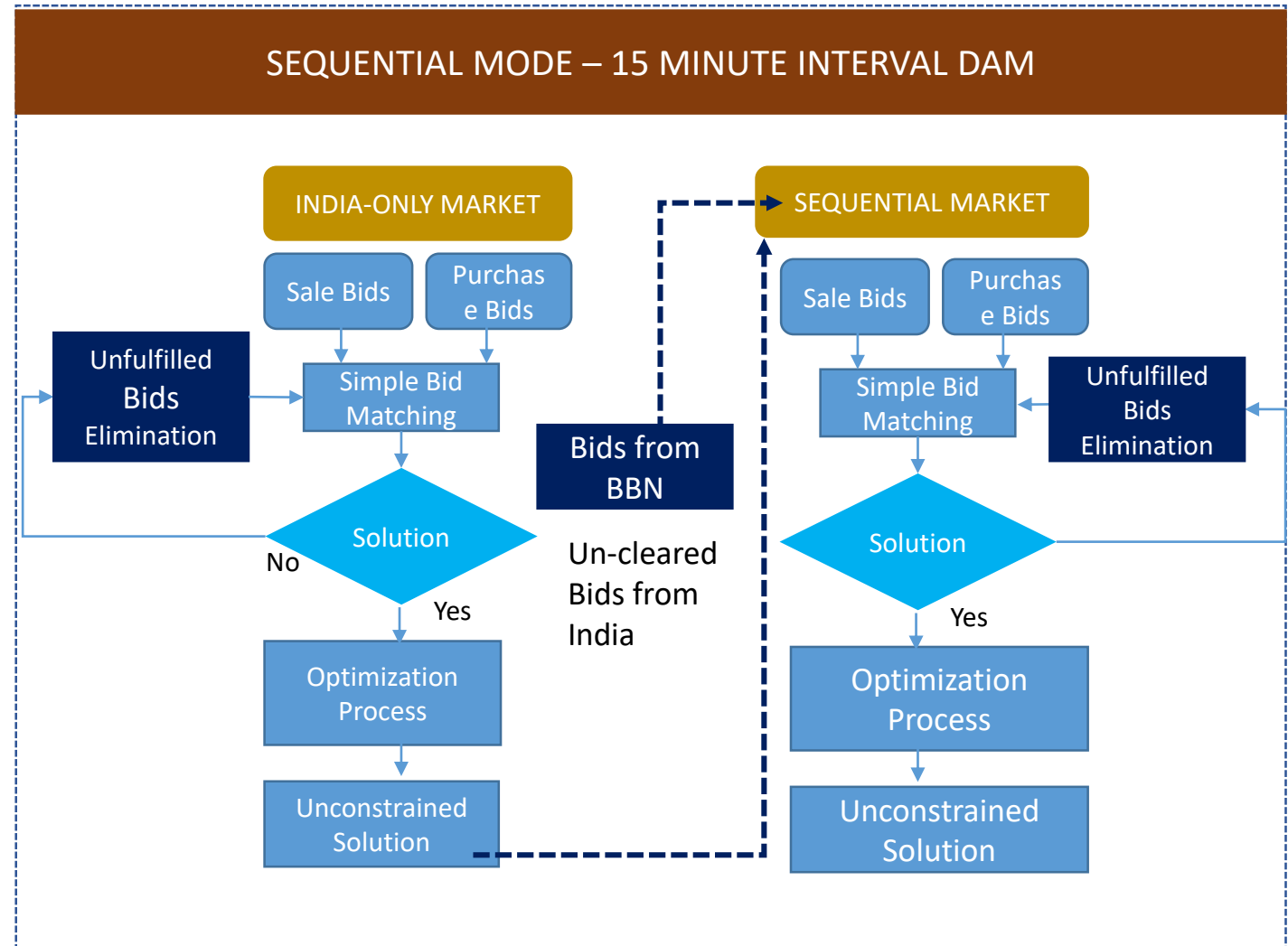
Conduct:

- Price discovery same as in Unified Mode.
- Exchange's simulation engine modified to initiate another round of iteration
- Price discovery occurs in two steps, one for each market

Performance:

- SWM and its distribution needs to be applied to both markets
- Minimal Impact on the Indian Market

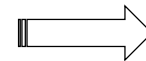
SARPEX's CLEARING ALGORITHM



Time Zones and deviation in BBIN

Time zones observed in BBIN relative to UTC

Country	Time zone (In Hours)	IST Deviation (In Minutes)
India	UTC + 5:30	-
Bhutan	UTC + 6:00	+30 minutes
Bangladesh	UTC + 6:00	+30 minutes
Nepal	UTC + 5:45	+15 minutes



Mismatches in time-zones has implications on coordination of DAM operational activities

Coordination Challenges in operating SARPEX due to Time Mismatches

Electricity Dispatch at the “day boundary” for three consecutive days

	D-2						D-1				D							
Slots	41	48	49	71	95	96	1	2	41	49	95	96	1	2	41	49	95	96
India	10:00	11:45	12:00	17:30	23:30	23:45	00:00	00:15	10:00	12:00	23:30	23:45	00:00	00:15	10:00	12:00	23:30	23:45
Nepal	10:15	12:00	12:15	17:45	23:45	00:00	00:15	00:30	10:15	12:15	23:45	00:00	00:15	00:30	10:15	12:15	23:45	00:00
Bhutan	10:30	12:15	12:30	18:00	00:00	00:15	00:30	00:45	10:30	12:30	00:00	00:15	00:30	00:45	10:30	12:30	00:00	00:15
Bangladesh	10:30	12:15	12:30	18:00	00:00	00:15	00:30	00:45	10:30	12:30	00:00	00:15	00:30	00:45	10:30	12:30	00:00	00:15

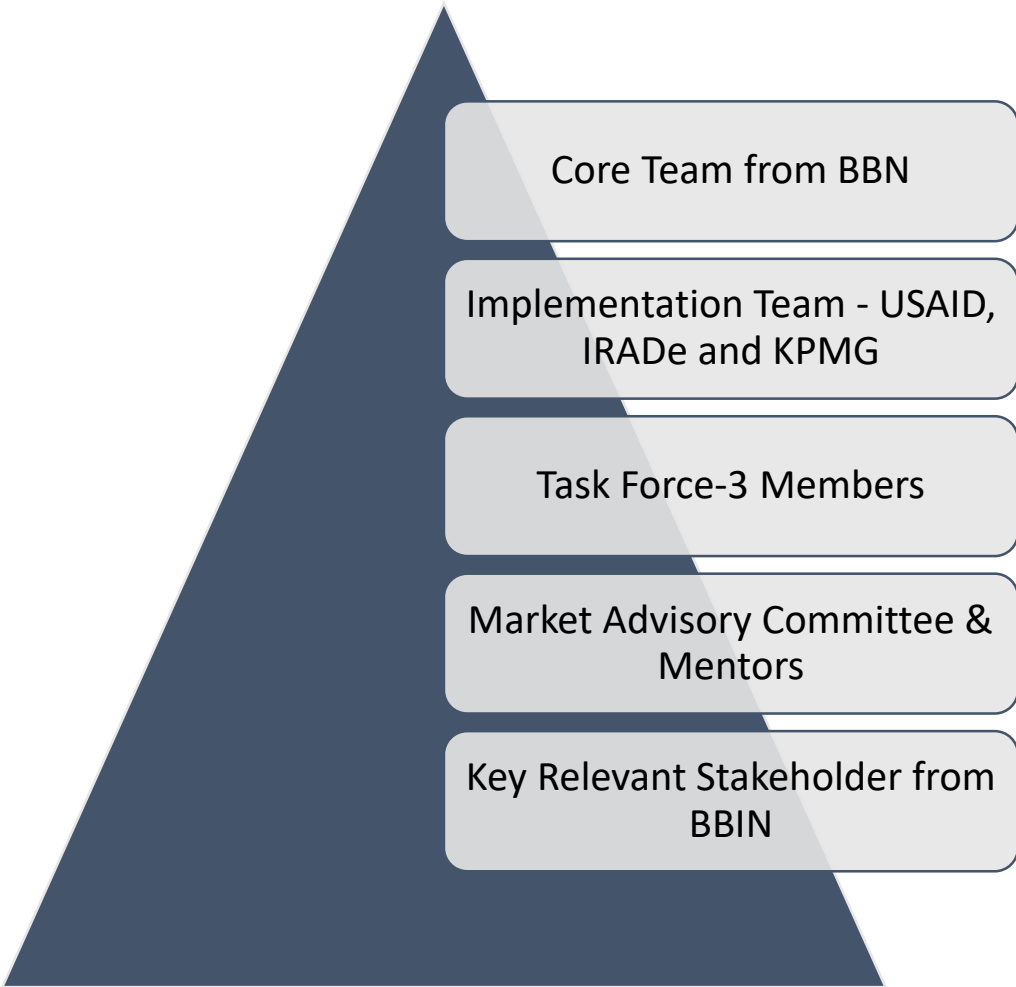
Coordination Issues

Day D-2
 Day D-1
 Day D

Dispatch periods at the “day boundary” i.e. Slot 95 and Slot 96 may lead to coordination issues. While these slots belong to Day “D-1” in India, they belong to Day “D” i.e. the next day in Bhutan, Bangladesh and Nepal



SARPEX TEAM



Market Advisory Committee

Name	Country	Designation	Organisation
Mr Anil Razdan	India	Ex- Secretary Power	Ministry of Power
Mr. Hans-Arild Bredesen	Norway	CEO	Nord Pool Consulting
Mr Peter Jogersen	Denmark	Vice President	Energinet, Denmark
Mr Musara Beta	South Africa	Chief Analysts	South African Power Pool

- Core Team Members are Government nominated members for bidding purpose and capacity building.
- Task Force-3 members are the senior level SA countries government representative to provide the directional inputs.
- The Market Advisory Committee (MAC) and Mentors formed to include suitable international experts who can provide guidance to the team for conducting the mock exercise.
- The implementation team members ensure all activities related to mock exercise are implemented and are responsible for following activities

Web portal for SARPEX Mock Exercise

- The portal is powered by a front-end web application which interacts with Market Clearing Engine at the back-end and allows users to see the results on the Web Portal.
- The web portal has been created to mimicking the regional power exchange- DAM
- Link <http://mocksarpex.eu.ai>



Thanks

For further information related to SARPEX you may also visit web portal

<http://mocksarpex.eu.ai>

Nepal Workshop & Stakeholder Consultation held on 11th-12th April 2017

- Mr. Dinesh Kumar Ghimire, Joint Secretary, Ministry of Energy, Nepal delivered the key note address and mentioned about the Nepal's long term plan for mitigating energy deficit.
- More than 30 participants from various organization has participated in the Workshop.
- The one to one meeting has been conducted with Ministry of Energy, Nepal Electricity Authority (NEA) and Load Dispatch Centre etc. to discuss the concept of SARPEX and its relevance for Nepal.



"South Asian Regional Power Exchange (SARPEX)- Mock Exercise"

Bhutan Stakeholder Workshop & Consultation held on 29th-30th July 2017.

- Keynote address has been delivered by Mr. Sonam P Wangdi Director General, DHPS, MoEA Bhutan
- More than 20 participants from different organization has participated in the Workshop.
- The one to one meeting has been conducted in the Ministry of Economic Affairs (MoEA), Druk Green Power Corporation (DGPC), Bhutan Power Corporation (BPC), Druk Holding & Investment etc.



"South Asian Regional Power Exchange (SARPEX)- Mock Exercise"



India Stakeholder Consultation

Central Electricity Authority: “One-to-one meetings with Central Electricity Authority (CEA) with the Designated Authority- Member Power System along with team.

POSOCO: The SARPEX mock exercise stakeholder consultation was held at POSOCO on 20th July’2017 with CEO, Advisor and other dignitaries.

Central Electricity Regulatory Commission:

- Submission followed by supplementary submissions to CERC draft notification were presented to CERC. The same are also available on CERC website.
- The SARPEX road-map and mock exercise was also shared and discussed in one to one meetings with various senior level officials of CERC.



"South Asian Regional Power Exchange (SARPEX)- Mock Exercise"

Bangladesh Workshop & Consultation held on 9th-10th August 2017

- Keynote address has been delivered by Mr. Mohammad Hossain, Director General, Power Cell, Bangladesh
- More than 30 participants from different organization has participated in the Workshop.
- The one to one meeting has been conducted in the Ministry of Mineral and Energy Resource, Bangladesh Electricity Regulatory Commission, Bangladesh Power Development Board, Dhaka Power Distribution Company.

