Application of Point of Connection methodology for sharing of Inter State Transmission charges and losses on the Short term Open Access transactions

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Abstract:
The CERC regulations on Sharing of ISTS charges & Losses-2010, were implemented w.e.f 1st July, 2011. Implementation of the above regulations represents a new regime in the methodology of Transmission charges and losses allocation for the ISTS(Inter State Transmission) system. Hitherto all ISTS power transactions which were previously being charged based on the uniform postage stamp methodology are now charged based on their point of connection(POC) to the ISTS Grid Viz. the POC charges and losses at the point of injection and at the point of withdrawal. The above represents a paradigm shift in various terms including cost of the transaction. The impact of the above methodology on the various types of contracts in the Indian Power Market with special emphasis on Short Term(Bilateral/Collective) are discussed in this paper.

1 - Introduction

The POC methodology was implemented w.e.f 1st July, 2011, vide implementation of the CERC(Sharing of ISTS charges & Losses) Regulations, 2010[1], with the intention of making transmission charges and losses for transactions sensitive to distance, direction and quantum of power flow as per the National Electricity Policy, 2005[2]. This paper deals with the application aspects of POC methodology in particular to bilateral short term open access transactions.

2 - Present structure of the Indian Power Market

The different types of contracts presently being used for transaction of power are as follows:

2.1]Long-term contracts:

Though there exists no formal definition of long term contracts it is expected that such contracts are aligned with long term Access(LTA) being availed by an utility corresponding to the LT PPAs being executed by them. As LTA means the right of use the inter-State transmission system for a period exceeding 12 years but not exceeding 25 years, it is expected that LT Contracts would range between 12 to 25 years.

2.2]Medium Term Contracts:

Again considering that no formal definition of Medium Term(MT) Contracts are existent, it is expected that MT contracts are aligned with Medium Term Open Access(MTOA) being availed by an Utility. As MTOA means the right of use the inter- State transmission system for a period exceeding 3 months but not exceeding 3 years, it is expected that MTOA contracts would range from 3 months to 3 years.

2.3]Short Term Contracts:

ST markets are defined as markets with contract period not exceeding one year. However, considering visibility issues in real time TTC / ATC, Short Term Open Access(STOA) transactions are allowed upto three months in advance. Again, the STOA transaction comprise of :

i) Bilateral transactions essentially meaning Over the Counter(OTC) contracts comprising of Advance / First Come First Serve / Day ahead transactions / Intraday or Contingency contracts

ii) Collective transactions essentially meaning contracts through PX comprising of Day ahead / Intra-Day or Contingency. Other than above Term ahead contracts are possible. Term Ahead market" means a market where physical delivery of electricity occurs on a date more than one day (T + 2 or more) ahead from the date of transaction (T) and the contracts in such market can be transacted weekly / monthly / yearly or more in advance.

The structure of the present Power Market is diagrammatically represented as follows:

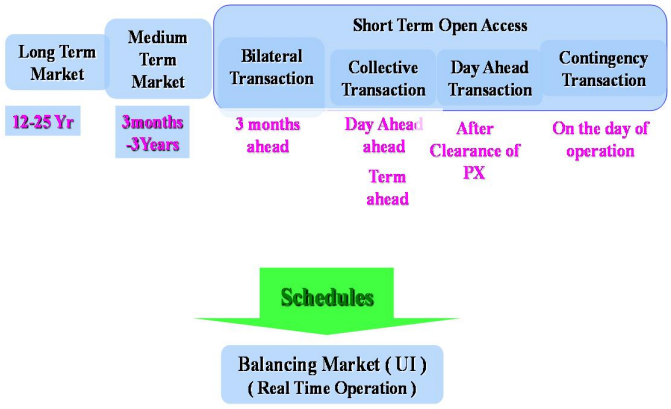

Fig-1-Power Market Structure

Out of the above different segments the share of different segments on an average for the F.Y 2010-11 are depicted below[3]:

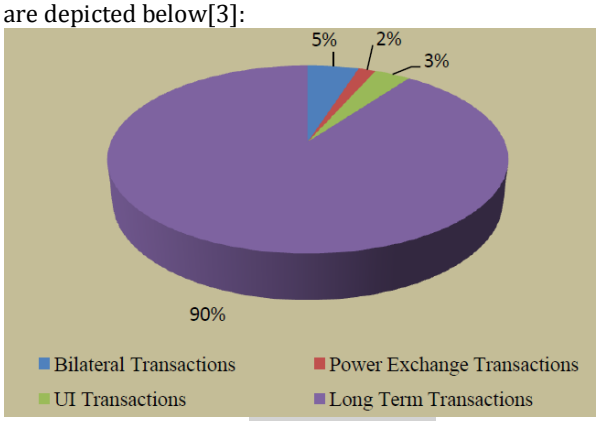

Fig-2-segment wise break-up CERC A.R.[2010-2011]

From the above we can see that Long Term market is the most dominant occupying 90% of market share. Bilateral transactions(OTC) either through Trader or

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directly occupy about 5% of market share. UI market which is basically a balancing market and Power Exchanges occupy more or less equal in market share with lesser volumes. While the UI volumes have been dwindling due to volume caps and restrictions imposed by CERC on UI volumes, forcing a transition from the balancing market to the contractual markets, Power Exchanges are mostly playing in the Day ahead market which is a small part of the entire electricity market.

3-Categories and Timelines for STOA(Bilateral) Transactions[4]

The STOA bilateral transactions are further sub-divided into various categories. The type and timelines are roughly mentioned below:

3.1]Advance : Application for Advance Scheduling for a Bilateral Transaction may be submitted to the nodal RLDC up to the fourth month, considering the month in which an Application is made being the first month. Nodal RLDC would mean the Regional Load Dispatch Centre(RLDC) of the region where the point of drawal is located. For Power Exchange transactions, nodal RLDC would be National Load Dispatch Centre(NLDC). In case of congestion in a particular corridor, e_bidding may be allowed only for advance transactions.

3.2]FCFS[First Come First Serve]:

Applications under FCFS are as follows:

i. Application received under "First Come First Served" category for Short-Term Open Access shall be considered only when transactions are commencing and terminating in the same calendar month.

ii. Application for scheduling a Bilateral Transaction which is commencing in the same month in which Application is made, provided that such Application is received at least four (4) days in advance from the date of commencement of the Bilateral Transaction.

iii. Application received during the last ten (10) days of the first month, for scheduling of transactions in the second month. However, applications received up to five (5) days prior to the end of the month shall be processed only after completing the process for Advance Scheduling of Bilateral Transactions for the second month.

3.3]Day Ahead : Applications received within three days prior to the date of scheduling and up to 15:00 Hrs. of the day

3.4] Contingency: Application after 1500 hrs of the day immediately preceding the day of scheduling.

The various categories and timelines are diagrammatically represented below:

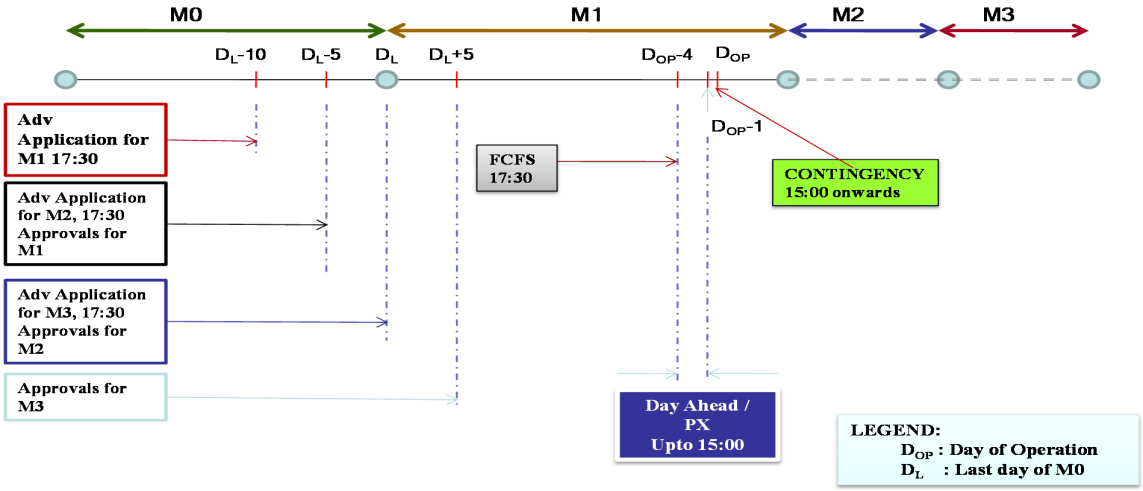


Fig-3-Categories & Timelines for Short Term Open Access(Collective)

4-Pre-POC Methodology of calculation of charges and apportioning of losses for transactions

Previously, the regional postage stamp method was being followed. This essentially implies that within a region transmission charges and losses were same. However, in case of transactions across inter-regional boundaries spanning two or more regions, transmission charges and losses of each region involved were progressively added leading to pancaking of transmission charges and losses. For LT and MT transactions, percentage of total weighted average allocations including all LTA/MTOA, for an entity was calculated. Buyers of the transaction were loaded with the LT and MT transmission charges corresponding to above percentage of the total regional transmission charges. For multiple regions, similarly, proportion of transmission charges of each region involved was payable. For STOA transactions, the following charges were applicable for bilateral/collective- ₹.80/MWh for each region involved subject to maximum of ₹.240/MWh. Taking the example in Section-8, ₹.80/MWh for each of ER, WR, NR was to be charged with total of ₹.240/MWh and for

collective transactions ₹100/MWh each for buyer and seller.

Similarly for losses, regional losses for each region were uniform being a single percentage figure. In case of contracts spanning multiple regions, losses were added progressively. Again, taking the example in Section-8, if we take loss of ER =3%, WR =4%, NR =3.5%, loss for the contract whether, LT,MT, or ST(except collective), the quantum of MW received by the Buyer would be P_{rec} where

P_{rec} = 100 x (1-0.03) x (1-0.03) x (1-0.04) x (1-0.035) x (1- 0.015) MW

The losses as applied in above, progressively, in order are DVC STU loss, ER loss, WR loss, NR loss, DTL STU loss.

Thus we can see in above the effect of pancaking of transmission charges and losses for transactions, which has been effectively removed vide the new POC methodology.

For Bilateral(Collective) involving transactions through PX, both seller and Buyer had to absorb the losses. While the Seller had to inject additionally, totaling to =100/(1-0.03)MW= 103.09MW ; the buyer would get an amount less than 100MW corresponding to = 100x (1-0.035)MW = 96.50MW. In case of PX as can be noted, POC mechanism was already inbuilt as the contract value was assumed to be 100MW at both the regional boundaries, leading to the effect of pancaking vide the intervening WR being eliminated

5-Methodology of loss calculation and determination of losses to be administered weekly on basis of SEM data

Before introduction of POC methodology for losses, losses were to be only borne by buyers, and a single uniform loss was calculated for a region. The losses were calculated from SEM data by aggregating the total injection and total withdrawal energy in MWh and determining the loss in MWh as difference between injection and withdrawal MWh. The above loss in MWh was divided by the total MWh injection, to get the losses in percentage. The above calculation was done on a daily basis and the same averaged over a week to get the loss for the previous week say, w-1 where w is the current week, as SEM data for the week w-1 only was available. The average loss for week w-1 as obtained in above was to be applied for week w+1, i.e the week ahead. For determination of loss in POC regime, the methodology basically remained the same. However, the loss from MWh is now determined blockwise for each block of 15 minutes and averaged over the 96 x 7 blocks in a week. Let this average loss be L%. As per CERC published results obtained using the Webnetuse software for computation of POC charges and losses, all constituents are divided into three Tiers for applications of POC losses viz. Tier-I (Low slab), Tier-II(Average slab), Tier-III(High slab). The above categorization is done for POC injection loss and POC withdrawal separately. Those Average slab(Tie-II) would have POC losses for injection or withdrawal equal to L/2% . Those in low slab(Tier-I) would have injection/withdrawal loss = (L/2-0.3) %. Those in the higher Slab(Tier-III) would have POC injection/withdrawal loss= (L/2+0.3)%.

The method is summarized below:

- If w→ current week, loss of week w-1 is estimated & applied for week w+1
- If a = losses as per SEM data for w-1 losses for Tier I, II, III slabs would be

Low(Tier-I) = [a/2-0.3]% Average(Tier-II)= a/2 High(Tier-III) = [a/2+0.3]%

E.g. estimated loss for w-1 for ER = 3.90%

Low(Tier-I) = 1.65% Average(Tier-II)= 1.95% High(Tier-III) =2.25%

Now if West Bengal is in low withdrawal zone(Tier-I) and Farakka STPS is in high injection zone , a Long Term transaction from Farakka STPS to West Bengal would require application of 2.25%(Tier-III) injection loss and 1.65% (Tier-I) withdrawal loss for the total transaction.

6-The POC methodology for application of ISTS charges and losses for Long Term and Medium Term transactions

For LT and MT Transactions, losses are to be borne by the buyer as per the CERC approved procedures.

For LT and MT transactions losses are to be absorbed entirely by buyer. The point of contract in this case would be assumed at the injection point, i.e seller's boundary. Losses to be absorbed by Buyer would be the entire amount of the transaction loss:

=P - P(1-a/100)*(1-b/100)]

=P{(a+b)/100 - ab/10000}

Again if we similarly, carry out rounding off to two decimal places, the above can be approximately represented as: P(a+b)/100

Again, the charges and losses applied being independent of path pancaking is avoided.

7-The POC methodology for application of ISTS charges and losses for Short Term transactions[5]

The POC methodology essentially implies that any transaction would be charged essentially based on the applicable Point of Connection(POC) rates for the sink and source Zone. Similar treatment would also be given for losses. The ST POC rates for Short Term transactions would be in ₹./MWh.

To clarify let us take the following example:

Let there be a fictitious ST contract from an entity A in Zone-A to an entity B in Zone-B. Let Zone-A be located in Eastern Region(ER) and Zone-B in Northern Region(NR) in the Indian Territory.

Power can be sent from Zone-A to Zone-B either directly or via Western Region(WR).

Let us take injection and withdrawal POC of the Zone-A and Zone-B to be ₹.X/MWh and ₹.Y/MWh respectively. For a ST transaction from entity A to entity B for a contracted quantum of Energy E MWh, the quantum of transmission charges payable T is :

T = E*(X + Y) ₹.

For ST transactions viz.bilateral(OTC) and Collective(PX), losses are to be absorbed by both buyers and sellers. For purpose of loss calculations, the point of injection of all STOA contracts bilateral/PX, w.e.f 1st October, 2011 would be at the periphery of the regional boundary where the entity is located. Accordingly, the quantum of power P would deemed to be available at the inter-regional boundary of both ER and NR respectively.

If the Injection POC losses of Zone-A is a% and withdrawal POC loss of Zone-B is b%, the scheduled quantum of power to be injected by entity A(Inj_A) would be:

Inj_A= P/(1-a/100) MW

i.e. entity A would be apportioned losses by forcing A to inject more than the contracted quantum of P MW.

Quantum of power scheduled to be withdrawn by entity B(Wd_B) would be:

Wd_B = P*(1-b/100) MW

Thus B would be apportioned loss by cutting off B's schedule to lower than contracted value of P.

Hence , the total losses for the transaction would be:

Loss(L) =Inj_A-Wd_B MW

= P{ 1/(1-0.01a) – (1-0.01b)} MW

As per CTU procedures, losses are to be rounded off to two decimal places at each State/Inter-Regional boundary. If the above rounding off methodology is followed, the above loss can be approximately represented as: P(a+b)/(100-a)

Even if we consider, the contract path to be either vide the direct path ER to NR or via the wheeling path from ER to NR via WR, the transmission charges and losses would remain same as they are dependent on the zone of source and sink only and are independent of the path of the transaction. Thus pancaking of transmission charges and losses is avoided.

However for an embedded utility using State network the transmission charges for the use of the State network remain unaffected. The state transmission charges shall be in ₹/MWh, as determined by the respective State Commission and the same shall be intimated to RLDCs by concerned STU. Provided that in case the State Commission has not determined the Transmission charges in ₹./MWh (or the STU has not intimated the charges in ₹./MWh), the charges for use of the respective State network shall be payable at the rate of ₹.80/MWh for the energy approved.

8-Example of application of POC methodology for loss allocation

An example of application of POC loss is explained in this section:

<u>The details of the contracts are as follows:</u>

From:: Tata Steel(DVC) to NDPL Discom(DTL)

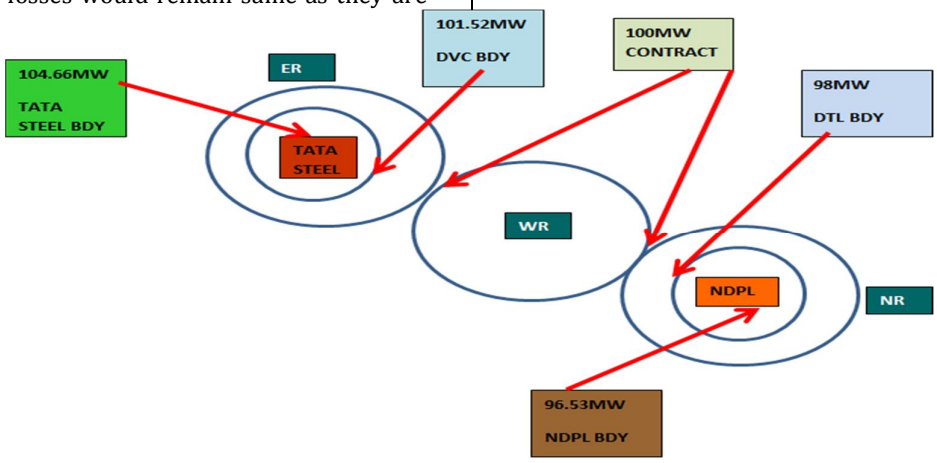
Contract path:: ER-WR-NR

Contract value:: 100MW Round the Clock(RTC) for 5 days = 12000MWh

Notional path followed by the transaction = Tata Steel →DVC →ER →WR →NR →DTL →NDPL

DVC STU loss = 3% DVC Injection POC loss=1.5% Delhi withdrawal POC loss = 2% DTL STU loss=1.5%

Loss are apportioned to both Buyers and sellers as depicted below in Fig.4. Quantum of Power at Various boundaries for 100MW contract after accounting for losses is shown



<u>Fig.4 Loss Allocation example</u>

9-Example of calculation of charges for transaction using POC methodology

All charges as applicable for STOA transactions considering application of POC methodology for the contract as mentioned at Section-7 are depicted in Figure-5. The following additional data may be assumed for calculation purposes:
DVC injection POC for STOA transactions = 14p/unit = ₹.140/MWh
Delhi withdrawal POC for STOA transactions = 10p/unit = ₹.100/MWh
DVC STU charges= ₹.80/MWh DTL STU charges = ₹.41.25/MWh

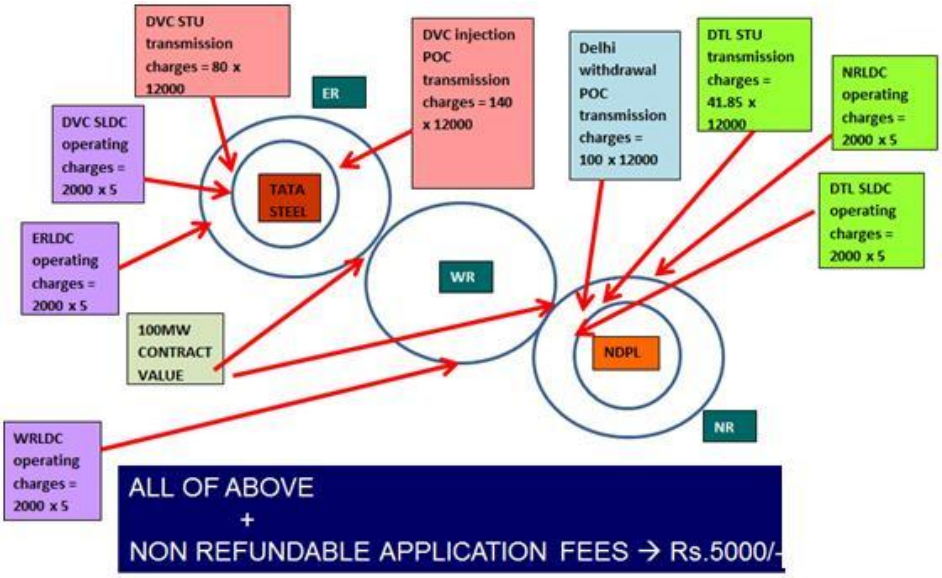


Fig.5 All charges & losses applicable for the STOA transaction

For LT and MT transactions, ST POC charges, SLDC/RLDC operating charges, STU transmission charges, would not be applicable. Instead LT POC charges for DVC injection(₹.1,00,000/MW/Month) and Delhi withdrawal (₹.70,000/MW/Month) , SLDC/STU charges as per SERC orders, RLDC Fees and charges would be applicable.

10-Analysis of application of POC charges and losses methodology on ST Power Markets

The impact analysis considering various factors impacting the power markets is done sequentially hereafter.

10.1] Impact on rates for STOA transaction:

The total number of rates for STOA bilateral transactions, for the ISTS system, has effectively increased from 3 to 21 on introduction of POC methodology to reflect distance and direction sensitivity. As described before, there were a total of 3 rates only in ₹/MWh viz. 80, 160, 240. For collective transactions the same was ₹ 100/MWh. Thus in pre-POC regime the rates do not reflect distance sensitivity as these are based on postage stamp method. After introduction of POC methodology, there are a total of 3 slab rates each for NEW Grid(combined NR,WR,ER,NER Grid) and SR Grid[NER–North Eastern Grid, SR-Southern Grid]. SR and NEW Grid are asynchronously connected via HVDC links, and the slab rates are different as per the published POC Results. The slab rates for STOA transactions are:

NEW Grid→ 10p/unit(Tier-I Low slab), 12p/unit(Tier-II –Average slab) and 14p/unit(Tier-III – High Slab)

SR Grid→ 11p/unit(Tier-I), 13p/unit(Tier-II), 15p/unit(Tier-III)

For a generalized case of say N possible slab rates, as any two slab rates can be paired up for a bilateral transaction, the number of possible stamp rates possible are= ${}^{N}C_2$, considering that order or permutation does not matter. However, considering that even the same slab rates can be paired up, additionally a total of N more numbers of rates are possible. Hence the total number of rates for STOA bilateral transactions would be = ${}^{N}C_2+N$ = $N(N+1)/2$ possible rates.

Thus as can be seen with total of 6 possible slab rates, the total number of stamp rates would now be= $6(6+1)/2$ = 21 possible stamp rates.

This introduction of POC methodology has in net resulted in increase of stamp rates for bilateral transactions from 3 to 21 possible rates. For STOA

collective transactions, the stamp rates have increased from 1 to 21 considering that ₹.100/MW as the rate for Pre-POC regime for each point of injection and drawal.

10.2] Impact on re-routing

In the present methodology of STOA handling, there exists the option of re-routing a transaction vide an alternate route in case the original route is congested i.e fully booked or over-booked. For example, in case of a transaction from WBSEDCL(West Bengal) to DTL(Delhi) if the direct path ER→NR is congested, the transaction can be re-routed vide an alternate route viz. ER→ WR→ NR, wherein, the ER→ WR and WR→ NR paths are not congested.
In the pre-POC regime, such re-routing impacted the transmission costs significantly as the charges were ₹.80/MWh for each region (subject to maximum of ₹.240/MWh). Thus in the above example of re-routing, under the pre-POC regime, the transmission costs would increase from ₹.160/MWh for direct ER→NR path to ₹.240/MWh for the ER→ WR→ NR path. Thus there is a increase of transmission costs by 50%. However, in the post-POC regime, the transmission cost would depend upon injection and withdrawal POC only and are totally independent of any intervening regions. This is because essentially in the post-POC regime pancaking of POC charges and losses is avoided as existed in pre-POC regime. However, a small increase in total transaction charges would result due to additional operating (scheduling) charges payable to the intervening region through which the STOA was re-routed.
Similarly, for losses if we consider loss of all regions approximately similar, insertion of intervening region would result in increase of losses by 50% in Pre-POC regime, but in the post-POC regime there would be no change in total loss for the transaction.

10.3]Impact on Merit order dispatch

POC mechanism supports merit order to a certain extent as pancaking of transmission charges and losses is avoided. In the pre-POC regime transmission charges and losses would be applied sequentially leading to accumulation of transmission charges and losses for a transaction. In the new POC regime the cheapest stations are not piled on with costs and losses leading to pancaking and distortion of merit order.

11-Comparison of Pre and Post POC regime effects – Tabular Summary
The tabular summary of comparison of pre-POC and post-POC regime to assess the impact of POC mechanism on Indian Power markets w.r.t various factors is depicted below in Table-1.

Table-1 Tabular comparison of pre-POc and post-POC market impacts

Comparison factor	Pre-POC	Post-POC	Net effect
STOA(Bilateral/Collective)			
Number of rate stamps	Bilateral-3, Collective-1	Bilateral and collective- 21	Number of stamp rates increased to bring in distance and direction sensitivity
Cost of STOA Transaction	Low as compared to energy costs	Low as compared to energy costs	Prevention of pancaking of transmission charges and losses under post POC regime
STOA volumes	5-7% of Market size	same	No impact on STOA volumes
Distance & Direction Sensitivity	Not existent	Existent	Step towards distance/direction sensitivity
Effect on Merit order Dispatch	Not supported	Supported	Step towards achieving merit order dispatch achieving security constrained optimal load flow
Losses	Higher	Lower on an average	Pancaking of losses prevented
Transparency & simplicity	Existent - lower	Existent- higher	
Whether costs/losses known upfront	No, due to issues of re-routing	Yes	
Re-Routing -impact on Transmission Charges	Significant cost impact	Minimum cost impact	Significant impact on re-routing volumes only in case of low MWh/MW contracts
Re-Routing –impact on transmission losses	-do-	-do-	-do-

12]-Conclusion

POC methodology has ensured the first step towards introduction of distance and direction sensitivity in Transmission charges and losses. The losses are expected to be lower on an average as compared to Pre-POC regime. The POC methodology is transparent and various charges and losses are known upfront. The POC methodology also promotes merit order dispatch.

13] Acknowledgement

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