CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI

Petition No. 180/2010

Coram
Dr. Pramod Deo, Chairperson
Shri V.S. Verma, Member
Shri M. Deena Dayalan, Member

Date of Hearing: 28.02.2012
Date of Order : 23.05.2013

In the Matter of:
Revised Pricing in case of transmission congestion based on "weighted average cost of power in the two or more sub markets" in Day Ahead Market.

And in the Matter of:
Power Exchange India Limited ….**Petitioner**

Parties Present:

1. Sh. Prabhijit Sarkar (PXIL)
2. Sh. Akhilesh Awasthi (IEX)
3. Sh. S.S. Barpanda (POSOCO)
4. Sh Samir Saxena (POSOCO)
5. Sh. M.G. Raoot (NPEX)

Order

Petitioner submitted the petition on 18.6.2010 seeking permission on revised pricing for Transmission Congestion Management in Day Ahead Market on Power Exchanges. The summary of the petition is as follows :-

a) Commission granted permission to PXIL for commencing operations of day ahead market vide order dated 30.9.2008 and PXIL commenced its operations from 22.10.2008.

b) Regulation 32 (iv) of Central Electricity Regulatory Commission (Power Market), 2010 states that:

"The Power Exchanges shall carry out Congestion Management using Market Splitting mechanism in Day Ahead market. The Power Exchange can develop its own Market Splitting Methodology with approval of the Commission."

c) Congestion Management is handled by market splitting mechanism presently in accordance with the directions of National Load Despatch Center (NLDC) in Day Ahead Spot market. Congestion occurs whenever the system state of the grid is characterized by one or more violations of the physical, operational, or policy constraints under which the grid operates in the normal state or under any one of the contingency cases in a set of specified contingencies.

d) In an initial iteration, all supply and demand across all zones is aggregated, and an unconstrained market clearing price (UMCP) is found. The algorithm furthermore calculates the cleared schedules for all market participants based on the UMCP. In the next iteration, the supply/demand balance within each zone is aggregated, and any zonal imbalance then represents the amount of transmission from/to that zone. If this calculated transmission amount exceeds the permitted transfer capability as decided by NLDC, then there is transmission congestion and the market splitting algorithm is initiated. The congested zone will be separated from the rest of the system, and the price within the zone will be adjusted to drive the supply/demand "imbalance" to a level to match the transfer capability.

e) Short term day ahead market through exchanges constitutes only 0.77% of the total energy generation, the present market splitting results in aberrations in price discovery in the region downstream the congested corridor. The price of power in that region goes up significantly compared to the region upstream the congested corridor. This results in vast difference in area prices between the regions downstream and upstream the congested corridor leading to a Congestion Revenue Surplus. Buyers in downstream area strongly object to higher price, whereas the sellers in the upstream area resent lower price.

f) PXIL proposes a variant of present Market Splitting Method which brings in improvements over the present method particularly in bringing down the average price

of power. PXIL proposes to implement revised pricing in case of market splitting method based on “weighted average prices of the different sub markets”.

g) In the proposed method, buyers pay the weighted average of the total cost with the flow on the congested corridor priced at the average of the two submarkets. Similarly, the sellers will also be paid at the weighted average price of the two MCPs of the sellers and buyers regions. This will result in a scenario where consumer's surplus will be equal to the generator's surplus. It would also lead to a lower weighted average cost for the buyer in the downstream area of congested corridor as compared to the present market splitting method.

h) Proposed method would also give locational commercial signals to generators and loads; and also provide commercial signals for augmentation of transmission capacity as in the present market splitting method.

i) Proposed method would moderate the price to be paid by buyers in the sub market downstream the congested corridor and help in containing the overall price of the power. In addition, it would be non discriminatory to all the participants at the exchange by facilitating equalization of the buyers surplus with the sellers surplus by a way of midpoint logic.

j) The detailed illustration was submitted as an Annexure to the proposal.

k) The petitioner made following prayers before the Commission:

(i) To allow the petitioner to introduce proposed Revised Pricing in case of Market Splitting "weighted average price of the two markets".

(ii) In view of the request submitted to Hon'ble Commission through our letter PXIL/BD/11062010/01 dated June 11, 2010, we beseech the Hon'ble Commission to eliminate the petition fee for this proposal for grant of financial support as this would lead to bringing down the prices of electricity traded through the exchange.

(iii) Any other order for smoother functioning of the proposed method.

2. A meeting was held with the petitioner in June, 2010 wherein petitioner was asked for certain clarifications on the proposed market splitting methodology and to correct discrepancies in the calculations for the illustrations given to explain the proposed methodology submitted with the petition dated 18.06.2010. Based on this discussion a letter seeking technical clarification was sent by the Commission on 1.7.2010 and the petitioner was requested to file the reply by 21.7.2010.Since no response was received from the petitioner for a long time, reminder was sent through an email dated 26.4.2011.

3. A second meeting in this matter was held with petitioner on 29.4.2011 and the issues of optimizing transmission congestion, prices in S2 region were discussed. Petitioner mentioned in its letter dated 3.05.2011 that they were in the process of compiling information for the queries asked by the Commission in its letter dated 01.07.2010 and sought more time for submitting clarifications.

4. Petitioner submitted the clarifications on the revised methodology on 29.6.2011 on below mentioned four points asked by the Commission in its letter dated 01.07.2010:

a) Resubmit the proposed methodology after correcting the discrepancies in the quoted examples on the methodology.
b) Explain different demand-supply scenarios with examples.
c) Furnish international experience of the proposed methodology.
d) Furnish literature references on the proposed methodology.

5. The petitioner submitted modified proposal on 13.7.2011. The extract of the modified petition is as follows:-

(i) **Introduction**

One of the biggest challenges in efficient functioning of electricity markets is to handle transmission congestion. Congestion arises when power flow to a region exceeds the transmission capacity available for that region.

In currently mandated market splitting method at exchanges, the participants on the exchanges and the exchanges are the ones, which are paying for the opportunity cost of congestion. The bilateral users (medium term and short term), do not pay this opportunity cost for the transmission system. There exists a substantial bias in favor of bilateral transactions and against the collective transactions through exchanges. It is a strong disincentive and affects the bids put by the participants on the exchanges. The present congestion management regime is not platform neutral, as any market mechanism ought to be and the participants on the exchange are at great disadvantage in comparison to bilateral and OTC market. Power exchanges are superior to bilateral and OTC markets in price discovery. The present congestion management regime is one of the reasons in hindering the shift of trade from inefficient bilateral transactions to collective transactions through exchanges. Our proposed method will somewhat neutralize this problem and will level the competition across all trading platforms in electricity markets.

(ii) **Fundamentals of Transmission Congestion**

Congestion places network constraints on dispatch and it interferes with the market's merit dispatch objective of meeting demand at the lowest possible cost. In the absence of congestion, generation units with the lowest cost supply electricity to meet the demand of consumers, but when congestion arises, this may not be possible and higher cost generating units have to be scheduled for dispatch. This introduces risk for the market, which consequently affects bidding, dispatch pricing, and long-term investment decisions.

a) **Effects of Congestion**

- Congestion can introduce physical and financial risks that participants have to manage.
- The magnitude of these risks depends largely upon the pricing and settlement arrangement in the market and how closely these rules are related to congestion management.

Both the above incentivize participants to engage in bidding which is not reflective of the marginal cost. The bidders might bid as must run stations i.e. a very low bid or extremely high bid as they anticipate non – dispatch due to congestion. Both the bidding patterns would result in disorderly bidding and therefore, skewed-pricing leading to inefficiency. Skewed-pricing may distort the investment decisions for both supply and demand side. This includes decisions on technology, location and timing. In long run, this can weaken the economic signals that support efficient locational investment decisions by generators and large industrial and commercial users. Locational signals assume greater importance in current Indian context of ambitious capacity augmentation plans. In addition to affecting the behavior of the market participants, congestion affects the market as a whole.

b) **Managing Congestion**

Some of the common methods used for handling congestion in electricity markets are:

- Redispatching.
- Coordinated auction of generation and transmission capacity (Explicit Auction).
- Nodal pricing or Locational Marginal Pricing.
- Market Splitting.

(iii) **Current Practice in Indian Markets**

Currently Congestion Management for Day Ahead Spot (DAS), is handled by market splitting mechanism in accordance with the directions of National Load Dispatch Center (NLDC). Congestion occurs whenever the state of the transmission grid is characterized by one or more violations of the physical, operational, or policy constraints against its normal state or from one of the contingency from a set of specified contingencies. In an initial iteration, bids of market participants from various bid zones are aggregated and an Unconstrained Market Clearing Price (UMCP) is discovered. The algorithm furthermore calculates the cleared schedules for all market participants based on the UMCP. In the next iteration, the supply/demand balance within each zone is aggregated, and any zonal "imbalance" then represents the amount of electricity from/to that zone. If this calculated transmission amount exceeds the permitted transfer capability as decided by NLDC, it amounts to transmission congestion and accordingly, "market splitting" algorithm is initiated. The congested zone is separated from the rest of the system, and the price is discovered for both the zones as separate markets. The discovered price is adjusted to drive the supply/demand "imbalance" to a level to match the permitted transfer capability.

a) **Experience in the Nordic Market**

The Nordic market, consisting of Norway, Sweden, Finland and Denmark uses the classical market-splitting model for congestion management. The power exchange splits the bid with geographical bid areas with limited capacities of exchange (as the entire transmission corridor is available to exchanges); a power pool price is set according to amounts of demand and generation offered in the whole market area. The Transmission System Operator (TSO) then computes a load flow and identifies constrained lines. It should be pointed out that the same later is used for evaluation of Net Transfer Capability (NTC). Geographical bid areas are defined across both sides of the bottleneck a new price is defined for each area with flows limited to the capacity of inter connected lines. Thus each area has its own pool price; area upstream of congestion corridor having a lower pool price whereas area downstream of congestion corridor having a higher pool price. This price

demand effect results in releasing of congestion by decreased demands in high priced areas and price increases in low priced areas. The generation side has opposite effect.

b) **Short Term Markets in India**

The Indian Short term power market stands about 8% of total generation of electricity. The occurrence of congestion in Indian Short Term Market not only leads to curtailment on the volumes of electricity transacted through exchanges but it also reduces the liquidity and leads to price rise.

(iv) **Proposed Market Splitting Method**

The proposed market splitting method the price to be paid by buyers will be the weighted average price of the sellers calculated as follows:

Let the number of surplus markets is 'm'
Let the number of deficit markets is 'n'
The index for surplus markets is 'j'. Therefore, number of surplus markets will go from 1, 2, 3…j….m.
The index for deficit markets is 'k'. Therefore, number of deficit markets will go from 1, 2, 3…k….n.
During Congestion, the power can flow from multiple surplus markets to multiple deficit markets. It is not necessary that power will flow from each surplus market to each deficit market.

Settlement price for sellers in surplus market j = **P (Settlement for Seller, Surplus (j)) =**

Settlement price for buyers in deficit market k = **P (Settlement for Buyer, Deficit (k)) =**

MCP (Surplus (j)) = Market Clearing Price for surplus market j.
MCV (Surplus (j)) = Market Clearing Volume for surplus market j.
MCP (Deficit (k)) = Market Clearing Price for deficit market k.
MCV (Deficit (k)) = Market Clearing Volume for deficit market k.

= Flow from surplus market j to deficit market k.

Values for many will be zero if there is no flow between these two regions.

= 0 (If no flow between surplus region j and deficit region k)

Example on Proposed Market Splitting Method

Assumptions:

- Zone 1 with Generator G1 and loads A & E
- Zone 2 with Generator G2 and load B
- Zone 3 with Generator G3 and load C
- Zone 4 with Generator G4 and load D

Inter regional Flow Paths:

- Zone 1 to Zone 2
- Zone 2 to Zone 3
- Zone 2 to Zone 4
- Zone 3 to Zone 4
- Zone 4 to Zone 1

The price bids for the different generators (supply) and loads (Demand) for a particular period are shown below.

	Demand						Supply				
Price	A	B	C	D	E	Aggregated Demand, MWh	G1	G2	G3	G4	Aggregated Supply, MWh
1.4	200	230	220	200	150	1000	0	0	0	0	0
1.6	200	230	220	200	150	1000	0	0	0	0	0
1.8	200	230	220	180	150	980	0	0	0	200	200
2	175	192	220	170	150	907	213	0	75	200	488
2.2	149	153	163	150	100	715	227	200	75	213	715
2.4	141	115	147	150	100	653	240	218	75	225	758
2.6	129	77	110	100	100	516	253	237	75	235	800
2.8	119	38	73	80	50	360	267	255	150	250	922
3	111	0	37	60	50	258	280	273	150	250	953
3.2	103	0	0	40	50	193	280	292	150	250	972
3.4	0	0	0	20	50	70	280	310	150	250	990
3.6	0	0	0	0	50	50	280	310	150	250	990

Price	Demand					Aggregated Demand, MWh	Supply				Aggregated Supply, MWh
	A	B	C	D	E		G1	G2	G3	G4	
3.8	0	0	0	0	50	50	280	310	150	250	990

PRICE BIDS FOR THE SUPPLY AND DEMAND OF ELECTRICITY

The MCP and MCV for the unconstrained market are Rs. 2.2/ Kwh and 715 MWh and respectively. The schedules and flows are as indicated below.

- Zone 1, G1 = 227 MWh, A = 149 MWh and E = 100 MWh. Net inter regional inflow of 22 MWh
- Zone 2, G2 = 200 MWh, B = 153 MWh. Net inter regional outflow of 47 MWh
- Zone 3, G3 = 75 MWh, C = 163 MWh. Net inflow of 88 MWh
- Zone 4, G4 = 213 MWh, D = 150 MWh. Net outflow of 63 MWh.

Inter regional flows (unconstrained) are as under:

Prioritized Distribution				
	Flow To			
From	Zone 1	Zone 2	Zone 3	Zone 4
Zone 1	0	0	0	22
Zone 2	0	0	-47	0
Zone 3	0	47	0	41
Zone 4	-22	0	-41	0

The flow scheduling has been done on Price –Quantity –Time (PQT) priority basis wherein the priority is decided based on Price.

Case I: Let us assume that there is congestion on the corridor between Zone 3 to Zone 2 and only 20MWh can flow on it. Between Zone 4 and Zone 3, no flow is allowed.

The market therefore splits between Sub Market 1 and Sub Market 2. Sub Market 1 comprises of Zone 1, Zone 2 & Zone 4 whereas Zone 3 is considered as Sub Market 2. The Aggregate Demand and Supply position for the two markets are plotted with revised configuration of C & G3 and is as shown in table given below:

Price	Demand					Aggregated Demand 1, MWh	Aggregated Demand 2, MWh	Supply				Aggregated Supply 1, MWh	Aggregated Supply 2, MWh,
	A	B	C	D	E			G1	G2	G3	G4		
0.01	200	230	220	200	150	800	220	0	0	20	0	0	20
1.4	200	230	220	200	150	800	220	0	0	0	0	0	20
1.6	200	230	220	200	150	800	220	0	0	0	0	0	20
1.8	200	230	220	180	150	780	220	0	0	0	200	200	20
2	175	192	220	170	150	707	220	213	0	75	200	413	95
2.2	149	153	220	150	100	572	220	227	200	75	213	640	95
2.4	141	115	200	150	100	526	200	240	218	75	225	683	95
2.6	129	77	180	100	100	426	180	253	237	75	235	725	95
2.8	119	38	180	80	50	307	180	267	255	140	250	772	160
3	111	0	180	60	50	241	180	280	273	140	250	803	160
3.2	103	0	160	40	50	213	160	280	292	140	250	822	160
3.4	0	0	100	20	50	90	100	280	310	140	250	840	160
3.6	0	0	100	0	50	70	100	280	310	140	250	840	160
3.8	0	0	100	0	50	70	100	280	310	140	250	840	160
20	0	0	0	0	0	20	0	280	310	140	250	840	160

Case I Corridor between Zone 2 and Zone 3 constrained to 20 MWh

The MCP/MCV for sub market 1 and sub market 2 are Rs 2.2/572 MWh and Rs. 3.11/160 MWh respectively. Sub Market 1 is surplus and Sub Market 2 is deficit. The price signals also manifest the same. The revised flows are depicted in table.

From	Flow To			
	Zone 1	Zone 2	Zone 3	Zone 4
Zone 1	0	0	0	0
Zone 2	0	0	20	0
Zone 3	0	-20	0	0
Zone 4	0	0	0	0

CASE 1 INTER REGIONAL FLOWS

In case of the classical market splitting method, the congestion revenue would have been calculated as per following equation.

However, in the proposed method, all the buyers in the region would pay the weighted average cost of power for the region. Therefore the buyers would pay,

The sellers would be paid as per the MCP of their respective markets. For the scheduling part, it would be prioritized with priority of price being the highest followed by quantity. However, equitable and equal methods of scheduling can also be used.

It is evident from the above case that the locational price signal is intact but the cost of power purchase has been brought down.

Though the above methods brings down the price of the power in the deficit region keeping the locational signal intact, it might lead to very high bidding by participants for prioritized scheduling, resulting into price increase. Moreover, only one of the affected participants is being benefitted. In order to overcome this disadvantage and be non-partisan to the participants, alternative 2 is proposed.

Alternative 2

In this case, the sellers as well as the buyers would be obligated with the weighted average charges. The power flow on the congested corridor would be charged at the midpoint of the two MCPs. Therefore,

Congestion fund (in thousands) =

Total amount paid by the buyers (in thousands) =

Total amount paid to the sellers (in thousands) =

According to new price, total amount paid by the buyers (in thousands) =

According to new price, total amount paid to the sellers (in thousands) =

We can see that after rounding, congestion fund is distributed evenly between buyers and sellers in surplus and deficit markets.

Thus, in this case as the MCPs of the two market price has a bearing on the price which participants would be obligated with, the incentive to disorderly bidding is inherently reduced. Moreover, the method is non-discriminatory to all the participants at the exchange

6. Staff of the Commission had a discussion with the petitioner on 27.7.2011 in which the following issues were raised and the corresponding clarifications were sought from the petitioner:

a) The prices for the buyers in the deficit market would be reduced and price the sellers in the surplus market will be increased in such a manner that the congestion amount is extinguished. As the buyer's price is lowered now, there will be incremental demand which will not be met. Similarly as the price is raised for sellers there would be incremental sellers ready to sell at the increased price. Since these participants will not be cleared even after revising the prices, they will be discriminated against. How will such a modification be justified.

b) This method of calculation of settlement prices for the buyers in the deficit region and for the sellers in the surplus region may lead to market distortion and some of the participants may try to exploit this new methodology.

c) The new settlement price calculated will dilute locational price signal for transmission congestion as the prices in surplus area and deficit area will converge. The rationale for market splitting is to provide transmission congestion signals.

7. In response to which, petitioner submitted its reply on 24.10.2011 along with letters from two eminent economists who were in support of the proposed methodology. The summary of the reply is as follows:

> "Question 1:- The paper proposes that once the market clearing prices are discovered in the surplus as well as the deficit markets, the buyers and sellers would be cleared accordingly. However, thereafter, the prices for the buyers in the deficit market would be decreased and vice versa for the sellers in the surplus market such that the congestion rent is extinguished. At these lower prices (as applied for buyers in the deficit market) now, there may be more demand available. Would these buyers (available at the lower prices) not be discriminated against?
>
> Answer:-
>
> It is important to conceptually differentiate between the Market Clearing Price and the Final Settlement Price. The Market Clearing Price (MCP) is obtained at the intersection of the Aggregate Demand and the Aggregate Supply curves, based on the price-volume combination quoted by each participant, both buyers and sellers in the market. The price quoted by the buyers and sellers is the price of electricity only, without taking into account transmission charges, losses or any other levies. All buyers who have quoted a price which is either equal or higher than the MCP are cleared and all sellers who have quoted a price which is either equal or lower than the MCP are cleared. This entire set of buyers and sellers are cleared at the MCP. This means that the price of only the energy component of electricity is the MCP.The MCP is therefore the specific price of electricity at which a set of buyers and a set of sellers have been identified for transacting.When it comes to financial settlement of the dues of the Buyers and Sellers, for each individual buyer and seller, in addition to the MCP, the charges related to transmission charges and losses, application and scheduling fees, transaction charges etc. are applied. The per unit rate payable by the seller or the buyer is therefore different from the MCP as declared by the exchange. This per unit rate is the Final Settlement Price. Thus, for each specific buyer and seller, the Final Settlement Price (FSP) is a combination of the MCP and the applicable charges or levies. In some cases the FSP may be higher or lower depending upon the specific case of the buyer and or seller and the charges applicable on them. Keeping the above concepts in view, PXIL's proposal is to keep the MCP discovered in the overall market as well as the surplus and deficit markets undisturbed.
>
> This would ensure that the set of buyers and sellers, who have been cleared on the basis of intersection of aggregate demand and supply, viz. at the MCP of their market, remains undisturbed.
>
> At the time of settlement, while calculating the FSP, the settlement prices of the buyers in the deficit market and the sellers in the surplus market would be adjusted such that the overall congestion rent as may have been created, is extinguished completely.
>
> Question 2:- This method of calculation of settlement prices for the buyers in the deficit region and for the sellers in the surplus region may lead to market manipulation by some of the participants, as they may try to exploit this methodology.

Answer:-

There is a minimal scope of manipulation as this methodology for calculation of settlement price will be public information and will be known to every participant. An individual participant cannot exploit this information for her/his own advantage, as other participants will be competing for the same advantage. The standard argument of efficient outcome being achieved due to market mechanisms and information symmetry will hold in this methodology. For example, let us assume there are N numbers of participants in the market and all of them know the pricing methodology mentioned in the paper. If each of them individually tries to exploit this methodology by adjusting their bid price then overall these participants will cut each other's benefit. If one participant cuts/increases the prices then so can the other N-1 participants. In addition, this methodology will be used on the daily basis for day ahead markets and to come up with a gaming strategy every single day is near to impossible, as other participants will also adjust their behaviour according to the outcomes observed in the past. Also, congestion and its magnitude in different regions for a given time slot is uncertain and difficult to predict. Congestion and its magnitude in a region in contingent upon the flow constraints provided by National Load Dispatch Centre (NLDC). These constraints are time varying and change on daily basis.This adds one more layer of difficulty for a potential manipulator. Therefore, it becomes very difficult to take advantage of this scenario and market manipulation, due to this methodology, does not appear to be a possibility at this point.

Question 3:- The new settlement price calculated will not provide correct locational price signal for congestion

Answer:-

This is answered somewhat by the answer given in the first question. The locational congestion signals provided by the prices calculated for the surplus and deficit regions will remain intact. The market participants will keep getting the same price signals, which they were getting earlier.The MCP calculated and the settlement price calculated is interlinked, but the purpose and function is very different. The settlement price is only for getting of trade for a participant whereas MCP is the price for the market, which provides a locational congestion signal. The MCPs in the surplus as well as the deficit market also continue to provide locational signals for developing generation assets as they continue to remain as it is. The pricing methodology promotes and enhances equity, efficiency, effectiveness and transparency in the markets and will reduce the uncertainty inherent in the market and boost confidence of the participants**"**

8. The petitioner also submitted opinion of two economists. The views of the economists is summarised below:

a) **Dr. Vijay Kelkar, Chairman, NSE**-The proposed methodology seeks to continue with the current matching mechanism without any changes for discovering the Market Clearing Price (MCP) and takes into account congestion and the consequent market

splits. The methodology goes a step further and derives a Final Settlement Prices (FSP) for both buyers and sellers such that their final obligations are adjusted and no congestion rent is created. This new methodology passes the touchstone of a good regulation as it ensures retention of complete transparency in the process while providing no opportunity for participants to game the marketplace with any adverse consequences. A national level market for power is being developed via Exchanges and they have been successful in attracting over 1000 retail consumers into the market. However, the market anomaly of the scarcity rent burden which is being levied only on consumers participating through power exchanges comes in the way of these consumers remaining in the market during period of extreme volatility caused by frequent congestion. Transactions through power exchanges have a lower priority in transmission corridor allocation by Load Dispatch Centres compared to other forms of power transactions arrangements. The lower priority accentuates the on-going congestion issues presently faced by certain regions in the country. The proposed methodology mitigates the financial impact faced by power exchange participants and benefits the Indian Power Market by reducing the price volatility, retaining the MCPs as discovered and providing locational price signals for generation siting as well as transmission planning in tandem. The revised methodology is a transparent and non-partisan method of providing equitable treatment for exchange participants.

b) **Dr. Santosh R Dastane**, Director, Neville Wadia Institute of Management Studies and Research,Pune: - While framing long term policy, we shall have to consider the basic compulsions of energy security throughout the country , the political economy of demand and supply of power , the positive and higher income elasticity of demand for power and so on. The short term impact of congestion rent might be manageable but in the long run it may lead to distorted investments across regions. This in turn may lead to organic imbalance in development projects. And if this really happens, short term solution may lead to long term imbalance. The prioritization given to long term users coming from the transmission planning philosophy and only inherent margins or unutilized capacities being made available to short term players would be the practice during this transition period for the power markets. Hence the need for congestion management solution to be

adaptive and flexible. Congestion rent is applicable only to the participants at the exchanges without any economic logic supporting the same. In the absence of majority of the flows through the exchanges, it needs to be equally/equitably shared among all the participants irrespective of the nature and type of usage. The methodology in vogue for deviations from unscheduled interchange does not explicitly penalize participants for causing congestion. The current congestion management regime penalizes the participants based on the planned flows the next day whereas the actual flows might be different. In the event of lesser congestion it leads to unnecessary loss to exchange participants whereas in case of higher congestion (to be measured by higher frequent in real time) no explicit congestion rent is applicable on all participants, which seems to be one sided. Compounding of more than one states into a zone could possibly lead to a situation wherein bidding by a particular state to meet its requirements of higher demand/risk due to agriculture requirements, seasonal requirements or political compulsions might lead to a price discovery at one of the boundary conditions, which would have to be borne by all the constituents. In view of the above, the proposed methodology offers to distribute the surplus created amongst the sellers and buyers based on the flow in their respective markets and flow on the congested corridor weighted against price in their respective markets and the average of the price between the markets is a brilliant solution and gives equal treatment to surplus and deficit sectors. We can also experiment on the basis of discriminatory prices. e.g. discrimination on the volume basis, or on the peak-hour off-peak-hour basis and so on. This would enable the users to take advantage of the price discrimination on the use basis and they will be in a position to calculate and bear their own risk of high/low prices. Since it is going to be selective and voluntary, the long term distortions will be minimal.

9. The Commission heard the matter on 12.1.2012. The Petitioner was directed to implead the National Load Despatch Centre, Inter-State traders and other Power Exchanges as respondents and serve copies of the petition and additional information filed in the matter by 25.1.2012 who shall file their responses by 10.2.2012 and the petitioner may file its response, if any, by 20.2.2012. The Commission also directed the petitioner to host on its website the petition

and other related information to enable the interested persons including market participants to file their response if any, by 20.2.2012.

10. The summary of the response received is as follows :

Submissions in support of proposed mechanism:

a) **Gujarat Urja Vikas Nigam Ltd. (GUVNL)-** GUVNL discussed the problems which it has faced due to congestion in transmission corridor. It supports PXIL's proposed congestion mechanism and put forth the following rationales:

(i) Proposed mechanism will give boost to sellers who are getting lower prices in the surplus region and will also reduce the burden on the buyer.

(ii) A large amount has already been accumulated in PSDF and lying idle whereas on the contrary, inter-regional transmission corridors of adequate capacity are not available.

(iii) Congestion creates network constraints on dispatch and introduces volume risk and price risk and encouraging participants for disorderly bidding / skewed pricing. Once the bidders resort to disorderly bidding, the congestion revenue increases irrespective of market liquidity. Moreover, congestion rents become higher even when congestion is less due to panic bidding by buyer Therefore, the present congestion management regime in long run affects investment decision of new generators and consumers along with progressive loss of confidence of the participants in power exchanges.

(iv) GUVNL in its earlier letters to Government of India also suggested that amount collected in PSDF should be utilized for creation of sufficient inter-regional corridor

b) **Shree Cement Limited**- Shree Cement supports the proposed methodology and suggests that the Congestion Revenue may be distributed among the sellers and the buyers in the surplus region and the buyers and sellers in the deficit region. But PXIL should not be given financial assistance for developing new software. It is the responsibility of PX to develop and modify its software for which it is not required to have financial assistance from outside agencies.

c) **Central Power Distribution Company Andhra Pradesh Limited (APCPDCL) -** APCPDCL submitted that the funds funded by the market participants should be used in their region only. In the interim that systemic deficiency relating to congestion is being addressed, congestion rent should be re-allocated to as per proposed methodology in order to provide relief to the market participants from Congestion rent being collected.

d) **GMR Trading-** GMR Trading supported the mechanism proposed by PXIL by giving the following rationales:

(i) Buyers of the deficit region would benefit by paying lesser cost than the price discovered by the existing method.

(ii) Sellers of the surplus region would also benefit by getting better prices than those discovered by existing mechanism.

(iii) Discovering the market price by weighted average method would also result in even distribution of congestion fund between buyers and sellers in surplus and deficit markets**.**

Submissions against the proposed methodology:

a) **Indian Energy Exchange (IEX)**- IEX is not in agreement with the proposed congestion mechanism of PXIL citing the following rationales:

(i) Plough back the congestion revenue so generated because of congestion puts a big question mark on transparency of price signals emerging out of the market. It would result in post facto adjustment of the prices derived & this adjustment would result in a situation where a participant who was ready to pay more got excluded as compared to a successful participant who has effectively paid. Similar situation would arise in case of sellers as well. This will lead to following consequences:

a) Will compromise with transparency of the market which should be avoided at all costs.

b) Participants would tend to bid more aggressively, as they expect some amount would be paid back. This may increase prices derived in the market.

c) Price signals emanating from such arrangement would be distorted.

d) Funds which are available for investment in the congested corridor would not be available.

(ii) Returning back congestion revenue to the participants would be worse than the problem itself.

(iii) Internationally all Day Ahead Markets currently run congestion management through market splitting (or market coupling) as is being done by power exchanges in India. Examples: EPEX, Nordpool Spot and other European exchanges.

Suggestions by IEX:

(i) Entire transmission capacity after allocation to long term customers should be utilized in the Day Ahead Market and left over if any could be utilized by the bilateral contracts.

(ii) Alternatively, after allocation to long term customers, entire transmission capacity may be put on day ahead auction in a separate market which can be named as "Day Ahead Transmission Capacity Market". Exchange as well as participants in the bilateral deals can participate in such as segment and buy out the transmission capacity. Amount paid by the exchange for such transmission capacity can be apportioned by the Exchange on the participants on that date through a suitable mechanism. Funds generated through auction would be legitimately belonging to the owners of the transmission capacity who can utilize it for removing congestion under Regulatory supervision. This mechanism will not tinker with the existing Market Splitting methodology, which is serving us well by giving adequate price signals, as well as it will create level playing field between transactions on exchanges and bilateral transactions.

b) **Power Operation System Co. Ltd. (POSOCO):**

(i) Existing Market Splitting gives price signal as it reflects the true willingness to pay for the power required. This is not the case in the proposed mechanism.

(ii) The proposed mechanism will lead to market manipulation in terms of changed bidding behavior.

(iii) Location price signals also gets distorted in this methodology as there is no price differential between upstream and downstream area as weighted average price of the two or more sub markets is taken.

(iv) Internationally Market Splitting methodology is used for congestion management.

(v) Proposed methodology is a violation of the provisions of the Regulation 33(i) of the CERC Power Market Regulations 2010.

(vi) Congestion revenue generated out of the process of Market Splitting in the Power Exchange is to be utilized in accordance with the provisions of Regulation 33(ii) CERC Power Market Regulations 2010.

c) **National Power Exchange Ltd. (NPEX)-** NPEX does not support proposed methodology but suggested its own methodology for congestion management.

(i) Existing Congestion mechanism helps in simultaneous conclusion of trade and transmission capacity allocation (implicit auction) as well as continues to incentivize the marginal cost based bidding, efficiency and merit order dispatch on the two sides of the congested corridor. Also, this method results in location price signals for energy (generation/consumption), investment in transmission and indicates cost of congestion- which reflects the economic value of 'scarce' transmission service in competitive market.

(ii) The method proposed is not backed by any reference in the global context.

(iii) Analysis of correlation between bidding behavior and the prices and/ or congestion would require much more extensive and an independent study before reaching any conclusions.

(iv) NPEX agrees with PXIL that participants at power exchange in India are at a disadvantage as compared to Bilateral/ OTC transactions with regard to open access and payment of opportunity cost of congestion. This is a larger issue that needs careful attention for development of electricity market.

(v) TSO does not have any incentive to reduce congestion by augmenting the transmission capacity, persistent congestion coupled with volume risk is likely to result in a loss of confidence of market participants in an efficient platform like power exchange.

(vi) Actual market data from the operating exchange may be used by PXIL as example to explain the proposal.

(vii) No example has been considered where any sub area has an inflow of A MW on one side as well as out flow of B MW to other zones. The formula/ methodology proposed by PXIL cannot be applied directly to such cases.

(viii) Settlement Price being different from clearing prices, there will be far more "paradoxically rejected bids", not only for block bids, but also for single-interval bids. This aspect may be difficult to explain to the affected participants.

(ix) There would be multiple settlement prices for each area and the real 'locational signal' may be lost. In other words, there will be 'multiple price discovery' leading to confusing price signals.

Suggested Methodology by NPEX:

NPEX proposes that congestion revenue either to be utilized for network reinforcement or to be shared among market participants. There is a strong need for socializing the congestion amount among the participants through simpler methods.

(i) Congestion amount may be used first for compensating the PX for loss of transaction fee due to congestion.

(ii) It should be utilized next for offsetting the POC charges at a uniform rate for all the cleared PX participants. The rate can be calculated by dividing the congestion revenue by total volume cleared for respective contract interval.

(iii) Balance amount, if any, can continue to be deposited as being done at present.

(iv) All power exchanges should use a common methodology for market splitting and area price determination to maintain a level playing field for power exchanges and the participants.

Other Stakeholder Views:

a) **Tata Power Trading Corporation Ltd. (TPTCL) -** It compares the Bilateral and Collective Transactions priority issues by comparing it with PXIL views.

b) **M.P. Power Trading Co. Ltd. (MPPTCL)** - Requested for additional time as it has not received the copy of the Petition.

11. Petitioner also submitted the rejoinder on 14.5.2012 on the basis of the comments submitted by the various respondents.

12. Public Hearing on this matter was held on 28.2.2012 in which the Petitioner made a detailed presentation on the revised methodology. The petitioner highlighted the following points:-

a) Proposed methodology does not change the Market Clearing Price (MCP) or Market Clearing Volume (MCV) calculation methodology.

b) It maintains the economic locational & price signals and addresses the discrimination treated on the exchange participants as only exchange participants pay the congestion rent.

c) Power Market Regulations allows Exchanges to choose a congestion management methodology under Regulation 32(iv). The proposed method may not necessarily result in a congestion rent being generated but still retain the economic principles and equitable treatment for all participants. Hence the petition is maintainable under both Regulation 32(iv) and Regulation 33(i).

d) The petitioner also highlighted that the Power Exchange model and congestion management model adopted in India is from Nordpool while the transmission conditions are not similar. In Nordpool, the transmission corridor after allocation to long term contracts is fully available for power exchange transactions and hence congestion is not frequent. Also the congestion fund is used to strengthen transmission and relieve congestion. The model in India needs to be suitably modified to suit Indian conditions. The suggested methodology shall undertake the classical market splitting and arrive at prices in surplus and deficit region. However, the Final settlement price will be adjusted as Final Settlement Price = MCP (Market Clearing Price) + Transmission Charges & Losses +/- Congestion Rent. For all the cleared buyers in deficit region who are paying a higher price, the FSP will be lowered and for all the Sellers who are cleared in the surplus who are receiving a lower price, the FSP (Final Settlement price) would be increased. The congestion rent would be distributed on a weighted average predetermined formula. The congestion rent, which would have been created previously, is extinguished by evenly redistributing the financial burden between buyers of the deficit market and sellers of the surplus market. It also mentioned that CERC's Staff Paper on power exchanges issued in July 2006 had laid down this alternative. The presentation through a Frequently Asked Questions(FAQ) also addressed various issues raised by the respondents to the petition in their written submission to Commission and to Petitioner regarding the proposed methodology of Congestion Management of the Petitioner. On Commission's query on how equitability among participants will be ensured the petitioner responded that the basic market splitting methodology and MCP (which is the energy price) is not being changed in any way. It is only an adjustment in the Final Settlement Price which in any case is different for different participants due to different transmission charges, open access charges etc.

13. The views of the respondents during the public hearing held on 28.2.2012 are as follows:-

a) **IEX** as a respondent raised objections regarding the proposed methodology. IEX submitted that Regulation 11 of Power Market Regulation, 2010 shall be adopted while applying congestion management methodology and Market splitting methodology cannot

be changed till this regulation is amended since market splitting is defined in the regulation. Also Congestion revenue is a transmission rent to secure corridor by the participants and should not go back to participants. It should go to the transmission asset owner as that is the scarce resource. As per them, the methodology lacks transparency and is not equitable on a certain set of power exchange participants. It illustrated an example where say there are different sellers bidding at ₹4/unit, ₹3.9/unit and ₹3.8/unit respectively and the sell bid of ₹3.8/unit is selected being the lowest price. While calculating the Final Settlement Price (FSP) and returning congestion rent say ₹0.20/unit to the selected bid (₹3.8/unit) his effective price then becomes ₹3.80+ ₹0.2= ₹4.0/unit. This will be unfair on other bidders who bid at ₹3.90/unit and ₹4/unit as they would still not be selected. While this method is attempting to address equitability of PX with other market participants in short term market, it is creating discrimination among power exchange participants and will not be viable in the long run as the fundamental concept of transparency provided by the exchange will be lost. In double sided close bid auction which is an elegant mechanism and adopted in India leading marginal bidding by both buyers and sellers at (marginal utility and at marginal cost respectively) this will lead to speculative element in the bidding as participants would attempt to guess the congestion rent. IEX produced 95% of congestion revenue and is equally concerned with the Petitioner's concerns of transmission congestion and unequal treatment of Power Exchanges. It also proposed that there should be Public hearing, as it is a larger market design issue and how transmission corridor allocation between -MTOA, STOA, Day ahead is done needs to be addressed.

Petitioner in reply to the speculative bidding responded that it will be difficult for any participant to guess in which hour and how much congestion rent would be and that the FSP calculation formula would be transparently known to all the participants and hence market behavior would adjust to it and find its equilibrium. Hence there fear of speculation and transparency is unfounded. Petitioner also replied that though long term solution can be worked out but there is a grave issue presently which needs to be addressed.

b) **National Load Despatch Centre (NLDC)** submitted that locational price signals will be lost in the proposed methodology. They also agreed with the example illustrated by IEX and that seconded it will be unfair to certain set participants of the power exchange. According to them the proposed methodology will lead to higher price bidding by buyers and bidding behavior will change and lead to speculative bidding.

c) **National Power Exchange (NPEX)** submitted that Indian market is an evolving market and in other developed markets transmission congestion is handled through Financial Transmission Rights (FTR) Till such mechanism can be adopted in Indian context, the congestion amount can be used to reduce the POC charges for the participants cleared on PX or to compensate for the loss of revenue to the PX. In specific rebuttal to the proposed methodology it mentioned that the sanctity of the MCP would be lost as certain money is being given back post the price discovery and the participants are ultimately concerned with their net price realization.

d) **Madhya Pradesh Power Trading Corporation Ltd. (MPPTCL)** submitted that it needs more time to respond as it has received the petition late. It also proposed that it should be allowed to respond in a public hearing.

14. Staff of the Commission had a meeting with both operational power exchanges on 26.9.2012. The issue on the use of congestion revenue generated on account of market splitting at Exchanges and possible alternative ways to avoid collection of congestion revenue were discussed. It was agreed that the exchanges should submit their written suggestions. Accordingly, both Exchanges submitted their written submissions on the utilization of congestion revenue. Following are their views on the utilization of congestion revenue:-

a) <u>PXIL Submission</u>

In the event of congestion Exchanges have to put in additional effort to run process cycles, while at the same time being compelled to settle for lower amount of transaction fee due to curtailed volumes. It would therefore be in the fitness of things that Exchanges

be compensated for this incremental effort as also be incentivized to undertake the additional investments in technological systems, processes and related R&D in order to be able to respond to the changing dynamics imposed on the market by the shifting patterns of congestion. Therefore, a suitable fee as processing charge to the extent of 2-3% of the congestion fund collected could be considered to be given to the exchanges.

NLDC would also have to shoulder the incremental burden of improving capacity within the various participants in the market to understand these changes as also lead the implementation process on a nationwide basis. Significant amount of time and energy would also need to be invested on scientific studies, conducting events such as workshops, seminars to educate the sector about the effects of congestion and the best way to handle it. In order to incentivize the system operator to lead such initiatives with enthusiasm, it would be appropriate to pass on some component of the congestion fund to them as a separate amount which can be utilized by them for such purposes. A charge of 5% of the congestion revenue is proposed to be vested with NLDC for the above purpose.

PXIL proposed the following methodology:

(i) Congestion Revenue for a given day will be calculated.

(ii) Fess of Exchanges and NLDC for managing Congestion Revenue refund will be deducted.

(iii) The remaining Congestion Revenue will be adjusted against the transmission charges of the sellers in the surplus market and the buyers in the deficit market. If congestion revenue is not sufficient to meet the transmission charges of these set of buyers and sellers then the congestion revenue will be pro-rated according to volumes cleared for this set of participants and they will have to bear rest of their transmission charges. Rest of the participants will keep bearing whole of their transmission charges.

(iv) If congestion revenue is left in excess then, rest of the exchange participant's transmission charges will be adjusted against the remaining congestion revenue after above step. Now if congestion revenue cannot meet whole of their transmission

charges then the remaining congestion revenue will be pro-rated according to volumes cleared for this set of participants and they will have to bear rest of their transmission charges. On the other hand if some congestion revenue is still left then this set of funds can be distributed back to buyers in the deficit market and sellers in the surplus market.

In this way all the objectives will be achieved. It will benefit the participants who bear the brunt of congestion revenue and we will ensure that all of the congestion revenue is exhausted.

b) IEX Submission

IEX suggested that the congestion fund could be created in line with Road Development Fund, which can be utilized for the purpose of transmission capacity creation across perennially congested corridor. This will ensure utilization of Congestion amount for relieving the cause. May be surplus amount in the UI account and reactive energy accounts can also be transferred to this fund. However, operationalizing this may require more comprehensive administrative efforts to get a cabinet approval and approvals from other ministries like MoF etc. Alternatively, the congestion fund could be utilised in the following manner:-

(i) Presently, POWERGRID receives PoC charges from open access customers, which is same for LTOA, MTOA and STOA transactions as approved by CERC.

(ii) PoC charges payable by the participants on a particular day would first be met out of the congestion amount and only balance amount would be recovered from the participants. Thus, total transmission charges receivable by the POWERGRID would remain same whereas participants would be required to pay only differential amount. In case congestion revenue is more than total PoC charges than the surplus could be retained and utilized for charges of subsequent days.

(iii) In effect, POWERGRID will continue to receive same PoC charge, at the same time participants would get benefit in terms of reduced PoC charges. We may also consider utilizing these charges towards state transmission charges, operating charges etc. In that order, Exchanges may be allowed to collect small margining fee (of say 1-2%).

(iv) There will be no correlation between those who have contributed towards congestion revenue and those who have got benefitted from reduced PoC charges. Therefore, this method does not skew the price signals for the market participants and at the same time the congestion revenue gets disbursed to exchange participants and gives relief in terms of reduced transmission charges.

IEX had sent a copy of its suggestions to PXIL. PXIL's response to the above IEX suggestion is as follows:

IEX methodology does not exactly offset the congestion revenue generated. Following are the two different scenarios:

(i) **Scenario1**- Congestion revenue collected is more than the transmission charges paid by various participants. IEX suggests that in this case surplus could be retained and utilized for charges of subsequent day. With increase in instances of congestion and with more number of regions getting split there may be a possibility that congestion revenue collected is more than the cumulative transmission charges paid by exchange participants. In this case, congestion revenue utilization problem will again arise as rather than congestion fund diminishing it will again start burgeoning (may be at a smaller rate).

(ii) **Scenario 2-** Congestion revenue collected is less than the transmission charges paid by the participants. If enough funds are not available through accumulated congestion revenue then in this case, the participants will have to pay rest of the charges. IEX has not clarified how they propose to distribute these charges between

different participants. Pro-rating rest of these charges according to volumes cleared for each participant can be one option. Another option can be PXIL methodology mentioned in petition no. 180/2010, in the concept paper we have shown the adjustment of congestion revenue the form of changes in price paid by buyers in the deficit markets and sellers in the surplus markets. In reality our methodology refunds the buyers and sellers exactly the amount which they have contributed for the congestion revenue. Therefore, if we have to readjust the congestion revenue against the transmission charges paid by the various participants then PXIL methodology does a better job as it achieves this outcome by targeting the participants who have contributed in it.

Analysis and Decision

15. The Commission has carefully considered the proposed methodology and the reasoning for the same furnished by the petitioner in its various submissions. The Commission has also considered the view of the other respondents in the matter made through the written submission and the public hearing held on 28.2.2012. At the outset it may be relevant to summarize the current practice, and rationale and philosophy behind adopting current market splitting methodology. Power Exchanges are transparent and neutral platforms where price discovery happens competitively based on demand and supply of power in the day ahead market. This is through a double sided closed bid auction resulting with a uniform price discovery for all buyers and sellers in a particular bid area. The methodology leads to social welfare maximization by maximizing both consumer surplus and producer (suppliers) surplus simultaneously. The successful suppliers gain since all of them are paid the highest cleared supplier's price i.e. they get a price same or higher than what they have quoted, while the successful consumers gain since they pay a price equal to or less than what they were willing to pay. The process is run in 15 minute time blocks in a day and hence there are 96 prices discovered in a single day. This is represented graphically in Figure 1. The methodology aggregates the demand and supply of power for all bid areas (bid areas are pre determined and published by National Load Deaptach Centre based on import and export capability of aggregate of control areas. All generators and loads electrically located in the bid area get / pay the price of their respective bid areas in the day

ahead market) and attempt to clear it in the first iteration. In case there are no transmission constrains between different regions and bid areas, a single uniform price, termed as Unconstrained Market Clearing price, is discovered for all the bid areas But if a transmission constraint is encountered, the market splits up into regional markets or bid areas. The social welfare is still maximized with transmission constraint. This is achieved by solving it as a mathematical optimization problem with the given transmission constraint, and objective function as maximization of social welfare. The price discovered will differ in different bid areas and is based on transmission corridor availability (both import and export capability) in the bid areas and the demand and supply in the bid area. Figure 2 represents a scenario where there is no power flow between two regions due to transmission constraint and hence prices are different (Surplus area has lower prices and deficit area has higher prices). Figure 3 shows that with transmission availability and power flow between surplus an deficit region, the prices in the two regions start converging. When discovered prices are different in different regions/ bid areas, congestion revenue gets created. This is quantified as :

(Price in Deficit Bid Area – Price in Surplus Bid Area) X Constrained flow between the Surplus Area to Deficit Area which is represented in Figure 4

The methodology leads to increase in power transfer between surplus and deficit regions, increased trade, and convergence of prices across the regions. By combining various areas / regions, it provides additional market for generators in the surplus area, and likewise, brings extra supply to consumers in the deficit area. This results in increased power price for generators in surplus area and reduced price for consumers in the deficit area.

In summary, the current methodology is a simultaneous energy and transmission capacity auction (implicit transmission auction) resulting in security constrained merit order dispatch in all markets. It also provides locational price signal for energy (generation/ consumption), investment in transmission corridor and provides indicative economic value of scare transmission service in a competitive market.

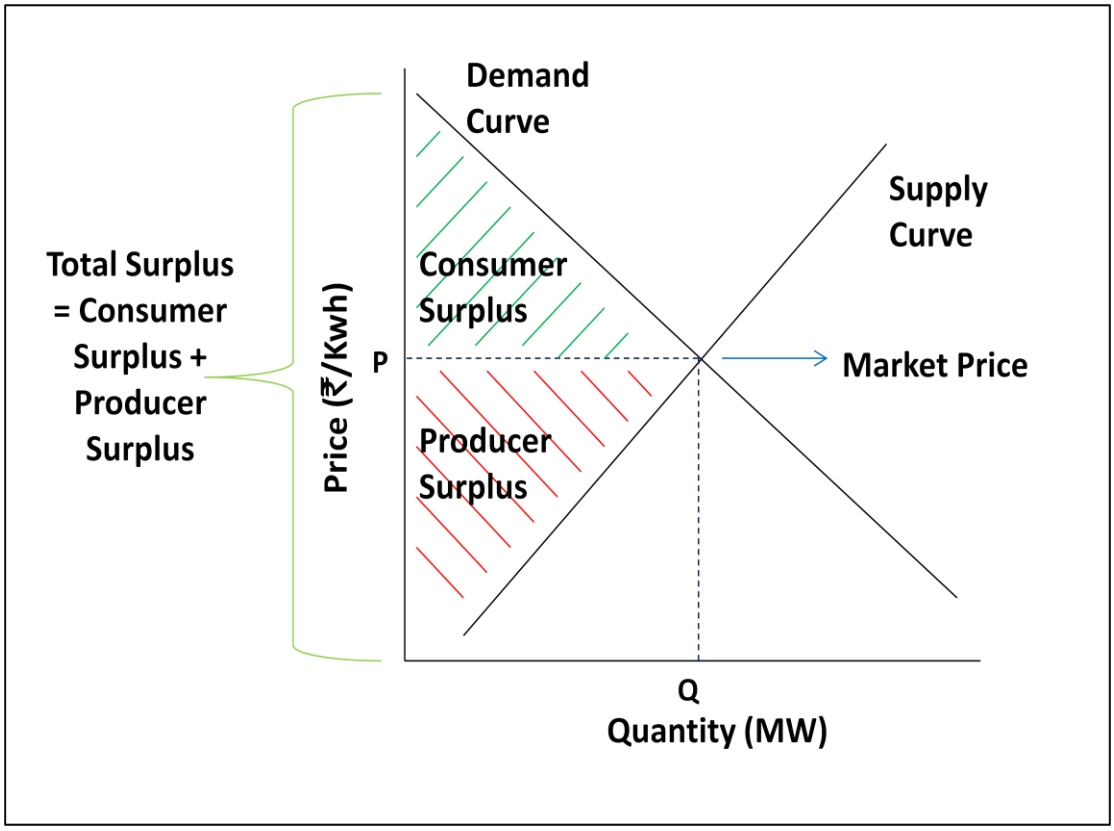

Figure 1: Double Sided Closed bid Auction with Uniform price leading to creation of Consumer surplus and Producer surplus

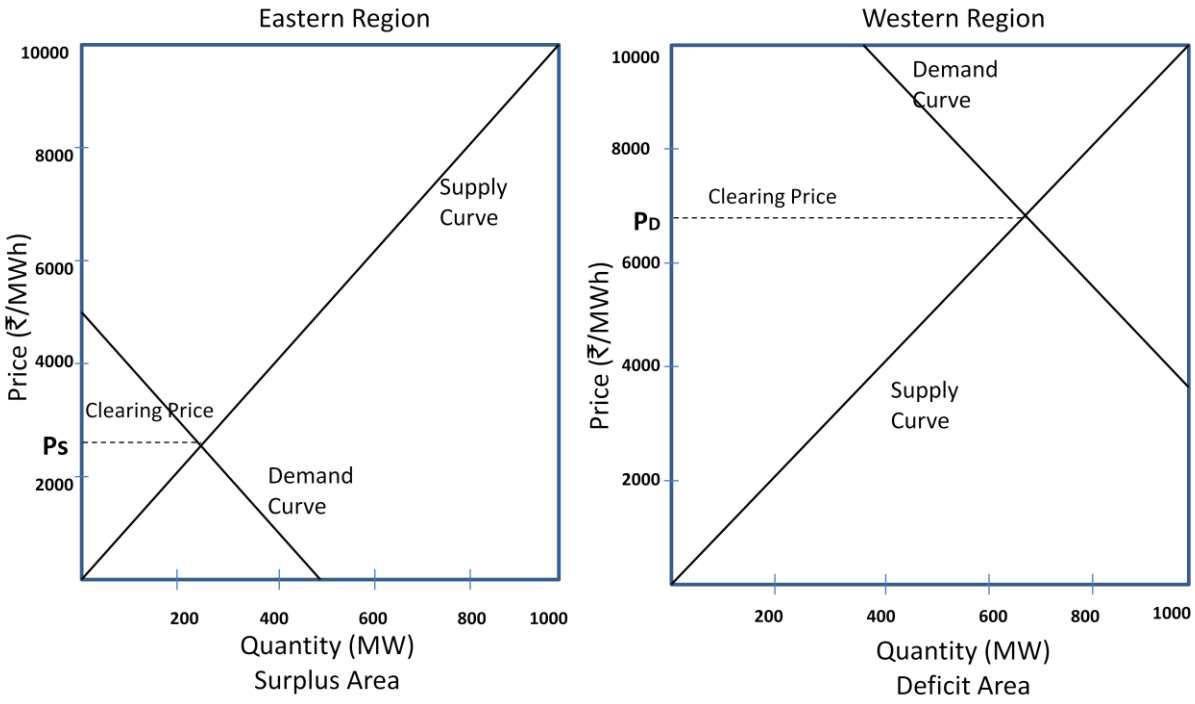

Figure 2: Two regions (Surplus and Deficit region) clearing separately, when No Transmission Corridor is available

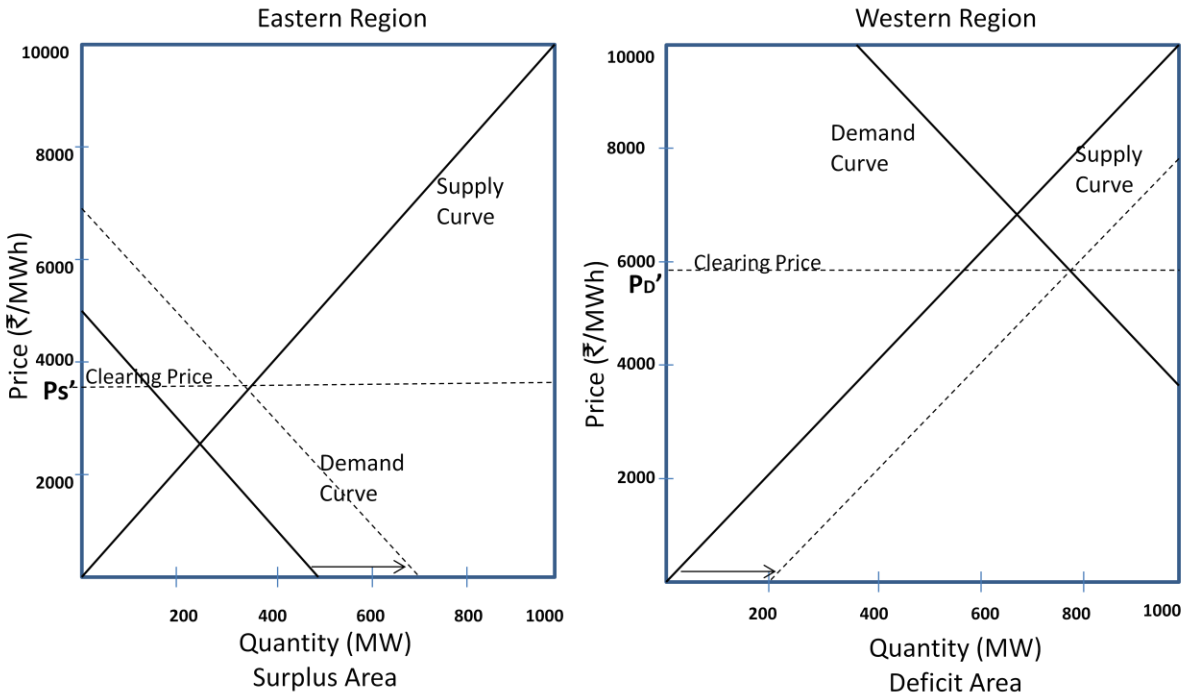

Figure 3: Benefit from availability of Transmission Corridor: Trade increases, Price Converge in the two regions

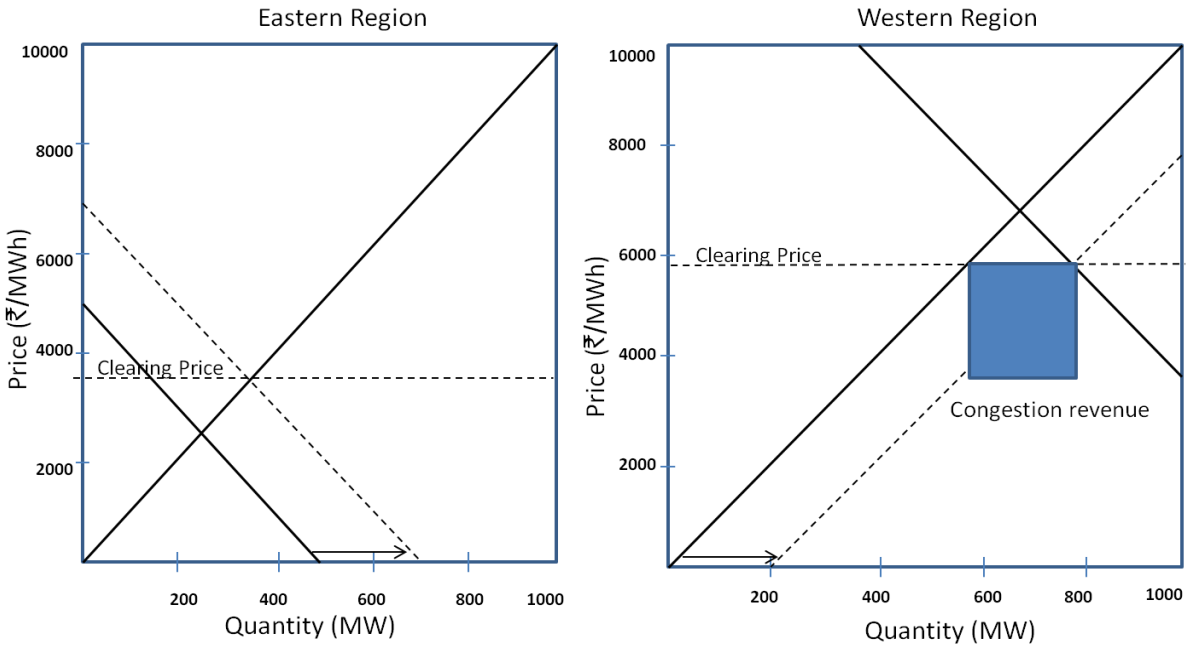

Figure 4: Creation of Congestion Revenue

16. The fundamental strength of the current price discovery mechanism used by the power exchanges is its transparency, neutrality and competitive price discovery. The market participants have faith in this methodology and perceive the exchanges to be a transparent, fair and neutral platform to all buyers and sellers. This perception has endowed significant credibility to these institutions. Any modification in the price discovery methodology should pass the test of transparency, fairness, neutrality towards all market participants.

17. The technical analysis and review of the modifications suggested by the petitioner is as follows:

a) As has been described in the preceding paragraphs, the present price discovery methodology is based on basic principle of microeconomics i.e. intersection of demand and supply curve representing the price at which demand and supply quantities are in

equilibrium. The supply curve reflects the marginal cost of generators whereas the demand curve reflects the marginal utility of consumers. The modification suggested by the petitioner disturbs this equilibrium. The impact of refund of congestion amount to the buyers in the deficit area and sellers in surplus area is akin to a subsidy in a market , and in principle, information on this should be available to all buyers and sellers in advance for the market to function optimally. The moment a subsidy (refund in this case) is introduced in a market in equilibrium, supply or demand curve shifts, depending on who is given subsidy. Figure 5 and 5.1 illustrates the impact of subsidy on supply side only (to generators where the supply curve shifts from S to S' or S1 to S1' or S2 to S2'), demand side only (to buyers where the demand curve shifts from D to D' or D1 to D1' or D2 to D2'), and to both demand and supply side. The change in price would dislocate the equilibrium point. The market clearing price could be higher or lower than the earlier price depending upon the slopes (elastic or inelastic) of demand and supply curves. In all cases, subsidy alters the discovered price, as well as quantities demanded and supplied. Which means, composition of buyers and sellers may also change with the new price and quantities. Though introduction of advance information on refund (with amount specified) will still lead to market equilibrium, the refund information in the suggested methodology is generated only after market clears. Since refund is proposed post price discovery (with no information to market participants), it affects the market in two ways; one the transaction price is no more the market discovered price, and second by influencing the behavior of market players through anticipated refund (a subsidy). Overall effect is distortion of market. While the petitioner may claim that the price discovery would not get altered and these payment are only a matter of final settlement price calculation, the fact is that the effective price of the buyers in the deficit region and sellers in the surplus region is no more that was discovered by the market.

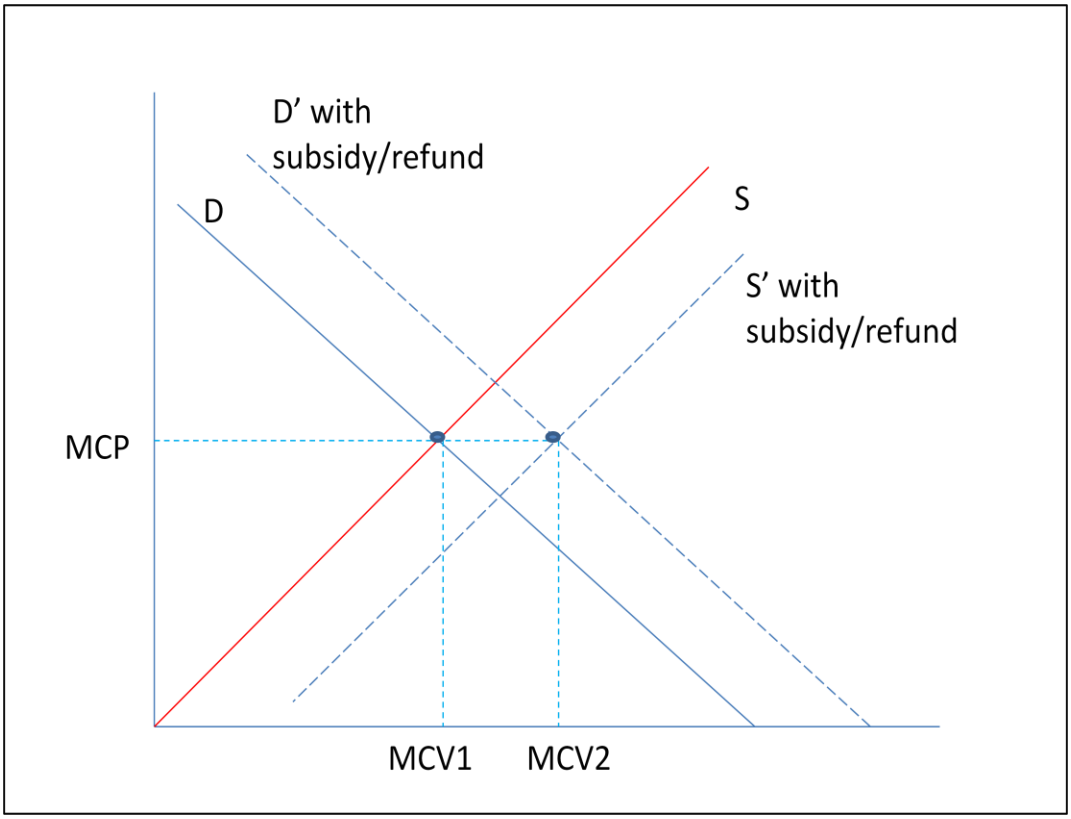

Figure 5: Impact of subsidy (refund in this case) in a market leading to change volume when both demand and supply are perfectly elastic

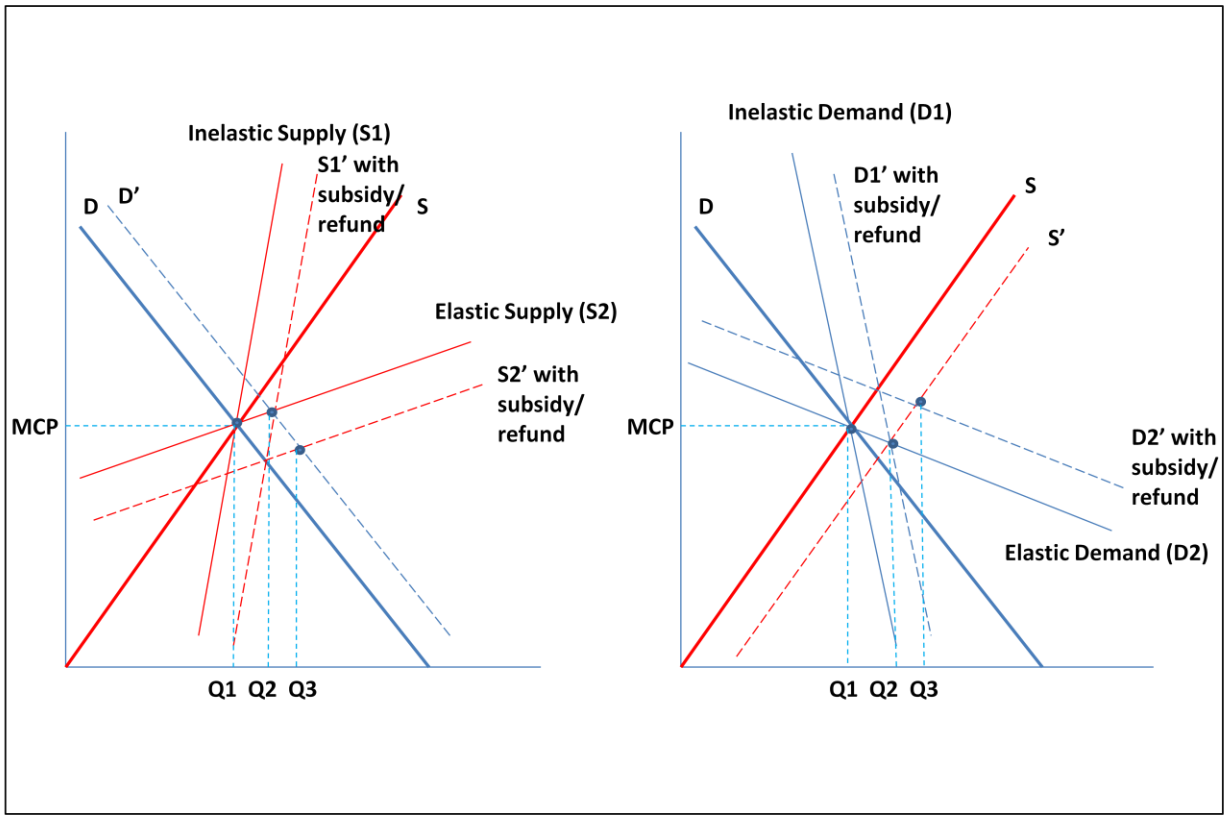

Figure 5.1: Impact of subsidy (refund in this case) in a market leading to change in price and volume when demand and supply are elastic or inelastic

b) It is obvious that buyers in deficit region and sellers in surplus region will welcome refund of any congestion amount, as it would increase their revenue realization. Hence they would favour any methodology which serves this end. The question is; is it in consumer and supplier's interest if successful market participants are refunded some money? Will it be fair and equitable to all the market participants?

Two sets of participants; "successful participants" and "would have been successful participants" emerge in this case. This is illustrated in the example in Figure 7:

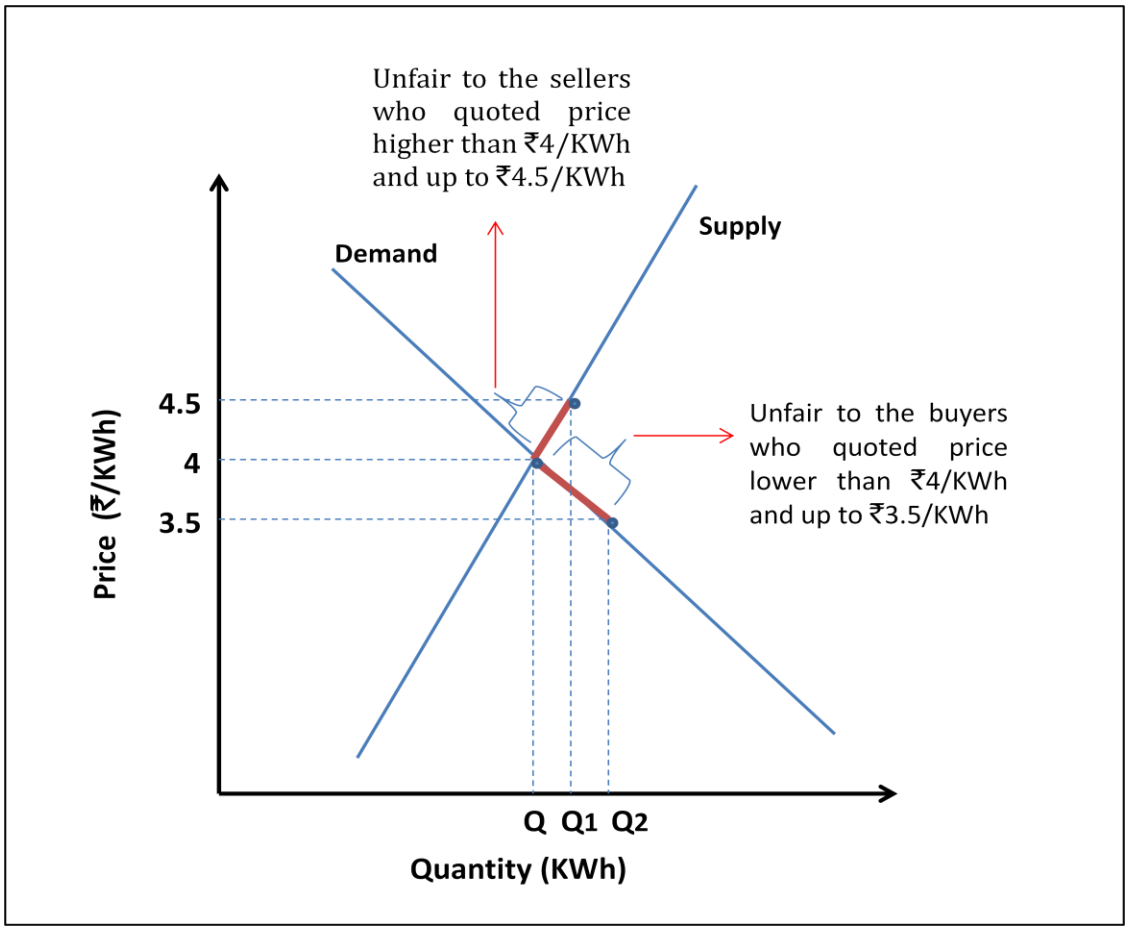

Figure 6: New Demand and Supply prices with new methodology

(not in equilibrium)

There would be some unsuccessful buyers who would have quoted lower than the present successful buyers but still quoted higher than the effective price paid by the successful buyers post refund. The point is explained more vividly through the below example:

- Market Price discovered = ₹4.00/ Kwh
- Congestion Revenue to be refunded to all successful buyers in congested region= ₹0.50/Kwh
- Hence ,effective price for successful buyers = ₹3.50/Kwh

In this case, the buyers who quoted above ₹3.50/Kwh but lesser than ₹4.00 /Kwh were not selected, since their price was lower than the discovered price of ₹

4.00/Kwh. However, the effective buying price of the successful buyers now being ₹ 3.50/ Kwh, it is unfair to the buyers who had quoted in the range of ₹3.50/Kwh to ₹4.00/Kwh.

Similarly on the supply side, there would be a set of unsuccessful sellers, who were not selected initially due to their bid price being higher than the price discovered in the market, but would have quoted lower than the effective price received by the successful sellers (after refund of congestion amount).

Hence the post facto adjustment as suggested in the methodology does not pass the test of equitability, fairness, neutrality and transparency.

c) While the suggested methodology by petitioner fails the test of fairness and transparency, the refund also has other negative effect on the price discovery process. Economic and Game Theory literature clearly suggests that the dominant strategy of bidding in a closed bid auction is truthful marginal cost bidding. Introduction of congestion refund methodology introduces an unknown parameter (refund) in the competitive market, and since it is an important decision-making parameter for market participants, it violates the pre-requisite for a competitive market (transparency and full information).It influences the behaviour of market participants, who are forced to estimate the expected congestion revenue and expected refund to be able to make their best bid. This would lead to more aggressive bidding by suppliers. Similarly, buyers would tend to quote higher prices. Extending this logic by the theory of Efficient Market Hypothesis, and assuming that all market participants have similar information, and hence will be able to predict expected congestion refund equally well, would then adjust their bids accordingly and the demand and supply curve would shift as explained in the subsidy illustration. Eventually, some of the current successful participants may be unsuccessful, or suffer, depending on deviation of actual refund from their estimate- more the deviation from their estimate, more they would suffer. Also the bidding would have moved from marginal cost bidding to a more complex bidding process where marginal cost, congestion refund are linked. This would vitiate the price discovery process and as a consequence distort the price discovered. It is relevant to mention here

that the prices discovered in the power exchange are now well accepted and benchmark prices for day ahead markets.

d) From an economic utility standpoint market splitting provides locational price signal for energy (generation/ consumption), investment in transmission corridor and provides indicative economic value of scare transmission service in a competitive market as stated above. While the proposed methodology of the petitioner would continue to calculate the bid area prices across the country, the effective price for certain set of consumers and generators would change in the post price discovery final settlement process. Also the bidding strategy for the market participants would change in anticipation of refund of congestion amount. These would lead to dilution of prices signals for emanating out of the day ahead price discovery process.

e) From the point of view of international best practices, the present methodology adopted is well established, time tested and being used in several leading European Power Exchanges. While adaptation to Indian market condition is an issue, which needs to be examined from corridor allocation priority perspective, it is felt that deviation from the well tested methodology has to be on very sound and strong technical footing.

f) There have been suggestions by both power exchanges PXIL and IEX to utilize the congestion fund for adjustment for transmission charges of the markets participants. As explained, PXIL (the petitioner) has suggested it should be adjusted against the transmission charges of the deficit region buyers and seller in surplus market, while IEX has suggested that it should be used to adjust the transmission charges for all the participants of power exchange. Both these suggestions are indirect means of refunds though in a different form i.e. through reduction of transmission charge. The fallout of reduction of transmission charges for all the exchange participants will be that the buyers in the deficit region would be cross subsidizing transmission charges of all the other exchange participants.

18. As far as present condition of transmission congestion is concerned, it is observed from the transaction data on power exchanges for the last few months, that congestion occurs mostly in SR to New Grid corridor, Chhattisgarh (W3) export corridor, Punjab (N3) Import, ER – NER Corridor. While congestion is a dynamic phenomenon and changes based on nature of load, seasonal pattern, agricultural demand it is prudent to be mindful of the pattern and use the information in transmission planning. As a part of set procedures, POSOCO informs the transmission planning division at CEA about the above transmission congestion phenomenon on a periodic basis. On the infrastructure development front, the SR – New grid integration is expected to be completed by January 2014. This will reduce transmission congestion to SR region. There are several generation plants in advanced stages of Commission in SR region. These shall also help to reduce congestion.

19. From power market design standpoint, a mix of long term contracts and short term contracts is required in any market due to inherent advantages and disadvantages of different types of contracts. It is well accepted that transmission congestion, high prices, price volatility are inherent features of day ahead markets and the market participants are well aware of these risks, its consequences when they choose to participate in the power exchange day ahead markets. The participants have the option of contracting long term power to immune themselves from these risks if they so desired. It is relevant to point out that power exchanges are voluntary platforms.

20. Having said that, the Commission is aware that the congestion is being faced mostly by the Power Exchange participants by the virtue of being allotted transmission corridor last in the priority of transmission corridor allocation which are guided by the principles laid in Grant of Connectivity, Long Term Access and Medium Term Open Access in interstate Transmission and related matters Regulation 2009 and Open Access in Inter State Transmission Regulation 2008. It is a considered view that Long term open access contracts should get highest priority in transmission corridor allocation since these customers through their long term commitment to transmission tariff provide funding for building transmission lines. Thereafter, medium term open access customers followed by short term open access customers are allotted corridor. The

day ahead power exchanges are provided corridor once the requirement of the above mentioned customers has been met. Power Exchanges have raised this issue at several fora. This has been one of the drivers triggering the suggested modification by the petitioner.

21. At this juncture, the Commission would stress that market splitting methodology is intended to provide price signals for identification of transmission lines where congestion is occurring and ideally congestion amount accruing through market splitting mechanism should be used to address the reasons which cause the congestion. This entails investing the fund in creation of new transmission assets or investing the fund on low investment - high yield projects like reactive energy compensation, shunt-series reactors for voltage profile improvement. This would be the optimum utilization of the fund and in the interest of the market participants in the long run. Various other means for utilization of congestion fund apart from creation of transmission asset have been prescribed in the Power Market Regulation and Power System Development Fund (PSDF) Regulation, 2010.

22. In light of the above analysis and discussion which brings out clearly that the suggested methodology by the petitioner will not address the issue of congestion fund creation efficiently, and on the other hand will distort the market , the Commission is of the view that the present price methodology in the day ahead market should continue. The Commission is not inclined to change a well settled classical market splitting methodology. While principle and priority of the issue of transmission corridor allocation between long term, medium term and short term is well settled, the Commission acknowledges that the short term market design with respect to transmission corridor allocation can be further improved with a more holistic approach towards transmission corridor allocation. The Commission directs the staff to undertake study on various options for equitable transmission corridor allocation among all short term market participants including expanding the scope of ebidding mechanism stipulated under Short Term open access Regulations to include Power Exchanges or the participants on the Power Exchange. A discussion paper for stakeholder consultation covering different alternatives should be published. We realize that is a complex matter and a common ground for diverse participants needs to be

arrived at in good faith taking into account concerns and interest of all the parties and consistent with public interest for the development of power market.

23. The second prayer of the petitioner related to waiver to petition fee and grant of financial support for software development so as to bring down the price of electricity for consumers. The petition filing fee is miniscule in comparison to the transaction value of electricity traded on power exchange and is towards covering the cost of operations of the regulatory commission. Software development cost is a part of the internal business operations of the exchange and hence finances have to be garnered through exchanges internal resources. Hence the prayer is not acceptable.

24. The matter is disposed of with above directions.

sd/-	sd/-	sd/-
(M Deena Dayalan)	**(V. S. Verma)**	**(Dr. Pramod Deo)**
Member	**Member**	**Chairperson**