Regulatory Update, Issues and Challenges: PoC Mechanism in India

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Puneet Chitkara, Principal

Agenda for Discussion

- How has the implementation of the PoC tariff regime progressed so far?
- What have some of the challenges been faced?
- What are the recent regulatory developments and how have they impacted different stakeholders?

Progress of Implementation

- Two Years since implementation
  - First year required removing difficulties in implementation of CERC (Sharing of inter-state transmission charges and losses) Regulations, 2010
  - Amendments were made essentially to redefine
    - “Approved Injection”,
    - “Approved Withdrawal”,
    - “Non-ISTS assets”
    - Criteria for Injection Zones
    - Criteria for Demand Zone in NER
  - Slabbing of PoC charges
- Pending Issues

“Rates” and “Charges”: An Important Distinction

- “Charges” for each node are directly available from the output of the model
- “Charges” are converted into rates by dividing them by LTA Generation or Demand
- Ideally “Rates” should be computed using the injections/demand in the model itself
  - This deviation causes distortion, e.g.:
  - For Uttar Pradesh (Demand)
    - Total Charges to be recovered are: Rs 64,34,58,135 per month
    - Demand used in Load Flow: 6981 MW
    - Rate according to the Model: Rs 92,173 per MW per Month
    - Demand (LTA): 5195 MW
    - Rate according Demand (LTA): Rs. 123857 per MW per Month

First Level of Distortion is caused here…

Do “Rates” really need to be distorted in practical applications?

- “Rates” need not be distorted
  - Zonal rates can ideally be computed directly from “Injections” and “Demand” used in the Load Flow Analysis
  - Charges are computed by multiplying the “Rates” by “Approved Injections” and “Approved Withdrawal”
    - Since these “Approved Injections” and “Approved Withdrawals” are based on LTA / (Capacity – Aux Cons) in some cases, total collection for ISTS differs from what is actually required
    - This is acceptable and bound to happen – Examples – UK, Australia – where explicit adjustments are made to ensure complete recovery
    - Adjustment of “Rates” is traditionally done at this stage by scaling up or scaling down to meet the ARR requirement of the ISTS network (scaling up is to the extent of approximately18% in NEW Grid)

Why are the “Rates” not acceptable sometimes in India?

- Sometimes “distortion” happens more than what is minimally required in practical applications because of:
  - Each ISTS 400 kV generation node is a zone, even though the network has other state 400 kV nodes also
    - Is it difficult to identify how much “network” do some generators located at state 400 kV nodes utilize?
  - For “Demand” – there is a huge difference between “Demand” used in Load Flow and “Approved Withdrawal” , e.g., the case of UP above, also Uttarakhand – where the Load Flows indicate an injection of only 326 MW from Roorkee, Rishikesh and Kashipur, but LTA considered is only 764 MW

Scaling-up is upto 18% in NEW grid and approximately 39% in SR…
This scaling causes distortions in “signals”. There are ways to avoid this

Overcharging?

- ISTS Network owners cannot recover more than there ARR
- Transmission tariffs have gone up due to new investments
- Hence No Complaints on account of this… All this can be explained

Concerns of DICs

- Concerns of Generators addressed considerably by the Commission
  - Except, inclusion of generators connected in the state networks… *Generators connected with ISTS are subsidizing their competitors*
- Concerns of States are yet to be addressed
  - "We use much less of the ISTS, why are we being charged so high"?
  - "Flows from our network wheels into the other states" – Are we being compensated?
  - Are the states being compensated reasonably for their assets?
  - New investments in the state which may carry inter-state power – *SERCs have declined to approve such investments*

Solution 1: Capture Utilization of the State Lines and Compensate the States

- Uttar Pradesh asked for approval for 18 lines. Approval of lines at 132 kV not granted
- Further, even the list given by UP was not complete, for example Anpara-Unnao, 765 kV line, 409 km, which as per the computations, is used to the extent of up to 69.46% by either ISGS or Loads located in other states.
  - This is a costly line and currently the consumers of Uttar Pradesh are paying for it
  - This line is critical for carrying power from not only power plants in eastern UP, but also, from Tala, Kahalgaon, Farakka etc
- Similarly Agra-Unnao, 400 kV line – 274.8 km line – is a costly line and is being used up to 77.95% by either ISGS or loads in other states

There are many examples of such lines not only in UP but in other states also

Both these lines could give a revenue of INR12 Cr to UP per month

Suggestions based on above

- It is fairly straight forward to compute percentage utilization of state lines based on the output of the model (UP Example)
- There is no reason that a line should be declared as ISTS line if it carries 50% inter-state power
  - State-owned lines carrying 40% power or even 5% power can be very critical for reliable and secure system operation
  - AND as shown above it is possible to capture % utilization by ISGS or demand outside the state

This will considerably help the states, especially intervening states like UP, MP, Maharashtra, West Bengal in NEW Grid and Andhra Pradesh and Karnataka in SR – who have considerable network of their own

Solution 2: Can the network Utilization by generators connected in the state network be computed?

- Even on the truncated network, it is possible to compute network utilization by any generator
- Example – Next Slide

Based on the data for Andhra Pradesh – Network Utilization is as follows

Bus Name	Owner	Area	Zone	Generator PoC (Rs./MW)	Load PoC (Rs./MW)	Generation (MW)	Load (MW)	Generation Nodal Charges (Rs)	Demand Nodal Charges (Rs)
BOOTHPUR	AP_ISTS	AP	AP	0	59309	0	138	0	8184704
BPLPALLI	AP_ISTS	AP	AP	26300	0	393	0	10335993	0
CHITOOR4	AP_ISTS	AP	AP	0	79899	0	220	0	17577754
CHNKMPLY	SR_CTU	SR_CTU	AP	0	60065	0	123	0	7387968
CNP-FSC1	SR_CTU	SR_CTU	AP	0	0	0	0	0	0
CNP-FSC2	SR_CTU	SR_CTU	AP	0	0	0	0	0	0
DICHIPLY	AP_ISTS	AP	AP	0	38[illegible]	0	34	0	352[illegible]
GAJWEL	AP_ISTS	AP	AP	0	21078	0	25	0	[illegible]
GAUTAMI	AP_ISTS	AP	AP	40018	0	410	0	16407440	0
GHANAPUR	SR_CTU	SR_CTU	AP	0	24612	0	578	0	14225830
GMR	AP_ISTS	AP	AP	40176	0	304	0	12213580	0
GOOTY	SR_CTU	SR_CTU	AP	0	45001	0	183	0	8235161
JEGRUADU	AP_ISTS	AP	AP	40165	0	140	0	5623108	0
KALPAKKA	AP_ISTS	AP	AP	0	731	0	210	0	153454
KHAMMAM	SR_CTU	SR_CTU	AP	0	1[illegible]	0	97	0	1585192
KONSEEMA	AP_ISTS	AP	AP	40037	0	350	0	14013089	0
KTPS	AP_ISTS	AP	AP	34520	0	400	0	13808048	0
KURNOOL	AP_ISTS	AP	AP	0	37845	0	345	0	13056556
LANCO4	AP_ISTS	AP_ISGS	AP	39089	0	350	0	13681072	0

These numbers reflect utilization of ISTS by these generators, but if there sale is to the home state only, these generators will not be charged for use of ISTS as per this amendment

Moreover, these charges are for the levels of injections (in column 7) and the rates should be as indicated in column 5

Implications of non-inclusion of such state generators

- The scaling-up in Andhra Pradesh was required up to approximately 39%
- This has resulted in increased charges elsewhere – causing a perception of something “unfair” about the process – because reality of the system does not justify high charges and the high charges are just accounting adjustments
- As agreed earlier – such accounting adjustments are necessary even in developed nations where such mechanisms have been implemented – but these should be minimized if possible

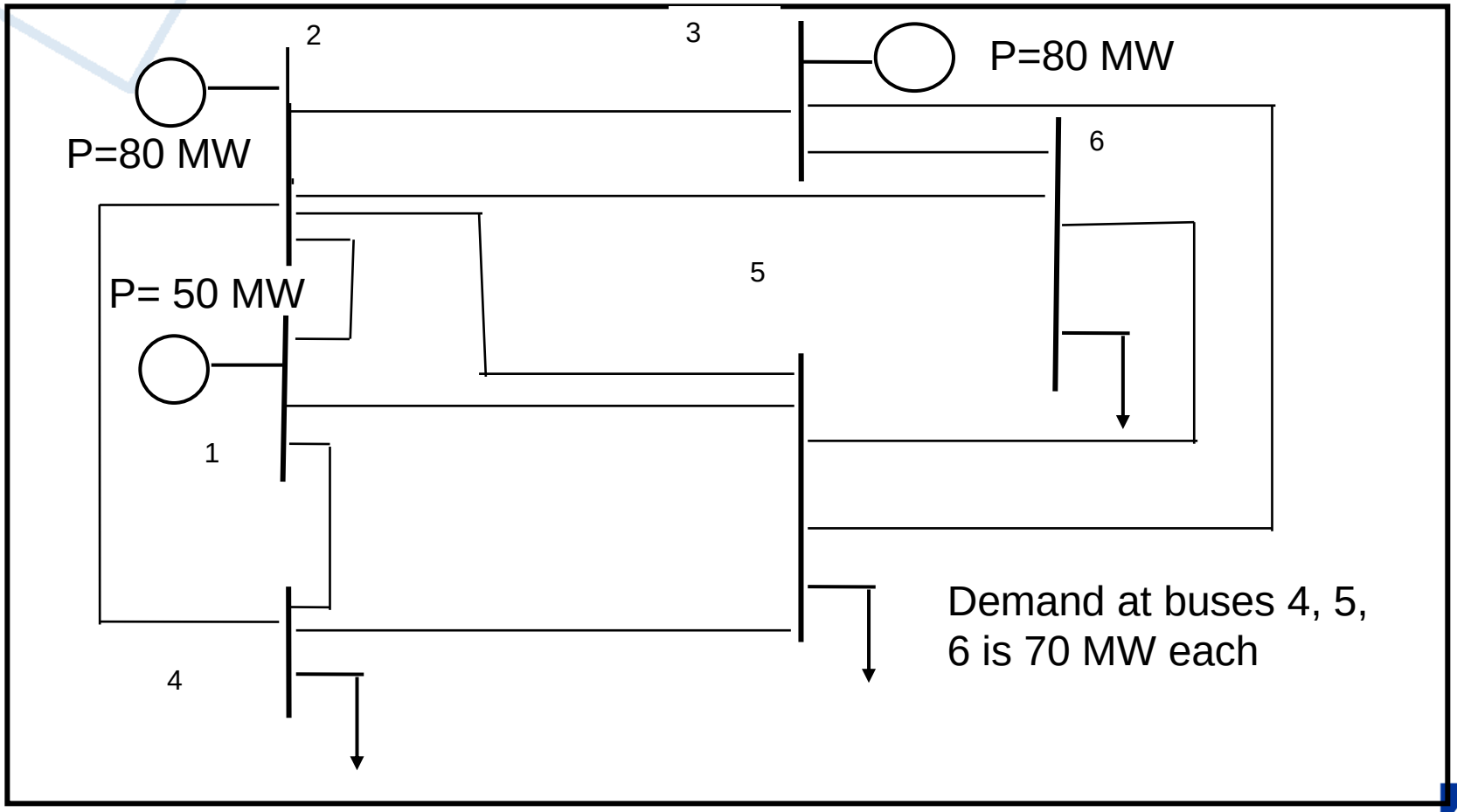
Inclusion of such charges on these generators could have prevented the need for such a high “scale-up” factor

PoC rates for 2011-12 v/s PoC rates for 2012-13

- There is definitely an improvement – the tariffs are much more reflective of network realities
- An important factor has been categorization of each 400 kV node where a generator is connected as an injection zone
- However, there are still a few concerns – which will be smoothened as we learn and move ahead

Thank You

6 Bus Example



6 Bus Example: An implementation of MP Method

- Base Case Line Flows
- Line flows with 1 MW increment / withdrawal at Generation / Demand Buses

	Line 1-2	Line 1-4	Line 1-5	Line 2-3	Line 2-4	Line 2-5	Line 2-6	Line 3-5	Line 3-6	Line 4-5	Line 4-6
Base Case	0.025	-0.3	-0.225	0.0875	-0.325	-0.25	-0.2875	-0.3375	-0.375	0.075	-0.0375
G1	0.0219	-0.3033	-0.2286	0.0868	-0.3253	-0.2506	-0.289	-0.3374	-0.3758	0.0747	-0.0385
G2	0.0265	-0.3008	-0.2257	0.086	-0.3274	-0.2522	-0.2899	-0.3382	-0.3758	0.0751	-0.0376
G3	0.0257	-0.3008	-0.2249	0.0906	-0.3265	-0.2506	-0.2878	-0.3411	-0.3783	0.076	-0.0372
D4	0.0257	-0.3031	-0.225	0.0886	-0.3288	-0.2506	-0.2873	-0.3392	-0.376	0.0781	-0.0367
D5	0.0253	-0.3006	-0.227	0.0878	-0.3259	-0.2523	-0.2882	-0.3401	-0.376	0.0736	-0.0359
D6	0.0244	-0.3006	-0.2262	0.0874	-0.325	-0.2506	-0.2911	-0.338	-0.3785	0.0744	-0.0405

6 Bus Example

- Differences in Line Flows

	Line 1-2	Line 1-4	Line 1-5	Line 2-3	Line 2-4	Line 2-5	Line 2-6	Line 3-5	Line 3-6	Line 4-5	Line 4-6
G1	-0.0031	0.0033	0.0036	-0.0007	0.0003	0.0006	0.0015	-0.0001	0.0008	-0.0003	0.001
G2	0.0015	0.0008	0.0007	-0.0015	0.0024	0.0022	0.0024	0.0007	0.0008	0.0001	0.0001
G3	0.0007	0.0008	-0.0001	0.0031	0.0015	0.0006	0.0003	0.0036	0.0033	0.001	-0.0003
D4	0.0007	0.0031	0	0.0011	0.0038	0.0006	-0.0002	0.0017	0.001	0.0031	-0.0008
D5	0.0003	0.0006	0.002	0.0003	0.0009	0.0023	0.0007	0.0026	0.001	-0.0014	-0.0016
D6	-0.0006	0.0006	0.0012	-0.0001	0	0.0006	0.0036	0.0005	0.0035	-0.0006	0.003

6 Bus Example

Computation of the total change in line flows: Multiply change in flows with total MW injected

	Line 1-2	Line 1-4	Line 1-5	Line 2-3	Line 2-4	Line 2-5	Line 2-6	Line 3-5	Line 3-6	Line 4-5	Line 4-6
G1	-0.155	0.165	0.18	-0.035	0.015	0.03	0.075	-0.005	0.04	-0.015	0.05
G2	0.12	0.064	0.056	-0.12	0.192	0.176	0.192	0.056	0.064	0.008	0.008
G3	0.056	0.064	-0.008	0.248	0.12	0.048	0.024	0.288	0.264	0.08	-0.024
D4	0.049	0.217	0	0.077	0.266	0.042	-0.014	0.119	0.07	0.217	-0.056
D5	0.021	0.042	0.14	0.021	0.063	0.161	0.049	0.182	0.07	-0.098	-0.112
D6	-0.042	0.042	0.084	-0.007	0	0.042	0.252	0.035	0.245	-0.042	0.21

6 Bus Example

All flow which decongest the network set to zero

	Line 1-2	Line 1-4	Line 1-5	Line 2-3	Line 2-4	Line 2-5	Line 2-6	Line 3-5	Line 3-6	Line 4-5	Line 4-6
G1	0	0.165	0.18	0	0.015	0.03	0.075	0	0.04	0	0.05
G2	0.12	0.064	0.056	0	0.192	0.176	0.192	0.056	0.064	0.008	0.008
G3	0.056	0.064	0	0.248	0.12	0.048	0.024	0.288	0.264	0.08	0
D4	0.049	0.217	0	0.077	0.266	0.042	0	0.119	0.07	0.217	0
D5	0.021	0.042	0.14	0.021	0.063	0.161	0.049	0.182	0.07	0	0
D6	0	0.042	0.084	0	0	0.042	0.252	0.035	0.245	0	0.21
Sum	0.246	0.594	0.46	0.346	0.656	0.499	0.592	0.68	0.753	0.305	0.268

6 Bus Example

Marginal Participation Factor of generation / demand at each bus

ARR (Rs/hr)	7488.584	7488.584	7488.584	7488.584	7488.584	7488.584	7488.584	7488.584	7488.584	7488.584	7488.584
	Line 1-2	Line 1-4	Line 1-5	Line 2-3	Line 2-4	Line 2-5	Line 2-6	Line 3-5	Line 3-6	Line 4-5	Line 4-6
G1	0.00%	27.78%	39.13%	0.00%	2.29%	6.01%	12.67%	0.00%	5.31%	0.00%	18.66%
G2	48.78%	10.77%	12.17%	0.00%	29.27%	35.27%	32.43%	8.24%	8.50%	2.62%	2.99%
G3	22.76%	10.77%	0.00%	71.68%	18.29%	9.62%	4.05%	42.35%	35.06%	26.23%	0.00%
D4	19.92%	36.53%	0.00%	22.25%	40.55%	8.42%	0.00%	17.50%	9.30%	71.15%	0.00%
D5	8.54%	7.07%	30.43%	6.07%	9.60%	32.26%	8.28%	26.76%	9.30%	0.00%	0.00%
D6	0.00%	7.07%	18.26%	0.00%	0.00%	8.42%	42.57%	5.15%	32.54%	0.00%	78.36%

6 Bus Example

- Computation of transmission charges at each node

	Line 1-2	Line 1-4	Line 1-5	Line 2-3	Line 2-4	Line 2-5	Line 2-6	Line 3-5	Line 3-6	Line 4-5	Line 4-6	Rs/hr	Rs/ kW/ hr
G1	0.00	2080.16	2930.32	0.00	171.23	450.22	948.72	0.00	397.80	0.00	1397.12	8375.57	0.17
G2	3652.97	806.85	911.65	0.00	2191.78	2641.26	2428.73	616.71	636.48	196.42	223.54	14306.40	0.18
G3	1704.72	806.85	0.00	5367.54	1369.86	720.34	303.59	3171.64	2625.48	1964.22	0.00	18034.24	0.23
D4	1491.63	2735.73	0.00	1666.53	3036.53	630.30	0.00	1310.50	696.15	5327.94	0.00	16895.32	0.24
D5	639.27	529.50	2279.13	454.51	719.18	2416.16	619.83	2004.30	696.15	0.00	0.00	10358.02	0.15
D6	0.00	529.50	1367.48	0.00	0.00	630.30	3187.71	385.44	2436.52	0.00	5867.92	14404.87	0.21