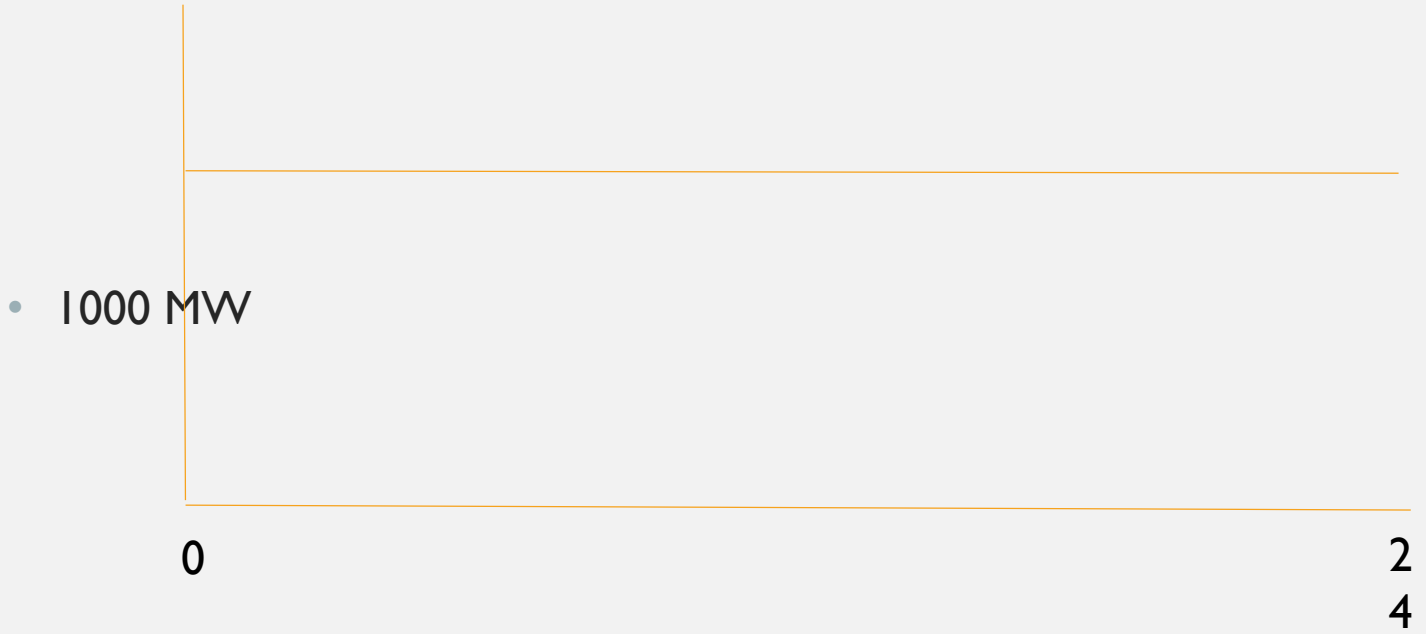# FINANCIAL IMPACT ON EXISTING THERMAL POWER PLANTS FOR BALANCING INTERMITTENCY OF RENEWABLES

Pankaj Batra

Member (Planning),

Central Electricity Authority
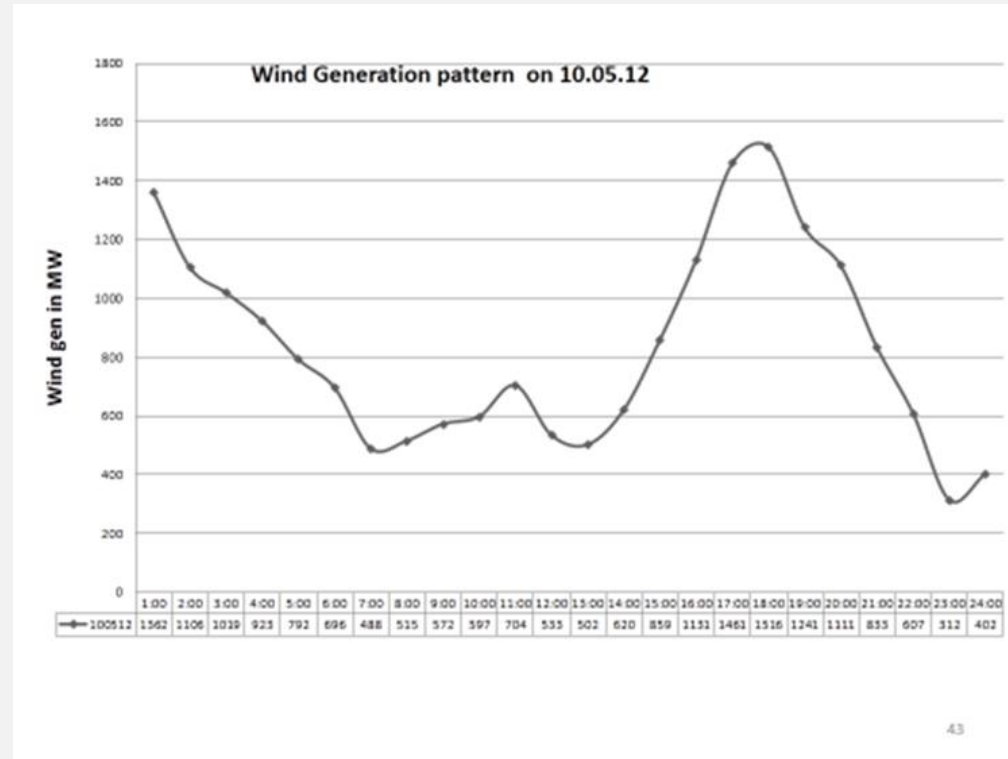
COAL-BASED THERMAL POWER PLANT

GENERATION FROM A COAL-BASED THERMAL POWER PLANT

- 1000 MW

0   2
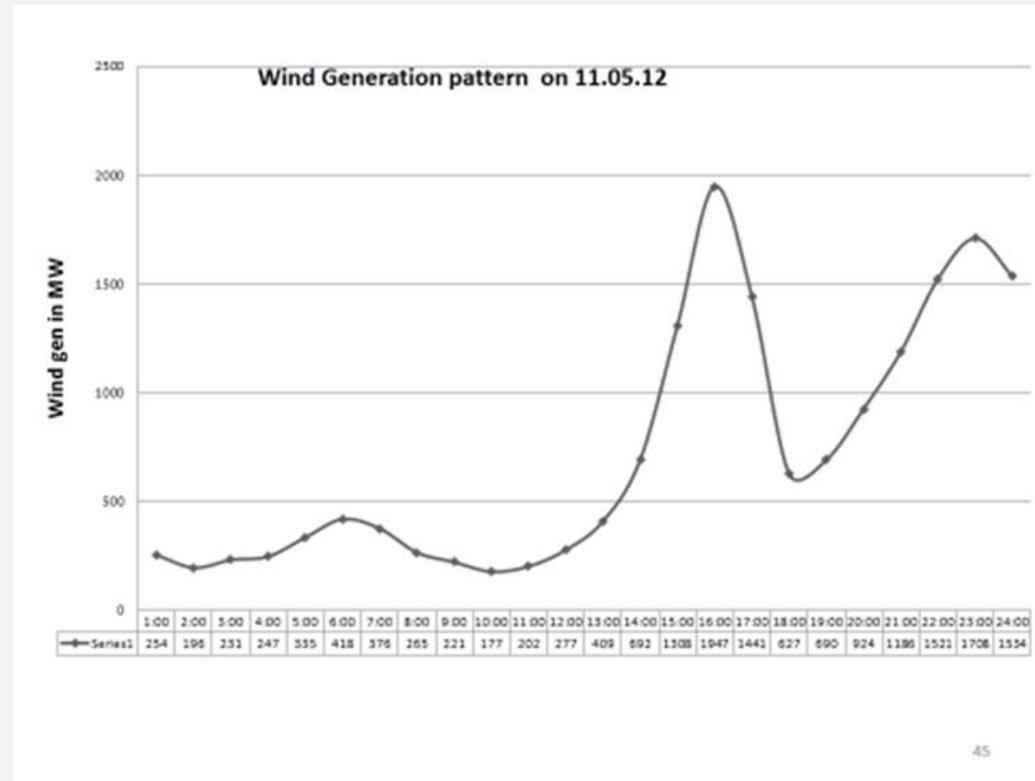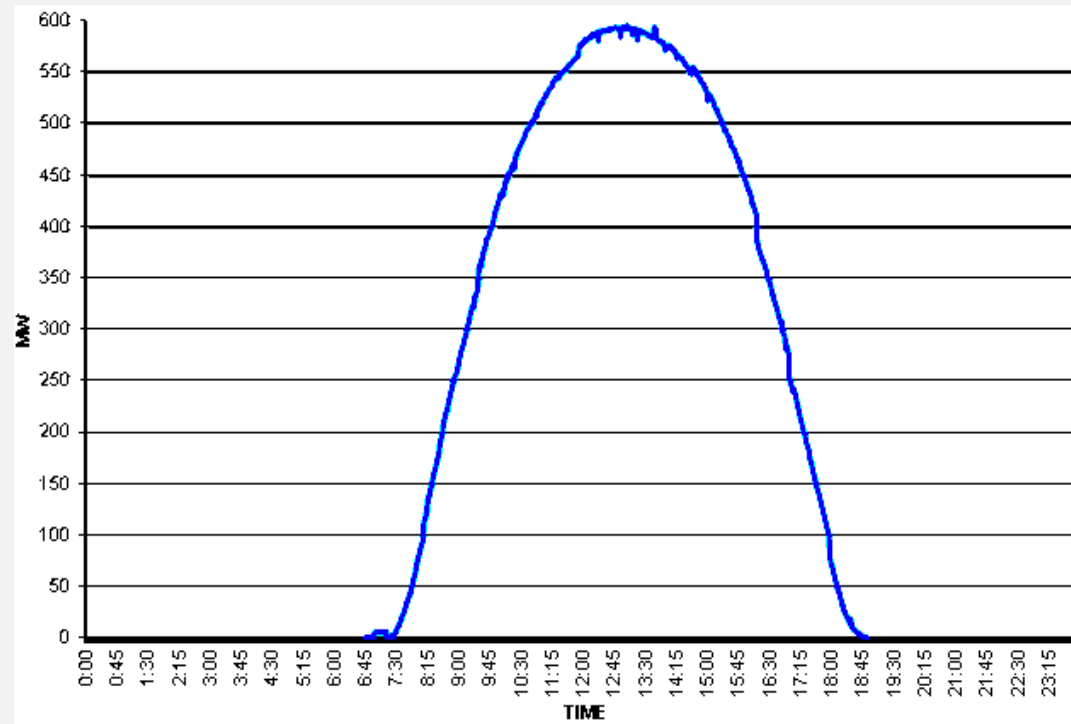   4

WIND FARM IN TAMIL NADU

WIND GENERATION ON CONSECUTIVE DAYS

Wind Generation pattern on 10.05.12

	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
100512	1562	1106	1019	923	792	696	488	515	572	597	704	535	502	620	859	1131	1461	1516	1241	1111	835	607	312	402

WIND GENERATION ON CONSECUTIVE DAYS

Wind Generation pattern on 11.05.12

|	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	24:00
Series1	254	196	231	247	335	418	376	265	221	177	202	277	409	692	1308	1947	1441	627	690	924	1186	1521	1708	1554

45

SOLAR PARK

TYPICAL SOLAR GENERATION OVER A DAY IN GUJARAT FOR A NON-CLOUDY DAY

SOLAR GENERATION ON A CLOUDY DAY 1-9-2012 IN THE **CHARANKA SOLAR PARK** GUJARAT (CAPACITY OF ABOUT 200 MW)
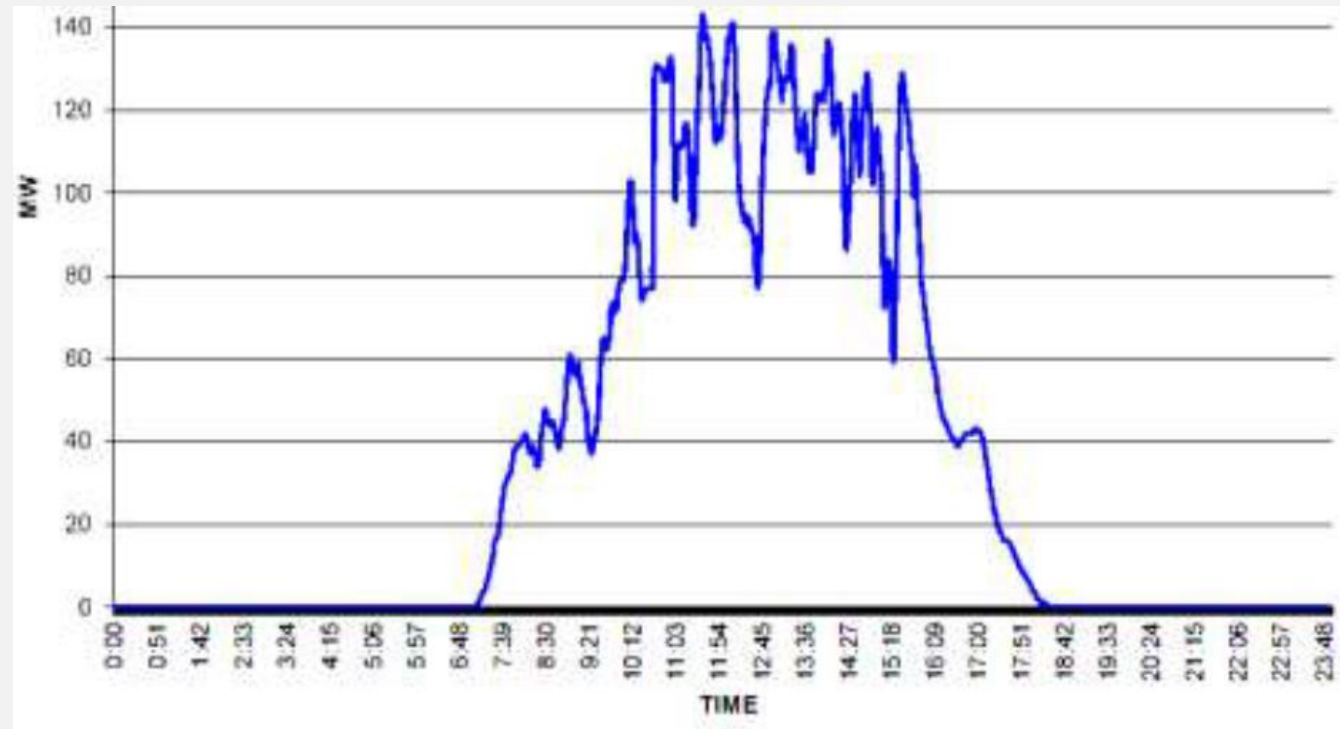
SOLAR GENERATION ON A CLOUDY DAY 9-9-2012 IN THE **CHARANKA SOLAR PARK** GUJARAT
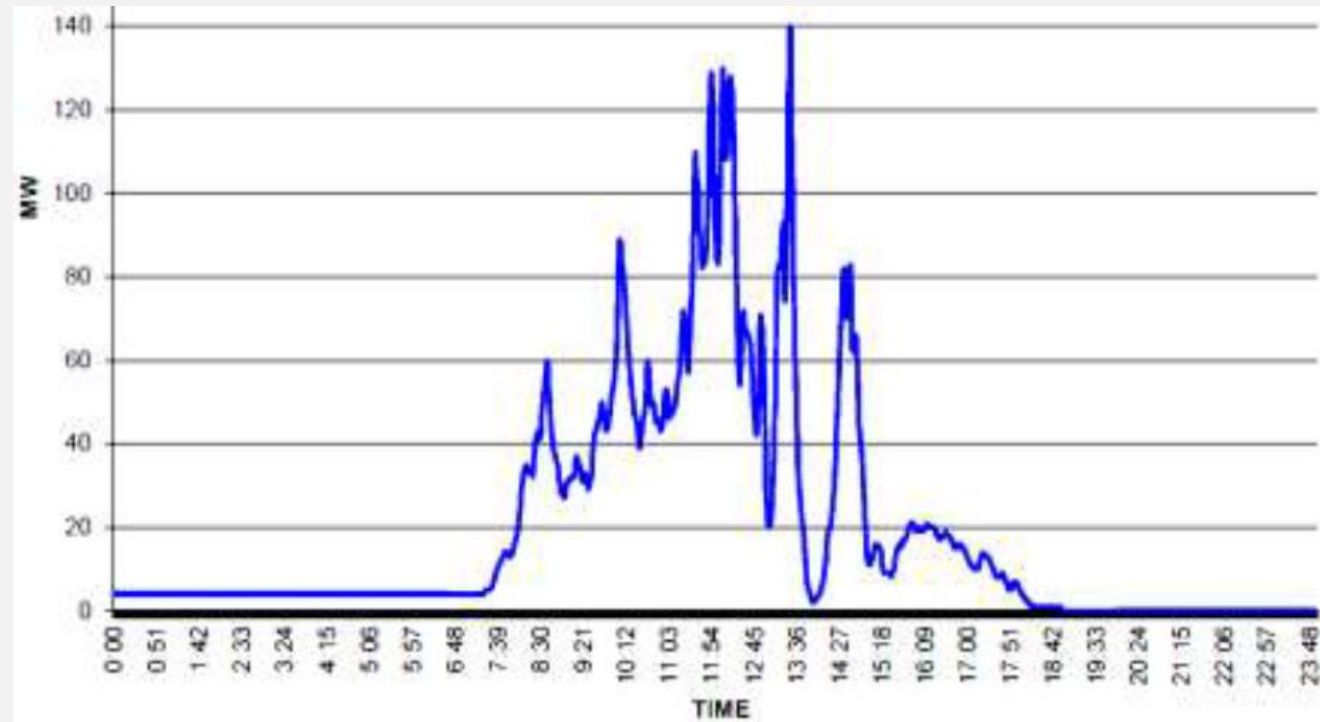
ADVERSE FINANCIAL IMPACT ON THERMAL POWER STATIONS

- Adverse impact due to lower efficiency on account of
  - Higher heat rate
  - Higher auxiliary consumption per unit
- Higher fixed charge per unit due to lower PLF
- Higher O&M due to greater wear and tear
- Loss of Equivalent Operating Hours in Gas Stations

OTHER FINANCIAL IMPLICATIONS

- Higher Deviation charge to host State on account of CERC's Deviation Settlement Mechanism for Inter-State Power Flows

- Standby charge for generation assets in case of reduction of wind/solar generation

- Extra transmission charges on account of lower Capacity Utilization Factor

HEAT RATE CURVE FOR COMBINED CYCLE POWER PLANT

Heat Rate vs % Load of typical combined cycle plant
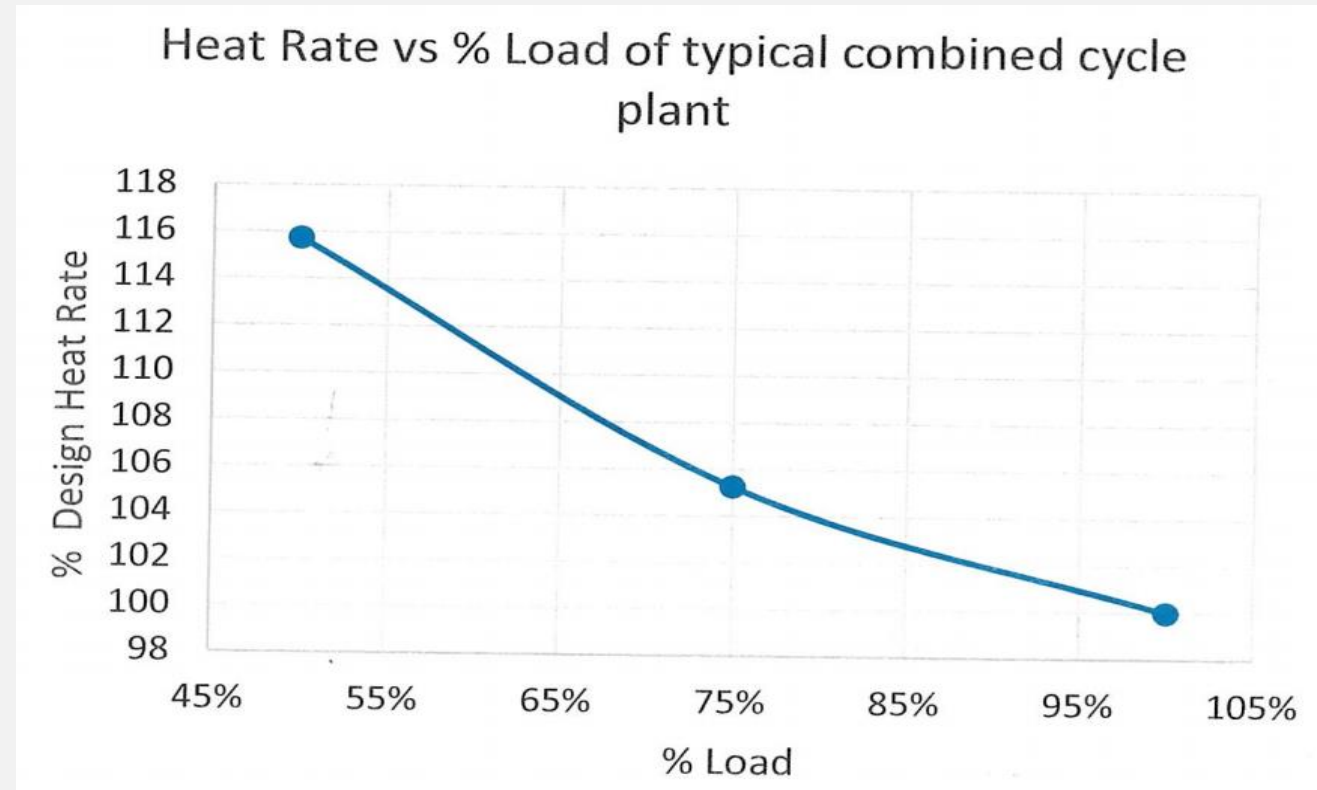
DETERIORATION OF HEAT RATE

(i) In case of coal / lignite based generating stations, following station heat rate degradation or actual heat rate, whichever is lower, shall be considered for the purpose of compensation:

S. No.	Unit loading as a % of Installed Capacity of the Unit	Increase in SHR (for supercritical units) (%)	Increase in SHR (for sub-critical units) (%)
1	85-100	Nil	Nil
2	75-84.99	1.25	2.25
3	65-74.99	2	4
4	55-64.99	3	6

ENHANCED AUXILIARY CONSUMPTION

(ii) In case of coal / lignite based generating stations, the following Auxiliary Energy Consumption degradation or actual, whichever is lower, shall be considered for the purpose of compensation:

Sl. No	Unit Loading (% of MCR)	% Degradation in AEC admissible
1.	85 – 100	NIL
2.	75 – 84.99	0.35
3.	65 – 74.99	0.65
4.	55 - 64.99	1.00

CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) (SECOND AMENDMENT) REGULATIONS, 2015

- Notified on 7 th August, 2015.

- Effect from 1 st November, 2015.

- "**Absolute Error**" shall mean the absolute value of the error in the actual generation of wind or solar generators which are regional entities with reference to the scheduled generation and the **'Available Capacity'** (AvC), as calculated using the following formula for each 15 minute time block: Error (%) = **100 X [Actual Generation– Scheduled Generation] / (AvC)**

	Table – I: Deviation Charges in case of under injection	
Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable to Regional DSM Pool
1	<= 15%	At the Fixed Rate for the shortfall energy for absolute error upto 15%
2	>15% but <= 25%	At the Fixed Rate for the shortfall energy for absolute error upto 15% + 110% of the Fixed Rate for balance energy beyond 15% and upto 25%
3	>25% but <=35%	At the Fixed Rate for the shortfall energy for absolute error upto 15% + 110% of the Fixed Rate for balance energy beyond 15% and upto 25% + 120% of the Fixed Rate for balance energy beyond 25% and upto 35%
4	> 35%	At the Fixed Rate for the shortfall energy for absolute error upto 15% + 110% of the Fixed Rate for balance energy beyond 15% and upto 25% + 120% of the Fixed Rate for balance energy beyond 25% and upto 35% + 130% of the Fixed Rate for balance energy beyond 35%

Table – II: Deviation Charges in case of over injection

Sr. No.	Absolute Error in the 15-minute time block	Deviation Charges payable
1	< = 15%	At the Fixed Rate for excess energy upto 15%
2	>15% but <= 25%	At the Fixed Rate for excess energy upto 15% + 90% of the Fixed Rate for excess energy beyond 15% and upto 25%
3	>25% but <=35%	At the Fixed Rate for excess energy upto 15% + 90% of the Fixed Rate for excess energy beyond 15% and upto 25% + 80% of the Fixed Rate for excess energy beyond 25% and upto 35%
4	> 35%	At the Fixed Rate for excess energy upto 15% + 90% of the Fixed Rate for excess energy beyond 15% and upto 25% + 80% of the Fixed Rate for excess energy beyond 25% and upto 35% + 70% of the Fixed Rate for excess energy beyond 35%

CERC(DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS)(THIRD AMENDMENT) REGULATIONS, 2016

- Renewable Rich State means a State whose minimum combined installed capacity of wind and solar power is 1000 MW or more.

SPECIAL DISPENSATION FOR RENEWABLE RICH STATES

## Deviation Limits for Renewable Rich States

S.No	States having combined installed capacity of Wind and Solar projects	Deviation Limits (MW)-"L"
1	1000– 3000 MW	200
2	> 3000 MW	250

GEC PHASE-I

- **Phase – I** : Rs. 24,000 crores (Rupees 11,000 Crores for inter-State transmission system and Rs. 13,000 Crores for intra-State Transmission System) has been utilised for evacuation of 20,000 MW, coming to about Rs.0.72 Crore per Mega Watt.

- **Phase-2** : for evacuation of power from solar parks, Rs. 12,000 Crores has been utilised for evacuation of 20,000 MW, coming to about Rs.0.6 Crore/MW.

- Normal evacuation system from a pit head coal-based plant to the load centre works out to about Rs.1.5 Crore/MW to Rs.2.0 Crore/MW

MAX WIND GENERATION DAY IN TN
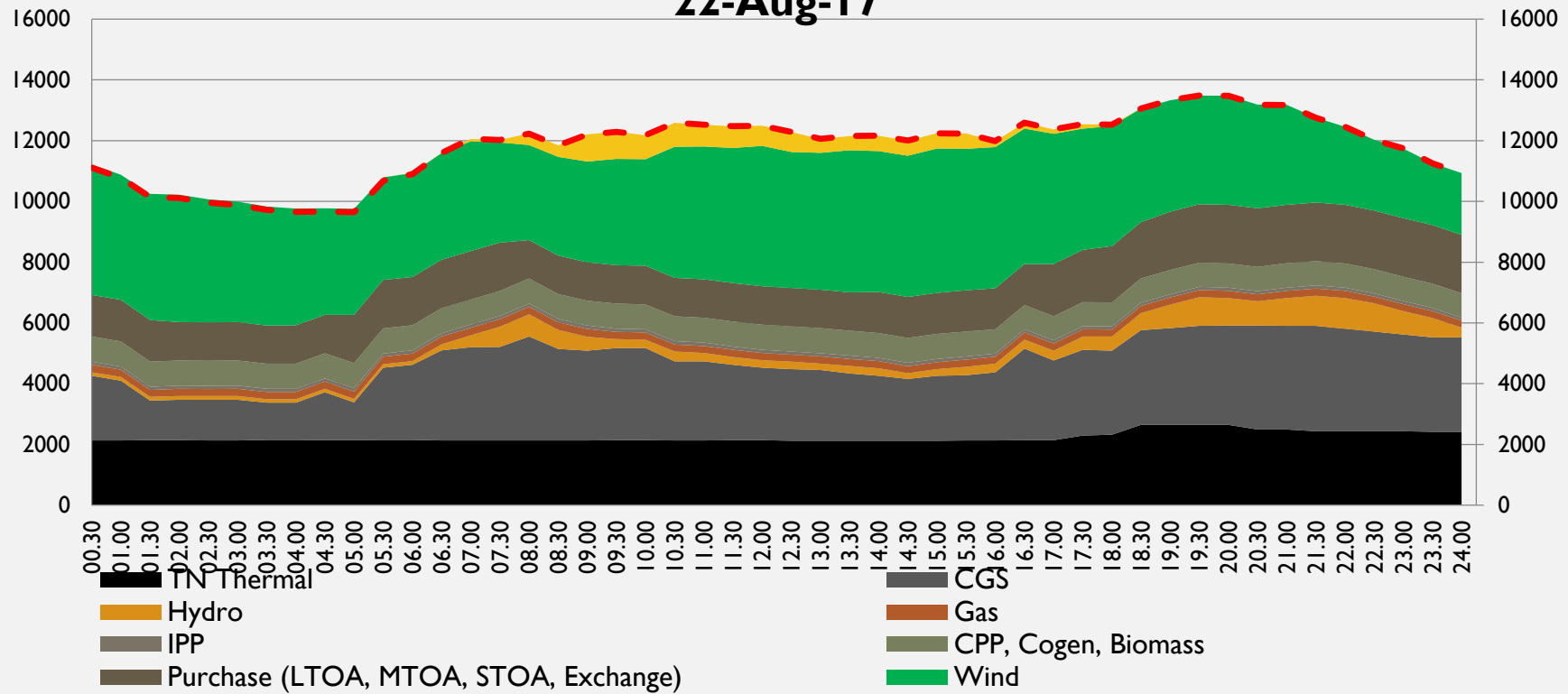
TEST CASE OF TAMIL NADU – 22.8.2017

- Extra fixed charge due to lower PLF of CGS(Rs/Kwh)-(Spread over renewable generation)   Rs. 0.37

- Extra fuel charge due to inefficient operation of CGS(Rs/Kwh)-(Spread over renewable generation)   Rs. 0.06

- Extra fixed charge + fuel charge due to lower PLF of TN Stns(Rs/Kwh)-(Spread over renewable generation)   Rs. 0.03

- **Total**   **Rs. 0.46**

OTHER FINANCIAL IMPLICATIONS

- Impact of DSM charges CGS(Rs/Kwh)-(Spread over renewable generation) Rs. 0.35

- Backing down Coal generation fuel charge@ Rs. 2/kwh in order to take must run renewable generation at Rs. 4.0/Kwh assuming 25% replacement (Rs/Kwh)-(Spread over renewable generation) ~~Rs. 0.50~~ -0.50

- Stand by charge @10% of max renewable generation (Rs/Kwh)- Spread over renewable generation Rs. 0.23

- Extra transmission charge (Rs/Kwh)- Spread over renewable generation Rs. 0.26

- **Total** ~~**Rs. 1.34**~~ 0.34

THANK YOU