CHALLENGES IN FORECASTING AND SCHEDULING OF SOLAR POWER PLANTS AFTER STRINGENT AND FREQUENT CHANGES IN CERC (DEVIATION SETTLEMENT MECHANISM) REGULATIONS

CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2014

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) REGULATIONS, 2014 (SALIENT FEATURES)

The regulation was win-win situation for all i.e. regulators, grid-controllers and developers. The deviations w.r.t the bands were not much, and grid stability was maintained.

The band was symmetric and there were no issues related to under scheduling or over-scheduling.

Provision for Intraday revision to be implemented from 4th time block onwards

This regulation proves worthy as the grid stability was maintained having minimum revenue losses to the developers.

CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2022 (ENFORCED FROM 05TH DEC 2022)

Seller	Deviation by way of over injection	Deviation by way of under injection
For WS seller	Zero: Provided that such seller shall be paid back for over injection as under: (i) @ contract rate, or in the absence of a contract rate, @ the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block, up to [*5% Deviation -WS seller (in %)*]; And (ii) @ 90% of the contract rate, or in the absence of a contract rate, @ 90% of the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block for deviation beyond [*5% Deviation-WS seller (in %)*] and up to [*10% Deviation-WS seller (in %)*].	(i) Zero up to [*10% Deviation-WS seller (in %)*]; and (ii) @ 10% of the normal rate of charges for deviation beyond [*10% Deviation-WS seller (in %)*]: Provided that such seller shall pay back for the total shortfall in energy against its schedule in any time block due to under injection, @ the contract rate, or in the absence of a contract rate, @ the weighted average ACP of the Day Ahead Market segments of all Power Exchanges, for the respective time block.

CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2022 (ENFORCED FROM 5TH DEC 2022) (SALIENT FEATURES)

SPDA

This regulation was seeming to be revenue driven model keeping at stake the grid stability, which was introduced without analyzing its impact on grid stability as well as on the developers.

The deviation band was narrowed down to 5% straight from 15%, which results in heavy deviations during fluctuating weather conditions, thereby impacting grid stability in adverse way.

The developers were compelled to over-schedule as the deviation bands were kept unsymmetric. Thereby leading to more deviations and creating threat for grid stability.

It was observed during heavy weather fluctuating conditions, that the grid frequency was varied on frequent basis, thereby impacting grid stability.

As the band was narrowed down, along with that the penalty rates were also increased which was a heavy burden on developers' revenue. Therefore, one can easily understand that it was a revenue driven model keeping at stake the grid stability.

Taking into account, the grid situation, Hon'ble CERC issued guidance though Orders and from 08.02.2023, the Suo-motu Order in Petition No. 1/SM/2023 came into effect

CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2022 (AS PER ORDER DATED : 6TH FEB 2023 IN PETITION NO. 1/SM/2023) (ENFORCED:8TH FEB 2023)

Entity	Charges for deviation payable to Deviation and Ancillary Service Pool Account	
Seller	**Deviation by way of over injection**	**Deviation by way of under injection**
For WS seller being a generating station based on solar or hybrid of wind –solar resources	Zero: Provided that such seller shall be paid back for over injection as under: (i) @ contract rate, or in the absence of a contract rate, @ the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block, up to [10% DWS]; and (ii) @ 90% of the contract rate, or in the absence of a contract rate, @ 90% of the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block for deviation beyond [10% DWS] and up to [15% DWS]	(i) Zero up to [10% DWS] and (ii) @ 10%of contract rate or in the absence of a contract rate, @ the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block for deviation beyond [10% DWS] and up to [15%DWS] and (iii) @ 50% of contract rate or in the absence of a contract rate, @ the weighted average ACP of the Day Ahead Market segments of all Power Exchanges for the respective time block for deviation beyond [15% DWS]: Provided that such seller shall pay back for the total shortfall in energy against its schedule in any time block due to under injection, @ the contract rate, or in the absence of a contract rate, @ the weighted average ACP of the Day Ahead Market segments of all Power Exchanges, for the respective time block.

CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2022 (AMENDMENT)(ENFORCED FROM :8TH FEB 2023) (SALIENT FEATURES)

Based on the operational feedback from Grid-India and discussion with developers and their associations, Suo-Motu Order in Petition No. 1/SM/2023 provided guiding principles for deviation settlement for WS Sellers.

Vide the Order, the bands were relaxed a bit from 5% to 10% , however the unsymmetric nature of regulation was still maintained forcing the developers to overschedule.

Along with this the amendment via IEGC 2023 and GNA 2022 regulations effective from 01st Oct 2023, it was enforced that the Intraday revisions were to be implemented from 7th and 8th time blocks if made during odd or even time blocks respectively.

These amendments adversely impacted grid stability which can be clearly observed during sudden weather fluctuations on regional level (ex: 16.10.2023) or during foggy and dynamic weather conditions during months of Dec-23 and Jan-24.

These regulations along with IEGC 2023 and GNA Regulations 2022 have impacted both, grid stability and RE generators revenue connected to grid. As it has **increased average %age revenue losses from 0.45% to almost 3.5%, which is almost 8.75 times**, incurring heavy losses and demotivating RE developers to further invest in RE plants.

UN-IMPLEMENTED CLAUSE OF IEGC 2023 REGULATIONS (CLAUSE 45- SUBCLAUSE(11)(B)AND (11)(C))

(11) Scheduling of WS seller and ESS by QCA:

(a) The regional entity renewable energy generating station(s) or Projects based on energy storage system(s) connected at a particular ISTS substation or at multiple ISTS substations located in a State may appoint a QCA on their behalf to coordinate and facilitate scheduling for such generating stations or energy storage system(s). The responsibility of QCA is listed at Annexure-6 to these regulations.

(b) NLDC shall submit a procedure for aggregation of pooling stations for the purpose of combined scheduling and deviation settlement for wind or solar or renewable hybrid generating stations that are regional entities, within six (6) months of notification of these regulations for approval of the Commission.

(c) The QCA shall be registered with the concerned RLDC.

IMPLEMENTED CLAUSE OF IEGC 2023 REGULATIONS (CLAUSE 49 - SUBCLAUSE 4(C)) - ENFORCED FROM 01.10.2023

(c) Based on the request for revision in schedule made as per sub-clauses (a) and (b) of this clause, any revision in schedule made in odd time blocks shall become effective from 7th time block and any revision in schedule made in even time blocks shall become effective from 8th time block, counting the time block in which the request for revision has been received by the RLDCs to be the first one.

S No.	Regulations prior to 05.12.2022	Regulations after 05.12.2022, 08.02.2023 and 01.10.2023
1	CERC (Deviation Settlement Mechanism and Related Matters) Regulations 2014	CERC (Deviation Settlement Mechanism and Related Matters) Regulations 2022 along with partial implementation of IEGC 2023
2	Symmetrical band of errors for both under-injection and over-injection : (0% to 15%; 15% to 25% ; 25% to 35% ; 35% and above) and rate of penalization were 10% of PPA: 20% of PPA ; 30% of PPA were adequate	The error band has been narrowed down unsymmetrically to 10% and 15% range for over-injection and under-injection. Also, at the same time rate of penalization has been increased, as generators are not paid anything for over-injection beyond 15%.
3	The Intraday revisions were implemented from 4th time block and in each 1:30 hrs, generators can make one Intraday revisions.	W.e.f 01.10.2023 the Intraday revisions are now implemented from 7th and 8th time block respectively for the revisions made in odd or even time blocks respectively.
4	Various forecasting agencies were not able to predict the local climate changes.	Various forecasting agencies were not able to predict the local climate changes, and as the time duration has now been increased to 2 hrs, so these agencies are unable to provide the forecast prior to 2 hrs.
5	The regulations was acted with full force with all clauses of regulations being acted.	w.e.f 01.10.2023, IEGC 2023 was partially implemented as Clause 45, sub-clause 11b was not implemented, however caluse 49 sub-clause 4c has been implemented. So, aggregation of generators at pooling station has put on hold while Intraday blocks to be implemented from 7th and 8th time block has been enforced, leading to higher grid unstability and higher revenue losses to generators.
6	Grid stability - freiendly resgulation	It seems that grid stability has been compromised with the revenue driven approach of this regulations. As at the same instant of time, for under-injection and over-injection by two different generators, one generator is paid nothing for over-injection beyond 15% while other generator is made to pay heavily for the under-injection beyond 15%, at the rate of 50% of the contract rate.

Comparison of Scenarios before and after implementation of the CERC(Deviation Settlement Mechanism and Related Matters) Regulations 2022 (w.e.f. 05.12.22) and IEGC 2023 (w.e.f. 01.10.23)

IMPACTS AND CONSEQUENCES AFTER IMPLEMENTATION OF NEW IEGC ACT 2023 ALONG WITH CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2022 (AS PER ORDER DATED : 6TH FEB 2023)

No prominent forecasting agencies including Solargis, IMD and ISRO as well as the weather forecasters are not able to predict the sudden movements of clouds.

The delay in implication of the forecast on remc portal due to 7th block (for odd) and 8th block (for even) rule resulted in deviation of actual from schedule forecast, resulting in severe grid unstability and higher revenue losses to developers.

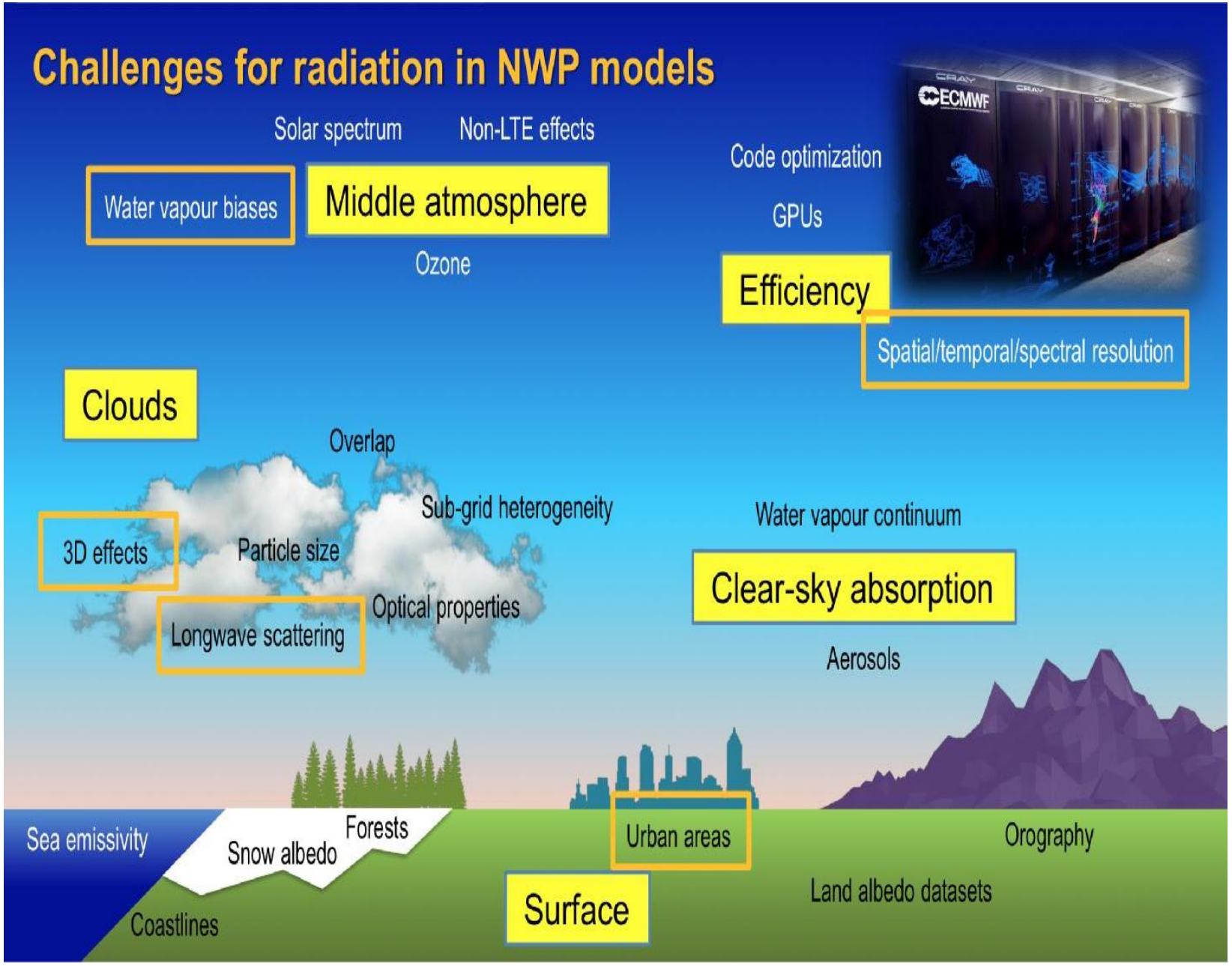
After the implementation of IEGC 2023, the revenue loss for developers has increased from **less than 1% (prior to 5th Dec 2022) to ~4%** which is quite a huge loss for developers.

Also, the grid stability has been put on stake as due to sudden variations of load due to climate change resulted in heavy fluctuations in grid frequency, as can be observed in case of 16.10.2023. Such incidences are frequent during monsoon and foggy conditions, resulting in grid unstability and higher revenue loss to generators/developers.

compromised with the revenue driven approach of this regulations. As at the same instant of time, for under-injection and over-injection by two different generators, one generator is paid nothing for over-injection beyond 15% while other generator is made to pay heavily for the under-injection beyond 15%, at the rate of 50% of the contract

CONDITIONS LEADING TO GENERATION LOSS AND REVENUE LOSS ON FOGGY AND CLOUDY WEATHER CONDITIONS

- For the solar plants, cloudy and foggy conditions leads to generation loss w.r.t the normal days when weather conditions are not much variable throughout the generating period.
- Also, in addition to it the new IEGC Regulations 2023 effective from 01.10.2023, adds further to the revenue losses, As during cloudy and foggy conditions, the forecast can only be effective after 7th and 8th time block respectively, if Intraday revisions are done in odd or even time blocks, respectively. So this basically create lag between the implemented schedule and the actual climate conditions thereby resulting in grid unstability and higher revenue losses to developers.
- Hon'ble CERC draft DSM proposal 2024, is a further threat to grid unstability, and also it eats up more of the revenue of developer. Because in the draft proposal, the rate of penalization has been increased while narrowing the deviation band.
- The complete severe Impact of 7th and 8th Block implementation for Intraday revisions is yet to be seen during the monsoon (June to Oct) and foggy season (Dec-Jan)

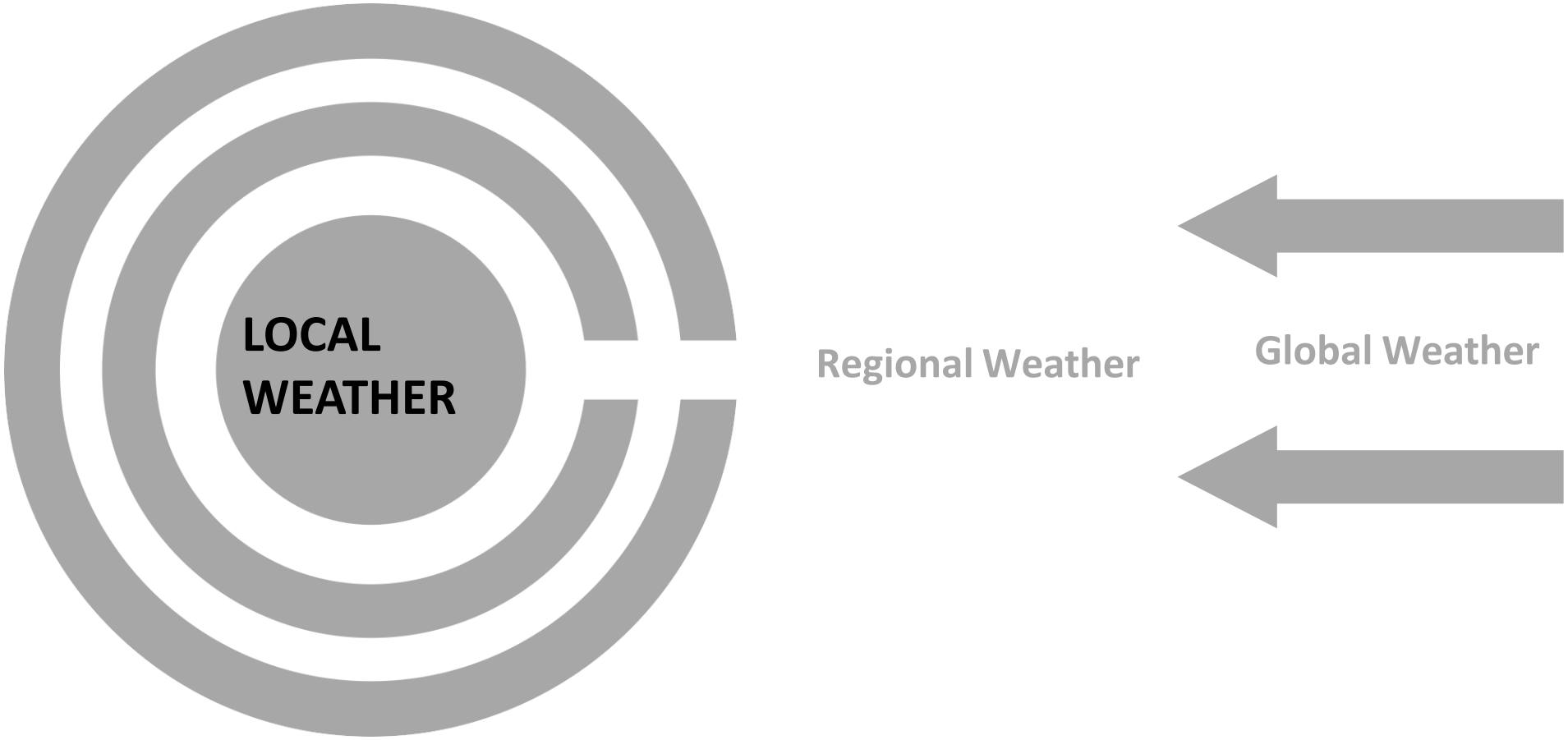


SPDA

CHALLENGES IN RADIATION FORECASTING

- There are many unmeasurable variable parameters which affects weather parameters and cloud movements.

As the RE projects are critically are dependent on climatic conditions, most of the times it is mainly the local weather which impacts forecasting instead of global or regional weather

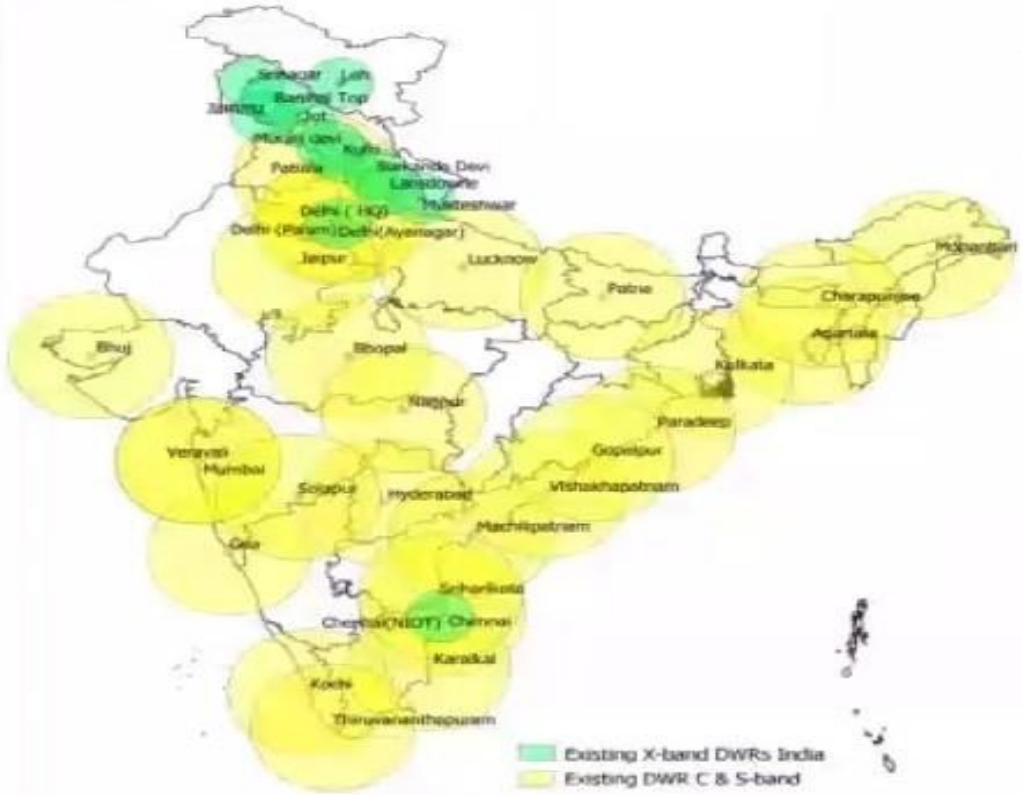


Clouds cause the largest deviations in intra-day forecasts

It can be observed from the above picture that as the Clouds form a dynamic 3-dimensional system and are impossible to model accurately

CURRENT STATUS OF IMD RADAR NETWORKS IN INDIA (AS PER IMD MOM DATED 07.05.24, RADAR PRODUCTS UTILIZATION FOR WEATHER FORECASTING

RADAR NETWORKS



Total Radar installed: 39

- S Band – 22
- C Band – 5
- X Band – 12

Dual/ Single polarization

- S band – 4 / 18
- C band – 5 / 0
- X band – 12 / 0

Radar with SSPA Technology

- C band – 1
- X band – 8

OEM wise RADAR

- BEL – 4
- Astra – 10
- Gematronik - 5
- Vaisala – 2
- ISRO – 3
- Metstar - 12
- Data Patterns – 2
- Toshiba – 1

Major Radar Data Centre Infrastructure

1. High end Servers for processing Radar data on near real time basis
2. Network Switches
3. NAS Storage (>100TB)
4. Advanced Workstations
5. Radar Data processing software & In house developed tools
6. Upper Air Instrumentation Division Website

18

CURRENT STATUS OF IMD RADAR NETWORKS IN INDIA (AS PER IMD MOM DATED 07.05.24, RADAR PRODUCTS UTILIZATION FOR WEATHER FORECASTING (CONTD....)

It can be observed from previous slide that RADAR technology of IMD is being missing at many key places, where the solar parks/farms are present and are operational as of now, for example: majority areas of Rajasthan, Gujarat and Karnataka.

Also, the RADAR technology itself have limitation to provide accurate forecast, as discussed by IMD in their meeting on 07.05.2024, titled: RADAR products utilization for weather forecast.

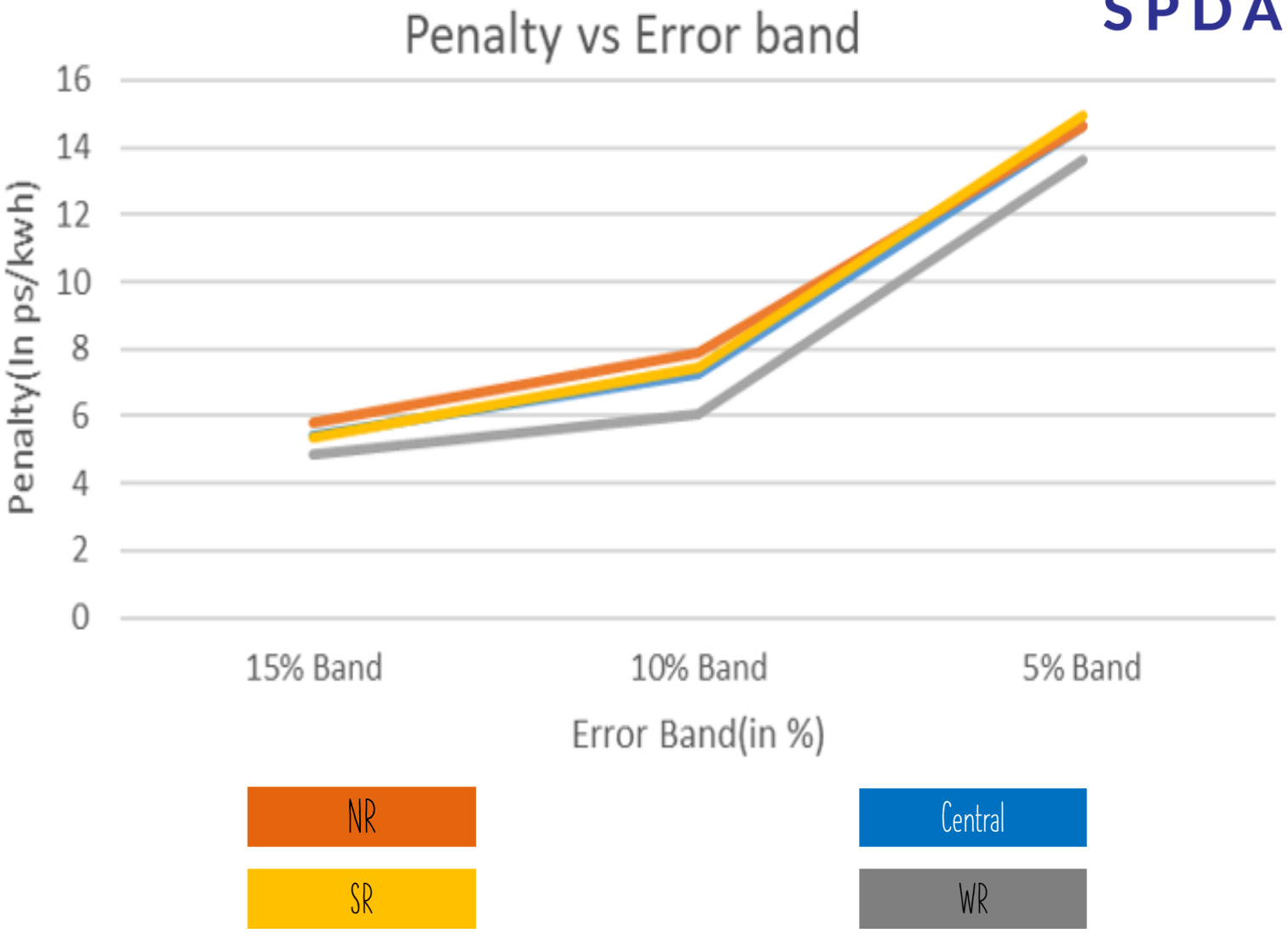
As the regulators are demanding accurate forecast that too prior 2hrs, such level of accuracy can't be achieved with the current technology available across the world.

ERRORS in MEASUREMENT of by RADAR Technology

But radar measurements are prone to error …

1. Radar beam overshooting the shallow precipitation at long ranges. Radar beam is at several kilometers above the ground at long ranges.
2. Low level evaporation of precipitation beneath the radar beam
3. Orographic enhancement above hills which goes undetected beneath
4. Vertical profile of reflectivity. There is a variation of reflectivity in the vertical. Uncertainty in the extrapolation of the reflectivity measured aloft to the ground.
5. Overestimation of precipitation in the melting layer (bright band). If the radar beam intercepts the ML, the result is an increase of power reflected back to the radar. Errors can be up to a factor of 5 in the bright band.
6. Changes in the Drop Size Distribution *N(D)*. This affects the *Z-R* relationship.
7. Partial beam blocking. Hills close to the radar block the beam path. This blocking can be total or partial.
8. Representativeness errors. Radar scans with a given spatial and temporal resolution
9. Attenuation by hydrometeors and atmospheric gases. Affects higher frequencies (e.g. C-band=5GHz or X-band = 10GHz).
10. Ground clutter. Ground echoes because radar scans at low elevation angles.
11. Anomalous propagation of the radar beam due to changes in the atmospheric conditions. The path of the beam departs from standard propagation and in some cases it is bent towards the earth surface producing ground echoes.
12. Radar miscalibration. This can bias the rainfall estimations.

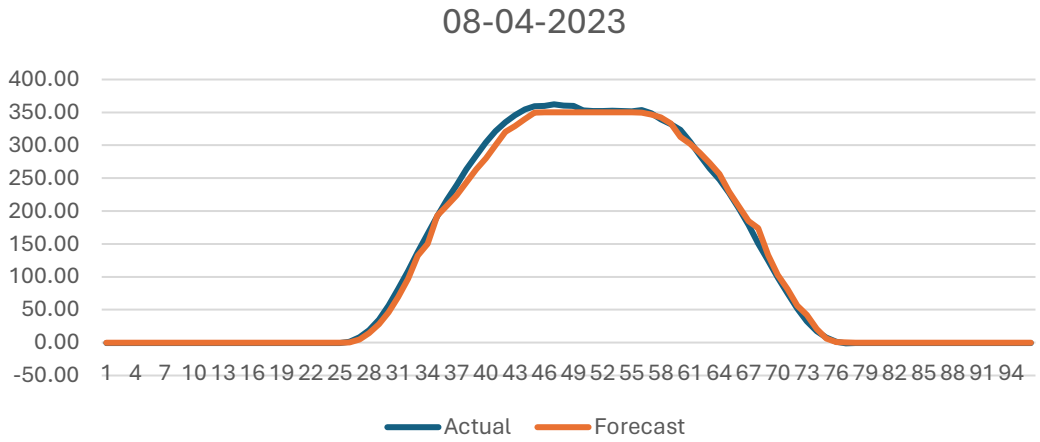
CASE STUDY - IMPACT OF REDUCING THE DEVIATION BAND FROM 15% TO 5% FOR SOLAR PLANTS

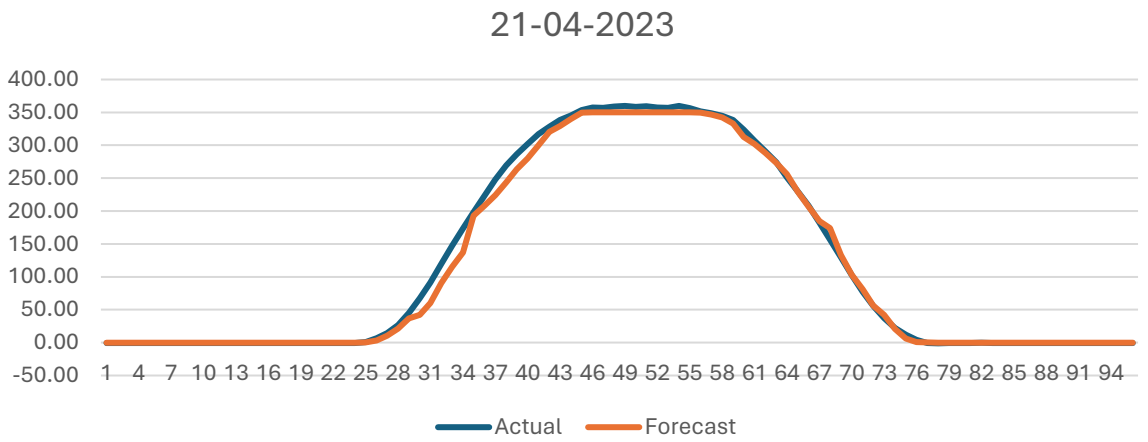


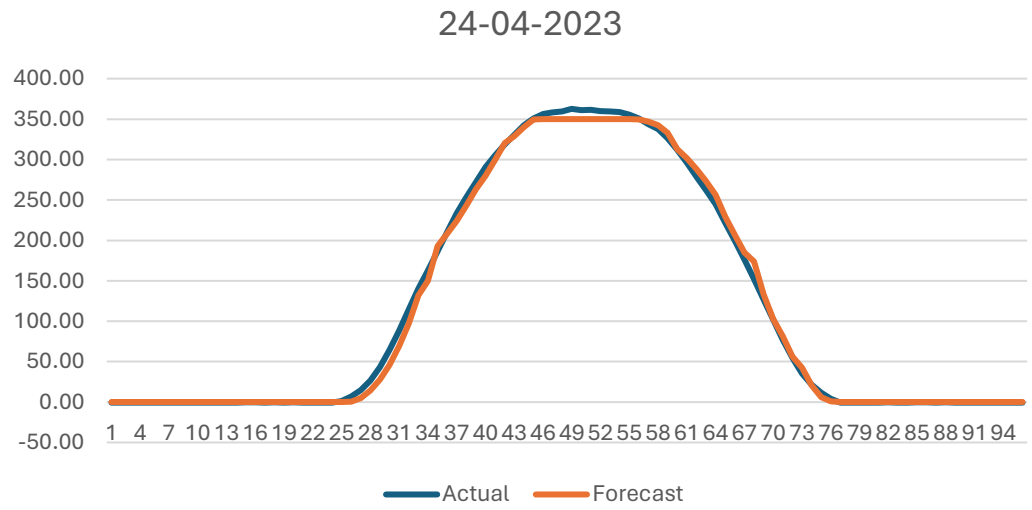
CASE STUDIES - ASSUMPTIONS

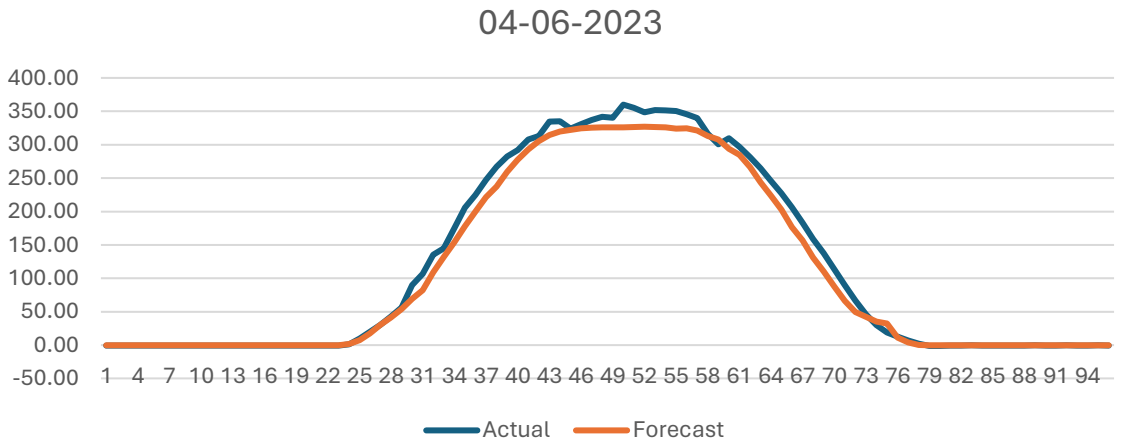
- Plants Considered : Plant-1 (Bikaner -350 MW), Plant-2 (Bhadla-2 region -320 MW).
- Normal Generation Days considered are along with their average Generation during constant/less variable weather conditions.
- Foggy and Cloudy days considered when the weather conditions are quite dynamic and is variable in nature due to Foggy or cloudy conditions. The clouds are mostly local clouds which are in moving conditions leading to high variability in generation.

CASE STUDY-1: PLANT-1(BIKANER-350 MW) (CLEAR DAYS)



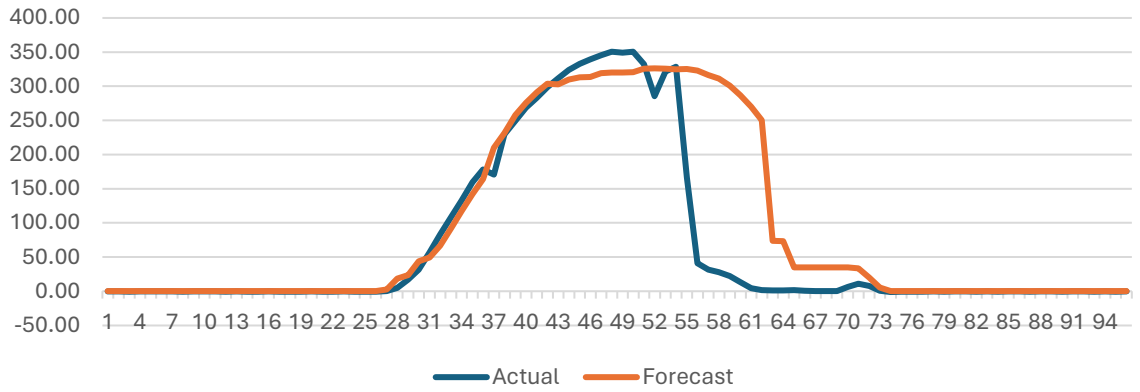




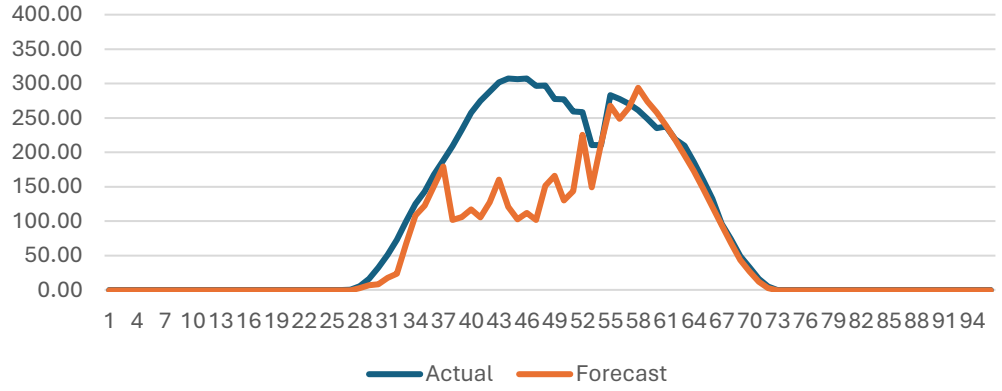


CASE STUDY-1: PLANT-1(BIKANER-350 MW) (FOGGY AND CLOUDY DAYS)

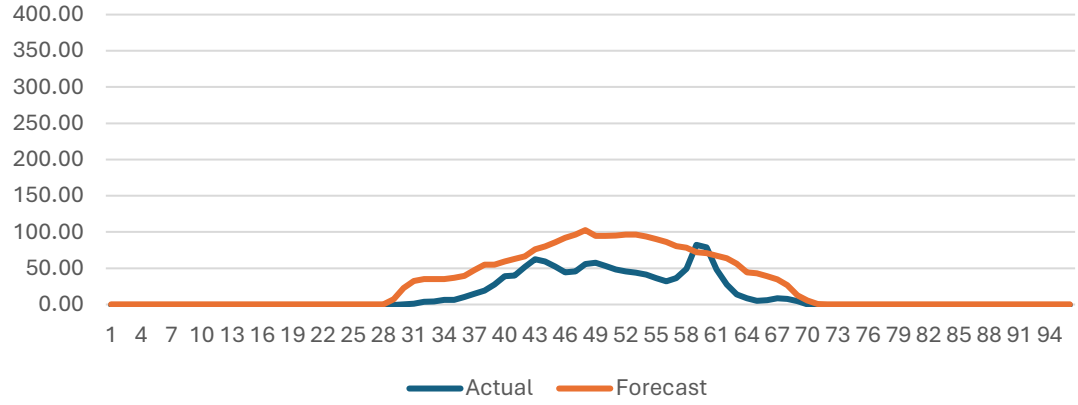
16-10-2023



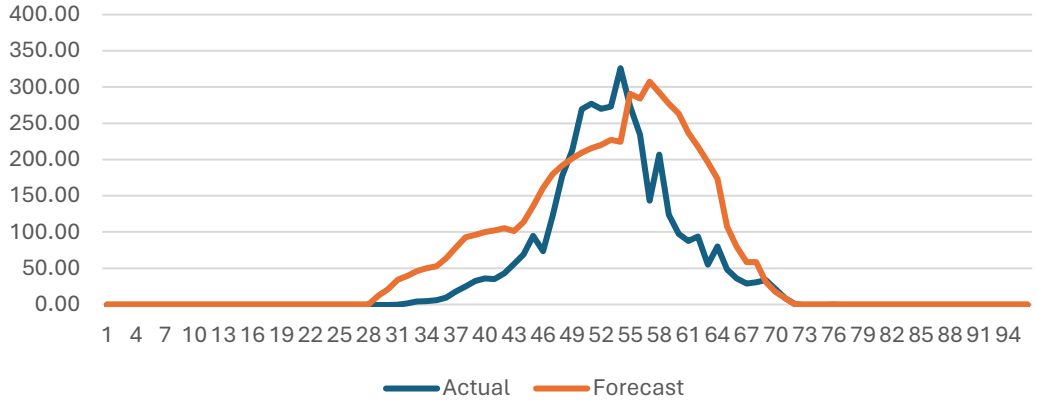
22-12-2023



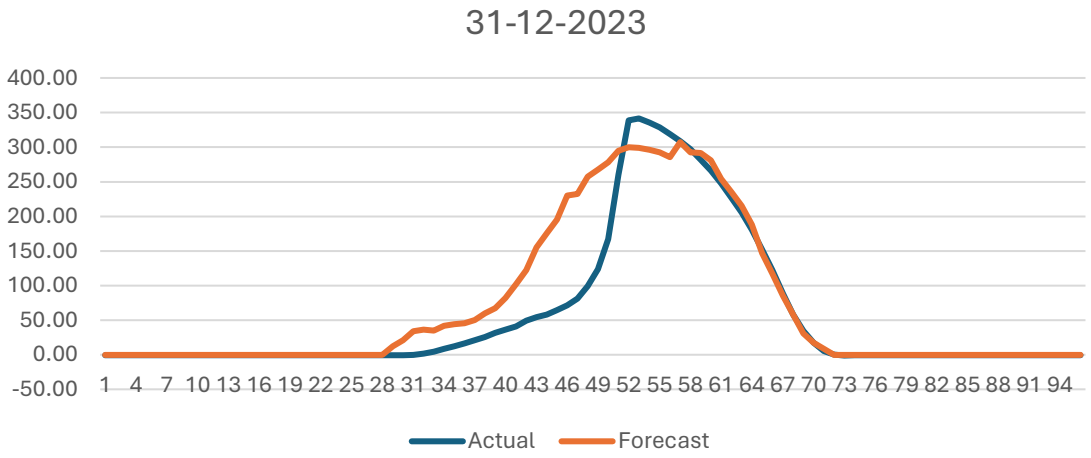
27-11-2023

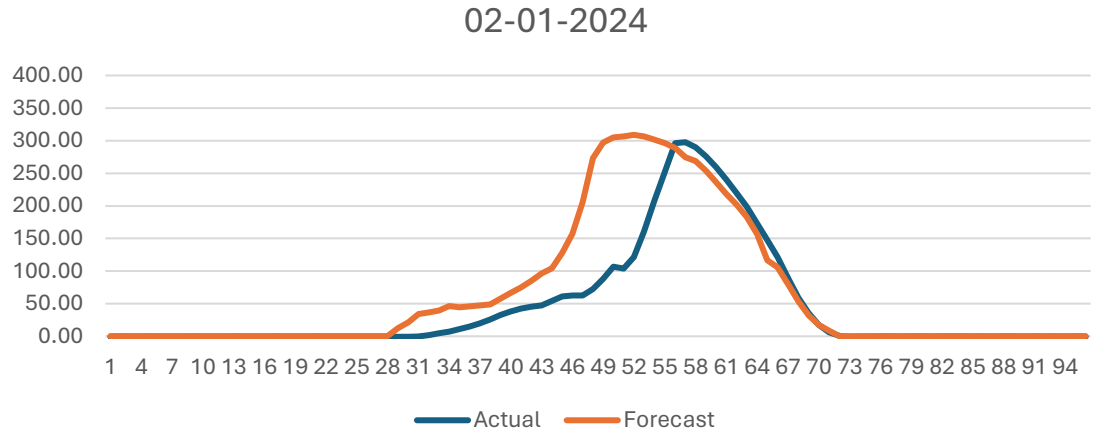


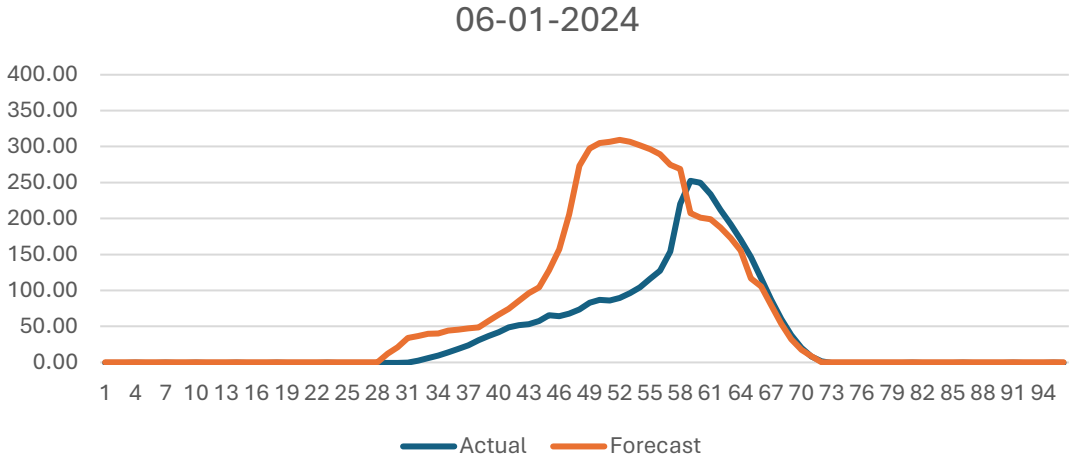
30-12-2023

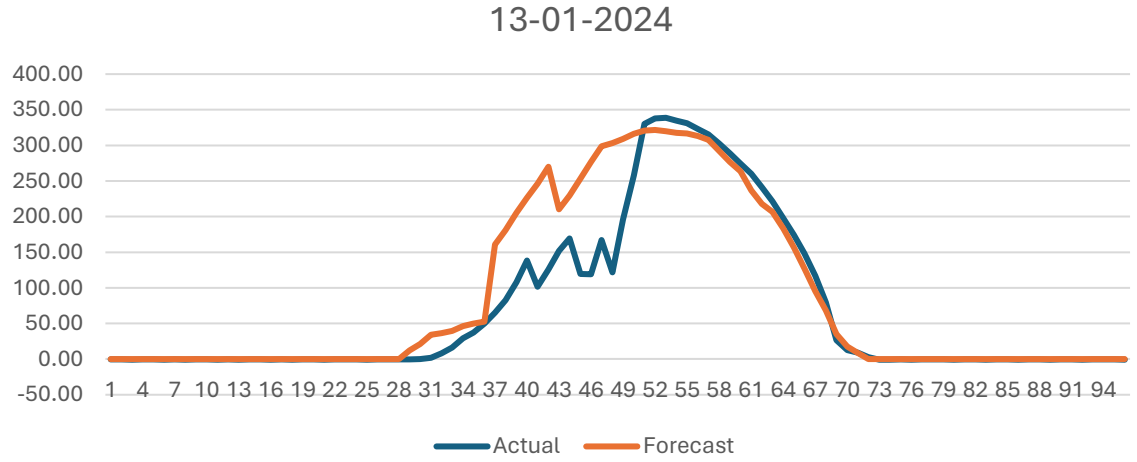


CASE STUDY-1: PLANT-1(BIKANER-350 MW) (FOGGY AND CLOUDY DAYS) (CONTD...)



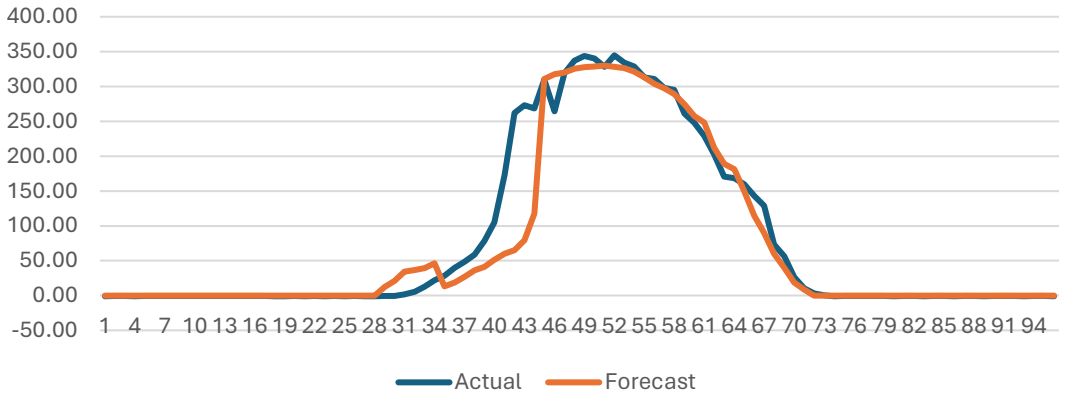




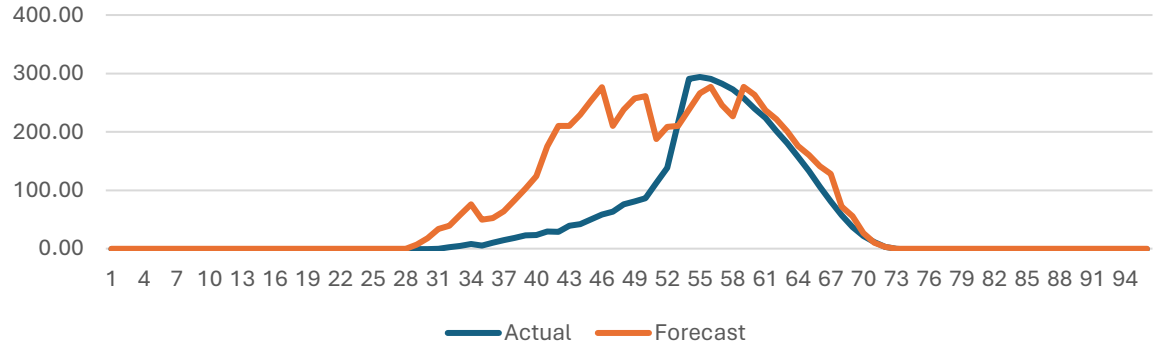


CASE STUDY-1: PLANT-1(BIKANER-350 MW) (FOGGY AND CLOUDY DAYS) (CONTD...)

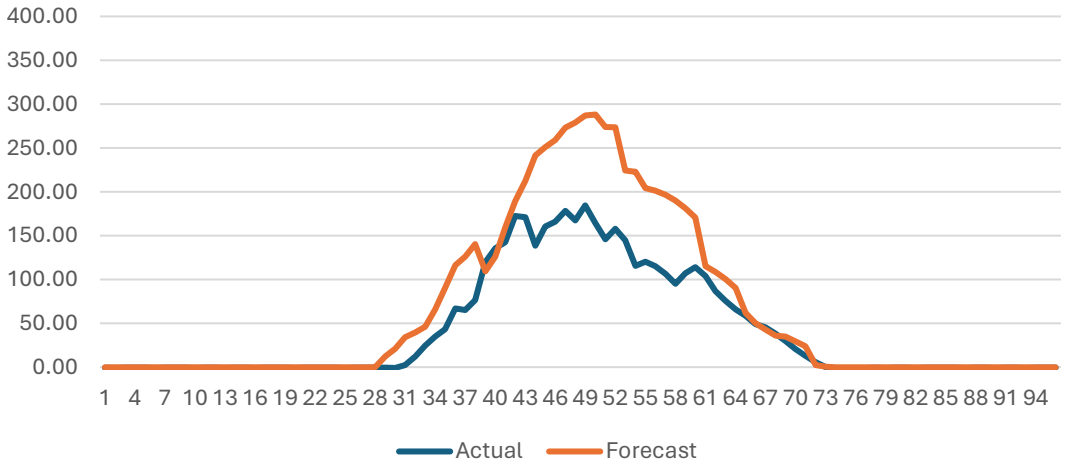
15-01-2024



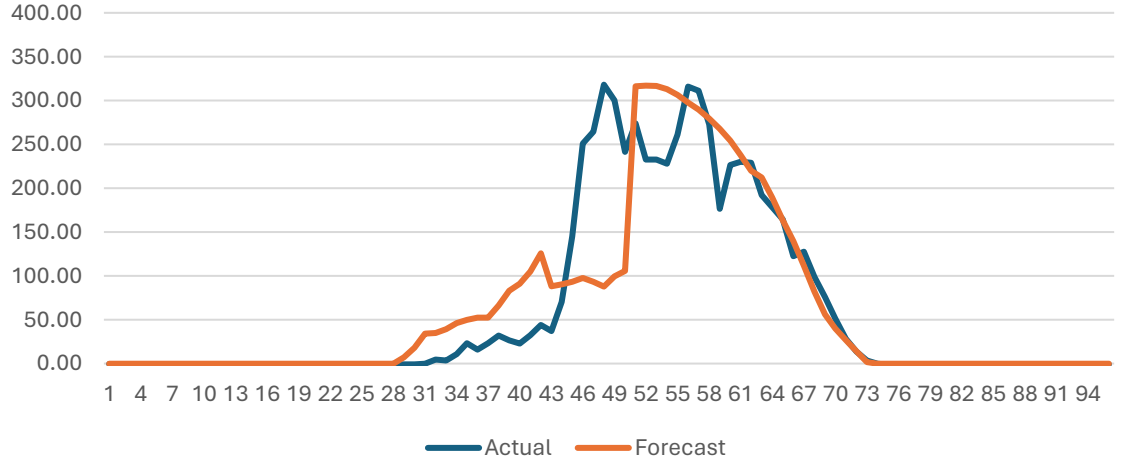
17-01-2024



28-01-2024



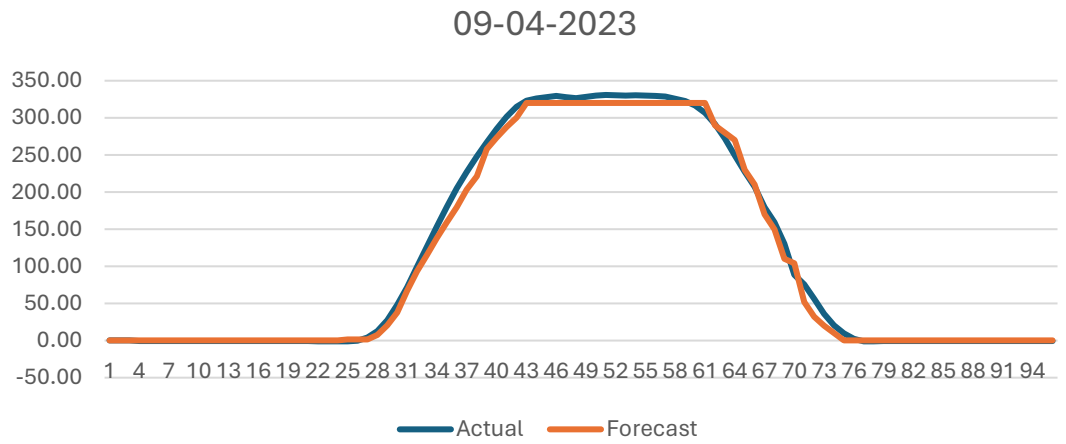
04-02-2024

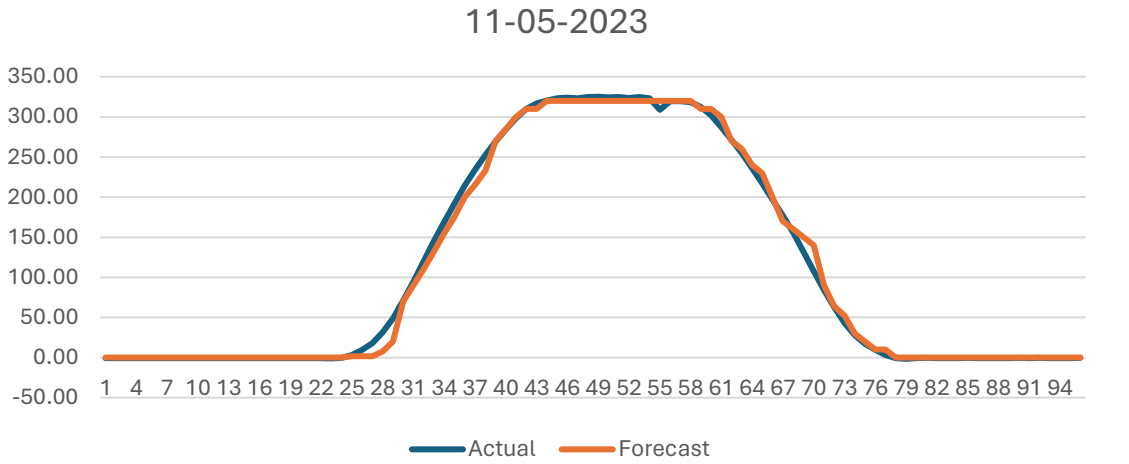


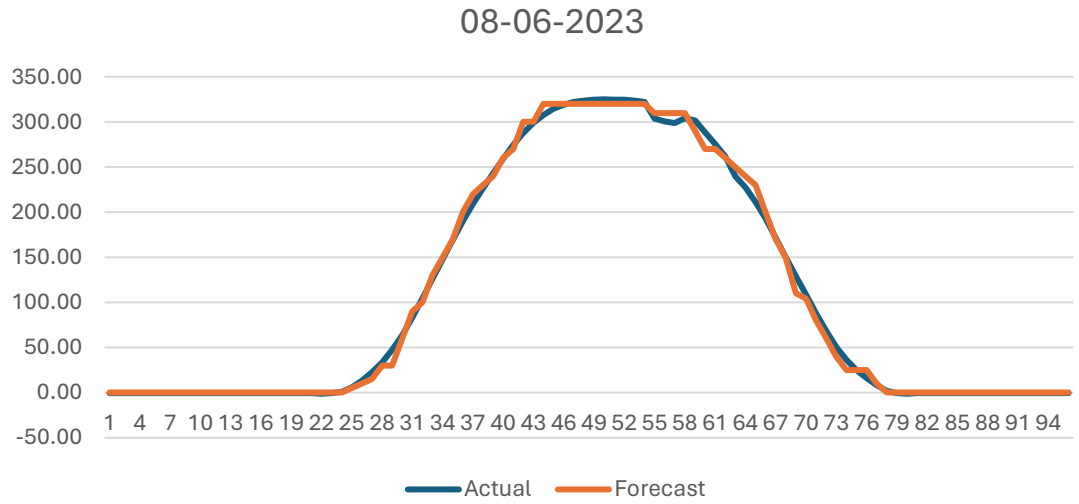
GENERATION LOSS ANALYSIS FOR PLANT-1 (BIKANER 350 MW)

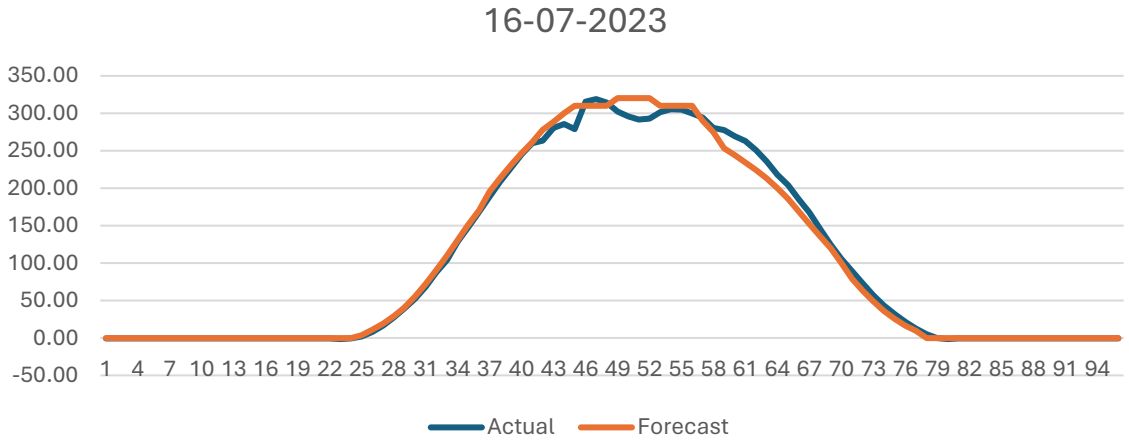
Average Generation during clear days (MWh)		2842.55		
		Bikaner-350 MW		
Date	Weather conditions	Generation (MWh)	Generation Loss (MWh)	%age Deviation
8-Apr-23	Clear Days	2831.93	-10.62	-0.37%
21-Apr-23	Clear Days	2875.05	32.5	1.14%
24-Apr-23	Clear Days	2814.99	-27.56	-0.97%
4-Jun-23	Clear Days	2848.25	5.69	0.20%
16-Oct-23	Foggy and Cloudy days	1637.09	-1205.46	-42.41%
22-Oct-23	Foggy and Cloudy days	1483.92	-1358.64	-47.80%
27-Nov-23	Foggy and Cloudy days	309.77	-2532.78	-89.10%
30-Dec-23	Foggy and Cloudy days	1000.75	-1841.81	-64.79%
31-Dec-23	Foggy and Cloudy days	1336.82	-1505.73	-52.97%
2-Jan-24	Foggy and Cloudy days	1084.21	-1758.34	-61.86%
6-Jan-24	Foggy and Cloudy days	894.95	-1947.6	-68.52%
13-Jan-24	Foggy and Cloudy days	1674.49	-1168.06	-41.09%
15-Jan-24	Foggy and Cloudy days	1923.21	-919.35	-32.34%
17-Jan-24	Foggy and Cloudy days	1059.8	-1782.76	-62.72%
28-Jan-24	Foggy and Cloudy days	1003.46	-1839.09	-64.70%
4-Feb-24	Foggy and Cloudy days	1471.43	-1371.13	-48.24%

CASE STUDY-2: PLANT-2 (BHADLA-2, 320 MW) (CLEAR DAYS)



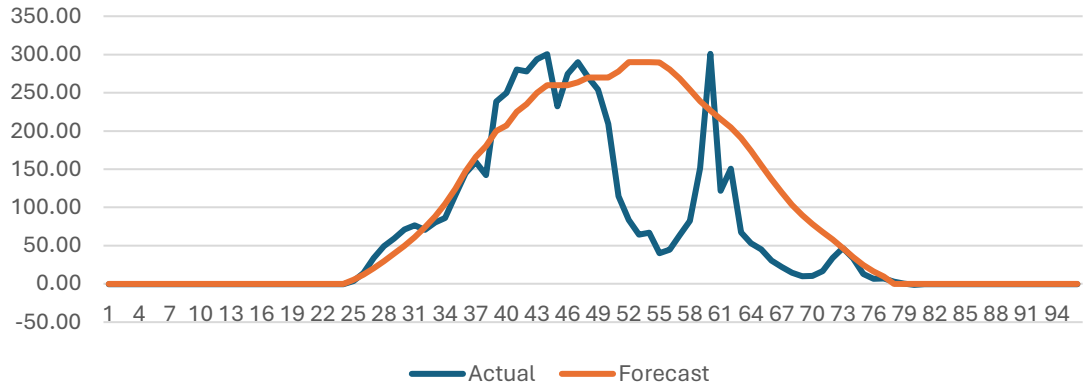




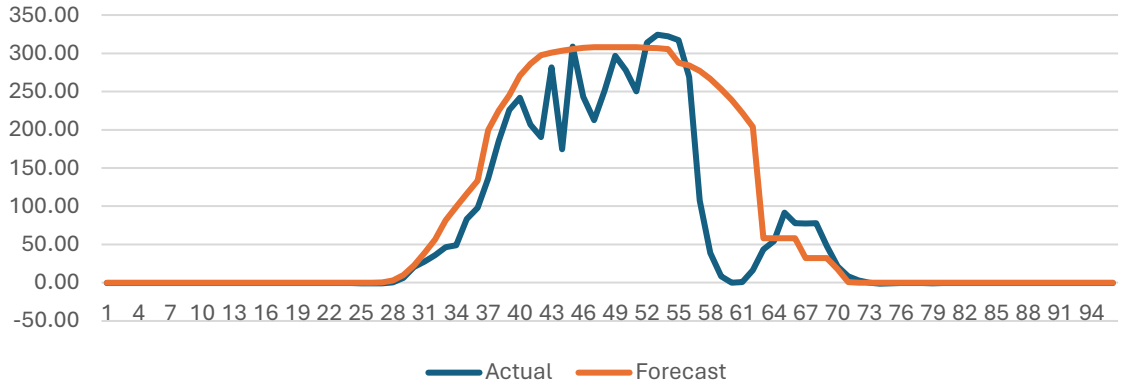


CASE STUDY-2: PLANT-2 (BHADLA-2, 320 MW) (FOGGY AND CLOUDY DAYS)

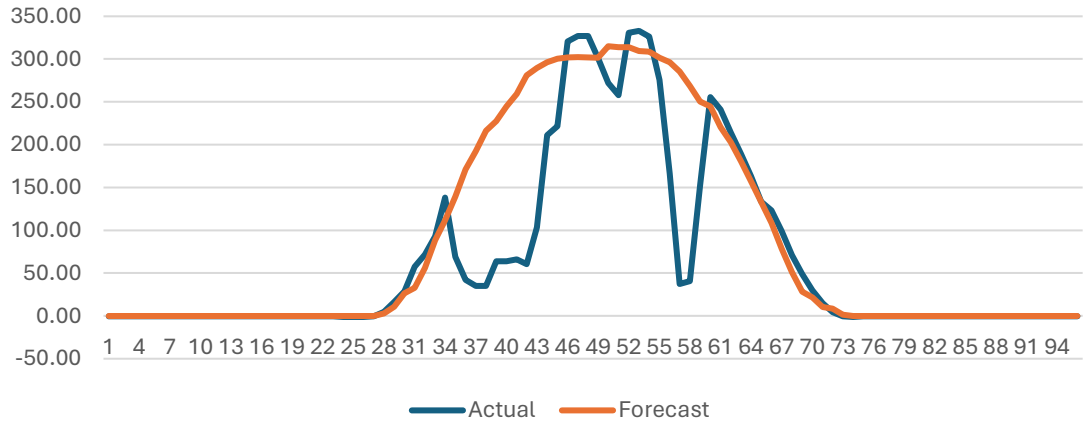
07-07-2023



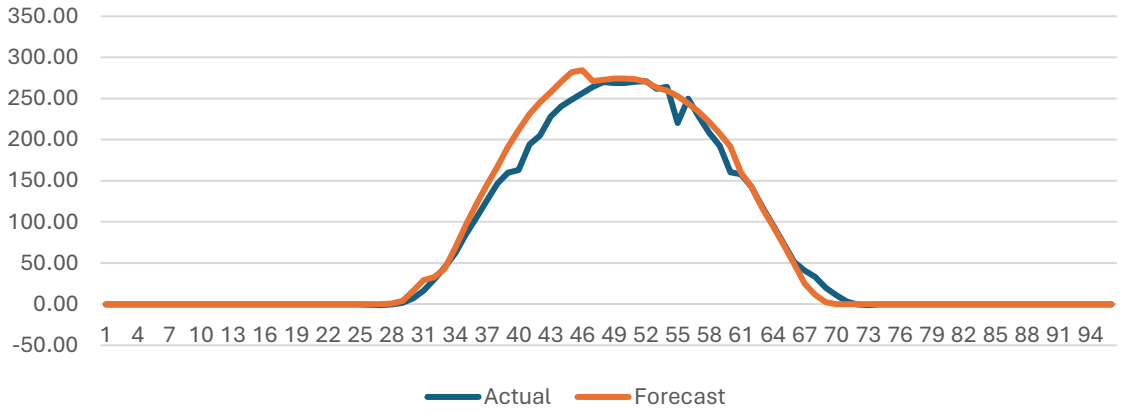
16-Oct-23



22-10-2023

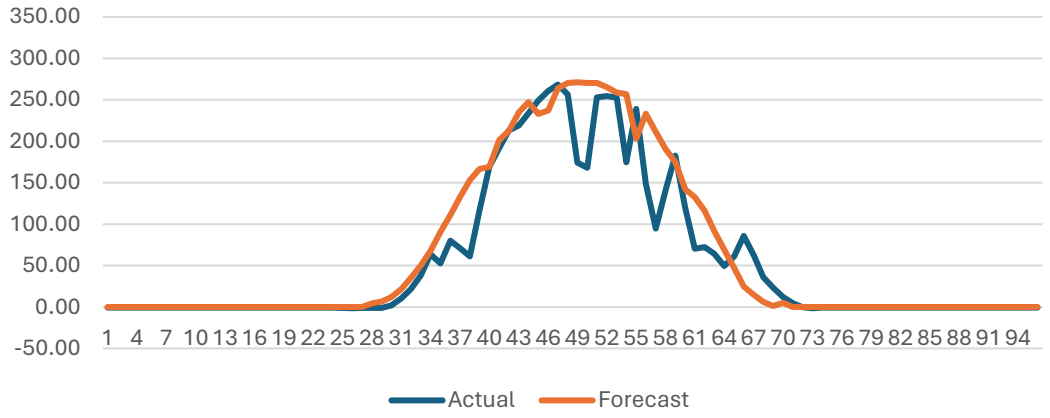


08-11-2023

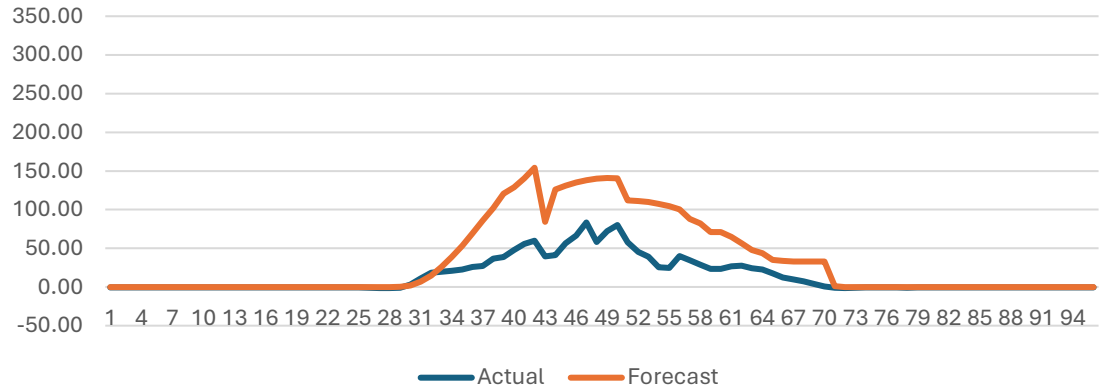


CASE STUDY-2: PLANT-2 (BHADLA-2, 320 MW) (FOGGY AND CLOUDY DAYS) (CONTD...)

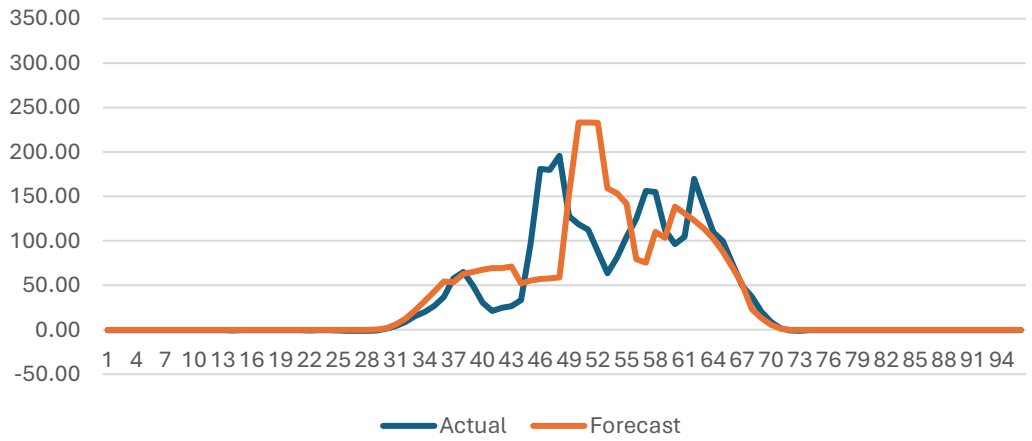
09-11-2023



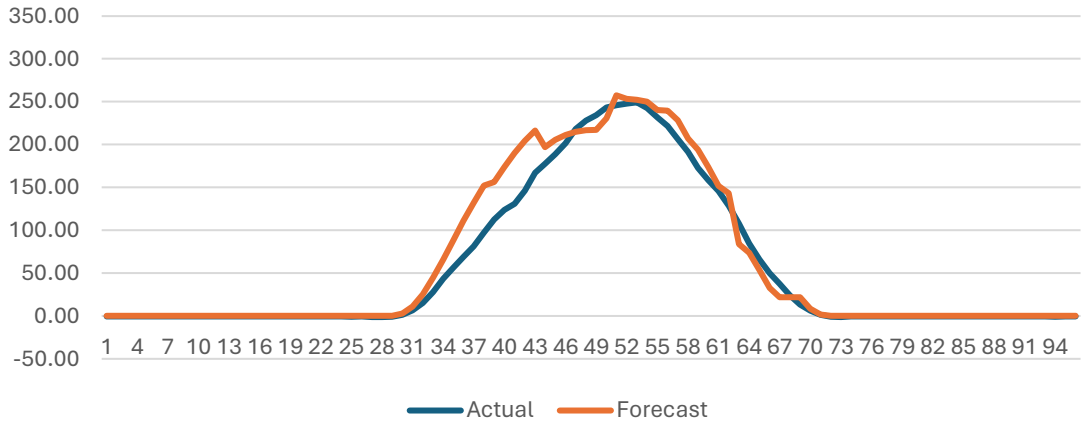
26-11-2023



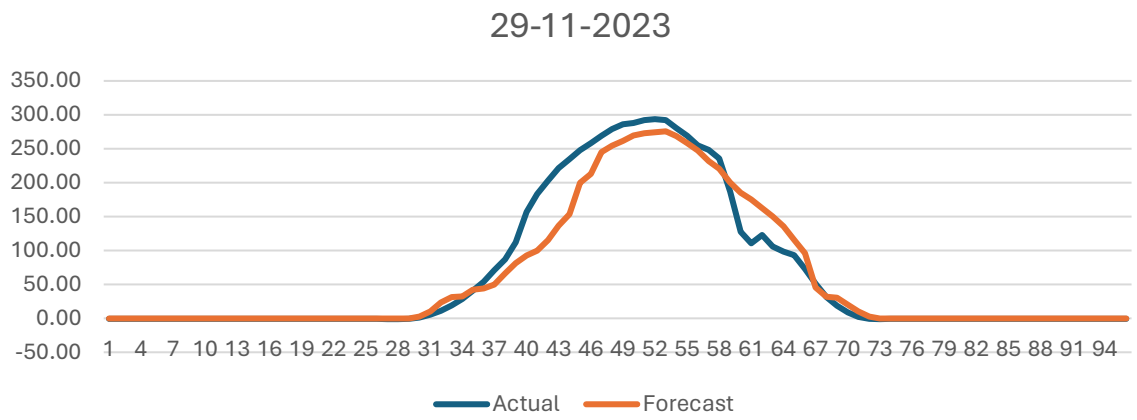
27-11-2023

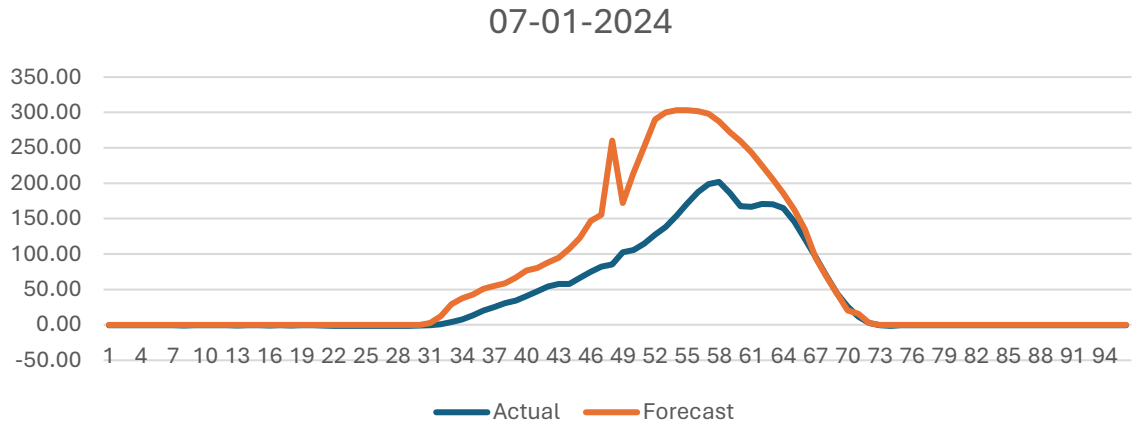


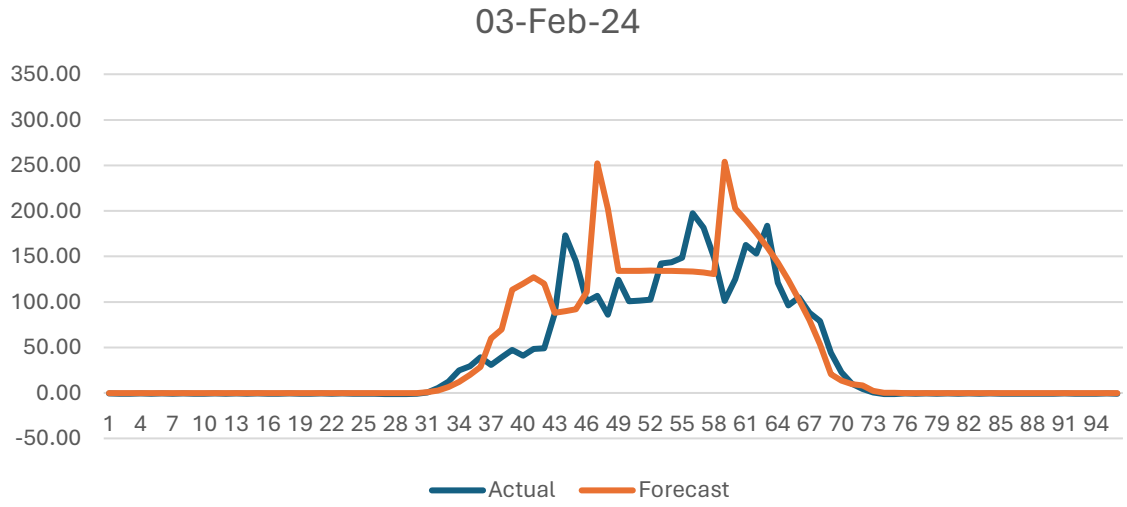
28-11-2023

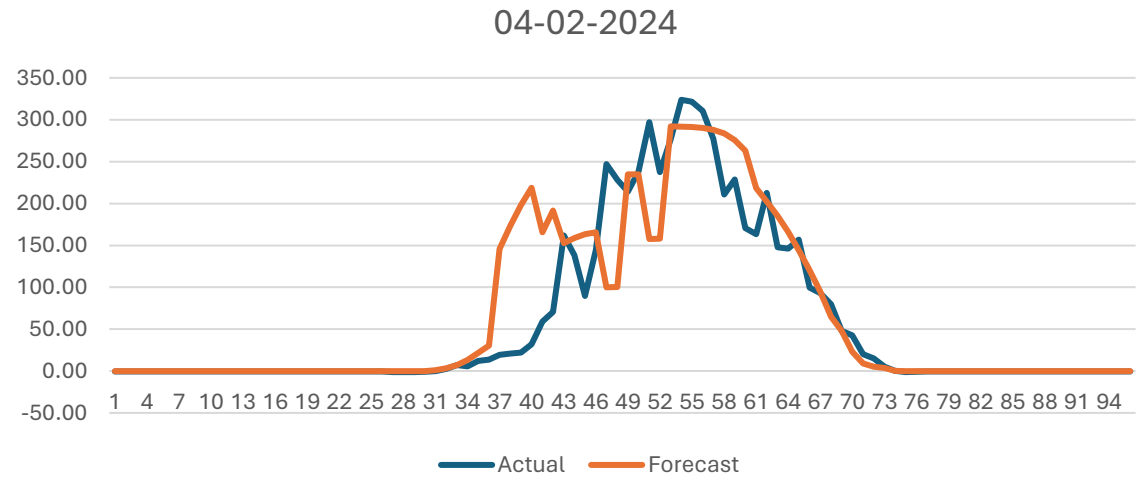


CASE STUDY-2: PLANT-2 (BHADLA-2, 320 MW) (FOGGY AND CLOUDY DAYS) (CONTD...)









GENERATION LOSS ANALYSIS FOR PLANT-2 (BHADLA-2, 320 MW)

Average Generation during clear days (MWh)		2604.18		
Bhadla-2- 320 MW				
Date	Weather conditions	Generation (MWh)	Generation Loss (MWh)	%age Deviation
9-Apr-23	Clear Days	2687.9	83.72	3.21%
11-May-23	Clear Days	2694.78	90.6	3.48%
8-Jun-23	Clear Days	2593.57	-10.61	-0.41%
16-Jul-23	Clear Days	2440.48	-163.7	-6.29%
7-Jul-23	Foggy and Cloudy days	1487.78	-1116.4	-42.87%
16-Oct-23	Foggy and Cloudy days	1509.92	-1094.26	-42.02%
22-Oct-23	Foggy and Cloudy days	1600.54	-1003.64	-38.54%
8-Nov-23	Foggy and Cloudy days	1607.07	-997.11	-38.29%
9-Nov-23	Foggy and Cloudy days	1322.69	-1281.49	-49.21%
26-Nov-23	Foggy and Cloudy days	336.51	-2267.67	-87.08%
27-Nov-23	Foggy and Cloudy days	798.24	-1805.94	-69.35%
28-Nov-23	Foggy and Cloudy days	1341.41	-1262.77	-48.49%
29-Nov-23	Foggy and Cloudy days	1553.89	-1050.29	-40.33%
7-Jan-24	Foggy and Cloudy days	1536.93	-1067.25	-40.98%
3-Feb-24	Foggy and Cloudy days	2047.01	-557.17	-21.40%
4-Feb-24	Foggy and Cloudy days	1735.07	-869.11	-33.37%

Losses attributed on account of large variation in weather conditions on cloudy & foggy days

SPDA

Bikaner-350 MW	
Date	DSM Penalty Loss (INR)
16-Oct-23	₹5,95,507.17
22-Oct-23	₹5,08,024.91
27-Nov-23	₹ 12,639.77
02-Dec-23	₹ 12,704.40
10-Dec-23	₹ 8,123.64
30-Dec-23	₹3,44,627.77
31-Dec-23	₹2,48,201.53
2-Jan-24	₹3,65,082.77
6-Jan-24	₹5,53,921.39
13-Jan-24	₹3,01,491.03
15-Jan-24	₹3,14,987.81
17-Jan-24	₹5,02,159.30
28-Jan-24	₹2,87,278.37
4-Feb-24	₹5,22,102.41

Bhadla-2-320 MW	
Date	DSM Penalty Loss (INR)
7-Jul-23	₹6,29,545.98
16-Oct-23	₹4,25,832.70
22-Oct-23	₹5,41,248.51
8-Nov-23	₹2,200.83
9-Nov-23	₹1,23,309.44
26-Nov-23	₹1,76,280.96
27-Nov-23	₹2,88,716.42
28-Nov-23	₹18,624.90
29-Nov-23	₹1,22,562.05
7-Jan-24	₹3,54,298.62
3-Feb-24	₹1,77,906.69
4-Feb-24	₹4,27,950.34

SUMMARY from CASE STUDIES

Developers are experiencing twin impacts of foggy and cloudy conditions.

- Generation losses due to foggy and cloudy weather conditions w.r.t to the normal days.
- High DSM penalties due to unpredictable weather conditions as mentioned in point (i).
- Also, due to climate change world-wide, the variability and uncertainty has increased over period and same could be observed by comparing the present years with previous years, That number of days with higher weather uncertainty has increased.

The new CERC IEGC Regulation effective from 01.10.2023, has increased the DSM penalties for the developers from less than 1% to 3% to 4% of total revenue, as the Intraday revisions are getting implemented after almost 2 hrs., under such dynamic weather conditions.

Block-wise analysis of Solar Projects w.r.t DSM penalty for Deviation Bands (SRLDC plants)

SPDA

		SRLDC --FY 2021-22 (29.03.2021-27.03.2022)											
		Plant-1 150MW						Plant-2 150MW					
S.No.	Deviation %	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	3068	3993	7061	₹0.00	40.62%	0.00%	3014	3721	6735	₹ 0.00	38.21%	0.00%
2	5%-10%	1711	2561	4272	₹0.00	24.57%	0.00%	1977	2693	4670	₹ 0.00	26.49%	0.00%
3	10%-15%	1053	1886	2939	₹0.00	16.91%	0.00%	1074	1905	2979	₹ 0.00	16.90%	0.00%
4	15%-20%	643	699	1342	₹ 318,378.69	7.72%	7.40%	611	783	1394	₹ 558,213.90	7.91%	8.12%
5	20%-25%	396	318	714	₹ 571,036.45	4.11%	13.27%	420	392	812	₹ 1,074,416.56	4.61%	15.63%
6	25%-30%	269	188	457	₹ 724,876.34	2.63%	16.84%	240	222	462	₹ 1,208,182.44	2.62%	17.57%
7	30%-50%	350	192	542	₹ 2,102,246.06	3.12%	48.85%	304	233	537	₹ 3,401,567.27	3.05%	49.48%
8	>50%	40	17	57	₹ 587,124.78	0.33%	13.64%	28	10	38	₹ 632,305.59	0.22%	9.20%
TOTAL		7530	9854	17384	₹4,303,662.32			7668	9959	17627	₹6,874,685.76		

		SRLDC FY-2022 -23 (28.03.2022-04.12.2022)											
		Plant-1 150MW						Plant-2 150MW					
S.No.	Deviation %	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	2310	2511	4821	₹0.00	39.52%	0.00%	1990	2923	4913	₹0.00	39.56%	0.00%
2	5%-10%	1336	1543	2879	₹0.00	23.60%	0.00%	1107	2199	3306	₹0.00	26.62%	0.00%
3	10%-15%	754	1080	1834	₹0.00	15.03%	0.00%	677	1282	1959	₹0.00	15.77%	0.00%
4	15%-20%	491	529	1020	₹ 248,463.81	8.36%	1.57%	403	468	871	359080.76	7.01%	1.94%
5	20%-25%	278	305	583	₹ 466,550.25	4.78%	2.95%	233	184	417	545864.83	3.36%	2.95%
6	25%-30%	178	190	368	₹ 595,589.23	3.02%	3.77%	166	65	231	618026.9	1.86%	3.34%
7	30%-50%	221	217	438	₹ 1,713,065.62	3.59%	10.84%	229	68	297	1983789.53	2.39%	10.72%
8	>50%	246	11	257	₹ 12,775,593.47	2.11%	80.86%	425	0	425	14997919.13	3.42%	81.05%
TOTAL		5814	6386	12200	₹15,799,262.38			5230	7189	12419	₹18,504,681.15		

Block-wise analysis of Solar Projects w.r.t DSM penalty for Deviation Bands (SRLDC plants) contd...

S.No.	Deviation %	SRLDC--FY-2022-23 (05.12.2022-07.02.2023)											
		Plant-1 150MW						Plant-2 150MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	859	739	1598	₹ 0.00	54.69%	0.00%	679	1098	1777	₹ 0.00	60.16%	0.00%
2	5%-10%	617	86	703	₹ 19,591.59	24.06%	1.81%	376	317	693	₹ 72,730.45	23.46%	4.57%
3	10%-15%	236	35	271	₹ 156,111.47	9.27%	14.44%	143	44	187	₹ 263,074.51	6.33%	16.52%
4	15%-20%	128	20	148	₹ 275,392.21	5.07%	25.47%	104	7	111	₹ 231,541.28	3.76%	14.54%
5	20%-25%	62	7	69	₹ 182,571.35	2.36%	16.89%	59	8	67	₹ 320,793.97	2.27%	20.14%
6	25%-30%	50	1	51	₹ 112,406.20	1.75%	10.40%	36	0	36	₹ 111,769.30	1.22%	7.02%
7	30%-50%	72	3	75	₹ 296,612.75	2.57%	27.44%	68	3	71	₹ 487,350.08	2.40%	30.60%
8	>50%	7	0	7	₹ 38,399.95	0.24%	3.55%	12	0	12	₹ 105,271.45	0.41%	6.61%
TOTAL		2031	891	2922	₹1,081,085.52			1477	1477	2954	₹1,592,531.04		

S.No.	Deviation %	SRLDC--FY-2022-23 and 2023-24 (08.02.2023-30.09.2023)											
		Plant-1 150MW						Plant-2 150MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	1874	3568	5442	₹ 0.00	47.75%	0.00%	2326	3623	5949	₹ 0.00	51.06%	0.00%
2	5%-10%	927	2419	3346	₹ 0.00	29.36%	0.00%	1128	1950	3078	₹ 0.00	26.42%	0.00%
3	10%-15%	605	585	1190	₹ 273,486.99	10.44%	2.79%	695	724	1419	₹ 537,836.28	12.18%	4.86%
4	15%-20%	377	208	585	₹ 1,339,865.37	5.13%	13.68%	408	185	593	₹ 2,006,673.70	5.09%	18.13%
5	20%-25%	242	94	336	₹ 1,878,114.79	2.95%	19.17%	206	77	283	₹ 2,576,239.31	2.43%	23.28%
6	25%-30%	157	51	208	₹ 1,839,350.95	1.83%	18.78%	136	31	167	₹ 2,344,278.69	1.43%	21.18%
7	30%-50%	218	46	264	₹ 3,859,271.07	2.32%	39.40%	142	14	156	₹ 3,331,491.65	1.34%	30.10%
8	>50%	26	0	26	₹ 605,637.99	0.23%	6.18%	7	0	7	₹ 272,130.15	0.06%	2.46%
TOTAL		4426	6971	11397	₹9,795,727.16			5048	6604	11652	₹11,068,649.78		

Block-wise analysis of Solar Projects w.r.t DSM penalty for Deviation Bands (SRLDC plants) contd...

		SRLDC FY-2023-24 (01.10.2023-31.03.2024)											
S.No.	Deviation %	Plant-1 150MW						Plant-2 150MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	1312	2850	4162	₹ 0.00	49.81%	0.00%	1822	2041	3863	₹ 0.00	45.31%	0.00%
2	5%-10%	504	2104	2608	₹ 0.00	31.21%	0.00%	854	1822	2676	₹ 0.00	31.39%	0.00%
3	10%-15%	288	395	683	₹ 152,013.85	8.17%	2.51%	413	615	1028	₹ 387,839.09	12.06%	4.00%
4	15%-20%	247	116	363	₹ 801,884.68	4.34%	13.27%	276	155	431	₹ 1,530,502.52	5.06%	15.78%
5	20%-25%	146	51	197	₹ 1,106,786.23	2.36%	18.31%	169	51	220	₹ 1,959,182.41	2.58%	20.20%
6	25%-30%	120	27	147	₹ 1,256,827.59	1.76%	20.79%	98	17	115	₹ 1,559,592.20	1.35%	16.08%
7	30%-50%	169	19	188	₹ 2,550,607.17	2.25%	42.20%	173	13	186	₹ 4,022,284.57	2.18%	41.47%
8	>50%	8	0	8	₹ 176,630.02	0.10%	2.92%	7	0	7	₹ 240,822.26	0.08%	2.48%
TOTAL		2794	5562	8356	₹6,044,749.54			3812	4714	8526	₹9,700,223.05		

It can be observed from three years data, that the average forecasting accuracy (FY-21-22 : 81.83% ; Fy-22-23 (28.03.22 to 04.12.22): 80.02% ; FY-22-23 (05.12.22 to 07.02.23): 57.41% ; FY-22-23 and 23-24 (08.02.23 to 30.09.23) : 77.28% ; FY-23-24 (01.10.23 to 31.03.24) : 78.85% remain in same range except the case when band is narrowed down, while the rate of penalization has increased every time when the regulation has been changed. So, basically it can be derived from above analysis that the grid stability is not able to enhance with frequent changes in regulation rather, it creates a source of revenue losses for the generator.

Block-wise analysis of Solar Projects w.r.t DSM penalty for Deviation Bands (NRLDC region)

SPDA

NRLDC --FY-2022-23 (28.03.2022-04.12.2022)													
S.No.	Deviation %	Plant-1 350MW						Plant-2 250MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	2811	3576	6387	₹0.00	50.57%	0.00%	3231	4289	7520	₹0.00	59.35%	0.00%
2	5%-10%	1384	2000	3384	₹0.00	26.79%	0.00%	1077	1908	2985	₹0.00	23.56%	0.00%
3	10%-15%	655	913	1568	₹0.00	12.41%	0.00%	484	561	1045	₹0.00	8.25%	0.00%
4	15%-20%	244	273	517	₹290,143.57	4.09%	4.93%	245	212	457	₹170,855.44	3.61%	5.62%
5	20%-25%	150	126	276	₹485,825.32	2.19%	8.25%	164	114	278	₹349,410.44	2.19%	11.49%
6	25%-30%	98	73	171	₹613,115.25	1.35%	10.41%	100	32	132	₹325,187.75	1.04%	10.69%
7	30%-50%	192	68	260	₹2,451,778.32	2.06%	41.65%	164	43	207	₹1,387,222.66	1.63%	45.62%
8	>50%	53	15	68	₹2,046,410.44	0.54%	34.76%	41	6	47	₹808,070.69	0.37%	26.57%
TOTAL		5587	7044	12631	₹5,887,272.90			5506	7165	12671	₹3,040,746.98		

NRLDC-- FY-2022-23 (05.12.2022-07.02.2023)													
S.No.	Deviation %	Plant-1 350MW						Plant-2 250MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	1181	800	1981	₹0.00	71.67%	0.00%	943	1060	2003	₹0.00	72.70%	0.00%
2	5%-10%	287	95	382	₹33,934.40	13.82%	1.31%	260	160	420	₹43,388.35	15.25%	2.09%
3	10%-15%	121	20	141	₹154,800.99	5.10%	5.99%	83	40	123	₹217,045.01	4.46%	10.44%
4	15%-20%	61	8	69	₹260,543.88	2.50%	10.08%	42	14	56	₹236,976.24	2.03%	11.40%
5	20%-25%	53	1	54	₹186,935.19	1.95%	7.23%	39	5	44	₹191,326.46	1.60%	9.20%
6	25%-30%	41	1	42	₹212,234.39	1.52%	8.21%	29	5	34	₹234,981.48	1.23%	11.30%
7	30%-50%	68	9	77	₹1,073,177.11	2.79%	41.50%	48	17	65	₹1,077,915.35	2.36%	51.85%
8	>50%	13	5	18	₹664,205.31	0.65%	25.69%	10	0	10	₹77,438.43	0.36%	3.72%
TOTAL		1825	939	2764	₹2,585,831.27			1454	1301	2755	₹2,079,071.32		

Block-wise analysis of Solar Projects w.r.t DSM penalty for Deviation Bands (NRLDC region) contd...

		NRLDC--FY-2022-23 and FY-2023-24 (08.02.2023-30.09.2023)											
S.No.	Deviation %	Plant-1 350MW						Plant-2 250MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	3674	4297	7971	₹0.00	66.23%	0.00%	2127	4754	6881	₹0.00	57.12%	0.00%
2	5%-10%	1131	1182	2313	₹0.00	19.22%	0.00%	779	2262	3041	₹0.00	25.24%	0.00%
3	10%-15%	481	222	703	₹359,637.72	5.84%	1.86%	386	572	958	₹348,282.42	7.95%	2.31%
4	15%-20%	262	101	363	₹1,718,709.86	3.02%	8.88%	255	163	418	₹1,447,414.54	3.47%	9.58%
5	20%-25%	176	54	230	₹2,729,085.16	1.91%	14.10%	182	61	243	₹2,108,685.99	2.02%	13.96%
6	25%-30%	127	26	153	₹2,839,577.96	1.27%	14.67%	143	22	165	₹2,117,669.19	1.37%	14.02%
7	30%-50%	204	41	245	₹8,048,091.56	2.04%	41.58%	225	52	277	₹6,440,238.65	2.30%	42.64%
8	>50%	53	4	57	₹3,660,905.19	0.47%	18.91%	58	5	63	₹2,641,823.26	0.52%	17.49%
TOTAL		6108	5927	12035	₹19,356,007.45			4155	7891	12046	₹15,104,114.05		

		NRLDC -- FY-2023-24 (01.10.2023-31.03.2024)											
S.No.	Deviation %	Plant-1 350MW						Plant-2 250MW					
		Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)	Under-Injection Blocks	Over-Injection Blocks	Total Blocks	Penalty (INR)	%age of Total Blocks	Penalty (%age)
1	0%-5%	2585	2226	4811	₹0.00	58.98%	0.00%	1871	2445	4316	₹0.00	53.24%	0.00%
2	5%-10%	1125	851	1976	₹0.00	24.22%	0.00%	545	1653	2198	₹0.00	27.12%	0.00%
3	10%-15%	480	141	621	₹294,084.32	7.61%	2.24%	292	498	790	₹278,554.85	9.75%	3.01%
4	15%-20%	217	41	258	₹1,129,294.38	3.16%	8.59%	185	128	313	₹1,069,656.73	3.86%	11.54%
5	20%-25%	144	14	158	₹1,724,604.07	1.94%	13.11%	132	65	197	₹1,855,961.53	2.43%	20.02%
6	25%-30%	87	11	98	₹1,759,570.32	1.20%	13.38%	82	24	106	₹1,454,695.71	1.31%	15.69%
7	30%-50%	140	41	181	₹4,923,393.75	2.22%	37.43%	127	42	169	₹3,911,402.29	2.08%	42.20%
8	>50%	48	6	54	₹3,322,907.50	0.66%	25.26%	15	2	17	₹698,840.49	0.21%	7.54%
TOTAL		4826	3331	8157	₹13,153,854.34			3249	4857	8106	₹9,269,111.60		

Observations from Block-wise Analysis

- With amendments and frequent changes in the CERC DSM Regulations resulting in narrowing of the band, it can be observed that the rate of penalization has been increased and it has not at all impacted the forecasting efficiency, thereby contributing to higher grid unstability and higher revenue losses for the developers.
- Hon'ble CERC draft DSM proposal 2024, seems to focus on revenue enhancing model rather than focusing on enhancement of grid stability, as in this new regulation also, the rate of penalization has been increased while narrowing the deviation band. If it came into force, will results in higher revenue losses for the developers, as compared to current regulations, which on average will rise from 3.49% to almost around 5.5% of the total revenue loss, which will impact developers quite badly.
- It seems that the draft DSM proposal 2024, has not considered any of the challenges faced by the RE developers in load forecasting of solar and wind, since it works on only two things viz. narrowing of deviation band, increasing rate of penalization also keeping the clause related to Intraday revisions to be implemented from 7^{th} and 8^{th} time block from the

HON'BLE HIGH COURT COMMENTS ON DSM

- Hon'ble High court order on RERC Wind and Solar DSM regulation 2017 w.e.f 01.01.2018:

"*…Regulatory Commission to bear in mind the facts that in the case of generation by wind energy, the scheduling or forecasting may not be as accurate or flawless as in case of thermal power or other traditional mode of generation of electricity.*"

Hon'ble High court directed RERC to conduct Public Hearing and Until then RRVPNL shall remain restrained from recovering the deviation charges from the petitioners and/or QCAs.

DRAFT CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2024

(4) Charges for Deviation, in respect of **a WS Seller being a generating station based on wind or solar or hybrid of wind–solar resources,** including such generating stations aggregated at a pooling station through QCA shall be without any linkage to grid frequency, as under:

Deviation by way of over injection (Receivable by the Seller)	**Deviation by way of under injection (Payable by the Seller)**
(i) for $VLw_S(1)$ @ contract rate; (ii) for $VLw_S(2)$ @ 90% of contract rate (iii) for $VLw_S(3)$ @ 50% of contract rate, (iv) beyond $VLw_S(3)$ @ Zero;	v) for $VLw_S(1)$ @ contract rate; (vi) for $VLw_S(2)$ @ 110% of contract rate; (vii) for VL_{S3} @ 150% of contract rate; (viii) beyond $VLw_S(3)$ @ 200% of contract rate.

Note: Volume Limits for WS Seller :

WS Seller	**Volume Limit**
A generating station based on solar or a hybrid of wind –solar resources or aggregation at a pooling station	$VLw_S(1)$ = Deviation up to 5% D_{WS} $VLw_S(2)$ = Deviation beyond 5% D_{WS} and up to 10% D_{WS} $VLw_S(3)$ = Deviation beyond 10% D_{WS} and up to 20% D_{WS}

DRAFT CERC (DEVIATION SETTLEMENT MECHANISM AND RELATED MATTERS) REGULATIONS, 2024

As per the Draft Notification No. L-1/260/2021/CERC, the regulations titled : CERC (Deviation Settlement Mechanism and Related Matters) Regulations,2024 are introduced.

As per this new regulation, it seems that the objective is to implement the original version of the CERC (Deviation Settlement Mechanism and Related Matters) Regulations,2022, which was havoc for grid stability as well as connected RE developers.

Deviation slabs are reduced from 10% to 5% without having thorough analysis of this impact along with the IEGC Regulations which have made Intraday revisions effective from 7th and 8th time blocks if made during odd or even time blocks respectively..

On analysis of draft proposal on current scenario, it is observed that average %age revenue losses for RE developers will further increase from 3.5% to 8.10%,which will be a huge loss for RE developers, thereby discouraging them to further invest in RE plants..

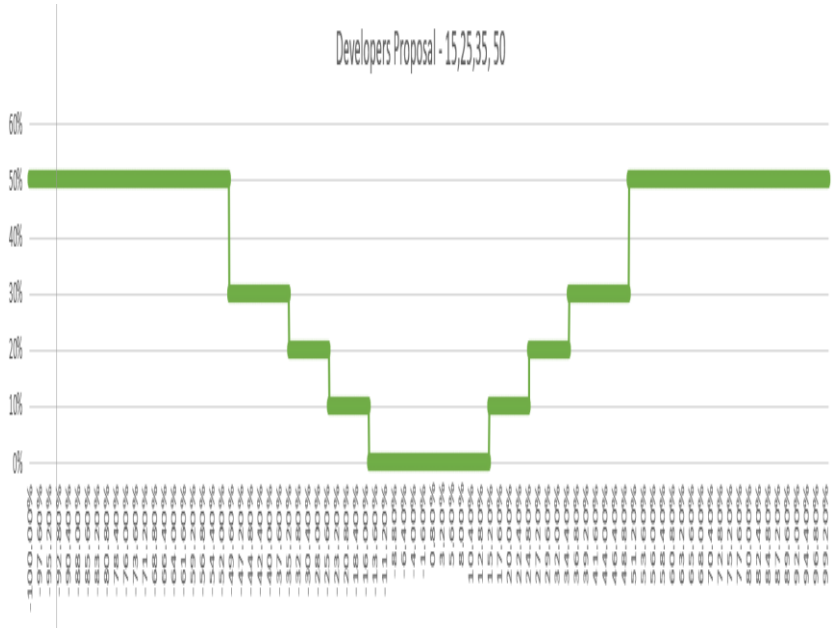
SUMMARY

- Looking at other developed and developing countries Regulations. Their laws are quite relaxed w.r.t the deviation bands for RE generators/sellers. Few examples are: European countries like: Germany, England and developing countries like: Brazil, Philippines, Colombia, Vietnam. However, in India, the Regulations seems to be de-motivating factor looking at the target of GoI of achieving 500 GW grid connected RE plants.
- The Intraday revisions implementation from 7th and 8th time block, must be repealed and it must be implemented from 2nd time blocks, specifically in case of RE plants. So, that grid stability can be maintained.
- The aggregation of developers at PSS end along with suitable solution to resolve any issue pertaining to settlement of payments between QCA and RE developers must be provided in the Regulations.

SPDA

SPDA PROPOSAL

	Deviation slab range	Penalty rate
Developers Proposal	15% to 25%	10% of PPA
	25% to35%	20% of PPA
	35% to 50%	30% of PPA
	>50%	50% of PPA



Proposal contd....

In case of generation loss due to uncertainty in weather conditions, it must be considered under Force Majeure conditions and relaxation must be provided to developers as the PPAs of the generating plants are in terms of generation units and the generators due to weather variability are unable to fulfill their commitments and loose revenue due to DSM provisions.

The forecasting and scheduling may be taken up by GRID-INDIA / RLDC / REMCs for accurate forecast, the fees for such activities will be borne by the generators/developers.

In case of such sudden deviations under high fluctuations of weather conditions, the Grid Controller/ RPCs must consider the forecasted load equal to the actual load for the number of time blocks in which such heavy deviations are observed.

The revenue generated from DSM settlement by RLDCs must be used for exploration, research regarding installation of BESS system at RE plants, to mitigate such heavy deviations due to cloud movements.

Provisions on IEGC Regulations to be implemented in totality, including aggregation of generators at pooling stations, as per clause no 45 (11)(b), and (11)(c).

The implementation period for effectivity of revisions in schedule may be made from 2nd time block onwards or 4th time block as per previous IEGC Regime

Allow aggregation at State level as recommended in the NREL, MNRE report/FOR Model. This may be implemented as part of the Regulatory Sandbox mechanism as adopted by finance sector regulator such as RBI, SEBI, IRDAI, PFRDA etc.

Forecasting should be made centralized as followed by other developed countries like USA, Australia, Germany, Spain etc. The forecasting charges to be shared amongst RE Generators.

DSM REGULATIONS IN OTHER EUROPEAN AND DEVELOPING COUNTRIES

European Energy Markets- Imbalance calculations for Conventional Generator and Consumer

Country	Day ahead Markets (Schedule Granulite)	TSOs	IB Settlement	Imbalance settlement for Renewable Energy Sources	Imbalance Positions for generation and consumption
Spain	60 Mins	Red Eléctrica de España	Two price system	Imbalance is calculated at the TSO level	Separate imbalance position for Generation and consumption
France	30 Mins	RTE France	Single pricing system	Imbalance settlement is exempted for Renewable Energy Sources	Same imbalance position for Generation and consumption
Belgium	15 Mins	ELIA	two price system	Imbalance is calculated at the TSO level	Same imbalance position for Generation and consumption
Netherland	15 Mins	TenneT	Single pricing system		
Germany	15 Mins	50 Hz,			
Austria	15 Mins	TRANSNETBW GmBH			
Poland	15 Mins	PSE	two price system		
Italy		TERNA	two price system	Imbalance is Calculated for each consumption or production unit	NA
Portugal		REN	NA	Imbalance is calculated by imbalance area.	NA
Sweden	60 Mins	Svenska kraftnat	Two pricing for generation and single pricing for consumption	Imbalance calculated at the TSO level	Separate imbalance position for Generation and consumption
Norway	60 Mins	Statnett			
Denmark	60 Mins	Energinet			

European Energy Markets- Exemptions for Renewable Energy source in imbalance settlements

- Renewable energy sources are exempted from paying imbalance charges for following countries in Europe-:
  1. France
  2. Slovakia
  3. Hungary
  4. Lithuania
  5. Serbia
  6. Monaco

DSM REGULATIONS IN OTHER DEVELOPING COUNTRIES

Philippines	Gaps: There are no penalties for high-deviation forecasts. Recommendations: • Initiate modest penalties for large deviations to improve forecasting accuracy. • Use information about VRE forecasting uncertainty for improving dispatching and reserves planning.
Colombia	Gaps: Very small amount of installed VRE capacity compared to the high potential for VRE. A new VRE forecasting policy is currently in place, and a pilot is ongoing. Recommendations: • Work with weather services and meteorological research agencies to significantly improve weather forecasting accuracy specific to parameters of interest to VRE forecasting. • Use information about VRE forecasting uncertainty for improving dispatching and reserves planning.
Vietnam	Gaps: No policy is currently in place, although there are active discussions by the dispatch center regarding alternatives for the design of a VRE forecasting framework. Recommendations: • Design a fast dispatching framework that includes VRE forecasting policy and regulations, detailed design of the process, and data requirements from generators and others. • Conduct a pilot to assess the achievable accuracy of VRE forecasting, readiness of dispatch centers to integrate VRE forecasting into dispatching, and current level of weather forecasting accuracy of parameters like solar irradiation and wind speed at 50+ meters above ground level. • Upgrade dispatching systems to sub-hourly dispatches.

THANK YOU

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Additional comments on draft CERC (Deviation Settlement Mechanism and related matters) Regulations, 2024

The Deviation Settlement Mechanism (DSM) was established to safeguard grid stability amidst the growing disparities between scheduled and actual energy production. We wish to draw attention to the fact that while these deviations have largely remained consistent since 2015, the financial ramifications on Renewable Energy (RE) generators have escalated significantly.

The proposed DSM mechanism appears to prioritize commercial interests over technical imperatives essential for grid stability. It's noteworthy that although solar energy generation capacity has advanced since 2015, the technology for weather prediction available to generators/QCAs hasn't progressed at a commensurate pace. Consequently, generators still face substantial DSM penalties, leading to diminished revenue.

It's important to recognize that the primary responsibility of solar generators is electricity generation, contingent upon local weather conditions. Expecting them to accurately forecast weather, in addition to their core activities, imposes undue burdens and costs. Despite earnest efforts, current technologies fail to accurately predict critical factors like cloud cover, crucial for solar irradiation stability.

Reasons for the inefficiency of weather forecasting agencies:

- Technological limitations persist, with existing methods and technologies such as Numerical models, AI models, satellite-based cloud vector forecasting, and cloud sensors falling short of desired accuracy.
- Infrastructure constraints, particularly the scarcity of accurate radars under government control, further hinder accurate forecasting.
- Temporal and spatial limitations impede forecasting precision, with agencies unable to provide forecasts with sufficient lead time or fine-grained spatial resolution.
- Rapidly changing cloud formations, including localized, fast-moving, momentary, and low-level clouds, pose additional challenges.

Efforts undertaken by stakeholders:

- Solar developers and QCA agencies have collaborated with expert weather forecasting agencies to enhance forecasting accuracy.
- Real-time data sharing between RE developers and agencies aims to refine AI-based forecasting models.
- Collaboration with government agencies seeks to augment numerical weather models through shared data.

Initiatives by the CEA:

- An expert committee, comprising government agencies and RE developers, was formed to enhance weather forecasting accuracy.
- The IMD showcased existing weather products to RE developers, focusing on radar technology, albeit primarily for rainfall or lightning prediction.
- The NCMRWF is enhancing forecasting accuracy based on numerical models, with increased data sharing aiding model validation.

Conclusion and suggestions:

Presently, forecasting accuracy falls short of expectations, acknowledged by both the IMD and NCMRWF in recent public forums. The reliance on commercial mechanisms for forecasting accuracy overlooks the technological realities. Collaboration among RE developers, weather forecasting agencies, and government departments, led by government agencies, is vital for achieving desired forecasting accuracy. Regulators should periodically assess technological maturity and adjust commercial Regulations accordingly, considering consultation with IMD and NCMRWF essential. Until then, reverting to 2014 Regulations seems prudent.

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