

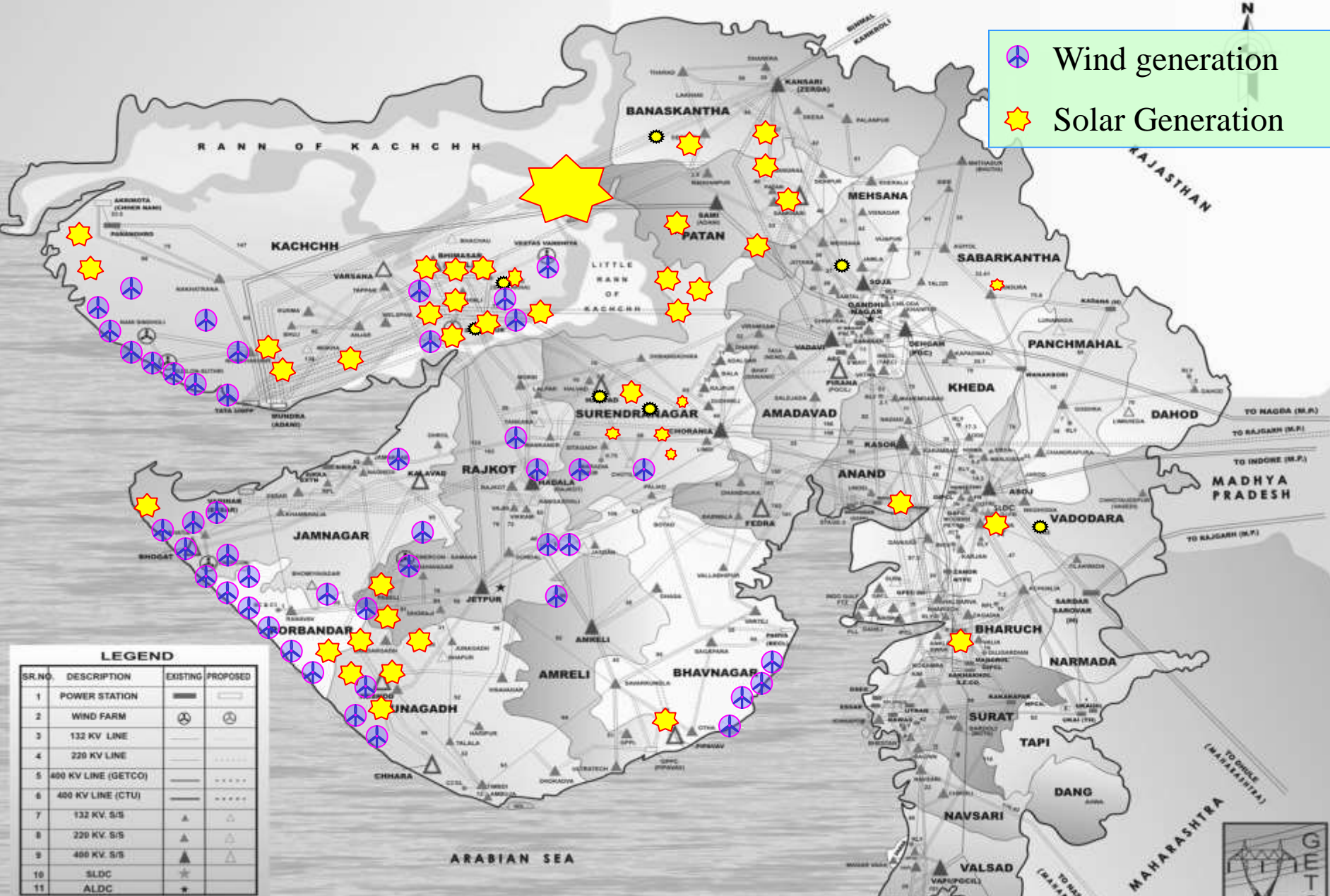


Gujarat Energy Transmission Co. Ltd.
State Load Dispatch Centre,
Gujarat

POWER MAP OF GUJARAT

 Wind generation
 Solar Generation



LEGEND

SR.NO.	DESCRIPTION	EXISTING	PROPOSED
1	POWER STATION		
2	WIND FARM		
3	132 KV LINE		
4	220 KV LINE		
5	400 KV LINE (GETCO)		
6	400 KV LINE (CTU)		
7	132 KV. S/S		
8	220 KV. S/S		
9	400 KV. S/S		
10	SLDC		
11	ALDC		

FIGURE SHOWS LINE LENGTH IN KMS.
 PREPARED BY: M.N.SHAH, Jr. Engineer
 Map City dated up to January '88





Renewable Energy

- Amongst renewable energy from wind, solar, biomass, geo-Thermal, mini Hydro etc, the Solar and Wind energy plays the important role in the system operation due to its invariable and uncertain nature, mostly wind Energy.
- Commission, therefore, intends to review the RRF mechanism approved vide order dated 9.7.2013 after giving due consideration to interests of the wind generators and other stakeholders as well as in the interest of safe, secure and reliable operation of the grid. **While the forecasting and scheduling of wind generation shall continue as per the provisions of the Grid Code and RRF procedure approved vide order dated 9.7.2013, the commercial mechanism outlined therein shall remain suspended till further orders.**

- Solar generation forecasting Overall



Solar generation summary 2013-14

Date	Variation in Solar gen.		Max MW
		Mus	
21.03.14	Max	4.972	683
04.07.13	Min	0.729	92

- Note: solar generation considered during a day period only.
- “No solar generation during evening peak period”
- “Temperature, UV index, humidity etc... data reliability is most effected to the forecast.”
- “Forecast of solar most affected during rain falling or cloud cover.”
- **Solar ramp up and ramp down plays the crucial role in system operation.**
- **Generally, Solar generation keep previous day solar generation pattern except in rainy or cloudy days.**

Solar Energy

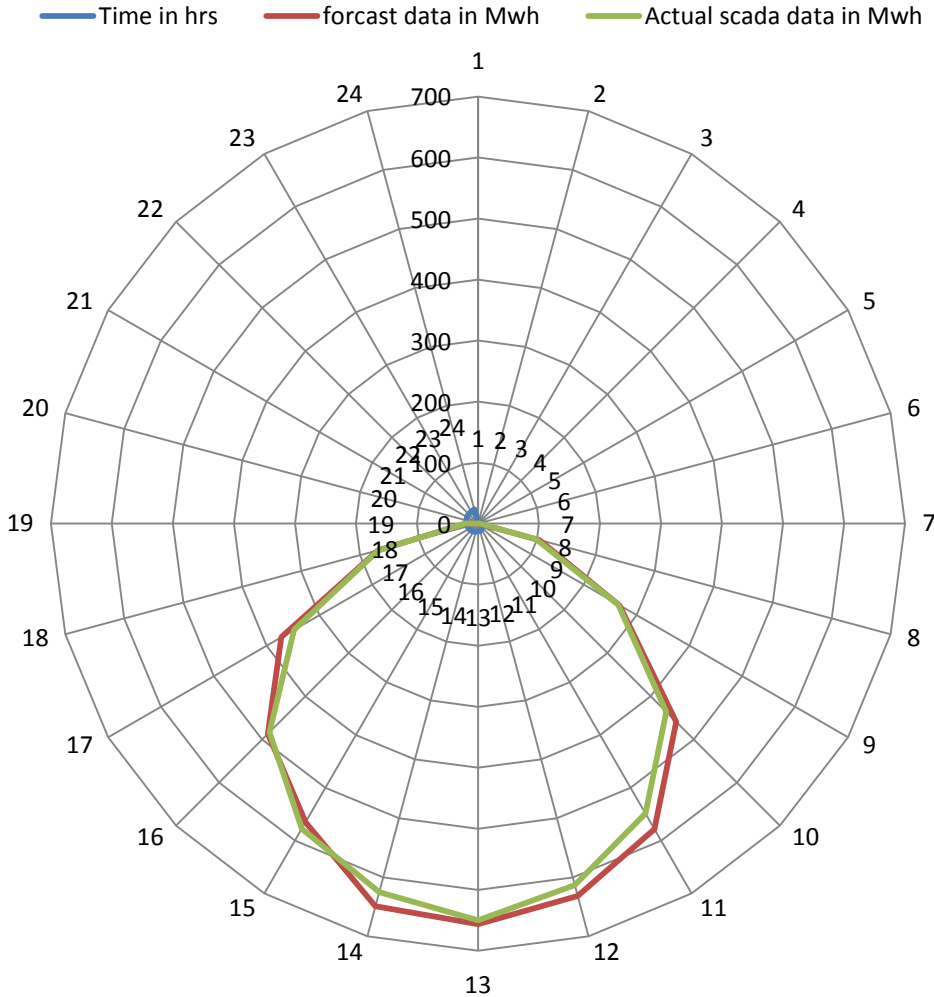
- 77 Nos of [solar plants](#)
- 856.81 MW installed capacity including
- 223.98MW (Charanaka solar park)
- In, Gujarat, All Solar, except 5MW & below, fall under RRF which provide the Declaration.
- Even for forecasting -based on temperature of same day w.r.t previous day temperature (hourly data may taken threw www.accuweather.com)
- $(G2 = (t2/t1) * G1)$ where $t2$ same day temp, $t1$ previous day temp and $G1$ previous day solar gen & $G2$ output of same day solar gen) in response to:
- Bifurcation into 17 Region for overall forecast
 - Anjar (35.00MW)
 - Bhachau (54.93MW)
 - Bharuch (06.00MW)
 - Dhanera (25.00MW)
 - Dwarka (25.00MW)
 - G,Nagar (3.00MW)
 - Halwad(73.00MW)
 - Harij (30.20MW)
 - Junagadh (50.00MW)
 - Khambhat (6.00MW)
 - Nakhatrana (45.00MW)
 - Patan (56.50MW)
 - Radhanpur (223.98MW)
 - S'nagar (118.00MW)
 - Talod (20.20MW)
 - Una (20.00MW)
 - Upleta (55.00MW)



High sunlight Period -Solar Forecast vs Actual gen for 11.04.14



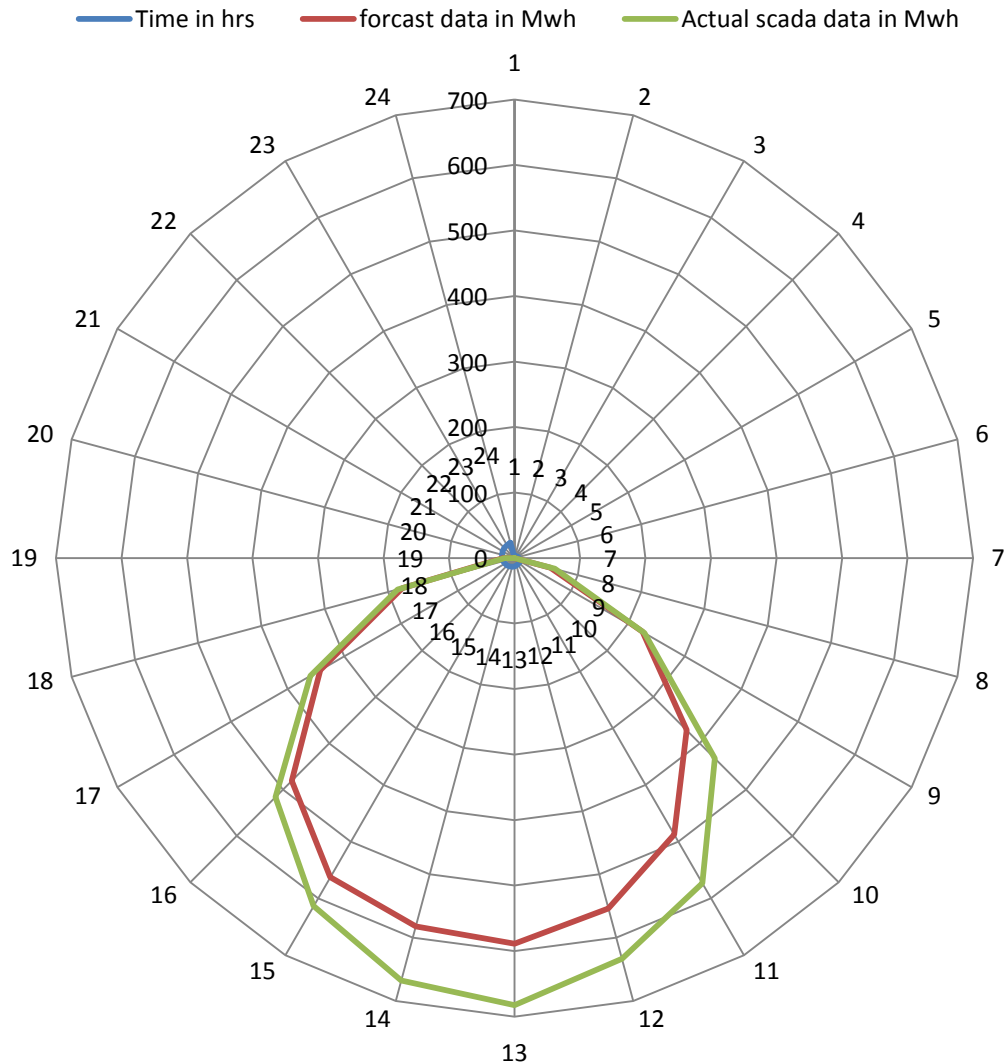
Solar Forecast vs Actual gen for 11.04.2014



Time in hrs	Average Temp C	forecast data in Mwh	Actual scada data in Mwh	Diff Mwh (F-A)
1	27	0	0	0
2	27	0	0	0
3	26	0	0	0
4	25	0	0	0
5	24	0	0	0
6	24	0	0	0
7	23	1	3	-2
8	24	104	98	6
9	26	268	266	2
10	26	459	436	23
11	28	578	549	29
12	31	632	613	18
13	33	656	650	6
14	35	649	625	24
15	37	565	578	-13
16	38	487	483	4
17	38	372	348	24
18	37	170	169	0
19	36	20	21	0
20	34	0	0	0
21	32	0	0	0
22	31	0	0	0
23	30	0	0	0
24	29	0	0	0
Total		4.96	4.84	0.12

Solar Forecast vs Actual gen for 21.03.14

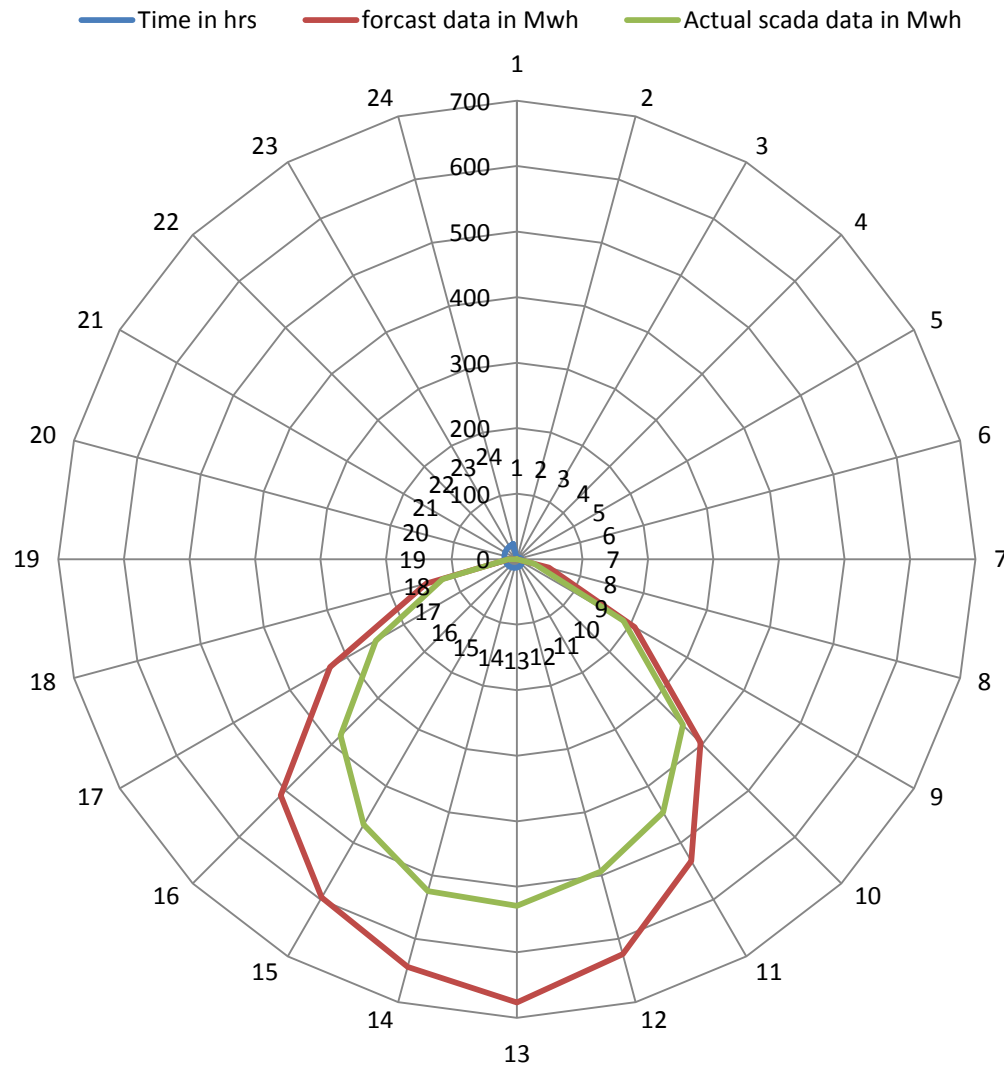
Highest 4.972 Mu's of Solar gen in March month



Time in hrs	Average Temp C	forecast data in Mwh	Actual scada data in Mwh	Diff Mwh (F-A)
1	25	0	0	0
2	24	0	0	0
3	24	0	0	0
4	22	0	0	0
5	22	0	0	0
6	21	0	0	0
7	20	0	0	0
8	20	57	64	-7
9	22	225	229	-4
10	22	371	433	-61
11	25	487	574	-86
12	27	554	633	-80
13	28	589	683	-94
14	30	582	668	-86
15	32	562	613	-51
16	33	481	516	-35
17	33	342	360	-17
18	34	178	185	-7
19	32	17	15	3
20	31	0	0	0
21	29	0	0	0
22	28	0	0	0
23	27	0	0	0
24	26	0	0	0
Total		4.45	4.97	-0.52

Solar Forecast vs Actual gen for 03.03.14

Lowest 3.796 Mu's of Solar gen in March month



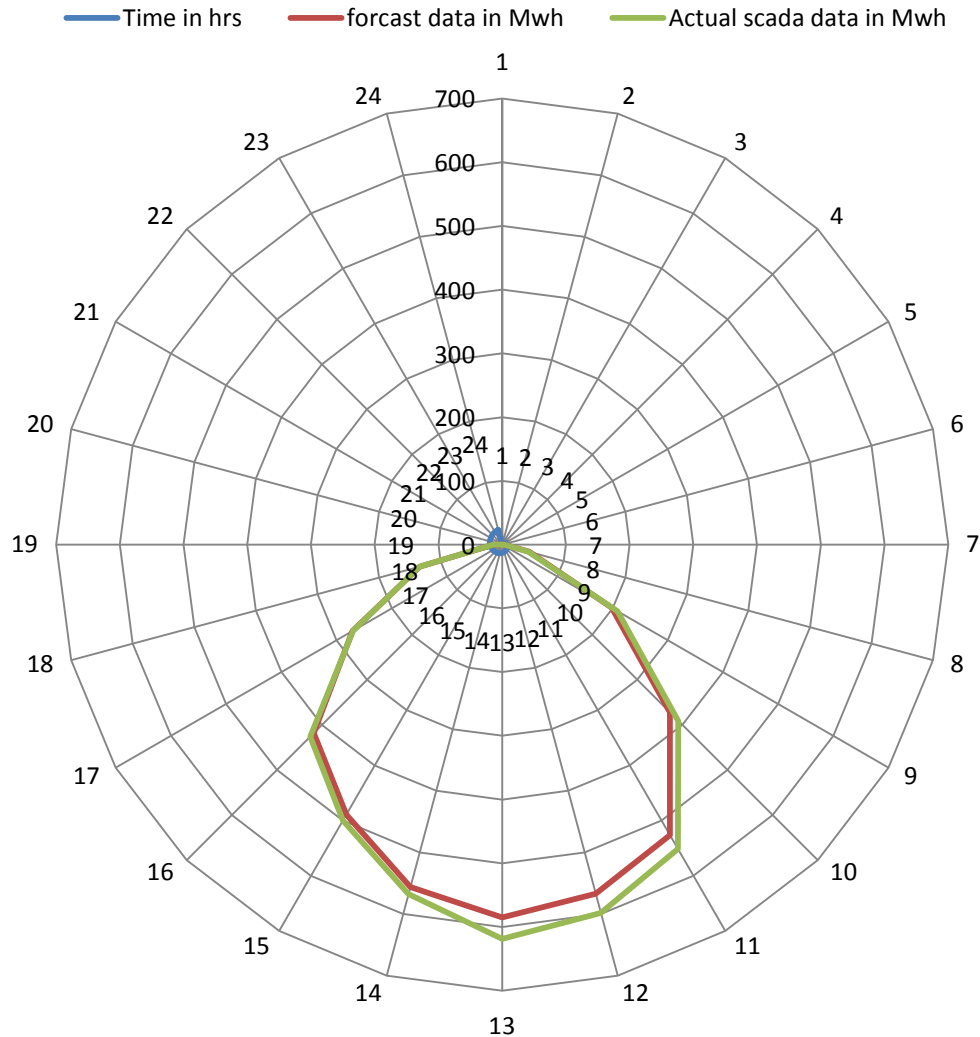
Time in hrs	Average Temp C	forecast data in Mwh	Actual scada data in Mwh	Diff (F-A)
1	21	0	0	0
2	21	0	0	0
3	20	0	0	0
4	18	0	0	0
5	17	0	0	0
6	17	0	0	0
7	17	0	0	0
8	18	50	27	23
9	19	208	188	20
10	20	396	358	38
11	22	532	446	86
12	25	624	494	130
13	27	677	529	148
14	28	644	525	120
15	30	596	468	128
16	31	510	381	129
17	31	330	249	81
18	30	143	118	26
19	29	13	14	-1
20	27	0	0	0
21	26	0	0	0
22	25	0	0	0
23	24	0	0	0
24	23	0	0	0
Total		4.72	3.80	0.93

Solar Forecast vs Actual gen for 11.03.14

Average 4.580 Mu's of Solar gen in March month



Solar Forecast vs Actual gen for 11.03.2014



Time in hrs	Average Temp C	forecast data in Mwh	Actual scada data in Mwh	Diff Mwh (F-A)
1	25	0	0	0
2	25	0	0	0
3	24	0	0	0
4	24	0	0	0
5	22	0	0	0
6	22	0	0	0
7	21	3	3	0
8	21	44	42	2
9	22	198	209	-10
10	23	372	391	-19
11	26	526	551	-25
12	28	567	599	-31
13	30	585	619	-34
14	31	556	568	-12
15	33	489	500	-11
16	33	418	426	-8
17	33	271	270	1
18	32	134	134	0
19	31	14	14	0
20	30	0	0	0
21	28	0	0	0
22	27	0	0	0
23	26	0	0	0
24	25	0	0	0
Total		4.18	4.33	-0.15



- Wind generation forecasting



Wind generation summary 2013-14

Date	Variation in wind gen.		Max MW	Min MW
		MW		
07/01/2014	Max	1568	1693	125
21/11/2013	Min	117	124	7

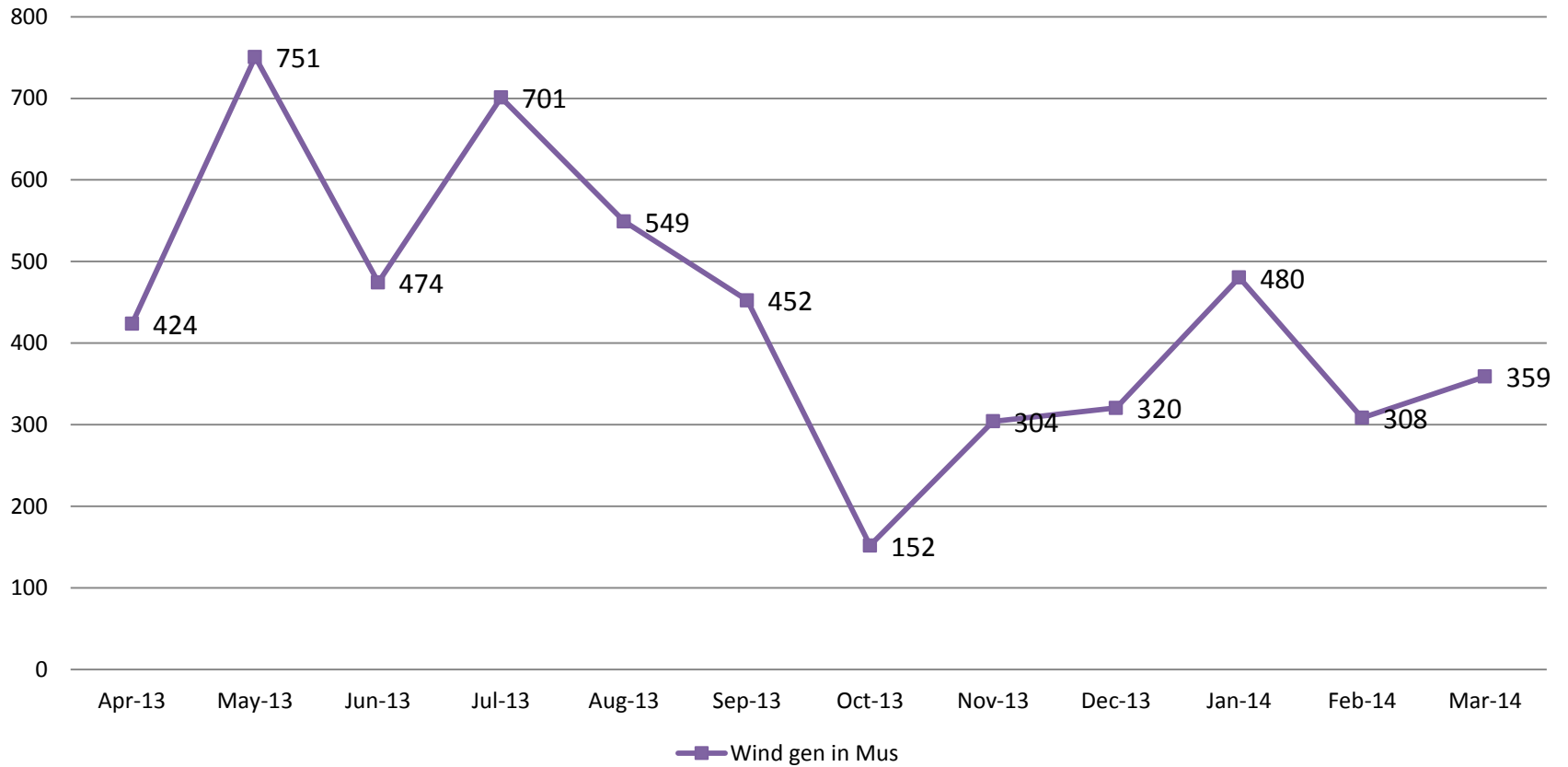
Date	Variation in wind gen.		Max MW	Min MW
		Mus		
24/05/2013	Max	41.899	2034	1326
21/11/2013	Min	1.349	124	7

Variation in wind gen. MW	No of Days
more than 1000MW	82
more than 500MW	267
less than 500MW	98



Variation in wind generation in Mus month wise

Wind gen in Mus vs Month 13-14





Integration Issues of Wind

- Planning criterion for RE
- Variability and Intermittency
- Forecasting and Scheduling
- SCADA / telemetry
- Network related Problems and Congestion
- Commercial mechanism implementation



Impact of rapid increase of Renewable Energy on Grid

- instability in grid and creates load management problem due to uncertainty in generation.
- critical loading or constraint is observed due to high wind generation on lines i.e.
 - 400KV APL – Dehgam 1&2,
 - 400KV Kasor – Choraniya,
 - 220KV Tappar – Shivalakha etc. or
- Due to low wind generation, overloading problem observed on Jetpur ICT and Amreli ICT etc.
- Due to low wind generation, planned separation or isolation of network is carried out to avoid major black out in case of ICT tripping
- Adequate grid infrastructure is needed to transmit the renewable energy to the load centers.

Impact of generation from RE sources on conventional Power Plants



- Due to high wind generation, backing down of thermal units of higher rating / efficiency (i.e. APL, EPGL, CGPL etc...) is carried out.
- Issues are encountered due to frequent starting & stopping of thermal units under RSD for different intervals owing to high wind generation scenario.
- Frequent start / stop of the unit leads to additional HFO consumption over and above the normal consumption. Due to unusual start / stop situation, generating cost increases as well as it is difficult to maintain inventory on account of secondary fuel (HFO) as well as spares during AOH / COH & of R&M.
- Due to higher wind generation, the backing down of conventional or cheaper generation may have to be done and sometimes, wind generation may also have to be backed down to maintain system operation.
- Due to seasonal availability of wind generation & day-time availability of solar generation with very low PLF, the transmission network created for RE remains sub-optimally utilized resulting in commercial burden to the consumers

Study case of B/Dn of conventional generation due to High Wind gen. (except DGB, all are thermal gen.)

BACKDOWN DETAILS FOR THE DATE 20.05.13			
TIME BLOCK	WIND	GSECL B/D	STATION NAME
1	639	324	GTPS 5=37,UTPS=70.5018,WTPS1-6=167.8,WTPS 7=48.2
2	552	310	GTPS 5=37,UTPS=57,WTPS1-6=167.8,WTPS 7=48.2
3	489	410	GTPS 5=37,UTPS=157,WTPS1-6=167.8,WTPS 7=48.2
4	503	410	GTPS 5=37,UTPS=157,WTPS1-6=167.8,WTPS 7=48.2
5	471	410	GTPS 5=37,UTPS=157,WTPS1-6=167.8,WTPS 7=48.2
6	391	327	GTPS 5=19,UTPS=107,WTPS1-6=167.8,WTPS 7=33.35
7	406	349	GTPS 5=28.5,UTPS=119.501,WTPS1-6=167.8,WTPS 7=33.35
8	372	411	GTPS 5=38,UTPS=157,WTPS1-6=167.8,WTPS 7=48.2
9	400	411	GTPS 5=38,UTPS=157,WTPS1-6=167.8,WTPS 7=48.2
10	463	410	GTPS 5=37,UTPS=157,WTPS1-6=167.8,WTPS 7=48.2
11	636	411	GTPS 5=37,UTPS=157,WTPS1-6=168.35,WTPS 7=48.2
12	713	414	GTPS 5=37,UTPS=157,WTPS1-6=172.25,WTPS 7=48.2
13	779	433	GTPS 5=37,UTPS=157,WTPS1-6=190.75,WTPS 7=48.2
14	812	450	GTPS 5=37,UTPS=157,WTPS1-6=207.75,WTPS 7=48.2
15	939	460	GTPS 5=37,KLTPS=7,UTPS=157,WTPS1-6=211,WTPS 7=48.2
16	1138	453	GTPS 5=37,KLTPS=0,UTPS=157,WTPS1-6=211,WTPS 7=48.2
17	1303	453	GTPS 5=37,UTPS=157,WTPS1-6=211,WTPS 7=48.2
18	1216	463	GTPS 5=37,KLTPS=10,KLTPS=10,UTPS=157,WTPS1-6=211,WTPS 7=48.2
19	1144	464	GTPS 5=38,KLTPS=10,KLTPS=10,UTPS=157,WTPS1-6=211,WTPS 7=48.2
20	1019	548	DGB-I=94,GTPS 5=38,UTPS=157,WTPS1-6=211,WTPS 7=48.2
21	975	525	DGB-I=71,GTPS 5=38,UTPS=157,WTPS1-6=211,WTPS 7=48.2
22	866	492	DGB-I=38,GTPS 5=38,UTPS=157,WTPS1-6=211,WTPS 7=48.2
23	880	484	DGB-I=31,GTPS 5=37,UTPS=157,WTPS1-6=211,WTPS 7=48.2
24	763	484	DGB-I=31,GTPS 5=37,UTPS=157,WTPS1-6=211,WTPS 7=48.2

Cont... (except DGB, all are thermal gen.)

BACKDOWN DETAILS FOR THE DATE 23.09.13			
TIME BLOCK	WIND	GSECL B/D	STATION NAME
1	1637	438	DGB -2 SPOT=35,GTPS-5=37,STPS=39.25,UTPS=92,WTPS=181.8,KLTPS=53
2	1622	438	DGB -2 SPOT=35,GTPS-5=37,STPS=39.25,UTPS=92,WTPS=181.8,KLTPS=53
3	1683	438	DGB -2 SPOT=35,GTPS-5=37,STPS=39.25,UTPS=92,WTPS=181.8,KLTPS=53
4	1609	438	DGB -2 SPOT=35,GTPS-5=37,STPS=39.25,UTPS=92,WTPS=181.8,KLTPS=53
5	1425	438	DGB -2 SPOT=35,GTPS-5=37,STPS=39.25,UTPS=92,WTPS=181.8,KLTPS=53
6	1507	435	DGB -2 SPOT=32,GTPS-5=37,STPS=39.25,UTPS=92,WTPS=181.8,KLTPS=53
7	1265	435	DGB -2 SPOT=32,GTPS-5=37,STPS=39.25,UTPS=108,WTPS=181.8,KLTPS=53
8	1159	438	DGB -2 SPOT=32,GTPS-5=37,STPS=42,UTPS=92,WTPS=181.8,KLTPS=53
9	963	431	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,UTPS-6=63.4,WTPS=181.8,KLTPS=53
10	1120	430	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,UTPS-6=63.4,WTPS=181.8,KLTPS=52
11	1062	378	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,UTPS-6=63.4,WTPS=181.8
12	936	378	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,UTPS-6=63.4,WTPS=181.8
13	954	269	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8
14	993	321	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8,KLTPS=52
15	996	321	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8,KLTPS=52
16	1045	321	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8,KLTPS=52
17	938	321	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8,KLTPS=52
18	972	269	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8
19	1211	269	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8
20	1224	321	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8,KLTPS=52
21	1184	321	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8,KLTPS=52
22	1338	269	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8
23	1476	269	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8
24	1611	269	DGB -2 SPOT=32,GTPS-5=37,STPS=17.9,UTPS=46,WTPS=181.8



Sample case study of 20/5/2011 when wind Generation was high (31.674 MUS) is taken and back down of units having rate less than wind rate of Rs 3.56 is worked out as under

Gen Unit	MUs Back down	Unit Rate	Amount in Cr.
WTPS 1-6	5.028	2.43	1.221685
WTPS 7	1.037	2.39	0.247939
UTPS	0.770	1.91	0.147023
GTPS 5	0.259	2.06	0.053354
GTPS1-4	2.453	2.36	0.57879
APL	0.700	1.51	0.1057
STPS	1.250	3.28	0.409988
UGB-II	2.353	2.08	0.48938
DGB-I	0.434	3.54	0.153725
DGB-II	0.568	2.19	0.124392
EPOL	2.112	2.74	0.578688
GIPCL-I	1.730	2.52	0.435938
GIPCL-II	0.987	2.28	0.225036
GPEC	6.345	1.63	1.034175
JHANOR	2.190	2.01	0.440201
KAWAS	2.940	2.02	0.593853
KAHELGAON	0.455	2.21	0.100532
ONGC-H	0.260	1.9	0.0494
SOLARIS	0.029	2.8	0.008064
VSTPS-I	0.134	1.44	0.019296
Total	32.032	Av Rate 2.19	7.017157

Loss due to backing down of units having rate less than Wind rate = $(3.56-2.19) \times 32.032$ MUS
=Rs 4.3 Cr.

- Wind generation forecasting Overall

Wind Energy

- 48 Nos of [pooling station](#)
- 3351.95 MW installed capacity
- Non RRF Installed Capacity :2353.50 MW
- RRF Installed Capacity :998.45MW

- 32 Nos of Non RRF pooling station
- 16 Nos of RRF pooling station

- Bifurcation into 8 Region for overall forecast
 - Jamnagar (347.12MW)
 - Okha (60.70MW)
 - Mundra (48.00MW)
 - Kandla (758.58MW)
 - Porbandar (1198.36MW)
 - Suthri (595.60MW)
 - Jakhau (331.40MW)
 - Amarapur (12.20MW)



Wind power forecasting methodology

- Consider the power available from the wind: *the wind power equation*.

- $P = \frac{1}{2} \rho A V^3$

- $P =$ power in watts

- $\rho =$ The air density (1.2 kg/m^3 @ sea level and 20° C)

- $A =$ The swept area of the turbine blades (m^2 square meters)

- $V =$ wind speed (meters per second)

- where $A = \pi r^2$

— $r =$ Radius of blade in m

- Now consideration of.....

- $P_1 = \frac{1}{2} \delta_1 A V_1^3$

- $P_2 = \frac{1}{2} \delta_2 A V_2^3$

- $P_2 = P_1 * (\delta_2 / \delta_1) * (V_2 / V_1)^3$

- Looking to the low or negligible effect of δ , it can be avoided

- where $P_1 =$ Previous day generation

$\delta_1 =$ Previous day Air density

$V_1 =$ Previous day Velocity

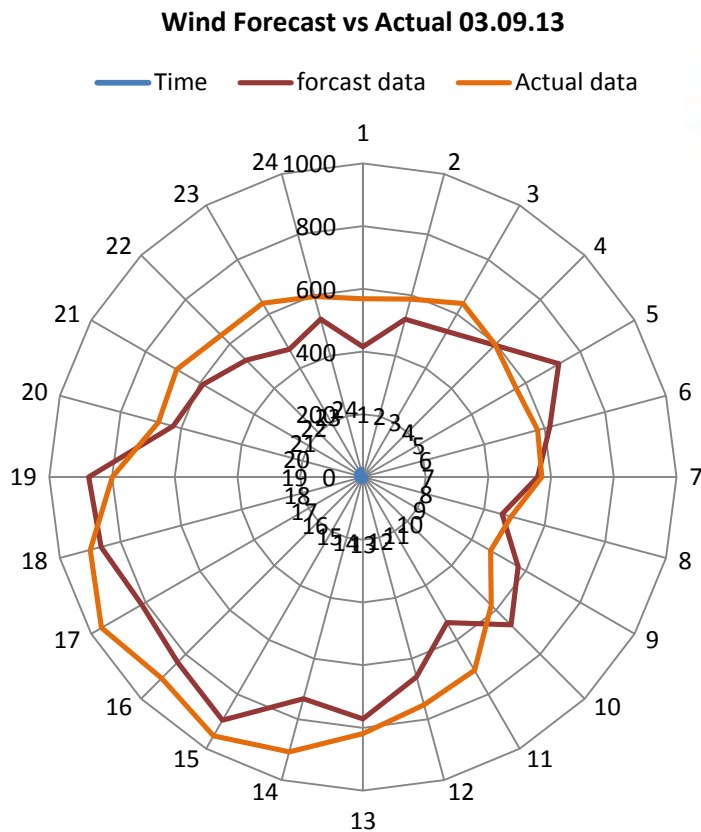
$P_2 =$ Same day generation

$\delta_2 =$ Same day Air density

$V_2 =$ Same day Velocity

High wind period - Forecast vs Actual 03.09.13

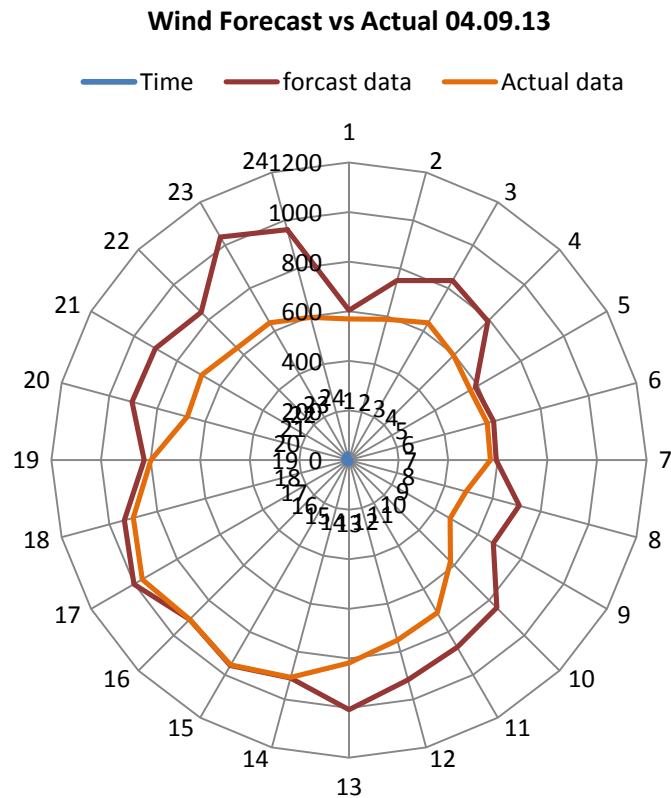
Time in hrs	Forecast data Mwh	Actual data Mwh	Diff in %
1	415	568	-37
2	520	587	-13
3	536	638	-19
4	594	596	0
5	721	564	22
6	617	577	7
7	557	571	-2
8	460	489	-6
9	571	470	18
10	668	578	13
11	536	712	-33
12	660	752	-14
13	772	818	-6
14	733	907	-24
15	896	954	-6
16	836	908	-9
17	814	962	-18
18	864	900	-4
19	874	799	9
20	627	675	-8
21	589	686	-16
22	526	639	-21
23	470	639	-36
24	521	596	-14
Total	15.38	16.59	-8



(+) deviation %	(-) deviation %	Nos of (+) hrs blocks	Nos of (-) hrs blocks	Perception %
0 to 5	0 to -5	0	3	13
5 to 10	-5 to -10	2	5	29
10 to 15	-10 to -15	1	3	17
15 to 20	-15 to -20	1	3	17
20 to 25	-20 to -25	1	2	13
25 to 30	-25 to -30	0	0	0
30 to 50	-30 to -50	0	3	13
Above 50	Above 50	0	0	0

High wind period - Forecast vs Actual 04.09.13

Time in hrs	Forecast data Mwh	Actual data Mwh	Diff in %
1	604	568	6
2	749	587	22
3	836	638	24
4	792	596	25
5	588	564	4
6	603	577	4
7	594	571	4
8	710	489	31
9	672	470	30
10	842	578	31
11	872	712	18
12	918	752	18
13	1007	818	19
14	910	907	0
15	957	954	0
16	909	908	0
17	1001	962	4
18	938	900	4
19	826	799	3
20	906	675	25
21	901	686	24
22	842	639	24
23	1038	639	38
24	961	596	38
Total	19.98	16.59	17

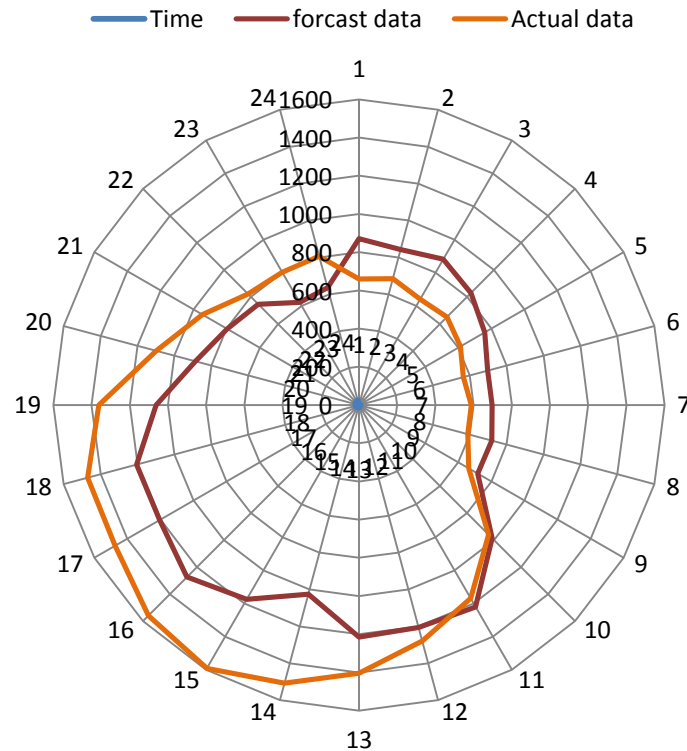


(+) deviation %	(-) deviation %	Nos of (+) hrs blocks	Nos of (-) hrs blocks	Perception %
0 to 5	0 to -5	9	0	38
5 to 10	-5 to -10	1	0	4
10 to 15	-10 to -15	0	0	0
15 to 20	-15 to -20	3	0	13
20 to 25	-20 to -25	5	0	21
25 to 30	-25 to -30	2	0	8
30 to 50	-30 to -50	4	0	17
Above 50	Above 50	0	0	0

High wind period - Forecast vs Actual 05.09.13

Time in hrs	Forecast data Mwh	Actual data Mwh	Diff in %
1	872	660	24
2	843	685	19
3	882	640	27
4	830	651	22
5	761	613	19
6	698	566	19
7	697	587	16
8	720	589	18
9	717	663	8
10	985	960	3
11	1221	1168	4
12	1206	1278	-6
13	1215	1404	-16
14	1026	1507	-47
15	1175	1592	-35
16	1273	1559	-22
17	1205	1475	-22
18	1205	1470	-22
19	1062	1362	-28
20	887	1098	-24
21	798	947	-19
22	746	822	-10
23	621	803	-29
24	635	806	-27
Total	22.28	23.90	7

Wind Forecast vs Actual 05.09.13



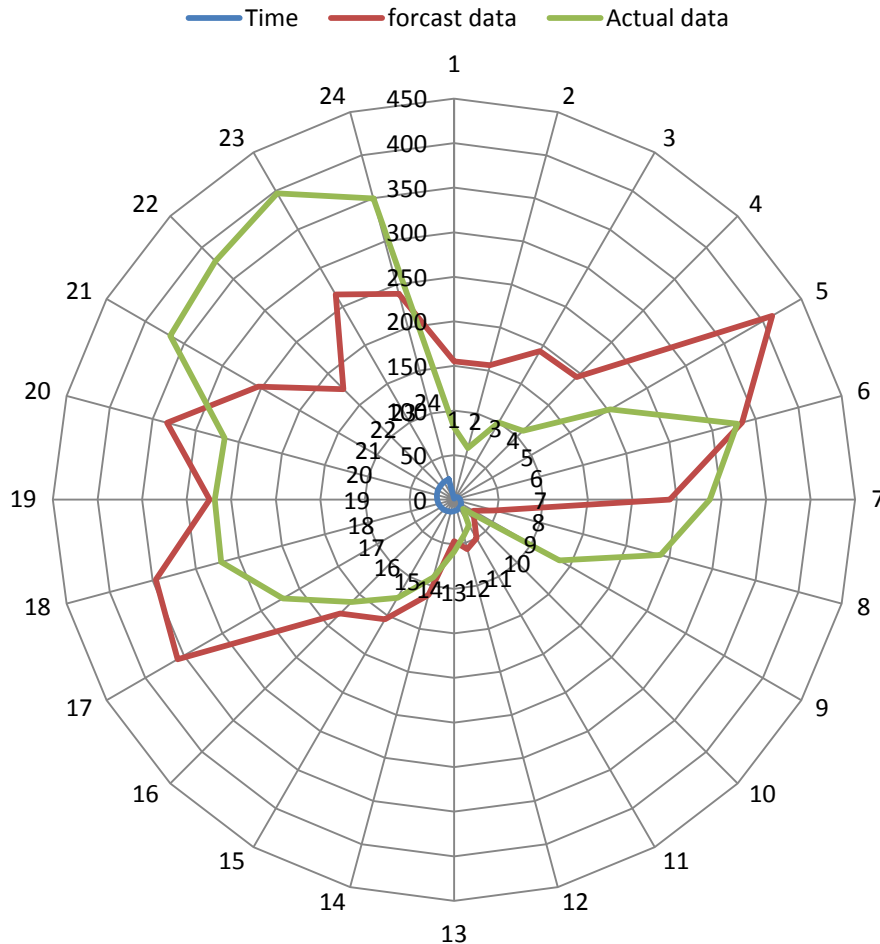
(+) deviation %	(-) deviation %	Nos of (+) hrs blocks	Nos of (-) hrs blocks	Perception %
0 to 5	0 to -5	2	0	8
5 to 10	-5 to -10	1	1	8
10 to 15	-10 to -15	0	1	4
15 to 20	-15 to -20	5	2	29
20 to 25	-20 to -25	2	4	25
25 to 30	-25 to -30	1	3	17
30 to 50	-30 to -50	0	2	8
Above 50	Above 50	0	0	0



Wind Forecast vs Actual gen (Over all) for 19.03.14

Lowest 4.593 Mu's of wind gen in March month

Wind Forecast vs Actual gen for 19.03.14

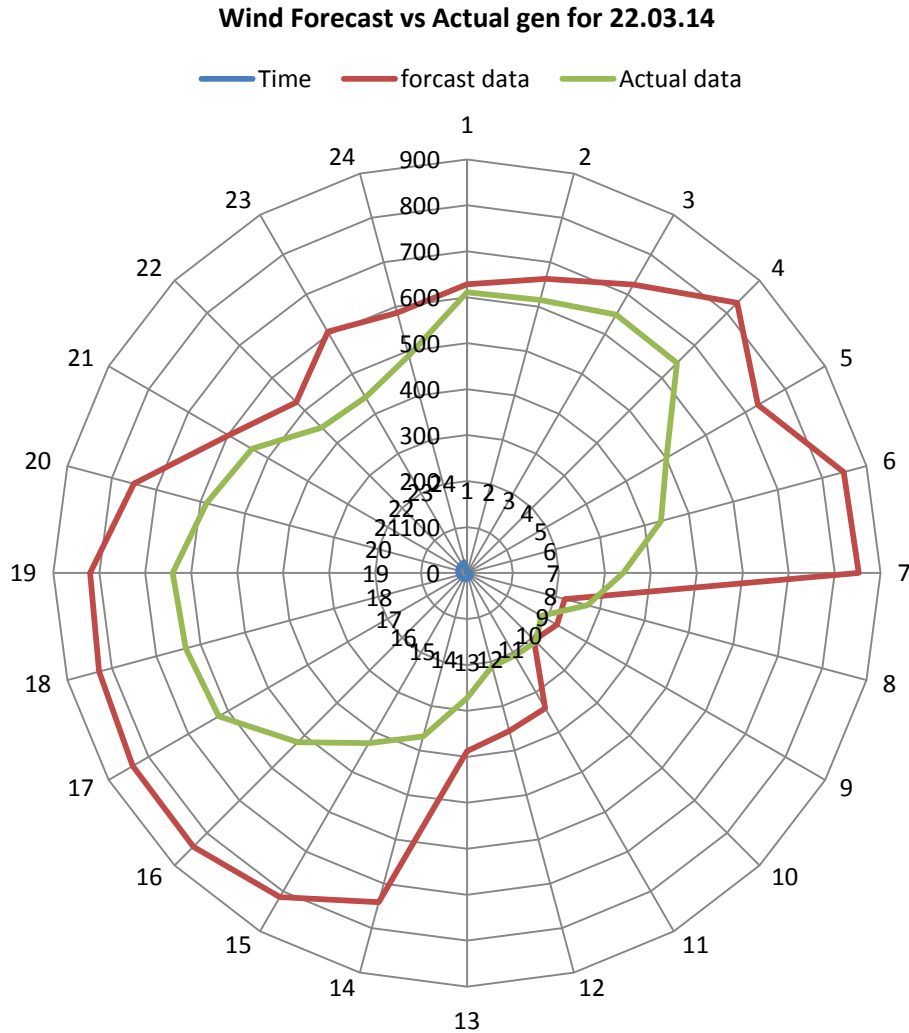


Time in hrs	forecast data in Mwh	Actual data in Mwh	Diff in % w.r.t forecast
1	155	81	48
2	156	60	61
3	192	100	48
4	194	109	44
5	412	202	51
6	335	329	2
7	242	287	-18
8	46	240	-416
9	25	136	-445
10	32	14	55
11	50	33	33
12	57	42	27
13	47	58	-25
14	111	90	18
15	155	127	18
16	180	162	10
17	358	222	38
18	346	271	22
19	274	269	2
20	333	267	20
21	254	368	-45
22	175	379	-116
23	266	397	-49
24	239	350	-46
Total	4.64	4.59	0.93



Wind Forecast vs Actual gen (**Over all**) for 22.03.14

Average **10.88 Mu's** of wind gen in **March** month



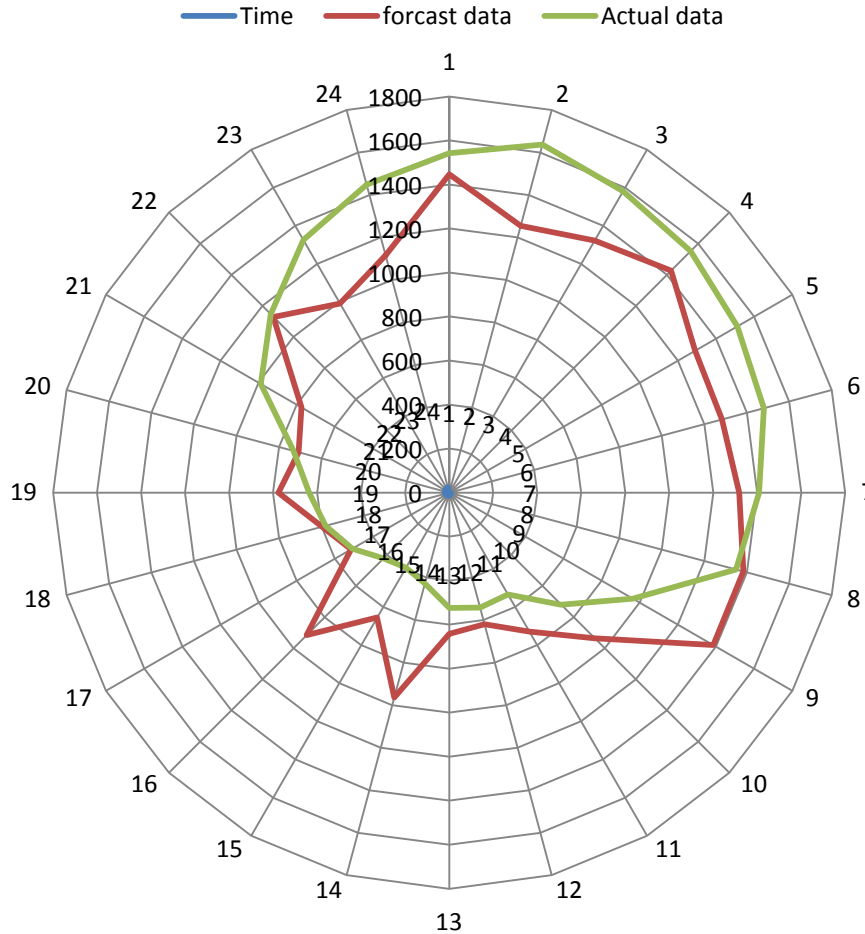
Time in hrs	forecast data in Mwh	Actual data in Mwh	Diff in % w.r.t forecast
1	628	611	3
2	663	615	7
3	725	649	10
4	832	646	22
5	731	501	32
6	848	437	49
7	852	340	60
8	220	271	-23
9	226	186	17
10	206	212	-3
11	340	208	39
12	356	210	41
13	388	272	30
14	741	368	50
15	815	428	48
16	842	521	38
17	840	623	26
18	829	633	24
19	820	640	22
20	750	586	22
21	599	540	10
22	525	447	15
23	606	442	27
24	586	489	17
Total	14.97	10.88	27



Wind Forecast vs Actual gen (**Over all**) for 13.03.14

Highest 23.958 Mu's of wind gen in **March** month

Wind Forecast vs Actual gen for 13.03.14



Time in hrs	forecast data in Mwh	Actual data in Mwh	Diff in % w.r.t forecast
1	1446	1543	-7
2	1254	1638	-31
3	1322	1580	-20
4	1426	1551	-9
5	1289	1512	-17
6	1283	1481	-15
7	1319	1408	-7
8	1384	1349	2
9	1386	965	30
10	937	719	23
11	730	535	27
12	620	542	13
13	641	524	18
14	965	427	56
15	655	394	40
16	915	422	54
17	515	509	1
18	598	582	3
19	775	636	18
20	708	733	-4
21	775	989	-28
22	1129	1147	-2
23	992	1325	-34
24	1116	1449	-30
Total	24.18	23.96	1

- Wind generation forecasting Non RRF

Wind power forecasting methodology of Non RRF

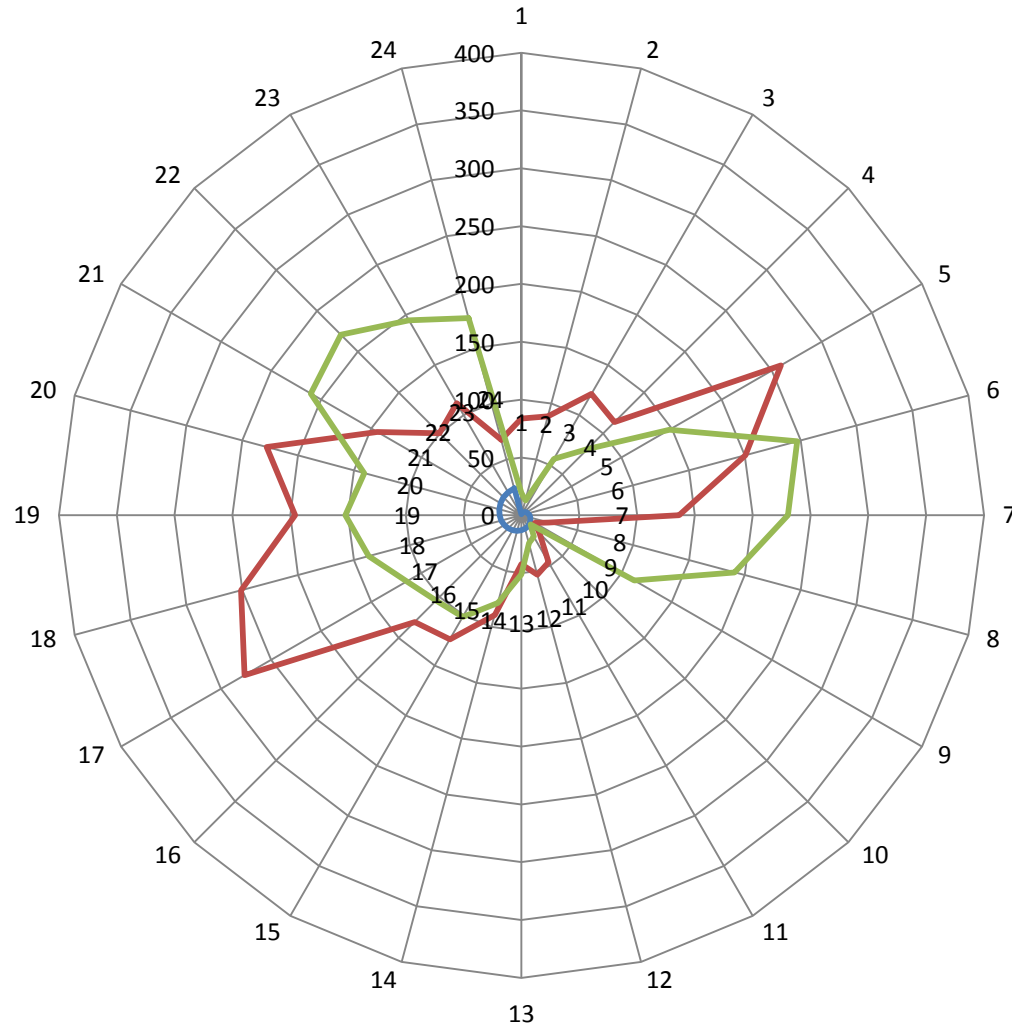
- Bifurcation into 8 Region
 - Jamnagar (314.12MW)
 - Okha (29.95MW)
 - Mundra (48.00MW)
 - Kandla (680.18MW)
 - Porbandar (560.96MW)
 - Suthri (595.60MW)
 - Jakhau (112.50MW)
 - Amarapur (12.20MW)



Wind Forecast vs Actual gen (Non RRF) for 19.03.14

Lowest 4.593 Mu's of wind gen in March month

— Time in hrs — forecast data in Mwh (Non RRF) — Actual data in Mwh (Non RRF)



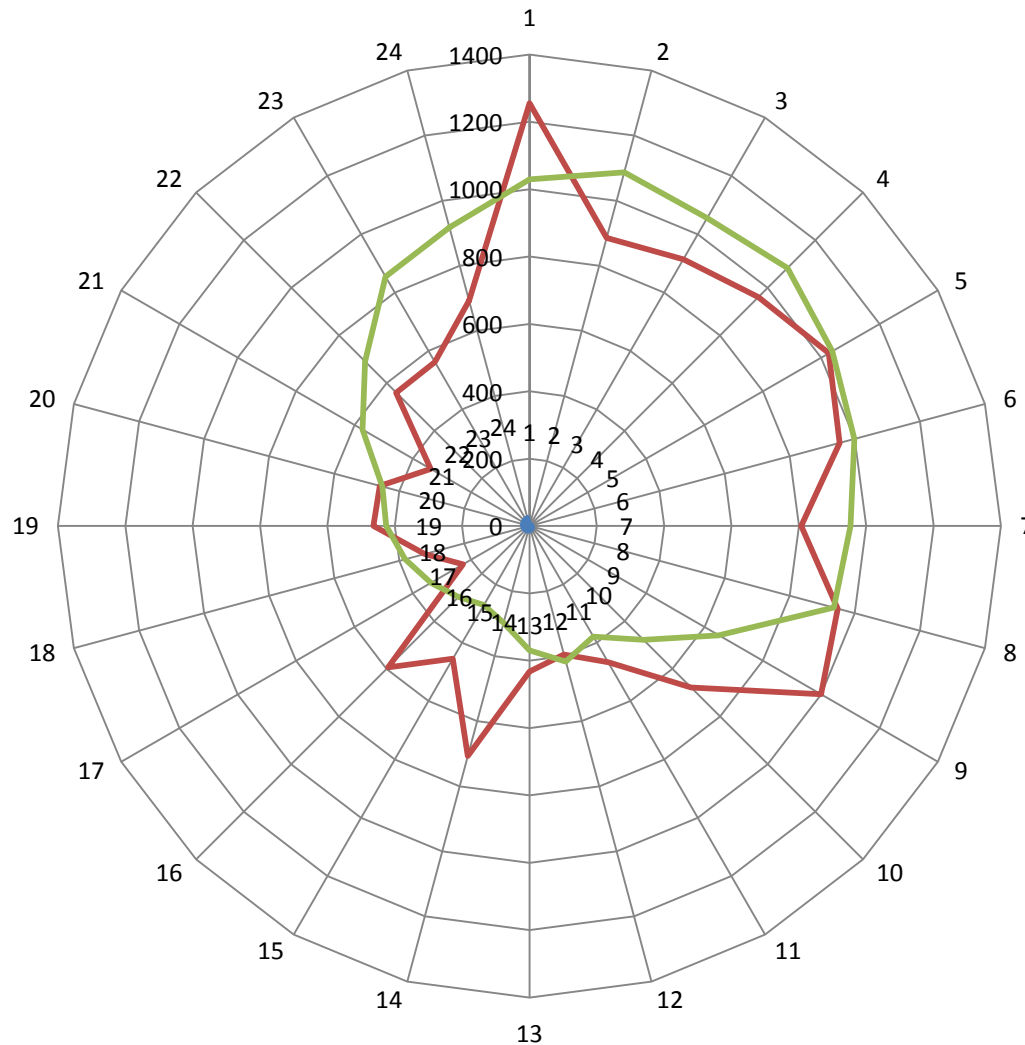
Time in hrs	forecast wind Gen in Mwh (Non RRF)	Actual wind Gen in Mwh (Non RRF)	Diff (F-A) Mwh
1	84	19	64
2	89	13	76
3	121	56	65
4	114	81	33
5	259	148	111
6	200	247	-46
7	136	230	-94
8	24	191	-167
9	13	113	-99
10	22	11	11
11	47	21	25
12	53	25	28
13	42	51	-9
14	89	78	11
15	124	102	22
16	130	104	26
17	277	115	162
18	251	137	114
19	196	152	44
20	228	141	87
21	144	210	-66
22	100	221	-121
23	112	195	-83
24	68	176	-109
Total	2.92	2.84	0.09

Wind Forecast vs Actual gen (Non RRF) for 13.03.14

Highest 23.958 Mu's of wind gen in March month



— Time in hrs — forecast data in Mwh (Non RRF) — Actual data in Mwh (Non RRF)



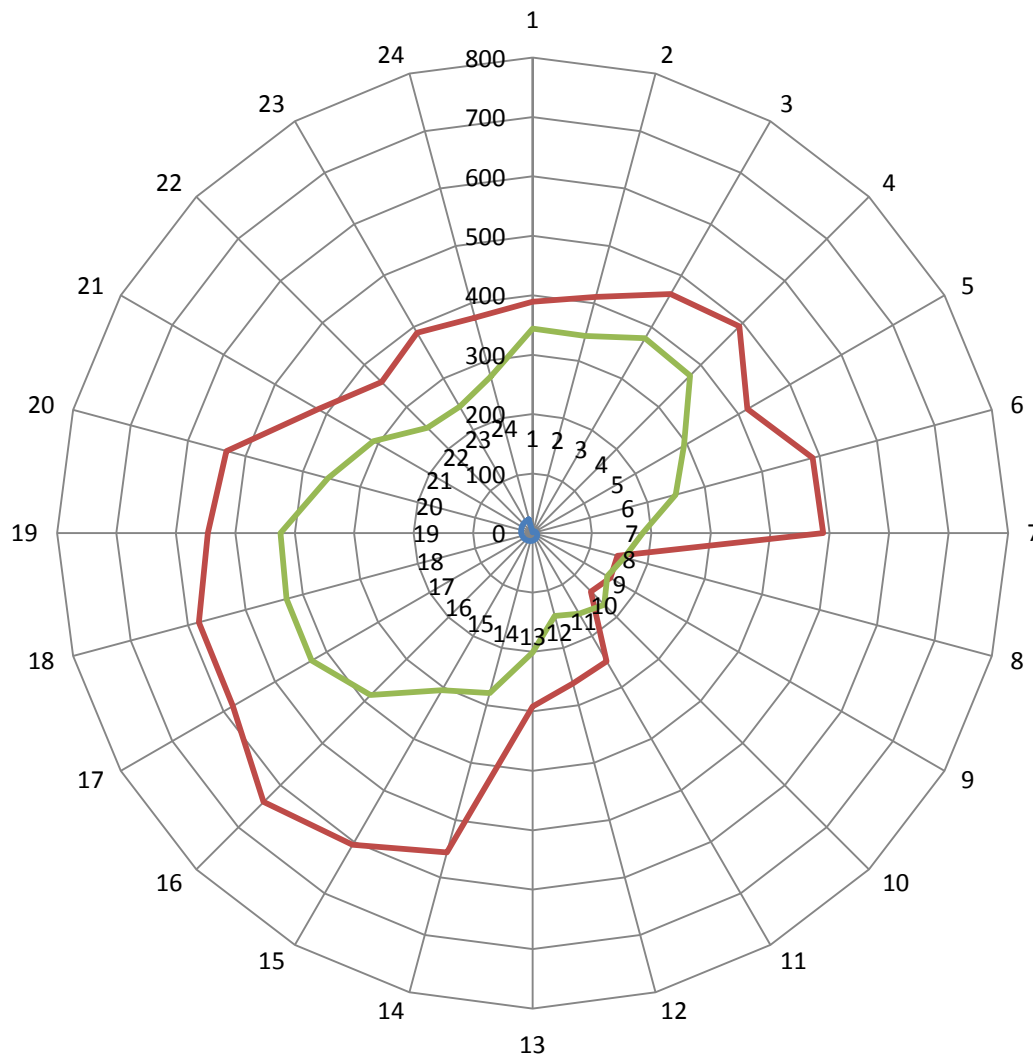
Time in hrs	forecast wind Gen in Mwh (Non RRF)	Actual wind Gen in Mwh (Non RRF)	Diff (F-A) Mwh
1	1255	1029	226
2	885	1087	-202
3	914	1055	-141
4	961	1083	-122
5	1026	1038	-12
6	953	998	-45
7	807	953	-147
8	948	936	12
9	999	648	351
10	678	478	200
11	467	379	88
12	395	417	-22
13	432	369	62
14	707	298	409
15	455	270	185
16	594	298	296
17	228	338	-110
18	321	382	-61
19	464	426	38
20	460	452	8
21	339	573	-234
22	559	691	-131
23	562	855	-293
24	693	918	-226
Total	16.10	15.97	0.13

Wind Forecast vs Actual gen (Non RRF) for 22.03.14

Average 10.875 Mu's of wind gen in March month



— Time in hrs — forecast data in Mwh (Non RRF) — Actual data in Mwh (Non RRF)



Time in hrs	forecast wind Gen in Mwh (Non RRF)	Actual wind Gen in Mwh (Non RRF)	Diff (F-A) Mwh
1	389	344	45
2	411	343	68
3	464	378	86
4	492	375	117
5	417	294	123
6	488	250	238
7	489	185	303
8	148	160	-12
9	151	145	6
10	139	171	-32
11	250	157	93
12	262	144	118
13	292	201	91
14	556	279	278
15	605	306	300
16	640	385	254
17	582	429	153
18	581	428	153
19	546	424	122
20	533	356	177
21	417	309	108
22	359	250	109
23	389	245	144
24	375	273	102
Total	9.97	6.83	3.14

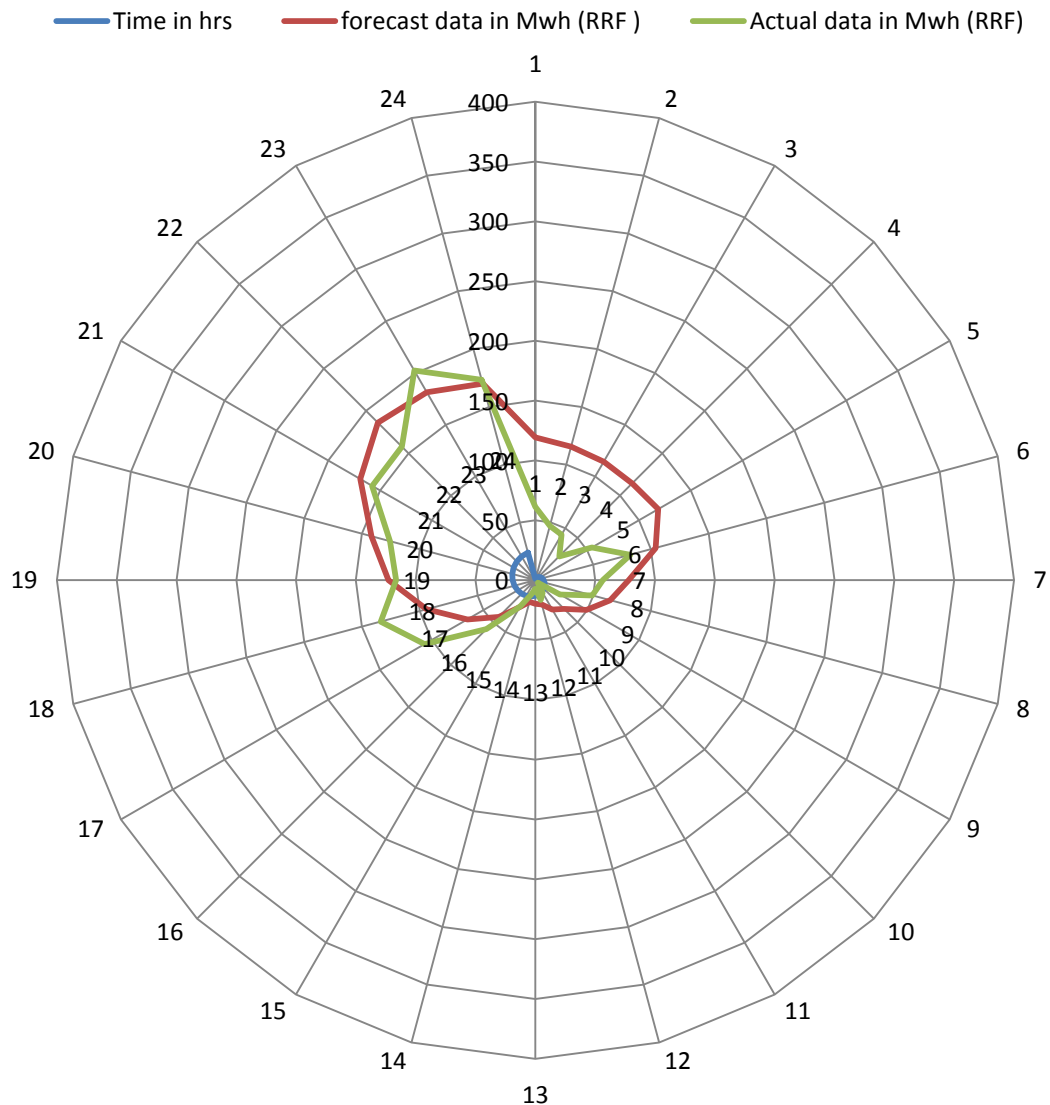
• Wind generation forecasting RRF scheduling

Wind power forecasting methodology of RRF

Sr. No	RRF polling station	Inst. Cap (MW)	Area	Coordinating Agency	Forecasting Agency
1	M.GUNDA(GMSH)	29.80	PORBANDAR	GMSH	In house
2	GOLIDA(GFL)	70.00	PORBANDAR	GFL	3 tier
3	TEBHDA(ENERCON)	268.00	PORBANDAR	WIND WORLD	meteologica
4	RASALIYA(ENERCON)	65.60	JAKHAU	WIND WORLD	meteologica
5	ADODAR(SUZLON)	38.00	PORBANDAR	Unilink Engineering	3 tier
6	BALMBHA(SUZLON)	33.00	JAMNAGAR	Unilink Engineering	3 tier
7	BHOJAPURI(SUZLON)	50.40	KANDLA	Unilink Engineering	3 tier
8	HALENDAS(SUZLON)	39.90	PORBANDAR	Unilink Engineering	3 tier
9	GORSAR(SUZLON)	25.50	PORBANDAR	Unilink Engineering	3 tier
10	JAMANVADA(SUZLON)	153.30	JAKHAU	Unilink Engineering	3 tier
11	PAREVDA(SUZLON)	25.20	PORBANDAR	PAREVDA RENEW POWER	meteologica & manikaran
12	VASAI(SUZLON)	30.75	OKHA	Unilink Engineering	3 tier
13	MOTAGUNDA(SUZLON)	58.80	PORBANDAR	Unilink Engineering	3 tier
14	TITHAWA(AZELIA)	28.00	KANDLA	AZELIA	In house
15	VADALI(WIND WORLD)	52.80	PORBANDAR	WIND WORLD	meteologica
16	RAJAPARA(SUZLON)	29.40	PORBANDAR	Unilink Engineering	3 tier
Total		998.45			

Wind Forecast vs Actual gen (RRF) for 19.03.14

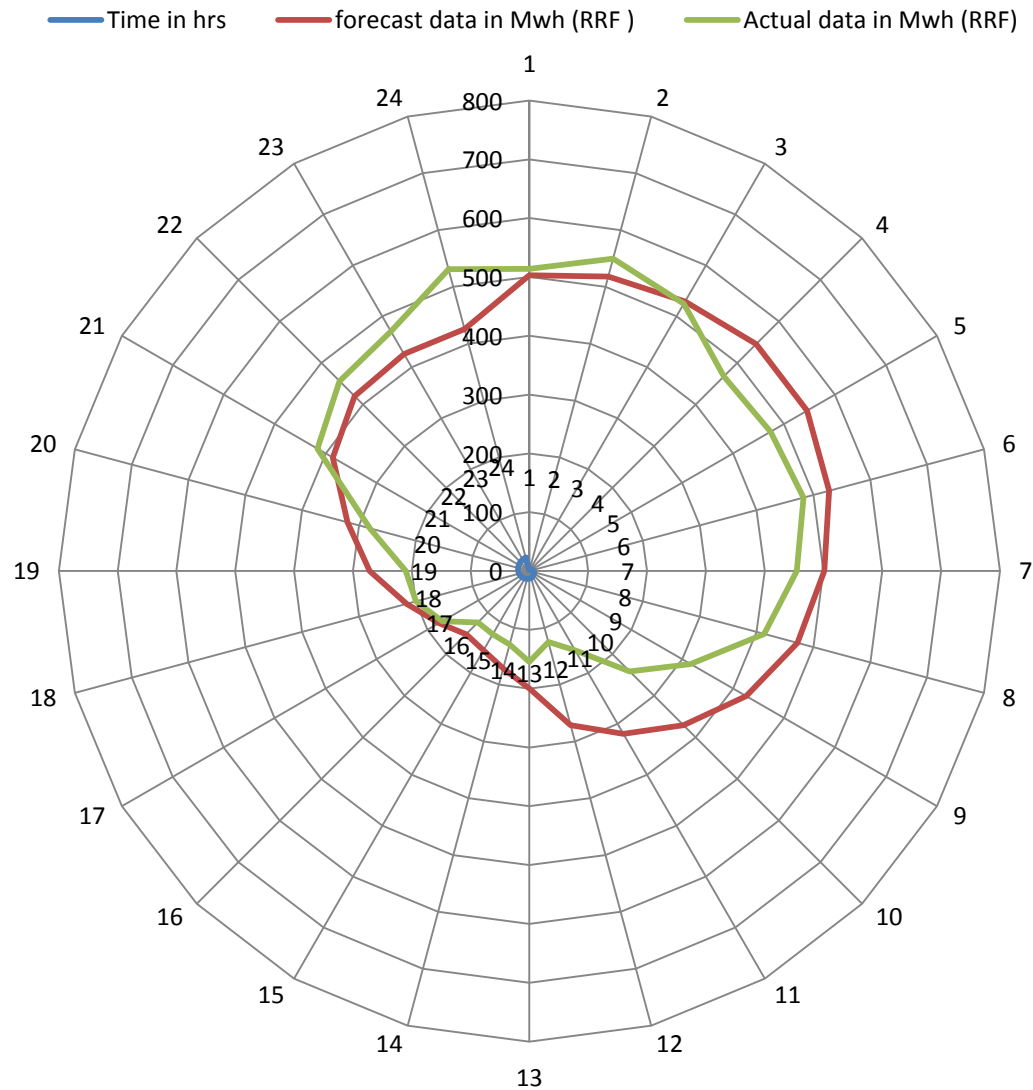
Lowest 4.593 Mu's of wind gen in March month



Time in hrs	forecast wind Gen in Mwh (RRF)	Actual wind Gen in Mwh (RRF)	Diff (F-A) Mwh
1	119	61	58
2	116	47	69
3	114	44	70
4	114	28	86
5	119	55	64
6	104	82	22
7	78	56	22
8	65	49	16
9	49	24	26
10	34	3	31
11	28	12	16
12	21	17	4
13	20	7	13
14	19	12	7
15	26	25	1
16	43	58	-15
17	66	107	-41
18	94	134	-40
19	123	116	7
20	142	126	16
21	169	157	12
22	186	158	28
23	181	202	-21
24	170	173	-3
Total	2.20	1.75	0.45

Wind Forecast vs Actual gen (RRF) for 13.03.14

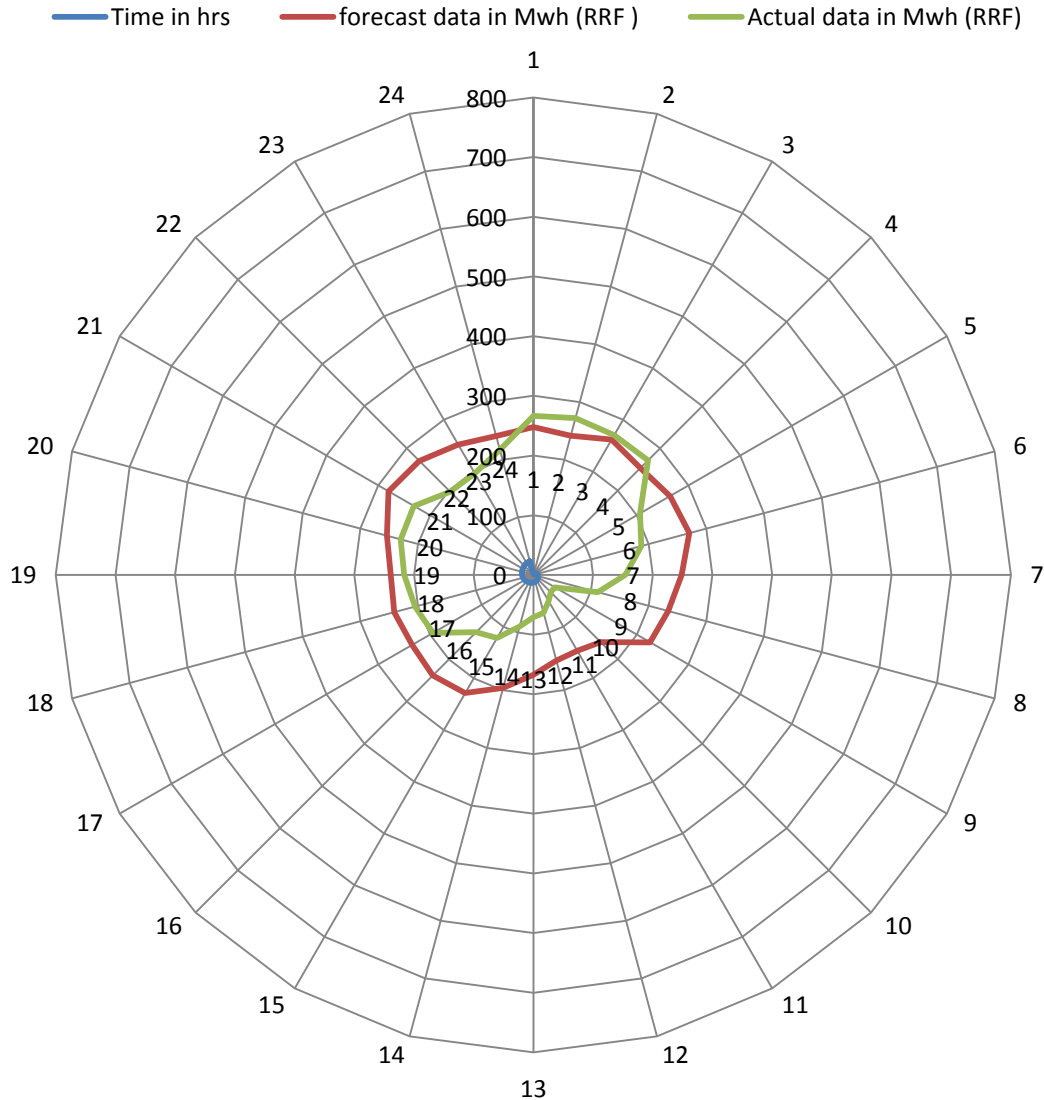
Highest 23.958 Mu's of wind gen in March month



Time in hrs	forecast wind Gen in Mwh (RRF)	Actual wind Gen in Mwh (RRF)	Diff (F-A) Mwh
1	503	513	-10
2	518	550	-32
3	529	525	4
4	545	468	77
5	545	473	72
6	528	482	45
7	501	455	46
8	472	414	59
9	426	316	109
10	371	241	130
11	320	156	164
12	271	125	146
13	199	154	45
14	172	129	43
15	156	124	32
16	152	124	29
17	178	171	6
18	216	200	16
19	272	210	62
20	320	281	40
21	386	416	-30
22	420	457	-36
23	426	470	-44
24	426	531	-105
Total	8.85	7.99	0.87

Wind Forecast vs Actual gen (RRF) for 22.03.14

Average 10.875 Mu's of wind gen in March month



Time in hrs	forecast wind Gen in Mwh (RRF)	Actual wind Gen in Mwh (RRF)	Diff (F-A) Mwh
1	248	266	-19
2	241	272	-31
3	262	270	-9
4	253	271	-18
5	264	206	58
6	271	187	83
7	248	154	94
8	234	111	123
9	226	41	185
10	159	41	118
11	147	51	96
12	149	66	83
13	167	71	96
14	196	89	107
15	229	122	107
16	238	136	103
17	235	194	40
18	241	205	36
19	239	216	23
20	254	230	24
21	280	231	49
22	270	197	73
23	252	196	56
24	241	217	24
Total	5.54	4.04	1.50

Balancing Philosophy of wind generation forecasting ...



Real time wind energy forecasting....

Data from website is being updated from time to time (on www.bbc.co.uk/weather, 3 Hrs wind speed forecast is available) and real time wind generation data is observed through SCADA.

As per the forecasted wind generation / Actual wind generation, the following actions are taken.

Day ahead plan mode

Planning of net availability of power with running m/c.

Planning of net available of power after sale/purchase allocation through Discoms.

Planning of other (RSD) based station.

Within day plan mode (2-3hrs before)

Necessary change in Central Sector requisition.

Planning for hydro generation.

Planning of other (RSD) gas based station in peak time, if required.

Fine tuning on the basis of real time weather data through various website for necessary system operation.

Real time plan mode

Conventional generating units are back down or pick up as per the merit list. Normally Gujarat keeps operational reserve up to 500-1000 MW.

Processing for central sector requisition, if found necessary.

To advise to maintain the schedule to generators.

- Forecasted wind generation is compared with actual wind generation to ascertain deviations and for further analysis.

Accuracy of RRF station as per forecasting provided by developers @ **Low Wind** Scenario on 19.03.14



Performance Index of RRF pooling station for the 19.03.14 (Low wind scenario 4.59mu's)															
Sr. No	RRF polling station	Inst. Cap (MW)	Forecasting Agency	Deviation in No of Blocks						Perception %					
				less than - 30%	Between - 30% to 50	Between 0 to 30	Between 30 to 50	More than 50	TOTAL No of blocks	less than - 30%	Between - 30% to 50	Between 0 to 30	Between 30 to 50	More than 50	Perception %
1	M.GUNDA(GMSH)	29.8	In house	60	13	4	3	16	96	63	14	4	3	17	100
2	GOLIDA(GFL)	70	3 tier	59	8	12	10	7	96	61	8	13	10	7	100
3	TEBHDA(ENERCON)	268	meteologica	53	22	11	3	7	96	55	23	11	3	7	100
4	RASALIYA(ENERCON)	65.6	meteologica	47	14	14	2	19	96	49	15	15	2	20	100
5	ADODAR(SUZLON)	38	3 tier	38	31	9	3	15	96	40	32	9	3	16	100
6	BALMBHA(SUZLON)	33	3 tier	16	80	0	0	0	96	17	83	0	0	0	100
7	BHOJAPURI(SUZLON)	50.4	3 tier	19	76	1	0	0	96	20	79	1	0	0	100
8	HALEND(A(SUZLON)	39.9	3 tier	18	68	2	1	7	96	19	71	2	1	7	100
9	GORSAR(SUZLON)	25.5	3 tier	32	51	7	4	2	96	33	53	7	4	2	100
10	JAMANVADA(SUZLON)	153.3	3 tier	39	4	5	1	47	96	41	4	5	1	49	100
11	PAREVDA(SUZLON)	25.2	meteologica & manikaran	51	32	4	3	6	96	53	33	4	3	6	100
12	VASAI(SUZLON)	30.75	3 tier	34	43	12	2	5	96	35	45	13	2	5	100
13	MOTAGUNDA(SUZLON)	58.8	3 tier	22	59	1	4	10	96	23	61	1	4	10	100
14	TITHAWA(AZELIA)	28	In house	55	9	1	1	30	96	57	9	1	1	31	100
15	VADALI(ENERCON)	52.8	meteologica	62	23	6	1	4	96	65	24	6	1	4	100
16	RAJAPARA(SUZLON)	29.4	3 tier	81	12	3	0	0	96	84	13	3	0	0	100
	Total	998.45		686	545	92	38	175	1536	45	35	6	2	11	100

Accuracy of RRF station as per forecasting provided by developers @ Average Wind Scenario on 22.03.14



Performance Index of RRF pooling station for the 22.03.14 (Average wind scenario 10.88mu's)															
Sr. No	RRF polling station	Inst. Cap (MW)	Forecasting Agency	Deviation in No of Blocks						Perception %					
				less than -30%	Between -30% to 50	Between 0 to 30	Between 30 to 50	More than 50	TOTAL No of blocks	less than -30%	Between -30% to 50	Between 0 to 30	Between 30 to 50	More than 50	Perception %
1	M.GUNDA(GMSH)	29.8	In house	64	9	11	3	9	96	67	9	11	3	9	100
2	GOLIDA(GFL)	70	3 tier	23	12	17	9	35	96	24	13	18	9	36	100
3	TEBHDA(ENERCON)	268	meteologica	42	31	19	4	0	96	44	32	20	4	0	100
4	RASALIYA(ENERCON)	65.6	meteologica	65	31	0	0	0	96	68	32	0	0	0	100
5	ADODAR(SUZLON)	38	3 tier	49	21	8	13	5	96	51	22	8	14	5	100
6	BALMBHA(SUZLON)	33	3 tier	56	24	6	0	10	96	58	25	6	0	10	100
7	BHOJAPURI(SUZLON)	50.4	3 tier	32	46	9	1	8	96	33	48	9	1	8	100
8	HALENDAS(SUZLON)	39.9	3 tier	47	41	0	2	6	96	49	43	0	2	6	100
9	GORSAR(SUZLON)	25.5	3 tier	57	22	1	4	12	96	59	23	1	4	13	100
10	JAMANVADA(SUZLON)	153.3	3 tier	41	30	1	2	22	96	43	31	1	2	23	100
11	PAREVDA(SUZLON)	25.2	meteologica & manikaran	57	23	9	6	1	96	59	24	9	6	1	100
12	VASAI(SUZLON)	30.75	3 tier	48	33	13	2	0	96	50	34	14	2	0	100
13	MOTAGUNDA(SUZLON)	58.8	3 tier	63	17	14	2	0	96	66	18	15	2	0	100
14	TITHAWA(AZELIA)	28	In house	15	9	5	1	66	96	16	9	5	1	69	100
15	VADALI(ENERCON)	52.8	meteologica	25	37	12	3	19	96	26	39	13	3	20	100
16	RAJAPARA(SUZLON)	29.4	3 tier	77	11	4	4	0	96	80	11	4	4	0	100
	Total	998.45		761	397	129	56	193	1536	50	26	8	4	13	100

Accuracy of RRF station as per forecasting provided by developers @ High Wind Scenario on 13.03.14 in month March



Performance Index of RRF pooling station for the 13.03.14 (High wind scenario 23.96mu's)

Sr. No	RRF polling station	Inst. Cap (MW)	Forecasting Agency	Deviation in No of Blocks						Perception %					
				less than -30%	Between -30% to 50	Between 0 to 30	Between 30 to 50	More than 50	TOTAL No of blocks	less than -30%	Between -30% to 50	Between 0 to 30	Between 30 to 50	More than 50	Perception %
1	M.GUNDA(GMSH)	29.8	In house	64	18	8	6	0	96	67	19	8	6	0	100
2	GOLIDA(GFL)	70	3 tier	22	13	15	14	32	96	23	14	16	15	33	100
3	TEBHDA(ENERCON)	268	meteologica	41	40	13	2	0	96	43	42	14	2	0	100
4	RASALIYA(ENERCON)	65.6	meteologica	31	37	17	11	0	96	32	39	18	11	0	100
5	ADODAR(SUZLON)	38	3 tier	42	38	10	5	1	96	44	40	10	5	1	100
6	BALMBHA(SUZLON)	33	3 tier	44	19	19	1	13	96	46	20	20	1	14	100
7	BHOJAPURI(SUZLON)	50.4	3 tier	26	31	22	11	6	96	27	32	23	11	6	100
8	HALEND(A(SUZLON)	39.9	3 tier	45	31	12	2	6	96	47	32	13	2	6	100
9	GORSAR(SUZLON)	25.5	3 tier	27	25	41	3	0	96	28	26	43	3	0	100
10	JAMANVADA(SUZLON)	153.3	3 tier	17	47	32	0	0	96	18	49	33	0	0	100
11	PAREVDA(SUZLON)	25.2	meteologica & manikaran	36	25	20	10	5	96	38	26	21	10	5	100
12	VASAI(SUZLON)	30.75	3 tier	29	25	42	0	0	96	30	26	44	0	0	100
13	MOTAGUNDA(SUZLON)	58.8	3 tier	18	25	23	8	22	96	19	26	24	8	23	100
14	TITHAWA(AZELIA)	28	In house	5	5	2	2	82	96	5	5	2	2	85	100
15	VADALI(ENERCON)	52.8	meteologica	40	13	24	12	7	96	42	14	25	13	7	100
16	RAJAPARA(SUZLON)	29.4	3 tier	35	5	5	2	49	96	36	5	5	2	51	100
Total		998.45		522	397	305	89	223	1536	34	26	20	6	15	100



Diff of Accuracy of RRF station at Diff Site @ Low (19.03.14 –4.59mus), Average (22.03.14 –10.88mus), High (13.03.14 --23.96mus) Wind Scenario

Performance Index of RRF pooling station for the 13.03.14, 19.03.14 & 22.03.14															
Sr. No	RRF polling station	Inst. Cap (MW)	Forecasting Agency	Deviation in No of Blocks						Perception %					
				less than -30%	Between n -30% to 50	Between n 0 to 30	Between n 30 to 50	More than 50	TOTAL No of blocks	less than -30%	Between n -30% to 50	Between n 0 to 30	Between n 30 to 50	More than 50	Perception %
1	M.GUNDA(GMSH)	29.8	In house	188	40	23	12	25	288	65	14	8	4	9	100
2	GOLIDA(GFL)	70	3 tier	104	33	44	33	74	288	36	11	15	11	26	100
3	TEBHDA(ENERCON)	268	meteologica	136	93	43	9	7	288	47	32	15	3	2	100
4	RASALIYA(ENERCON)	65.6	meteologica	143	82	31	13	19	288	50	28	11	5	7	100
5	ADODAR(SUZLON)	38	3 tier	129	90	27	21	21	288	45	31	9	7	7	100
6	BALMBHA(SUZLON)	33	3 tier	116	123	25	1	23	288	40	43	9	0	8	100
7	BHOJAPURI(SUZLON)	50.4	3 tier	77	153	32	12	14	288	27	53	11	4	5	100
8	HALENDAS(SUZLON)	39.9	3 tier	110	140	14	5	19	288	38	49	5	2	7	100
9	GORSAR(SUZLON)	25.5	3 tier	116	98	49	11	14	288	40	34	17	4	5	100
10	JAMANVADA(SUZLON)	153.3	3 tier	97	81	38	3	69	288	34	28	13	1	24	100
11	PAREVDA(SUZLON)	25.2	meteologica & manikaran	144	80	33	19	12	288	50	28	11	7	4	100
12	VASAI(SUZLON)	30.75	3 tier	111	101	67	4	5	288	39	35	23	1	2	100
13	MOTAGUNDA(SUZLON)	58.8	3 tier	103	101	38	14	32	288	36	35	13	5	11	100
14	TITHAWA(AZELIA)	28	In house	75	23	8	4	178	288	26	8	3	1	62	100
15	VADALI(ENERCON)	52.8	meteologica	127	73	42	16	30	288	44	25	15	6	10	100
16	RAJAPARA(SUZLON)	29.4	3 tier	193	28	12	6	49	288	67	10	4	2	17	100
	Total	998.45		1969	1339	526	183	591	4608	43	29	11	4	13	100



Forecaster wise / Site wise accuracy during different wind scenario Developer- In House forecasting Mechanism

Agency	M.GUNDA(GMSH) - Installed capacity 24.65 MW					
In House		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	63	14	4	3	17
	Average wind	67	9	11	3	9
	High wind	67	19	8	6	0

Agency	TITHAWA(AZELIA) - Installed Capacity - 28.00 MW					
In House		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	57	9	1	1	31
	Average wind	16	9	5	1	69
	High wind	5	5	2	2	85



Forecaster wise / Site wise accuracy during different wind scenario meteorologica

Agency	TEBHDA(ENERCON) Installed capacity - 240.80 MW					
meteologica		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	55	23	11	3	7
	Average wind	44	32	20	4	0
	High wind	43	42	14	2	0

Agency	RASALIYA(ENERCON) Installed Capacity - 62.40 MW					
meteologica		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	49	15	15	2	20
	Average wind	68	32	0	0	0
	High wind	32	39	18	11	0

Agency	PAREVDA(SUZLON) Installed Capacity 25.20 MW					
meteologica		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	53	33	4	3	6
	Average wind	59	24	9	6	1
	High wind	38	26	21	10	5

Forecaster wise / Site wise accuracy during different wind scenario 3 tier As per RRF Mechanism

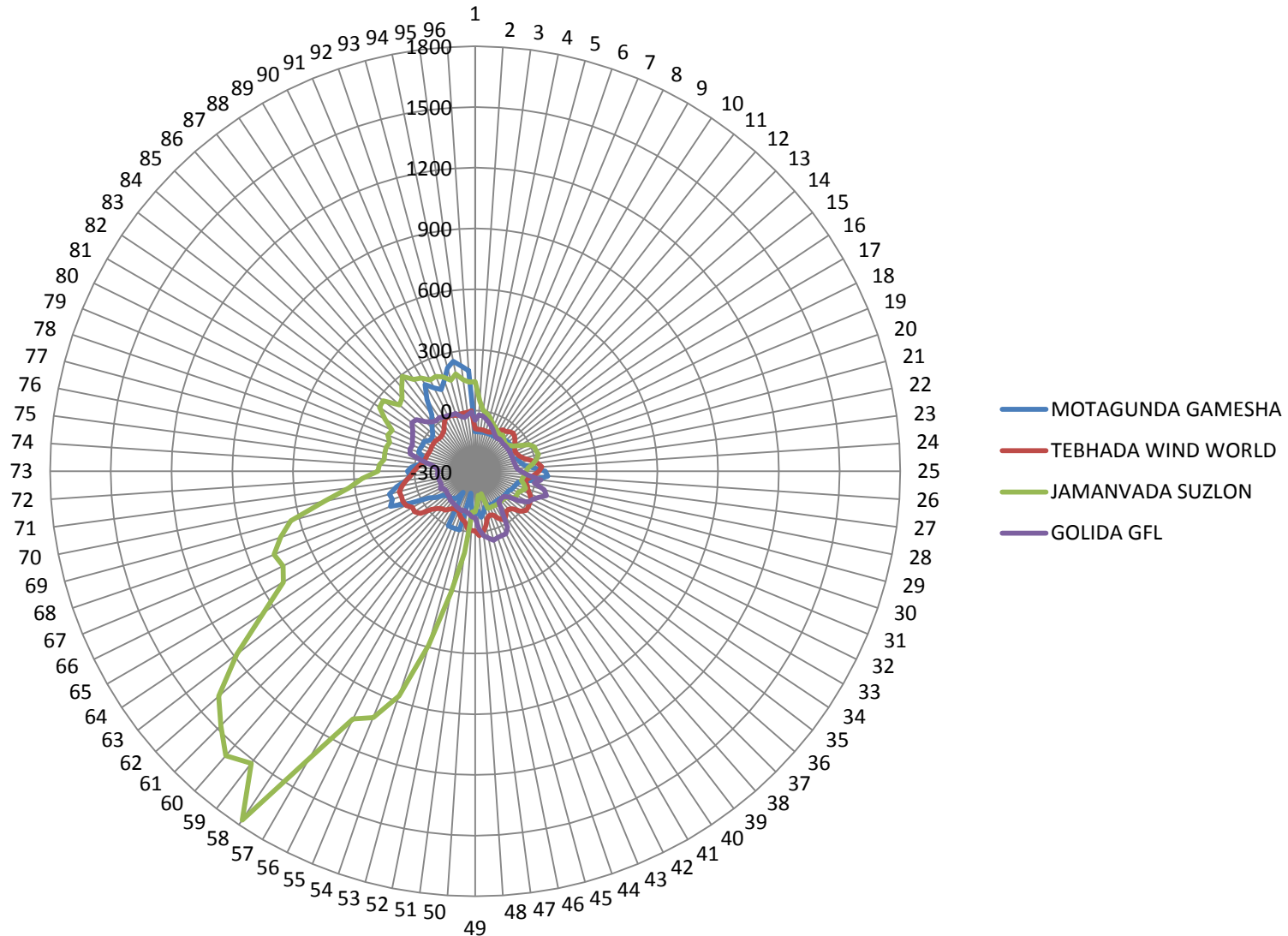
Agency	GODILA (GFL)- Installed Capacity - 50 MW					
3 tier		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	61	8	13	10	7
	Average wind	24	13	18	9	36
	High wind	23	14	16	15	33

Agency	BHOJAPURI (SUZLON) Installed capacity - 50.40 MW					
3 tier		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	20	79	1	0	0
	Average wind	33	48	9	1	8
	High wind	27	32	23	11	6

Agency	JAMANVADA (SUZLON) Installed capacity - 138.60 MW					
3 tier		less than -30%	Between -30% to 50%	Between 0 to 30%	Between 30% to 50%	More than 50%
	Low wind	41	4	5	1	49
	Average wind	43	31	1	2	23
	High wind	18	49	33	0	0

Wind deviation in % as on 19.03.14 (Low wind scenario 4.59Mus) (Gamesha, Wind World, Suzlon, GFL)

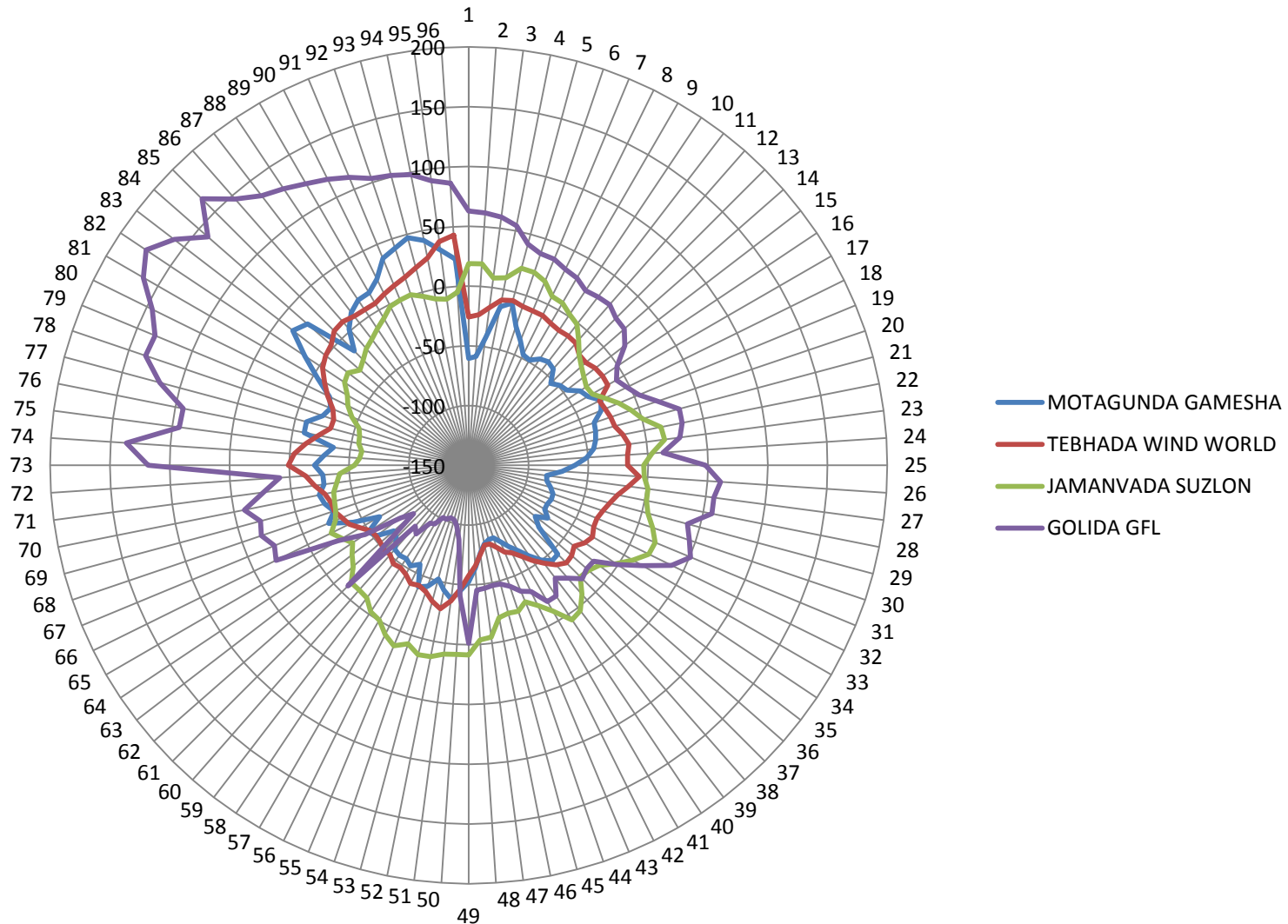
Wind deviation in % on 19.03.14



Wind deviation in % as on 13.03.14 (High wind scenario 23.96Mus) (Gamesha, Wind World, Suzlon, GFL)



Wind deviation in % on 13.03.14





Observation on wind forecasting....

- Wind generation forecasting depends upon *accuracy of weather data*.
- Forecast of wind more affected *during heavy rain*.
- Forecasting by RRF stations are *found not prominent at sometime*.
- Sudden rise/fall of wind speed may lead to wide variation in wind generation forecasting.
- *Zero generation or very low generation* at any WEG due to any reason on previous day may give wrong forecast for today even after change in wind speed.
- Generally as per power curve of wind energy generation, there shall not be much change in wind generation after certain limits. Example any increase in wind speed after 15mph, there is saturation in wind generation. However, *due to comparative study/analysis of wind speed of two conservative days suggested above, there may be more wind generation on next day* if wind speed is more than 15mph, since wind generation varies with $(\text{wind speed})^3$.
- *As per present practice, WEG are segregated as per their location & due to non availability of the exact location of WEG/pooling station & weather data of that location, wind generation forecast may not be so accurate.*



Forecasting Based on [RRF station](#) Declaration & revision there of... Generally, RRF Wind farm available at Near or around Non RRF station in all Area

- To obtained Same day forecasting in 24 hrs i.e say F1 to F24
- Previous day RRF DC for 16 pooling station averaging in 24hrs i.e D1 to D24
- Previous day Actual Generation of 47 pooling station in 24hrs i.e A1 to A24
- Factor for every hour i.e say f1 to f24 :Division of A1 to A24 / D1 to 24
- Average factor i.e a= average of factor -f1 to f24

- Now, to obtain same day forecasting in 24 hrs i.e say F1 to F24
- $F1 \text{ to } F24 = a * d1 \text{ to } d24$
(where d1 to d24 is same day RRF DC for 16 pooling station)

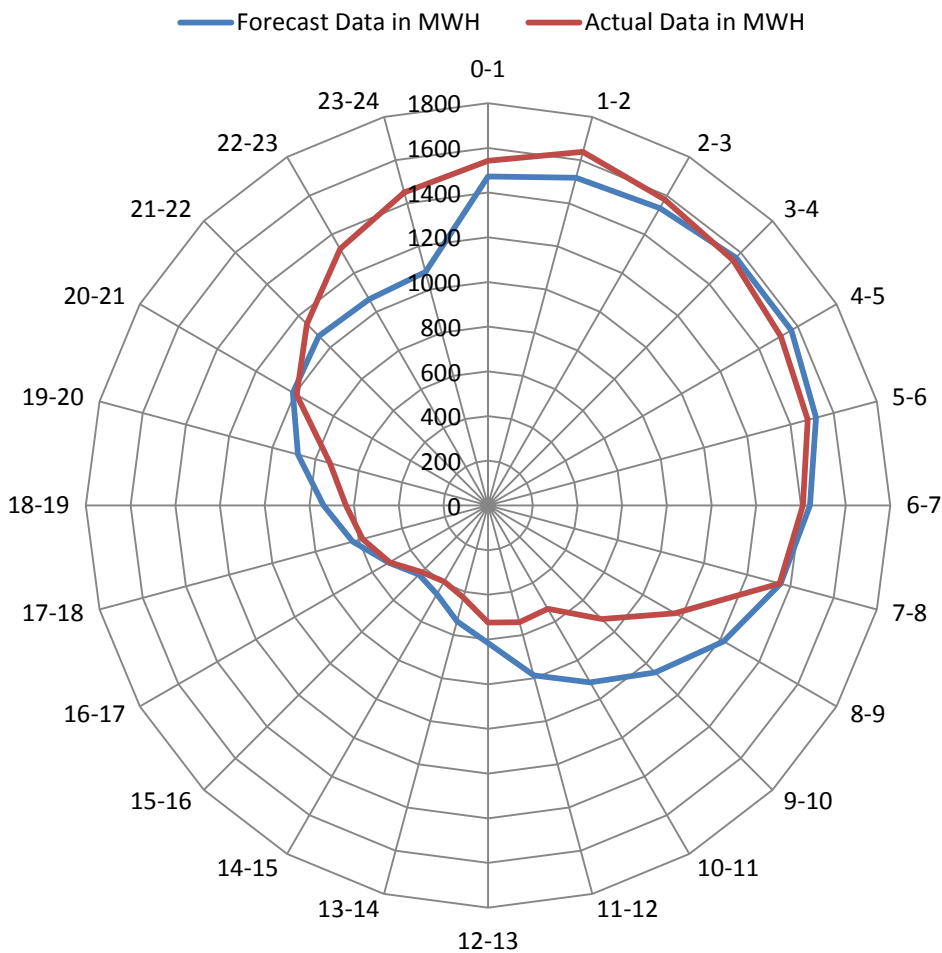
- By using this method, at least pattern of wind generation for the same day can be obtain in most of cases in 24hrs .

Wind Forecast vs Actual gen for 13.03.14 w.r.t RRF DC

High 23.96 Mu's of wind gen in March month



Forecast Vs Actual Data on 13.03.14



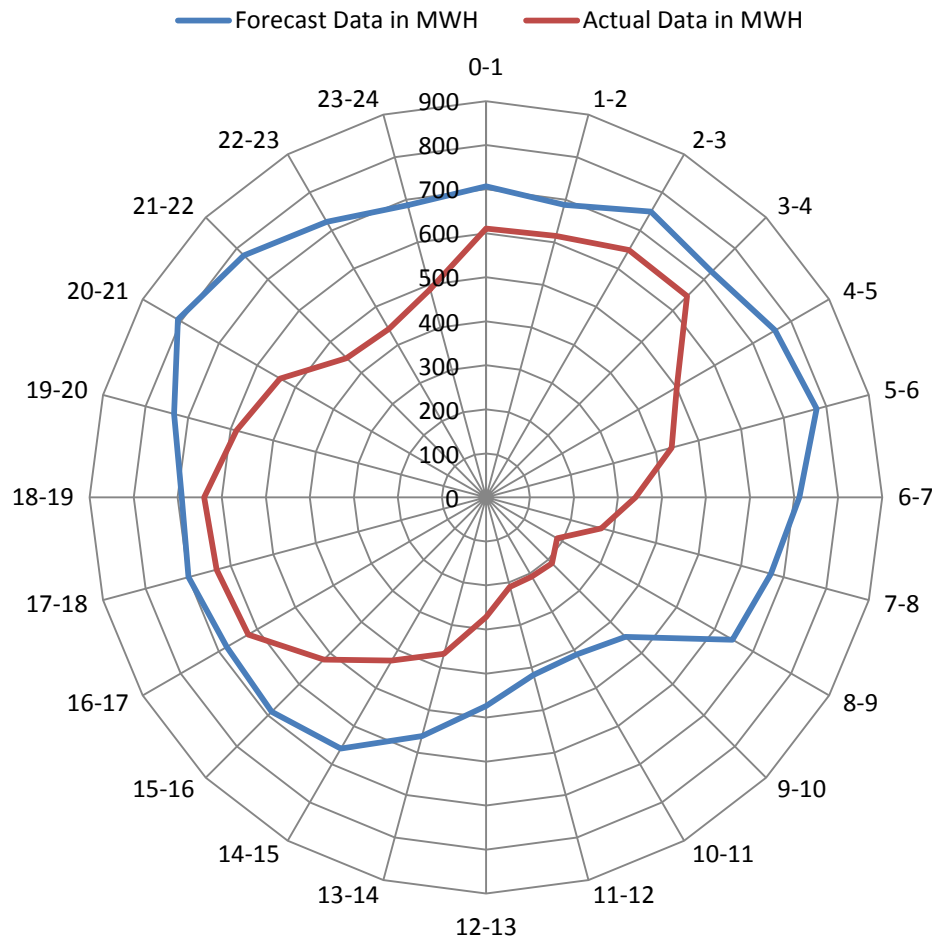
Time in hrs	Forecast Data in MWH	Actual Data in MWH	Diff (F-A)	Diff w.r.t F
0-1	1472	1543	-71	-5
1-2	1518	1638	-119	-8
2-3	1536	1580	-45	-3
3-4	1568	1551	17	1
4-5	1567	1512	56	4
5-6	1519	1481	38	3
6-7	1440	1408	32	2
7-8	1354	1349	4	0
8-9	1217	965	252	21
9-10	1056	719	337	32
10-11	914	535	379	41
11-12	787	542	245	31
12-13	616	524	92	15
13-14	536	427	109	20
14-15	459	394	64	14
15-16	438	422	17	4
16-17	513	509	4	1
17-18	627	582	45	7
18-19	737	636	101	14
19-20	881	733	149	17
20-21	1009	989	20	2
21-22	1071	1147	-76	-7
22-23	1065	1325	-260	-24
23-24	1081	1449	-368	-34
Total in Mus	24.98	23.96	1.02	4.10

Wind Forecast vs Actual gen for 22.03.14 w.r.t RRF DC

Average 10.88 Mu's of wind gen in March month



Forecast Vs Actual Data on 22.03.14

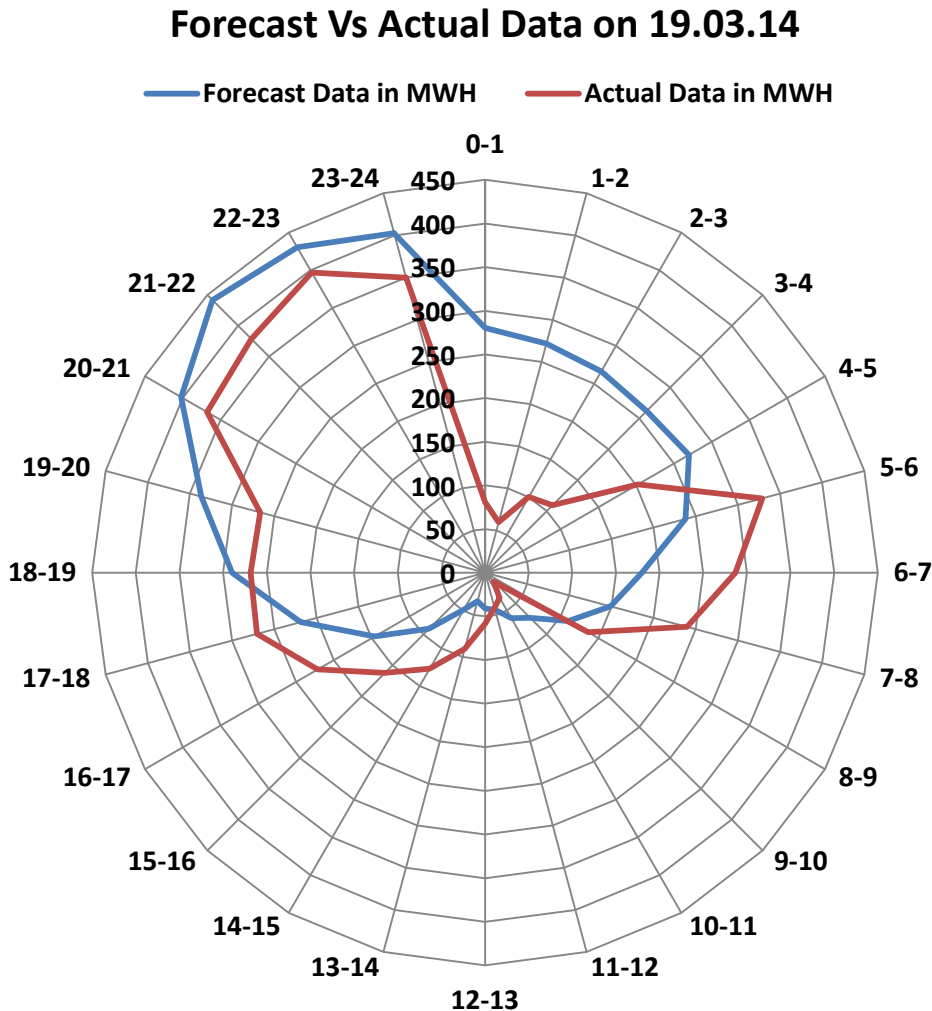


Time in hrs	Forecast Data in MWH	Actual Data in MWH	Diff (F-A)	Diff w.r.t F
0-1	610	611	0	0
1-2	594	615	-21	-4
2-3	647	649	-2	0
3-4	626	646	-20	-3
4-5	655	501	154	24
5-6	672	437	235	35
6-7	615	340	275	45
7-8	579	271	308	53
8-9	558	186	372	67
9-10	386	212	175	45
10-11	356	208	148	42
11-12	361	210	150	42
12-13	409	272	137	34
13-14	484	368	116	24
14-15	569	428	141	25
15-16	594	521	73	12
16-17	587	623	-37	-6
17-18	604	633	-30	-5
18-19	597	640	-44	-7
19-20	633	586	47	7
20-21	698	540	157	23
21-22	671	447	224	33
22-23	624	442	182	29
23-24	593	489	104	18
Total in Mus	13.72	10.88	2.85	20.74 50



Wind Forecast vs Actual gen for 19.03.14 w.r.t RRF DC

Low 4.59 Mu's of wind gen in March month



Time in hrs	Forecast Data in MWH	Actual Data in MWH	Diff (F-A)	Diff w.r.t F
0-1	280	81	200	71
1-2	272	60	211	78
2-3	266	100	166	62
3-4	262	109	153	58
4-5	270	202	68	25
5-6	238	329	-91	-38
6-7	180	287	-107	-60
7-8	149	240	-91	-61
8-9	110	136	-26	-24
9-10	73	14	59	80
10-11	60	33	27	45
11-12	44	42	2	5
12-13	41	58	-17	-42
13-14	34	90	-56	-165
14-15	49	127	-78	-159
15-16	91	162	-72	-79
16-17	146	222	-76	-52
17-18	219	271	-52	-24
18-19	290	269	21	7
19-20	336	267	70	21
20-21	402	368	34	8
21-22	442	379	63	14
22-23	430	397	33	8
23-24	403	350	53	13
Total in Mus	5.09	4.59	0.49	9.72



wind forecasting way forward.... Pilot Project

- Pilot Project for RE forecasting with PGCIL
- Five Forecasting Service Provider have agreed to provide RE forecasting for 5 months on non commercial base.
- Initially, following six pooling stations of three wind developers viz Suzlon, Enercon and Vestas are selected for about 1261MW wind and Charanka solar park for about 224MW solar:

NAME OF WIND FARM S/S OWNER	CONNECTED WIND FARM S/S (SENDING END)	CONNECTED GETCO S/S (RECEIVING END)	Area	INS. CAP. IN MW
ENERCON	BHOGAT	132 KV BHATIA	JAMNAGAR	180.26
ENERCON	SADODAR	220 KV PANALI	PORBANDAR	462.4
SUZLON	VARSHAMEDI	132 KV WANKANER	KANDLA	119.7
SUZLON	VANKU	66 KV KOTHARA	JAKHAU	50
SUZLON	SUTHRI	220 KV NANAI KHAKHAR	SUTHRI	270.8
VESTAS	WANDHIYA	220 KV SHIVLAKHA	KANDLA	177.9

1261.06

Charanka solar park	19 Nos of Solar Plants	224.10 MW
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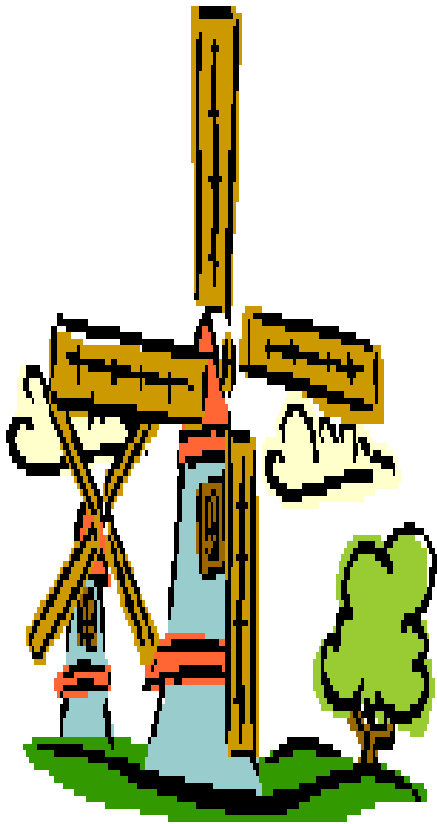
wind forecasting way forward....

Need for Scheduling leads to.....

- Forecasting
- Revising to minimize Unscheduled Interchange
- Real Time monitoring (SCADA requirements)
- Need to measure Actual (Metering)
- UI accounting (pool participation)
- RRF (presently, suspended by Commission)

Suggestion-

- **Wind generation schedule (Declaration) should be implemented/made compulsory for all the WEG (Non RRF & RRF) so as to have proper planning of other generators (due to sudden rise or fall in the wind generation, pick up and back down of other thermal or gas units can be restricted.)**
- REMC may be developed at all SLDC.



Thank you all....