

# Power System Operation Corporation Limited

Ref. No.: NLDC/SO/2020-21

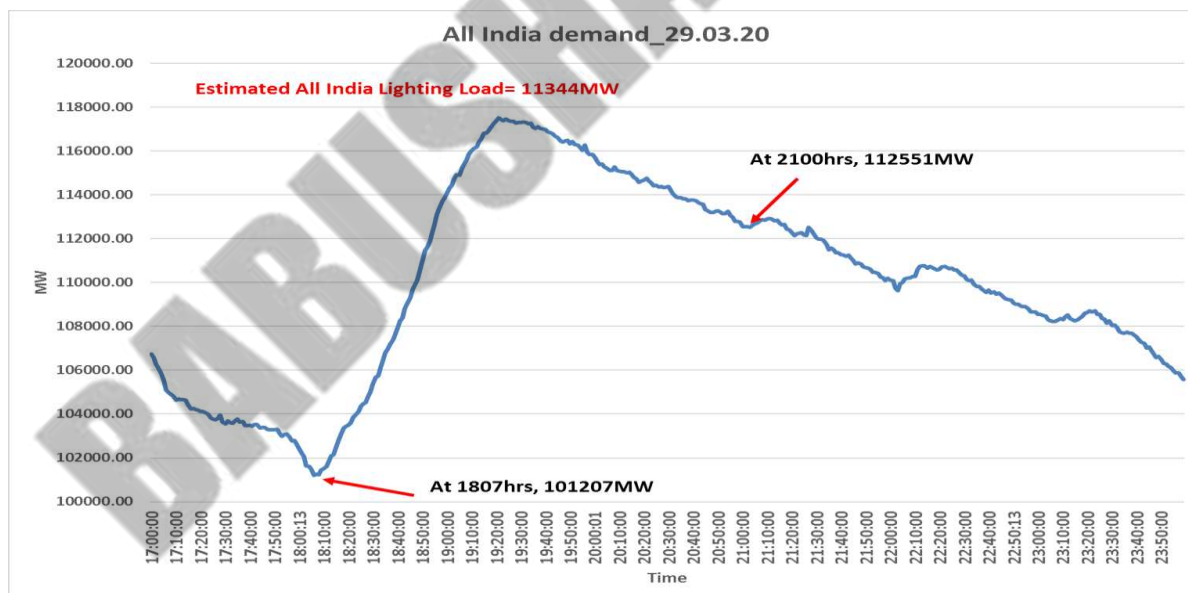
Date: 04<sup>th</sup> April 2020.

**Sub: Advisory for Reliable & Secure System Operation during the lighting load switch off on 05<sup>th</sup> April 2020 at 21:00 hrs for nine (9) minutes.**

In order to ensure reliable and secure grid operation during upcoming event, all RLDCs/ SLDCs and NLDC are requested to kindly follow the below mentioned guidelines:-

## **A.) Estimate of demand reduction:**

From the demand pattern of 29<sup>th</sup> March 2020 (Sunday), it has been observed that nadir All India demand was around 101207 MW at 1807hrs and subsequently it has increased up to 112551MW at 2100hrs during evening peak. Therefore, considering the load behavior it is anticipated that lighting load of household consumers may be the difference of all India demand at 18:07 hrs and 21:00 hrs i.e. 11344 MW. The all India demand curve of 29<sup>th</sup> March 2020 is given below.



Further, a separate exercise has been carried out to find the total demand reduction at grid level based on the number of household consumers in India. The calculated total reduction in demand which is reflected at grid level is 12879 MW. The complete state wise load reduction details are attached as Annexure I and summary of region wise load reduction details is given below in table.

**Region Wise Details of load reduction during light switch off event on 05th April 2020**

S.No.	Region	No of Rural household consumers (a)	No of urban household consumers (b)	Load of Rural household consumers (MW) (c = 50*a)	Load of urban household consumers (MW) (d = 100*b)	Reduced Load of Rural household Consumers (MW) (e = c*.80)	Reduced Load of urban household Consumers (MW) (f = d*.80)	Total Reduced Demand as reflected at consumer level (MW) (g = e+f)	Total Reduced Demand as reflected at Grid level (MW) (g / 0.8)
1	Northern Region	42293470	13214064	2115	1321	1692	1057	2749	3436
2	Western Region	35669904	19020928	1783	1902	1427	1522	2948	3686
3	Southern Region	43854642	4668665	2193	467	1754	373	2128	2660
4	Eastern Region	41183918	4515705	2059	452	1647	361	2009	2511
5	North Eastern Region	8362568	1689177	418	169	335	135	470	587
	<b>Total</b>	<b>171364502</b>	<b>43108539</b>	<b>8568</b>	<b>4311</b>	<b>6855</b>	<b>3449</b>	<b>10303</b>	<b>12879</b>

From both the above methods, it is inferred that total domestic lighting load reduction on All India level is anticipated to the tune of 12-13 GW.

Unlike normal operation, this reduction in load of the order of 12-13 GW would happen in 2-4 minutes and recover nine minutes later within 2-4 minutes. This sharp reduction in load and recovery, which is unprecedented, will need to be handled through hydro and gas resources identified and enclosed at Annexure II.

**B.) Generation Scheduling & Frequency Control**

- a. All clocks at generating stations may be synchronized to Indian standard time (IST).
- b. During the evening peak hours i.e from 18:10 to 20:00 hrs. hydro generation will be reduced and conserved for providing flexibility during 21:00 hrs. event. During this time thermal and gas generation shall be scheduled in a manner so as to manage the peak.
- c. Subsequently after the peak hours, thermal Inter State Generating Stations (ISGS) generation would be gradually reduced to near technical minimum level of 60 % by 20:55 hrs. and simultaneously hydro generation shall be increased to maintain the load generation balance.
- d. Hydro generation and gas generation shall be ramped down starting from 20:57 hrs. keeping a watch on the system frequency. The hydro units should be kept rolling at 0 – 10 % of the rating and not to be disconnected during this period. Gas station shall be ramped down to the minimum level.

- e. Ramping up of thermal machines shall be carried out from 21:05 hrs onwards. further from 21:09hrs onwards Hydro generation shall be ramped up to meet increase in load. After stabilization of system parameters hydro units may be withdrawn in consultation with RLDCs & SLDCs.
- f. Pumped storage hydro units shall be brought in pumping mode by 20:45 hrs and will be kept in service till 21:09 hrs. After that, machines shall be withdrawn from the grid through under frequency relays graded between 49.90 to 49.70 Hz amongst the units at each of the pumped hydro stations.
- g. Wind generators of ISGS/ intra state level shall be advised to automatically disconnect the wind generating plants at the ISTS/intra state transmission level when frequency is more than 50.2 Hz. This over frequency setting may be removed after the event & units synchronized after 21:30 hrs. This setting may be implemented at the transmission level sub-stations.
- h. For having a better level of ramping resources, Security Constrained Economic Despatch (SCED) may be stopped from 1800 hours onwards and would be resumed any time after the event.
- i. All India grid frequency may be kept at lower side of the IEGC band i.e 49.90 Hz from 20:30 hrs onwards in view of anticipated frequency rise due to demand reduction at 21:00 hrs.
- j. Primary response of all generating stations shall be in service. All the hydro power plants would reduce their governor droop setting from the current level of 4-5% to 1-2% or whatever lower value feasible latest by 1200 hours of 5<sup>th</sup> April 2020 and confirm to the respective SLDC/RLDC the revised settings implemented. This would be reverted to the original setting anytime on 6<sup>th</sup> April 2020.
- k. All defense mechanisms such as Under Frequency / df/dt relays and Automatic demand management systems shall be in service and healthiness shall also be ensured.

**C.) Voltage Control measures:**

- a. Since COVID-19 containment measures implemented from 25<sup>th</sup> March 2020 nearly 220-240 lines at 400 kV voltage level and above are kept in open condition for voltage control. System voltages have been within the Indian Electricity Grid code (IEGC) band. As per studies during the above event the voltage levels would be within control keeping the generation scheduling as per section-B above. The list of 400 kV and above buses where the voltage level is expected to rise by more than 0.01 pu is indicated at Annexure-III.
- b. Notwithstanding the above, all switching operation of transmission lines, line reactors & bus reactors shall be completed by 20:00 hrs. to keep voltages preferably around 760/400kV respectively.
- c. All reactors should put in service wherever required, latest by 20:00 hrs .
- d. STATCOMS and SVCs shall be in voltage control mode with reference voltage of 400 kV.
- e. Capacitors at distribution level to be kept off to maintain voltage at nominal.

- f. All thermal and hydro machines would absorb/generate reactive power as per capability curve. It is expected that the operation of hydro units in the 0-10% would increase the reactive power generation/absorption capability.

**D.) General guidelines :**

- a. All regional entities may be advised to maintain their interchange with the grid as per schedule.
- b. Reserve Regulation Ancillary Service (RRAS) dispatch instructions for ISGS shall be issued by NLDC to maintain the load-generation balance in real-time.
- c. HVDC set points may be kept in a manner such that adequate margin in inter-regional corridors is available and keep Inter/ Intra regional node voltages as suggested above.
- d. All SLDCs may advise DISCOMs to avoid any feeder switching operation from 20:00 to 22:00 hrs.
- e. Round the clock availability of communication systems & SCADA data shall be ensured by all entities.
- f. Strengthening of control room staff may be carried out NLDC and all RLDCs/SLDC shall remain in alert mode and monitor the grid closely in order to take care of any contingency.
- g. SLDCs shall advise respective DISCOMs to ensure that distribution substations, housing society/ residential apartments main supply shall not be switched off at feeder / mains level. Necessary direction may also be sent to Resident Welfare Associations (RWA) in this regard.
- h. All RLDCs/SLDCs & NLDC are advised to extend the evening shift timings till 22:00 hrs. preferably and allow overlap with the incoming night shift.
- i. All the entities shall ensure black start facilities mentioned in the restoration procedures of RLDCs are in healthy condition.

All senior personnel should be available at the generating stations, substations, Load Despatch Centers (LDCs) between 18:00 to 22:00 hrs. on 05<sup>th</sup> April 2020.

Annexure-I: Anticipated reduction in demand.

Annexure-II : Operating margins for hydro & gas stations.

Annexure-III: List of substations where voltage would rise by 0.01 pu and above during load disconnection

## Region Wise Details of load reduction during light switch off event on 05th April 2020

S.No.	Region	No of Rural household consumers (a)	No of urban household consumers (b)	Load of Rural household consumers (MW) (c = 50*a)	Load of urban household consumers (MW) (d = 100*b)	Reduced Load of Rural household Consumers (MW) (e = c*.80)	Reduced Load of urban household Consumers (MW) (f = d*.80)	Total Reduced Demand as reflected at consumer level (MW) (g = e+f)	Total Reduced Demand as reflected at Grid level (MW) (g / 0.8)
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<b>Note</b>	The source of no of rural and urban household consumers is saubhagya web portal
	It is assumed that Load of each rural and urban household consumer are 50 and 100 Watt respectively
	It is assumed that both load of each rural and urban consumer will reduce by 80%.
	Transmission and distribution losses are considered as 20 %.

## State Wise details of load reduction during light switch off event on 05th April 2020

S.No	State/UT	No of Rural household consumers (a)	No of urban household consumers (b)	Load of Rural household consumers (MW) (c = 50*a)	Load of urban household consumers (MW) (d = 100*b)	Reduced Load of Rural household Consumers (MW) (e = c*.80)	Reduced Load of urban household Consumers (MW) (f = d*.80)	Total Reduced Demand as reflected at consumer level (MW) (g = e+f)	Total Reduced Demand as reflected at Grid level (MW) (g / 0.8)
1	Uttar Pradesh	21053398	8123365	1053	812	842	650	1492	1865
2	Rajasthan	9178075	3580576	459	358	367	286	654	817
3	Punjab	3693050	11	185	0	148	0	148	185
4	Haryana	3469097	875	173	0	139	0	139	174
5	Jammu & Kashmir	1881056	579306	94	58	75	46	122	152
6	Uttarakhand	1532454	560602	77	56	61	45	106	133
7	Himachal Pradesh	1486340	369329	74	37	59	30	89	111
8	Maharashtra	14761239	10060801	738	1006	590	805	1395	1744
9	Madhya Pradesh	9736193	2884814	487	288	389	231	620	775
10	Gujarat	6554612	4859920	328	486	262	389	651	814
11	Chhattisgarh	4489652	1215393	224	122	180	97	277	346
12	Goa	128208	0	6	0	5	0	5	6
13	Telangana	6157086	442654	308	44	246	35	282	352
14	Andhra Pradesh	11407070	55932	570	6	456	4	461	576
15	Tamil Nadu	10285848	0	514	0	411	0	411	514
16	Karnataka	8804899	1461170	440	146	352	117	469	586
17	Kerala	7104123	2708909	355	271	284	217	501	626
18	Puducherry	95616	0	5	0	4	0	4	5
19	Odisha	8208971	1462882	410	146	328	117	445	557
20	Jharkhand	5910110	987240	296	99	236	79	315	394
21	Bihar	11907539	2065583	595	207	476	165	642	802
22	West Bengal	15058530	0	753	0	602	0	602	753
23	Sikkim	98768	0	5	0	4	0	4	5
24	Assam	5992843	1109764	300	111	240	89	328	411
25	Tripura	791553	0	40	0	32	0	32	40
26	Meghalaya	561913	73889	28	7	22	6	28	35
27	Manipur	412815	40858	21	4	17	3	20	25
28	Nagaland	276726	247144	14	25	11	20	31	39
29	Arunachal Pradesh	202875	99486	10	10	8	8	16	20
30	Mizoram	123843	118036	6	12	5	9	14	18
	<b>Total</b>	<b>171364502</b>	<b>43108539</b>	<b>8568</b>	<b>4311</b>	<b>6855</b>	<b>3449</b>	<b>10303</b>	<b>12879</b>

Note

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It is assumed that Load of each rural and urban household consumer are 50 and 100 Watt respectively

It is assumed that both load of each rural and urban consumer will reduce by 80%.

Transmission and distribution losses are considered as 20 %.

## Northern Region

S.No.	Name	Utility	Type (S/R/P)	I/C (MW)	DC	maximum	Minimum Generation	Flexibility	Remarks
1	Bairasiul	NHPC	P	180	110	110	20	90	One m/c under outage
2	Chamera-II	NHPC	P	300	100	100	10	90	two m/c under outage
3	Chamera-I	NHPC	P	540	555	555	21	534	
4	Salal	NHPC	R	690	700	700	36	664	
5	Dhauliganga	NHPC	P	280	292	292	28	264	
6	Tanakpur	NHPC	R	94.2	62	62	24	38	
7	Chamera-III	NHPC	P	231	240	240	60	180	
8	Parbati III	NHPC	P	520	130	130	10	120	
9	Dulhasti	NHPC	P	390	405	405	120	285	
10	Naptha Jhakri	SJVN	P	1500	1605	1605	1020	585	
11	Rampur	SJVN	P	412	370	370	245	125	
12	Tehri	THDC	S	1000	573	573	100	473	DC low head DC is reduced
13	Koteshwar	THDC	S	400	102	102	70	32	
14	Koldam	NTPC	P	800	872	872	160	712	
15	Pong	BBMB	S	396	180	180	90	90	Machine may be put in synchronous condenser mode
16	Dehar	BBMB	R	990	645	645	560	85	
17	Bhakra complex	BBMB	S	1379	1035	1035	140	895	
18	Baglihar	J&k		900		300	220	80	
19	RSD	Punjab		600		450	360	90	
20	Ramgarh gas			110		110	50	60	from 50 to 110 generation can be flexed
21	Vishuprayag	UP		440		70	35	35	
22	alalnanda	UP		330		150	0	150	ROR, can not be varied, either on full load or close down
23	Rihand	UP		300		170	0	170	can be varied
24	Obra	UP		99		50	0	50	can be varied
25	Baspa	HP		300		70	0	70	confirm from MD, SLDC
26	Bhabha			120		40	0	40	M/C may be kept on mechanical rolling mode without any problem
27	giri			60		20	0	20	
28	bassi			60		15	0	15	
29	chibro plus khodri	Uttarakhand		360		360	160	200	
30	Dharasu			304		152	20	132	
	<b>Total</b>					<b>9933</b>	<b>3559</b>	<b>6374</b>	

Western Region										
S.No.	Name	Utility	Type (S/R/P)	I/C (MW)	DC	maximum	Minimum Generation	Flexibility	Remarks	
1	Koyna IV Hy	Maharashtra		1000		747	0	747		
2	Koyna III Hy			320		161	0	161		
3	Koyna I & II Hy			600		538	219	319		
4	Bhira Hy			150		70	0	70		
5	Uran Gas				672		294	273	21	
6	Ukai Hy	Gujarat		300		140	68	72		
7	Kadana Hy				240		50	0	50	
8	Indirasagar Hy	Madhya Pradesh		1000		500	0	500		
9	Omkareshwar Hy				520		330	0	330	
10	Hasdeo Bango Hy	Chattisgarh		120		40	0	40		
11	Sardar Sarovar Hydro	Shared		1450		830	50	780		
12	Kawas Gas				656		460	280	180	
13	Gandhar Gas				657		190	170	20	
	<b>Total</b>					4350	1060	3290		



Southern Region									
S.No.	Name	Utility	Type (S/R/P)	I/C (MW)	DC	maximum	Minimum Generation	Flexibility	Remarks
1	SRISAILAM RBPH		Storage	770	661	660	480	180	
2	LOWER SILERU		Storage	460	345	300	240	60	
3	UPPER SILERU		Storage	240	180	170	150	20	
4	DONKARAYI		-	25	25	15	12	3	
5	NSR RT.CANAL.P.H		-	90	0	0	0	0	
6	SRISAILAM LBPH		Storage	900	900	750		750	
7	N'SAGAR		Storage	816	815	600		600	
8	NSR LT.CANAL.P.H		Storage	60	60	20		20	
9	JURALA		Run of River	234	0	0	0	0	
10	LOWER JURALA		Run of River	240	0	0	0	0	
11	PULICHINTALA		Run of River	120	0	0	0	0	
12	SHARAVATHY		Storage	1,035	950	950	200	750	
13	NAGJHERI		Storage	885	840	840	480	360	
14	VARAHI		Storage	460	460	460	60	400	
15	SHARAVATHI TAIL RACE		Storage	240	220	220	140	80	
16	KADRA		Storage	150	150	150	114	36	
17	JOG (MGHES)		Storage	139	46	46	30	16	
18	KODASALLI		Storage	120	120	120	72	48	
19	SUPA		Storage	100	96	96	0	96	
20	LINGANAMAKKI.P.H.		Storage	55	42	42	20	22	
21	ALMATTI		Run of River	290	0	0	0	0	
22	IDUKKI		Storage	780	390	360	90	270	
23	SABARIGIRI		Storage	340	340	320	160	160	
24	DI + EXTENTION + ADDL. EXTN.		Storage	225	225	200	105	95	
25	L.PERIYAR		Storage (Small)	180	180	162	135	27	
26	AMANGALAM + EXTENSION		Storage (Small)	78	78	73	64	9	
27	IDAMALAYAR		Storage	75	75	52	40	12	
28	SHOLAYAR		Storage	54	36	36	20	16	
29	KAKKAD		Storage (Small)	50	50	36	34	2	
30	KADAMPARAI		Storage	400	300	300	210	90	
31	METTUR TUNNEL		Storage	200	200	200		200	
32	KUNDAH-I to VI		Storage	585	585	423		423	
33	VARA ULTIMATE (PUSHEP)		Storage	150	150	150		150	
	<b>Total</b>					<b>7751</b>	<b>2856</b>	<b>4895</b>	

Eastern Region									
S.No.	Name	Utility	Type (S/R/P)	I/C (MW)	DC	maximum	Minimum Generation	Flexibility	Remarks
1	RANGIT HPS	ISGS	Pondage (3hr.)		60.00	60.00	21.00	39.00	
2	TEESTA HPS	ISGS	Pondage (3hr.)		510.00	510.00	60.00	450.00	
3	CHUZACHEN	IPP	Run of River		99.00	99.00	0.00	99.00	
4	DIKCHU Hep	IPP	Run of River		96.00	96.00	0.00	96.00	
5	JORETHANG	IPP	Run of River		96.00	96.00	0.00	96.00	
6	TASHIDING	IPP	Run of River		97.00	97.00	0.00	97.00	
7	TEESTA STG III Hep	Odisha	Storage		1200.00	1200.00	120.00	1080.00	
8	BALIMELA HPS	Odisha	Storage		330.00	330.00	0.00	330.00	
9	BURLA HPS/HIRAKUD I	Odisha	Storage		85.50	85.50	0.00	85.50	
10	PLIMA HPS / HIRAKUD II	Odisha	Storage		24.00	24.00	0.00	24.00	
11	INDRAVATI	Odisha	Storage		450.00	450.00	0.00	450.00	
12	RENGALI HPS	Odisha	Storage		150.00	150.00	0.00	150.00	
13	U.KOLAB	Odisha	Storage		320.00	320.00	0.00	320.00	
14	TLDP III	West Bengal	Pondage (3hr.)		132.00	132.00	18.00	114.00	
15	TLDP IV		Pondage (3hr.)		160.00	160.00	24.00	136.00	
	<b>Total</b>					3810	243	3567	

North Eastern Region									
S.No.	Name	Utility	Type (S/R/P)	I/C (MW)	DC	maximum	Minimum Generation	Flexibility	Remarks
1	AGBPP-GAS	NEEPCO		291	210	210	155	55	
2	AGTCCPP-GAS	NEEPCO		135	122	122	71	51	
3	DOYANG	NEEPCO	R	75	33	33	30	3	1 machines under outage
4	LOKTAK	NHPC	S	105	69	69	16	53	1 machine under outage
5	PALATANA-GAS	OTPC		726	630	630	400	230	
6	PARE	NEEPCO	R	110	54	54	40	14	1 machine under outage
7	RANGANADI	NEEPCO	R	405	401	401	220	181	one machine will be withdrawn to acheive min value
8	<b>Total</b>					1519	932	587	
9									
All India Figures									
						maximum	Minimum Generation	Flexibility	Remarks
	Total					27363	8650	18713	

765 kV Stations with maximum increase in voltage							
BUS No.	BUS	VOLTAGE (pu) - Case A 2nd April -21:00 Hrs	VOLTAGE (pu) - Case B 5th April - 21:00 Hrs	DELTA (pu)	Voltage (kV) - Case A	Voltage (kV) - Case B	DELTA KV
337009	[PUNE GIS-PG 765.00]	1.012	1.019	0.007	774.1	779.5	5.4
337008	[EKTUNI 765.00]	1.002	1.008	0.007	766.3	771.4	5.1
337006	[DHULE-BDTCL 765.00]	0.982	0.988	0.006	751.5	756.0	4.5
337005	[AURANGABD-PG765.00]	1.025	1.031	0.005	784.5	788.6	4.1
337012	[NEW PARLI-PG765.00]	1.027	1.032	0.005	786.0	789.6	3.6
337004	[SOLAPUR-PG 765.00]	1.025	1.030	0.005	784.4	787.9	3.5
337002	[AKOLA 765.00]	1.003	1.008	0.004	767.6	770.8	3.2

400 kV Stations with maximum increase in voltage								
BUS No.	BUS	VOLTAGE	VOLTAGE (pu) - Case A 2nd April -21:00 Hrs	VOLTAGE (pu) - Case B 5th April - 21:00 Hrs	DELTA (pu)	Voltage (kV) - Case A	Voltage (kV) - Case B	DELTA KV
524005	[MISA4	400.00]	0.995	1.017	0.022	397.89	406.80	8.91
524006	[AZARA4	400.00]	1.011	1.031	0.020	404.58	412.42	7.85
544001	[KILLING4	400.00]	1.023	1.041	0.018	409.13	416.48	7.35
534001	[IMPHAL-PG4	400.00]	1.043	1.060	0.018	417.01	424.10	7.10
524004	[BALIPARA FSC	400.00]	0.991	1.008	0.016	396.54	403.02	6.48
524009	[SILCHAR4	400.00]	1.030	1.046	0.016	411.82	418.29	6.47
514002	[KAMENG4	400.00]	1.003	1.019	0.016	401.18	407.55	6.37
524003	[BALIPARA4	400.00]	1.001	1.017	0.016	400.43	406.78	6.35
454008	[KOZHIKODE	400.00]	1.044	1.059	0.015	417.48	423.51	6.03
524007	[BCHARIALI4	400.00]	1.001	1.016	0.015	400.30	406.28	5.98
524002	[BGTPP-NTPC4	400.00]	1.000	1.014	0.013	400.19	405.50	5.30
524001	[BONGAIGAON4	400.00]	1.001	1.014	0.013	400.52	405.79	5.27
434020	[MYSORE	400.00]	1.050	1.063	0.013	420.12	425.30	5.18
334017	[SOLAPUR-MS	400.00]	1.012	1.025	0.013	404.84	409.96	5.11
434013	[HASSAN	400.00]	1.052	1.064	0.012	420.84	425.60	4.76
334035	[NASIK-SINNER	400.00]	1.019	1.029	0.011	407.43	411.72	4.29
334012	[BABLESHWAR	400.00]	1.017	1.027	0.011	406.67	410.95	4.28
434021	[UDUPI PCL	400.00]	1.032	1.042	0.010	412.63	416.78	4.15
334016	[JEJURI	400.00]	1.003	1.013	0.010	401.27	405.40	4.13