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Dt Health Report A Diagnostic Tool-Identification of Transmission & Distribution Losses

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Keywords : *Distribution Transformer (DT), Distribution Transformer Meter (DT meter), Common meter reading instruments (CMRI), Transmission & Distribution (T&D) Aggregate technical & commercial (AT&C), Management information system (MIS), Meter Read Data (MRD) and Nehru Place (NPL).*

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I. Introduction

Knowledge of the reliability of transformers and other electrical equipment is an important consideration in the power distribution system. To evaluate the reliability of a distribution utility, it is necessary to have accurate reliability data on distribution transformers [1]. The quality of supply of electricity and data can be measured by installing DT meters individually on distribution transformers in the network and also by collecting and analyzing the meter read data of the network, But many utilities, such as UHBVN, Haryana and other states like Utter Pradesh are not using these type of DT meters yet. So they are often facing the problem of DT failure till now. Power distribution utilities Like UHBVN, Haryana most of DTs are burnt due to overloading, under loading and phase unbalancing, because of unavailability of data for protection of distribution transformer and maintain the same, which can be taken only from the DT meter of distribution transformer. Proper utilization of information is not an easy task. The important task that remains is an effective analysis to obtain information that will assist in decision making. Distribution transformer management information system report offers rich, specialized functionality which is of great help to the power distribution utilities to meet their information needs. It includes the operational & performance parameters of distribution transformer are analyzed from DT meter reading. This solution provides an excellent, user-friendly interface to document and view elements like substation, feeder and distribution transformer and associated metering point. Supply of quality and reliability is the key analysis module of this solution.

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II. Theoretical Background

a) Distribution Transformer

Distribution transformer is costly and critical equipment in electricity distribution network. Their outages due to failure causes immense inconvenience in the network management and involve high expenditure on account of repair/replacement. Any distribution utility therefore takes all possible actions to reduce downtime/failure of transformers to a minimum and to enlarge their lives, at the most economic cost [2]. Distribution transformer is a static electric device which steps down the 11 KV (primary) voltage to 440 volts between phase and 230 volts between phase and neutral (secondary) through star-delta winding by electromagnetic induction which feeds different types of load such as domestic, commercial, agriculture and industrial etc. hence distribution transformer for the form the essential link between power quality and large number of consumers [3]. So the DT meter should be used to monitor various critical condition of Distribution Transformer.

b) Distribution Transformer Meter

The DT meter and distribution transformer are an important elements of electrical network involved in the energy distribution and thus in the energy audit of electricity distribution. Figure 1 shows the image of distribution transformer meter. The parameters which are logged by the DT meters are as following:-

- Half hourly logging of KW , KVAR and voltage (phase-wise) for peak KVA conditions

- Half hourly logging of KWH
- Duration of power availability or power outage (in minutes) during each half
- Hour interval/ event logging for power OFF & power ON.

Figure 1: Distribution transformer meter

The downloaded meter read data is processed in software tool to generate the DT health reports. So the distribution utility uses the data of DT reports like O & M – for information on DT health and running parameters of distribution transformers, System - for augmentation scheme finalization and Energy Audit– for loss calculation. Reports on the following aspects are to be generated:-

- Distribution Transformer overloaded/ period of overloading
- Unbalancing of Distribution Transformer/ level of unbalancing/ neutral current
- Reactive power drawn from the Distribution Transformer so that if capacitor required may be installed
- Reliability and quality of supply
- History and types of faults occurring in addition to the recording of energy on ½ hours basis.
- Under loading of Distribution Transformers

c) Common Meter Reading Instrument

Common Meter Reading Instrument (CMRI) is a hand held device used for reading (uploading) the data of different make of meters and to have a capability to dump (download) the same to the base computer system. It can be interfaced with external peripherals like printers, barcode scanners etc. This specification covers supply and delivery of Common Meter Reading Instrument. Fig. 2 shows the image of Common Meter Reading Instrument (CMRI).

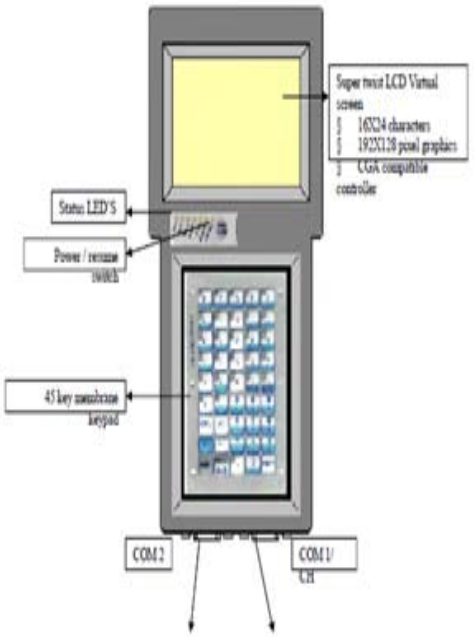

Figure 2 : Common meter reading instrument (CMRI)

CMRI Data Analysis

- Instant Parameters
- Tamper Events
- Load Survey Graphs
- Billing Data

III. Analysis and Implementation

Analysis can be well understood from the flow chart as illustrated in Fig. 3. The data obtained from DT meter is to be uploaded with the help of CMRI and also dump the same to the computer system. Further it is converted into Correct & Corrupt data form as a .CSV file. If there is any exceptional data found the process follows the path 'YES' and sent again for re-reading of DT meter. If there is no exception on ambiguity, the process attains the path 'NO'. It means the data is uploaded in the software tool for generation of DT health report. Figure 4 shows the cyclic representation of energy auditing is divided into five steps as:

- DT metering.
- Collection of meter read data with the help of CMRI.
- Analysis and calculation with the help of software Tool.
- Generation of DT health reports.
- Take corrective actions on behalf of DT health report which is the part of an energy auditing.

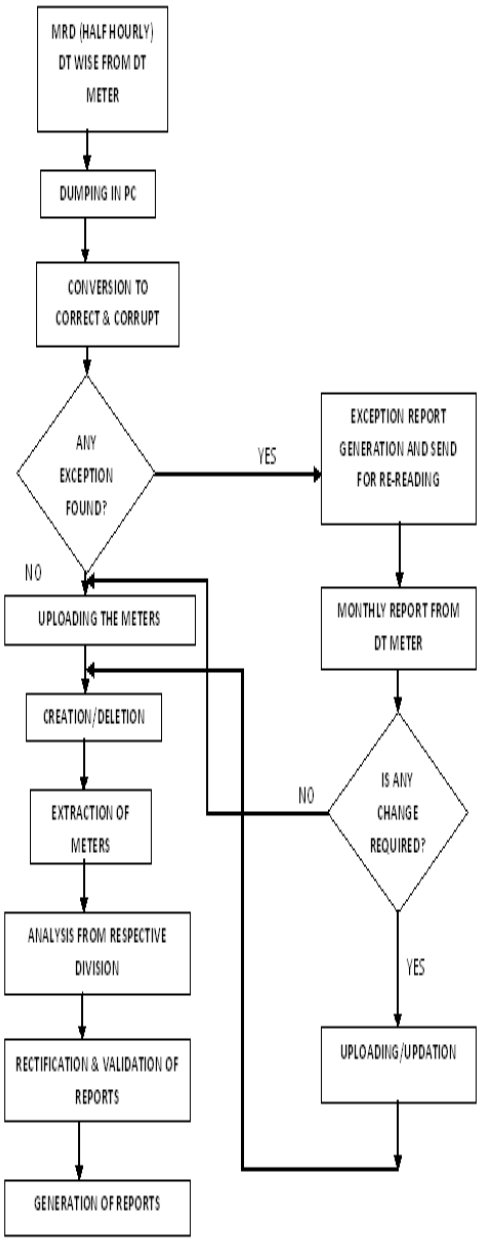

Figure 3 : Flow chart for maintaining the sequential process from MRD to report generation.

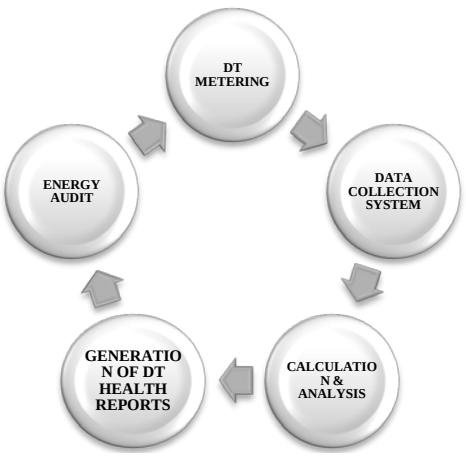

Figure 4 : Cyclic representation of energy auditing

Figure 5 shows the schematic diagram of overall solution scheme of DT health report. As per the previous practice a proposed technique has been implemented as diagnostic tool ensuring that the fulfillment of requirements for the protection distribution system. Various information parameters in the form of reports are generated with a month-on-month trend of the progress of a distribution system.

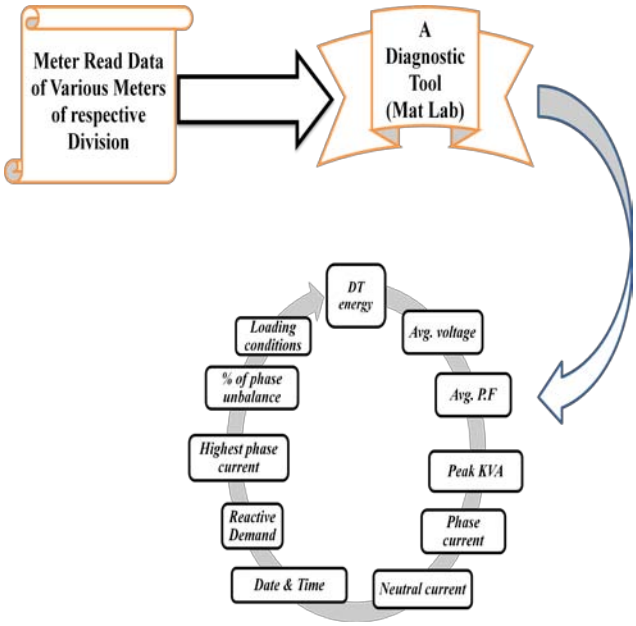

Figure 5 : Schematic diagram of overall solution scheme

IV. Generation of DT Health Reports

a) Meter read data of various meter of respective division

The raw data such as active power (phase-wise), reactive power (phase-wise) and voltage (phase-wise) as shown in Table I is to be collected from DT meters with the help of CMRI. This raw data is to be used for getting the necessary information about distribution transformer individually. Thus, further this information acts as input for the diagnostic tool for finding various necessary parameters as shown in figure 5.

b) A diagnostic tool

In which various parameters calculate with the help of software based tool in the form of DT health report. This software has been implemented in MatLab. Now, further this DT health report plays an important role in identification of the various losses of distribution system such as T&D losses with the help of eq. (1), which is very important task for making a distribution system to be healthy and protected.

$$T\&D\ LOSS\ (\%) = \frac{DT\ ENERGY\ -\ BILLED\ CONSUMER\ ENERGY}{DT\ ENERGY} \times 100 \quad (1)$$

V. Results

The input data have taken from Nehru Place, BSES Power Rajdhani limited, Delhi, of one DT meter named as M-134 GK having serial no.19503122 day long as shown in Table I. Similarly the whole data have taken for a month long of ten meters, i.e. ten distribution transformers as shown in the figure 6, for making DT health report. As discussed earlier, DT meter logging the data half hourly clearly shown in Table I. After carrying out the DT health reports of distribution transformer it can be visualized that it displays the various parameters which are to be encircled i.e. DT energy, power factor, voltage, current on each phase, neutral current, peak KVA etc. as shown in figure 6 and exhibits the loading conditions which are the necessary parameter for fulfillment of DT Health reports which is further used for identification of T&D and AT&C losses. So it can be intimated that a DT health report is for better for identification of T&D and AT&C losses then that of older one i.e. 11 KV feeder losses reports. That's why the protection of Distribution transformer is easy to handle and maintain the same. Figure 6 & 7 shows the output results of DT health report of ten distribution transformer. Figure 8 shows the output response of demand curve (KW) vs time. Figure 9 shows the load curve (KVA) vs time and Figure 10 shows the neutral current vs time. These graphs as shown in figure 8, 9 & 10 as per the time slot clearly mentioned in third column of input Table 1. The main importance of this paper as well as the main achievements of the same is:-

- Energy accounting / energy auditing
- Identify overloading, under loading.
- Identify technical losses.
- DT Name and DT Code
- DT Capacity
- Energy Consumption
- Peak Loading
- Total KVA
- R Phase KVA
- Y Phase KVA
- B Phase KVA
- Neutral Current
- Hrs. of Supply
- Voltage Curve
- Current Curve
- Hrs. of Interruption
- Power factor
- Reactive Demand
- Load Duration

MIS REPORT OF DISTRIBUTION TRANSFORMER OF NPL

Sr. No.	STUDY PERIOD		DT NAME	Meter Serial No.	KVA RATING	MF	DT Energy (KWH) for Month	Average Voltage	AVERAGE POWER FAC	Peak Loading Conditions									
											B-Phase		Y-Phase		R-Phase		Neutral Current (AMP)	Date and Time
										Peak KVA	KVA	I(AMP)	KVA	I(AMP)	KVA	I(AMP)		
1	12/21/2010	1/20/2011	M-134 GK	19503122	630	200	127383	240	0.97	298	79.3	343.6	95	412.4	123.5	536.6	169.44	9/1/2011 10:00
2	12/21/2010	1/20/2011	EPRI	19503124	630	200	123398	236	0.98	317	117	514.6	78.8	347.3	122	539.3	180.92	12/1/2011 9:00
3	12/21/2010	1/20/2011	OCS GKI	19503125	400	120		243										20/01/2011 00:00
4	12/21/2010	1/20/2011	BEHIND K	29500004	990	320		241		224	72.9	304.9	78	324	73.6	308	17.727	7/1/2011 8:00
5	12/21/2010	1/20/2011	MASJID M	29500005	1000	320	54120	241	0.63	222	76.3	323.2	76.8	325.6	69.2	294.4	30.082	12/1/2011 8:00
6	12/21/2010	1/20/2011	M-BLOCK	29500050	990	320	66648	172	0.95	304	108	453.3	91.2	383.7	105.2	442.6	64.963	22/12/2010 18:00
7	12/21/2010	1/20/2011	KAILASH	29500051	1000	320	136326	239	0.98	306	101	413.4	110	450.8	94.69	389.1	53.792	10/1/2011 18:30
8	12/21/2010	1/20/2011	E-273GK 1	29500052	990	320	126450	241	0.96	295	94	395.4	104	436.5	97.62	409.3	36.207	10/1/2011 10:00
9	12/21/2010	1/20/2011	FIRE STN	29500053	400	120	5397.2	245	0.88	28.2	13.8	55.67	0.55	2.228	13.87	56.2	53.707	10/1/2011 16:30
10	12/21/2010	1/20/2011	PANAI WA	29500054	630	200	78074	246	0.97	221	83.9	344.8	89.8	365.6	47.52	194	162.21	9/1/2011 11:30

Figure 6 : DT health report (part 1)

Reactive Demand (KVAr)		HIGHEST PHASE CURRENT		% Relative Phase Unbalance			% of	Loading Conditions (in HH:MI)																					
								<20%				20%-40%				40%-80%				80%-100%				>100%					
MAX	MIN	CURRENT (AMP)	Phase	B-Phase	Y-Phase	R-Phase	Phase Unbalance	B-Phase	Y-Phase	R-Phase	Total	B-Phase	Y-Phase	R-Phase	Total	B-Phase	Y-Phase	R-Phase	Total	B-Phase	Y-Phase	R-Phase	Total	B-Phase	Y-Phase	R-Phase	Total				
21.8	6.13	536.585	R	92.6	100	107	14.3	181	190	175	175	538	460	422	493	25	95	148	76												
22.1	-0.2	575.998	B	111	89.7	99.5	21.1	140	213	183	171	499	515	494	522	106	16	68	51.5												
	-0.1							744	744	744	744																				
74.8	-0.3	343.08	B	98.6	112	89.6	22.2	729	728	737	734	15.5	16	7	10																
22.8	-0.3	364.259	Y	108	112	79.3	33.2	714	688	741	734	30.5	56.5	3.5	10																
31.9	-20	458.881	Y	15.1	141	144	129	734	710	704	738	10.5	34	40.5	6.5																
21.3	-0.3	512.212	Y	96.5	98.8	105	8.19	482	445	374	424	262	299	370	321																
24.8	-0.3	460.903	Y	95.4	97.9	107	11.2	540	537	440	519	204	208	304	225																
1.93	-0.2	64.9152	B	131	23.2	146	123	744	744	744	744																				
17.2	-0.2	406.616	Y	96.7	127	75.9	51.5	528	353	682	510	216	373	62.5	234	0.5	19														

Figure 7 : DT health report (part 2)

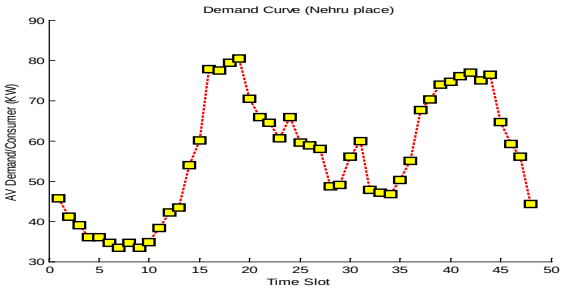

Figure 8 : Demand curve (KW) vs Time

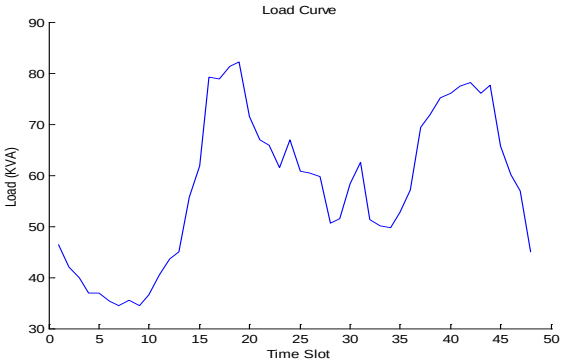

Figure 9 : Load curve (KVA) vs Time

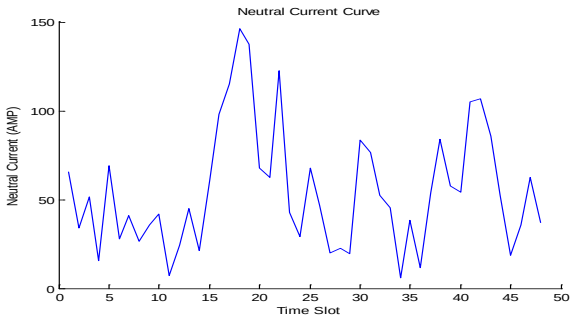

Figure 10 : Neutral current vs Time

VI. Conclusion & Future Scope

From the survey of distribution utilities like UHBVN & DHBVN we found that the main reason for distribution transformer failure is overloading, under loading and phase unbalancing even then they are calculating the T&D losses based on 11KV feeder which are not helpful for maintaining the protection of transformers. So, for handle these type of situations we generates a DT health report with the help of MatLab based software program which gives the information parameters such as under loading, overloading, phase unbalancing as shown in Fig. 5 and also gives the consumption DT energy for calculating the T&D losses of a specific area and protection of the transformers.

The study on the DT health report revealed that additional information is needed than that information found in the reward of the failure reports. Some of the additional information is the following:-

- DT energy demand of respective mouth.
- Highest phase current with phase name
- Overloading condition/ period of overloading

The internal failure rate of DT is very high; nevertheless, it is believed that the classification on failure rate in the actual health report was not clearly classified and distinct. Based on the data recorded reliability results shown very acceptable. It reveals that DT meters should be installed on distribution transformer individually instead of one 11KV feeder .This DT health report can also be generated for many transformers collectively and then integrated with the consumer database for getting the information about T&D as well as AT&C losses directly for the protection of distribution transformer with the help of soft computing technique.

Appendix

Table 1: Input data

MeterNo	Date and time	KVA rating	Active(I) B-phase W(I)	Active(I) Y-phase W(I)	Active(I) R-phase	Reactive Net B-	Reactive Net Y-	Reactive Net R-	Vb V	Vy V	Vr V
19503122	20-01-2011 00:00	630	241.5	266.8	177.1	43.7	41.4	39.1	245.41	245.18	246.6
	20-01-2011 00:30	630	227.7	211.6	177.1	32.2	41.4	48.3	247.02	246.56	247.7
	20-01-2011 01:00	630	227.7	204.7	154.1	32.2	46	39.1	247.71	247.25	248.4
	20-01-2011 01:30	630	190.9	181.7	167.9	36.8	41.4	41.4	248.63	248.4	249.3
	20-01-2011 02:00	630	230	181.7	128.8	36.8	46	36.8	249.55	249.09	250.7
	20-01-2011 02:30	630	195.5	170.2	154.1	32.2	36.8	36.8	250.93	250.7	251.9
	20-01-2011 03:00	630	204.7	147.2	149.5	27.6	43.7	48.3	251.62	251.16	252.5
	20-01-2011 03:30	630	195.5	170.2	154.1	27.6	39.1	43.7	251.16	250.93	252.3
	20-01-2011 04:00	630	197.8	156.4	147.2	36.8	43.7	41.4	251.39	251.16	252.5
	20-01-2011 04:30	630	204.7	174.8	142.6	46	69	50.6	247.94	247.71	249.1
	20-01-2011 05:00	630	197.8	188.6	188.6	52.9	78.2	55.2	245.18	244.49	246.1
	20-01-2011 05:30	630	232.3	195.5	204.7	48.3	59.8	59.8	241.96	241.5	242.7
	20-01-2011 06:00	630	246.1	184	220.8	59.8	57.5	62.1	235.06	235.06	236.2
	20-01-2011 06:30	630	255.3	271.4	282.9	62.1	69	71.3	235.06	234.14	235.8
	20-01-2011 07:00	630	305.9	338.1	257.6	50.6	87.4	78.2	235.29	234.14	235.8
	20-01-2011 07:30	630	322	450.8	393.3	59.8	80.5	87.4	235.52	234.14	235.8
	20-01-2011 08:00	630	299	441.6	420.9	62.1	71.3	92	233.91	233.22	234.4
	20-01-2011 08:30	630	312.8	372.6	506	87.4	64.4	101	231.84	231.38	232.3
	20-01-2011 09:00	630	308.2	411.7	487.6	75.9	62.1	104	229.54	228.85	229.1
	20-01-2011 09:30	630	317.4	338.1	400.2	62.1	41.4	82.8	228.16	228.39	228.6
	20-01-2011 10:00	630	324.3	292.1	372.6	59.8	50.6	66.7	226.55	226.55	227
	20-01-2011 10:30	630	259.9	292.1	416.3	66.7	57.5	66.7	228.62	228.85	229.1
	20-01-2011 11:00	630	328.9	273.7	305.9	57.5	48.3	59.8	229.31	229.54	230.2

20-01-2011 11:30	630	326.6	310.5	351.9	57.5	62.1	57.5	230.23	230.46	231.4
20-01-2011 12:00	630	308.2	338.1	248.4	41.4	64.4	62.1	231.15	230.69	231.6
20-01-2011 12:30	630	259.9	312.8	310.5	57.5	78.2	69	231.38	230.92	231.8
20-01-2011 13:00	630	276	292.1	301.3	62.1	80.5	69	232.76	232.3	233.7
20-01-2011 13:30	630	227.7	246.1	255.3	62.1	80.5	69	232.53	232.07	232.8
20-01-2011 14:00	630	232.3	255.3	248.4	75.9	89.7	69	230.92	230.92	232.1
20-01-2011 14:30	630	220.8	324.3	294.4	66.7	101	75.9	233.68	232.3	233.9
20-01-2011 15:00	630	248.4	292.1	358.8	94.3	85.1	87.4	235.29	234.6	235.5
20-01-2011 15:30	630	202.4	236.9	278.3	85.1	104	85.1	235.29	235.06	235.8
20-01-2011 16:00	630	213.9	218.5	273.7	82.8	87.4	82.8	235.98	235.75	236.2
20-01-2011 16:30	630	232.3	232.3	236.9	73.6	96.6	78.2	234.37	234.14	234.8
20-01-2011 17:00	630	223.1	253	278.3	82.8	71.3	85.1	234.83	234.6	235.5
20-01-2011 17:30	630	280.6	276	269.1	82.8	69	71.3	232.99	233.22	234.4
20-01-2011 18:00	630	326.6	310.5	377.2	73.6	71.3	89.7	229.54	229.54	230.2
20-01-2011 18:30	630	340.4	303.6	409.4	82.8	55.2	92	229.08	229.77	230
20-01-2011 19:00	630	333.5	365.7	409.4	69	57.5	82.8	231.61	231.38	231.8
20-01-2011 19:30	630	333.5	409.4	377.2	71.3	55.2	87.4	231.84	232.07	232.5
20-01-2011 20:00	630	308.2	450.8	381.8	59.8	66.7	85.1	234.37	234.14	234.8
20-01-2011 20:30	630	303.6	446.2	404.8	64.4	57.5	82.8	235.52	235.06	236
20-01-2011 21:00	630	331.2	443.9	349.6	66.7	55.2	71.3	238.28	238.28	239.4
20-01-2011 21:30	630	365.7	423.2	356.5	69	64.4	71.3	237.82	237.59	239
20-01-2011 22:00	630	324.3	335.8	310.5	46	57.5	59.8	238.51	238.51	239.4
20-01-2011 22:30	630	294.4	322	271.4	43.7	52.9	62.1	238.97	238.97	240.1
20-01-2011 23:00	630	312.8	299	230	43.7	46	52.9	241.27	241.73	242.9
20-01-2011 23:30	630	243.8	230	190.9	36.8	34.5	48.3	244.03	244.03	245.2

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