Jalgaon Municipal Corporation

Dist: Jalgaon (M.S.)

Detailed Project Report

On

Energy Audit

[Existing Water Supply System]

Prepared By

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ISO 9001: 2008, A Meghe Group Company
PREMIER SOLUTION PROVIDER - AUTODESK INC, USA

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ABBREVIATIONS

DPR	: Detail Project Report
ESCO	: Energy Service Company
ESR	: Elevated Storage Reservoir
EA	: Energy Audit
GSR	: Ground Storage Reservoir
kWh/ML	: kWh per million liter of water
MD	: Maximum Demand
PF	: Power Factor
PFR	: Pre-Feasibility Report
SEC	: Specific Energy Consumption
TOD	:Time of Day
WTP	: Water Treatment Plant

ACKNOWLEDGEMENT

We express our sincere gratitude to the Municipal Corporation Jalgaon for giving the opportunity to carry out the Project Study report for Energy Audit, present the observations and findings. We thankfully acknowledge their support and guidance provided during the conduct of this exercise.

Last but not the least; we are thankful to working staff of the pumping stations at Jalgaon with whom we interacted during the field studies for their wholehearted support in data collection, observations and undertaking measurements.

ADCC Infocad Ltd. Nagpur

1. EXECUTIVE SUMMARY

1.1 OBJECTIVE OF STUDY

The objective of the study is to find out the deficiencies in water supply Energy system to improve the overall energy efficiency of the Jalgaon water supply scheme which could lead to savings in the electricity consumption, thereby resulting in energy cost reduction.

1.2 OVERVIEW OF THE JALGAON WATER SUPPLY SCHEME

The Jalgaon water supply scheme is developed by Maharashtra Jeevan Pradhikaran (MJP). It comprises of one raw water pumping station, one water treatment plant, two booster pumping station and one pumping station for supplying water to ESR's.

Following table shows the details of these pumping stations:

Jalgaon Municipal Corporation					
Water Supply Pumps					
Sr. No.	**Location**	**Pump Rating (HP)**	**Type**	**No. Of Pumps**	**Remarks**
1	Waghur Raw Water Pumping	500	Horizontal Centrifugal	6	
2	Water Treatment Plant Umale				Water supply by Gravity
3	Girna Pumping Station (Old)	50	Horizontal Centrifugal	1	
4	Girna Pumping Station (Old)	80	Horizontal Centrifugal	2	Pump no. 1 is not in working condition
5	Girna Pumping Station (New)	75	Horizontal Centrifugal	2	
6	Raymond Chowk	75	Horizontal Centrifugal	1	
7	DSP Chowk	75	Horizontal Centrifugal	1	

1.3 ENERGY CONSUMPTION PATTERNS FOR JALGAON WATER SUPPLY SCHEME

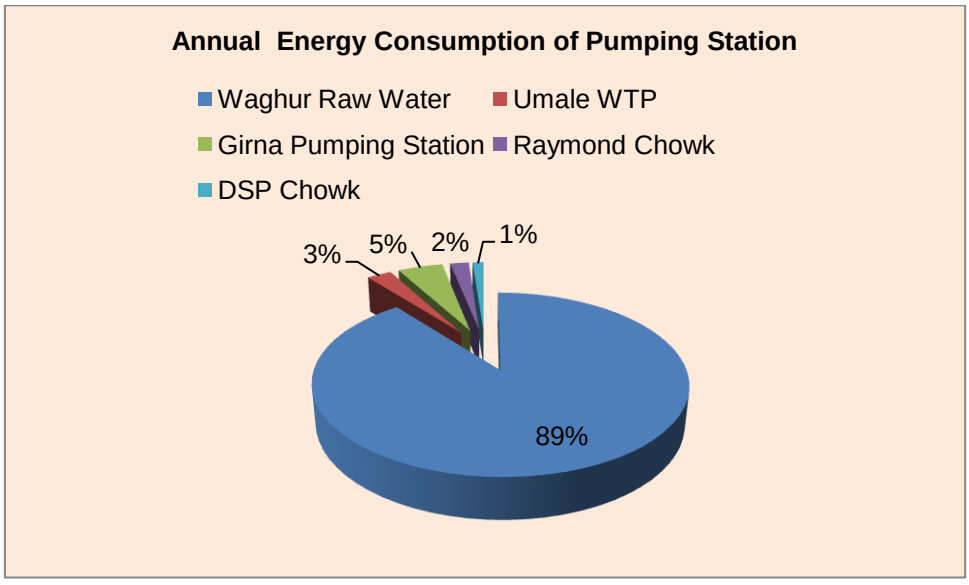
The overall energy consumption of Jalgaon water supply scheme comprises of energy consumption of five pumping stations i.e. Waghur raw water pumping station, WTP At Umale, Girna Pumping Station, DSP chowk booster pumping station & Raymond chowk booster pumping station.

The overall electrical energy consumption of the Jalgaon water supply scheme is 1,10,04,422 kWh/annum, costing Rs. 5,76,96,909/- per annum.

1.4 PUMPING STATION WISE ENERGY CONSUMPTION

Following table shows the annual energy consumption at different pumping station

Pumping Station Wise Energy Consumption								
Sr. No.	Source / Pumping Station Name	Contract Demand (kVA)	No of Months for Which Billing Data is Available	Total Unit Consumption kWh	Total Energy Bill (Rs.)	Estimated Annual Consumption in kWH	Estimated Annual Bill Amount in Rs.	Average Cost of Electricity Units (Rs.kWh)
1	Waghur Raw Water	1444	11	9024150	47626660	9844527	51956356	5.27
2	Umale WTP	125	12	285942	1498328	285942	1498328	5.25
3	Girna Pumping Station	232	12	526468	2671533	526468	2671533	5.10
4	Raymond Chowk	50	8	145106	581296	217659	871944	4.05
5	DSP Chowk	120	12	129826	698747	129826	698747	5.39
Total				**10111492**	**53076564**	**11004422**	**57696909**	



From the above graph it is clear that, Waghur raw water consumption is approx. 89% of total energy consumption, WTP at Umale consumption is 3% of total energy consumption, Girna pumping station consumption is 5% of total energy consumption, DSP Chowk booster pumping consumption is 1% of total energy consumption & Raymond chowk booster pumping consumption is 2% of total energy consumption.

- At Waghur raw water pumping, contract demand is 1444 KVA but maximum demand was more than contract demand for two months out of 11 months for which bills are received.
- At Waghur raw water pumping, average power factor is 0.97 and PF incentive of Rs.9, 49,304 has been received for 11 months for which bills are received.
- At Girna pumping station, average power factor is 0.97 and PF incentive of Rs. 1,30,700 has been received
- At DSP chowk booster pumping station, average power factor is 1 and incentive of Rs.42, 906 has been received.

1.5 PUMPING STATION WISE PUMPING EFFICIENCY:

Combined efficiency of different pumps & motors at different pumping station for which field measurement were possible is tabulated as under

Sr.No	Name of Pumping Station	Motor Rated Power KW	Overall Pump & Motor Combined Efficiency %
1	Pump-1 Waghur Raw Water	375	70.09
2	Pump-2 Waghur Raw Water	375	55.89
3	Pump-3 Waghur Raw Water	375	61.17
4	Pump-4 Waghur Raw Water	375	60.62
5	Pump-5 Waghur Raw Water	375	73.15
6	Pump-6 Waghur Raw Water	375	66.92
7	Pump-1 Girna Pumping Station New	55	69.99
8	Pump-2 Girna Pumping Station New	55	68.17
9	Pump-1 Girna Pumping Station Old	37	38.82
10	Pump-2 Girna Pumping Station Old	60	80.75
11	DSP Chowk Booster Pumping	55	68.76

It is observed that some of the pumps are operating at head which are different from their rated head and pumps are not operating at their Best Efficiency Point (BEP).

1.6 PUMPING STATION WISE ELECTRICAL EFFICIENCY:

Electricity bill of pumping are analyzed and power factor variation was found between

- 0.94 to 0.98 at Waghur raw water,
- 0.98 to 1 At WTP
- 0.85 to 1 At Girna pumping station
- 0.98 to 1 At DSP chowk booster pumping station
- 0.98 to 1 At Raymond chowk booster pumping station

hence there is a scope for improvement. Details of annual PF penal charges, PF Incentive are as under-:

Sr. No.	Name of Pumping Station	Average PF	PF Incentive Per Annum (Rs.)	PF Penalty Charges Per Annum (Rs.)
1	Waghur Raw Water	0.97	1035604	
2	Umale WTP	0.99	74997	
3	DSP Chowk	1.00	42906	
4	Girna Pumping Station	0.98	130700	11718
5	Raymond Chowk	0.950	9392	-
Total			**1293599**	**11718**

Utilization of electricity units in different time zones of TOD tariff is analysed & details are tabulated as under

Details of Utilization of TOD Tariff at Raw Waghur Water

Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	1133.28	-1	**I**	**III**
B	0600 hr to 0900 & 1200 hr to 1800 hr	1154.01	0	**II**	**II**
C	0900 hr to 1200 hr	1157.64	0.8	**III**	**I**
D	1800 hr to 2200 hr	1031.61	1.1	**IV**	**IV**

Details of Utilization of TOD Tariff at WTP Umale

Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	35.55	-1	I	II
B	0600 hr to 0900 & 1200 hr to 1800 hr	29.65	0	II	III
C	0900 hr to 1200 hr	28.80	0.8	III	IV
D	1800 hr to 2200 hr	36.65	1.1	IV	I

Details of Utilization of TOD Tariff at Girna Pumping Station

Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual Priority
A	2200 hr to 0600 hr	63.06	-1	I	II
B	0600 hr to 0900 & 1200 hr to 1800 hr	57.72	0	II	III
C	0900 hr to 1200 hr	70.85	0.8	III	I
D	1800 hr to 2200 hr	51.54	1.1	IV	IV

Details of Utilization of TOD Tariff at DSP Chowk Booster Pumping Station

Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	7.53	-1	I	IV
B	0600 hr to 0900 & 1200 hr to 1800 hr	13.27	0	II	III
C	0900 hr to 1200 hr	21.92	0.8	III	II
D	1800 hr to 2200 hr	27.58	1.1	IV	I

Above table shows the utilization of power in different time zones of TOD tariff

1.7 ENERGY CONSERVATION MEASURES (ECMS) WITH COST BENEFIT ANALYSIS

The Energy Conservations Measures (ECMs) identified for Jalgaon water supply system are tabulated as below. The energy saving calculation is done for all the pumping stations at which they should be implemented with medium and major investment.

ECM 1: Provision of APFC Panel for Improvement of Power Factor with Medium Investment

- Total Annual Savings = Rs. 27,48,399
- Total Investment = Rs. 11,20,185
- Payback period = 5 months

ECM 2: Pump Upgradation, Energy Monitoring and Pump & Motor Replacement with Medium Investment

- Total Annual Savings = Rs. 34,32,756
- Total Investment = Rs. 21,48,760
- Payback period = 7.5 month

Comprehensive Energy Conservation program is explained in following table:

Comprehensive Energy Saving Action Plan & Investment Plan						
Sr.No	**Description of Action Plan**	**Investment**		**Annual Savings**		**Payback Period**
		Rating HP	**Rs (Lacs)**	**kWh**	**Rs (Lacs)**	**Months**
	For Equipment Efficiency Improvement					
1	**Waghur Raw Water Pumping Station**					
	1.1) Pump Efficiency					
	a) Energy Monitoring for 500 HP pump no.1	500	0.125			
	b) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.2	500	4.86	229857	12.14	4.8
	c) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.3	500	4.86	181548	9.59	6.1
	d) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.4	500	4.86	197864	10.45	5.6
	e) Energy Monitoring for 500 HP pump no.5	500	0.125			
	f) Energy Monitoring for 500 HP pump no.6	500	0.125			
	1.2) Electrical Efficiency					
	a) APFC Panel for P.F. Improvement		11.20		27.48	4.9
2	**Girna Pumping Station**					
	2.1) Pump Efficiency					
	a) Energy Monitoring New Pumping Station 75 HP Pump no. 1	75	0.125	-	-	-
	b) Energy Monitoring New Pumping Station 75 HP Pump no. 2	75	0.125	-	-	-
	c) Pump + Motor replacement for Old Pumping Station 50 HP Pump no. 1	50	6.044	42566	2.16	33.61
	d) Energy Monitoring Old Pumping Station 80 HP Pump no. 2	80	0.125	-	-	-
3	**DSP Chowk Booster Pumping**					
	3.1) Pump Efficiency					
	a) Energy Monitoring DSP Chowk Booster Pump 75 HP		0.125	-	-	-
	Total Energy Conservation Program 1+2+3	**Total**	**32.69**	**651835**	**61.81**	**6.35**

Conclusion

Above table prevails the details of total energy conservation /saving action & investment plan for Jalgaon Municipal Corporation including short term and long term investment. Total investment programe for above pumping stations comes out to be Rs. 32.69 lakhs with annual savings 6.52 lakh kWh and 61.81 lakhs Rs. Municipal Corporation may initiate the energy saving programe as discussed above.

Road Map for Rehabilitation through ESCO

As discussed in executive summary, there is scope for energy conservation and thus potential of considerable saving in energy cost. In order to implement this energy saving project proper ESCO (Energy Service Company) should be searched. A list of the Bureau of Energy Efficiency (BEE) Empanelled ESCOs is available on BEE website (www.bee-india.nic.in).

In order to bring ESCO into picture the Municipal Council/MJP has to float a RFP (Request for Proposal) giving a brief overview of the expectations and savings possible through the project implementation. The RFP should ask for EOI (Expression of Interest) from the interested ESCOs to implement and run the project for a considerable period of time and proving the monetary savings. After receiving the EOIs from interested ESCOs, Municipal Council/MJP should float a two part tender stating all the technical and financial eligibility criteria and other terms and conditions. The successful bidder (here ESCO) shall implement the project. It will be ESCOs responsibility to implement the project and demonstrate the monetary savings. The project can be implemented on Guaranteed Savings or Share Savings basis. In both the cases the ESCO has to overcome its investment through savings achieved.

The three energy conservation measures which are identified and mentioned in executive summery are divided in three parts as per the investment required. These three parts are ECMs with low investment, ECMs with medium investment and ECMs with major investment. The implementation program for these energy conservation measures can be divided into two phases depending on the investments required. These three phases are as follows:

Phase-I

In this phase the implementing agency should focus on the ECMs with low investment. As given in the executive summary there is only one ECM which has medium investment. It is provision of APFC panel for improvement of power factor.

Phase-II

In this phase the implementing agency should focus on the ECMs with medium investment. As given in the executive summary there is only one ECM which has medium investment. It is upgradation of pumps, Energy Monitoring and Pump & Motor replacement.

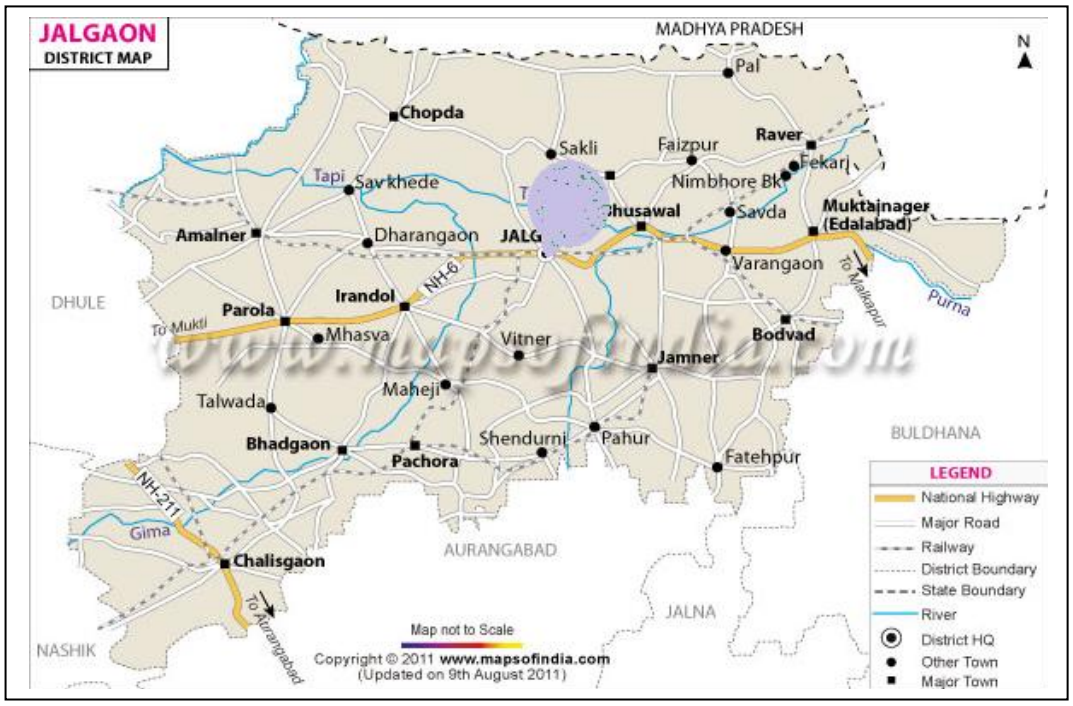
2. INTRODUCTION AND BACKGROUND OF JALGAON MUNICIPAL CORPORATION

2.1 PREAMBLE

Jalgaon is a city and a municipal corporation located in the Jalgaon district.

Jalgaon is located at 21.03°N 75.34°E. It has an average elevation of 209meters. Located within the productive, irrigated agricultural region of Khandesh, Jalgaon has a municipal corporation which is home to 460,468 inhabitants at the 2011 census.

Modern Jalgaon now has major industrial areas, educational institutes and good hospitals. The city is well developed with good roads, shopping malls, and residential areas, and also has good communication and transport infrastructure. Known as "Banana-City", it contributes to about half of the Maharashtra state's Banana production.



As of 2011 India census Jalgaon has a population of 4, 60,468.

CITY STATISTICS

CITY MASTER	
Name of City	Jalgaon
Class of City	Municipal Corporation
Tahsil	Jalgaon
District	Jalgaon
Region	Nashik
Area in sq.km.	68.24
Average Rainfall (mm)	730
No. of Wards	69
No. of Elected Members	69
Population	1991: 2,42,193
	2001: 3,68,000
	2011: 4,60,468

2.2 INTRODUCTION TO JALGAON WATER SUPPLY SCHEME

Jalgaon is district of maharashtra state, Jalgaon water supply scheme is developed by Maharashtra Jeevan Pradhikaran (MJP).

Water supply system comprises of following pumping stations,

i) Waghur Raw Water Pumping
ii) Water Treatment Plant at Umale
iii) Girna Pumping Station
iv) DSP Chowk Booster Pumping Station
v) Raymond Chowk Booster Pumping Station

2.2.1 Waghur Raw Water Pumping Station

This source is major raw water source for Jalgaon city. Waghur scheme have 6 Nos. pumps (4 working+2 standby) installed in 2007. The pumps used in raw water are horizontal type, with discharge rating of 1355 m^3/hr having motor rated power of 500 HP. Water is pumped through 1168 mm MS water pipe line of approximately length of 7 Kms up to WTP.

At head works, 2x3000 KVA (33/3.3 KV) & 1x160KVA (33/0.433kv) transformers are provided for electrical supply.

Details of electrical installations at Waghur raw water pumping stations are tabulated as under

Raw Water Waghur Motor Details							
Sr. No.	**Description**	**Motor No.1**	**Motor No.2**	**Motor No.3**	**Motor No.4**	**Motor No.5**	**Motor No.6**
1	Make	Alstom	Alstom	Alstom	Alstom	Alstom	Alstom
2	KW/HP	375/500	375/500	375/500	375/500	375/500	375/500
3	Current (A)	82	82	82	82	82	82
4	Voltage (V)	3300	3300	3300	3300	3300	3300
5	Speed (rpm)	1482	1482	1482	1482	1482	1482
6	Phase	3	3	3	3	3	3
7	Efficiency (%)	93	93	93	93	93	93
8	P.F.	83	83	83	83	83	83
9	Connection	Star	Star	Star	Star	Star	Star
10	Weight(Kg)	3000	3000	3000	3000	3000	3000

Raw Water Waghur Pump Details							
Sr. No.	**Description**	**Pump No.1**	**Pump No.2**	**Pump No.3**	**Pump No.4**	**Pump No.5**	**Pump No.6**
1	Make	Kirloskar	Kirloskar	Kirloskar	Kirloskar	Kirloskar	Kirloskar
2	Pump Type	12 VPH 4	12 VPH 4	12 VPH 4	12 VPH 4	12 VPH 4	12 VPH 4
3	Total Head (m)	75	75	75	75	75	75
4	Discharge(M3/hr)	1355	1355	1355	1355	1355	1355
5	Size (mm)	350 x 300	350 x 300	350 x 300	350 x 300	350 x 300	350 x 300
6	Speed(RPM)	1485	1485	1485	1485	1485	1485
7	Impeller Dia	4.86 mm BR	4.86 mm BR	4.86 mm BR	4.86 mm BR	4.86 mm BR	4.86 mm BR
8	Input Power	375 KW	375 KW	375 KW	375 KW	375 KW	375 KW
9	Pump Sr.No.	1709604001	1709604002	1709604003	1709604004	1709604005	1709604006

Raw Water Waghur H. T. Transformer Details				
Sr. No	**Description**	**Transformer no.1**	**Transformer no.2**	**Remarks**
1	Make	EMCO	EMCO	Both are in Working Condition
2	KVA	3000	3000	
3	Volts H.V.(V)	33000	33000	
4	No Load L.V.(V)	3300	3300	
5	Current H.V.(A)	52.48	52.48	
6	Current L.V.(A)	524.86	524.86	
7	Total Mass (Kg)	6900	6900	
8	Phase	3	3	
9	Frequency (Hz)	50	50	
10	Conn. Symbol	Dyn.11	Dyn.11	
11	Type of Cooling	ON-AN	ON-AN	
12	Year of Mfg.	2005	2005	
13	Oil Temp.Rise.Deq.	C50	C50	
14	Wdg.Temp.Rise.Deq	L55	L55	
15	Impedance Volts%	6.0399	6.0399	
16	Volume of Oil	I1890	I1890	
17	Untanking Mass	2840	2840	
18	Class of Insulation	A	A	
19	Maker Sr. No.	2169	2170	

Raw Water Waghur L.T. Transformer Details		
Sr. No	**Details**	**Transformer no. 1**
1	Make	Trans Delta Electrical
2	Model No.	IS 2026/1977
3	KVA	160
4	Volts H.V.(V)	33000
5	No Load L.V.(V)	433
6	Current H.V.(A)	2.80
7	Current L.V.(A)	213.35
8	Phase H.V.	3
9	Phase L.V.	3
10	Frequency (Hz)	50
11	Imp Voltage	5.67%
12	Vector Group	Dyn11
13	Code & WDG wt. (Kg)	514
14	Wt.of oil (Kg)	322
15	Total Wt.(Kg)	1100
16	Oil In Lit	370
17	Year of Mfg.	2006
18	Sr. No.	P-E / DT/ 176
19	Granted Maxi. Temp.	50

Raw Water Waghur H.T. Capacitor Details		
Sr. No.	**Description**	**Capacitor**
1	Total Capacitor	6
1	Make	Madhav Capacitor pvt.ltd.
2	Type	PPMO Year 2006
3	Rated KVAR	120
4	Frequency (Hz)	50
5	Current (A)	21
6	Rated Voltage (KV)	3.3
7	Phase	3
8	Temp. Category	50 C

Motor Starter Raw Water Waghur		
Sr. No.	**Description**	**Starter Motor**
1	Type	VD4:12.12.25
2	Sr. No.	V9946 Year 2006
3	Standard	IEC-62271-100
4	Rated Voltage (KV)	12
5	Frequency (Hz)	50
6	Normal Current (A)	1250
7	S.C.B. Current (KA)	26.3
8	Duration of S.C.	3.5
9	S.C.M.Current (KA)	66 KA
10	Operation Sequence	0-0-35-CO-3 Min Co.
11	Closing Coil	110 V DC
12	Operating Coil	110 V DC
13	Motor	230 VAC
14	Mass	100 kg

Energy bill details of Waghur raw water pumping station is tabulated as under:

Jalgoan Municipal Corporation														
Energy Consumption Sheet for Wajhur Raw Water, Consumer ID -110019004480														
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges	Energy Charges	TOD Tarff EC	F.A.C.	Other Charges	PF Incentive	Total Amount	Avg. unit cost
1	Dec-11	558750	1444	1430	1443	0.93	214500	2399887	-14945	218471	111750		2929664	5.24
2	Feb-12	790380	1444	1431	1454	0.94	214650	3394761	-27404	339468	105911		4027387	5.10
3	Mar-12	768720	1444	1447	1463	0.96	217050	3301729	-13118	330165		-38358	3797469	4.94
4	Apr-12	891450	1444	1395	1397	0.96	209250	3828867	-8341.5	382878		-44127	4368527	4.90
5	May-12	855420	1444	1331	1331	0.98	199650	3674114	-8686.5	367403		-126974	4105506	4.80
6	Jun-12	868800	1444	1392	1392	0.97	208800	3731583	-4981.5	373150		-86171	4222380	4.86
7	Jul-12	796800	1444	1343	1343	0.97	201450	3422336	-3522	623177		-84869	4158572	5.22
8	Aug-12	924210	1444	1337	1337	0.97	200550	3969574	-3597	710902		-97549	4779881	5.17
9	Sep-12	853470	1444	1328	1335	0.98	252320	4310024	-51333	733131		-157324	5086817	5.96
10	Oct-12	856530	1444	1329	1331	0.98	252510	4325477	-68082	606338		-153487	4962755	5.79
11	Nov-12	859620	1444	1309	1311	0.98	248710	4341081	-52782	811137		-160444	5187702	6.03
Total		**9024150**					**2419440**	**40699433**	**-256791**	**5496220**	**217661**	**-949304**	**47626660**	

2.2.2 Water Treatment Plant (WTP)

Capacity of Umale water treatment plant (WTP) is 132 MLD. Pure water is supplied from Umale WTP to Gendalal mill ESR, Akashwani Kendra ESR, Hemukalni ESR, Khanderao Nagar ESR, Pimprala Shivar ESR, Nimkhedi ESR & Dreamland ESR & Girna pumping station by Gravity. The capacity of Gendalal mill ESR is 2.5 ML, Akashwani Kendra ESR is 2.8 ML, Hemukalni ESR is 3.90 ML, Khanderao Nagar ESR is 2.8 ML, Pimprala Shivar ESR is 2.8ML, Nimkhedi ESR is 2.8 ML & Dreamland ESR is 2.8 ML. Water is supplied through 450 mm to 1500 mm, CI pipe line.

At WTP 1 x 200 KVA (33 /0.433 KV) transformer is provided for Electrical supply.

At WTP, 1 x 160 KVA (33 /0.433 KV) transformer is also provided as stand by for Electrical supply.

Details of electrical installations at WTP at Umale are tabulated as under

WTP Umale Transformer Details				
Sr. No	**Details**	**Transformer no.1(old)**	**Transformer no.2 (New)**	**Remarks**
1	Make	Trans Delta Electrical	Dwarka Industries	Trans. No.2 is in Stand by Condition
2	KVA	200	160	
3	Volts H.V. (V)	33000	33000	
4	No Load L.V.(V)	433	440	
5	Current H.V. (A)	3.50	2.80	
6	Current L.V. (A)	266.68	210	
7	Phase H.V.	3	3	
9	Phase L.V.	3	3	
8	Frequency (Hz)	50	50	
10	Imp Voltage	5.70%	4.10%	
11	Vector Group	Dyn11	Dyn11	
12	Oil In (Ltr)	390	460	
13	Type of Cooling	ON-AN	ON	
14	Year of Mfg.	2008	2012	
15	Sr. No.	DE / DT / 178	DL/B99	

Umale: Flash Mixing Motor Details		
Sr.No.	**Description**	**Motor no.-1**
1	Make	Crompton Greaves
2	KW/HP	9.3/12.5
3	Amp (A)	17.5
4	Speed (RPM)	1460
5	Frequency	50 Hz
6	Voltage	415

Motor Details (Clarifloculator No. 1 & 2 Bridge)			
Sr.No.	**Description**	**Motor No.-1**	**Motor No.-2**
1	Make	Crompton Greaves	Crompton Greaves
2	KW/HP	3.7/5	3.7/5
3	Current (A)	9.7	9.7
4	Speed(rpm)	1430	1430
5	Frequency (Hz)	50	50
6	Voltage (v)	415	415

Motor Details (Over Head Tank Umale Filter Plant)				
Sr. No.	Description	Motor- 1	Motor- 2	Motor- 2
1	Input Power (KW/HP)	5.5/7.5	5.5/7.5	5.5/7.5
2	Current (A)	10.8	10.8	10.8
3	Speed (rpm)	1430	1430	1430
4	Frequency (Hz)	50	50	50
5	Voltage (V)	415	415	415
6	Make	Alstom	Alstom	Alstom

Pump Details (Over Head Tank Umale Filter Plant)				
Sr. No.	Description	Pump No.-1	Pump No.-2	Pump No.-3
1	Model	OB100/120	OB100/120	OB100/120
2	Mat Code	83	83	83
4	M/C Name	Centrifugal Pump	Centrifugal Pump	Centrifugal Pump
5	Total Head (m)	10	10	10
6	Discharge (M3/hr)	120	120	120
7	Input (KW)	4.9	4.9	4.9
8	Impeller Dia.	C1/205	C1/205	C1/205
9	Size (mm)	100/125	100/125	100/125
10	Pump Sr.No.	10222050011	10222050012	10222050013

Motor Details (Recirculation Pump House Filter Plant Umale)			
Sr. No.	Description	Motor- 1	Motor- 2
1	Make	Alstom	Alstom
2	Input Power (KW/HP)	5.5/7.5	5.5/7.5
3	Current (A)	10.8	10.8
4	Speed(RPM)	1440	1440
5	Frequency (Hz)	50	50

Pump Details (Recirculation Pump House Filter Plant Umale)			
Sr.No.	**Description**	**Pump No.-1**	**Pump No.-2**
1	Pump Type	DB100/20	DB100/20
2	Pump Sr.No.	102220514	102220515
3	Discharge (M3/hr)	120	120
4	Pump Input (KW)	4.9	4.9
5	Size (mm)	100/125	100/125
6	Speed(RPM)	1450	1450
7	Pump Make	Kirloskar	Kirloskar

Motor Details Filter Plant Umale (Chlorine)				
Sr. No.	**Description**	**Motor No.-1**	**Motor No.-1**	**Motor No.-1**
1	Made	Kirloskar	Kirloskar	Kirloskar
2	M/c No.	TDAA13/8B2B	TDAA13/8B2B	TDAA13/8B2B
3	Frame No.	BM-132 S	BM-132 S	BM-132 S
4	Input Power (KW/HP)	5.50	5.50	5.50
5	Speed(RPM)	2900	2900	2900
6	Voltage (V)	415	415	415
7	Frequency (Hz)	50	50	50
8	Current (A)	10	10	10

Pump Details Filter Plant Umale (Chlorine)				
Sr. No.	**Description**	**Pump No.-1**	**Pump No.-2**	**Pump No.-3**
1	Make	Kirloskar	Kirloskar	Kirloskar
2	Pump Type	DB 32 / 20	DB 32 / 20	DB 32 / 20
3	O/A No.	2189A0980/0020	2189A0980/0020	2189A0980/0020
4	Total Head (m)	40	40	40
5	Discharge (m3/hr)	20	20	20
6	Impeller Dia. (mm)	C I. 205	C I. 205	C I. 205
7	Size (mm)	32 x 50	32 x 50	32 x 50
8	Speed(RPM)	2900	2900	2900
9	Mat Code	83	83	83

Motor Details (TCL Liquid Tank)				
Sr. No.	**Description**	**Motor No.1**	**Motor No.2**	**Motor No.3**
1	Made	Crompton Graves	Crompton Graves	Crompton Graves
2	M/c No.	NDA 4 J	NDA 4 J	NDA 4 J
3	Frame No.	ND 80	ND 80	ND 80
4	Speed (rpm)	1410	1410	1410
5	Voltage (V)	415	415	415
6	Current (A)	1.75	1.75	1.75
7	Input Power (KW/HP)	0.75/1	0.75/1	0.75/1

Details of Energy Bills for WTP Umale are tabulated as under:

Jalgoan Municipal Corporation														
Energy Consumption Sheet for Umale WTP, Consumer ID -110019004680														
Sr. No.	**Month**	**Total Units KWH**	**Contract Demand KVA**	**Billing Demand KVA**	**Actual Demand KVA**	**PF**	**Demand Charges**	**Energy Charges**	**TOD Tarff EC**	**F.A.C.**	**Other Charges**	**PF Incentive**	**Total Amount**	**Avg. unit cost**
1	Dec-11	18954	125	63	58	0.98	9450	81409	-528	7411	3790.8	-3046	98487	5.20
2	Jan-12	28131	125	63	61	0.98	9450	120825	-924	10999	5626.2	-7299	138678	4.93
3	Feb-12	23220	125	63	54	0.99	9450	99732	-725.25	9973	3111.4	-6077	115464	4.97
4	Mar-12	21522	125	63	57	0.99	9450	92439	-450	9244	0	-5534	105149	4.89
5	Apr-12	25614	125	63	54	0.99	9450	110015	-679.2	11001	0	-6489	123297	4.81
6	May-12	24858	125	63	60	0.98	9450	106768	-924	10677	0	-3779	122191	4.92
7	Jun-12	25791	125	63	67	0.98	9450	110775	-388.8	11077	0	-3945	126968	4.92
8	Jul-12	22212	125	63	61	0.98	9450	95403	395	17372	0	-3679	118941	5.35
9	Aug-12	24858	125	63	62	0.99	9450	106768	29	19120	0	-6768	128598	5.17
10	Sep-12	24165	125	63	60	1.00	11970	122033	-1260	20758	0	-10745	142756	5.91
11	Oct-12	22998	125	63	48	1.00	11970	116140	-1224.3	16280	0	-10022	133144	5.79
12	Nov-12	23619	125	63	59	0.99	11970	119276	-1264.8	22287	0	-7613	144655	6.12
Total		**285942**					**120960**	**1281583**	**-7945**	**166199**	**12528**	**-74997**	**1498328**	

2.2.3 Girna Pumping Station (New & Old)

At old Girna pumping station, 2 x 80 HP (1 working+1 standby) & 1 x 50 HP centrifugal pumps are installed. 80 HP pumps have discharge rating of 475 m3/hr and are used for supplying water from Girna pumping station to DSP Chowk ESR through MS water pipe line of 273.7 mm & 50 HP pump is used for feeding water from Girna pumping station to Collector quarter ESR through MS water pipe line of 206.8 mm.

At new Girna pumping station 2 x 75 HP (1 working+1 standby) centrifugal pumps are installed. These pumps having discharge rating of 375 m3/hr and are used for supplying water from Girna pumping station to Girna tank ESR through MS water pipe line of 273.7mm.Overall sump capacity of Girna pumping station GSR no. 1 is 4.5 ML, GSR no. 2 is 1.125 ML & GSR no. 3 is 3.5 ML.

At Girna pumping station, 1 x 250 KVA (11 /0.433 KV) & 1 x 200 KVA (11/0.433 KV) transformers are provided for electrical supply. 1 x 200 KVA (11/0.433 KV) transformer is not in working condition.

APFC Panel of 200 Kvar (20 Kvar x 10) is provided for automatic power factor correction at Girna pumping station. Out of these 10 unit, 5 unit of 20 Kvar were not working.

Details of electrical installations at Girna pumping stations are tabulated as under

Motor Details Girna Pumping Station (New)		
Description	**Motor-1**	**Motor-2**
Make	Kirloskar	Kirloskar
Rating (HP)	75	75
Speed(RPM)	1470	1470
Voltage(V)	415	415
Current(A)	96	96
Freq.(Hz)	50	50
Efficiency (%)	91	91
Phase	3	3
Duty	81	81
Temp Rise	70◦C	70◦C
Ambient Temp.	50◦C	50◦C
NDE	8311	8311
INS. Class	F	F
BRGS	DE N 314	DE N 314
REF.	IS 12615	IS 12615
M/C. No.	VJG55-01	VJG55-02

Pump Details Girna Pumping Station (New)		
Description	**Pump-1**	**Pump-2**
Make	Kirloskar	Kirloskar
Pump Type	UP 150/38B	UP 150/38B
Pump Input (KW)	31.15	31.15
Rated Discharge (m3/hrs)	375	375
Total Head (m)	25	25
Rated Speed (rpm)	1450	1450
Impeller Dia.	BR/310	BR/310
Motor (HP)	75	75
Size	150x200 mm	150x200 mm

Motor Details Girna Pumping Station (Old)			
Description	**Motor-1**	**Motor-2**	**Motor-3**
Make			Kirloskar
Frame No.			LD225 SMK11
Rating (HP)	80	80	50
Speed(rpm)	Details are not Available	Details are not Available	1470
Voltage(V)			415
Current(A)			64
Freq.(Hz)			50
Efficiency (%)			92
Phase			3
Duty			51
Ambient Temp.			40◦C
NDE			6313
INS. Class			B
BRGS			DE 6313
REF.			IS 325
M/C. No.			EED 206-62

Pump Details Girna Pumping Station (Old)			
Description	**Pump-1**	**Pump-2**	**Pump-3**
Make	Kirloskar	Kirloskar	Details are not Available.
Pump Type	UP 200/30	UP 200/30	
Pump Input (KW)	39.11	39.11	
O/A No.	2111A1000/04	2111A1000/04	
Rated Discharge (m3/hrs)	475	475	
Total Head (m)	26	26	
Rated Speed (rpm)	1475	1475	
Size	200x250 mm	200x250 mm	
Pump No.	1747208072	1747208073	

Girna Pumping Station H. T. Transformer Details				
Sr. No.	**Description**	**Transformer no.1**	**Transformer no.2**	**Remarks**
1	Make	Sneha Industry	Pactil	Trans.No.2 is not working Condition
3	KVA	250	200	
4	No Load Volts. H.V.(V)	11000	11000	
5	No Load Volts. L.V.(V)	433	433	
6	Current H.V.(A)	13.08	10.3	
7	Current L.V.(A)	332.5	266.70	
8	Phase (HV/LV)	3	3	
10	Cooling	ON	ON	
11	Frequency (Hz)	50	50	
12	Maxi temp rise in Oil	45◦C	45◦C	
13	I/p Voltage (%)	5	4.06	
14	Vector Group	DY11	DY11	
15	Oil in lit	410	292	
16	Total Wt.	1450	1130	
17	Year of Manufacturing	1996	1984	
18	Maker Sr. No.	DT-1	J-39698	

Details of energy bills for Girna pumping station are tabulated as under:

Jalgoan Municipal Corporation															
Energy Consumption Sheet for Girna Pumping Station, Consumer ID -110019003582															
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges	Energy Charges	TOD Tarff EC	F.A.C.	Other Charges	PF Incentive	PF Penalty	Total Amount	Avg. unit cost
1	Dec-11	37072	232	142	142	0.85	21300	152718	-26.8	13902	7414.4		11718	207026	5.58
2	Jan-12	50346	232	135	135	0.97	20250	207400	1155.9	18879.8	10069.2	-5108.87		252646	5.02
3	Feb-12	38298	232	118	118	1.00	17700	157769	-784.6	15778.8	5285.2	-13702.36		182046	4.75
4	Mar-12	46218	232	128	128	0.99	19200	190395	652.3	19041.8		-11399.23		217890	4.71
5	Apr-12	52426	232	123	123	1.00	18450	215969	-1370.4	21599.5		-17825.36		236823	4.52
6	May-12	41744	232	124	124	1.00	18600	171948	-2016.1	17196.9		-14401.01		191328	4.58
7	Jun-12	45150	232	121	121	0.99	18150	186004	-1493	18602		-11063.14		210200	4.66
8	Jul-12	46628	232	129	129	0.98	19350	192092	-1100	34981.8		-7359.74		237965	5.10
9	Aug-12	43934	232	129	129	0.97	19350	180986	-4	32414.5		-6982.41		225765	5.14
10	Sep-12	43390	232	128	128	0.99	24320	205235	-1788	33353.9		-18278.44		242842	5.60
11	Oct-12	39102	232	131	131	0.99	24890	184952	-3769	26577.6		-11632.55		221019	5.65
12	Nov-12	42160	232	129	129	0.99	24510	199417	-3912.8	38917.9		-12946.6		245985	5.83
Total		**526468**					**246070**	**2244885**	**-14456**	**291247**	**22769**	**-130700**	**11718**	**2671533**	

2.2.4 Raymond Chowk Booster Pump :-

At Raymond chowk 75 HP booster pump is installed. Water is supplied from Raymond booster pump tapping point to Mehrun area distribution directly. The pump used at Raymond chowk booster pumping station is horizontal centrifugal type with discharge rating of 350 m3/hr.

Raymond Pump Details	
Description	**Pump**
Make	Kirloskar
Pump Type	UP 200/30
Pump Input (KW)	53.04
Rated Discharge M^3/hr	350
Total Head (m)	50
Rated Speed (rpm)	1450
Motor (HP)	75
Size	150x200 mm
Pump No.	1747200072

Detail of energy bills for Raymond Chowk booster pumping is tabulated as under:

Jalgoan Municipal Corporation												
Energy Consumption Sheet for Raymond Chowk, Consumer ID -110010060826												
Sr. No.	**Month**	**Total Units KWH**	**Contract Demand KVA**	**Billing Demand KVA**	**PF**	**Demand Charges**	**Energy Charges**	**F.A.C.**	**Other Charges**	**PF Incentive**	**Total Amount**	**Avg. unit cost**
1	Dec-11	10342	50	20		1400	35682	3247	2068.4		42398	4.10
2	Jan-12	14984	50	20		1400	51697	4705	2996.8		60799	4.06
3	Feb-12	21418	50	20		1400	73896	7389			82685	3.86
4	Mar-12	21810	50	20		1400	75249	7524			84173	3.86
5	May-12	22214	50	20		1400	76643	7664			85707	3.86
6	Jun-12	20756	50	20		1400	71612	12836			85848	4.14
7	Jul-12	21588	50	20	1.0	1400	74483	13562		-6261	83183	3.85
8	Dec-12	11994	50	20	0.9	1800	50375	4329			56503	4.71
Total		**145106**				**11600**	**509637**	**61256**	**5065**	**-6261**	**581296**	

2.2.5 DSP Chowk Booster Pumping:-

At DSP Chowk, 75 HP booster pump is installed. Water is supplied from DSP booster pump tapping point to Nityanand ESR area distribution directly. The pump used at DSP Chowk booster pumping station are horizontal centrifugal type with discharge rating of 382 m3/hr.

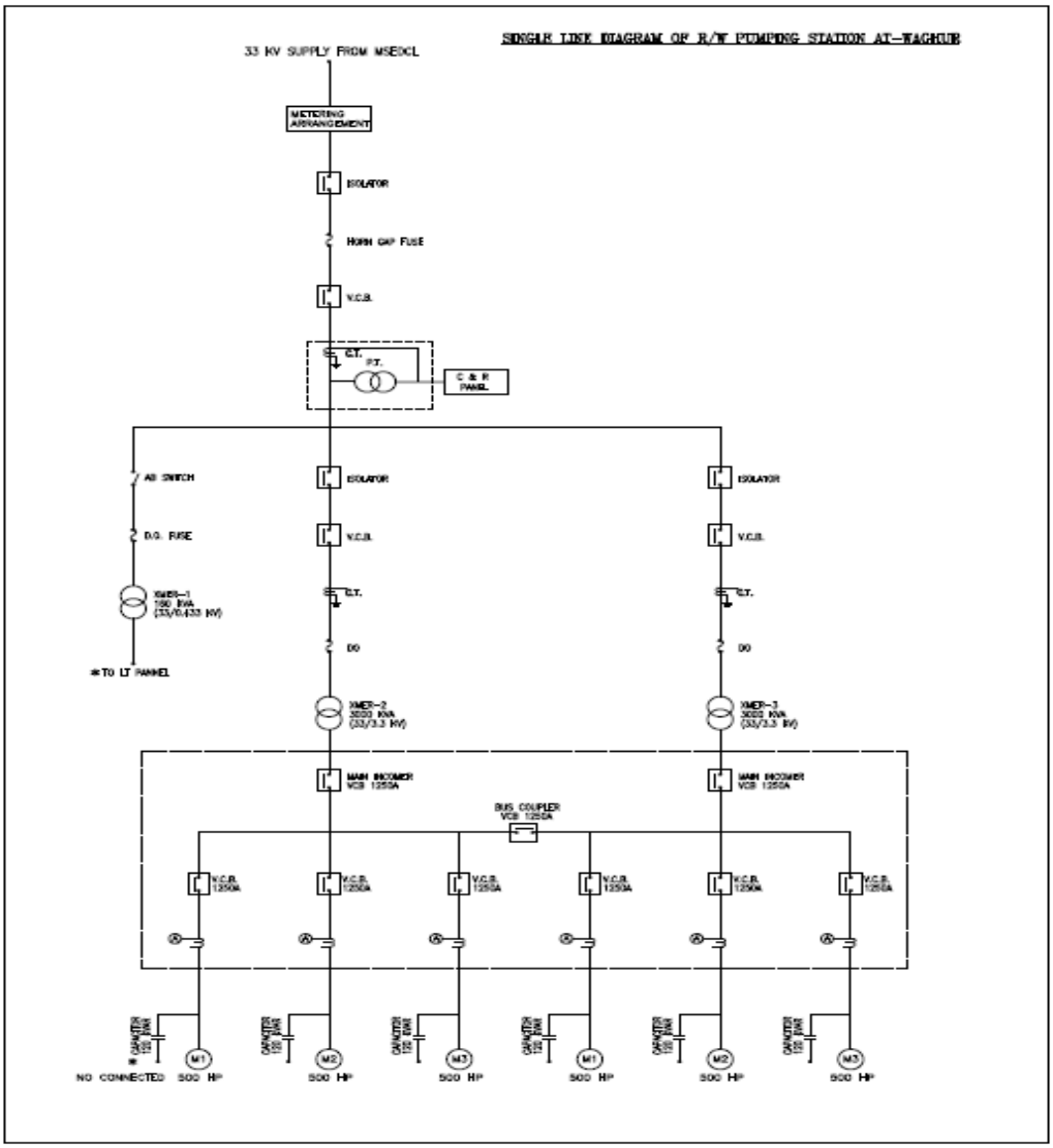
DSP Chowk Pump Details	
Description	**Pump**
Make	Kirloskar
Rated Discharge (m3/hrs)	382
Total Head (m)	34
Motor (HP)	75
Input suction Dia. (mm)	266.75

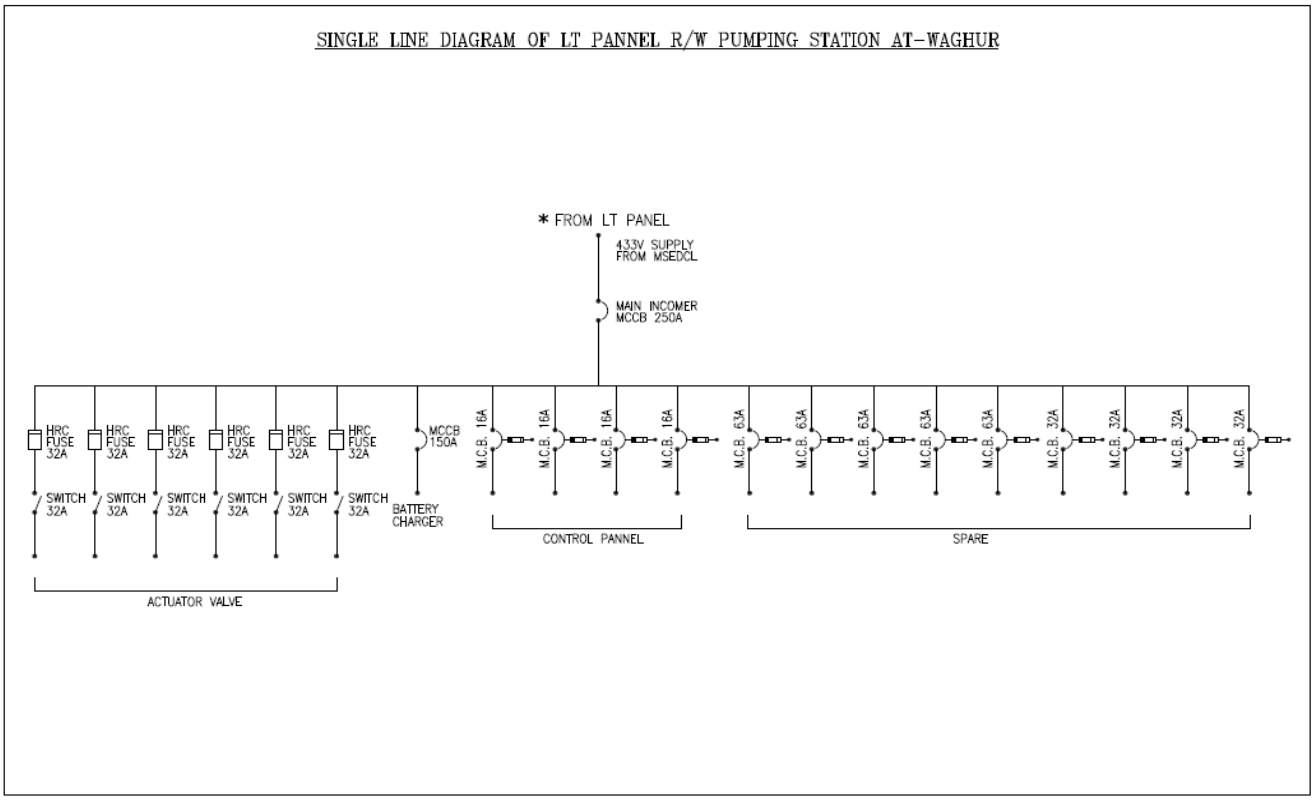
Detail of energy bills for DSP Chowk booster pumping is tabulated as under:

Jalgoan Municipal Corporation															
Energy Consumption Sheet for DSP Chowk, Consumer ID -110019004910															
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges	Energy Charges	TOD Tarff EC	F.A.C.	Other Charges	PF Incentive	Electricity Duty	Total Amount	Avg. unit cost
1	Apr-11	9902	120	60	57	0.982	9000	37628	2818.8	3366.68	0	-1584	4753	55982	5.65
2	May-11	11178	120	60	53	0.997	9000	42476	3706	3514.36		-4109	5383	59971	5.37
3	Jun-11	13250	120	60	53	0.997	9000	50350	4161.7	4037.28		-4728	6079	68900	5.20
4	Jul-11	12426	120	60	54	0.990	9000	47219	4726.5	4583.95		-3276	5898	68150	5.48
5	Aug-11	9340	120	60	54	0.993	9000	35492	3732.9	3296.09		-2598	430	49353	5.28
6	Sep-11	11176	120	60	53	0.997	9000	42324	5223.7	4246.88	2236	-1412		61618	5.51
7	Oct-11	9854	120	60	53	0.999	9000	36953	3914.7	3744.52	1971	-3891		51692	5.25
8	Nov-11	10944	120	60	53	0.997	9000	42536	4719	4158.72	2189	-4382		58220	5.32
9	Dec-11	10398	120	60	57	0.996	9000	42835	2188	3899.25	2080	-4200		55801	5.37
10	Jan-12	10270	120	60	53	0.998	9000	42307	3365.8	3851.25	2054	-4240		56338	5.49
11	Feb-12	9664	120	60	53	1.000	9000	39811	2390.6	3981.57	1353	-3958		52579	5.44
12	Mar-12	11424	120	60	54	1.000	9000	47061	3903.2	4706.69		-4527		60144	5.26
Total		**129826**					**108000**	**506991**	**44850**	**47387**	**11882**	**-42906**	**22543**	**698747**	

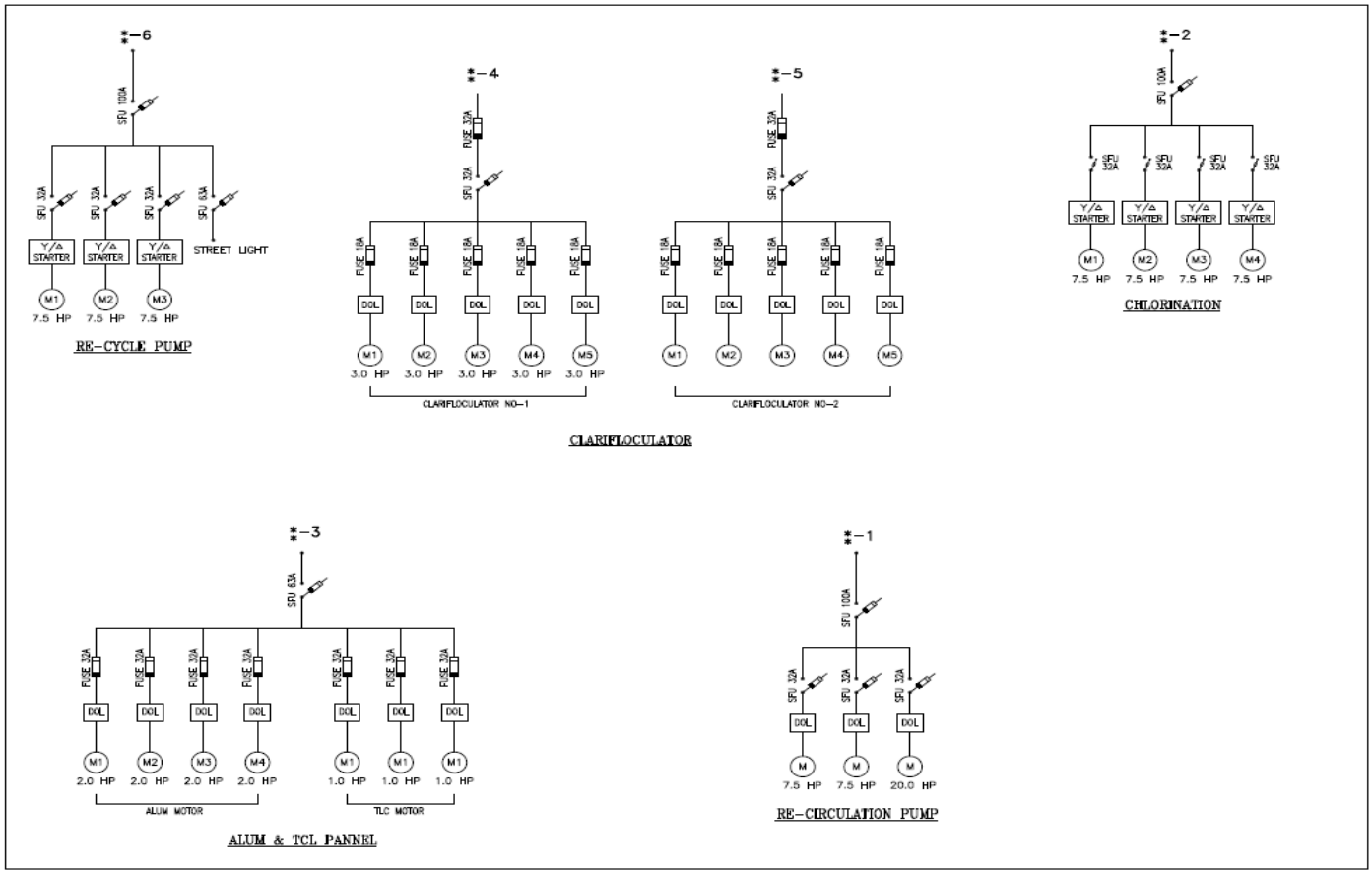
2.3 SINGLE LINE DIAGRAMS:

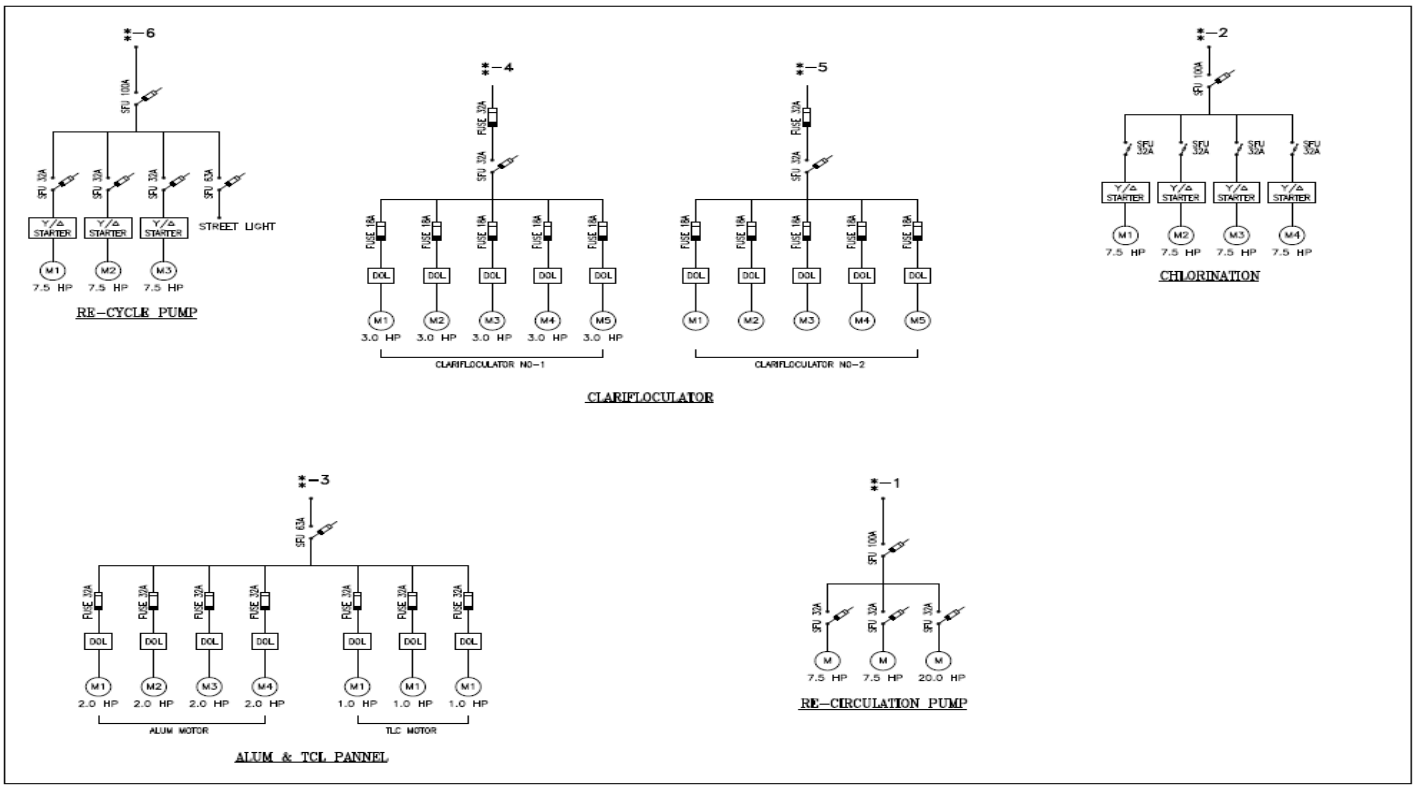
- **Waghur Raw Water Pumping**



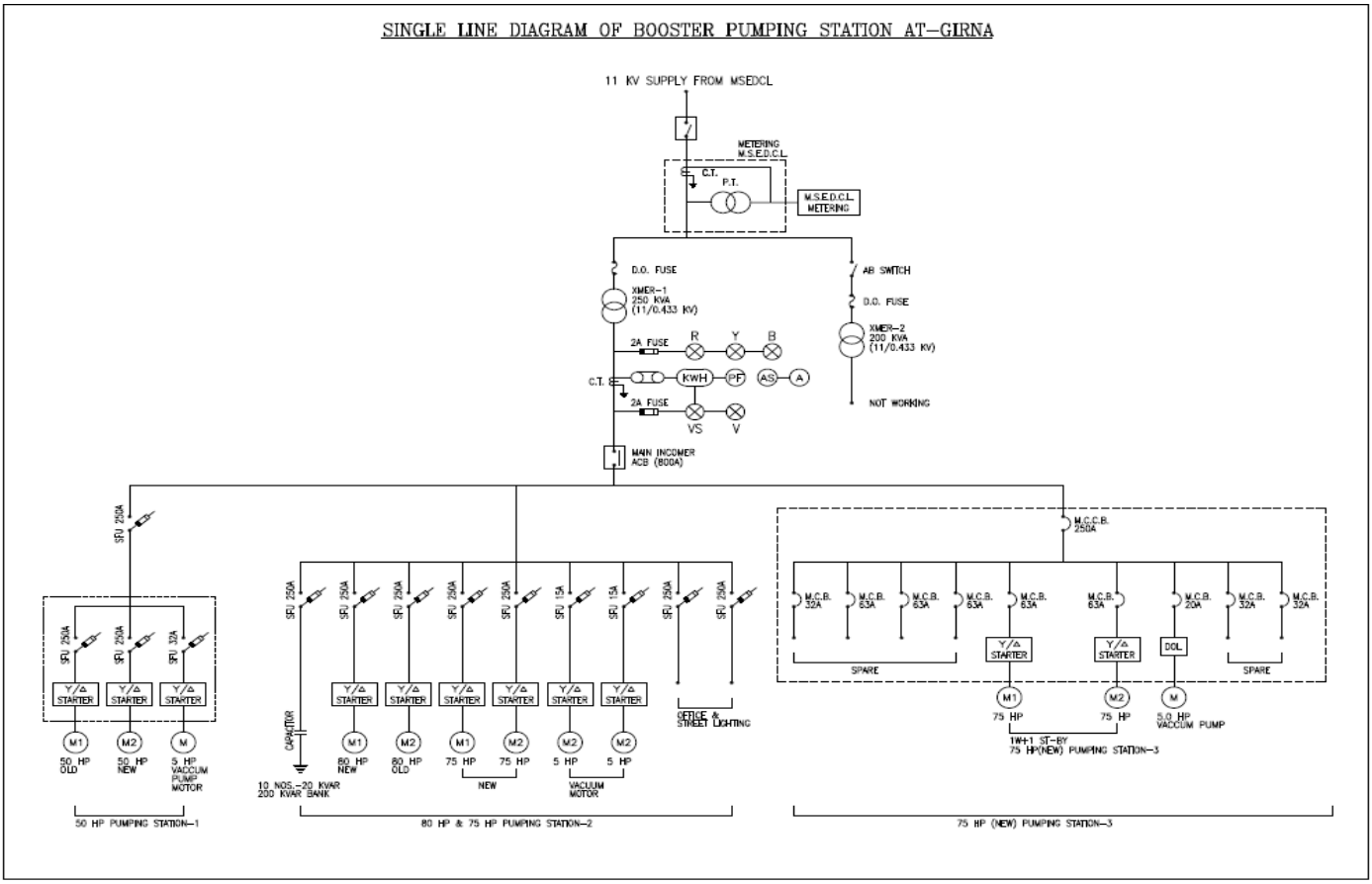

SINGLE LINE DIAGRAM OF LT PANNEL R/W PUMPING STATION AT-WAGHUR
* FROM LT PANEL
433V SUPPLY FROM MSEDCL
MAIN INCOMER MCCB 250A
HRC FUSE 32A
SWITCH 32A
MCCB 150A
BATTERY CHARGER
M.C.B. 16A
M.C.B. 63A
M.C.B. 32A
CONTROL PANNEL
SPARE
ACTUATOR VALVE

❖ **WTP At Umale**


*-6
SFU 100A
SFU 32A
SFU 63A
Y/Δ STARTER
STREET LIGHT
M1 M2 M3
7.5 HP
RE-CYCLE PUMP
*-4
*-5
FUSE 32A
SFU 32A
FUSE 16A
DOL
M1 M2 M3 M4 M5
3.0 HP
CLARIFLOCULATOR NO-1
CLARIFLOCULATOR NO-2
CLARIFLOCULATOR
*-2
SFU 100A
SFU 32A
Y/Δ STARTER
M1 M2 M3 M4
7.5 HP
CHLORINATION
*-3
SFU 63A
FUSE 32A
DOL
M1 M2 M3 M4
2.0 HP
M1 M1 M1
1.0 HP
ALUM MOTOR
TLC MOTOR
ALUM & TCL PANNEL
*-1
SFU 100A
SFU 32A
DOL
M M M
7.5 HP 7.5 HP 20.0 HP
RE-CIRCULATION PUMP


*-6
SFU 100A
SFU 32A
SFU 63A
Y/Δ STARTER
STREET LIGHT
M1 7.5 HP
M2 7.5 HP
M3 7.5 HP
RE-CYCLE PUMP
*-4
FUSE 32A
SFU 32A
FUSE 16A
DOL
M1 3.0 HP
M2 3.0 HP
M3 3.0 HP
M4 3.0 HP
M5 3.0 HP
CLARIFLOCULATOR NO-1
*-5
CLARIFLOCULATOR NO-2
CLARIFLOCULATOR
*-2
SFU 32A
M1 7.5 HP
M2 7.5 HP
M3 7.5 HP
M4 7.5 HP
CHLORINATION
*-3
SFU 63A
M1 2.0 HP
M2 2.0 HP
M3 2.0 HP
M4 2.0 HP
ALUM MOTOR
M1 1.0 HP
M1 1.0 HP
M1 1.0 HP
TLC MOTOR
ALUM & TCL PANNEL
*-1
M 7.5 HP
M 7.5 HP
M 20.0 HP
RE-CIRCULATION PUMP

❖ **Girna Pumping Station**



3. OBJECTIVE & SCOPE OF THE PROJECT

3.1 OBJECTIVE OF THE PROJECT

It is proposed to implement 24 x 7 water supplies Scheme for the Jalgaon City and hence it is required to improve the technical efficiency of the pumping station while conducting energy audit for the water supply scheme. Following are the objectives of the project:

- To identify the areas to reduce the specific energy input in water supply i.e. kWh/ ML.
- To identify the actions with cost benefit analysis.
- Monitoring & evaluation system for the energy efficiency.
- To ensure the end result & providing same as greater benefit to the water end user while reducing operating costs, energy use per capita energy consumption
- Bidding process & procurement strategy.
- Improved process

3.2 SCOPE OF THE PROJECT

Scope of Energy Audit Includes:

1) Introductory meeting with Jalgaon Municipal Corporation & MJP staff
2) Discussions on approach & methodology for the work
3) Approval on the approach & methodology
4) Inception visit to pumping installations
5) Mobilization of the team for filed measurement & Data collection
6) Pump & motor efficiency testing
7) Filed Measurements for various other parameters.
8) Identification of system losses & potential saving
9) Specific energy consumption benchmark to be fixed
10) Estimation of energy saving proposal
11) Submission of Detailed Project Report

3.3 BASIC DATA (ON ENERGY CONSUMER IN WATER SUPPLY &PUMPING UNDER THE SCOPE OF ENERGY AUDIT):-

3.3.1 Total no. of Raw Water Pumping Stations (01 Nos.)

- Waghur Raw Water Pumping station

3.3.2 Total no. of Pure Water Pumping Station & Water Treatment Plant (01 No.)

- Water Treatment Plant, Umale

4. APPROACH & METHODOLOGY FOLLOWED

4.1 ENERGY AUDIT:-

The energy auditor relies on his experience to gather all relevant written, oral or visual information that can lead to a quick analysis of the existing energy situation. It focuses on the identification of obvious sources of possible improvement in energy use, such as missing essential components, leaks, inoperative instrumentation and superfluous operation.

This is a measured survey followed by a plant energy analysis. Sophisticated instruments, such as flow meters used to enable the auditor to compute efficiency and balances during typical equipment operation. The tests performed and instruments required depend on the type of facility, the objective, scope and level of handling of the energy management programmer. The tests conducted include combustion efficiency tests, measurement of temperature and airflow of major fuel-using equipment, determination of power factor degradation caused by various pieces of electrical equipment and testing of process systems for operation within specification.

After obtaining the results, the auditor validates them using preliminary computation and existing support materials such as tables and charts. Then, he builds energy and mass balances, first for each major piece of equipment tested, and then, for the plant as a whole. From such balances, he can determine the energy efficiency of each equipment and scope for possible improvement in efficiency, with costs and benefits of selected options for each opportunity. The detailed report presents the auditor's recommendations, with costs, benefits and implementation aspects.

4.2 STEPS IN ENERGY AUDIT PROGRAM:

In an Energy Audit, detailed data are collected. This data is summarized in table and charts and analyzed. Although sophisticated instrument are used, energy auditing is not an exact science. The auditor must use his knowledge and judgment to collect and interpret data suitably. The various steps in an energy audit program are given below:

4.2.1 Step-1 Review Energy Management Program to Date :

The programs are customarily reviewed with senior corporate staff. The auditor can decide what changes may be needed in the scope of the proposed energy audit in detailed if required. If there is no formal program, the auditor will try to understand why.

4.2.2 Step-2 Data Collection & Preparation of Energy Audit:

The Energy Audit should be conducted after the review. It consists essentially of gathering and analyzing data. It uses available data only, without the use of sophisticated instruments. The results of this activity depend on the ability and experience of the auditor. The output is normally:

- Setup the Bench Mark for existing specific energy use in KWh/MLD.
- Development of energy consumption / cost data base for a facility

- Objective evaluation of plant condition
- Identification of major energy-consuming systems

Energy Audit generally has six steps.

A) Organize Resources:-

- Manpower / time frame.
- Instrumentation.

B) Identify Data Requirements:-

- Data forms for pumps, motors, WTP, ESR, Source details.
- Energy Bills
- System efficiency

C) Collect Data:-

C-1) Conduct Informal meetings:-

- Energy manager / equipment manufacturers.
- Municipal Council Engineers.
- Operations and Maintenance personnel

C-2) Conduct Plant Walkthrough / Visual Inspection:-

- Material / energy flow through plant.
- Major functional departments.
- Any installed instrumentation, including utility meters.
- Energy report procedures.
- Production and operational reporting procedures.
- Conservation opportunities.

D) Analysis Data:-

D-1) Develop Database :-

- Historical data for all energy suppliers.
- Time frame basis.
- Other related data.
- Process flow sheets.
- Pump Motor Details

D-2) Evaluate Data:-

- Energy use – consumption, cost, and schedules.
- Energy consumption indices.
- Plant operations.

- Energy saving potential.
- Plant energy management program.
- Factors affecting specific energy consumption.

D-3) Develop Action Plan:-

- Conservation opportunities for immediate implementation.
- Projects for further study.
- Resources for energy audit.
- Systems for test
- Instrumentation – portable and fixed
- Manpower requirements

4.2.3 Step-3 Develop Action Plan, Including Energy Audit:

On the basis of the review, the energy auditor should develop an action plan, considering:

- ★ Management of energy – related matters.
- ★ Monitoring and reporting considerations.
- ★ Availability of resources for implementing the action plan.

4.2.4 Step-4 Carry out Energy Audit Field Work:-

The energy auditor can now conduct the fieldwork for the EA, which comprises two main tasks:

The first task is to gather data to evaluate all energy aspects, expanding on it, to fill gaps and learn more about the plant operation.

The auditor usually interviews selected personnel, examines records, observes operations, monitors and checks conditions. This may involve repeated data collection and review.
The important task is to perform tests on selected equipment to evaluate its efficiency.

4.2.5 Step-5 Evaluate Collected Data:-

Based on the raw data generated, efficiency of various equipment is evaluated. This involves detailed calculation, using computers and at times, specially designed software.

4.2.6 Step-6 Identify Conservation Opportunities:-

The results of the evaluation can be used to identify the energy conservation opportunities:

- Better operation and maintenance by low-cost housekeeping measures.

- Recovery of waste energy, direct or indirect consumption.
- Improvement of equipment efficiency.
- Installation of advanced control systems.
- Change of technology

These low cost opportunities require little or no major capital investment and have immediate returns on investment. On a simple payback basis, they have paybacks of less than a year.

Capital-intensive measures require large investments. Simple payback periods are usually more than a year. The auditor should use payback period as a guideline, while making his list of recommendations. Consultant shall explore the possibilities of funding or BOT concept from ESCO companies, financial institutes, Govt. grant, subsidies etc.

4.2.7 Step-7 Develop Action Plan of Implementation:

The auditor shall assist the municipal council to arrange the funds to implement the measures identified, especially if capital requirements are large. Instead, and he will complete a report, which will present his findings, with a concrete and time-bound action plan.

It should usually be possible to implement some O & M measures immediately. However, capital intensive measures may require feasibility studies before a decision can be made to implement them.

An action plan often includes a recommendation for self-financing. In a self-financing program, O & M changes are implemented and the resulting cost benefits are invested directly in lower-cost capital-intensive measures to bring in more savings. Eventually, these savings are used to pay for the most capital-intensive measures.

4.2.8 Step-8 Continue to Monitor Energy Use:

Energy efficiency in a water supply system cannot begin and end with the Energy Audit. To sustain its energy efficiency, a MUNICIPAL COUNCIL must continue to monitor its energy use.
The EA report should recommend improvements to the existing monitoring and reporting procedures for energy use. Without such a system, it is hard to spot changes in consumption that result from increase or decrease in efficiency. Possible improvements that can be made to monitoring and reporting procedures include:

- ★ Upgrading Of Instrumentation.
- ★ Development of Energy Consumption Indices.
- ★ Development of Energy Models.

5. ENERGY AUDIT FOR PUMPING SYSTEMS OF MUNICIPAL CORPORATION

Water supply is one of the major functions of any Municipal Corporation in terms of providing safe water to its residents. The water supply pumping systems include the portable water supply schemes and bore wells. The energy charges on water supply pumping systems also occupy a major portion of the electricity bill of the Municipal Council as well as overall municipal expenditure. Hence, special attention shall be paid for energy conservation in the water supply system.

5.1 COMPONENTS OF A WATER SUPPLY SYSTEM:

A detailed overview of various components of water supply systems with functions And major issues. The main components of a water supply pumping system include:

- Pumping Stations
- Motors
- Pumps

The major aspects of the technical study for the water supply system have been broadly classified as follows:

- Hydraulic of Water Supply Systems.
- Pumping System Electrical System and
- Electric Drives.

5.1.1 Pumping Stations:

A. The comprehensive energy audit has been evaluate the present operating efficiency of existing water pumping system including accounting of specific energy consumption and shall identify the scope for improvement in the EE. The energy saving measures shall be realistic, practicable and implementable.

B. Basic information about pumping stations such as installed capacity, number of pumps operated etc. has been collected for respective pumping stations.

5.1.2 Motors:

A motor is a device that converts electric energy into kinetic energy in the form of rotation, whereas a pump takes kinetic energy from the motor and converts into static energy i.e. building up the pressure or water head. Motors at various pumping stations shall be listed. The data relating to date of installation, life period, and details of rated parameters from the nameplate date of repair, frequency of repair, efficiency of motors etc. has been complied in each pumping stations.

Major Issues and Observations:

- Low efficiency of motor
- Old motors

A. Low efficiency of the motor is one of the major causes for the high energy consumption in water supply pumping systems. Low efficiency causes less discharge of water and more energy consumption.

B. Poor efficiency of motors is mainly due to inadequate and improper O&M practices, under loading, Rewinding, wrong selection considering overall cost.

- **High energy consumption:** The low efficient motors consume high energy thereby causing burden on the municipal budget.
- **Frequent rewinding:** The motors if frequently rewind and rewinding is not done properly, then it may affect the efficiency of the motor.
- **Overheating: Excessive** load, improper discharge and head will cause overheating of the motor. It results in high consumption of electricity and consequently, high utility bills.

C. The possible measures for improving the efficiency of motors are as follows:

i) Replacement of old motors by Energy efficient Motors
ii) Rewinding of motors
iii) Maintenance of rated head and discharge and
iv) Adjustable speed drives

i) Replacement of Old Motors :-

In many of the pumping stations, the old motors are running even after their designed life period. The repair cost of these motors will be very high and will be more than the replacement cost. Hence, it is desirable to replace the old motors with new Energy efficient Motors to save energy and to run the pumping system efficiently.

ii) Rewinding of Motors :-

While rewinding is done, care shall be taken to use wire of the same gauge as that of the original winding and also checks resistance and no load losses after rewinding.

iii) Maintenance of Rated Head and Discharge :-

The efficiency of a motor depends on head and discharge. To ensure maximum efficiency, the head and discharge shall be maintained at the rated value.

iv) Adjustable Speed Drives :-

Selection of pump motor with a higher operating efficiency adds to the overall efficiency of the pumping system. In addition, to function efficiently, the motor shall be selected to work correctly with the pump. The motor shall match various requirements of the pump, such as start-up time, numbers of stops and starts pump speed and required torque.

To match varying load requirements, one of the best available options to improve efficiency is to install an automatic speed drive (ASD) motor. As the

name implies, ASDs make pump speed adjustments to meet the particular requirements of a given system at a given time. One popular type of ASD is the variable frequency drive (VFD), which uses electronic controls to regulate motor speed. By slowing an oversized pump, a VFD reduces energy losses in pump operation.

Energy Savings by VFD Systems

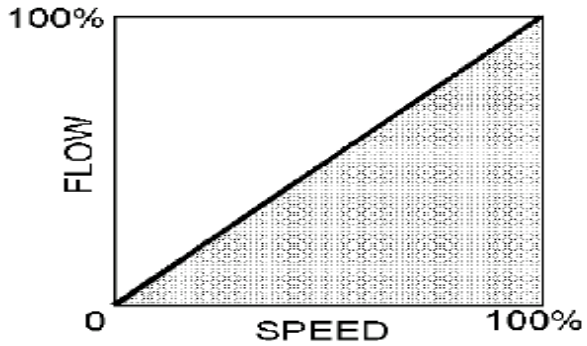
AC motor-driven applications that do not require full speed can save energy by controlling the motor with a variable speed drive. Energy cost saving with variable torque can be significant, often paying for the cost of VFD within short span of time. In variable torque applications such as fans and blowers, the torque required varies roughly with the square of the speed, and the horsepower required varies roughly with the cube of the speed, resulting in a large reduction of horsepower for even a small reduction in speed. The motor will consume only 25% as much power at 63% speed than it will at 100% speed. This is referred to as the Affinity Laws, which define the relationships between speed, flow, torque, and horsepower.

The Laws of Affinity

- FLOW is proportional to motor speed.
- PRESSURE is proportional to the motor speed squared.
- POWER is proportional to the motor speed cubed.

Energy conservation opportunity is available through the speed adjustments.

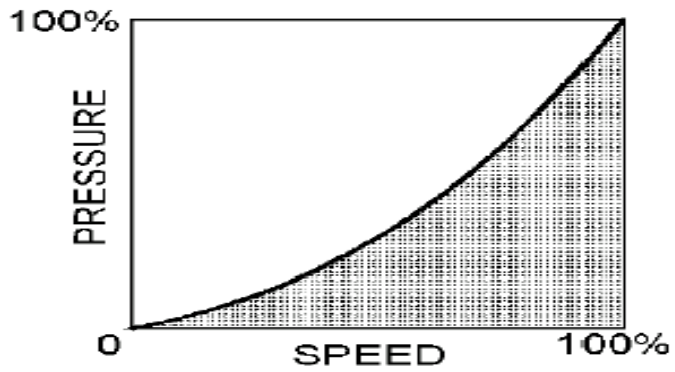
Figure 4.1: Flow ∞ Speed



(Q1 / Q2) = (N1 / N2)
Where,
Q1 = flow at N1
Q2 = flow at N2
N1 = speed at Q1
N2 = speed at Q2

i

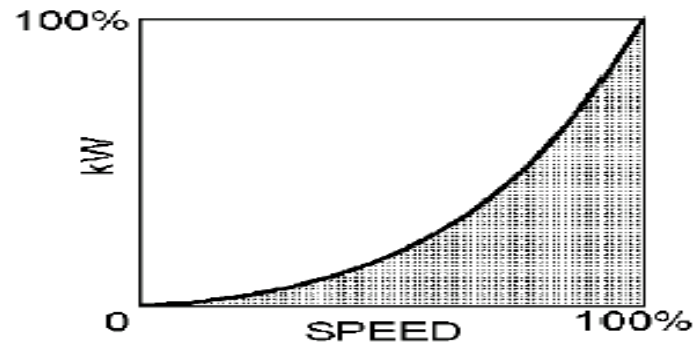
Figure 4.2: Pressure ∝ (Speed)^2



$(P_1 / P_2) = (N_1 / N_2)^2$
Where,
P_1 = Pressure at N_1
P_2 = Pressure at N_2
N_1 = speed at P_1
N_2 = speed at P_2

Varying the RPM by 10% decrease or increase the static pressure by 27%

Figure 4.3: Power ∝ (Speed)^3



$(kW_1 / kW_2) = (N_1 / N_2)^3$
Where,

kW_1 = kilo watt at N_1
kW_2 = kilo watt at N_2
N_1 = speed at kW_1
N_2 = speed at kW_2

Varying the RPM by 10% decrease or increase the power requirement by 27%

5.1.3 Pumps:

Pumps at various pumping stations shall be listed. The basic details of pumps such as size, rated flow, pump input power; rated speed etc. shall be listed in tabular format. Issues

The efficiency of the pumps shall be analyzed based on the data collected. Pumps with poor efficiency shall be listed. The problems, causes and proposed energy saving measures of low efficiency pumps has been given for each pumping stations.

The problems faced by Municipal Council with respect to pumps can be categorized as follows:

- ★ Low efficiency of pumps.
- ★ Scheduling of filling practices and
- ★ Obsolete pumps.

Efficiency Evaluation of a Pumping System:-

Efficiency is calculated at all the actual operating conditions and pump design duty point Condition by observing the following:

A. Measurement of Electrical Input:-

Electrical input parameters like input to motor, voltage, current, power factor & KWh etc. can be measured by portable clamp on type power line meter.

B. Measurement of Pump Head:-

Pump head can be calculated as follows:

H = Hd-Hs; where,
Hd = Discharge pressure of pump measured by pressure gauge on Discharge line
Hs = Suction pressure of pump measured by pressure gauge on suction line

C. Measurement of Flow:

I) Wrap on Ultrasonic Flow Meter:

Now for the measurements of water velocity, instantaneous flow rate and totalized flow for a specified time, portable wrap-on type ultrasonic flow meters are available. This instrument works on the transit time principle and is compatible with any pipe or lining material in which sound is propagated. The instruments have a built-in database so that for setting up of the instrument for site conditions, pipe material, pipe diameter, pipe thickness and lining details are to be entered in the instrument by an interactive keypad. If the pipe material or the lining material is not readily available in the equipment database, there is provision of entering the velocity of sound in the material of pipe on which testing is to be carried out.

Out of the above methods, measurement by wrap-on type flow meter is the only method where system outage is not required. For accurate measurements, all the instruments require straight pipe lengths of 10 times the diameter of pipe on the upstream side and 5 times the diameter of the pipe on the downstream side.

II) Procedure to Measure Flow Using Ultrasonic Flow Meter:-

a) Measure the diameter and thickness of the pipe.
b) Feed the above data along with type of fluid, temperature of the fluid, pipe material, lining details etc.
c) Note down the spacing required for the transducers (Calculated by the A Meter).
d) Fix the stand as per the spacing calculated.
e) Apply grease to the transducers for proper contact and to avoid air entry and fix them to the stand.
f) Connect the leads to the transducers and to the flow meter.
g) Note down the flow and velocity.

III) Once all the above-mentioned Parameters are Measured, the Efficiency of The Pumping

System can be evaluated as follows:-

The overall efficiency of a pumping system is energy transferred to water divided by the electrical input to pump prime mover (generally electric motor) i.e.

$$\eta = \frac{\text{KW Water}}{\text{KW Input}} \text{ where,}$$

η = overall efficiency of pump and motor

KW Input = input to motor in KW

KW Water = energy transferred to water

Energy transferred to water by the pump is:

$$\text{KW water} = \frac{Q \times H}{367.2} \text{ where,}$$

Q = pump discharge in m^3 / hr.
H = pump head in meter.

D. Efficiency of Pumps:-

The problems of inefficiency of pumps are mainly due to inadequate O&M practices lack of awareness and wrong selection.

- ★ Low efficiency of the motor: Efficiency of the pumps also depends upon the motor efficiency.
- ★ Obsolete Pumps: Old age pumps also contribute to low efficiency as the running period goes on.
- ★ Damage of impellers: Difference in impeller diameters due to damage also causes lower discharge and lower efficiency of pumps.
- ★ Non-synchronization of motors and pumps: For attaining full efficiency of the pumping systems, the motors and pumps shall be synchronized.
- ★ Suction side obstructions: The obstructions in suction side reduce the flow velocity and discharge thereby affecting the efficiency of the pumps
- ★ Changes in load parameters of head and discharge: If there are changes in head and discharge from that of designed parameters, the efficiency of the pump reduces

E. Energy Saving Measures:-

In case of pumping systems such as municipal water utilities, where pumps are usually state-of-the-art and well designed, manufactured and tested, there is potential reported for improving pump efficiency by better system design and proper selection and matching of system components.

In the area of pump system design, a systemic approach to determine potential efficiency opportunities can be applied. The system may be evaluated based on the following attributes:

I. Is the system really required?
II. Is the system correctly designed?
III. Is the equipment really efficient?
IV. Are the controls efficient?

A) Is the System Really Required?

Examining the question of whether a system is really needed or not can potentially lead to the largest saving opportunities. Does the system really require all of its present pumps, valves, bypass lines and so on or can it be redesigned to make better use of gravity and reduce frictional losses.

B) Is the System Correctly Designed?

Once it is determined that a system is actually necessary, an audit team needs to determine if the system is designed correctly. For example, system designer's often intentionally oversize equipment to ensure the equipment meets maximum system requirements. In some cases, the excess margins are as high as 20%, leading to inefficient operational issues. Corrections to over-design of pumping systems include:

- Installing a correctly sized pump.
- Sometimes installing a variable speed drive (VSD) motor.
- Reducing impellers.

C) Is the Equipment Efficient?

Upgrading to newer, higher efficiency equipment will likely improve system performance if correctly sized and integrated into the entire water system. Equipment's likely to produce maximum savings include:

- Energy efficient motors.
- Variable speed drives.
- Impellers.

D) Is the Equipment Matched to the Task?

The pumps need to correspond to the system's requirements; impellers need to be sized to create desired flow rates. Cost-effectively matching water pressure and flow rate requirements with, for example, pump and motor characteristics is one of the most critical efficiency steps in system design. Pumps will more often work at their best efficiency point if a water utility is able to analyze water system requirements

accurately and match them with the appropriate pumps using pump performance curves.

Based on the above analysis of the pump system, energy saving potential with modifications in the following areas can be determined:

I) Reduction in leakages
II) Correcting inaccuracies in pump sizing
III) Reducing work load of pumping
IV) Trimming / Replacement of the impellers v) Aging of pumps.
V) Control strategy.
VI) Using energy efficient motors.
VII) Low friction pipe and coatings.
VIII) Valves.
IX) Capacitors.
X) Piping design.
XI) Operation & Maintenance Practices.

I) Reduction of Leakage:-

The first and foremost action needed in energy conservation in pumping systems will be the prevention / reduction of leakages from piping systems. It is estimated that up to 5% reduction in power consumption is achievable by this simple action alone. The common leak prone areas include water pipelines, connections / joints, valves etc. Leakages are a serious problem in most municipal water pumping and supply systems and they give rise to the following clear adverse effects.

- Wastage of precious water.
- Low supply of water to citizens. Low pressure and water not reaching tail ends and higher localities.
- Additional cost of energy and
- Additional wear and tear.

Attempts to quick-fix the leakage by increasing the pressure actually proves counterproductive. Increasing pressure is usually less cost effective than fixing the leaks and maintaining a lower pressure. Furthermore, higher system pressure actually exacerbates the leakages, wasting even more water and energy.

II) Correcting Inaccuracies of Pump Sizing :-

A centrifugal pump is designed to operate with highest efficiency for a combination of total head and discharge capacity called its design duty point or Best Efficiency Point (BEP). In actual duty conditions, a pump will generate head matching the system head requirement. Many times the estimation of head is done on the basis of preliminary data on project proposal when details of the geography / geology are not known, and data on user needs as well as sizing of the pumping system is not finalized.

Experience shows that many installations have selected the pumps with large safety margins and system requirements are not known beforehand. It becomes very clear that selection of proper pump for a given duty point is vital from energy efficient operation viewpoint. In most of the cases, losses of efficiency can be as high as 20% to 30% or even more. The other major inaccuracies for pump sizing reasons include:

- Additional pumps added to existing installations to meet the increasing demand of water.
- Apparently, the pumps satisfy the revised requirement of the water supply system. However, from the energy consumption viewpoint, the combination of old and new pumps may not be efficient.
- Modifications or changes in the pumping system after pump installation.
- In case of miss-match in head, the pump efficiency will be lower than its best efficiency point.

III) Reducing the Pumping Workload:-

This can be achieved by either:

- Reducing of obstruction in the suction / delivery pipes thereby effecting a reduction in frictional losses. This includes removal of unnecessary valves of the system due to changes. Even system and layout changes may help in this, including increased pipe diameter.
- Replacement of components deteriorated due to wear and tear during operation.
- Modifications in the piping system.
- Modification in flow control strategies.

IV) Trimming / Replacement of the Impellers:-

- Impeller trimming refers to the process of matching the diameter of an impeller to reduce the energy added to the system fluid. Impeller trimming offers a useful correction to pumps that, through overly conservative design practices or changes in system loads, are oversized for their application.
- Trimming an impeller provides a level of correction below buying a smaller impeller from the pump manufacturer. Sometimes smaller impellers may not be available for the pump size in question and impeller trimming is the only practical alternative short of replacing the entire pump / motor assembly. Impeller trimming reduces tip speed, which in turn directly lowers the amount of energy imparted to the system fluid and lowers both the flow and pressure generated by the pump. For many pumps, for a given casing, a number of impellers are available from manufacturers.
- If the pump head required is lower than the best efficiency point head, the easiest method could be by reducing the pump impeller. Selection of impellers with a smaller diameter can bring the pump characteristic. Such modifications are recommended to be done within 10-15% of the largest diameter of the impeller.

V) Replacement of Components Deteriorated Due to Wear & Tear During Operation and Ageing of Pumps:-

In old pumping stations where pumps have been working for more than 10 -15 years, we can expect critical pump parts such as impeller, volute at impeller entry and throat tongue diffusers etc. to have worn out. The actual performance of the pump accordingly comes down; rebuilding the parts to original dimensions and proper maintenance can restore the pump efficiency to original level over prolonged period

of operation. In India, in recent times, one of the main causes of shortfall in performance of flow rate and head from targeted values is reduction of power supply frequency. After detailed study of the system and the problems encountered, the solution needed to be arrived at by designing and developing a new impeller offset the negative impact of lower frequency.

VI) Control Strategy:-

Capacity variation ordinarily is accomplished by a change in the pump head, speed or both simultaneously. One of the common methods used to regulate the flow is discharge throttling. Throttling of any type of valve in discharge line will increase the system head. Discharge throttling moves the operating point to one of lower efficiency and power is lost at the throttle valve.

Especially in large pumping installations and where pumps are of the continuous duty type, review of operational requirement and power loss is an important aspect to take corrective measures and save substantial energy.

VII) Using Energy Efficient Motors:-

When motors are oversized and operate for extended periods at significantly less than full load, there are three significant operational penalties reduced efficiency, reduced slip and reduced power factor.

- ★ Recognizing that motors are often oversized for their applications, it is necessary to verify the economics of energy efficient motors that are one standard size smaller than the original motor.
- ★ The efficiency margin offered by new energy efficient motors over new standard efficiency motors can vary from about one to over six percentage points.
- ★ In the proactive replacement scenarios, the 'standard' efficiency motor being replaced is probably 5 to 10 years old. These older motors have likely been rewound “one or more times”, and their efficiency is likely to have been lower upon purchase than a newer model. Thus, the spread in efficiency in a replacement scenario is likely to be higher.
- ★ Energy efficient motors run cooler and therefore have potentially longer life than their standard efficiency counterparts.
- ★ In designing “new installations”, it is economically attractive to purchase “energy efficient” motors over “standard efficiency” models.

VIII) Lower Friction Pipe and Coatings:-

Pipes made of smooth material, such as polyvinyl chloride, when compared with traditional cast iron pipes, can reduce friction loses. Lower friction pipes can increase energy savings by 6 to 8 percent. Applying certain resin and polymer coatings to the insides of a pump can achieve another 1 to 3 percent improvement. Coatings can also reduce erosion and corrosion in pipes and pumps.


IX) Valves:-

Valves play a critical role in a water pumping system by controlling flow and pressure. There are numerous types of valves for different functions. In choosing the proper valve for a specific purpose, however, the impact of the valve on system efficiency should be considered. Some valves are offer more friction to the system than others.

For example, throttle valves are more efficient than bypass valves, because a throttle valve is still able to maintain an upstream pressure that assists in moving water through parallel parts of the system. The energy used to pump water that is by passed in a system using a bypass valve is wasted.

In a parallel distribution system, instead of throttling valve, rescheduling of supply can be made to maintain high water flow and low energy consumption.

X) Capacitors

Installing capacitors can reduce the energy required to run certain equipment. Capacitors are devices that store electrical energy and are used to correct low power factors. Certain electrical equipment, such as transformers, motors and high intensity lighting creates a magnetic field in their operation that cause low power factors. Often this equipment represents a major portion of the electric power used at a facility. Besides wasting energy, a low power factor can cause premature equipment failure. Additionally, electric utilities often levy penalty fees for low power factors, and capacitors may avoid such unnecessary expenses.

Proper and regular operation and maintenance, duly maintaining the necessary records, carrying out repairs and replacing the worn out parts, gauges, meters with genuine and standard company products in time is required, apart from supervision by senior officers at regular intervals. This preventive measure helps in the following ways:

- ★ Prevents spending of huge amount if a break down occurs.
- ★ Avoids interruptions in water supply and power supply to the public.
- ★ Extends life of the equipment and its smooth functioning and avoids high early investment and
- ★ Above all, helps to make equipment's energy efficient and thereby save scarce financial resources.

E) Water Accounting Systems:

- Implementing a system of water accounting is a valuable first step in controlling losses. Water accounting should ideally begin at the source and extend to end users to determine water losses
- By quantifying the known and unknown delivered water deficit, loss accounting can give the authorities an idea of how much leakage exists in the distribution system.
- Losses should be tracked monthly, especially in high-risk areas to help identify new leaks, inaccurate meters, and illegal water diversions. A comparison of the quantity of water leaving the system with that sold to customers shall help quantify losses.
- Even under good management conditions, unaccounted for water normally constitutes 10-15 percent of the water produced. Therefore, if water loss is greater than 15 -20 percent of the water produced, corrective action is necessary.
- It is important to stress that unaccounted for water reduction programs need constant maintenance and monitoring. Leaks will reoccur if authorities are not vigilant.

F) Leak Detection and Repair Strategy:

The leak detection and repair strategy shall include regular inspection, pipeline survey, observation of pressure of water in select taps in different localities etc. Use of computer assisted leak detection equipment, sonic leak detection survey, or any other acceptable method for detecting leaks can improve the accuracy of detections. Leak reduction shall also involve equipment cleaning and other maintenance efforts to improve the distribution system as it currently operates and prevent future leaks and ruptures.

5.1.4 Power Bore Wells:

In many Municipal Councils, a significant volume of water is being supplied by bore wells are due to lack of sufficient surface source. Considerable expenditure is being made by the ULBs towards electricity charges for the bore wells.

5.1.4.1 Situation Analysis :

The first step in the situation analysis of bore wells is to get a clear picture by collecting all necessary details. The basic information and technical details about the power bore wells shall be collected.
The common problems and issues associated with power bores are as follows,

- Old bore wells: Many of the power bore wells are old and without proper maintenance.
- Overloading of bore wells: The ground water has depleted from the time of installation. This result in overloading of bore wells, as they have to run extra to pump water.
- Poor O & M: There are continuous leakages from the taps due to poor O & M practices.

- Misuse of power bores: In some cases, the power bores are located on private lands and are monopolized and misused.
- Defunct, dried up or contaminated bores: Due to rapid depletion of ground water, power bores are getting dried up and became defunct; in industrial areas, bore well water gets contaminated.
- Low efficiency pump sets: As there is no proper selection of suitable capacity of pump set with high efficiency, the power bores are coupled with low efficiency pump sets.
- Seasonal recharging of bores: The submergible pumps are not located at appropriate depth to take care of seasonal variations of ground water levels.
- Head loss due to high friction in the GI pipes: In power bores, GI pipes are used which leads to head loss due to high friction resulting in wastage of energy.

The data collected shall be analyzed and the problematic power bore wells shall be listed. Analysis shall include problems, causes and energy saving measures.

5.1.4.2 Energy Efficiency for Power Bore Wells :-

The energy saving measures with respect to bore wells is described as follows:

- Disconnecting defunct bore wells
- Operation of bore wells
- Improved O & M.
- Capacitors
- On and off controls
- Energy meters and
- Appropriate Design

Defunct Bore Wells:

All the defunct bore wells shall be identified and the utility authorities shall be addressed for disconnecting power. This will save the ULB from paying minimum electric charges for defunct bores. This is prevalent in many towns leading to huge unnecessary losses and a financial strain on the ULB budget.

Operation of Bore Well:

In case of power bores located on private sites, the bores shall be handed over to the actual users to pay the charges by themselves. To prevent unauthorized use of power bores, the operation responsibility shall be given to local neighborhood groups etc.

Improved O & M:

Water leakages shall be minimized through improved O & M practices and regular monitoring.

Capacitors:

Capacitors banks and single-phase presenters shall be installed at all the bore well installations to save energy.

On and Off Controls:

On and off controls shall be provided where there is reduced flow. This enables to control the supply.

Energy Meters:

Energy meters shall be installed at all the bore wells for monitoring of monthly energy consumption. The misuse of the bore wells shall be detected with review of energy consumption over a period of time.

Appropriate Design:

Design criteria of the bore wells (particularly depth) shall be looked into to prevent excessive motor loading for the new power bore wells. Only energy efficient pumps shall be procured in future rather than low cost, high energy consuming pumps.

5.1.5 MAXIMUM DEMAND (MD) AND POWER FACTOR (PF):

5.1.5.1 Energy Tariff and Bills :

Electricity is normally the most expensive form of energy purchased. Electric power generation requires major capital investment and considerable operating expense. Because of this, electric utility companies have developed rate schedules that try to give them a fair rate of return for their money invested.

Customers are normally billed according to these charges based on maximum demand, power factor and energy consumption. Recently some of the utilities have introduced rate schedule for reactive energy consumption based on maximum demand power factor, and energy consumption. Customers may also be charged a flat rate fee per meter.

1.1) In-depth understanding of the electricity charge levy system is necessary for proper energy management. The electricity bills are dependent on three factors

- ★ Maximum demand (MD).
- ★ Power Factor (PF) and
- ★ Actual consumption as per the meter

1.2) Maximum demand is the power demand in KVA that the plant consumes at any point of time during a month. The consumer, and in this case, the ULB has a contract MD for each of its installations. Contract MD is the agreement demand that the ULB opted for its pumping station while applying for connection. The maximum demand charge is based on the highest sustained consumption rate over a given period. Usually, the time period is 15-30 minutes. The demand is normally measured in terms of kilowatts (KW) or kilovolt amperes (KVA). The charge is usually a cost per unit of demand.

1.3) Consumption charges are based on the amount of electricity used in terms of kilowatt-hours. Charges are usually computed on a cost per unit of consumption. The charges are often assessed on a block basis, with a reduction in the amount charged for consumption above a stated level.

When determining a rate schedule, the Discom estimates what it will pay for fuel to generate electricity. Unfortunately, the charges on which it bases its calculations often change, so the utility passes on this charge in the form of a 'fuel adjustment charge'.

As part of an electrical system audit, one needs to collect information on the following:

- ★ Maximum demand charges, KVA (i.e. How fast is the electricity used?)
- ★ Energy charges, KWH (i.e., How much electricity is consumed?)
- ★ Time of Day charges, Peak/Non-peak period (i.e. when the electricity is utilized?)
- ★ Power factor charge, P.F. (i.e. Real power use versus apparent power use factor).
- ★ Other incentives and penalties applied from time to time.
- ★ High tension tariff and low tension tariff rate changes. Type of tariff clause and rate for various categories such as water installations.
- ★ Slab rate cost and its variation.

1.4) Power distribution company (Discom) collects the power charges on billing demand i.e. the actual consumption demand or 80% of contract demand, whichever is more. Similarly, energy consumption charges are levied on the actual units' consumption or 50 units per KVA of billing demand, whichever is higher. So electricity bills can be drastically minimized by opting correct contract MD.

1.5) At the first instance, all the meters in water supply systems, power bores, street lighting and indoor lighting shall be listed out. The electricity bills for these meters for the last 12 months shall be compiled.

1.6) The steps to analyze the electricity bills and to make modifications in the MD and PF are as follows:

- ♦ Find out the minimum and maximum total consumption demand from the electricity bills for a period of 12 months.
- ♦ Compare the total consumption demand with the contract demand.
- ♦ If the total consumption demand is less than 80% of the contract demand, the ULB is paying minimum billing demand charges, even though the actual consumption is less
- ♦ If the total consumption demand is more than the contract demand, then the ULB is paying double charges for the demand over and above the contract demand.

Remedial Measure

1.7) The following are the actions to be taken as remedy:

If the total consumption demand is less than 80% of contract demand, Discom shall be addressed to decrease the contract demand to the maximum consumption demand observed in a year.

If the total consumption demand is more than the contract demand, Discom shall be addressed to increase the contract demand to the maximum consumption demand observed in a year.

5.1.5.2 Power Factor :

1.1) The ratio of active power (KW) to the total power (KVA) gives the power factor (PF). The Discom charges additional amounts as surcharge for maintaining low PF. The disadvantages of low PF are as follows:

- Larger equipment all along the system for a given capacity.
- Increased current.
- Increased heat losses and
- High voltage drop and high line losses.

1.2) To assess the PF, all meters have been listed first. Then electricity bills for these meters for the last 12 months have been collected. Then the PF as indicated in the bills has been compiled.

1.3) The data collected has been analyzed to verify whether the PF is less than 0.99.

Remedial Actions

1.4) It is imperative to maintain PF always above 0.90 to avoid unnecessary and high surcharge. The PF can be improved by using correct rated capacitors. The KVAR rating of capacitors required for the desired improvement in power factor are given. In addition, the calculations to arrive at the KVAR rating of the capacitor are also provided.

1.5) Benefits of the PF improvement are as follows:-

- Reduction in current drawn.
- Reduction in transformer losses.
- Reduction in cable losses.
- Improvement in voltage regulation.
- Saving in the KVA demand.
- Saving in the penalties.
- Enhancement in the life of switchgear / cables.

6. ENERGY EFFICIENCY IN PUMPING INSTALLATIONS

6.1 Waghur Raw Water Pumping Station

This source is major raw water source for Jalgaon city. Waghur scheme have 6 Nos. pumps (4 working+2 standby) are installed in 2007. The pumps used in raw water are horizontal type with discharge rating of 1355 m^3/hr having motor rated power of 500 HP. Water is pumped through 1168 mm MS water pipe line of approximately length of 7 Kms up to WTP.

At head works, 2x3000 KVA (33/3.3 KV) & 1x160KVA (33/0.433kv) transformers are provided for electrical supply.

Jalgoan Municipal Corporation														
Energy Consumption Sheet for Waghur Raw Water, Consumer ID -110019004480														
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges	Energy Charges	TOD Tarff EC	F.A.C.	Other Charges	PF Incentive	Total Amount	Avg. unit cost
1	Dec-11	558750	1444	1430	1443	0.93	214500	2399887	-14945	218471	111750		2929664	5.24
2	Feb-12	790380	1444	1431	1454	0.94	214650	3394761	-27404	339468	105911		4027387	5.10
3	Mar-12	768720	1444	1447	1463	0.96	217050	3301729	-13118	330165		-38358	3797469	4.94
4	Apr-12	891450	1444	1395	1397	0.96	209250	3828867	-8341.5	382878		-44127	4368527	4.90
5	May-12	855420	1444	1331	1331	0.98	199650	3674114	-8686.5	367403		-126974	4105506	4.80
6	Jun-12	868800	1444	1392	1392	0.97	208800	3731583	-4981.5	373150		-86171	4222380	4.86
7	Jul-12	796800	1444	1343	1343	0.97	201450	3422336	-3522	623177		-84869	4158572	5.22
8	Aug-12	924210	1444	1337	1337	0.97	200550	3969574	-3597	710902		-97549	4779881	5.17
9	Sep-12	853470	1444	1328	1335	0.98	252320	4310024	-51333	733131		-157324	5086817	5.96
10	Oct-12	856530	1444	1329	1331	0.98	252510	4325477	-68082	606338		-153487	4962755	5.79
11	Nov-12	859620	1444	1309	1311	0.98	248710	4341081	-52782	811137		-160444	5187702	6.03
Total		**9024150**					**2419440**	**40699433**	**-256791**	**5496220**	**217661**	**-949304**	**47626660**	
Estimated Annual		**9844527**					**2639389**	**44399381**	**-280136**	**5995877**	**237448**	**-1035604**	**51956356**	
Average		**820377**				**0.97**		**3699948**					**4329696**	**5.27**

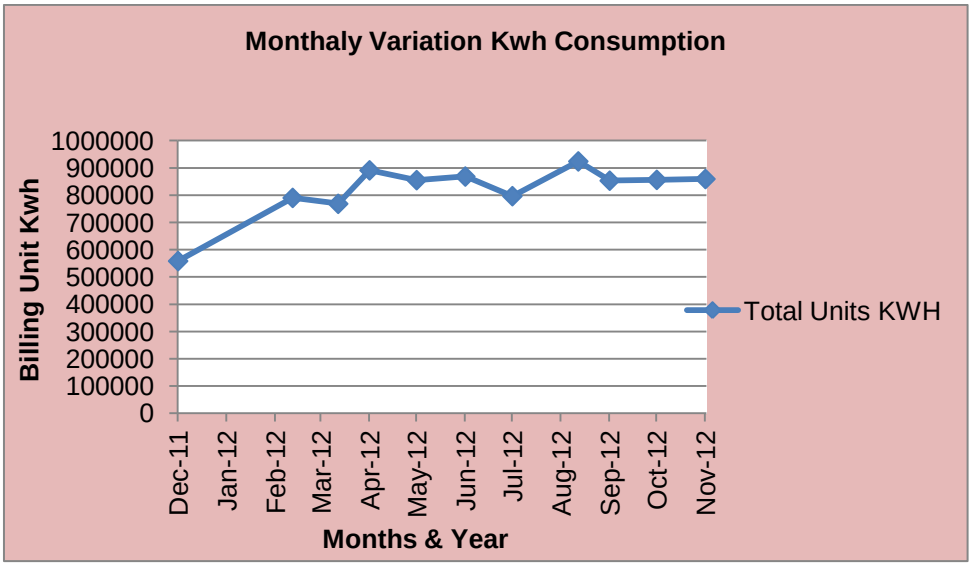
- Contract Demand is 1444 KVA but maximum demand was more than contract demand for two months out of 11 months for which bills are received.
- Average cost of electricity units is Rs. 5.27 per KWh.
- Average power factor is 0.97 and incentive of Rs.9, 49,304 has been received for 11 months for which bills are received.

6.1.1 Pumping Hours:-

At Waghur raw water 4 nos pumps are operating for 22 hours per day (approx as per billing data).

6.1.2 Monthly Energy Consumption (kWh):-

The graph below shows the monthly energy consumption of Waghur raw water pumping. Maximum energy consumption was in the month of Aug 2012.



Measuring and recording of energy consumption is useful in comparing energy consumption to a measured output i.e. water discharged and setting a benchmark to control energy consumption. Monitoring energy consumption to the set target on a regular basis may results in to reduction in kWh/ML

6.1.3 Pump Efficiency:-

Field test for pump efficiency has been carried out on 01/02/2013. Field measurement sheets are given in Annexure. Results of field test are tabulated as following:

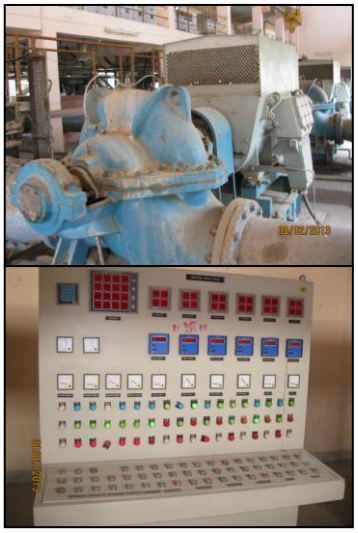
Sr.No	Name of Pumping Station	Motor Rated Power KW	Overall Pump & Motor Combined Efficiency %
1	Pump-1 Waghur Raw Water	375	70.09
2	Pump-2 Waghur Raw Water	375	55.89
3	Pump-3 Waghur Raw Water	375	61.17
4	Pump-4 Waghur Raw Water	375	60.62
5	Pump-5 Waghur Raw Water	375	73.15
6	Pump-6 Waghur Raw Water	375	66.92

Following table shows overall efficiency of pumps & motors at Waghur raw water pumping station:-

Pump & Motor Efficiency													
Sr. No	**Pumping Station Location**	**Motor Rated Power**	**Type of Pump**	**Rated Flow m3/h**	**Flow m3/h**	**Flow m3/s**	**Total Head**	**Rated Head**	**Motor Rated Efficiency %**	**Hydraulic Power, ph (KW)**	**Measured KW**	**Overall Pump + Motor Combined Efficiency %**	**Pump Efficiency % (Hydraulic Power, ph/Power input to the pump shaft)*100**
		kW								**Qxhxpxg /1000**			
1	Pump-1 Waghur Raw Water	375	Centrifugal Pump	1355	1171.4	0.325	70.66	75	93	224.65	320.52	70.09	75.36
2	Pump-2 Waghur Raw Water	375	Centrifugal Pump	1355	972.0	0.270	65.66	75	93	173.22	309.92	55.89	60.10
3	Pump-3 Waghur Raw Water	375	Centrifugal Pump	1355	851.0	0.236	72.06	75	93	166.44	272.07	61.17	65.78
4	Pump-4 Waghur Raw Water	375	Centrifugal Pump	1355	824.1	0.229	75.66	75	93	169.23	279.14	60.62	65.19
5	Pump-5 Waghur Raw Water	375	Centrifugal Pump	1355	1194.8	0.332	73.66	75	93	238.87	326.53	73.15	78.66
6	Pump-6 Waghur Raw Water	375	Centrifugal Pump	1355	957.4	0.266	75.66	75	93	196.60	293.77	66.92	71.96

Observations:-

- For pumps no.1 to pump no.6 rated head is 75 meter and operating head at the time of measurements are found to be 70.66, 65.66, 72.06, 75.66, 73.66 & 75.66 meter respectively. Combined pump & motor efficiency observed for pump set no. 1 is 70.09%, pump no.2 is 55.89%, pump no.3 is 61.17%, pump no.4 is 60.62%, pump no.5 is 73.15%, pump no.6 is 66.92%
- Average power factor is 0.97 which is good, but there is a scope for further improvement
- There is no recording and monitoring of flow & energy parameters.



6.1.4 The Energy Saving Potential for Waghur Raw Water Pumping:-

The energy conservation potential for Waghur raw pumping station is given as under:

Pump Modification / Up-gradation: - for 500 HP, Pump no.2, 3 & 4.

The pump modification can be done by following:-

- Overhauling & Providing Polymer Coating inside of pump

Estimated energy saving potential by improvement in pump efficiency as given below:-

Pump efficiency and Saving of Waghur Raw Water																		
Sr. No	Pumping Station Location	Motor Rated Power kW	Type of Pump	Rated Flow m3/h	Actual Flow m3/h	Total Head (M)	Rated Head (M)	Hydraulic Power, ph (KW) Qxhxpxg /1000	Measured KW	Overall Pump + Motor Combined Efficiency%	Pump Efficiency % (Hydraulic Power, ph/Power input to the pump shaft)*100	Running Hour	kW for 65 & 70% Combined Efficiency	Present Annual Consump'n	Proposed Annual Consump'n	Total Saving in kWh for combined efficiency of 70%	Avg Unit Rate in Rs.	Annual Saving after by Overhauling (Rs.)
1	Pump-2 Waghur Raw Water	375	Centrifugal Pump	1355	972.0	65.66	75	173.22	309.92	55.89	60.10	14.5	266.5	1640252	1410394	229857	5.28	1213647
2	Pump-3 Waghur Raw Water	375	Centrifugal Pump	1355	851.0	72.06	75	166.44	272.07	61.17	65.78	14.5	237.8	1439930	1258382	181548	5.28	958576
3	Pump-4 Waghur Raw Water	375	Centrifugal Pump	1355	824.1	75.66	75	169.23	279.14	60.62	65.19	14.5	241.8	1477348	1279484	197864	5.28	1044723
													Total	**4557531**	**3948260**	**609270**		**3216947**
65 & 70% combined efficiency is considerd by Overhauling																		

Thus, Estimated Annual Energy Saving Potential (Rs.) = 32, 16,947 /-

6.1.5 Online Monitoring System :-

Effective control and real time monitoring system required for operating the pumping system at prescribed efficiency level.

Measuring and recording of energy consumption useful in comparing energy consumption to a measured output i.e. water discharged and setting a benchmark to control energy consumption.

- Recording: - Measuring and recording energy consumption
- Analyzing: - Correlating energy consumption to an appropriate standard or benchmark.
- Comparing: - Comparing energy consumption to an appropriate standard or benchmark
- Setting Targets: - Setting targets to reduce or control energy consumption
- Monitoring: - Comparing energy consumption to the set target on a regular basis.
- Reporting: - Reporting the results including any variances from the target which have been set
- Controlling: - Implementing management measures to correct any variances, which may have occurred.

6.1.6 Polymer Protective Coatings inside of pumps :-

Waghur raw water pumps have the potential to increase the efficiency by 3 to 5% by applying polymer coating to the casing and the impeller. Composite coatings have proven to be very effective in extending the life of pumps and other components of system and improving efficiency of pumping operation. Combining coating and other refurbishing techniques, it is possible to breathe a new life in old worn out and obsolete pumps and fittings. In refurbishing, it is possible to redesign and change shapes of hydraulic passages blades to change the performance of the pump to match the changed system requirements.

6.1.7 Action Plan & Investment Summary:-

Energy saving potential action plan for Waghur raw water pumping shall be achieved while implementing following efficiency improvement actions as tabulated below:

Action Plan Summary											
Sr. No	Pump No	Pump Rating Details			Pump Field Testing Details			Combined Efficiency (%)	Mechanical Action Plan		
		Flow (LPS)	Head (m)	Motor kW	Flow (LPS)	Head (m)	Kwh		Energy Monitoring	Pump+ Motor Replacement	Polymer Coating to Pump
Waghur Raw Water Pumping Station											
1	Waghur Raw Water pump-1	376.38	75	375	325.38	65.66	320.52	55.89	✔	x	x
2	Waghur Raw Water pump-2	376.38	75	375	270.00	65.66	309.92	55.89	✔	x	✔
3	Waghur Raw Water pump-3	376.38	75	375	236.39	72.06	272.07	61.17	✔	x	✔
4	Waghur Raw Water pump-4	376.38	75	375	228.91	75.66	279.14	60.62	✔	x	✔
5	Waghur Raw Water pump-5	376.38	75	375	331.89	75.66	326.53	60.62	✔	x	x
6	Waghur Raw Water pump-6	376.38	75	375	265.94	75.66	293.77	60.62	✔	x	x

As the combined efficiency of pump no.2 is 55.89%, pump no. 3 is 61.17% & pump no 4 is 60.62%. It is advisable to carrying out overhauling & provides polymer coating to the pumps.

Investment details and payback calculations are tabulated as under:-

Waghur Raw Water Pumping Station					
Investment Summary					
Action Plan		Investment	Saving		Payback
	Description	In Rs. Lakhs	In kwh	In Rs. Lakhs	Months
Waghur Raw Water Pumping Station					
1	a) Energy Monitoring for 500 HP pump no.1	0.125	-	-	-
2	b) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.2	4.86	229857	12.136	4.80
3	c) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.3	4.86	181548	9.586	6.08
4	d) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.4	4.86	197864	10.447	5.58
5	e) Energy Monitoring for 500 HP pump no.1	0.125	-	-	-
6	f) Energy Monitoring for 500 HP pump no.1	0.125	-	-	-
Note :- 1) Payback period calculation is based on achieving the combined efficiency of 70 %					
2) Investment cost given above is approximate estimated cost and may differ at the time of tendering.					

6.1.8 Conclusion

It is advisable to carrying out overhauling & provides polymer coating inside of pumps no 2, 3 & 4.

6.2 Girna Pumping Station (New & Old)

At old Girna pumping station 2 x 80 HP (1 working+1 standby) & 1 x 50 HP centrifugal pumps are installed. 80 HP pumps have discharge rating of 475 m3/hr and are used for supplying water from Girna pumping station to DSP Chowk ESR through MS water pipe line of 273.7 mm & 50 HP pumps are used for feeding water from Girna pumping station to Collector quarter ESR through MS water pipe line of 206.8 mm.
At new Girna pumping station 2 x 75 HP (1 working+1 standby) centrifugal pumps are installed. These pumps having rating of 375 m3/hr and are used for supplying water from Girna pumping station to Girna tank ESR through MS water pipe line of 273.7mm.Overall sump capacity of Girna pumping station GSR no. 1 is 4.5 ML, GSR no. 2 is 1.125 ML & GSR no. 3 is 3.5 ML.

At Girna, 1 x 250 KVA (11 /0.433 KV) & 1 x 200 KVA (11/0.433 KV) transformers are provided for electrical supply. 1 x 200 KVA (11/0.433 KV) transformer is not in working condition.

APFC Panel of 200 Kvar (20 Kvar x 10) is provided for automatic power factor correction at Girna pumping station. Out of these 10 units, 5 unit of 20 Kvar were not working.

Jalgoan Municipal Corporation															
Energy Consumption Sheet for Girna Pumping Station, Consumer ID -110019003582															
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges	Energy Charges	TOD Tarff EC	F.A.C.	Other Charges	PF Incentive	PF Penalty	Total Amount	Avg. unit cost
1	Dec-11	37072	232	142	142	0.85	21300	152718	-26.8	13902	7414.4		11718	207026	5.58
2	Jan-12	50346	232	135	135	0.97	20250	207400	1155.9	18879.8	10069.2	-5108.87		252646	5.02
3	Feb-12	38298	232	118	118	1.00	17700	157769	-784.6	15778.8	5285.2	-13702.36		182046	4.75
4	Mar-12	46218	232	128	128	0.99	19200	190395	652.3	19041.8		-11399.23		217890	4.71
5	Apr-12	52426	232	123	123	1.00	18450	215969	-1370.4	21599.5		-17825.36		236823	4.52
6	May-12	41744	232	124	124	1.00	18600	171948	-2016.1	17196.9		-14401.01		191328	4.58
7	Jun-12	45150	232	121	121	0.99	18150	186004	-1493	18602		-11063.14		210200	4.66
8	Jul-12	46628	232	129	129	0.98	19350	192092	-1100	34981.8		-7359.74		237965	5.10
9	Aug-12	43934	232	129	129	0.97	19350	180986	-4	32414.5		-6982.41		225765	5.14
10	Sep-12	43390	232	128	128	0.99	24320	205235	-1788	33353.9		-18278.44		242842	5.60
11	Oct-12	39102	232	131	131	0.99	24890	184952	-3769	26577.6		-11632.55		221019	5.65
12	Nov-12	42160	232	129	129	0.99	24510	199417	-3912.8	38917.9		-12946.6		245985	5.83
Total		**526468**					**246070**	**2244885**	**-14456**	**291247**	**22769**	**-130700**	**11718**	**2671533**	

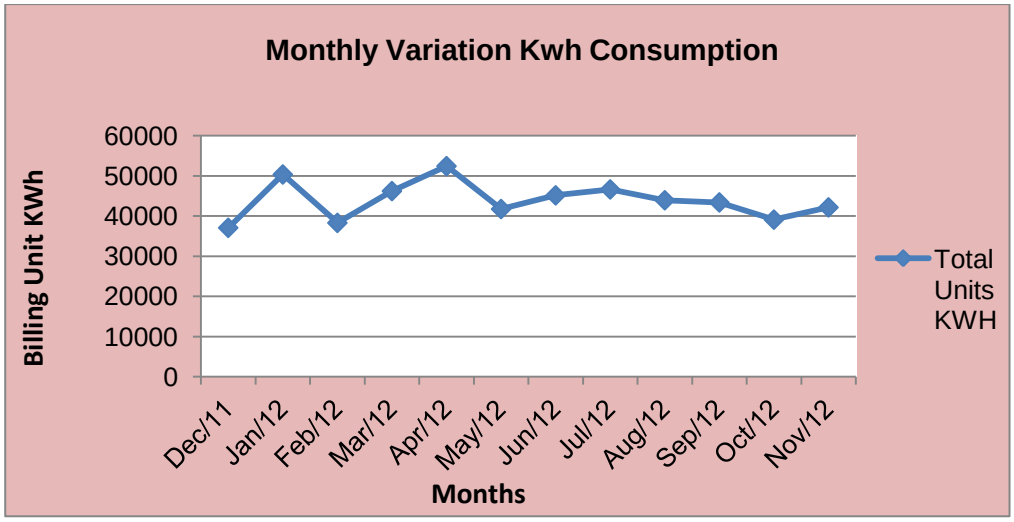
- Contract Demand is 232 KVA but highest maximum demand was 142kva, far less than contract demand
- Average cost of electricity units is Rs. 4.64 per KWh.
- Average power factor is 0.97 and PF incentive of Rs. 1,30,700 has been received

6.2.1 Pumping Hours:-

These pumps are operating for 17 hours per day (approx as per billing units).

6.2.2 Monthly Energy Consumption (kWh):-

The graph below shows the monthly energy consumption of Girna pumping station. Maximum energy consumption was in the month of Apr-12.



Measuring and recording of energy consumption is useful in comparing energy consumption to a measured output i.e. water discharged and setting a benchmark to control energy consumption. Monitoring energy consumption to the set target on a regular basis may results in to reduction in kWh/ML

6.2.3 Pump Efficiency:-

Field test for pump efficiency has been carried out on 02/02/2013. Field measurement sheets are given in Annexure. Results of field test are tabulated as following:

Sr.No	Name of Pumping Station	Motor Rated Power KW	Overall Pump & Motor Combined Efficiency %
1	Pump-1 Girna Pumping Station New	55	69.99
2	Pump-2 Girna Pumping Station New	55	68.17
3	Pump-1 Girna Pumping Station Old	37	38.82
4	Pump-2 Girna Pumping Station Old	60	80.75

Following table shows overall efficiency of pumps & motors at Girna pumping station

	Pump & Motor Efficiency												
Sr.No	**Pumping Station Location**	**Motor Rated Power kW**	**Type of Pump**	**Rated Flow m3/h**	**Actual Flow m3/h**	**Flow m3/s**	**Total Head (M)**	**Rated Head (M)**	**Motor Rated Efficiency%**	**Hydraulic Power, ph (KW) Qxhxpxg /1000**	**Measured KW**	**Overall Pump + Motor Combined Efficiency%**	**Pump Efficiency % (Hydraulic Power, ph/Power input to the pump shaft)*100**
1	Pump-1 Girna Pumping Station New	55	Centrifugal Pump	375	417.2	0.116	21.27	25	94	24.08	34.41	69.99	74.46
2	Pump-2 Girna Pumping Station New	55	Centrifugal Pump	375	446.7	0.124	19.94	25	94	24.18	35.46	68.17	72.52
3	Pump-1 Girna Pumping Station Old	37	Centrifugal Pump	-	129.8	0.036	33.95	-	92	11.96	30.81	38.82	42.20
4	Pump-2 Girna Pumping Station Old	60	Centrifugal Pump	475	459.1	0.128	29.81	26	94	37.14	46.00	80.75	85.90

Observations:-

- At Girna new pumping station, for pumps no.1 & 2, 75 HP rated head is 25 meter and operating head at the time of measurements are found to be 21.27 & 19.94 meter. Combined pump & motor efficiency observed for pump set no. 1 is 69.99%, pump no.2 is 68.17%.
- At Girna old pumping station, for pumps no. 2, 80 HP, rated head is 26 meter and operating head at the time of measurements are found to be 29.81 meter. Combined pump & motor efficiency observed for pump set no. 2, 80 HP is 80.75%.
- Average power factor is 0.98 which is good,
- Voltage is found on higher side.
- Electrical installation is unsafe and not systematic.
- There is no recording and monitoring of flow & energy parameters.

6.2.4 The Energy Saving Potential for Girna Pumping Station:-

The energy conservation potential for Girna pumping station is given as under:

Pump Replacement -: For Pump no. 1, 50 HP, Old pump house

Improvement in existing pumping system efficiency can be achieved by providing better efficient pump with pump parameter as per system requirement in place of existing ageing pumps, so that pumping machinery can operate at its best efficiency point.

Estimated energy saving potential by improvement in pump efficiency as given below:-

Pump efficiency and Saving of Girna Pumping Station																		
Sr.No	Pumping Station Location	Motor Rated Power kW	Type of Pump	Rated Flow m3/h	Actual Flow m3/h	Flow m3/s	Total Head (M)	Rated Head (M)	Hydraulic Power, ph (KW) Qxhxpxg /1000	Measured KW	Overall Pump + Motor Combined Efficiency %	Pump Efficiency % (Hydraulic Power, ph/Power input to the pump shaft)*100	Running Hour Per Day	kW for 70 % Combined Efficiency	Present Annual Consump'n	Proposed Annual Consump'n	Total Saving in kWh for combined efficiency of 70%	Avg Unit Rate in Rs.	Annual Saving after by Replacement (Rs.)
1	Pump-1 Girna Pumping Station Old	37	Centrifugal Pump		129.8	0.036	33.95		11.96	30.81	38.82	42.20	8.5	17.1	95576	53010	42566	5.07	215810
															95576	**53010**	**42566**		**215810**
70 % combined efficiency is considerd by replacement with energy efficient pump																			

Thus, Estimated Annual Energy Saving Potential (Rs.) = 2, 15,810 /-

6.2.5 Online Monitoring System :-

Effective control and real time monitoring system required for operating the pumping system at prescribed efficiency level.

Measuring and recording of energy consumption useful in comparing energy consumption to a measured output i.e. water discharged and setting a benchmark to control energy consumption.

- Recording: - Measuring and recording energy consumption
- Analyzing: - Correlating energy consumption to an appropriate standard or benchmark.
- Comparing: - Comparing energy consumption to an appropriate standard or benchmark
- Setting Targets: - Setting targets to reduce or control energy consumption
- Monitoring: - Comparing energy consumption to the set target on a regular basis.
- Reporting: - Reporting the results including any variances from the target which have been set
- Controlling: - Implementing management measures to correct any variances, which may have occurred.

6.2.6 Action Plan & Investment Summary:-

Energy saving potential action plan for Girna Pumping station shall be achieved while implementing following efficiency improvement actions as tabulated below:

Action Plan Summary											
Sr. No	Pump No	Pump Rating Details			Pump Field Testing Details			Combined Efficiency (%)	Mechanical Action Plan		
		Flow (LPS)	Head (m)	Motor kW	Flow (LPS)	Head (m)	Kwh		Energy monitoring	Pump+ Motor Replacement	Overhauling & Polymer Coating of Pumps
Girana Pumping Station											
1	Pump-1 Girna Pumping Station New	104.16	25	55	115.88	21.27	34.41	69.99	✔	x	x
2	Pump-2 Girna Pumping Station New	104.16	25	55	124.08	19.94	35.46	68.17	✔	x	x
3	Pump-1 Girna Pumping Station Old			37	36.05	33.95	30.81	38.82	✔	✔	x
4	Pump-2 Girna Pumping Station Old	131.94	26	60	127.53	29.81	46.00	80.75	✔	x	x

As old pumping station pump no. 1, 50 HP pump set is operating at low efficiency i.e. 38.80% & the pump is quite old. It is advisable to replace the old pump and motor for assured increased efficiency as per system requirement in place of existing ageing pumps, so that pumping machinery can operate at its best efficiency point.

Investment details and payback calculations are tabulated as under:-

Girna Pumping Station					
Investment Summary					
Action Plan		**Investment**	**Saving**		**Payback**
Description		In Rs. Lakhs	In kwh	In Rs. Lakhs	Months
Girna Pumping Station					
1	a) Energy Monitoring New Pumping Station 75 HP Pump no. 1	0.125	-	-	-
2	b) Energy Monitoring New Pumping Station 75 HP Pump no. 2	0.125	-	-	-
3	c) Pump + Motor replacement for Old Pumping Station 50 HP Pump no. 1	6.04	42566	2.16	33.61
4	d) Energy Monitoring Old Pumping Station 80 HP Pump no. 2	0.125	-	-	-
Note :- 1) Payback period calculation is based on achieving the combined efficiency of 70 %					
2) Investment cost given above is approximate estimated cost and may differ at the time of tendering.					

6.2.7 Conclusion

It is advisable to replace existing raw water 50 Pump no.1, having low efficiency by high efficiency pump & motor as per system requirement in place of existing ageing pumps, so that pumping machinery can operate at its best efficiency point.

6.3 DSP Chowk Booster Pumping Station

At DSP Chowk, 75 HP booster pump is installed. Water is supplied from DSP booster pump tapping point to Nityanand ESR area distribution directly. The pump used at DSP Chowk booster pumping station are horizontal centrifugal type with discharge rating of 382 m3/hr.

Jalgoan Municipal Corporation															
Energy Consumption Sheet for DSP Chowk, Consumer ID -110019004910															
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges	Energy Charges	TOD Tarff EC	F.A.C.	Other Charges	PF Incentive	Electricity Duty	Total Amount	Avg. unit cost
1	Apr-11	9902	120	60	57	0.982	9000	37628	2818.8	3366.68	0	-1584	4753	55982	5.65
2	May-11	11178	120	60	53	0.997	9000	42476	3706	3514.36		-4109	5383	59971	5.37
3	Jun-11	13250	120	60	53	0.997	9000	50350	4161.7	4037.28		-4728	6079	68900	5.20
4	Jul-11	12426	120	60	54	0.990	9000	47219	4726.5	4583.95		-3276	5898	68150	5.48
5	Aug-11	9340	120	60	54	0.993	9000	35492	3732.9	3296.09		-2598	430	49353	5.28
6	Sep-11	11176	120	60	53	0.997	9000	42324	5223.7	4246.88	2236	-1412		61618	5.51
7	Oct-11	9854	120	60	53	0.999	9000	36953	3914.7	3744.52	1971	-3891		51692	5.25
8	Nov-11	10944	120	60	53	0.997	9000	42536	4719	4158.72	2189	-4382		58220	5.32
9	Dec-11	10398	120	60	57	0.996	9000	42835	2188	3899.25	2080	-4200		55801	5.37
10	Jan-12	10270	120	60	53	0.998	9000	42307	3365.8	3851.25	2054	-4240		56338	5.49
11	Feb-12	9664	120	60	53	1.000	9000	39811	2390.6	3981.57	1353	-3958		52579	5.44
12	Mar-12	11424	120	60	54	1.000	9000	47061	3903.2	4706.69		-4527		60144	5.26
Total		129826					108000	506991	44850	47387	11882	-42906	22543	698747	

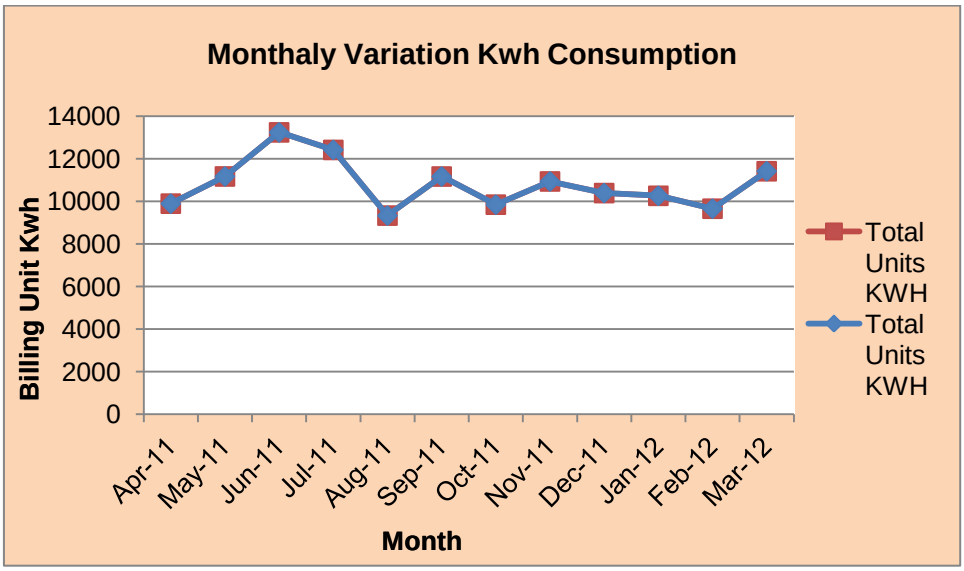
- Contract Demand is 120KVA but maximum demand was 57Kva, far less than contract demand.
- Average cost of electricity units is Rs. 5.39 per KWh.
- Average power factor is 1 and incentive of Rs.42, 906 has been received.

6.3.1. Pumping Hours:-

These pumps are operating for 8 hours per day (approx as per billing units).

6.3.2. Monthly Energy Consumption (kWh):-

The graph below shows the monthly energy consumption of DSP chowk pumping station. Maximum energy consumption was in the month of June-11.



Measuring and recording of energy consumption is useful in comparing energy consumption to a measured output i.e. water discharged and setting a benchmark to control energy consumption. Monitoring energy consumption to the set target on a regular basis may results in to reduction in kWh/ML

6.3.3. Pump Efficiency:-

Field test for pump efficiency has been carried out on 31/01/2013. Field measurement sheets are given in Annexure. Results of field test are tabulated as following:

Sr.No	Name of Pumping Station	Motor Rated Power KW	Overall Pump & Motor Combined Efficiency %
1	DSP Chowk Booster Pumping Station	55	68.76

Following table shows overall efficiency of pumps & motors at DSP chowk booster pumping station

Pump & Motor Efficiency													
Sr.No	Pumping Station Location	Motor Rated Power kW	Type of Pump	Rated Flow m3/h	Actual Flow m3/h	Flow m3/s	Total Head (M)	Rated Head (M)	Motor Rated Efficiency %	Hydraulic Power, ph (KW) Qxhxpxg /1000	Measured KW	Overall Pump + Motor Combined Efficiency%	Pump Efficiency % (Hydraulic Power, ph/Power input to the pump shaft)*100
1	DSP Chowk Booster Pumping	55	Centrifugal Pump	382	386.6	0.107	28.18	34	91	29.57	43.00	68.76	75.56

Observations:-

- At DSP Chowk booster pumping station, for pumps no.1, 75 HP rated head is 34 meter and operating head at the time of measurements are found to be 28.18 meter. Combined pump & motor efficiency observed for pump set no. 1 is 68.76%.
- Average power factor is 1, which is good.
- Electrical installation is unsafe and not systematic.
- There is no recording and monitoring of flow & energy parameters.
- Pump & motors are operating combined efficiency of 68.76%, which is satisfactory.

6.3.4 Online Monitoring System :-

Effective control and real time monitoring system required for operating the pumping system at prescribed efficiency level.

Measuring and recording of energy consumption useful in comparing energy consumption to a measured output i.e. water discharged and setting a benchmark to control energy consumption.

- Recording: - Measuring and recording energy consumption
- Analyzing: - Correlating energy consumption to an appropriate standard or benchmark.
- Comparing: - Comparing energy consumption to an appropriate standard or benchmark
- Setting Targets: - Setting targets to reduce or control energy consumption
- Monitoring: - Comparing energy consumption to the set target on a regular basis.
- Reporting: - Reporting the results including any variances from the target which have been set
- Controlling: - Implementing management measures to correct any variances, which may have occurred.

6.3.5 Action Plan & Investment Summary:-

Energy saving potential action plan for DSP Chowk booster pumping shall be achieved while implementing following efficiency improvement actions as tabulated below:

Action Plan Summary											
Sr. No	Pump No	Pump Rating Details			Pump Field Testing			Combined Efficiency (%)	Mechanical Action Plan		
		Flow (LPS)	Head (m)	Motor kW	Flow (LPS)	Head (m)	Kwh		Energy monitoring	Pump+ Motor Replacement	Overhauling of Pump
DSP Chowk Booster Pumping											
1	DSP Chowk Booster Pumping	106.11	34.0	55.0	107.39	28.18	43.00	68.76	✔	x	x

As pump & motors are operating combined efficiency of 68.76%, which is satisfactory, it is advisable to carrying out the energy monitoring only.

6.4 Raymond Chowk Booster Pumping Station

There was no arrangement to fix pressure guage hence pressure measurement was not possible, hence pump efficiency is not calculated.

7. ELECTRICAL EFFICIENCY

7.1 DEMAND & POWER FACTOR

Electricity is normally the most expensive form of energy purchased. Electric power generation requires major capital investment and considerable operating expense. Because of this, electric utility companies have developed rate schedules that try to give them a fair rate of return for their money invested.

Customers are normally billed according to these charges based on maximum demand, power factor and energy consumption. Recently some of the utilities have introduced rate schedule for reactive energy consumption based on maximum demand power factor, and energy consumption. Customers may also be charged a flat rate fee per meter.

An in-depth understanding of the electricity charge levy system is necessary for proper energy management. The electricity bills are dependent on three factors viz :

- ★ Unit Consumption (kWh)
- ★ Maximum demand (MD)
- ★ Power Factor (PF)

A vast majority of electrical loads in industrial and utility installations are inductive in nature. Typical examples are motors, transformers, drive etc. Such load consumes both active and reactive power. The active power is used by the load to meet its real output requirement where as reactive power is used by the load to meet its magnetic field requirement. The reactive power (inductive) is always 90 degrees lagging with respect to active power.

Active Power and Reactive Power

The supply of reactive power from the system results in reduced installation efficiency due to

- ❖ Increases current flow for a given load.
- ❖ Higher voltage drops in the system.
- ❖ Increases in losses of transformer switchgear and cables.
- ❖ Higher KVA demand from the supply system.
- ❖ Levy of penalties by the electricity supply authorities.

It is therefore necessary to reduce and manage the flow of reactive power to achieve higher efficiency of the electrical system and reduction in cost of electricity consumed.

The most cost effective method of reducing and managing reactive power is by power factor improvement through power capacitors. As power factor tends to unity the electrical efficiency will improve.

The benefits can be summarized as follows.

- Saving in KVA (demand) charges.
- Release of system capacity by which additional loads can be easily added.
- Reduction in current drawn.
- Improved voltage regulation.
- Increased life of switchgear/cables due to reduced operating temperatures.

Formula for the improvement of power factor, from existing PF to desired PF (i.e. unity PF), for a given Load, is given as under:

KVAr Required = kW X (Tan θ_1 -Tan θ_2)

Where Tan θ_1 is the trigonometric ratio for the present power factor, and Tan θ_2 is the trigonometric ratio for desired power factor

θ_1 Existing ($Cos^{-1}PF_1$)

θ_2 Improved ($Cos^{-1}PF_2$)

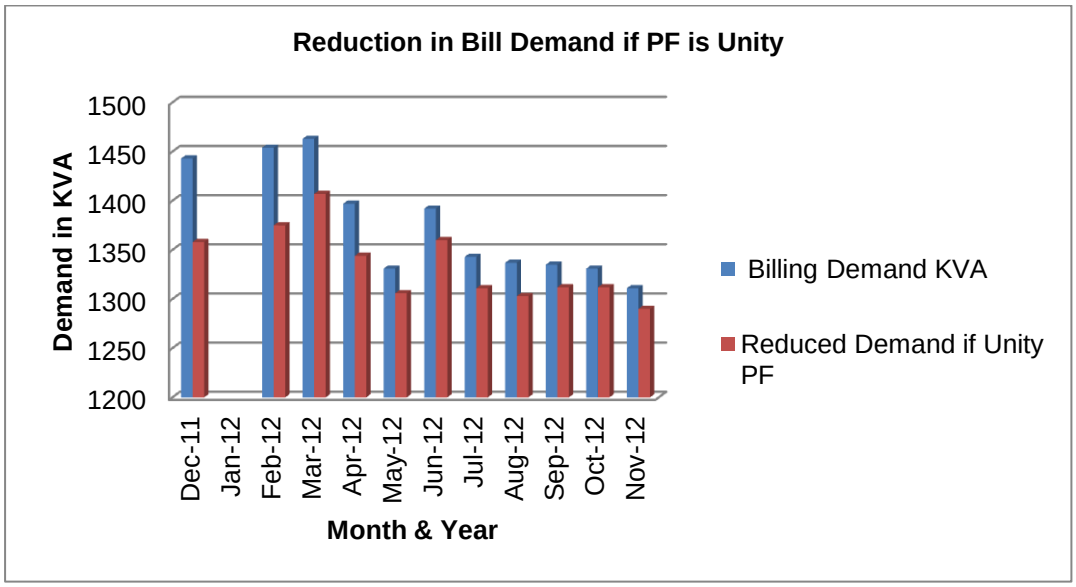
Contract MD is the agreement demand that the municipal council opted for its pumping station while applying for connection. The maximum demand charge is based on the highest sustained consumption rate over a given period. Usually, the time period is 15 - 30 minutes. The demand is normally measured in terms of kilovolt amperes (KVA). The charge is usually a cost per unit of demand.

7.1.1 Waghur Raw Water Pumping Station

Saving potential due to maintaining unity power factor is tabulated as under. There will be two saving; one saving on account of Pf incentive, second saving will be due to reduction in demand and demand charges.

Energy Consumption Sheet for Waghur Raw Water, Consumer ID -110019004480																	
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges in Rs.	Energy Charges in Rs.	TOD Tarff EC in Rs.	F.A.C. in Rs.	Other Charges in Rs	PF Incentive in Rs.	Total Amount in Rs.	Avg. Unit Cost in Rs.	Reduced Demand if Unity PF	Reduction in Billing Demand (kVA) if Unity Pf	Additional PF Incentive for Unity PF in Rs.
1	Dec-11	558750	1444	1430	1443	0.94	214500	2399887	-14945	218471	111750		2929664	5.24	1357.52	72.48	197539
2	Feb-12	790380	1444	1431	1454	0.94	214650	3394761	-27404	339468	105911		4027387	5.10	1375.17	55.83	275835
3	Mar-12	768720	1444	1447	1463	0.96	217050	3301729	-13118	330165		-38358	3797469	4.94	1407.18	39.82	230578
4	Apr-12	891450	1444	1395	1397	0.96	209250	3828867	-8341.5	382878		-44127	4368527	4.90	1343.70	51.30	264798
5	May-12	855420	1444	1331	1331	0.98	199650	3674114	-8686.5	367403		-126974	4105506	4.80	1305.61	25.39	169494
6	Jun-12	868800	1444	1392	1392	0.97	208800	3731583	-4981.5	373150		-86171	4222380	4.86	1359.86	32.14	215436
7	Jul-12	796800	1444	1343	1343	0.97	201450	3422336	-3522	623177		-84869	4158572	5.22	1310.64	32.36	212105
8	Aug-12	924210	1444	1337	1337	0.97	200550	3969574	-3597	710902		-97549	4779881	5.17	1303.44	33.56	243800
9	Sep-12	853470	1444	1328	1335	0.98	252320	4310024	-51333	733131		-157324	5086817	5.96	1312.21	15.79	211699
10	Oct-12	856530	1444	1329	1331	0.98	252510	4325477	-68082	606338		-153487	4962755	5.79	1312.29	16.71	207246
11	Nov-12	859620	1444	1309	1311	0.98	248710	4341081	-52782	811137		-160444	5187702	6.03	1289.94	19.06	215892
Total		**9024150**					**2419440**	**40699433**	**-256791**	**5496220**	**217661**	**-949304**	**47626660**			**394.44**	**2444423**
Estimated Annual		**9844527**					**2639389**	**44399381**	**-280136**	**5995877**	**237448**	**-1035604**	**51956356**				
Average		**820377**				**0.97**		**3699948**					**4329696**	**5.27**			
Total Reduction in KVA demand if PF is Achieved to unity															**394.4**		
Saving due to reduction in demand in Rs.															**74943**		
Additional PF Incentive for unity PF															**2444423**		
Estimated total saving in energy bill on account of improvement in power factor to unity Rs.															**2,519,366**		
Total Annual saving due to Unity Power Factor															**2748399**		

As per details in above table the average power factor observed for the pumping station is 0.97 which is good but pumping station can earn incentives in total energy bill(maximum up to 7%) while maintaining P.F. to unity. Total saving potential due to additional Incentive and Reduction in Demand charges is **Rs. 2748399/-**



It is imperative to maintain PF always above 0.90 to avoid unnecessary and high surcharge. The PF can be optimum improved by using correct rated capacitors and their proper operation.

The calculations to arrive at the correct KVAr rating of the capacitor are given as under:

Additional Capacitor(KVAr) required for Improving Power Factor							
Sr. No.	Pumping Locations	Actual P.F.		Target P.F.		Maximum Demand in kW	kVAr Required
1	Waghur Raw Water Pumping	Cos θ1	Tan θ1	Cos θ2	Tan θ2		
		0.8	0.75	0.996	0.089	1329	878

*Considering 0.8 power factor without any capacitors

720 kVAr capacitors are already installed. Capacitors should be made on according to load. Excess capacitor may lead to leading power factors and over voltage which is not desirable.

For improvement of power factor to unity in automatic mode it is suggested to install automatic power factor controller panel with 115 Kvar capacitor rating for each 3000 KVA transformer.

Details of Capacitors

The ALL Polypropylene capacitors are designed for super heavy duty application. These capacitors are impregnated with Non PCB type oil for superior performance. The capacitors come with a steel enclosure and have an internal fuse for over pressure disconnection. These capacitors have a high peak inrush current withstand capacity hence these capacitor are considered.

Investment details for power factor improvement are as under:

Details and Investment for Capacitor				
Description	Proposed Qty. (set)	Total Investment (Rs)	Estimated saving/Annum (Rs.)	Pay Back (Month)
Supplying & erecting 115 Kvar APFC panel for 3000 KVA Transformer	2	1046505	2748399	
Supplying & erecting 25 Kvar APFC panel for 160 KVA Transformer	1	73680		
Total		**1120185**	**2748399**	**4.89**

7.1.2 Umale WTP

Saving potential due to maintaining unity power factor is tabulated as under. There will be saving; on account of additional Pf incentive.

Energy Consumption Sheet for Umale WTP, Consumer ID -110019004680																
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges in Rs.	Energy Charges in Rs.	TOD Tarff EC in Rs.	F.A.C. in Rs.	Other Charges in Rs	PF Incentive in Rs.	Total Amount in Rs.	Avg. Unit Cost in Rs.	Reduced Demand if Unity PF Achived in KVA	Additional PF Incentive for Unity PF in Rs.
1	Dec-11	18954	125	63	58	0.98	9450	81409	-528	7411	3790.8	-3046	98487	5.20	56.95	3931
2	Jan-12	28131	125	63	61	0.98	9450	120825	-924	10999	5626.2	-7299	138678	4.93	60.08	2825
3	Feb-12	23220	125	63	54	0.99	9450	99732	-725	9973	3111.4	-6077	115464	4.97	53.78	2383
4	Mar-12	21522	125	63	57	0.99	9450	92439	-450	9244		-5534	105149	4.89	56.83	2223
5	Apr-12	25614	125	63	54	0.99	9450	110015	-679	11001		-6489	123297	4.81	53.89	2609
6	May-12	24858	125	63	60	0.98	9450	106768	-924	10677		-3779	122191	4.92	59.28	5076
7	Jun-12	25791	125	63	67	0.98	9450	110775	-389	11077		-3945	126968	4.92	66.13	5252
8	Jul-12	22212	125	63	61	0.98	9450	95403	395	17372		-3679	118941	5.35	60.14	4889
9	Aug-12	24858	125	63	62	0.99	9450	106768	29	19120		-6768	128598	5.17	61.50	2707
10	Sep-12	24165	125	63	60	1.00	11970	122033	-1260	20758		-10745	142756	5.91	59.94	
11	Oct-12	22998	125	63	48	1.00	11970	116140	-1224	16280		-10022	133144	5.79	48.05	
12	Nov-12	23619	125	63	59	0.99	11970	119276	-1265	22287		-7613	144655	6.12	58.88	3071
Total		**285942**					**120960**	**1281583**	**-7945**	**166199**	**12528**	**-74997**	**1498328**			**34966**
Average		**23829**				**0.99**		**106799**					**124861**	**5.24**		
Additional PF Incentive for unity PF in Rs.															**34966**	
Estimated Annual Saving Potential by Improvement in Power Factor to Unity in Rs.															**34966**	

As per details in above table the average power factor observed for the pumping station is 0.99 which is good but pumping station can earn incentives in total energy bill(maximum up to 7%) while maintaining P.F. to unity. Total saving potential due to additional incentive is Rs. 34,966/-

It is imperative to maintain PF always above 0.90 to avoid unnecessary and high surcharge. The PF can be optimum improved by using correct rated capacitors and their proper operation.

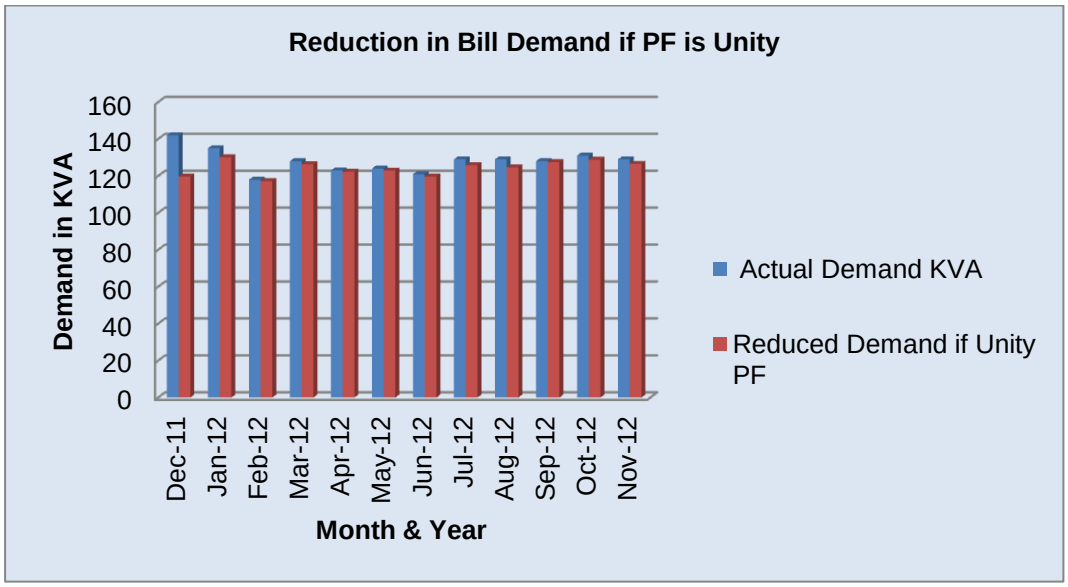
As the average power factor is 0.99 & power factor is found 1 in two month hence additional capacitors are not required.

7.1.3 Girna Pumping Station

Saving potential due to maintaining unity power factor is tabulated as under. There will be three saving; one saving on account of elimination of PF penalty, second saving will be additional Pf incentive, third saving will be due to reduction in demand and demand charges.

Energy Consumption Sheet for Girna Pumping Station, Consumer ID -110019003582																			
Sr. No.	Month	Total Units KWH	Contract Demand KVA	Billing Demand KVA	Actual Demand KVA	PF	Demand Charges in Rs.	Energy Charges in Rs.	TOD Tarff EC in Rs.	F.A.C. in Rs.	Other Charges in Rs.	PF Incentive in Rs.	PF Penalty in Rs.	Total Amount in Rs.	Avg. Unit Cost in Rs.	Saving in P.F. Penalty in RS.	Reduced Demand if Unity PF Achived in KVA	Reduction in Billing Demand (kVA) if Unity Pf Achived	Additional PF Incentive for Unity PF in Rs.
1	Dec-11	37072	232	142	142	0.85	21300	152718	-26.8	13902	7414.4		11718	207026	5.58	11718	120.61	21.39	12930
2	Jan-12	50346	232	135	135	0.97	20250	207400	1155.9	18880	10069.2	-5109		252646	5.02		131.20	3.80	12298
3	Feb-12	38298	232	118	118	1.00	17700	157769	-784.6	15779	5285.2	-13702		182046	4.75		118.17		
4	Mar-12	46218	232	128	128	0.99	19200	190395	652.3	19042		-11399		217890	4.71		127.36	0.64	4571
5	Apr-12	52426	232	123	123	1.00	18450	215969	-1370.4	21600		-17825		236823	4.52		123.25		
6	May-12	41744	232	124	124	1.00	18600	171948	-2016.1	17197		-14401		191328	4.58		123.88	0.12	
7	Jun-12	45150	232	121	121	0.99	18150	186004	-1493	18602		-11063		210200	4.66		120.64	0.36	4454
8	Jul-12	46628	232	129	129	0.98	19350	192092	-1100	34982		-7360		237965	5.10		126.80	2.20	9844
9	Aug-12	43934	232	129	129	0.97	19350	180986	-4	32415		-6982		225765	5.14		125.63	3.37	9290
10	Sep-12	43390	232	128	128	1.00	24320	205235	-1788	33354		-18278		242842	5.60		128.51		
11	Oct-12	39102	232	131	131	0.99	24890	184952	-3769	26578		-11633		221019	5.65		129.82	1.18	4724
12	Nov-12	42160	232	129	129	0.99	24510	199417	-3912.8	38918		-12947		245985	5.83		127.58	1.42	5251
Total		**526468**					**246070**	**2244885**	**-14456**	**291247**	**22769**	**-130700**	**11718**	**2671533**		**11718**		**34.49**	**63362**
Average		**43872**				**0.98**		**187074**						**222628**	**5.07**				
Total Saving in Power Factor Penalty if PF is achieved to unity in Rs.																**11,718**			
Total Reduction in Billing Demand Due to Unity Power Factor in KVA																**34.5**			
Saving due to Reduction in Demand in Rs.																**6553**			
Additional PF Incentive for unity PF in Rs.																**63362**			
Estimated Annual Saving Potential by Improvement in Power Factor to Unity in Rs.																**81,633**			

As per details in above table the average power factor observed for the pumping station is 0.98 which is good but pumping station can earn incentives in total energy bill(maximum up to 7%) while maintaining P.F. to unity. Total saving potential due to PF penalty, additional incentive and reduction in demand charges is **Rs. 81,633/-**



It is imperative to maintain PF always above 0.90 to avoid unnecessary and high surcharge. The PF can be optimum improved by using correct rated capacitors and their proper operation.

The calculations to arrive at the correct KVAr rating of the capacitor are given as under:

Additional Capacitor(KVAr) required for Improving Power Factor							
Sr. No.	Pumping Locations	Actual P.F.		Target P.F.		Maximum Demand in kW	kVAr Required
1	Girna Raw Water Pumping	Cos θ1	Tan θ1	Cos θ2	Tan θ2		
		0.8	0.75	0.996	0.089	124.79	82

*Considering 0.8 power factor without any capacitors

APFC Panel of 200 Kvar (20 Kvar x 10) is already installed for automatic power factor correction at Girna pumping station. Out of these 10 unit, 5 unit of 20 Kvar was not working.

As the average power factor is 0.99 & power factor is found 1 in two month hence additional capacitors are not required.

7.2 TIME OF DAY (TOD) TARIFF

Time of Day (TOD) tariff, is recognized globally across electricity supplier utilities, as an important. Demand Side Management (DSM) measure which is used as a means of incentivizing consumers to shift a portion of their loads from peak times to off-peak times, thereby improving the system load factor by reducing the demand on the system during peak period.

The TOD tariffs send price signals to consumers that reflect the underlying cost of generating, transmitting and supplying electricity, and enables resources to be allocated more judiciously and efficiently. Further price based demand response can reduce or shape consumer demand particularly to reduce load at peak hours on the electricity system. Hence, TOD tariff assumes importance in the context of propagating and implementing DSM and achieving energy efficiency in the country.

Electrical utilities (MAHADISCOM) like to have flat demand curve to achieve high plant efficiency. They encourage user to draw more power during off-peak hours (say during night time) and less power during peak hours. As per their plan, they offer TOD Tariff, which may be incentives or disincentives. Energy meter will record peak and non-peak consumption separately by timer control. TOD tariff gives opportunity for the municipal council to reduce their billing, as off peak hour tariff charged are quite low in comparison to peak hour tariff.

S. N.	Consumer category & Consumption Slab	Tariffs	
		Fixed / Demand Charge	Energy Charge (Rs/kWh)
1	**HT IV – Public Water Works & Sewage Treatment Plants**		
A	Express Feeders	Rs 190 per kva per month	5.05
B	Non-express Feeders		4.73
2	**TOD Tariffs (in addition to above base tariffs) for HT I, HT II and HT IV categories**		
	0600 hours to 0900 hours		0.00
	0900 hours to 1200 hours		0.80
	1200 hours to 1800 hours		0.00
	1800 hours to 2200 hours		1.10
	2200 hours to 0600 hours		-1

The operating kWh consumption during different zones of TOD for the Water Pumping Station is as follows:

7.2.1. Waghur Raw Water Pumping Station

Unit consumption summary in different slots of TOD tariff at Waghur raw water pumping station is tabulated as under

TOD Summary of Waghur Raw Water Jalgaon Muniipal Corporation, Consumer ID -110019004480										
Sr No.	Month	No of Days in Month	Monthly Consumption (A) Zone	Average Power Cons/Hrs.	Monthly Consumption (B) Zone	Average Power Cons/Hrs.	Monthly Consumption (C) Zone	Average Power Cons/Hrs.	Monthly Consumption (D) Zone	Average Power Cons/Hrs.
			22 TO 6		6 TO 9 & 12 TO 18		9 TO 12		18 TO 22	
1	Dec-11	31	183330	739	225390	808	80490	865	69540	561
2	Feb-12	28	272730	1218	304080	1207	101700	1211	111870	999
3	Mar-12	31	254490	1026	301890	1082	101250	1089	111090	896
4	Apr-12	30	295770	1232	344580	1276	110490	1228	140610	1172
5	May-12	31	293550	1184	314730	1128	103410	1112	143730	1159
6	Jun-12	30	293730	1224	323130	1197	108150	1202	143790	1198
7	Jul-12	31	265680	1071	301950	1082	99270	1067	129900	1048
8	Aug-12	31	309840	1249	347070	1244	114210	1228	153090	1235
9	Sep-12	30	284760	1187	327270	1212	107190	1191	134250	1119
10	Oct-12	31	283470	1143	344820	1236	118920	1279	109320	882
11	Nov-12	30	286320	1193	330000	1222	113640	1263	129660	1081
Total			**3023670**		**3464910**		**1158720**		**1376850**	
Average			**274879**	**1133**	**314992**	**1154**	**105338**	**1158**	**125168**	**1032**

Details of Utilization of TOD Tariff at Raw Water Waghur					
Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	1133.28	-1	I	III
B	0600 hr to 0900 & 1200 hr to 1800 hr	1154.01	0	II	II
C	0900 hr to 1200 hr	1157.64	0.8	III	I
D	1800 hr to 2200 hr	1031.61	1.1	IV	IV

Above table shows the utilization of power in different time zones of TOD tariff

7.2.2. Water Treatment Plant, Umale

Unit consumption summary in different slots of TOD tariff at WTP Umale is tabulated as under

TOD Summary of WTP Umale Jalgaon Muniipal Corporation , Consumer ID -110019004680										
Sr No.	Month	No of Days in Month	Monthly Consumption (A) Zone	Average Power Cons/Hrs.	Monthly Consumption (B) Zone	Average Power Cons/Hrs.	Monthly Consumption (C) Zone	Average Power Cons/Hrs.	Monthly Consumption (D) Zone	Average Power Cons/Hrs.
			22 TO 6		6 TO 9 & 12 TO 18		9 TO 12		18 TO 22	
1	Dec-11	31	7026	28.33	6411	22.98	2082	22.39	3435	27.70
2	Jan-12	31	10422	42.02	9720	34.84	2844	30.58	5145	41.49
3	Feb-12	28	8529	38.08	8088	32.10	2463	29.32	4140	36.96
4	Mar-12	31	7740	31.21	7599	27.24	2241	24.10	3942	31.79
5	Apr-12	30	9270	38.63	9084	33.64	2619	29.10	4641	38.68
6	May-12	31	9276	37.40	8571	30.72	2505	26.94	4506	36.34
7	Jun-12	30	9360	39.00	8799	32.59	2760	30.67	4872	40.60
8	Jul-12	31	7713	31.10	7515	26.94	2439	26.23	4545	36.65
9	Aug-12	31	8883	35.82	8247	29.56	3072	33.03	4656	37.55
10	Sep-12	30	8622	35.93	8037	29.77	2982	33.13	4524	37.70
11	Oct-12	31	8208	33.10	7686	27.55	2769	29.77	4335	34.96
12	Nov-12	30	8643	36.01	7524	27.87	2730	30.33	4722	39.35
Total			**103692**		**97281**		**31506**		**53463**	
Average			**8641**	**35.55**	**8107**	**29.65**	**2625.5**	**28.80**	**4455.25**	**36.65**

Details of Utilization of TOD Tariff at WTP Umale					
Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	35.55	-1	I	II
B	0600 hr to 0900 & 1200 hr to 1800 hr	29.65	0	II	III
C	0900 hr to 1200 hr	28.80	0.8	III	IV
D	1800 hr to 2200 hr	36.65	1.1	IV	I

Above table shows the utilization of power in different time zones of TOD tariff

7.2.3. Girna pumping Station

Unit consumption summary in different slots of TOD tariff at Girna pumping station is tabulated as under

TOD Summary of Girna Pumping Station, Jalgaon Muniipal Corporation , Consumer ID -110019003582										
Sr No.	Month	No of Days in Month	Monthly Consumption (A) Zone	Average Power Cons/Hrs.	Monthly Consumption (B) Zone	Average Power Cons/Hrs.	Monthly Consumption (C) Zone	Average Power Cons/Hrs.	Monthly Consumption (D) Zone	Average Power Cons/Hrs.
			22 TO 6		6 TO 9 & 12 TO 18		9 TO 12		18 TO 22	
1	Dec-11	31	11120	44.84	16008	57.38	5044	54.24	4900	39.52
2	Jan-12	31	18066	72.85	17388	62.32	7270	78.17	7622	61.47
3	Feb-12	28	13332	59.52	13718	54.44	6084	72.43	5164	46.11
4	Mar-12	31	16462	66.38	15716	56.33	7012	75.40	7028	56.68
5	Apr-12	30	18996	79.15	17890	66.26	7726	85.84	7814	65.12
6	May-12	31	15538	62.65	14358	51.46	6124	65.85	5720	46.13
7	Jun-12	30	16196	67.48	15914	58.94	6910	76.78	6132	51.10
8	Jul-12	31	16616	67.00	16374	58.69	6600	70.97	7040	56.77
9	Aug-12	31	15144	61.06	15200	54.48	6934	74.56	6656	53.68
10	Sep-12	30	14072	58.63	16294	60.35	6808	75.64	6216	51.80
12	Oct-12	31	13478	54.35	15290	54.80	5528	59.44	4806	38.76
12	Nov-12	30	15068	62.78	15458	57.25	5474	60.82	6160	51.33
Total			**184088**		**189608**		**77514**		**75258**	
Average			**15341**	63.06	**15801**	57.72	**6460**	70.85	**6272**	51.54

Details of Utilization of TOD Tariff at Girna ESR					
Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	63.06	-1	**I**	**II**
B	0600 hr to 0900 & 1200 hr to 1800 hr	57.72	0	**II**	**III**
C	0900 hr to 1200 hr	70.85	0.8	**III**	**I**
D	1800 hr to 2200 hr	51.54	1.1	**IV**	**IV**

Above table shows the utilization of power in different time zones of TOD tariff

7.2.4. DSP Chowk Booster Pump

Unit consumption summary in different slots of TOD tariff at DSP Chowk booster pumping station is tabulated as under

TOD Summary of DSP Chowk Booster Pumping Station, Jalgaon Muniipal Corporation , Consumer ID - 110019004910										
Sr No.	Month	No of Days in Month	Monthly Consumption (A) Zone	Average Power Cons/Hrs.	Monthly Consumption (B) Zone	Average Power Cons/Hrs.	Monthly Consumption (C) Zone	Average Power Cons/Hrs.	Monthly Consumption (D) Zone	Average Power Cons/Hrs.
			22 TO 6		6 TO 9 & 12 TO 18		9 TO 12		18 TO 22	
1	Apr-11	30	2068	8.62	3056	11.32	2254	25.04	2514	20.95
2	May-11	31	2188	8.82	3352	12.01	2120	22.80	3518	28.37
3	Jun-11	30	2538	10.58	4254	15.76	2616	29.07	3842	32.02
4	Jul-11	31	1774	7.15	4356	15.61	2304	24.77	3992	32.19
5	Aug-11	31	1318	5.31	2992	10.72	2266	24.37	2764	22.29
6	Sep-11	30	1122	4.68	3506	12.99	3418	37.98	3130	26.08
7	Oct-11	31	1526	6.15	2972	10.65	2266	24.37	3090	24.92
8	Nov-11	30	1280	5.33	3956	14.65	1574	17.49	4134	34.45
9	Dec-11	31	2486	10.02	3644	13.06	1314	14.13	2954	23.82
10	Jan-12	31	1820	7.34	3632	13.02	1290	13.87	3528	28.45
12	Feb-12	28	2132	9.52	3426	13.60	1046	12.45	3060	27.32
12	Mar-12	31	1704	6.87	4430	15.88	1558	16.75	3732	30.10
Total			**21956**		**43576**		**24026**		**40258**	
Average			**1830**	7.53	**3631**	13.27	**2002**	21.92	**3355**	27.58

Details of Utilization of TOD Tariff at DSP Chowk Booster Pumping Station					
Name of Zone	Time	Average unit consumption /hr	Applicable additional Tariff (Rs./unit)	Desired Priority	Actual priority
A	2200 hr to 0600 hr	7.53	-1	**I**	**IV**
B	0600 hr to 0900 & 1200 hr to 1800 hr	13.27	0	**II**	**III**
C	0900 hr to 1200 hr	21.92	0.8	**III**	**II**
D	1800 hr to 2200 hr	27.58	1.1	**IV**	**I**

Above table shows the utilization of power in different time zones of TOD tariff

8 COMPREHENSIVE ACTION & INVESTMENT PLAN SUMMARY

Comprehensive Energy Conservation program is explained in following table:

Comprehensive Energy Saving Action Plan & Investment Plan						
Sr.No	Description of Action Plan	Investment		Annual Savings		Payback Period
		Rating HP	Rs (Lacs)	kWh	Rs (Lacs)	Months
	For Equipment Efficiency Improvement					
1	Waghur Raw Water Pumping Station					
	1.1) Pump Efficiency					
	a) Energy Monitoring for 500 HP pump no.1	500	0.125			
	b) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.2	500	4.86	229857	12.14	4.8
	c) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.3	500	4.86	181548	9.59	6.1
	d) Overhauling, Polymer Coating & Energy Monitoring for 500 HP pump no.4	500	4.86	197864	10.45	5.6
	e) Energy Monitoring for 500 HP pump no.5	500	0.125			
	f) Energy Monitoring for 500 HP pump no.6	500	0.125			
	1.2) Electrical Efficiency					
	a) APFC Panel for P.F. Improvement		11.20		27.48	4.9
2	Girna Pumping Station					
	2.1) Pump Efficiency					
	a) Energy Monitoring New Pumping Station 75 HP Pump no. 1	75	0.125	-	-	-
	b) Energy Monitoring New Pumping Station 75 HP Pump no. 2	75	0.125	-	-	-
	c) Pump + Motor replacement for Old Pumping Station 50 HP Pump no. 1	50	6.044	42566	2.16	33.61
	d) Energy Monitoring Old Pumping Station 80 HP Pump no. 2	80	0.125	-	-	-
3	DSP Chowk Booster Pumping					
	3.1) Pump Efficiency					
	a) Energy Monitoring DSP Chowk Booster Pump 75 HP		0.125	-	-	-
	Total Energy Conservation Program 1+2+3	**Total**	**32.69**	**651835**	**61.81**	**6.35**

Conclusion

Above table prevails the details of total energy conservation /saving action & investment plan for Jalgaon Municipal Corporation including short term and long term investment. Total investment programe for above pumping stations comes out to be Rs. 32.69 lakhs with annual savings 6.52 lakh kWh and 61.81 lakhs Rs. Municipal Corporation may initiate the energy saving programe as discussed above.

9 Lighting Efficiency

9.1 Introduction

Lighting is an essential service in all the building, industries & utilities. Innovation and continuous improvement in the field of lighting has given rise to energy saving opportunities in this area.

In Jalgaon Municipal Corporation, Waghur Raw Water Pumping, Water Treatment Plant at Umale, Girna Pumping Station, Raymond Chowk Booster Pumping & DSP Chowk Booster Pumping, lighting system consists of mainly following type of luminaries

- Fluorescent Tube lighting with copper ballast
- HPSV

List of lighting

Sr. No.	Location	FTL 2 X 40 W	FTL 1 X 40 W	Ceiling fan	Exhaust Fan	Mercury Lamp 1 x 250 W	150 W HPSV
1	Waghur Raw Water Pumping	50		3	6	24	
2	WTP At Umale		30	7	3		28
3	Girna Pumping Station		13	9	3		9
4	DSP Chowk Booster Pumping		2				
5	Raymond Chowk Booster Pumping		2				

9.2 Study of Illumination Systems

The whole lighting system mainly consists of FTL, HPSV. The Luminance levels of different locations are most important in any utilities or building. At Jalgaon Municipal Corporation, lux level is measured with the help of Lux meter. Figures show the Lux level for different tasks

Measurement of Lux Level

Lux measurement							
Sr.No.	Location	Sample No.01	Sample No.02	Sample No.03	Sample No.04	Sample No.05	Average
Waghur Raw Water Pumping							
1	Pump House Raw Water	70	185	135	124	219	202.4
		248	300	175	268	300	
2	Panel Floor	180	133	159	232	194	173.3
		176	184	170	140	165	
3	Store Room 2	220	85	240	245	280	214
4	Office	205	238	195	156	100	178.8
5	Store Room 1	80	85	110	155	128	111.6
6	Street Light Pole	30	28	15	32	24	21.5
		18	19	20	17	12	
WTP At Umale							
1	Assembly point	86	56	20	70	25	35.9
		12	13	11	16	50	
2	Labolatory	70	80	90	105	74	73.3
		60	40	50	100	64	
3	Street Light Pole	30	25	15	6	20	21.4
		35	28	14	30	11	
4	Panel &Blower Room	25	10	40	90	70	47
5	Rapid Sand Filter	20	40	50	102	115	65.4
6	TCL Room	10	11	9	40	4	14.8
7	TCL& Alum Passage	8	16	21	40	50	27
8	Recirculation Room	14	10	3	63	49	27.8
9	Chlorination Room	5	17	30	12	15	15.8
Girna Pumping Station							
1	Pump House No. 1	1.7	1.8	1.5	2	15.5	4.5
2	Pump House No. 2	86.2	14.7	2.1	1	6.6	22.12
3	Pump House No. 3	2	1	2	3.6	6.4	3
4	Street Light Pole	5.2	2.8	35.5	20.4	14.5	17.45
		47.6	13.7	7.6	12.9	14.3	

Standard Illumination Level

Standard Illumination Level		
Sr No	Location	Illumination Level (Lux)
1	Ware House	100 to 200
2	Office Work	200 to 300
3	Computer Room	250 to 300
4	Corridors	60 to 80
5	Waiting Rooms	140 to 160
6	Stairs	90 to 110
7	Toilets	90 to 110
8	Parking	15 to 25
9	Building Room	125 to 175
10	DG Room	125 to 175
11	Electric Panel Room	125 to 175
12	Pump House	100

❒ **Observations:-**

a. Lux level is found low, lux level should be improved by providing additional fittings.
b. Ordinary copper chokes are used for fluorescent tubes.

9.3 Different useful product for Energy efficiency in lighting

T5 FLUORESCENT TUBE LIGHT

The Fluorescent tube lights in use presently in India are of the T12 (40w) and T8 (36W). T12 implies that the tube diameter is 12/8" (33.8mm), T8 implies diameter of 8/8" (26mm) and T5 implies diameter of 5/8" (16mm). This means that the T5 lamp is slimmer than the 36W slim tube light. The advantage of the T5 lamps is that due to its small diameter, luminaries efficiencies can be improved by about 5%. However, these lamps are about 50mm shorter in length than T12 and T8 lamps, which implies that the existing luminaries cannot be used. In addition, T5 lamp can be operated only with electronic ballast. These lamps are available abroad in ratings of 14W, 21W, 28W and 35W. The efficiency of the 35W T5 lamp is about 104 lm/W (lamp only) and 95 lm/W (with electronic ballasts), while that of the 36W T8 lamp is about 100 lm/W (lamp only) and 89 lm/W (with electronic ballast). This may appear to be a small improvement of about 7%, but with the use of super-reflective aluminum luminaries of higher efficiency, T5 lamps can effect an overall efficiency improvement ranging from 11% to 30%. T5 lamps have a coating on the inside of the glass wall that stops mercury from being absorbed into the glass and the phosphors. This drastically reduces the need for mercury from about 15 milligrams to 3 milligrams per lamp. This may be advantageous in countries with strict waste disposal laws.

Installing reflectors in most fixtures can improve its efficiency because light leaving the lamp is more likely to "reflect" off interior walls and exit the fixtures.

The reflectors are two types:

- Diffuse
- Secular.

Conventional diffuse reflectors have reflectance of 70 to 80% when new. Newer high-reflectance or semi-diffuse materials have reflectance as high as 85% Conventional diffuser absorb much of the light & scatter it rather than reflecting it to the area required. Over a period of time the reflectance values can decline due to the accumulation of dust and dirt as well as yellowing caused by the UV light.
Anodized aluminum is a common material used in Secular reflector. They maximize optics & secular reflectivity thus allowing more precise control of light & sharper cutoff & give 85-90% reflectance.

CFL

Compact fluorescent lamps (CFLs) are replacing incandescent light bulbs at a rapid rate due to their tremendous energy savings and longer lifetime. Additional energy savings can be achieved by dimming, but the electronic ballast required to control the lamp has a higher cost and is difficult to design.

LED

Light emitting diodes, commonly called LEDs, are real unsung heroes in the electronics world. They do dozens of different jobs and are found in all kinds of devices. Among other things, they form numbers on digital clocks transmit information from remote controls, light up watches and tell you when your appliances are turned on. Collected together, they can form images on a jumbo television screen or illuminate a traffic light.

Basically, LEDs are just tiny light bulbs that fit easily into an electrical circuit. But unlike ordinary incandescent bulbs, they don't have a filament that will burn out, and they don't get especially hot. They are illuminated solely by the movement of electrons in a semiconductor material, and they last just as long as a standard transistor. The lifespan of an LED surpasses the short life of an incandescent bulb by thousands of hours. Tiny LEDs are already replacing the tubes that light up LCD HDTVs to make dramatically thinner televisions.

9.4 Advantages of Providing Aluminum Anodized Reflector where there are no reflectors

Replacement of ordinary reflector by Anodized Aluminum reflector for all single/ twin tube light fitting. Increases the Lux level at operating area by 30 to 40 % over normal tube light fitting without reflectors. The existing stove enameled reflectors are replaced by Anodized aluminum reflector ensures Lux level increase at operating level by 20 to 25 %.

An Electronic Ballast has low loss & increase the Lamp efficacy. Ordinary Copper Ballast is conventional electromagnetic ballast & is used to provide higher voltage to start the tube light & subsequently limit the current during normal operation. Electronic Ballast is oscillators that convert the supply frequency to about 20,000 to 30,000 Hz. The losses in electronic ballast for tube light are only about 1 watt in place of 10 to 15 watt in standard electromagnetic ballast.

The additional advantage of electronic ballast is that the efficacy of tube light improves at higher frequencies if the ballast is optimized to provide same output as with conventional ballast. Hence a saving of about 15 to 20 watts per tube light can be achieved. Other advantage includes less audible noise, less weight & dimming capabilities.

9.5 Advantages of Electronic Ballast:-

Connectional ballast (Copper Ballast) has more energy loss & have low power factor. as electronic ballasts have following advantages

a] Conventional copper ballasts have 14 to 16 watt loss, while electronic ballast have 1 to 2 Watt loss for single 36 watt tube. Thus there is power consumption of 50 to 52 watt for copper ballast and 37 to 38 watt for electronic ballast, resulting into saving of power consumption by 35%

b] It operates on low voltage.

c] It has improved power factor.

d] It increases life of lamps.

e] Increases in light output by 8 to 12 % are achievable.

9.6 Energy saving can be achieved in energy consumption of Lighting, by following measures.

a. Replacement of ordinary tube light fitting 1 x 40 W, with copper ballast by T-5 tube light fitting 1 x 28 W with electronic ballast
b. Uses of more switch control for flexibility to switch off the lights i.e. reducing number of lamps per switch in group control.
c. Separate switches for light near window to facilitate their switches off during day time

T5 tube gives 15 to 18% more Light output compare to ordinary tube. Also mirror optics /Aluminum anodized reflectors increases Lux level by 30 to 40% at operating area.

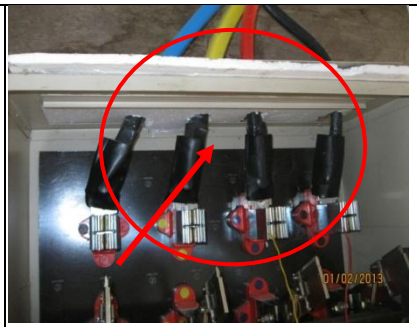
10. PROJECT COMPONENTS & FIELD TEST PHOTOGRAPHS

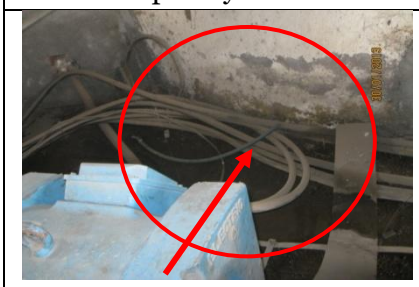
Sr. No.	Location	Observation	References Photographs	Recommendation
1	At Waghur Raw Water Pumping Station	Ammeter is not in working condition in transformer main incomer panel.	Annexure - A ,Ref. photo no. 1	It should be repaired or replaced
2		At motor no.1 capacitors are not connected across motor terminals	Annexure - A ,Ref. photo no. 2	It should be checked & capacitors should be connected across motor terminal for improvement of power factor
3		Capacitor of motor no.6 is found defective.	Annexure - A ,Ref. photo no. 3	It should be checked & corrected
4		Pressure gauge of pump no.01, 03 & 0 5 is not in working condition.	Annexure - A ,Ref. photo no. 4	It should be repaired or replaced
5		Switchyard area is not clear, grass & weeds are found in the switchyard.	Annexure - A ,Ref. photo no. 5	Cutting of grass & weeds necessary
6		Cable gland is not fixed properly at motor no.1		Cable glands should be connected properly to avoid stress on cable connections
8		No identification for earth pit in switchyard area.		Proper identification should be provided
9		Oil leakage is found LV side of transformer		It should be checked & corrected
10		Fixture cover is not found at pole no 2.		Cover should be provided for weather protection
11		Earthing is not provided properly at street lighting poles		Earthing should be provided
12		Unplugged holes are found at junction box at street light		Unplugged holes should be plugged to avoid entry of mice & lizard
13		Glands are not provided to junction box at street light		Gland should be provided
14	At WTP Umale	Identification tag to earthing pit in switchyard area is not provided.		Proper identification should be provided

Sr. No.	Location	Observation	References Photographs	Recommendation
15		Oil leakage is observed from LV bushing side in operational transformer.		It should be checked & corrected
16		Four pole structures is found rusted in switchyard area.		Painting should be carried out.
17		Gland is not properly fixed at outgoing cable of transformer.	Annexure - A ,Ref. photo no. 11	Cable glands should be fixed properly to avoid stress on cable connections
18		Cable dressing is not proper from panel to motor terminal.	Annexure - A ,Ref. photo no. 7	Cable should be clamped properly
19		Gland is not fixed properly at bed wash motor no. 3.	Annexure - A ,Ref. photo no. 6	Cable glands should be connected properly to avoid stress on cable connections
20		Cover is not found at some street light fitting.	Annexure - A ,Ref. photo no. 9	Cover should be provided for weather protection
21		Glands are not provided to street lighting junction box cables.		Glands should be provided
22		Cable dressing is not proper from panel to motor terminal.		Cable should be clamped properly
23		Tubelight fitting is not installed properly; it is hanging on the wall.		Proper arrangement for lighting should be done.
24		PVC tapped joint cable is used for making connection to exhaust fan no 2.		Proper connector should be provided
25		Gland is not fixed properly at motor no.3.		Cable glands should be fixed properly to avoid stress on cable connections
26		Glands are not provided to street lighting junction box cables.		Glands should be provided
27	At Girna Pumping Station	Oil leakage is found at HV side Bushing of Transformer no. 1.		It should be checked & corrected
28		Transformer body & four pole structure is found rusted.	Annexure - A ,Ref. photo no. 12	Painting should be carried out.
29		AB switch is found bypassed at switchyard.		It should be checked & corrected

Sr. No.	Location	Observation	References Photographs	Recommendation
30		No lighting connection found in pump house at 50HP Motor.		Proper arrangement for lighting should be done.
31		Terminal cover of motor no. 1 found is open at 80HP Motor.	Annexure - A ,Ref. photo no. 14	Proper cover should be provided
32		Cable dressing is not proper from panel to motor cable.		Cable should be clamped properly
33		Motor no 2 is not in working condition.		It should be made operational
34		Glands are not found at motor terminal.		Gland should be provided.
35		PVC taped joint cable is used for making connection to tube lighting		Proper connector should be provided
36		Scrap material is found in pump house room.	Annexure - A ,Ref. photo no. 16	It should be removed.
37		20 kVAR 5 nos capacitor bank is found not in working condition at APFC Panel.		It should be checked & capacitors should be made operational for improvement of power factor

Annexure-A

<table>
<tr><th colspan="3">Condition of electrical Installation at Waghur Raw Water Pumping</th></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>1) Ammeter is not in working condition in transformer main incomer panel.</td><td>2) At motor no.1 capacitors are not connected.</td><td>3) Capacitor of motor no.6 is found defective.</td></tr>
<tr><td>  </td><td>  </td><td></td></tr>
<tr><td>4)Pressure gauge of Pump No.01, 03 & 0 5 is not in working condition.</td><td>5) Switchyard area is not clear, grass & weeds are found in the switchyard.</td><td></td></tr>
<tr><th colspan="3">Condition of electrical Installation at WTP At Umale</th></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td>6) Gland is not fixed properly at bed wash motor no. 3.</td><td>7) Cable dressing is not proper from panel to motor terminal.</td><td>8) Glands are not provided at changeover panel.</td></tr>
</table>

		
9) Cover is not found at street light fitting.	10) Cable dressing is not proper from panel to motor terminal.	11) Gland is not properly fixed at outgoing cable of transformer.
Condition of electrical Installation at Girna Pumping Station		
		
12) Transformer body & four pole structure is found rusted.	13) Cover is not found at LT terminal of transformer.	14) Terminal cover of motor no. 1 is found open at 80HP Motor.
		
15) Lighting arrangement is found temporary.	16) Scrap material is found in pump house room.	17) PVC tapped joint is found at transformer outgoing cable.
		
18) Proper cable dressing is not found at incomer cable.	19) 50 HP motor-pump panel is found damage.	20) Scrap material is found in 50 HP pump house room.

ANNEXURE

B. Energy Measurement Sheet

1. Waghur Raw Water Pumping Stations

❖ **Pump No.1**

Location	Waghur Raw Water	Frame No.	355-93		Current (A)	82	Speed (RPM)	1482	CT Ratio	100/5		Motor Make	Alstom Ltd
Pump No.	1	M/c No.	180098		Voltage(V)	3300	Efficiency (%)	93	PT Ratio	3.3/110		Rating (kw/HP)	375/500
Date	11-02-13	Line Voltage Measurement			Current Measurement			KW/ Phase			Total Kw	PF	KWh Reading
Time	Frequency	U1 RMS	U2 RMS	U3 RMS	A1 RMS	A2 RMS	A3 RMS						
	Hz	V	V	V	A	A	A	kW	kW	kW	kw		KWh
12:10:00 PM	50.01	3339	3351	3348	54.34	67.74	61.44	97.2	113.0	105.8	316.0	0.89	26.33
12:15:00 PM	50.06	3309	3321	3324	54.84	67.96	62.04	97.3	113.2	106.4	316.9	0.90	52.74
12:20:00 PM	50.08	3309	3321	3324	55.1	67.86	62.22	97.6	113.2	106.8	317.5	0.90	79.20
12:25:00 PM	50.07	3306	3318	3321	55.32	67.94	61.9	97.9	113.2	106.2	317.3	0.90	105.64
12:30:00 PM	50.14	3312	3324	3327	55.72	67.92	62.12	98.7	113.4	106.9	318.9	0.90	132.22
12:35:00 PM	50.17	3315	3324	3324	56.06	68.38	61.9	99.4	114.1	106.4	319.9	0.90	158.88
12:40:00 PM	50.06	3312	3324	3324	55.76	67.74	61.66	98.5	112.9	105.8	317.2	0.90	185.31
12:45:00 PM	50.16	3312	3327	3327	56.06	68.06	62.2	99.0	113.8	107.0	319.8	0.90	211.96
12:50:00 PM	50.29	3315	3330	3333	57.04	68.68	62.76	96.6	114.3	113.9	324.8	0.90	239.03
12:55:00 PM	50.42	3321	3333	3336	57.94	69	63.14	97.2	114.8	116.4	328.4	0.90	266.40
1:00:00 PM	50.25	3309	3324	3327	57.54	68.3	62.6	96.1	113.1	115.0	324.2	0.90	293.41
1:05:00 PM	50.12	3300	3312	3315	57.42	67.72	61.98	95.6	111.6	113.5	320.6	0.89	320.14
Unit Consumption per hour kWh													**320.52**

❖ **Pump No.2**

Location	Waghur Raw Water	**Frame No.**	355-93		**Current (A)**	82	**Speed (RPM)**	1482	**CT Ratio**	100/5		**Motor Make**	Alstom Ltd
Pump No.	2	**M/c No.**	180098		**Voltage(V)**	3300	**Efficiency (%)**	93	**PT Ratio**	3.3/110		**Rating (kW/HP)**	375/500
Date	**01-02-13**	**Line Voltage Measurement**			**Current Measurement**			**KW/ Phase**			**Total Kw**	**PF**	**KWh Reading**
Time	**Frequency**	**U1 RMS**	**U2 RMS**	**U3 RMS**	**A1 RMS**	**A2 RMS**	**A3 RMS**						
	Hz	**V**	**V**	**V**	**A**	**A**	**A**	**kW**	**kW**	**kW**	**kw**		**KWh**
2:50:00 PM	49.88	3264	3282	3279	54.74	60.04	52.7	98.3	107.6	103.9	309.8	0.98	25.81
2:55:00 PM	49.92	3264	3285	3282	54.66	60.3	53.14	98.2	108.1	104.8	311.1	0.98	51.74
3:00:00 PM	49.98	3258	3279	3273	55.08	60.76	53.28	98.9	108.7	104.9	312.6	0.98	77.79
3:05:00 PM	49.87	3258	3276	3270	54.72	60.26	52.78	98.3	107.7	103.9	309.8	0.98	103.61
3:10:00 PM	49.82	3264	3279	3276	54.6	59.72	52.38	98.2	106.8	103.3	308.2	0.98	129.30
3:15:00 PM	49.73	3264	3279	3273	54.5	59.52	51.7	98.0	106.4	101.9	306.3	0.98	154.82
3:20:00 PM	49.74	3267	3282	3276	54.36	59.38	51.84	97.8	106.2	102.2	306.2	0.98	180.34
3:25:00 PM	49.91	3276	3291	3288	55.76	60.74	53.3	100.6	109.0	105.5	315.2	0.98	206.60
Unit Consumption per hour kWh													**309.92**

❖ **Pump No.3**

Location	Waghur Raw Water	**Frame No.**	355-93		**Current (A)**	82	**Speed (RPM)**	1482	**CT Ratio**	100/5		**Motor Make**	Alstom Ltd
Pump No.	3	**M/c No.**	180098		**Voltage(V)**	3300	**Efficiency (%)**	93	**PT Ratio**	3.3/110		**Rating (kw/HP)**	375/500
Date	**01-02-13**	**Line Voltage Measurement**			**Current Measurement**			**KW/ Phase**			**Total Kw**	**PF**	**KWh Reading**
Time	**Frequency**	**U1 RMS**	**U2 RMS**	**U3 RMS**	**A1 RMS**	**A2 RMS**	**A3 RMS**						
	Hz	**V**	**V**	**V**	**A**	**A**	**A**	**kW**	**kW**	**kW**	**kW**		**KWh**
5:30:00 PM	49.89	3378	3390	3387	46.28	50.8	43.34	85.7	94.2	89.1	268.9	0.98	39.81
5:35:00 PM	50.19	3384	3402	3402	46.84	51.96	44.88	87.1	96.8	92.6	276.5	0.98	62.85
5:40:00 PM	50.18	3381	3396	3396	47.1	52.02	44.7	87.5	96.7	92.1	276.4	0.98	85.88
5:45:00 PM	50.13	3375	3390	3390	47.06	51.7	44.56	87.3	96.0	91.7	275.0	0.98	108.80
5:50:00 PM	50.24	3375	3390	3387	47.62	52.42	44.62	88.5	97.2	91.7	277.4	0.98	131.91
5:55:00 PM	50.15	3363	3378	3378	47.34	52.04	44.78	87.6	96.2	91.7	275.5	0.98	154.88
6:00:00 PM	49.9	3345	3363	3363	46.1	51.12	44	84.8	94.1	89.7	268.6	0.98	177.26
6:05:00 PM	49.95	3336	3357	3354	46.24	51.58	44.04	85.0	94.7	89.6	269.3	0.98	199.70
6:10:00 PM	49.92	3324	3339	3333	46.84	51.7	43.6	86.1	94.7	87.7	268.5	0.98	222.07
6:15:00 PM	49.8	3312	3327	3318	46.66	51.3	43.12	88.0	96.1	81.8	266.0	0.98	244.24
6:20:00 PM	49.87	3306	3324	3321	46.36	51.52	44.16	87.2	96.6	83.7	267.6	0.98	266.54
Unit Consumption per hour kWh													**272.07**

❖ **Pump No.4**

Location	Waghur Raw Water	Frame No.	355-93		Current (A)	82	Speed (RPM)	1482	CT Ratio	100/5		Motor Make	Alstom Ltd
Pump No.	4	M/c No.	180098		Voltage(V)	3300	Efficiency (%)	93	PT Ratio	3.3/110		Rating (kw/HP)	375/500
Rating kW/HP		375 / 500								Date		01-02-13	
Time	Frequency	Line Voltage Measurement			Current Measurement			KW/ Phase			Total Kw	PF	KWh Reading
		U1 RMS	U2 RMS	U3 RMS	A1 RMS	A2 RMS	A3 RMS						
	Hz	V	V	V	A	A	A	kW	kW	kW	kw		KWh
12:30:00 PM	49.83	3309	3297	3285	51.62	52.36	44.7	96.6	96.2	83.7	276.4	0.976	23.03
12:35:00 PM	49.78	3306	3297	3285	51.4	52.44	44.52	96.1	96.2	83.3	275.6	0.975	46.00
12:40:00 PM	49.79	3312	3297	3288	51.76	52.1	44.78	96.8	95.7	83.9	276.5	0.976	69.04
12:45:00 PM	49.85	3315	3303	3291	52.02	52.64	44.86	97.5	96.7	84.1	278.3	0.975	92.24
12:50:00 PM	49.96	3312	3303	3288	52.32	53.44	45.22	98.1	98.4	84.8	281.3	0.977	115.68
12:55:00 PM	50.07	3321	3309	3294	53	53.78	45.74	99.6	99.2	86.0	284.8	0.977	139.41
1:00:00 PM	49.94	3318	3306	3294	52.32	53.2	45.3	98.2	98.0	85.1	281.3	0.977	162.86
1:05:00 PM	49.69	3306	3294	3288	51.04	51.68	44.64	95.3	94.9	83.6	273.8	0.975	185.68
1:10:00 PM	49.85	3318	3309	3297	51.48	52.78	44.86	96.7	97.3	84.3	278.2	0.976	208.86
1:15:00 PM	49.77	3315	3309	3291	51.4	52.58	44.4	96.4	96.8	83.3	276.6	0.976	231.91
1:20:00 PM	49.95	3318	3309	3294	52.04	53.28	45.14	97.7	98.3	84.8	280.8	0.977	255.31
1:25:00 PM	50.02	3318	3312	3297	52.32	53.94	45.36	98.3	99.6	85.3	283.2	0.977	278.91
Unit Consumption per hour kWh													279.14

❖ **Pump No.5**

Location	Waghur Raw Water	Frame No.	355-93		Current (A)	82	Speed (RPM)	1482	CT Ratio	100/5		Motor Make	Alstom Ltd
Pump No.	5	M/c No.	180098		Voltage(V)	3300	Efficiency (%)	93	PT Ratio	3.3/110		Rating (kw/HP)	375/500
Date	01-02-13	Line Voltage Measurement			Current Measurement			KW/ Phase			Total Kw	PF	KWh Reading
Time	Frequency	U1 RMS	U2 RMS	U3 RMS	A1 RMS	A2 RMS	A3 RMS						
	Hz	V	V	V	A	A	A	kW	kW	kW	kw		KWh
11:05:00 AM	49.77	3312	3306	3291	65.16	68.92	59.62	109.6	112.0	102.4	324.0	0.877	27.00
11:10:00 AM	49.71	3315	3309	3294	64.68	68.9	59.2	109.0	112.0	101.5	322.5	0.876	53.87
11:15:00 AM	49.72	3318	3315	3300	64.46	69.06	59.12	108.8	112.4	101.4	322.6	0.876	80.76
11:20:00 AM	50.06	3333	3330	3312	65.9	70.08	60.06	112.0	115.1	103.7	330.8	0.879	108.33
11:25:00 AM	49.88	3339	3333	3318	65.26	69.08	59.38	110.6	113.1	102.4	326.1	0.876	135.50
11:30:00 AM	49.84	3345	3339	3327	65.04	68.62	59.32	110.1	112.4	102.5	325.1	0.875	162.60
11:35:00 AM	49.89	3348	3342	3330	65.28	68.96	59.34	110.8	113.1	102.7	326.7	0.876	189.82
11:40:00 AM	49.95	3348	3339	3327	65.6	68.86	59.46	111.4	113.2	103.1	327.6	0.877	217.12
11:45:00 AM	49.96	3345	3339	3324	65.52	69.14	59.06	111.6	113.5	102.2	327.3	0.877	244.39
11:50:00 AM	50.06	3348	3345	3324	65.88	69.76	59.24	112.6	114.8	102.6	329.9	0.878	271.88
11:55:00 AM	50.07	3348	3342	3327	65.98	69.4	59.5	112.5	114.3	103.2	330.0	0.879	299.39
12:00:00 PM	49.8	3351	3345	3327	65.08	68.38	58.22	110.7	111.8	100.7	323.2	0.875	326.32
Unit Consumption per hour kWh													**326.53**

❖ **Pump No.6**

Location	Waghur Raw Water	**Frame No.**	355-93		**Current (A)**	82	**Speed (RPM)**	1482	**CT Ratio**	100/5		**Motor Make**	Alstom Ltd
Pump No.	6	**M/c No.**	180098		**Voltage(V)**	3300	**Efficiency (%)**	93	**PT Ratio**	3.3/110		**Rating (kw/HP)**	375/500
Date	**01-02-13**	**Line Voltage Measurement**			**Current Measurement**			**KW/ Phase**			**Total Kw**	**PF**	**KWh Reading**
Time	**Frequency**	**U1 RMS**	**U2 RMS**	**U3 RMS**	**A1 RMS**	**A2 RMS**	**A3 RMS**						
	Hz	**V**	**V**	**V**	**A**	**A**	**A**	**kW**	**kW**	**kW**	**kw**		**KWh**
4:00:00 PM	50.04	3285	3279	3261	61.6	64.1	53.44	102.8	111.1	83.2	297.0	0.872	24.75
4:05:00 PM	50.02	3288	3279	3264	61.4	63.94	53.2	102.5	110.7	82.8	296.0	0.871	49.42
4:10:00 PM	50.02	3285	3279	3261	61.38	64	53.22	102.3	110.9	82.8	296.0	0.871	74.09
4:15:00 PM	49.92	3282	3276	3261	60.8	63.14	53.14	100.9	109.4	82.6	292.9	0.87	98.49
4:20:00 PM	49.78	3279	3273	3255	60.24	62.6	52.32	99.7	107.9	81.0	288.6	0.868	122.54
4:25:00 PM	49.81	3291	3279	3264	60.58	62.52	52.26	100.5	107.7	81.2	289.5	0.867	146.67
4:30:00 PM	49.92	3309	3300	3282	60.88	62.96	52.58	101.6	109.1	82.0	292.7	0.867	171.06
4:35:00 PM	49.95	3294	3285	3273	60.98	63.04	52.98	101.5	109.4	82.6	293.5	0.869	195.51
4:40:00 PM	49.96	3294	3285	3270	61.04	63.36	52.86	101.7	109.9	82.4	294.0	0.87	220.01
4:45:00 PM	49.95	3297	3288	3267	61.18	63.46	52.44	102.1	109.7	81.7	293.5	0.869	244.47
4:50:00 PM	49.91	3306	3297	3279	60.8	63.12	52.34	101.5	109.3	81.5	292.3	0.867	268.83
4:55:00 PM	50.27	3327	3318	3303	62.06	64.36	53.94	104.5	113.0	85.0	302.5	0.871	294.04
Unit Consumption per hour kWh													**293.77**

2. Girna Pumping Stations New

❖ Pump No.1

JALGAON MUNICIPAL CORPORATION, JALGAON					
Energy Measurement Sheet					
Location	Girna Pumping Station New 75 HP (1 No.)			Date :-	30-01-13
Pump No.	1				
Motor Make	Kirloskar .	Voltage	415	Energy meter	
Frame	SA225M	Current (A)	91		
M/c No.	UJG55-09	Speed (Rpm)	1475	CT Ratio	250/5
Rating kw/HP	55/75	Efficiency (%)	94%	PT Ratio	
Parameter	Time				
	18:45	19:00	19:15	19:30	19:45
VLL	417.4	418.8	426..2	426.9	426.7
A	52.8	52	53.5	53.2	53.4
PF	0.93	0.94	0.92	0.92	0.92
Hz	49.8	49.9	49.8	49.8	49.7
RV	240	240.8	245.6	245.2	245.4
YV	242.8	243.6	248.6	248	248.7
BV	240	240.8	245.2	245.6	244.9
Volt RY	418.0	419.8	427	428.7	427.2
Volt YB	418.4	418	426.7	425	424.1
Volt BR	416	417	424.6	425	424.1
Amps R	47	47.4	48.6	48.8	48.2
Amps Y	53.4	53.8	52.6	53	53.2
Amps B	57.6	57.2	57.8	58.6	57.3
cos R	0.98	0.99	0.98	0.98	0.98
cos Y	0.95	0.95	0.94	0.94	0.95
cos B	0.88	0.88	0.88	0.89	0.89
kw R	11.04	11.28	11.68	11.68	11.72
kw Y	12.40	12.32	12.24	12.48	12.5
kw B	12.16	12.24	12.32	12.32	12.3
kva R	11.19	11.51	12.05	11.88	11.76
kva Y	12.4	12.32	12.24	12.48	12.5
kva B	13.8	14.01	14.22	14.51	14.45
kvar rR	1.77	1.65	2.12	2.41	2.36
kvar rY	3.62	3.83	4.33	4.4	4.38
kvar rB	6.3	6.45	7.23	7.36	7.4
Total - KW	35.76	36.05	36.32	36.72	36.7
kwh I	29.80	29.89	29.98	30.06	30.15

Unit Consumption per Hour = 30.15 –29.80 * 100

= 34.41 kWh

Multiplying Factor = 100

❖ **Pump No.2**

JALGAON MUNICIPAL CORPORATION, JALGAON					
Energy Measurement Sheet					
Location	Girna Pumping Station New 75 HP (2 No.)			Date :-	30-01-13
Pump No.	2				
Motor Make	Kirloskar .	Voltage	415	Energy meter	
Frame	SA225M	Current (A)	91		
M/c No.	UJG55-02	Speed (Rpm)	1475	CT Ratio	250/5
Rating kw/HP	55/75	Efficiency (%)	94%	PT Ratio	
Parameter	Time				
	17:30	17:45	18:00	18:15	18:30
VLL	429.2	410.3	411.7	412	411.8
A	53.9	53	53.4	53.8	54
PF	0.92	0.94	0.94	0.95	0.94
Hz	50	49.9	49.95	49.4	49.5
RV	246.8	236.0	236.2	235	235.7
YV	250.0	238.4	238.1	238.4	237
BV	247.6	236.4	235.9	236	236.5
Volt RY	430.8	411.1	412.3	411.2	415
Volt YB	430.2	411.1	412.3	412.5	412.8
Volt BR	428.5	408.4	407.8	408.4	410.5
Amps R	49.6	49	49.5	49.8	49.4
Amps Y	54	53.2	53.1	53.7	53.4
Amps B	57	57.2	57.8	57.3	58
cos R	0.98	0.99	0.98	0.97	0.98
cos Y	0.95	0.97	0.96	0.96	0.95
cos B	0.86	0.89	0.9	0.89	0.89
kw R	11.77	11.6	11.64	11.55	12.01
kw Y	12.88	12.32	12.3	12.32	12.45
kw B	12.24	12.09	12.07	12.4	12.84
kva R	12.09	11.54	11.5	11.45	11.68
kva Y	13.42	12.68	12.6	12.65	12.55
kva B	14.33	13.61	14.55	14.42	14.35
kvar rR	2.3	1.51	2.56	2.84	2.81
kvar rY	4.2	2.96	4.8	4.36	4.45
kvar rB	7.25	5.84	5.81	5.67	5.7
Total - KW	36.96	36.08	36.35	36.42	37.08
kwh I	30.09980	30.18184	30.27250	30.36170	30.45443

Unit Consumption per Hour = 30.45 –30.09 * 100

= 34.41 kWh

Multiplying Factor = 100

3. Girna Pumping Stations Old 50 HP

JALGAON MUNICIPAL CORPORATION, JALGAON					
Energy Measurement Sheet					
Location	Girna Pumping Station (Old)			Date :-	3.02.13
Pump No.	1				
Motor Make	Kirloskar .	Voltage	415	Energy meter	
Frame	LD225 SMK11	Current (A)	64		
M/c No.	EED 206-62	Speed (Rpm)	1470	CT Ratio	200/5
Rating kW / HP	37 / 50	Efficiency (%)	91%	PT Ratio	
Parameter	Time				
	7:35	7:50	8:05	8:20	8:35
VLL	410	411.2	411	403	403.9
A	48.8	50.8	53.2	51.7	50.6
PF	0.971	0.971	0.973	0.978	0.975
Hz	49.77	49.88	50.13	49.89	49.78
RV	238	238.4	238	234.4	234.4
YV	237.2	237.6	236.4	233	233.2
BV	236.8	238	238	231.8	231.2
Volt RY	410.0	411.8	411.2	406	404.9
Volt YB	410	410.8	410.8	399	402.1
Volt BR	411	411.5	411.1	398	403.2
Amps R	57	58.8	59.8	59	58.2
Amps Y	43	45	45.2	43.9	42.6
Amps B	49	51.4	54.3	51.2	50.4
cos R	0.999	0.999	0.998	0.998	0.998
cos Y	0.999	0.999	0.999	0.995	0.998
cos B	0.915	0.914	0.915	0.933	0.931
kw R	13.52	14.08	14.08	13.92	13.54
kw Y	10.16	10.72	10.72	10.32	10.07
kw B	10.56	11.36	11.6	11.12	11.67
kva R	13.63	14.18	14.13	13.85	13.73
kva Y	10.18	10.57	10.7	10.34	9.44
kva B	11.63	12.66	12.55	11.83	11.71
kvar rR	0.95	0.5	0	1.2	0.73
kvar rY	0.78	0.79	0.03	0.64	0.44
kvar rB	4.71	5.1	5.07	4.4	4.27
Total - KW	34.4	36.48	36.32	35.2	34.4
Total KVA	35.56	37.53	37.32	36.04	35.18
KVAR IMP	6.5	6.9	6.67	5.44	5.23
kwh I	2919.19	2926.07	2934.53	2942.00	2950.00
kwh E	33.71	33.71	37.71	33.71	33.71

Unit Consumption per Hour = **2950** – 2919.19 * 100

= 30.81 kWh

Multiplying Factor = 100

4. Girna Pumping Stations Old 80 HP

JALGAON MUNICIPAL CORPORATION, JALGAON					
Energy Measurement Sheet					
Location	Girna Pumping Station Old 80 HP			Date :-	31.01.13
Pump No.	1				
Motor Make		Voltage	415	Energy meter	
Frame		Current (A)			
M/c No.		Speed (Rpm)		CT Ratio	200/5
Rating kW/HP	60 / 80	Efficiency (%)		PT Ratio	415
Parameter	Time				
	9:00	9:15	9:30	9:45	10:00
VLL	418	421	419	420	420
A	71.3	70.8	71.8	71.6	72.3
PF	0.91	0.91	0.91	0.91	0.91
Hz	50	49.76	49.71	49.9	50.01
RV	242	245.0	242	242	242
YV	244.0	244	243	244	244
BV	242	241	241	241	242
Volt RY	422.5	422.3	420.2	421	421.5
Volt YB	420.5	419.5	417	418	418.9
Volt BR	420	422	418	419	420
Amps R	71.8	71.6	69.9	71.4	72.4
Amps Y	71.2	70.6	71.6	71.4	72.6
Amps B	72.4	71.8	72.1	72.6	72.8
cos R	0.93	0.93	0.92	0.93	0.93
cos Y	0.91	0.92	0.93	0.91	0.9
cos B	0.9	0.91	0.9	0.9	0.91
kw R	16.16	16.08	15.7	16.16	16.95
kw Y	15.19	15.08	15.06	15.91	15.98
kw B	15.76	15.36	15.08	15.68	15.48
kva R	17.5	17.4	17.54	17.52	17.62
kva Y	17.3	17.2	17.5	17.37	17.52
kva B	17.5	17.1	17.3	17.37	17.72
kvar rR	7.41	6.32	6.63	6.6	6.2
kvar rY	7.5	7.5	7.2	7.3	7.4
kvar rB	7.3	7.4	7.3	7.3	7.5
Total - KW	47.92	47.28	47.68	47.6	48.56
TotalW KVA	52.44	51.67	51.02	52.15	52.03
KVAR IMP	21.5	21.47	20.86	20.85	21.24
kwh I	2835	2848	2858	2872	2881

Unit Consumption per Hour = 2881 – 2835 * 100

= 46 kWh

Multiplying Factor = 100

5. Raymond Chowk Booster Pumping 75 HP

JALGAON MUNICIPAL CORPORATION, JALGAON					
Energy Measurement Sheet					
Location	Raymond Booster Pumping			Date :-	07-02-13
Pump No.	1				
Motor Make	Kirloskar	Voltage	415	Energy meter	
Frame		Current (A)			
M/c No.		Speed (Rpm)		CT Ratio	200/5
Rating kw/HP	55 / 75	Efficiency (%)		PT Ratio	
Parameter	Time				
	12:30	12:45	13:00	13:15	13:30
VLL	407.8	405.9	410.6	412.1	411
A	65	65.7	71.2	70.4	70.4
PF	0.98	0.99	0.97	0.97	0.97
Hz	49.9	50.04	50.28	50.2	50.2
RV	232	232.0	234.4	50.2	234.8
YV	234.8	234.4	238	236	237.6
BV	236.4	236.4	238.8	238.4	239.2
Volt RY	404.9	403.9	409.4	240.4	409.1
Volt YB	408.4	407.3	412.9	410.4	413.6
Volt BR	405.3	405.3	410.1	415.4	411.1
Amps R	70.2	71	72.8	412.5	71
Amps Y	69.4	69.2	71.4	71	69.4
Amps B	56.4	57.6	70.2	69.2	71.2
cos R	0.98	0.98	0.99	70.8	0.98
cos Y	0.98	0.98	0.98	0.98	0.97
cos B	0.99	0.99	0.96	0.97	0.96
kw R	16.32	16.16	16.97	0.96	16.4
kw Y	16.16	16	17	16.48	16.32
kw B	13.28	13.36	16.78	16.29	16.4
kva R	16.47	16.44	16.96	16.24	16.64
kva Y	16.57	16.38	16.98	16.53	16.52
kva B	13.32	13.49	16.64	16.81	16.88
kvar rR	2.78	2.55	2.39	2.96	2.81
kvar rY	3.12	3.06	3.67	3.28	3.12
kvar rB	1.03	1.26	4.46	4.64	4.57
Total - KW	45.44	45.92	49.68	48.88	48.88
Total KVA	46.15	46.35	50.86	50.04	50.21
kwh E	3445.00	3454.00	3469.00	3480.00	3492.14

Unit Consumption per Hour = 3492.14 – 3445 * 100

= 46 kWh

Multiplying Factor = 100

6. DSP Chowk Booster Pumping 75 HP

JALGAON MUNICIPAL CORPORATION, JALGAON					
Energy Measurement Sheet					
Location	DSP Chowk Booster Pump			Date :-	31.01.13
Pump No.	1				
Motor Make	Kirloskar	Voltage	415	Energy meter	
Frame		Current (A)			
M/c No.		Speed (Rpm)	1475	CT Ratio	200/5
Rating kw/HP	75 HP	Efficiency (%)		PT Ratio	415
Parameter	Time				
	15:45	16:00	16:15	16:30	16:45
VLL	427.4	427.4	428.3	429	432.7
A	67.2	67.1	65.5	65	66.3
PF	0.88	0.88	0.87	0.88	0.87
Hz	49.79	49.79	49.72	49.5	49.82
RV	243.2	243.2	244	244	246.4
YV	246.8	246.8	247.6	247.5	249.6
BV	249.6	249.6	250.8	250.2	253.2
Volt RY	424.3	424.3	425.2	425.7	429.2
Volt YB	430.2	430.2	431.6	431.6	435.4
Volt BR	426.7	427.4	428.5	428.5	432.5
Amps R	67.8	65.8	65.8	66.8	66.2
Amps Y	68	65.8	66.2	66.4	67.2
Amps B	66	63.8	64.2	64	64.2
cos R	0.86	0.85	0.85	0.85	0.86
cos Y	0.89	0.89	0.88	0.89	0.89
cos B	0.88	0.89	0.88	0.88	0.88
kw R	14.18	14.76	13.68	13.76	14.09
kw Y	14.94	14.48	14.64	14.78	14.96
kw B	14.50	14.92	14	14.16	14.24
kva R	16.23	15.02	16.05	16.15	16.23
kva Y	16.43	16.23	16.39	16.51	16.49
kva B	16.07	16.02	15.95	15.1	16.22
kvar rR	8.3	8.29	8.41	8.26	8.25
kvar rY	7.5	7.26	7.41	7.36	7.36
kvar rB	7.5	7.78	7.6	7.49	7.46
Total - KW	43.96	43.48	42.36	42.8	43.2
Total KVA	48.01	48.25	48.69	49.88	48.84
kwh E	3321.00	3328.00	3344.00	3353.00	3364.00

Unit Consumption per Hour = 3364 – 3321 * 100

= 46 kWh

Multiplying Factor = 100

C. Pump Field Measurement Sheet

1. Waghur Raw Water Pumping Station

❖ **Pump No. 1**

JALGAON MUNICIPAL CORPORATION JALGAON									
Pump Field Measurement Sheet									
Location :-	**Waghur Raw Water Pump-1**					**Date :-**	11-02-13		
Pump No :-	1	**Rated Flow (m3/hr)**	1355	**Ext. Pipe Dia (mm)**	517	**Pump Center Level (m)**		0.98	
Pump Make	Kirloskar	**Rated Speed (RPM)**	1485	**Material of Pipe**	Steel				
Sr. No.	1709604001	**RPM Meter**	Digital	**Thickness (mm)**	7.7	**PG Ht. from Pump Floor (m)**		0.6	
Impeller Dia	486 mm BR	**Rated Input Power (kW)**		**Internal Probe Distance (mm)**	225				
Delivery/Suction (mm)		**PR Gauge**	Analog	**Probe Type**	Z	**PG Ht. from Pump Center Level (m)**		-0.38	
Rated Head (m)	75	**Flow Meter**	Ultraflux	**Internal Dia (mm)**					
Flow Meter Readings									
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head**	**Dam Water Level (m) {A}**	**Pump Center Level (m) from floor level {B}**	**Total Suction Head (B-A)**	**Total Head (m)**
12:10	1169	7.5	75	-0.38	74.62	4.94	0.98	-3.96	70.66
12:25	1165	7.5	75	-0.38	74.62	4.94	0.98	-3.96	70.66
12:40	1183	7.5	75	-0.38	74.62	4.94	0.98	-3.96	70.66
12:55	1165	7.5	75	-0.38	74.62	4.94	0.98	-3.96	70.66
13:10	1175	7.5	75	-0.38	74.62	4.94	0.98	-3.96	70.66
Average	**1171.4**	**7.5**	**75**	**-0.38**	**74.62**	**4.94**	**0.98**	**-3.96**	**70.66**
Note:-		**Sensor Type**				**Tested By**			
		Real Gain (DB)		**27**		**Start Time**	**12:10**		
		Sound Velocity		**1488**		**Stop Time**	**13:10 PM**		
		Quality Index (%)		**100%**		**Witnessed By**			

❖ **Pump No. 2**

JALGAON MUNICIPAL CORPORATION JALGAON									
Pump Field Measurement Sheet									
Location :-	**Waghur Raw Water Pump-2**					**Date :-**	**01-02-13**		
Pump No :-	2	**Rated Flow (m3/hr)**	1355	**Ext. Pipe Dia (mm)**	517	**Pump Center Level (m)**		**0.98**	
Pump Make	Kirloskar	**Rated Speed (RPM)**	1485	**Material of Pipe**	Steel				
Sr. No.	1709604002	**RPM Meter**	Digital	**Thickness (mm)**	7.7	**PG Ht. from Pump Floor (m)**		**0.6**	
Impeller Dia	486 mm BR	**Rated Input Power (kW)**		**Internal Probe Distance (mm)**	225				
Delivery/Suction (mm)		**PR Gauge**	Analog	**Probe Type**	Z	**PG Ht. from Pump Center Level (m)**		**-0.38**	
Rated Head (m)	75	**Flow Meter**	Ultraflux	**Internal Dia (mm)**					
Flow Meter Readings									
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head (M)**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head**	**Dam Water Level (m) {A}**	**Pump Center Level (m) from floor level {B}**	**Total Suction Head (B-A)**	**Total Head (m)**
14:50	975.2	7.0	70	-0.38	69.62	4.94	0.98	-3.96	65.66
15:05	977.0	7.0	70	-0.38	69.62	4.94	0.98	-3.96	65.66
15:20	965.9	7.0	70	-0.38	69.62	4.94	0.98	-3.96	65.66
15:35	953.3	7.0	70	-0.38	69.62	4.94	0.98	-3.96	65.66
15:50	988.6	7.0	70	-0.38	69.62	4.94	0.98	-3.96	65.66
Average	**972.0**	**7.0**	**70**	**-0.38**	**69.62**	**4.94**	**0.98**	**-3.96**	**65.66**
Note:-		**Sensor Type**				**Tested By**			
		Real Gain (DB)		**20**		**Start Time**	**14:50**		
		Sound Velocity		**1491**		**Stop Time**	**15:50**		
		Quality Index (%)		**100%**		**Witnessed By**			

❖ **Pump No. 3**

JALGAON MUNICIPAL CORPORATION JALGAON									
Pump Field Measurement Sheet									
Location :-		**Waghur Raw Water Pump-3**				**Date :-**	**01-02-13**		
Pump No :-		3	**Rated Flow (m3/hr)**	1355	**Ext. Pipe Dia (mm)**	517	**Pump Center Level (m)**		0.98
Pump Make		Kirloskar	**Rated Speed (RPM)**	1485	**Material of Pipe**	Steel			
Sr. No.		1709604003	**RPM Meter**	Digital	**Thickness (mm)**	7.7	**PG Ht. from Pump Floor (m)**		0.6
Impeller Dia		486 mm BR	**Rated Input Power (kW)**		**Internal Probe Distance (mm)**	242.45			
Delivery/Suction (mm)			**PR Gauge**	Analog	**Probe Type**	Z	**PG Ht. from Pump Center Level (m)**		-0.38
Rated Head (m)		75	**Flow Meter**	Ultraflux	**Internal Dia (mm)**				
Flow Meter Readings									
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head (M)**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head (M)**	**Dam Water Level (m) {A}**	**Pump Center Level (m) from floor level {B}**	**Total Suction Head (B-A)**	**Total Head (m)**
17:30	856.35	7.6	76	-0.38	75.62	4.94	0.98	-3.96	71.66
17:45	844.55	7.7	77	-0.38	76.62	4.94	0.98	-3.96	72.66
18:00	880.07	7.5	75	-0.38	74.62	4.94	0.98	-3.96	70.66
18:15	834.50	7.6	76	-0.38	75.62	4.94	0.98	-3.96	71.66
18:30	839.87	7.8	78	-0.38	77.62	4.94	0.98	-3.96	73.66
Average	**851.1**	**7.6**	**76**	**-0.38**	**76.02**	**5**	**0.98**	**-3.96**	**72.06**
Note:-		**Sensor Type**				**Tested By**			
		Real Gain (DB)		**44**		**Start Time**	**17:30**		
		Sound Velocity		**1485**		**Stop Time**	**18:30**		
		Quality Index (%)		**100%**		**Witnessed By**			

❖ **Pump No. 4**

JALGAON MUNICIPAL CORPORATION JALGAON									
Pump Field Measurement Sheet									
Location :-	**Waghur Raw Water Pump-4**					**Date :-**	**01-02-13**		
Pump No :-	4	**Rated Flow (m3/hr)**	1355	**Ext. Pipe Dia (mm)**	517	**Pump Center Level (m)**		0.98	
Pump Make	Kirloskar	**Rated Speed (RPM)**	1485	**Material of Pipe**	Steel				
Sr. No.	1709604004	**RPM Meter**	Digital	**Thickness (mm)**	7.7	**PG Ht. from Pump Floor (m)**		0.6	
Impeller Dia	486 mm BR	**Rated Input Power (kW)**		**Internal Probe Distance (mm)**	225				
Delivery/Suction (mm)		**PR Gauge**	Analog	**Probe Type**	Z	**PG Ht. from Pump Center Level (m)**		-0.38	
Rated Head (m)	75	**Flow Meter**	Ultraflux	**Internal Dia (mm)**					
Flow Meter Readings									
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head (M)**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head(M)**	**Sump / Water Level (m) {A}**	**Pump Center Level (m) from floor level {B}**	**Total Suction Head (B-A)**	**Total Head (m)**
12:30	822.60	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
12:45	802.70	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
13:00	842.10	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
13:15	796.90	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
13:30	856.40	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
Average	**824.1**	**8.0**	**80**	**-0.38**	**79.62**	**4.94**	**0.98**	**-3.96**	**75.66**
Note:-		**Sensor Type**				**Tested By**			
		Real Gain (DB)		**26**		**Start Time**	**12:30**		
		Sound Velocity		**1492**		**Stop Time**	**13:30**		
		Quality Index (%)		**100%**		**Witnessed By**			

❖ **Pump No. 5**

JALGAON MUNICIPAL CORPORATION JALGAON									
Pump Field Measurement Sheet									
Location :-		Waghur Raw Water Pump-5				Date :-	01-02-13		
Pump No :-		5	Rated Flow (m3/hr)	1355	Ext. Pipe Dia (mm)	517	Pump Center Level (m)		0.98
Pump Make		Kirloskar	Rated Speed (RPM)	1485	Material of Pipe	Steel			
Sr. No.		1709604005	RPM Meter	Digital	Thickness (mm)	7.7	PG Ht. from Pump Floor (m)		0.6
Impeller Dia		486 mm BR	Rated Input Power (kW)		Internal Probe Distance (mm)	225			
Delivery/Suction (mm)			PR Gauge	Analog	Probe Type	Z	PG Ht. from Pump Center Level (m)		0.38
Rated Head (m)		75	Flow Meter	Ultraflux	Internal Dia (mm)				
Flow Meter Readings									
Time	Flow (M3/HR)	Pressure (Kg/cm2) Discharge	Discharge Head (M)	PG Ht. Pump Discharge (m)	Total Discharge Head (M)	Dam Water Level (m) {A}	Pump Center Level (m) from floor level {B}	Total Suction Head (B-A)	Total Head (m)
11:05	1119.00	7.0	70	-0.38	69.62	4.94	0.98	-3.96	65.66
11:20	1202.00	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
11:35	1228.00	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
11:50	1199.00	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
12:05	1226.00	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
Average	**1194.8**	**7.8**	**78**	**-0.38**	**77.62**	**4.94**	**0.98**	**-3.96**	**73.66**
Note:-		Sensor Type				Tested By			
		Real Gain (DB)		18		Start Time	11:00		
		Sound Velocity		1493		Stop Time	12:05		
		Quality Index (%)		100%		Witnessed By			

❖ **Pump No. 6**

JALGAON MUNICIPAL CORPORATION JALGAON									
Pump Field Measurement Sheet									
Location :-		**Waghur Raw Water Pump-6**				**Date :-**	**01-02-13**		
Pump No :-		6	**Rated Flow (m3/hr)**	1355	**Ext. Pipe Dia (mm)**	517	**Pump Center Level (m)**		0.98
Pump Make		Kirloskar	**Rated Speed (RPM)**	1485	**Material of Pipe**	Steel			
Sr. No.		1709604006	**RPM Meter**	Digital	**Thickness (mm)**	7.7	**PG Ht. from Pump Floor (m)**		0.6
Impeller Dia		486 mm BR	**Rated Input Power (kW)**		**Internal Probe Distance (mm)**	225			
Delivery/Suction (mm)			**PR Gauge**	Analog	**Probe Type**	Z	**PG Ht. from Pump Center Level (m)**		-0.38
Rated Head (m)		75	**Flow Meter**	Ultraflux	**Internal Dia (mm)**				
Flow Meter Readings									
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head (M)**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head (M)**	**Dam Water Level (m) {A}**	**Pump Center Level (m) from floor level {B}**	**Total Suction Head (B-A)**	**Total Head (m)**
16:00	965.50	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
16:15	970.40	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
16:30	950.20	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
16:45	946.50	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
17:00	954.40	8.0	80	-0.38	79.62	4.94	0.98	-3.96	75.66
Average	**957.4**	**8.0**	**80**	**-0.38**	**79.62**	**5**	**0.98**	**-3.96**	**75.66**
Note:-		**Sensor Type**				**Tested By**			
		Real Gain (DB)		**27**		**Start Time**	**16:00**		
		Sound Velocity		**1488**		**Stop Time**	**17:00**		
		Quality Index (%)		**100%**		**Witnessed By**			

2. Girna Pumping Stations New

❖ Pump No.1

JALGAON MUNICIPAL CORPORATION, JALGAON										
Pump Field Efficiency Measurement Sheet										
Location :-	**Girna Pumping Station New 75 HP (1 No.)**						**Date :-**	**30-01-13**		
Pump No :-	1	**Rated Flow (m3/hr)**	375	**Ext. Pipe Dia (mm)**			**Pump Center Level (m)**		0.6	
Pump Make	Kirloskar	**Rated Speed (RPM)**	1450	**Material of Pipe**		Steel				
Sr. No.	2188A9280	**RPM Meter**		**Thickness (mm)**		7	**PG Ht. from Pump Floor (m)**		0.4	
Impeller Dia	310 Br	**Rated Input Power (kW)**	55	**Internal Probe Distance (mm)**		210				
Delivery/Suction (mm)	200	**PR Gauge**	Analog	**Probe Type**		Z	**PG Ht. from Pump Center Level (m)**		-0.2	
Rated Head (m)	25	**Flow Meter**	Ultraflux	**Internal Dia (mm)**						
Flow Meter Readings										
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head (M)**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head (M)**	**Sump / Water Level (m) {A}**	**Total Sump Depth (m) {B}**	**Pump Center Level (m) from floor level {C}**	**Total Suction Head (B+C-A)**	**Total Head (m)**
18:45	429.100	1.80	18	-0.20	17.80	2.70	4	0.60	1.90	19.70
19:00	422.700	1.98	20	-0.20	19.60	2.65	4	0.60	1.95	21.55
19:15	400.000	2.00	20	-0.20	19.80	2.60	4	0.60	2.00	21.80
19:30	417.500	2.00	20	-0.20	19.80	2.80	4	0.60	1.80	21.60
19:45	416.500	2.00	20	-0.20	19.80	2.70	4	0.60	1.90	21.70
Average	**417.2**	**2.0**	**20**	**-0.20**	**19.36**	**3**	4	**0.60**	**1.91**	**21.27**
Note:-		**Sensor Type**				**Tested By**				
		Real Gain (DB)		**20**		**Start Time**		18:45		
		Sound Velocity		**1496**		**Stop Time**		19:45		
		Quality Index (%)		**100%**		**Witnessed By**				

❖ **Pump No.2**

JALGAON MUNICIPAL CORPORATION, JALGAON										
Pump Field Measurement Sheet										
Location :-	**Girna Pumping Station New 75 HP (2 No.)**					Date :-	**30-01-13**			
Pump No :-	2	**Rated Flow (m3/hr)**	375	**Ext. Pipe Dia (mm)**		**Pump Center Level (m)**		0.6		
Pump Make	Kirloskar	**Rated Speed (RPM)**	1450	**Material of Pipe**	Steel					
Sr. No.		**RPM Meter**		**Thickness (mm)**	7	**PG Ht. from Pump Floor (m)**		0.4		
Impeller Dia	310 Br	**Rated Input Power (kW)**	31.75	**Internal Probe Distance (mm)**	210					
Delivery/Suction (mm)	200	**PR Gauge**	Analog	**Probe Type**	Z	**PG Ht. from Pump Center Level (m)**		-0.2		
Rated Head (m)	25	**Flow Meter**	Ultraflux	**Internal Dia (mm)**						
Flow Meter Readings										
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head**	**Sump / Water Level (m) {A}**	**Total Sump Depth (m) {B}**	**Pump Center Level (m) from floor level {C}**	**Total Suction Head (B+C-A)**	**Total Head (m)**
17:30	444.500	1.80	18	-0.20	17.80	2.90	4	0.60	1.70	19.50
17:45	446.400	1.80	18	-0.20	17.80	2.88	4	0.60	1.72	19.52
18:00	445.900	1.85	19	-0.20	18.30	2.80	4	0.60	1.80	20.10
18:15	446.800	1.85	19	-0.20	18.30	2.70	4	0.60	1.90	20.20
18:30	449.700	1.85	19	-0.20	18.30	2.50	4	0.60	2.10	20.40
Average	**446.7**	**1.83**	**18**	**-0.20**	**18.10**	**3**	4	**0.60**	**1.84**	**19.94**
Note:-		**Sensor Type**				**Tested By**				
		Real Gain (DB)		**20**		**Start Time**		**17:30**		
		Sound Velocity		**1496**		**Stop Time**		**18:30**		
		Quality Index (%)		**100%**		**Witnessed By**				

3. Girna Pumping Stations Old 50 HP

JALGAON MUNICIPAL CORPORATION, JALGAON										
Pump Field Measurement Sheet										
Location :-	**Girna Pumping Station Old 50 HP**						**Date :-**	**03-02-13**		
Pump No :-	1	**Rated Flow (m3/hr)**		**Ext. Pipe Dia (mm)**			206.8	**Pump Center Level (m)**		0.5
Pump Make	Kirloskar	**Rated Speed (RPM)**		**Material of Pipe**			CI			
Sr. No.		**RPM Meter**		**Thickness (mm)**			12.5	**PG Ht. from Pump Floor (m)**		0.26
Impeller Dia		**Rated Input Power (kW)**		**Internal Probe Distance (mm)**			93			
Delivery/Suction (mm)		**PR Gauge**	Analog	**Probe Type**			Z	**PG Ht. from Pump Center Level (m)**		0.24
Rated Head (m)		**Flow Meter**	Ultraflux	**Internal Dia (mm)**						
Flow Meter Readings										
Time	**Flow (M3/HR)**	**Pressure (Kg/cm2) Discharge**	**Discharge Head (M)**	**PG Ht. Pump Discharge (m)**	**Total Discharge Head (M)**	**Sump / Water Level (m) {A}**	**Total Sump Depth (m) {B}**	**Pump Center Level (m) from floor level {C}**	**Total Suction Head (B+C-A)**	**Total Head (m)**
7:35	135.214	2.20	22	-0.24	21.76	3.40	4	0.50	1.10	22.86
7:50	131.036	3.00	30	-0.24	29.76	2.80	4	0.50	1.70	31.46
8:05	132.972	3.60	36	-0.24	35.76	2.40	4	0.50	2.10	37.86
8:20	121.627	3.60	36	-0.24	35.76	2.00	4	0.50	2.50	38.26
8:35	128.300	3.40	34	-0.24	33.76	1.60	4	0.50	2.90	36.66
Average	**129.8**	**3.2**	**32**	**-0.24**	**31.36**	**2**	4	**0.50**	**2.06**	**33.42**
Note:-		**Sensor Type**				**Tested By**				
		Real Gain (DB)		**34**		**Start Time**		**7:35**		
		Sound Velocity		**1490**		**Stop Time**		**8:35**		
		Quality Index (%)		**100%**		**Witnessed By**				

4. Girna Pumping Stations Old 80 HP

JALGAON MUNICIPAL CORPORATION, JALGAON										
Pump Field Efficiency Measurement Sheet										
Location :-		Girna Pumping Station Old 80 HP (1 No.)					Date :-	31-01-13		
Pump No :-		1	Rated Flow (m3/hr)	475	Ext. Pipe Dia (mm)		273.7	Pump Center Level (m)		0.45
Pump Make			Rated Speed (RPM)	1475	Material of Pipe		Steel			
Sr. No.			RPM Meter		Thickness (mm)		12	PG Ht. from Pump Floor (m)		0.57
Impeller Dia			Rated Input Power (kW)	55	Internal Probe Distance (mm)		149			
Delivery/Suction (mm)			PR Gauge	Analog	Probe Type		Z	PG Ht. from Pump Center Level (m)		0.12
Rated Head (m)		26	Flow Meter	Ultraflux	Internal Dia (mm)					
Flow Meter Readings										
Time	Flow (M3/HR)	Pressure (Kg/cm2) Discharge	Discharge Head (M)	PG Ht. Pump Discharge (m)	Total Discharge Head (M)	Sump / Water Level (m) {A}	Total Sump Depth (m) {B}	Pump Center Level (m) from floor level {C}	Total Suction Head (B+C-A)	Total Head (m)
9:00	460.431	2.80	28	0.12	28.12	2.90	4	0.45	1.55	29.67
9:15	451.498	2.80	28	0.12	28.12	2.88	4	0.45	1.57	29.69
9:30	455.034	2.80	28	0.12	28.12	2.80	4	0.45	1.65	29.77
9:45	457.761	2.80	28	0.12	28.12	2.70	4	0.45	1.75	29.87
10:00	470.933	2.80	28	0.12	28.12	2.50	4	0.45	1.95	30.07
Average	**459.13**	**2.8**	**28**	**0.12**	**28.12**	**2.8**	4	**0.45**	**1.69**	**29.81**
Note:-		Sensor Type				Tested By				
		Real Gain (DB)		45		Start Time		9:00		
		Sound Velocity		1489		Stop Time		10:00		
		Quality Index (%)		100%		Witnessed By				

5. DSP Chowk Booster Pumping 75 HP

JALGAON MUNICIPAL CORPORATION, JALGAON										
Pump Field Measurement Sheet										
Location :-	DSP Chowk Booster Pump						Date :-	03-02-13		
Pump No :-	1	Rated Flow (m3/hr)	382	Ext. Pipe Dia (mm)	266.75		Pump Center Level (m)	0.52		
Pump Make		Rated Speed (RPM)		Material of Pipe	M.S					
Sr. No.		RPM Meter		Thickness (mm)	7		PG Ht. from Pump Floor (m)	0.75		
Impeller Dia		Rated Input Power (kW)		Internal Probe Distance (mm)	122					
Delivery/Suction (mm)		PR Gauge	Analog	Probe Type	Z		PG Ht. from Pump Center Level (m)	0.3		
Rated Head (m)	34	Flow Meter	Ultraflux	Internal Dia (mm)						
Flow Meter Readings										
Time	Flow (M3/HR)	Pressure (Kg/cm2) Discharge	Discharge Head (M)	PG Ht. Pump Discharge (m)	Total Discharge Head (M)	Sump / Water Level (m) {A}	Pressure (m) Suction {B}	Pump Center Level (m) from floor level {C}	Total Suction Head (B+C-A)	Total Head (m)
15:45	397.300	4.10	41	0.30	41.30	0.00	12.00	0.52	12.52	28.78
16:00	375.800	4.00	40	0.30	40.30	0.00	15.00	0.52	15.52	24.78
16:15	378.400	4.20	42	0.30	42.30	0.00	12.00	0.52	12.52	29.78
16:30	390.600	4.00	40	0.30	40.30	0.00	11.00	0.52	11.52	28.78
16:45	390.800	4.10	41	0.30	41.30	0.00	12.00	0.52	12.52	28.78
Average	**386.6**	**4.1**	**41**	**0.30**	**41.10**	**0**	12.40	**0.52**	**12.92**	**28.18**
Note:-		Sensor Type				Tested By				
		Real Gain (DB)		20		Start Time		15:45		
		Sound Velocity		1499		Stop Time		16:45		
		Quality Index (%)		100%		Witnessed By				

6. Raymond Chowk Booster Pumping 75 HP

JALGAON MUNICIPAL CORPORATION, JALGAON			
Pump Field Measurement Sheet			
Location :-	**Raymond Booster Pumping**		
Pump No :-	1	**Rated Flow (m3/hr)**	350
Pump Make	Kirloskar Brother Ltd	**Rated Speed (RPM)**	1450
Sr. No.	1747200092	**RPM Meter**	Digial
Impeller Dia		**Rated Input Power (kW)**	
Delivery/Suction (mm)	155 / 200	**PR Gauge**	Analog
Rated Head (m)	50	**Flow Meter**	Ultraflux

Flow Meter Readings	
Time	**Flow (M3/HR)**
12:30	252.300
12:45	261.100
1:00	257.900
1:15	254.800
1:30	252.700
Average	**255.8**

D. Details of Energy Audit Recommendations

Name of Scheme:	Jalgaon Municipal Corporation								
Details of Energy Audit Recommendations									
Sr.No.	Energy Audit Carried Out/ Name of Pumping Station	Rated Capacity of Existing Pump in HP	Overall Efficiency in %	After E A proposed HP of E.E. Pump / Replacing Energy efficient Pumps	Cost of New Energy Efficient Pump/ Overhauling/Polymer	Net Annual Saving due to E.E. Pump & Motor in Rs.	Annual kwh savings	References	Page No
1	Waghur Raw Water pump-2	500	55.89	500	485625	1213647	229857	1) 6.1.3 Pump Efficiency 2) 6.1.4 Energy Saving Potential 3) 6.1.7 Investment Summary	1) 58 Page no., 2) 60 Page no 3) 63 Page no
2	Waghur Raw Water pump-3	500	61.17	500	485625	958576	181548	1) 6.1.3 Pump Efficiency 2) 6.1.4 Energy Saving Potential 3) 6.1.7 Investment Summary	1) 58 Page no., 2) 60 Page no 3) 63 Page no
3	Waghur Raw Water pump-4	500	60.62	500	485625	1044723	197864	1) 6.1.3 Pump Efficiency 2) 6.1.4 Energy Saving Potential 3) 6.1.7 Investment Summary	1) 58 Page no., 2) 60 Page no 3) 63 Page no
4	Pump-1 Girna Pumping Station Old	50	38.82	50	604385	215810	42566	1) 6.2.3 Pump Efficiency 2) 6.2.4 Energy Saving Potential 3) 6.2.6 Investment Summary	1) 65 Page no., 2) 67 Page no 3) 69 Page no

Sr_No	Name of Pumping Station	Existing Average P.F.	Recommended KVAR	Additional Cost for Providing capacitors (in Rs)	Saving In Power Factor Penalty in Rs	Reduction In Demand KVA	Saving Due to reduction in Demand in Rs	Additional PF Incentive	Annual savings by improvement in power factor (in Rs.)	References	Page No
1	Waghur Raw Water Pumping Station	0.97	175	523252		394.4	81756	2666643	2748399	1) 7.1.1 PF Saving	1) 78 Page no.,

E. Estimates for EC Measures at Different Pumping Station

❖ Waghur Raw Water Pumping

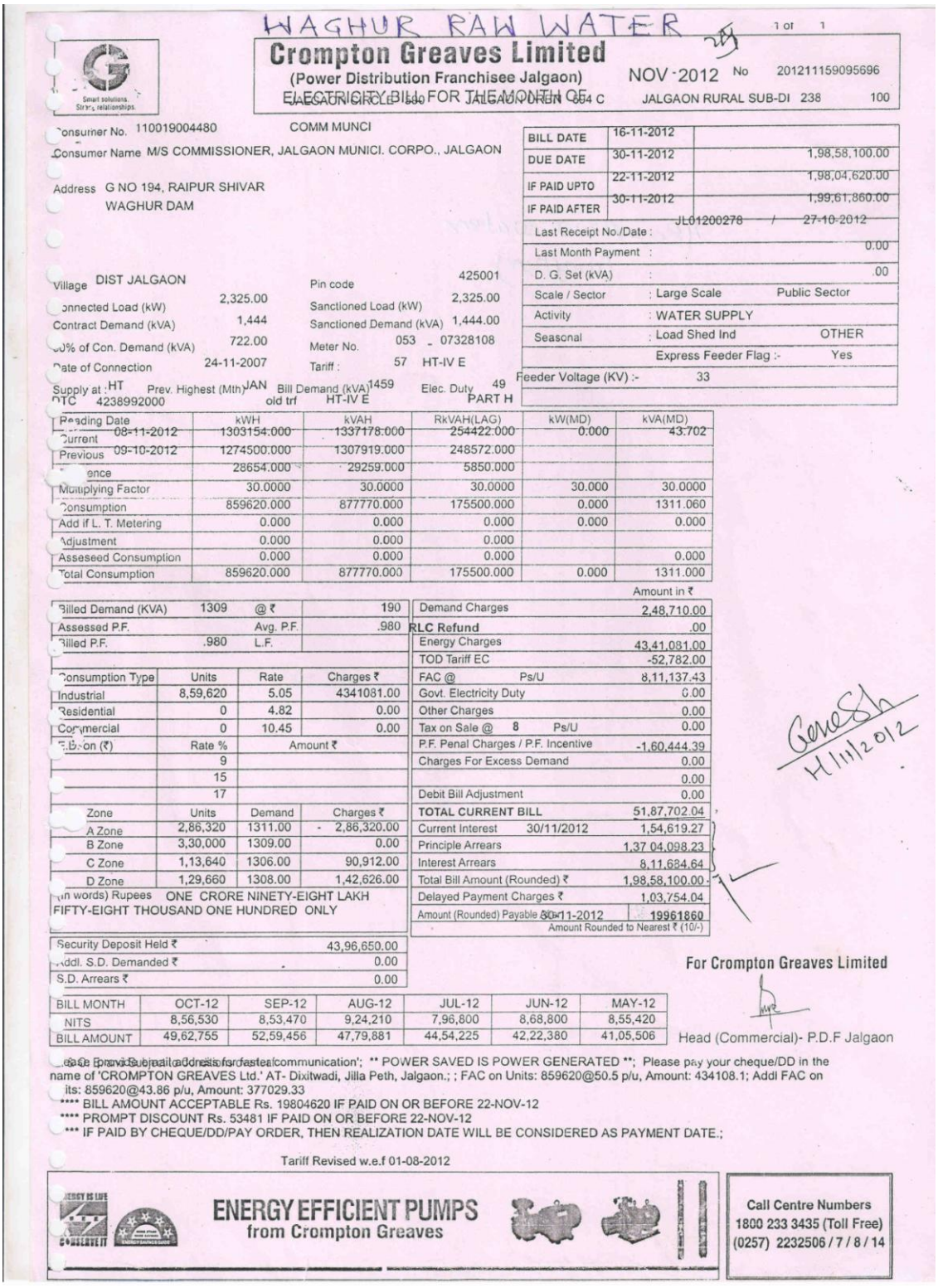
BUDGETORY ESTIMATE FOR WAGHUR RAW WATER PUMPING						
Sr. No	**QTY**		**DESCRIPTION OF ITEM**	**REFERANCE MJP/PWD/MARKET RATE**	**RATE IN Rs**	**AMOUNT IN Rs**
1			**Horizontal CENTRIFUGAL PUMP 500 HP**			
	3	Nos	Overhauling, Polymer Protective Coating to the Pump Impeller and Casing	Market Rate	450000	**1350000**
2			**ENERGY METER**			
	3	Nos	Multifunctional power analyzer cum Energy Meter for Energy Efficiency Monitoring System	Market Rate	12500	**37500**
			Gross Total			**1387500**
			Add 5 % for contingencies			69375
			TOTAL		Rs.	**1456875**

- **Girna Pumping Station**

BUDGETORY ESTIMATE FOR GIRNA PUMPING STATION						
SR.NO	**QTY**		**DESCRIPTION OF ITEM**	**REFERANCE MJP/PWD/MARKET RATE**	**RATE IN Rs**	**AMOUNT IN Rs**
1			**HORIZONTAL CENTRIFUGAL PUMP FOR WTP-50 HP**			
	1	Nos	Providing, erecting commissioning & giving satisfactory test and trial of Centrifugal Monoblock pump set confirming to IS 9079 operating at 2900 RPM with Bronze impeller, priming funnel cock suitable flanges at suction and delivery side. Pump shall have common shaft for pump and motor. Pump set shall be suitable for working at various discharge and head requirements. Pump shall be erected on Provided CC foundation block with suitable foundation bolts grouted in C.C foundation block 50 HP	Market Rate	225000	225000
2			**FOOT MOUNTED MOTOR TEFC FOR WTP-50 HP**			
	1	Nos	Motor shall be suitable for working on 415 V+-10%, 3Ph, 50Hz, A.C Supply. Motor shall be TEFC type 50 HP rating.	Item no. MJP, MO 4-13, page no. 78	172867	172867
3			**MCCB**			
	1	nos	Providing & erecting 3 Pole MCCB upto 200A of 35kA SC rating, thermal and magnetic setting with provided leads on iron frame/laminated board with sheet metal Enclosure, with variable setting.	Item No. PWD CSR 5-5-2, page no.51	14191	14191
4			**AUTO TRANSFORMER STARTER WITH AIR BREAK CONTACTOR (LOCALLY FABRICATED)**			

BUDGETORY ESTIMATE FOR GIRNA PUMPING STATION						
SR.NO	**QTY**		**DESCRIPTION OF ITEM**	**REFERANCE MJP/PWD/MARKET RATE**	**RATE IN Rs**	**AMOUNT IN Rs**
	1	nos	Providing erecting and giving test and trial of fully automatic, Auto Transformer Starter for 50 HP motor with air Break Contactor, assembled locally with contactors of approved make in 14 SWG sheet steel fabricated, floor mounted type cubical panel, suitable for operation on 380-440 Volts, 3 phase, 50 Hz fitted with accessories as below the incoming and outgoing cable and boxes shall be on either sides of main panel. The cable entries from auto transformer shall be totally enclosed in sheet metal. The starter shall have screened louvers on both sides. 1) Oil immersed copper wound auto transformer with 50%, 65% and 80% tapping including first fill of oil. 2) All air break contactors of AC 3 duty of suitable rating as mentioned. 3) Bimetallic overload relay. 4) Timer ON and OFF delay. 5) Master Timer. 6) Ammeter with CTs and selector switch. 7) No volt release.8) Motor ON,OFF and TRIP indication lamp. 8) Motor Protection relay, solid state with protection CTs. 10) Thermostat with 1 NO + 1 NC for Oil temperature. 11) Door interlock switch with 1 NO + 1 NC 12) Control Fuse. Starter for Motor HP/Contactor Rating "Main/Start/Run".	Item No.MJP, LG 5-2,page no. 52	118007	118007
5			**CABLE & GLANDS**			
	25	Mtr	3 Core, 70 sq. mm Aluminium conductor XLPE/PVC insulated & armoured cable.	Item No. MJP, CB 4-9, page no.60	514.00	12850.00
	2	Nos	Supplying & erecting Siemens type brass cable glands for 3 1/2 core 70sq mm for PVC armoured cable.	Item No. PWD CSR 7-7-6, page no.69	95.00	190.00
6			**ENERGY METER**			
	1	Nos	Multifunctional power analyzer cum Energy Meter for Energy Efficiency Monitoring System	Market Rate	12500	12500
			Sub Total			**555605**
7			**MISCELLANEOUS FOR ACCESSORIES AND INSTALLATIONS**			**20000**
			Gross Total		Rs.	**575605**
			Add 5 % for contingencies			**28780**
			Total		Rs.	**604385**

Scan Copy of Electricity Bill for Waghur Raw Water Pumping



WAGHUR RAW WATER

1 of 1

Crompton Greaves Limited
(Power Distribution Franchisee Jalgaon)
ELECTRICITY BILL FOR THE MONTH OF NOV-2012 No 201211159095696
JALGAON CIRCLE 500 JALGAON URBAN 554 C JALGAON RURAL SUB-DI 238 100

Consumer No. 110019004480 COMM MUNCI
Consumer Name M/S COMMISSIONER, JALGAON MUNICI. CORPO., JALGAON
Address G NO 194, RAIPUR SHIVAR
WAGHUR DAM

BILL DATE	16-11-2012	
DUE DATE	30-11-2012	1,98,58,100.00
IF PAID UPTO	22-11-2012	1,98,04,620.00
IF PAID AFTER	30-11-2012	1,99,61,860.00
Last Receipt No./Date :	JL01200278 / 27-10-2012	
Last Month Payment :		0.00
D. G. Set (kVA) :		.00
Scale / Sector	: Large Scale	Public Sector
Activity	: WATER SUPPLY	
Seasonal	: Load Shed Ind	OTHER
	Express Feeder Flag :-	Yes
Feeder Voltage (KV) :-	33	

Village DIST JALGAON Pin code 425001
Connected Load (kW) 2,325.00 Sanctioned Load (kW) 2,325.00
Contract Demand (kVA) 1,444 Sanctioned Demand (kVA) 1,444.00
80% of Con. Demand (kVA) 722.00 Meter No. 053 - 07328108
Date of Connection 24-11-2007 Tariff : 57 HT-IV E
Supply at : HT Prev. Highest (Mth) JAN Bill Demand (kVA) 1459 Elec. Duty 49
OTC 4238992000 old trf HT-IV E PART H

Reading Date	kWH	kVAH	RkVAH(LAG)	kW(MD)	kVA(MD)
Current 08-11-2012	1303154.000	1337178.000	254422.000	0.000	43.702
Previous 09-10-2012	1274500.000	1307919.000	248572.000		
Difference	28654.000	29259.000	5850.000		
Multiplying Factor	30.0000	30.0000	30.0000	30.000	30.0000
Consumption	859620.000	877770.000	175500.000	0.000	1311.060
Add if L. T. Metering	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000		
Asseseed Consumption	0.000	0.000	0.000		0.000
Total Consumption	859620.000	877770.000	175500.000	0.000	1311.000

Billed Demand (KVA)	1309	@ ₹	190
Assessed P.F.		Avg. P.F.	.980
Billed P.F.	.980	L.F.	

Consumption Type	Units	Rate	Charges ₹
Industrial	8,59,620	5.05	4341081.00
Residential	0	4.82	0.00
Commercial	0	10.45	0.00

E.Duty on (₹)	Rate %	Amount ₹
	9	
	15	
	17	

Zone	Units	Demand	Charges ₹
A Zone	2,86,320	1311.00	2,86,320.00
B Zone	3,30,000	1309.00	0.00
C Zone	1,13,640	1306.00	90,912.00
D Zone	1,29,660	1308.00	1,42,626.00

(In words) Rupees ONE CRORE NINETY-EIGHT LAKH FIFTY-EIGHT THOUSAND ONE HUNDRED ONLY

Amount in ₹

Demand Charges	2,48,710.00
RLC Refund	.00
Energy Charges	43,41,081.00
TOD Tariff EC	-52,782.00
FAC @ Ps/U	8,11,137.43
Govt. Electricity Duty	0.00
Other Charges	0.00
Tax on Sale @ 8 Ps/U	0.00
P.F. Penal Charges / P.F. Incentive	-1,60,444.39
Charges For Excess Demand	0.00
	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	51,87,702.04
Current Interest 30/11/2012	1,54,619.27
Principle Arrears	1,37,04,098.23
Interest Arrears	8,11,684.64
Total Bill Amount (Rounded) ₹	1,98,58,100.00
Delayed Payment Charges ₹	1,03,754.04
Amount (Rounded) Payable 30-11-2012	19961860

Amount Rounded to Nearest ₹ (10/-)

Security Deposit Held ₹	43,96,650.00
Addl. S.D. Demanded ₹	0.00
S.D. Arrears ₹	0.00

Genesh 14/11/2012

For Crompton Greaves Limited

Head (Commercial)- P.D.F Jalgaon

BILL MONTH	OCT-12	SEP-12	AUG-12	JUL-12	JUN-12	MAY-12
NITS	8,56,530	8,53,470	9,24,210	7,96,800	8,68,800	8,55,420
BILL AMOUNT	49,62,755	52,59,456	47,79,881	44,54,225	42,22,380	41,05,506

Please Provide Email address for faster communication'; ** POWER SAVED IS POWER GENERATED **; Please pay your cheque/DD in the name of 'CROMPTON GREAVES Ltd.' AT- Dixitwadi, Jilla Peth, Jalgaon.; ; FAC on Units: 859620@50.5 p/u, Amount: 434108.1; Addl FAC on Units: 859620@43.86 p/u, Amount: 377029.33
**** BILL AMOUNT ACCEPTABLE Rs. 19804620 IF PAID ON OR BEFORE 22-NOV-12
**** PROMPT DISCOUNT Rs. 53481 IF PAID ON OR BEFORE 22-NOV-12
*** IF PAID BY CHEQUE/DD/PAY ORDER, THEN REALIZATION DATE WILL BE CONSIDERED AS PAYMENT DATE.;

Tariff Revised w.e.f 01-08-2012

ENERGY EFFICIENT PUMPS
from Crompton Greaves

Call Centre Numbers
1800 233 3435 (Toll Free)
(0257) 2232506 / 7 / 8 / 14

Scan Copy of Electricity Bill for WTP At Umale

UMALE WTP

Crompton Greaves Limited
(Power Distribution Franchisee Jalgaon)
ELECTRICITY BILL FOR THE MONTH OF NOV-2012 No 201211159095700
JALGAON CIRCLE 590 JALGAON URBN 594 C JALGAON RURAL SUB-DI 238 102

Consumer No. 110013004680 MUNCI CORP
Consumer Name M/S COMMISSIONER,JALGAON MUNCIPAL CORPORATION J/
Address G.NO 107A,109/3 UMALE SHIVAR
TAL& DIST JALGAON

BILL DATE	16-11-2012	
DUE DATE	30-11-2012	3,94,280.00
IF PAID UPTO	22-11-2012	3,92,760.00
IF PAID AFTER	30-11-2012	3,97,170.00

Last Receipt No./Date : JL01200279 / 27-10-2012
Last Month Payment : 0.00
D. G. Set (kVA) : .00
Scale / Sector : Large Scale Public Sector
Activity : WATER SUPPLY
Seasonal : Load Shed Ind OTHER
Express Feeder Flag :- Yes
Feeder Voltage (KV) :- 33

Village Pin code 425001
Connected Load (kW) 245.60 Sanctioned Load (kW) 245.60
Contract Demand (kVA) 125 Sanctioned Demand (kVA) 125.00
% of Con. Demand (kVA) 62.50 Meter No. 053 - 07427518
Date of Connection 28-01-2008 Tariff : 57 HT-IV E
Supply at : HT Prev. Highest (Mth) JUN Bill Demand (kVA) 67 Elec. Duty 49
DTC 4238993000 old trf HT-IV E PART H

Reading Date	kWH	kVAH	RkVAH(LAG)	kW(MD)	kVA(MD)
Current 08-11-2012	401955.000	415143.000	56806.000	0.000	19.721
Previous 09-10-2012	394082.000	407190.000	55963.000		
Difference	7873.000	7953.000	843.000		
Multiplying Factor	3.0000	3.0000	3.0000	3.000	3.0000
Consumption	23619.000	23859.000	2529.000	0.000	59.163
Add if L. T. Metering	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000		
Asseseed Consumption	0.000	0.000	0.000		0.000
Total Consumption	23619.000	23859.000	2529.000	0.000	59.000

Billed Demand (KVA) 63 @₹ 190
Assessed P.F. Avg. P.F. .994
Billed P.F. .994 L.F.

Consumption Type	Units	Rate	Charges ₹
Industrial	23,619	5.05	119275.95
Residential	0	4.82	0.00
Commercial	0	10.45	0.00

E.D. on (₹)	Rate %	Amount ₹
	9	
	15	
	17	

Zone	Units	Demand	Charges ₹
A Zone	8,643	48.00	- 8,643.00
B Zone	7,524	46.00	0.00
C Zone	2,730	59.00	2,184.00
D Zone	4,722	54.00	5,194.20

(In words) Rupees THREE LAKH NINETY-FOUR THOUSAND TWO HUNDRED EIGHTY ONLY

Amount in ₹

Demand Charges	11,970.00
RLC Refund	.00
Energy Charges	1,19,275.95
TOD Tariff EC	-1,264.80
FAC @ Ps/U	22,286.89
Govt. Electricity Duty	0.00
Other Charges	0.00
Tax on Sale @ 8 Ps/U	0.00
P.F. Penal Charges / P.F. Incentive	-7,613.40
Charges For Excess Demand	0.00
	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	1,44,654.64
Current Interest 30/11/2012	2,187.80
Principle Arrears	2,39,143.53
Interest Arrears	8,292.51
Total Bill Amount (Rounded) ₹	3,94,280.00
Delayed Payment Charges ₹	2,893.09
Amount (Rounded) Payable 30-11-2012	397170

Amount Rounded to Nearest ₹ (10/-)

Security Deposit Held ₹	7,40,150.00
Addl. S.D. Demanded ₹	0.00
S.D. Arrears ₹	0.00

Census 1/11/2012

For Crompton Greaves Limited

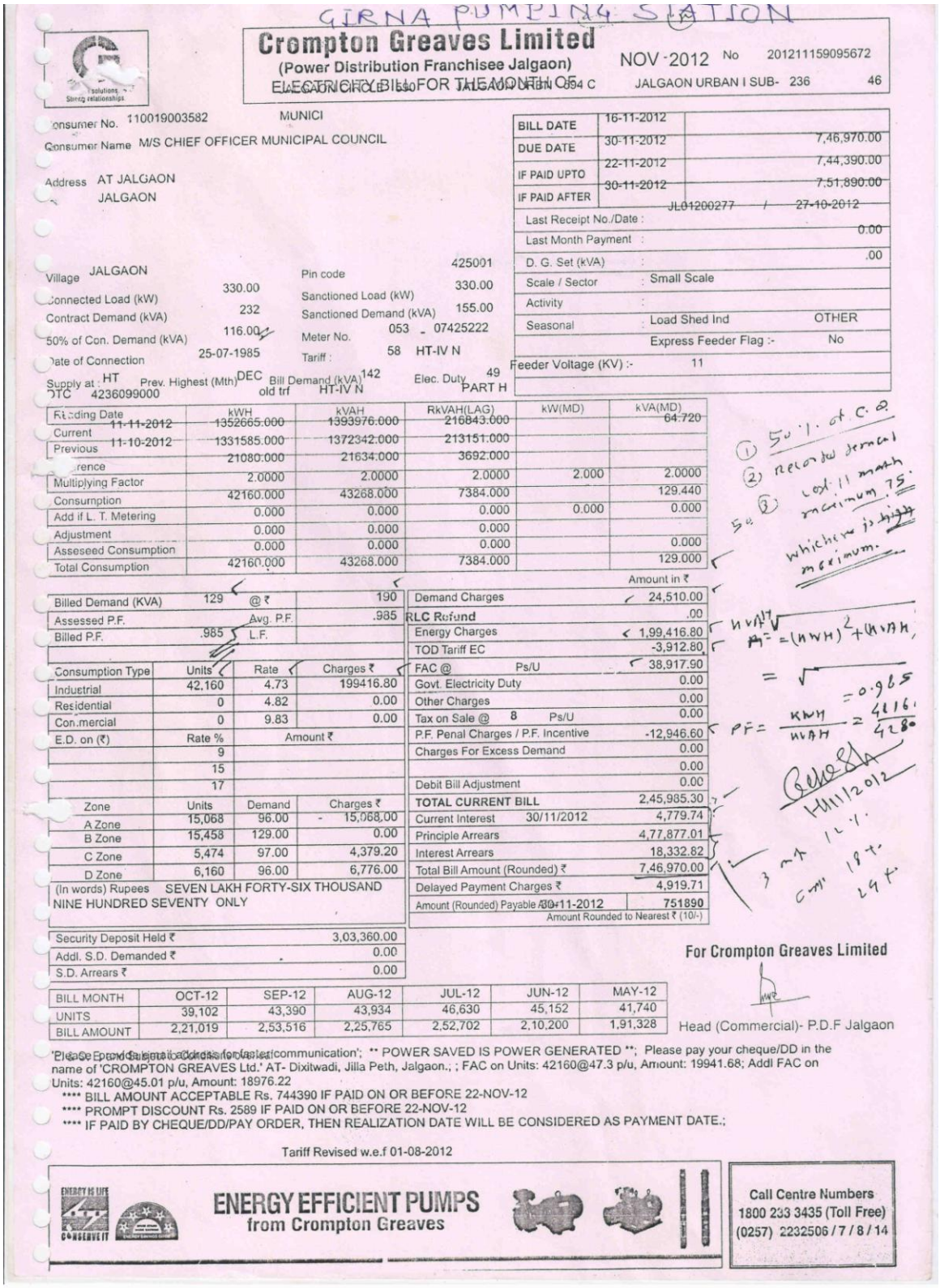
Head (Commercial)- P.D.F Jalgaon

BILL MONTH	OCT-12	SEP-12	AUG-12	JUL-12	JUN-12	MAY-12
UNITS	22,998	24,165	24,858	22,212	25,791	24,858
BILL AMOUNT	1,33,144	1,47,504	1,28,599	1,27,718	1,27,568	1,22.191

Please provide your mobile no. for faster communication'; ** POWER SAVED IS POWER GENERATED **; Please pay your cheque/DD in the name of 'CROMPTON GREAVES Ltd.' AT- Dixitwadi, Jilla Peth, Jalgaon.; ; FAC on Units: 23619@50.5 p/u, Amount: 11927.6; Addl FAC on Units: 23619@43.86 p/u, Amount: 10359.29
*** BILL AMOUNT ACCEPTABLE Rs. 392760 IF PAID ON OR BEFORE 22-NOV-12
**** PROMPT DISCOUNT Rs. 1523 IF PAID ON OR BEFORE 22-NOV-12
*** IF PAID BY CHEQUE/DD/PAY ORDER, THEN REALIZATION DATE WILL BE CONSIDERED AS PAYMENT DATE.;

Tariff Revised w.e.f 01-08-2012

Scan Copy of Electricity Bill for Girna Pumping Station



GIRNA PUMPING STATION

Crompton Greaves Limited
(Power Distribution Franchisee Jalgaon)
ELECTRICITY BILL FOR THE MONTH OF NOV-2012 No 201211159095672
JALGAON CIRCLE 550 JALGAON URBAN 554 C JALGAON URBAN I SUB- 236 46

Consumer No. 110019003582 MUNICI
Consumer Name M/S CHIEF OFFICER MUNICIPAL COUNCIL
Address AT JALGAON
JALGAON

BILL DATE	16-11-2012		
DUE DATE	30-11-2012		7,46,970.00
IF PAID UPTO	22-11-2012		7,44,390.00
IF PAID AFTER	30-11-2012		7,51,890.00
Last Receipt No./Date :		JL01200277 /	27-10-2012
Last Month Payment :			0.00
D. G. Set (kVA) :			.00
Scale / Sector	: Small Scale		
Activity	:		
Seasonal	: Load Shed Ind		OTHER
	Express Feeder Flag :-		No
Feeder Voltage (KV) :-	11		

Village JALGAON — Pin code 425001
Connected Load (kW) 330.00 — Sanctioned Load (kW) 330.00
Contract Demand (kVA) 232 — Sanctioned Demand (kVA) 155.00
50% of Con. Demand (kVA) 116.00 — Meter No. 053 - 07425222
Date of Connection 25-07-1985 — Tariff : 58 HT-IV N
Supply at HT — Prev. Highest (Mth) DEC — Bill Demand (kVA) 142 — Elec. Duty 49
OTC 4236099000 — old trf — HT-IV N — PART H

	kWH	kVAH	RkVAH(LAG)	kW(MD)	kVA(MD)
Reading Date	11-11-2012				64.720
Current	1352665.000	1393976.000	216843.000		
Previous	11-10-2012	1331585.000	1372342.000	213151.000	
Difference		21080.000	21634.000	3692.000	
Multiplying Factor		2.0000	2.0000	2.0000	2.000
Consumption		42160.000	43268.000	7384.000	129.440
Add if L. T. Metering		0.000	0.000	0.000	0.000
Adjustment		0.000	0.000	0.000	
Asseseed Consumption		0.000	0.000	0.000	0.000
Total Consumption		42160.000	43268.000	7384.000	129.000

Billed Demand (KVA)	129	@ ₹	190
Assessed P.F.		Avg. P.F.	.985
Billed P.F.	.985	L.F.	

Consumption Type	Units	Rate	Charges ₹
Industrial	42,160	4.73	199416.80
Residential	0	4.82	0.00
Commercial	0	9.83	0.00
E.D. on (₹)	Rate %	Amount ₹	
	9		
	15		
	17		

Zone	Units	Demand	Charges ₹
A Zone	15,068	96.00	15,068.00
B Zone	15,458	129.00	0.00
C Zone	5,474	97.00	4,379.20
D Zone	6,160	96.00	6,776.00

(In words) Rupees SEVEN LAKH FORTY-SIX THOUSAND NINE HUNDRED SEVENTY ONLY

	Amount in ₹
Demand Charges	24,510.00
RLC Refund	.00
Energy Charges	1,99,416.80
TOD Tariff EC	-3,912.80
FAC @ Ps/U	38,917.90
Govt. Electricity Duty	0.00
Other Charges	0.00
Tax on Sale @ 8 Ps/U	0.00
P.F. Penal Charges / P.F. Incentive	-12,946.60
Charges For Excess Demand	0.00
	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	2,45,985.30
Current Interest 30/11/2012	4,779.74
Principle Arrears	4,77,877.01
Interest Arrears	18,332.82
Total Bill Amount (Rounded) ₹	7,46,970.00
Delayed Payment Charges ₹	4,919.71
Amount (Rounded) Payable 30-11-2012	751890
Amount Rounded to Nearest ₹ (10/-)	

Security Deposit Held ₹	3,03,360.00
Addl. S.D. Demanded ₹	0.00
S.D. Arrears ₹	0.00

For Crompton Greaves Limited
Head (Commercial)- P.D.F Jalgaon

BILL MONTH	OCT-12	SEP-12	AUG-12	JUL-12	JUN-12	MAY-12
UNITS	39,102	43,390	43,934	46,630	45,152	41,740
BILL AMOUNT	2,21,019	2,53,516	2,25,765	2,52,702	2,10,200	1,91,328

'Please Encash Cheque/DD at Collection Counter'; ** POWER SAVED IS POWER GENERATED **; Please pay your cheque/DD in the name of 'CROMPTON GREAVES Ltd.' AT- Dixitwadi, Jilla Peth, Jalgaon., ; FAC on Units: 42160@47.3 p/u, Amount: 19941.68; Addl FAC on Units: 42160@45.01 p/u, Amount: 18976.22
**** BILL AMOUNT ACCEPTABLE Rs. 744390 IF PAID ON OR BEFORE 22-NOV-12
**** PROMPT DISCOUNT Rs. 2589 IF PAID ON OR BEFORE 22-NOV-12
**** IF PAID BY CHEQUE/DD/PAY ORDER, THEN REALIZATION DATE WILL BE CONSIDERED AS PAYMENT DATE.;

Tariff Revised w.e.f 01-08-2012

ENERGY EFFICIENT PUMPS
from Crompton Greaves

Call Centre Numbers
1800 233 3435 (Toll Free)
(0257) 2232506 / 7 / 8 / 14

Scan Copy of Electricity Bill for DSP Chowk Booster Pumping Station

DSP CHOWK PUMPING STATION 1 of 1

Crompton Greaves Limited
(Power Distribution Franchisee Jalgaon)
ELECTRICITY BILL FOR THE MONTH OF MAR 2012 No. 201203159092688
JALGAON CIRCLE 590 JALGAON URBN 594 C JALGAON URBAN I SUB- 236 72

Consumer No. 110019004910 COMMISIONE
Consumer Name COMMISIONER, MUNICIPAL CORPORATION JALGAON
Address DSP CHOWK, JALGAON

BILL DATE	16-03-2012
DUE DATE	30-03-2012 62,950.00
IF PAID UPTO	22-03-2012 62,310.00
IF PAID AFTER	30-03-2012 64,160.00
Last Receipt No./Date	CG11200361 / 07-03-2012
Last Month Payment	52,579.00
D. G. Set (kVA)	.00
Scale / Sector	Small Scale Public Sector
Activity	WATER SUPPLY
Seasonal	Load Shed Ind INDUST
	Express Feeder Flag :- No
Feeder Voltage (KV) :-	11

Village Pin code 425001
Connected Load (kW) 179.10 Sanctioned Load (kW) 179.10
Contract Demand (kVA) 120 Sanctioned Demand (kVA) 120.00
50% of Con. Demand (kVA) 60.00 Meter No. 053 - 08190136
Date of Connection 24-01-2009 Tariff : 58 HT-IV N
Supply at : HT Prev. Highest (Mth)APR Bill Demand (kVA)55 Elec. Duty 49
DTC 4236320 old trf HT-IV N PART H

Reading Date	kWH	kVAH	RkVAH(LAG)	kW(MD)	kVA(MD)
Current 10-03-2012	185153.000	188767.000	14808.000	0.000	26.825
Previous 08-02-2012	179441.000	183031.000	14701.000		
Difference	5712.000	5736.000	107.000		
Multiplying Factor	2.0000	2.0000	2.0000	2.000	2.0000
Consumption	11424.000	11472.000	214.000	0.000	53.650
Add if L. T. Metering	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000		
Asseseed Consumption	0.000	0.000	0.000		
Total Consumption	11424.000	11472.000	214.000	0.000	54.000

Billed Demand (KVA)	60	@ ₹	150
Assessed P.F.		Avg. P.F.	1.000
Billed P.F.	1.000	L.F.	

Consumption Type	Units	Rate	Charges ₹
Industrial	11,424	3.6	41126.40
Residential	0	3.72	0.00
Commercial	0	7.95	0.00

E.D. on (₹)	Rate %	Amount ₹
	9	
	15	
	17	

Zone	Units	Demand	Charges ₹
A Zone	1,704	51.00	1,448.40
B Zone	4,430	52.00	0.00
C Zone	1,558	53.00	1,246.40
D Zone	3,732	54.00	4,105.20

(In words) Rupees SIXTY-TWO THOUSAND NINE HUNDRED FIFTY ONLY

Security Deposit Held ₹	3,29,450.00
Addl. S.D. Demanded ₹	0.00
S.D. Arrears ₹	0.00

Amount in ₹

Demand Charges	9,000.00
Energy Charges	.00
RLC Refund	
TOD Tariff EC +Addl Charge	47,061.17
FAC @ Ps/U	3,903.20
Govt. Electricity Duty	4,706.69
Other Charges +Genco Charge	0.00
Tax on Sale @ 8 Ps/U	0.00
P.F. Penal Charges / P.F. Incentive	0.00
Charges For Excess Demand	4,526.97
	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	0.00
Current Interest 31/03/2012	60,144.09
Principle Arrears	23.11
Interest Arrears	2,778.60
Total Bill Amount (Rounded) ₹	8.64
Delayed Payment Charges ₹	62,959.00
Amount (Rounded) Payable After 30-03-2012	1,202.88
Amount Rounded to Nearest ₹ (10/-)	641.60

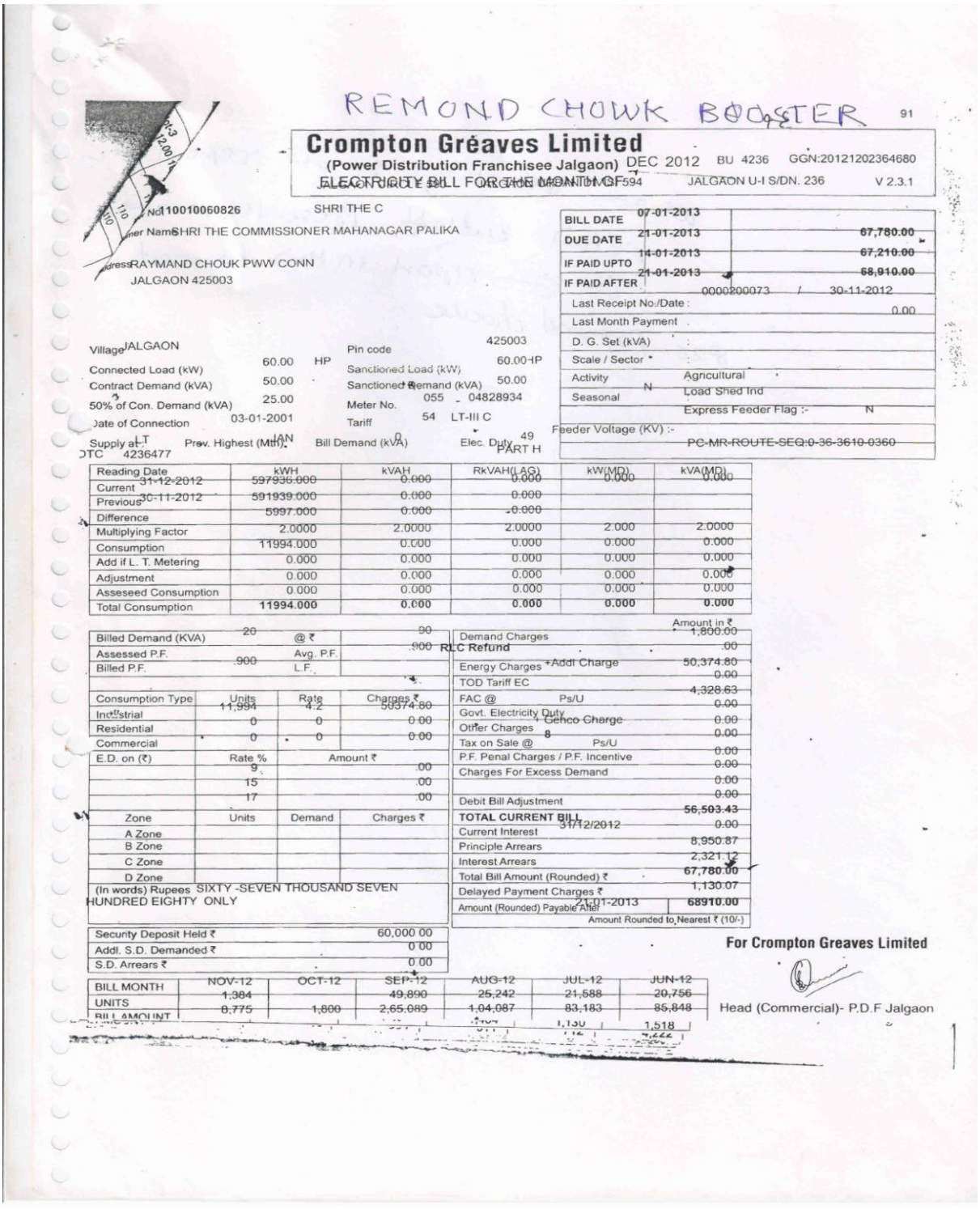
For Crompton Greaves Limited

Head (Commercial)- P.D.F Jalgaon

BILL MONTH	FEB-12	JAN-12	DEC-11	NOV-11	OCT-11	SEP-11
UNITS	9,664	10,270	10,398	10,944	9,854	11,176
BILL AMOUNT	52,579	56,338	55,801	58,220	51,692	58,617

E & O.E and Subject to Conditions overleaf.
"INTIMATE YOUR P.A.N. NUMBER TO CIRCLE OFFICE"; ** POWER SAVED IS POWER GENERATED **; ; Addl Charge (MERC case no. 69/2011) Rs. 1713.6@15 ps/u on Units 11424; Addl Charge (MERC case no. 100/2011) Rs. 4221.17 @36.95ps/u on units: 11424; FAC on Units: 11424@41.2 p/u, Amount: 4706.69
**** BILL AMOUNT ACCEPTABLE Rs. 62310 IF PAID ON OR BEFORE 22-MAR-12
**** PROMPT DISCOUNT Rs. 647 IF PAID ON OR BEFORE 22-MAR-12
**** IF PAID BY CHEQUE/DD/PAY ORDER, THEN REALIZATION DATE WILL BE CONSIDERED AS PAYMENT DATE.;

Scan Copy of Electricity Bill for Raymond Chowk Booster Pumping Station



REMOND CHOWK BOOSTER 91

Crompton Greaves Limited
(Power Distribution Franchisee Jalgaon) DEC 2012 BU 4236 GGN:20121202364680
ELECTRICITY BILL FOR THE MONTH OF JALGAON U-I S/DN. 236 V 2.3.1

No 110010060826 SHRI THE C
Name SHRI THE COMMISSIONER MAHANAGAR PALIKA
Address RAYMAND CHOUK PWW CONN
JALGAON 425003

BILL DATE	07-01-2013
DUE DATE	21-01-2013 67,780.00
IF PAID UPTO	14-01-2013 67,210.00
IF PAID AFTER	21-01-2013 68,910.00
Last Receipt No./Date	0000200073 / 30-11-2012
Last Month Payment	0.00
D. G. Set (kVA)	
Scale / Sector	
Activity	Agricultural
Seasonal	N Load Shed Ind
	Express Feeder Flag :- N
Feeder Voltage (KV) :-	
PC-MR-ROUTE-SEQ:0-36-3610-0360	

Village JALGAON Pin code 425003
Connected Load (kW) 60.00 HP Sanctioned Load (kW) 60.00 HP
Contract Demand (kVA) 50.00 Sanctioned Demand (kVA) 50.00
50% of Con. Demand (kVA) 25.00 Meter No. 055 04828934
Date of Connection 03-01-2001 Tariff 54 LT-III C
Supply at LT Prev. Highest (Mtd) JAN Bill Demand (kVA) 0 Elec. Duty 49 PART H
OTC 4236477

	kWH	kVAH	RkVAH(LAG)	kW(MD)	kVA(MD)
Reading Date					
Current 31-12-2012	597936.000	0.000	0.000	0.000	0.000
Previous 30-11-2012	591939.000	0.000	0.000		
Difference	5997.000	0.000	0.000		
Multiplying Factor	2.0000	2.0000	2.0000	2.000	2.0000
Consumption	11994.000	0.000	0.000	0.000	0.000
Add if L. T. Metering	0.000	0.000	0.000	0.000	0.000
Adjustment	0.000	0.000	0.000	0.000	0.000
Asseseed Consumption	0.000	0.000	0.000	0.000	0.000
Total Consumption	**11994.000**	**0.000**	**0.000**	**0.000**	**0.000**

Billed Demand (KVA)	20	@ ₹	90
Assessed P.F.		Avg. P.F.	.900
Billed P.F.	.900	L.F.	

Consumption Type	Units	Rate	Charges ₹
Industrial	11,994	4.2	50374.80
Residential	0	0	0.00
Commercial	0	0	0.00

E.D. on (₹)	Rate %	Amount ₹
	9	.00
	15	.00
	17	.00

Zone	Units	Demand	Charges ₹
A Zone			
B Zone			
C Zone			
D Zone			

(In words) Rupees SIXTY -SEVEN THOUSAND SEVEN HUNDRED EIGHTY ONLY

Security Deposit Held ₹	60,000 00
Addl. S.D. Demanded ₹	0 00
S.D. Arrears ₹	0 00

Amount in ₹

Demand Charges	1,800.00
RLC Refund	.00
Energy Charges +Addl Charge	50,374.80
TOD Tariff EC	0.00
FAC @ Ps/U	4,328.63
Govt. Electricity Duty	0.00
Other Charges + Genco Charge	0.00
Tax on Sale @ 8 Ps/U	0.00
P.F. Penal Charges / P.F. Incentive	0.00
Charges For Excess Demand	0.00
	0.00
Debit Bill Adjustment	0.00
TOTAL CURRENT BILL	56,503.43
Current Interest 31/12/2012	0.00
Principle Arrears	8,950.87
Interest Arrears	2,321.12
Total Bill Amount (Rounded) ₹	67,780.00
Delayed Payment Charges ₹	1,130.07
Amount (Rounded) Payable After 21-01-2013	68910.00

Amount Rounded to Nearest ₹ (10/-)

BILL MONTH	NOV-12	OCT-12	SEP-12	AUG-12	JUL-12	JUN-12
UNITS	1,384		49,890	25,242	21,588	20,756
BILL AMOUNT	6,775	1,800	2,65,089	1,04,087	83,183	85,848
					1,130	1,518

For Crompton Greaves Limited

Head (Commercial)- P.D.F Jalgaon