ENERGY AUDIT AT "KERALA WATER AUTHORITY PH HEAD WORKS- ALUVA"

Energy Audit Report

Year: 2020-21

Energy Management Centre – Kerala
Dept of Power, Govt of Kerala.State Designated Agency
Sreekrishna Nagar, Sreekariyam P.O., Thiruvananthapuram – 695 017
Ph: 0471 - 2594922, 2594924,Fax: 0471 – 2594923
e-mail: emck@keralaenergy.gov.in

ENERGY AUDIT REPORT

KERALA WATER AUTHORITY PUMPING STATION

ALUVA

Energy Audit Report

KERALA WATER AUTHORITY PUMPING STATION-ALUVA

Report No: EA 581 & 582

2020-October

Energy Audit Team:

Suresh Babu B V, Accredited Energy Auditor, AEA 33
B. Zachariah, Chief Technical Consultant
Abin Baby, Project Engineer
Mahesh Ramachandran E, Project Engineer
Mohammed Aneez, Project Engineer

Accredited Energy Auditor, AEA 33
Bureau of Energy Efficiency
Government of India

Empaneled Energy Auditor, EMCEEA-0211F,
Energy Management Centre
Government of Kerala.

Acknowledgment

We were privileged to work together with the administration and staff of Kerala Water Authority pumping station, Aluva for their timely help extended to complete the study and bringing out this report on Energy Audit.

We are happy to acknowledge the help extended by Sri. Anil K Augustine Assistant Executive Engineer for their quality interactions and advices to make this audit complete.

We thank our consultants, engineers and backup staff for their dedication to bring this report.

Thank you.

B V Suresh Babu
Accredited Energy Auditor
AEA 33, Bureau of Energy Efficiency
For OTTOTRACTIONS

This Page is Intentionally Kept Blank

Contents

Certification

This is to certify that

The data collection has been carried out diligently and truthfully;

All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorised and no tampering of such devices has occurred;

All reasonable professional skill, care and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts;

Adequate training provided to personnel involved in daily operations after implementation of recommendations; and

The energy audit has been carried out in accordance with the Bureau of Energy Efficiency (Manner and Intervals of Time for the Conduct of Energy Audit) Regulations, 2010.

SURESH BABU B V
ACCREDITED ENERGY AUDITOR (AEA 33)

This Page is Intentionally Kept Blank

OTTOTRACTIONS- ENERGY AUDIT						
Executive Summary						
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects						
KWA PUMPING STATION, ALUVA						
Sl No	Projects	Investment	Cost saving	SPB	Energy saved	
		(Lakhs Rs)	(Rs)/Yr	Months	kWh/Yr	toE/Yr
1	Energy Saving in Lighting by replacing existing 173 No's T12 Lamps to 18W LED Tube	0.61	1.65	4.40	27506	2.37
2	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Tanker pump set	10.91	2.20	59.51	36653	3.15
3	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in WW Pump (Plant 3)	11.79	2.38	59.51	39636	3.41
4	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in WW Pump set (Plant 4)	4.26	0.86	59.51	14320	1.23
5	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Blowers	8.32	1.68	59.51	27958	2.40
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW1-HT1)	41.00	23.28	21.13	388068	33.37
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW1-HT3)	30.75	29.49	12.51	491436	42.26
8	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT1)	26.65	10.14	31.53	169068	14.54

9	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT2)	22.55	13.61	19.88	226884	19.51
10	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT4)	22.55	24.34	11.12	405588	34.88
11	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW3-HT1)	36.90	35.06	12.63	584292	50.25
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW3-HT2)	36.90	27.91	15.87	465156	40.00
13	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW3-HT3)	36.90	41.26	10.73	687660	59.14
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT1)	64.58	71.64	10.82	1193988	102.68
15	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT2)	64.58	70.33	11.02	1172088	100.80
16	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT6)	18.45	36.74	6.03	612324	52.66
17	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT1)	64.58	39.74	19.50	662256	56.95
18	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT3)	64.58	56.50	13.71	941700	80.99
19	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT3)	64.58	56.50	13.71	941700	80.99
20	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	51.25	12.46	49.37	207612	17.85
21	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	51.25	17.77	34.62	296088	25.46

22	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT5)	51.25	17.98	34.21	299592	25.76
23	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT1)	11.28	29.91	4.52	498444	42.87
24	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT5)	15.38	4.94	37.34	82344	7.08
25	Energy Saving by arresting leakages in flanges and other joints of the line.	--	--	--	--	--
26	Energy saving by reducing heat loss from terminations points & cables of electrical systems (as per TI report)	--	--	--	--	--
27	Energy saving by converting existing LT motors in PWPH No 3 to HT supply to reduce the downtime and maintenance	--	--	--	--	--
28	Improve the power factor to unity will save energy cost by getting PF incentives.	--	--	--	--	--
29	Installation of Solar Power Plants (50kWe) on the rooftop and other vacant area to cater lighting loads.	37.5	3.83	117	63875	
		849.5	631.83	26	10536236	901

This Page is Intentionally Kept Blank

1

Introduction

A detailed energy audit has been carried out at **KERALA WATER AUTHORITY PUMPING STATION, Aluva** in September 2020. **Energy Management Centre – Kerala (EMC) has entrusted** OTTOTRACTIONS an Accredited Energy Auditor of Bureau of Energy Efficiency and Empaneled Energy Auditor of Energy Management Centre, Government of Kerala to conduct this audit for EMC. The energy audit has identified energy conservation opportunities and recommended projects to improve energy efficiency of the facility.

About EMC-Kerala

Kerala Government has become the first State Government in India to establish an **Energy Management Centre (EMC)** at State level, aiming primarily to remould and instrumentalise energy sector as a catalyst in promoting a development process which is econo-ecologically sustainable. With a view to making energy sector achieve such a lead and catalytic role, EMC has evolved a novel and comprehensive energy management approach and institutional philosophy encompassing management of energy technology systems - both conventional and non-conventional, energy conservation in all sectors of the economy, energy resource management, rural and urban energy systems, energy education and training, energy generation and conservation based employment and poverty alleviation programmes.

India, one of the most affected countries in terms of energy shortage and increasing energy price became one such country in the world to adopt energy management measures at the earliest in all sectors of the economy on a priority basis, including popularising and promoting renewable energy technology and resources.

When liberalization and globalization of economy take effect, energy management aimed at enhancing total energy efficiency in all sectors of the economy becomes a major factor in determining the comprehensive competitiveness of the economy. Giving due consideration to this energy-economy interaction process/scenario, the Government of Kerala took leadership initiatives for establishing a multi-disciplinary Energy Management Centre under the Department of Power.

This energy audit report complies with the clauses in *Energy Conservation Act, 2001* on mandatory energy audit (**Form 4** [refer regulation 6(2)] guidelines for preparation of energy audit report) and complies with the G.O (Rt) No.2/2011/PD dated 01.01.2011 issued by Government of Kerala on mandatory energy audit.

1.1. General plant/establishment details and descriptions

Kerala water authority was established in first April 1984 under Kerala water and waste water ordinance. The Aluva PH Head works subdivision with consumer numbers 10/1010 (1355670000844) & 23/2357 (1355670001036) have four plants. Plant -1 established in the year 1965, Plant – 2 in 1977, Plant-3 in 1992 and plant-4 in 2002 at the head works Aluva. It has an installed capacity of 225 MLD (million liters per day) with 365 days working for all four plants together. Now plant is operating in its optimum capacity. The capacity utilisation is near 100%.

Base line Data (Electrical System)		
Code	EA 581	EA 582
Facility	KERALA WATER AUTHORITY, ALUVA	KERALA WATER AUTHORITY, ALUVA
Provider	KSEB Ltd	KSEB Ltd
Consumer No	1355670001036	1355670000844
Contract Demand (kVA)	1800	3418
Tariff	HT1(A) Industrial	HT1(A) Industrial
Energy Charge Rs/ kWh Z1	5.5	5.5
Energy Charge Rs/ kWh Z2	8.25	8.25
Energy Charge Rs/ kWh Z3	4.125	4.125
Demand Charge Rs/ kVA	300	300
Excess Demand Rs/kVA	150	150
Energy Bill Analysis interval	2018-19	2018-19

1.2. Energy audit team

The Energy Audit team is listed below. Besides this list various domine experts also participated in this project.

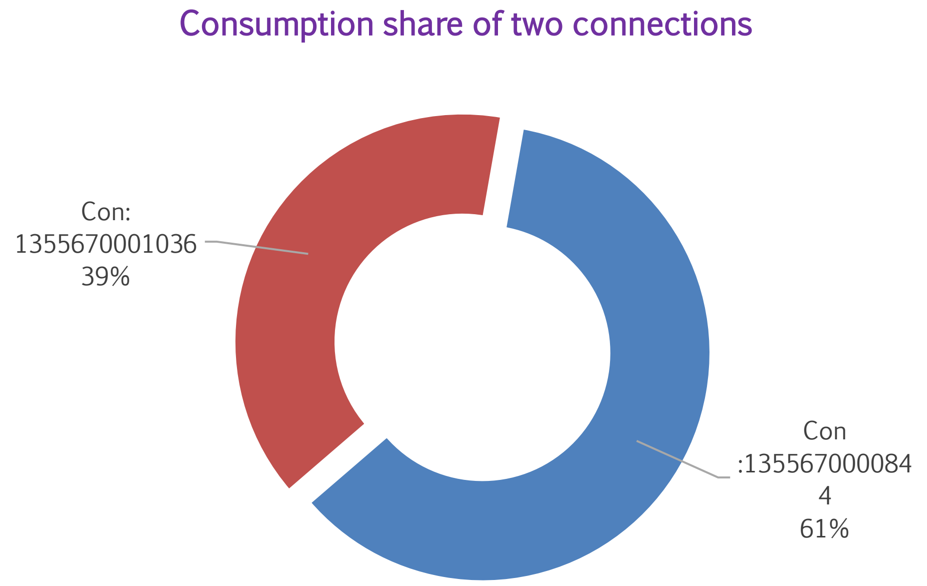
1. Suresh Babu B V, Accredited Energy Auditor, AEA 33
2. B. Zachariah, Chief Technical Consultant
3. Abhijith M R, Certified Energy Auditor
4. Abin Baby, Project Engineer
5. Mahesh Ramachandran E, Project Engineer
6. Mohammed Aneez, Project Engineer

1.3. Component of production cost

1. Energy (Electricity)
2. Manpower (Permanent & Contract)
3. Consumables
4. Overhead & others

1.4. Major energy use areas

Electricity from KSEB 100% holds the share in the total energy consumed in this facility.

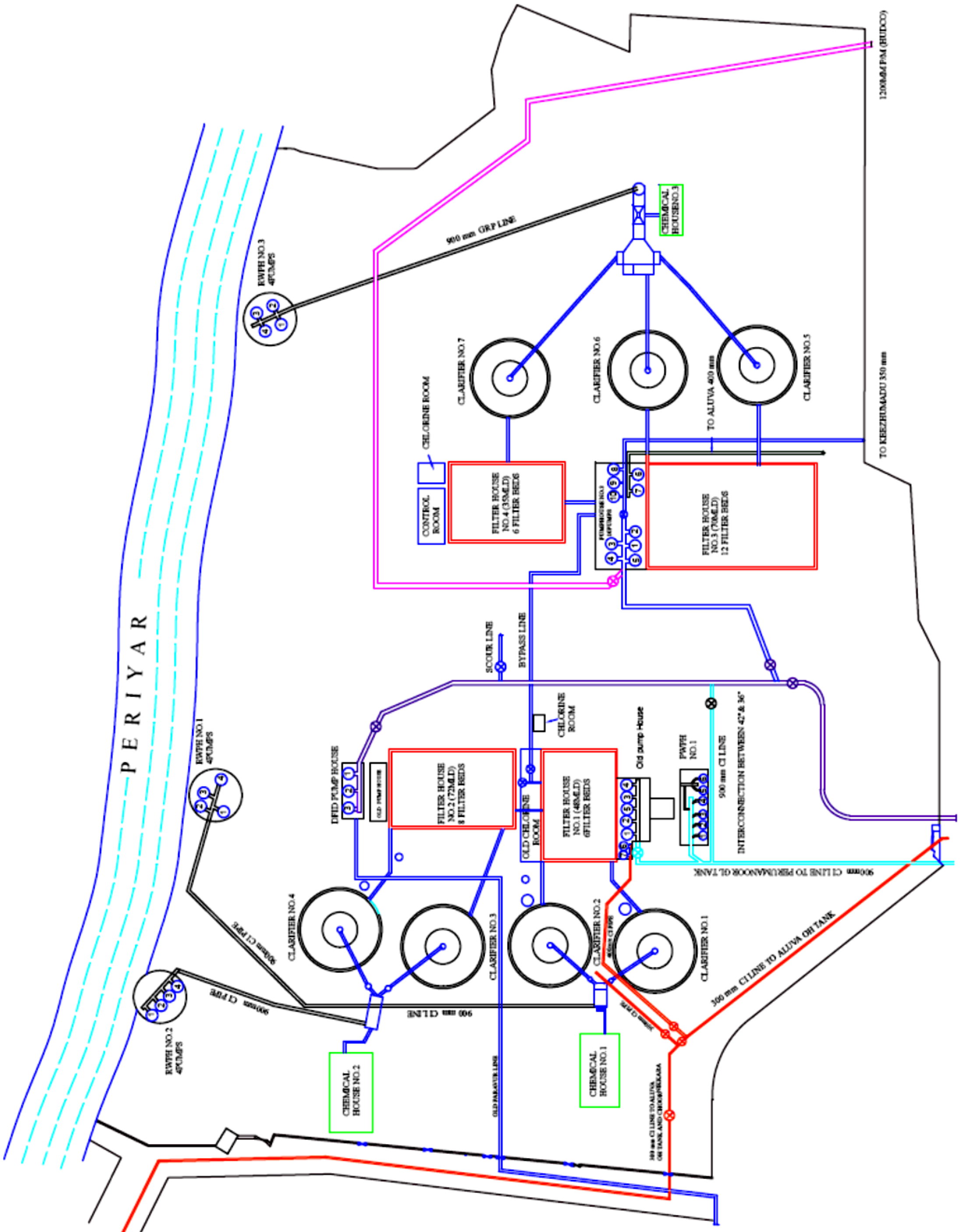


This Page is Intentionally Kept Blank

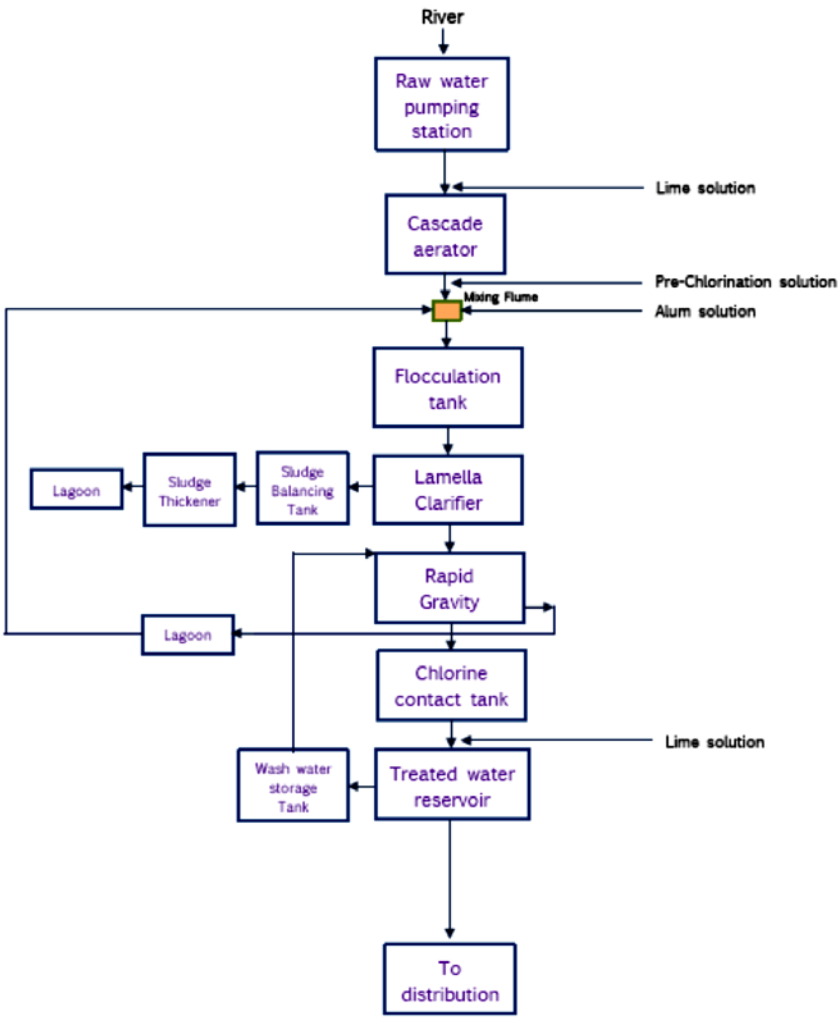
2

Production process description

SCHEMATIC DIAGRAM OF PLANT NO.I,II,III,IV



The Aluva head works having four plants: Plant -1 established in the year 1965 having 48 MLD, Plant – 2 in 1977 having 72 MLD, Plant-3 in 1992 having 70 MLD and plant-4 in 2002 having 35 MLD. The raw water intake is from Periyar through three intake wells. First commissioned in 1965, this plant has been progressively modified over the years with its capacity being gradually increased from an initial 48,000m^3/day to now delivering approximately 290,000m^3 of treated clear water into the EMWSS and Aluva water supply system daily. Taking water from the Periyar River, raw water pumps deliver water to the WTP located inside the campus. Here the water is treated in the following processes:



This Page is Intentionally Kept Blank

3

Energy and utility system description

3.1. List of utilities

Electricity is only fuel used in the facility.

3.2 Brief description of each utility

3.2.1 Electricity

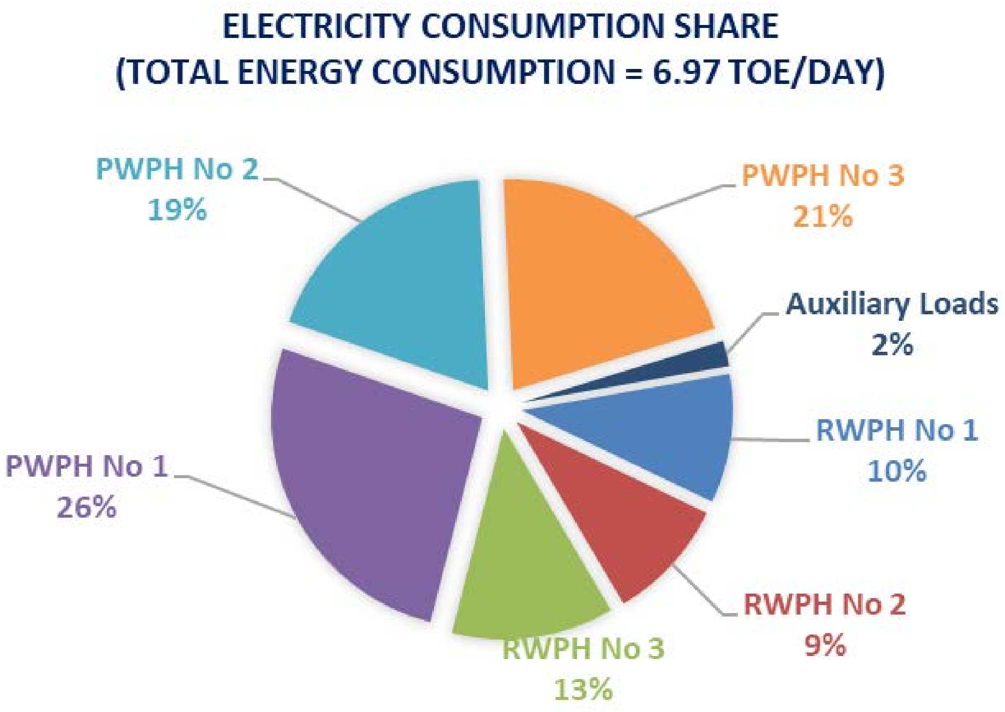
The facility is a consumer of Kerala State Electricity Board (KSEB) under HT – I (A) Industrial Tariff category at 11 kV. The facility having two HT connections with contract demand of 1800 kVA and 3418 kVA. The details of transformer installed in the facility are given below.

Details of Transformers				
Sl.No	Make	Year of manufacturing	Rating (kVA)	Voltage (kV)
1	ITL Co	1977	1000	0.440
2	ITL Co	1977	1000	0.440
3	ITL Co	1977	1000	0.440
4	ITL Co	1977	1000	0.440
5	KEL Co	1967	500	0.440
6	ITL Co	1963	500	0.440
7	KEL Co	1987	500	0.440
8	ITL Co	1992	1500	3.3
9	ITL Co	1992	1500	3.3
10	ITL Co	1992	1500	3.3
11	ITL Co	2008	1500	3.3
12	ITL Co	1992	500	0.440
13	ITL Co	1992	500	0.440
14	TELK	2015	6300	3.3
15	TELK	2015	6300	3.3

The power factor is being maintained as .95 in consumer number 1355670000844 and 0.97 in consumer number 1355670001036 of this facility. The electrical load study and power quality analysis has been conducted and the results and reports are given in the "Technical Supplement" of this report.

4

Detailed process flow diagram and energy and material balance



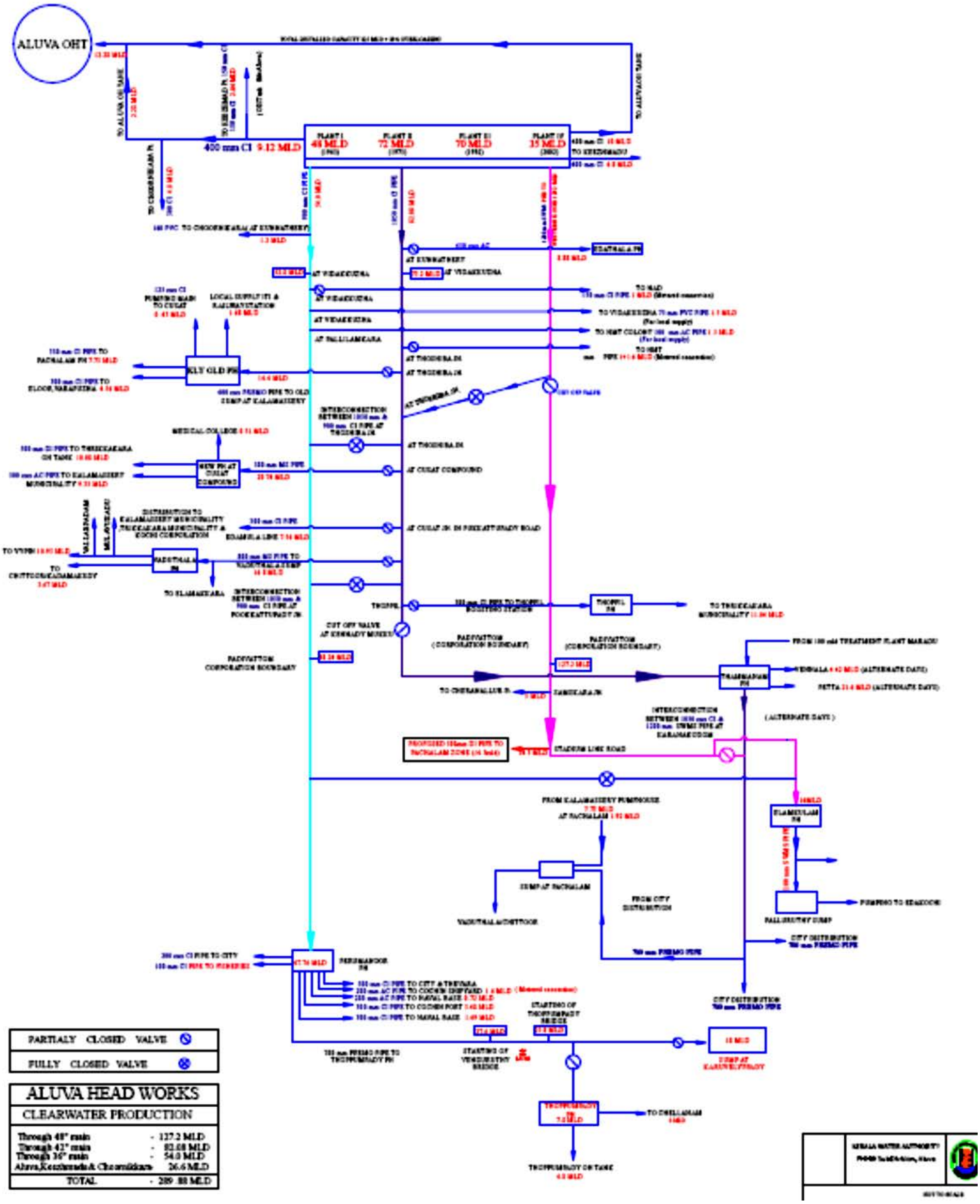
The energy balance of this facility is given above. The auxiliary loads caters 2% of the total load

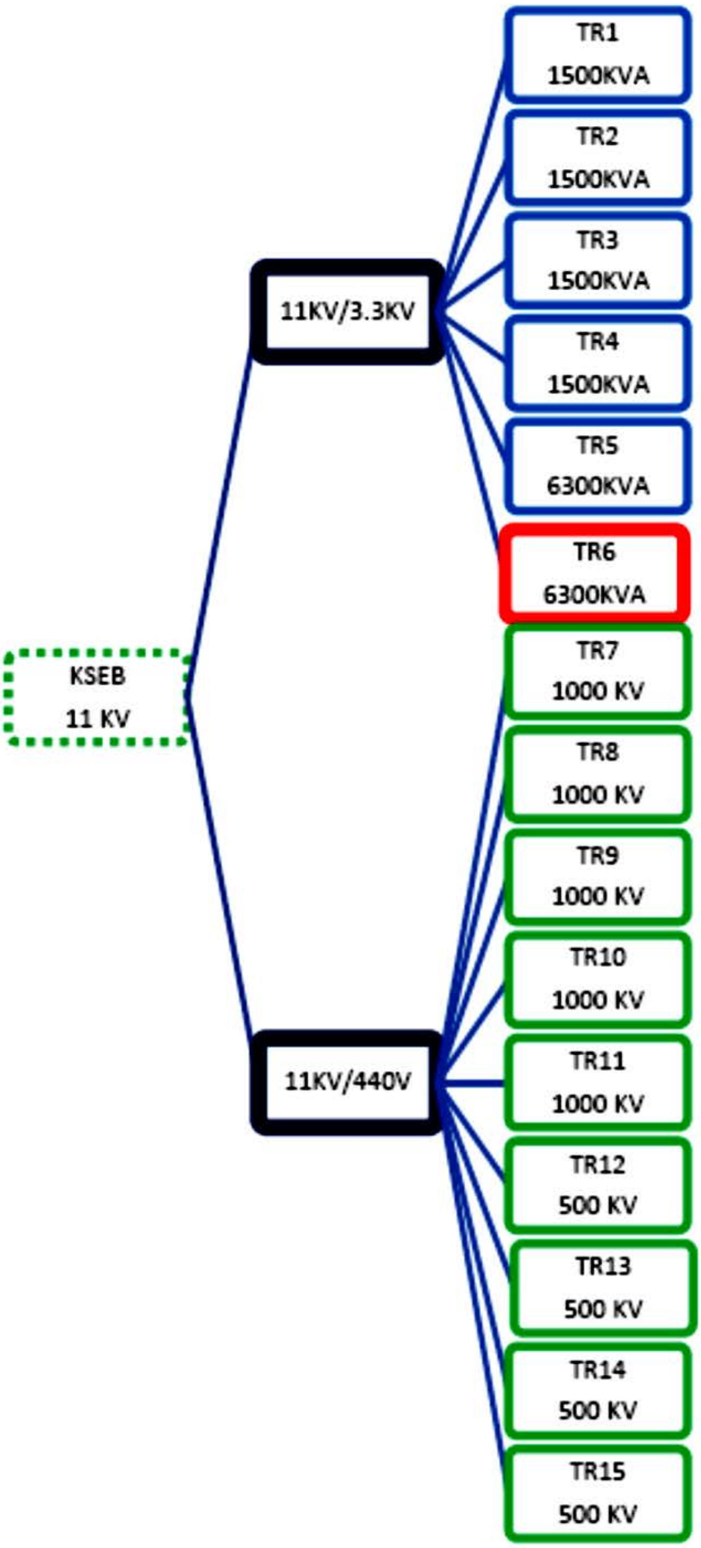
Plant Operation

The Pumping Station has 15 transformers, out of 15, 5 numbers are 11kV/3.3kV HT transformers and 9 numbers are 11kV / 440 V LT transformers. One transformer is installed with 11kV/3.3kV but not commissioned yet. There are three substations SS1, SS2 and SS3. There are two KSEB connections as detailed above which fed to this substation. SS1 is operating for LT motors and ancillary loads. SS2 and SS3 (in which SS3 is tapped form SS1) is used to operate HT motors. The detailed SLD of substations and process are given in this section.

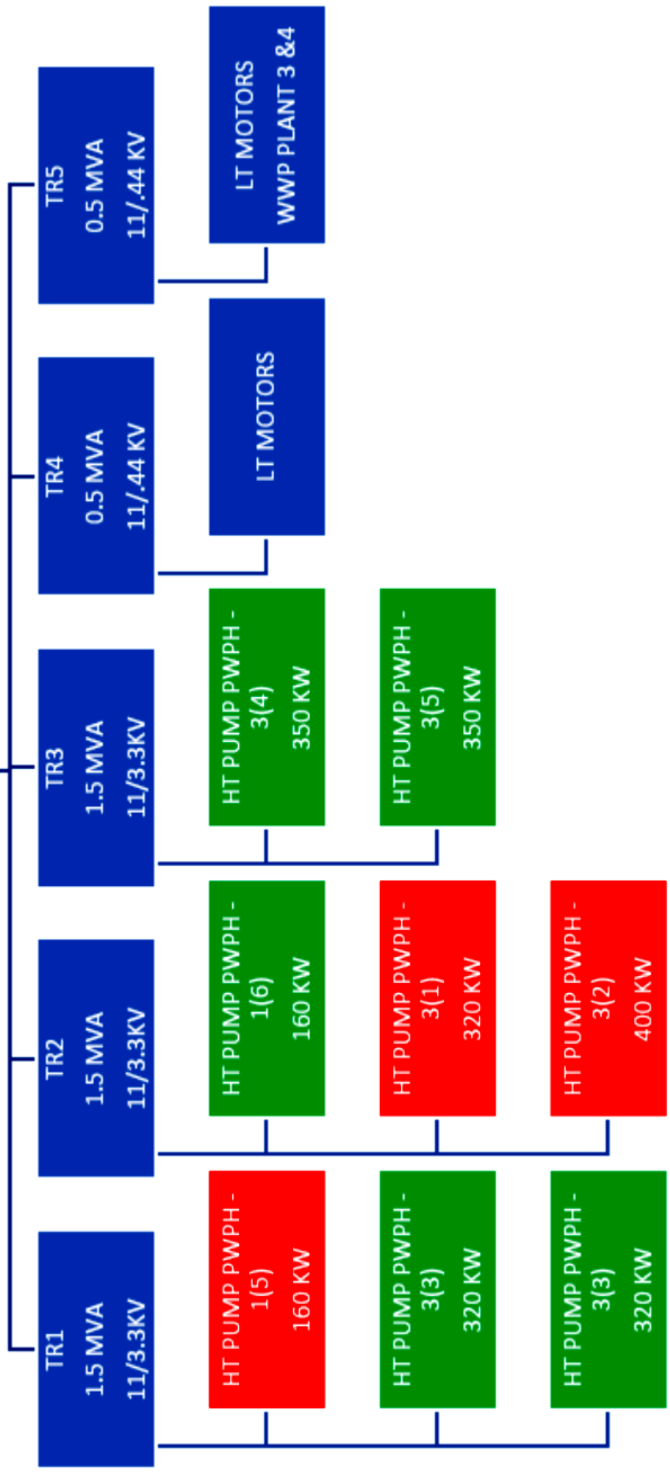
KERALA WATER AUTHORITY

DISTRIBUTION FROM ALUVA HEAD WORKS

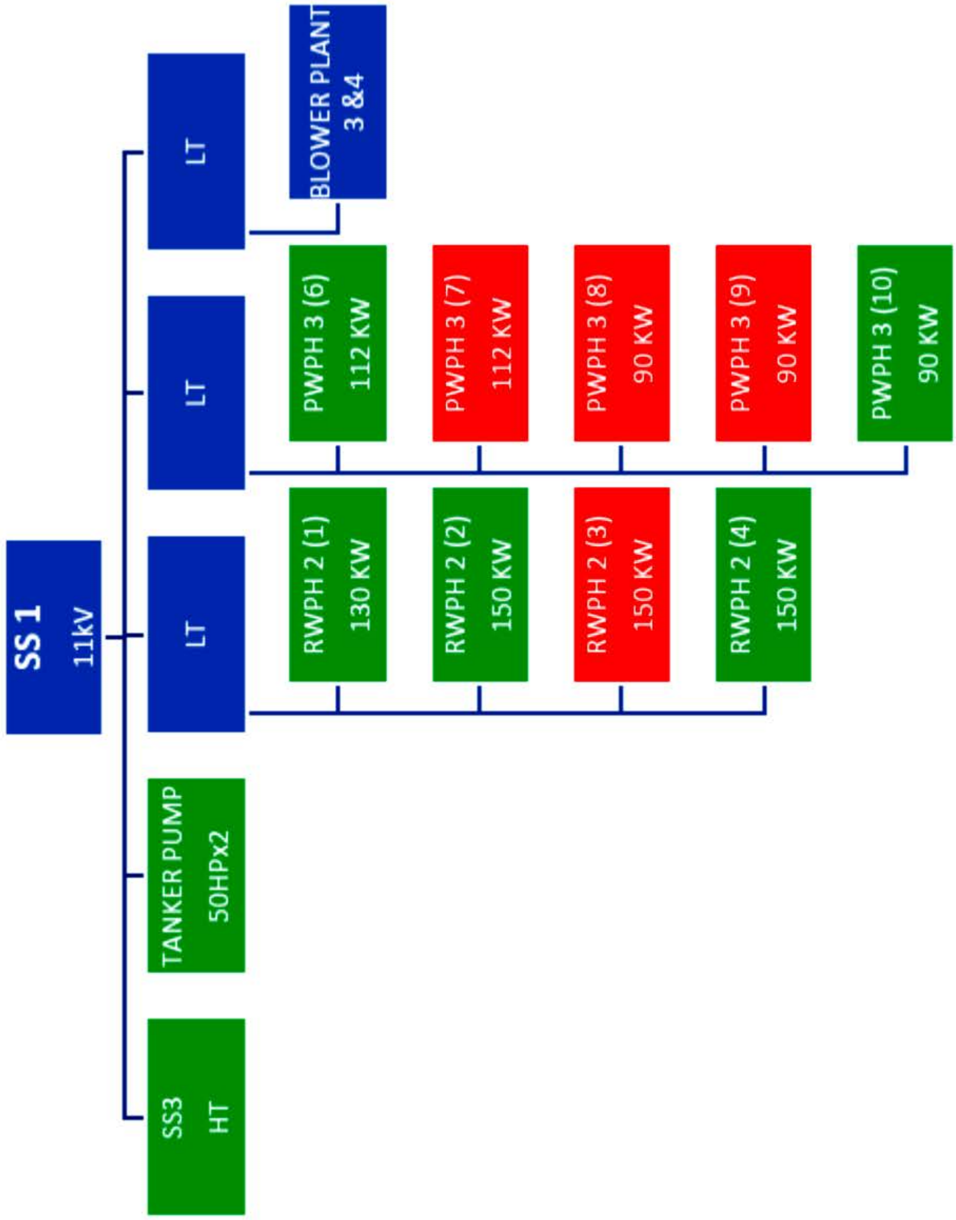



KSEB
11 KV
11KV/3.3KV
11KV/440V
TR1
1500KVA
TR2
1500KVA
TR3
1500KVA
TR4
1500KVA
TR5
6300KVA
TR6
6300KVA
TR7
1000 KV
TR8
1000 KV
TR9
1000 KV
TR10
1000 KV
TR11
1000 KV
TR12
500 KV
TR13
500 KV
TR14
500 KV
TR15
500 KV

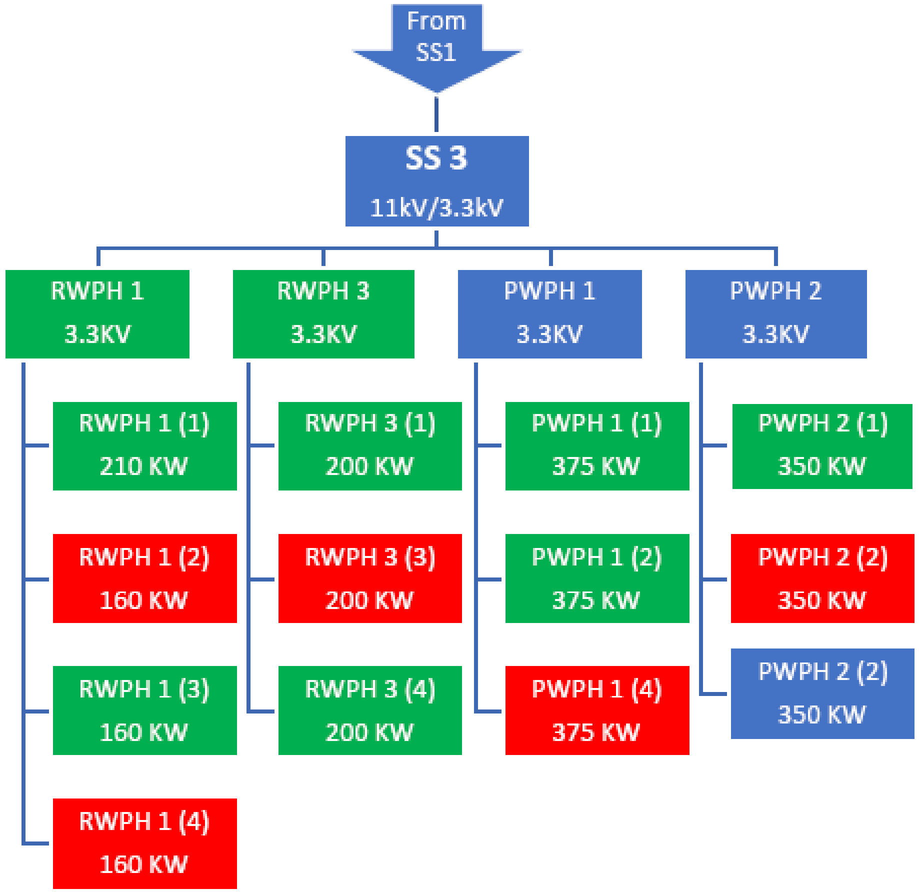
SINGLE LINE DIAGRAM FOR SS2



SINGLE LINE DIAGRAM FOR SS1



SINGLE LINE DIAGRAM FOR SS3



This Page is Intentionally Kept Blank

5

Performance evaluation of major utilities and process equipment's/systems.

5.1. List of equipment and process where performance testing was done.

- Electrical System
- Pumps
- Lighting System
- Renewable Energy

5.2. Results of performance testing

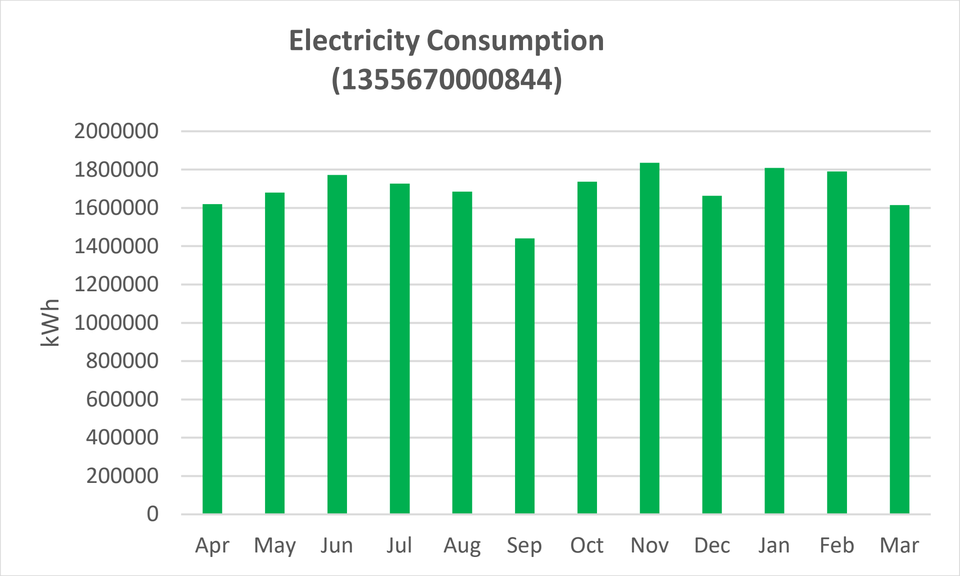
5.2.1. Electrical System

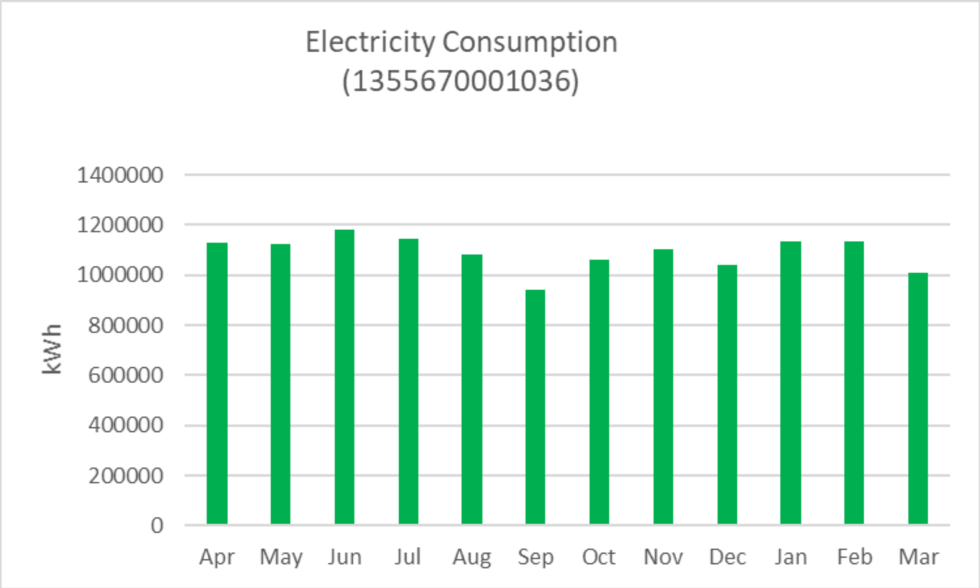
The average unit cost of electricity is **6 Rs/kWh**. This is taken as the basis for the financial analysis of electrical energy efficiency projects. The information on average energy consumption is taken from the historical electricity bill analysis. The electricity is fed from centralized substations. The Maximum demand observed during electricity bill analysis was 2994 kVA and 1887 kVA for both connections respectively. 3.3 kVA consumption is 92% and LT motor/light load consumption is 8 %.

Electricity Consumption

The Electricity consumption details for the financial year 2018-19 is plotted below. The Total consumption was found to be 334.52 Lakhs Units in the year 18-19.

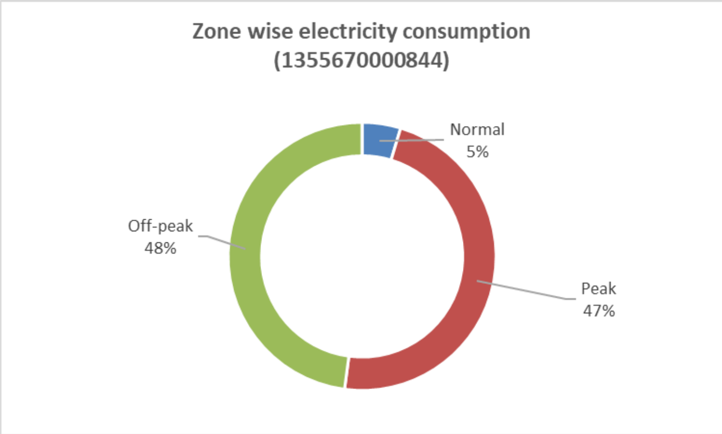
Month	Consumer Nos		Total
	1355670000844	1355670001036	
	kWh	kWh	kWh
Apr	1619080	1127040	2746120
May	1679700	1126000	2805700
Jun	1772760	1183320	2956080
Jul	1727200	1142880	2870080
Aug	1685000	1081920	2766920
Sep	1441160	939040	2380200
Oct	1737640	1062400	2800040
Nov	1835560	1101400	2936960
Dec	1663680	1038560	2702240
Jan	1808640	1134800	2943440
Feb	1789960	1131800	2921760
Mar	1615200	1007560	2622760
Total	**20375580**	**13076720**	**33452300**



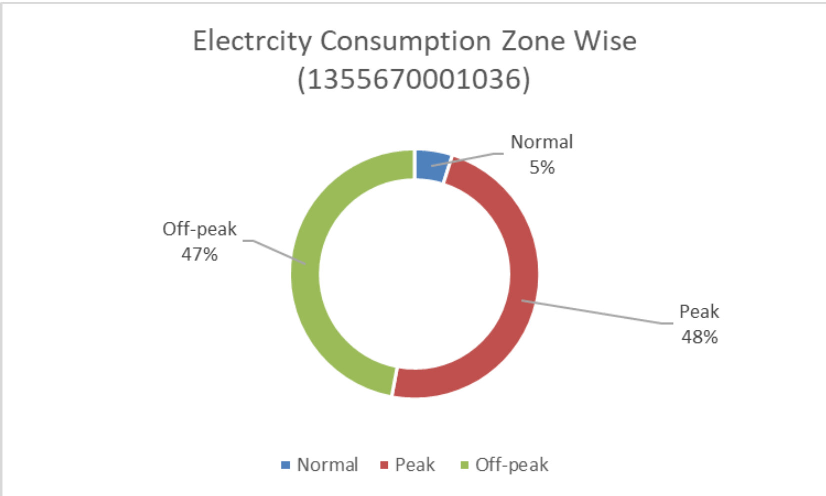


The details of water handled by the plant is given in the technical supplement of this report.

The Zone wise Energy Consumption Profile is shown below ,which shows 38% of total energy consumption in a day is at normal hours, 30% at peak hours and 32% at non peak hours.



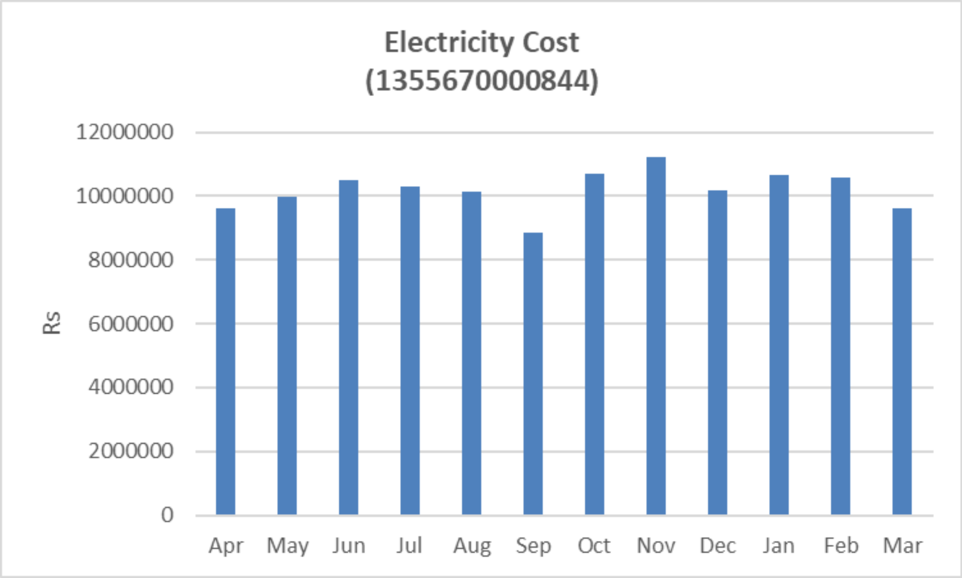
Zone	kWh
Normal	2638
Peak	26915
Off-peak	27170

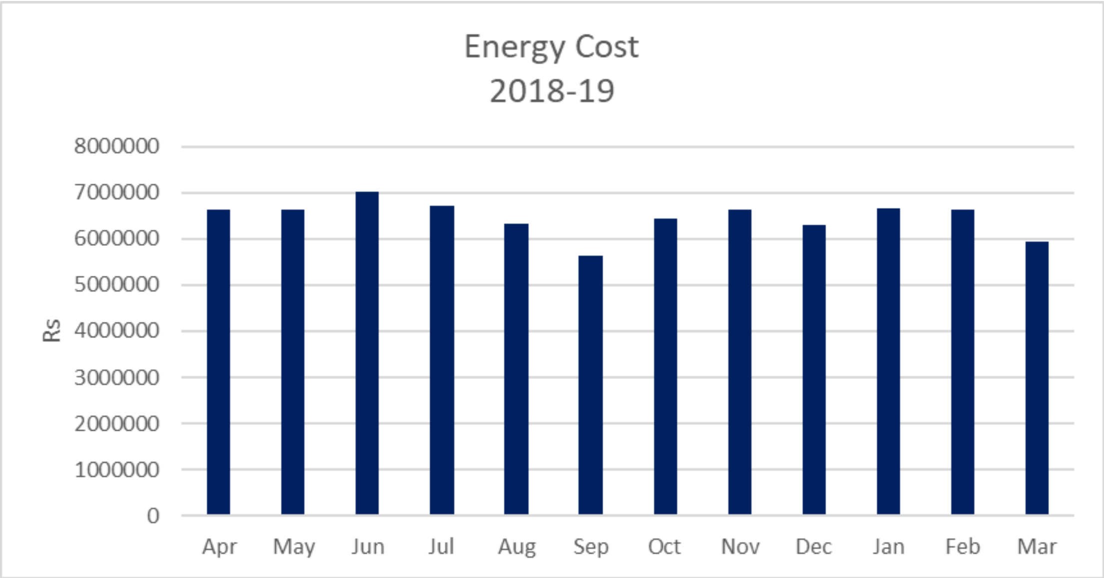


Zone	kWh
Normal	1887
Peak	18518
Off-peak	18128

The peak load consumption can be reduced by curtailing some non essential loads like backwash, cleaning etc.

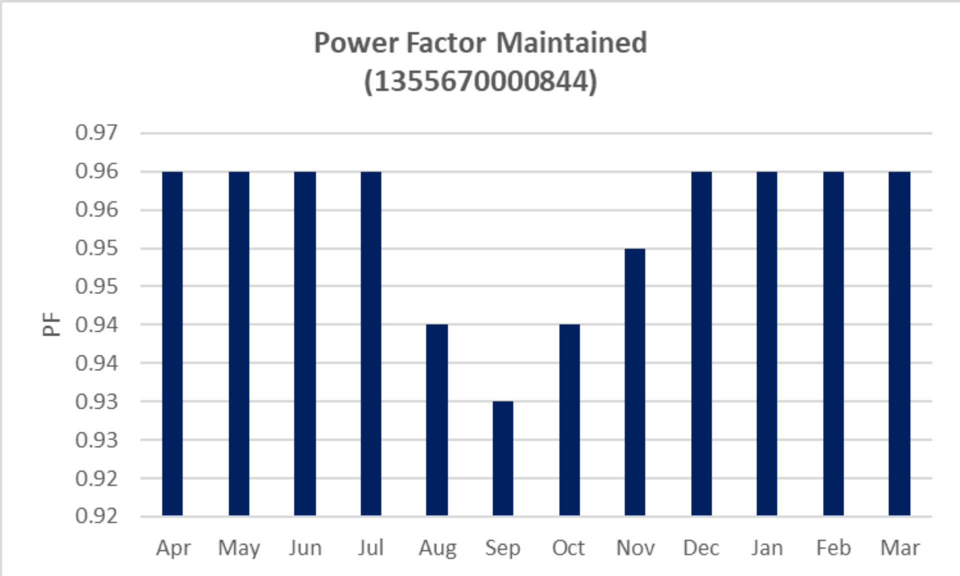
The electricity cost profile for the year 2018-19 is given below.

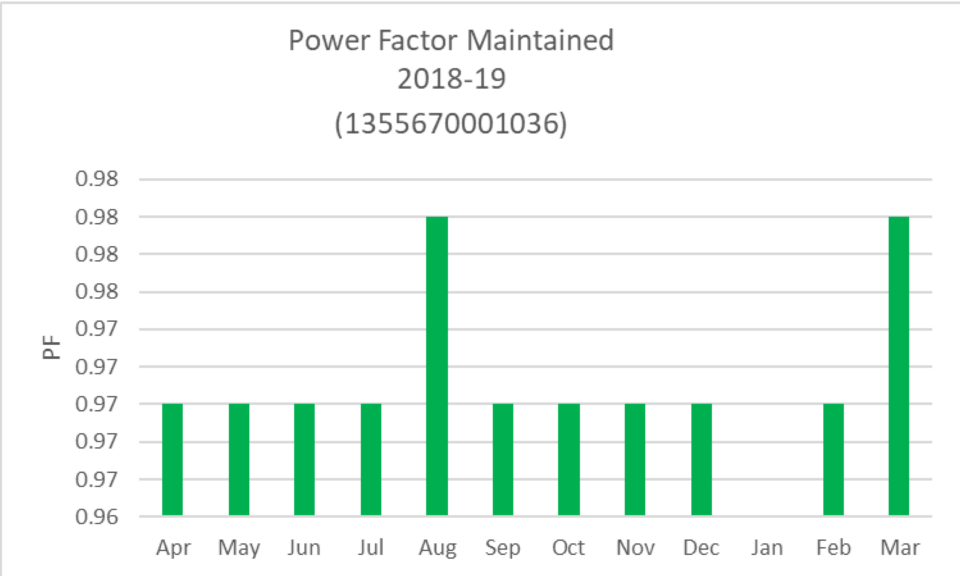




Power Factor

The average power factor observed is 0.93 which is very low. It is strongly recommended to add capacitors to improve power factor to unity. The power factor variation for the financial year 2018-19 is shown below.





During load study it is observed that the power factor average is 0.93(see technical supplement)

Capacitors

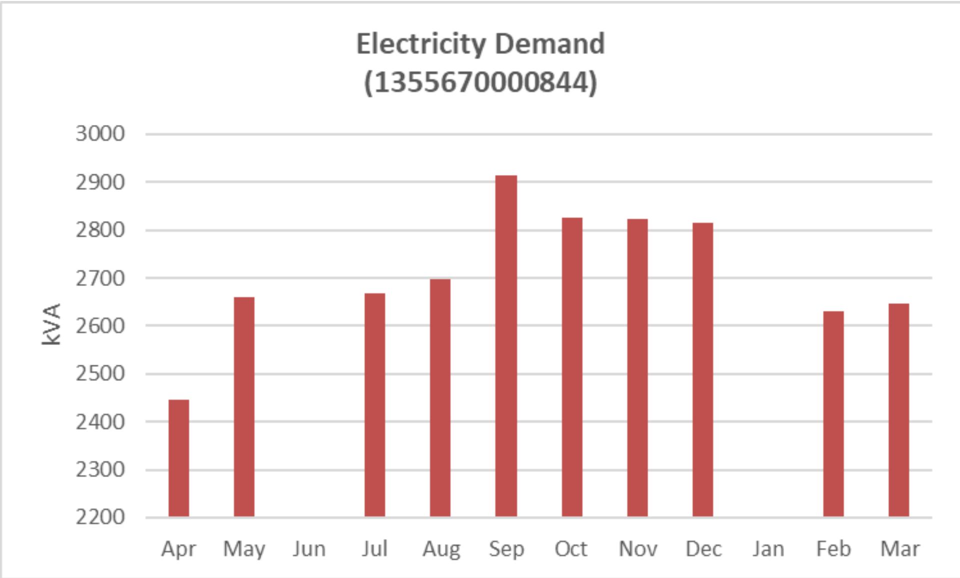
The performance study of Capacitor is given below

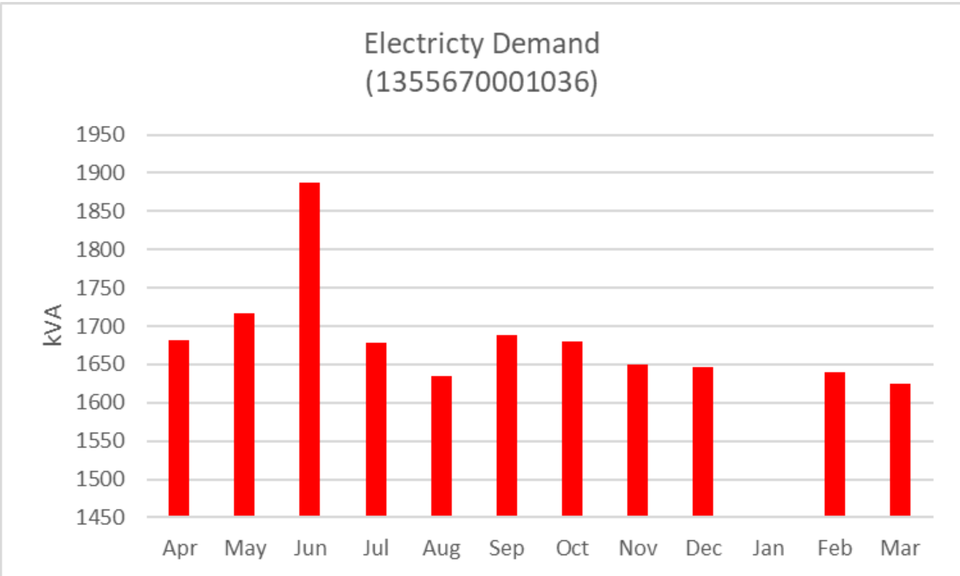
Capacitor Requirment								
Sl.No	Location	Motors	HP	Make	KW (Rated)	kW (Measured)	PF	Required kVAR
1	RWPH No.1	HT Motor No 1	282	KBL	210	163	0.99	15
2		HT Motor No 3	215	KBL	160	171	0.99	14
3	RWPH No.2	Pump set No 1	175	KBL	131	106	0.88	56
4		Pump set No 2	200	Johnston oil lub	149	111	0.77	91
5		Pump set No 4	200	Johnston oil lub	149	102	0.59	137
6	RWPH No.3	HT Motor No 1	268	KBL	200	111	0.64	133
7		HT Motor No 2	268	KBL	200	125	0.63	149
8		HT Motor No 3	268	KBL	200	184	0.95	55
9	PWPH No.1	HT Motor No 1	503	KBL	375	378	0.95	110
10		HT Motor No 2	503	KBL	375	370	0.95	113
11		HT Motor No 6 M-2	215		160	142	0.98	22
12	PWPH No.2	HT Motor No 1	469	KBL	350	331	0.99	46
13		HT Motor No 3	469	KBL	350	310	0.8	230
14	PWPH No3	HT Motor No 3	429	KBL	320	200	0.65	226
15		HT Motor No 4	469	KBL	350	200	0.65	225
16		HT Motor No 5	469	KBL	350	202	0.65	231
17		LT Motor 1 (to Kizhumad)	150	KBL	112	107	0.98	17
18		LT Motor 5 (to aluva)	120		90	83	0.85	50

1920 kVAr is the requirement to improve the power factor to near unit at the motor side.

Demand Control

The facility has a contract demand of 2994 kVA and 1887 kVA. As mentioned above the present average power factor of the plant is 0.93. The electricity demand variation for the financial year 2018-19 is shown below.





The load curve of mains electrical load study of Mains is given below. Demand control can be done by improving power factor to unity.

5.2.2. Pumps

The list of pumps is given below. The detailed specification of pumps are given below. The pump details like Q, H, efficiency and make are given in the detailed performance analysis of each pumps given in the respective tables.

List of Pumps					
Sl.No	Location	Motor Code	HP	MLD	Make
1	RWPH No.1	HT Motor No 1	282		KBL
2		HT Motor No 2	215		KBL
3		HT Motor No 3	215		KBL
4		HT Motor No 4	215		KBL
5	RWPH No.2	Pump set No 1	175	38	KBL
6		Pump set No 2	200	40	Johnston oil lub
7		Pump set No 3	200	40	Johnston oil lub
8		Pump set No 4	200	40	Johnston oil lub
9	RWPH No.3	HT Motor No 1	268	45	KBL
10		HT Motor No 2	268	45	KBL
11		HT Motor No 3	268	45	KBL
12		HT Motor No 4	268	45	KBL
13	PWPH No.1	HT Motor No 1	502.68	35	KBL
14		HT Motor No 2	502.68	35	KBL
15		HT Motor No 3	502.68	35	KBL
16		HT Motor No 4	502.68	35	KBL
17		HT Motor No 5 M-1	215		
18		HT Motor No 6 M-2	215		
19	PWPH No.2	HT Motor No 1	469	35	KBL
20		HT Motor No 2	469	35	KBL
21		HT Motor No 3	469	35	KBL
22	PWPH No 3	HT Motor No 1	429		KBL
23		HT Motor No 2	536		Marathon
24		HT Motor No 3	429		KBL
25		HT Motor No 4	469		KBL
26		HT Motor No 5	469		KBL
27		LT Motor 1 (to Kizhumad)	150	8.5	KBL
28		LT Motor 2 (to Kizhumad)	150	8.5	KBL
29		LT Motor 3 (to Kizhumad)	120	8.5	KBL
30		LT Motor 4 (to aluva)	120	8	
31		LT Motor 5 (to aluva)	120	8	
32	Tanker pump set	Pump set No 1	50	9.5	KBL
33		Pump set No 2	50	9.5	Luby
34	WW pump sets in plant No 3	Pump set No 1	50	9.5	Luby
35		Pump set No 2	50	9.5	Luby
36	WW pump sets in plant No 4	Pump set No 1	20	3.5	Remi
37		Pump set No 2	20	3.5	Remi

Performance Evaluation of Pumps					
Raw Water Pump House 1 - HT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 1 (1)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Total head developed by pump	m	22
	Motors	6	Rated load of the motor	kW	210
		7	Measured load of the motor	kW	163
		8	Efficiency of standard motor	%	84.3
		9	Type of Motor		SRIM
		10	Motor power	kW	210.00
	Pumps	11	Make		KBL
		12	HP		282
		13	Efficiency	%	87
		14	Combined efficiency of the system (rated)		73.341
		15	Combined efficiency of the system (Actual)		59.185
		16	Volt	kV	3.202
		17	Amps	A	70.6
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	900.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	22
		24	Flow	m^3/s	0.447
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	96.47
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NILL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	110.35
		33	% loading of pump on head	%	81.48
		34	% loading of motor	%	77.62

Performance Evaluation of Pumps					
Raw Water Pump House 1 - HT Pump 3					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 1 (3)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	27
	Motors	6	Rated load of the motor	kW	160
		7	Measured load of the motor	kW	171
		8	Efficiency of standard motor	%	82.7
		9	Type of Motor		SRIM
		10	Motor power	kW	160.00
	Pumps	11	Make		KBL
		12	HP		215
		13	Efficiency	%	83.5
		14	Combined efficiency of the system (rated)	%	69.05
		15	Combined efficiency of the system (actual)	%	52.66
		16	Volt	kV	3.25
		17	Amps	A	30
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	900.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	22
		24	Flow	m^3/s	0.417
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	90.05
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	103.00
		33	% loading of pump on head	%	81.48
		34	% loading of motor	%	106.88

Performance Evaluation of Pumps					
Raw Water Pump House 2 - LT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 2 (LT 1)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	24
	Motors	6	Rated load of the motor	kW	130
		7	Measured load of the motor	kW	106
		8	Efficiency of standard motor	%	92
		9	Type of Motor		IM
		10	Motor power	kW	106.00
	Pumps	11	Make		KBL
		12	HP		175
		13	Efficiency	%	86
		14	Combined efficiency of the system (rated)	%	79.12
		15	Combined efficiency of the system (actual)	%	69.23
		16	Volt	V	392
		17	Amps	A	180
		18	rpm	rpm	1440
	Pipe Line	19	Material		CI
		20	Size	mm	1050.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	38.00
		23	Head	m	22
		24	Flow	m^3/s	0.340
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	73.38
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	77.31
		33	% loading of pump on head	%	91.67
		34	% loading of motor	%	81.54

Performance Evaluation of Pumps					
Raw Water Pump House 2 - LT Pump 2					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 2 (LT 2)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	24
	Motors	6	Rated load of the motor	kW	150
		7	Measured load of the motor	kW	111
		8	Efficiency of standard motor	%	90
		9	Type of Motor		IM
		10	Motor power	kW	111.00
	Pumps	11	Make		Johnston
		12	HP		200
		13	Efficiency	%	80
		14	Combined efficiency of the system (rated)	%	72.00
		15	Combined efficiency of the system (actual)	%	67.08
		16	Volt	V	227
		17	Amps	A	210
		18	rpm	rpm	1440
	Pipe Line	19	Material		CI
		20	Size	mm	1050.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	40.00
		23	Head	m	23
		24	Flow	m^3/s	0.330
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	74.46
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	71.28
		33	% loading of pump on head	%	95.83
		34	% loading of motor	%	74.00

Performance Evaluation of Pumps					
Raw Water Pump House 2 - LT Pump 4					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
Design Details	General	2	Pump ID	RWPH 2 (LT 4)	
Design Details	General	3	Pump Application	Raw Water	
Design Details	General	4	Water Quality	Raw	
Design Details	General	5	Rated head of pump	m	24
Design Details	Motors	6	Rated load of the motor	kW	150
Design Details	Motors	7	Measured load of the motor	kW	102
Design Details	Motors	8	Efficiency of standard motor	%	90
Design Details	Motors	9	Type of Motor		IM
Design Details	Motors	10	Motor power	kW	102.00
Design Details	Pumps	11	Make		Johnston
Design Details	Pumps	12	HP		200
Design Details	Pumps	13	Efficiency	%	80
Design Details	Pumps	14	Combined efficiency of the system (rated)	%	72.00
Design Details	Pumps	15	Combined efficiency of the system (actual)	%	56.55
Design Details	Pumps	16	Volt	V	249
Design Details	Pumps	17	Amps	A	230
Design Details	Pumps	18	rpm	rpm	1440
Design Details	Pipe Line	19	Material		CI
Design Details	Pipe Line	20	Size	mm	1050.00
Design Details	Pipe Line	21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	40.00
Operating Details	Output	23	Head	m	21
Operating Details	Output	24	Flow	m^3/s	0.280
Operating Details	Output	25	Density of water	kg/m^3	1000
Operating Details	Output	26	Gravitational Constant	m/s^2	9.81
Operating Details	Output	27	Hydraulic Power	kW	57.68
Operating Details	Output	28	Type of Flow Control Mechanism		Throttling
Operating Details	Output	29	Discharge throttle valve position % open	%	100
Operating Details	Output	30	Flow Control Frequency		NIL
Operating Details	Output	31	Working hours per day	Hrs	24
Operating Details	Output	32	% loading of pump on flow	%	60.48
Operating Details	Output	33	% loading of pump on head	%	87.50
Operating Details	Output	34	% loading of motor	%	68.00

Performance Evaluation of Pumps					
Raw Water Pump House 3 - HT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 3 (HT 1)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	27
	Motors	6	Rated load of the motor	kW	200
		7	Measured load of the motor	kW	111
		8	Efficiency of standard motor	%	82
		9	Type of Motor		SRIM
		10	Motor power	kW	111.00
	Pumps	11	Make		KBL
		12	HP		268
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	69.70
		15	Combined efficiency of the system (actual)	%	54.88
		16	Volt	KV	3.25
		17	Amps	A	30
		18	rpm	rpm	1800
	Pipe Line	19	Material		GRP
		20	Size	mm	1050.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	45.00
		23	Head	m	23
		24	Flow	m^3/s	0.270
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	60.92
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	51.84
		33	% loading of pump on head	%	85.19
		34	% loading of motor	%	55.50

Performance Evaluation of Pumps					
Raw Water Pump House 3 - HT Pump 2					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 3 (HT 2)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	27
	Motors	6	Rated load of the motor	kW	200
		7	Measured load of the motor	kW	125
		8	Efficiency of standard motor	%	82
		9	Type of Motor		SRIM
		10	Motor power	kW	125.00
	Pumps	11	Make		KBL
		12	HP		268
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	69.70
		15	Combined efficiency of the system (actual)	%	59.57
		16	Volt	KV	3.14
		17	Amps	A	37
		18	rpm	rpm	1800
	Pipe Line	19	Material		GRP
		20	Size	mm	1050.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	45.00
		23	Head	m	23
		24	Flow	m^3/s	0.330
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	74.46
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	63.36
		33	% loading of pump on head	%	85.19
		34	% loading of motor	%	62.50

Performance Evaluation of Pumps					
Raw Water Pump House 3 - HT Pump 3					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	RWPH 3 (HT 3)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	27
	Motors	6	Rated load of the motor	kW	200
		7	Measured load of the motor	kW	184
		8	Efficiency of standard motor	%	82
		9	Type of Motor		SRIM
		10	Motor power	kW	184.00
	Pumps	11	Make		KBL
		12	HP		268
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	69.70
		15	Combined efficiency of the system (actual)	%	49.26
		16	Volt	KV	3.26
		17	Amps	A	35.1
		18	rpm	rpm	1800
	Pipe Line	19	Material		GRP
		20	Size	mm	1050.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	45.00
		23	Head	m	21
		24	Flow	m^3/s	0.440
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	90.64
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	84.48
		33	% loading of pump on head	%	77.78
		34	% loading of motor	%	92.00

Performance Evaluation of Pumps					
Pure Water Pump House 1 - HT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 1 (HT 1)	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	375
		7	Measured load of the motor	kW	378
		8	Efficiency of standard motor	%	82
		9	Type of Motor		SRIM
		10	Motor power	kW	378.00
	Pumps	11	Make		KBL
		12	HP		503
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	69.70
		15	Combined efficiency of the system (actual)	%	51.83
		16	Volt	KV	3.26
		17	Amps	A	70
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	63
		24	Flow	m^3/s	0.317
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	195.92
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	78.25
		33	% loading of pump on head	%	76.83
		34	% loading of motor	%	100.80

Performance Evaluation of Pumps					
Pure Water Pump House 1 - HT Pump 2					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 1 (HT 2)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	375
		7	Measured load of the motor	kW	370
		8	Efficiency of standard motor	%	82
		9	Type of Motor		SRIM
		10	Motor power	kW	370.00
	Pumps	11	Make		KBL
		12	HP		503
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	69.70
		15	Combined efficiency of the system (actual)	%	51.78
		16	Volt	KV	3.26
		17	Amps	A	70
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	63
		24	Flow	m^3/s	0.310
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	191.59
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	76.53
		33	% loading of pump on head	%	76.83
		34	% loading of motor	%	98.67

Performance Evaluation of Pumps					
Pure Water Pump House 1 - HT Pump 6					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 1 (HT 6)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	160
		7	Measured load of the motor	kW	143
		8	Efficiency of standard motor	%	82
		9	Type of Motor		SRIM
		10	Motor power	kW	143.00
	Pumps	11	Make		KBL
		12	HP		215
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	69.70
		15	Combined efficiency of the system (actual)	%	41.16
		16	Volt	KV	3.16
		17	Amps	A	26
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	50
		24	Flow	m^3/s	0.120
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	58.86
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	29.62
		33	% loading of pump on head	%	60.98
		34	% loading of motor	%	89.38

Performance Evaluation of Pumps					
Pure Water Pump House 2 - HT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 2 (HT 1)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	350
		7	Measured load of the motor	kW	331
		8	Efficiency of standard motor	%	85
		9	Type of Motor		SRIM
		10	Motor power	kW	331.00
	Pumps	11	Make		KBL
		12	HP		469
		13	Efficiency	%	75
		14	Combined efficiency of the system (rated)	%	63.75
		15	Combined efficiency of the system (actual)	%	62.59
		16	Volt	KV	3.26
		17	Amps	A	60
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	44
		24	Flow	m^3/s	0.480
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	207.19
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	118.49
		33	% loading of pump on head	%	53.66
		34	% loading of motor	%	94.57

Performance Evaluation of Pumps					
Pure Water Pump House 2 - HT Pump 3					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 2 (HT 3)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	350
		7	Measured load of the motor	kW	310
		8	Efficiency of standard motor	%	85
		9	Type of Motor		SRIM
		10	Motor power	kW	310.00
	Pumps	11	Make		KBL
		12	HP		469
		13	Efficiency	%	75
		14	Combined efficiency of the system (rated)	%	63.75
		15	Combined efficiency of the system (actual)	%	52.91
		16	Volt	KV	3.25
		17	Amps	A	70
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	44
		24	Flow	m^3/s	0.380
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	164.02
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	93.81
		33	% loading of pump on head	%	53.66
		34	% loading of motor	%	88.57

Performance Evaluation of Pumps					
Pure Water Pump House 3 - HT Pump 3					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 3 (HT 3)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	320
		7	Measured load of the motor	kW	200
		8	Efficiency of standard motor	%	90
		9	Type of Motor		SRIM
		10	Motor power	kW	200.00
	Pumps	11	Make		KBL
		12	HP		429
		13	Efficiency	%	88.5
		14	Combined efficiency of the system (rated)	%	79.65
		15	Combined efficiency of the system (actual)	%	71.42
		16	Volt	KV	3.16
		17	Amps	A	57
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	28
		24	Flow	m^3/s	0.520
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	142.83
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	128.37
		33	% loading of pump on head	%	34.15
		34	% loading of motor	%	62.50

Performance Evaluation of Pumps					
Pure Water Pump House 3 - HT Pump 4					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 3 (HT 4)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	350
		7	Measured load of the motor	kW	200
		8	Efficiency of standard motor	%	90
		9	Type of Motor		SRIM
		10	Motor power	kW	200.00
	Pumps	11	Make		KBL
		12	HP		469
		13	Efficiency	%	88.5
		14	Combined efficiency of the system (rated)	%	79.65
		15	Combined efficiency of the system (actual)	%	67.30
		16	Volt	KV	3.22
		17	Amps	A	53
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	35.00
		23	Head	m	28
		24	Flow	m^3/s	0.490
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	134.59
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	120.96
		33	% loading of pump on head	%	34.15
		34	% loading of motor	%	57.14

Performance Evaluation of Pumps				
Pure Water Pump House 3 - HT Pump 5				
Sl No		Description	Unit	Parameters
Design Details / General	1	Unit code	KWA ALUVA	
	2	Pump ID	PWPH 3 (HT 5)	
	3	Pump Application	Pure Water	
	4	Water Quality	Raw	
	5	Rated head of pump	m	82
Motors	6	Rated load of the motor	kW	350
	7	Measured load of the motor	kW	202
	8	Efficiency of standard motor	%	90
	9	Type of Motor		SRIM
	10	Motor power	kW	202.00
Pumps	11	Make		KBL
	12	HP		469
	13	Efficiency	%	88.5
	14	Combined efficiency of the system (rated)	%	79.65
	15	Combined efficiency of the system (actual)	%	61.33
	16	Volt	KV	3.23
	17	Amps	A	53
	18	rpm	rpm	1800
Pipe Line	19	Material		CI
	20	Size	mm	1200.00
	21	Length	m	NA
Operating Details / Output	22	Water Pumping Details of station	mld	35.00
	23	Head	m	28
	24	Flow	m^3/s	0.451
	25	Density of water	kg/m^3	1000
	26	Gravitational Constant	m/s^2	9.81
	27	Hydraulic Power	kW	123.88
	28	Type of Flow Control Mechanism		Throttling
	29	Discharge throttle valve position % open	%	100
	30	Flow Control Frequency		NIL
	31	Working hours per day	Hrs	24
	32	% loading of pump on flow	%	111.33
	33	% loading of pump on head	%	34.15
	34	% loading of motor	%	57.71

Performance Evaluation of Pumps					
Pure Water Pump House 3 - LT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 1 (HT 1)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	112
		7	Measured load of the motor	kW	107
		8	Efficiency of standard motor	%	90
		9	Type of Motor		SRIM
		10	Motor power	kW	107.00
	Pumps	11	Make		KBL
		12	HP		150
		13	Efficiency	%	88.5
		14	Combined efficiency of the system (rated)	%	79.65
		15	Combined efficiency of the system (actual)	%	37.96
		16	Volt	V	228
		17	Amps	A	158
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	8.50
		23	Head	m	60
		24	Flow	m^3/s	0.069
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	40.61
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	70.14
		33	% loading of pump on head	%	73.17
		34	% loading of motor	%	95.54

Performance Evaluation of Pumps					
Pure Water Pump House 3 - LT Pump 5					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA ALUVA	
		2	Pump ID	PWPH 3 (HT 5)	
		3	Pump Application	Pure Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	82
	Motors	6	Rated load of the motor	kW	90
		7	Measured load of the motor	kW	83
		8	Efficiency of standard motor	%	85
		9	Type of Motor		SRIM
		10	Motor power	kW	83.00
	Pumps	11	Make		KBL
		12	HP		120
		13	Efficiency	%	84.5
		14	Combined efficiency of the system (rated)	%	71.83
		15	Combined efficiency of the system (actual)	%	67.02
		16	Volt	V	396
		17	Amps	A	140
		18	rpm	rpm	1800
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	8.00
		23	Head	m	54
		24	Flow	m^3/s	0.105
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	55.62
		28	Type of Flow Control Mechanism		Throttling
		29	Discharge throttle valve position % open	%	100
		30	Flow Control Frequency		NIL
		31	Working hours per day	Hrs	24
		32	% loading of pump on flow	%	113.40
		33	% loading of pump on head	%	65.85
		34	% loading of motor	%	92.22

5.2.3. Lighting system

Lighting is one of the major electrical loads connected in the system. T12 and T8 tubes are extensively used in most of the areas and Sodium vapor, Fluorescent etc. in factory/ street lighting. Hardly any LED lights or tubes are used. This is a good component of the load of the facility and replacing these T12 & T 8 tubes with LED tubes can lead to a significant reduction in the load. Good lighting design can reduce costs and have the added benefit of decreasing internal heat gains, thus reducing the need for air conditioning too.

List of Light Loads

Sl. No.	Location	T12	T8	T5	CFL	LED-B	LED-B (40W)	LED-T	CF	EF	PF	PC	AC (1.5T)
1	Office	17	1						4			2	
2	Substation 1	10	1						4	1			
3	Substation 2	3		1				1	2	1			
4	Substation 3	44						8		5			
5	Old Control Room	3	3					1	1			3	1
6	Pump Room	3						2		4			
7	Treatment Plant	29						5	1	4	1		
8	Raw Water PH 1	3				1		1	1				
9	Raw Water PH 2	3							1				
10	PWPH	58					8	2	6	4	1		
Total		**173**	**5**	**1**	**0**	**1**	**8**	**20**	**20**	**19**	**2**	**5**	**1**

All T8 and T12 Lamps shall be replaced with LED tubes or even T5 and the existing CFLs may be shifted to LED in phased manner. Since lighting does not have a separate feeder, the voltage stabilizer cannot be used specifically for this purpose.

Power Quality

Power quality is simply the interaction of electrical power with electrical equipment. If electrical equipment operates correctly and reliably without being damaged or stressed, we would say that the electrical power is of good quality. On the other hand, if the electrical equipment malfunctions, is unreliable, or is damaged during normal usage, we would suspect that the power quality is poor.

In any alternating current network, flow of current depends upon the voltage applied and the impedance (resistance to AC) provided by elements like resistances, reactance's of inductive and capacitive nature. Harmonics occurs as spikes at intervals which are multiples of the mains (supply) frequency and these distort the pure sine wave form of the supply voltage & current. The poor power quality end up with power loss.

Power system harmonic distortion is not a new phenomenon - efforts to limit it to acceptable proportions have been a concern of power engineers from the early days of utility systems. At that time, the distortion was typically caused by the magnetic saturation of transformers or by certain industrial loads, such as arc furnaces or arc welders. The major concerns were the effects of harmonics on synchronous and induction machines, telephone interference, and power capacitor failures. In the past, harmonic problems could often be tolerated because equipment was of conservative design and grounded wye-delta transformer connections were used judiciously.

Harmonic distortion

Harmonic distortion problems are not new to utility and industrial power systems. In fact, such distortion was observed by utility operating personnel as early as the first decade of this century. Typically, the distortion was caused by nonlinear loads connected to utility distribution systems. In addition to the increase in harmonic generators and network resonances, electric systems and loads have become no less, and in some cases even more, sensitive to harmonics. There are a number of areas of new and continuing concern

- Computers, computer-controlled machine tools, and various types of digital controllers are especially susceptible to harmonics, as well as to other types of interference.
- Harmonics can cause damaging dielectric heating in underground cables.
- Inductive metering can be adversely affected by harmonics.
- Capacitor bank failures are frequently caused by harmonics.
- Less conservative designs for rotating machines and transformers aggravate heating problems caused by harmonics.
- Harmonics can be especially troublesome to communication systems.

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		RWPH No 2 (No 4 -200HP)			
Date & Time		21-01-2020 11:31 to 21-01-2020 11:32			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	249.00		Normal
		Y	249.00		
		B	229.00		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.88			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA-Technical standards for connectivity to the grid-	R	181.33	0.78	Within permissible limit at Average load during load
		Y	181.45	0.83	
		B	167.05	0.89	
11	THD (I) % Permissible limits<8% as per CEA-Technical standards for connectivity to the grid-	R	181.33	1.07	Within permissible limit at Average load during load
		Y	181.45	1.24	
		B	167.05	0.89	
12	Frequency	50			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		RWPH No 2 (No 4 -200HP)		
Date & Time		21-01-2020 11:31 to 21-01-2020 11:32		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	249.00	Normal
		Y	249.00	
		B	229.00	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	0.77		Low power factor
8	Load Current (Waveform)	Sine wave		Normal
9	Load generated disturbances	Absent		Ref. Technical suppliment

Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	215.90	0.62	Within permissible limit at Average load during load study
		Y	210.40	0.72	
		B	207.20	0.55	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	215.90	1.67	Within permissible limit at Average load during load study
		Y	210.40	1.86	
		B	207.20	1.68	
12	Frequency	50			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		RWPH No 2 (No 4 -200HP)		
Date & Time		21-01-2020 11:31 to 21-01-2020 11:32		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	249.00	Normal
		Y	249.00	
		B	229.00	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	0.59		Low power factor
8	Load Current (Waveform)	Sine wave		Normal
9	Load generated disturbances	Absent		Ref. Technical suppliment

Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	236.90	0.76	Within permissible limit at Average load during load study
		Y	230.20	0.72	
		B	236.80	0.73	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	236.90	3.45	Within permissible limit at Average load during load study
		Y	230.20	3.69	
		B	236.80	3.23	
12	Frequency	50			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

<table>
<tr><th colspan="5">POWER QUALITY ANALYSIS REPORT</th></tr>
<tr><td colspan="5">KWA Aluva</td></tr>
<tr><td colspan="2">Location & Code:</td><td colspan="3">SS-2</td></tr>
<tr><td colspan="2">Date & Time</td><td colspan="3">11-03-2020 10:05 to 11-03-2020 10:14</td></tr>
<tr><td colspan="2">Reference</td><td colspan="3">Technical Supplement</td></tr>
<tr><td>Sl No</td><td>Category</td><td colspan="2">Summary Analysis</td><td>Remarks</td></tr>
<tr><td>1</td><td>Voltage Continuity (Input)</td><td colspan="2">Good</td><td>Normal</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">RMS Voltage level</td><td>R</td><td>10.504kV</td><td rowspan="3">Normal</td></tr>
<tr><td>Y</td><td>10.448kV</td></tr>
<tr><td>B</td><td>10.473kV</td></tr>
<tr><td>3</td><td>Voltage wave forms</td><td colspan="2">Sine wave</td><td>Normal</td></tr>
<tr><td>4</td><td>Dips & Swells</td><td colspan="2">Not recorded during load study period</td><td>Normal</td></tr>
<tr><td>5</td><td>Transient Voltages</td><td colspan="2">Not recorded during load study period</td><td>Normal</td></tr>
<tr><td>6</td><td>Voltage fluctuations / flicker</td><td colspan="2">Not recorded during load study period</td><td>Normal</td></tr>
<tr><td>7</td><td>Power factor</td><td colspan="2">0.99</td><td>Normal</td></tr>
<tr><td>8</td><td>Load Current (Waveform)</td><td colspan="2">Sine wave</td><td>Normal</td></tr>
<tr><td>9</td><td>Load generated disturbances</td><td colspan="2">Absent</td><td>Ref. Technical suppliment</td></tr>
</table>

<table>
<tr><th colspan="2">Harmonic Analysis</th><th>Phase</th><th>Load (A)</th><th>THD (%)</th><th></th></tr>
<tr><td rowspan="3">10</td><td rowspan="3">THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)</td><td>R</td><td>81.02</td><td>1.48</td><td rowspan="3">Within permissible limit at Average load during load study</td></tr>
<tr><td>Y</td><td>81.84</td><td>1.25</td></tr>
<tr><td>B</td><td>77.14</td><td>1.38</td></tr>
<tr><td rowspan="3">11</td><td rowspan="3">THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))</td><td>R</td><td>81.02</td><td>3.10</td><td rowspan="3">Within permissible limit at Average load during load study</td></tr>
<tr><td>Y</td><td>81.84</td><td>2.99</td></tr>
<tr><td>B</td><td>77.14</td><td>3.71</td></tr>
<tr><td>12</td><td>Frequency</td><td colspan="3">49.98</td><td>Normal</td></tr>
<tr><td>13</td><td>Reliability of electricity supply</td><td colspan="3">Good</td><td>Normal</td></tr>
<tr><td>14</td><td>Earthing</td><td colspan="3">Good</td><td>Normal</td></tr>
</table>

POWER QUALITY ANALYSIS REPORT

KWA Aluva

Sl No	Category	Summary Analysis			Remarks
Location & Code:		RWPH-3			
Date & Time		11-03-2020 09:55 to 11-03-2020 10:02			
Reference		Technical Supplement			
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	10.478kV		Normal
		Y	10.426kV		
		B	10.450kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.96			Normal
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	29.44	1.39	Within permissible limit at Average load during load study
		Y	27.58	1.11	
		B	29.13	1.40	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	29.44	2.11	Within permissible limit at Average load during load study
		Y	27.58	2.18	
		B	29.13	2.35	
12	Frequency	50.07			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		RWPH-3 (Pump-2)			
Date & Time		11-03-2020 10:30 to 11-03-2020 10:33			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.143kV		Normal
		Y	3.142kV		
		B	3.171kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.64			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	33.90	2.21	Within permissible limit at Average load during load study
		Y	37.50	1.80	
		B	35.24	1.55	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	33.90	1.62	Within permissible limit at Average load during load study
		Y	37.50	1.37	
		B	35.24	1.50	
12	Frequency	50			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		4.PWPH-3 (Pump-3)			
Date & Time		11-03-2020 10:35 to 11-03-2020 10:37			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.140kV		Normal
		Y	3.140kV		
		B	3.168kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.66			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	53.91	2.28	Within permissible limit at Average load during load study
		Y	58.00	2.16	
		B	56.07	1.61	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	53.91	3.39	Within permissible limit at Average load during load study
		Y	58.00	2.38	
		B	56.07	2.87	
12	Frequency	50			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		PWPH-1(Pump-6)			
Date & Time		11-03-2020 10:43 to 11-03-2020 10:46			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.158kV		Normal
		Y	3.164kV		
		B	3.164kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.98			Normal
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	27.41	1.50	Within permissible limit at Average load during load study
		Y	26.61	1.80	
		B	24.99	2.09	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	27.41	1.94	Within permissible limit at Average load during load study
		Y	26.61	2.51	
		B	24.99	2.23	
12	Frequency	50.06			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		6.PWPH-3(Pump 5) HT			
Date & Time		11-03-2020 10:51 to 11-03-2020 10:54			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.222kV		Normal
		Y	3.221kV		
		B	3.229kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	-0.65			Leading
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	56.01	2.13	Within permissible limit at Average load during load study
		Y	53.54	2.18	
		B	55.19	2.07	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	56.01	4.20	Within permissible limit at Average load during load study
		Y	53.54	5.00	
		B	55.19	5.03	
12	Frequency	49.98			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		PWPH-3(Pump-4)			
Date & Time		11-03-2020 10:56 to 11-03-2020 10:59			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.217kV		Normal
		Y	3.225kV		
		B	3.224kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	-0.65			Leading
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	53.74	1.89	Within permissible limit at Average load during load study
		Y	53.51	2.22	
		B	54.68	2.31	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	53.74	4.44	Within permissible limit at Average load during load study
		Y	53.51	5.44	
		B	54.68	5.52	
12	Frequency	50.03			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT

KWA Aluva

Location & Code:	8.RWPH-3(Pump 1)
Date & Time	11-03-2020 11:24 to 11-03-2020 11:30
Reference	Technical Supplement

Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.190kV		Normal
		Y	3.253kV		
		B	3.240kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.64			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	32.98	1.51	Within permissible limit at Average load during load study
		Y	30.30	1.30	
		B	30.36	1.56	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	32.98	1.04	Within permissible limit at Average load during load study
		Y	30.30	1.32	
		B	30.36	1.56	
12	Frequency	50.01			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		9.RWPH-1(Pump 3)		
Date & Time		11-03-2020 11:33 to 11-03-2020 11:36		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	3.196kV	Normal
		Y	3.257kV	
		B	3.246kV	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	0.99		Normal
8	Load Current (Waveform)	Sine wave		Normal
9	Load generated disturbances	Absent		Ref. Technical suppliment

Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	29.95	0.95	Within permissible limit at Average load during load study
		Y	30.74	1.04	
		B	30.29	1.23	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	29.95	2.16	Within permissible limit at Average load during load study
		Y	30.74	2.05	
		B	30.29	2.78	
12	Frequency	50.02			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		PWPH-2 (Pump-1)		
Date & Time		11-03-2020 11:38 to 11-03-2020 11:41		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	3.199kV	Normal
		Y	3.260kV	
		B	3.248kV	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	0.99		Normal
8	Load Current (Waveform)	Sine wave		Normal
9	Load generated disturbances	Absent		Ref. Technical suppliment

Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	59.19	1.01	Within permissible limit at Average load during load study
		Y	60.50	1.10	
		B	59.24	1.32	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	59.19	2.83	Within permissible limit at Average load during load study
		Y	60.50	2.63	
		B	59.24	2.72	
12	Frequency	50.05			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		11.PWPH-1(Pump 1)			
Date & Time		11-03-2020 11:47 to 11-03-2020 11:50			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.202kV		Normal
		Y	3.266kV		
		B	3.252kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.95			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	69.94	1.47	Within permissible limit at Average load during load study
		Y	70.43	1.25	
		B	69.90	1.50	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	69.94	1.15	Within permissible limit at Average load during load study
		Y	70.43	1.03	
		B	69.90	1.47	
12	Frequency	49.9			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		12.PWPH-1(Pump 2)		
Date & Time		11-03-2020 11:52 to 11-03-2020 11:56		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	3.199kV	Normal
		Y	3.261kV	
		B	3.249kV	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	0.95		Low power factor
8	Load Current (Waveform)	Sine wave		Normal
9	Load generated disturbances	Absent		Ref. Technical suppliment

Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	68.22	1.56	Within permissible limit at Average load during load study
		Y	70.48	1.21	
		B	68.14	1.48	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	68.22	1.05	Within permissible limit at Average load during load study
		Y	70.48	0.95	
		B	68.14	1.33	
12	Frequency	49.9			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		13.RWPH-1(Pump 1)		
Date & Time		11-03-2020 12:07 to 11-03-2020 12:09		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	3.197kV	Normal
		Y	3.258kV	
		B	3.245kV	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	-0.99		Leading Power factor
8	Load Current (Waveform)	Distorted		Winding problem
9	Load generated disturbances	Absent		Ref. Technical suppliment

Sl No	Harmonic Analysis	Phase	Load (A)	THD (%)	Remarks
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	29.19	0.99	Within permissible limit at Average load during load study
		Y	29.78	1.09	
		B	28.55	1.23	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	29.19	4.55	Above permissible limit at Average load during load study
		Y	29.78	5.80	
		B	28.55	8.80	
12	Frequency	49.9			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		14.RWPH-3(Pump 3)			
Date & Time		11-03-2020 12:07 to 11-03-2020 12:09			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.205kV		Normal
		Y	3.268kV		
		B	3.255kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.95			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	33.52	0.98	Within permissible limit at Average load during load study
		Y	35.24	1.12	
		B	33.78	1.26	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	33.52	1.19	Within permissible limit at Average load during load study
		Y	35.24	1.13	
		B	33.78	1.48	
12	Frequency	50.01			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		15.PWPH-2(Pump 3)			
Date & Time		11-03-2020 12:16 to 11-03-2020 12:18			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	3.197kV		Normal
		Y	3.257kV		
		B	3.246kV		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.80			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	67.71	1.00	Within permissible limit at Average load during load study
		Y	70.56	1.11	
		B	68.88	1.23	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	67.71	0.85	Within permissible limit at Average load during load study
		Y	70.56	1.05	
		B	68.88	1.13	
12	Frequency	50.05			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Aluva					
Location & Code:		120HP to Aluva			
Date & Time		21-01-2020 11:13 to 21-01-2020 11:16			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	397.11		Normal
		Y	396.95		
		B	397.20		
3	Voltage wave forms	Sine wave			Normal
4	Dips & Swells	Not recorded during load study period			Normal
5	Transient Voltages	Not recorded during load study period			Normal
6	Voltage fluctuations / flicker	Not recorded during load study period			Normal
7	Power factor	0.85			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical suppliment
Harmonic Analysis		**Phase**	**Load (A)**	**THD (%)**	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	141.50	1.24	Within permissible limit at Average load during load study
		Y	140.37	1.57	
		B	140.35	1.82	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	141.50	2.01	Within permissible limit at Average load during load study
		Y	140.37	2.00	
		B	140.35	2.11	
12	Frequency	50.056			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT				
KWA Aluva				
Location & Code:		150HP to Kizhumad		
Date & Time		21-01-2020 11:08 to 21-01-2020 11:10		
Reference		Technical Supplement		
Sl No	Category	Summary Analysis		Remarks
1	Voltage Continuity (Input)	Good		Normal
2	RMS Voltage level	R	229.53	Normal
		Y	228.77	
		B	229.37	
3	Voltage wave forms	Sine wave		Normal
4	Dips & Swells	Not recorded during load study period		Normal
5	Transient Voltages	Not recorded during load study period		Normal
6	Voltage fluctuations / flicker	Not recorded during load study period		Normal
7	Power factor	0.98		Normal
8	Load Current (Waveform)	Sine wave		Normal
9	Load generated disturbances	Absent		Ref. Technical supplment

Sl No	Harmonic Analysis	Phase	Load (A)	THD (%)	Remarks
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	162.50	1.28	Within permissible limit at Average load during load study
		Y	157.83	1.49	
		B	155.86	1.64	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	162.50	0.94	Within permissible limit at Average load during load study
		Y	157.83	0.96	
		B	155.86	1.00	
12	Frequency	49.97			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

This Page is Intentionally Kept Blank

6

Energy efficiency in utility and process system

Specific Energy Consumption (SEC)

OTTOTRACTIONS- ENERGY AUDIT		
Energy Performance Index		
1	Total Production in (MLD)	290
2	Actual annual production M^3	105850000
3	Annual Electricity Consumption (kWh)	33452300
4	**Specific Energy Consumption kWh/m^3**	**0.32**

The Specific Energy Consumption is 0.32 kWh/m^3

or it can be read as 3.125 m^3/kWh consumed.

This value may be taken as internal bench mark for future reference and improvement. As the common headers are used separate SEC for individual pumps are not taken but combined SEC is established. The SEC established includes auxiliary consumption also.

7

Evaluation of energy management system

Energy management policy

There is no written energy policy available. A draft energy management policy is given below. The management may constitute an energy management policy and display the same in the plant to motivate the staff.

KERALA WATER AUTHORITY

PH DIVISION, ALUVA

ENERGY POLICY

(Draft)

We are committed to optimally utilize various forms of energy in a cost effective manner to effect conservation of energy resources. We are committed to conserve the energy which is a scarce resource with the requisite consistency in the efficiency, effectiveness in the cost involved in the operations and ensuring that production quality and quantity, environment, safety, health of people are maintained. We are also committed to increase the renewable energy share of the total energy we use.

We are also committed to monitor continuously the saving achieved and reduce its specific energy consumption by minimum of 2% every year.

Date -----------------------

Head of the Institution

7.1. Energy management monitoring system

- **Energy Management Cell** has to be constituted with an objective to revise action plan for energy conservation thereby reducing the production cost.
- Energy conservation tips/ posters are displayed in crucial points.
- Use of renewable energy has to be encouraged.
- Flow meters and energy meters shall be installed in all major pumps. The meter reading shall be recorded in regular frequencies. It is recommended to install meters with communication capability to get real-time energy performance data and monitoring of pump performance.
- Specific Energy Consumption monitoring shall be done regularly by utilizing the data from flow meters and energy meters installed and connected to the on line monitoring system.
- Energy performance data shall be included in the existing online reporting system so that better comparison of plant operation can be done in terms of energy.

7.2. Training to staff responsible for operational and Documentation.

- The staff need to be made more aware of the importance of energy saving and management.
- Log books shall be maintained to record Electricity Consumption and Diesel consumption.
- TOD reading shall be taken and compared with KSEB regularly.

7.3. Renewable Energy

- No renewable energy projects implemented.

8

Energy Conservation Measures and Recommendations

8.1. Electrical System

- Electrical safety measures have to be implemented.
- As , all pure water and raw water pumps are operating 24hr a day, the scheduling may be done based on the performance test results given in the 5th chapter. The motors with combined efficiency near the design efficiency may be used for regular applications and the lowest performing pumps may be used as standby.
- As per the electrical load studies conducted the capacitance requirement in demand side (motor end) is 1920 kVAR, which may cost around 8 lakhs Rs. For PF improvement. This will help increasing the PF to unity and will get incentives for the same. The demand will also come down due to better power factor.
- **FCMA** starters are used here which are harmonic free, rugged magnetic soft **starters** for motor starting. **FCMA** is an acronym for flux compensated magnetic amplifier which is basically a modulated inductive impedance. When connected in series with the motor the **FCMA** reduces the starting current to a low value. It is advised to switch all the starters to FCMA to save energy as well as to improve Switch gears & starters,
- Sub meters with communication facility shall be implemented for the effective monitoring of energy and water (like SEC)
- Pumping machinery is subjected to wear & tear, erosion and corrosion due to its nature of functioning, and therefore it is vulnerable to failures. Generally, failures or interruptions are mostly attributed to pumping machinery rather than any other component. Therefore, correct operation and timely maintenance and upkeep of pumping stations and pumping machinery are of vital importance. Sudden failures can be avoided by timely inspection, follow up actions on observations of inspection and planned periodical maintenance. Downtime can be reduced by maintaining inventory of fast-moving spare parts. Obviously due attention needs to be paid to all such aspects for efficient and reliable functioning of pumping machinery.

- The carbon emission factor has been taken from the CO2 Baseline Database for the Indian Power Sector User Guide Version 14.0 December 2018 of Central Electricity Authority. The value take for southern grid is 0.83.
- The foundations, descaling of pipes etc. has to be checked regularly for optimizing the efficiency of the pumping system.

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code EA 581.01	
Energy Saving in Lighting by replacing existing 173 No's T12 Lamps to 18W LED Tube	
Existing Scenario	
173 in the facility. During discussion with officers it is observed that the average utility of these fittings are of 80%.	
Proposed System	
The existing T12 may be replaced to LED tube of 18 W in phased manner and the savings will be of 67 % (inclusive of improved light output and reduced energy consumption)	
Financial Analysis	
Annual working hours (hr)	6570
No of fittings	173
Total load (kW)	9.52
Annual Energy Consumption (kWh)	50011
Expected Annual Energy saving for replacing all fittings (kWh)	27506
Cost of Power	6.00
Annual saving in Lakhs Rs (1st year)	1.65
Investment required for complete replacements [@Rs 350 per fittings](Lakhs Rs)	0.61
Simple Pay Back (in Months)	4.40

Energy Saving Proposal Code 581.02	
Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Tanker pump set	
Existing scenario	
2 No's 50HP motors are used in Tanker pump set . Both motors are aged and re-winded. Re-winding reduces the efficiency of the motors further.	
Proposed system	
It is recommended to replace the existing standard efficiency motor with Energy Efficient Motors. Energy Efficient Motors (EEM) IE3 or higher grade delivers efficiency above 90%.There is an increase of energy efficiency in IE3 replacement with standard efficiency motors Energy savings by motor replacement can be worked out by the simple relation, ie. kW savings = kW output x ($1/\eta$ old- $1/\eta$ new), where old and new are the existing and proposed motor efficiency.	
Financial Analysis	
Annual working hours (hr)	5840
No of motors to be replaced.	2
Total load (kW)	64.2
Existing efficiency of the motors (%)	77
Proposed efficiency of the motors (%)	92
Annual Energy consumption (kWh) (@60% avg utility)	224803
Expected annual energy saving (kWh)	36653
Cost of Power	6.00
Annual saving in Lakhs Rs (1st year)	2.20
Investment required (Lakhs Rs)[@17000 Rs/kW]	10.91
Simple Pay Back (in Months)	59.51

Energy Saving Proposal Code 581.03	
Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in WW Pump (Plant 3)	
Existing scenario	
2 No's 50HP motors are used in WW pump sets in plant No 3. Both motors are aged and re-winded. Re-winding reduces the efficiency of the motors further.	
Proposed system	
It is recommended to replace the existing standard efficiency motor with Energy Efficient Motors. Energy Efficient Motors (EEM) IE3 or higher grade delivers efficiency above 90%.There is an increase of energy efficiency in IE3 replacement with standard efficiency motors Energy savings by motor replacement can be worked out by the simple relation, ie. kW savings = kW output x (1/η old- 1/η new), where old and new are the existing and proposed motor efficiency.	
Financial Analysis	
Annual working hours (hr)	5840
No of motors to be replaced.	2
Total load (kW)	69.4
Existing efficiency of the motors (%)	77
Proposed efficiency of the motors (%)	92
Annual Energy consumption (kWh) (@60% avg utility)	243101
Expected annual energy saving (kWh)	39636
Cost of Power	6.00
Annual saving in Lakhs Rs (1st year)	2.38
Investment required (Lakhs Rs)[@17000 Rs/kW]	11.79
Simple Pay Back (in Months)	59.51

Energy Saving Proposal Code 581.04	
Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in WW Pump set (Plant 4)	
Existing scenario	
2 No's 20HP motors are used in WW pump sets in plant No 4. Both motors are aged and re-winded. Re-winding reduces the efficiency of the motors further.	
Proposed system	
It is recommended to replace the existing standard efficiency motor with Energy Efficient Motors. Energy Efficient Motors (EEM) IE3 or higher grade delivers efficiency above 90%.There is an increase of energy efficiency in IE3 replacement with standard efficiency motors Energy savings by motor replacement can be worked out by the simple relation, ie. kW savings = kW output x (1/η old- 1/η new), where old and new are the existing and proposed motor efficiency.	
Financial Analysis	
Annual working hours (hr)	5840
No of motors to be replaced.	2
Total load (kW)	25.1
Existing efficiency of the motors (%)	77
Proposed efficiency of the motors (%)	92
Annual Energy consumption (kWh) (@60% avg utility)	87830
Expected annual energy saving (kWh)	14320
Cost of Power	6.00
Annual saving in Lakhs Rs (1st year)	0.86
Investment required (Lakhs Rs)[@17000 Rs/kW]	4.26
Simple Pay Back (in Months)	59.51

Energy Saving Proposal Code 581.05	
Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Blowers	
Existing scenario	
4 No's 20HP motors are used in Blowers of plant No 3 & 4. all motors are aged and re-winded. Re-winding reduces the efficiency of the motors further.	
Proposed system	
It is recommended to replace the existing standard efficiency motor with Energy Efficient Motors. Energy Efficient Motors (EEM) IE3 or higher grade delivers efficiency above 90%. There is an increase of energy efficiency in IE3 replacement with standard efficiency motors Energy savings by motor replacement can be worked out by the simple relation, ie. kW savings = kW output × (1/η old- 1/η new), where old and new are the existing and proposed motor efficiency.	
Financial Analysis	
Annual working hours (hr)	5840
No of motors to be replaced.	4
Total load (kW)	48.9
Existing efficiency of the motors (%)	77
Proposed efficiency of the motors (%)	92
Annual Energy consumption (kWh) (@60% avg utility)	171477
Expected annual energy saving (kWh)	27958
Cost of Power	6.00
Annual saving in Lakhs Rs (1st year)	1.68
Investment required (Lakhs Rs)[@17000 Rs/kW]	8.32
Simple Pay Back (in Months)	59.51

Energy Saving Calculation

Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT1)

Sl No			Description	Unit	Existing System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	210	200
		3	Efficiency of standard motor	%	84.3	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	210.00	118.70
		6	Efficiency	%	87	90
		7	Combined efficiency of the system (rated)	%	73	81
		8	Combined efficiency of the system (measured)	%	59	81
		9	**Head**	**m**	**22**	**23**
		10	**Flow**	**m^3/s**	**0.447**	**0.447**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**96.53**	**100.92**
	Input	14	Total Electrical Power drawn	kW	163.00	118.70
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1427880	1039812
		18	Annual power Savings, kWh	kWh		388068
		19	Annual Savings	Rs. In Lakhs		**23.28**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**200.00**
		22	Investment	Rs. In Lakhs		**41.00**
		23	Simple Payback period	**Months**		**21.13**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT1)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	130	130
		3	Efficiency of standard motor	%	92	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	130.00	110.70
		6	Efficiency	%	86	90
		7	Combined efficiency of the system (rated)	%	79	81.00
		8	Combined efficiency of the system (measured)	%	69	81.00
		9	**Head**	**m**	**22**	**22**
		10	**Flow**	**m^3/s**	**0.340**	**0.340**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**73.38**	**73.38**
	Input	14	Total Electrical Power drawn	kW	130.00	110.70
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1138800	969732
		18	Annual power Savings, kWh	kWh		169068
		19	Annual Savings	Rs. In Lakhs		**10.14**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**130.00**
		22	Investment	Rs. In Lakhs		**26.65**
		23	Simple Payback period	**Months**		**31.53**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT2)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	150	110
		3	Efficiency of standard motor	%	75	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	150.00	124.10
		6	Efficiency	%	75	90
		7	Combined efficiency of the system (rated)	%	72.000	81.00
		8	Combined efficiency of the system (measured)	%	67.000	81.00
		9	**Head**	m		**0**
		10	**Flow**	m^3/s		**0.330**
		11	**Density of water**	kg/m^3	**1000**	**1000**
		12	**Gravitational Constant**	m/s^2	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**0.00**	**0.00**
	Input	14	Total Electrical Power drawn	kW	150.00	124.10
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1314000	1087116
		18	Annual power Savings, kWh	kWh		226884
		19	Annual Savings	Rs. In Lakhs		**13.61**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**110.00**
		22	Investment	Rs. In Lakhs		**22.55**
		23	Simple Payback period	**Months**		**19.88**

Energy Saving Calculation

Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT4)

Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	150	110
		3	Efficiency of standard motor	%	90	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	150.00	1.04
		6	Efficiency	%	80	90
		7	Combined efficiency of the system (rated)		0.720	0.81
		8	Combined efficiency of the system (measured)		0.560	0.81
		9	**Head**	**m**		**0**
		10	**Flow**	**m^3/s**	**0.280**	**0.280**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**0.00**	**0.00**
	Input	14	Total Electrical Power drawn	kW	150.00	103.70
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1314000	908412
		18	Annual power Savings, kWh	kWh		405588
		19	Annual Savings	Rs. In Lakhs		**24.34**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**110.00**
		22	Investment	Rs. In Lakhs		**22.55**
		23	Simple Payback period	**Months**		**11.12**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT1)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	200	180
		3	Efficiency of standard motor	%	82	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	200.00	133.30
		6	Efficiency	%	85	90
		7	Combined efficiency of the system (rated)		0.697	0.81
		8	Combined efficiency of the system (measured)		0.540	0.81
		9	**Head**	**m**	**27.3**	**27.3**
		10	**Flow**	**m^3/s**	**0.270**	**0.270**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**72.31**	**72.31**
	Input	14	Total Electrical Power drawn	kW	200.00	133.30
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1752000	1167708
		18	Annual power Savings, kWh	kWh		584292
		19	Annual Savings	Rs. In Lakhs		**35.06**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**180.00**
		22	Investment	Rs. In Lakhs		**36.90**
		23	Simple Payback period	**Months**		**12.63**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW3-HT2)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	200	180
		3	Efficiency of standard motor	%	82	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	200.00	146.90
		6	Efficiency	%	85	90
		7	Combined efficiency of the system (rated)	%	0.697	0.81
		8	Combined efficiency of the system (measured)	%	0.595	0.81
		9	**Head**	**m**	**23**	**23**
		10	**Flow**	**m^3/s**	**0.330**	**0.330**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**74.46**	**74.46**
	Input	14	Total Electrical Power drawn	kW	200.00	146.90
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1752000	1286844
		18	Annual power Savings, kWh	kWh		465156
		19	Annual Savings	Rs. In Lakhs		**27.91**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**180.00**
		22	Investment	Rs. In Lakhs		**36.90**
		23	Simple Payback period	**Months**		**15.87**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT3)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	200	180
		3	Efficiency of standard motor	%	82	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	200.00	121.50
		6	Efficiency	%	85	90
		7	Combined efficiency of the system (rated)	%	0.697	0.81
		8	Combined efficiency of the system (measured)	%	0.492	0.81
		9	**Head**	**m**	**21**	**21**
		10	**Flow**	**m^3/s**	**0.440**	**0.440**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**90.64**	**90.64**
	Input	14	Total Electrical Power drawn	kW	200.00	121.50
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1752000	1064340
		18	Annual power Savings, kWh	kWh		687660
		19	Annual Savings	Rs. In Lakhs		**41.26**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**180.00**
		22	Investment	Rs. In Lakhs		**36.90**
		23	Simple Payback period	**Months**		**10.73**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor(PW1-HT1)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	375	315
		3	Efficiency of standard motor	%	82	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	378.00	241.70
	Pump	6	Efficiency	%	85	90
		7	Combined efficiency of the system (Measured)		0.518	0.81
		8	Combined efficiency of the system (Rated)		0.697	0.81
		9	**Head**	**m**	**63**	**63**
		10	**Flow**	**m^3/s**	**0.317**	**0.317**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**195.72**	**195.72**
	Input	14	Total Electrical Power drawn	kW	378.00	241.70
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	3311280	2117292
		18	Annual power Savings, kWh	kWh		1193988
		19	Annual Savings	Rs. In Lakhs		**71.64**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**315.00**
		22	Investment	Rs. In Lakhs		**64.58**
		23	Simple Payback period	**Months**		**10.82**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT2)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	375	315
		3	Efficiency of standared motor	%	82	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	370.00	236.20
		6	Efficiency	%	85	90
		7	Combined efficiency of the system (Measured)		0.517	0.81
		8	Combined efficiency of the system (Rated)		0.697	0.81
		9	**Head**	**m**	**63**	**63**
		10	**Flow**	**m^3/s**	**0.310**	**0.310**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**191.58**	**191.58**
	Input	14	Total Electrical Power drawn	kW	370.00	236.20
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	3241200	2069112
		18	Annual power Savings, kWh	kWh		1172088
		19	Annual Savings	Rs. In Lakhs		**70.33**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**315.00**
		22	Investment	Rs. In Lakhs		**64.58**
		23	Simple Payback period	**Months**		**11.02**

Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT6)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	160	90
		3	Efficiency of standared motor	%	82	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	142.00	72.10
		6	Efficiency	%	85	90
		7	Combined efficiency of the system (Measured)		0.411	0.81
		8	Combined efficiency of the system (Rated)		0.697	0.81
		9	**Head**	**m**	**50**	**50**
		10	**Flow**	**m^3/s**	**0.120**	**0.120**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**58.86**	**58.86**
	Input	14	Total Electrical Power drawn	kW	142.00	72.10
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1243920	631596
		18	Annual power Savings, kWh	kWh		612324
		19	Annual Savings	Rs. In Lakhs		**36.74**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**90.00**
		22	Investment	Rs. In Lakhs		**18.45**
		23	Simple Payback period	**Months**		**6.03**

Energy Saving Calculation

Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT1)

Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	350	315
		3	Efficiency of standard motor	%	85	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	331.00	255.40
		6	Efficiency	%	75	90
		7	Combined efficiency of the system (Measured)		0.625	0.81
		8	Combined efficiency of the system (Rated)		0.638	0.81
		9	**Head**	**m**	**44**	**44**
		10	**Flow**	**m^3/s**	**0.480**	**0.480**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**207.19**	**207.19**
	Input	14	Total Electrical Power drawn	kW	331.00	255.40
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	2899560	2237304
		18	Annual power Savings, kWh	kWh		662256
		19	Annual Savings	Rs. In Lakhs		**39.74**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**315.00**
		22	Investment	Rs. In Lakhs		**64.58**
		23	Simple Payback period	**Months**		**19.50**

Energy Saving Calculation

Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT3)

Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	350	315
		3	Efficiency of standared motor	%	85	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	310.00	202.50
		6	Efficiencyof Pump	%	75	90
		7	Combined efficiency of the system (Measured)		0.529	0.81
		8	Combined efficiency of the system (Rated)		0.638	0.81
		9	**Head**	**m**	**44**	**44**
		10	**Flow**	**m^3/s**	**0.380**	**0.380**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**164.02**	**164.02**
	Input	14	Total Electrical Power drawn	kW	310.00	202.50
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	2715600	1773900
		18	Annual power Savings, kWh	kWh		941700
		19	Annual Savings	Rs. In Lakhs		**56.50**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**315.00**
		22	Investment	Rs. In Lakhs		**64.58**
		23	Simple Payback period	**Months**		**13.71**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT3)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	350	315
		3	Efficiency of standared motor	%	85	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	310.00	202.50
		6	Efficiencyof Pump	%	75	90
		7	Combined efficiency of the system (Measured)		0.529	0.81
		8	Combined efficiency of the system (Rated)		0.638	0.81
		9	**Head**	**m**	**44**	**44**
		10	**Flow**	**m^3/s**	**0.380**	**0.380**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**164.02**	**164.02**
	Input	14	Total Electrical Power drawn	kW	310.00	202.50
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	2715600	1773900
		18	Annual power Savings, kWh	kWh		941700
		19	Annual Savings	Rs. In Lakhs		**56.50**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**315.00**
		22	Investment	Rs. In Lakhs		**64.58**
		23	Simple Payback period	**Months**		**13.71**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	320	250
		3	Efficiency of standared motor	%	90	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	200.00	176.30
		6	Efficiency	%	88.5	90
		7	Combined efficiency of the system (Measured)		0.714	0.81
		8	Combined efficiency of the system (Rated)		0.797	0.81
		9	**Head**	**m**	**28**	**28**
		10	**Flow**	**m^3/s**	**0.520**	**0.520**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**142.83**	**142.83**
	Input	14	Total Electrical Power drawn	kW	200.00	176.30
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1752000	1544388
		18	Annual power Savings, kWh	kWh		207612
		19	Annual Savings	Rs. In Lakhs		**12.46**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**250.00**
		22	Investment	Rs. In Lakhs		**51.25**
		23	Simple Payback period	**Months**		**49.37**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	350	250
		3	Efficiency of standared motor	%	90	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	200.00	166.20
		6	Efficiency	%	88.5	90
		7	Combined efficiency of the system (Measured)		0.673	0.81
		8	Combined efficiency of the system (Rated)		0.797	0.81
		9	**Head**	**m**	**28**	**28**
		10	**Flow**	**m^3/s**	**0.497**	**0.497**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**136.52**	**136.52**
	Input	14	Total Electrical Power drawn	kW	200.00	166.20
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1752000	1455912
		18	Annual power Savings, kWh	kWh		296088
		19	Annual Savings	Rs. In Lakhs		**17.77**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**250.00**
		22	Investment	Rs. In Lakhs		**51.25**
		23	Simple Payback period	**Months**		**34.62**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT5)						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	350	250
		3	Efficiency of standared motor	%	90	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	202.00	167.80
		6	Efficiency	%	88.5	90
		7	Combined efficiency of the system (Measured)		0.673	0.81
		8	Combined efficiency of the system (Rated)		0.797	0.81
		9	**Head**	**m**	**28**	**28**
		10	**Flow**	**m^3/s**	**0.451**	**0.451**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**123.88**	**123.88**
	Input	14	Total Electrical Power drawn	kW	202.00	167.80
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	1769520	1469928
		18	Annual power Savings, kWh	kWh		299592
		19	Annual Savings	Rs. In Lakhs		**17.98**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**250.00**
		22	Investment	Rs. In Lakhs		**51.25**
		23	Simple Payback period	**Months**		**34.21**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	110	55
		3	Efficiency of standared motor	%	90	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	107.00	50.10
		6	Efficiency	%	88.5	90
		7	Combined efficiency of the system (Measured)		0.379	0.81
		8	Combined efficiency of the system (Rated)		0.797	0.81
		9	**Head**	**m**	**60**	**60**
		10	**Flow**	**m^3/s**	**0.069**	**0.069**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**40.55**	**40.55**
	Input	14	Total Electrical Power drawn	kW	107.00	50.10
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	937320	438876
		18	Annual power Savings, kWh	kWh		498444
		19	Annual Savings	Rs. In Lakhs		**29.91**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**55.00**
		22	Investment	Rs. In Lakhs		**11.28**
		23	Simple Payback period	**Months**		**4.52**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-						
Sl No			Description	Unit	Old System	New System
Design Parameters	Motors	1	Total number of motors to be replaced	1	Standard	IE2
		2	Rated load of the motor	kW	90	75
		3	Efficiency of standared motor	%	85	90
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	83.00	73.60
		6	Efficiency	%	84.5	90
		7	Combined efficiency of the system (Measured)		0.67	0.81
		8	Combined efficiency of the system (Rated)		0.718	0.81
		9	**Head**	**m**	**54**	**54**
		10	**Flow**	**m^3/s**	**0.105**	**0.105**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydrouling Power**	**kW**	**55.62**	**55.62**
	Input	14	Total Electrical Power drawn	kW	83.00	73.60
		15	Unit Cost	Rs./kWh	6	6
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	727080	644736
		18	Annual power Savings, kWh	kWh		82344
		19	Annual Savings	Rs. In Lakhs		**4.94**
		20	Investment for Pumps (as per kWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**75.00**
		22	Investment	Rs. In Lakhs		**15.38**
		23	Simple Payback period	**Months**		**37.34**

OTTOTRACTIONS- ENERGY AUDIT						
KWA PUMPING STATION, ALUVA						
Greenhouse Gas Mitigation through Major Energy Efficiency Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Energy Saving in Lighting by replacing existing 173 No's T12 Lamps to 18W LED Tube	27506	27.51	10	20.08	200.79
2	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	36653	36.65	10	26.76	267.56
3	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	39636	39.64	10	28.93	289.34
4	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	14320	14.32	10	10.45	104.54
5	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	27958	27.96	10	20.41	204.10
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT1)	388068	388.07	10	283.29	2832.90
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT3)	491436	491.44	10	358.75	3587.48
8	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT1)	169068	169.07	10	123.42	1234.20
9	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT2)	226884.0	226.88	10	165.63	1656.25
10	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT4)	405588.00	405.59	10	296.08	2960.79
11	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT1)	584292.00	584.29	10	426.53	4265.33
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW3-HT2)	465156.00	465.16	10	339.56	3395.64

13	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT3)	687660.00	687.66	10	501.99	5019.92
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor(PW1-HT1)	1193988.00	1193.99	10	871.61	8716.11
15	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT2)	1172088.00	1172.09	10	855.62	8556.24
16	)Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT6)	612324.00	612.32	10	447.00	4469.97
17	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT1)	662256.00	662.26	10	483.45	4834.47
18	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT3)	941700.00	941.70	10	687.44	6874.41
19	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT3)	941700.00	941.70	10	687.44	6874.41
20	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	207612.00	207.61	10	151.56	1515.57
21	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	296088.00	296.09	10	216.14	2161.44
22	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT5)	299592.00	299.59	10	218.70	2187.02
23	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT1)	498444.00	498.44	10	363.86	3638.64
24	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT5)	82344.00	82.34	10	60.11	601.11

OTTOTRACTIONS- ENERGY AUDIT			
Implementation Schedule			
KWA PUMPING STATION, ALUVA			
Sl No	Projects	SPB	Implementation Schedule
1	Energy Saving in Lighting by replacing existing 173 No's T12 Lamps to 18W LED Tube	4.40	Short Term
2	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
3	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
4	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
5	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT1)	21	Short Term
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT3)	13	Short Term
8	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT1)	32	Short Term
9	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT2)	20	Short Term
10	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT4)	11	Short Term
11	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT1)	13	Short Term
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW3-HT2)	16	Long Term

13	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT3)	11	Short Term
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor(PW1-HT1)	11	Short Term
15	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT2)	11	Short Term
16	)Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT6)	6	Short Term
17	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT1)	20	Short Term
18	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT3)	14	Short Term
19	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT3)	14	Short Term
20	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	49	Short Term
21	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	34	Short Term
22	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT5)	34	Short Term
23	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT1)	5	Short Term
24	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT5)	37	Short Term

Implementation Schedule Short Term			
KWA PUMPING STATION, ALUVA			
Sl No	Projects	SPB	Implementation Schedule
1	Energy Saving in Lighting by replacing existing 173 No's T12 Lamps to 18W LED Tube	4.40	Short Term
2	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT1)	21	Short Term
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW1-HT3)	13	Short Term
4	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT1)	32	Short Term
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT2)	20	Short Term
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor (RW2-LT4)	11	Short Term
7	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT1)	13	Short Term
8	Energy Efficiency in Existing Pumping system by replacing inefficient motor(RW3-HT3)	11	Short Term
9	Energy Efficiency in Existing Pumping system by replacing inefficient motor(PW1-HT1)	11	Short Term
10	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT2)	11	Short Term
11	)Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW1-HT6)	6	Short Term
12	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT1)	20	Short Term
13	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW2-HT3)	14	Short Term
14	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT3)	14	Short Term
15	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	49	Short Term
16	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT4)	34	Short Term
17	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-HT5)	34	Short Term
18	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT1)	5	Short Term
19	Energy Efficiency in Existing Pumping system by replacing inefficient motor (PW3-LT5)	37	Short Term

Implementation Schedule Medium Term			
KWA PUMPING STATION, ALUVA			
Sl No	Projects	SPB	Implementation Schedule
1	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
2	Energy saving by replacing the existing 50HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
3	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term
4	Energy saving by replacing the existing 20HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Minirator	59.51	Medium Term

9

Technical Supplement

Electricity Bill Details (2018-2019)											
Month	Name of the Consumer			KWA PH Subdivision, Aluva							
	Contract demnad (kVA)		3418 kVA	Consumer number & Section			1355670000844				
	Tariff		HT I (A) INDUSTRIAL				Aluva town				
	kWh				kVA			PF	PF Penalty / Incentive	Rs(Total)	Rs/kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3				
Apr	809080	267280	542720	1619080	2445	2448	2438	0.96	-267148	9609377	**5.94**
May	842880	277240	559580	1679700	2660	2664	2671	0.96	-277134	9971916	**5.94**
Jun				1772760				0.96		10478469	**5.91**
Jul	862640	288960	575600	1727200	2667	2654	2658	0.96	-284988	10280612	**5.95**
Aug	835720	279000	570280	1685000	2697	2699	2750	0.94	-155350	10117775	**6.00**
Sep	721640	241680	477840	1441160	2914	2787	2794	0.93	-118896	8861829	**6.15**
Oct	863560	290480	583600	1737640	2825	2848	2867	0.94	-191140	10698130	**6.16**
Nov	914120	306080	615360	1835560	2824	2827	2845	0.95	-252389	11201470	**6.10**
Dec	825840	280560	557280	1663680	2816	2689	2828	0.96	-274507	10181645	**6.12**
Jan				1808640				0.96		10675874	**5.90**
Feb	889360	301200	599400	1789960	2630	2642	2656	0.96	-295343	10569982	**5.91**
Mar	800720	272120	542360	1615200	2646	2657	2663	0.96	-266508	9617892	**5.95**
				20375580	2638	26915	27170	0.95		122264971	6.00

Electricity Bill Details (2018-2019)											
Month	Name of the Consumer				KWA PH Subdivision, Aluva						
	Contract demnad (kVA)		1800 kVA		Consumer number & Section			1355670001036			
	Tariff		HT I (A) INDUSTRIAL					Kaloor			
	kWh				kVA			PF	PF Penalty / Incentive	Rs(Total)	Rs/kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3				
Apr	562240	188320	376480	1127040	1682	1667	1649	0.97	-216955	6627245	**5.88**
May	566480	188360	371160	1126000	1717	1691	1677	0.97	-216755	6632095	**5.89**
Jun	590160	198440	394720	1183320	1887	1871	1853	0.97	-227789	7007536	**5.92**
Jul	572920	190120	379840	1142880	1678	1671	1645	0.97	-220004	6712096	**5.87**
Aug	542800	180920	358200	1081920	1635	1627	1594	0.98	-238022	6338277	**5.86**
Sep	462520	161600	314920	939040	1688	1801	1652	0.97	-180765	5641785	**6.01**
Oct	528040	179120	355240	1062400	1680	1662	1642	0.97	-204512	6434848	**6.06**
Nov	547080	179920	374400	1101400	1649	1642	1608	0.97	-212020	6643266	**6.03**
Dec	516120	173920	348520	1038560	1647	1637	1606	0.97	-199923	6291861	**6.06**
Jan				1134800						6656201	**5.87**
Feb	565520	186680	379600	1131800	1639	1630	1605	0.97	-217871	6640203	**5.87**
Mar	500240	167120	340200	1007560	1625	1619	1597	0.98	-221663	5933361	**5.89**
				13076720	1887	18518	18128	0.97			

- **HT Capacitor requirement is 3313kVAr**
- **LT Capacitor requirement is 103.8kVAr**

Capacitor Requirment								
Sl.No	Location	Motors	HP	Make	KW (Rated)	kW (Measured)	PF	Required kVAR
1	RWPH No.1	HT Motor No 1	282	KBL	210	163	0.99	15
2		HT Motor No 3	215	KBL	160	171	0.99	14
3	RWPH No.2	Pump set No 1	175	KBL	131	106	0.88	56
4		Pump set No 2	200	Johnston oil lub	149	111	0.77	91
5		Pump set No 4	200	Johnston oil lub	149	102	0.59	137
6	RWPH No.3	HT Motor No 1	268	KBL	200	111	0.64	133
7		HT Motor No 2	268	KBL	200	125	0.63	149
8		HT Motor No 3	268	KBL	200	184	0.95	55
9	PWPH No.1	HT Motor No 1	503	KBL	375	378	0.95	110
10		HT Motor No 2	503	KBL	375	370	0.95	113
11		HT Motor No 6 M-2	215		160	142	0.98	22
12	PWPH No.2	HT Motor No 1	469	KBL	350	331	0.99	46
13		HT Motor No 3	469	KBL	350	310	0.8	230
14	PWPH No3	HT Motor No 3	429	KBL	320	200	0.65	226
15		HT Motor No 4	469	KBL	350	200	0.65	225
16		HT Motor No 5	469	KBL	350	202	0.65	231
17		LT Motor 1 (to Kizhumad)	150	KBL	112	107	0.98	17
18		LT Motor 5 (to aluva)	120		90	83	0.85	50

Sl.No			HP	MLD	Make	KW (Rated)	Line pressure (kg/cm2)	kW (Measured)	kVAR	kVA	Pf
1	RWPH No.1	HT Motor No 1	282		KBL	210	2.2	163	15	165	0.99
2		HT Motor No 2	215		KBL	160	2.3				
3		HT Motor No 3	215		KBL	160	2.2	171	14	173	0.99
4		HT Motor No 4	215		KBL	160	2.1				
5	RWPH No.2	Pump set No 1	175	38	KBL	131	2.2	106	56	120	0.88
6		Pump set No 2	200	40	Johnston oil lub	149	2.3	111	91	144	0.77
7		Pump set No 3	200	40	Johnston oil lub	149	2.2				
8		Pump set No 4	200	40	Johnston oil lub	149	2.1	102	137	171	0.59
9	RWPH No.3	HT Motor No 1	268	45	KBL	200	2.3	111	133	173	0.64
10		HT Motor No 2	268	45	KBL	200	2.2	125	149	198	0.63
11		HT Motor No 3	268	45	KBL	200	2.1	184	55	192	0.95
12		HT Motor No 4	268	45	KBL	200	2.2				
13	PWPH No.1	HT Motor No 1	503	35	KBL	375	6.3	378	110	393	0.95
14		HT Motor No 2	503	35	KBL	375	6.3	370	113	387	0.95
15		HT Motor No 3	503	35	KBL	375	6.3				
16		HT Motor No 4	503	35	KBL	375	6.3				
17		HT Motor No 5 M-1	215			160	6.3				
18		HT Motor No 6 M-2	215			160	5.0	142	22	145	0.98
19	PWPH No.2	HT Motor No 1	469	35	KBL	350	4.4	331	46	334	0.99
20		HT Motor No 2	469	35	KBL	350	4.4				
21		HT Motor No 3	469	35	KBL	350	4.4	310	230	385	0.8

22	PWPH No 3	HT Motor No 1	429		KBL	320	2.8				
23		HT Motor No 2	536		Marathon	400	2.8				
24		HT Motor No 3	429		KBL	320	2.8	200	226	308	0.65
25		HT Motor No 4	469		KBL	350	2.8	200	225	308	0.65
26		HT Motor No 5	469		KBL	350	2.8	202	231	311	0.65
27		LT Motor 1 (to Kizhumad)	150	8.5	KBL	112	6.0	107	17	109	0.98
28		LT Motor 2 (to Kizhumad)	150	8.5	KBL	112	6.0				
29		LT Motor 3 (to Kizhumad)	120	8.5	KBL	90	6.0				
30		LT Motor 4 (to aluva)	120	8		90	5.4				
31		LT Motor 5 (to aluva)	120	8		90	5.4	83	50	97	0.85
32	Tanker pump set	Pump set No 1	50	9.5	KBL	37					
33		Pump set No 2	50	9.5	Luby	37		20.8			
34	WW pump sets in	Pump set No 1	50	9.5	Luby	37					
35	plant No 3	Pump set No 2	50	9.5	Luby	37					
36	WW pump sets in	Pump set No 1	20	3.5	Remi	15					
37	plant No 4	Pump set No 2	20	3.5	Remi	15					

Rated Flow of Diffferent Pumps								
Sl.No			HP	MLD	M3/day	Hrs	M3/hr	Make
1	RWPH No.1	HT Motor No 1	282		0	24	0	KBL
2		HT Motor No 2	215		0	24	0	KBL
3		HT Motor No 3	215		0	24	0	KBL
4		HT Motor No 4	215		0	24	0	KBL
5	RWPH No.2	Pump set No 1	175	38	38000	24	1583	KBL
6		Pump set No 2	200	40	40000	24	1667	Johnston oil lub
7		Pump set No 3	200	40	40000	24	1667	Johnston oil lub
8		Pump set No 4	200	40	40000	24	1667	Johnston oil lub
9	RWPH No.3	HT Motor No 1	268	45	45000	24	1875	KBL
10		HT Motor No 2	268	45	45000	24	1875	KBL
11		HT Motor No 3	268	45	45000	24	1875	KBL
12		HT Motor No 4	268	45	45000	24	1875	KBL
13	PWPH No.1	HT Motor No 1	0	35	35000	24	1458	KBL
14		HT Motor No 2	0	35	35000	24	1458	KBL
15		HT Motor No 3	0	35	35000	24	1458	KBL
16		HT Motor No 4	0	35	35000	24	1458	KBL
17		HT Motor No 5 M-1	215		0	24	0	
18		HT Motor No 6 M-2	215		0	24	0	
19	PWPH No.2	HT Motor No 1	469	35	35000	24	1458	KBL
20		HT Motor No 2	469	35	35000	24	1458	KBL
21		HT Motor No 3	469	35	35000	24	1458	KBL
22	PWPH No 3	HT Motor No 1	429		0	24	0	KBL
23		HT Motor No 2	536		0	24	0	Marathon
24		HT Motor No 3	429		0	24	0	KBL
25		HT Motor No 4	469		0	24	0	KBL
26		HT Motor No 5	469		0	24	0	KBL
27		LT Motor 1 (to Kizhumad)	150	8.5	8500	24	354	KBL
28		LT Motor 2 (to Kizhumad)	150	8.5	8500	24	354	KBL
29		LT Motor 3 (to Kizhumad)	120	8.5	8500	24	354	KBL
30		LT Motor 4 (to aluva)	120	8	8000	24	333	
31		LT Motor 5 (to aluva)	120	8	8000	24	333	
32	Tanker pump set	Pump set No 1	50	9.5	9500	24	396	KBL
33		Pump set No 2	50	9.5	9500	24	396	Luby
34	WW pump sets in plant No 3	Pump set No 1	50	9.5	9500	24	396	Luby
35		Pump set No 2	50	9.5	9500	24	396	Luby
36	WW pump sets in plant No 4	Pump set No 1	20	3.5	3500	24	146	Remi
37		Pump set No 2	20	3.5	3500	24	146	Remi

KERALA WATER AUTHORITY

MONTHLY PRODUCTION REPORT OF P.H.HEAD WORKS SECTION, ALUVA.

MONTH : NOVEMBER 2019

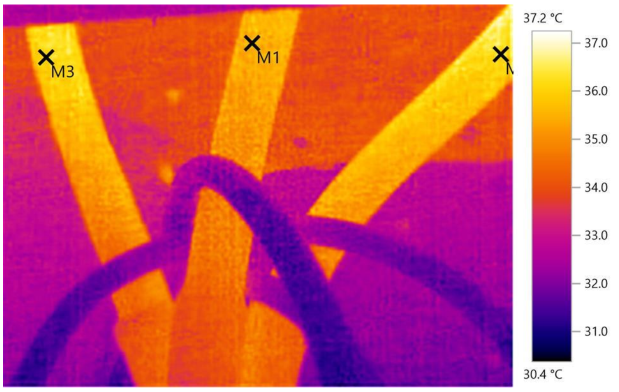
Date	36" PWPH 1	42" PWPH 2	48" PWPH 3	Aluva/P WPH 1	Choornik kara	Aluva PWPH 3	Keezhmad PWPH 3	Total
11-01-2019	53.86	81.89	125.12	6.72	3.75	8.08	6.72	286.14
11-02-2019	53.120	82.100	125.100	6.040	3.700	8.120	4.810	282.99
11-03-2019	53.210	82.130	125.010	6.490	3.720	8.010	5.120	283.69
11-04-2019	53.810	82.050	125.100	6.500	3.700	8.700	5.140	285
11-05-2019	54.400	82.120	125.180	6.560	3.750	8.540	5.270	285.82
11-06-2019	54.510	82.100	125.700	6.580	3.700	8.100	4.910	285.6
11-07-2019	54.460	82.14	125.010	6.770	3.730	7.760	5.440	285.31
11-08-2019	54.210	82.100	125.120	6.610	3.810	7.610	5.410	284.87
11-09-2019	54.010	82.120	125.160	6.390	3.680	7.810	4.820	283.99
11-10-2019	54.120	82.160	125.190	6.540	3.750	7.500	5.100	284.36
11-11-2019	54.250	82.580	125.010	6.440	3.740	7.610	5.600	285.23
11-12-2019	54.690	82.730	125.100	6.090	3.470	7.010	5.670	284.76
13/11/2019	53.810	81.350	125.180	6.990	3.840	8.120	4.850	284.14
14/11/2019	52.100	81.330	124.010	7.090	3.860	7.100	4.810	280.3
15/11/2019	54.070	82.950	122.100	7.080	3.810	7.810	5.790	283.61
16/11/2019	54.190	82.210	113.310	7.200	3.880	7.860	5.990	274.64
17/11/2019	53.360	80.120	120.120	7.150	3.780	7.600	5.990	278.12
18/11/2019	53.520	82.540	122.100	7.210	3.950	7.800	5.850	282.97
19/11/2019	53.210	82.280	125.120	7.100	3.870	7.860	4.860	284.3
20/11/2019	53.860	82.310	125.160	7.230	3.940	7.810	4.860	285.17
21/11/2019	54.260	78.190	124.100	6.020	3.450	7.860	5.100	278.98
22/11/2019	54.100	82.100	125.160	7.080	3.780	7.880	5.060	285.16
23/11/2019	53.120	82.100	125.080	7.100	3.910	7.710	4.000	283.02
24/11/2019	53.210	82.280	125.100	7.140	3.960	7.800	4.860	284.35
25/11/2019	52.530	82.100	125.160	7.100	3.900	6.570	3.980	281.34
26/11/2019	54.440	81.660	118.100	7.030	3.890	7.100	4.160	276.38
27/11/2019	54.260	81.430	117.540	7.090	3.970	7.180	5.120	276.59
28/11/2019	53.810	82.430	121.070	7.110	3.870	7.580	4.760	280.63
29/11/2019	52.360	79.450	112.440	5.880	3.460	6.170	3.840	263.6
30/11/2019	53.860	82.560	124.440	6.360	3.540	7.810	5.990	284.56

Thermography report

Company	OTTOTRACTIONS ACCREDITED ENERGY AUDITOR BUREAU OF ENERGY EFFICIENCY	Customer	KERALA WATER AUTHORITY THIRUVANANTHAPURAM
Tester	Abin baby		

Device testo 875-1i Serial No.: 2621731 Lens: Standard 32°

Task Energy Audit

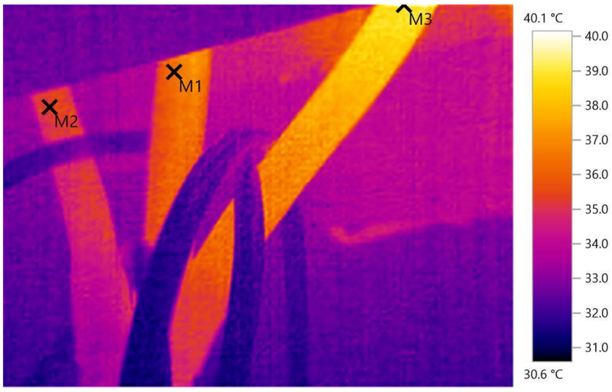


Picture data:				
	Date:	11-03-2020	Emissivity:	0.95
	Measuring Time:	11:46:28	Refl. temp. [°C]:	20.0
	File:	PWPH-1 (Pump-1).BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	35.5	0.95	20.0	69A
Measure point 2	36.1	0.95	20.0	70A
Measure point 3	36.0	0.95	20.0	69A

Remarks: Bench mark

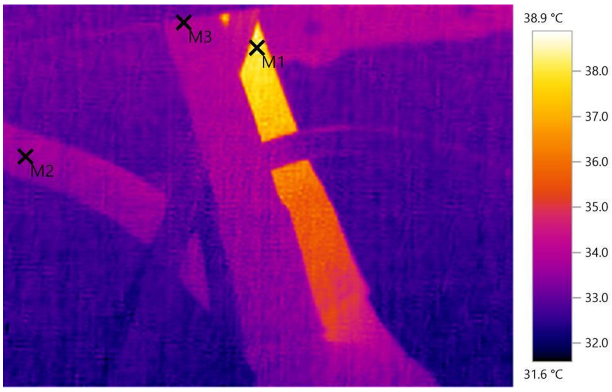


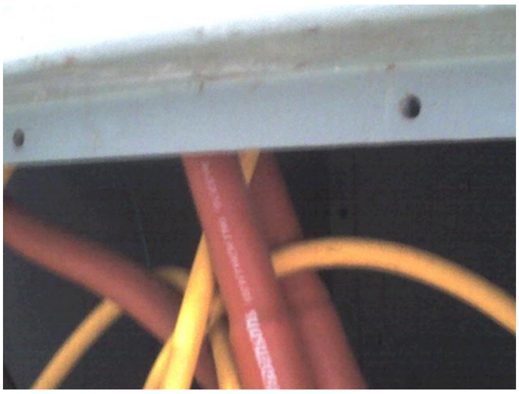
Picture data:	**Date:**	11-03-2020	**Emissivity:**	0.95
	Measuring Time:	11:51:42	**Refl. temp. [°C]:**	20.0
	File:	PWPH-1 (Pump-2).BMT		

Picture markings:

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	36.4	0.95	20.0	68A
Measure point 2	35.4	0.95	20.0	70A
Measure point 3	39.4	0.95	20.0	68A

Remarks: Terminal loose at R-Phase





Picture data:	**Date:**	11-03-2020	**Emissivity:**	0.95
	Measuring Time:	11:25:04	**Refl. temp. [°C]:**	20.0
	File:	RWPH 3 (Pump-1).BMT		

Picture markings:

Thermography report

OTTOTRACTIONS
Energy Engineering Environment

Measurement Objects	Temp. [°C]	Emiss.	Refl. temp. [°C]	Remarks
Measure point 1	38.4	0.95	20.0	33A
Measure point 2	33.6	0.95	20.0	30A
Measure point 3	33.7	0.95	20.0	30A

Remarks: Terminal loose at R-Phase

28-10-2020 , ____________ ____________

Abin baby

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Aluva
Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 2.SS-2

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
Average value in the period		10504	10448	10473	81.22	82.06	77.26	1440	484	488	469	204	77
Maximum value in the period		10551	10498	10522	82.29	82.77	78.22	1455	490	492	474	207	78
Time of maximum value		11-03-2020 10:14:40	11-03-2020 10:14:42	11-03-2020 10:14:40	11-03-2020 10:07:26	11-03-2020 10:08:56	11-03-2020 10:05:48	11-03-2020 10:05:48	11-03-2020 10:07:26	11-03-2020 10:05:48	11-03-2020 10:05:44	11-03-2020 10:05:46	11-03-2020 10:06:16
Minimum value in the period		10470	10408	10433	80.28	81.21	76.41	1427	479	484	464	201	76
Time of minimum value		11-03-2020 10:06:54	11-03-2020 10:09:02	11-03-2020 10:09:02	11-03-2020 10:13:44	11-03-2020 10:13:32	11-03-2020 10:13:46	11-03-2020 10:12:54	11-03-2020 10:12:54	11-03-2020 10:12:54	11-03-2020 10:12:54	11-03-2020 10:12:54	11-03-2020 10:05:16
11-03-2020	10:05:14												
	10:05:16	10493	10440	10469	81.72	82.30	77.76	1447	486	489	472	203	76
	10:05:18	10490	10437	10469	81.77	82.26	77.68	1446	486	489	471	204	77
	10:05:20	10492	10439	10470	81.69	82.23	77.65	1446	486	489	471	203	76
	10:05:22	10495	10440	10470	81.66	82.31	77.69	1446	486	489	471	203	77
	10:05:24	10491	10440	10468	81.80	82.38	77.85	1448	487	490	472	204	77
	10:05:26	10490	10438	10466	81.82	82.37	77.88	1448	487	489	472	204	77
	10:05:28	10493	10441	10466	81.66	82.40	77.90	1448	486	490	473	204	76
	10:05:30	10493	10441	10464	81.71	82.49	77.97	1449	486	490	473	205	77
	10:05:32	10494	10442	10467	81.82	82.53	78.04	1451	487	490	473	205	77
	10:05:34	10489	10438	10463	81.89	82.52	78.06	1451	487	490	473	205	77
	10:05:36	10490	10436	10468	81.96	82.43	77.84	1449	488	490	472	205	77
	10:05:38	10493	10441	10469	81.87	82.44	77.91	1450	487	490	473	205	77
	10:05:40	10494	10442	10469	81.93	82.52	78.03	1451	488	491	473	206	77
	10:05:42	10499	10446	10472	81.90	82.58	78.03	1452	487	491	473	206	77
	10:05:44	10492	10439	10466	82.05	82.68	78.15	1453	488	491	474	206	77
	10:05:46	10494	10443	10470	82.10	82.66	78.18	1454	489	491	474	207	77
	10:05:48	10497	10445	10471	82.07	82.72	78.22	1455	488	492	474	207	77
	10:05:50	10496	10445	10467	81.91	82.66	78.21	1453	488	492	474	206	77
	10:05:52	10495	10443	10465	81.78	82.54	78.05	1451	487	491	473	205	77
	10:05:54	10493	10444	10464	81.65	82.42	78.05	1449	486	490	473	205	76
	10:05:56	10492	10442	10462	81.57	82.36	77.96	1448	485	490	473	203	76
	10:05:58	10494	10442	10463	81.46	82.27	77.81	1445	485	489	472	203	76
	10:06:00	10494	10442	10464	81.46	82.25	77.73	1445	485	489	471	203	76
	10:06:02	10494	10439	10464	81.47	82.29	77.66	1445	485	489	471	203	76
	10:06:04	10498	10441	10468	81.46	82.28	77.60	1445	485	489	471	203	77
	10:06:06	10503	10448	10471	81.41	82.27	77.68	1446	485	489	471	203	76
	10:06:08	10501	10445	10469	81.47	82.35	77.67	1446	485	490	471	203	77
	10:06:10	10501	10446	10470	81.59	82.44	77.82	1448	486	490	472	204	77
	10:06:12	10496	10439	10465	81.69	82.52	77.85	1449	486	491	472	204	77
	10:06:14	10492	10434	10462	81.71	82.51	77.77	1448	486	490	471	204	77
	10:06:16	10494	10436	10466	81.75	82.53	77.72	1448	487	490	471	205	78
	10:06:18	10490	10434	10463	81.84	82.51	77.84	1449	487	490	472	205	77
	10:06:20	10483	10429	10459	81.94	82.48	77.87	1448	487	490	472	205	77
	10:06:22	10478	10424	10457	82.11	82.51	77.93	1449	488	490	472	205	78
	10:06:24	10479	10426	10455	81.97	82.52	77.93	1449	487	490	472	205	77
	10:06:26	10476	10422	10455	82.06	82.51	77.81	1448	488	490	471	204	77
	10:06:28	10475	10423	10454	82.08	82.51	77.89	1449	488	489	472	205	77
	10:06:30	10474	10424	10452	82.04	82.51	78.02	1450	488	489	472	204	77
	10:06:32	10477	10428	10456	82.04	82.42	77.97	1449	488	489	472	204	77
	10:06:34	10475	10426	10453	82.08	82.49	78.04	1450	488	489	472	204	76
	10:06:36	10481	10432	10460	81.94	82.35	77.88	1448	488	489	472	204	76

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Aluva
Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Measurement interval	1 Second
Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 2.SS-2

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
11-03-2020	10:06:38	10478	10428	10457	81.98	82.36	77.87	1448	488	489	472	203	76
	10:06:40	10473	10423	10453	82.00	82.35	77.85	1447	488	488	471	203	76
	10:06:42	10473	10421	10454	82.14	82.44	77.88	1449	488	489	472	204	77
	10:06:44	10477	10424	10457	82.15	82.50	77.88	1449	489	489	472	204	77
	10:06:46	10481	10427	10460	82.07	82.46	77.80	1449	488	489	471	204	77
	10:06:48	10481	10428	10462	82.11	82.49	77.84	1450	489	490	472	204	77
	10:06:50	10479	10426	10457	82.12	82.58	77.93	1450	488	490	472	204	77
	10:06:52	10480	10428	10460	82.19	82.64	77.97	1452	489	490	472	205	77
	10:06:54	10470	10417	10449	82.25	82.68	78.05	1451	489	490	472	205	77
	10:06:56	10471	10416	10449	82.23	82.70	78.00	1451	489	490	472	205	78
	10:06:58	10472	10419	10449	82.12	82.63	77.97	1450	488	490	472	205	77
	10:07:00	10472	10420	10449	82.05	82.58	77.97	1449	488	490	472	204	77
	10:07:02	10471	10417	10449	82.06	82.57	77.92	1449	488	489	471	204	77
	10:07:04	10474	10421	10450	81.95	82.48	77.87	1447	487	489	471	204	77
	10:07:06	10482	10428	10458	81.84	82.41	77.78	1447	487	489	471	203	77
	10:07:08	10483	10431	10459	81.80	82.33	77.75	1446	487	489	471	203	77
	10:07:10	10480	10427	10457	81.98	82.45	77.86	1448	488	489	471	204	77
	10:07:12	10483	10428	10460	81.99	82.50	77.77	1449	488	490	471	204	77
	10:07:14	10479	10425	10458	82.13	82.57	77.93	1450	488	490	472	205	77
	10:07:16	10478	10426	10458	82.13	82.51	77.87	1450	489	489	472	205	77
	10:07:18	10477	10423	10456	82.19	82.59	77.91	1450	489	490	472	205	78
	10:07:20	10480	10425	10459	82.14	82.56	77.84	1450	489	490	471	205	78
	10:07:22	10483	10428	10461	82.21	82.67	77.89	1451	489	491	472	205	78
	10:07:24	10481	10426	10462	82.26	82.64	77.85	1451	489	490	472	205	78
	10:07:26	10482	10428	10465	82.29	82.57	77.84	1451	490	490	472	205	78
	10:07:28	10485	10431	10465	82.21	82.58	77.83	1451	489	490	471	205	78
	10:07:30	10481	10430	10465	82.24	82.43	77.79	1450	489	489	471	205	77
	10:07:32	10483	10431	10463	82.10	82.49	77.82	1450	489	490	471	204	77
	10:07:34	10485	10430	10462	82.09	82.62	77.85	1450	489	490	472	205	77
	10:07:36	10485	10432	10463	82.10	82.56	77.88	1451	489	490	472	205	77
	10:07:38	10487	10434	10460	81.84	82.50	77.85	1448	487	490	472	204	77
	10:07:40	10484	10432	10457	81.85	82.50	77.91	1448	487	490	472	203	76
	10:07:42	10479	10427	10454	81.92	82.46	77.86	1448	487	489	472	203	76
	10:07:44	10477	10424	10451	81.91	82.54	77.84	1448	487	490	471	204	77
	10:07:46	10482	10427	10453	81.77	82.52	77.77	1447	486	490	471	203	77
	10:07:48	10482	10429	10454	81.73	82.42	77.79	1446	486	489	471	202	76
	10:07:50	10484	10431	10458	81.79	82.41	77.71	1446	487	489	471	203	76
	10:07:52	10477	10422	10451	81.86	82.47	77.72	1446	487	489	471	203	77
	10:07:54	10482	10429	10455	81.69	82.37	77.70	1446	486	489	471	203	76
	10:07:56	10483	10428	10456	81.75	82.42	77.63	1445	486	489	470	203	77
	10:07:58	10489	10432	10461	81.67	82.40	77.55	1445	486	489	470	203	77
	10:08:00	10487	10430	10458	81.65	82.40	77.57	1445	486	489	470	203	77
	10:08:02	10493	10434	10459	81.44	82.38	77.51	1444	485	489	470	202	77
	10:08:04	10494	10435	10461	81.43	82.41	77.48	1444	485	489	470	203	77
	10:08:06	10492	10433	10457	81.44	82.45	77.56	1444	485	490	470	203	77
	10:08:08	10492	10432	10457	81.48	82.50	77.56	1445	485	490	470	203	77
	10:08:10	10493	10431	10456	81.37	82.48	77.49	1443	484	490	470	202	77
	10:08:12	10491	10429	10454	81.33	82.47	77.50	1443	484	490	470	202	77
	10:08:14	10488	10427	10450	81.41	82.55	77.59	1444	484	490	470	203	77

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

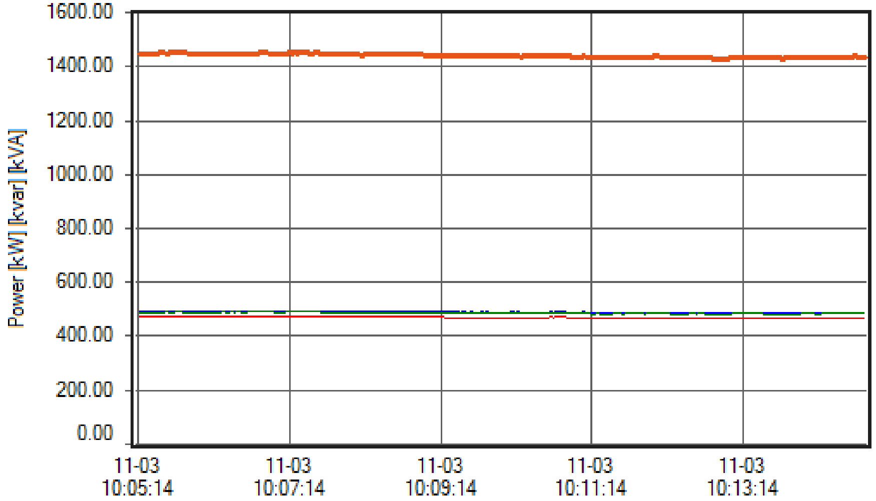
Title	KWA Aluva
Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Measurement interval	1 Second — Data interval: 2 Second
Comment	Model number : PW3360 S/N.140512994 2.SS-2

Date	Time	U1[V]	U2[V]	U3[V]	I1[A]	I2[A]	I3[A]	P[kW]	P1[kW]	P2[kW]	P3[kW]	Q[kvar]	Q1[kvar]
11-03-2020	10:08:16	10487	10425	10449	81.46	82.62	77.62	1445	485	490	470	203	77
	10:08:18	10491	10429	10454	81.50	82.61	77.61	1445	485	490	470	204	77
	10:08:20	10497	10434	10460	81.46	82.55	77.47	1445	485	490	470	203	78
	10:08:22	10498	10435	10460	81.46	82.61	77.57	1446	485	491	470	204	78
	10:08:24	10496	10433	10458	81.47	82.63	77.58	1446	485	491	470	204	78
	10:08:26	10497	10436	10459	81.38	82.53	77.57	1445	485	490	470	204	77
	10:08:28	10495	10433	10457	81.39	82.53	77.56	1445	485	490	470	204	77
	10:08:30	10490	10427	10451	81.42	82.63	77.58	1444	484	490	470	204	77
	10:08:32	10492	10430	10454	81.49	82.65	77.65	1446	485	491	471	204	77
	10:08:34	10492	10429	10453	81.44	82.65	77.62	1445	485	491	470	204	77
	10:08:36	10488	10428	10451	81.43	82.55	77.59	1444	484	490	470	204	77
	10:08:38	10490	10430	10452	81.45	82.57	77.67	1445	485	490	470	204	77
	10:08:40	10492	10431	10454	81.50	82.65	77.70	1446	485	491	471	204	77
	10:08:42	10493	10431	10454	81.48	82.69	77.69	1446	485	491	470	205	78
	10:08:44	10491	10429	10451	81.48	82.70	77.70	1446	485	491	470	205	78
	10:08:46	10491	10426	10452	81.53	82.71	77.64	1446	485	491	470	205	78
	10:08:48	10491	10427	10452	81.54	82.72	77.63	1446	485	491	470	205	78
	10:08:50	10491	10427	10452	81.51	82.74	77.66	1446	485	491	470	205	78
	10:08:52	10490	10427	10453	81.52	82.66	77.61	1445	485	491	470	205	78
	10:08:54	10492	10430	10452	81.43	82.64	77.63	1445	484	491	470	204	78
	10:08:56	10484	10422	10443	81.42	82.77	77.73	1445	484	491	471	205	78
	10:08:58	10485	10421	10442	81.32	82.66	77.64	1444	484	490	470	204	77
	10:09:00	10478	10415	10436	81.36	82.70	77.69	1443	484	491	470	204	77
	10:09:02	10472	10408	10433	81.48	82.67	77.62	1443	484	490	469	204	78
	10:09:04	10481	10419	10440	81.32	82.62	77.62	1443	483	490	470	204	77
	10:09:06	10481	10419	10440	81.31	82.62	77.63	1443	483	490	470	204	77
	10:09:08	10493	10434	10455	81.29	82.47	77.54	1443	484	490	470	204	77
	10:09:10	10506	10444	10470	81.30	82.38	77.36	1443	484	490	469	204	78
	10:09:12	10511	10450	10476	81.23	82.22	77.24	1442	484	489	469	204	78
	10:09:14	10514	10454	10480	81.22	82.19	77.22	1442	484	489	469	204	77
	10:09:16	10517	10456	10483	81.21	82.21	77.13	1442	485	489	468	204	78
	10:09:18	10518	10456	10483	81.14	82.15	77.12	1441	484	489	468	203	78
	10:09:20	10521	10459	10486	81.16	82.16	77.13	1442	484	489	468	204	78
	10:09:22	10524	10460	10489	81.17	82.17	77.05	1442	485	490	468	205	78
	10:09:24	10522	10457	10488	81.09	82.10	76.97	1440	484	489	467	203	78
	10:09:26	10518	10457	10484	81.04	82.02	76.98	1439	484	488	467	203	77
	10:09:28	10517	10457	10486	81.08	81.94	76.96	1439	484	488	467	202	77
	10:09:30	10514	10457	10485	81.17	81.94	77.07	1440	484	488	468	203	77
	10:09:32	10512	10454	10482	81.20	81.97	77.09	1440	484	488	468	203	77
	10:09:34	10510	10452	10480	81.16	81.96	77.09	1439	484	488	468	203	77
	10:09:36	10512	10456	10483	81.19	81.95	77.12	1440	484	488	468	203	77
	10:09:38	10513	10458	10483	81.17	81.99	77.21	1441	484	488	469	203	77
	10:09:40	10516	10461	10487	81.13	81.89	77.15	1440	484	487	468	203	77
	10:09:42	10519	10465	10488	81.05	81.84	77.10	1440	484	487	469	203	77
	10:09:44	10518	10462	10490	81.24	81.92	77.11	1441	485	488	468	203	77
	10:09:46	10510	10452	10482	81.23	81.99	77.07	1440	484	488	468	203	77
	10:09:48	10507	10450	10478	81.17	81.97	77.10	1439	484	488	468	203	77
	10:09:50	10502	10445	10472	81.25	82.04	77.21	1440	484	488	468	203	77
	10:09:52	10500	10443	10470	81.28	82.03	77.23	1440	484	488	468	203	77

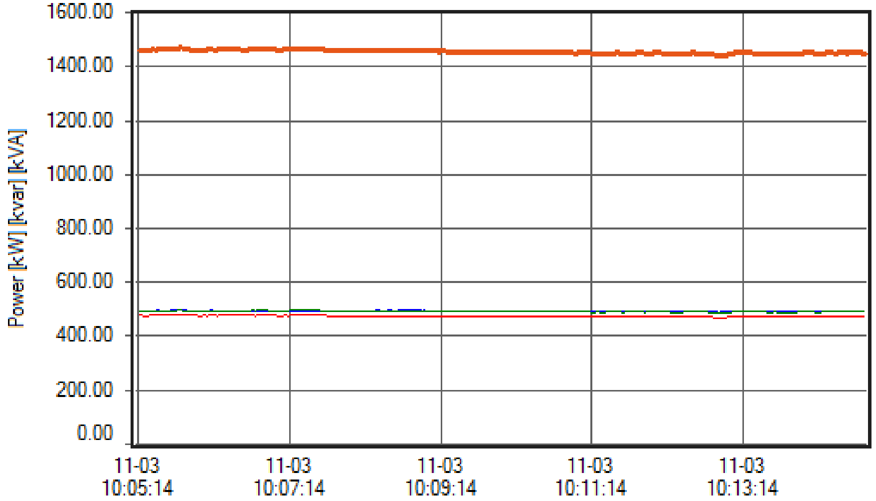
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

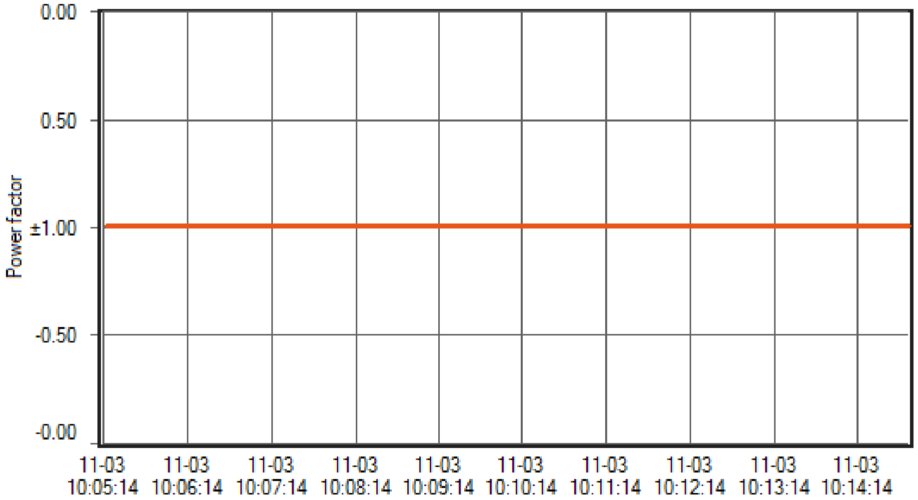
Title	KWA Aluva		
Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50		
Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 2.SS-2		



Left axis
P[kW] P1[kW] P2[kW] P3[kW]

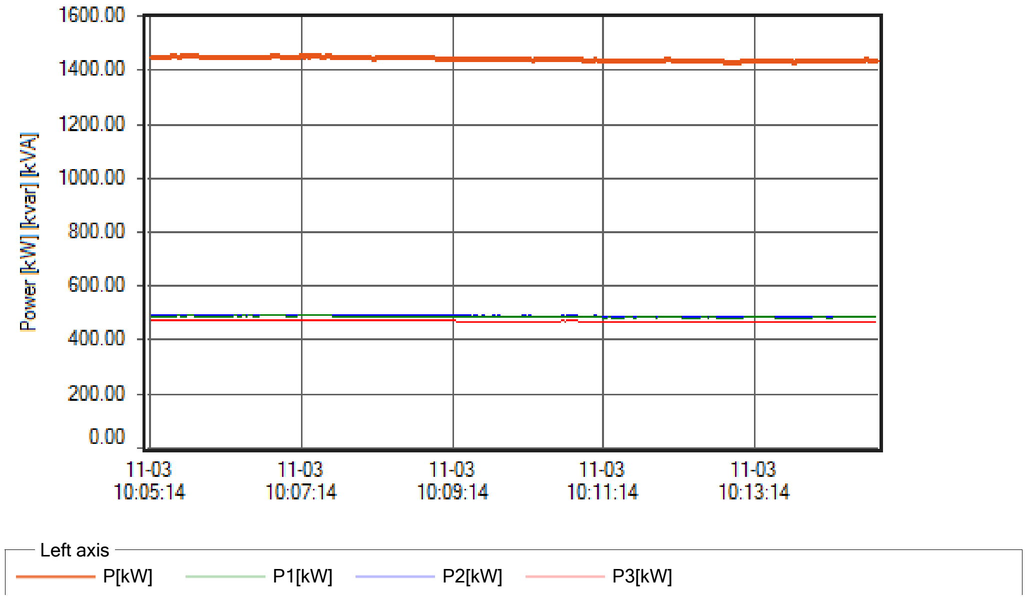


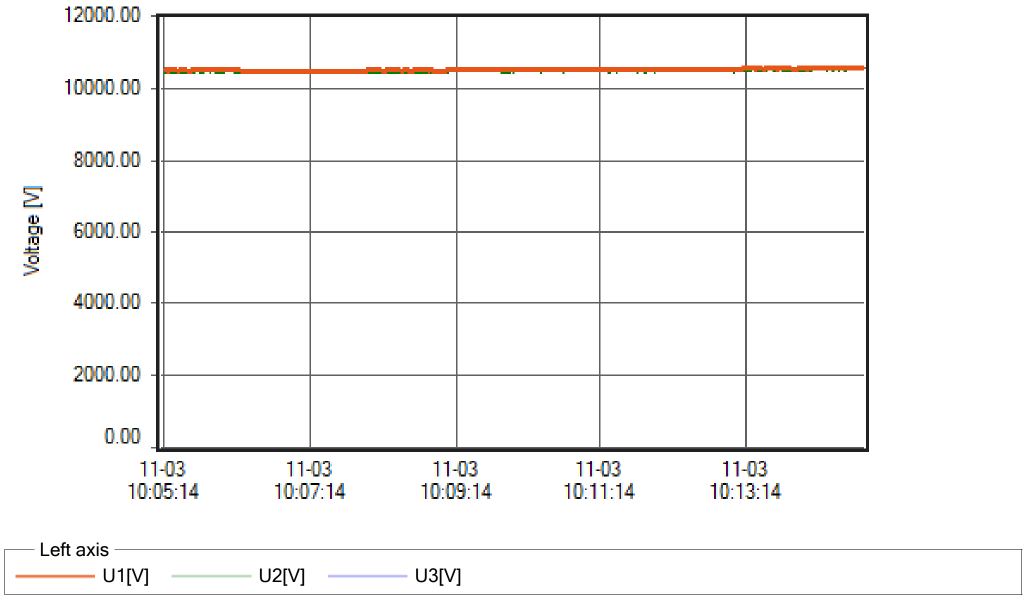
Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

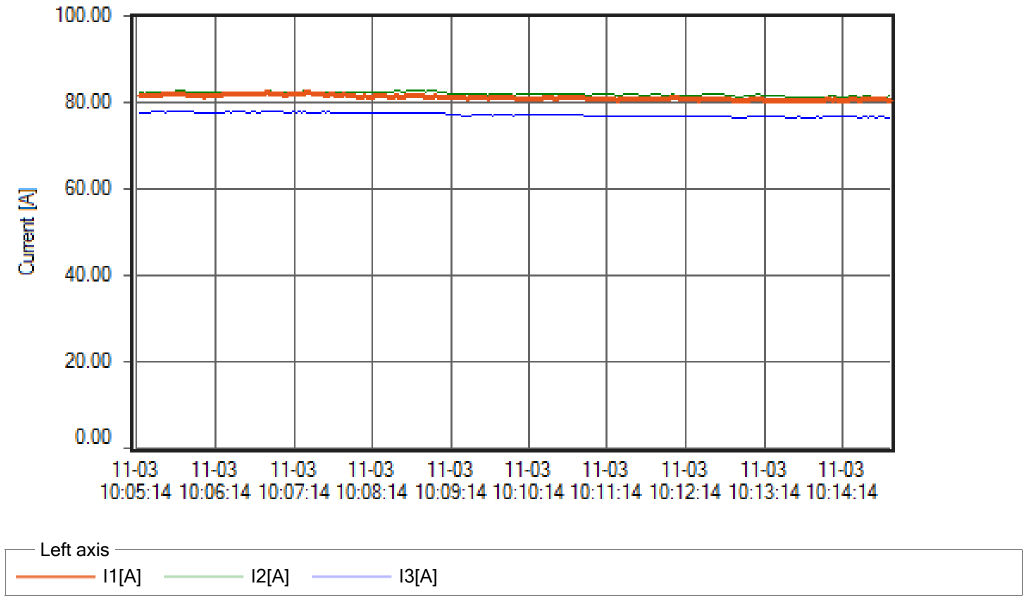


Left axis
PF PF1 PF2 PF3

OTTOTRACTIONS Energy-Engineering-Environment Time series graph	Title	KWA Aluva		
	Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50		
	Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50		
	Measurement interval	1 Second	Data interval	2 Second
	Comment	Model number : PW3360 S/N.140512994 2.SS-2		



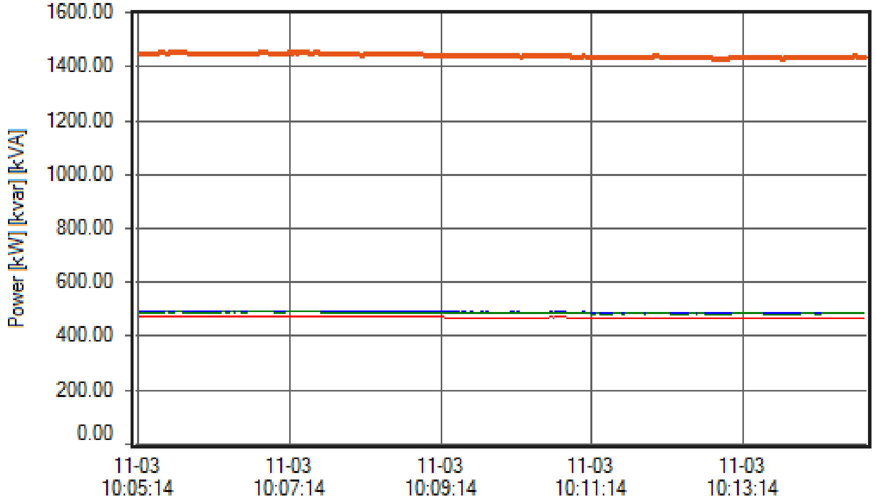


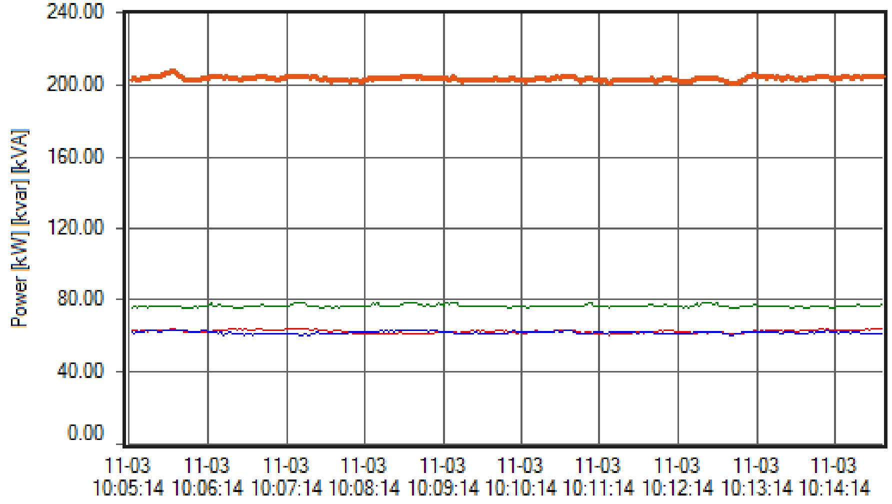


OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

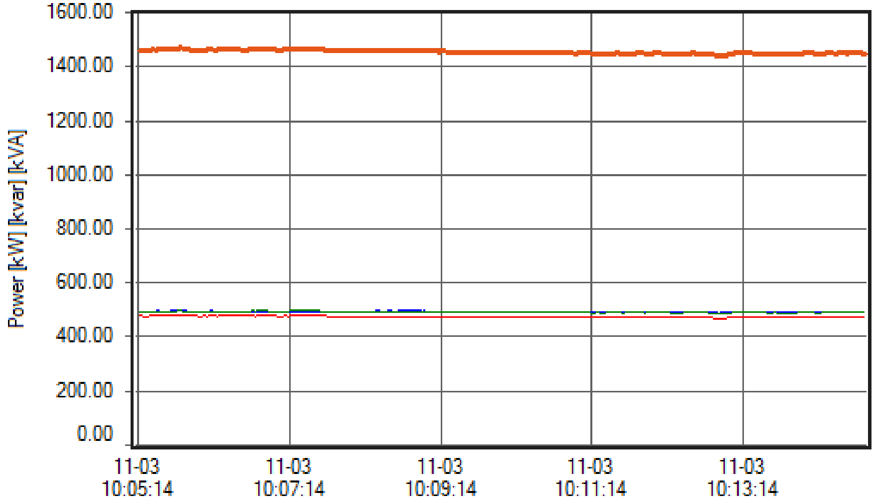
Title	KWA Aluva
Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
Measurement interval	1 Second — Data interval: 2 Second
Comment	Model number : PW3360 S/N.140512994 2.SS-2





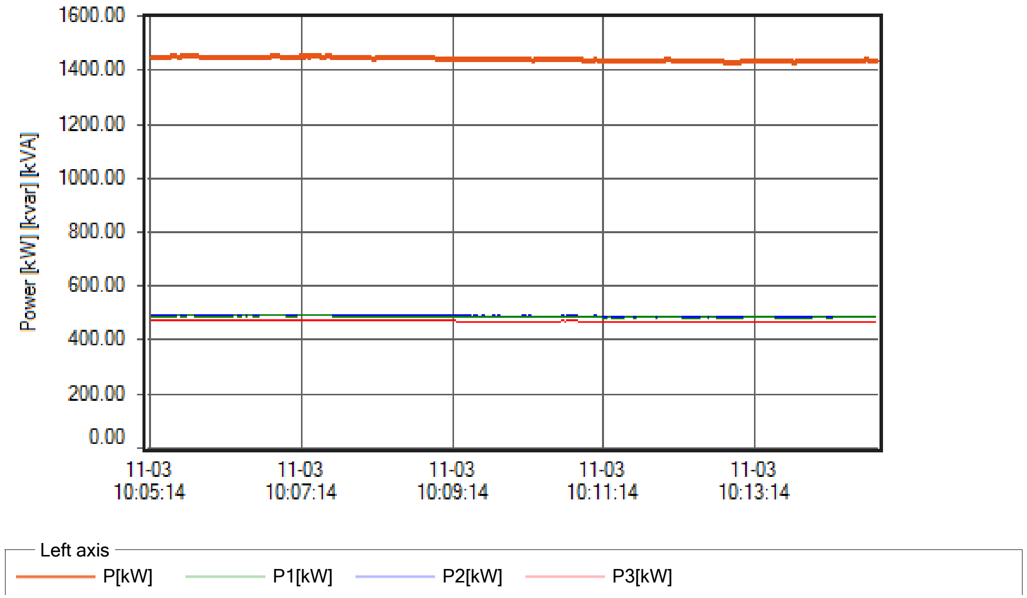
Left axis: P[kW] P1[kW] P2[kW] P3[kW]

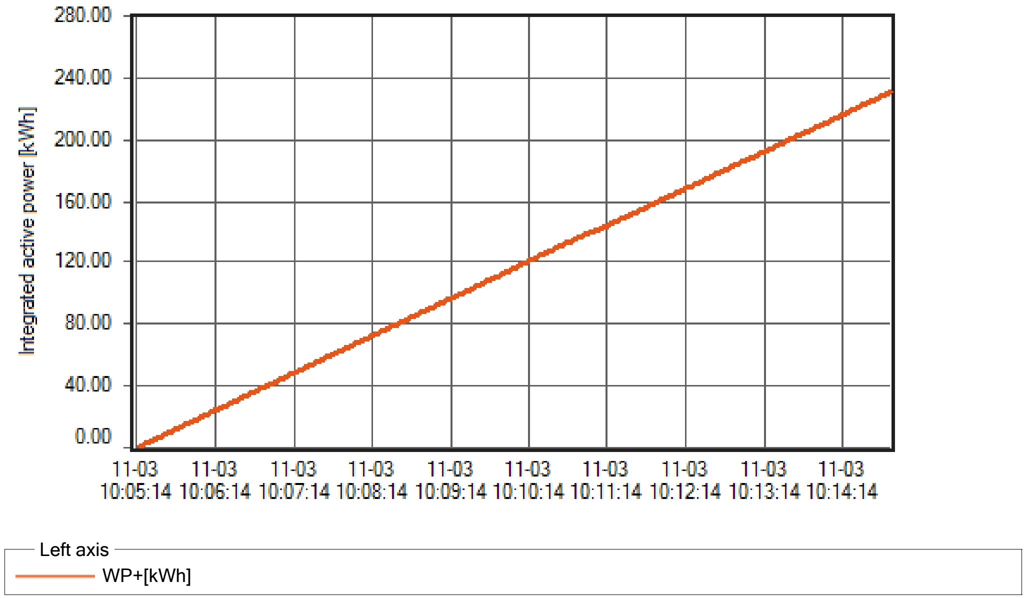
Left axis: Q[kvar] Q1[kvar] Q2[kvar] Q3[kvar]

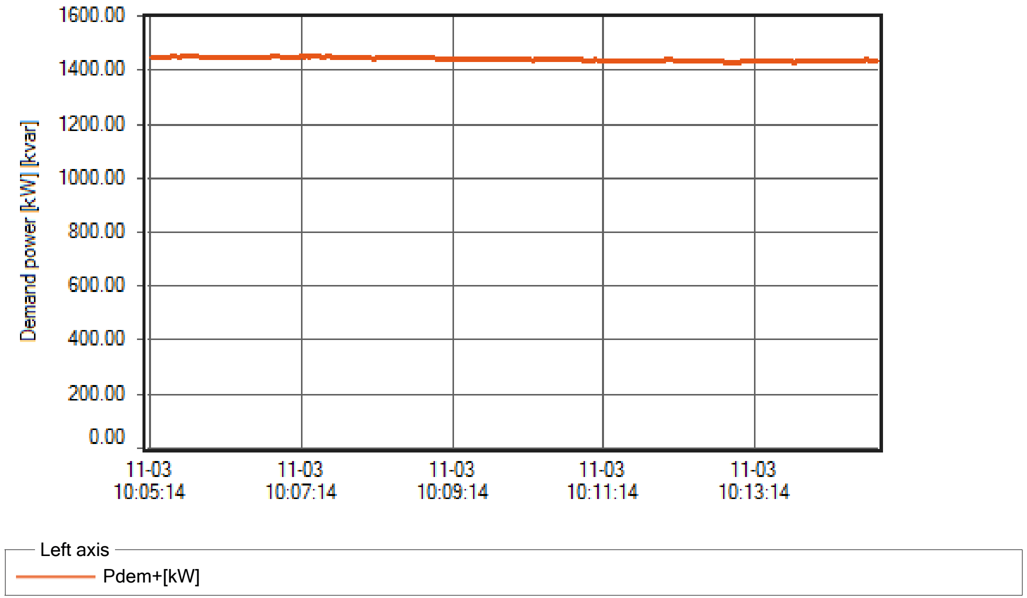


Left axis: S[kVA] S1[kVA] S2[kVA] S3[kVA]

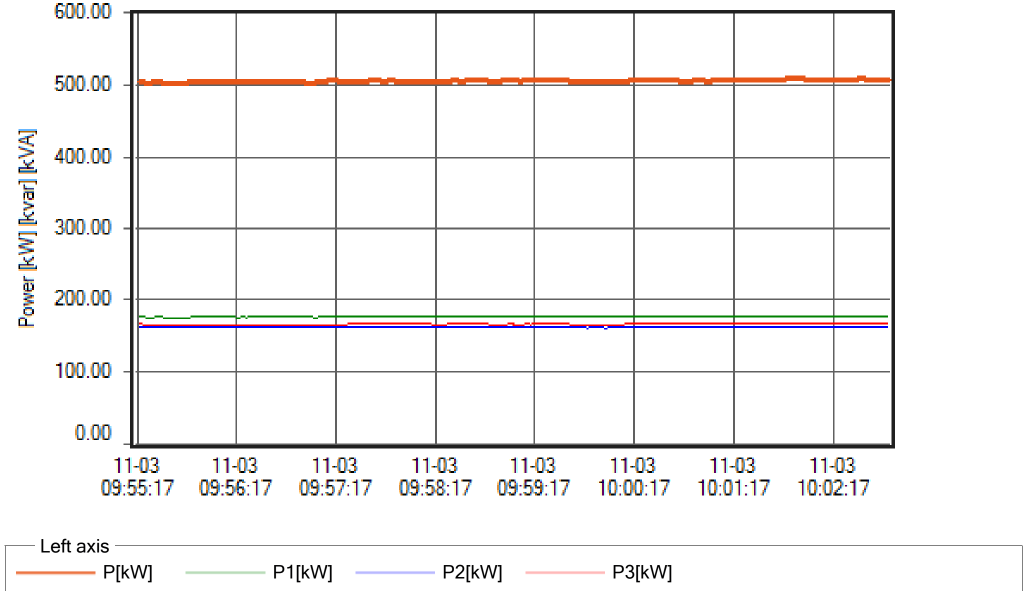
Time series graph	Title	KWA Aluva
	Measurement period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
	Display period	11-03-2020 10:05:14 - 11-03-2020 10:14:50
	Measurement interval	1 Second — Data interval: 2 Second
	Comment	Model number : PW3360 S/N.140512994 2.SS-2

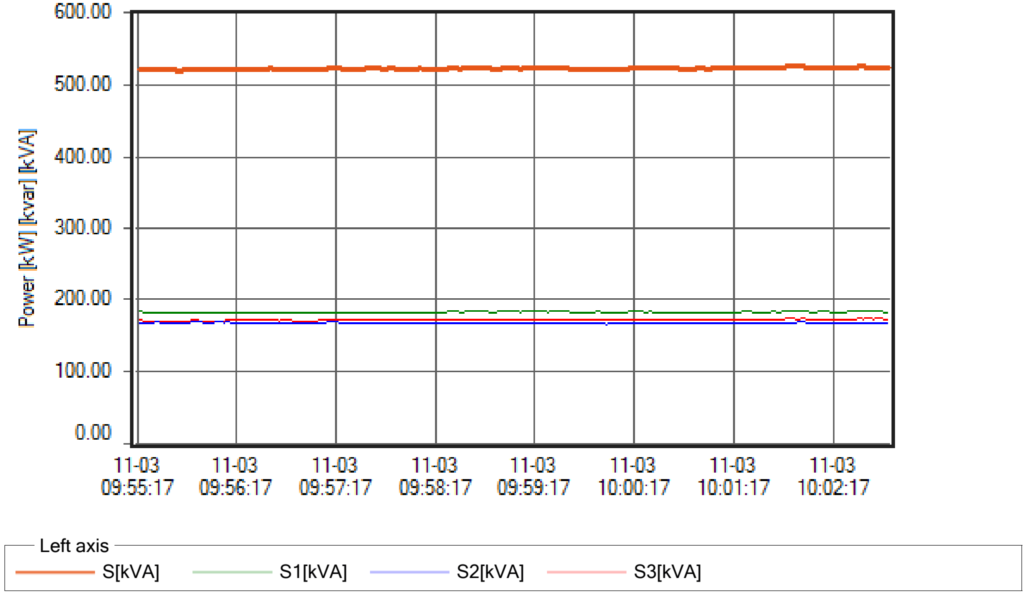


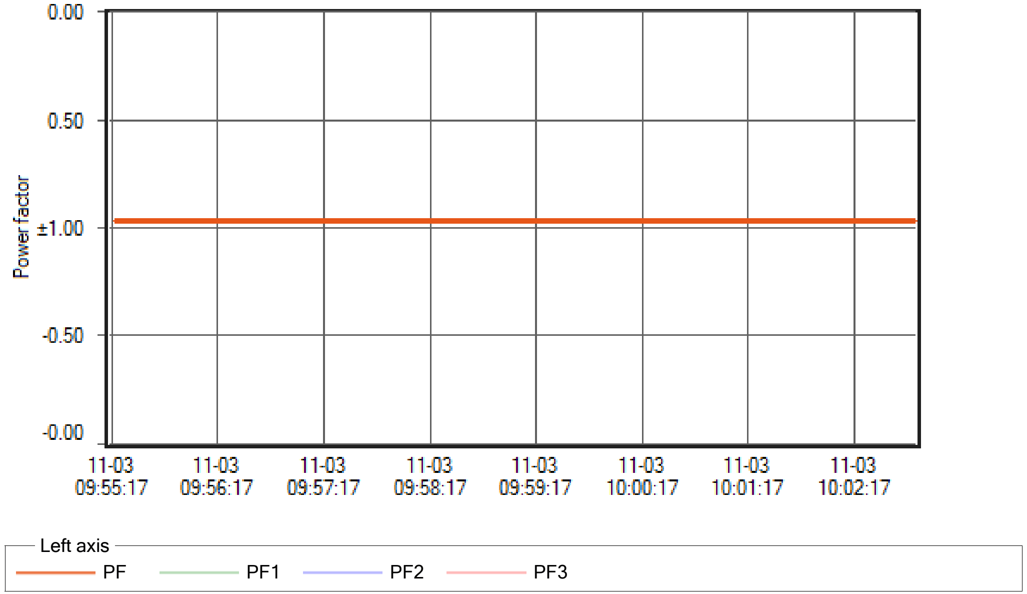




OTTOTRACTIONS Energy-Engineering-Environment Time series graph	Title	KWA Aluva		
	Measurement period	11-03-2020 09:55:17 - 11-03-2020 10:02:52		
	Display period	11-03-2020 09:55:17 - 11-03-2020 10:02:51		
	Measurement interval	1 Second	Data interval	2 Second
	Comment	Model number : PW3360 S/N.140512994 RWPH 3		

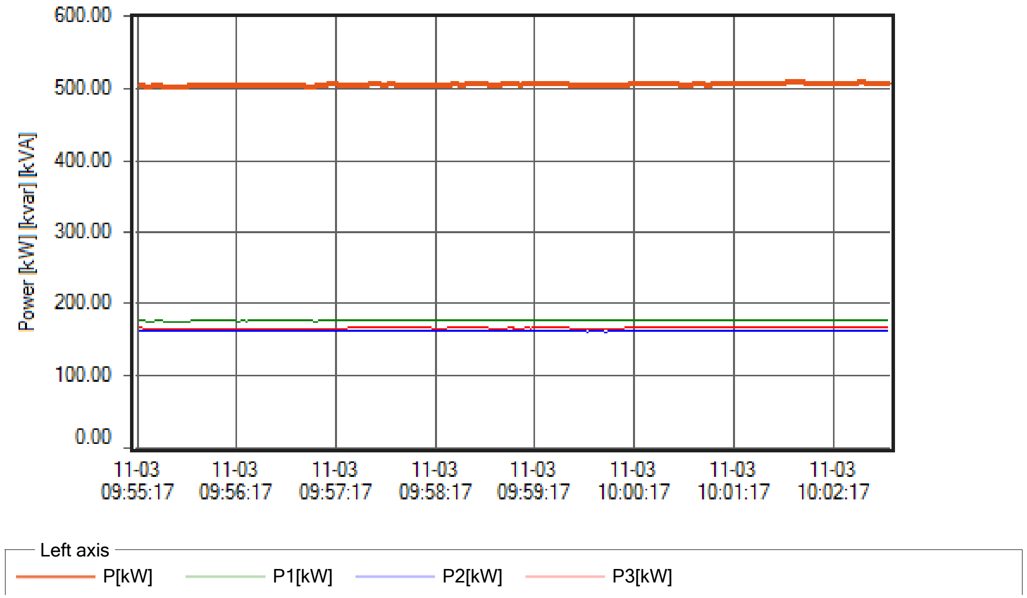


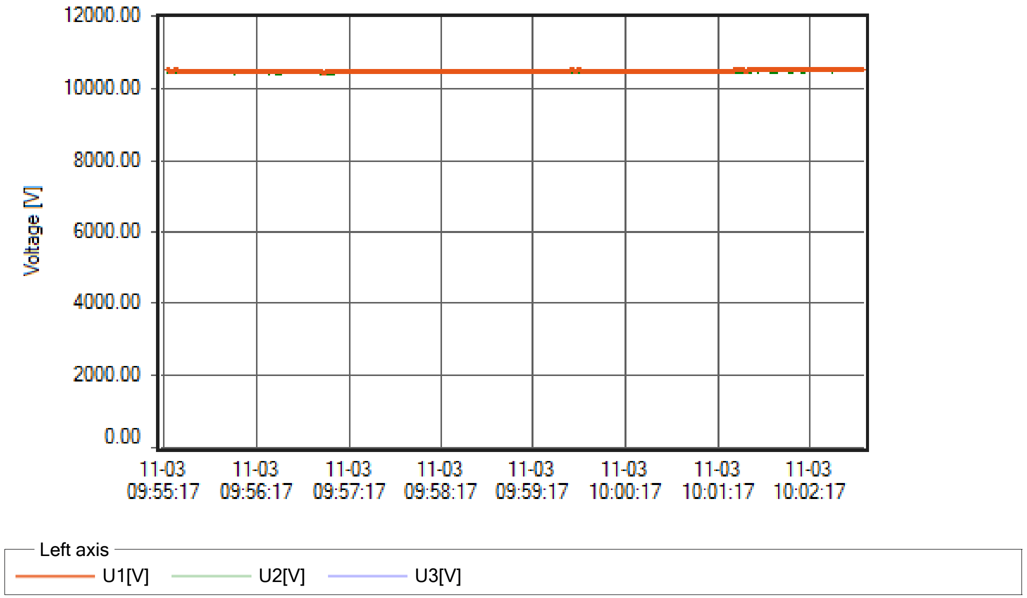


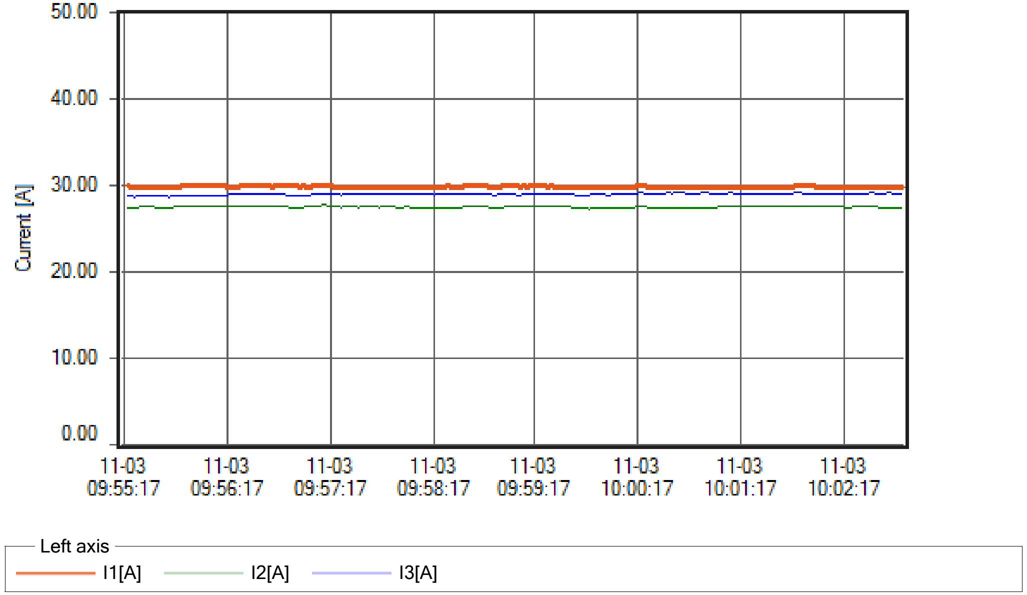


119

Time series graph	Title	KWA Aluva
	Measurement period	11-03-2020 09:55:17 - 11-03-2020 10:02:52
	Display period	11-03-2020 09:55:17 - 11-03-2020 10:02:51
	Measurement interval	1 Second / Data interval: 2 Second
	Comment	Model number : PW3360 S/N.140512994 RWPH 3



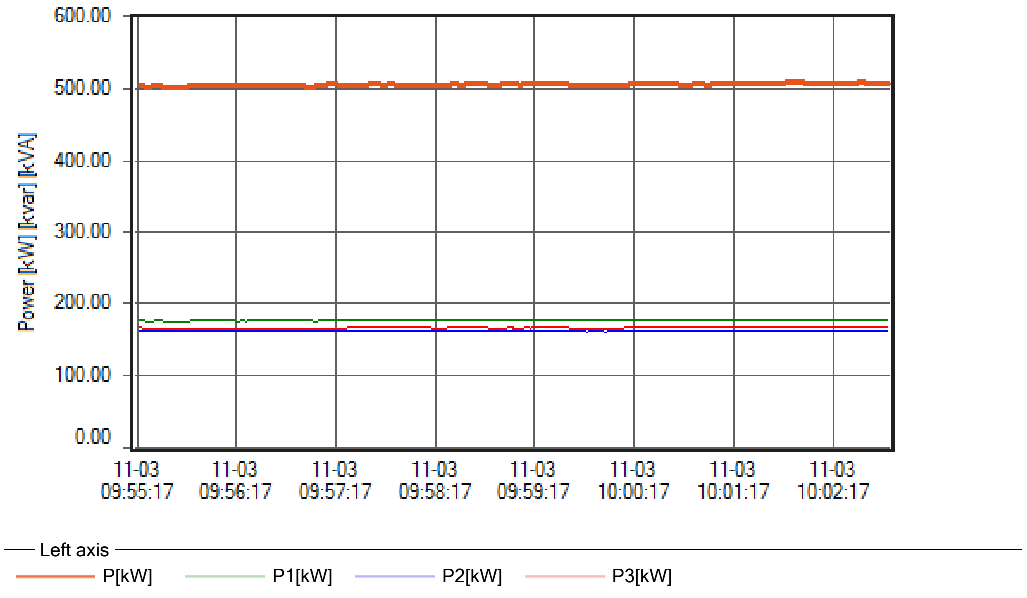


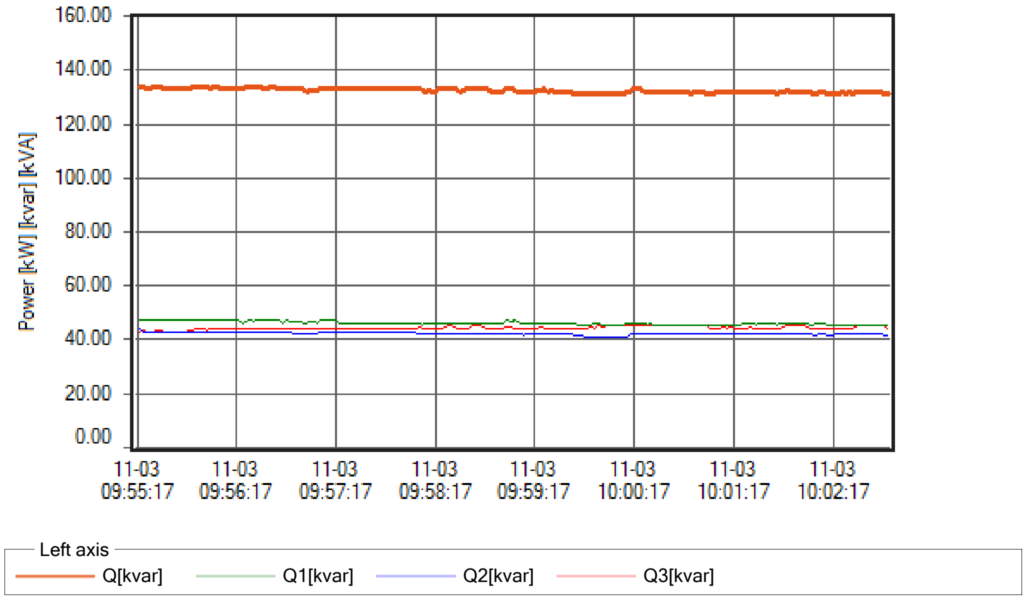


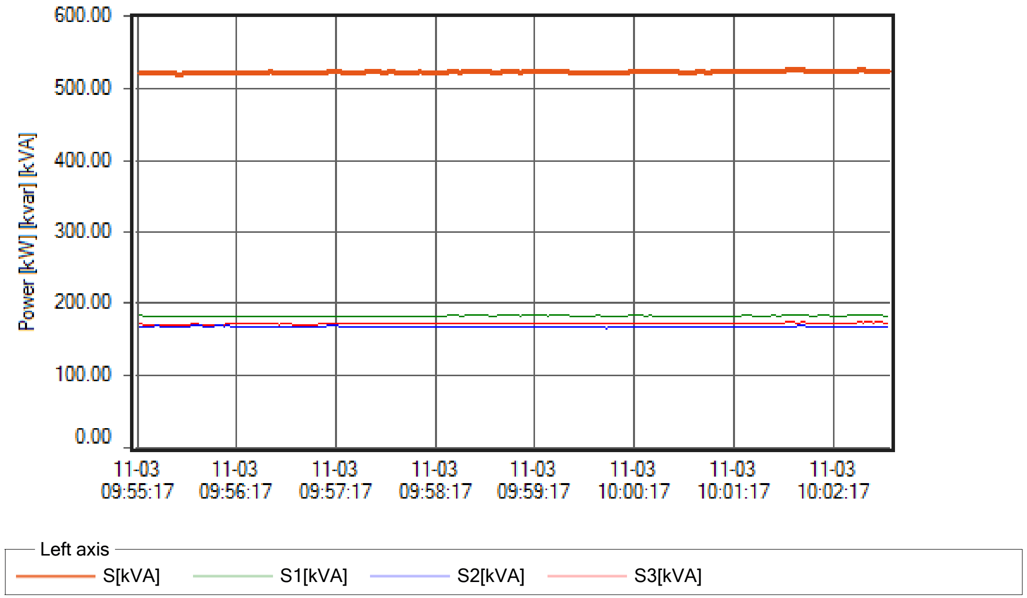
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

Title	KWA Aluva		
Measurement period	11-03-2020 09:55:17 - 11-03-2020 10:02:52		
Display period	11-03-2020 09:55:17 - 11-03-2020 10:02:51		
Measurement interval	1 Second	Data interval	2 Second
Comment	Model number : PW3360 S/N.140512994 RWPH 3		



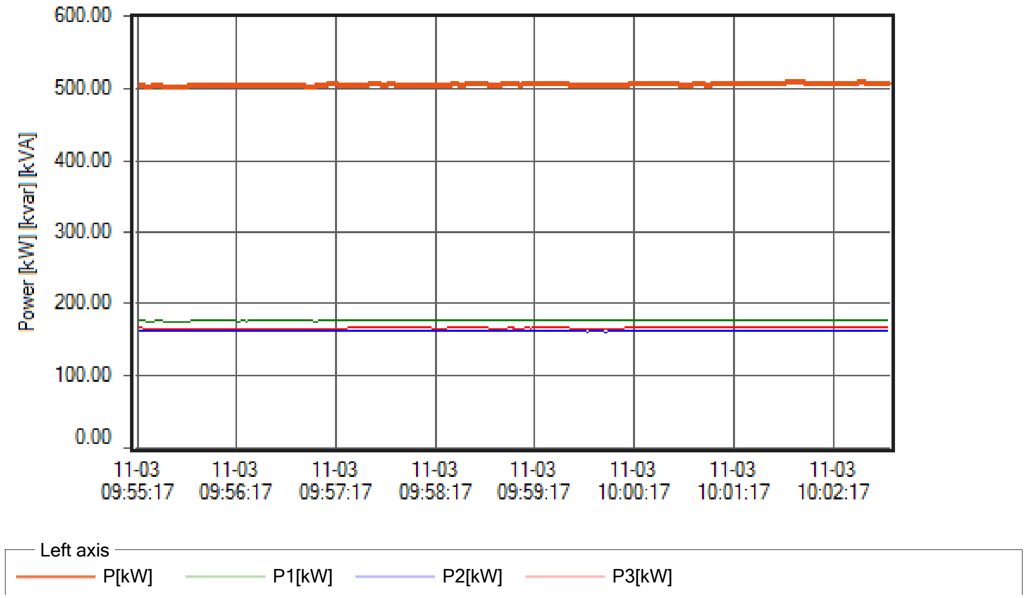


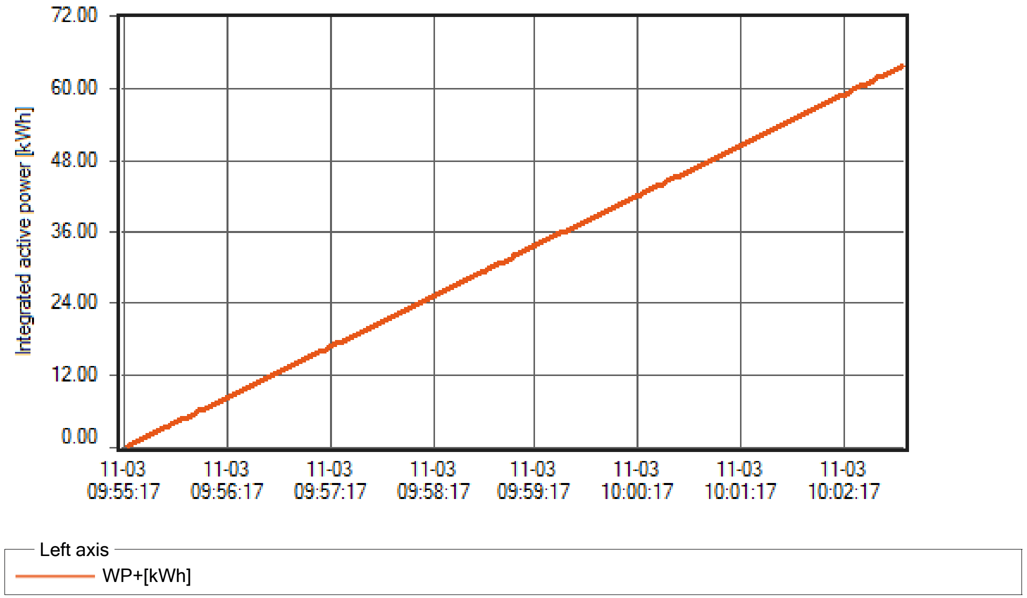


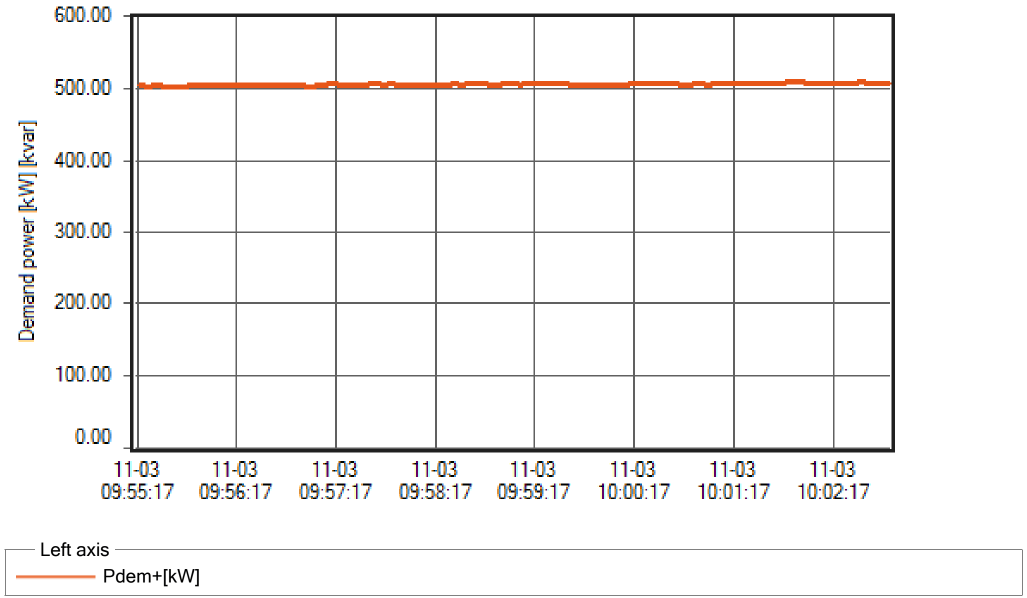
OTTOTRACTIONS Energy-Engineering-Environment

Time series graph

Title	KWA Aluva
Measurement period	11-03-2020 09:55:17 - 11-03-2020 10:02:52
Display period	11-03-2020 09:55:17 - 11-03-2020 10:02:51
Measurement interval	1 Second — Data interval: 2 Second
Comment	Model number : PW3360 S/N.140512994 RWPH 3



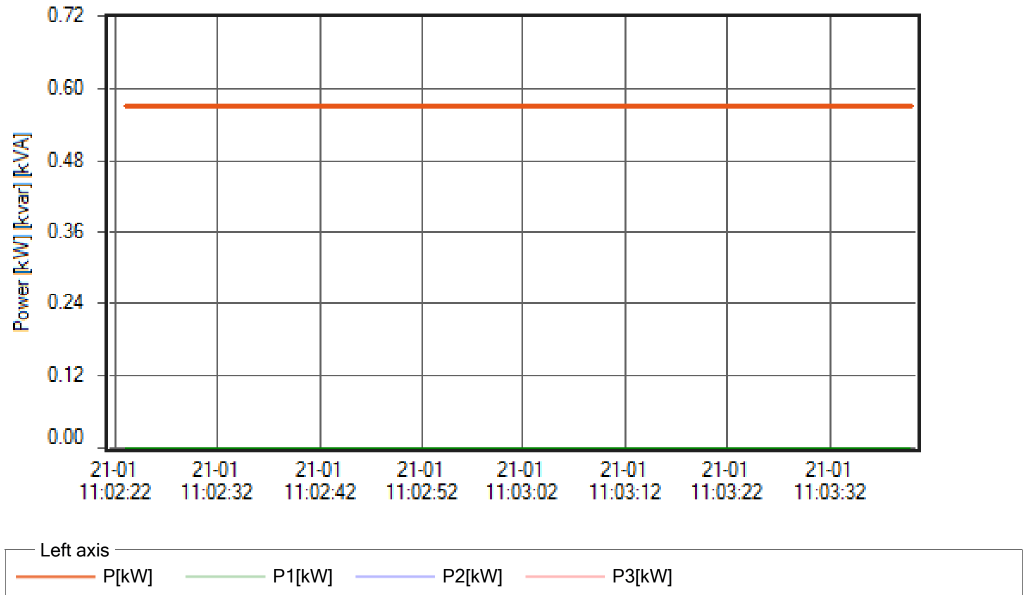


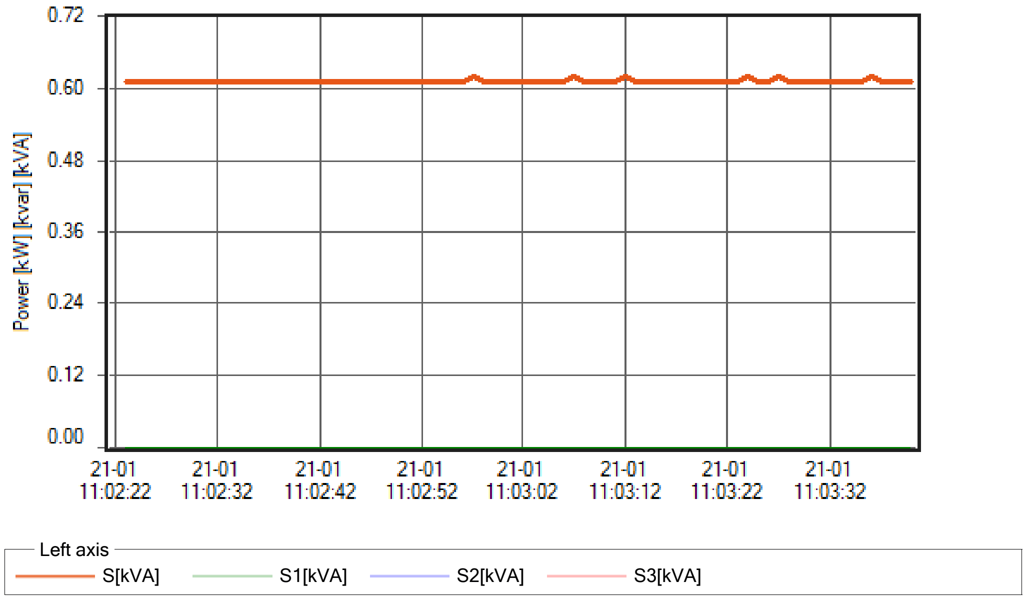


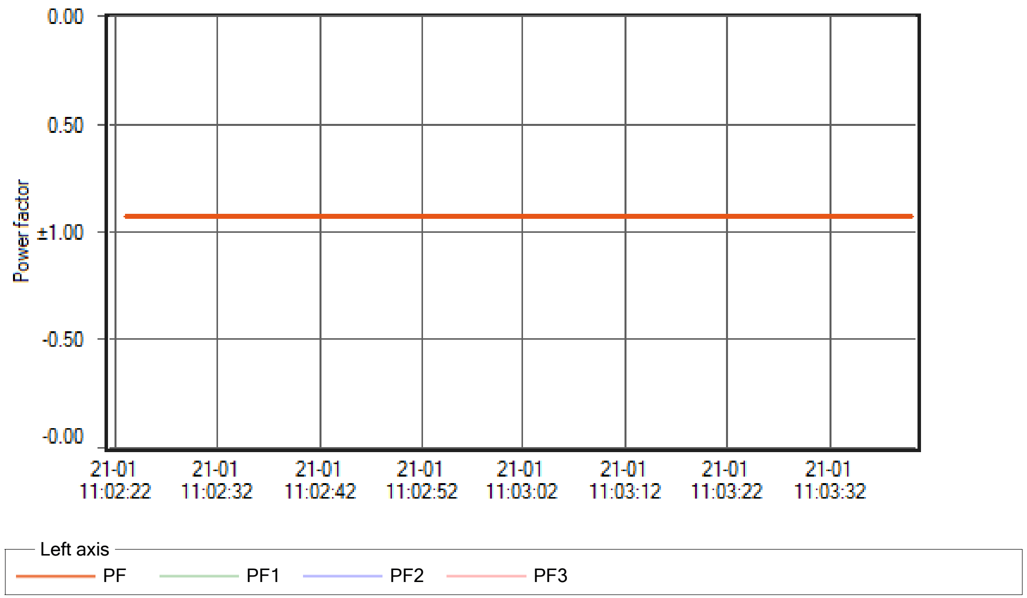
122

Time series graph

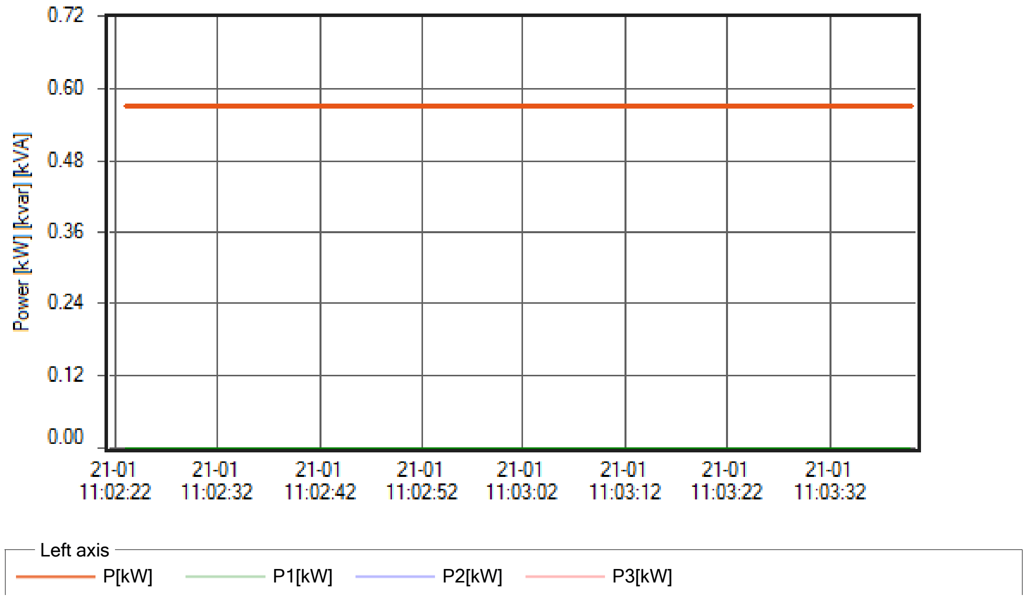
Title	KWA Aluva
Measurement period	21-01-2020 11:02:22 - 21-01-2020 11:03:40
Display period	21-01-2020 11:02:22 - 21-01-2020 11:03:40
Measurement interval	1 Second — Data interval: 1 Second
Comment	Model number : PW3360 S/N.140512994 Light feeder

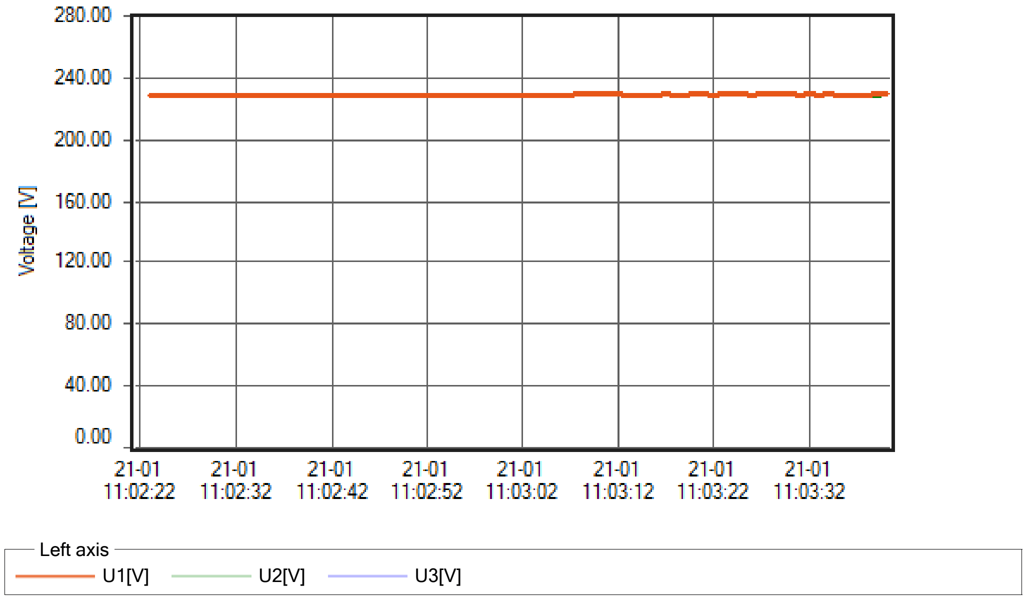


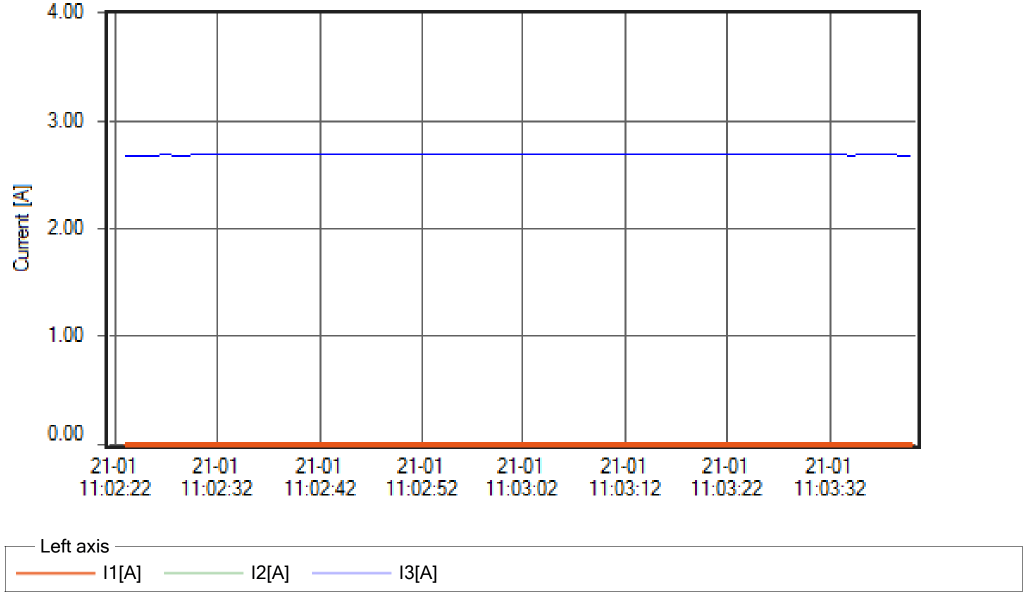




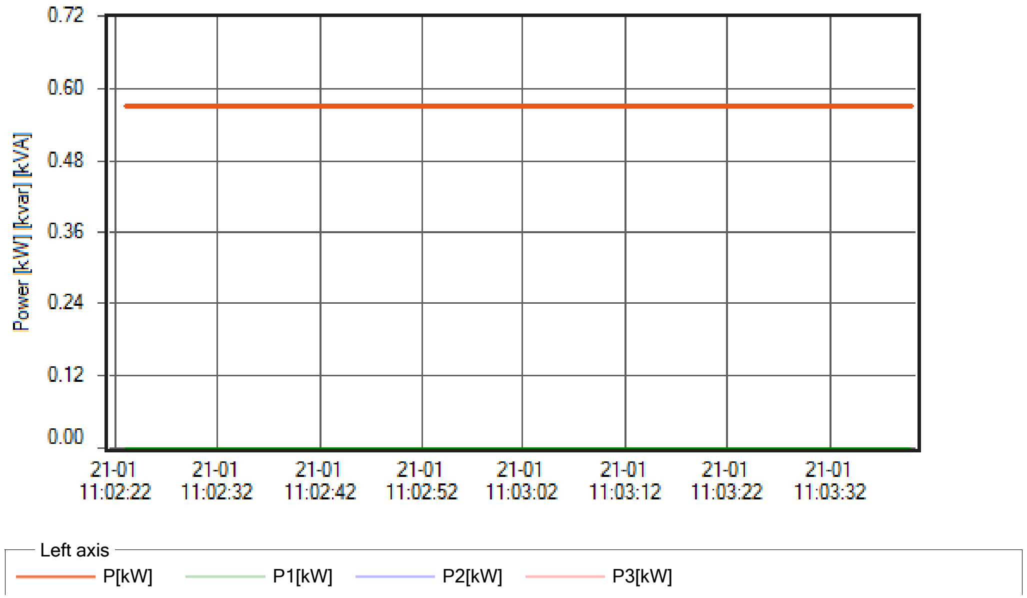
Time series graph	Title	KWA Aluva	
	Measurement period	21-01-2020 11:02:22 - 21-01-2020 11:03:40	
	Display period	21-01-2020 11:02:22 - 21-01-2020 11:03:40	
	Measurement interval	1 Second	Data interval 1 Second
	Comment	Model number : PW3360 S/N.140512994 Light feeder	

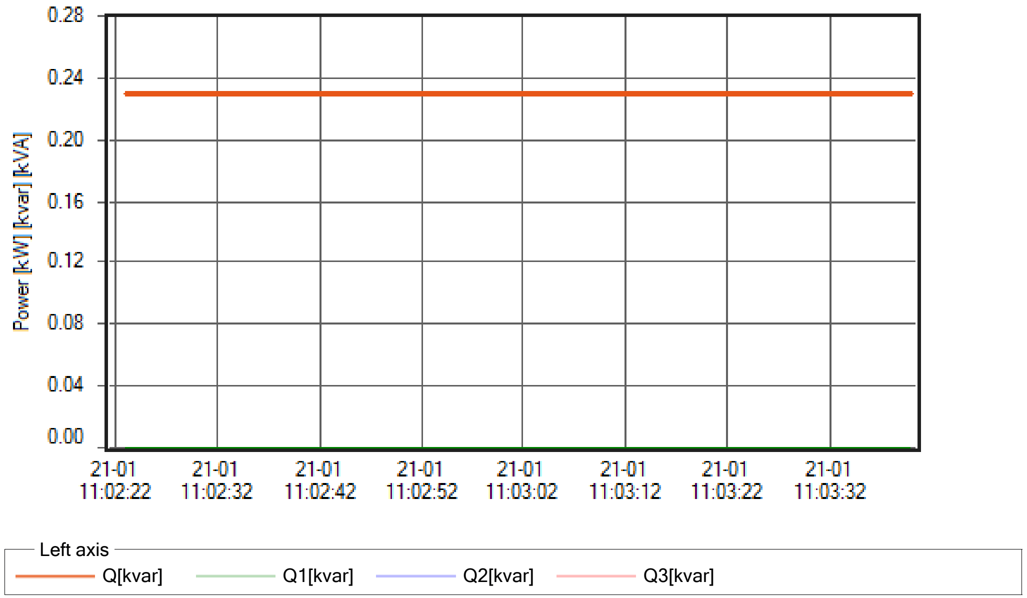


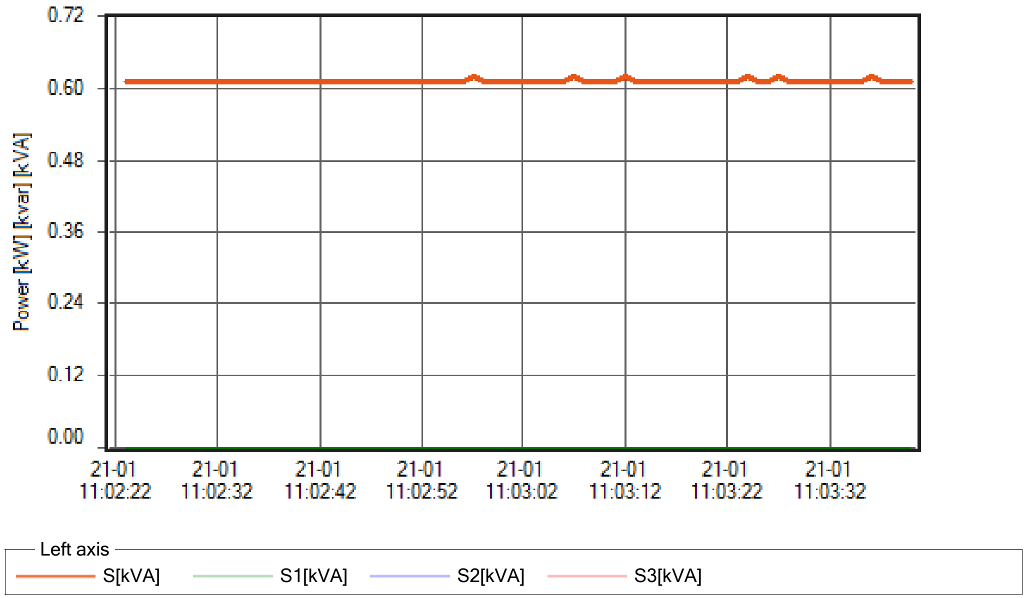




OTTOTRACTIONS Energy-Engineering-Environment	Title	KWA Aluva
Time series graph	Measurement period	21-01-2020 11:02:22 - 21-01-2020 11:03:40
	Display period	21-01-2020 11:02:22 - 21-01-2020 11:03:40
	Measurement interval	1 Second — Data interval: 1 Second
	Comment	Model number : PW3360 S/N.140512994 Light feeder



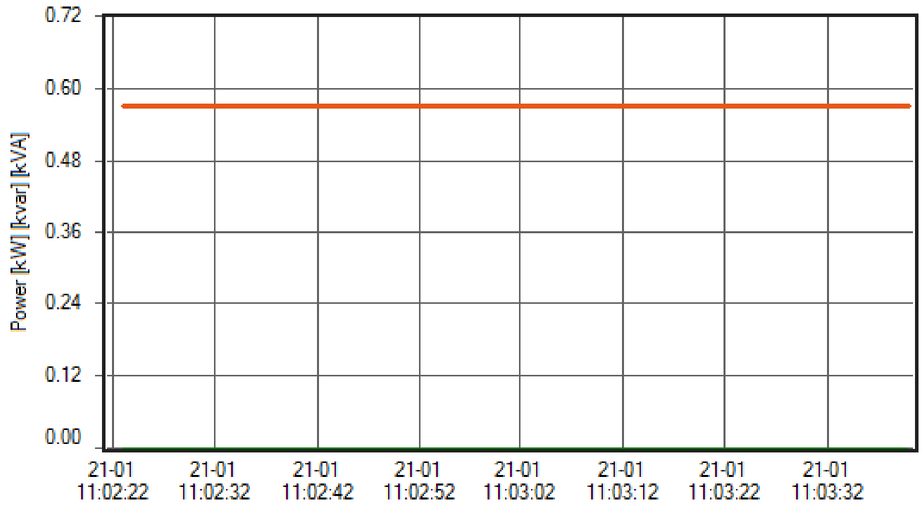




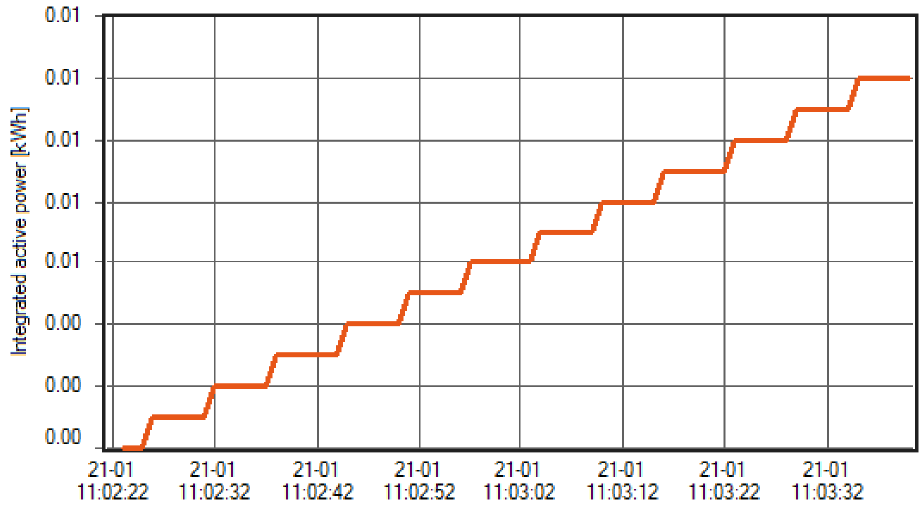
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

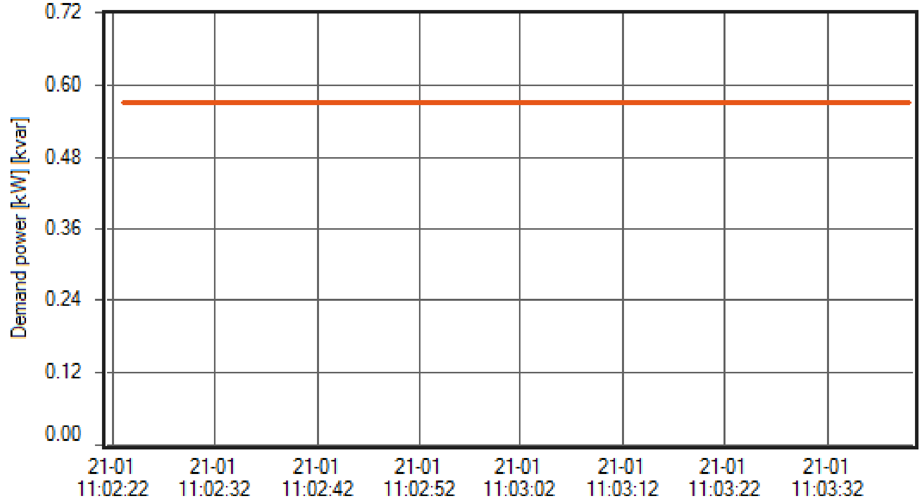
Title	KWA Aluva
Measurement period	21-01-2020 11:02:22 - 21-01-2020 11:03:40
Display period	21-01-2020 11:02:22 - 21-01-2020 11:03:40
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 Light feeder



Left axis
P[kW] P1[kW] P2[kW] P3[kW]

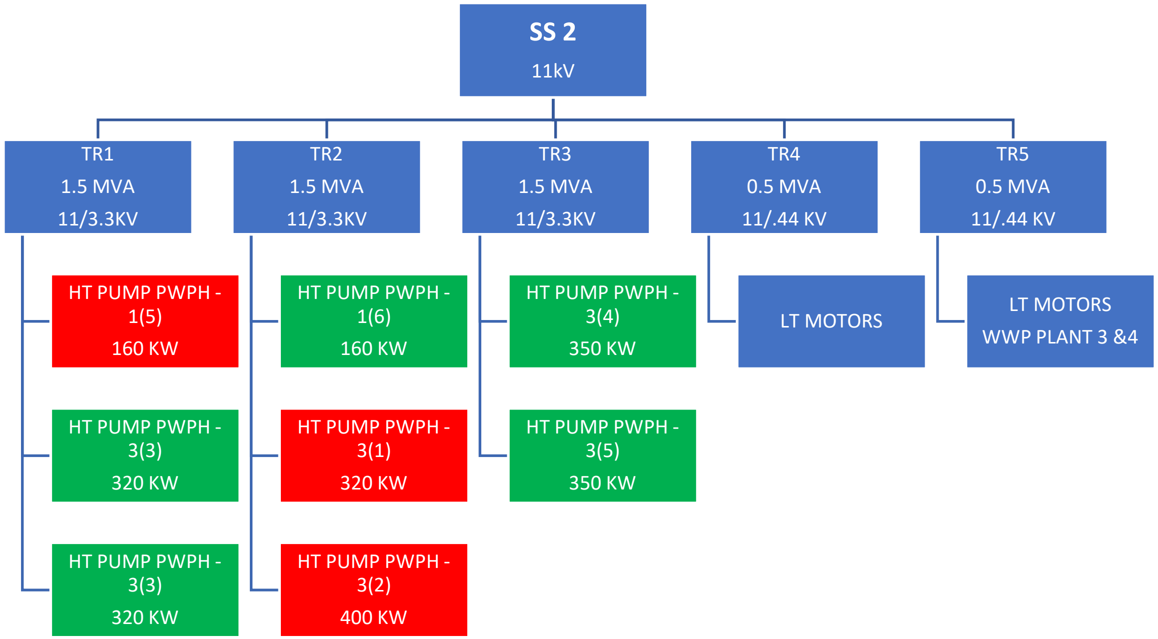


Left axis
WP+[kWh]

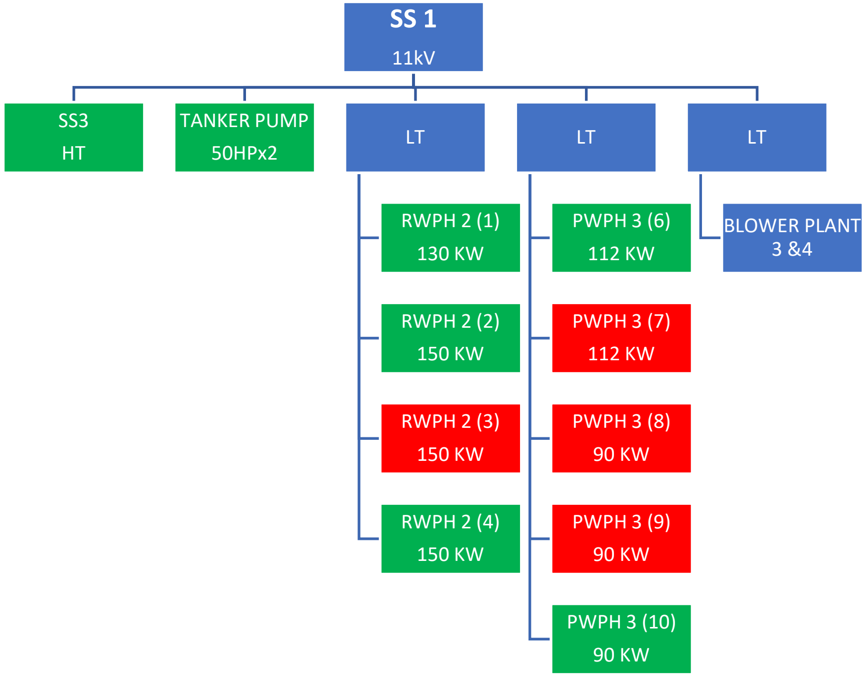


Left axis
Pdem+[kW]

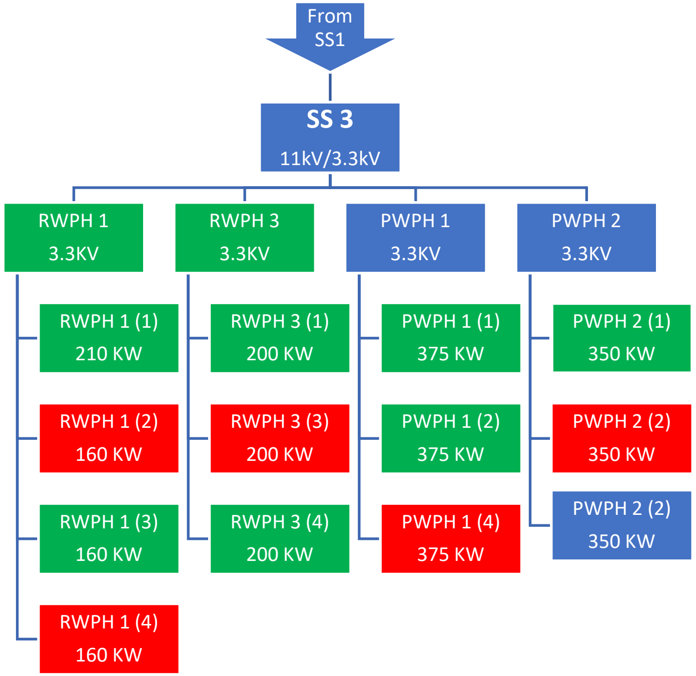
SINGLE LINE DIAGRAM FOR SS2

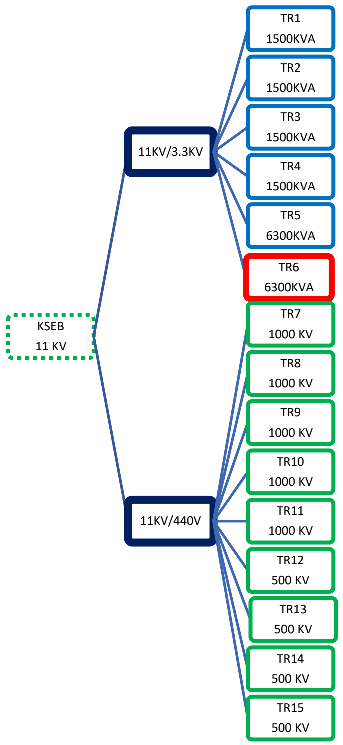


SINGLE LINE DIAGRAM FOR SS1

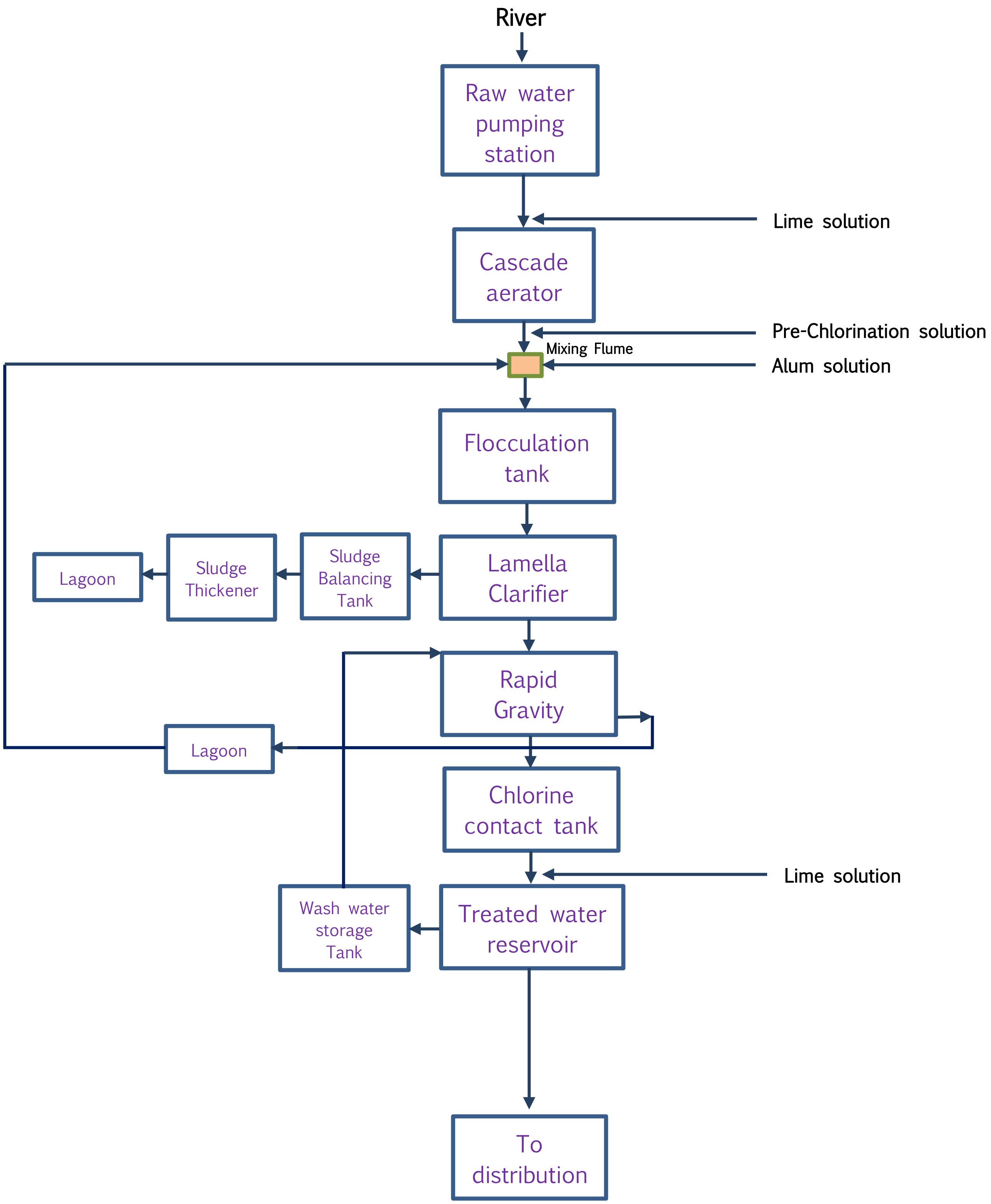


SINGLE LINE DIAGRAM FOR SS3

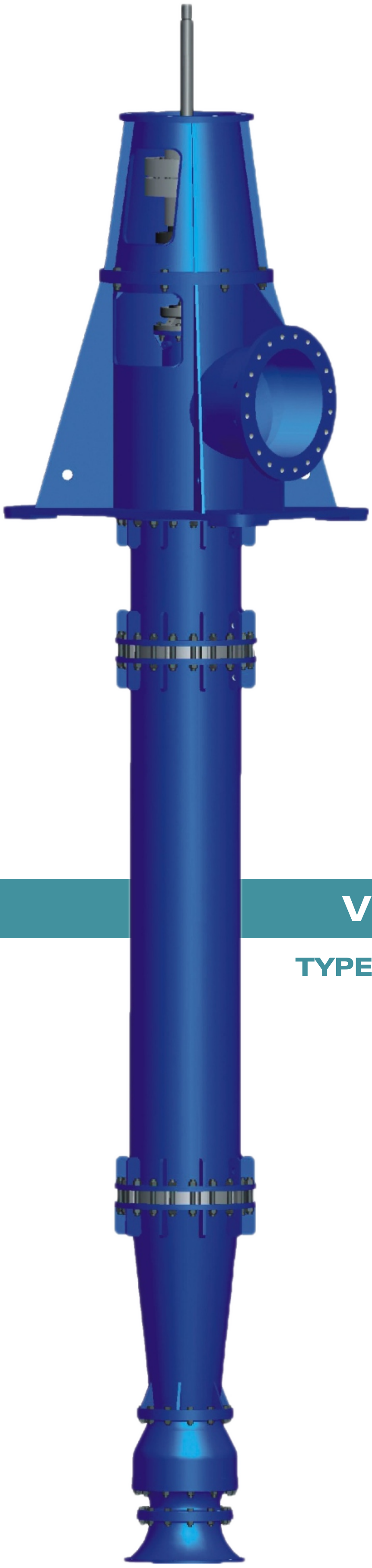




KSEB
11 KV
11KV/3.3KV
11KV/440V
TR1
1500KVA
TR2
1500KVA
TR3
1500KVA
TR4
1500KVA
TR5
6300KVA
TR6
6300KVA
TR7
1000 KV
TR8
1000 KV
TR9
1000 KV
TR10
1000 KV
TR11
1000 KV
TR12
500 KV
TR13
500 KV
TR14
500 KV
TR15
500 KV


River
Raw water pumping station
Lime solution
Cascade aerator
Pre-Chlorination solution
Mixing Flume
Alum solution
Flocculation tank
Lagoon
Sludge Thickener
Sludge Balancing Tank
Lamella Clarifier
Rapid Gravity
Lagoon
Chlorine contact tank
Lime solution
Wash water storage Tank
Treated water reservoir
To distribution

Enriching Lives



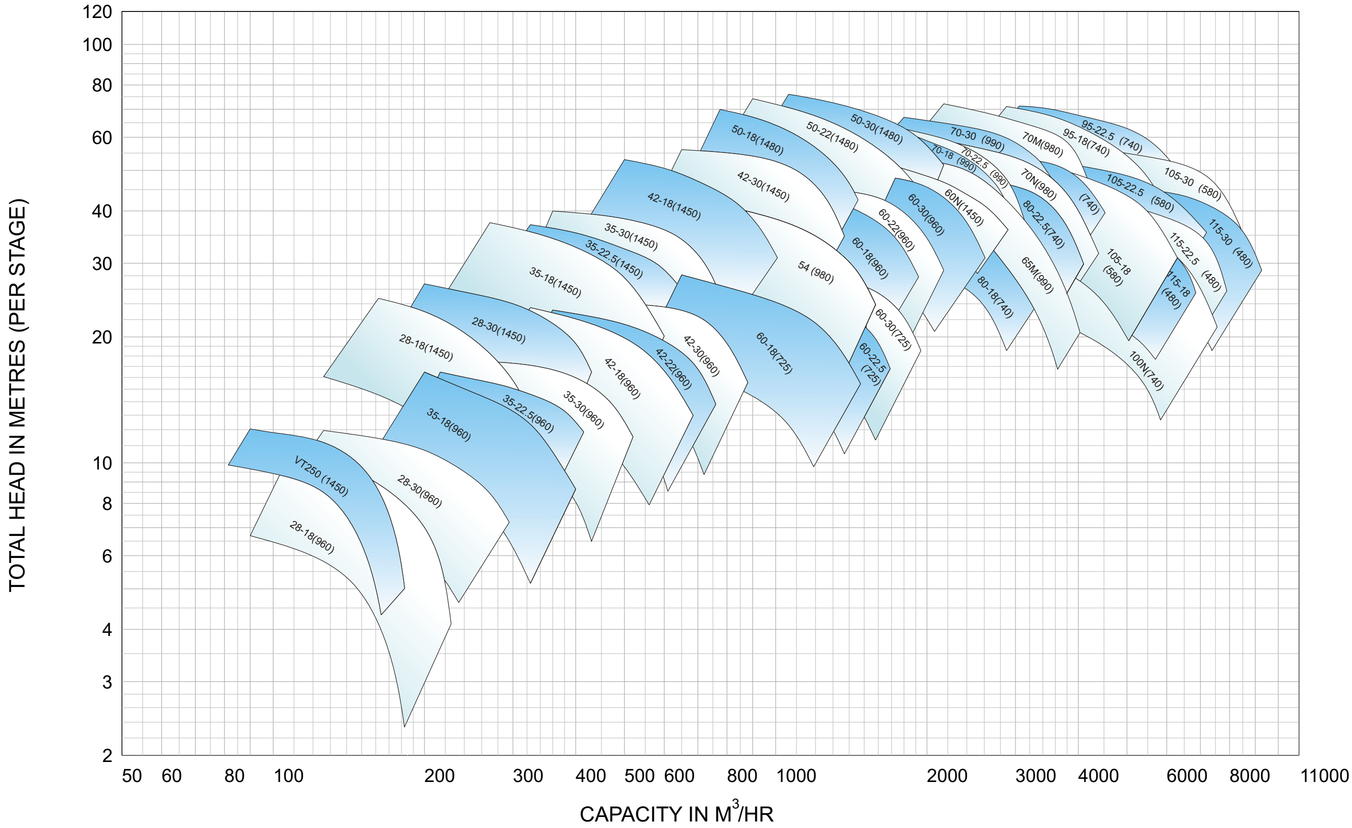
VERTICAL PUMPS

TYPE - BHR / BHQ / BHM / BHK / BHMa / BHA

KIRLOSKAR BROTHERS LIMITED

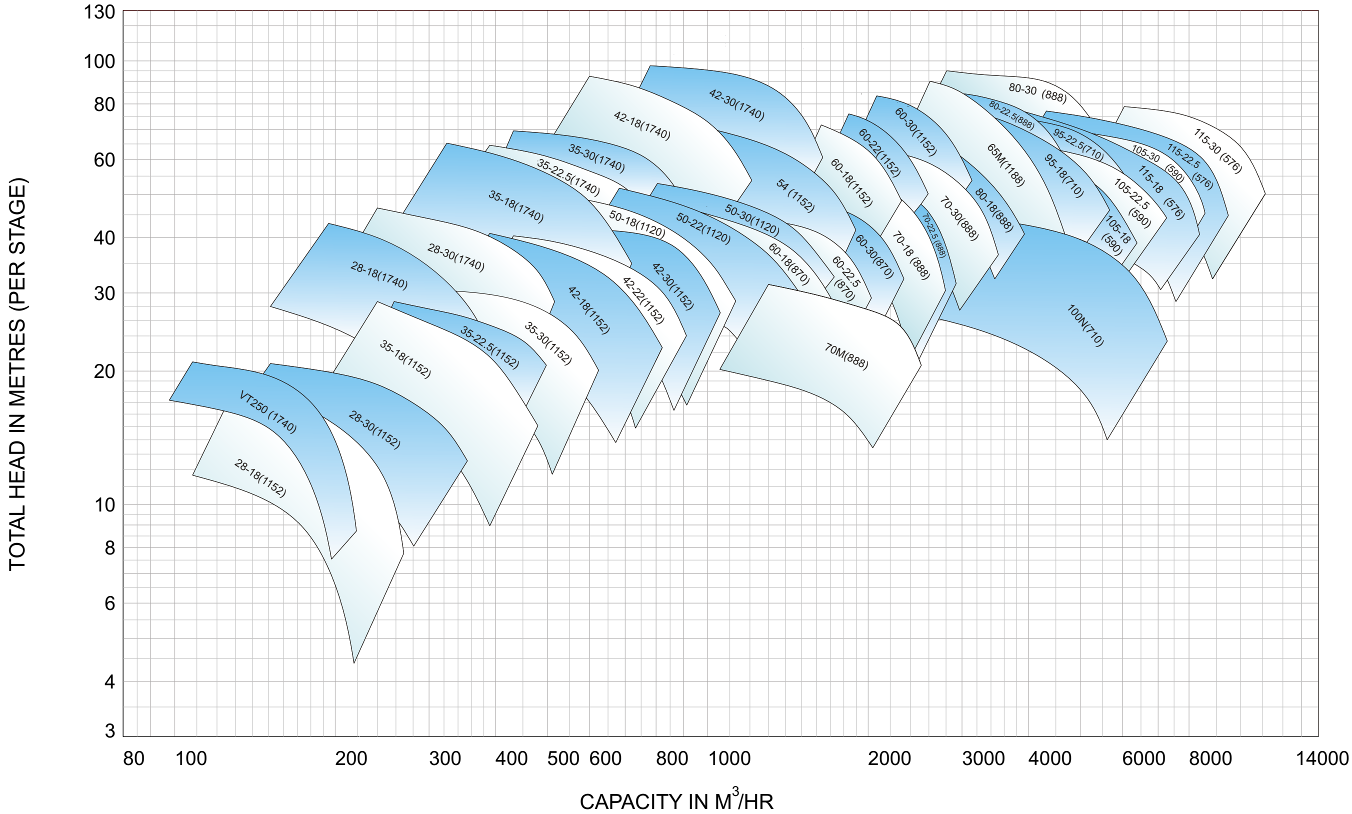
A Kirloskar Group Company

FAMILY CURVES FOR BHR PUMPS (50HZ)



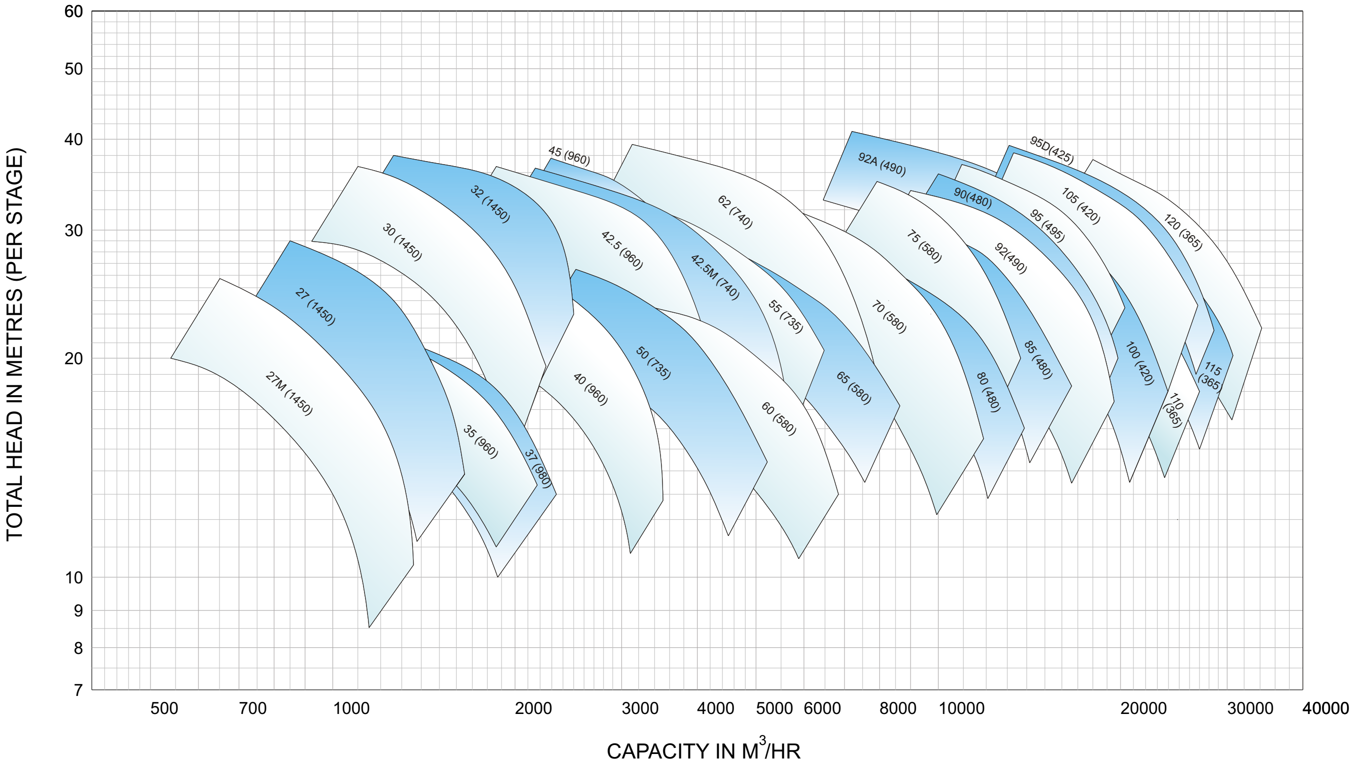
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHR PUMPS (60HZ)



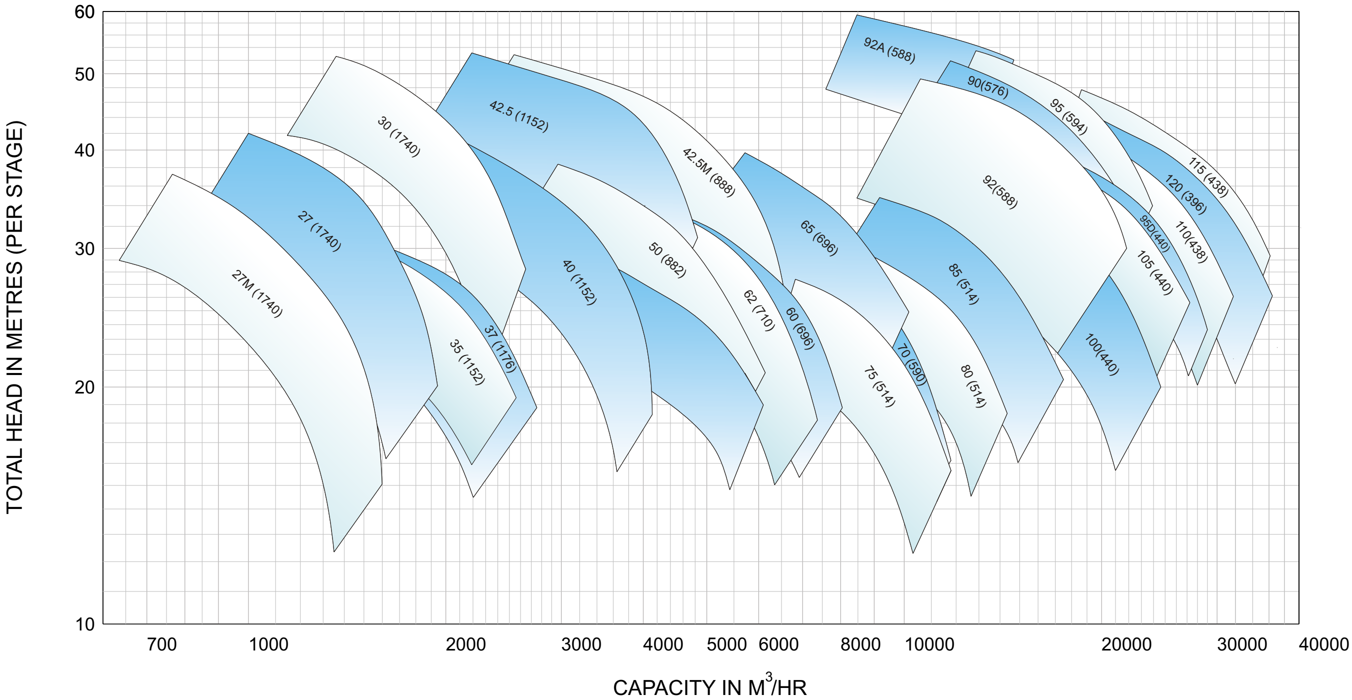
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHQ PUMPS (50HZ)



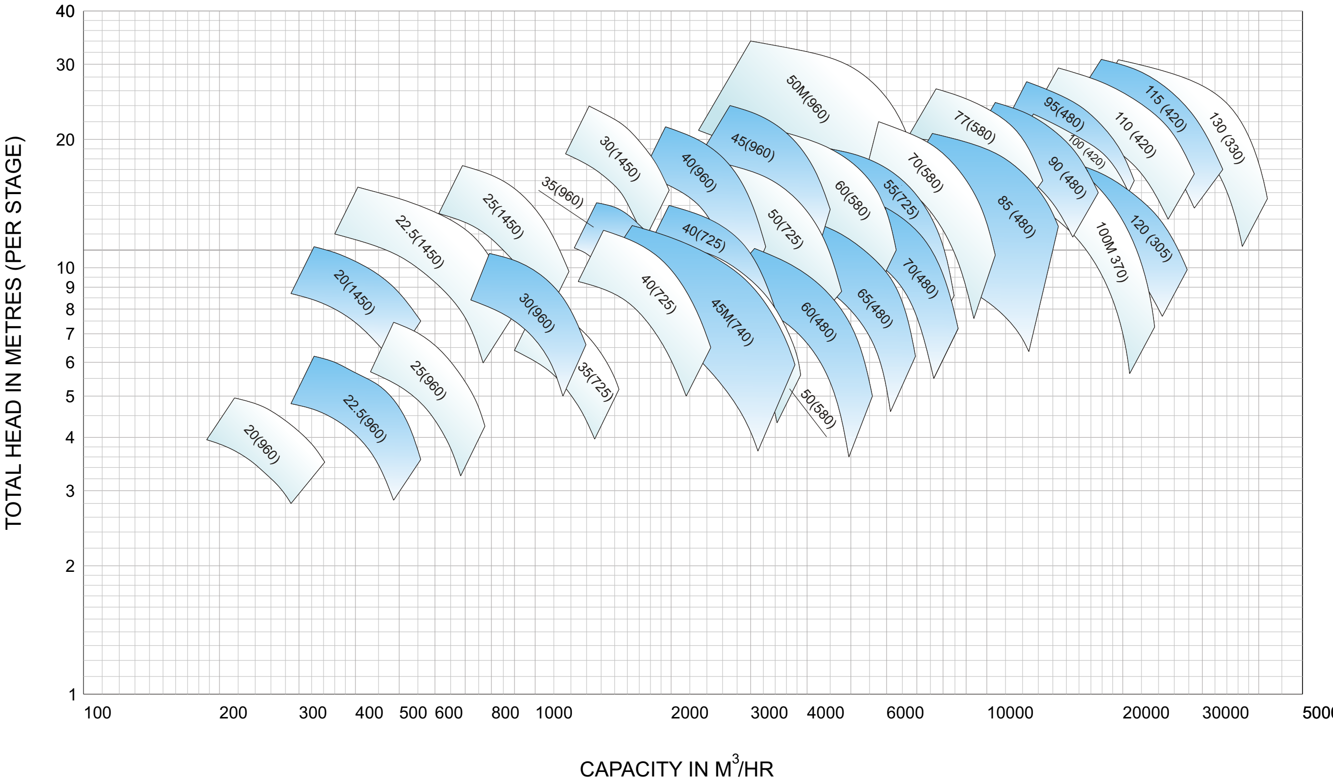
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHQ PUMPS (60HZ)



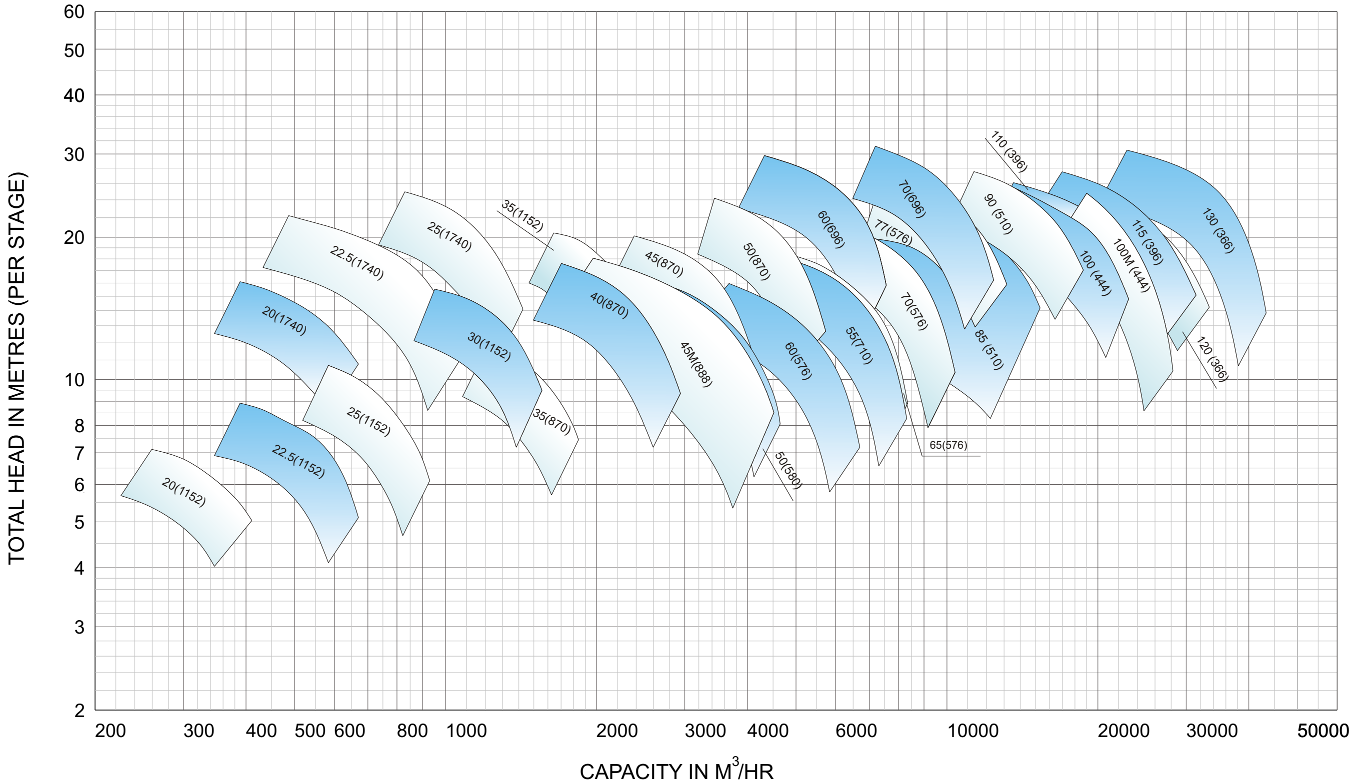
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHM PUMPS (50HZ)



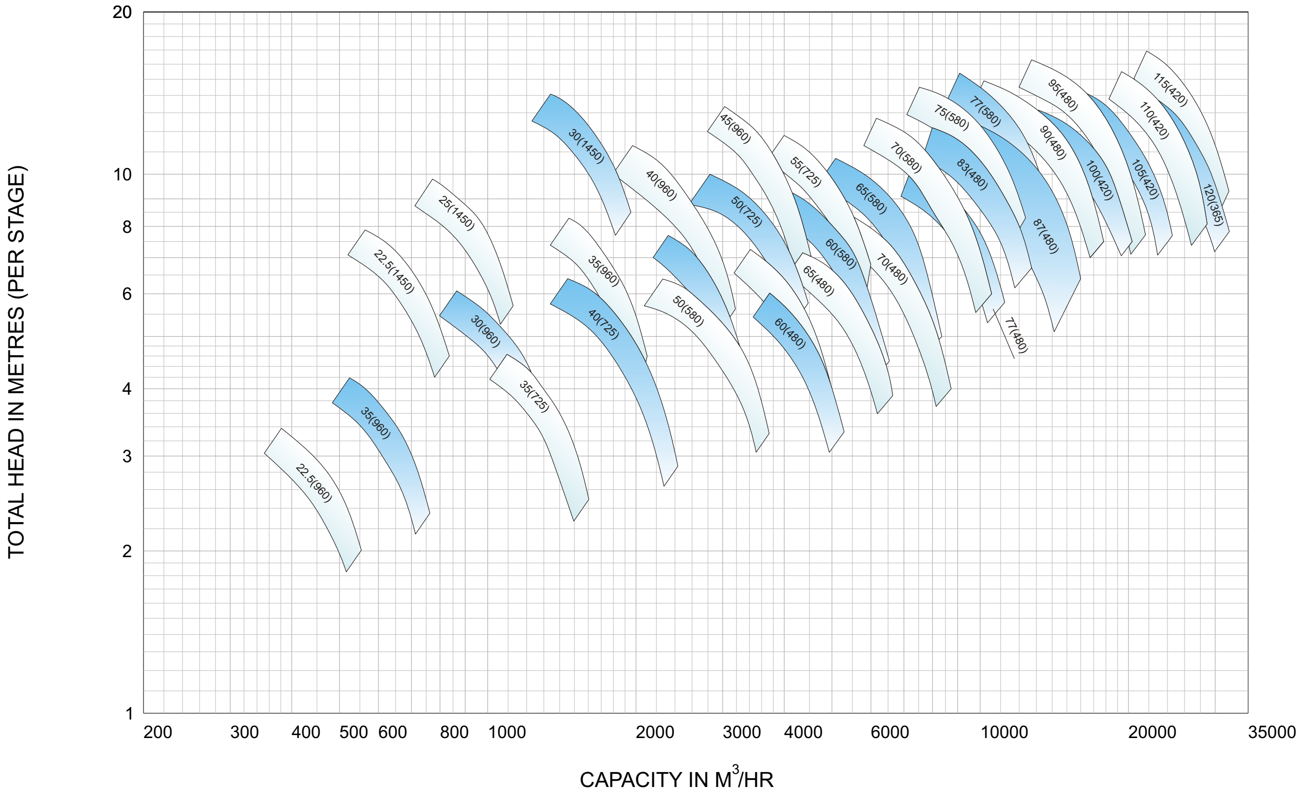
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHM PUMPS (60HZ)



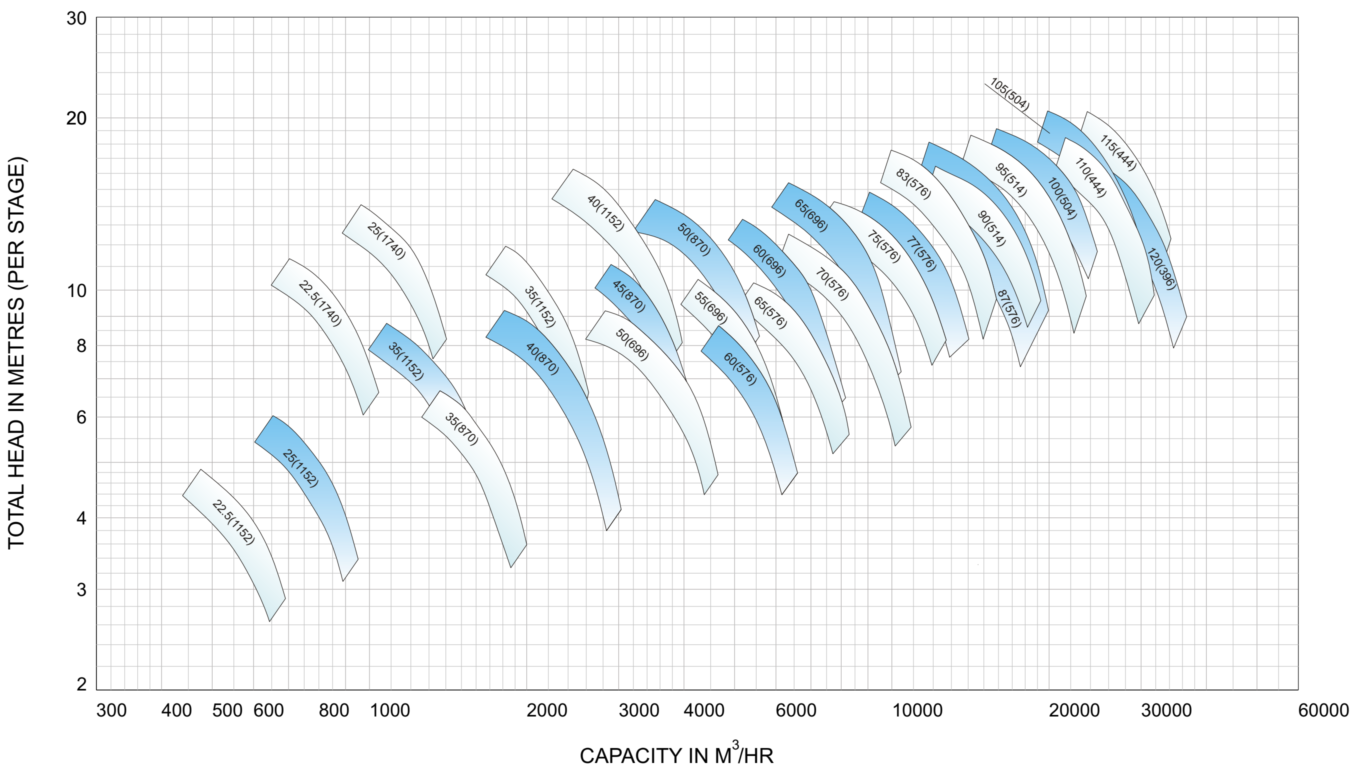
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHMa PUMPS (50HZ)



NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHMa PUMPS (60HZ)



NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

ABOUT KBL

Kirloskar Brothers Limited (KBL) is a world class pump manufacturing company with expertise in engineering and manufacture of systems for fluid management. Established in 1888 and incorporated in 1920, KBL is the flagship company of the $ 2.1 billion Kirloskar Group. KBL, a market leader, provides complete fluid management solutions for large infrastructure projects in the areas of water supply, power plants, irrigation, oil & gas and marine & defence. We engineer and manufacture industrial, agriculture and domestic pumps, valves and hydro turbines.

In 2003, KBL acquired SPP Pumps, United Kingdom and established SPP INC, Atlanta, USA, as a wholly owned subsidiary of SPP, UK to expand its international presence. In 2007, Kirloskar Brothers International B.V., The Netherlands and Kirloskar Brothers (Thailand) Ltd., a wholly owned subsidiary in Thailand, were incorporated. In 2008, KBL incorporated Kirloskar Brothers Europe B.V. (Kirloskar Pompen B.V. since June 2014), a joint venture between Kirloskar International B.V. and Industrial Pump Group, The Netherlands. In 2010, KBL further consolidated its global position by acquiring Braybar Pumps, South Africa. SPP MENA was established in Egypt in 2012. In 2014, KBL acquired SyncroFlo Inc., the largest independent fabricator of commercial and municipal domestic water booster pumps.

To further strengthen its global position, in 2015, Kirloskar Pompen B.V. acquired Rodelta Pumps International, The Netherlands.

KBL has joint venture cooperation with Ebara, Japan since 1988 for the manufacture of API 610 standard pumps. Kirloskar Corrocoat Private Limited is a joint venture cooperation with Corrocoat, UK since 2006. KBL acquired The Kolhapur Steel Limited in 2007 and Hematic Motors in 2010.

KBL has eight manufacturing facilities in India at Kirloskarvadi, Dewas, Kondhapuri, Shirwal, Sanand, Kaniyur, Kolhapur and Karad. In addition, KBL has global manufacturing and packaging facilities in Egypt, South Africa, Thailand, The Netherlands, United Arab Emirates, United Kingdom and United States of America. KBL has 12,700 channel partners in India and 80 overseas and is supported by best-in-class network of Authorised Centres and Authorised Refurbishment Centres across the country.

All the manufacturing facilities at KBL are certified for ISO 9001, ISO 14001, ISO 50001, BS OHSAS 18001 and SA8000. In addition, the Kirloskarvadi plant is also certified for N & NPT Stamp. KBL's corporate office in Pune is certified for ISO 9001 & Sa8000.

The factories deploy Total Quality Management tools using European Foundation for Quality Management (EFQM) model.
The Kirloskarvadi plant of KBL is a state-of-the-art integrated manufacturing facility having Asia's largest hydraulic research centre with testing facility upto 5000 kW and 50,000 m^3/hr.

KBL is the ninth pump manufacturing company in the world to be accredited with the N and NPT certification by American Society of Mechanical Engineers (ASME).

Pumps | Valves | Hydro Turbines | Turnkey Projects

Water Resource Management | Irrigation | Power | Industry | Oil & Gas | Marine & Defence | Building & Construction| |
Distribution (Small Pumps) | Valves | Customer Service & Spares

KIRLOSKAR BROTHERS LIMITED
A Kirloskar Group Company

Registered Office: Udyog Bhavan, Tilak Road , Pune 411002. Tel: +91(20)24440770
Global Headquarters: “Yamuna”, Survey No. 98/(3.7), Baner, Pune 411045. Tel: +91(20)27214444
Email: marketing@kbl.co.in, Website: www.kirloskarpumps.com, CIN No.: L29113PN1920PLC000670

OUR COMPANIES

SPP	SyncroFlo	BP	KOPL	RODELTA
United Kingdom	U.S.A.	South Africa	India	The Netherlands

Jyoti Ltd.

Water • Power • Progress

JYOTI
Vertical Turbine Pumps
(oil & water-lubricated)

Manufactured, designed
and made the First Vertical Turbine
(VT) Pump in India, way back in 1942

ISO 9001:2015 || TUV INDIA

APPLICATION

Pumps for

- irrigation
- urban & rural water supply
- Cooling tower
- Fire fighting
- Flood control
- Mine dewatering
- Thermal power stations
- Condensate extraction
- General & process water in industries
- Oil field water services and a hoast of other needs.

RANGE

Bowl sizes	150 mm to 600 mm
Capacity	200 lpm to 33200 lpm
Head	upto 225 mts

For higher capacities refer to us.

SPECIAL DESIGN FEATURES

- Heavy wall cast iron bowls & cast iron / Stainless Steel impellers provided for maximum operating life, under ardous Indian conditions.
- Impeller shafts of stainless steel
- Column pipes and line shafts are machined and threaded on double ended special purpose machines in single setting ensuring concentricity.
- All shaft couplings in water lubricated pumps are made of stainless steel for extra-long life.

CONSTRUCTIONAL FEATURES

'JYOTI' VT pumps are offered in non-pull out construction as a standard design. The pump can be supplied for coupling with vertical hollow shaft motors or vertical solid shaft motors. Also for surface discharge or underground discharge.

BOWLS

Standard bowls are made of close grained cast iron. The diffuser vanes are cast integrally.

IMPELLERS

Impellers are closed or semi-open type, statically and dynamically balanced for vibration-free operation. They are secured to the impeller shaft with tapered lock collects or keys & split rings. The impeller position can be adjusted vertically by means of impeller-adjusting nut provided in the drive.

IMPELLER SHAFT

Impeller shaft is of stainless steel, accurately ground to close tolerances. The shaft is supported by bearings above and below each impeller.

COLUMN PIPES

Column pipes are normally supplied in nominal lengths of 3.0m, 1.5m and 0.75m pipes of non-standard lengths also can be supplied on request.

LINE SHAFTS

Line shafts are of high grade carbon steel, ground to close tolerances and threaded concentrically at the ends. Available in nominal lengths of 3.0m, 1.5m and 0.75m and in non-standard lengths to suit specific site conditions. Line shaft in stainless steel and suitable for muff couplings also can be supplied, if required.

LINE SHAFT BEARINGS

Made of bronze for oil lubricated pumps and Nitrile Rubber for water lubricated pumps.

SHAFT ENCLOSING TUBES

(for oil-lubricated pump)

These heavy duty steel tubes protect the line shafts from corrosion and foreign materials and support the line shaft bearings. The tubes are threaded concentrically in one setting at both ends. Available in different lengths, as line shafts.

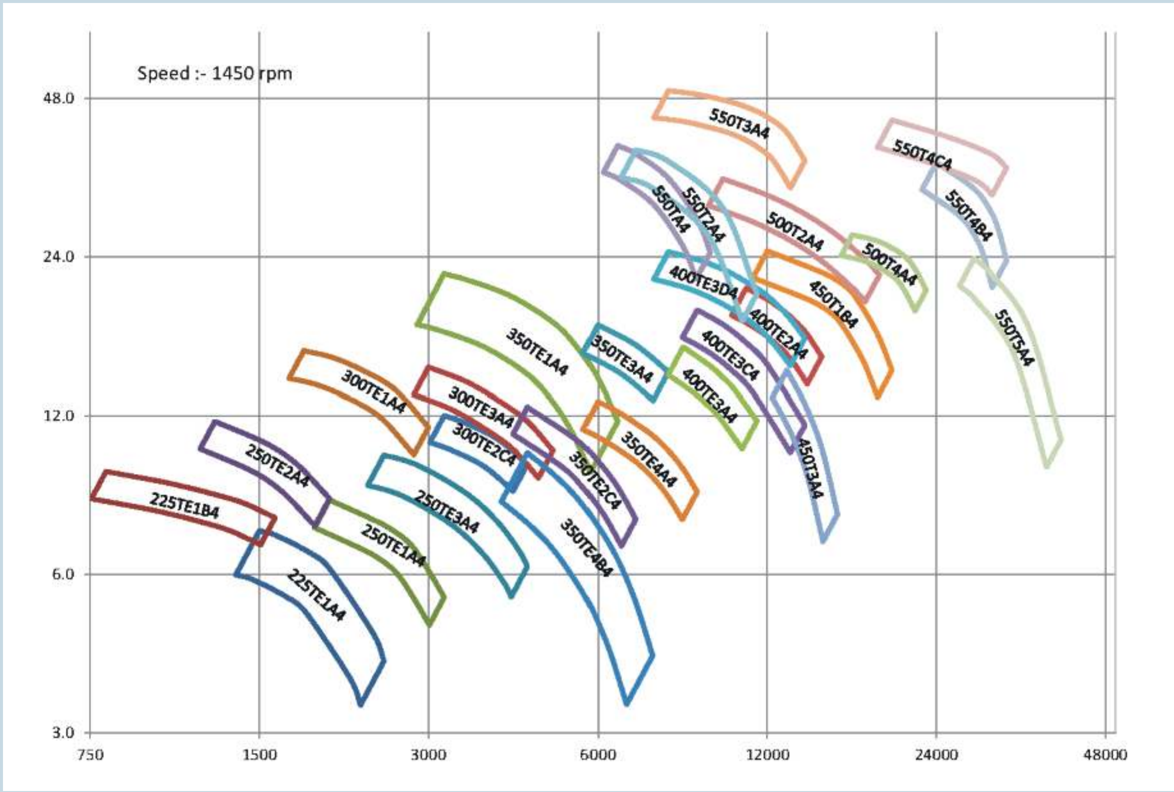
DISCHARGE HEAD

Standard construction in cast iron. Fabricated ones also can be supplied on request. Pump can be supplied with surface or underground discharge to suit specific site conditions.

DRIVES

Electrical motors with vertical hollow shaft or vertical solid shaft are normally used. Alternatively right angle gear head with diesel engine also can be used.

FAMILY CURVE FOR STANDARD VT PUMPS (225 to 550 mm)



STANDARD MATERIAL OF CONSTRUCTION

OIL LUBRICATED / WATER LUBRICATED / FORCE LUBRICATED PUMP

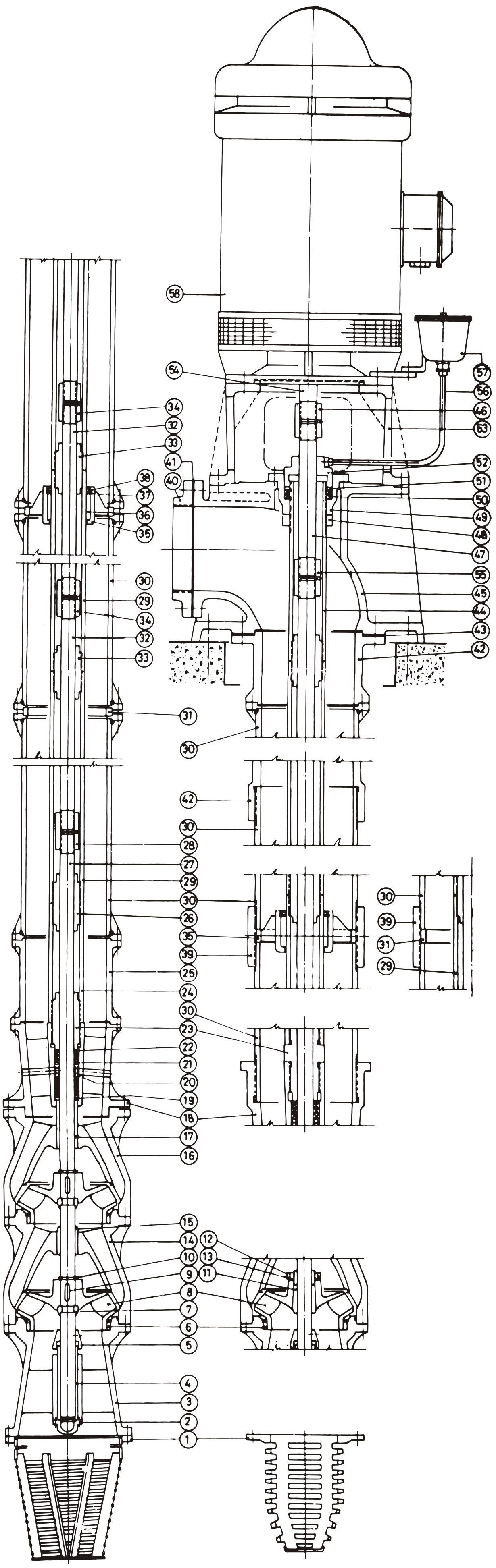
S.NO.	PART DESCRIPTION	MATERIAL	SPECIFICATION
1	STAINER	M.S.	IS : 2062 St.42-S
2	SUCTION CASE	CAST IRON	IS : 210 Gr FG-200
3	SUCTION CASE BEARING	BRONZE	IS : 318 Gr LTB2
4	IMPELLER SEAL RING	CAST IRON	IS : 210 Gr FG-200
		BRONZE	IS : 318 Gr LTB2
5	IMPELLER	CAST IRON	IS : 210 Gr FG-200/260
		BRONZE	IS : 318 Gr LTB2
6	BOWL	CAST	IRON IS : 210 Gr FG-260
7	IMPELLER SHAFT	ST. STEEL	ASTM A276 SS 410
8	DISCHARGE CASE	CAST IRON	IS : 210 Gr FG-200/260
9	COLUMN PIPE ADOPTOR	CAST IRON	IS : 210 Gr FG-200/260
10	GUIDE SPIDER/BEARING HOLDER	CAST IRON	IS : 210 Gr FG-200/260
11	COLUMN PIPE	ERW STEEL	IS : 1239 Class C / IS : 1978
		M.S. FABRICATED	IS : 2062 St.42-S
12	SHAFT ENCLOSING TUBE (OL)	STEEL	IS : 1239 Class C / IS : 1978
13	LINE SHAFT CARBON	STEEL	IS: 1570 C40 / ASTM A276 SS 410
14	LINE SHAFT COUPLING (OL) CARBON	STEEL	IS: 1570 C40 / ASTM A276 SS 410
15	LINE SHAFT COUPLING (WL) ST.	STEEL	ASTM A276 SS 410
16	LINE SHAFT BEARING (OL)	BRONZE	IS : 318 Gr LTB2
17	LINE SHAFT BEARING (WL)	NITRILE RUBBER	SHORE HARDNESS 60-65
18	TOP COLUMN FLANGE	CAST IRON	IS : 210 Gr FG-200/260
19	DISCHARGE HEAD BODY	CAST IRON	IS : 210 Gr FG-200/260
		M.S. FABRICATED	IS : 2062 St.42-S
20	HEAD SHAFT CARBON	STEEL	IS: 1570 C40 / ASTM A276 SS 410
21	STUFFING BOX	CAST IRON	IS : 210 Gr FG-200/260
22	GLAND	CAST IRON	IS : 210 Gr FG-200/260
23	MOTOR SKIRT	CAST IRON	IS : 210 Gr FG-200/260
		M.S. FABRICATED	IS : 2062 St.42-S
24	MOTOR	VERTICAL HOLLOW OR	IS: 325
		SOLID SHAFT	

NOTE : Material of Construction mentioned above are our standard ones, other materials to suit specific site conditions can be supplied on request.

OPTIONAL ACCESSORIES

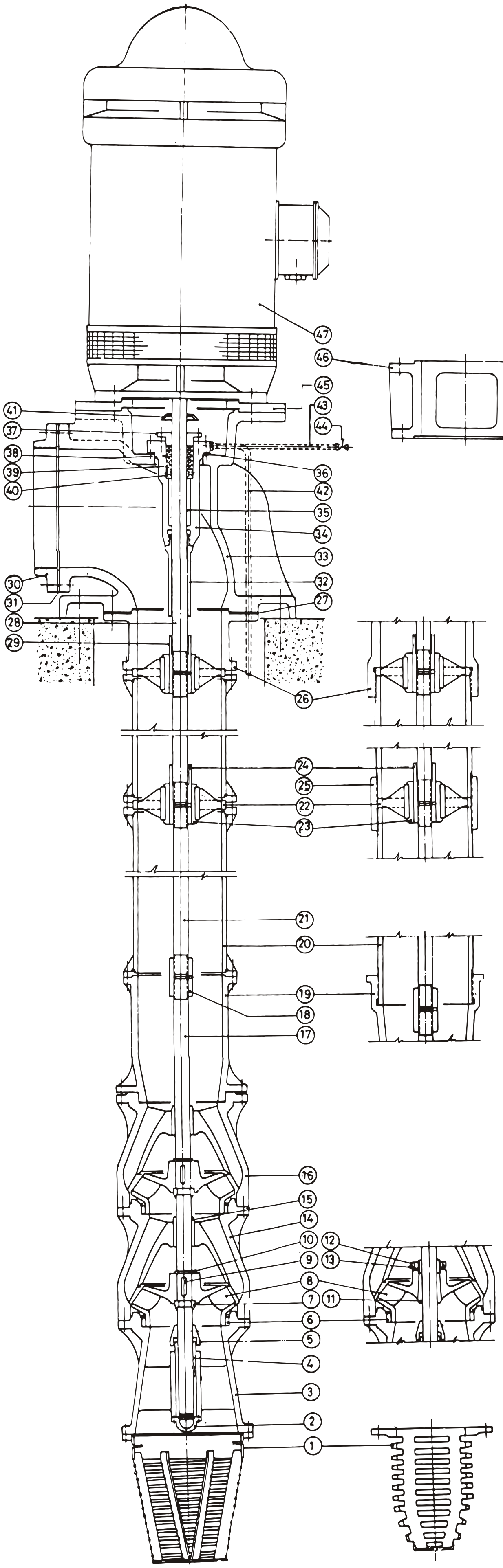
- Foundation bolts
- Sole plate
- Companion flanges.

'JYOTI' VERTICAL TURBINE PUMP
(OIL-LUBRICATED)

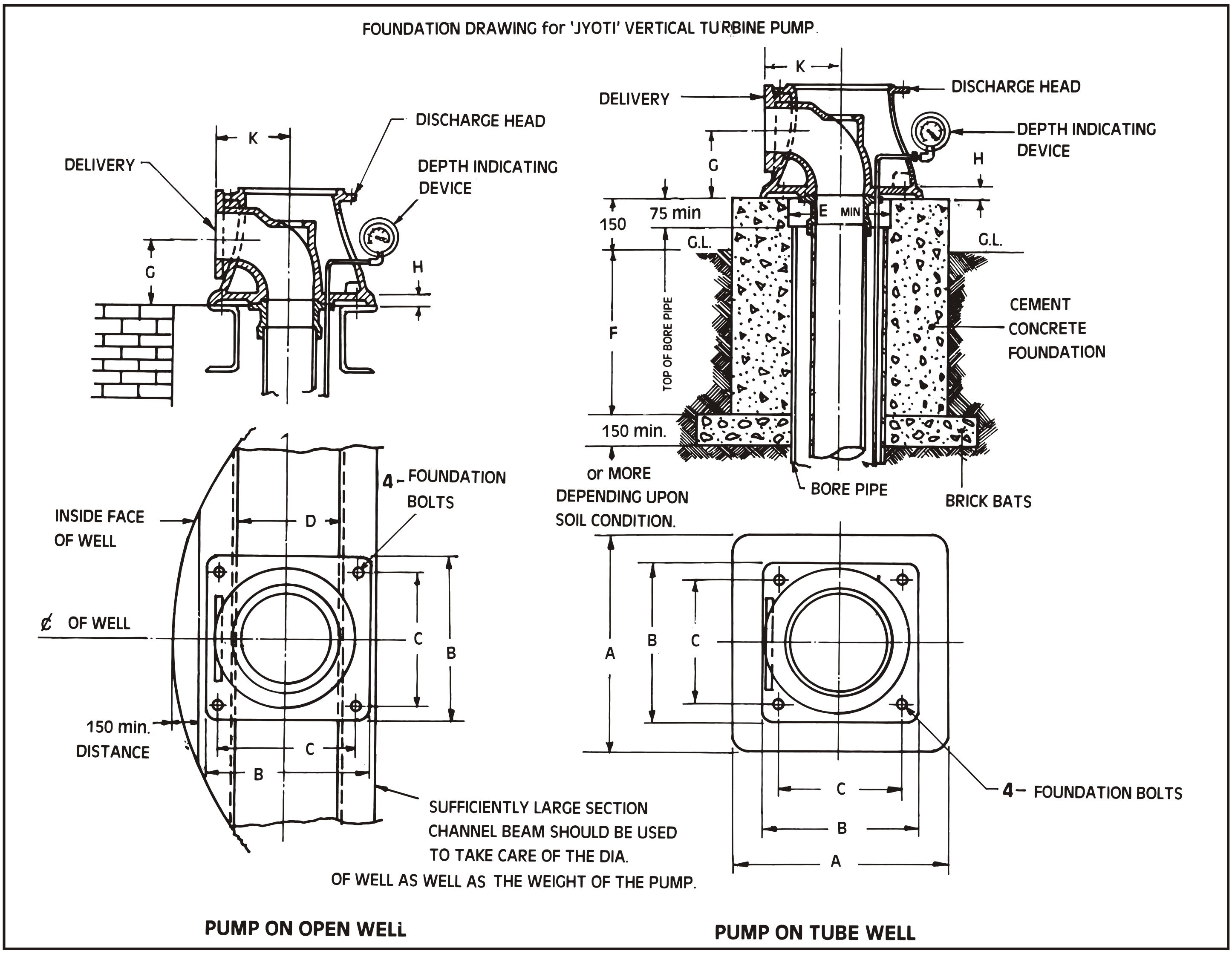


Sr. No.	PART NAME
58	Vertical Hollow Shaft Motor
57	Automatic Lubricator Assly
56	Oiling Pipe
55	Head Shaft Coupling
54	Head Shaft
53	Motor Skirt or Adapting Plate
52	Gland
51	Gland Packing Ring
50	Gland Packing
49	Tube Tension Plate
48	Check Nut
47	Head Shaft Extension
46	Head Shaft Extension Coupling
45	Discharge Head Body
44	Tube Tension Nipple
43	Top Column Flange Gasket
40	Delivery Flange (Up to D-150 Dis-Head)
39	Column Pipe Coupling
38	Circlip
37	Rubber Guide Ring Washer
36	Rubber Guide Ring
35	Guide Spider
34	Line Shaft Coupling
33	Line Shaft Bearing
32	Line Shaft
31	Column pipe spacer
30	Column Pipe Flanged or Threaded
29	Shaft Enclosing Tube
28	Impeller Shaft Coupling
27	Impeller Shaft
26	Impeller Shaft Bearing
25	Column Pipe Adoptor
24	Tubing Adaptor
23	Discharge Case Bearing
22	Impeller Shaft Packing Ring
21	Impeller Shaft Packing
20	Lantern Ring
19	Distance Piece
18	Discharge Case Flange or Threaded
17	Top Bowl Bearing
16	Top Bowl
15	Bowl Bearing
14	Bowl
13	Impeller Collect Nut Washer
12	Impeller Collet Nut
11	Impeller Collet
10	Circlip
9	Impeller Key
8	Impeller
7	Impeller Holding Split Ring
6	Impeller Seal Ring
5	Suction Case Sand Collar
4	Suction Case Bearing
3	Suction Case
2	Suction Case Plug
1	Suction Pipe Strainer

'JYOTI' VERTICAL TURBINE PUMP
(WATER-LUBRICATED)



Sr. No.	PART NAME
46	Vertical Hollow Shaft Motor
45	Adapting Plate or Distance Piece
44	Valve
43	Water Lubricating Tube
42	Water Leakage Tube
41	Water Deflector
40	Lantern Ring
39	Gland Packing
38	Gland Packing Ring
37	Gland
36	Stuffing Box Gasket
35	Stuffing Box Bush
34	Stuffing Box
33	Discharge Head Body
32	Stilling Pipe
31	Delivery Flange Gasket
30	Delivery Flange (Up to D-150 Dis-Head)
29	Head Shaft Coupling
28	Head Shaft
27	Top Column Flange Gasket
26	Top Column Flange - Flanged or Threaded
25	Column Pipe Coupling Threaded
24	Line Shaft Coupling
23	Rubber Bearing
22	Brg. Holder Flanged or Threaded
21	Line Shaft
20	Column Pipe flanged or Threaded
19	Col. Pipe flanged or Threaded or Threaded
18	Impeller Shaft Coupling
17	Impeller Shaft
16	Top Bowl
15	Bowl Bearing
14	Bowl
13	Impeller Collet Nut washer
12	Impeller Collet Nut
11	Impeller Collet
10	Circlip
9	Impeller Key
8	Impeller
7	Impeller Holding Split Ring
6	Impeller Seal Ring
5	Suction Case Sand Collar
4	Suction Case Bearing
3	Suction Case
2	Suction Case Plug
1	Suction pipe Strainer



Discharge Head	A	B	C	D	E	F	G	H	K	L	M	N	Foundation		
													Dia	No.	Length
D/DS 100	600	400	335	260	295	460	156	30	190	4	18	178	M 16	4	250
D/DS 150	640	440	375	295	330	460	203	35	215	8	18	235	M 20	4	300
D/DS 200	775	565	485	410	410	610	235	45	285	8	18	292	M 24	4	500
D/DS 250	900	690	600	500	520	610	270	60	350	8	22	356	M 24	4	500
D/DS 300	900	700	600	500	520	610	320	60	355	12	22	406	M 24	4	500
D/DS 350	1050	850	740	625	590	700	365	60	430	12	24	470	M 24	4	500
D/DS 400	1050	850	740	625	590	700	380	60	430	12	24	521	M 24	4	500

All dimensions are in mm except otherwise stated.

Note : Delivery flanges are acording to BS : 10, Table "E"

Jyoti Ltd. VADODARA (INDIA)

Water • Power • Progress

FOR FURTHER ENQUIRIES PLEASE CONTACT

BRANCH OFFICES

PUMP DIVISION
Nanubhai Amin Marg, Industrial Area,
P.O. Chemicals Industries,
Vadodara-390 003 (India).
Phones : +91-265-3054444
Fax : +91-265-2281871
2280671
E-mail : pumps@jyoti.com
Website : www.jyoti.com

Bangalore : 35/3, 2nd Floor, Novelty Mansion, 2nd Cross, IV Block, Kumarapark West, Bangalore-560 020. Telefax : 080-23562248 E-mail : bangalore@jyoti.com

Chennai : VEE DEE YEM Complex, 1st Floor, 270, Lloyds Road, Royapettah, Chennai 600014, Ph. : 044-28131754, Fax : 044-28133178, E-mail : chennai@jyoti.com

Indore : E-mail : indore@jyoti.com (Resident Representative (M) 09303211776

Kolkata : 45, Jhowtalla Road, Syed Amir Ali Avenue, Kolkata-700 019, Ph. : 033-22902056, Fax : 033-22875267, E-mail : kolkata@jyoti.com

Mumbai : Narsinh Sadan, Flat No. 102, 1st Floor, 1st Road, Golibar, Santacruz (East), Mumbai-400 055. Ph. : 022-26134403 (D), 26122848, E-mail : mumbai@jyoti.com

New Delhi : 7, Jantar Mantar Road, New Delhi-110 001. Ph. : 011-23340576, E-mail : delhi@jyoti.com

Secundrabad : 5-4-187/7, 1st Floor, Karbala Maidan, M. G. Road, Secundarabad-500 003. Ph. : 040-27544587 (D), 2754708 Fax : 040-27543673, E-mail : jyotisec@jyoti.com

In keeping with the technological strides the world is making in the engineering field, we introduce changes in the design of our products. Hence, the products as actually supplied might have features varying here from.

This Page is Intentionally Kept Blank