ENERGY AUDIT AT
KWA CHOWARA WATER
TREATMENT & PUMPING STATION

Energy Audit Report

Year: 2020-21

Energy Management Centre – Kerala
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ENERGY AUDIT REPORT

KERALA WATER AUTHORITY PUMPING STATION

CHOWARA

Energy Audit Report

KERALA WATER AUTHORITY PUMPING STATION-CHOWARA

Report No: EA 583

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, Chowara 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 Smt. Sheeba C.V 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

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)

OTTOTRACTIONS- ENERGY AUDIT						
Executive Summary						
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects						
KWA CHOWARA						
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 32 No's T12 Lamps to 18W LED Tube	0.11	0.31	4.31	4182	0.36
2	Energy saving by replacing the existing 22HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Backwash	5.07	0.70	87.12	9376	0.81
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump HT 1	52.95	147.36	4.31	1978008	170.11
4	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump HT 2	58.55	137.44	5.11	1844856	158.66
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw Water Pump HT 1	85.42	89.54	11.45	1201872	103.36
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw Water Pump HT 2	92.71	87.12	12.77	1169460	100.57
25	Energy Saving by arresting leakages in flanges and other joints of the line.	-	-	-	-	-
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	5.49
Total		332	466	35	6271629	539

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Introduction

A detailed energy audit has been carried out at **KERALA WATER AUTHORITY PUMPING STATION, CHOWARA** 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 Chowara PH Head works subdivision with consumer numbers 26/4361 (135570004051). It has an installed capacity of 63 MLD (million liters per day) with 365 days working. Capacity utilisation of the plant is near 100%

Base line Data (Electrical System)	
Code	EA 583
Facility	KERALA WATER AUTHORITY, CHOWARA
Provider	KSEB Ltd
Consumer No	135570004051
Contract Demand (kVA)	1850
Tariff	HT1(A) Industrial
Energy Charge Rs/ kWh Z1	5.5
Energy Charge Rs/ kWh Z2	8.25
Energy Charge Rs/ kWh Z3	4.125
Demand Charge Rs/ kVA	300
Excess Demand Rs/kVA	150
Energy Bill Analysis interval	2019-20

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.

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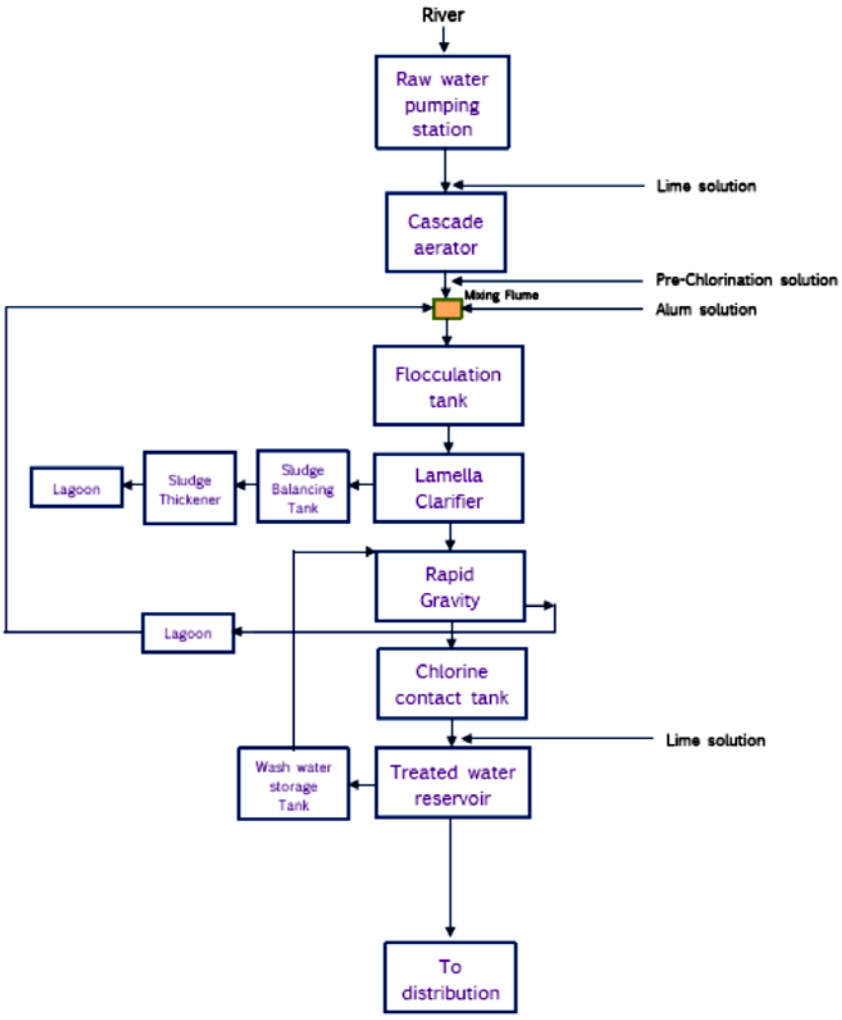
Production process description

The Aluva head works having four main pumps two raw water pumps and to clear water pumps. The raw water pumps are 430kW rated. The raw water pump-2 is working 24hrs to reach the required production and other one is standby. The clear water pumps are 430kW rated. The detailed flow diagram of the system is given below.



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

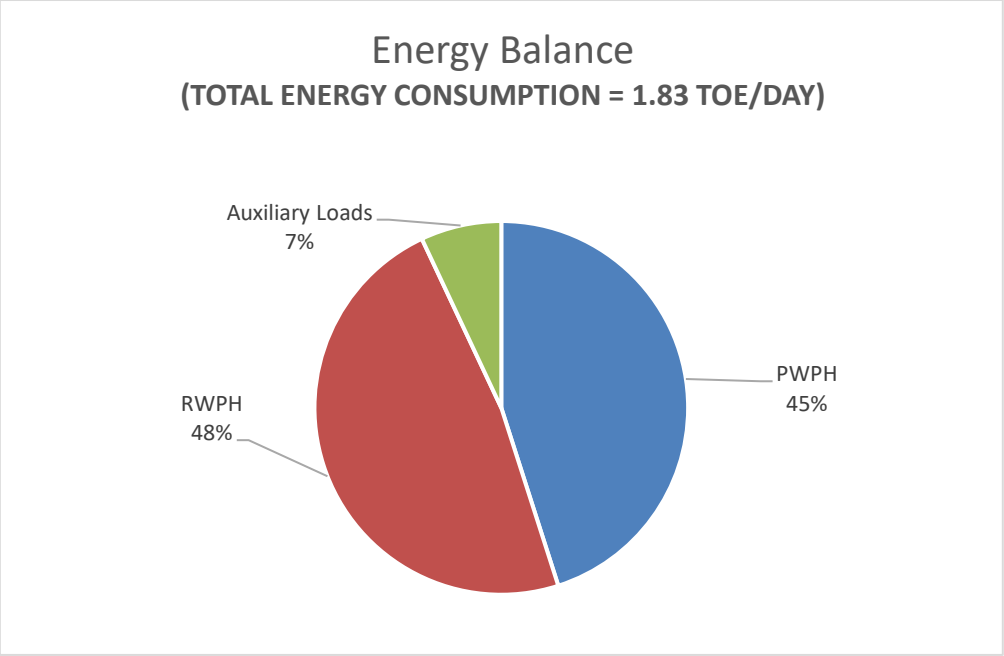
The facility is a consumer of Kerala State Electricity Board (KSEB) under HT – I (A) Industrial Tariff category at 11 kV. The facility having two HT connections with contract demand of 1850 kVA. The details of transformer installed in the facility are given below.

Details of Transformers				
Sl.No	Make	Year of manufacturing	Rating (kVA)	Voltage (kV)
1	Universal	2005	2000	0.440
2	Universal	2005	2000	0.440
3	Universal	2005	500	6.6
4	Universal	2005	500	6.6

The power factor is being maintained as 0.75. 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

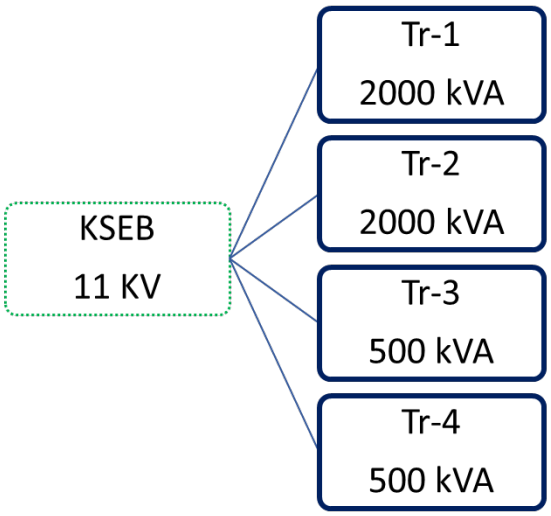
Detailed process flow diagram and energy and material balance



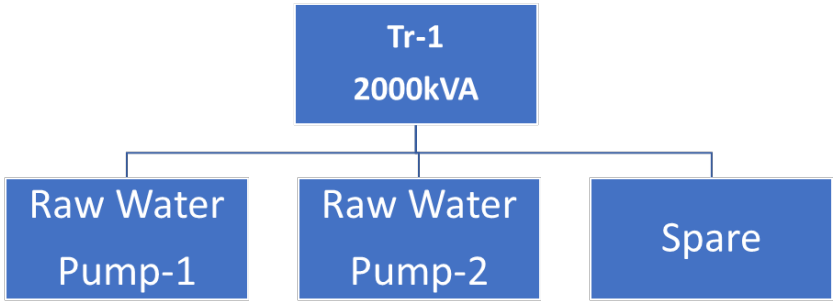
The energy balance of this facility is given above. The auxiliary loads caters 7% of the total load

Plant Operation

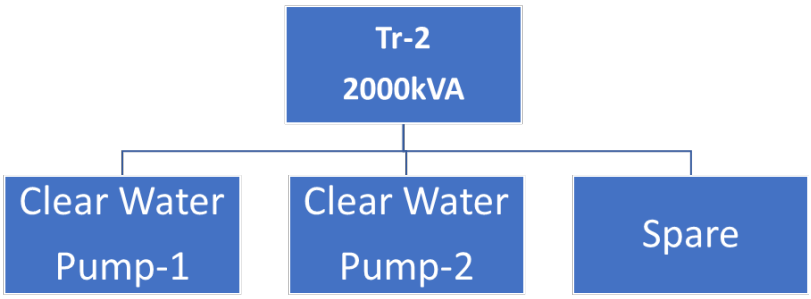
The Pumping Station has 4 transformers, out of 4, 2 numbers are 2000kVA, 11kV/3.3kV HT transformers and 2 numbers are 500kVA 11kV / 440 V LT transformers. The detailed SLD of substations and process are given in this section.



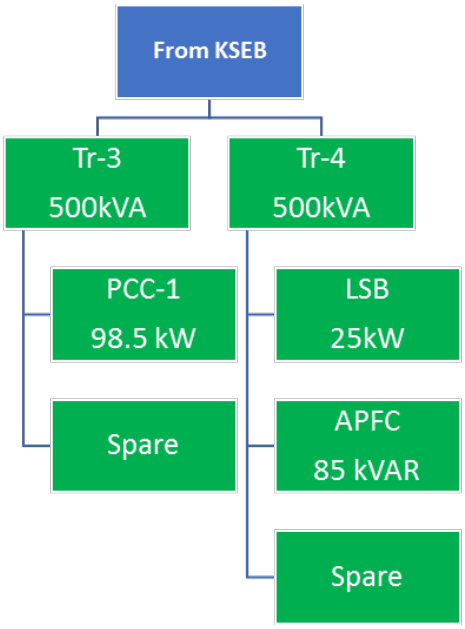
SINGLE LINE DIAGRAM FOR TRANSFORMER-1



SINGLE LINE DIAGRAM FOR TRANSFORMER-2



SINGLE LINE DIAGRAM FOR TRANSFORMER-3 & 4



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

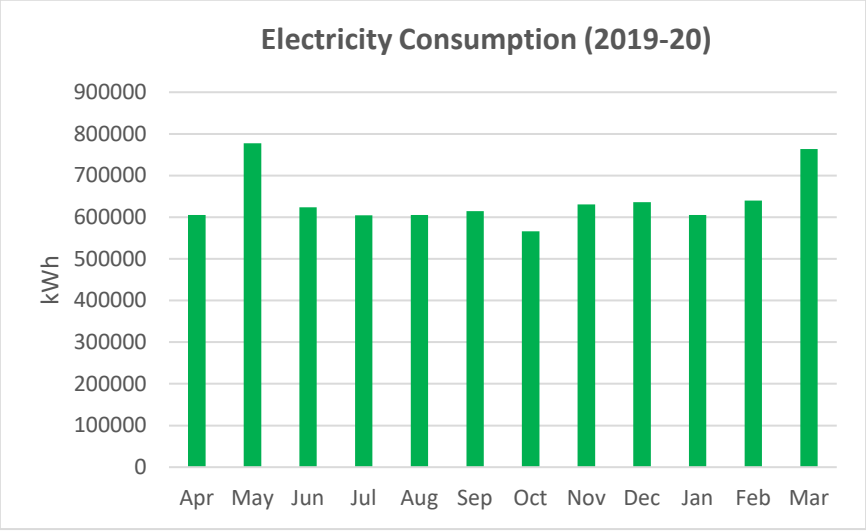
5.2. Results of performance testing

5.2.1. Electrical System

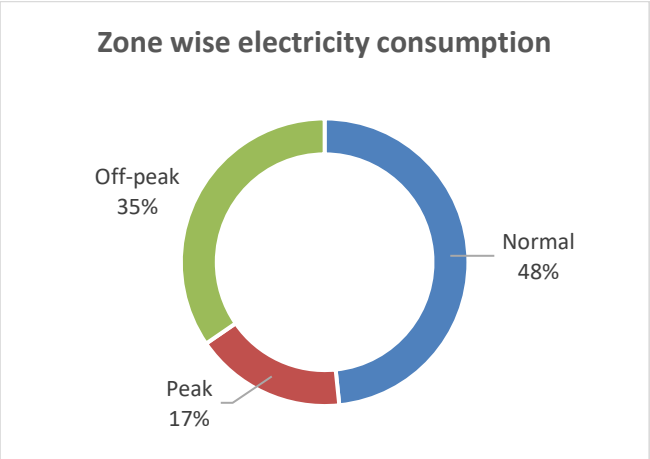
The average unit cost of electricity is **7.45 Rs/kWh**. This is taken as the basis for the financial analysis of electrical energy efficiency projects. The information on average energy consumption is taken from the historical electricity bill analysis. The electricity is fed from centralized substations. The Maximum demand observed during electricity bill analysis was 1293 kVA. 3.3kV consumed 97% of the total consumption and LT Motor consumption is 3%.

Electricity Consumption

The Electricity consumption details for the financial year 2019-20 is plotted below. The Total consumption was found to be 73.24 Lakhs Units in the year 19-20.



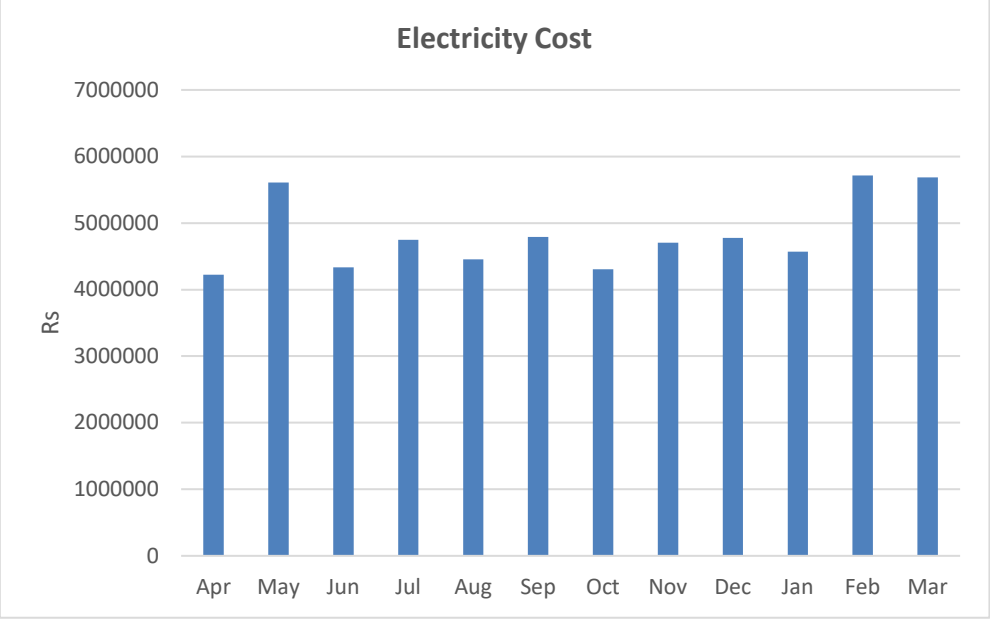
The Zone wise Energy Consumption Profile is shown below ,which shows 48% of total energy consumption in a day is at normal hours, 35% at peak hours and 17% at non peak hours.



Zone	kWh
Normal	3717540
Peak	1305460
Off-peak	2650580

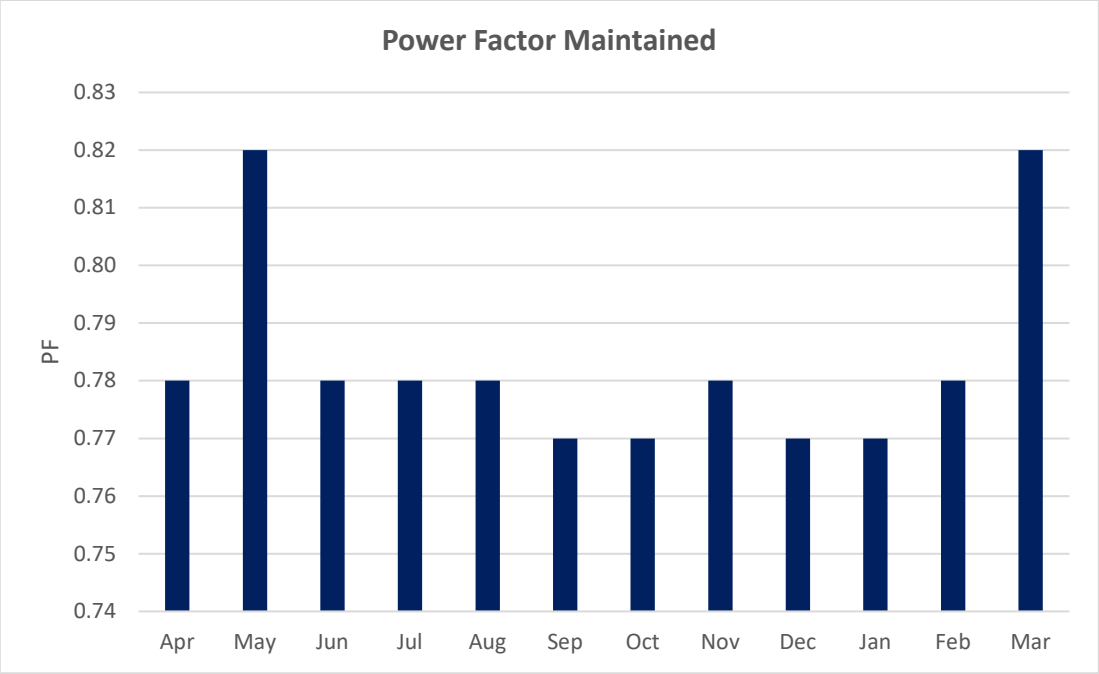
The peak load consumption can be reduced by curtailing some non essential loads like backwash, cleaning etc.

The electricity cost profile for the year 2019-20 is given below.



Power Factor

The average power factor observed is 0.78 which is very low. From load study the required capacitance rating is 605kvar for RWP-2 and PWP-2. It is strongly recommend 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 0.78(see technical supplement)

Capacitors

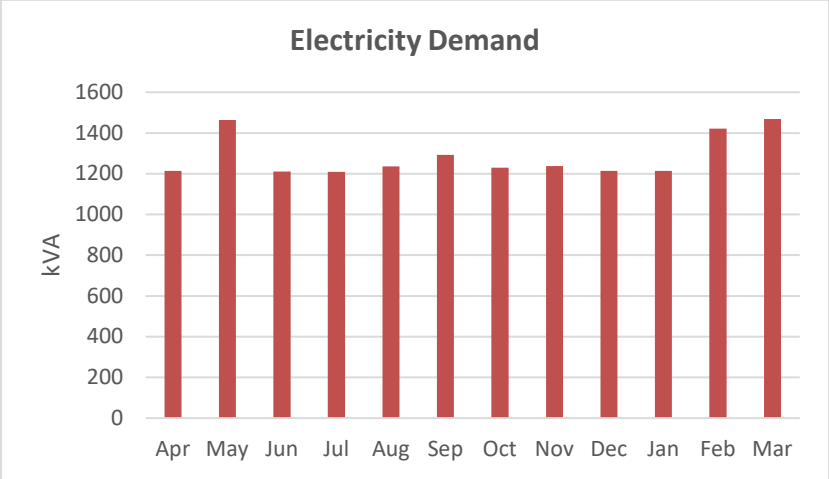
The performance study of Capacitor is given below

Sl.No		HP	Flow (m^3/hr)	Make		KW (Rated)	Head (m)	kW (Measured)	RPM	kVAR	Pf
				Pump	Motor						
1	PWP-1	576				430			960		
2	PWP-2	576	0.760	Kirloskar	Alstrom	430	40	401	960	298	0.80
3	RWP-1	576				430			960		
4	RWP-2	576	0.821			430	37	434	960	307	0.81
5	Back wash motor-1	22	0.065	Kirloskar		16.5	17.2		1500		
6	Back wash motor-2	22				16.5			1500		
7	Blower motor-1	40				30					
8	Blower motor-2	40				30					
9	Flash mixture motor -1	5				3.7					
10	Flash mixture motor -2	5				3.7					

605 kVAR is the requirement to improve the power factor to near unity at the motor side. During energy audit the power factor is very low. As per the recommendation from the auditor KWA installed capacitor banks to improve the power factor. After installing the capacitors, the power factor is improved to 0.95.

Demand Control

The facility has a contract demand of 1850kVA. As mentioned above the present average power factor of the plant is 0.75 and the average recorded maximum demand is 1293 kVA as per historical energy consumption analysis. The electricity demand variation for the financial year 2019-20 is shown below. If the power factor is bringing towards 1 then the demand can be controlled by reduction of 25%.



5.2.2. Pumps

The list of pumps are given below.

Sl.No	Pumps	HP	KW (Rated)	kW (Measured)	RPM	kVAR	Pf
1	PWP-1	576	430		960		
2	PWP-2	576	430	401	960	298	0.80
3	RWP-1	576	430		960		
4	RWP-2	576	430	434	960	307	0.81
5	Back wash motor-1	22	16.5		1500		
6	Back wash motor-2	22	16.5		1500		
7	Blower motor-1	40	30				
8	Blower motor-2	40	30				
9	Flash mixture motor -1	5	3.7				
10	Flash mixture motor -2	5	3.7				

Performance Evaluation of Pumps					
Pure Water Pump House 1 - HT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA CHOWARA	
		2	Pump ID	PWP 1	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	40
	Motors	6	Rated load of the motor	kW	430
		7	Measured load of the motor	kW	398
		8	Efficiency of standard motor	%	94
		9	Type of Motor		SRIM
		10	Motor power	kW	398.00
	Pumps	11	Make		KBL
		12	HP		447
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	79.90
		15	Combined efficiency of the system (actual)	%	39.04
		16	Volt	KV	6.6
		17	Amps	A	46
		18	rpm	rpm	960
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station (rated Flow)	mld	65.00
		23	Head	m	22
		24	Flow	m^3/s	0.720
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	155.39
		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	%	95.70
		33	% loading of pump on head	%	55.00
		34	% loading of motor	%	92.56

Performance Evaluation of Pumps					
Pure Water Pump House 1 - HT Pump 2					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA CHOWARA	
		2	Pump ID	PWPH (HT 2)	
		3	Pump Application	Pure Water	
		4	Water Quality	Good	
		5	Rated head of pump	m	40
	Motors	6	Rated load of the motor	kW	430
		7	Measured load of the motor	kW	401
		8	Efficiency of standard motor	%	94
		9	Type of Motor		SRIM
		10	Motor power	kW	401.00
	Pumps	11	Make		KBL
		12	HP		447
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	79.90
		15	Combined efficiency of the system (actual)	%	42.86
		16	Volt	KV	6.55
		17	Amps	A	44
		18	rpm	rpm	960
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	65.00
		23	Head	m	24
		24	Flow	m^3/s	0.730
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	171.87
		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	%	97.03
		33	% loading of pump on head	%	60.00
		34	% loading of motor	%	93.26

Performance Evaluation of Pumps					
Raw Water Pump House - HT Pump 1					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA CHOWARA	
		2	Pump ID	RWPH (HT 1)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	37
	Motors	6	Rated load of the motor	kW	430
		7	Measured load of the motor	kW	415
		8	Efficiency of standard motor	%	94
		9	Type of Motor		SRIM
		10	Motor power	kW	415.00
	Pumps	11	Make		KBL
		12	HP		442
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	79.90
		15	Combined efficiency of the system (actual)	%	60.42
		16	Volt	KV	6.55
		17	Amps	A	46
		18	rpm	rpm	960
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	65.00
		23	Head	m	36
		24	Flow	m^3/s	0.710
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	250.74
		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	%	94.38
		33	% loading of pump on head	%	97.30
		34	% loading of motor	%	96.51

Performance Evaluation of Pumps					
Raw Water Pump House - HT Pump 2					
Sl No			Description	Unit	Parameters
Design Details	General	1	Unit code	KWA CHOWARA	
		2	Pump ID	RWPH (HT 1)	
		3	Pump Application	Raw Water	
		4	Water Quality	Raw	
		5	Rated head of pump	m	37
	Motors	6	Rated load of the motor	kW	430
		7	Measured load of the motor	kW	435
		8	Efficiency of standard motor	%	94
		9	Type of Motor		SRIM
		10	Motor power	kW	435.00
	Pumps	11	Make		KBL
		12	HP		442
		13	Efficiency	%	85
		14	Combined efficiency of the system (rated)	%	79.90
		15	Combined efficiency of the system (actual)	%	62.56
		16	Volt	KV	6.55
		17	Amps	A	46
		18	rpm	rpm	960
	Pipe Line	19	Material		CI
		20	Size	mm	1200.00
		21	Length	m	NA
Operating Details	Output	22	Water Pumping Details of station	mld	65.00
		23	Head	m	38
		24	Flow	m^3/s	0.730
		25	Density of water	kg/m^3	1000
		26	Gravitational Constant	m/s^2	9.81
		27	Hydraulic Power	kW	272.13
		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	%	97.03
		33	% loading of pump on head	%	102.70
		34	% loading of motor	%	101.16

5.2.3. Lighting 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.

Sl. No.	Location	T12	T8	CFL	LED-B	CF	PC	Printer
1	Office	2	1			3	1	1
2	Substation	2		1	2	1		
3	Plant	26			6	6		
4	Intake Well cum PH	2		1	2	1		
Total		**32**	**1**	**2**	**10**	**11**	**1**	**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 Chowara					
Location & Code:		PWP-2			
Date & Time		11-03-2020 14:30 to 11-03-2020 14:32			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	6.55kV		Normal
		Y	6.53kV		
		B	6.51kV		
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 supplement
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	44.05	1.19	Within permissible limit at Average load during load study
		Y	44.41	1.24	
		B	43.58	1.27	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	44.05	1.40	Within permissible limit at Average load during load study
		Y	44.41	1.32	
		B	43.58	1.01	
12	Frequency	50.07			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

POWER QUALITY ANALYSIS REPORT					
KWA Chowara					
Location & Code:		RWP-2			
Date & Time		11-03-2020 14:19 to 11-03-2020 14:24			
Reference		Technical Supplement			
Sl No	Category	Summary Analysis			Remarks
1	Voltage Continuity (Input)	Good			Normal
2	RMS Voltage level	R	6.55kV		Normal
		Y	6.54kV		
		B	6.52kV		
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	0.81			Low power factor
8	Load Current (Waveform)	Sine wave			Normal
9	Load generated disturbances	Absent			Ref. Technical supplement
Harmonic Analysis		Phase	Load (A)	THD (%)	
10	THD (V) % (Permissible limits<3% as per CEA- Technical standards for connectivity to the grid-2007)	R	47.15	1.09	Within permissible limit at Average load during load study
		Y	47.06	0.97	
		B	46.38	0.93	
11	THD (I) % Permissible limits<8% as per CEA- Technical standards for connectivity to the grid-2007))	R	47.15	1.06	Within permissible limit at Average load during load study
		Y	47.06	1.27	
		B	46.38	1.27	
12	Frequency	49.9			Normal
13	Reliability of electricity supply	Good			Normal
14	Earthing	Good			Normal

6

Energy efficiency in utility and process system

Specific Energy Consumption (SEC)

OTTOTRACTIONS- ENERGY AUDIT		
Energy Performance Index		
1	Total Production in (MLD)	63
2	Actual annual production M^3	22995000
3	Annual Electricity Consumption (kWh)	7673580
4	**Specific Energy Consumption kWh/m^3**	**0.33**

The Energy Performance Index (EPI)

0.33 kWh/m^3 or 3.03 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, CHOWARA

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.

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 605 kVAR, which may cost around 3 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 583.01	
Energy Saving in Lighting by replacing existing 32 No's T12 Lamps to 18W LED Tube	
Existing Scenario	
32 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)	5400
No of fittings	32
Total load (kW)	1.76
Annual Energy Consumption (kWh)	7603
Expected Annual Energy saving for replacing all fittings (kWh)	4182
Cost of Power	7.45
Annual saving in Lakhs Rs (1st year)	0.31
Investment required for complete replacements [@Rs 350 per fittings](Lakhs Rs)	0.11
Simple Pay Back (in Months)	4.31

OTTOTRACTIONS-ENERGY AUDIT	
Energy Saving Proposal Code 583.02	
Energy saving by replacing the existing 22HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Backwash	
Existing scenario	
2 No's 22HP motors are used for back wash .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 by 15%. 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)	2920
No of motors to be replaced.	2
Total load (kW)	32.8
Existing efficiency of the motors (%)	77
Proposed efficiency of the motors (%)	92
Annual Energy consumption (kWh) (@60% avg util	57508
Expected annual energy saving (kWh)	9376
Cost of Power	7.45
Annual saving in Lakhs Rs (1st year)	0.70
Investment required (Lakhs Rs)[@15450 Rs/kW]	5.07
Simple Pay Back (in Months)	87.12

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure						
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	430	258
		3	Efficiency of standard motor	%	94	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	398.00	172.20
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	79.9	90
		8	Combined efficiency of the system (measured)	%	39	90
		9	**Head**	**m**	**22**	**22**
		10	**Flow**	**m^3/s**	**0.720**	**0.720**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**155.39**	**155.39**
	Input	14	Total Electrical Power drawn	kW	398.00	172.20
		15	Unit Cost	Rs./kWh	7.45	7.45
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	3486480	1508472
		18	Annual power Savings, kWh	kWh		1978008
		19	Annual Savings	Rs. In Lakhs		**147.36**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**258.30**
		22	Investment	Rs. In Lakhs		**52.95**
		23	Simple Payback period	**Months**		**4.31**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure						
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	430	286
		3	Efficiency of standard motor	%	94	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	401.00	190.40
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	79.9	90
		8	Combined efficiency of the system (measured)	%	43	90
		9	**Head**	**m**	**24**	**24**
		10	**Flow**	**m^3/s**	**0.730**	**0.730**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**171.87**	**171.87**
	Input	14	Total Electrical Power drawn	kW	401.00	190.40
		15	Unit Cost	Rs./kWh	7.45	7.45
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	3512760	1667904
		18	Annual power Savings, kWh	kWh		1844856
		19	Annual Savings	Rs. In Lakhs		**137.44**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**285.60**
		22	Investment	Rs. In Lakhs		**58.55**
		23	Simple Payback period	**Months**		**5.11**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw						
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	430	417
		3	Efficiency of standard motor	%	94	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	415.00	277.80
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	79.9	90
		8	Combined efficiency of the system (measured)	%	60	90
		9	**Head**	**m**	**36**	**36**
		10	**Flow**	**m^3/s**	**0.710**	**0.710**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**250.74**	**250.74**
	Input	14	Total Electrical Power drawn	kW	415.00	277.80
		15	Unit Cost	Rs./kWh	7.45	7.45
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	3635400	2433528
		18	Annual power Savings, kWh	kWh		1201872
		19	Annual Savings	Rs. In Lakhs		**89.54**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**416.70**
		22	Investment	Rs. In Lakhs		**85.42**
		23	Simple Payback period	**Months**		**11.45**

Energy Saving Calculation						
Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw						
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	430	452
		3	Efficiency of standard motor	%	94	95
		4	Type of Motor		Standard	IE2
		5	Motor power	kW	435.00	301.50
		6	Efficiency	%	85	95
		7	Combined efficiency of the system (rated)	%	79.9	90
		8	Combined efficiency of the system (measured)	%	63	90
		9	**Head**	**m**	**38**	**38**
		10	**Flow**	**m^3/s**	**0.730**	**0.730**
		11	**Density of water**	**kg/m^3**	**1000**	**1000**
		12	**Gravitational Constant**	**m/s^2**	**9.81**	**9.81**
		13	**Hydraulic Power**	**kW**	**272.13**	**272.13**
	Input	14	Total Electrical Power drawn	kW	435.00	301.50
		15	Unit Cost	Rs./kWh	7.45	7.45
		16	Annual operating Hours	Hours	8760	8760
		17	Annual energy consumption	kWh/year	3810600	2641140
		18	Annual power Savings, kWh	kWh		1169460
		19	Annual Savings	Rs. In Lakhs		**87.12**
		20	Investment for Pumps (as per KWA guideline @15525 per hp)	Rs/kW		20500
		21	Proposed pump load	kW		**452.25**
		22	Investment	Rs. In Lakhs		**92.71**
		23	Simple Payback period	**Months**		**12.77**

OTTOTRACTIONS- ENERGY AUDIT						
KWA CHOWARA						
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 32 No's T12 Lamps to 18W LED Tube	4182	4.18	10	3.05	30.53
2	Energy saving by replacing the existing 22HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Backwash	9376	9.38	10	6.84	68.45
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump HT 1	1978008	1978.01	10	1443.95	14439.46
4	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump HT 2	1844856	1844.86	10	1346.74	13467.45
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw Water Pump HT 1	1201872	1201.87	10	877.37	8773.67
6	Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw Water Pump HT 2	1169460	1169.46	10	853.71	8537.06
Total		6207754.01	6207.75		4531.66	45316.60

OTTOTRACTIONS- ENERGY AUDIT			
Implementation Schedule- Medium Term			
KWA CHOWARA			
Sl No	Projects	SPB	Implementation Schedule
1	Energy Saving in Lighting by replacing existing 32 No's T12 Lamps to 18W LED Tube	4.31	Medium Term
2	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump HT 1	4.31	Medium Term
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Pure Water Pump HT 2	5.11	Medium Term
3	Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw Water Pump HT 1	11.45	Medium Term
5	Energy Efficiency in Existing Pumping system by replacing inefficient motor Raw Water Pump HT 2	12.77	Medium Term
OTTOTRACTIONS- ENERGY AUDIT			
Implementation Schedule- Long Term			
1	Energy saving by replacing the existing 22HP standard efficiency motors with energy efficient IE3 (or higher rated) motor in Backwash	87.12	Long term

9

Technical Supplement

Electricity Bill Details (2019-20)												
Month	Name of the Consumer				KERALA WATER AUTHORITY,CHOWARA							
	Contract demnad		1850		Consumer number & Section			1355700004051				
	Tariff		HT I (A) INDUSTRIAL					Chowara				
	kWh				kVA			PF		PF	` (Total)	`/ kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3		Incentive	Penalty		
Apr	295900	102620	207020	605540	1208	1203	1214	0.78	0.00	399656	4222218	**6.97**
May												
Jun	307960	102440	213300	623700	1215	1227	1211	0.78	0.00	411642	4336354	**6.95**
Jul	290140	106300	208340	604780	1200	1193	1209	0.78	0.00	399154	4749523	**7.85**
Aug	286540	104000	215120	605660	1197	1195	1236	0.78	0.00	476668	4453584	**7.35**
Sep	299680	107100	207860	614640	1198	1182	1293	0.77	0.00	547797	4791522	**7.80**
Oct	268560	95740	202020	566320	1196	1208	1229	0.77	0.00	504732	4303782	**7.60**
Nov	310760	105640	214480	630880	1209	1208	1238	0.78	0.00	525996	4704336	**7.46**
Dec	309580	107980	218460	636020	1203	1188	1214	0.77	0.00	566852	4775390	**7.51**
Jan	288100	105000	212600	605700	1207	1198	1214	0.77	0.00	539830	4570237	**7.55**
Feb												
Mar												

KWA 63MLD LOG BOOK OF PWPH AT HEAD WORKS				
Voltage	Water Level	Starting time and motor number	Residual chonine	Pump pressure
6.6	1.50	1	2.0	3.7
6.6	1.25	1	2.0	3.5
6.6	1.10	1	2.0	3.5
6.6	1.25	1 (9.45)	2.0	3.6
6.6	2.60	1	2.0	3.6
6.6	2.50	1	2.0	3.6

KWA 63MLD LOG BOOK OF RWPH AT HEAD WORKS				
Water Level	Voltage	Starting time and motor number	A	Pump pressure
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.75	6.6	3	46	2.2
9.7	6.6	3	46	2.2
9.7	6.6	3	46	2.2
9.65	6.6	3	46	2.2
9.65	6.6	3	46	2.2
9.6	6.6	3	46	2.2
9.6	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2
9.5	6.6	3	46	2.2

KWA 63MLD LOG BOOK OF RWPH AT HEAD WORKS				
Water Level	Voltage	Starting time and motor number	A	Pump pressure
9.50	6.6	3	46	2.2
9.50	6.6	3	46	2.2
9.50	6.6	3	46	2.2
9.50	6.6	3	46	2.2
9.50	6.6	3	46	2.2
9.50	6.6	3	46	2.2
9.50	6.6	3	46	2.2
9.45	6.6	3	46	2.2
9.45	6.6	3	46	2.2
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.45	6.6	4	46	2.4
9.40	6.6	4	46	2.4
9.40	6.6	4	46	2.4
9.40	6.6	4	46	2.4
9.40	6.6	4	46	2.4
9.40	6.6	4	46	2.4
9.40	6.6	4	46	2.4
9.40	6.6	4	46	2.4

Date	time	Raw water	Filtered water from Bod	Delivery line
09-12-2019	9:00 AM	2.5	0.8	0.9
10-12-2019	9:00 AM	2.1	0	0
11-12-2019	8:15 AM	2.0	0	0
12-12-2019	12:05 PM	2.8	0	0.2
13-12-2019	11:15 AM	2.4	0.6	0.8
14-12-2019	9:00 AM	2.6	0.8	0.4
15-12-2019	10:00 AM	2.2	0.6	0.4
16-12-2019	8.30 AM	4.3	0	0.8
17-12-2019	8.45 AM	5.6	0	0.7
18-12-2019	8.20 AM	6.8	0	0.5
19-12-2019	8:00 AM	5.1	0	0.1
20-12-2019	10.00 AM	2.6	0.8	1
21-12-2019	8.20 AM	3.2	0	0.1
22-12-2019	10:00 AM	3.6	0	0.4
23-12-2019	12.10 AM	3.8	0	0.8
24-12-2019	10.00 AM	2.8	0.2	1
25-12-2019	8.15 AM	5.2	0	0.2
26-12-2019	8.15 AM	3.3	0	0.1
27-12-2019	8.45 AM	2.4	0.1	1
28-12-2019	8.15 AM	5.1	0.1	0.3
29-12-2019	10:00 AM	4.1	0.1	0.4
30-12-2019	11.15 AM	4.8	0.4	0.9
31-12-2019	9.00 AM	3.1	1	2
01-01-2020	8.15 AM	2.7	0.1	0.3
02-01-2020	8.50 AM	3.3	0.6	1
03-01-2020	8.45 AM	2.2	0	0.1
04-01-2020	8.20 AM	2.3	0	0.1
05-01-2020	10:00 AM	2.4	0.3	0.2
06-01-2020	9:00 AM	2.7	0.4	1.5
07-01-2020	9:00 AM	2.4	0	0.2
08-01-2020	9:00 AM	2.6	0.2	1
09-01-2020	9.30 AM	2.9	0.1	0.9
10-01-2020	10.30 AM	2.2	0.5	0.7
11-01-2020	8.10 AM	2.2	0.2	0.4
12-01-2020	10:00 AM	2.3	0.2	0.3
13-01-2020	9.30 AM	4.3	0.9	1.2
14-01-2020	9.30 AM	3.2	0.6	0.8
15-01-2020	8.50 AM	2.7	0.7	1
16-01-2020	9:00 AM	2.9	0.4	1
17-01-2020	9:00 AM	3.3	1.2	1
18-01-2020	8.10 AM	2.5	0.1	0.3
19-01-2020	10:00 AM	2.8	0.2	0.7
20-01-2020	9.30 AM	3.2	0.8	1.5
21-01-2020	9:00 AM	3.8	1.2	2.1

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Aluva
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-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		6554	6544	6525	44.04	44.46	43.51	401	133	137	130	297	101
Maximum value in the period		6563	6553	6534	44.13	44.54	43.61	401	134	138	130	298	102
Time of maximum value		11-03-2020 14:30:09	11-03-2020 14:30:13	11-03-2020 14:30:13	11-03-2020 14:32:05	11-03-2020 14:30:11	11-03-2020 14:31:14	11-03-2020 14:30:09	11-03-2020 14:32:05	11-03-2020 14:30:55	11-03-2020 14:30:09	11-03-2020 14:30:09	11-03-2020 14:30:11
Minimum value in the period		6546	6536	6518	43.95	44.36	43.43	400	133	137	130	295	101
Time of minimum value		11-03-2020 14:30:36	11-03-2020 14:30:36	11-03-2020 14:30:36	11-03-2020 14:31:34	11-03-2020 14:31:15	11-03-2020 14:30:51	11-03-2020 14:30:15	11-03-2020 14:30:09	11-03-2020 14:30:09	11-03-2020 14:30:09	11-03-2020 14:31:38	11-03-2020 14:30:09
11-03-2020	14:30:08												
	14:30:09	6563	6552	6533	44.01	44.53	43.49	401	133	137	130	298	101
	14:30:10	6562	6550	6532	44.02	44.52	43.45	401	133	137	130	298	101
	14:30:11	6562	6549	6532	44.03	44.54	43.46	401	133	137	130	298	102
	14:30:12	6562	6550	6532	44.04	44.53	43.47	401	133	137	130	298	102
	14:30:13	6563	6553	6534	44.01	44.48	43.49	401	133	137	130	298	101
	14:30:14	6563	6552	6534	44.03	44.50	43.51	401	133	137	130	298	101
	14:30:15	6562	6552	6534	44.02	44.45	43.49	400	133	137	130	298	101
	14:30:16	6562	6553	6533	44.04	44.48	43.53	401	133	137	130	298	101
	14:30:17	6562	6551	6533	43.99	44.45	43.47	400	133	137	130	297	101
	14:30:18	6558	6548	6528	44.03	44.52	43.52	401	133	137	130	298	101
	14:30:19	6558	6547	6529	44.00	44.47	43.48	401	133	137	130	297	101
	14:30:20	6561	6548	6530	44.08	44.54	43.48	401	133	137	130	298	102
	14:30:21	6558	6546	6529	44.05	44.46	43.46	401	133	137	130	297	101
	14:30:22	6556	6545	6527	44.08	44.48	43.50	401	133	137	130	297	101
	14:30:23	6555	6544	6526	44.04	44.48	43.48	400	133	137	130	297	101
	14:30:24	6555	6544	6524	44.00	44.51	43.51	400	133	137	130	297	101
	14:30:25	6554	6543	6524	44.00	44.49	43.48	400	133	137	130	297	101
	14:30:26	6555	6543	6525	44.02	44.52	43.48	400	133	137	130	297	101
	14:30:27	6554	6543	6524	44.02	44.49	43.49	400	133	137	130	297	101
	14:30:28	6552	6543	6523	44.00	44.47	43.52	400	133	137	130	297	101
	14:30:29	6553	6543	6523	44.00	44.49	43.54	400	133	137	130	297	101
	14:30:30	6552	6543	6524	43.98	44.46	43.53	400	133	137	130	297	101
	14:30:31	6550	6541	6522	44.01	44.45	43.55	400	133	137	130	297	101
	14:30:32	6551	6541	6522	43.98	44.44	43.52	400	133	137	130	296	101
	14:30:33	6550	6541	6522	44.07	44.47	43.56	400	133	137	130	297	101
	14:30:34	6551	6542	6524	44.02	44.40	43.51	400	133	137	130	297	101
	14:30:35	6550	6542	6523	44.04	44.43	43.56	400	133	137	130	297	101
	14:30:36	6546	6536	6518	44.04	44.45	43.53	400	133	137	130	296	101
	14:30:37	6547	6537	6519	44.05	44.47	43.53	400	133	137	130	297	101
	14:30:38	6550	6541	6521	44.01	44.47	43.51	400	133	137	130	297	101
	14:30:39	6551	6541	6522	44.02	44.50	43.51	400	133	137	130	297	101
	14:30:40	6550	6539	6520	44.00	44.49	43.48	400	133	137	130	296	101
	14:30:41	6549	6537	6519	44.04	44.52	43.49	400	133	137	130	297	101
	14:30:42	6551	6538	6521	44.07	44.51	43.46	400	133	137	130	297	101
	14:30:43	6550	6539	6522	44.06	44.45	43.46	400	133	137	130	296	101
	14:30:44	6551	6540	6522	44.08	44.46	43.50	400	133	137	130	297	101
	14:30:45	6550	6540	6523	44.08	44.43	43.48	400	133	137	130	296	101
	14:30:46	6552	6542	6525	44.10	44.44	43.52	400	133	137	130	297	101
	14:30:47	6554	6543	6525	44.04	44.44	43.46	401	133	137	130	296	101
	14:30:48	6552	6541	6523	44.09	44.48	43.51	401	133	137	130	297	101
	14:30:49	6552	6541	6523	44.05	44.44	43.46	401	133	137	130	296	101

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Aluva		
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-2		

Date	Time	Q2[kvar]	Q3[kvar]	S[kVA]	S1[kVA]
Average value in the period		99	97	499	167
Maximum value in the period		100	97	499	168
Time of maximum value		11-03-2020 14:30:09	11-03-2020 14:30:09	11-03-2020 14:30:09	11-03-2020 14:30:20
Minimum value in the period		98	96	498	167
Time of minimum value		11-03-2020 14:30:51	11-03-2020 14:30:40	11-03-2020 14:30:25	11-03-2020 14:30:09
11-03-2020	14:30:08				
	14:30:09	100	97	499	167
	14:30:10	100	97	499	167
	14:30:11	100	97	499	167
	14:30:12	100	97	499	167
	14:30:13	100	97	499	167
	14:30:14	100	97	499	167
	14:30:15	100	97	499	167
	14:30:16	100	97	499	167
	14:30:17	99	97	499	167
	14:30:18	100	97	499	167
	14:30:19	99	97	499	167
	14:30:20	99	97	499	168
	14:30:21	99	97	499	167
	14:30:22	99	97	499	167
	14:30:23	99	97	499	167
	14:30:24	99	97	499	167
	14:30:25	99	97	498	167
	14:30:26	99	97	499	167
	14:30:27	99	97	498	167
	14:30:28	99	97	498	167
	14:30:29	99	97	499	167
	14:30:30	99	97	498	167
	14:30:31	99	97	498	167
	14:30:32	99	97	498	167
	14:30:33	99	97	499	167
	14:30:34	99	97	498	167
	14:30:35	99	97	498	167
	14:30:36	99	97	498	167
	14:30:37	99	97	498	167
	14:30:38	99	97	498	167
	14:30:39	99	97	498	167
	14:30:40	99	96	498	167
	14:30:41	99	96	498	167
	14:30:42	99	97	498	167
	14:30:43	99	97	498	167
	14:30:44	99	97	498	167
	14:30:45	99	97	498	167
	14:30:46	99	97	499	167
	14:30:47	99	97	498	167
	14:30:48	99	97	499	167
	14:30:49	99	97	498	167

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

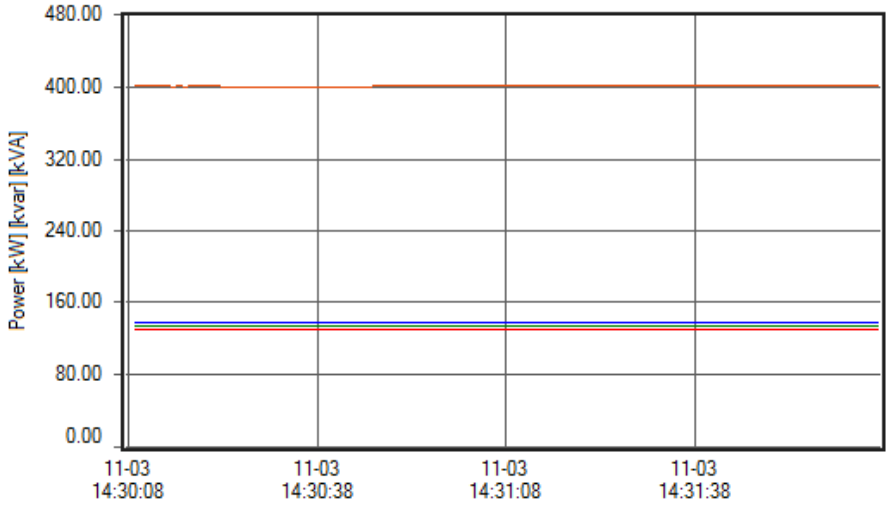
Title	KWA Aluva
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-2

Date	Time	S2[kVA]	S3[kVA]	PF	PF1	PF2	PF3	WP+[kWh]	Pdem+[kW]
Average value in the period		169	162	0.8038	0.7966	0.8120	0.8024		401
Maximum value in the period		170	163	0.8051	0.7980	0.8146	0.8034		401
Time of maximum value		11-03-2020 14:30:09	11-03-2020 14:31:14	11-03-2020 14:32:04	11-03-2020 14:31:15	11-03-2020 14:32:06	11-03-2020 14:31:02		11-03-2020 14:30:09
Minimum value in the period		169	162	0.8021	0.7950	0.8086	0.8012		400
Time of minimum value		11-03-2020 14:30:15	11-03-2020 14:30:09	11-03-2020 14:30:14	11-03-2020 14:30:11	11-03-2020 14:30:14	11-03-2020 14:31:14		11-03-2020 14:30:15
11-03-2020	14:30:08								
	14:30:09	170	162	0.8025	0.7952	0.8094	0.8026	0.1	401
	14:30:10	170	162	0.8026	0.7952	0.8094	0.8028	0.2	401
	14:30:11	170	162	0.8025	0.7950	0.8091	0.8030	0.3	401
	14:30:12	170	162	0.8023	0.7951	0.8087	0.8027	0.4	401
	14:30:13	170	162	0.8025	0.7957	0.8088	0.8026	0.6	401
	14:30:14	170	162	0.8021	0.7952	0.8086	0.8022	0.7	401
	14:30:15	169	162	0.8026	0.7958	0.8093	0.8023	0.8	400
	14:30:16	170	162	0.8022	0.7955	0.8088	0.8019	0.9	401
	14:30:17	169	162	0.8029	0.7959	0.8098	0.8026	1.0	400
	14:30:18	170	162	0.8027	0.7956	0.8095	0.8026	1.1	401
	14:30:19	169	162	0.8033	0.7962	0.8103	0.8029	1.2	401
	14:30:20	170	162	0.8025	0.7950	0.8100	0.8022	1.3	401
	14:30:21	169	162	0.8034	0.7962	0.8109	0.8027	1.4	401
	14:30:22	169	162	0.8029	0.7959	0.8104	0.8021	1.6	401
	14:30:23	169	162	0.8033	0.7961	0.8106	0.8028	1.7	400
	14:30:24	169	162	0.8030	0.7959	0.8098	0.8030	1.8	400
	14:30:25	169	162	0.8032	0.7961	0.8103	0.8030	1.9	400
	14:30:26	169	162	0.8031	0.7957	0.8103	0.8029	2.0	400
	14:30:27	169	162	0.8032	0.7961	0.8102	0.8028	2.1	400
	14:30:28	169	162	0.8034	0.7967	0.8101	0.8030	2.2	400
	14:30:29	169	162	0.8029	0.7962	0.8094	0.8027	2.3	400
	14:30:30	169	162	0.8034	0.7969	0.8099	0.8031	2.4	400
	14:30:31	169	162	0.8030	0.7966	0.8097	0.8024	2.6	400
	14:30:32	169	162	0.8035	0.7970	0.8102	0.8030	2.7	400
	14:30:33	169	162	0.8031	0.7965	0.8102	0.8021	2.8	400
	14:30:34	169	162	0.8035	0.7971	0.8106	0.8024	2.9	400
	14:30:35	169	162	0.8033	0.7969	0.8103	0.8022	3.0	400
	14:30:36	169	162	0.8039	0.7973	0.8111	0.8029	3.1	400
	14:30:37	169	162	0.8033	0.7966	0.8105	0.8025	3.2	400
	14:30:38	169	162	0.8035	0.7966	0.8106	0.8029	3.3	400
	14:30:39	169	162	0.8033	0.7962	0.8103	0.8028	3.4	400
	14:30:40	169	162	0.8035	0.7963	0.8107	0.8032	3.6	400
	14:30:41	169	162	0.8036	0.7962	0.8109	0.8032	3.7	400
	14:30:42	169	162	0.8033	0.7957	0.8112	0.8026	3.8	400
	14:30:43	169	162	0.8038	0.7964	0.8119	0.8026	3.9	400
	14:30:44	169	162	0.8034	0.7963	0.8115	0.8019	4.0	400
	14:30:45	169	162	0.8039	0.7968	0.8121	0.8024	4.1	400
	14:30:46	169	162	0.8032	0.7963	0.8113	0.8015	4.2	400
	14:30:47	169	162	0.8038	0.7965	0.8120	0.8026	4.3	401
	14:30:48	169	162	0.8034	0.7962	0.8114	0.8022	4.4	401
	14:30:49	169	162	0.8040	0.7967	0.8121	0.8028	4.6	401

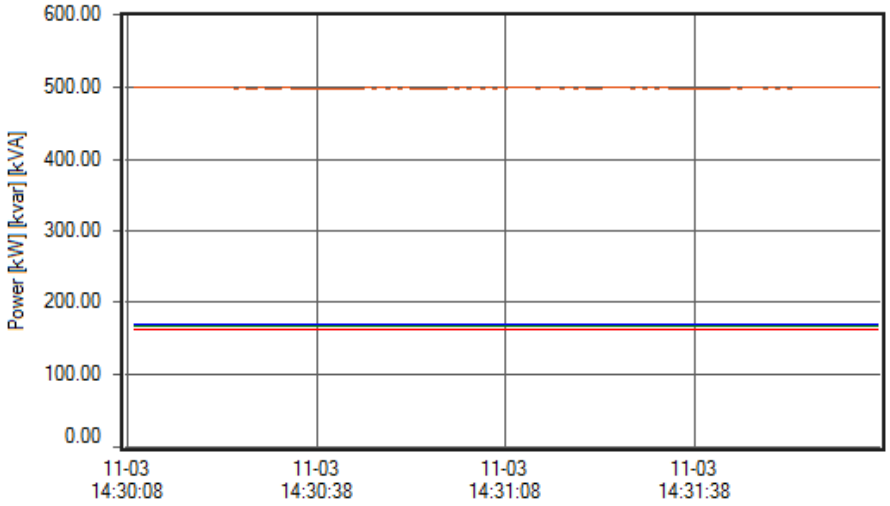
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

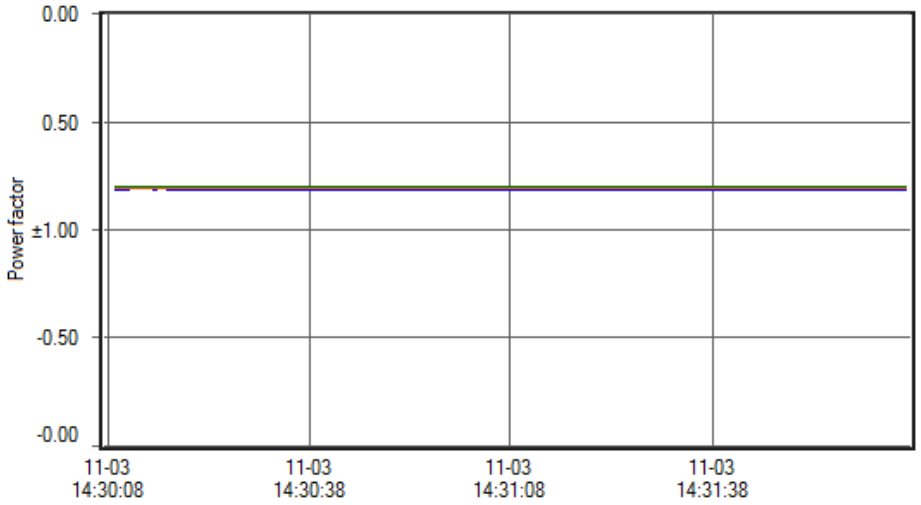
Title	KWA Aluva		
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-2		



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



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

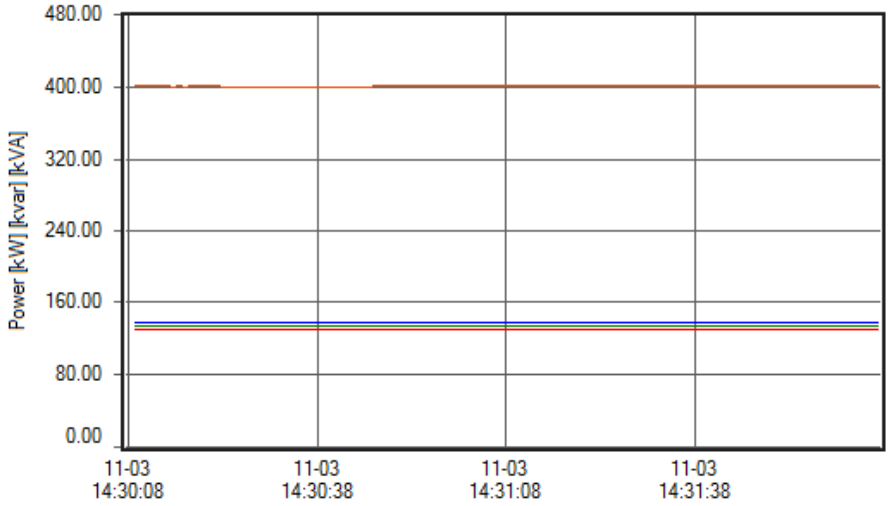


Left axis
PF PF1 PF2 PF3

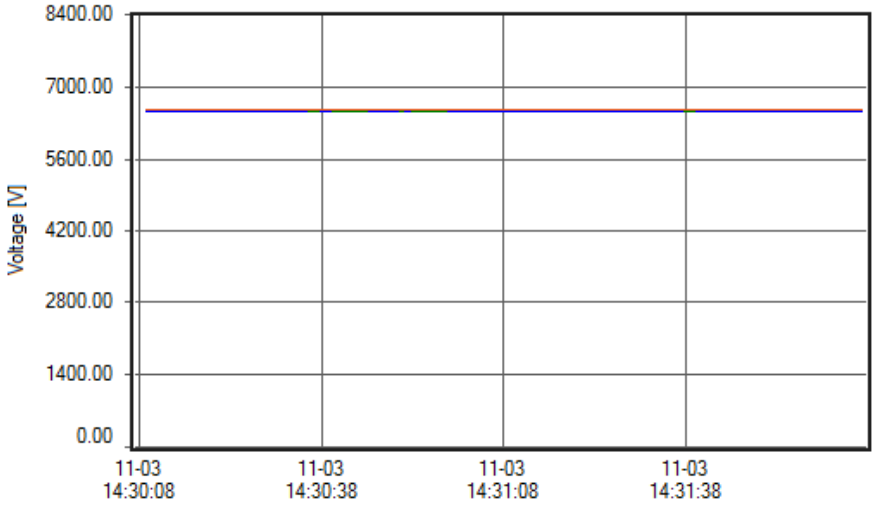
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

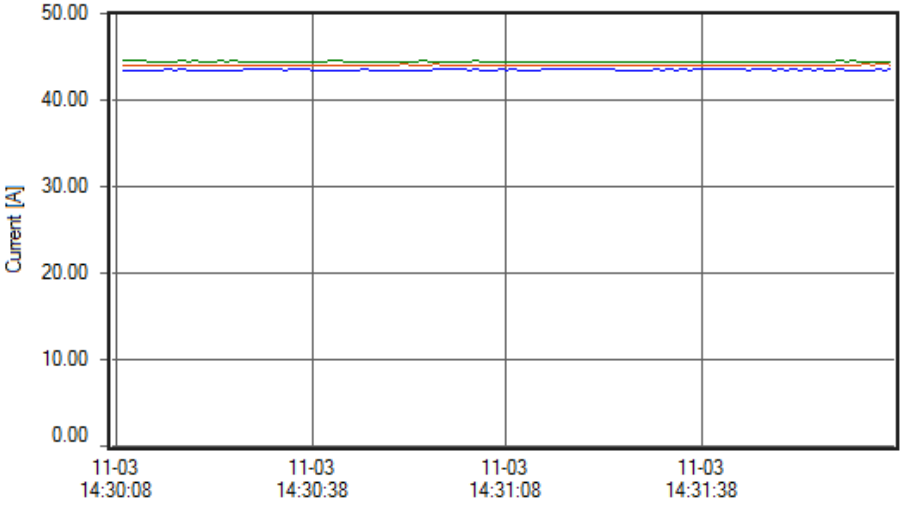
Title	KWA Aluva		
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-2		



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



Left axis
U1[V] U2[V] U3[V]

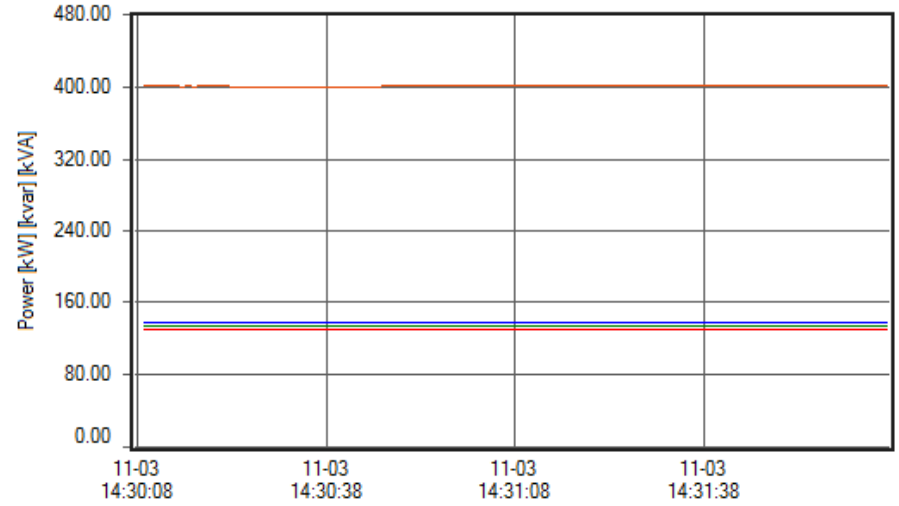


Left axis
I1[A] I2[A] I3[A]

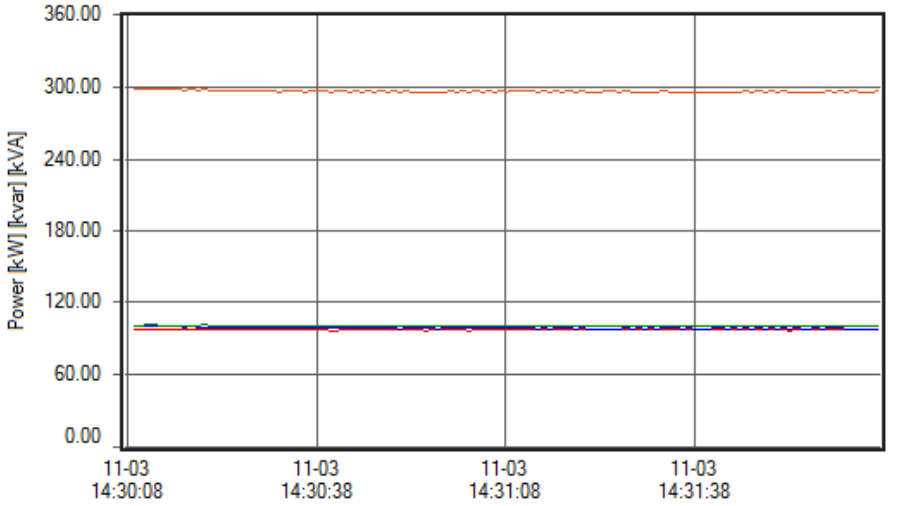
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

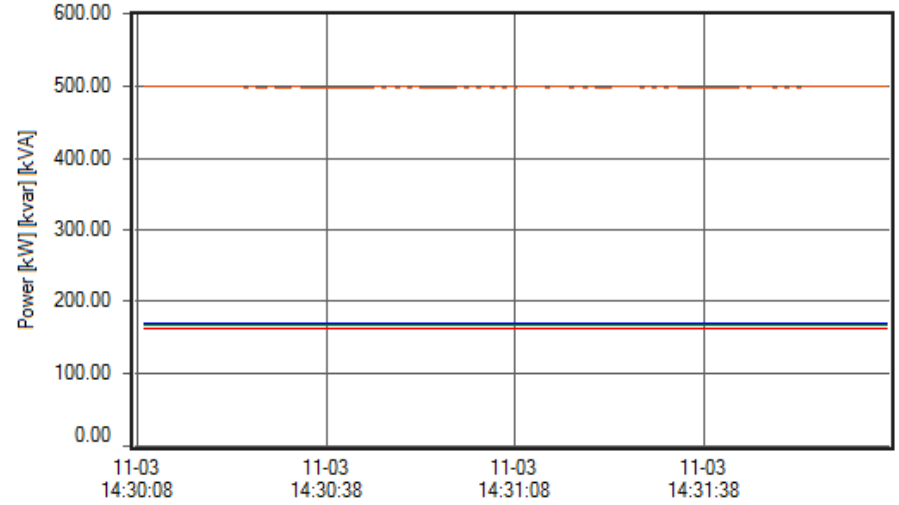
Title	KWA Aluva		
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-2		



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



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

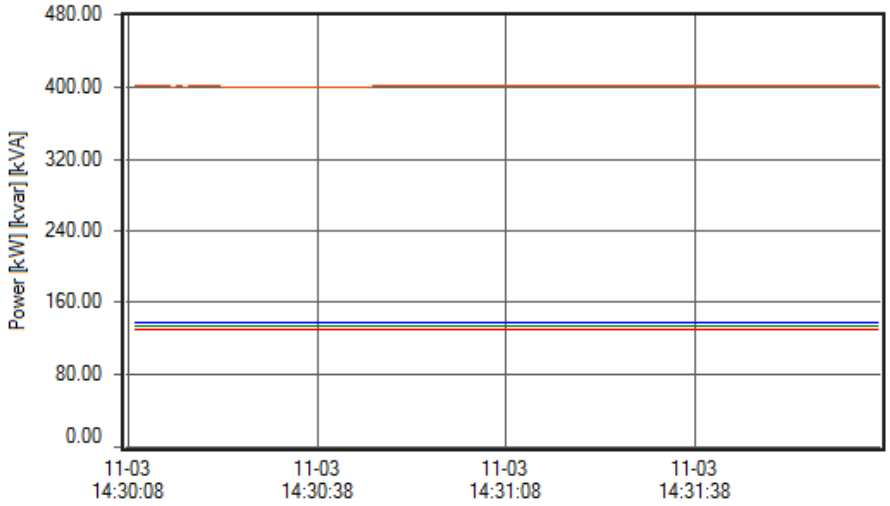


Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

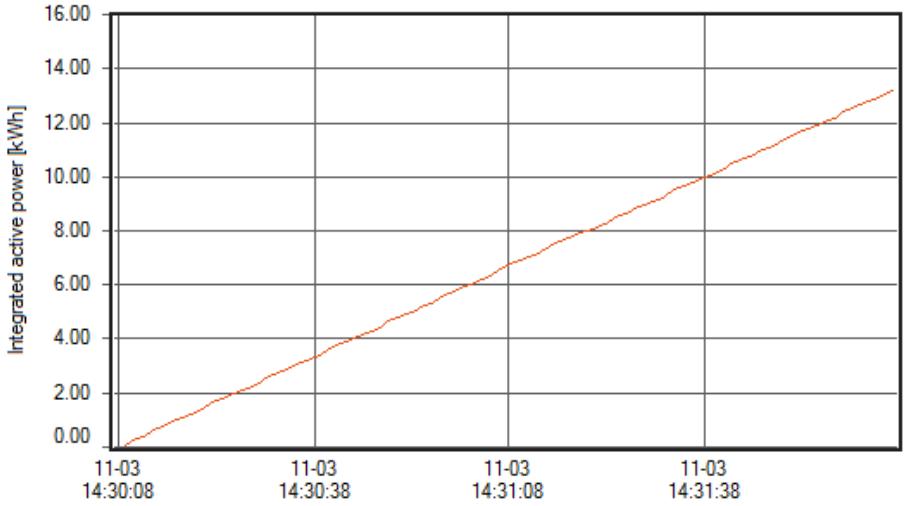
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

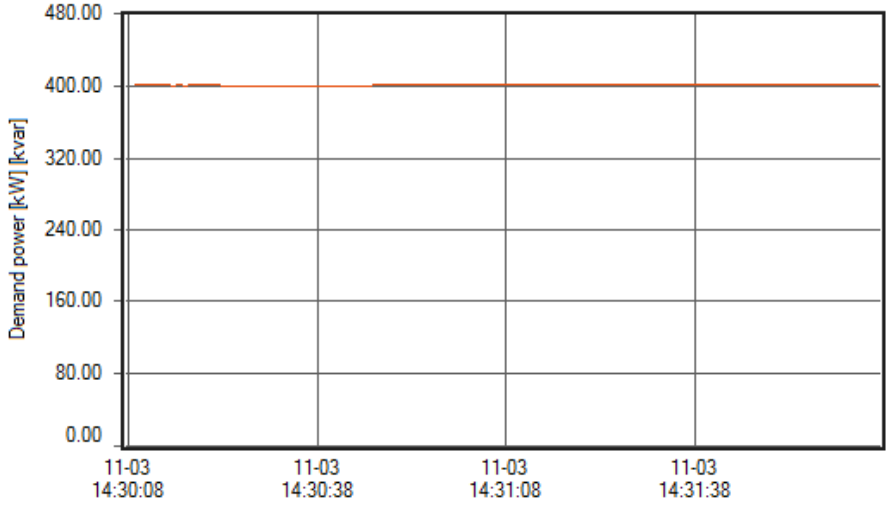
Title	KWA Aluva
Measurement period	11-03-2020 14:30:08 - 11-03-2020 14:32:07
Display period	11-03-2020 14:30:08 - 11-03-2020 14:32:07
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 PWP-2



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



Left axis
WP+[kWh]



Left axis
Pdem+[kW]

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Aluva
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-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		6551	6542	6521	47.09	46.97	46.28	434	146	145	143	304	102
Maximum value in the period		6595	6586	6564	47.29	47.16	46.50	435	146	146	144	307	103
Time of maximum value		11-03-2020 14:20:25	11-03-2020 14:20:20	11-03-2020 14:20:20	11-03-2020 14:22:49	11-03-2020 14:24:37	11-03-2020 14:24:39	11-03-2020 14:20:34	11-03-2020 14:19:53	11-03-2020 14:20:01	11-03-2020 14:20:59	11-03-2020 14:19:53	11-03-2020 14:19:53
Minimum value in the period		6526	6518	6499	46.85	46.75	46.06	433	145	145	143	302	101
Time of minimum value		11-03-2020 14:23:49	11-03-2020 14:23:31	11-03-2020 14:23:48	11-03-2020 14:19:55	11-03-2020 14:20:13	11-03-2020 14:20:25	11-03-2020 14:19:55	11-03-2020 14:19:54	11-03-2020 14:19:53	11-03-2020 14:19:53	11-03-2020 14:22:43	11-03-2020 14:24:07
11-03-2020	14:19:52												
	14:19:53	6589	6580	6558	46.97	46.84	46.11	434	146	145	143	307	103
	14:19:54	6587	6578	6556	46.96	46.88	46.13	434	145	145	143	306	103
	14:19:55	6585	6577	6554	46.85	46.87	46.10	433	145	145	143	306	103
	14:19:56	6585	6576	6554	46.90	46.88	46.15	434	145	145	143	306	103
	14:19:57	6586	6577	6556	46.92	46.85	46.12	434	145	145	143	306	103
	14:19:58	6588	6578	6556	46.91	46.90	46.11	434	145	145	143	307	103
	14:19:59	6589	6579	6556	46.86	46.90	46.07	434	145	145	143	306	103
	14:20:00	6590	6580	6557	46.87	46.90	46.09	433	145	145	143	307	103
	14:20:01	6591	6581	6558	46.91	46.95	46.18	434	145	146	143	307	103
	14:20:02	6591	6583	6559	46.86	46.88	46.15	434	145	145	143	307	103
	14:20:03	6588	6581	6558	46.90	46.87	46.15	434	145	145	143	307	103
	14:20:04	6589	6580	6558	46.89	46.84	46.12	434	145	145	143	306	103
	14:20:05	6588	6580	6558	46.94	46.88	46.16	434	145	145	143	307	103
	14:20:06	6592	6584	6562	46.86	46.80	46.07	433	145	145	143	306	103
	14:20:07	6592	6583	6562	46.88	46.80	46.11	433	145	145	143	307	103
	14:20:08	6591	6583	6561	46.86	46.79	46.08	433	145	145	143	306	103
	14:20:09	6591	6582	6561	46.88	46.80	46.09	433	145	145	143	307	103
	14:20:10	6591	6583	6562	46.94	46.82	46.14	434	145	145	143	307	103
	14:20:11	6592	6585	6563	46.93	46.80	46.14	434	146	145	143	307	103
	14:20:12	6591	6583	6563	46.96	46.80	46.11	434	146	145	143	307	103
	14:20:13	6591	6584	6563	46.89	46.75	46.11	434	145	145	143	306	103
	14:20:14	6588	6581	6559	46.91	46.85	46.18	434	145	145	143	307	103
	14:20:15	6589	6580	6559	46.94	46.85	46.15	434	146	145	143	306	103
	14:20:16	6589	6581	6559	46.89	46.83	46.10	433	145	145	143	307	103
	14:20:17	6589	6580	6559	46.95	46.87	46.12	434	146	145	143	306	103
	14:20:18	6589	6580	6559	46.90	46.83	46.09	434	145	145	143	306	103
	14:20:19	6592	6583	6562	46.92	46.85	46.13	434	145	145	143	307	103
	14:20:20	6594	6586	6564	46.87	46.84	46.11	434	145	145	143	307	103
	14:20:21	6593	6585	6563	46.91	46.85	46.13	434	145	145	143	307	103
	14:20:22	6591	6583	6562	46.91	46.82	46.14	434	146	145	143	306	103
	14:20:23	6592	6584	6562	46.90	46.82	46.13	434	145	145	143	307	103
	14:20:24	6590	6583	6559	46.90	46.88	46.17	434	145	145	143	306	103
	14:20:25	6595	6586	6564	46.86	46.79	46.06	433	145	145	143	307	103
	14:20:26	6593	6584	6562	46.92	46.85	46.11	434	145	145	143	307	103
	14:20:27	6593	6584	6563	46.94	46.84	46.11	434	146	145	143	307	103
	14:20:28	6591	6583	6562	46.98	46.87	46.19	434	146	145	143	307	103
	14:20:29	6593	6586	6564	46.90	46.80	46.17	434	146	145	143	307	103
	14:20:30	6594	6585	6563	46.97	46.91	46.19	434	146	146	143	307	103
	14:20:31	6591	6583	6561	46.93	46.84	46.13	434	146	145	143	306	103
	14:20:32	6591	6582	6561	46.96	46.88	46.17	434	146	145	143	307	103
	14:20:33	6589	6582	6560	46.94	46.83	46.18	434	146	145	143	307	103

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

Title	KWA Aluva
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-2

Date	Time	Q2[kvar]	Q3[kvar]	S[kVA]	S1[kVA]
Average value in the period		102	100	530	178
Maximum value in the period		103	101	532	179
Time of maximum value		11-03-2020 14:19:53	11-03-2020 14:20:03	11-03-2020 14:20:01	11-03-2020 14:20:28
Minimum value in the period		101	99	528	177
Time of minimum value		11-03-2020 14:22:06	11-03-2020 14:20:56	11-03-2020 14:23:03	11-03-2020 14:21:03
11-03-2020	14:19:52				
	14:19:53	103	100	531	178
	14:19:54	103	100	531	178
	14:19:55	103	100	531	178
	14:19:56	103	100	531	178
	14:19:57	103	100	531	178
	14:19:58	103	100	531	178
	14:19:59	103	100	531	178
	14:20:00	103	100	531	178
	14:20:01	103	100	532	178
	14:20:02	103	100	531	178
	14:20:03	103	101	531	178
	14:20:04	103	100	531	178
	14:20:05	103	101	531	178
	14:20:06	103	100	531	178
	14:20:07	103	101	531	178
	14:20:08	103	100	531	178
	14:20:09	103	101	531	178
	14:20:10	103	101	531	178
	14:20:11	103	101	531	178
	14:20:12	103	101	531	178
	14:20:13	103	101	531	178
	14:20:14	103	101	531	178
	14:20:15	103	100	531	178
	14:20:16	103	101	531	178
	14:20:17	103	100	531	178
	14:20:18	103	100	531	178
	14:20:19	103	101	531	178
	14:20:20	103	100	531	178
	14:20:21	103	101	531	178
	14:20:22	103	101	531	178
	14:20:23	103	101	531	178
	14:20:24	103	100	531	178
	14:20:25	103	101	531	178
	14:20:26	103	101	531	178
	14:20:27	103	101	531	178
	14:20:28	103	101	532	179
	14:20:29	103	101	531	178
	14:20:30	103	101	532	179
	14:20:31	103	100	531	178
	14:20:32	103	101	532	178
	14:20:33	103	101	531	178

OTTOTRACTIONS
Energy-Engineering-Environment

Time series data

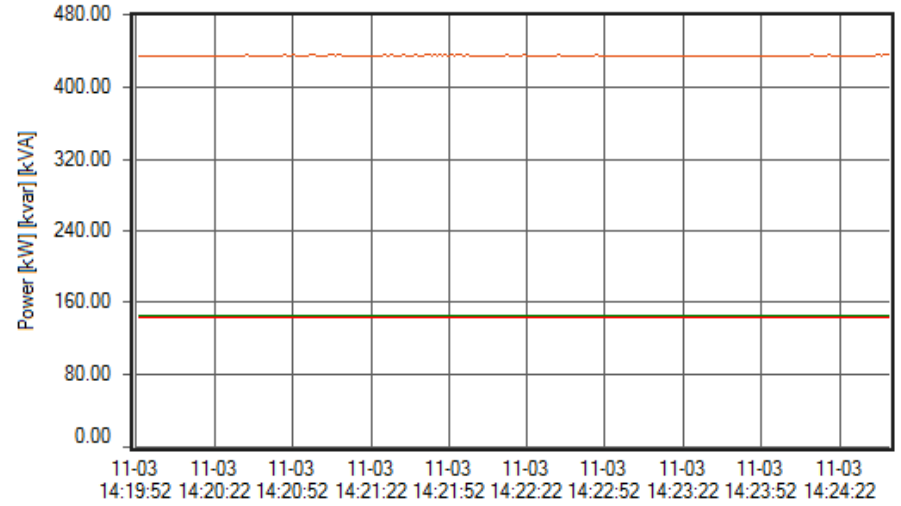
Title	KWA Aluva
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-2

Date	Time	S2[kVA]	S3[kVA]	PF	PF1	PF2	PF3	WP+[kWh]	Pdem+[kW]
Average value in the period		177	174	0.8192	0.8183	0.8186	0.8206		434
Maximum value in the period		178	175	0.8208	0.8201	0.8209	0.8226		435
Time of maximum value		11-03-2020 14:19:53	11-03-2020 14:19:53	11-03-2020 14:24:00	11-03-2020 14:22:43	11-03-2020 14:23:02	11-03-2020 14:24:37		11-03-2020 14:20:34
Minimum value in the period		177	174	0.8161	0.8151	0.8146	0.8176		433
Time of minimum value		11-03-2020 14:21:08	11-03-2020 14:20:54	11-03-2020 14:20:07	11-03-2020 14:19:58	11-03-2020 14:19:53	11-03-2020 14:20:12		11-03-2020 14:19:55
11-03-2020	14:19:52								
	14:19:53	178	175	0.8167	0.8162	0.8146	0.8193	0.1	434
	14:19:54	178	175	0.8169	0.8160	0.8155	0.8191	0.2	434
	14:19:55	178	175	0.8170	0.8159	0.8160	0.8191	0.4	433
	14:19:56	178	175	0.8168	0.8159	0.8157	0.8188	0.5	434
	14:19:57	178	175	0.8172	0.8163	0.8164	0.8188	0.6	434
	14:19:58	178	175	0.8164	0.8151	0.8156	0.8185	0.7	434
	14:19:59	178	175	0.8170	0.8156	0.8162	0.8194	0.8	434
	14:20:00	178	175	0.8164	0.8152	0.8154	0.8187	1.0	433
	14:20:01	178	175	0.8168	0.8158	0.8156	0.8192	1.1	434
	14:20:02	178	175	0.8166	0.8158	0.8153	0.8188	1.2	434
	14:20:03	178	175	0.8166	0.8158	0.8155	0.8185	1.3	434
	14:20:04	178	175	0.8171	0.8162	0.8161	0.8189	1.4	434
	14:20:05	178	175	0.8163	0.8154	0.8155	0.8181	1.6	434
	14:20:06	178	175	0.8166	0.8157	0.8159	0.8184	1.7	433
	14:20:07	178	175	0.8161	0.8154	0.8152	0.8178	1.8	433
	14:20:08	178	175	0.8167	0.8160	0.8159	0.8183	1.9	433
	14:20:09	178	175	0.8164	0.8156	0.8157	0.8181	2.0	433
	14:20:10	178	175	0.8165	0.8159	0.8158	0.8180	2.2	434
	14:20:11	178	175	0.8167	0.8162	0.8159	0.8179	2.3	434
	14:20:12	178	175	0.8164	0.8156	0.8160	0.8176	2.4	434
	14:20:13	178	175	0.8167	0.8164	0.8159	0.8179	2.5	434
	14:20:14	178	175	0.8168	0.8162	0.8157	0.8184	2.7	434
	14:20:15	178	175	0.8171	0.8164	0.8163	0.8187	2.8	434
	14:20:16	178	175	0.8164	0.8154	0.8156	0.8181	2.9	433
	14:20:17	178	175	0.8171	0.8160	0.8165	0.8188	3.0	434
	14:20:18	178	175	0.8167	0.8157	0.8160	0.8184	3.1	434
	14:20:19	178	175	0.8162	0.8154	0.8154	0.8179	3.3	434
	14:20:20	178	175	0.8167	0.8157	0.8157	0.8186	3.4	434
	14:20:21	178	175	0.8163	0.8155	0.8155	0.8181	3.5	434
	14:20:22	178	175	0.8170	0.8164	0.8162	0.8186	3.6	434
	14:20:23	178	175	0.8161	0.8154	0.8153	0.8177	3.7	434
	14:20:24	178	175	0.8171	0.8164	0.8159	0.8190	3.9	434
	14:20:25	178	175	0.8162	0.8152	0.8155	0.8179	4.0	433
	14:20:26	178	175	0.8166	0.8155	0.8159	0.8183	4.1	434
	14:20:27	178	175	0.8167	0.8155	0.8162	0.8183	4.2	434
	14:20:28	178	175	0.8166	0.8157	0.8159	0.8182	4.3	434
	14:20:29	178	175	0.8166	0.8161	0.8156	0.8182	4.5	434
	14:20:30	178	175	0.8164	0.8154	0.8157	0.8182	4.6	434
	14:20:31	178	175	0.8171	0.8160	0.8165	0.8188	4.7	434
	14:20:32	178	175	0.8167	0.8157	0.8161	0.8184	4.8	434
	14:20:33	178	175	0.8166	0.8159	0.8158	0.8182	4.9	434

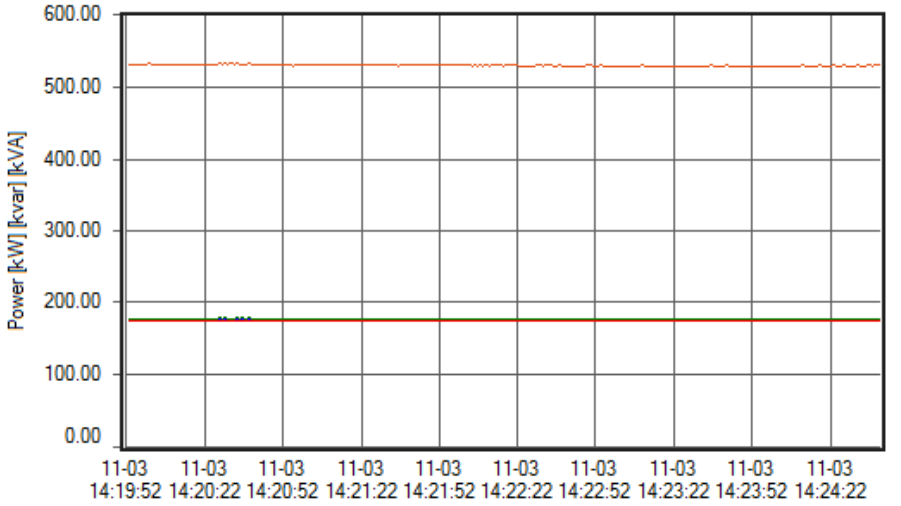
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

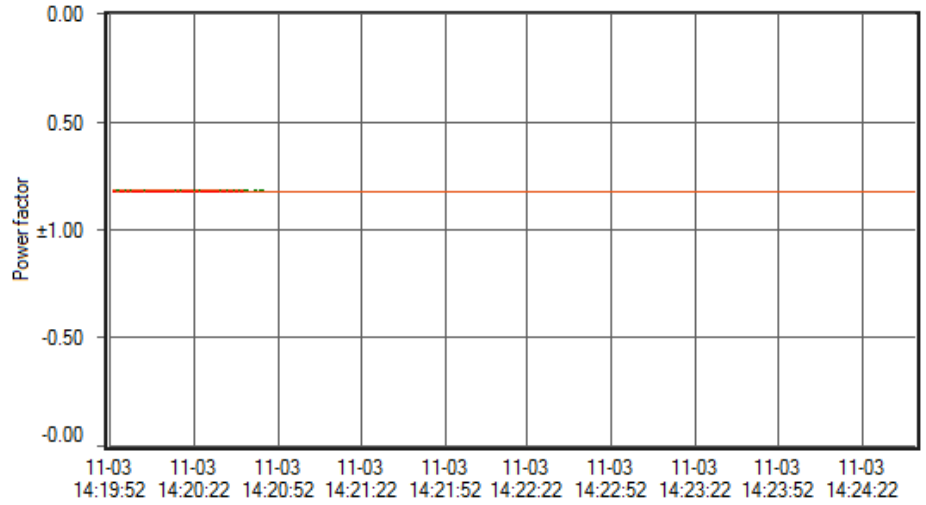
Title	KWA Aluva
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-2



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



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

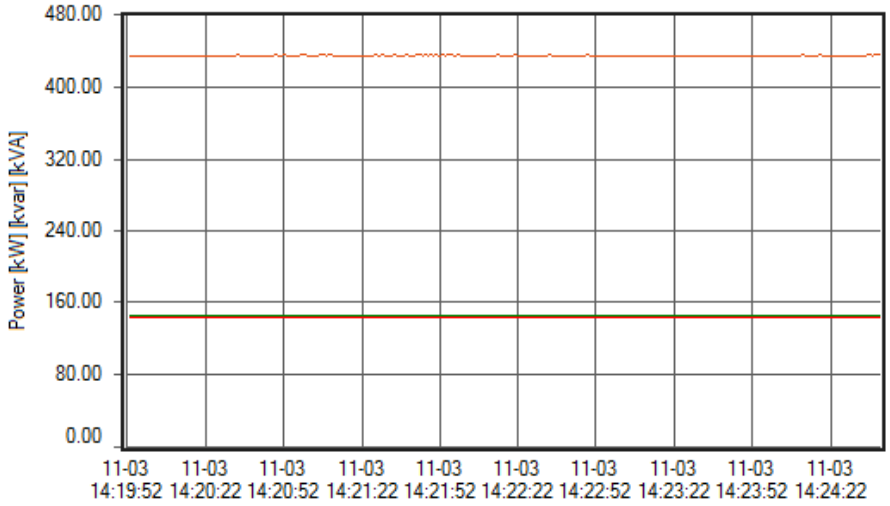


Left axis
PF PF1 PF2 PF3

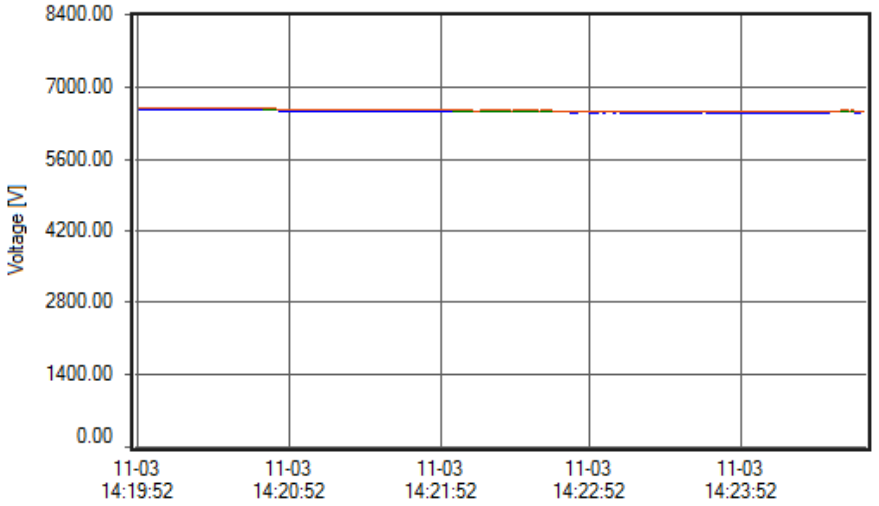
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

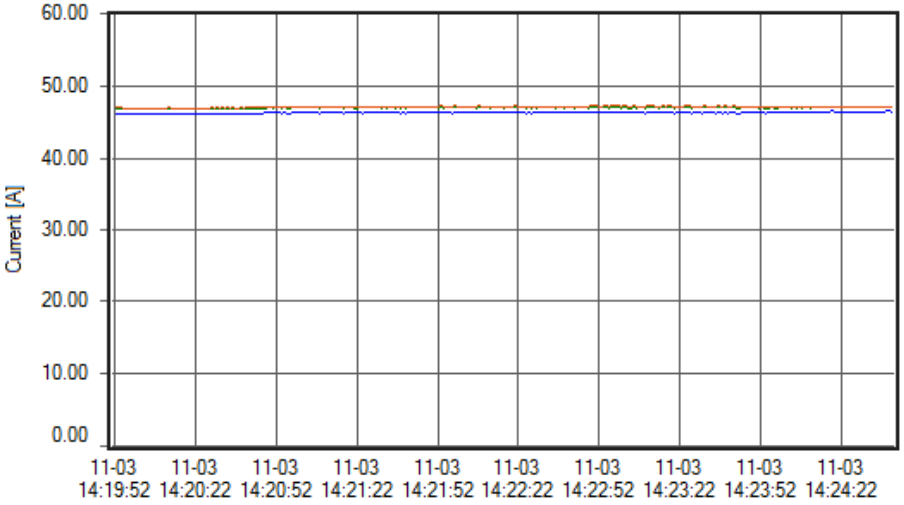
Title	KWA Aluva		
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41		
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-2		



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



Left axis
U1[V] U2[V] U3[V]

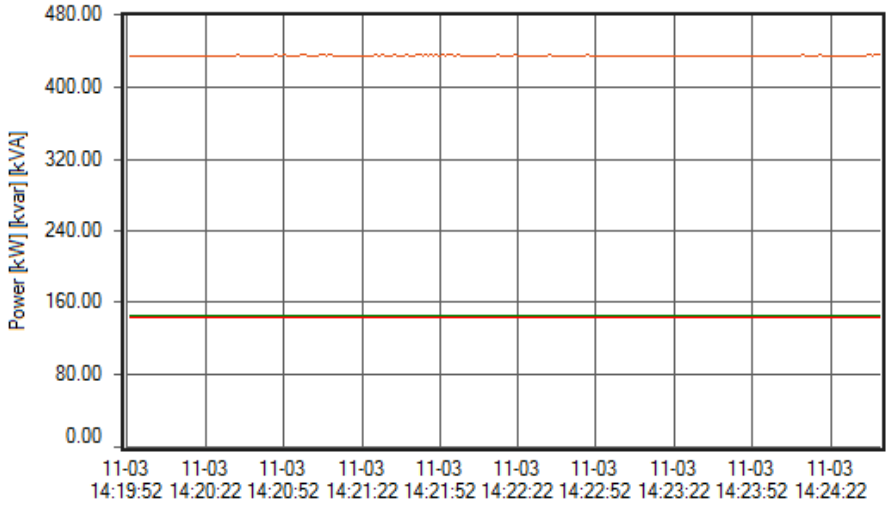


Left axis
I1[A] I2[A] I3[A]

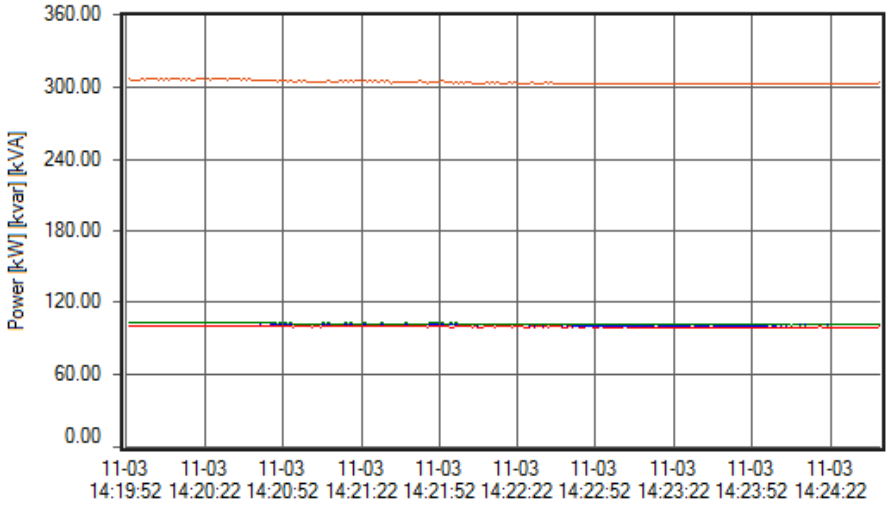
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

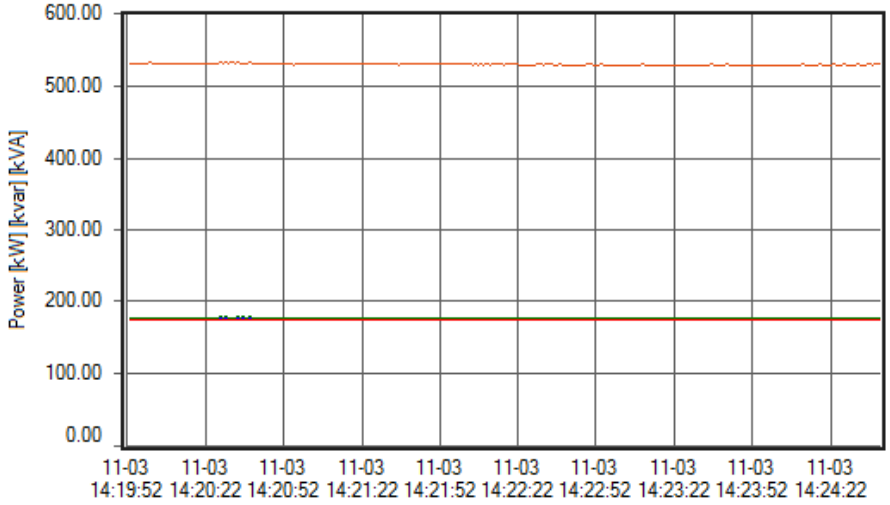
Title	KWA Aluva		
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41		
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41		
Measurement interval	1 Second	Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-2		



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



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

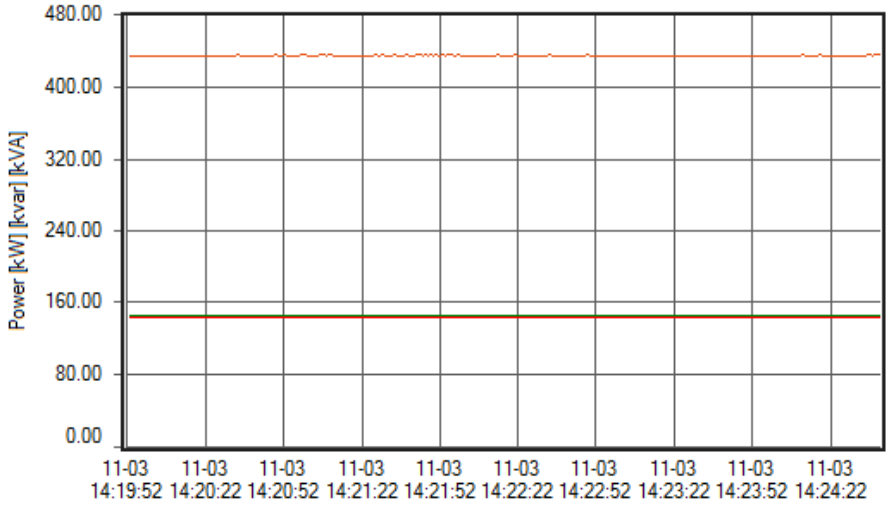


Left axis
S[kVA] S1[kVA] S2[kVA] S3[kVA]

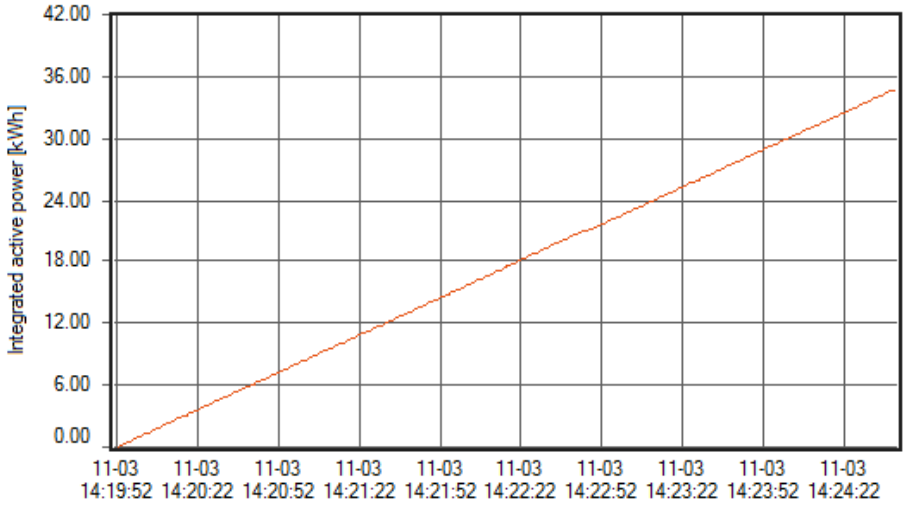
OTTOTRACTIONS
Energy-Engineering-Environment

Time series graph

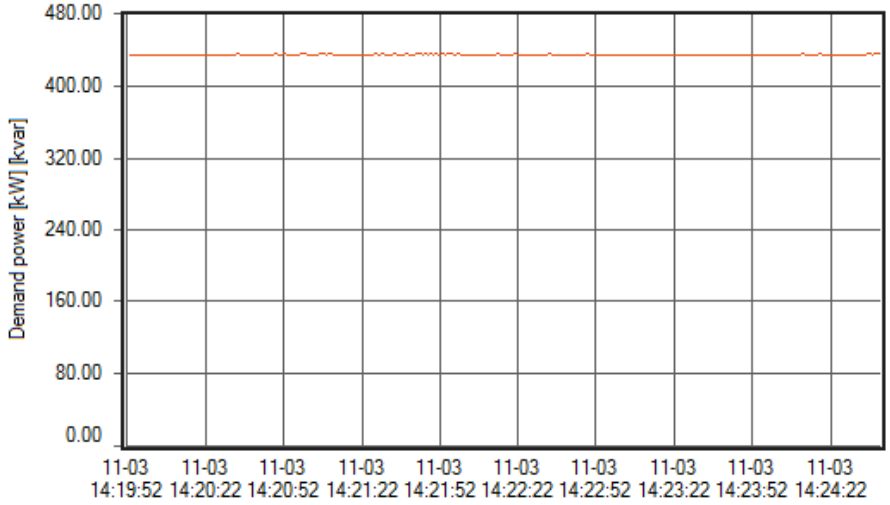
Title	KWA Aluva
Measurement period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Display period	11-03-2020 14:19:52 - 11-03-2020 14:24:41
Measurement interval	1 Second
Data interval	1 Second
Comment	Model number : PW3360 S/N.140512994 RWP-2



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

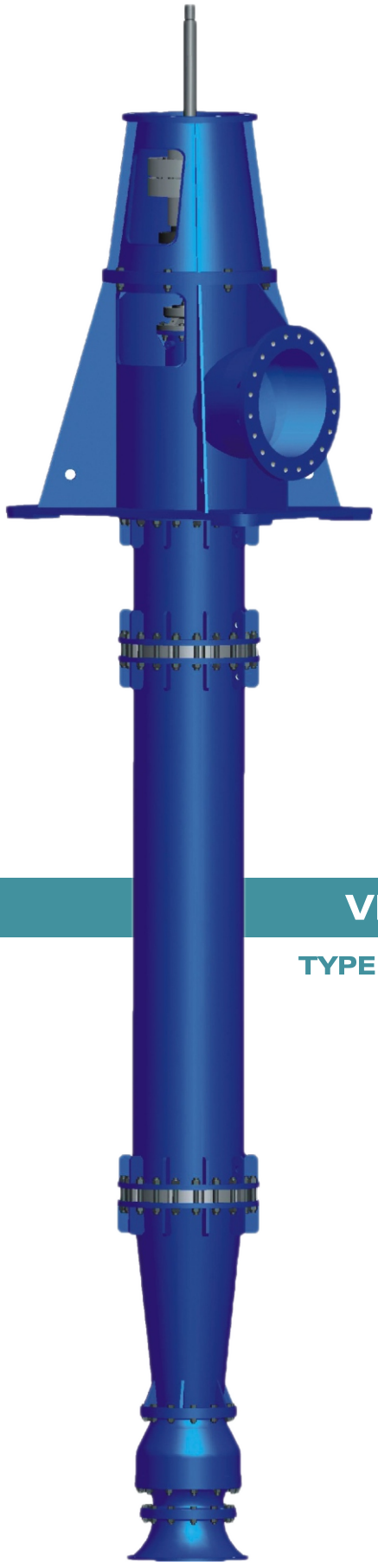


Left axis
WP+[kWh]



Left axis
Pdem+[kW]

Enriching Lives



VERTICAL PUMPS

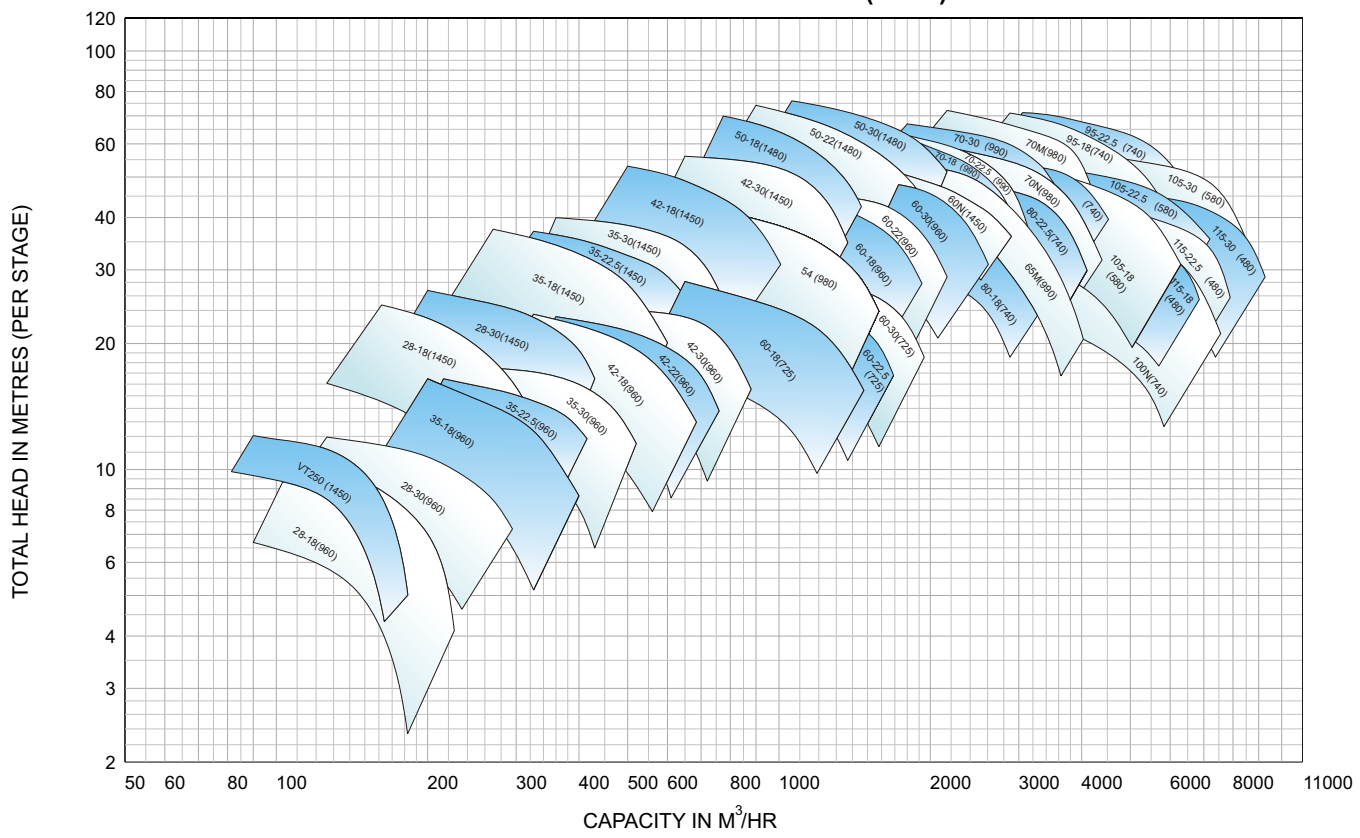
TYPE - BHR / BHQ / BHM / BHK / BHMa / BHA

CE Ex

KIRLOSKAR BROTHERS LIMITED

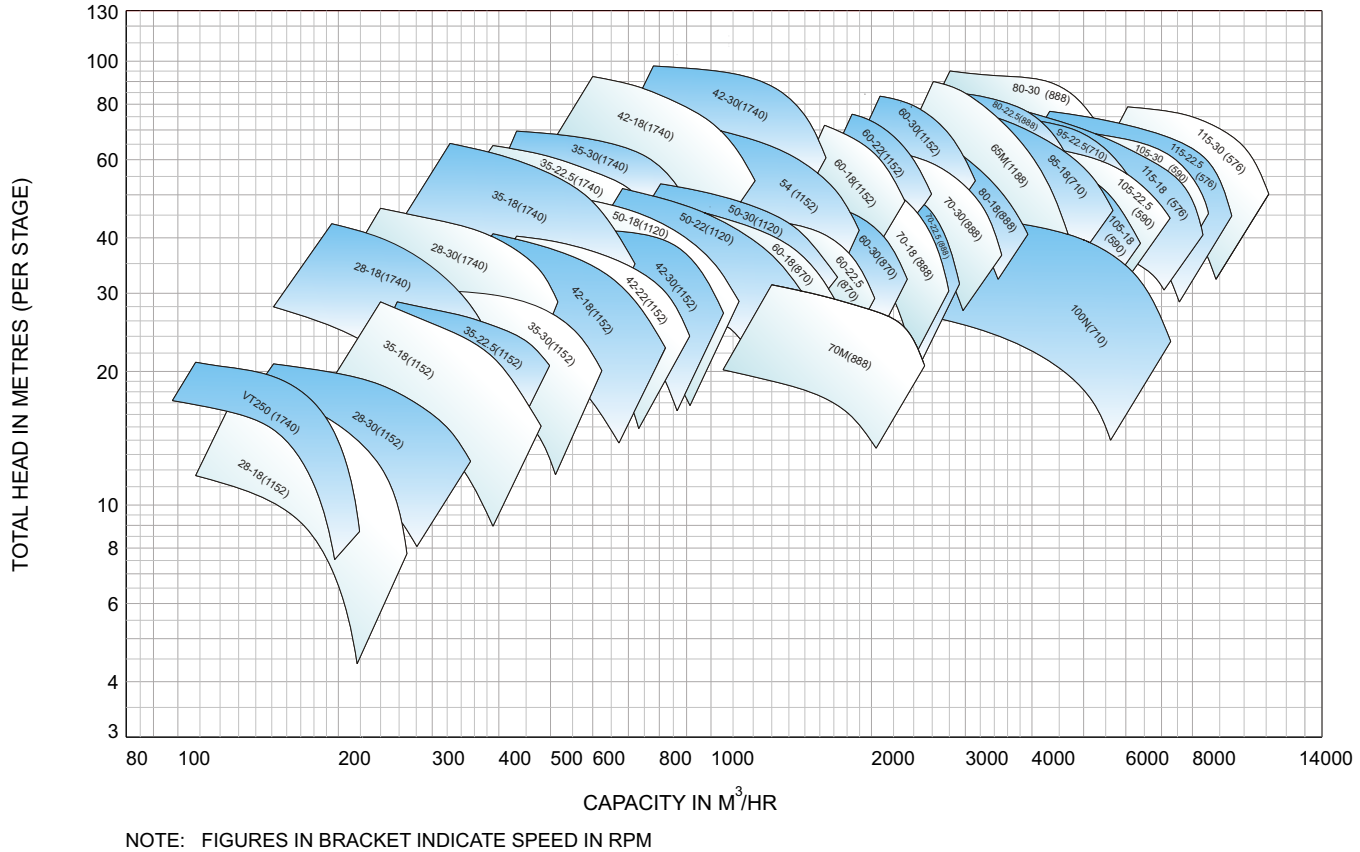
A Kirloskar Group Company

FAMILY CURVES FOR BHR PUMPS (50HZ)



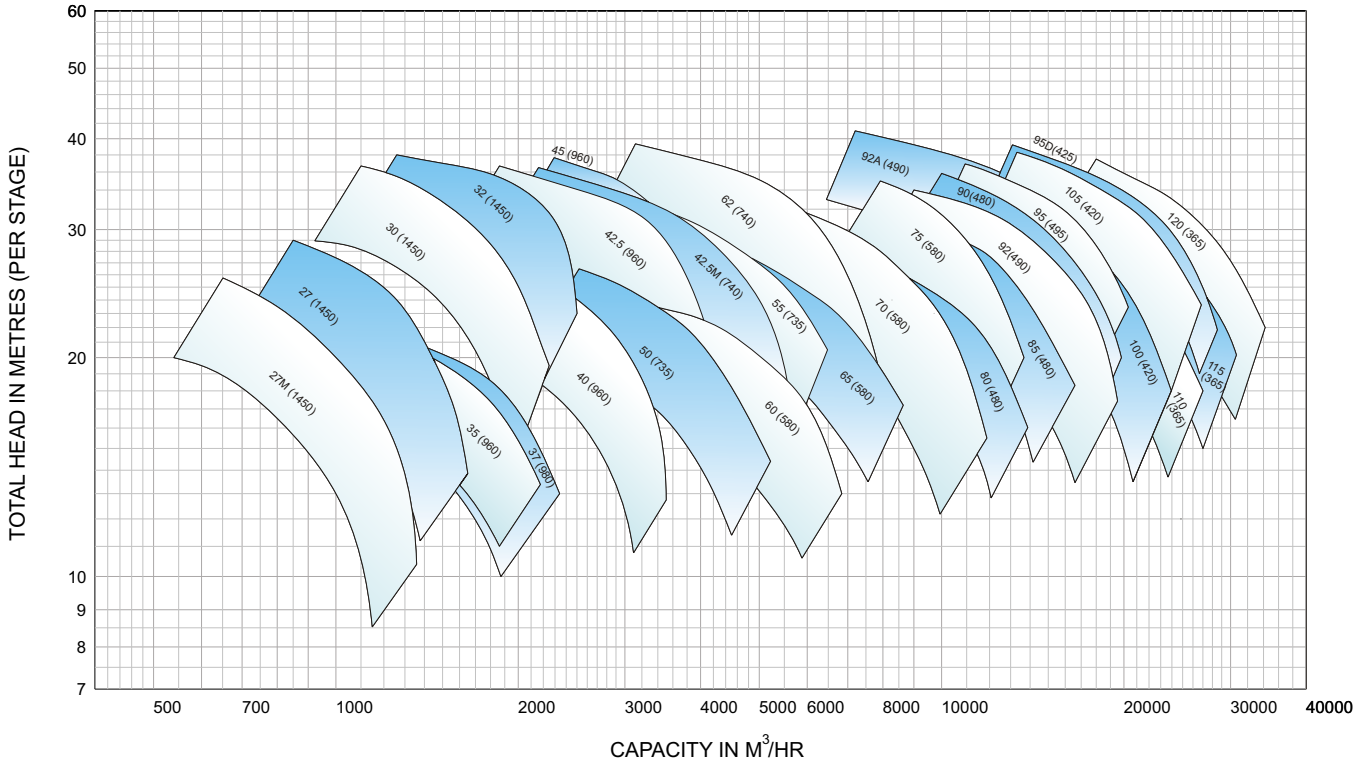
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHR PUMPS (60HZ)



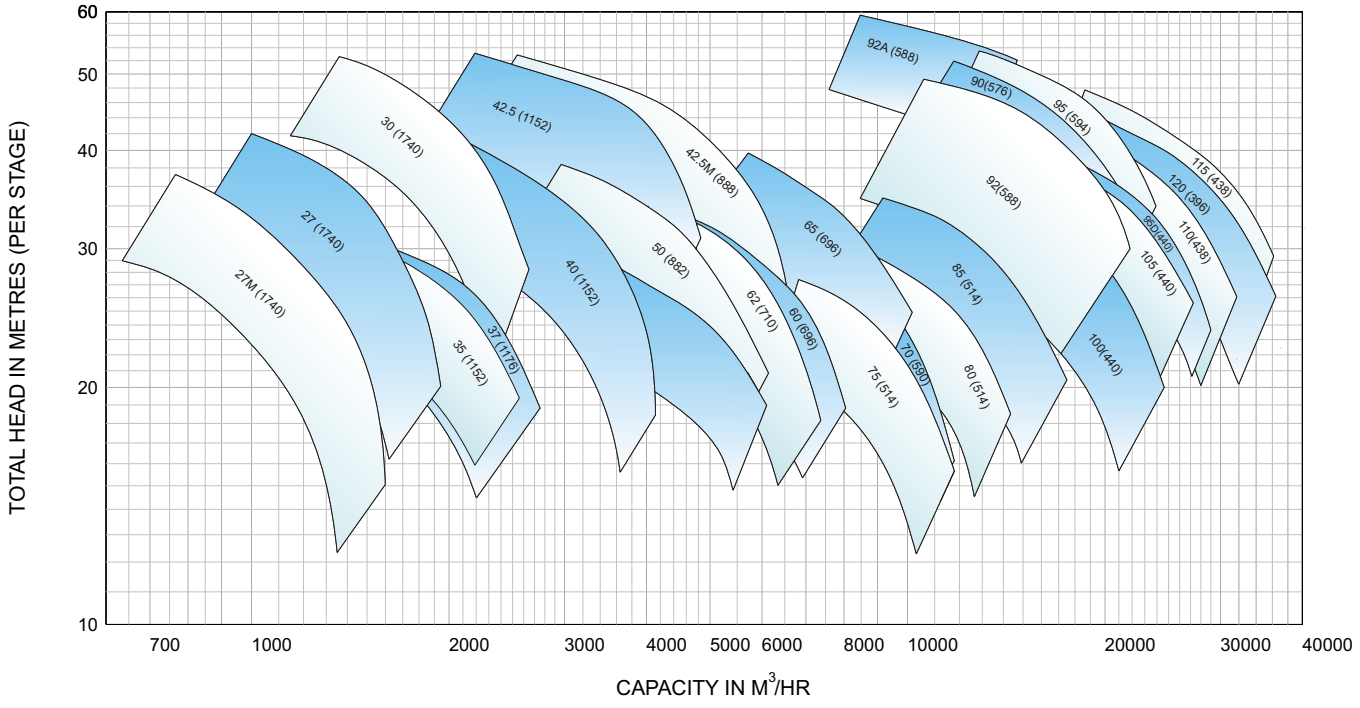
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHQ PUMPS (50HZ)



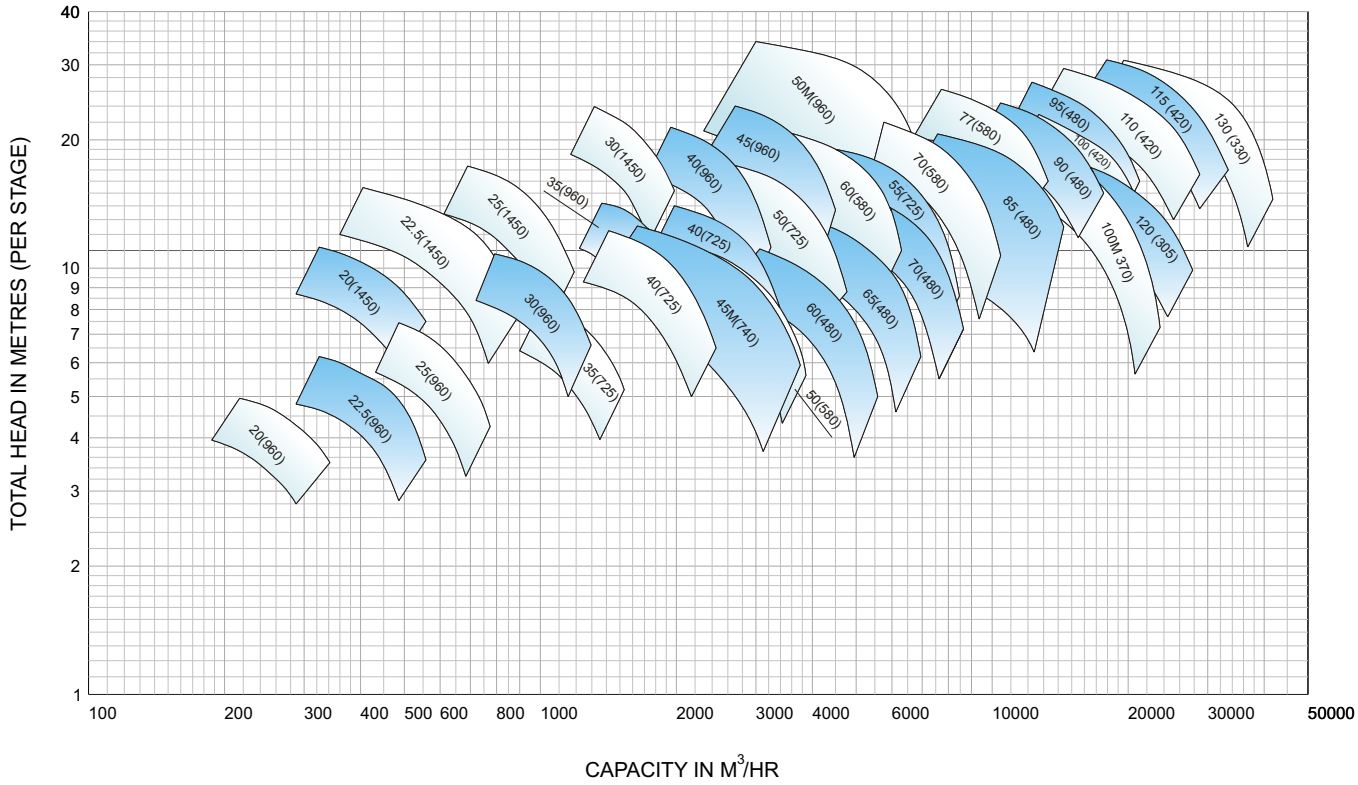
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHQ PUMPS (60HZ)



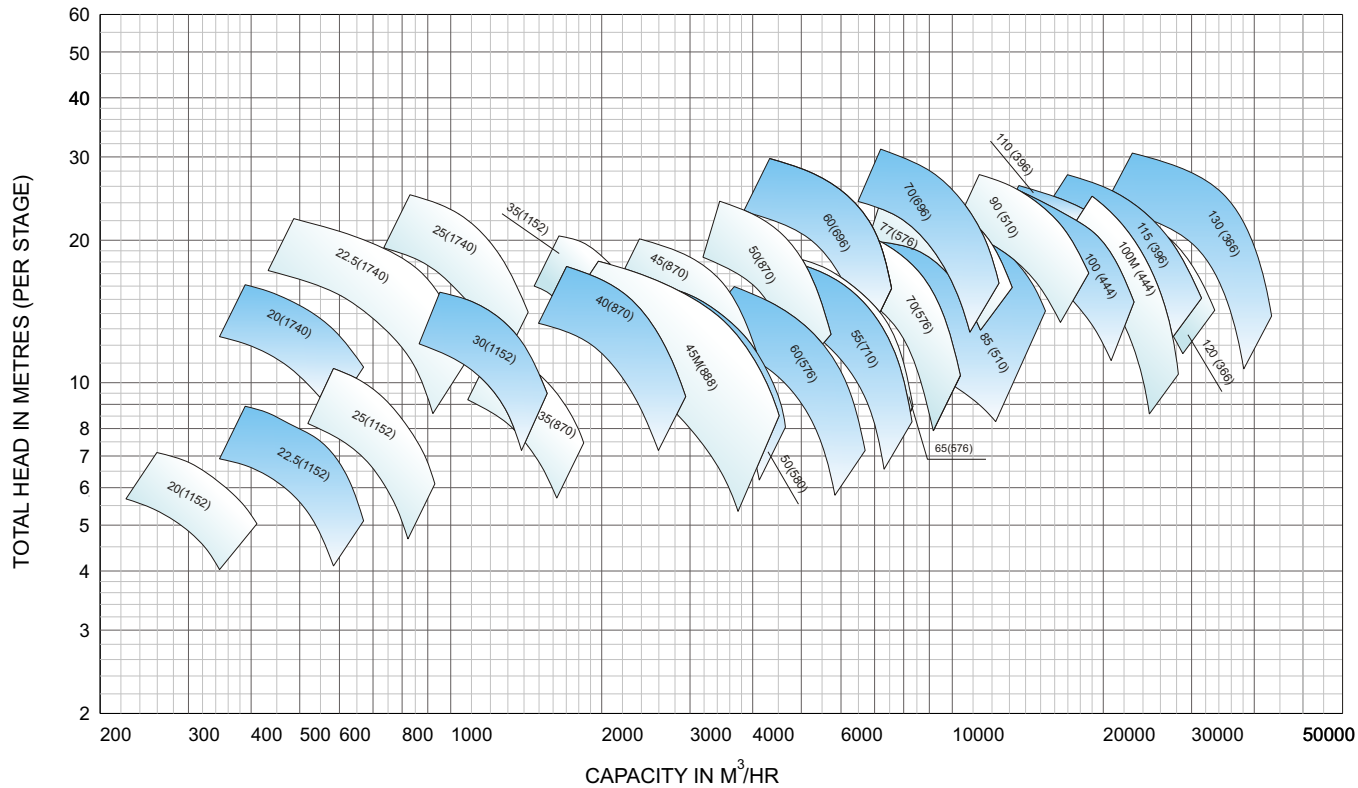
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHM PUMPS (50HZ)



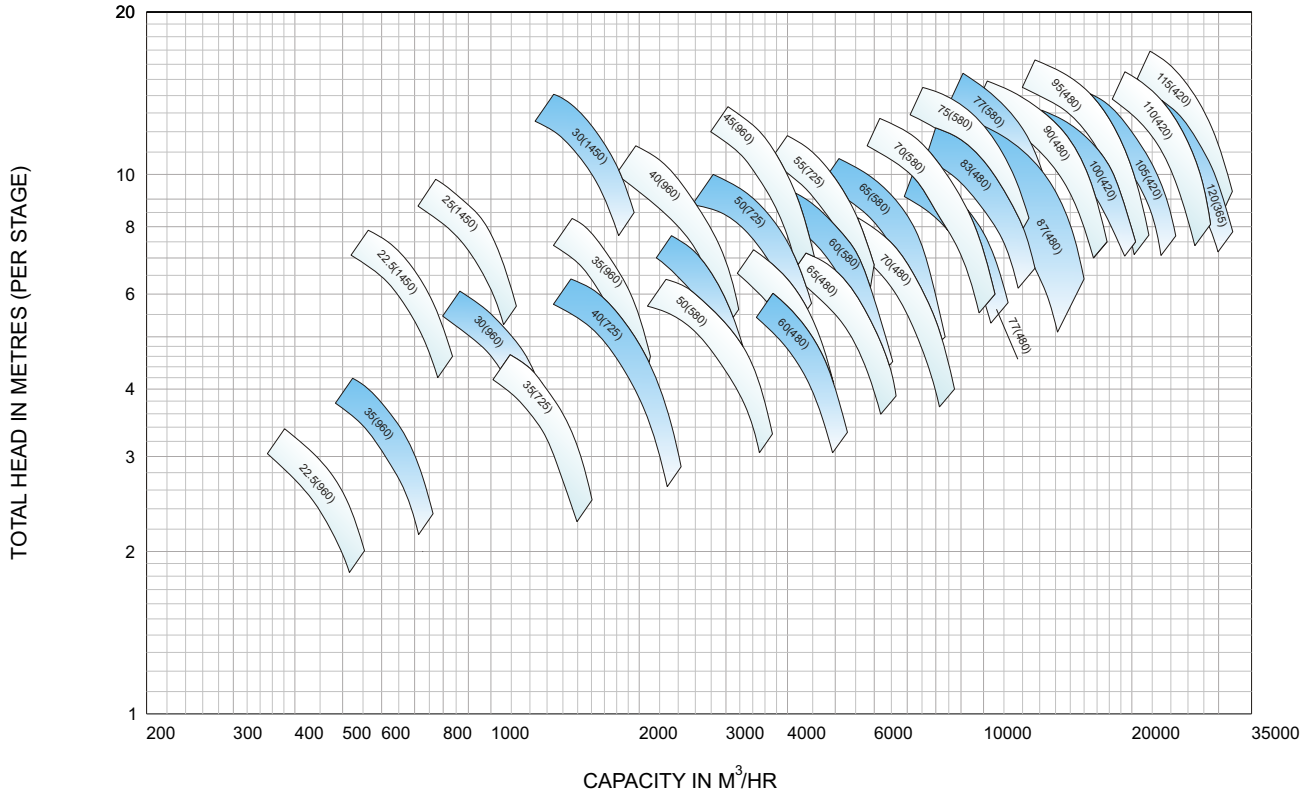
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

FAMILY CURVES FOR BHM PUMPS (60HZ)



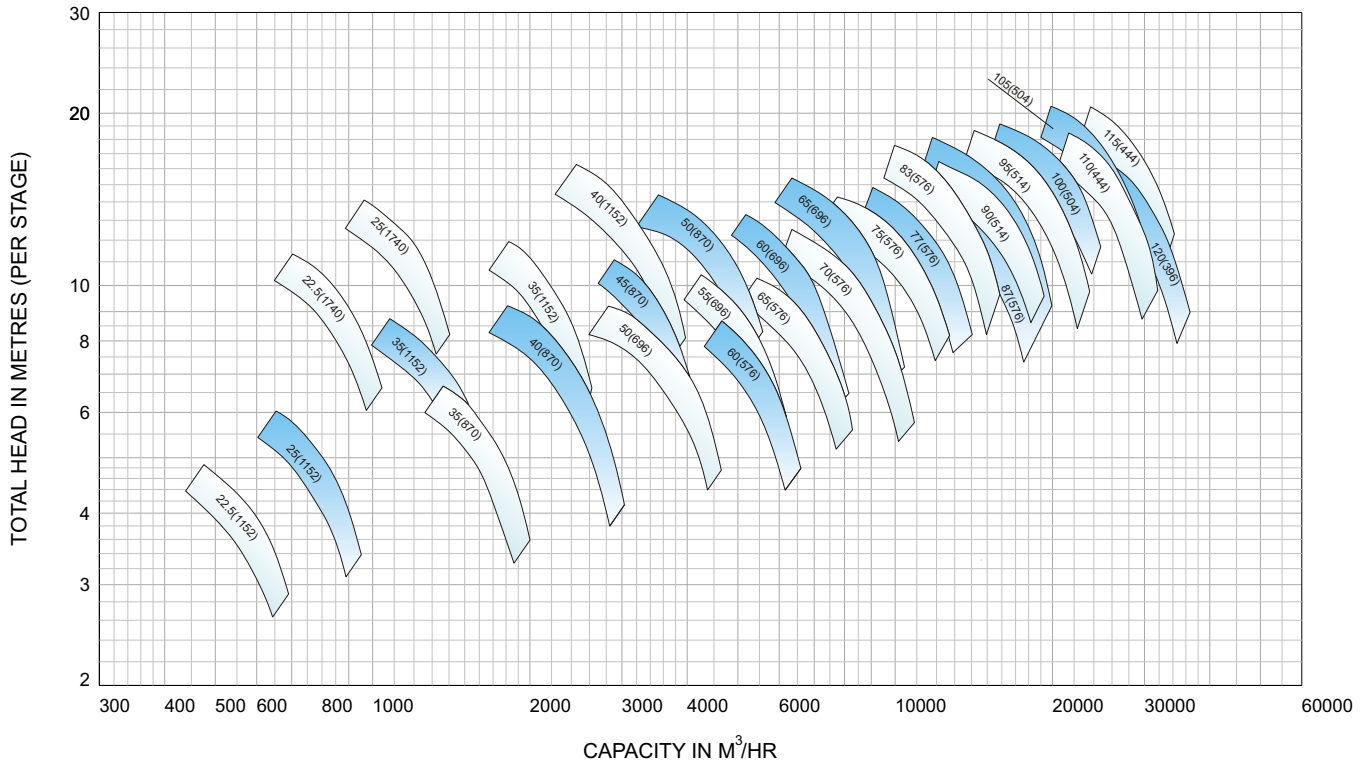
NOTE: FIGURES IN BRACKET INDICATE SPEED IN RPM

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

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KIRLOSKAR BROTHERS LIMITED

A Kirloskar Group Company

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Email: marketing@kbl.co.in, Website: www.kirloskarpumps.com, CIN No.: L29113PN1920PLC000670

OUR COMPANIES

United Kingdom | U.S.A. | South Africa | India | The Netherlands

VT-BHR-BHQ - 06-2016

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

TÜV INDIA
TÜV NORD GROUP

70 YEARS OF ENGINEERING EXCELLENCE

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.

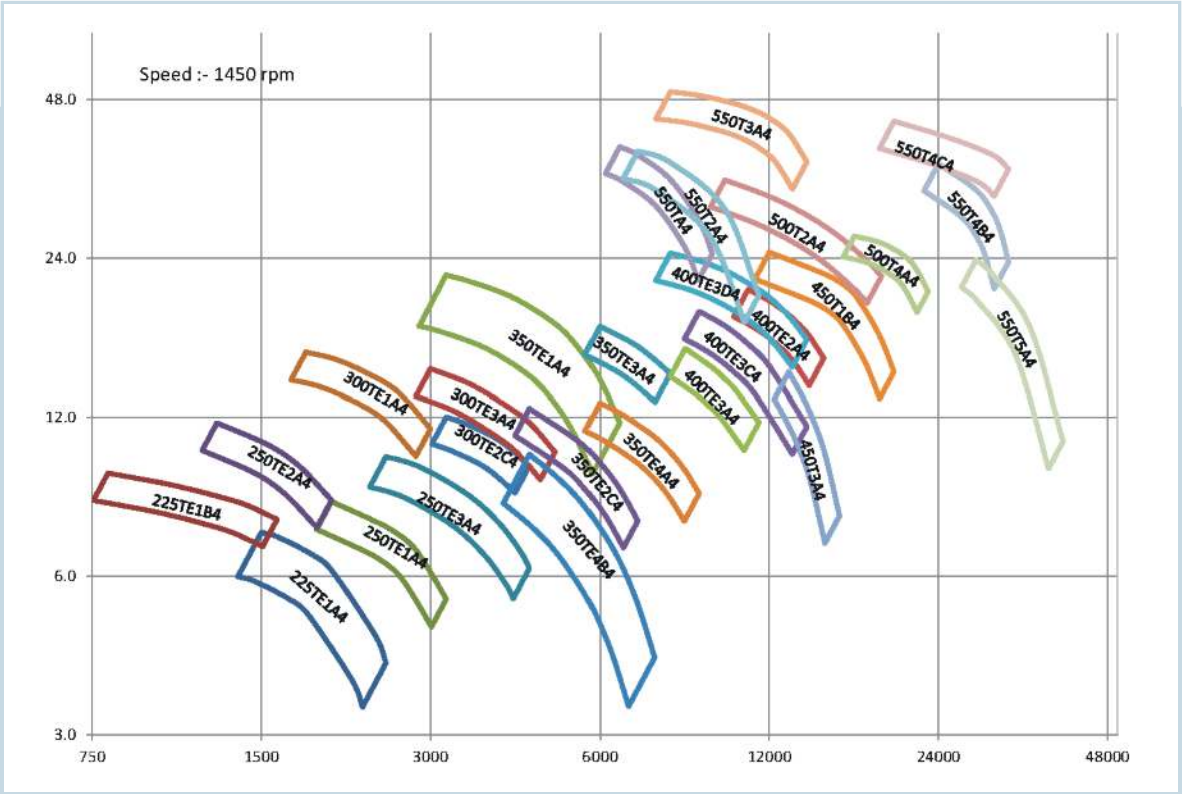
DISCHARGE HEAD

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

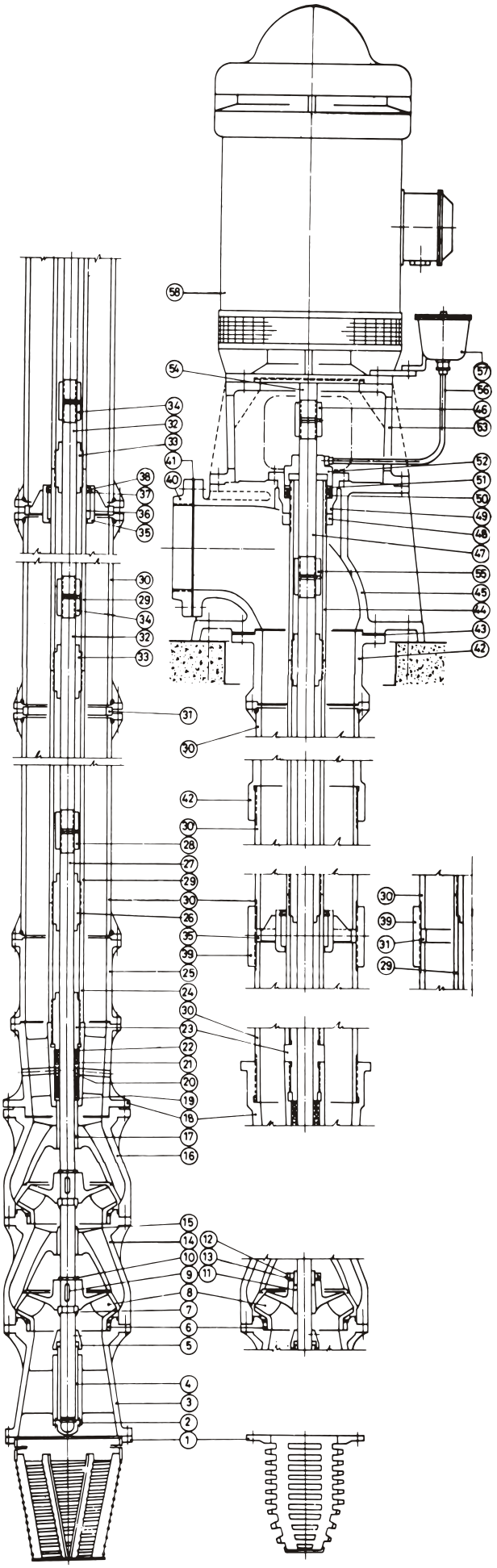
S.NO.	PART DESCRIPTION	MATERIAL	SPECIFICATION
1	STAINER	M.S.	IS : 2062 St.42-S
2	SUCTION CASE	CAST IRON	IS : 210 Gr FG-200
3	SUCTION CASE BEARING	BRONZE	IS : 318 Gr LTB2
4	IMPELLER SEAL RING	CAST IRON	IS : 210 Gr FG-200
		BRONZE	IS : 318 Gr LTB2
5	IMPELLER	CAST IRON	IS : 210 Gr FG-200/260
		BRONZE	IS : 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

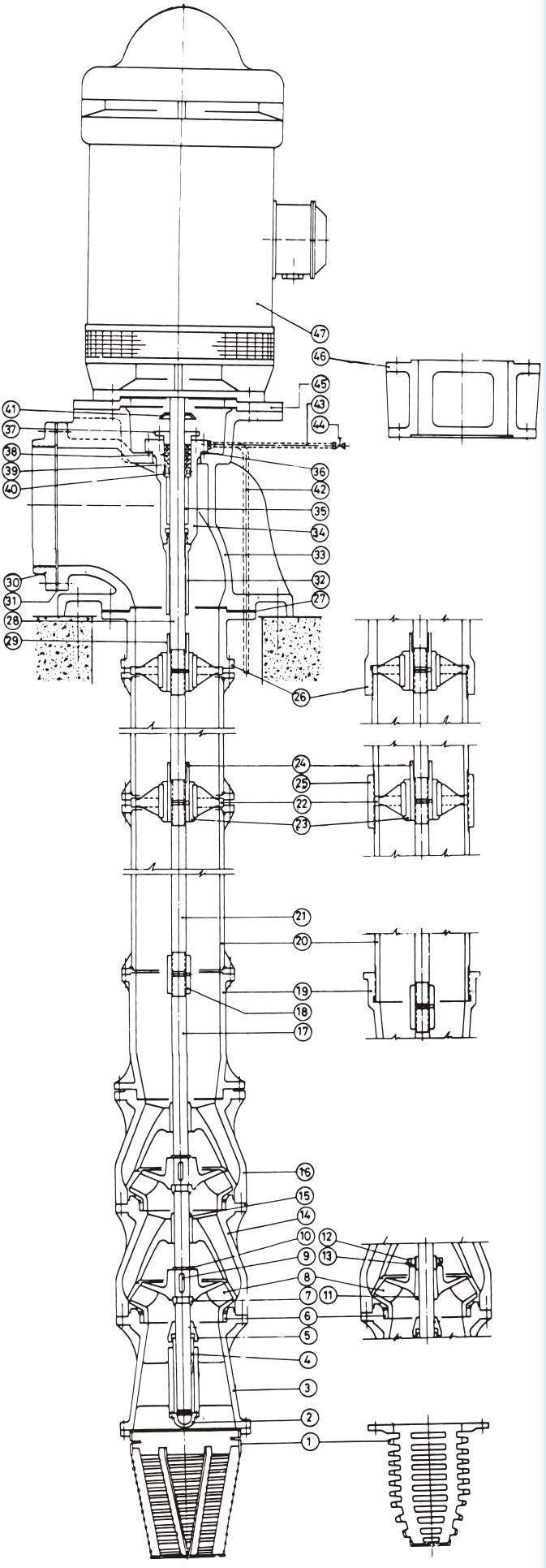
● Foundation bolts ● Sole plate ● Companion flanges.

'JYOTI' VERTICAL TURBINE PUMP
(OIL-LUBRICATED)



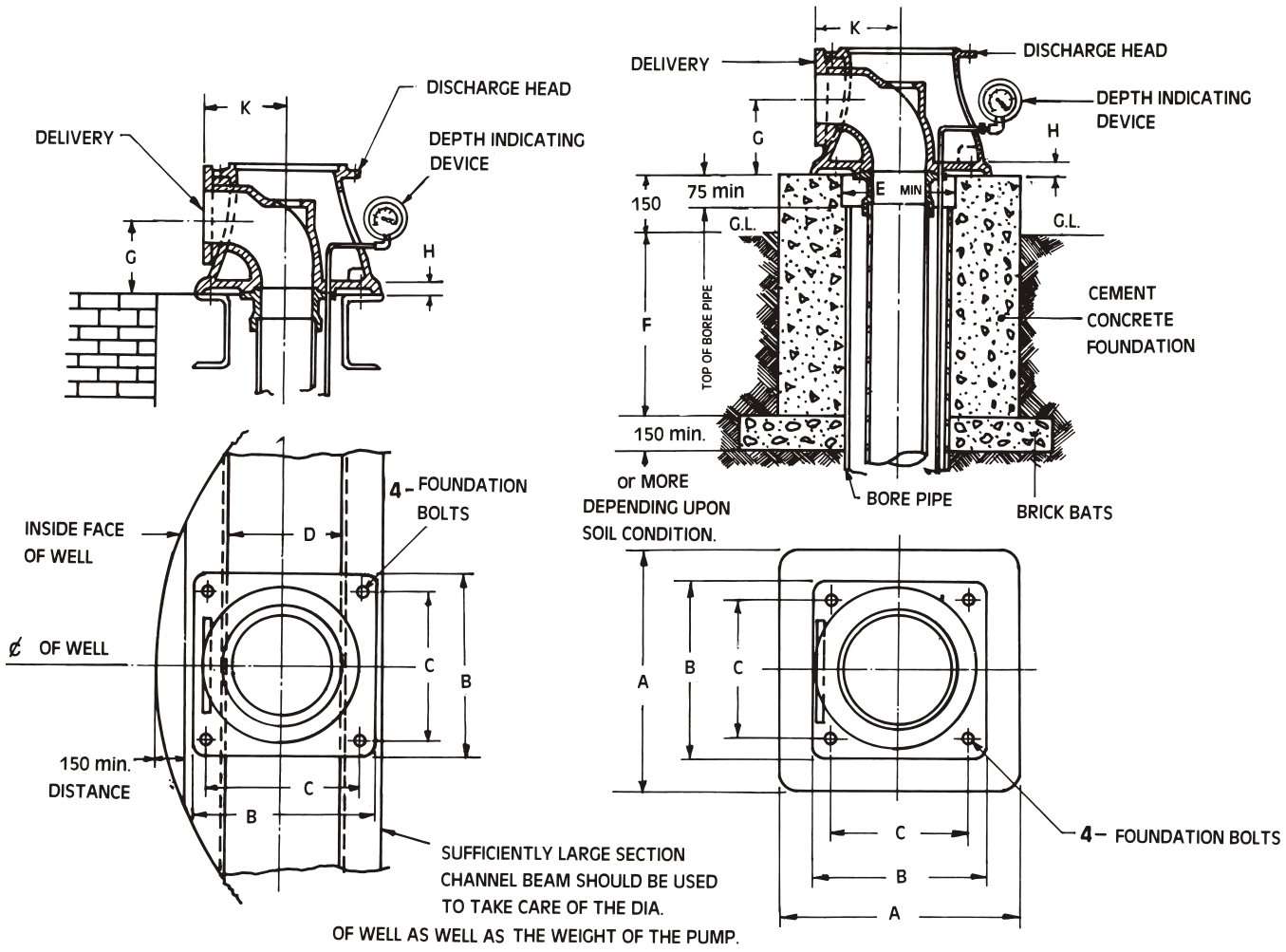
Sr. No.	PART NAME
58	Vertical Hollow Shaft Motor
57	Automatic Lubricator Assly
56	Oiling Pipe
55	Head Shaft Coupling
54	Head Shaft
53	Motor Skirt or Adapting Plate
52	Gland
51	Gland Packing Ring
50	Gland Packing
49	Tube Tension Plate
48	Check Nut
47	Head Shaft Extension
46	Head Shaft Extension Coupling
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

FOUNDATION DRAWING for 'JYOTI' VERTICAL TURBINE PUMP



PUMP ON OPEN WELL **PUMP ON TUBE WELL**

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

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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.