REPORT ON ENERGY AUDIT OF WTP AT PATTUVAM UNDER THALIPARAMBA DIVISION, KWA

TEAM ENERGY AUDIT, KWA NOVEMBER 2021

ACKNOWLEDGMENT

We, the team members, take this opportunity to express our sincere gratitude to Sri. Venkiteshpathy.S, IAS, MD KWA, who entrusted this assignment and gave timely directions to complete the audit as per schedule. We at KWA consider his leadership and inspiration a privilege.

We would like to express our thanks to Sri. Muhammed Hanees, AEE, Head work sub division Irikkur, and Sri. Arjun Govind AE HW Section, Irikkur, who is in charge of this plant. We also thank all the staff of HW Section, especially the operating staff at the water treatment plant.

We do not have any hesitation, that is to say, there are many initiatives shown from the operations wing at HO to address the energy issues faced by KWA, under the leadership of CE operations and his team. We take the privilege to express our gratitude to them.

As the team leader, I would like to express my gratitude to Sri. Manoj M, EE Sulthan Bathery and Smt. Sabeer Rehman, EE Kollam, both of them kindly spared their team members so that we could finish the audit on time.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects						
KWA WATER TREATMENT PLANT, PATTUVAM						
Sl. No.	**Projects**	**Investment in Lakhs Rs.**	**Cost savings in Rs. per year**	**Payback period**		**Energy saved in Kwh per year**
				Year	Month	
1	OPERATIONAL OPTIMISATION OF TRANSFORMERS- ONE KEEP AS STANDBY	0	120888	0.00	0	21024
2	IMPROVING 0.5 m (average) WATER LEVEL AT TWR	0	210415	0.00	0	36594
3	OPTIMISATION IN USAGE OF CLARIFIER AND FLOCCULATION AS DESIGN CAPACITY 93 MLD AND UTILISED CAPACITY IS ONLY 53 MLD	0	312294	0	0.0	54312
4	SUPPLY AND FIXING OF NEW BY-PASS SHUTTER ARRANGEMENTS VALVE TO GUIDE USED WASH WATER TO THE LAGOON.	350000	488996	0.72	8.6	89724
5	REPLACING OF BACKWASH WATER MOTOR PUMP SETS OF 40 HP BY 30 HP @ 2 Nos.	920000	164701	5.59	67	28644
6	USE OF RECYCLED USED WASH WATER FROM LAGOON BY USING 10 kW SOLAR PLANT. (PUMPING MECHANISM WITH 32 M Head)	950000	1807809	0.53	6.3	249103
7	REPLACING LESS EFFICIENT TREATED WATER MOTORs @2 Nos. PUMPSET (CF) BY EFFICIENT ONE @ 177 HP each	6800000	2067058	3.29	39.5	359488

1. INTRODUCTION

KWA is a PSU under the Govt. of Kerala which is empowered to construct and run the water supply schemes to cater potable water to the public and to construct and run the sewerage schemes in favour of LSGDs. In both cases, the electrical equipment which comes across the different operations in the plant and pumping stations is consuming a tremendous quantity of electricity directly and indirectly. There are 277 HT and more than 2000 LT connections associated with KWA at different pumping stations and WTPs all over Kerala by which more than 3300 MLD water is produced. M/s KWA is liable to pay Rs.3600 million per year to M/s Kerala State Electricity Board Limited. A preliminary study indicates that even the basic principle of energy conservation methodology has not been implemented in our pumping stations owing to a lack of awareness in energy conservation activities. For KWA, the energy audit and water audit are complementary as both are having the potential to contribute to the existence of KWA. The Govt. of Kerala has formulated the autonomous body to look into the energy audit program in Kerala as the nodal agency, the Energy Management Centre (EMC) is continuously demanding to implement the corrective steps to avoid energy wastages in pumping stations as it is very essential for the financial sustainability of the organization and the prosperity of our nation. It is also realized that the energy audit through the empanelled agencies are more concentrated on energy aspects rather than water wastages as they have less expertise in the latter still it consumes more money and time. The main locations can be identified by audit in both cases viz. the places where less efficiency was reported due to the procedural (operational) errors and the place where losses occurred due to the implementation of out-dated technology. It is also taken into consideration that the implementation of advanced technology in this sector will improve the service stability of KWA. The Honourable Managing Director has issued an order to create a team by selecting experienced hands from KWA itself to conduct energy and water audit

1.1 VISION

Promoting good energy management practices in KWA through water and energy audit

1.2 MISSION

Implement energy optimization technologies.

Adopt benchmarking for energy consumption canters of KWA

1.3 SLOGAN

Measure before leave

1.4 SCOPE

The energy audit is concentrating on two aspects viz.

1) Operational optimization
   This can be achieved by giving proper training to the staff, implementing a procedural system to fix the responsibility and target the culprits, those who are negligent in optimum operation, Transferring technical knowhow to the concerned, which improves the morale also.
2) Technology up gradation

There is high scope for implementing advanced technology in KWA since the energy conservation methodologies are vastly developed in the recent era but still, M/s KWA is running with the conventional mechanism.

1.5 ENERGY AUDIT TEAM

The team members of the energy audit has been carried out as per order number KWA/JB/EW/EMC/EA/7813/2019 dated 17.09.21 by Managing Director KWA

1) Sri. Sajan,S , PH Sub Division, Chavara
2) Sri. Salmanul Farisi, P H Sub Division, Chavara
3) Sri. Jilson Devasia, P H Section, Sulthanbathery
4) Sri. Thomson M. C., P H Section, Mananthavady
5) Sri. Sajith K., P H Section, Sulthanbathery

Headed by Sri. Thampy.S, Assistant Executive Engineer, O/o CE South region Kwa Thiruvananthapuram.

Date of Audit: 17.01.2022 to 20.01.2022

1.6 ABOUT THE ENERGY AUDIT TEAM, KWA

This team consists of six operating staff having more experience in the water and energy sector with academic qualifications @ M Tech, and B Tech. of mechanical and electrical disciplines and they are working under the leadership of a registered Energy Manager.

1.7 MAJOR ACTIVITIES OF ENERGY AUDIT TEAM, KWA.

1) Carry out an energy audit in favour of KWA
2) Carry out water audit in favour of KWA
3) Study and evaluation of energy audit reports submitted by certified energy auditors.
4) Inspect the pumping stations for rectification work on energy related issues.
5) Technical support to water authority officers on energy related issues.

1.8 METHODOLOGY

1) Survey for requirement
2) Data collection
3) Planning of audit
4) Site observation
5) Auditing
   Power measurement
   Flow measurement
   Energy balancing
   Water balancing
6) Determination of opportunities for energy reduction and conservation options.
7) Exploiting the possibilities to encourage introducing the technology advancement in the water and energy related sector at KWA from the R & D institutions.
8) Conducting sensitization programs and making consensus for implementing zero investment recommendations.
9) Preparation of draft energy audit report including cost benefit analysis.
10) Conducting discussions on the draft report with stakeholders.

11) Answering queries.
12) Preparation of final report.
13) Implementing phase by the competent authority.
14) Promoting feedback for further corrective actions.

2. WATER TREATMENT PROCESS

Raw water is treated to remove dissolved natural color, suspended solids, and iron and to produce water free of pathogenic organisms indicated by the absence of coliform bacteria.

Another requirement is the low aluminium concentration that originates from the aluminium sulphate coagulant when coagulation pH is not within an optimum pre-set range.

As a minimum, the treated water quality will comply with the ‘desirable limiting’ values given in the Indian Drinking Water Quality Standards, the Manual on Water Supply and Treatment, Ministry of Urban Development, Government of India, 1999.

The treatment processes will be designed to produce treated water that is equal to, if not in many respects, better than the desirable limiting values in the Indian Drinking Water Quality Standards. These will be specified as performance criteria for the takeover of the treatment works following completion. Therefore the works should be operated to achieve these performance standards most of the time, with the ‘desirable limiting’ values in Indian Drinking Water Quality Standards being satisfied all the time.

Table 2 below lists the treated water quality requirements for assessing the performance of the work, and corresponding 'desirable limiting values' in the Indian Drinking Water Quality Standards (IDWQS). The values are given only for those parameters which are affected by the treatment process in place. Values of other parameters except those which occur in particulate form would be equal to those in the raw water. For comparison, guideline values given by World Health Organisation (WHO) (1993), which are the same as those proposed in the 2004 Guidelines are also listed.

2.1. Treated Water Quality Criteria (Limiting Values)

Parameter	Performance Standard to be met in 95% of the sample analyzed.	Indian Drinking Water Quality Standard (Desirable Limit) to be met all the time	WHO Guideline Values (1993) and those proposed in 2004 Guideline Values
Colour (^{o} Hazen)	5 ^{o} Hazen	5	Should be colourless
Turbidity (NTU)	1.0	1.0	1.0
Taste and Odour	Unobjectionable	Unobjectionable	Not offensive to consumers
Iron as Fe (mg/l)	0.1	0.3	0.3
Manganese as Mn (mg/l)	0.05	0.1#	0.4
Aluminium as Al (mg/l)	0.1	0.2#	0.2
pH	pHs ±0.4,pHs being the saturation pH value	6.5 to 8.5	<8.0 (for disinfection)
Total coliform (per 100ml)	Nil	Nil	Nil
Faecal coliform (per 100ml)	Nil	Nil	Nil
Free chlorine (after 30 minutes of effective contact time) (mg/l)	>0.5	0.2*	>0.5**

 # Iron, manganese, and aluminium values of 0.1 mg/l as Fe, 0.05 mg/l as Mn, and 0.03 mg/l as Al gave in IDEAS are too low to comply with. Less stringent values equal to the WHO values will be used.

** The proposed value is low for disinfection. A value of greater than 0.5 mg/l is proposed for 100%ile.*

*** Ct (C – free residual chlorine concentration in mg/l after a contact time t in minutes) > 15 mg.min/l*

The above treated water quality criteria also represent the filter performance except for turbidity, pH, bacteriological quality, and final free chlorine residual. They are influenced by the post filtration treatment. Filtered water turbidity standards will be set at 0.5 NTU (95%ile compliance) and 1 NTU (100%ile compliance).

The performance of clarifiers is defined by the following clarified water quality criteria:

Turbidity:	5 NTU
Colour	5 ^{o} Hazen
Aluminium as Al:	0.5 mg/l

A conventional treatment process using coagulation, flocculation, clarification, rapid sand filtration, and disinfection will be used.

Detailed below are brief descriptions of the adopted treatment process.

- Coagulation by dosing aluminium sulphate,
- Flocculation under moderate intensity mixing conditions,
- Clarification of flocculated water with sludge blanket / Lamella clarifiers,
- Filtration of clarified water by rapid gravity sand filters,
- Disinfection of filtered water by chlorine dosing,
- Final pH-correction by dosing lime,
- Clarifier sludge thickening and settlement in sludge lagoons.

The plant items for the treatment process are briefly described below.

2.2. INLET WORKS

The inlet works will comprise an inlet pipe equipped with a magnetic flow meter feeding a cascade aerator with stilling basin. Hydrated lime will be dosed at the aerator inlet. The outlet from the aerator will connect to a channel.

2.3. MIXING FLUME

The channel from the aerator will be provided with a flume where chlorine and hydrated aluminium sulphate flocculants will be dosed. Mixing will be by hydraulic means.

There is a flow division chamber to divide the flow emerging from the flume equally between the clarifiers.

2.4. CLARIFLOCULATION

Clarifiers are the lamella sedimentation type with mechanical flocculates.

The Lamella clarifiers have a settling rate of 0.85 $m^3/h/m^2$ of the projected plate area.

In sludge blanket clarifiers, sludge is collected in a series of hoppers placed at the top level of the blanket. The hoppers of each clarifier have separate manifolds.

Lamella sedimentation tanks are provided with sludge scrapers.

Desludging of clarifiers is under the hydrostatic head; the desludging valves are fitted with pneumatic actuators to allow for automatic desludging on timer control

.

2.5. RAPID GRAVITY FILTERS

After clarification, the clarified water will flow to the rapid gravity sand filters for the removal of residual suspended solids. The filtration unit will consist of six individual filters, which can be operated independently via motorized valves fitted with electric or pneumatic actuators.

2.6. WASH WATER REUSE

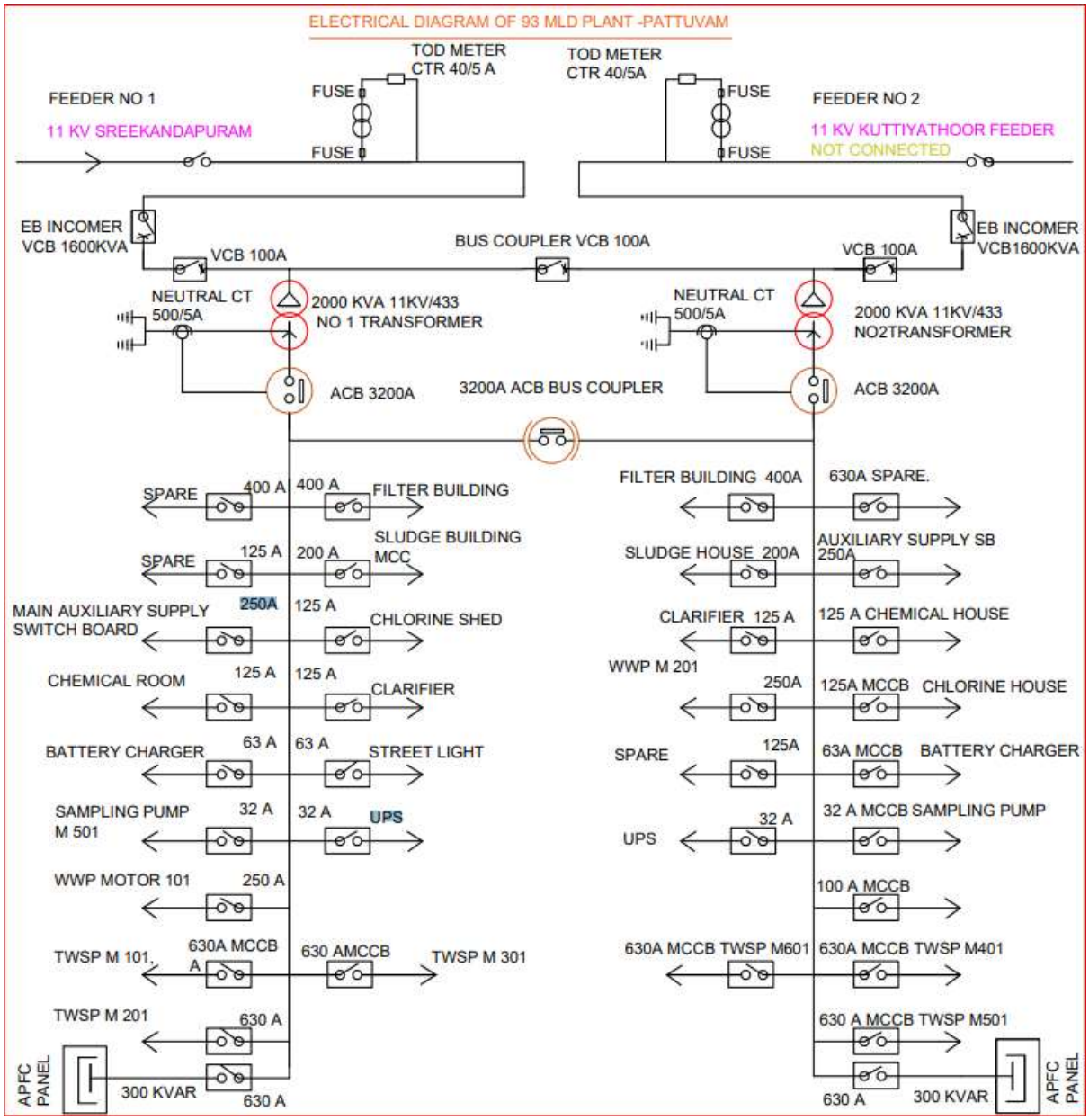
Used wash water from the filters is collected in a tank and pumped to the works inlet chamber, the rate will be less than 5% of maximum works inflow. The tank is provided with two compartments to allow one to be taken out for cleaning.

Two pumps (1 duty, 1 standby) of the Submersible type are provided.

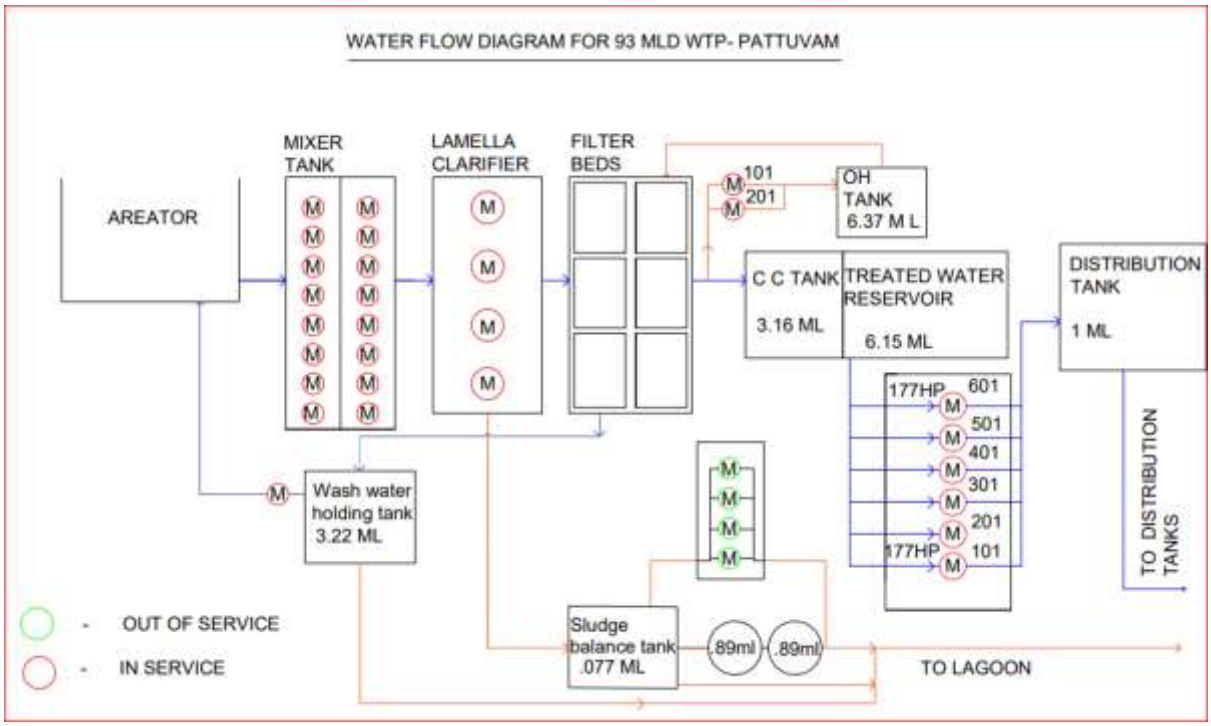
2.7 PHOTOGRAPH OF WASTE WATER COLLECTION TANK

2.8 WASTEWATER PUMPING

3. ELECTRICAL DIAGRAMS



4. WATER FLOW DIAGRAM



5. CONTROL AND MONITORING SYSTEMS

The treatment works are provided with modern facilities to operate the treatment plant items. A central computer based Supervisory Control and Data Acquisition (SCADA) system will be provided at the water treatment works to monitor alarms, plant status, and analogue signals.

The SCADA system is situated in a dedicated control room in the works administrative building (filter building). The SCADA system receives the data from the works monitoring and control systems, and the raw water pumping station. The raw water pumps are operable from the works control room. Data from the works is relayed to the Regional Control Centre, located at the scheme administrative building

6. POWER CHARGE ANALYSIS

6.1 Electricity Bill Details (2020-2021)													
	Name of the Consumer			KERALA WATER AUTHORITY, KWA, SECTION,IRIKKUR									
	CONTRACT DEMAND in KVA			670		75% of CD=503		WATER TREATMENT PLANT & CLEAR WATER PUMPING					
	Tariff		**HT I (A) INDUSTRIAL**			**Consumer number**		**LCN11/5639**	**KSEB Section**	**IRIKKUR**			
Month	KWh				KVA								
	Z1	**Z2**	**Z3**	**Total**	**Z1**	**Z2**	**Z3**	**Max**	**PF**	**PF penalty/incentive in Rs.**	**Energy charge in Rs.**	**Rs/KWh**	
Dec-20	115488	2792	85944	204224	614	460	492	614	0.99	23486	1385090	6.78220973	
Jan-21	111856	6112	90616	208584	625	475	497	625	0.99	23987	1413944	6.77877498	
Feb-21	130416	24272	63520	218208	648	505	604	648	0.99	25694	1477198	6.76967847	
Mar-21	157232	49376	64736	271344	521	497	490	521	0.99	31205	1740081	6.41282284	
Apr-21	137456	42344	68728	248528	488	478	468	488	1	35726	1596396	6.42340501	
May-21	141680	39968	70216	251864	507	479	466	507	0.99	28964	1623117	6.44441842	
Jun-21	139400	44440	44376	228216	505	489	470	505	1	32806	1479663	6.48360763	
Jul-21	134168	39768	66168	240104	518	495	468	518	0.99	27612	1559119	6.49351531	
Aug-21	134712	45584	78664	258960	482	482	469	482	1	37226	1655185	6.39166281	
Sep-21	147296	48496	74840	270632	489	478	463	489	1	38903	1722080	6.36317952	
Oct-21	150248	45408	77600	273256	511	504	465	511	1	39281	1739838	6.36706239	
Nov-21	132144	49448	76464	258056	514	508	462	514	1	37096	1653743	6.4084656	

6.2 POWER CHARGE V/S PRODUCTION

POWER CHARGE VERSUS PRODUCTION					
MONTH	MONTHLY PRODUCTION IN ML	ENERGY IN KWH	ENERGY CHARGE IN Rs.	KWH/ML	Rs./ML
Dec-20	1335.65	204224	1385090	152.90233	1037.016
Jan-21	1395.74	208584	1413944	149.44331	1013.043
Feb-21	1402.38	218208	1477198	155.59834	1053.351
Mar-21	1686.66	271344	1740081	160.87653	1031.673
Apr-21	1688.5	248528	1596396	147.18863	945.4522
May-21	1656.81	251864	1623117	152.01743	979.6639
Jun-21	1426.98	228216	1479663	159.92936	1036.919
Jul-21	1551.45	240104	1559119	154.76103	1004.943
Aug-21	1674.46	258960	1655185	154.65284	988.4888
Sep-21	1707.45	270632	1722080	158.50069	1008.568
Oct-21	1778.45	273256	1739838	153.6484	978.289
Nov-21	1681.93	258056	1653743	153.4285	983.2413
Total			19045454	154.41228	1005.054

6.3 POWER BILL ANALYSIS

On observing the power bill data of last one year, the bills for the months August 2021 and September 2021 the maximum demand was 482 kVA and 489 kVA respectively. These values are lesser than the 75 % of CD (75% 0f 670), however this is because of an incidental requirement of reduction in operation. The remaining ten months the maximum demand was within 75 % and 100% of the CD. There were recommendations to replace less efficient motor pump sets and idling of some motor mechanisms in the treating process. Once the recommendations are implemented, there will be scope for reducing the Contract Demand as per the reduced demand in future if there are no requirements to increase the utilised capacity of the plant. The average energy charge comes around Rs.1.005 per Kl for treating process and clear water pumping.

7 KNOW YOUR PLANT

PRODUCTION COST (KNOW YOUR PLANT)-Jica Pattuvam								
Yearly production in ml					**18986.46**			
Sl. No.	**Components**	**Unit**	**Quantity**	**Rate in Rs.**	**Amount in Rs.**	**Cost in Rs.per mld**	**Cost in Rs.per kl**	**In %**
	Electrical expenses for raw water pumping	Rs.			61886854	3259.526		63.55624
1	Electrical expenses for clear water pumping and allied treating operations	Rs.			19045454	1003.107		19.5592
2	Salaries				3579584	188.5335		3.676143
3	Wages				4071150	214.4239		4.180969
4	O and M expenditure				3221159	169.6556		3.308049
5	Expenditure through TA				209082	11.01216		0.214722
	Chemicals							0
6	Alum	MT	168.4	22243	3745721	197.2838		3.846761
7	Lime	MT	85.6	12980	1111088	58.52002		1.141059
8	Chlorine	MT	40.62	12390	503281.8	26.50741		0.516858
Total					**97373374**	**5128.569**	**5.128569**	**100**

8. TRANSFORMERS @ 2 Nos

8.1 TRANSFORMER SPECIFICATION		
1	MAKE	INDOTECH TRANSFORMERS
2	RATED KVA	2000
3	RATED VOLTAGE	HV 11000
		LV 433
4	AMPERE	HV 83.98
		LV 2667
5	PHASE	3
6	SR NO	IT- 43450
7	WORK ORDER NO	IT-3055
8	CUSTOMER'S REF	MGB PO 749 DATED 28.4.2009
9	CUSTOMER	M/S VA TECH WABAG
10	YEAR OF MANUFACTURE	2009
11	TYPE OF COOLING	ONAN
12	FREEQUENCY	50 HZ
13	IMPEDANCE %	6.38
14	VECTOR GROUP REF NO	DYN11
15	CORE & WINDING Kg	2495
16	OIL Kg	1635
17	TOTAL WEIGHT Kg	6335
18	OIL IN LITERS	1630

8.2 PHOTOGRAPH OF TRANSFORMERS

8.3 Calculation for transformer losses of capacity 2000 kva

Calculation for transformer loss of capacity 2000 kva								
No load loss in watts =2400			Full load loss in watts=19000		Total load in kVA=540			
	Total loss= no load loss +(% of load/100)^2 * full load loss							
Sl. No.	Status		Percentage of load	No load loss in Watts	Load loss in Watts	Sub total	Total loss in Watts	System loss in Watts
1	Transformer 1 alone in operation		27	2400	3785.1	6185.1	6185.1	6185.1
1	Transformer 2 alone in operation		27	2400	3785.1	6185.1	6185.1	
2	Transformer 1 & 2 are equally shared	Transformer 1	13.5	2400	2746.275	5146.275	5146.275	10292.55
		Transformer 2	13.5	2400	2746.275	5146.275	5146.275	
3	Load is connected any one and the other one is in on position (existing)	Transformer 1 (loaded)	27	2400	3785.1	6185.1	6185.1	8585.1
		Transformer 2 (not loaded)	0	2400	0	2400	2400	

9. STUDY OF PUMPS AND MOTORS

9.1 101 C W MOTOR DATA

Motor and Pump performance chart No.101					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica Plant			
	Application	Clear water pumping			
	Location ID	93 MLD –WTP	101		
Pipe line	Material			MS	
	Size		mm	1118	
	Length		M	500	
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	275622510006			
	Principle of operation	Squirrel cage induction			
	Power		HP	177	
	Speed		RPM	1485	
	Frequency		Hz	50	
	Voltage		Volt	415	413
	Current		Amps	223	220
	PF				0.99
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type	**SCT250/38**			
	ID. No.	**1737709006**			
	Impeller Diameter	**CF 8M**			
	Column pipe Diameter				
	Speed		**RPM**	**1485**	
	Flow/Discharge		**M3/Hr**	**937**	**929**
	Head		**M**	**39.5**	**39**

	Density		**Kg/M3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**177**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**24**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.2 101 USED WASH WATER PUMPING MOTOR

Motor and Pump performance chart Backwash reuse 50 hp-1					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Backwash water reuse.			
	Location ID	93 MLD - WTP			
Pipe line	Material			MS	
	Size		mm		
	Length		M		
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	Submersible			
	ID. No.				
	Principle of operation	Squirrel cage induction			
	Power		HP	50	
	Speed		RPM	1450	
	Frequency		Hz	50	
	Voltage		Volt	415	413
	Current		Amps		52
	PF				
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type				
	ID. No.				
	Impeller Diameter				
	Column pipe Diameter				
	Speed		**RPM**	**1450**	
	Flow/Discharge		**M3/Hr**		**221**

	Head		**M**	**27**	**27**
	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**50**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**8**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.3 201 C W MOTOR DATA

Motor and Pump performance chart 202					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Clear water pumping			
	Location ID	93 MLD - WTP	202		
Pipe line	Material			MS	
	Size		mm	1118	
	Length		M	500	
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	2.75623E+11			
	Principle of operation	Squirrel cage induction			
	Power		HP	177	
	Speed		RPM	1485	
	Frequency		Hz	50	
	Voltage		Volt	415	410
	Current		Amps	223	214
	PF				0.99
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type	**SCT250/38**			
	ID. No.	**1737709005**			
	Impeller Diameter	**CF 8M**			
	Column pipe Diameter				
	Speed		**RPM**	**1485**	
	Flow/Discharge		**M3/Hr**	**937**	**930**

	Head		**M**	**39.5**	**39**
	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**177**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**24**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.4 201 USED WASH WATER PUMPING MOTOR

Motor and Pump performance chart Used wash water 50 hp-2					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Backwash water reuse.			
	Location ID	93 MLD -WTP			
Pipe line	Material			MS	
	Size		mm		
	Length		M		
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	Submersible			
	ID. No.				
	Principle of operation	Squirrel cage induction			
	Power		HP	50	
	Speed		RPM	1450	
	Frequency		Hz	50	
	Voltage		Volt	415	415
	Current		Amps		48
	PF				
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type				
	ID. No.				
	Impeller Diameter				
	Column pipe Diameter				
	Speed		**RPM**	**1450**	

	Flow/Discharge		**M3/Hr**		**221**
	Head		**M**	**27**	**27**
	Density		**Kg/M3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**50**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**8**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.5 301 C W MOTOR DATA

Motor and Pump performance chart 301					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Clear water pumping			
	Location ID	93 MLD - WTP	301		
Pipe line	Material			MS	
	Size		mm	1118	
	Length		M	500	
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	2.75623E+11			
	Principle of operation	Squirrel cage induction			
	Power		HP	177	
	Speed		RPM	1485	
	Frequency		Hz	50	
	Voltage		Volt	415	413
	Current		Amps	223	218
	PF				0.99
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type	**SCT250/38**			
	ID. No.	**1737709004**			
	Impeller Diameter	**CF 8M**			
	Column pipe Diameter				
	Speed		**RPM**	**1485**	
	Flow/Discharge		**M3/Hr**	**937**	**940**

	Head		**M**	**39.5**	**39**
	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**177**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**24**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.6 401 C W MOTOR DATA

Motor and Pump performance chart 401					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Clear water pumping			
	Location ID	93 MLD - WTP	401		
Pipe line	Material			MS	
	Size		mm	1118	
	Length		M	500	
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	2.75623E+11			
	Principle of operation	Squirrel cage induction			
	Power		HP	177	
	Speed		RPM	1485	
	Frequency		Hz	50	
	Voltage		Volt	415	412
	Current		Amps	223	216
	PF				0.99
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type	**SCT250/38**			
	ID. No.	**1737709003**			
	Impeller Diameter	**CF 8M**			
	Column pipe Diameter				
	Speed		**RPM**	**1485**	
	Flow/Discharge		**M3/Hr**	**937**	**932**

	Head		**M**	**39.5**	**39**
	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**177**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**18**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.7 501 C W MOTOR DATA

Motor and Pump performance chart 501					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Clear water pumping			
	Location ID	93 MLD - WTP	501		
Pipe line	Material			MS	
	Size		mm	1118	
	Length		M	500	
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	2.75623E+11			
	Principle of operation	Squirrel cage induction			
	Power		HP	177	
	Speed		RPM	1485	
	Frequency		Hz	50	
	Voltage		Volt	415	412
	Current		Amps	223	218
	PF				
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type	**SCT250/38**			
	ID. No.	**1737709002**			
	Impeller Diameter	**CF 8M**			
	Column pipe Diameter				
	Speed		**RPM**	**1485**	
	Flow/Discharge		**M3/Hr**	**937**	**950**

	Head		**M**	**39.5**	**39**
	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**177**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**18**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.8 601 C W MOTOR DATA

Motor and Pump performance chart 601					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Clear water pumping			
	Location ID	93 MLD - WTP	601		
Pipe line	Material			MS	
	Size		mm	1118	
	Length		M	500	
Motor	Make	Marathon Electric			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	2.75623E+11			
	Principle of operation	Squirrel cage induction			
	Power		HP	177	
	Speed		RPM	1485	
	Frequency		Hz	50	
	Voltage		Volt	415	417
	Current		Amps	223	214
	PF				0.99
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirlosker Brothers**			
	Year of Manufacture	**2008**			
	Type	**SCT250/38**			
	ID. No.	**1737709001**			
	Impeller Diameter	**CF 8M**			
	Column pipe Diameter				
	Speed		**RPM**	**1485**	

	Flow/Discharge		**M3/Hr**	**937**	**910**
	Head		**M**	**39.5**	**39**
	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**177**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**18**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.9 BLOWER 201 MOTOR DATA

Motor and Pump performance chart					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Filterbed cleaning			
	Location ID	93 MLD -WTP			
Pipe line	Material			MS	
	Size		mm	150	
	Length		M	25	
Motor	Make	SIEMENS			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	N864138515			
	Principle of operation	Squirrel cage induction			
	Power		KW	45	
	Speed		RPM	1475	
	Frequency		Hz	50	
	Voltage		Volt	415	410
	Current		Amps	78	45
	PF			0.83	0.97
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
BLOWER	**working hours**				**0.5**
	Make	**USHA COMPRESSOR**			
	TYPE	**UR 1150**			
	Year of Manufacture	**2008**			
	Serial no	**890217**			
	CAPACITY	**2475 M3/H**			

9.10 BLOWER 301 MOTOR DATA

Motor and Pump performance chart					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Filterbed cleaning			
	Location ID	93 MLD -WTP			
Pipe line	Material			MS	
	Size		mm	150	
	Length		M	25	
Motor	Make	SIEMENS			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	N864138516			
	Principle of operation	Squirrel cage induction			
	Power		KW	45	
	Speed		RPM	1475	
	Frequency		Hz	50	
	Voltage		Volt	415	410
	Current		Amps	78	45
	PF			0.83	0.97
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
BLOWER	**working hours**				**0.5**
	Make	**USHA COMPRESSOR**			
	TYPE	**UR 1150**			
	Year of Manufacture	**2008**			
	Serial no	**890216**			
	CAPACITY	**2475 M3/H**			

9.11 OH BACKWASH 101 MOTOR DATA

Motor and Pump performance chart - Backwash 101					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	PATTUVAM Jica plant			
	Application	Clear water pumping for backwash	101		
	Location ID	93 MLD - WTP			
Pipe line	Material			MS	
	Size		mm	150	
	Length		M	25	
Motor	Make	SIEMENS			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	N8/64138495			
	Principle of operation	Squirrel cage induction			
	Power		HP	40	
	Speed		RPM	1470	
	Frequency		Hz	50	
	Voltage		Volt	415	414
	Current		Amps	54	44
	PF			0.83	0.99
	Efficiency				
	Starting mechanism	Soft starter			
	% of loading of on pump				
Pumps	**Make**	**Kirloskar**			
	Year of Manufacture				
	Type	**UP125/30A**			
	ID. No.	**1745608058**			
	Impeller Diameter			**LTB5/290**	
	Column pipe Diameter				
	Speed		**RPM**	**1465**	
	Flow/Discharge		**M3/Hr**	**242**	**199.43**
	Head		**M**	**24**	**24**

	Density		**Kg/M 3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**40**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**4**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.12 OH BACKWASH 201 MOTOR DATA

Motor and Pump performance chart- Backwash 201					
Utility	**Description**	**Parameters**		**Design/Name plate details**	**Operating details**
General	Location	WTP-PATTUVAM Jica plant			
	Application	Clear water pumping for back washing			
	Location ID	93 MLD -WTP			
Pipe line	Material			MS	
	Size		mm	150	
	Length		M	25	
Motor	Make	SIEMENS			
	Year of Manufacture	2008			
	Type	CF			
	ID. No.	N8/64138494			
	Principle of operation	Squirrel cage induction			
	Power		HP	30	
	Speed		RPM	1470	
	Frequency		Hz	50	
	Voltage		Volt	415	414
	Current		Amps	54	41
	PF			0.83	0.99
	Efficiency				
	Starting mechanism	Soft starter			

	% of loading of on pump				
Pumps	**Make**	**Kirloskar**			
	Year of Manufacture				
	Type	**UP125/30A**			
	ID. No.	**1745608059**			
	Impeller Diameter			**LTB5/290**	
	Column pipe Diameter				
	Speed		**RPM**	**1465**	
	Flow/Discharge		**M3/Hr**	**242**	**188.65**
	Head		**M**	**24**	**24**
	Density		**Kg/M3**	**1000**	
	Gravitational Constant		**M/s2**	**9.81**	
	Prime mover rating		**HP**	**40**	
	Type of control	**Throttling**			
	Status of valve	**Open fully**			
	Working Hours		**Hrs**		**4**
	% of loading of on head				
	% of loading of on discharge				
	% of loading of on motor				
Combined	Efficiency				

9.13 OTHER MOTOR DETAILS

OTHER MOTOR DETAILS											
Sl no	Description	Quantity in Nos	Power in KW	Current		Voltage		Speed in rpm	Status	working Hours	CONSUMPTION ENERGY IN KWH
				Rated	operational	Rated	Operational				
1	Flocculator motor	16	2.2	4.4	3	415	408	1435	working	24	50.34
2	Scrapper motor	4	0.75	2	1.3	415	410	935	working	24	21.92
3	Alum agitator	2	2.2	4.4	3.2	415	408	1435	working	24	53.70
4	Alum recirculation motor	2	1.5	3.3	2.8	415	408	1415	working	12	23.49
5	Feed pump	2	3.7	7	5.9	415	410	1440	working	1	4.15
6	Lime agitator	2	1.1	2.5	2.3	415	411		working	1.5	2.43
7	Lime feed pump	2	3.7	7	3	415	410	1440	working	8	16.86
8	Sludge thickener	4	2.2	4.9	0	415		950	Not working	0	0.00
9	Valve driving motor	8	0.37	0.93	0.9	415	408	2800	working	24	15.10
10	Compressor	2	3.7	7	6	415	408	1440	working	20	83.90
11	Vacuum pump	2	2.2	4.2	4	415	410	2840	working	1	2.81
12	Drainage pump	2	1.5	3.1	3	415	411		working	1	2.11
13	Chlorin shed	3	2.2	4.2	3	415	408	2850	standby	24	50.34
14	Compressor	2	3.7	7	6.7	415	405	1450	working	12	55.80
15	Used wash water pumping	2	37		52	415	405		working	4	144.36
	TOTAL	55									527.32

9.14. LIGHT LOAD IN CLARIFIER AND GALLERY

LIGHT LOAD						
SL NO		WATTAGE	QUANTITY	TOTAL QUANTITY IN KW	WORKING Hrs	ENERGY IN KWH
	CHLORINE ROOM					
1	TUBE LIGHT	40	16	0.64	12	7.68
2	MERCURY LAMP	30	7	0.21	12	2.52
3	HALOGEN LAMP	70	2	0.14	12	1.68
	ALUM FED BUILDING			0		0
1	MERCURY LAMP	30	15	0.45	12	5.4
2	LED	50	1	0.05	12	0.6
	FILTER BED AND GALLERY			0		0
1	MERCURY LAMP	70	35	2.45	12	29.4
2	TUBE LIGHT	40	3	0.12	12	1.44
	CLARIFIERS			0		0
1	FLUORESCENT TUBE	70	40	2.8	5	14
S	**SCADA ROOM & BUILDING**			0		0
	AC	2520	1	2.52	24	60.48
	TUBE LIGHT	40	49	1.96	24	47.04
	LAB AND OFFICE ROOM			0		0
1	FLUORESCENT TUBE	40	38	1.52	10	15.2
2	FLUORESCENT TUBE	60	3	0.18	10	1.8
	STREET & YARD LIGHTING			0		0
	HALOGEN	400	2	0.8	12	9.6
	FLUORESCENT TUBE	40	30	1.2	12	14.4
	SODIUM VAPOUR	70	31	2.17	12	26.04
	PANEL & MOTOR ROOM			0		0
	TUBE LIGHT	40	54	2.16	12	25.92
	EXHAUST FAN	60	9	0.54	0	0
	SODIUM VAPOUR LAMP	70	14	0.98	12	11.76
	TOTAL			**20.89**		**275**

9.15 EFFICIENCY TESTS FOR PUMP SETS

EFFICIENCY TESTS FOR PUMP SETS											
			18-01-2022		No. of trial		3	Time	11:00:00 to 1.30 pm		
Location	**No.**	**Type**	**HP**	**INPUT DATAS**				**OUTPUT DATAS**			**Efficiency in %**
				Voltage in Volts	**Current in Amps**	**PF**	**INPUT in KW**	**Discharge in M3/S**	**Head in m**	**OUTPUT in KW**	
Clear water	101	CF	177	413	220	0.99	155.80	0.2581	39	98.75	63.38
Clear water	201	CF	177	410	214	0.99	150.45	0.2583	39	98.82	65.69
Clear water	301	CF	177	413	218	0.99	154.38	0.2611	39	99.89	64.71
Clear water	401	CF	177	412	216	0.99	152.59	0.2589	39	99.05	64.91
Clear water	501	CF	177	412	218	0.99	154.01	0.2639	39	100.97	65.56
Clear water	601	CF	177	417	214	0.99	153.01	0.2528	39	96.72	63.21
Used wash water	101	SUB	50	413	52	0.99	36.82	0.0614	27	16.26	44.16
Used wash water	201	SUB	50	415	48	0.99	34.16	0.0614	27	16.26	47.61
Back wash pumping	201	CF	40	414	41	0.99	29.10	0.0524	24	12.34	42.39
Back wash pumping	101	CF	40	414	44	0.99	31.23	0.0554	24	13.04	41.76

10. SPECIFIC ENERGY CONSUMPTION

Calculation of Specific Energy Consumption for WTP Pattuvam			
	Existing in kwh/ML of water	Savings proposed in kwh/ML of water	Proposed in kwh/ML of water
Clear water pumping and other treating process	149.21	43.58	105.63
Light load	5.20	0.00	5.20
Total	154.41		110.83

11. SENSITIZATION PROGRAM FOR STAFF

There was no wide level of acceptance for energy audit as it was mistakenly interpreted as energy audit is a fault-finding mechanism similar to other audits. The success of any audit depends on the transparency and the involvement of the stakeholders. The cooperation and coordination among the staff are very essential for the collection of data as well as for the successful implementation of the audit report. During the awareness camp the Head Operator Supervisor and operating staff were present. The discussions were fruitful and the confidence among the staff was improved. The preliminary recommendations were also discussed and ensured cooperation for implementing the same.

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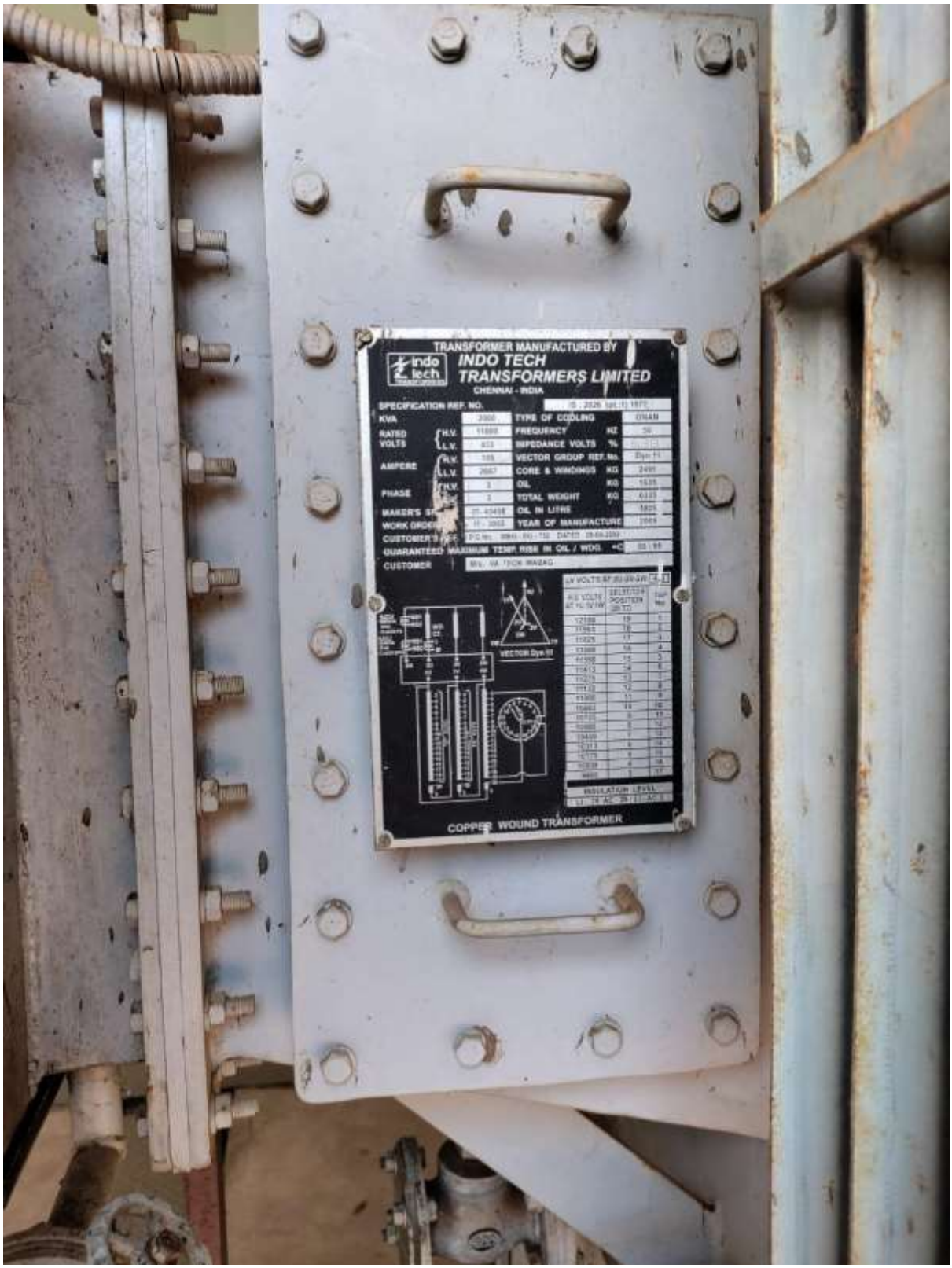
12. Energy Audit – Recommendations

1 Used wash water by pass arrangement to sludge lagoon by gravity instead of pumping.

It is noted that the used wash water is pumped into lagoon by a bypass arrangement as the wash water is not fit to recycle. As this practice is consuming more energy, would have been avoided. On observing the existing mechanism, it is realised that the provision of shutter mechanism with the construction of opening to guide the used wash water into the lagoon which avoids the pumping of used wash water. This proposal brings the savings of 89724 kWh per year. And expenditure for the work can be recouped within 1.4 years. And the pumping mechanism can be used once the quality of used wash water meets the required standards.

2 Transformer load sharing



The existing transformers @ 2 Nos. having capacity 2000 kVA are loaded at present. On evaluation of different conditions of operations with the calculation of no load and load

losses, it is ascertained that it could be the best option that the load can be engaged in any of the transformers at a time and the remaining can be kept as standby as not even connected to the power line. The calculation sheet for savings is appended. It could be taken care that the stand by transformer must be taken in to active at least once in a month so that to ensure to maintain the megger value and safe condition for transformer oil. The savings we expected in this case is more than Rupees 1.2 lakhs per year and energy can be saved 21024 Kwh per year. This fact has been discussed on the awareness programme of this audit and it was implemented.

3 Optimisation in usage of Clarifier and flocculation as design capacity 93 mld and utilised capacity is only 53 mld

It has been observed that there are 16 Nos. mixer tank motors @2.2 Kw and 4 Nos. scrapper motors @ 0.75 kW to manage the designed quantity of 93 mld water. At present the utilised capacity is only 53 mld. It is recommending shutting down on way of opening into the flocculators and hence one fourth of the motors input can be avoided (ie. 2Nos. of 2.2 kW and 1 number of 0.75 kW). This mechanism of operation can be relaxed once the quality of raw water becomes too bad.

4. Proper ventilation in MCC rooms & chemical rooms.

It has been observed that the ventilation facilities provided during the construction time of the plant have been subjected to changes which attract serious lapse in safety and affect durability of the machineries and equipment. It is recommended to restore the ventilation facilities at the earliest.

5. Recycling of used wash water from sludge lagoons with solar energy.

We observed that over flow of wash water from the lagoon, which creates nuisance. The possibility for pumping this water from the lagoon to Clarifier with the help of solar plants can be exploited. The proposal for the same is appended which saves an amount of Rs.18, 07,809 per year.

6 Keeping average water level more than 3.5 m in the sump.

It is observed that the average water level maintained in the Treated water reservoir is below 3 m against the maximum level of 4.3 m. On experiment it is realised that it could be easily to increase the average water level to 3.5 m so as to reduce the pumping charge. The savings in respect of money and energy is postulated in the calculation sheet of executive summary. This is the zero investment recommendation. This fact has been discussed on the awareness

programme. An energy savings for 36593.88 Kwh and an amount of savings for Rs.2.1 lakhs has been observed in this respect on calculations.

7. Replacing Back wash motor pump sets of 40 hp capacity by 30 hp @2 nos.

The efficiency of existing backwash 40 hp motor pump sets @ 2 numbers is very less (42%). The discharges of these pump sets are very less. It is recommending replacing these motors by efficient motor pump sets having capacity of 30 hp. It is calculated that 28644 kWh can be saved per year and the capital cost incurred can be recouped within 67 months.

8 Replacing less efficient treated water motor pump sets of capacity 177 hp with efficient @ 2 nos.

The efficiency of existing Treated water motor pump sets of 177 hp @ 2 numbers is very less (63.25%). It is recommending replacing these motors by efficient motor pump sets having the same rated capacity. It is calculated that 355488 kWh can be saved per year and the capital cost incurred can be recouped within 39.5 months.

9 General recommendations for the maintenance of motors

Inadequate maintenance of motors can significantly increase losses and lead to unreliable operation. For example, improper lubrication can cause increased friction in both the motor and associated drive transmission equipment. Resistance losses in the motor, which rise with the temperature, would increase. Providing adequate ventilation and keeping motor cooling ducts clean can help dissipate heat to reduce excessive losses. The life of the insulation in the motor would also be longer: for every 10o C increase in motor operating temperature over the recommended peak, the time before rewinding would be needed is estimated to be halved.

A checklist of good maintenance practices to help ensure proper motor operation would include:

1. Inspecting motors regularly for wear in bearings and housings (to reduce frictional losses) and for dirt/dust in motor ventilating ducts (to ensure proper heat dissipation).

2. Checking load conditions to ensure that the motor is not over or under loaded. A change in motor load from the last test indicates a change in the driven load, the cause of which should be understood.

3. Lubricating appropriately. Manufacturers generally give recommendations for how

and when to lubricate their motors. Inadequate lubrication can cause problems, as noted above. Over lubrication can also create problems, e.g.excess oil or grease from the motor bearings can enter the motor and saturate the motor insulation, causing premature failure or creating a fire risk.

4. Checking periodically for proper alignment of the motor and the driven equipment.

Improper alignment can cause shafts and bearings to wear quickly, resulting in damage to both the motor and the drive equipment.

5. Ensuring that supply wiring and terminal box are properly sized and installed. Inspect regularly the connections at the motor and starter to be sure that they are clean and tight.

6. Valve operation has to be ensured on starting and stopping of the motor to ensure the low load on starting and to protect the motor from backpressure respectively.

7. The logbook has to be maintained in such a way that voltage and current of every hour are documented so that to avail the same for future references.

CONCLUSION

The objective of the study was to delineate the issues in energy consumption of wtp, to optimize the method of operation, to understand the extent of deviation from the standard of operation, and to explore the possibility of adopting advanced technologies in our sector. On evaluation, it may be realized that each power utility centre has a unique optimization need. It is also realized that the present specific energy consumption of wtp is 154.41 kWh per ML. The kWh per ML consumption is comparatively low in the filter house as the head creation required is less. Benchmarking for energy use has been proposed as 115 kWh per ML for treating and clear water pumping and it can be achieved by introducing the proposed operating procedure.

This plant is constructed on proper planning and operating with proper procedure, still, we have energy saving options to be implemented which are listed for implementation.

It is also noted that the appreciable effort made by operational staff and section staff to run the automated plant without outsourcing in a successful manner. This practice may be initiated to the other water treatment plants, constructed under JICA aid, running under KWA at other districts.

ANNEXURE

14.1 PAYBACK PERIOD CALCULATION

Energy Saving Calculation				
Energy Efficiency in Existing Pumping system by replacing inefficient motors (CF) for clear water pumping @ 177 hp each, 2 Nos.				
	Description Unit	**Unit**	**Old System**	**New System**
	Type of Motor	Induction		
	Class of Motor		Standard	IE2
	Motor power (rated)	Kw	132	132.00
	Efficiency (rated)	%	95.5	95.50
	Combined system efficiency of the system (measured)	%	63.76	
	Pump efficiency	%		78.00
	Combined efficiency of the system (rated)	%	70	74.49
Require ment	Head	m	39	39.00
	Flow	m^3/s	0.257	0.2603
	Density of water	kg/m3	1000	1000.00
	Gravitational Constant	m/s^2	9.81	9.81
	Hydraulic Power required to meet the demand by existing pumpset	kW	98.33	99.59
	Total Electrical Power drawn to meet the requirement	kW	154.21	133.69
	Unit Cost for power	Rs./kWh	5.75	5.75
	Annual operating Hours	Hours	8760	8760.00
	Annual energy consumption	kWh /year	1350897.93	1171153.75
	Annual power Savings, kWh	kWh		179744.17
	Annual Savings	Rs. In Lakhs		10.34
	For two Nos	Rs. In Lakhs		20.67
	Proposed load	Kw		132.00
	Investment required in Lakhs	Rs, in lakhs		34.00
	For two Nos			68.00
	Simple Payback period	In years		3.29
		In months		39.48

14.2 PAYBACK PERIOD CALCULATION

OPERATIONAL OPTIMISATION OF TRANSFORMERS-ONE KEEP AS STANDBY-PATTUVAM			
	Load status	**Total Loss in Watts**	
	Load is connected any one and the other one is in on position (existing)	**8585.1**	
	Transformer No.1 or No.2 alone in operation latter in off position	**6185.1**	
Savings in kW			2.4
No. working Hours per year			8760
Energy savings per year in kWh			21024
Cost in Rs. per kWh			5.75
Amount Savings in Lakhs per year			1.2089
Investment required			0

14.3 PAYBACK PERIOD CALCULATION

Energy Saving Calculation				
Replacing Back wash motor pump sets of 40 hp by 30 hp @2 Nos.				
	Description Unit	**Unit**	**Old System**	**New System**
	Type of Motor	Induction		
	Class of Motor		Standard	IE2
	Motor power (rated)	Kw	30	22.00
	Efficiency (rated)	%	95.5	95.50
	Combined system efficiency of the system (measured)	%	42.00	
	Pump efficiency	%		78.00
	Combined efficiency of the system (rated)	%	70	74.49
Requirement	Head	m	24	24.00
	Flow	m^3/s	0.0554	0.0672
	Density of water	kg/m3	1000	1000.00
	Gravitational Constant	m/s^2	9.81	9.81
	Hydraulic Power required to meet the demand by existing pumpset	kW	13.04	15.83
	Total Electrical Power drawn to meet the requirement	kW	31.06	21.25
	Unit Cost for power	Rs./kWh	5.75	5.75
	Annual operating Hours @4 hrs per day	Hours	1460	1460.00
	Annual energy consumption	kWh /year	45341.259	31019.42
	Annual power Savings, kWh	kWh		14321.84
	Savings per year for 2 Nos.	kWh		28643.68
	Annual Savings	Rs. In Lakhs		1.647012
	Proposed load	Kw		22.00
	Investment required in Lakhs @15225 / hp @2 Nos	Rs, in lakhs		9.20
	Simple Payback period	In years		5.59
		In months		67.03

14.4 PAYBACK PERIOD CALCULATION

Energy Saving Calculation				
Keeping TWR average water level as 3.5,Pattuvam				
	Description Unit	**Unit**	**Old System**	**New System**
	Average Suction level of Treated water Reservoir	**m**	**3**	**3.5**
Requirement	Total Head required to pump the water	m	39	38.5
	Average rate of Flow for 49.5 mld	m^3/s	0.55	0.55
	Density of water	kg/m3	1000	1000
	Gravitational Constant	m/s^2	9.81	9.81
	Hydraulic Power required to meet the demand by existing pumpset	kW	210.42	207.73
	Total Electrical Power drawn to meet the requirement	kW	325.84	321.66
	Unit Cost for power	Rs./kWh	5.75	5.75
	Annual operating Hours	Hours	8760	8760
	Annual energy consumption	kWh /year	2854318.09	2817724.3
	Annual power Savings, kWh	kWh		36593.822
	Annual Savings	Rs. In Lakhs		2.1041447
	Investment required in Lakhs	Rs, in lakhs		0
	Simple Payback period	In years		0
		In months		0

14.5 PAYBACK PERIOD CALCULATION

Energy Saving Calculation			
Usage of used wash water from Lagoon to Clarifier with Solar plant (with the pumping mechanism of 32 m head)			
Description Unit	**Unit**	**Existing mechanism**	**Proposed mechanism**
Quantity of water required to pump for recycling	mld	1.70	1.7
Head	m	130	27
Flow	m^3/s	0.019700	0.0197
Density of water	kg/m3	1000	1000
Gravitational Constant	m/s^2	9.81	9.81
Hydraulic power	kW	25.123410	5.2179
Electrical power would have been incurred with 70% of system	kW	35.89	7.4542
Energy charge in Rs./kWh		5.75	0
Working hours / year		8760	8760
kWh per annum	kWh	314402	65298.779
Savings in kWh per year			249102.75
Energy charge per year	Rs.	1807809	0
Savings in Rs.per year (The savings will reflect in the power bill of Raw water pumping)	Rs.		1807809
Investment required in Rs.	Rs.		950000
Simple Payback period	In years		0.525498
	In months		6.3059766

14.6 PAYBACK PERIOD CALCULATION

Energy Saving Calculation			
SUPPLY AND FIXING OF NEW BY-PASS SHUTTER MECHANISM TO GUIDE USED WASH WATER TO THE LAGOON.			
Description Unit	**Unit**	**Existing pumping mechanism**	**Proposed by-pass valve mechanism**
Quantity of water required to pump for recycling	mld	1.768	0.0000
Required additional head due to the recycling		24	0
Head savings	m	0	24
Flow	m^3/s	0.06134	N/A
Density of water	kg/m3	1000	N/A
Gravitational Constant	m/s^2	9.81	N/A
Hydraulic power	kW	14.4418896	0.00
Electrical power incurred with 47% efficiency of existing motors	kW	30.72742468	0.00
Energy charge in Rs./kWh		5.45	0.00
Working hours / year @8 hrs per day		2920	0
kWh can be saved per year	kWh	89724.08007	0
Energy charge required	Rs.	488996.2364	0
Energy charges savings per year	Rs.		488996
Investment required to prepare bypass valve and for civil works	Rs.		350000.00
Simple Payback period	In years		1.40
	In months		16.77

14.7 PAYBACK PERIOD CALCULATION

Optimisation in usage of Clarifier and flocculation as design capacity 93 mld and utilised capacity is only 53 mld			
Particulars		Units	Quantity
Total kW of motors under proposal of shut down	(2.2*4)+0.75*1	kW	9.55
Expected input with 65 % efficiency		kW	6.2
No. working Hours per day		Hours	24
No. working Hours per year		Hours	8760
Energy savings per year in kWh		kWh	54312
Cost in Rs. per kWh		Rs.	5.75
Amount Savings		Rs.	312294
Investment required			0