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adani

APSEZ/EnvCell/2017-18/040 **Date:** 22.11.2017

To

Additional Principal Chief Conservator of Forests (C),
Ministry of Environment, Forest and Climate Change,
Regional Office (WZ), E-5, Kendriya
Paryavaran Bhawan, Arera Colony,
Link Road No. – 3, Bhopal – 462 016.
E-mail: rowz.bpl-mef@nic.in

Sub : Half yearly Compliance report for Environment Clearance for the "Township and area development project" at Survey no. 141 (part), village: Mundra, Dist. Kutch, by M/s. Adani Mundra SEZ Infrastructure Pvt. Ltd."

Ref : Environment clearance granted to Adani Mundra SEZ Infrastructure Pvt. Ltd. vide letter dated 20th February, 2010 bearing SEIAA letter no. SEIAA/GUJ/EC/8(b)/44 /2010.

Dear Sir,

Please refer to the above cited reference for the said subject matter. In connection to the same, it is to state that copy of the compliance report for the Environmental Clearance for the period of April – 2017 to September – 2017 is enclosed here for your records. The stated information is also provided in form of a CD (soft copy).

Thank you,
Yours Faithfully,
For, **M/s Adani Ports and Special Economic Zone Limited**

Ennarasu Karunesan
Chief Executive Officer
Mundra & Tuna Port

Encl: As above

Copy to:

1) Zonal Officer, Regional Office, CPCB – Western Region, Parivesh Bhawan, Opp. VMC Ward Office No. 10, Subhanpura, Vadodara – 390 023
2) Member Secretary, GPCB – Head Office, Paryavaran Bhavan, Sector 10 A, Gandhi Nagar – 382 010
3) Member Secretary, SEIAA, Gujarat, Paryavaran Bhavan, GPCB, Sector 10 A, Gandhi Nagar – 382 010
4) Regional Officer, Regional Office GPCB (Kutch-East), Gandhidham, 370201

01/12/17

कार्यालय / OFFICE
पर्यावरण एवं वन मंत्रालय (केन्द्रीय)
Ministry of Environment & Forests (C)
क्षेत्रीय कार्यालय (पश्चिम)
Regional Office (West)

Environmental Clearance Compliance Report

of

Township and Area Development Project, Village: Mundra, Dist. Kutch, Gujarat

of

Adani Mundra SEZ Infrastructure Pvt. Limited

for the period of

April-2017 to September-2017

Index

Compliance Report of Environment Clearance

adani	**Adani Mundra SEZ Infrastructure Pvt. Ltd., Mundra.**	**From : April,17** **To : September,17**
Status of the conditions stipulated in Environment Clearance		

Half yearly Compliance report for Environment Clearance for the project "Township and area development project at Mundra, Dist. Kachchh, Gujarat of M/s. Adani Mundra SEZ Infrastructure Pvt. Ltd." issued vide letter no. SEIAA/GUJ/EC/8(b)/44/2010 dated 20th February 2010.

Sr. No.	Conditions	Compliance Status as on 30-09-2017
A. Specific Conditions		
A.1	**Construction Phase:**	
1.	Minimum Aerial distance of 100 m shall be kept between processing & non – processing areas of SEZ, as proposed.	Complied during the construction phase. Not applicable at present. The details of the compliances with respect to construction phase are submitted in Oct 16 to March 17 compliance report.
2.	Height of the buildings in the project shall be restricted to 42 meter (in view of the height restriction specified by the aviation authority) or the height permissible under the bylaws prescribed the SEZ authority, whichever is more stringent. This, however, shall not increase the total population envisaged under the EIA report prepared and submitted to SEAC and SEIAA and shall not increase in the resource consumption like total water usage or wastes generated.	Construction work for the project is partially completed. However, no construction activity carried out during the compliance period of Apr'17 to Sep'17. All the specific conditions provided for construction phase will be considered upon recommencement of construction activity in future.
2(a)	The requirement for fire prevention, line safety in relation to fire and fire protection of the building shall be fulfilled in the project, as per the National Building Code of India so as to minimize danger to life and property from fire.	
2(b)	All high rise buildings shall have at least two staircases with a condition that the nearest staircases shall be available at every 30 meter from all places in a given building.	

Sr. No.	Conditions	Compliance Status as on 30-09-2017
3.	The project proponent shall not obstruct the flow of river Bhukhi passing through the social infrastructure area and shall not do any encroachment on the said river, as per their undertaking dated 21/07/2009. All necessary precautions and measures shall be taken in order to ensure that natural drainage of river Bhukhi passing through the project site is not altered / affected.	Complied during the construction phase. Not applicable at present. The details of the compliances with respect to construction phase are submitted in Oct 16 to March 17 compliance report. Construction work for the project is partially completed. However, no construction activity carried out during the compliance period of Apr'17 to Sep'17. All the specific conditions provided for construction phase will be considered upon recommencement of construction activity in future.
4.	Additional bridge / walkthrough over the Bhukhi river passing through the site shall be provided between the two bridges planned to be provided so as to reduce distance to be travelled during the emergency situations.	
5.	If SEZ authority permits, adequate parapet / fencing shall be provided along the banks of river Bhukhi passing through the site for preventing fall of animals / humans.	
6.	All required sanitary and hygienic measures shall be provided before starting the construction activities and to be maintained throughout the construction phase.	
7.	The construction site shall be provided with adequately barricades of at least 3 m height on its periphery with adequate signage	
8.	Adequate first aid facilities shall be provided in the project both during construction and operation of the project.	
9.	Adequate drinking water, sanitation and other amenities	

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	shall be provided for construction workers at the site. The safe disposal of wastewater and solid wastes generated during the construction phase should be ensured.	
10.	Provision should be made for the supply of fuel (Kerosene or cooking gas), utensils such as pressure cookers etc. to the laborers during construction phase.	Complied during the construction phase. Not applicable at present. The details of the compliances with respect to construction phase are submitted in Oct 16 to March 17 compliance report. Construction work for the project is partially completed. However, no construction activity carried out during the compliance period of Apr'17 to Sep'17. All the specific conditions provided for construction phase will be considered upon recommencement of construction activity in future.
11.	The project proponent shall ensure that the construction labours are provided with adequate amenities for lighting, drinking water, sanitation etc. to ensure that do not ruin the existing environmental condition.	
12.	Adequate personal protective equipments shall be provided to the construction workers to ensure their safety and the project proponent shall ensure its usage by the labours.	
13.	All topsoil excavated during construction activities should be stored separately for use in horticultural / landscape development within the project site.	
14.	Disposal of debris including the excavated material during construction phase shall not create adverse effect on neighbouring communities and shall be disposed of only at the approved sites with the approval of the competent authority after taking the necessary precautions for general safety and health aspects.	
15.	Use of diesel generator sets	

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	during construction phase should be enclosed type and confirm to EPA rules for air and noise emission standards.	
16.	Ready-made mix concrete should be used so far as possible	Complied during the construction phase. Not applicable at present. The details of the compliances with respect to construction phase are submitted in Oct 16 to March 17 compliance report. Construction work for the project is partially completed. However, no construction activity carried out during the compliance period of Apr'17 to Sep'17. All the specific conditions provided for construction phase will be considered upon recommencement of construction activity in future.
17.	Water demand during construction should be reduced by use of curing agents, plasticizers and other best practices.	
18.	Vehicles hired for bringing construction material at site should be in good conditions and confirm to applicable air and noise emission standards and should be operated only during non-peak hours.	
19.	Ambient noise levels shall conform to residential standards both during day and night. Incremental pollution load on the ambient air and noise quality should be closely monitored during construction phase.	
20.	Fixtures for showers, toilet, flushing and drinking should be of low flow either by use of aerator or pressure reducing devices or sensor based control.	
21.	Fly ash should be used as building material in the construction as per provision of Fly Ash Notification under EPA.	
22.	Structural design aspects in accordance to the seismic zone shall be strictly adhered to.	
23.	No ground water shall be used and the water required during construction phase shall be sourced from Gujarat Water Infrastructure Ltd.	
24.	The construction materials and debris shall be properly stored	

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	and handled to avoid negative impacts such as air pollution and public nuisances by blocking the roads and public passages. Appropriate barricading shall be done and signboards shall be put at such site.	
25.	Ambient Air Quality Monitoring / Noise monitoring shall be carried out during the construction. The location of ambient air quality monitoring stations and its frequency shall be decided in consultation with GPCB.	Complied during the construction phase. Not applicable at present. The details of the compliances with respect to construction phase are submitted in Oct 16 to March 17 compliance report. Construction work for the project is partially completed. However, no construction activity carried out during the compliance period of Apr'17 to Sep'17. All the specific conditions provided for construction phase will be considered upon recommencement of construction activity in future.
26.	The provisions of the buildings and other construction workers rules shall be met with by the project proponent in addition to other statutory requirements under different environmental pollution control and safety related acts and rules.	
27.	Environment Management Cell shall be formed, which will supervise and monitor the environment related aspects of the project during construction and operational phases in addition to observance of Gujarat Building and other constructions workers act and rules including registration of the project under this act.	
A.2	**Operation Phase:**	
28.	Fresh water requirement during the operation phase shall not exceed 9 MLD and it shall be sourced from Gujarat Water Infrastructure Ltd. Metering of the water shall be done and its records shall be maintained. No ground water shall be extracted.	Complied. No ground water is extracted. Fresh water requirement for Samudra township and Adani Hospital is approximately 1.10 MLD which is sourced through Gujarat Water Infrastructure Ltd. (GWIL) pipeline from Narmada water supply and APSEZ desalination plant. No ground water is being Extracted. Record maintained for quantity of water usage during the period Apr'17 to Sep'17 is attached as

Sr. No.	Conditions	Compliance Status as on 30-09-2017
		Annexure – 1.
29.	The total sewage generation from the proposed social infrastructure project shall not exceed 7.2 MLD.	Complied. Average quantity of sewage generation was 810 KLD at Samudra township and 18 KLD at Adani Hospital. Average total quantity of sewage generation was 0.8 MLD. Generated sewage is treated to utilize for horticulture purpose. Details of sewage generated during the periodApr'17 to Sep'17, is attached as **Annexure – 2.**
30.	The project proponent shall install and operate adequate sewage treatment plants (STP) comprising of 3 modules of STP (each of 2.5 MLD) to achieve ultimate capacity of 7.5 MLD, for treatment of sewage. These STP modules shall be operated regularly and effectively to achieve the GPCB norms.	Complied. STP having capacity of 2.5 MLD is constructed and operated in township area. Treated sewage is utilized for horticulture purposes after achieving discharge norms of GPCB. One STP having capacity of 30 KLD is constructed and operated in Hospital. Treated sewage is utilized for horticulture purposes. Third party analysis of the treated water is being carried out twice in a month by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratory Pvt. Ltd. Summary of the same for duration from Apr'17 to Sep'17 is mentioned below. **PARAMETERS** | **UNIT** | **Min** | **Max** | **Perm. Limit$** pH | -- | 6.56 | 7.61 | 6.5 – 8.5 TSS | mg/L | 13 | 29 | 30 BOD (3 Days @ 27 °C) | mg/L | 6 | 19 | 20 Residual Chlorine | mg/L | 0.5 | 0.9 | > 0.5 $ as per CC&A granted by GPCB Please refer **Annexure – 1** for detailed analysis reports. Approx. INR 12 Lakh is spent for all environmental monitoring activities during Apr'17 to Sep'17 .
31.	Two modules of STP of 2.5 MLD (i.e. total 5 MLD) shall be installed on one side of the Bhukhi River and one module of STP of 2.5 MLD shall be installed on the other side of the Bhukhi	Complied. At present one STP of 2.5 MLD is installed on one side of Bhukhi river for Samudra Township and one STP of 30 KLD is installed on other side of Bhukhi river for Adani Hospital. Hence no cross drainage civil work is carried out at

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	River passing through the social infrastructure project. Hence no any cross drainage civil work shall be carried out.	AMSIPL Area.
32.	Out of total 7.2 MLD of treated sewage conforming the GPCB norms, 2 MLD treated sewage shall be utilized within the project area for plantation / gardening whereas balance 5.2 MLD of treated sewage shall be utilized in the identified area of MPSEZL for plantation / gardening.	Complied. During Apr'17 to Sep'17 approx. 0.8 MLD treated water is used for gardening / plantation purpose within township area / APSEZ area.
33.	In no case, the wastewater / treated sewage shall be discharged into the river Bhukhi passing through the social infrastructure project.	Complied During Apr'17 to Sep'17 approx. 0.8 MLD treated water is used for gardening / plantation purpose within township area / APSEZ area. Hence in no case, the wastewater / treated sewage is discharged into the river Bhukhi passing through the social infrastructure project.
34.	Best available technology shall be used for disinfection of treated sewage before reuse / discharge.	Complied. Chlorination treatment is provided for disinfection before reuse.
35.	Rain water harvesting of roof top run off of the building to be constructed as a part of social infrastructure as per the plan submitted shall be implemented. Before recharging the rain water, pre-treatment must be done to remove suspended matter.	Complied. Location of rain water harvesting was earmarked at one of location in identified SEZ area based on direction of flow of storm water channel. However underground water is saline in nature due to sea water ingress and harvested water is likely to get contaminated in high tide. The project will be taken up upon finding out the solution for rain water harvesting within project boundary.
36.	The Municipal Solid Waste (MSW) shall be properly collected and segregated at source and it shall be disposed as per the guidelines of the MSW Rules 2000, as may be amended time to time. The dried biomass from the STP will be used as manure in gardening / plantation.	Complied. A well-established system for Municipal Solid Waste (MSW) management is in place. Municipal solid waste collection from AMSIPL area is being done on daily bases. Collected dry waste is being transported to Material Recovery Facility (MRF) where it is being sorted out in different streams e.g. paper/plastic/cardboard/glass/metal. These sorted waste is further transported for recycling.

Sr. No.	Conditions	Compliance Status as on 30-09-2017
		AMSIPL has installed Organic Waste Converter within premises for converting food waste in to manure and generated manure is being utilized by horticulture department in green belt area. Total 23.6 MT of food waste was converted to manure during the compliance period Dry waste collection drive including plastic free drive and waste segregation drive is being organised on regularly basis..
37.	The Bio-medical Waste (BMW) shall be disposed as per guidelines of BMW rules 1998 as may be amended from time to time.	Complied. Multispecialty hospital has taken the necessary approvals from GPCB for the disposal of Bio Medical Waste. Total 1684.5 kg of bio medical waste was disposed to Common Bio Medical Waste Treatment facility during Apr'17 to Sep'17 by M/s Distormed Kutch Services Pvt. Ltd at the frequency of once in two days. . Log book showing the record of Bio-medical Waste collection is attached as **Annexure - 3**
38.	Hazardous wastes, if any generated during the operation phase shall be handled as per the Hazardous Waste (Management, Handling & Transboundary Movement) Rules 2008, as may be amended from time to time.	Point Noted. No hazardous waste was generated during the compliance period of Apr'17 to Sep'17. If any hazardous waste generation in future, it will be dispose through authorised agency only.
39.	54,600 sq.m. area shall be earmarked for the parking purpose as proposed. The area earmarked for the parking shall be used for parking only. No other activity shall be permitted in this area.	Complied. Construction work for the project is partially completed. Entire parking area is earmarked within township premises. This parking is earmarked within township premises and is used for said purpose only.
40.	Necessary signage including continuous display of status of parking availability at entry, exit and all other appropriate places shall be provided which should have appropriate size of letters and shall be visible from the at least 50 meter distance from the adjacent road.	Complied. Project is under development and area is earmarked for parking area as per National Building Code requirement. Trained security guards are available round the clock to guide/help for entry, exit and parking. Continuous display regarding status of parking availability will be installed once project is in full-fledged operation.
41.	No public space shall be used or blocked for the parking and the trained staff shall be deployed to	Complied. Adequate parking area has been provided as per National Building Code. Trained security guards are

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	guide the visitors for parking and helping the senior citizens and physically challenged people	available round the clock to guide/help for entry, exit and parking to senior citizens and physically challenged people.
42.	Traffic congestion near the entry and exit points from the roads adjoining the proposed project site must be avoided.	Complied. Separate entry and exits have been provided at main gate with architectural divider for proper traffic management. Appropriate arrangements are madefor emergency situations.
43.	Common utilities like drinking water facility, toilets etc shall be provided on each floor with adequate signage thereof. Adequate distance shall be maintained between the drinking water and toilet blocks.	Complied. Common utilities like drinking water facility, toilets etc.are provided at Adani Hospital and commercial building with adequate distance between drinking water & toilet facilities..
44.	The green belt shall be developed in 50 Hectares area in terms of peripheral green belt around the project site, road side plantation and green belt on either side of the Bhukhi river. The project proponent shall plant at least 20,000 trees in green belt, as proposed. The open spaces inside the social infrastructure project shall be suitably landscape and covered with vegetation of indigenous variety.	Complied. AMSIPL has developed 38.67 ha area as green belt with plantation of 40070 saplings in AMSIPL premises. The open spaces inside the social infrastructure project are suitably landscaped and covered with green lawn and other vegetation. It may be noted that to enhance the marine biodiversity, till date APSEZ has carried out mangrove afforestation in more than 2800 ha. area across the coast of Gujarat. Total expenditure for the same till date is INR 782 lakh. So, far APSEZ have developed more than 400 ha. area as greenbelt with plantation more than 8.0 Lacs saplings within the APSEZ area. Details of the green belt development activity done by APSEZL Mundra are attached as **Annexure – 4.**
45.	The area earmarked as green area shall be used only for green belt and shall not be altered for any other purpose. The fund earmarked for green belt development shall not be diverted for any other purpose.	Complied. The area earmarked as green area is used only for green belt and not altered for any other purpose. Separate budget for the horticulture department is earmarked every year. The spent budget for Horticulture Departmental for the period of Apr'17 to Sep'17 is INR 554 lacs. Details upon green belt development is provided in condition no. 44 above.
46.	The project proponent shall explore the application of solar energy and shall be incorporated	Complied. Solar system of **1.5 MW** has been installed within township.

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	for the illumination of common areas, lighting of internal roads and passages in addition to solar water heating, if any.	Information has been already submitted to MoEF&CC along with Half Yearly Compliance Report Apr'16 to Sep'16. There is no further change.
47.	The acoustic enclosures shall be installed at all noise generating equipments and the noise level shall be maintained as per the MoEF / CPCB guidelines / norms both during day and night time.	Complied. D.G. Sets having acoustic enclosures are provided as stand-by and used in case of main power failure only. However, regular noise monitoring is being carried out. Noise (once in a month) monitoring is being carried out by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratory Pvt. Ltd. Summary of the same for duration of Apr'17 to Sep'17 is mentioned below. **Total Sampling Locations: 2 Nos.** **Noise** / **Unit** / **Avg. Value** / **Perm. Limit** Day Time / dB(A) / 62.9 / 75 Night Time / dB(A) / 58.3 / 70 Please refer **Annexure – 1** for detailed analysis reports. Approximately INR 12 Lakh is spent for all environmental monitoring activities during the compliance period (till Sep 2017).
48.	The project proponent shall install the electric appliances, which are energy efficient and meeting with the Bureau of Energy Efficiency norms, wherever applicable.	Complied. Energy Conservation through Installation of Motion Sensor (Occu switch) & AC Temp. Controls in buildings are provided. AMSIPL has installed the electric appliances which meets the Energy Efficiency norms.
49.	The energy audit shall be conducted at regular interval for the project and the recommendations of the audit report shall be implemented with spirit.	Complied. Energy audit for Samudra Township is carried out regularly and report of the same is attached as **Annexure – 5**. Recommendations of this report will be implemented gradually. Energy audit is carried our once in a three years. Last audit was carried out on 21.01.2017 by M/s. Mitcon Consultancy & Engineering Services Ltd.
50.	The roof should meet regulatory requirement as per Energy Conservation Building Code by using appropriate thermal insulation material to fulfil requirements.	Complied. Energy Conservation Building Code. is considered during the development of buildings.
51.	Use of glass shall be minimal to	Complied.

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	reduce the electricity consumption and load on air-conditioning.	Minimal glass is used in air conditioning areas to reduce electricity consumption and load on air-conditioning.
52.	Risk estimation shall be carried out for the project and disaster management plan shall be prepared and its recommendations shall be implemented in the time bound manner.	Complied. Emergency Response Plan was prepared by Trivedi & Associates Technical Services Pvt. Ltd in August, 2015 for AMSIPL which included risk estimation for medical emergency, fire emergency, natural calamities. Detail are submitted to the MoEF & CC along with half yearly compliance report for the period from Apr – 2015 to Sep – 2015. Various plans as fire service plan, communication plan, mutual aid plan, evacuation plan are implemented to combat with emergency situations.
53.	The raw water sumps will be equipped with suction differential head / partition so as to insure that minimum 500 KL water shall remain reserved as fire water as proposed.	Complied. 250 KL of fire water is reserved with fire hydrant system for Adani hospital. Approximately 400 KL water is available in 6 different water tanks at various sectors of Samudra Township. In total, more than 500KL water is reserved as fire water at AMSIPL.
54.	Necessary emergency lighting system along with emergency power back up system shall be provided. In addition, emergency public address system arrangement and signage for emergency exit route shall be provided on each floor.	Complied. Power is supplied through M/s MPSEZ Utilities Private Limited to the project site. Power failure is the rarest situation in the area and in case of such emergency, there is provision of 125 KVA movable DG set. Public address system is available with the security staff in the vicinity. Emergency contact is display each block as below Security control: 8980048877 Township Security control: 8980015046 Medical Adani hospital reception: 2838-619555 Medical Emergency Number -: 2838-619667 Medical Emergency mobile Number: 7574848413 Fire control room-: 2838-255801 Fire control room mob.: 9879114996
55.	Necessary auto glow, signage at all appropriate places shall be	Complied. Auto glow signage is provided at adequate locations

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	provided to guide the people towards exits and assembly points during the unforeseen emergency and eventuality conditions.	to provide guidance to the people towards exits. Also the township & Adani Hospital is under security guard surveillance to combat with unforeseen emergency conditions. Photograph showing the auto glow signages were submitted along with last compliance submission for the duration of Oct'16 to Mar'17.
56.	Training to the staff for the First Aid and Fire Fighting Alarm with regular mock drill shall be conducted regularly and shall be made in integral part of the disaster management plan of the project.	Complied. For first aid situations a First Aid centre is provided at Samudra Township. Multispecialty Hospital is part of the project activity which can be utilised for medical emergencies. APSEZ has provided training to 19 personnel for First-aid through Red Cross Society during 20.04.17 to 21.04.17. Regular mock drill is also conducted at project site. The report of the same is attached as **Annexure – 6.**
57.	Ozone Depleting Substance (Regulation and Control) rules shall be followed while designing the air conditioning system of the project.	Complied. Ozone Depleting Substance inventory was produced and is maintained during the compliance period of Apr'17 to Sep'17. New gas being used in refilling is ozone friendly in nature.
58.	Environment Management Cell shall be formed by the project proponent during operation phase which will supervise and monitor the environment related aspects of the project including incremental pollution loads on the ambient air quality, noise and water quality periodically till the management of the project remains with the project proponent.	Complied. APSEZL as group has a well structured Environment Cell, staffed with qualified manpower for implementation of the Environmental Monitoring and Management Plan. Organogram showing Environment Management Cell is attached as **Annexure – 7**. Ambient Air Quality (twice in a week) and Noise (once in a month) monitoring are being carried out by NABL and MoEF&CC accredited agency namely M/s. Pollucon Laboratory Pvt. Ltd. Summary of the same for duration from Apr'17 to Sep'17 is mentioned below. Total Sampling Locations: 2 Nos.

Parameter	Unit	Min	Max	Perm. Limit$
PM_{10}	µg/m³	38.6	92.8	100
$PM_{2.5}$	µg/m³	15.4	54.5	60
SO_2	µg/m³	5.2	26.4	80
NO_2	µg/m³	16.4	44.3	80
Noise	**Unit**	**Avg. Value**		**Perm. Limit**

Sr. No.	Conditions	Compliance Status as on 30-09-2017
		Day Time | dB(A) | 62.9 | 75 Night Time | dB(A) | 58.3 | 70 $ as per NAAQ standards, 2009 Please refer **Annexure – 1** for detailed analysis reports. Approx. INR 12 Lakh is spent for all environmental monitoring activities during compliance period (till Sep'17)
B. General Conditions		
59.	The project proponent shall permit the outside people to use the social infrastructures like hospital, schools, colleges etc. coming up in the proposed project, as per their undertaking dated 21/07/2009.	Complied. Outside people are allowed access to use the social infrastructures like hospital and school. Total 5840 patients including OPD (Out Patient Department) as well IPD (In-Patient Department) from nearby villages were treated in the Hospital during Apr'17 to Sep'17. Approx Rs. 47.25 Lakh worth of free medical services given to nearby villagers during Apr'17 to Sep'17.
60.	Various provisions of the Environment (Protection) Act, 1986 and the Rules / Notifications issued there under by the Ministry of Environment and Forest, Govt. of India, from time to time shall be strictly complied with.	Point noted.
61.	No further expansion or modification in the plant shall be carried out without prior approval of the MoEF/SEIAA as the case may be. In case of deviations or alterations in the project proposal from those submitted to MoEF / SEIAA / SEAC for clearance, a fresh reference shall be made to the SEIAA / SEAC to assess the adequacy of conditions imposed and to add additional environmental protection measures required, if any.	Point noted.
62.	The project authorities shall earmark adequate funds to	Complied. Separate budget for the Environment cell is

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	implement the conditions stipulated by SEIAA as well as GPCB along with the implementation schedule for all the conditions stipulated herein. The funds so provided shall not be diverted for any other purpose.	earmarked every year. All environmental and horticulture activities are considered at group level and budget allocation is also done accordingly. Budget for environmental management measures (including horticulture) for the FY 2017-18 is to the tune of INR 966 lakh. Out of which, Approx. INR 682 lakhs are spent during compliance period. Detailed breakup of the expenditures is attached as **Annexure –8.**
63.	The applicant shall inform the public that the project has been accorded Environmental Clearance by the SEIAA and i.e. copies of the clearance letter are available with the GPCB and may also be seen at the website of SEIAA / SEAC / GPCB. This shall be advertised within seven days from the date of the clearance letter, in at least two local newspaper that are widely circulated in the region, one of which shall be in the Gujarati language and the other in English. A copy each of the same shall be forwarded to the concerned regional office of the Ministry.	Already complied. Not applicable at present. The advertisement was circulated in Gujarati language through local newspaper – Kutchh Mitra as well as in English language through local newspaper – Indian Express on the date of 10.03.2010. Information has been already submitted to MoEF & CC along with half yearly compliance report April – 2015 to Sep – 2015 and there is no further change.
64.	It shall be mandatory for the project management to submit half yearly compliance report in respect of the stipulated prior Environmental Clearance terms and conditions in hard and soft copies to the regulatory authority concerned, on 1st June and 1st December of each calendar year.	Complied. Last compliance report submitted to the Ministry of Environment, Forests & Climate Change as well as SEIAA with letter reference No. APSEZL/EnvCell/2017-18/005 dated 23.05.2017 in soft as well as hard copy.
65.	The project authorities shall also adhere to the stipulations made by the Gujarat Pollution Control Board.	Point noted.
66.	The project authorities shall inform the GPCB, regional office of MoEF and SEIAA about the	Complied

Sr. No.	Conditions	Compliance Status as on 30-09-2017
	date of financial closure and final approval of the project by the concerned authorities and the date of start of the project.	
67.	The SEIAA may revoke or suspend the clearance, if implementation of any of the above conditions is not found satisfactory.	Point noted.
68.	The company in a time bound manner shall implement these conditions. The SEIAA reserves the right to stipulate additional conditions, if the same is found necessary. The above conditions will be enforced inter-alia under the provisions of the water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981, the environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules 2003 and the Public Liability Insurance Act, 1991 along with their amendments and rules.	Complied. The company has implemented the provided conditions and the compliance report is being submitted regularly. Last half yearly compliance report was submitted to Ministry of Environment, Forest & Climate Change and other concerned government agencies / offices vide our letter reference No. APSEZL/EnvCell/2017-18/005 dated 23.05.2017 in soft as well as hard copy. A copy of the same is also available on our weblink: https://www.adaniports.com/ports-downloads
69.	This environmental clearance is valid for five years from the date of issue.	Point noted.
	Additional condition – (amendment to Environment Clearance Order No. SEIAA/GUJ/EC/8(b)/44/2010 dated 20 February 2010	
--	The applicant shall carry out comparative carbon footprint study of low rise building with large ground coverage v/s high rise building with low ground coverage through reputed institute like CEPT or GIDR and submitted to SEIAA within one year from the issuance of EC.	Complied. Comparative carbon footprint study report submitted to the MoEF & CC along with half yearly compliance report Oct – 2014 to March – 2015.

Annexure – 1

"HALF YEARLY ENVIRONMENTAL MONITORING REPORT"

FOR

ADANI MUNDRA SEZ INFRASTRUCTURE PVT. LTD.
TAL: MUNDRA, KUTCH, MUNDRA – 370 421

MONITORING PERIOD:
APRIL 2017 TO SEPTEMBER 2017

PREPARED BY:

POLLUCON LABORATORIES PVT.LTD.

PLOT NO.5/6 "POLLUCON HOUSE", OPP. BALAJI INDUSTRIAL SOCIETY, OLD SHANTINATH SILK MILL LANE, NEAR GAYTRI FARSAN MART, NAVJIVAN CIRCLE, UDHANA MAGDALLA ROAD, SURAT-395007.
PHONE/FAX – (+91 261) 2455 751, 2601 106, 2601 224.
E-mail: pollucon@gmail.com Web: www.polluconlab.com

TC - 5945 ISO 9001:2008 ISO 14001:2004 OHSAS 18001:2007

RESULTS OF STP WATER OUTLET

SR. NO	TEST PARAMETERS	Unit	AMSIPL SAMUNDRA TOWNSHIP STP OUTLET							
			April-17		May-17		June-17		GPCB Permissible Limit	TEST METHOD
			5/4/17	17/4/17	5/3/17	17/5/17	6/6/17	19/6/17		
1	pH	--	7.09	6.63	6.94	7.49	6.56	7.46	**--**	IS3025(P11)83Re.02
2	Total Suspended Solids	mg/L	24	26	28	13	26	28	**30**	IS3025(P17)84Re.02
3	BOD (3 days @ 270 C)	mg/L	18	17	19	16	12	14	**20**	IS 3025 (P44)1993Re.03Edition2.1
4	Residual Chlorine	mg/L	0.8	0.5	0.5	0.6	0.7	0.6	**Min 0.5**	APHA(22nd Edi)4500 Cl

SR. NO	TEST PARAMETERS	Unit	AMSIPL SAMUNDRA TOWNSHIP STP OUTLET							
			July-17		Aug-17		Sept-17		GPCB Permissible Limit	TEST METHOD
			5/7/17	19/7/17	3/8/17	23/8/17	4/9/17	20/9/17		
1	pH	--	7.61	7.5	7.39	6.88	7.33	6.9	**--**	IS3025(P11)83Re.02
2	Total Suspended Solids	mg/L	16	22	16	14	22	26	**30**	IS3025(P17)84Re.02
3	BOD (3 days @ 270 C)	mg/L	10	10	8	6	10	17	**20**	IS 3025 (P44)1993Re.03Edition2.1
4	Residual Chlorine	mg/L	0.5	0.5	0.7	<0.8	0.7	0.7	**Min 0.5**	APHA(22nd Edi)4500 Cl

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

SR. NO	TEST PARAMETERS	Unit	ADANI HOSPITAL STP OUTLET							
			April-17		May-17		June-17		GPCB Permissible Limit	TEST METHOD
			5/4/17	17/4/17	5/3/17	17/5/17	6/6/17	19/6/17		
1	pH	--	7.28	7.22	7.13	7.31	7.02	7.4	**--**	IS3025(P11)83Re.02
2	Total Suspended Solids	mg/L	26	24	22	29	22	26	**30**	IS3025(P17)84Re.02
3	BOD (3 days @ 270 C)	mg/L	14	14	15	14	18	16	**20**	IS 3025 (P44)1993Re.03Edition2.1
4	Residual Chlorine	mg/L	0.5	0.7	0.8	0.9	0.6	0.5	**Min 0.5**	APHA(22ndEdi)4500 Cl

*Below Detection limit

SR. NO	TEST PARAMETERS	Unit	ADANI HOSPITAL STP OUTLET							
			July-17		Aug-17		Sept-17		GPCB Permissible Limit	TEST METHOD
			5/7/17	19/7/17	4/8/17	23/8/17	4/9/17	20/9/17		
1	pH	--	7.51	7.35	7.49	7.37	7.11	7.34	**--**	IS3025(P11)83Re.02
2	Total Suspended Solids	mg/L	22	24	24	22	22	20	**30**	IS3025(P17)84Re.02
3	BOD (3 days @ 270 C)	mg/L	16	14	19	16	17	19	**20**	IS 3025 (P44)1993Re.03Edition2.1
4	Residual Chlorine	mg/L	0.8	0.8	0.5	0.6	0.7	0.8	**Min 0.5**	APHA(22ndEdi)4500 Cl

*Below Detection limit

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

RESULTS OF AMBIENT AIR QUALITY MONITORING

SAMUDRA TOWNSHIP STP					
Sr. No.	Date of Sampling	Particulate Matter (PM_{10}) µg/m3	Particulate Matter ($PM_{2.5}$) µg/m3	Sulphur Dioxide (SO_2) µg/m3	Oxides of Nitrogen (NO_2) µg/m3
1	01/04/2017	66.91	29.52	10.23	31.37
2	05/04/2017	92.59	50.72	25.28	44.28
3	08/04/2017	75.52	32.43	21.79	27.61
4	12/04/2017	49.59	18.71	15.74	34.60
5	15/04/2017	57.58	30.80	17.32	33.67
6	19/04/2017	71.31	40.74	6.26	18.22
7	22/04/2017	56.30	20.37	8.63	22.83
8	26/04/2017	76.19	39.50	12.20	19.37
9	29/04/2017	61.30	28.69	20.12	26.36
10	05/03/2017	53.68	24.53	13.21	31.38
11	05/06/2017	69.29	32.43	16.51	28.89
12	05/10/2017	58.37	26.61	8.60	24.11
13	13/05/2017	72.59	34.51	19.36	34.08
14	17/05/2017	63.32	27.44	17.15	21.41
15	20/05/2017	49.77	21.62	6.88	19.63
16	24/05/2017	56.48	31.60	7.79	36.95
17	27/05/2017	42.52	15.38	11.15	26.81
18	31/05/2017	70.51	28.69	5.18	21.01
19	06/03/2017	78.50	38.66	14.25	42.89
20	06/07/2017	56.79	30.35	7.87	26.73
21	06/10/2017	43.49	18.71	9.44	21.63
22	14/06/2017	58.19	32.43	15.79	35.35
23	17/06/2017	48.19	21.62	12.32	23.54
24	21/06/2017	74.17	40.74	10.94	31.60
25	24/06/2017	52.40	19.54	17.42	27.57
26	28/06/2017	63.38	39.50	20.46	34.41
27	05/07/2017	78.63	44.49	21.74	33.37
28	08/07/2017	82.59	54.46	19.70	20.15
29	12/07/2017	62.71	32.43	10.17	30.22
30	19/07/2017	46.36	19.68	14.88	30.43

Continue..

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

SAMUDRA TOWNSHIP STP					
Sr. No.	**Date of Sampling**	**Particulate Matter (PM_{10}) µg/m3**	**Particulate Matter ($PM_{2.5}$) µg/m3**	**Sulphur Dioxide (SO_2) µg/m3**	**Oxides of Nitrogen (NO_2) µg/m3**
31	22/07/2017	46.79	24.53	13.35	36.31
32	26/07/2017	63.38	30.35	16.52	38.71
33	29/07/2017	40.32	17.46	7.83	19.59
34	02/08/2017	73.62	39.50	20.27	36.61
35	05/08/2017	83.38	53.63	12.26	19.59
36	09/08/2017	61.18	36.59	18.18	38.76
37	12/08/2017	56.30	23.70	16.44	23.69
38	16/08/2017	76.49	44.49	14.14	30.58
39	19/08/2017	68.50	30.35	17.22	22.39
40	23/08/2017	82.71	38.66	21.96	40.48
41	26/08/2017	65.33	26.61	8.67	21.53
42	30/08/2017	40.62	15.38	11.11	27.51
43	02/09/2017	52.58	31.60	8.64	25.39
44	06/09/2017	65.57	29.52	18.19	30.35
45	09/09/2017	76.49	42.41	21.21	19.42
46	13/09/2017	57.58	32.43	15.87	36.51
47	16/09/2017	38.61	15.38	5.24	22.41
48	20/09/2017	56.30	36.59	10.58	32.48
49	23/09/2017	73.62	39.50	26.45	42.68
50	27/09/2017	61.42	24.53	22.69	27.53
51	30/09/2017	54.47	20.37	12.65	24.18
	TEST METHOD	**IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)**	**Gravimetric- CPCB - Method (Vol.I,May-2011)**	**IS:5182(Part II):Improved West and Gaeke**	**IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)**

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

RESULTS OF AMBIENT AIR QUALITY MONITORING

SAMUDRA TOWNSHIP CUSTOMER CARE					
Sr.No.	Date of Sampling	Particulate Matter (PM_{10}) µg/m3	Particulate Matter ($PM_{2.5}$) µg/m3	Sulphur Dioxide (SO_2) µg/m3	Oxides of Nitrogen (NO_2) µg/m3
1	01/04/2017	92.80	42.47	16.38	26.40
2	05/04/2017	81.60	47.47	18.72	33.35
3	08/04/2017	65.48	29.56	7.80	30.43
4	12/04/2017	70.53	33.73	11.74	25.22
5	15/04/2017	51.57	26.46	14.18	31.50
6	19/04/2017	89.31	52.46	19.19	22.30
7	22/04/2017	77.51	35.39	17.56	35.64
8	26/04/2017	83.59	45.38	9.39	23.39
9	29/04/2017	72.52	32.48	12.52	37.52
10	05/03/2017	46.76	20.40	16.52	27.75
11	05/06/2017	57.17	25.40	13.35	24.83
12	05/10/2017	77.21	33.73	11.19	19.94
13	13/05/2017	65.29	29.56	9.42	25.67
14	17/05/2017	56.33	24.57	5.20	30.05
15	20/05/2017	61.50	34.56	10.40	26.50
16	24/05/2017	86.48	48.72	14.92	26.08
17	27/05/2017	55.61	28.73	8.64	20.03
18	31/05/2017	63.49	35.39	12.22	32.34
19	06/03/2017	71.19	34.56	11.77	32.37
20	06/07/2017	62.83	38.72	13.95	36.21
21	06/10/2017	52.60	21.65	5.51	25.56
22	14/06/2017	74.62	35.39	17.55	19.59
23	17/06/2017	65.78	30.40	14.27	33.13
24	21/06/2017	79.32	43.72	7.95	22.15
25	24/06/2017	60.18	23.73	12.33	30.45
26	28/06/2017	45.32	29.56	18.17	29.39
27	05/07/2017	70.71	39.56	11.50	23.39
28	08/07/2017	56.33	33.73	16.64	26.34
29	12/07/2017	69.33	37.47	8.76	17.09
30	19/07/2017	40.20	15.62	10.28	27.40

Continue..

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

SAMUDRA TOWNSHIP CUSTOMER CARE					
Sr.No.	**Date of Sampling**	**Particulate Matter (PM_{10}) µg/m3**	**Particulate Matter ($PM_{2.5}$) µg/m3**	**Sulphur Dioxide (SO_2) µg/m3**	**Oxides of Nitrogen (NO_2) µg/m3**
31	22/07/2017	62.41	20.40	10.48	28.33
32	26/07/2017	51.51	24.57	14.93	30.77
33	29/07/2017	46.28	19.57	12.22	29.50
34	02/08/2017	65.17	36.64	10.48	27.24
35	05/08/2017	70.59	42.47	14.20	29.40
36	09/08/2017	59.22	26.65	12.74	32.43
37	12/08/2017	49.41	20.40	8.73	26.38
38	16/08/2017	67.52	38.72	17.53	28.59
39	19/08/2017	56.69	35.39	15.88	31.57
40	23/08/2017	75.28	33.73	11.39	37.48
41	26/08/2017	58.61	23.73	13.23	18.38
42	30/08/2017	52.72	19.57	9.67	21.40
43	02/09/2017	45.62	15.41	17.30	30.23
44	06/09/2017	55.12	25.40	21.23	36.66
45	09/09/2017	62.29	38.72	18.32	27.43
46	13/09/2017	76.79	42.47	11.36	33.42
47	16/09/2017	43.57	18.74	7.91	29.52
48	20/09/2017	72.58	46.63	16.65	24.64
49	23/09/2017	67.22	30.40	14.29	31.42
50	27/09/2017	53.38	21.65	13.36	35.00
51	30/09/2017	66.38	26.65	8.68	28.57
	TEST METHOD	**IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)**	**Gravimetric- CPCB - Method (Vol.I,May-2011)**	**IS:5182(Part II):Improved West and Gaeke**	**IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)**

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

RESULTS OF AMBIENT AIR QUALITY MONITORING

PUB/ADANI HOUSE								
Sr. No.	Date of Sampling	Particulate Matter (PM10) µg/m^3	Particulate Matter (PM 2.5) µg/m^3	Sulphur Dioxide (SO2) µg/m^3	Oxides of Nitrogen (NO2) µg/m^3	Carbon Monoxide as CO mg/m^3	Hydrocarbon as CH_4 mg/m^3	Benzene as C_6H_6 µg/m^3
1	04/04/2017	57.59	22.49	18.97	38.58	0.37	BDL*	BDL*
2	07/04/2017	62.61	28.73	22.04	29.64	0.44	BDL*	BDL*
3	11/04/2017	76.49	36.64	6.33	17.20	0.62	BDL*	BDL*
4	14/04/2017	74.49	41.57	9.60	30.46	0.82	BDL*	BDL*
5	18/04/2017	63.60	34.56	19.40	24.85	0.25	BDL*	BDL*
6	21/04/2017	50.71	20.40	8.79	19.88	0.57	BDL*	BDL*
7	25/04/2017	71.47	38.73	13.07	28.83	0.15	BDL*	BDL*
8	28/04/2017	60.50	30.40	11.62	21.45	0.60	BDL*	BDL*
9	02/05/2017	53.50	28.73	8.73	21.53	0.64	BDL*	BDL*
10	05/05/2017	66.20	26.65	20.91	26.53	0.24	BDL*	BDL*
11	09/05/2017	75.81	33.73	13.80	30.58	0.11	BDL*	BDL*
12	12/05/2017	63.23	30.40	10.95	25.14	0.68	BDL*	BDL*
13	16/05/2017	72.40	31.65	17.52	27.76	0.39	BDL*	BDL*
14	19/05/2017	61.18	24.57	21.50	42.48	0.30	BDL*	BDL*
15	23/05/2017	80.40	41.64	9.59	33.52	0.95	BDL*	BDL*
16	26/05/2017	58.58	29.57	18.64	29.85	0.53	BDL*	BDL*
17	30/05/2017	81.58	37.48	6.17	19.38	0.70	BDL*	BDL*
18	02/06/2017	74.51	37.48	8.89	30.88	1.02	BDL*	BDL*
19	06/06/2017	55.42	27.48	11.82	19.80	0.56	BDL*	BDL*
20	09/06/2017	49.53	19.57	10.51	26.73	0.13	BDL*	BDL*
21	13/06/2017	73.39	34.56	5.61	17.53	0.70	BDL*	BDL*
22	16/06/2017	59.32	22.49	18.45	28.06	0.26	BDL*	BDL*
23	20/06/2017	68.37	36.64	14.97	38.08	0.31	BDL*	BDL*
24	23/06/2017	82.38	30.40	9.63	29.40	0.14	BDL*	BDL*
25	27/06/2017	63.41	26.65	15.13	25.54	0.41	BDL*	BDL*
26	30/06/2017	45.62	29.57	7.16	22.45	0.72	BDL*	BDL*
27	04/07/2017	76.37	37.48	16.63	30.41	0.70	BDL*	BDL*
28	07/07/2017	66.89	32.48	11.95	27.42	1.02	BDL*	BDL*
29	11/07/2017	70.17	26.65	13.46	18.34	0.56	BDL*	BDL*
30	14/07/2017	61.20	28.68	12.72	24.52	0.62	BDL*	BDL*

Continue...

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

PUB/ADANI HOUSE								
Sr. No.	**Date of Sampling**	**Particulate Matter (PM10) μg/m³**	**Particulate Matter (PM 2.5) μg/m³**	**Sulphur Dioxide (SO2) μg/m³**	**Oxides of Nitrogen (NO2) μg/m³**	**Carbon Monoxide as CO mg/m³**	**Hydrocarbon as CH_4 mg/m³**	**Benzene as C_6H_6 μg/m³**
31	18/07/2017	59.57	23.74	17.59	31.21	0.12	BDL*	BDL*
32	21/07/2017	52.63	20.40	10.63	23.14	0.27	BDL*	BDL*
33	25/07/2017	69.18	33.73	15.89	33.38	0.31	BDL*	BDL*
34	28/07/2017	74.20	39.56	9.90	26.45	0.40	BDL*	BDL*
35	01/08/2017	54.61	30.40	10.19	33.76	0.45	BDL*	BDL*
36	04/08/2017	66.70	38.73	19.55	36.18	0.50	BDL*	BDL*
37	08/08/2017	59.32	33.73	12.83	26.53	0.85	BDL*	BDL*
38	11/08/2017	62.30	29.57	15.94	31.26	0.52	BDL*	BDL*
39	15/08/2017	78.60	37.48	17.48	23.06	0.33	BDL*	BDL*
40	18/08/2017	69.92	28.73	14.86	41.38	0.87	BDL*	BDL*
41	22/08/2017	49.59	19.57	11.44	24.60	0.23	BDL*	BDL*
42	25/08/2017	52.50	24.57	13.42	35.27	0.32	BDL*	BDL*
43	29/08/2017	46.31	21.65	9.71	29.30	0.25	BDL*	BDL*
44	01/09/2017	55.42	21.65	12.32	26.89	0.18	BDL*	BDL*
45	05/09/2017	78.42	40.39	24.31	37.44	0.26	BDL*	BDL*
46	08/09/2017	60.50	27.48	10.63	35.49	0.40	BDL*	BDL*
47	12/09/2017	71.91	38.73	26.14	39.15	0.46	BDL*	BDL*
48	15/09/2017	65.58	30.40	15.84	25.54	0.29	BDL*	BDL*
49	19/09/2017	56.22	25.40	20.59	30.11	0.60	BDL*	BDL*
50	22/09/2017	89.57	42.47	18.94	27.53	0.32	BDL*	BDL*
51	26/09/2017	68.19	37.48	14.90	33.61	0.54	BDL*	BDL*
52	29/09/2017	58.58	24.57	11.33	43.50	0.79	BDL*	BDL*
	TEST METHOD	**IS:5182(Part 23):Gravimetric CPCB - Method (Vol.I,May-2011)**	**Gravimetric-CPCB - Method (Vol.I,May-2011)**	**IS:5182(Part II):Improved West and Gaeke**	**IS:5182(Part VI):Modified Jacob & Hochheiser (NaOH-NaAsO2)**	**NDIR Digital Gas Analyzer**	**SOP: HC: GC/GCMS/Gas analyzer**	**IS 5182 (Part XI):2006/CPCB Method**

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

RESULT NOISE LEVEL MONITORING

Result of Noise level monitoring [Day Time]

SR. NO.	Name of Location	SAMUNDRA TOWNSHIP STP					
		Result [Leq dB(A)]					
	Sampling Date & Time	19/04/2017	24/05/2017	21/06/2017	26/07/2017	09/08/2017	13/09/2017
1	6:00-7:00	58.4	59.2	62.4	61.7	62.3	63.1
2	7:00-8:00	58.1	63.1	66.1	55.4	58.8	68.4
3	8:00-9:00	62.4	62.8	62.4	59.1	52.1	62.1
4	9:00-10:00	60.4	66.2	59.4	61.7	60	68.1
5	10:00-11:00	68.4	68.1	60.4	65.8	59.7	65.2
6	11:00-12:00	65.7	72.1	60.7	65.1	67.4	59.1
7	12:00-13:00	67.1	70.1	63.4	59.1	62.9	56.1
8	13:00-14:00	62.6	65.1	61.8	62.7	61.4	63.1
9	14:00-15:00	63.4	68.2	65.1	67.4	62.7	61.4
10	15:00-16:00	64.1	62.4	61.4	62.4	64.8	65.2
11	16:00-17:00	68.7	63.4	61.8	61.8	62	68.7
12	17:00-18:00	62.4	65.8	62.7	60.9	67.4	66.2
13	18:00-19:00	68.4	68.1	64.8	63.8	65.8	68.4
14	19:00-20:00	69.4	62.4	59.7	62.8	61.9	64.3
15	20:00-21:00	67.2	64.8	62.4	65.1	59.8	69.8
16	21:00-22:00	62.4	65.6	60.1	61.8	58.1	67.2
Day Time Limit*		75 Leq dB(A)					

Result of Noise level monitoring [Night Time]

SR. NO.	Name of Location	SAMUNDRA TOWNSHIP STP					
		Result [Leq dB(A)]					
	Sampling Date & Time	19/04/2017 & 20/04/2017	24/05/2017 & 24/05/2017	21/06/2017 & 22/06/2017	26/07/2017 & 27/07/2017	09/08/2017 & 10/08/2017	13/09/2017 & 14/08/2017
1	22:00-23:00	60.4	61.4	59.4	65.1	64	61.4
2	23:00-00:00	61.5	58.4	62.4	58.7	57.2	60.8
3	00:00-01:00	59.8	55.1	61.4	53.7	51.6	65.1
4	01:00-02:00	62.1	5.2	60.4	52.9	50.9	62.9
5	02:00-03:00	60.4	57.1	60.7	52.1	58.8	59.9
6	03:00-04:00	60.8	62.4	61.8	56.4	52.4	60.4
7	04:00-05:00	61.7	61.4	59.7	55.9	60	58.1
8	05:00-06:00	62.5	59.8	62.1	58.4	51.6	62.4
Night Time Limit*		70 Leq dB(A)					

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

Result of Noise level monitoring [Day Time]

SR. NO.	Name of Location	SAMUNDRA TOWNSHIP CUSTOMER CARE					
		Result [Leq dB(A)]					
	Sampling Date & Time	05/04/2017	05/10/2017	28/06/2017	12/07/2017	16/08/2017	27/09/2017
1	6:00-7:00	54.1	58.1	55.1	54.1	52.4	57.1
2	7:00-8:00	59.4	62.1	60.4	59.1	60.4	60.5
3	8:00-9:00	55.1	65.1	62.1	62.4	61.9	63.1
4	9:00-10:00	63.4	60.1	65.4	63.1	58.7	65.1
5	10:00-11:00	68.4	59.4	61.7	69.1	68.4	60.4
6	11:00-12:00	62.4	62.8	65.4	65.1	64.5	69.4
7	12:00-13:00	61.4	65.4	68.4	62.4	65.1	62.4
8	13:00-14:00	68.4	63.1	61.7	60.4	68.7	65.3
9	14:00-15:00	62.1	68.4	65.1	59.7	68.98	69.4
10	15:00-16:00	64.1	62.1	66.1	57.1	62.4	62.4
11	16:00-17:00	63.7	65.1	68.4	60.4	61.4	60.8
12	17:00-18:00	68.4	61.4	63.4	60.9	63.84	59.1
13	18:00-19:00	66.1	68.7	61.8	63.1	59.1	57.2
14	19:00-20:00	66.4	66.7	60.4	66.7	62.7	62.1
15	20:00-21:00	69.4	60.1	62.7	69.1	64.8	65.4
16	21:00-22:00	67.2	59.8	61.8	65.5	61.9	63.1
Day Time Limit*		75 Leq dB(A)					

Result of Noise level monitoring [Night Time]

SR. NO.	Name of Location	SAMUNDRA TOWNSHIP CUSTOMER CARE					
		Result [Leq dB(A)]					
	Sampling Date & Time	05/04/2017 & 06/04/2017	10/05/2017 & 11/05/2017	28/06/2017 & 29/06/2017	12/07/2017 & 13/07/2017	16/08/2017 & 17/08/2017	27/09/2017 & 28/09/2017
1	22:00-23:00	68.4	62.1	62.4	62.8	60.4	60.4
2	23:00-00:00	65.1	57.1	65.4	65.7	58.8	52.1
3	00:00-01:00	58.1	54.1	59.7	55.4	59.4	57.1
4	01:00-02:00	53.4	51.4	57.4	59.8	54.1	53.4
5	02:00-03:00	62.1	56.1	52.4	56.8	58.5	60.4
6	03:00-04:00	60.4	52.4	56.4	55.4	60.4	62.4
7	04:00-05:00	61.4	58.1	58.4	53.4	54.1	61.4
8	05:00-06:00	60.8	55.1	60.4	68.4	63.7	67.4
Night Time Limit*		70 Leq dB(A)					

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

MINIMUM DETECTION LIMIT [MDL]

Ambient Air Parameter		
Sr. No.	**Test parameter**	**MDL**
1	Particulate Matter (PM10)	10
2	Particulate Matter (PM 2.5)	10
3	Sulphur Dioxide (SO_2) (µg/m3)	5
4	Nitrogen Dioxide (NO_2) (µg/m3)	5

Stack parameter		
Sr. No.	**Test parameter**	**MDL**
1	Particulate Matter (mg/Nm3)	10
2	Sulphur Dioxide(ppm)	1.52
3	Oxides of Nitrogen (ppm)	2.65

H. T. Shah
Lab Manager

POLLUCON LABORATORIES PVT. LTD. SURAT-3

Dr. Arun Bajpai
Lab Manager (Q)

Annexure – 2

adani

ANNEXURE – 2

Water Consumption and Wastewater Generation Details for AMSIPL (April'17 to September'17)			
Month	**Water Consumption, KL**	**STP Water Inlet, KL**	**STP Water Outlet, KL**
Apr'17	30,718	23,974	25,879
May'17	26,373	22,300	24,315
Jun'17	32,160	26,178	27,997
Jul'17	33,134	19,654	19,034
Aug'17	32,704	26,319	22,971
Sep'17	33,164	24,046	23,270
Total	**1,88,253**	**1,42,471**	**1,43,466**

Note:

1. Treated sewage water is completely used for gardening purpose
2. As for the good faith and life of MBR we use to flush the one MBR with treated water from the other i.e. approx. 4 times a month. That water is again treated through MBR, because of that the outlet reading is higher than the inlet.

Annexure – 3

DISTROMED KUTCHH SERVICES PVT. LTD.

MONTH : SEPT '17

Date	Challan No.	BMW WASTE CATEGORIES				Total Kg.	Sign.
		Category Yellow	Category Red	Category Blue	Category White		
		Yellow Bag	Red Bag	Blue Bag/*C.B.	*PPC		
1	004/0007183	15	7	3	1	26kg	[illegible]
2							
3	0						
4	004/0007224	20	10	4.500	0.500	35kg	[illegible]
5							
6	11230	10	6	5	1	22kg	[illegible]
7							
8	004/0007336	5	3	2	-	10 kg	[illegible]
9							
10							
11	004/0007377	15	5	5.5	0.5	26 kg	[illegible]
12							
13	10303	15	5.5	4	0.5	25 kg	[illegible]
14							
15	10387	8	4	2	500gm	14.5kg	[illegible]
16							
17							
18	11359	18	7	2	0.500	27.5	[illegible]
19							
20	/007453	5	5	1	0.500	11.5 kg	[illegible]
21							
22	004/0007577	5	3	2		10 kg	[illegible]
23							
24							
25	007646	15	5	3	-	23 kg	[illegible]
26							
27	0007739	18	10	1.8	0.200	30kg	[illegible]
28							
29	004/0007802	7	5	5		17kg	[illegible]
30							
31							
		156 kg.	75.5kg	40.8kg	5.2	277.5	

*PPC : Puncture Proof Container

*C.B. Cardboard Box

Annexure – 4

Details of Greenbelt development at APSEZ, Mundra

LOCATION	Total Green Zone Detail				
	Area (In Ha.)	Trees (Nos.)	Palm (Nos.)	Shrubs (SQM)	Lawn (SQM)
SV COLONY	65.34	30051.00	6965.00	51138.00	80069.00
PORT & NON SEZ	77.52	131942.00	18613.00	68166.78	58455.18
SEZ	99.52	227135.00	15924.00	220449.60	27462.03
MITAP	2.48	8168.00	33.00	1670.00	4036.00
WEST PORT	83.20	182118.00	50221.00	24112.00	22854.15
AGRO- PARK	7.52	17244.00	1332.00	5400.00	2121.44
SOUTH PORT	14.08	25150.00	3430.00	3882.00	4826.97
Samudra Township	38.67	28252.00	11818.00	19978.07	35071.67
Productive Farming	15.69	19336.00	0.00	0.00	0.00
TOTAL (APSEZL)	**404.02**	**669396.00**	**108336.00**	**394796.45**	**234896.44**
		777732			

DRG NO. HORTI/APSEZL

Implemented Green Zone Development In APSEZL Area
(Mangrove afforestation and Conservation,
Green Zone area & Additional Green Belt Development)

A. Green Development at APSEZL,Mundra (Till Nov.2017) as per EC

Green Belt Developed as per EC Condition

Sr No.	Symbol	EC	Ec Details	Locations	Green Belt (ha.)	Trees (No.)	Avarage Tree Density (ha.)
GB1		23.Au.1995	Handling facility of General cargo/LPG/Chemical and their storage terminal at Navinal island	Navinal island, Liquid area	15.15	51605	3406
GB2		20.Sept..2000	Port Expantion project including dry/bulk/breck bulk cargo/container terminal ,Rly Link , related ancillary and back up	Inside port,Avenue, Fire station,Rly.building, CT2 area,etc	13.66	18074	1323
GB3		21.july 2004	SPM,COT and connected pipeline at mundra port	IOCL/HPCL /HMPL area	6.1853	7607	1230
GB4		05.Feb.2007	Development of Multipurpose berth(T2),Mundra	Terminal 2	4.37	5988	1370
GB5		12.Jan.2009	Waterfront development project at mundra	Waterfront area (Adani hou and nearer area,South and west basin,APL Road,etc)	122.36	281819	2303
GB6		20.Feb.2010	Eslablisment of CETP (17MLD) capacity at survey no.141(part),mundra	CETP area and treated water utilization area	16.98	31083	1831
GB7		20.Feb.2010	Township and area Development project at survey no.141(Part),Mundra	Samudra township , Adani hospital,Perifery of Bhukhi river bank,etc	43.55	59166	1359
(A.)Total					222.26	455342	2049

Additional Green Belt Developed

B. Additional Green Development at APSEZL,Mundra (Till Nov.2017)

Sr No.		Area Details	Green Belt (ha.)	Trees(No.)	Tree Density (ha.)
GB8		Shantiwan colony ,Adani School,Temple,Guest houses,Mundra	65.34	40554	621
GB9		Mitap and nearer area	2.4	8168	3403
GB10		Agripark area	7.52	17244	2293
GB11		Airstrip and airstrip road ,Along road from Rly Gate 24 to 25,North gate & other SEZ area	88.79	243059	2737
GB12		New Development (area 1 to 13 ,A,B)	26.03	38625	1484
(B.)Total			190.08	347650.00	1828.97

Total Green Development at APSEZL,Mundra (Till Nov.2017)

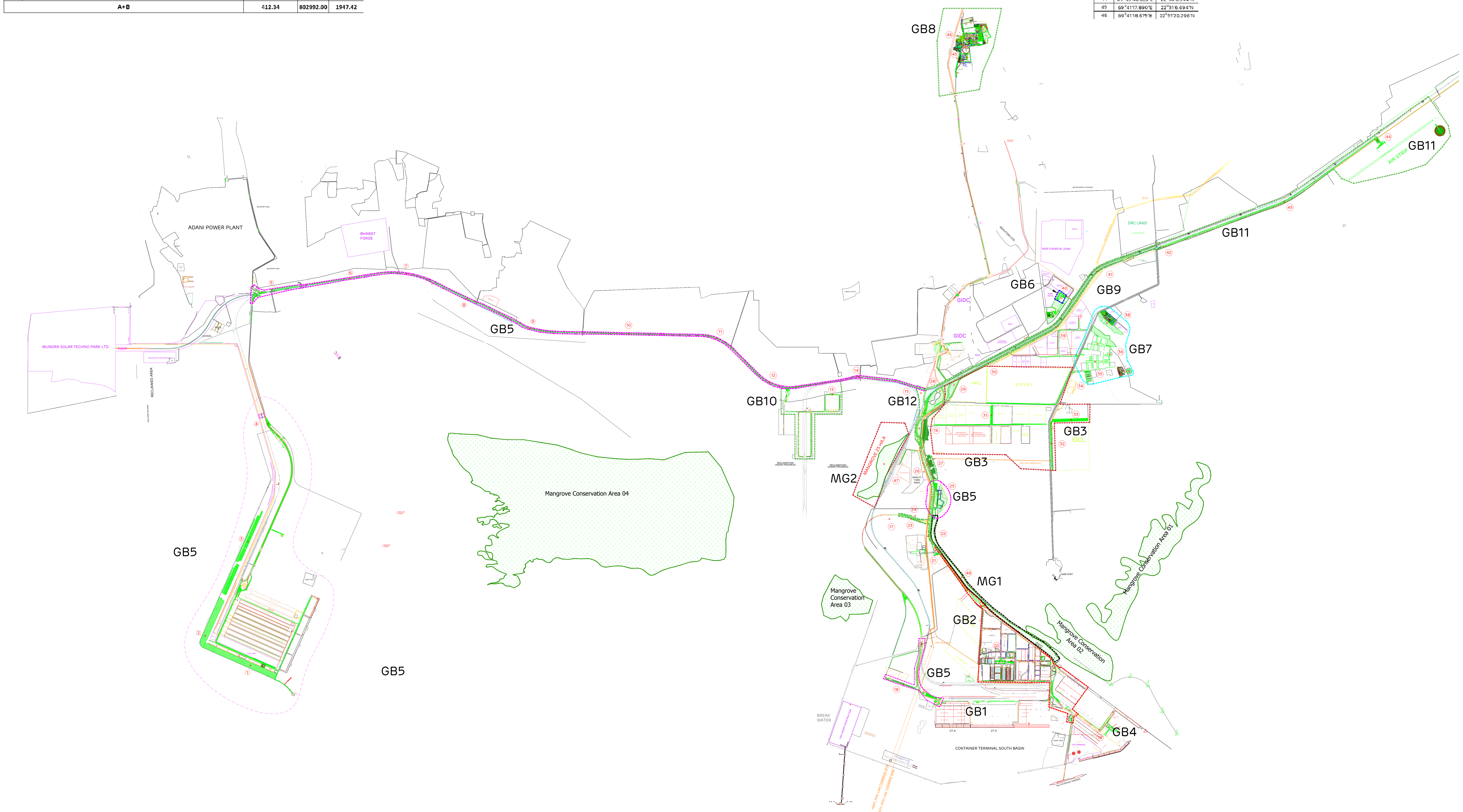
Sr No.	Area Details	Green Belt (ha.)	Trees (No.)	Tree Density (ha.)
A+B		412.34	802992.00	1947.42

Lat Long Of Green Belt Area

Sr. No.	Latitude	Longitude
1	69°33'29.798"E	22°44'58.842"N
2	69°33'2.398"E	22°45'14.365"N
3	69°33'32.735"E	22°46'17.109"N
4	69°33'44.520"E	22°47'20.650"N
5	69°33'41.090"E	22°48'43.306"N
6	69°34'31.981"E	22°48'50.120"N
7	69°35'11.003"E	22°48'54.268"N
8	69°35'58.337"E	22°48'36.557"N
9	69°36'38.620"E	22°48'19.674"N
10	69°37'44.608"E	22°48'16.751"N
11	69°38'35.659"E	22°48'14.104"N
12	69°39'12.518"E	22°47'46.137"N
13	69°39'51.720"E	22°47'39.717"N
14	69°40'10.522"E	22°47'50.513"N
15	69°40'48.508"E	22°47'40.312"N
16	69°40'47.610"E	22°47'18.746"N
17	69°40'28.982"E	22°46'29.237"N
18	69°40'38.406"E	22°44'44.679"N
19	69°42'43.751"E	22°44'17.492"N
20	69°40'47.412"E	22°44'57.528"N
21	69°40'56.317"E	22°46'6.039"N
22	69°40'53.035"E	22°46'13.077"N
23	69°40'42.589"E	22°46'28.874"N
24	69°40'43.374"E	22°46'32.176"N
25	69°41'0.640"E	22°46'38.096"N
26	69°40'50.601"E	22°46'53.156"N
27	69°40'54.883"E	22°47'3.674"N
28	69°40'57.778"E	22°47'36.690"N
29	69°41'9.996"E	22°47'44.044"N
30	69°41'30.201"E	22°47'57.091"N
31	69°41'34.576"E	22°47'26.535"N
32	69°42'13.593"E	22°47'8.318"N
33	69°42'26.888"E	22°47'23.693"N
34	69°42'37.345"E	22°47'50.499"N
35	69°42'42.020"E	22°47'58.785"N
36	69°42'51.726"E	22°48'3.073"N
37	69°42'43.597"E	22°48'9.573"N
38	69°42'50.969"E	22°48'21.573"N
39	69°42'14.688"E	22°48'18.784"N
40	69°42'19.806"E	22°48'37.682"N
41	69°42'43.190"E	22°48'52.628"N
42	69°43'26.341"E	22°49'8.778"N
43	69°44'49.105"E	22°49'36.665"N
44	69°45'48.623"E	22°50'8.344"N
45	69°41'17.890"E	22°51'6.694"N
46	69°41'18.675"E	22°51'20.296"N

Lat Long Of Mangrove Area

Sr. No.	Latitude	Longitude
47	69°40'22.704"E	22°46'59.824"N
48	69°41'12.855"E	22°45'49.811"N



DRG. TITLE:

Landscape Drawing

SCALE :- N.T.S.

DATE : 14.11.2017

DEPT.OF HORTICULTURE
ADANI PORTS & SPECIAL ECONOMIC ZONE LIMITED,
MUNDRA .

Annexure – 5

IS/ISO 9001:2008 Certified

2016-17

Doc. No. : EAR 59-4
Date : 21/01/17
Assign No. : SO/16-17/03594
Date: 25/10/16

adani

Energy Audit Report Samudra Township

Prepared for

Adani Ports and Special Economic Zone Limited
Post Bag No. 1, Village - Dhrub,
Tal - Mundra, Kutch 370421
Gujarat

Prepared by

MITCON Consultancy & Engineering Services Ltd.
215, 2nd Floor, Ratna Business Square
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Navrangpura, Ahmedabad-380 009

January -2017

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Delivery Challan No.: EAR 59-4 **Date: 21.01.2017**

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Prepared by: Chintan Shah

Checked By: Shakil Mansuri

Approved by: Deepak Zade

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LIST OF FIGURES

LIST OF APPENDIX

ABBREVIATIONS

°C	Degree Centigrade
A	Ampere
AC	Alternating Current
Avg.	Average
APSEZL	Adani Ports & SEZ Ltd.
BEE	Bureau of Energy Efficiency
cm.	Centimeter
Cr.	Crore
CHW	Chilled Water
CHWP	Chilled Water pump
CW	Cooling Water
CWP	Cooling Water Pump
DC	Direct Current
DG	Diesel Generator
Dia.	Diameter
Ft. or ft	Feet
F.O.	Furnace Oil
FD	Forced Draft
GoI	Government of India
gm.	Gram
hr.	Hour
ID	Induced Draft
Ins.	Insulated
kCal	Kilo Calories
kg.	Kilogram
KL	Kilo Liter
kV	Kilo Volt
kVA	Kilo Volt Ampere
kVAr	Kilo Volt Ampere Reactive
kW	Kilo Watt
kWh	Kilo Watt Hour
Lit	Liter
Lt	Liter
Ltd.	Ltd.
M or m	Meter
Max.	Maximum
MD	Maximum Demand
Min.	Minimum
MITCON	MITCON Consultancy & Engineering Services Ltd.
m	Meter
Samudra Township	Samudra Township
MT	Metric Ton
MW	Mega Watts
No.	Number
N.G.	Natural Gas
p.a.	Per Annum
PF	Power Factor
Rs.	Rupees
Temp.	Temperature
V	Voltage
VFD	Variable Frequency Drive
yr.	Year

HIGHLIGHTS OF THE REPORT

A. Samudra Township	-	**A Profile**
• Location	-	Adani Ports & SEZ Ltd., Post Bag No.1 Village Dhrub, Taluka: Mundra, Gujarat
• Year of Establishment	-	2009
• Business Activity	-	Samudra Township is a residential area with over 1368 occupied flats. It is governed by Adani Ports & SEZ Ltd.
B. Energy Scene		
• Total Annual Energy Bill	-	Rs. 2.547 Cr. (Dec-15 to Nov-16)
• Electricity Supply Company	-	MUPL
• HT Connection No. & Contract Demand	-	200009 & (900 kVA from Dec-15 to Apr-16 and 775 kVA from May-16)
• Major Energy Sources	-	Electricity and Diesel
• Major Connected Loads	-	Air conditioner, lighting, ceiling fan, water geyser, other home appliances
C. Contact Details		
• Engineer In charge	-	Mr. Sudershan Singh Dy. Manager (Engineering Services)
• E-Mail	-	sudershan.singh@adani.com 9979869867

D. Key Result Areas for Energy Savings & Estimated Potential along with Broad Cost Benefit.

Sr. No.	Energy Saving Area	Saving Potential in Kwh Lacs	Saving Potential in Rs. Lacs	Investment in Rs. Lacs	Simple Payback Period in Months
I. SHORT TERM AREAS					
1	Energy Saving by shifting load of Block C1 TRF06 on TRF04 and isolating TRF06	0.1015	0.710	0.5	9
2	Energy Saving by replacing Recirculation Pump with New High efficient pump	0.403	2.56	1.2	6
3	Energy Saving by Suction Cleaning in Raw sewage water pump 1	0.029	0.19	0.1	7
	Subtotal (I)	**0.533**	**3.452**	**1.800**	7
II. MID TERM AREAS					
4	Replacement of 70 W MH with 21 W LED in parking lights	0.199	1.266	2.19	21
	SubTotal (II)	**0.199**	**1.266**	**2.190**	21
III. LONG TERM AREAS					
5	Energy Saving by shifting load of TRF03 batching plant to TRF02 STP and isolating TRF03 batching plant	0.050	0.317	0.8	30
6	Replacement of conventional ceiling fans with energy efficient fans	3.698	23.483	66.67	35
7	Replacement of 44 W CFL with 21 W LED in parking lights	0.148	0.938	1.92	25
	Subtotal (III)	**3.896**	**24.738**	**69.39**	34
	Intangible areas of energy saving				
8	Replacement of water geyser with solar water heater. Although terrace of many blocks have been used for solar PV system, available empty terraces can be utilized.				
9	Overhaul of Refrigerant Piping Insulation & Filter Maintenance				
10	Optimal AC Temperature Setting				
11	Enhanced Use of Natural Lighting				
12	Building-Envelope & Air-Conditioned Space Insulation				
13	Heat Gain Reducing Paint				
14	Replace Re-winded motors & Pump with high efficiency motors & pumps in STP of Samudra Township				
	Grand total (I+II+III)	**4.628**	**29.456**	**73.38**	30

EXECUTIVE SUMMARY

1. TRF06 is operating at less than 20% load. Shifting of Block C1 load to Block B15 will save in iron losses.

Description	Unit	Existing Block C1 TRF06	Existing Block B15 TRF04	Proposed Block B15 & Block C1 on Block B15
Rated kVA	kVA	1000	1000	1000
Loading	kW	150	250	400
Loading	%	15	30	40
Iron loss	kW	2.2	2.2	2.2
Copper loss	kW	13.3	13.3	13.3
Actual Losses	kWh	2.52	3.07	4.42
Annual calculated losses	kWh	21813	26486	38152
Power Loss	kWh	21813	26486	38152
Annual losses in	Rs.	152694	185403	267064
Total Annual losses	Rs.			71033
Saving kWh	kWh			10148
Investment for Switchgear	Rs.			50000
Simple payback period	month			8

2. Energy Saving by replacing Recirculation Pump with New High efficient pump

Sr. No.	Description	Unit	Recirculation pump 1	Recirculation pump 2	Recirculation pump 3
1	Rated Kw	Kw	7.5	7.5	7.5
2	Measured Power	Kw	7.17	9.61	7.26
3	Opt. Hr/day	hr/day	24	24	24
4	Motor Efficiency	%	87	87	87
5	Pump Head	mtr.	2	2	2
6	Existing Flow	m3/hr	152	158	146
7	Efficiency of pump	%	13.3	10.3	12.6
8	Unit cost	Rs./Kwh	6.35	6.35	6.35
9	Annual opt. day	day	120	120	120
10	Proposed efficiency of pump %	%	65	65	65
11	Proposed Head	mtr.	5	5	5
12	Proposed Flow	m3/hr	160	160	160
13	Estimated power	Kw	3.35	3.35	3.35
14	Power Saving	KWH	3.82	6.26	3.91

15	Annual saving possible	Rs./yr	69794	114417	71440
16	Annual saving possible	kWh/yr	10991.2	18018.4	11250.4
17	Investment for 5 kW New High Efficient Pump	Rs.	40000	40000	40000
18	Simple payback period	months	7	4	7

3. Energy Saving by Suction Cleaning in Raw sewage water pump 1

Sr. No.	Description	Unit	Raw sewage water pump 1
1	Rated Kw	kW	5.5
2	Measured Power	kW	2.32
3	Opt. Hr/day	hr/day	12
4	Motor Efficiency	%	87
5	Pump Head	m	2.5
6	Existing Flow	m^3/hr	25
7	Efficiency of pump	%	8.6
8	Unit cost	Rs./Kwh	6.35
9	Annual opt. day	day	300
10	Proposed efficiency of pump %	%	65
11	Proposed Head	m	3
12	Proposed Flow	m^3/hr	120
13	Estimated power	kW	1.51
14	Power Saving	kWh	0.81
15	Annual saving possible	Rs./yr	18537
16	Annual saving possible	kWh/yr	2919.21
17	Investment for Suction Cleaning	Rs.	10000
18	Simple payback period	months	6

4. Replacement of 70 W MH with 36 W LED

Description	Unit	Existing	Proposed
Qty of parking lights	#	200	200
Qty of lights ON during audit	#	146	146
Running	Hr/day	11	11
Total Power	kW	10.22	5.256
Energy Saving	kWh/day	54.604	

Description	Unit	Existing	Proposed
Annual energy saving	kWh/yr		19930.46
Annual Cost Saving	Rs/yr		126558
Investment	Rs.		219000
Simple Payback	Month		21

5. Batching plant Transformer and STP Transformer are operating below 15% loading. Shifting of load on STP Transformer and isolating Batching plant Transformer will save in iron losses

Description	Unit	Existing	Proposed
Rated kVA	kVA	200	315
Loading	kW	20	100
Loading	%	10	32
Iron loss	kW	1.2	1.2
Copper loss	kW	4.45	6.45
Actual Losses	kWh	1.25	0.68
Annual calculated losses	kWh		4989
Annual losses	Rs.		31679
Saving in Power	kWh/ year		4989
Investment for Cable and Switchgear	Rs.		80000
Simple payback period	month		30

6. Replacement of conventional ceiling fans with energy efficient fans

Particular	Unit	Value
Total Fan		3968
Fans to be replaced at 70% of total occupancy		2778
Existing power/ fan	W	60
Power of Energy efficient fan	W	28
16 hours a day for non-winter days	hr/yr	4160
Energy Saving	kWh/yr	369807
Saving in Cost	Rs./yr	2348277
Investment @2400 Rs/Fan	Rs.	6667200
Simple Payback	Month	34

7. Replacement of 44 W CFL with 21 W LED in parking lights

Description	Unit	Existing	Proposed
Qty of parking lights		160	160
Running	Hr/day	11	11
Total Power	kW	7.04	3.36
Energy Saving	kWh/day		40.48

Annual energy saving	kWh/yr.	14775.2
Annual Cost Saving	Rs./yr.	93822.52
Investment	Rs..	192000
Simple Payback	Month	25

Preface

- Samudra Township is a residential area under Adani Ports and SEZ Ltd built in 2013 and is still expanding. The colony has more than 1350 schemes from studio apartments to 3 BHK flats. It houses other areas of human activity such as club house, Children Park, cricket ground, open air theatre, shopping centre, hospital, etc. Temple, shopping centre, teacher's colony and sewage treatment plant, are some areas inside colony premises whose power supply is considered under colony.

- The colony has club house area wherein there are tennis court, badminton court, basketball court, volleyball court and indoor games such as chess, table tennis, pool and snooker, etc. The club house also consists of Gymnasium and dining hall areas.

- The colony in houses various type of flats categorized into A, B, and C type. A type are 1 BHK flats. B type are 2 BHK flats whereas, C type consists of 3 BHK flats. Studio apartment and bachelor's block consist of 1 room and washrooms only.

- In the premises of the colony horticulture department and research lab is established. Water and power supply to this area is supplied from the same sources as that of other areas.

- Average residents of colony are more than two thousand. Families and bachelors from different cultures and different parts of India reside in the colony. Colony organises cultural events and celebrates different festivals from time to time.

ACKNOWLEDGEMENTS

- An energy audit is a joint venture of consultant and industry to account & contain energy usage without sacrificing the purpose of usage of energy. The contribution of Adani Ports And SEZ Ltd. (APSEZL), Samudra Township (Samudra Township) team is equally important in this venture. We sincerely acknowledge the contribution of the following dignitaries and site engineering personnel because of whom the study could progress smoothly –

Sr. No.	Name	Designation
1	Mr. Nirav Shah	Associate Gen Manager (Engineering Services)
2	Mr. Shailesh Kanjariya	Deputy. Manager (Asset Management)
3	Mr. Jagmal Nandaniya	Sr. Engineer (Engineering Services)
4	Mr. Sudershan Singh	Deputy Manager (Engineering Services)
5	Mr. Prasanna	Officer (Asset Management)

- We are also thankful to the other staff members who were actively involved while collecting the data and conducting the field studies.

Chapter 1 Introduction

1.1 Preamble

- Samudra Township is a residential township with more than 1368 occupied apartments/flats/ bungalows. It has its club house, shopping market mall, entertainment parks, school, open theatre, etc.

- Average annual energy bill is Rs. 2.547 Cr. (Dec-15 to Nov-16). Electricity consumption is shares the major chunk in the total annual energy bill i.e. up to 100 %, Energy share of Diesel consumption has been nil during the audit period. Diesel is only used for DG set.

- In order to reduce increasing energy costs, APSEZL approached MITCON for conduct of energy audit. MITCON submitted its vide proposal no. ECS/EEC/AL/2016-17/366 dated Sep 21, 2016. This proposal was accepted by APSEZL vide its purchase order no. 4800022101 dated Oct 20, 2016.

- This energy audit report for Samudra Township, Mundra presents the analysis of the data collected, observations made and field trials undertaken from 20 Dec, 2016 to 30 Dec, 2016. It is governed by the objectives, scope of work, and methodology discussed in ensuing paragraphs.

Baseline Parameters for Energy Audit

Parameter	Value	Unit
Operating Days	365	Days/year
Operating hours	24	Hr/day
Electricity Unit Rate for saving calculation	6.35	Rs./kWh
Diesel unit rate	55	Rs./ltr
Diesel density	0.834	kg/ltr
Diesel GCV	11084	kCal/kg

1.2 Objectives

- To undertake an energy audit so as to identify areas for energy saving, both without and with investment.

- To compare values for energy consumption as against the occupancy levels and identify potential areas for energy savings / energy optimization (both short-term areas requiring minor investments with attractive paybacks and mid / long term system improvement areas needing moderate investments and paybacks ranging between 12 to 30 months).

- To undertake renewable energy application assessment study.

- To prioritize distinct areas identified for energy savings depending upon saving potential, skills, and time frame for execution, investment cost, paybacks etc.

- To design an "Energy Monitoring System" for effective monitoring of energy consumption and analysis of energy efficiency.

- To provide assistance while implementation.

1.3 Scope Of Work

- To correlate monthly data of occupancy / activity with electricity, diesel and water consumption, for a period of 12 - 18 months of normal operation.

Part-I

- **Electrical**

- To study electrical energy metering, monitoring and control system existing at site and to recommend a suitable system for future monitoring.
- To study monthly power factor, maximum demand, working hours, load factor etc. for the reference period along with monthly electricity consumption and establish scope for MD control through load optimization of load factor and through detailed load management study.
- To recommend a specific rationalization / optimization program based on measurement of DB power factors, existing capacitor system and its maintenance, automatic / manual controls required etc.
- To study monthly transformer loading with existing & future connected load so as to recommend a specific rationalization / optimization plan for transformer capacity. Analysis of transformer efficiency, losses at various loadings.
- Study of APFC system working on various loadings to understand pattern of various feeders capacitors working.
- To undertake a detailed motor load study on all motors equal to and above 2 kW size with the help of a clamp on load manager to identify instantaneous motor parameters like kW, KVA, P.F., A, V, frequency etc. and establish their variations over a load cycle (for variable load drives, if any). This study will help establish / recommend motor specific rationalization plan including star conversion, downsizing, use of motor energy savers and high efficiency drives etc.
- Based on the above to evaluate the possibility of replacing major motors with energy efficient motors. To provide cost benefit analysis for the replacement policy. Analysis of suitable drive type, alignment etc. to reduce energy consumption.
- To measure current & voltage harmonics of main equipment up to 24^{th} level with 3-Φ power analyser & to give remedial solutions to remove / suppress harmonics. Suggestion with remedial action to install active / passive harmonics filter.
- Thermography at important electrical PCCs, MCCs & major loads above 63 A switches
- To undertake pumping energy audit on pumps having capacity above 2 kW Pumping audit will mainly cover measurement of water flow, power input, head with digital pressure gauge etc. This exercise will establish the operating duty point of each pump and possibility of energy conservation through pump capacity rationalization, impeller trimming etc. This will help to selection of energy efficient pump running.
- Recommendations on effective & precise control of blowers / fans working with modern control systems. Installation of high efficiency blowers, lobe blowers, aeration blowers for various applications.
- Study of UPS and Voltage Stabilizer System.
- To study compressed air system, in terms of compressor type, make, capacity, loading, motor type / size / loading etc. and to undertake output efficiency test for the operating compressors. This will identify opportunities for compressed air generation optimization and energy savings. Pump up test will be conduct to identify the FAD and leakage volume.

- To undertake compressed air leakages tests & recommend the locations of air leakage. Study of pressure drop and distribution network loop option to precise running of the system.
- To undertake lux survey for the major identified areas and streetlight with the help of a lux meter both during day and night time and recommend a specific plan for rationalization of lighting load through use of north light and switching off use of energy efficient lighting equipment like tri-phosphor fluorescent tube light etc. Possibility checking for installation of LED lighting, occupancy sensor, light pipe, switching point operation.
- Detailed study of streetlight and colony lighting.

- **Water - Basic Study**

- To study water receipt, storage, distribution and utilization in the plant so as to identify scope of water usage and pumping efficiencies.
- Study of R.O or D.M. generation of water & reutilization of wastage water.
- E.T.P./S.T.P. area energy consumption will be study under primary level.

- **Diesel Generator Sets**

- Measurement of electrical energy generated and fuel consumption (based on drop in fuel level)
- Evaluation of specific energy generation ratio (SEGR) and comparing with standards.
- Analysis of loading pattern on diesel generator sets.
- Waste heat recovery system installation option to be study for D.G. Sets.

- **Renewable Energy & Carbon Credits at Preliminary Study**

- To undertake renewable energy application pre-assessment study, which mainly include adaptation of onsite renewable energy technologies like solar power projects, solar thermal systems, biogas etc.
- Pilot study for carbon credits (cost benefit analysis, road map for implementation)

Part-II

- **Air Conditioning System**

- Study of air conditioners performance and efficiency
- Study of utilization factor, operations, running hours reduction by efficient utilization
- Study of maintenance factors
- Study of reduction of heat load, effective area utilization, human general behaviours, history, records, installation locations etc.
- Calculation of energy efficiency index as per standard available practices.

1.4 Methodology

- MITCON deputed following team of experts for conducting the audit and worked in close association with APSEZL.
  - Mr. Deepak Zade, Sr. Vice President
  - Mr. Krunal Shah, Asst. Vice President
  - Mr. Shakil Mansuri, Senior Consultant
  - Mr. Chintan Shah, Project Consultant
  - Mr. Maulik Patel, Certified Energy Auditor
  - Mr. Kalpesh Patel, Associate Consultant
  - Mr. Anand Shah , Associate Consultant
  - Mrs. Sangita Mainkar, Data Management
  - Mr. Jitendra Shinde, Data Management
- MITCON submitted an execution work plan for the assignment for which APSEZL provided relevant data support.
- APSEZL Nominated specific persons from Engr. / Maintenance sections along with a co-ordinator of senior managerial level for this audit.
- MITCON undertook an "Orientation Meeting" with management / Engr. / Maintenance personnel prior to start of the audit. MITCON's team conducted all necessary field trials and measurements.
- MITCON provided all the instruments necessary for conducting the field trials.
- Following instruments were used by MITCON's team.

Table 1 Instruments Used by Energy Audit Team

Sr. No.	Instrument Name	Specification
1.	Demand Analyser	Suitable for 1φ, 3φ. 156 electrical parameters like voltage, current, frequency, harmonics, active & reactive power, power factor etc.
2.	Clamp-on Power Meter	0 - 1200 kW 0 - 600 Voltage, AC 0 - 800 Voltage, DC 0 - 2000 A, Current, AC / DC
3.	Lux Meter	0 - 50,000 Lux Level Non Contact Type
4.	Digital Thermo Anemometer	0 - 45 m / sec. ± 3%
5.	Relative Humidity and Temperature Indicator	RH – 10% to 95% Temp. – 0 – 100 °C Handheld unit
7.	Infrared Thermometers	40 °C to 500 °C
8.	Portable Temperature Indicator-Digital	50 °C to 1200 °C
9.	Ultrasonic Flow Meter	0 – 15 m/sec 25 – 5000 mm pipe dia. homogeneous liquids without gas bubbles +/- 0.5 %
10.	Thermal Imager	Measure 0-500 °C of Temperature Profiles of surface area
11.	Multifunction Instrument	Measure °C, air velocity

12.	Digital Pressure Gauge	0 to 30 kg/cm2 with 0.1 kg/cm2 accuracy
13.	Stop Watch	0.00 to 2000 minutes
14.	Sling psychrometer	0-50 °C
15	Laser distance meter	0-40 m lateral distance, room area and volume

Chapter 2 Back Drop on Energy Scene

2.1 Energy Scene

- Primary energy sources for the township are Electricity and Diesel. These sources are consumed for the various heating, cooling, lighting applications in the building, operating DG set during power cut off, etc.

- Segregation of annual energy bill is presented in the following figures. Electricity bill share is 100% followed by Diesel which has almost nil consumption from Dec-15 to Nov-16.

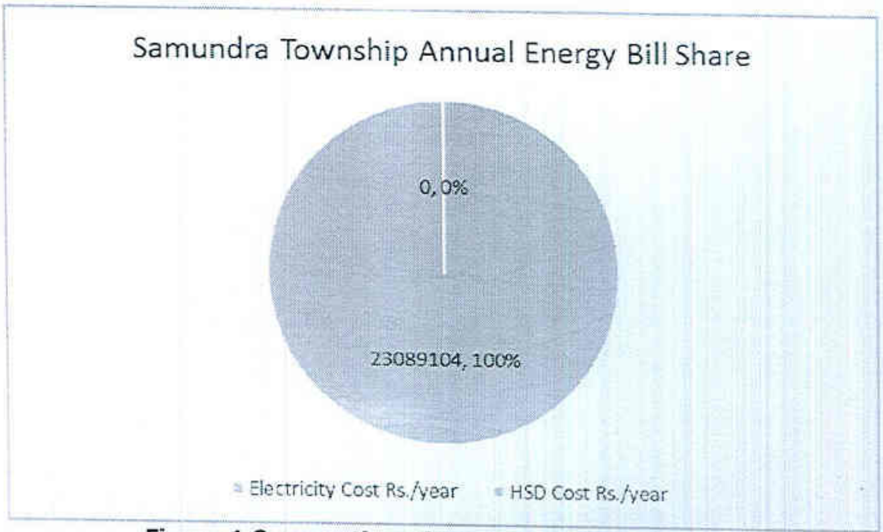


Figure 1 Segregation of Annual Energy Bill

2.2 Energy: Sources & Utilisation

2.2.1 Electricity

- The source of outside power for the buildings is from MUPL power grid at 11 KV. The power received is further stepped down to 11000 V/433 V through 6 transformers and is distributed to all power distribution buses.

- Additionally, there is one DG set of 125 KVA to ensure back up power supply to the township. D.G. set is used as power back up when power is not receiving from electricity grid.

- Present building Contract demand is 775 KVA. Facility actual demand is lower than contract demand in all months.

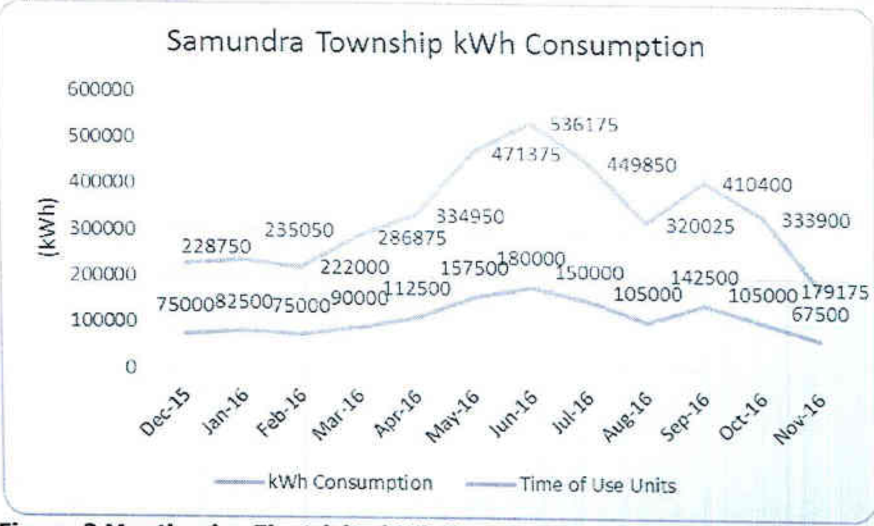


Figure 2 Month wise Electricity kWh Consumption – As per MUPL Bill

- Maximum Consumption observed in the month of Jun-16 whereas minimum consumption observed in the month of Nov-16. Average monthly consumption is 3.34 Lacs kWh.

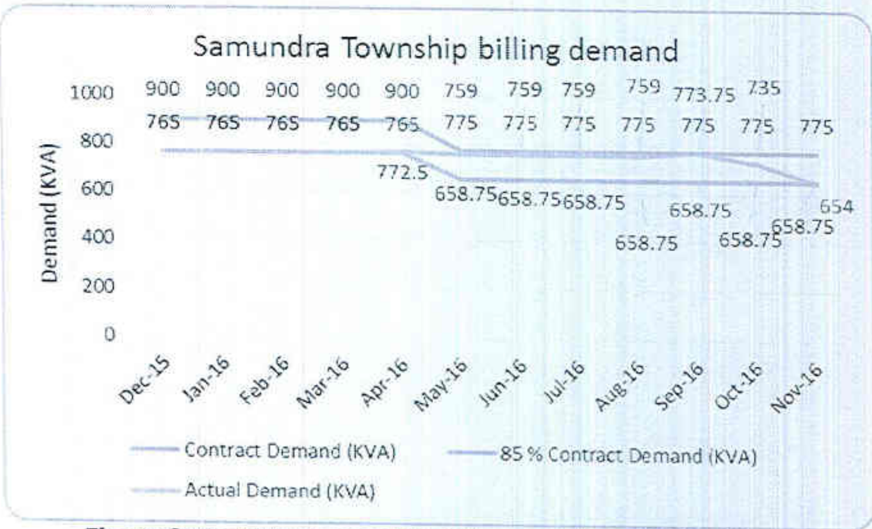


Figure 3 Monthly Demand Variation – As Per MUPL Bills

- Samundra Township (Samundra Township) had contract demand of 900 kVA from Dec-15 to Apr-16. The demand was reduced after Apr-16 by the management in view of reduced capacity consumption. The bill demand is less than contract demand in all months from Dec-15 to Nov-16.

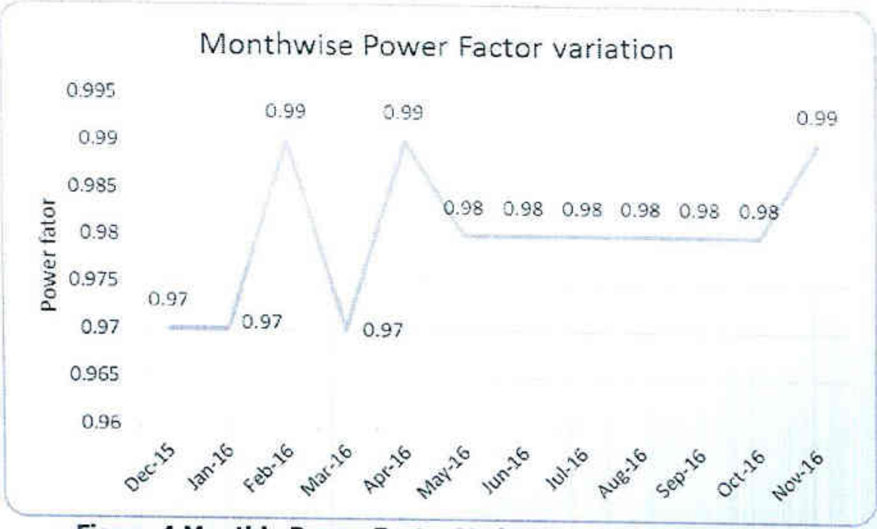


Figure 4 Monthly Power Factor Variation – As Per MUPL Bills

- Average Power factor observed is 0.98 despite of no capacitor banks are online with power distribution network.

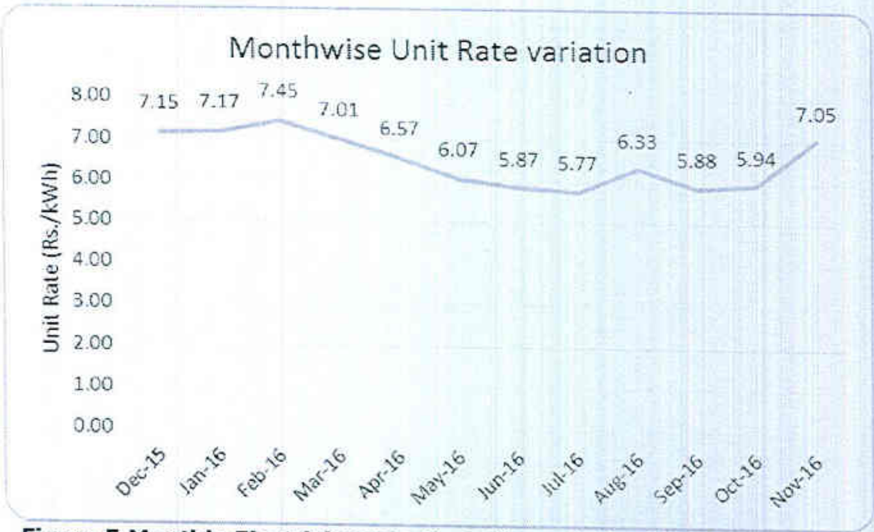


Figure 5 Monthly Electricity Rate Variation – As Per MUPL Bills

- Average unit cost as per electricity bill from Dec-15 to Nov-16 is 6.35 Rs./kWh.

2.2.2 Diesel

- Diesel is used to run the DG sets to ensure the uninterrupted power supply, whenever distribution Power supply fails. As per Samudra Township Diesel record and log book, the diesel consumption is nil. The fuel is also used for vehicle transport but Samudra Township engineering dept. maintains separate records for both purposes.

2.2.3 Water

- Water is available from Narmada canal and it utilised for two major purposes. 1. Residential purpose, 2. Horticulture. An STP is installed at Samudra Township to recycle waste water and reduce canal water pumping. 1 MLD is the present daily demand of Samudra Township.

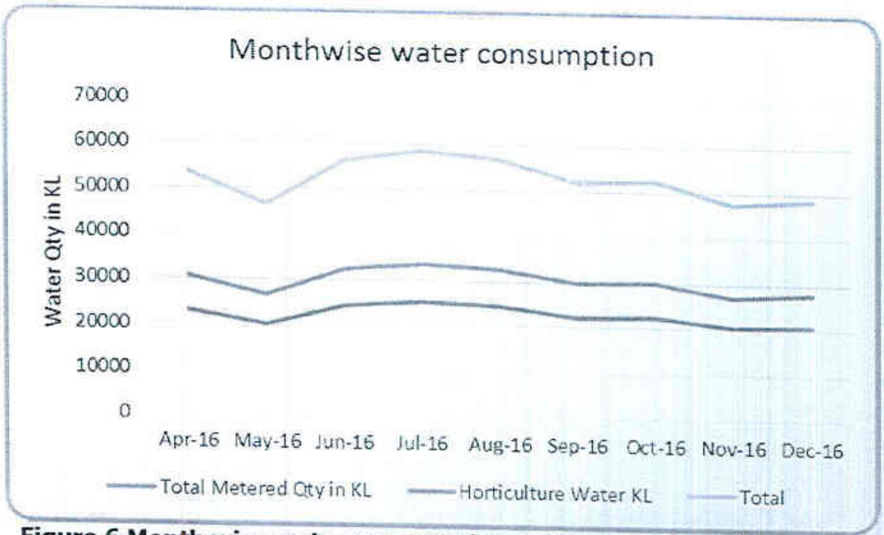


Figure 6 Month wise water consumption of Samudra Township

2.3 Energy Metering, Monitoring & Control System - Existing Status

2.3.1 Electricity

- Electricity is providing by MUPL at 11 kV. The power received is stepped down to 433 V through nos. of Transformer in Samudra Township.
- kWh and kVAh is being logged in log book by engineering department.
- A 1.5 MW solar plant is in the commissioning phase at Samudra Township. The Solar PV panels are installed at rooftops of more than 50 blocks and a central power system is commissioned at electrical control room in the premises.

2.3.2 Diesel

- Diesel is being purchased and stored in diesel storage tank. Eng. Department of takes record through level indicator. Diesel is used in DG sets only during power cut off from grid and performance and reliability testing.

2.3.3 Water

- Water is available from Narmada canal through water supply authority of MUPL and it is utilised for two major purposes. 1. Residential purpose, 2. Horticulture.
- Proper metering and totalizers are installed at the pump line.
- Daily record of water consumption is maintained by Samudra Township.

2.4 Level of Awareness

- Housekeeping is observed in line & maintenance is also observed in good condition.
- Using of natural lighting whenever possible during day time for office use was seen at some places.
- Air conditioners with inverters are not installed in Samudra township.
- Streetlights with LED fixtures has been fitted for reduction of lighting power.
- Based on geographical time zone, timers for turning on/off streetlights has been installed in street lighting.

Suggestions: -

- Open a scheme for obtaining suggestions for conserving energy.
- Display regularly the usage of energy, energy cost & consumption of all departments.

Chapter
3 Energy Conservation Opportunities
(Observations, Field Trials, Analysis and Key Result Areas)

3.1 INTRODUCTION

- The study of township operations, data collection, observations, field trials and analysis of various areas was undertaken, keeping in view the energy scene at Samudra Township, focus areas elaborated in the previous chapter and with a view to identity energy conservation opportunities in the same. The basis for this is the orientation visit, discussions with the engineering personnel and the agreed plan for data collection and field trials. All these trials were undertaken at normal operating conditions.

3.2 TRANSFORMERS & DISTRIBUTION SYSTEM

- Single line diagram of Electrical System as attached in separate sheet.

3.2.1 Distribution Transformers

- As described earlier, the source of electric power for the township is from MPSEZ grid at incoming at 11 KV. The power received is further stepped down to 433V through a six transformers at various locations and is further distributed in Samudra Township.
- During audit period performance is tested by measuring electrical parameters for each Transformer under operation.
- Installation and performance of transformers is as under.

Table 2 Transformer Installation Details

Description	TRF01	TRF02	TRF03	TRF04	TRF05	TRF06
Location	Electrical Room	STP	Batching plant	Block B15	Block B67	Block C1
Make	Ames Impex	Universal	SKP	CSS	CSS	CSS
KVA	125	315	200	1000	1000	1000
HV Volts	11 kV	11 kV	11 kV	11 kV	11 kV	11 kV
LV Volts	0.433 kV	0.433 kV	0.433 kV	0.433 kV	0.433 kV	0.433 kV
HV AMPS	6.56 A	16.55	10.49			
LV AMPS	166.86	420	266.67			
Impedance Voltage (%)	4.0	NA	3.85			
Cooling Type	Dry type	ONAN	ONAN	Dry type	Dry type	Dry type
Connection	Dyn11	Dyn11	Dyn11	Dyn11	Dyn11	Dyn11
Serial No.	2340	NA	NA			
Year of Mfg	2009	2007	2011			

- Power measurement of transformers was conducted which included monitoring of variation in voltage, load, power factor, Current, harmonics and other incidental parameters. The detailed 1-minute interval data logging is available separately in chart and Load cycle as shown below.

➤ **125 kVA Transformer TRF01**

TRF01 is a transformer that is utilised for distribution of power in streetlight, area light and passage light

The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

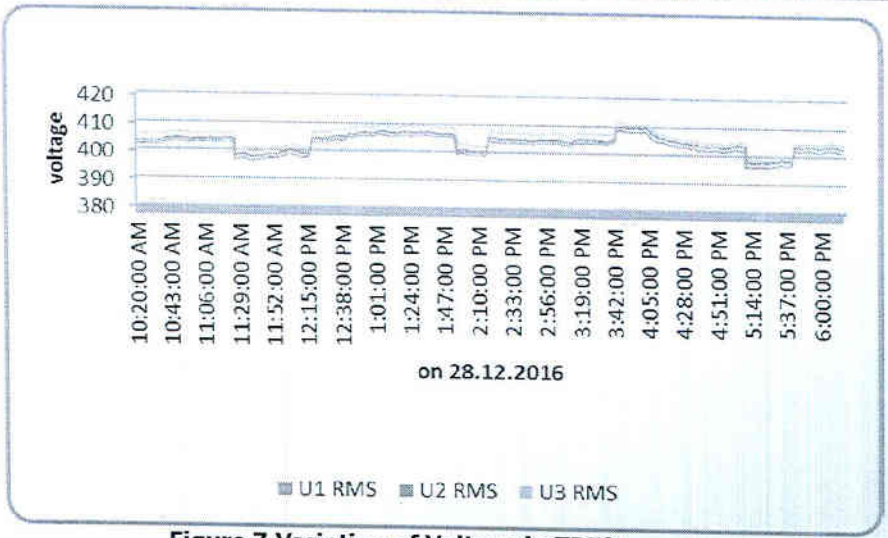


Figure 7 Variation of Voltage in TRF01

- The plot of voltage vs. time has been separately prepared to analyse the variation. The same is typical for the day and may vary daily. The chart indicates a normal range of 410 to 405 V. The average for the day is 412 V. Voltage measurements at several equipment's over other days also indicates similar pattern.

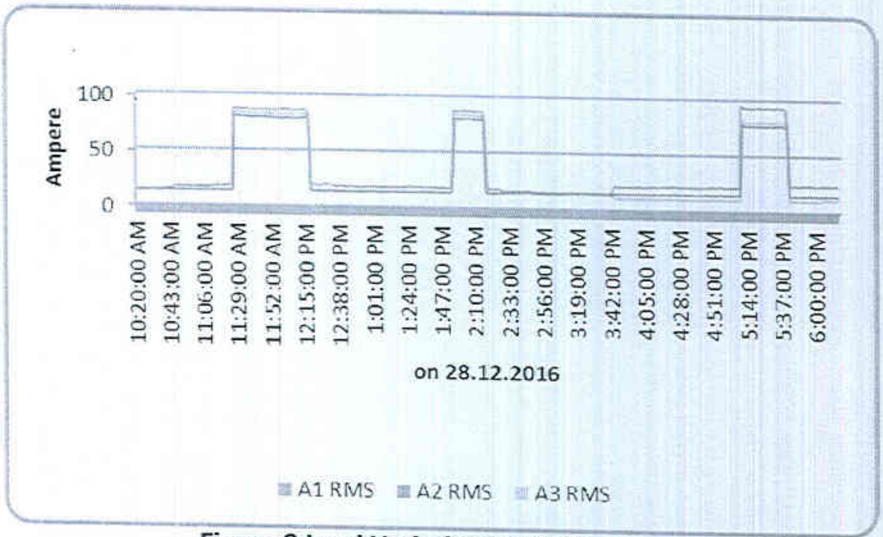


Figure 8 Load Variation in TRF01

- The load pattern indicates maximum load 97 A, whereas minimum load is 11 A. Average load observed 43 A.

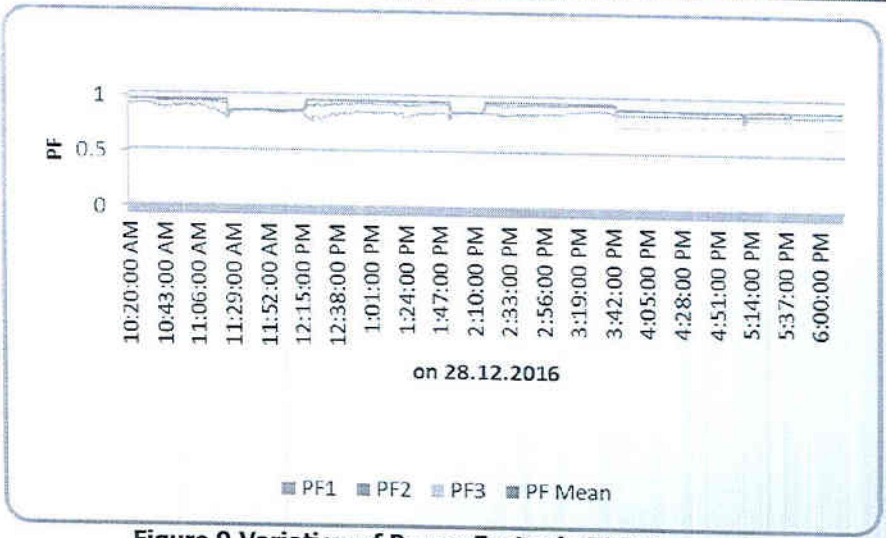


Figure 9 Variation of Power Factor in TRF01

- The average power factor is 0.9. Minimum power factor is 0.78 whereas 0.94 being maximum.

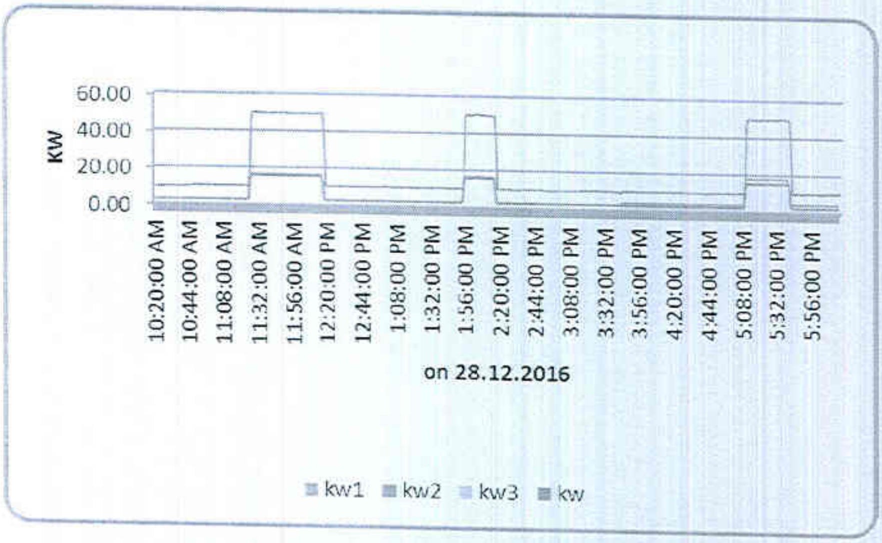


Figure 10 Power Variation in TRF01

- The load pattern indicates maximum power 50.6 kW, whereas minimum power is 8.9 kW. Average power observed is 19 kW.

Table 3 Electrical parameters of TRF01

Parameter	V	A	PF	KW	Hz	% V THD	%A THD
Maximum	412.2	96.6	0.944	50.48	50.24	1.3	14.6
Minimum	396.1	10.6	0.783	8.84	49.83	0.4	1
Average	404	43.8	0.9	19	50.00	0.89	5.83

315 KVA Transformer TRF02

TRF02 is utilised in Sewage Treatment Plant for operating pump sets and filter plants. The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

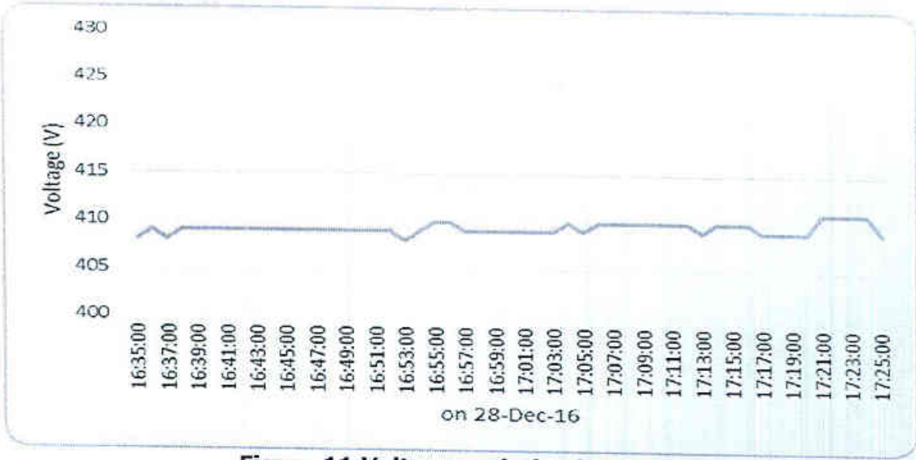


Figure 11 Voltage variation in TRF02

- Maximum voltage 411 V, whereas minimum voltage is 408 V. The average voltage is 409 V. The transformer is operated under low voltage variation as such the load variation is also less.

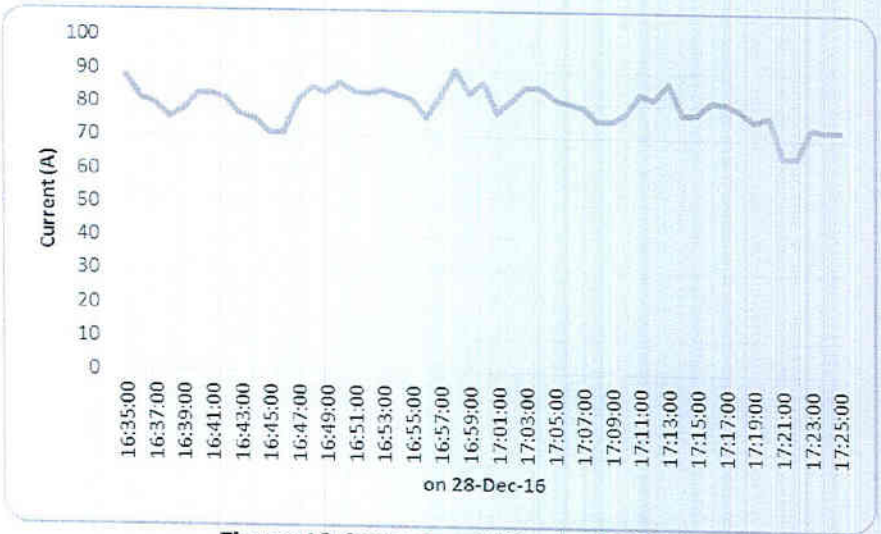


Figure 12 Current variation in TRF02

- Maximum current in TRF02 was observed as 90 A, whereas minimum current of 65 A. Average current of 80 A is measured during the period of audit.

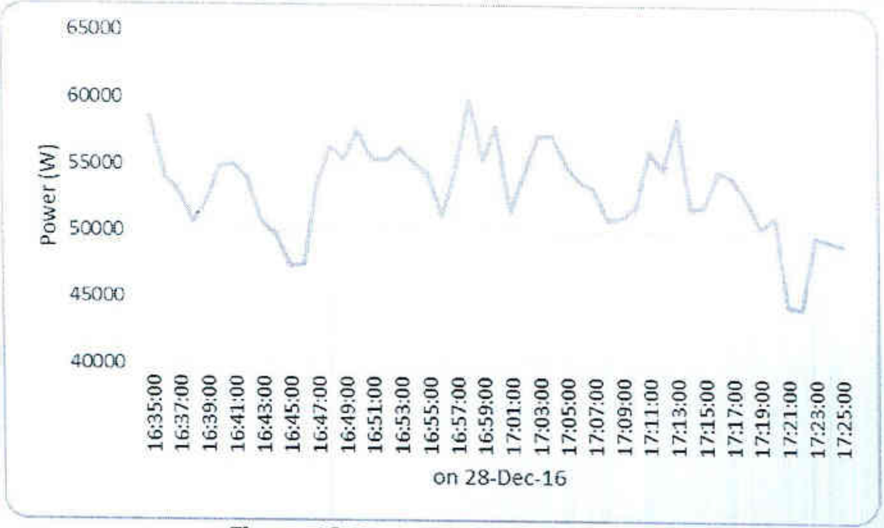


Figure 13 Power variation in TRF02

- Maximum Power measured in TRF02 was 60 kW whereas 44 kW being the minimum. Average measured power was 53 kW.

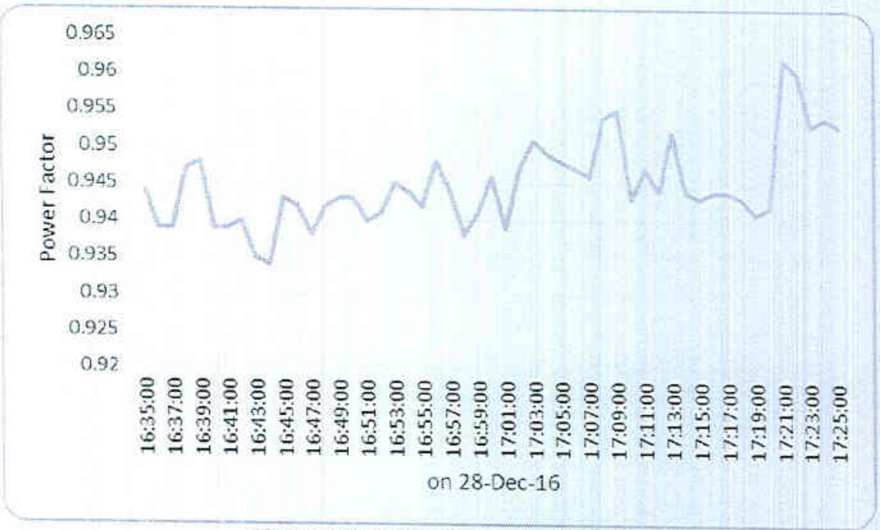


Figure 14 PF variation in TRF02

- Maximum pf measured in TRF02 was 0.962 and 0.934 being the lowest. Average pf was 0.94. Power factor is continuously hunting between maximum and minimum points and needs fine tuning. The maximum measured power factor is also less and pf upto 0.999 is recommended using capacitor banks for reactive power compensation.

Table 4 Electrical parameters of TRF02

Parameter	V	A	PF	KW	Hz	% V THD	%A THD
Maximum	411	90.3	0.962	60	50.3	2.54	36.4
Minimum	408	64.8	0.934	44.2	49.9	2.03	23.8
Average	409.35	79.55	0.94	53.26	50.05	2.26	27.72

- **200 kVA Transformer (Batching Plant) TRF03**

TRF03 is utilised whenever batching plant is operated in Samudra Township. The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

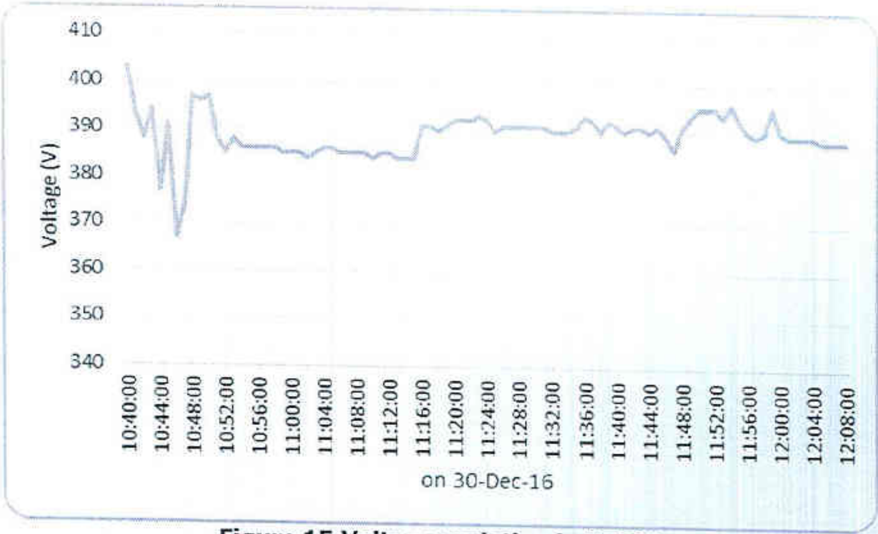


Figure 15 Voltage variation in TRF03

- Maximum voltage 403 V, whereas minimum voltage is 367 V. The average voltage is 389 V.

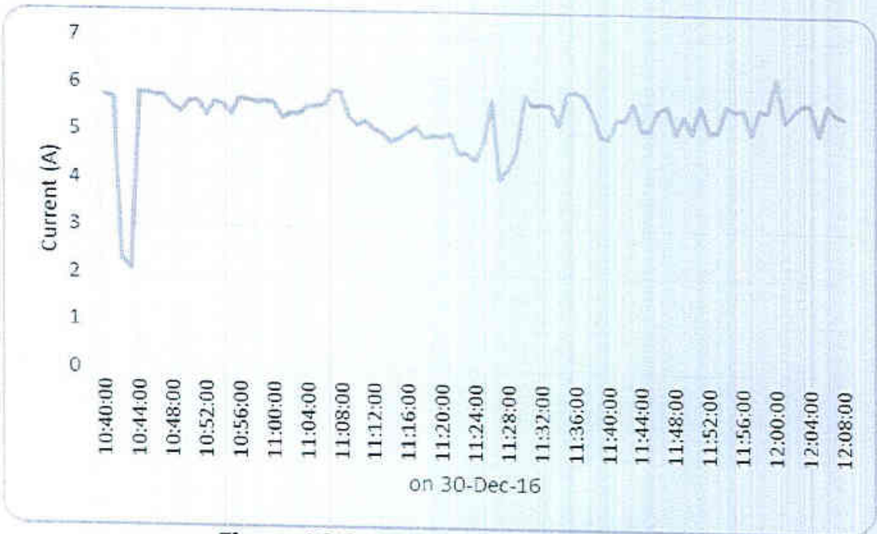


Figure 16 Current Variation in TRF03

- Maximum current is 6.2 A, minimum being 2 A. The average current is 5.29 A.

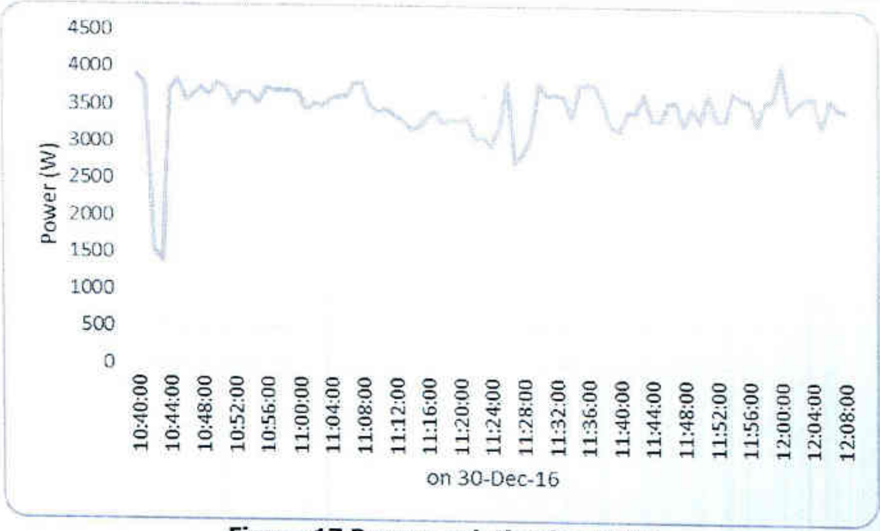


Figure 17 Power variation in TRF03

- Maximum power measured in TRF03 was 4.35 kW whereas minimum was 1.4. Average power measured was 5.2 kW.
- Since the transformer is 200 KVA maximum measured power of 4.35 kW directs that the transformer is operated at under rating.

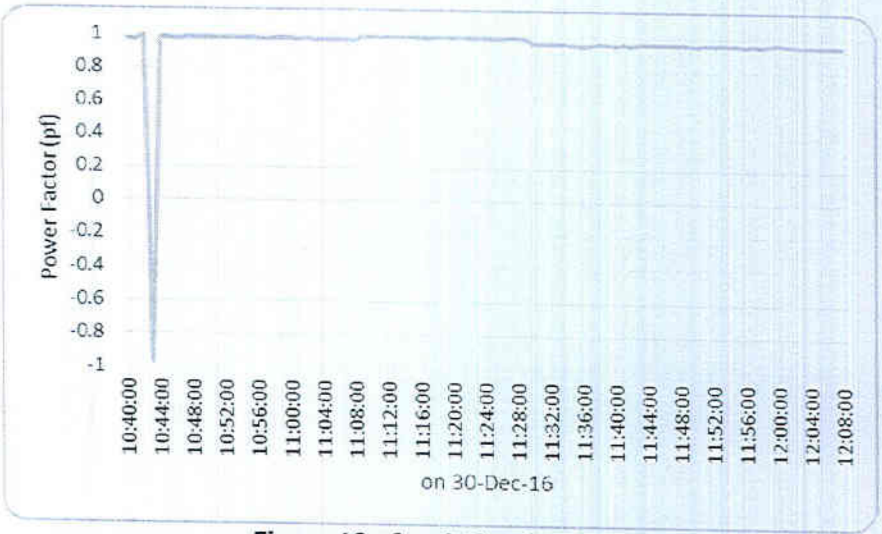
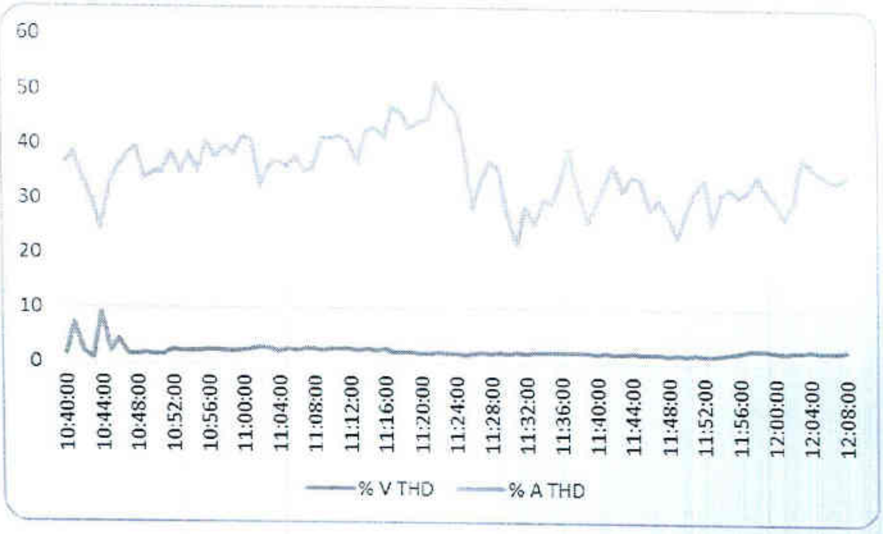


Figure 18 pf variation in TRF03

- Maximum measured pf was 1 whereas minimum pf was 0.95. Average pf was 0.98.



- Maximum %V THD was measured as 9 %. Maximum % A THD was measured as 51.5 %. The average % A THD was 35 %. The current harmonics are above permissible limits.

Table 5 Electrical parameters of TRF03

Parameter	V	A	PF	KW	Hz	% V THD	%A THD
Maximum	403	6.24	1	4.35	51.3	9.06	51.5
Minimum	367	2.1	0.949	1.4	49.9	0.937	21.8
Average	389.10	5.29	0.98	3.47	50.01	2.17	35.28

- **1000 kVA Transformer TRF04 at Block B15**

The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

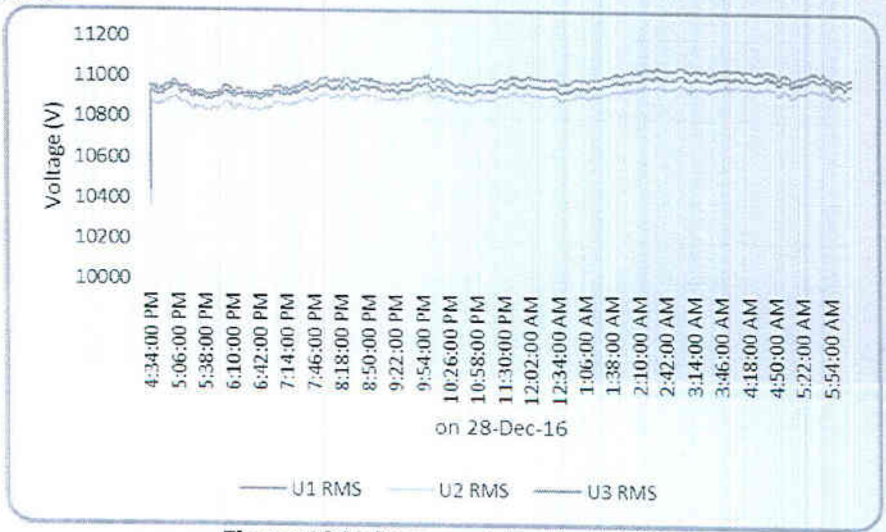


Figure 19 Voltage variation in TRF04

- Power log in was taken from primary of transformer. The maximum voltage measured was 11.06 kV whereas, minimum was 10.37 kV. Average voltage measured was 10.84 kV

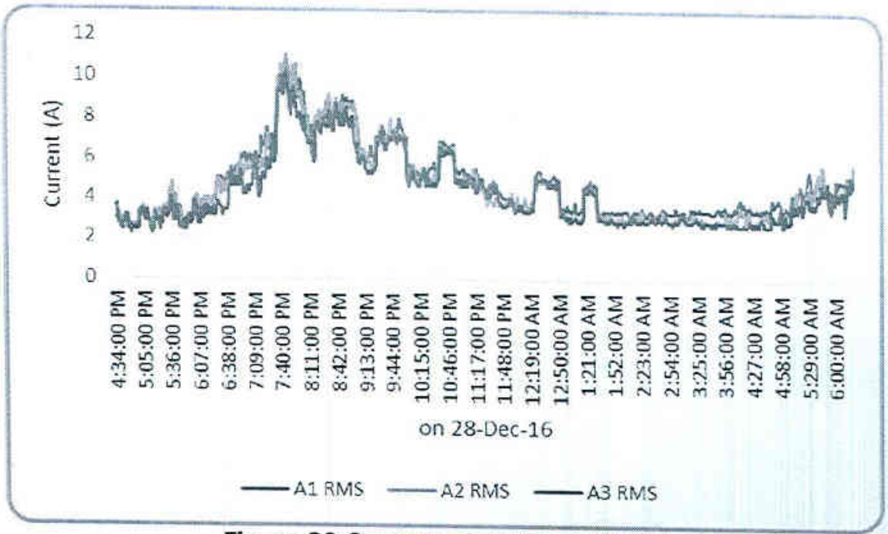


Figure 20 Current variation in TRF04

- The maximum current measured from primary of transformer was 11.1 A whereas, minimum current was 2.25 A. Average measured current was 5.85 A.

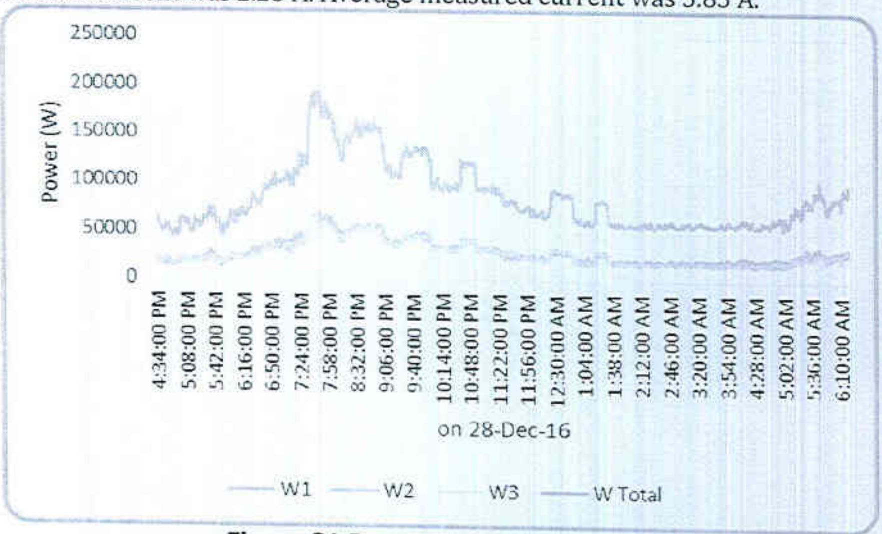


Figure 21 Power variation in TRF04

- Power log in was taken from primary of transformer. The maximum power measured was 193 kW whereas, minimum was 44 kW. Average power measured was 86 kW.

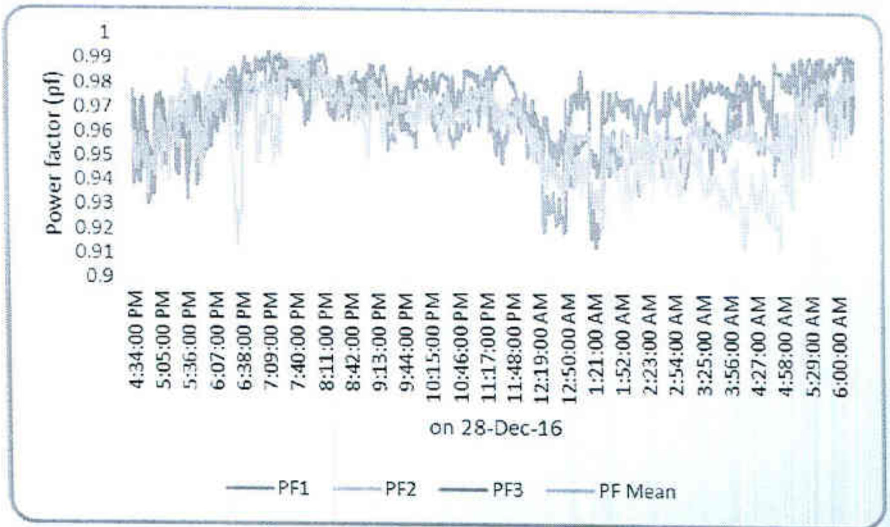


Figure 22 PF variation in TRF04

- The maximum pf measured from primary of transformer was 0.988 whereas, minimum was 0.931. Average measured pf was 0.971. Operating power factor is low and resulting in power losses.

Table 6 Electrical parameters of TRF04

Parameter	V	A	PF	KW	Hz	% V THD	%A THD
Maximum	11060	11.1	0.988	193.09	50.24	1.2	21.7
Minimum	10370	2.25	0.931	43.90	49.79	0.7	6.8
Average	10848.6	5.85	0.97	85.98	50.01	0.9	14.6

- **1000 kVA transformer TRF05 at Block B67**

The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

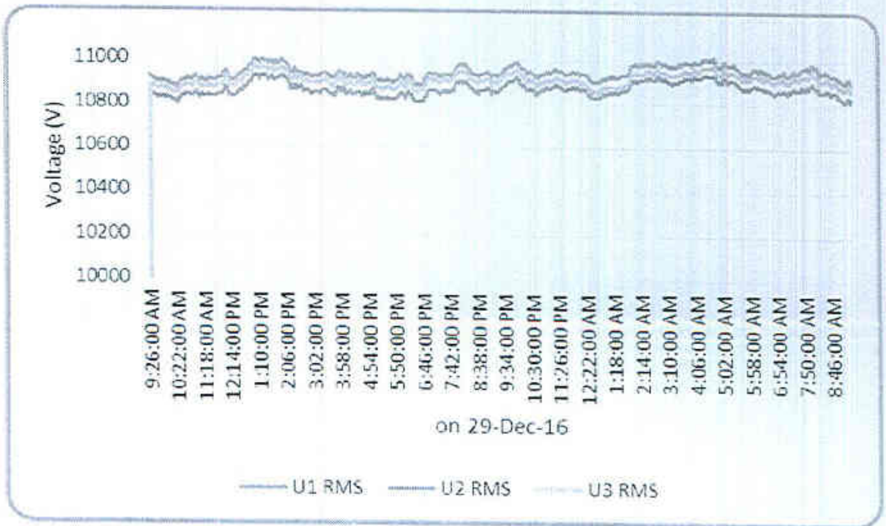


Figure 23 Voltage variation in TRF05

- Power log in was taken from primary of transformer. The maximum voltage measured was 11.02 kV whereas, minimum was 9.47 kV. Average voltage measured was 10.62 kV.

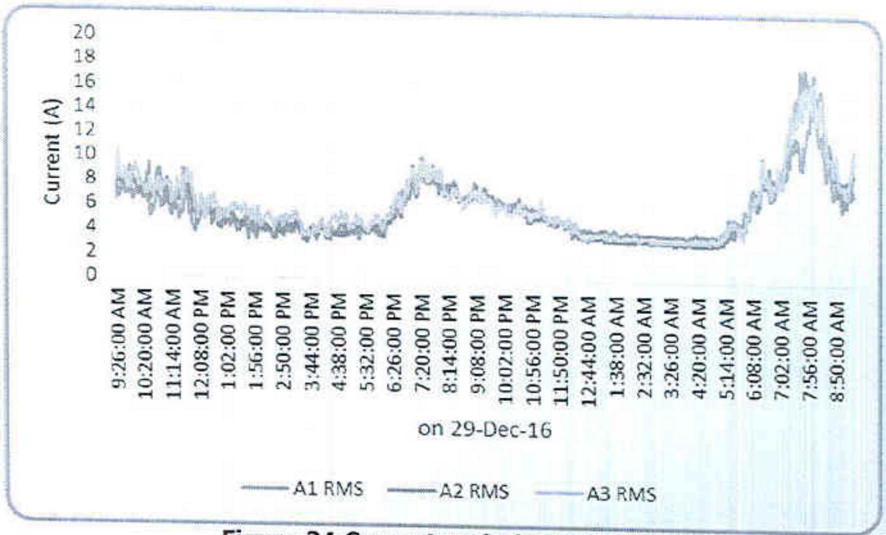


Figure 24 Current variation in TRF05

- The maximum current measured from primary of transformer was 17.8 A whereas, minimum current was 3A. Average measured current was 8.7 A.

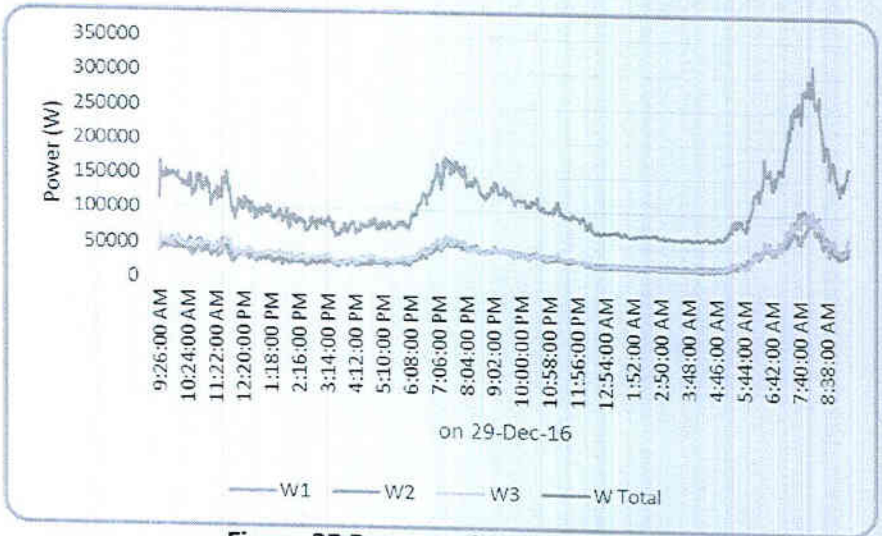


Figure 25 Power variation in TRF05

- Power log in was taken from primary of transformer. The maximum power measured was 318 kW whereas, minimum was 61 kW. Average power measured was 111.7 kW.

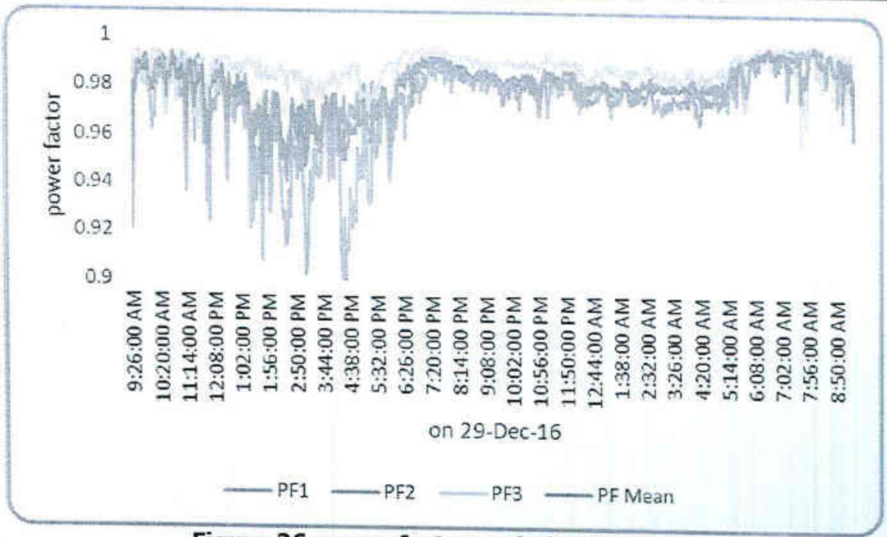


Figure 26 power factor variation in TRF05

- The maximum PF measured from primary of transformer was 0.998 whereas, minimum was 0.943. Average measured PF was 0.967.

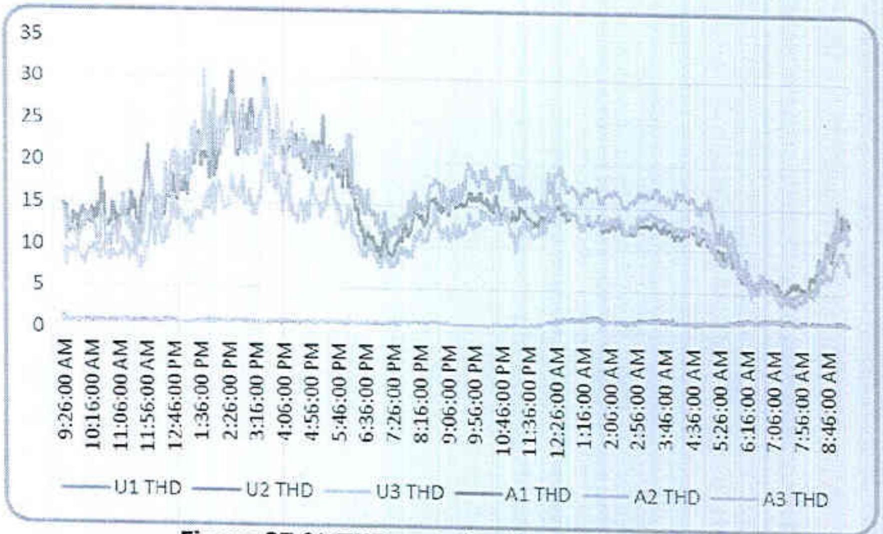


Figure 27 % THD variation in TRF05

- Maximum % V THD measured was 1.9 % which is under permissible limit. Maximum % A THD measured was 31.1 % and average being 15.24 %. The current harmonics in the transformer is above permissible limits.

Table 7 Electrical parameters of TRF05

Parameter	V	A	PF	KW	Hz	% V THD	%A THD
Maximum	11020	17.85	0.998	317.86	50.17	1.9	31.1
Minimum	9470	3	0.943	60.84	49.75	0.6	3.5
Average	10623	8.66	1.0	111.66	50.0	1.19	15.24

- **1000 kVA Transformer TRF06 at Block C1**

The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

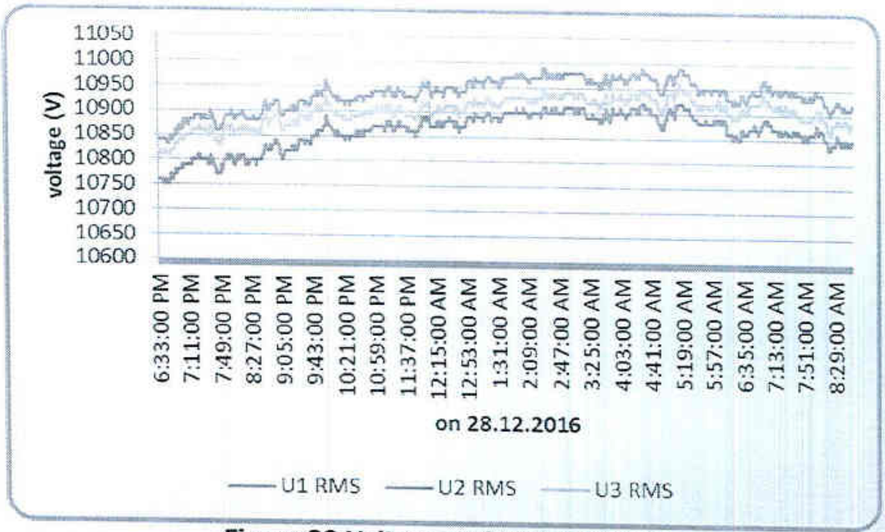


Figure 28 Voltage variation in TRF06

- Power log in was taken from primary of transformer. The maximum voltage measured was 10.99 kV whereas, minimum was 10.75 kV. Average voltage measured was 10.84 kV.

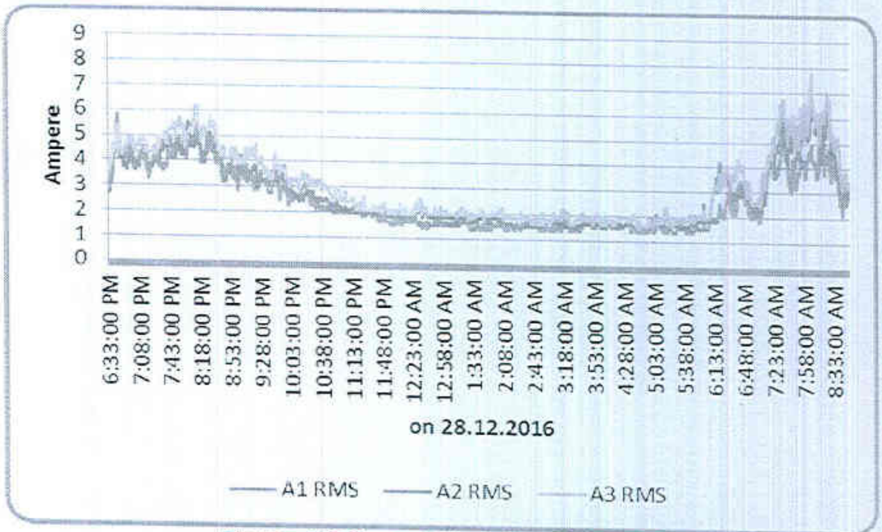


Figure 29 Current Variation in TRF06

- The maximum current measured from primary of transformer was 7.8 A whereas, minimum current was 1.3 A. Average measured current was 3.7 A.

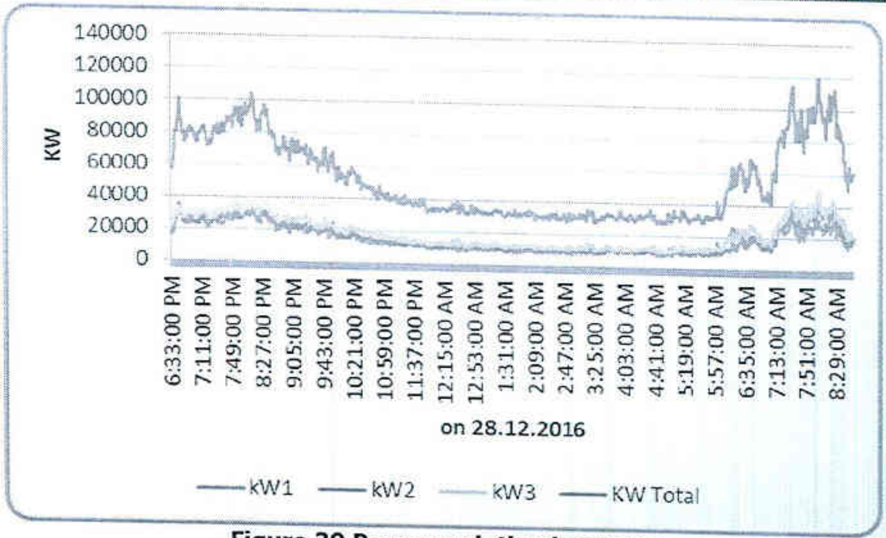


Figure 30 Power variation in TRF06

- Power log in was taken from primary of transformer. The maximum power measured was 120 kW whereas, minimum was 27.3 kW. Average power measured was 52.9 kW.

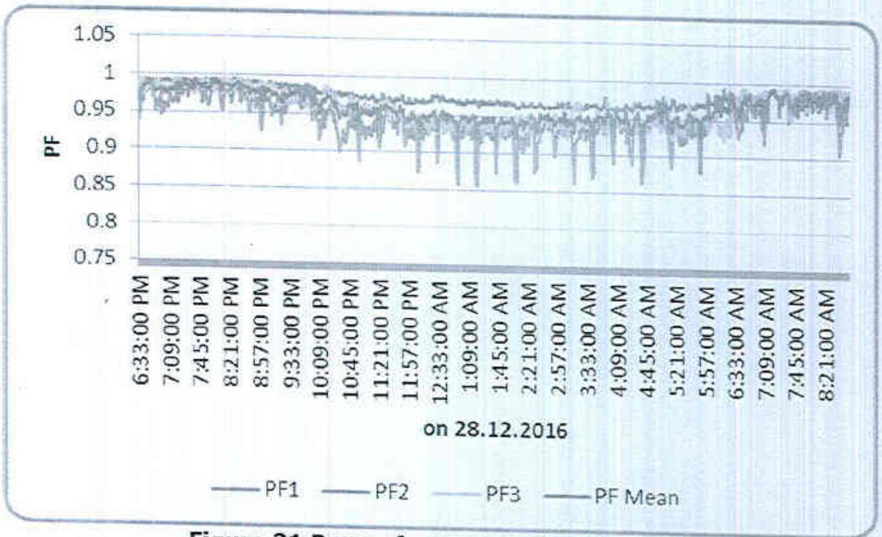


Figure 31 Power factor variation in TRF06

- The maximum PF measured from primary of transformer was 0.994 whereas, minimum was 0.921. Average measured PF was 0.962.

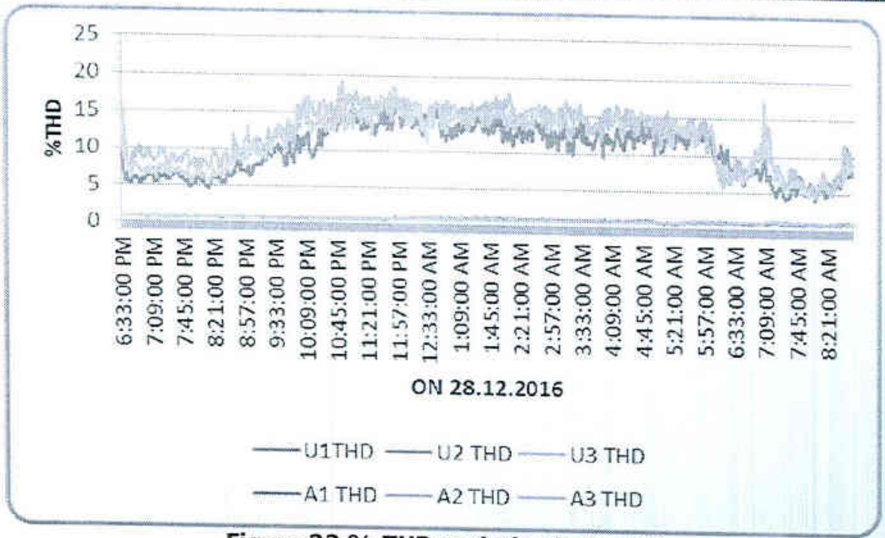


Figure 32 % THD variation in TRF06

- Maximum % V THD measured was 1.3 % which is under permissible limit. Maximum % A THD measured was 19.4 and average being 11.32 %. The current harmonics in the transformer is above permissible limits.

Table 8 Electrical parameters of TRF06

Parameter	V	A	PF	KW	Hz	% V THD	%A THD
Maximum	10990	7.8	0.994	119.86	50.15	1.3	19.4
Minimum	10750	1.3	0.921	27.32	49.8	0.6	4.1
Average	10884	3.66	0.962	52.89	50.0	0.89	11.32

3.2.2 Observation and recommendation

From the data measured and recorded during audit period transformer efficiency is calculated and is described in table below:

Table 9 Transformer Efficiency

Sr. No.	Description	Units	TRF01	TRF02	TRF03	TRF04	TRF05	TRF06
	Location		Electrical Room (Lighting TRF)	STP	Batching plant	Block B15	Block B67	Block C1
1	**Rated KVA**	**KVA**	125	315	200	1000	1000	1000
2	Rated No Load Loss	kW	0.455	0.9	0.64	1.8	1.8	1.8
3	Rated Copper Loss	kW	2.8	6.45	4.45	13.3	13.3	13.3
4	Average Operating Demand	KVA	21.6	31	3.563	88.75	113	54
5	Average Operating Load	kW	19.0	30	3	86	107	52
6	Average Operating PF	P.F	0.88	0.97	0.97	0.97	0.95	0.96

Sr. No.	Description	Units	TRF01	TRF02	TRF03	TRF04	TRF05	TRF06
7	%Loading at Max. Effi.	%	40.31	37.35	37.92	36.79	36.79	36.79
8	% Loading at Present	%	17.28	9.84	1.78	8.88	11.30	5.40
9	Operating Load Loss	kW	0.08	0.06	0.00	0.10	0.17	0.04
10	Total Operating Load Loss	kW	0.54	0.96	0.64	1.90	1.97	1.84
11	Power Out Put	kW	19.00	30.00	3.47	86.00	107.00	52.00
12	Power Input	kW	19.54	30.96	4.11	87.90	108.97	53.84
13	Efficiency at avg. load	%	97.24	96.89	84.41	97.83	98.19	96.58
14	Efficiency at max. load	%	97.89	98.09	86.43	98.82	99.02	98.35
15	Efficiency at min. load	%	94.92	96.11	68.62	96.0	97.04	93.71

* Considering Average load per day

- Current harmonics in each transformer is more than 10 %. This is above permissible standard limits.
- Transformers were maintained by regular monitoring of increase in insulation oil. Cleaning of breather is done as per maintenance SOP.
- % loading on each transformer is below 20 % during the time of audit.
- TRF02 and TRF06 are kept in charging mode. The type of load which is connected to these transformers do not operate continuously or even daily.
- Since TRF02 was relatively closer to TRF03 and since % loading on both transformer was below 20%, it is recommended to transfer load of TRF02 on TRF03. In this way charging current and iron losses of transformer will be reduced.
- Similarly load on TRF06 can be shifted to TRF04 as % loading on both transformers was less than 20%

Table 10 Energy Saving by shifting load of TRF03 to TRF02 and isolating TRF03

Description	Unit	Existing	Proposed
Rated kVA	kVA	200	315
Loading	kW	20	100
Loading	%	10	32
Iron loss	kW	1.2	1.2
Copper loss	kW	4.45	6.45
Actual Losses	kWh	1.25	0.68
Annual calculated losses	kWh		4989
Annual losses	Rs.		31679
Saving in Power	kWh/ year		4989
Investment for Cable and Switchgear	Rs.		80000
Simple payback period	month		30

As per the above table 10% Load observed on Batching plant 200 kVA Transformer Similarly observed in STP Transformer Hence it is recommended that the load of Batching plant Transformer is shifted to STP Transformer Due to constant load Saving of Batching plant

Transformer and as per the below table Load of Block C1 transformer Transfer to Block 15 Transformer.

Table 11 Energy Saving by shifting load of Block C1 TRF06 on TRF04 and isolating TRF06

Description	Unit	Existing Block C1 TRF06	Existing Block B15 TRF04	Proposed Block B15 & Block C1 on Block B15
Rated kVA	kVA	1000	1000	1000
Loading	kW	150	250	400
Loading	%	15	30	40
Iron loss	kW	2.2	2.2	2.2
Copper loss	kW	13.3	13.3	13.3
Actual Losses	kWh	2.52	3.07	4.42
Annual calculated losses	kWh	21813	26486	38152
Power Loss	kWh	21813	26486	38152
Annual losses in	Rs.	152694	185403	267064
Total Annual losses	Rs.			71033
Saving kWh	kWh			10148
Investment for Switchgear	Rs.			50000
Simple payback period	month			8

3.3 Harmonics Study

- Harmonics are one of the most well-known power quality phenomena and are the result of the distortion of sinusoidal signal of the voltage and / or current. Distorted waveforms can be broken down into sum of components at the fundamental frequency and at the frequencies multiple of the fundamental one. Harmonics are signal components with frequencies that are integer multiples of the fundamental operating frequency of the system.

- The distortion of the sinusoidal waveform and the presence of harmonics are originated by the nonlinear characteristics typical of several devices like UPS and other electronic equipment etc. It is common to use general indexes of harmonics distortion such as Total Harmonic Distortion (THD), a parameter that briefly quantifies the harmonic distortion of a signal.
- The presence of harmonics in a network with capacitors causes a current overload on the capacitor itself and results in increase in temperature and reduces the life of capacitors. Further, the problems that may originate from the presence of harmonics are overload in the PF correction capacitor banks, overload of the neutral conductor, additional losses in transformers and in rotating electrical machines, measurement errors in the counters and untimely triggering of safety relays, disturbance and faults in electronic equipment and computers.

➤ <u>**Effect of Harmonics**</u>: The presence of harmonics in a network would result in:

- Current overload on the capacitor and increase in temperature which reduces the life of capacitors.
- Increased resistance of conductors thereby increased losses and thermal failures.
- Additional losses in transformers and in rotating electrical machines.

- Measurement errors in the counters and untimely triggering of safety relays.
- Disturbance and faults in electronic equipment and computers.
- Study of harmonics was carried out for approximately for 24 hours at an interval of 1 minutes and the summary of observations are presented below.

Below figures shows IEEE standard for voltage and current harmonics.

Table 12 IEEE standard for voltage harmonics as per IEEE 519

Low-voltage system classification and distortion limits			
	Special Applications[1]	General System	Dedicated system[2]
Notch Depth	10%	20%	50%
THD (voltage)	3%	5%	10%
Notch Area[3] (A_N)	16400	22800	36500
Note: The value A_N for other than 480 V systems should be multiplied by V/480			
1. Special applications include hospitals and airports			
2. A dedicated system is exclusively dedicated to the converter load			
3. In volt-microseconds at rated voltage and current			

Table 13 IEEE standard for current harmonics as per IEEE 519

Current Distortion Limits for General Distribution System (120 V through 69000V)				
Maximum Harmonic Current Distortion in Percent of I_L				
Individual Harmonic Order (Odd Harmonics)				
I_{SC}/I_L	≤ 11	$11 \leq h \leq 17$	$17 \leq h \leq 23$	TDD
<20*	4	2	1.5	5
20<50	7	3.5	2.5	8
50<100	10	4.5	4	12
100<1000	12	5.5	5	15
>1000	15	7	6	20
Where: I_{SC}= maximum shot circuit current at PCC; I_L= maximum demand load current (fundamental frequency component) at PCC				

- As per described in above measurement and standard it is suggested to put harmonics filter for better quality of power. We had suggested vender for harmonics filter$I_{rms}= I_1(1+THD^2)^{0.5}$, where: I_1= Fundamental current, Above equation shows that reduction in harmonics is reduction in losses ($I_{rms}= I_1$, where: THD=0). Harmonics increase rms current for a load drown a fundamental current, also its increase in joule losses, not taking in the account but skin effect.

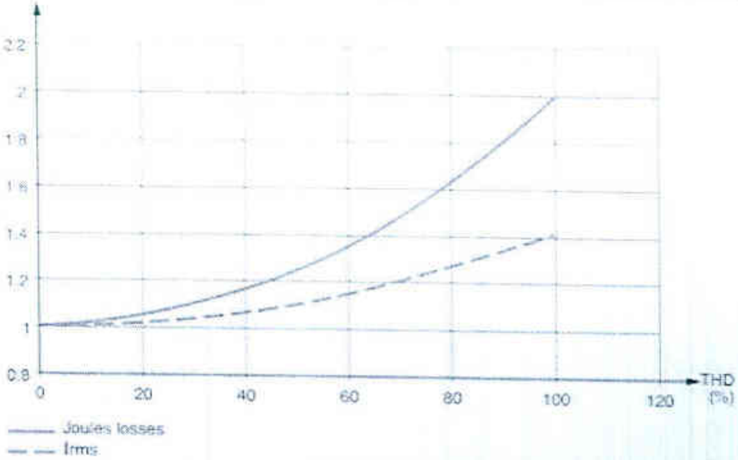


Figure 33 Harmonics losses

(The reference point in graph is 1 for I_{rms} and joules losses, the case when there are no harmonics)

Table 14 Harmonics Level on Transformer LT Side

Equipment	THD V % (Range)			THD A % (Range)		
	R	Y	B	R	Y	B
TRF01	0.4-1.3	0.5-1.2	0.5-1.3	2.4-14.6	1.1-6.5	1-9.3
TRF02	1.1-6.8	1.1-6.8	1.2-7.4	4.8-36.2	4.5-36.4	3.8-36.1
TRF03	0.93-9.8	0.96-6.9	1.1-7.8	21.8-46.8	22.5-51.5	21.8-36.9
TRF04	0.7-1.1	0.7-1.2	0.7-1.1	7.4-16.4	6.9-21	6.8-21.8
TRF05	0.6-1.1	0.7-1.9	0.7-1.8	4.6-30.8	4.2-31.1	3.5-21.2
TRF06	0.6-1.1	0.6-1.3	0.6-1.2	4.1-16.8	4.6-19.4	4.5-18

- Voltage harmonics (% total harmonic distortion) recorded at the transformer side is not within specified limits by ANSI Standard IEEE 519 - 1992 which is 3% of Voltage Harmonics and 5% whereas current harmonics. It is suggested to carry out a detailed harmonics study over a period of time such that THD is maintained within safe limits. A typical study would record **3rd, 5th, 7th, 9th, 11th and higher currents Harmonics** to detect the source and suitable **Active or Passive filters** to suppress it.

3.4 DG Set

3.4.1 Installation Details

- 1 no. of DG set of 125 kVA is installed in the premises of electrical control room of Samudra Township. Installation details are as mentioned in below table:

Table 15 DG installation details

Particulars	DG1
Make	Kirloskar
Location	Samudra Township
Rated kVA	125
rpm	1500
Engine no.	---
Amp	174
PF	0.8
Excitation volt	43
Running hours	13
Volt	415
Make(generator)	---

3.4.2 Operation and performance details

- It is observed that DG set was not operational during Dec-15 to Dec-16 as per Samudra Township record and log data.
- DG was test run for 1 hour during audit by Samudra Township engineering dept.
- Fuel gauge and level sensors for Diesel consumption were not installed on DG set and hence fuel consumption could not be quantified.

Table 16 operation and performance details of DG set

Sr. No.	Description	Units	Value
1	Starting energy meter reading	kWh	0.0
2	Ending energy meter reading	kWh	27.5
3	Start fuel tank reading	ltr	NA
4	End fuel tank reading	ltr	NA
5	Specific Fuel Consumption	ltr/kWh	NA
6	Generating Electricity	kWh	27.5
7	Fuel used	ltr	NA
8	Capacity of DG set	kVA	125
9	Operating Power factor	PF	0.8

The brief summary charts for variation in voltage, Current, Demand & P.F. is presented below.

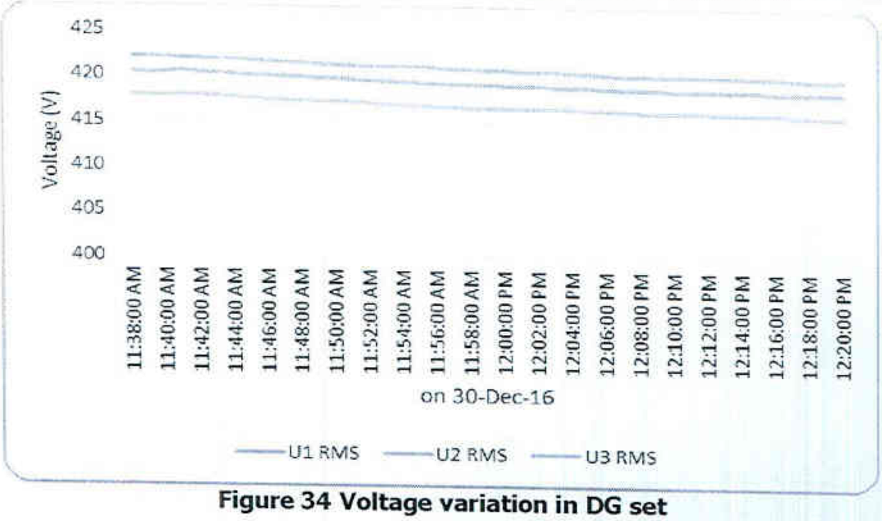


Figure 34 Voltage variation in DG set

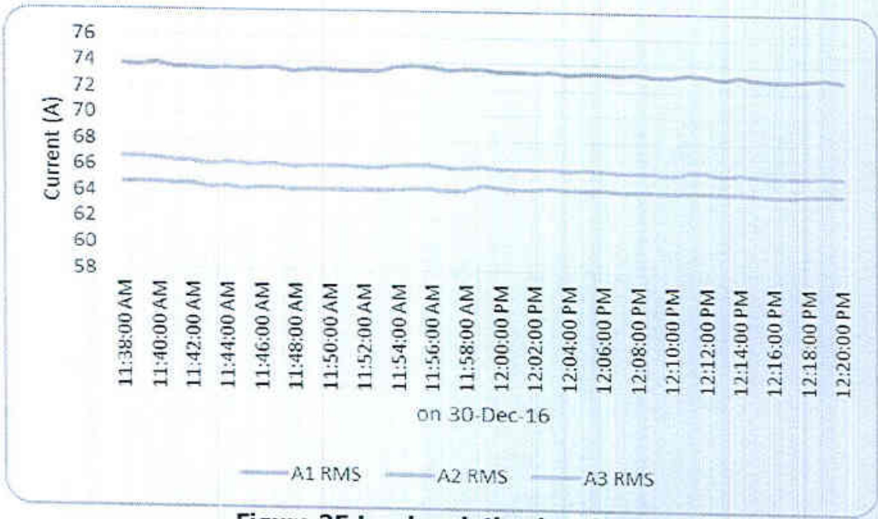


Figure 35 Load variation in DG set

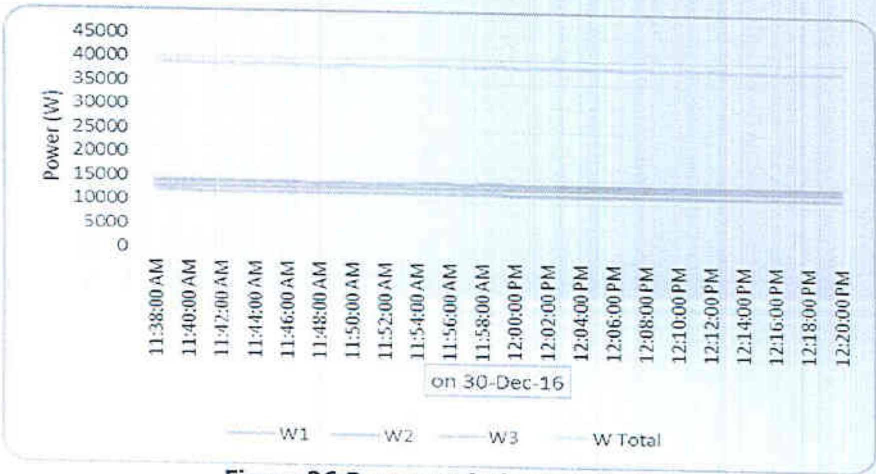


Figure 36 Power variation in DG set

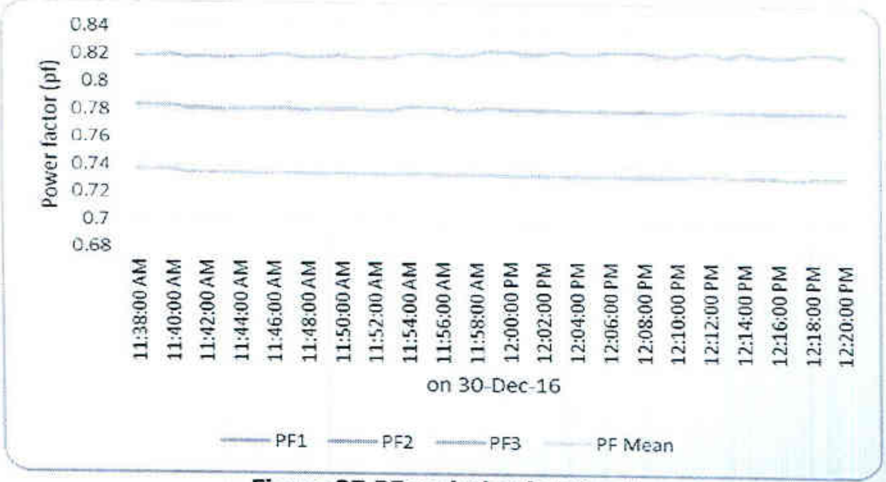


Figure 37 PF variation in DG set

3.5 Pumping System

3.5.1 Installation and performance details of pumps

- There are more than 20 pumps of different capacities are installed at Samudra Township out of which 10 pumps that are above 1.5 kW motor rating have been included in the study.
- Most of the pumps are installed in Sewage treatment plant (STP) where water is collected from township's sewage system and is re circulated after filtration. Installation, operation and performance details of the pumps studied is described in below table.
- 700 to 800 KL of STP is filtered and re circulated into township for Gardening.
- A 30 HP water pump is installed for gardening as well as for treat water supply. Pump was in off condition during the time of audit.
- Total installed filtration capacity is 2 MLD against the demand of 1 MLD.

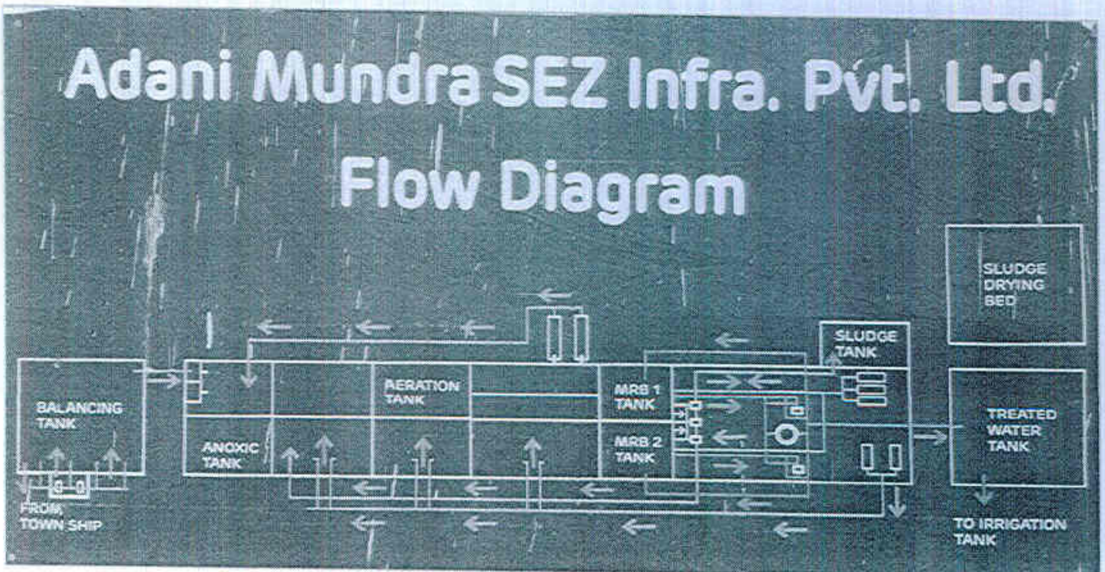


Figure 38 Sewage Water pumping schematic diagram

Table 17 Process and Sewage water pump performance details

Particulars	Unit	Process pump 1	Process pump 2	Raw sewage water pump 2	Raw sewage water pump 1	Irrigation pump 1	pump at customer care office
Make		Grundfos	Grundfos				
Rated Flow	m^3/hr	45	45				
Rated Head	m	15	15				
Line Size	inch	6"	6"	6"	6"	3"	6"
Pump purpose		MRB tank to treated water tank	MRB tank to treated water tank	Balancing tank to aeration tank	Balancing tank to aeration tank	for all garden	Raw sewage water supply from township to STP
Connected Motor kW	KW	3	3	5.5	5.5	22	37.5
Measured Operating Flow in	$m^3/Hr.$	34	50	120	25	68	300
Fluid density	kg/m^3	1000	1000	1000	1000	1000	1000
Discharge Pressure	kg/cm^2	0.5	0.4	0.25	0.25	4.55	1.7
Suction Pressure	kg/cm^2	0.2	0.2	0	0	-0.15	0.1
Operating Head	m	3.0	2.0	2.5	2.5	47.0	16.0
Hydraulic Power	kW	0.28	0.27	0.82	0.17	8.71	13.08
Rated Motor Efficiency	%	82.5	82.5	85	85	91	86
Measured Motor Input Power	kW	2.15	2.96	3.24	2.32	17.1	38.7
Pump Input power	kW	1.8	2.4	2.8	2.0	15.6	33.3
Pump Efficiency	%	15.7	11.2	29.7	8.6	56.0	39.3
Overall Efficiency	%	12.9	9.2	25.2	7.3	50.9	33.8
Running Hr.	Hr.	18	20	12		13-14	02-03

Table 18 Sewage water Recirculation Pump performance details

Particulars	Unit	Recirculation pump 1	Recirculation pump 2	Recirculation pump 3	Parallel combination of recirculation pump 1 & 2	Parallel combination of recirculation pump 2 & 3	Parallel combination of recirculation pump 1 & 3
Make		Kirloskar	Kirloskar	Kirloskar	Kirloskar	Kirloskar	Kirloskar
Rated Flow	m^3/hr	90	90	90	90	90	90
Rated Head	m	18.5	18.5	18.5	18.5	18.5	18.5
Line Size	inch	10"	10"	10"	10"	10"	10"
Pump purpose		MRB tank to aeration tank					
Connected Motor	KW	7.5	7.5	7.5	7.5 + 7.5	7.5 + 7.5	7.5 + 7.5
Measured Operating Flow	m^3/hr	152	158	146	282	288	287
Fluid density	kg/m^3	1000	1000	1000	1000	1000	1000
Discharge Pressure	kg/cm^2	0.4	0.4	0.4	0.4	0.4	0.4
Suction Pressure	kg/cm^2	0.2	0.2	0.2	0.2	0.2	0.2
Operating Head	m	2.0	2.0	2.0	2.0	2.0	2.0
Hydraulic Power	kW	0.83	0.86	0.80	1.54	1.57	1.56
Rated Motor Efficiency	%	87	87	87	87	87	87
Motor Input Power	kW	7.17	9.61	7.26	17.1	17.4	14.18
Pump Input power	kW	6.2	8.4	6.3	14.9	15.1	12.3
Pump Efficiency	%	13.3	10.3	12.6	10.3	10.4	12.7
Overall Efficiency	%	11.6	9.0	11.0	9.0	9.0	11.0
Running hr.	Hr.	24					

3.5.2 Observation and Recommendation

- Process Pump 1 and pump 2 are running in parallel combination. Auto back house system is installed. Measured power of auto back house was 1.15 kW.
- Speed control AC drive (VFD) was installed on Process Pump 2. The VFD is operated at 45.8 Hz
- Poor operating efficiency of process pumps have been observed as per measurement and calculation. It is recommended to replace two process pumps with energy efficient pump.
- There were two raw water sewage pumps out of which pump 2 is mostly operated and pump 1 was kept in standby.

- Measured flow rate of raw water sewage pump 2 was 120 m^3/hr whereas, pump 1 was only 25 m^3/hr. The low flow rate in pump 1 was due to choking in the suction line. It is recommended that proper maintenance and overhauling is recommended so as to improve pump performance.
- There are two irrigation pumps. Pump 2 was under maintenance. Calculated efficiency of pump 1 is 50.9 % based on measured parameters.
- After Suction Cleaning in Raw sewage water pump 1 it shall be saving of **Rs. 0.18 Lacs/Annum** with improving pump performance also with estimated investment of around **Rs.0.1 Lacs** with simple payback of **6 months**.

Table 19 Energy Saving by Suction Cleaning in Raw sewage water pump 1

Sr. No.	Description	Unit	Raw sewage water pump 1
1	Rated Kw	Kw	5.5
2	Measured Power	Kw	2.32
3	Opt. Hr/day	hr/day	12
4	Motor Efficiency	%	87
5	Pump Head	mtr.	2.5
6	Existing Flow	m3/hr	25
7	Efficiency of pump	%	8.6
8	Unit cost	Rs./Kwh	6.35
9	Annual opt. day	day	300
10	Proposed efficiency of pump %	%	65
11	Proposed Head	mtr.	3
12	Proposed Flow	m3/hr	120
13	Estimated power	Kw	1.51
14	Power Saving	KWH	0.81
15	Annual saving possible	Rs.	18537
16	Investment for Suction Cleaning	Rs.	10000
17	Simple payback period	months	6

Table 20 Energy Saving by replacing Recirculation Pump with New High efficient pump

Sr. No.	Description	Unit	Recirculation pump 1	Recirculation pump 2	Recirculation pump 3
1	Rated Kw	Kw	7.5	7.5	7.5
2	Measured Power	Kw	7.17	9.61	7.26
3	Opt. Hr/day	hr/day	24	24	24
4	Motor Efficiency	%	87	87	87
5	Pump Head	mtr.	2.0	2.0	2.0
6	Existing Flow	m3/hr	152	158	146
7	Efficiency of pump	%	13.3	10.3	12.6
8	Unit cost	Rs./Kwh	6.35	6.35	6.35
9	Annual opt. day	day	120	120	120
10	Proposed efficiency of pump %	%	65	65	65
11	Proposed Head	mtr.	5	5	5

Sr. No.	Description	Unit	Recirculation pump 1	Recirculation pump 2	Recirculation pump 3
12	Proposed Flow	m3/hr	160	160	160
13	Estimated power	Kw	3.35	3.35	3.35
14	Power Saving	KWH	3.82	6.26	3.91
15	Annual saving possible	Rs.	69794	114417	71440
16	Investment for 5 kW New High Efficient Pump	Rs.	40000	40000	40000
17	Simple payback period	months	7	4	7

Observation and Recommendation

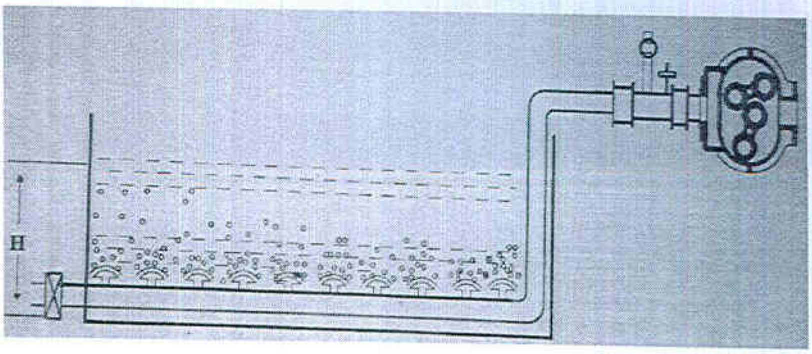
- Recirculation pump one was running for 24 Hours, where as sometime parallel pump was also running during requirement.
- Recirculation pump no. 2 observed re-wounded pump take high current then other two pumps.
- The running condition of pump for the fulfilling requirement is 24 Hr., changeover of pumps takes place after 12 hours of continuous operation.
- Three combinations of parallel pumping were taken. From the above table it can be observed that each pump has poor operating efficiency.
- After Replacement of New High efficient Re circulation pump 1, 2, & 3 it shall be saving of **Rs. 2.55 Lacs/Annum** with improving pump performance also with estimated investment of around **Rs.1.2 Lacs** with simple payback of **6 months**.

3.6 AIR BLOWERS

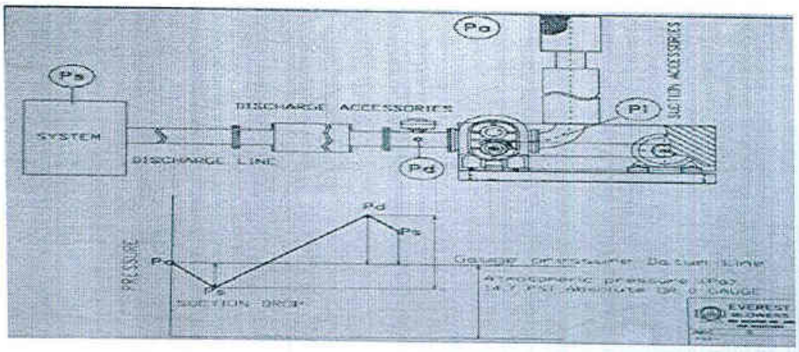
3.6.1 Installation and performance details

Air blowers are installed at STP for water aeration. Installation and operating details are as mentioned in below table:

Sr. No	Particulars	Unit	MRB blower 1	MRB blower 2	MRB blower 3	Main Blower 1	Main Blower 2
1	Make/Model		Everest/ twin lobe	Everest/ twin lobe	Everest/ twin lobe	Everest/ twin lobe	Everest/ twin lobe
2	Sr. No		EB09022034	EB090220312	EB09022033	902669	902670
3	Rated Flow	m^3/hr	400	400	400	2200	2200
4	Rated Pressure	kg/cm^2	0.55	0.55	0.55	0.6	0.6
5	Suction Filter area	m^2	0.25	0.25	0.25	0.72	0.72
6	Measured Suction air velocity	m/sec	0.84	0.81	0.7	0.3	0.7
7	Actual Discharge Pressure	kg/cm^2	0.3	0.3	0.4	0.55	0.55
8	Operating Flow	m^3/hr	756	729	630	778	1814
9	Actual Measured Power	KW	8.66	7.39	7.45	44	48.3
10	**Operating Efficiency**	%	**75**	**84**	**96**	**28**	**59**
11	Application (Used for)		MRB TANK	MRB TANK	MRB TANK	feeding to aeration tank	feeding to aeration tank
12	Running Hr.	Hr./ day	8	8	8	8	8



There is no compression or change in volume within the machine but the blower works under system back pressure conditions. Let us consider a case when the discharge of a blower is connected to the bottom of a tank, having water to a depth of H mm the air discharged accumulates in the discharge line until sufficient pressure is built (slightly over H mm of WG) when it starts to escape out. The system resistance or the static load on the blower is thus H mm WG the power consumed by the blower depends upon the flow rate and the total pressure head on the blower.



The total pressure across the blower is taken as the pressure across the inlet and the discharge port of the blower the pressure drop through inlet accessories and discharge accessories are a part of system drop the figure above indicates Pa as the ambient pressure. Ps is the pressure at the suction pressure Pd is the pressure at the discharge port of the blower and Ps is the actual system back pressure.

As seen from the curve the total work done by the blower is to raise the pressure of inlet volume form Ps to Pd ideally the blower is capable of resisting high pressures but the mechanical limitations increased pressure head to about 7000mm WG for air cooled blowers and 10000mm WG for water cooled blower in single stage operation

It is therefore important to insure that the drop between Pa and Ps and Pd and Ps should be as low as possible. This can be achieved by using adequate size piping and large radius bends wherever possible.

The blowers are generally selected for the maximum system pressure, which they may encounter during operation and the prime mover is selected accordingly when in operation the blower offers a considerable power saving since the power consumed by it depends upon the actual working pressure under which it operates and not the rated pressure.

Observations :

- Non-uniform air distribution in the tanks is observed for all air blower.
- Main blower 1 and 2 has VFD installed at the motor. The VFD is operated at 27.5 Hz set frequency.
- Main blower 1 Suction Air velocity observed low with low efficiency 28%, Hence it is recommended for Overhauling as well as Discharge cleaning at the bottom of tank.

3.7 Air Compressor

3.7.1 Installation Details

STP having Installed 2 nos. of air compressor of 25 cfm at Samudra, Out of 2 air compressor one compressor is working and other is under maintenance, air compressors are used for water aeration, Installation and performance details are mentioned in below table:

Table 21 Air Compressor installation details

Sr. No.	Description	Unit	Values
1	Make		Elgi
2	Model		E05EN-7
4	Pressure rating	Bar	7
5	Initial Pressure (P1)	Bar	0
6	Discharge Pressure (P2)	Bar	7
10	Rated Capacity	CFM	25
11	Motor rating	KW	5.5
14	Air Receiver capacity	m3/min	0.72

Table 22 Air Compressor performance study

Sr. No	Description	Unit	Value
1	Pump up time for filling up from initial pressure to final pressure	Sec	180
2	Total volume from air compressor to receiver	m^3	0.25
3	FAD	m^3/min	0.56
4	Corrected Actual Capacity Of the Compressor	CFM	19.9
5	**Volumetric Efficiency**	%	**79.8**
6	Specific Power Consumption (SPC)	KW/ CFM	0.28
7	Running Hr.	Hr.	9368

Table 23 Pump up test of Air compressor

Description	Unit	Value
Total Loaded time, t_l	sec	180
Total Unloaded time, t_u	sec	160
Total time, t	sec	340
Air Consumption = Q x (t_l / t)	cfm	13.24
Max. Pressure	kg/cm^2	7
Loading of Air Compressor	%	52.9
Unloading of Air Compressor	%	47.1
Loading Power	kW	6.4
Unloading Power	kW	2.8
Motor Input	kW	4.70

Observation

- The maximum set pressure is 7 kg/cm^2. Compressor load is cut off thereafter.
- Unloading time of receiver tank is 160 sec. Air compressor consumed 2.8 kW during unload period after that going in off mode, Hence it is required to minimise the Unloading time 160 Sec to 30 Sec.
- Specific power consumption of air compressor is 0.28 kW/cfm. Energy efficient air compressors with SPC ranging from 0.19 to 0.22 kW/cfm are available. Considering the difference, the air compressor performance at STP is poor.
- 0.441 kWh consume in every 5.6 minute cycle
- 4.725 kWh consume in every hour.
- Air compressor working 52 minutes on condition and 48 minutes off condition.
- 2.3 kWh Saving/hour by reducing Unload time of air compressor.
- Air compressor working 3 hours/day, for 250 days
- 1701 kWh/year Saving by reducing Unload time of air compressor
- **10801** Rs. Saving/year by reducing Unload time of air compressor by setting time in controller with Immediate Payback

3.8 AIR CONDITIONERS (AC)

3.8.1 Installation details of Air conditioners (AC)

Different number of connections of AC are given according to the type of residential scheme. It is observed that all most of all AC were BEE 2 star labeled.

Table 24 Air conditioners connection details

Block Type	No. of Flats	Qty. of AC	Total TR
1 BHK	316	316	474
2 BHK	660	660	990
3 BHK	192	384	576
Bachelor	294	294	441
Total	1462	1654	2481

3.8.2 Sample base air Conditioner performance

- Most of the installed AC are of 2 star 1.5 TR rating. On sample basis an air conditioner performance was tested. The performance is described in below table:

Table 25 Air Conditioner sample base performance study

Description	Units	Block B25 Flat- # 8
Make		Carrier
Type & BEE Star label		Split / 2 Star
Rated TR	TR	1.5
EER	W/W	2.9
Cooling Capacity	Watt	5150
Rated Power	Watt	1769
Room Set Temp.	°C	17
Suction Area	m^2	0.08
Velocity	m/s	2.3
Return Air Temp.	DB (°C)	21
	WB (°C)	17
Enthalpy of Return Air	KJ/KG	44.57
Supply Air Temp.	DB (°C)	10
	WB (°C)	7
Enthalpy of Supply Air	KJ/KG	22.53
Air Flow	CFM	390
Cooling Load	TR	1.36
Power Consumption	kW	2.1
SPC	kW/TR	1.54
Room Area	m^2	11.15
TR/m^2	TR/m^2	0.122

Table 26 Cost Benefit Analysis for replacement of BEE labelled 2 star AC with 5 Star AC

for 1.5 ton									
EER		Power kwh	Qty.	Working Hr./Annum	unit rate Rs.	Saving in Kwh	Saving in Rs. Lakh/Annum	Investment in Rs. (Lakh)	Payback period in month
2 star	2.7	2.1	500	2500	6.35	562500	35.72	150	50
5 star	3.42	1.65							

3.9 Lighting System

3.9.1 Lighting Installation details

Different variety of lighting schemes have been installed in Samudra Township. Brief description on total lighting is described in below table. Samudra Township has installed geographical timers in streetlight which automatically switch lights as per light conditions. 11 hrs in a day for an annual average working hours is taken for calculations.

Table 27 Street light installation details

Sr. No.	Description	Connected Load in kW	Luminary	Totals Qty	Total Load in kW
1	Sports Courts lighting	0.80	MH	24	19
2	Street Lights SON	0.25	HPSV	122	31
3	Street Lights SON	0.15	HPSV	110	17
4	Common Area Passage	0.01	CFL	912	12
5	Parking Lights & Garden	0.04	CFL	160	7
6	Parking Lights	0.07	MH	200	14
Total Connected Load in kW					**99**

Table 28 Lighting fixtures at indoor facilities

Block	Type	Luminary	Connected load in kW	Qty	Total Load in KW
A	1 BHK	T5	0.04	1264	50.56
		CFL	0.011	316	3.476
B	2 BHK	T5	0.04	3300	132
		CFL	0.011	1320	14.52
C	3 BHK	T5	0.04	1152	46.08
		CFL	0.011	576	6.336
Bachelor Appt.		T5	0.04	588	23.52
		CFL	0.011	294	32.234
Badminton court		LED	0.07	24	1.68
Total Connected Load in kW					**310.4**

3.9.2 Lux measurement and observation of street lighting

- Streetlights and parking lights at Samudra Township were anonymous during the time of audit. Energy audit team has marked tags on the light poles for the reference.
- Explanation of the marked tags is explained in the figure below. Some restricted and non-permissible areas have not been included in the part of lighting study.
- 9 point method was adopted for measuring pole to pole lighting intensity. Below Figure depicts the methodology. Two equations are primarily used for pole to pole and single pole respectively. They are:
  1. Pole to Pole measurement

$$Average\ Lux = \frac{(A_1 + A_2 + B_1 + B_2)}{16} + \frac{(C_1 + C_2 + C_3 + C_4)}{8} + \frac{D_4}{4}$$

  2. Single Pole measurement

$$Average\ Lux = \frac{A_1 + A_2 + B_1 + B_2 + C_1 + C_2 + C_3 + C_4 + D_4}{9}$$

- Parking lights have relatively less span compared to streetlights and so lux is measured at 6 points from pole to pole.

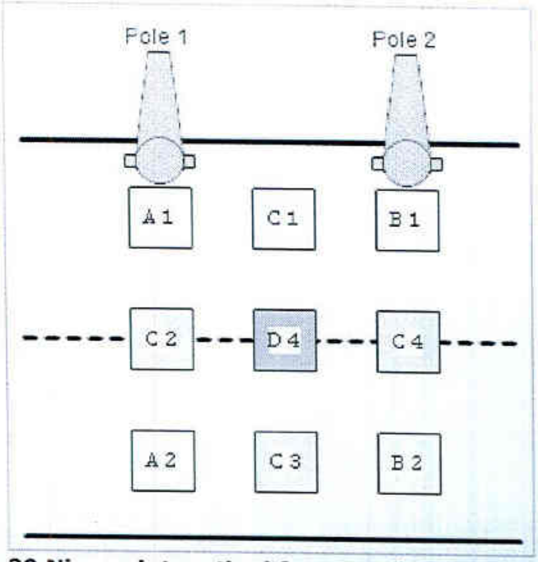


Figure 39 Nine point method for streetlight measurement

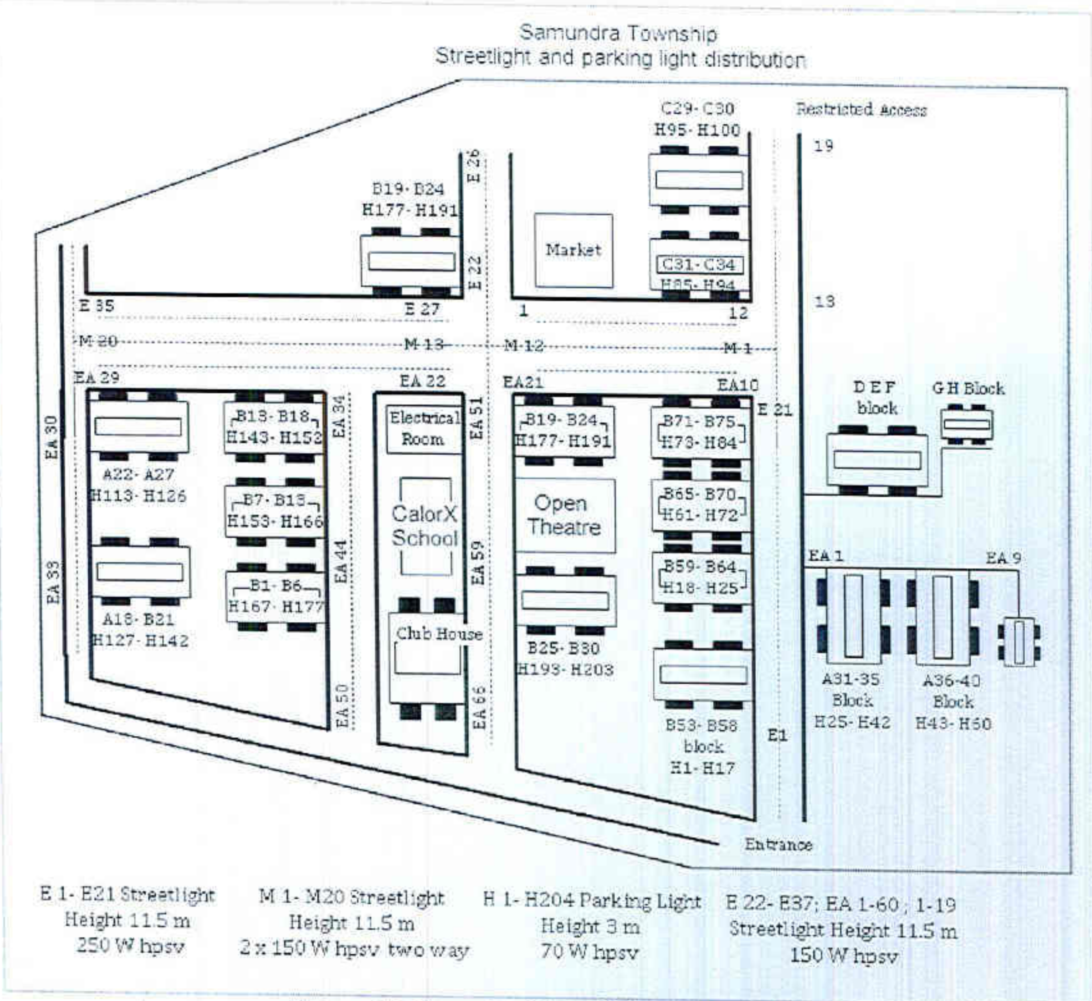


Figure 40 Samundra Streetlight distribution

Table 29 Streetlight Lux measurement

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
1	Entrance gate	E1	8	20	MH	31	35	24	28	19	34	27	25	24	40	sufficient
2	Entrance gate	E2	11.5	24	hpsv	15	14	4	12	43	9	10	12	22	12	sufficient
3	Entrance gate	E3	11.5	25	hpsv	13	16	6	10	31	11	9	11	12	14	sufficient
4	Entrance gate	E4	11.5	25	hpsv	14	11	8	11	32	1	6	9	24	18	sufficient
5	Main Road	E5	11.5	25	hpsv	15	16	6	17	37	8	8	10	11	19	sufficient
6	Main Road	E6	11.5	25	hpsv	14	20	4	9	33	12	9	10	18	14	sufficient
7	Main Road	E7	11.5	25	hpsv	19	20	3	19	32	9	11	18	25	25	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
8	Main Road	E8	11.5	25	hpsv	17	14	7	11	30	12	10	14	32	15	sufficient
9	Main Road	E9	11.5	25	hpsv	14	22	3	7	33	9	8	15	23	10	sufficient
10	Main Road	E10	11.5	25	hpsv											I
11	Main Road	E11	11.5	25	hpsv											I, Z
12	Main Road	E12	11.5	25	hpsv	17	22	3	11	32	7	7	12	19	27	sufficient
13	Main Road	E13	11.5	25	hpsv											I
14	Main Road	E14	11.5	25	hpsv	15	15	6	7	31	6	6	9	22	20	sufficient
15	Main Road	E15	11.5	25	hpsv	15	13	5	11	32	7	10	10	20	19	sufficient
16	Main Road	E16	11.5	25	hpsv	17	12	4	15	32	9	10	13	22	23	sufficient
17	Main Road	E17	11.5	25	hpsv	16	13	6	14	31	16	13	13	20	16	Z sufficient
18	Main Road	E18	11.5	25	hpsv											I
19	Main Road	E19	11.5	25	hpsv	13	9	17	16	32	11	10	11	12	10	Z sufficient
20	Main Road	E20	11.5	25	hpsv											I
21	Main Road	E21	11.5	25	hpsv	15	12	4	3	34	11	8	10	24	20	Z sufficient
22	Block A31-A40	EA1	9	23	hpsv	14	16	23	17	13	8	23	9	17	10	sufficient
23	Block A31-A41	EA2	9	23	hpsv	16	17	24	16	14	6	30	10	19	13	sufficient
24	Block A31-A42	EA3	9	23	hpsv	18	15	27	22	14	11	27	13	19	15	sufficient
25	Block A31-A43	EA4	9	23	hpsv	16	17	24	16	10	7	22	8	17	17	sufficient
26	Block A31-A44	EA5	9	23	hpsv	14	7	23	14	13	7	23	10	15	13	sufficient
27	Block A31-A45	EA6	9	23	hpsv	16	21	28	18	13	6	24	9	18	13	sufficient
28	Block A31-A46	EA7	9	23	hpsv	17	17	32	16	13	6	26	10	20	16	sufficient
29	Block A31-A47	EA8	9	23	hpsv	14	15	28	15	14	2	22	11	22	9	sufficient
30	Block A31-A48	EA9	9	single	hpsv	17	16	25	19	13	10	23	10	21	11	sufficient
31	Main Road Centre	M1	11.5	24	hpsv	18	24	18	7	25	14	20	24	16	16	sufficient
32	Main Road Centre	M2	11.5	24	hpsv	19	21	18	17	18	18	21	21	14	18	sufficient
33	Main Road Centre	M3	11.5	24	hpsv	24	20	22	34	21	28	20	21	26	23	sufficient
34	Main Road Centre	M4	11.5	24	hpsv	19	19	16	26	16	24	14	17	19	18	sufficient
35	Main Road	M5	11.5	24	hpsv	21	22	17	23	19	20	22	17	24	19	

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
	Centre															sufficient
36	Main Road Centre	M6	11.5	24	hpsv	19	16	20	22	20	20	19	19	19	18	sufficient
37	Main Road Centre	M7	11.5	24	hpsv	21	21	17	28	13	27	19	15	22	20	sufficient
38	Main Road Centre	M8	11.5	24	hpsv	16	22	17	18	9	22	17	10	11	17	sufficient
39	Main Road Centre	M9	11.5	24	hpsv	20	22	18	22	16	24	21	15	21	18	sufficient
40	Main Road Centre	M10	11.5	24	hpsv	20	17	23	18	20	19	20	19	20	18	sufficient
41	Main Road Centre	M11	11.5	24	hpsv	21	21	18	31	16	26	20	14	21	22	sufficient
42	Main Road Centre	M12	11.5	24	hpsv	20	24	15	32	9	27	16	14	23	19	sufficient
43	Main Road Centre	M13	11.5	24	hpsv	23	23	26	35	5	31	21	14	23	22	sufficient
44	Main Road Centre	M14	11.5	24	hpsv	21	18	19	28	18	26	15	21	22	21	sufficient
45	Main Road Centre	M15	11.5	24	hpsv	22	22	19	26	20	27	23	16	21	20	sufficient
46	Main Road Centre	M16	11.5	24	hpsv	19	22	18	17	17	22	22	14	18	18	sufficient
47	Main Road Centre	M17	11.5	24	hpsv	26	27	23	32	17	30	25	23	25	24	sufficient
48	Main Road Centre	M18	11.5	24	hpsv	20	20	18	22	22	18	17	18	19	20	sufficient
49	Main Road Centre	M19	11.5	24	hpsv	16	29	16	14	18	14	19	17	9	12	sufficient
50	Main Road Centre	M20	11.5	24	hpsv	24	28	18	35	20	28	23	16	25	22	sufficient
51	Main Road left	EA10	9	24	hpsv	23	27	18	35	8	33	19	15	24	22	sufficient
52	Main Road left	EA11	9	24	hpsv	22	20	16	33	20	26	20	15	25	20	sufficient
53	Main Road left	EA12	9	24	hpsv	20	21	18	31	10	26	20	11	21	19	sufficient
54	Main Road left	EA13	9	24	hpsv	19	21	16	19	18	20	21	17	15	18	sufficient
55	Main Road left	EA14	9	24	hpsv	21	21	21	28	15	22	21	16	21	22	sufficient
56	Main Road left	EA15	9	24	hpsv	23	23	21	34	13	26	19	19	25	21	sufficient
57	Main Road left	EA16	9	24	hpsv	19	21	17	28	9	21	22	10	18	18	sufficient
58	Main Road left	EA17	9	24	hpsv	18	22	21	31	2	25	22	9	14	15	sufficient
59	Main Road left	EA18	9	24	hpsv	25	30	20	33	13	33	22	17	25	25	sufficient
60	Main Road left	EA19	9	24	hpsv	19	23	16	32	12	30	18	10	15	16	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
61	Main Road left	EA20	9	24	hpsv	17	20	19	15	15	19	19	15	12	17	sufficient
62	Main Road left	EA21	9	24	hpsv	21	16	18	35	10	26	19	17	23	19	sufficient
63	Main Road left	EA22	9	24	hpsv	21	21	20	28	16	27	17	19	21	19	sufficient
64	Main Road left	EA23	9	24	hpsv	21	25	18	28	15	25	21	15	19	19	sufficient
65	Main Road left	EA24	9	24	hpsv	18	19	17	24	12	24	16	13	17	19	sufficient
66	Main Road left	EA25	9	24	hpsv	22	23	17	27	20	23	18	20	24	22	sufficient
67	Main Road left	EA26	9	24	hpsv	21	18	20	30	18	22	19	20	22	21	sufficient
68	Main Road left	EA27	9	24	hpsv	16	20	25	17	12	7	26	8	23	10	sufficient
69	Main Road left	EA28	9	24	hpsv	16	10	24	16	13	10	15	11	24	17	sufficient
70	Main Road left	EA29	9	24	hpsv	16	16	24	14	14	5	32	13	20	12	sufficient
71	Main Road Right	1	9	24	hpsv											I, Z
72	Main Road Right	2	9	24	hpsv	16	13	26	15	12	17	25	14	17	10	Z sufficient
73	Main Road Right	3	9	24	hpsv											I, Z
74	Main Road Right	4	9	24	hpsv	16	12	24	17	12	4	26	18	19	14	Z sufficient
75	Main Road Right	5	9	24	hpsv											I, Z
76	Main Road Right	6	9	24	hpsv	15	14	33	7	13	7	22	11	16	15	Z sufficient
77	Main Road Right	7	9	24	hpsv											I, Z
78	Main Road Right	8	9	24	hpsv	14	15	24	14	11	5	30	10	17	9	Z sufficient
79	Main Road Right	9	9	24	hpsv	16	16	22	23	11	8	25	12	22	12	Z sufficient
80	Main Road Right	10	9	24	hpsv											I, Z
81	Main Road Right	11	9	24	hpsv	18	23	28	16	8	10	25	19	18	15	Z sufficient
82	Main Road Right	12	9	24	hpsv	18	12	26	12	18	16	16	16	18	21	sufficient
83	Block C29-C34	13	9	23	hpsv	18	23	28	16	8	10	25	19	18	15	sufficient
84	Block C29-C34	14	9	23	hpsv	18	12	26	12	18	16	16	16	18	21	sufficient
85	Block C29-C34	15	9	23	hpsv	15	18	25	17	12	10	20	11	12	15	sufficient
86	Block C29-C34	16	9	23	hpsv	15	19	25	11	13	6	28	13	15	12	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
87	Block C29-C34	17	9	23	hpsv	17	8	25	16	12	10	22	13	24	18	sufficient
88	Block C29-C34	18	9	23	hpsv	19	15	26	18	12	9	28	12	24	18	sufficient
89	Block C29-C34	19	9	Single	hpsv	15	17	23	16	13	11	25	11	9	9	sufficient
90	Block A18-A27	EA30	9	23	hpsv	15	20	24	17	12	11	20	9	15	13	sufficient
91	Block A18-A27	EA31	9	23	hpsv											I, Z
92	Block A18-A27	EA32	9	23	hpsv	18	16	27	13	14	5	25	13	21	19	sufficient
93	Block A18-A27	EA33	9	Single	hpsv	16	17	25	21	13	6	22	9	17	7	sufficient
94	Block C1-C6	E22	9	23	hpsv	16	16	24	15	10	8	27	12	16	14	sufficient
95	Block C1-C6	E23	9	23	hpsv	15	14	23	14	12	9	26	12	23	9	sufficient
96	Block C1-C6	E24	9	23	hpsv	17	13	29	14	12	4	20	10	17	25	sufficient
97	Block C1-C6	E25	9	23	hpsv	15	14	24	16	18	15	24	8	15	9	sufficient
98	Block C1-C6	E26	9	Single	hpsv	18	20	33	15	12	7	30	14	16	14	sufficient
99	Block B13-B18	EA34	9	23	hpsv											I
100	Block B13-B18	EA35	9	23	hpsv	16	15	24	16	14	8	30	10	28	7	sufficient
101	Block B13-B18	EA36	9	23	hpsv	15	13	23	13	14	5	27	9	16	14	sufficient
102	Block B13-B18	EA37	9	23	hpsv	16	17	24	16	14	5	23	9	20	17	sufficient
103	Block B13-B18	EA38	9	23	hpsv	16	18	27	18	11	6	26	9	14	16	sufficient
104	Block B13-B18	EA39	9	23	hpsv	16	19	26	17	14	5	26	19	19	10	sufficient
105	Block B7-B12	EA40	9	23	hpsv	14	15	27	16	14	3	23	13	18	8	sufficient
106	Block B7-B12	EA41	9	23	hpsv											I
107	Block B7-B12	EA42	9	23	hpsv	14	15	29	7	14	6	26	9	17	8	sufficient
108	Block B7-B12	EA43	9	23	hpsv	18	21	26	20	10	7	27	9	21	14	Z sufficient
109	CalorX school	EA44	9	Single	hpsv											I, Z
110	CalorX school	EA45	9	23	hpsv	18	17	26	15	13	10	22	12	18	22	Z sufficient
111	Block B1-B6	EA46	9	23	hpsv	15	8	29	20	9	9	23	9	21	12	Z sufficient
112	Block B1-B6	EA47	9	23	hpsv											I, Z

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
113	Block B1-B6	EA48	9	23	hpsv											I
114	Block B1-B6	EA49	9	23	hpsv	20	10	24	14	12	7	25	21	24	23	Z sufficient
115	Block B1-B6	EA50	9	23	hpsv	16	14	31	15	12	5	23	11	18	14	sufficient
116	Block B19-B24	EA51	9	23	hpsv	15	16	24	23	12	7	23	11	20	8	sufficient
117	Block B19-B24	EA52	9	23	hpsv	16	13	24	13	18	8	30	6	20	15	sufficient
118	Block B19-B24	EA53	9	23	hpsv	16	16	25	25	13	4	19	12	18	14	Z sufficient
119	Block B19-B24	EA54	9	23	hpsv											I
120	Block B19-B24	EA55	9	23	hpsv											I, Z
121	Block B19-B24	EA56	9	23	hpsv	17	23	23	16	11	8	26	11	19	15	Z sufficient
122	Block B19-B24	EA57	9	23	hpsv	16	19	24	14	17	6	25	18	23	7	sufficient
123	Block B19-B24	EA58	9	23	hpsv	16	17	27	16	13	11	17	11	18	15	sufficient
124	Block B19-B24	EA59	9	23	hpsv	16	14	27	13	14	11	27	9	17	12	Z sufficient
125	Block B25-B30	EA60	9	23	hpsv											I
126	Block B25-B30	EA61	9	23	hpsv	16	11	23	17	12	10	19	12	19	15	Z sufficient
127	Block B25-B30	EA62	9	23	hpsv	16	17	28	20	14	3	26	6	21	15	Z sufficient
128	Block B25-B30	EA63	9	23	hpsv											I, Z
129	Block B25-B30	EA64	9	23	hpsv											I
130	Block B25-B30	EA65	9	23	hpsv	14	12	25	9	12	7	23	12	19	11	Z sufficient
131	Block B25-B30	EA66	9	Single	hpsv	17	23	25	14	10	6	27	11	23	13	sufficient
132	Main Road Right	E27	9	24	hpsv	13	16	25	13	12	4	15	12	18	9	sufficient
133	Main Road Right	E28	9	24	hpsv	16	24	24	18	13	11	27	9	20	8	sufficient
134	Main Road Right	E29	9	24	hpsv	19	11	32	13	15	8	26	20	17	22	sufficient
135	Main Road Right	E30	9	24	hpsv	17	11	29	16	11	7	24	12	17	20	sufficient
136	Main Road Right	E31	9	24	hpsv	17	11	25	17	14	14	25	20	22	10	sufficient
137	Main Road Right	E32	9	24	hpsv	16	11	26	19	14	11	23	11	19	11	sufficient
138	Main Road Right	E33	9	24	hpsv	15	16	26	13	17	8	26	8	15	13	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	C3	C4	D4	Remarks
139	Main Road Right	E34	9	24	hpsv	14	13	5	12	34	6	1	10	22	17	sufficient
140	Main Road Right	E35	9	Single	hpsv	11	10	12	16	8	16	14	5	4	9	Insufficie nt

Table 30 Parking lights lux measurement

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
1	Block B53-B58	H1	3	14	CFL								I
2	Block B53-B58	H2	3	14	CFL	8	10	8	7	14	5	8	sufficient
3	Block B53-B58	H3	3	14	CFL	11	12	12	11	15	8	13	sufficient
4	Block B53-B58	H4	3	14	CFL								I,Z
5	Block B53-B58	H5	3	14	CFL	9	9	9	8	13	8	10	sufficient
6	Block B53-B58	H6	3	14	CFL								I,Z
7	Block B53-B58	H7	3	Single	CFL	7	10	6	7	6	3	12	Insufficient
8	Block B53-B58	H8	3	14	CFL	10	10	7	10	12	7	15	sufficient
9	Block B53-B58	H9	3	14	CFL	9	13	6	10	8	7	15	sufficient
10	Block B53-B58	H10	3	14	CFL								I,Z
11	Block B53-B58	H11	3	14	CFL	7	9	5	12	9	2	10	Insufficient
12	Block B53-B58	H12	3	14	CFL								I,Z
13	Block B53-B58	H13	3	14	CFL	10	13	9	15	7	6	14	sufficient
14	Block B53-B58	H14	3	14	CFL								I,Z Insufficient
15	Block B53-B58	H15	3	14	CFL	8	13	5	13	3	5	12	sufficient
16	Block B53-B58	H16	3	14	CFL								I,Z
17	Block B53-B58	H17	3	Single	CFL	10	12	11	9	16	5	10	sufficient
18	Block B59-B64	H18	3	16	CFL	12	14	10	18	14	4	14	sufficient
19	Block B59-B64	H19	3	16	CFL								I,Z

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
20	Block B59-B64	H20	3	16	CFL	8	11	8	8	12	2	10	sufficient
21	Block B59-B64	H21	3	Single	CFL								I,Z
22	Block B59-B64	H22	3	16	CFL	9	9	9	10	11	6	14	sufficient
23	Block B59-B64	H23	3	16	CFL								I,Z
24	Block B59-B64	H24	3	16	CFL	9	14	6	13	12	6	7	sufficient
25	Block B59-B64	H25	3	Single	CFL								I,Z Insufficient
26	Block A31-A35	H26	3	14	CFL	10	8	8	12	13	8	14	sufficient
27	Block A31-A35	H27	3	14	CFL	11	13	12	14	14	3	11	sufficient
28	Block A31-A35	H28	3	14	CFL								I,Z
29	Block A31-A35	H29	3	14	CFL	10	14	8	18	6	4	11	sufficient
30	Block A31-A35	H30	3	14	CFL	8	10	9	8	10	2	13	sufficient
31	Block A31-A35	H31	3	14	CFL								I,Z
32	Block A31-A35	H32	3	14	CFL	9	13	11	14	9	3	9	sufficient
33	Block A31-A35	H33	3	14	CFL								I,Z
34	Block A31-A35	H34	3	Single	CFL								I
35	Block A31-A35	H35	3	14	CFL	8	13	4	12	6	2	14	sufficient
36	Block A31-A35	H36	3	14	CFL								I,Z
37	Block A31-A35	H37	3	14	CFL	10	8	9	9	14	8	14	sufficient
38	Block A31-A35	H38	3	14	CFL								I,Z
39	Block A31-A35	H39	3	14	CFL	10	12	11	10	11	5	12	sufficient
40	Block A31-A35	H40	3	14	CFL								I,Z
41	Block A31-A35	H41	3	14	CFL	8	8	8	10	6	4	14	sufficient
42	Block A31-A35	H42	3	Single	CFL	8	9	4	13	7	4	11	sufficient
43	Block A35-A40	H43	3	14	CFL	8	11	5	12	11	4	7	sufficient
44	Block A35-A40	H44	3	14	CFL								I,Z
45	Block A35-	H45	3	14	CFL	9	11	6	10	10	5	12	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
	A40												
46	Block A35-A40	H46	3	14	CFL								I,Z
47	Block A35-A40	H47	3	14	CFL	8	11	9	9	7	5	7	sufficient
48	Block A35-A40	H48	3	14	CFL								I,Z
49	Block A35-A40	H49	3	14	CFL								I
50	Block A35-A40	H50	3	14	CFL								I,Z
51	Block A35-A40	H51	3	Single	CFL	10	9	12	11	17	6	10	sufficient
52	Block A35-A40	H52	3	14	CFL	11	14	12	16	13	9	7	sufficient
53	Block A35-A40	H53	3	14	CFL	10	14	5	17	11	2	13	sufficient
54	Block A35-A40	H54	3	14	CFL								I,Z
55	Block A35-A40	H55	3	14	CFL	8	11	6	12	6	5	8	sufficient
56	Block A35-A40	H56	3	14	CFL								I,Z
57	Block A35-A40	H57	3	14	CFL	9	14	8	14	7	2	14	sufficient
58	Block A35-A40	H58	3	14	CFL								I,Z
59	Block A35-A40	H59	3	14	CFL	10	12	10	11	13	7	9	sufficient
60	Block A35-A40	H60	3	Single	CFL								I,Z
61	Block B65-B70	H61	3	12	CFL								I,Z
62	Block B65-B70	H62	3	12	CFL	9	14	4	12	9	3	13	sufficient
63	Block B65-B70	H63	3	12	CFL								I,Z
64	Block B65-B70	H64	3	12	CFL	10	12	11	10	9	7	11	sufficient
65	Block B65-B70	H65	3	12	CFL	11	13	11	14	11	3	15	sufficient
66	Block B65-B70	H66	3	Single	CFL	12	14	10	16	16	4	12	sufficient
67	Block B65-B70	H67	3	12	CFL	10	10	11	10	14	9	9	sufficient
68	Block B65-B70	H68	3	12	CFL	11	12	11	12	11	9	13	sufficient
69	Block B65-B70	H69	3	12	CFL	7	8	6	9	11	2	10	Insufficient
70	Block B65-B70	H70	3	12	CFL	12	12	12	10	18	10	11	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
71	Block B65-B70	H71	3	12	CFL								I,Z
72	Block B65-B70	H72	3	Single	CFL	11	14	6	15	12	7	14	sufficient
73	Block B71-B75	H73	3	12	CFL	12	12	11	12	16	10	12	sufficient
74	Block B71-B75	H74	3	12	CFL								I,Z
75	Block B71-B75	H75	3	12	CFL	9	11	9	8	12	7	9	sufficient
76	Block B71-B75	H76	3	12	CFL								I,Z
77	Block B71-B75	H77	3	12	CFL	9	10	9	9	12	5	11	sufficient
78	Block B71-B75	H78	3	Single	CFL	7	8	4	12	9	4	8	A Insufficient
79	Block B71-B75	H79	3	12	CFL	8	9	6	9	7	2	15	sufficient
80	Block B71-B75	H80	3	12	CFL	9	9	10	11	13	5	8	sufficient
81	Block B71-B75	H81	3	12	CFL	10	11	9	12	14	5	11	sufficient
82	Block B71-B75	H82	3	12	CFL	9	11	6	13	10	4	11	sufficient
83	Block B71-B75	H83	3	12	CFL								I
84	Block B71-B75	H84	3	Single	CFL	8	13	8	14	7	2	9	A, sufficient
85	Block C31-C34	H85	3	14	CFL	11	14	10	15	9	9	12	sufficient
86	Block C31-C34	H86	3	14	CFL	10	8	12	9	17	7	8	sufficient
87	Block C31-C34	H87	3	14	CFL	12	14	8	17	13	10	14	sufficient
88	Block C31-C34	H88	3	14	CFL	10	13	7	17	6	2	15	sufficient
89	Block C31-C34	H89	3	Single	CFL	9	13	12	10	11	6	7	sufficient
90	Block C31-C34	H90	3	14	CFL	7	12	7	9	7	0	10	Insufficient
91	Block C31-C34	H91	3	14	CFL	8	12	8	11	8	6	8	sufficient
92	Block C31-C34	H92	3	14	CFL	7	12	4	13	6	3	7	Insufficient
93	Block C31-C34	H93	3	14	CFL								I
94	Block C31-C34	H94	3	Single	CFL								I
95	Block C29	H95	3	15	CFL	8	9	9	7	15	3	7	sufficient
96	Block C29	H96	3	15	CFL	8	9	5	11	7	4	12	sufficient
97	Block C29	H97	3	Single	CFL	9	14	5	16	5	5	14	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
98	Block C30	H98	3	15	CFL	10	14	10	11	8	8	13	sufficient
99	Block C30	H99	3	15	CFL	11	11	11	13	14	4	15	sufficient
100	Block C30	H100	3	Single	CFL	9	8	9	12	10	4	11	sufficient
101	Block C1-C6	H101	3	15	CFL	8	9	9	6	7	5	14	sufficient
102	Block C1-C6	H102	3	15	CFL	9	11	7	14	8	7	8	sufficient
103	Block C1-C6	H103	3	15	CFL	9	13	4	10	6	7	15	sufficient
104	Block C1-C6	H104	3	15	CFL	8	8	10	9	9	6	10	sufficient
105	Block C1-C6	H105	3	15	CFL								I
106	Block C1-C6	H106	3	Single	CFL	9	14	8	13	6	4	13	sufficient
107	Block C1-C6	H107	3	15	CFL	10	9	11	12	16	4	12	sufficient
108	Block C1-C6	H108	3	15	CFL	7	10	5	11	6	5	9	Insufficient
109	Block C1-C6	H109	3	15	CFL	10	8	11	7	13	7	14	sufficient
110	Block C1-C6	H110	3	15	CFL								I
111	Block C1-C6	H111	3	15	CFL	9	14	4	14	8	4	12	sufficient
112	Block C1-C6	H112	3	Single	CFL	9	13	9	15	7	3	8	sufficient
113	Block A22-A27	H113	3	14	CFL	4	8	7	2	4	4	1	A, Insufficient
114	Block A22-A27	H114	3	14	CFL	8	8	8	8	12	5	12	sufficient
115	Block A22-A27	H115	3	14	CFL	11	10	12	9	15	5	15	sufficient
116	Block A22-A27	H116	3	14	CFL	10	9	11	13	14	3	12	sufficient
117	Block A22-A27	H117	3	14	CFL	6	12	4	9	5	0	7	Insufficient
118	Block A22-A27	H118	3	14	CFL	10	10	11	11	15	9	8	sufficient
119	Block A22-A27	H119	3	Single	CFL	10	14	5	15	10	8	9	sufficient
120	Block A22-A27	H120	3	14	CFL	9	13	8	11	12	5	9	sufficient
121	Block A22-A27	H121	3	14	CFL	9	9	8	9	13	4	12	sufficient
122	Block A22-A27	H122	3	14	CFL	9	8	11	5	17	2	15	sufficient
123	Block A22-A27	H123	3	14	CFL	10	14	12	14	11	3	10	sufficient
124	Block A22-A27	H124	3	14	CFL								I
125	Block A22-A27	H125	3	14	CFL	9	13	5	12	11	8	9	sufficient
126	Block A22-A27	H126	3	Single	CFL	10	11	10	10	14	3	14	sufficient
127	Block A18-A21	H127	3	14	CFL	7	8	9	9	9	5	7	Insufficient
128	Block A18-A21	H128	3	14	CFL	8	11	9	12	7	3	10	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
129	Block A18-A21	H129	3	14	CFL	7	13	4	12	3	1	14	Insufficient
130	Block A18-A21	H130	3	14	CFL	7	10	5	13	3	3	8	Insufficient
131	Block A18-A21	H131	3	14	CFL	9	9	10	9	8	4	14	sufficient
132	Block A18-A21	H132	3	14	CFL	7	9	5	13	7	5	7	Insufficient
133	Block A18-A21	H133	3	14	CFL	6	9	5	10	4	0	13	Insufficient
134	Block A18-A21	H134	3	Single	CFL	6	9	5	10	3	2	12	Insufficient
135	Block A18-A21	H135	3	14	CFL	8	8	9	9	7	5	12	sufficient
136	Block A18-A21	H136	3	14	CFL								I
137	Block A18-A21	H137	3	14	CFL								I
138	Block A18-A21	H138	3	14	CFL								I
139	Block A18-A21	H139	3	14	CFL	7	8	5	11	10	0	11	Insufficient
140	Block A18-A21	H140	3	14	CFL	10	10	12	10	11	8	13	sufficient
141	Block A18-A21	H141	3	14	CFL	10	8	12	7	11	8	15	sufficient
142	Block A18-A21	H142	3	Single	CFL								I
143	Block B13-B18	H143	3	14	CFL	7	8	7	5	11	5	9	Insufficient
144	Block B13-B18	H144	3	14	CFL	11	14	10	13	9	9	11	sufficient
145	Block B13-B18	H145	3	14	CFL	11	14	10	15	13	4	12	sufficient
146	Block B13-B18	H146	3	14	CFL	8	11	4	14	9	1	9	sufficient
147	Block B13-B18	H147	3	Single	CFL	10	12	8	13	12	3	13	sufficient
148	Block B13-B18	H148	3	12	CFL								I
149	Block B13-B18	H149	3	12	CFL	6	10	4	7	3	1	11	Insufficient
150	Block B13-B18	H150	3	12	CFL								I
151	Block B13-B18	H151	3	12	CFL	7	8	6	12	5	3	8	Insufficient
152	Block B13-B18	H152	3	Single	CFL	8	8	8	9	6	5	15	sufficient
153	Block B7-B13	H153	3	12	CFL	11	14	6	18	10	10	8	sufficient
154	Block B7-	H154	3	12	CFL	9	12	10	11	9	2	14	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
	B13												
155	Block B7-B13	H155	3	12	CFL								I
156	Block B7-B13	H156	3	12	CFL	11	11	11	15	12	6	12	sufficient
157	Block B7-B13	H157	3	12	CFL								I
158	Block B7-B13	H158	3	12	CFL								I
159	Block B7-B13	H159	3	Single	CFL	12	14	9	17	15	6	15	sufficient
160	Block B7-B13	H160	3	14	CFL								I
161	Block B7-B13	H161	3	14	CFL								I
162	Block B7-B13	H162	3	14	CFL								I
163	Block B7-B13	H163	3	14	CFL	12	11	12	15	16	7	14	sufficient
164	Block B7-B13	H164	3	14	CFL	8	9	6	12	7	6	9	sufficient
165	Block B7-B13	H165	3	14	CFL	10	8	12	9	16	8	8	sufficient
166	Block B7-B13	H166	3	Single	CFL	8	8	10	10	10	4	9	sufficient
167	Block B1-B6	H167	3	14	CFL								I Insufficient
168	Block B1-B6	H168	3	14	CFL	10	14	5	16	11	4	14	sufficient
169	Block B1-B6	H169	3	14	CFL	10	11	11	15	14	4	9	sufficient
170	Block B1-B6	H170	3	14	CFL	12	12	11	15	17	9	10	sufficient
171	Block B1-B6	H171	3	14	CFL								I
172	Block B1-B6	H172	3	Single	CFL	8	14	5	18	3	1	10	sufficient
173	Block B1-B6	H173	3	12	CFL	11	14	6	18	10	7	15	sufficient
174	Block B1-B6	H174	3	12	CFL	11	13	11	13	15	4	15	sufficient
175	Block B1-B6	H175	3	12	CFL	9	13	10	12	11	5	7	sufficient
176	Block B1-B6	H176	3	12	CFL	8	13	7	14	7	2	7	sufficient
177	Block B1-B6	H177	3	Single	CFL								I
178	Block B19-B24	H178	3	14	CFL	7	12	6	13	7	1	7	Insufficient
179	Block B19-B24	H179	3	14	CFL								I
180	Block B19-B24	H180	3	14	CFL								I
181	Block B19-B24	H181	3	14	CFL	10	10	9	7	14	8	13	sufficient
182	Block B19-B24	H182	3	14	CFL	8	9	10	8	10	1	10	sufficient
183	Block B19-B24	H183	3	14	CFL	9	10	6	13	10	6	11	sufficient

Sr. No.	Location	Pole tag	Height (m)	Span (m)	Luminary	Average Lux	A1	A2	B1	B2	C1	C2	Remarks
184	Block B19-B24	H184	3	Single	CFL	8	11	8	15	8	2	9	sufficient
185	Block B19-B24	H185	3	14	CFL	9	14	6	13	6	6	9	sufficient
186	Block B19-B24	H186	3	14	CFL								I
187	Block B19-B24	H187	3	14	CFL								I
188	Block B19-B24	H188	3	14	CFL								I
189	Block B19-B24	H189	3	14	CFL								I
190	Block B19-B24	H190	3	14	CFL								I
191	Block B19-B24	H191	3	Single	CFL								I
192	Block B25-B30	H192	3	14	CFL	9	14	4	16	7	5	9	sufficient
193	Block B25-B30	H193	3	14	CFL								I
194	Block B25-B30	H194	3	14	CFL	11	14	7	17	10	10	8	sufficient
195	Block B25-B30	H195	3	14	CFL	8	14	5	12	6	2	14	sufficient
196	Block B25-B30	H196	3	14	CFL								I
197	Block B25-B30	H197	3	Single	CFL	10	11	9	12	13	3	15	sufficient
198	Block B25-B30	H198	3	14	CFL	10	14	8	15	6	9	10	Sufficient
199	Block B25-B30	H199	3	14	CFL								I
200	Block B25-B30	H200	3	14	CFL								I
201	Block B25-B30	H201	3	14	CFL								I
202	Block B25-B30	H202	3	14	CFL	11	12	9	15	14	9	10	sufficient
203	Block B25-B30	H203	3	14	CFL	8	13	9	10	6	4	7	sufficient
204	Block B25-B30	H204	3	Single	CFL								I

Table 31 Remarks Legend

Observation ID	Full Form
A	Tree branches obstructing spread of light
G	Other light source nearby contributing extra light
I	Off/ Not Working

Z	Zig Zag/ scattered lighting arrangement

3.9.3 Energy Saving Projects in Lighting

- 160 Number of 44 W CFL used in parking lights can be replaced with 21 W LED.

Table 32 Replacement of 44 W CFL with 21 W LED

Description	Unit	Existing	Proposed
Qty of parking lights	#	160	160
Running	Hr/day	11	11
Total Power	kW	7.04	3.36
Energy Saving	kWh/day		40.48
Annual energy saving	kWh/yr		14775.2
Annual Cost Saving	Rs/yr		93822.52
Investment	Rs.		192000
Simple Payback	Month		25

- 200 Number of 70 W MH parking lights can be replaced with 36 W LED. Lights on 146 Number of poles were observed in ON condition and hence the saving is calculated on those numbers.

Table 33 Replacement of 70 W MH with 36 W LED

Description	Unit	Existing	Proposed
Qty of parking lights	#	200	200
Qty of lights ON during audit	#	146	146
Running	Hr/day	11	11
Total Power	kW	10.22	5.256
Energy Saving	kWh/day		54.604
Annual energy saving	kWh/yr		19930.46
Annual Cost Saving	Rs/yr		126558
Investment	Rs.		219000
Simple Payback	Month		21

- 6304 Number of 28 W T-5 tube lights can be replaced with 11 W tube type LED.

Table 34 Replacement of 28 W T-5 light with 11 W LED tube

Description	Unit	Existing	Proposed
Qty of indoor lights	#	6304	6304
Load Factor	#	60	60
Running Time	Hr/day	6	6
Total Power	kW	105.91	41.61
Energy Saving	kWh/day		385.80

Description	Unit	Existing	Proposed
Annual energy saving	kWh/yr		140819
Annual Cost Saving	Rs/yr		894199
Investment	Rs.		3467200
Simple Payback	Month		47

3.10 Ceiling Fan & Water Geyser

3.10.1 Installation details

- Two major connected load in Samudra Township are ceiling fan and water geyser.
- Installation details of these household utilities is mentioned in below table.
- Ceiling fan rated power is 65 W whereas, 1.5 kW geyser are installed.

Table 35 Ceiling Fan and water geyser installation details

Block Type	No. of Flats	Ceiling Fan Qty.	Water geyser Qty (1.5 kW)
1 BHK	316	632	316
2 BHK	660	1980	660
3 BHK	192	768	384
Bachelor	294	588	294
Total	1462	3968	1654
Total Power in kW		257.92	2481

3.10.2 Energy saving measures

- Ceiling fans Installed at Samudra Township are AC 1-phase and commercially available that deliver equal or higher air flow rate at nearly 50% of power consumed by conventional 60 W fan.

Table 36 Energy Efficient Fans

Parameter	Detail (Gorilla Energy Efficient Fan)
Span(mm/inch)	1200/48
Service Value/Air Delivery	>7
Input Voltage(V)	140-285
Power Consumption(W)	28
Frequency(Hz)	48-52
Air Delivery(CMM)	220
Power Factor	0.95
No. of Blades	3
Bearing	Deep Groove Double Sided Steel Shielding
Remote Control (10 Keys)	Speed Control, Timer and Sleep Mode
Guarantee	3 Years

Table 37 Replacement of existing ceiling fans with energy efficient fan

Particular	Unit	Value
Total Fan		3968
Fans to be replaced at 70% of total occupancy		2778
Existing power/ fan	W	60
Power of Energy efficient fan	W	28
16 hours a day for non-winter days	Hr./yr.	4160
Energy Saving	kWh/yr.	369807

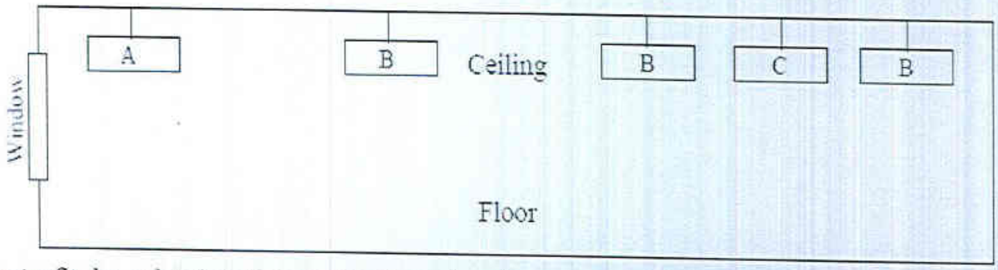
Particular	Unit	Value
Saving in Cost	Rs. Lakh/yr.	23.482
Investment @2400 Rs./Fan	Rs. Lakh	66.672
Simple Payback	Month	34

Intangible Areas of Energy conservation Opportunity at Samudra Township :

Lighting placement and controls.

- An example of energy efficient lighting control is illustrated by Figure, which depicts five rows of overhead lights in a workspace. During the brightest part of the day, ample daylight is provided by the window and thus only row C would need to be turned on. At times when daylight levels drop, all B rows would be turned on and row C would be turned off. Only at night or on very dark days would it be necessary to have both rows A and B turned on.

Lighting Placement & Control



- retrofit by adapting the luminaries already present. (For example, turning on the lighting in the rows away from the windows during the brightest parts of the day and turning on supplemental rows as needed later.)

Daylighting.

- Daylighting involves the efficient use of natural light in order to minimize the need for artificial lighting in buildings. Increasing levels of daylight within rooms can reduce electrical lighting loads by up to 70% Unlike conventional skylights, an efficient daylighting system may provide evenly dispersed light without creating heat gains. The reduced heat gains will reduce the need for cooling compared to skylights. Daylighting differs from other energy efficiency measures because its features are integral to the architecture of a building; therefore, it is applied primarily to new buildings and incorporated at the design stage. However, existing buildings can often be costeffectively refitted with daylighting systems. Various daylighting systems are available on the market, some of which can be supplied as kits to retrofit an existing building.

High-efficiency Motors, Pumps and Drives.

- High-efficiency motors reduce energy losses through improved design, better materials, tighter tolerances, and improved manufacturing techniques.

- With proper installation, high-efficiency motors can run cooler than standard motors and can consequently have higher service factors, longer bearing life, longer insulation life, and less vibration.
- Replacing a motor with a high-efficiency motor is often a better choice than rewinding a motor. The practice of rewinding motors currently has no quality or efficiency standards. The efficiency of a motor decreases after rewinding; typically by anywhere from 2-25%. Recent case study data show that new motors are not only more energy efficient, but also reduce overall operation costs. When considering whether to rewind a motor or to replace it with a higher-efficiency model,

> **Turning off lights in unoccupied areas.**

- An easy and effective measure is to encourage personnel to turn off lights in unoccupied building spaces. An energy management program that aims to improve the awareness of personnel with regard to energy use can help staff get in the habit of switching off lights and other equipment when not in use.

> **Replacement of Existing ACs with "7-Star" Natural Refrigerant Rated ACs (R290 Based)**

> **Replacement with Inverter ACs**

Digital Inverter technology maintains precise control of room temperature and creates a comfortable environment. In conventional split Air Conditioners, the compressor switches off once the set temperature is reached, and switches on again after temperature drops. The time it takes for the Split Air Conditioner to switch on and off causes the room temperature to greatly fluctuate. With Digital Inverter, the inverter control reduces the compressor power once the desired temperature has been reached, but continues operating at a reduced state to maintain a stable room temperature with minimal fluctuations. By putting an end to on/off compressor operation, the inverter technology also allows Digital Inverter to significantly reduce noise levels; Superior reliability has been achieved, due to the reduction of the compressor ON/OFF cycles. Digital DC Inverter Air Conditioners provide this benefit to consumers, helping them to achieve various benefits such as saving of at least 25% of their energy costs. These air conditioners are much quieter and offer higher levels of efficiency as their noisier counterparts. The average AC power consumption as recorded during winter (present time) is about 54.71 KW. This is likely to be 30 to 35% higher during hot season. The average consumption could be put at 60 KW/month over year. The power savings with digital inverter type AC units would at 20% would be 12 KW/month. The annual energy conservation potential of this intervention is: 94,000 kWh/year.

> **Overhaul of Refrigerant Piping Insulation & Filter Maintenance**

The Gas pipe insulation was found to be damaged at various points on the AC units. Mending / replacement of insulation would improve the performance of AC units. Cleaning of filters of all indoor units and cleaning of condenser fins by jet pumps. Average life of typical Split Units is considered to be 10 years in dry climates without corrosive pollutants.

> **Optimal AC Temperature Setting**

Using all Units at Specific Set Points can greatly reduce HVAC energy consumption. It was observed that the set-point for ACs was generally at 19° C. All AC units may be set at 23/24 °C for optimum power consumption. The annual energy conservation potential of this intervention is: 28,500 kWh/year

- **Enhanced Use of Natural Lighting**

- Natural lighting available at the premises through the existing glass facades needs to be exploited to reduce the lighting load exerted. Currently, most of the glass facades are shielded using vertical-blinds and artificial lighting is used even in areas in the vicinity of glass panes. This intervention has the twin beneficial impact of reducing manufacturing related LCA impacts of lighting fixtures as well as reduced energy consumption. Some green architecture guidelines specify design lighting loads in the vicinity of 7.5 W/sq.m. For building occupancy of 10 hours/day, the average annual electricity conservation and GHG emissions mitigation per sq. m of naturally lit space relative to conventionally lit space is estimated to be 27 kWh/sq.m and 24 kgCO2e/sq. m.

- **Building-Envelope & Air-Conditioned Space Insulation**

- Weather-Stripping of All Doors, especially the main entrance doors into all building cavities.
- Use of Air curtain on Ground Floor Entrance to curtail infiltration losses: Frequenting clients on Ground Floor through main entrance incurs losses due to infiltration. These could be curtailed using Air Curtains. The advantage would be more prominent during summer.

- **Heat Gain Reducing Paint**

- The Heat Gain Reducing Paint technology has the ability to reflect heat causing infrared rays from solar radiation. This intervention was designed to help reduce the internal temperature of the building i.e. reduce heat gain. Certification conducted by the Centre for Energy Studies and Research (CESR, India) indicates that Weather Shield Paints (i.e. solar reflective paints) can reduce the temperatures of walls by upto 50Cand that reflectivity rate for solar radiation through these paints is 0.40 relative to ordinary.
- Currently, the MAIN DOOR of the entrance to the Branch has a significant air-gap between the frame and the door while all back-office doors meant to separate Air Conditioned Spaces from non-conditioned spaces are either missing or kept ajar at all times.
- Exterior wall paint which exhibit a reflectivity rate of 0.21. i.e. these paints are approximately twice as effective in curbing building wall temperature rise due to solar radiation.

Renewable Power Feasibility at Adani House :

- Plant first can install LED lights and then can install solar PV system so that requirement of project kW will be reduce.

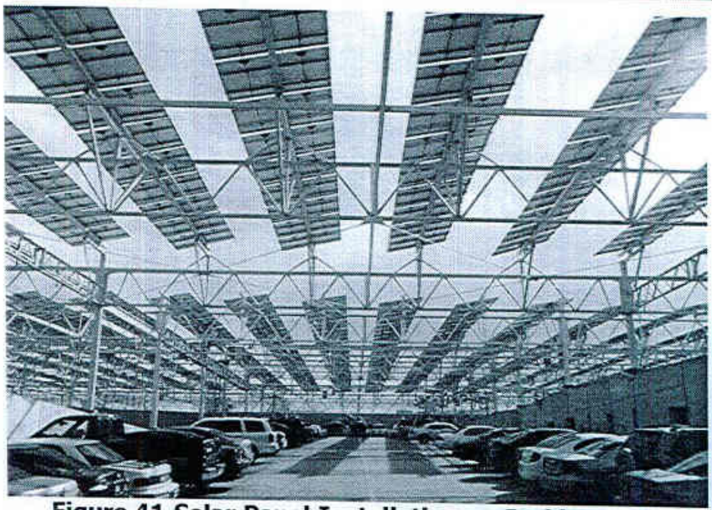


Figure 41 Solar Panel Installation on Parking Shed

- Plant can use the parking space or another non utilize space with feasibility study of solar PV panel installation.

➢ **Advantages of Water Percolation and Water Harvesting:**

Rainwater harvesting is collecting the run-off from a structure or other impervious surface in order to store it for later use. Traditionally, this involves harvesting the rain from a roof. The rain will collect in gutters that channel the water into downspouts and then into some sort of storage vessel. Rainwater collection systems can be as simple as collecting rain in a rain barrel or as elaborate as harvesting rainwater into large cisterns to supply your entire household demand.

The idea of rainwater harvesting usually conjures up images of an old farm cistern or thoughts of developing countries. The reality is that rainwater harvesting is becoming a viable alternative for supplying our households and businesses with water. It's not just for the farm anymore! There are many countries such as Germany and Australia where rainwater harvesting is a norm. Due to the green building movement, you will be seeing rainwater harvesting systems become more popular here in America.

The collection of rainwater is known by many names throughout the world. It ranges from rainwater collection to rainwater harvesting to rainwater catchment. In addition, terms such as roof water collection or rooftop water collection is also used in other countries.

We believe that rainwater harvesting is a viable technology in an urban setting. All that is necessary to take advantage of this resource is to capture the free water falling on your roof and direct it to a rainwater storage tank. By doing this, you can take control of your water supply and replace all or at least a substantial portion of your water needs. Rainwater harvesting systems can be configured to supply your whole house and/or your landscape needs.

What are the benefits of rainwater collection?

- Rainwater is a relatively clean and absolutely free source of water
- You have total control over your water supply (ideal for cities with water restrictions)
- It is socially acceptable and environmentally responsible

- It promotes self-sufficiency and helps conserve water
- Rainwater is better for landscape plants and gardens because it is not chlorinated
- It reduces storm water runoff from homes and businesses
- It can solve the drainage problems on your property while providing you with free water
- It uses simple technologies that are inexpensive and easy to maintain
- It can be used as a main source of water or as a backup source to wells and municipal water
- The system can be easily retrofitted to an existing structure or built during new home construction
- System are very flexible and can be modular in nature, allowing expansion, reconfiguration, or relocation, if necessary
- It can provide an excellent back-up source of water for emergencies

What Are The Uses Of Collected Rainwater

You can essentially use rainwater anywhere you use tap water. The idea of using drinking water to flush our toilets and water our lawns is wasteful and irresponsible, especially in light of population growth and water shortages across the country. Rainwater collection is a technique to green your home and to lessen your environmental footprint.

There are basically three areas where rainwater can be used:

- Irrigation use
- Indoor, non-potable use
- Whole house, potable use

Here are some ideas for specific uses of rainwater:

- Hand water your lawn and garden
- Connect rainwater collection system to irrigation/sprinkler system
- Wash your vehicles
- Wash your pets
- Refill your fountains and fish ponds
- Refill your swimming pool
- Replace the use of tap water with rainwater to wash your driveways and sidewalks (if you don't use a broom)
- Use it for all indoor non-potable fixtures (toilets and clothes washer)
- Use it for all potable needs when properly filtered and disinfected
- Use it for industrial processes instead of municipally treated water

How Much Rain Can be Collected?

The amount of rainfall that you can collect is governed by the following formula:

1" of rain x 1 sq. ft. = 0.623 gallons

Or put in an easy form to remember:

1" of rain from 1,000 sq. ft. will provide 623 gallons

To calculate the amount of rainwater you can collect, you need to know your annual average precipitation for your area.

Water Percolation:

In this method rain water collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability. Each drainpipe should have mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water over flow system.

In this method rain water collected from the roof of the building is diverted to a storage tank. The storage tank has to be designed according to the water requirements, rainfall and catchment availability. Each drainpipe should have mesh filter at mouth and first flush device followed by filtration system before connecting to the storage tank. It is advisable that each tank should have excess water over flow system.

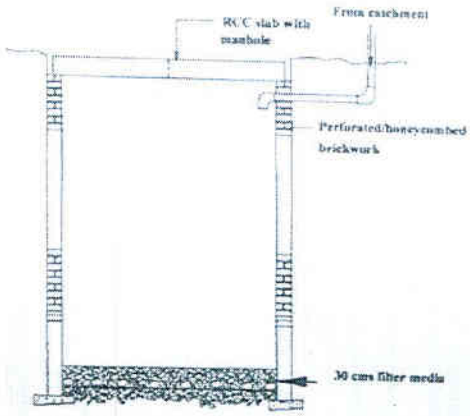
Ground water aquifers can be recharged by various kinds of structures to ensure percolation of rainwater in the ground instead of draining away from the surface. Commonly used recharging methods are:-

a) Recharging of bore wells
b) Recharging of dug wells.
c) Recharge pits
d) Recharge Trenches
e) Soak ways or Recharge Shafts
f) Percolation Tanks

Recharging of bore wells

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Optimum capacity of settlement tank/filtration tank can be designed on the basis of area of catchment, intensity of rainfall and recharge rate as discussed in design parameters. While recharging, entry of floating matter and silt should be restricted because it may clog the recharge structure. "first one or two shower should be flushed out through rain separator to avoid contamination. This is very important, and all care should be taken to ensure that this has been done."



Typical recharge pit

- Roof or terraces uses for harvesting should be clean, free from dust, algal plants etc.
- Roof should not be painted since most paints contain toxic substances and may peel off.
- Do not store chemicals, rusting iron, manure or detergent on the roof.
- Nesting of birds on the roof should be prevented.
- Terraces should not be used for toilets either by human beings or by pets.
- Provide gratings at mouth of each drainpipe on terraces to trap leaves debris and floating materials.
- Provision of first rain separator should be made to flush off first rains.
- Do not use polluted water to recharge ground water.
- Ground water should only be recharged by rainwater.
- Before recharging, suitable arrangements of filtering should be provided.
- Filter media should be cleaned before every monsoon season.
- During rainy season, the whole system (roof catchment, pipes, screens, first flush, filters, and tanks) should be checked before and after each rain and preferably cleaned after every dry period exceeding a month.
- At the end of the dry season and just before the first shower of rain is anticipated, the storage tank should be scrubbed and flushed off all sediments and debris

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Appendix - I

ELECTRICITY BILL

APPENDIX – I

ELECTRICITY BILL

CONSUMER NO: 200009
DISCOM: MUPL

Month	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16
Tarriff	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1	HTMD-1
Contract Demand (KVA)	900	900	900	900	900	775	775	775	775	775	775	775
85 % Contract Demand (KVA)	765	765	765	765	765	658.75	658.75	658.75	658.75	658.75	658.75	658.75
Actual Demand (KVA)	765	765	765	765	772.5	759	759	759	759	773.75	735	654
Billing Demand (KVA)	675	391	413	390	460	542	566	536	482	472	421	659
KVAH	235125	163824	160920	16224	214422	237402	244680	228660	225270	189552	184020	181425
PF	0.97	0.97	0.99	0.97	0.99	0.98	0.98	0.98	0.98	0.98	0.98	0.99
kWh Consumption	228750	235050	222000	286875	334950	471375	536175	449850	320025	410400	333900	179175
Time of Use Units	75000	82500	75000	90000	112500	157500	180000	150000	105000	142500	105000	67500
Demand Charges (Rs.)	626076	626076	585684	626076	611820	624809	601128	621166	621166	612612	601524	521928
Energy Charges (Rs.)	812063	834428	788100	1018406	1172325	1649813	1876613	1574475	1120088	1436400	1168650	627112.5
Fuel Surcharges (Rs.)	192150	220947	279720	361463	422037	593933	675581	404865	288023	369360	217035	116463.8
PF Adjustment Charges (Rs.)	-2950.9	-3032.1	-4062.6	-3700.7	-6129.6	-7353.4	-8364.8	-7017.7	-4992.4	-6402	-5208.8	-3278.9
Electricity Duty (Rs.)	6862.5	7051.5	3444.83	8606.25	0	0	0	0	0	0	0	0
Meter Charges (Rs.)	750	750	750	750	750	750	750	750	750	750	750	750
Total Bill (Rs.)	1634950	1686220	1653636	2011600	2200802	2861950	3145706	2594238	2025033	2412720	1982750	1262975
Total Bill-Demand Charges (Rs.)	1008874	1060144	1067952	1385524	1588982	2237142	2544578	1973072	1403868	1800108	1381226	741047
Units Rate	7.15	7.17	7.45	7.01	6.57	6.07	5.87	5.77	6.33	5.88	5.94	7.05

Appendix - II

MONTHLY FUEL & WATER CONSUMPTION

APPENDIX-II

WATER CONSUMPTION

- Monthly Water Consumption

Month	Total Metered Qty in KL	Horticulture Water KL	Total
Apr-16	30585	22939	53524
May-16	26625	19969	46594
Jun-16	32299	24225	56524
Jul-16	33596	25197	58793
Aug-16	32582	24437	57019
Sep-16	29853	22390	52243
Oct-16	30096	22572	52668
Nov-16	27194	20396	47590
Dec-16	27776	20832	48608
Total	**270606**	**202957**	**473563**

Appendix - III
MOTOR LOADING

MOTOR LOADING

Sr. No.	Identification	Rated Kw	Rated Effi. (%)	Volt	Amp.	KW	PF	% Loading	Remarks
1	MRB Tank to Aeration Tank 3	7.5	87	404	11.5	7	0.9	81.20	
2	Process pump 1	3	82.5	423	2.54	1.8	0.98	49.50	with VFD
3	MRB Tank to Aeration Tank 1	7.5	87	413	10.6	7.2	0.95	83.52	
4	MRB BLOWER 2	11	88	413	14.6	8	0.78	64.00	
5	Process pump 2	3	82.5	424	4.58	2.96	0.88	81.40	
6	MRB Tank to Aeration Tank 2	7.5	87	407	16	9.6	0.85	111.36	Rewound motor
7	Raw Water sewage pump 1	5.5	85	419	4.5	2.32	0.7	35.855	
8	Raw Water sewage pump 2	5.5	85	418	5.2	3.24	0.86	50.07	
9	Irrigation pump	22	91	413	29.1	17.1	0.82	70.73	
10	Pump at customer office	37.5	86	417	60	38.7	0.88	88.75	

Appendix –IV
LIST OF SUPPLIERS/ MANUFACTURERS

Appendix – IV
Vendor/ Manufacturers List

Sr. NO	Product/ Equipment	Contact Details
1	Lighting-T5	L-141 MIDC industrial area Ahmednagar-414111 Tel.0241-2779835/2778978 Email-ceo@eetamax.com Contact person: Mr.Dilip Joshi (CEO) Cell.9850895772
2	Energy conserver system for lighting load	Mag. Flux Power saver GLOABTEL convergence Ltd Contact person Mr.Rashes Joshi (DGM Sales) Cell No: +91 9322338581
3	Aircosaver (Energy saving in air conditioning system)	Ecopower Pvt. Ltd. 105 Neelkanth, 98 Marine Drive, Mumbai 400 002 INDIA. Telephone : +91 (22) 22839645 Fax : +91 (22) 22839646
4	Capacitors	Shreem Capacitors Pvt. Ltd. 7/39, Vikram Vihar, Lajpat Nagar-IV, New Delhi – 11024
5	Capacitors and APFC Panels	Matrix Controls & Engineers Pvt Ltd Rajeev Batra 9811624440, Rajeev@matrixcapacior.com E- 725 DSIDC, Industrial Complex, Narela, GT Road, Delhi – 110040 Ph: 01127786945 / 46 / 47, www.matrixcapacitor.com
6	Capacitors and APFC Panels	Saif Electronics 174, Hira Building, 1st Floor, Carnac Road, Opposite Police Commissioner office , Mumbai – 400002 Ph : 022 – 22064626 , 22086613, www.saifel.com
7	Lighting Systems	Philips India Ltd Regional office-North, 9th floor Ashoka Estate, 24, Barakhamba Road New Delhi – 110 001 Telephone No.: 3353280, 3317442, Fax No.: 3314332
8	Lighting Systems	OSRAM India Ltd. Signature Towers, 11th Floor, Tower B, South City-I, Gurgaon 122001, Haryana Tel: 0124- 6526175, 6526178, 6526185
9	Lighting Systems	1)Wipro Limited Sco 196-197, Sector 34-A, Chandigarh - 160 022

		2) Daril Lighting Pvt. Ltd. Ph: +91-265-2341774 M: 9925018665 Email: ceo@darilighting.com 3) Surya Roshni Ltd. Contact Person: Rohan Dave, Asst. Manager M: 9825513086; Email: suryaroshniahd@gmail.com
10	Lighting Voltage Control Systems	ES Electronics (India) Pvt. Ltd. Plot No.82, KIADB Industrial Area, Bommasandra – Jigani Link Road, Jigani Hobli, Anekal Taluk, Bangalore District – 562 106 Telefax: +91 - 8110 – 414547 / 414548,414549 / 414550 E-mail ID: eleindia@energysaversindia.com Website: www.energysaversindia.com
11	HVAC	Voltas Limited 19 J N Heredia Marg Ballard Estate Mumbai – 400038 Energy Audit Draft Report
12	Pumps	1) Shakti Pumps India Ltd. Tel: +91-7292-410500 Email: sale@shaktipumps.com 2) Lubi Industries LLP Tel: +91 79 30610100 Email: indsales@lubipumps.com 3) Grundfos Tel: +91 79 4003618 salesindia@grundfos.com
13	Variable Speed Drives	ABB India Ltd. Contact: Tukaram Korke, Manager-sales Ph: +91-20-66243828 M: +91-9765551612 tukaram.korke@in.abb.com

Annexure – 6

Community Awareness Session

Home Fire Safety Awareness Campaign “KNOWLEDGE AT YOUR DOORSTEP II”

On 15.04.2017 and 16.04.2017 home fire safety awareness campaign executed for home makers at Samudra Township and Shantivan Colony respectively. Compare to last year programme there was special inclusion in this programme of LPG fire safety which comprises of precautions while taking delivery of LPG cylinders , response in case of emergency in LPG with practical operation of Fire Extinguishers. Total 214 families at Samudra Township and 140 Families at Shantivan educated in home fire safety.

Activities carried out from 15.04.2017 to 21.04.2017

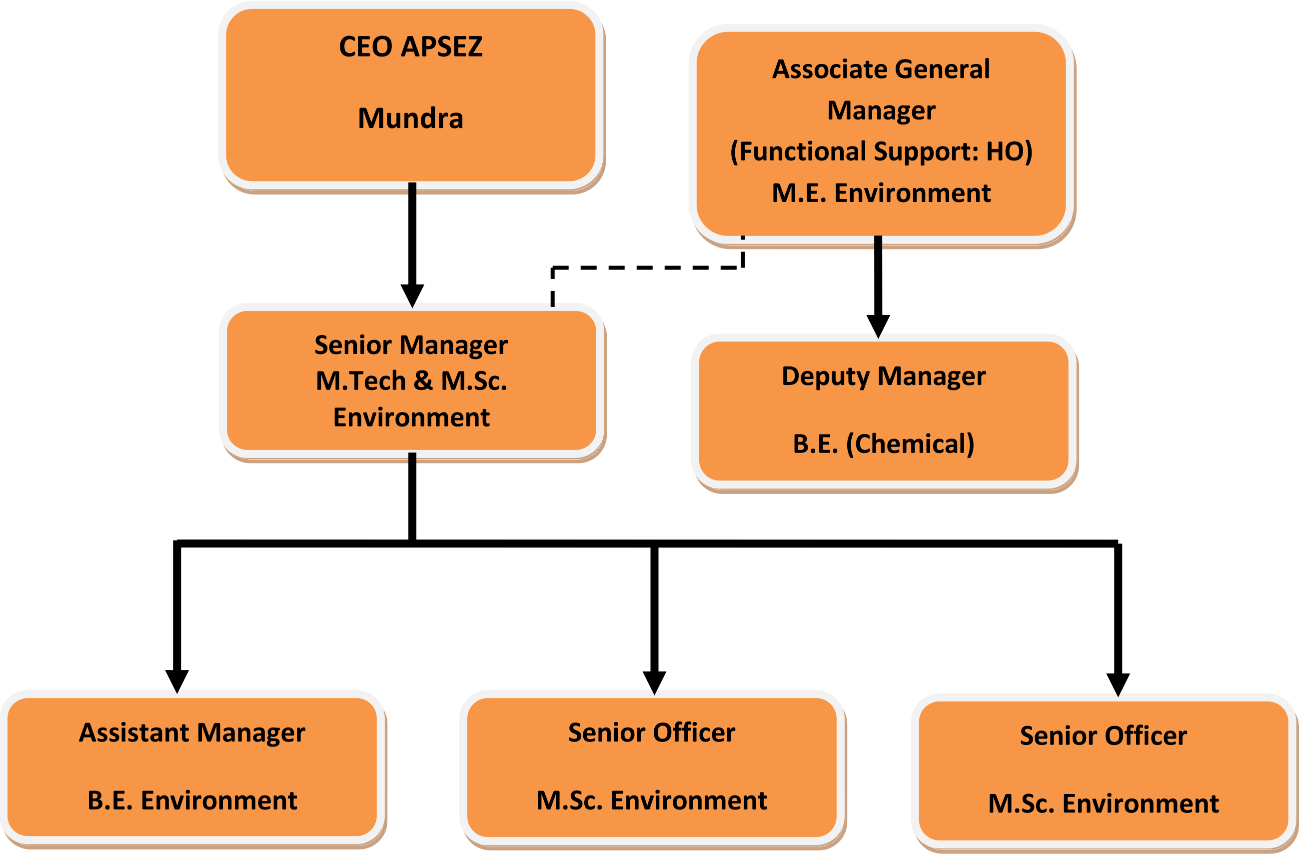
Observance of 73rd National Fire Service Week

Home Fire Safety Awareness Campaign “KNOWLEDGE AT YOUR DOORSTEP II_Snaps

adani

Annexure – 7

Organogram of Environment Management Cell, APSEZ, Mundra



Annexure – 8

Cost of Environmental Protection Measures

Sr. No.	Activity	Cost incurred (INR in Lakh)			Budgeted Cost (INR in Lakh)
		2015 – 16	2016 – 17	2017 – 18	2017 – 18
1.	Environmental Study / Audit and Consultancy	45.45	36.78	9.00	21.00
2.	Legal & Statutory Expenses	3.30	4.76	9.48	16.00
3.	Environmental Monitoring Services	26.80	27.95	12.00	36.00
4.	Hazardous / Non Hazardous Waste Management & Disposal	34.56	12.52	31.9	90.84
5.	Environment Day Celebration	7.18	6.71	2.68	10.00
6.	Treatment and Disposal of Bio-Medical Waste	1.22	1.27	0.75	1.44
7.	Mangrove Plantation, Monitoring & Conservation	73.64	72.38	60.0	60.0
8.	Other Horticulture Expenses	434.72	555.00	494.0	556.5
9.	O&M of Sewage Treatment Plant and Effluent Treatment Plant (including STP, ETP of Port & SEZ & Common Effluent Treatment Plant)	18.18	61.50	39.89	69.35
10.	Expenditure of Environment Dept. (Apart from above head)	135.90	131.83	22.83	104.91
	Total	**837.73**	**910.70**	**682.53**	**966.04**