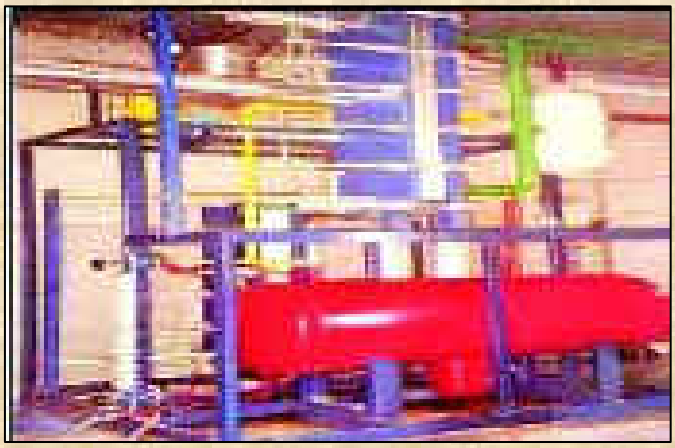
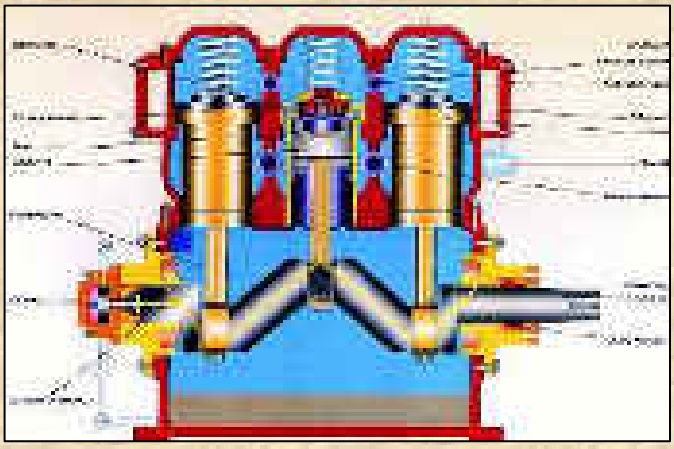
MANUAL ON ENERGY CONSERVATION MEASURES IN ICE MAKING CLUSTER BHIMAVARAM





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CONTENTS

List of Tables

List of Figures

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We assure you, always, of our best services.

V Ramchander
Managing Director

1. INTRODUCTION

1.1 Preamble

Small and Medium enterprises (SMEs) play an important role in creation of local employment and there by increase in regional income. Effective and Efficient utilization of raw material, thermal and electrical energy becomes imperative for their sustenance as they work on low profit margins. Moreover, the production processes in SMEs are based on technology concepts, which sometimes tend to become inefficient in a long run. The inefficient plant utilization and excessive use of raw material, fuel & energy also contribute to exceeding levels of energy intensities and environmental loads. Excessive utilization of thermal and electrical energy also impacts the regional energy balance and has direct impact on the local power utility and availability of fuel resources. It also impedes the improvement of productivity of local enterprises and the economic development of communities at large.

Energy efficiency and conservation issues in Industrial Clusters are traditionally dealt with addressing the issues at an individual unit level, which is a discrete approach to resolve energy problems. Most of the energy consumption is unevenly distributed and is larger in a cumulative context among small enterprises. Due to low incomes and non-availability of immediate and next to door solutions, the SMEs continue to draw and use excessive energy in a business-as-usual scenario. The uneven use of energy resources have a toll on the investments and erode the competitiveness of the SMEs. The paradigm of addressing energy security issues at a local level, and in particular the SME level has now shifted to energy efficiency improvements with a “Cluster Approach”. This enables augmenting the forward and backward linkages to the SME units, developing the skill capabilities of the SMEs to go for energy efficiency improvements, technology up gradation and market development by linking the Local Service Providers (LSPs) and financial linkages with the local Banks / Financial Institutions in augmenting loans for investments in energy efficiency projects.

In this context, the Bureau of Energy Efficiency (BEE) has initiated the Small & Medium Enterprise (SME) Program in twenty-five clusters in the country to address the energy efficiency and overall productivity improvements.

1.2 About the BEE-SME Program

The Government of India has set up The Bureau of Energy Efficiency (BEE) under the provisions of Energy Conservation Act, 2001. The mission of the BEE is to assist in developing policies and strategies with a thrust on self-regulation and market principles within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity by active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors. The objective of the BEE SME Energy Efficiency program is to accelerate the adoption of Energy Efficiency (EE) technologies and practices in the chosen SME clusters through knowledge sharing, capacity building and development of innovative financing mechanisms. Further information is available at **www.bee-india.nic.in**. There are 29 clusters identified under the BEE- SME's Program, these are as follows:

Table 1.1: List of Identified Clusters under BEE SME's Programme

S. No.	Name of Cluster/ Sector	Product
1	Jamnagar, Gujarat	Brass
2	Warangal, Andhra Pradesh	Rice Milling
3	Surat, Gujarat	Textiles
4	Pali, Rajasthan	Textiles
5	Morvi, Gujarat	Ceramics
6	Ahmedabad, Gujarat	Chemical Industries
7	Solapur, Maharashtra	Textile
8	Alwar & Sawai Madhopur, Rajasthan	Oil Mills
9	Bangalore, Karnataka	Machine Tools
10	Batala, Jalandhar & Ludhiana, Punjab	Casting & Forging
11	Bhimavaram, Andhra Pradesh	Ice Making Plants
12	Bhubaneswar, Orissa	Utensils
13	East&WestGodavari, Andhra Pradesh	Refractory
14	Ganjam, Orissa	Rice Milling
15	Gujarat	Dairy
16	Howrah, West Bengal	Galvanizing /Wire Drawing
17	Jagadhri, Haryana	Brass and Aluminum Utensils
18	Jodhpur, Rajasthan	Limestone
19	Jorhat, Assam	Tea Gardens
20	Kochi, Kerala	Sea Food Processing
21	Muzaffarnagar, UP	Paper
22	Orissa	Coal based Sponge Iron
23	Vapi, Gujarat	Chemicals
24	Varanasi, UP	Brick Kilns
25	Vellore, Tamilnadu	Rice Milling

26	Tirupur,Tamilnadu	Textile
27	Mangalore, Karnataka	Tiles
28	Allepe, Kerala	Coir
29	Firozabad, Uttar Pradesh	Glass

BEE-SME program is one of the activities to improve the energy efficiency in SME clusters across the selected industrial clusters. The broad objective of the BEE-SME program is to improve the energy intensity of the Indian economy by undertaking actions in the SME sector which directly or indirectly produce 60% of the GDP. Majority of SME's in these clusters are run by the manufacturers who don't have skilled manpower and who can practice energy efficiency programs for conservation of energy. The awareness of energy conservation in these areas is minimal which also affects the manufacturing cost.

Therefore, it will be useful to build their energy efficiency awareness and through studies give energy conservation recommendations including identification of technology up-gradation opportunities and demonstration of the same. This would help to address the cluster specific problems and enhancing energy efficiency in SME Clusters.

These studies would provide information on technology status, best operating practices, gaps in skills and knowledge, energy conservation opportunities, energy saving potential, capacity building of local service providers and entrepreneurs/ managers etc for each of the sub sector in SME's. For each cluster, an executing agency has entrusted with this activity.

APITCO Limited selected as executing agency by the BEE in Ice Making Units in Bhimavaram, West Godavari District to execute the project. The main objective of the implementing agency is to accelerate the adoption of Energy Efficiency Technologies and practices in cluster through knowledge sharing, capacity building and development of innovative financial mechanisms. The main role of the executive agency is to facilitate the implementation of project activities in the SME–BEE Ice milling cluster activities suggested by BEE.

Natural resources like Coal, natural gas, kerosene, diesel and coal used to generate energy. Energy here refers to electrical or thermal energy, which is produce by natural energy resources. Fuel is burnt to produce thermal energy for the process requirement. Whereas, electric energy is converted to mechanical energy through electric motors for moving, blending, crushing, compressing or any form of displacement activity.

In some end-uses (electrical equipments or appliances) electricity is converted to thermal energy according to industrial process requirements. Electricity is generated by thermal

energy and delivered to end-users through a transmission and distribution system. Using electricity to produce thermal energy is not a wise decision. This is because a lot of energy has already been lost during the generation, submission and distribution. Producing thermal energy using electricity will further increase the losses. More energy can be saved if fuel is used to directly produce thermal energy near to the end-use. This line of thinking relates to the phrase 'energy efficiency' in the title above.

If the term efficiency alone is used in the technical world, then the definition refers to performance of a particular machine or a system. It indicates how much quality output is obtained after deducting the losses in the system. This figure will be normally given in percentage form. When the word 'energy' is added to the word 'efficiency', then the whole perspective changes and a new definition is born.

1.3 Objectives of the Study

As we have seen the importance of the Energy Efficiency (EE), and the encouragement given by the government in urging private and government institutions towards the realization of energy security in India, it is worth to investigate the potential of implementing Energy Efficiency (EE) options in Ice Making Units in Bhimavaram. In view of this, the objectives of this work were structured as below.

- To carry out energy and technology audit in the Ice Units, to identify the energy efficiency measures
- To provide guidelines to other industries on EE measures on no cost, low-cost, medium-cost and high cost EE measures illustrated by a case study .
- To identify local service providers and their capacity building in technology augmentation
- To develop bankable Detailed Project Reports for Energy Efficiency Measures
- To link up financial institutions to the SMEs for implementation of EE Measures
- Capacity building of all local stakeholders in EE in Ice Milling Cluster.

1.4 Activities and Expected Outcome

Under this BEE SME Program, the following outcome is envisaged for Ice Making Cluster:

Activity 1: Energy Use and Technology Analysis

This activity has developed information base on the status of Ice Making cluster, identification & detailing of all possible energy efficiency measures, their techno economic

feasibility, overall potential to impact energy and environment scenario. Energy use and status of adaptation of technology in order to improve energy performance of the units in the cluster has been studied and analyzed. 15 technologies / energy conservation measures have been identified for preparation of Detail Project Report (DPR). This stage has been completed and findings have been presented in this manual.

Activity 2: Capacity Building of Local Service Providers (LSP's) and SME's

The Capacity Building Introductory Experts workshop will be conducted by APITCO under the guidance of the BEE. The objective of this activity is to create capacities among local services providers/technology provides in the SME clusters that would help in the uptake of the energy efficiency measures. The Local Service Providers (LSPs) and the technology providers identified during Activity 1, will be registered as experts with the SME programme of the BEE. A one-day Introductory Local Service Providers (LSPs) workshop will be organized with these experts and representatives from the industry/associations to share the outcome of Activity 1. The workshop will also identify issues regarding avenues for implementing energy efficiency measures, roadblocks in terms of capacities in the cluster, financing issues and carbon-market related issues. This activity will also involve the concerned SDA(s).

The output of this Activity will be a workshop proceeding which cover the entire activities of the workshop along with the outcome of the workshop on issues regarding implementation of energy efficiency measures. The activity will also enroll all the attending experts for the BEE SME Programme. A one-day Information Dissemination Workshop will be conducted in this cluster with the help of local industry association and enrolled Local Service Providers. The main focus of the workshop will be to share with the cluster the Energy Use and Technology Analysis manual prepared for the cluster. The workshop will discuss the energy efficiency measures identified in the cluster manuals and shortlist a minimum of 5 projects for which bankable Detailed Project Reports (DPR) will be prepared across maximum three segments of capacities in each cluster.

Another important focus of the cluster workshop will be to share the best practices prevailing in the cluster. The workshop will also discuss managerial issues related to implementing energy efficiency measures. These will have mainly the financing component: how to keep books, what types of financing schemes are presently available and discuss what further can be done in this regard. State Designated Agenesis (SDA) will also be involved in order

to help disseminate information. The output of this activity will be a list of 15 projects for this cluster for which bankable Detailed Project Reports (DPR) will be prepared.

Activity 3: Implementation of Energy Efficiency Measures

Scope of this activity is to facilitate the implementation of energy efficiency measures in Warangal Ice mill cluster through development of ready to use DPR's to facilitate bank financing. The development of 15 DPR's is in progress.

Activity 4: Facilitation of Innovative Financing Mechanism

The objective of this activity is to facilitate the implementation of energy efficient measures through innovative financing mechanisms without creating market distortion. Efforts are in progress to develop such mechanisms.

1.5 Project Duration

The total project duration is about 2.5 years and started in March 2009. Most of the activities will be completed by December 2010 and will be completed by June 2011.

1.6 Methodology

The methodology of the BEE-SME program is described below.

Preliminary Energy Audit

- Establish energy consumption in the organization
- Estimate the scope for saving
- Identify the most likely and the easiest areas for attention
- Identify immediate (especially no-low-cost) improvements/savings
- Set a reference point
- Identify areas for more detailed study/measurement
- Preliminary energy audit uses existing, or easily obtained data

Detailed Energy Audit

A comprehensive Energy audit provides a detailed energy Saving Proposals implementation plan for a facility, since it evaluates all major energy using systems. This type of audit offers most accurate estimate of energy savings and cost. It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost.

1.7 Structure of the Manual

Chapter II of the manual describes the Ice Making cluster, the products, cluster actors, energy consumption patterns, current policies and initiatives of local bodies, and technology up gradation needs.

Chapter III details on energy audit and technology assessment, methodology adopted, production processes and unit operations, energy consumption in production activities, and technology gap analysis. This Chapter also describes in detail energy conservation technologies, benefits of implementing energy efficiency measures, cost of implementation, savings and payback, barriers in implementation, availability of technology for implementation at local and regional level, identification of technologies / equipments for DPR preparation, techno-economics of technologies, barriers for implementation etc. the list of local service providers are annexed at the end.

Chapter IV Introduces approach to Small Group Activity (SGA) / Total Energy Management (TEM). It details the Small Group Activity (SGA) standards for practice, TEM and further, describes the ten stage activities. The chapter concludes with the tools used for SGA for TEM.

The annexure are followed by chapters briefing the technical calculations, list of LSPs, Techno commercial quotations for suggested technologies, Power tariff and financial schemes available for improvement of Energy Efficiency.

2. ICE MAKING CLUSTER-BHIMAVARAM

2.1 Ice Making Cluster Scenario

2.2 Overview of Ice Making Cluster-Bhimavaram

Bhimavaram (also called as Bheemavaramu) is a town and mandal in the West Godavari District in the state of Andhra Pradesh, India. It located geographically at 16.53° N 81.53°E.Bhimavaram is also called the "Second Bardo li of India". Mahatma Gandhi coined the name when he visited the town during the freedom movement in India. Bhimavaram is located 384 km from Hyderabad by road and430 km by train, 270 km from Visakhapatnam and 103 km from Vijayawada. National Highway NH 214 (Kathipudi to Pamarru) passes through this town.

Bhimavaram is one of the largest centers for aquaculture in India. It is producing rich aqua wealth in our country and it is next to Cochin. The city is home to more than 30 scrimping companies, most of which specialize in black prawn. Around 70% of all shrimp exports from Andhra Pradesh come from Bhimavaram. Ice making industry is one of major supporting industry to pisci-culture. Almost 80 units are in operation in this area which caters ice to aqua farms to support export. Bhimavaram is a centre of aqua and paddy business, prime centre of commerce and business, a fully developed education centre with many education Institutions. The Town is connected to by road and rail to all major cities. It has train facility connected to metropolitan cities, such as Chennai, Hyderabad, Bangalore and Kolkota.

2.2.1 Cluster Background

The Ice plants in Bhimavaram is spread in different areas surrounded in Bhimavaram Town. The different installed capacities are spread over Akivedu, Industrial Estates and Hundi Road in Bhimavaram town. Around 80 Ice makings plants are spread across the Bhimavaram town.

2.2.2 Products Manufactured

In Ice Making Cluster, all Ice Plants are manufacturing block Ice with different sizes. The weight of Ice blocks manufactured in Ice making cluster is from 90-130 kg with different sizes.

2.2.3 Categorization of Ice Plants

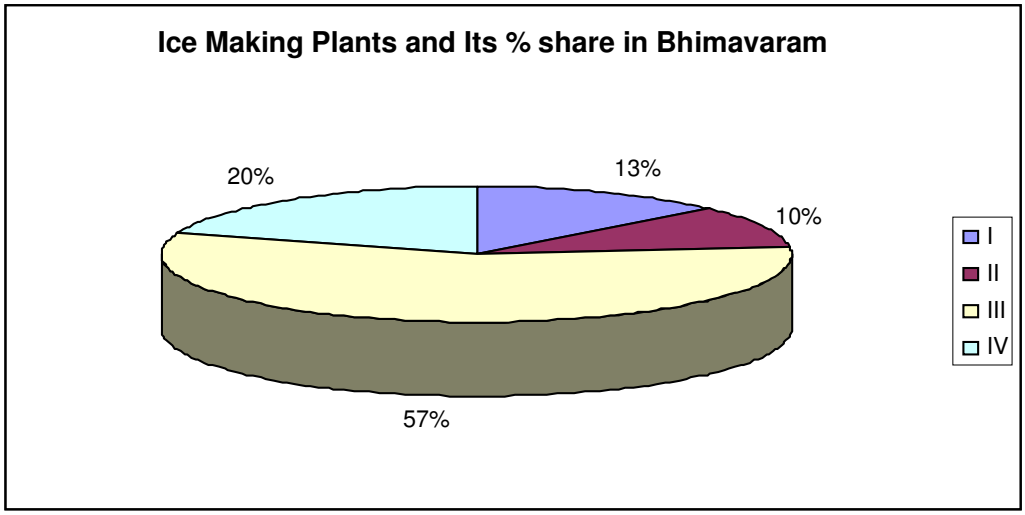
The Ice making Plants in Bhimavaram installed with different capacities in around Bhimavaram. These Ice plants are categorized in to four categories based on the survey

conducted during Energy use and Technology Audit. All existing 80 Ice plants fall under these categories in the cluster. The installed capacities in Ice Making cluster and its % share in the Bhimavaram is presented in Table No: 2.1 and Fig No: 2.1.

Table.2.1 Categorization of Ice Plants and % share in Bhimavaram

S. No	Category	Capacity Ranges (TPD)	No	%
1	I	<20 TPD	11	13
2	II	21-30 TPD	8	10
3	III	31-40 TPD	45	57
4	IV	>40 TPD	16	20
	Total		**80**	**100**

Fig 2.1: Installed capacities of Ice Plants and % Share in Bhimavaram

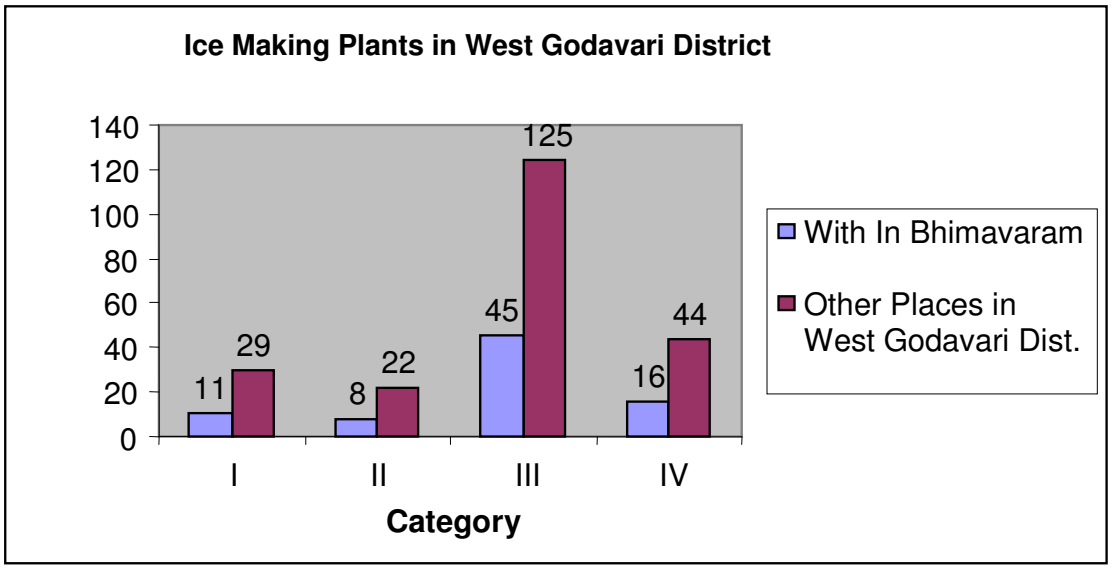


The ice Making plants are spread over all parts of West Godavari District. The details of the ice plants installed with different capacities throughout the West Godavari district is presented below in Table No: 2.2 and Fig No: 2.2.

Table.2.2 Category Wise Ice Plants in West Godavari district

S. No	Category	Capacity Ranges(TPD)	Bhimavaram cluster	Other Places in District
1	I	<20	11	29
2	II	21-30	8	22
3	III	31-40	45	125
4	IV	>40	16	44
	Total		**80**	**220**

Fig.2.2 Category Wise Ice Plants in West Godavari district



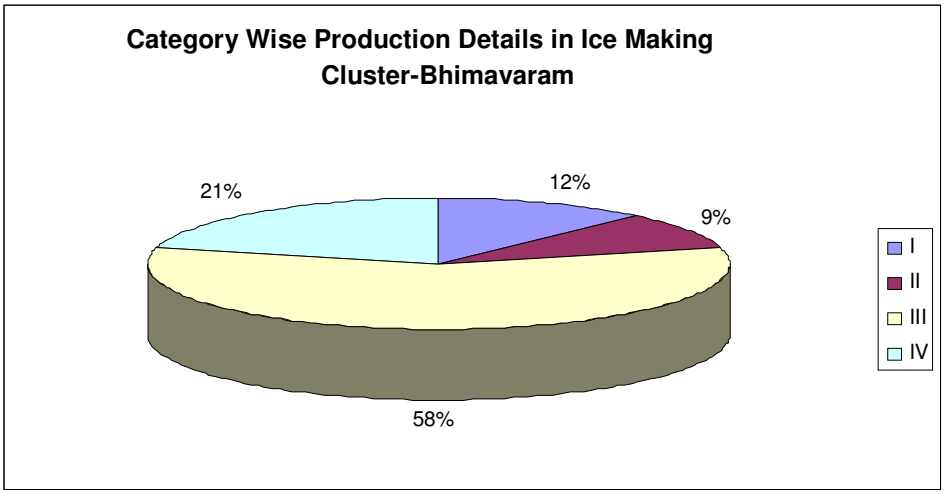
2.2.4 Production, Employment and Turnover

The total Production from these ice plants in the cluster is estimated as below.

Table 2.3: Category wise production and % share

S. No	Category	Capacity Ranges (TPD)	No	Production (TPY)	% Share
1	I	<20	11	46773	12
2	II	21-30	8	32000	9
3	III	31-40	45	217357	58
4	IV	>40	16	80000	21
	Total		80	376131	100

Fig 2.3 Category wise production and % share



The Annual Ice production from the Ice Making cluster is estimated based on the installed capacities and % utilization of plant is 376131 MT. The category-I (i.e 11 plants) contribution 12%, category-II (i.e. 9) plants of contribute 9%, category-III (i.e. 16) plants of contribute 58 %and Category-IV (i.e. 7 plants) adds in a share of 21%. Form the above table and graph it is observed that category-III Type Ice plants contributes maximum share of production in cluster compared to the other existing categories.

Table No: 2.4 Production –Employment –Turnovers

S. No	Details	Unit	Value
1	Total Production	Tons	376131
2	Employment (direct & Indirect)	No	500
3	Turnover(Approx)	Rs. Cr	36

The actual production and turnover is depends up on % utilization and no. of days in operation.

2.2.5 Energy Situation in the cluster (Energy Consumption Pattern of the cluster)

The energy consumption in Ice Making Cluster is mainly in the form of Electrical Energy (Electricity & Electricity from Diesel). The electrical energy is utilized to run the motors, pumps and plant lighting during production process. In all Ice Plants, major energy consumed equipment is mainly Refrigeration compressor motor followed by other motors, pumps and lighting.

2.2.5.1 Type of fuel used and Tariff

The major energy consumption i.e. Electricity in Ice plants is drawn from Andhra Pradesh Eastern Distribution Company limited (APEPDCL) and followed by diesel. Diesel is procured and used from open market to generate Power through DG sets during power off situations from DISCOMS. The details of energy used and the particulars are presented below.

Table No:2.5 Details of Energy Used in Ice Making Cluster

S.No	Particulars	Energy Details	
1	Type of Energy	Electrical	Diesel
2	Source of Energy	APEPDCL	Open Market
3	Type of Connection	LT	DG Sets
4	Category	Type-1	-
5	Tariff	₹3.75/kWh	₹38.90/L

The power tariff from the APEPDCL is ₹ 3.75 per unit (Details of Power tariff from APEPDCL Presented in Annexure) and the price of Diesel in open market is ₹38.90/L (Dec 2010) which is fluctuated time to time by the central govt.

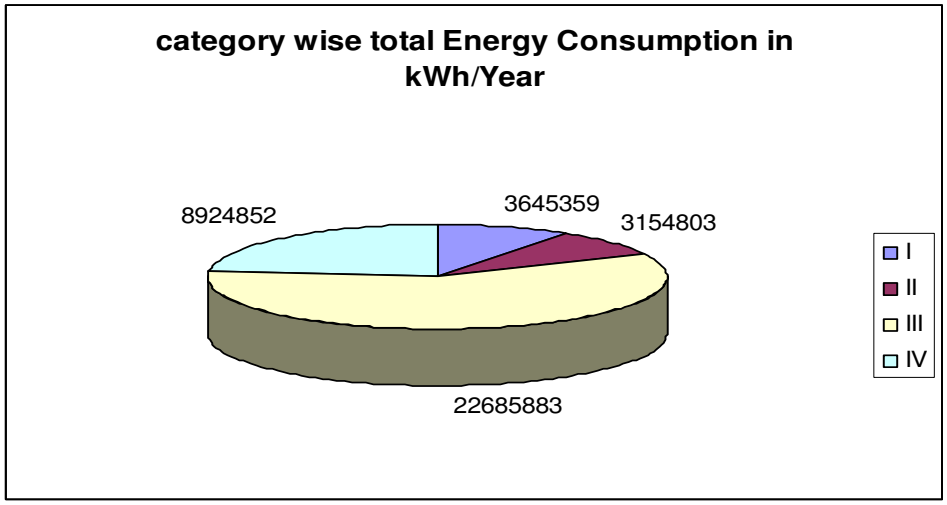
2.2.5.2 Energy Consumption Pattern in different Categories

The Energy consumption pattern in Ice Making Units in Bhimavaram is discussed below. The ice Making Units in Bhimavaram consumes both Electrical Energy and Diesel.

Table No. 2.6: Energy consumption pattern in Ice Making Units-Bhimavaram

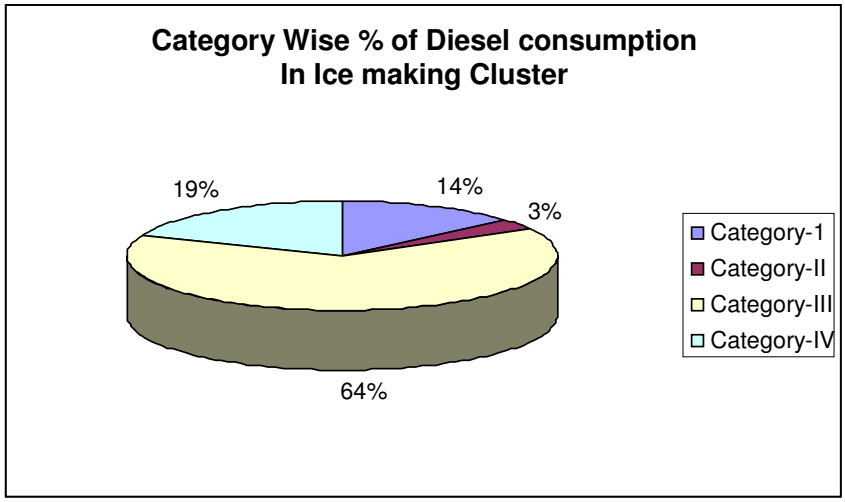
S.No	Category	No. of Units	Electrical Energy (kWh/Year)	Diesel Consumption Ltrs/Year	TOE/ Year
1	Category-1	11	3645359	103097	403
2	Category-II	8	3154803	26170	294
3	Category-III	45	22685883	489577	2380
4	Category-IV	16	8924852	143376	893
	Total	**80**	**38410897**	**762220**	**3971**

Fig No. 2.4: category Wise total Energy Consumption in Ice Making Cluster



The Total Annual Electrical Energy consumption by 80 Ice making plants in the Cluster is 38.41 Million Units. The Total Annual diesel consumption by 80 Ice making plants in Cluster is 762 kL.

Fig No. 2.5: Diesel Consumption in Ice Making Cluster



From the above Table and Fig it is observed that the major energy consumption, diesel consumption is by category –III contributes higher than the other category ice Plants.

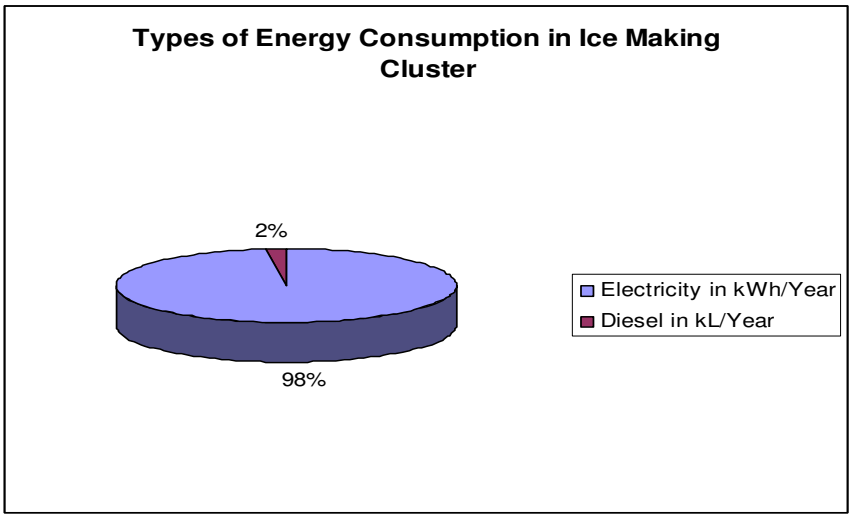
2.2.5.3 Energy Consumption profile in Ice Making Cluster

At the Cluster level energy consumption profile & availability of energy sources is presented in Table No: 2.7.

Table No2.7: Energy Consumption scenarios in Ice Making Cluster-Bhimavaram

S.No	Category	Unit	Quantity /Year	TOE/Year
1	Electricity	kWh	**38410897**	**3302**
2	Diesel	Ltrs	**762220**	**668**

Fig No2.6: Types of Energy Consumption and % in Ice Making Cluster-Bhimavaram



The total energy consumption by the cluster units is 38.41 million kWh/ year which is procured from APEPDCL. The Diesel consumption in Ice making cluster is 762 kL per year which is available and procured from local oil filling stations. The energy consumption and analysis of Ice plants for different categories are presented below.

2.2.5.4 Specific Energy Consumption:

Based on data collected and provided by the Unit Owners in the cluster, the specific energy consumption has been calculated. The details of specific energy consumption per ton of Ice manufactured for each category is presented below.

Table No:2.8 Energy Consumption and Sp. Energy consumption Pattern

S. No	Cate-gory	Capacity Range	No of Units	Energy Consumption		Production (Tons/Year)	Sp. Energy consumption	
				kWh/Year	Diesel Ltrs/Year		kWh/ Ton	TOE/ Ton
1	I	<20TPD	11	3645359	103098	48235	76	120
2	II	21-30 TPD	8	3154803	26171	32000	99	109
3	III	31-40 TPD	45	2.3E+07	489577	215759	105	91
4	IV	>40 TPD	16	8924852	143376	80000	112	90
	Total		**80**	**38410897**	**762222**	**375994**	**98**	**102**

Note: The specific energy consumption in Ice Plant depends up on operational parameters, % Utilization with respect to Installed capacity.

From the Above table it is observed that specific energy consumption by category-I ice plants is 83 kWh/ton and Category-II is 102 kWh/ton, Category-III is 114 kWh/ton and category0-IV is 118 kWh/ton of Ice. The difference of specific energy consumption is due to % utilization of Ice Making Units, Daily Production and Diesel Consumption.

2.3 Production Process in Ice Making

Raw water is pumped from local available water bodies such as pond / stream through raw water pump to overhead tank . This raw water from overhead tank is filled into the ice cans.

The production area of the plant has an Ice tank made of concrete. The ice tank contains the direct expansion coils, equally distributed throughout the tank and these coils are submerged in brine solution. The tank is provided with a suitable frame of hard wood for support the ice cans and a propeller or agitator for keeping the brine in motion: the brine in

the tank acts as a medium of contact only, the ammonia evaporating in the ice coils extracts the heat from the brine, which again absorbs the heat for the water in the cans.

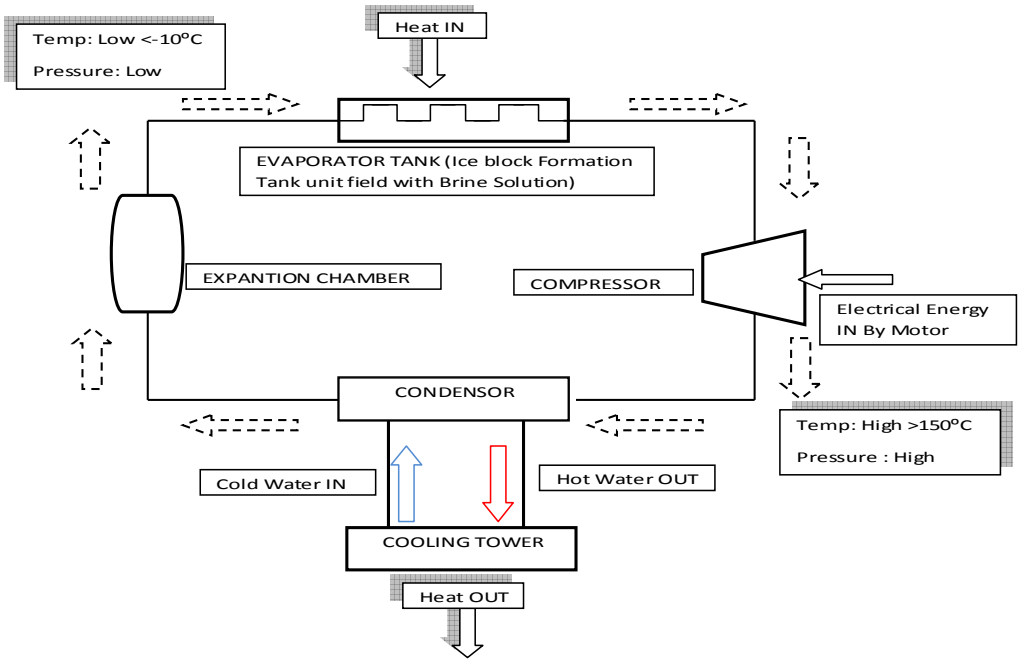
The dimensions of the can and the temperature of the brine are usually selected to give a freezing period of between 30-36 hours. Too rapid freezing results in brittle ice. The Ice block weight is more than 100 kg, depending on requirements. The thicker the block is the longer the freezing time. The size of the tank required is related to the daily production capacity.

Water is chilled for 48 hours for complete ice block formation. The Sp. gravity of brine is maintained at 1180 by adding salt of required quantity. Ice cans of fully formed ice blocks are removed from the chilling tank. The cans are emptied of the ice blocks and replaced into the chilling tank with water for the next batch. The removed ice blocks are further cursed into smaller pieces by ice crushers and loaded into plastic crates for transportation. As shown in Figure 3.1 for ice making by vapor compression cycle it includes the following four main sections:

- Compressor unit.
- Condenser Unit.
- Expansion Unit.
- Evaporator Unit

The Process Flow diagram of Ice manufacturing industry is as follows:

Figure2.7: Process Flow diagram Ice Making Industry



Brief description of the different process involved in the ice making industry is discussed below:-

1. **Compressor unit:** This is composed of a motor and compressor set where the electrical energy is converted to mechanical energy in the form of compression stroke which results in increasing the temperature (greater than 150^{o}C) and high pressure of the refrigerant (NH3)
2. **Condenser Unit:** Here the high temperature refrigerant coming from the condenser unit is allowed to cool down in a heat exchanger by the help of cooling tower. The temperature drops down from 159^{o}C to 40^{o}C.
3. **Expansion Unit:** Here the refrigerant is allowed to expand in the expansion tank, which results in a sudden drop in temperature and pressure. The temperature suddenly drops below (-10^{o}C) which is then fed into the evaporator.
4. **Evaporator tank:** It is a heat exchanger where the heat transfer medium is brine solution, which is field in the tank. This solution is continuously being agitated with an electrical agitator for proper mixing of the temperature. The time cycle for ice formation is around 24 – 36 hours it depends on the system performance of different pants.

The cans are manually or crane lifted and transports to a thawing tank at the end of the freezing tank, where they are submerged in water to release the ice from the moulds. In some cases, it is crushed for packing purposes.

2.4 Current Policies and Initiatives of Local Bodies

The any SME cluster is influenced by the various institutions and cluster actors. The Financial Institutions, Government Institutions and Associations play a major role followed by the Technical Institutions in the cluster. The following institutions are influenced in the Ice making Cluster, Bhimavaram. They are:

- Associations
- Financial Institutions i.e. Banks
- Institutions i.e. District Industries Centre (DIC)

2.4.1 Associations

The Ice making Units is formed an association called “Ice Factory Owners Welfare Association” to solve the issues in the cluster both Industrial and Govt. related. Only one

Association is exists in the Ice Making Cluster, Bhimavaram. The following information gives about the Association in the Cluster.

Table 2.9: Details of Associations in the Ice Making Cluster

S.No	Particulars	Details
1	Name of the Association	West Godavari District Ice Factory Owners Welfare Association
2	Established Year	2005
3	Activities	• Organizing the Industry related Programs • Solving Industrial related to Industry with respect to Govt and Private
3	Association Address	D.No.22 -15-41, Main Road, Bhimavaram
4	Contact Person with details	1.G.Venkata Bhima Raju, Hon. President 984836999
		2. J Subramanaya Raju, President 9849131555

2.4.2 Financial Institutions

In the Ice Making Cluster the following financial Institutions are exists to provide the different loans related to the Industry, salaries, raw material and other services to the Owners, employees.

The following banks are exists in the ice making Cluster to provide the services line loans, working capital and salaries to the employees in the cluster.

- Andhra bank
- Syndicate Bank
- Indian Bank
- State Bank of India
- Vijaya Bank
- UTI Bank
- Indian Overseas Bank

The relation ship among the Ice making Industry owners and the financial institutions are good.

2.4.3 Government Institutions:

The Government institutions play a major role in the cluster from the establishment to the operation of the installed plants. The following institutions play a vital role in the Ice making

cluster, Bhimavaram to register the ice plants and avail different schemes related to the Ice plants.

- Industries Department (District Industries Center)
- Dept of Income Tax
- Dept of Labor
- APEPDCL
- Factories department

2.5 Issues related to Energy Use and Conservation

The following issues are identified while interacting with the Ice plants owners and the other institutions during the technology Audit.

2.5.1 Availability of Electrical Energy:

All the Ice plants required electrical energy to operate the equipments installed in their plants. These ice plants draw electrical energy from the APEPDCL by registering their plants with contract maximum demand. There is shortage of energy supply during the summer season from the APEPDCL. Due to the power off situation in the plants the ice plants owners are utilizing the DG Sets to generate the power and run the equipments.

So far there have not been any issues related to long term failure of power or diesel supply. As the Ice plants are energy dependent, there is a vast opportunity for savings of energy in every Ice Plant operation in various capacities in the cluster. The ice plants are depending on the electricity. In the cluster energy conservation awareness and conscious is required among the Ice plants Owners and operators to conserve the energy. There is huge scope of Energy conservation in the Ice plants by utilizing the energy efficient motors and pumps instead of normal motors, pumps and re winded motors several times.

One more opportunity in the ice making plants is to install the flack ice /cube ice plants where the crushed ice/ domestic requirements. The flack/cube ice plant consumes less energy compare to the block ice plants.

2.5.2 Technological Issues

The other major issue in the Ice Plant is identification of the right technology and equipments based on the requirements in the marketing the finished products from the plant.

In the Ice Plants the ice production is mainly with the operation of compressor and motors and pumps. The ice plant owners in the cluster not aware of energy efficient equipments are neither available nor implemented to their plants. However, the first change is still a challenge, upon success, later on duplication and adaptation is extremely common in the cluster. The technologies need to be demonstrated within the cluster to create awareness. During visits and technology audit in the plant, many plant owners interested to adopt the energy efficient technologies to their plants.

2.5.3 Financial Issues

The plant owners have good contacts with the local banks to avail a loans and other services from the bank based on their transactions with the banks.

Among the SME's, the larger units, if convinced, are capable of either financing themselves or get the finance from their banks. The smaller units will require loan at comfortable rates and other support to raise the loan. However, as most of them have been able to expand their setup and grow, there is a readiness to spend for energy efficiency technologies which have good payback periods. Energy Efficiency Financing Schemes such as that of SIDBI's, if focused on the cluster, will play a catalytic role in implementation of identified energy conservation projects & technologies. The cluster has significant potential of implementing the Energy efficient equipments in the ice plants

2.5.4 Manpower related issues

The Ice plants in Bhimavaram, all the plants required limited skilled and unskilled manpower. But the skilled man power required for training on operation and maintenance of the equipments in the Ice plants.

In Ice making cluster at Bhimavaram, availability of skilled and trained manpower is one of the limitations. Number of Ice plants units has grown fast as compared to the availability of skilled manpower. Few local electrical persons are catering services of electrical equipments during the failure in many ice plants. For major equipments like Refrigeration Compressor, condensers in the plants etc. are maintenance and repair is take care by the equipment suppliers themselves. The units have age-old inefficient practices and well-experienced non-qualified staff in these industries. Even if the qualified staff joins for the sake of experience and jump to other industry after getting sufficient experience this is because of low salaries.

Specialized and focused training of the local service providers on better operation and maintenance of the equipments, importance of the energy and its use and energy

conservation measures will improve awareness among the unit owners and workforce. Original equipment suppliers should also participate in these programs.

2.5.5 Technology and Service Provider related issues

Many of the new technology providers have not shown keen interest for implementation of their new innovative technologies due to higher price by the SMEs in Bhimavaram.

The service providers in the Ice Making Cluster, Bhimavaram are available in the radius of 150 to 200 kms and are mainly from important cities such as Vijaywada and Hyderabad. Bhimavaram is well connected by rail, road, and rail to both cities. Few of the service providers have their activities in Bhimavaram to provide the service to the ice plants. The list of Local Service and Technology providers are presented in the Annexure.

3 ENERGY AUDIT AND TECHNOLOGY ASSESSMENT

3.1 Energy audit and Technology Assessment

The methodology adopted for BEE-SME Cluster program is presented below.

3.1.1 Energy Audit and Technology Assessment in Cluster:

Energy audit is a systematic study or survey to identify how energy is being used in a building, a plant, and identify the energy saving opportunities. Using proper audit methods and equipments, an energy audit provides essential information of energy consumption pattern in each process and how energy being used with in a plant/ industry. This will indicate the performance at the process level or overall plant. Based on information by energy audit, energy manager/ management can compare these performances against past and future levels for proper energy management. The energy audit report contains energy conservation opportunities and energy savings proposals comprising of technical and economic analysis of projects.

The viable energy conservation opportunities and energy saving proposals is then transformed into energy savings projects. It will facilitate the energy manager/management to draw up an action plan listing the projects in order of priority. He will then present it to the organizations management for approval. Providing tangible data enables the management to be at a better position to appreciate and decide on energy efficiency projects. Adopting this activity as a routine or part of the organizations culture gives life to energy management, and controlling the energy use by energy audit is what we refer to as Energy Management by facts.

Pre-Energy Audit Study: The Methodology adopted for pre - energy audit activities is as follows:

- Based on the situation analysis data provided by BEE on Ice making Plants in Bhimavaram, the activities were evolved and planned accordingly. Two to three Ice plants are visited and observed in detail to get deeper understanding of the energy issues in the industry before starting the work.
- Visited and interacted with president and members of the association and get their feedback and views.
- Based on the visit, identified high energy consuming equipments and analyzed ongoing technologies and started identifying gaps at the cluster level.

- Prepared the data collection format for energy audit and its field measurements
- Prepared a list of units to be audited taking care that all types and sizes are covered
- Depending on visit to the three units, started identifying possible energy conservation areas.
- Exclusive allocation of team personnel (who can also speak local language) from our team to work full time to convince the plant owners/persons to get ready for conducting the energy audit Used local maps, books and information provided by association to get further details on the cluster

Preliminary Energy Audit Study: The methodology adopted for Preliminary Energy Audit study in Ice Making Plants Cluster as follows:

- Conducted preliminary study in 30 units
- Collection of the past six month's electrical energy consumption data
- Establishment of the energy consumption scenario at the plant
- Establishment of the benchmarks of specific energy consumption of typical equipments wherever possible
- Study and Identification of major energy consuming sections and equipments for further work on identification of energy conservation opportunities
- Detailing of no cost and low cost saving measures at the plant.
- Identification of the areas for detailed study and listing the measurements required
- Modified previous formats for data collection and measurements and finalized for detail energy audit study

3.1.2 Detailed Energy Audit Study: The methodology adopted for Detail Energy Audit study in Ice Making Cluster as follows:

- Conducted detailed energy study in 30 units
- Detail observations on the equipments in terms of their functions, energy requirements
- Electrical measurements on the electrical equipments by Load Analyzer which includes the measurement of Voltage, Current, kWh, PF and harmonics percentage each major equipments such as motors and pumps and agitator.
- Performance evaluation and efficiency of refrigeration system conducted by taking the measurements like COP,EER etc.
- Calculated energy balance and Specific Energy Consumption at plant level and process level

- Carried out all the required measurements to quantify specific energy consumption of electrical and thermal energy at each of the major process - i.e. kWh/MT of ice
- Identification of alternative lower energy consumption or energy cost options for same process in the industry
- Analyzed the saving potential and investment required accordingly prioritized the measures and identified 15 technologies for preparation of DPR's

Benefits of Energy Audit: Detailed Energy audits in cluster indicate massive potential for energy savings in every sub-sector of industry with an average of almost ten percent of the energy usage. However, this can only materialize through replication in other factories within the respective industry sub-sector.

The results are bound to create a positive impact to the industries as well as the national economy and the environment. By saving energy in industries can reduce the emission of Green House Gases (GHG) into the atmosphere.

Technical Audits (Methodology): The following methodology has been adopted for conducting technical audit:

- Conducted technical energy study in 20 units
- Identify major equipments and technologies of the plant
- Whether the equipments installed are local make or reputed company make
- Various energy sources available in the cluster
- Energy use and specific energy consumption details
- Identify major constraints for installing energy efficient equipments
- Whether energy efficient equipment suppliers are available locally and identify the suppliers
- The strategy followed for selection of equipment suppliers by the management
- Any research or survey carried out prior to selection of the technologies adopted and available
- Discussions made with management of adopting new technologies for efficiency improvement
- Financial strength and investment that can be made for the improvement of energy efficiency by the plant management

3.2 Observations made during energy use and Technology Audit

The following Observations are made during the Energy Use and Technology Audit conducted in Ice making cluster, Bhimavaram.

3.2.1 Technology/Equipments Employed in Manufacturing Process

The manufacturing processes involved in all Ice making Plants are same. The installed capacities are based on capacity of equipments/ size of cooling bed etc. The lists of major equipments employed in Ice Plants are as follows.

- Refrigeration Compressor and Motor
- Evaporator (Cooling Bed)
- Compressor and Condenser Cooling water Pump
- Raw Water Pump
- Agitators

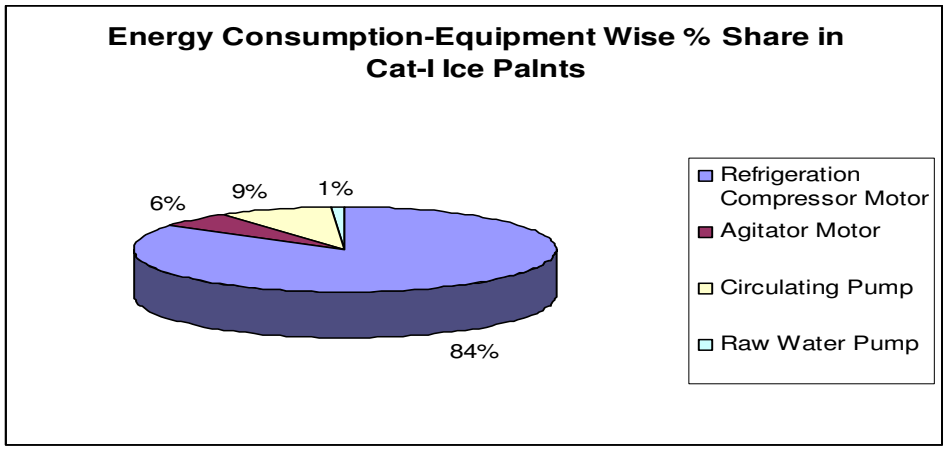
3.2.2 Energy Consumption and Availability

3.2.2.1 Energy Consumption by Category –I Ice Plants: The energy consumption pattern of Category-I Ice plants i.e. 11 Plants for major equipments are presented below. The major energy consumption of ice plant is mainly on compressor and followed by pumps and motors.

Table No3.1: Energy Consumption and Profile of Category-I Type Ice Plants

S.No	Process Equipment/Machinery	Consumption Units (kWh/Year)	%
1	Refrigeration Compressor Motor	3265218	84
2	Agitator Motor	224730	6
3	Circulating Pump	336006	9
4	Raw Water Pump	39842	1
	Total	**3865796**	**100**

Fig No3.1: Energy Consumption and Profile of Category-I Type Ice Plants



The total energy consumption by category –I Ice Plants i.e. 11 Plants is 3.86 million kWh/ year. From the above table it is observed that the major energy consumption by the Compressor motor consumes 84 % of the total energy consumed and followed by circulating pump, raw water pump and agitator with 6%, 9% and 1% respectively.

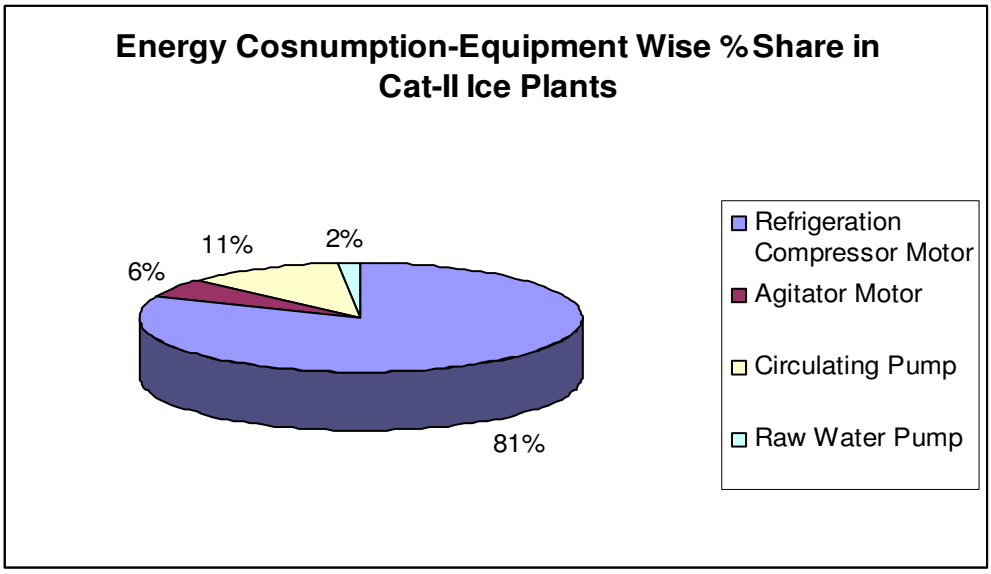
3.2.2.2 Energy Consumption by Category –II Ice Plants

The energy consumption pattern of Category-II Ice plants i.e. 8 Plants for major equipments are presented below. The major energy consumption of ice plant is mainly on compressor and followed by pumps and motors.

Table No3.2: Energy Consumption and Profile of Category-II Type Ice Plants

S.No	Process Equipment/Machinery	Consumption Units (kWh/Year)	%
1	Refrigeration Compressor Motor	2385344	81
2	Agitator Motor	162624	6
3	Circulating Pump	333888	11
4	Raw Water Pump	49336	2
	Total	**2931192**	**100**

Fig No3.2: Energy Consumption and Profile of Category-II Type Ice Plants



The total energy consumption by category –II Ice Plants i.e. 8 Plants is 2.93 million kWh/ year. From the above table it is observed that the major energy consumption by the Compressor motor consumes 81 % of the total energy consumed and followed by circulating pump, raw water pump and agitator with 6%,11% and 2% respectively.

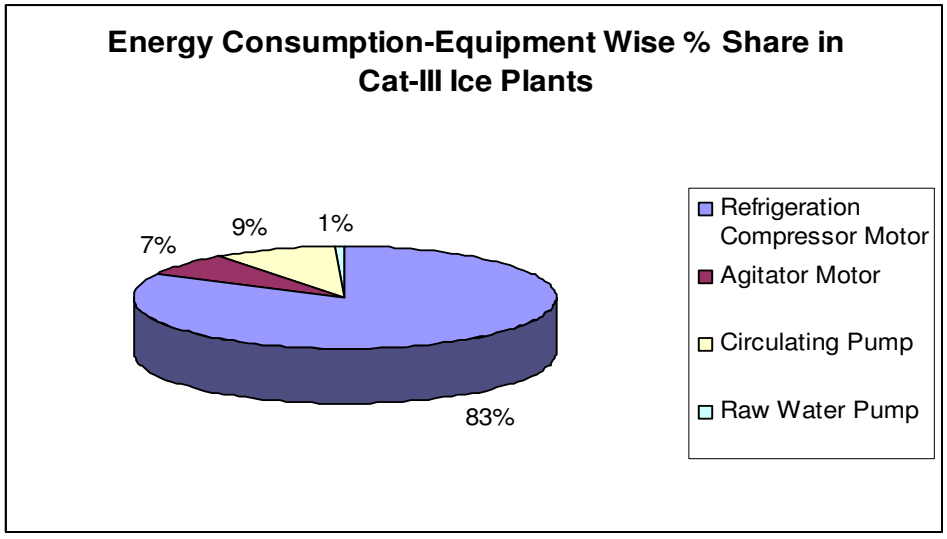
3.2.2.3 Energy Consumption by Category –III Ice Plants:

The energy consumption pattern of Category-III Ice plants i.e. 45 Plants for major equipments are presented below. The major energy consumption of ice plant is mainly on compressor and followed by pumps and motors.

Table No 3.3: Energy Consumption and Profile of Category-III Type Ice Plants

S.No	Process Equipment/Machinery	Consumption Units (kWh/Year)	%
1	Refrigeration Compressor Motor	14247233	82
2	Agitator Motor	1246638	7
3	Circulating Pump	1629396	9
4	Raw Water Pump	158445	1
	Total	**17281712**	**100**

Fig No3.3: Energy Consumption and Profile of Category-III Type Ice Plants



The total energy consumption by category –III Ice Plants i.e. 45 Plants is 17.28 million kWh/ year. From the above table it is observed that the major energy consumption by the Compressor motor consumes 82 % of the total energy consumed and followed by circulating pump, raw water pump and agitator with 7%,9% and 1% respectively.

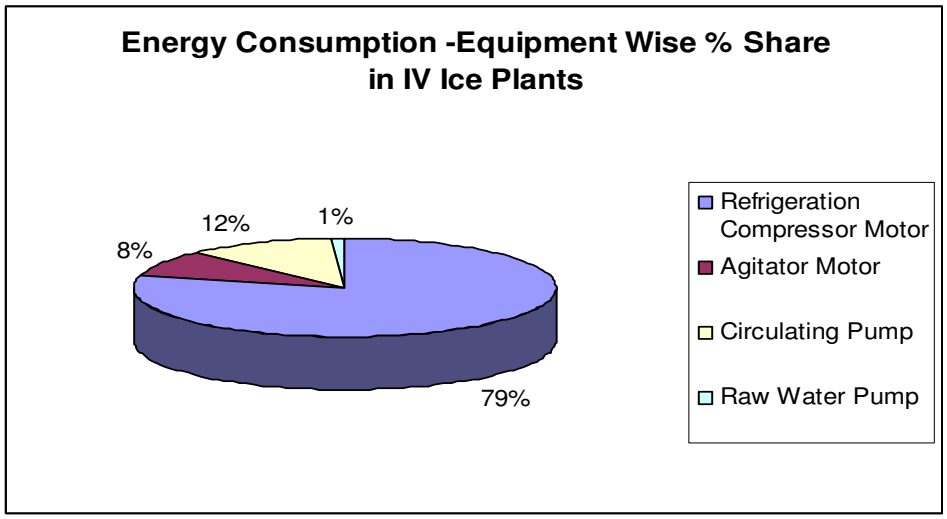
3.2.2.4 Energy Consumption by Category –IV Ice Plants

The energy consumption pattern of Category-IV Ice plants i.e. 16 Plants for major equipments are presented below. The major energy consumption of ice plant is mainly on compressor and followed by pumps and motors.

Table No3.4: Energy Consumption and Profile of Category-IV Type Ice Plants

S.No	Process Equipment/Machinery	Consumption Units (kWh/Year)	%
1	Refrigeration Compressor Motor	4430784	79
2	Agitator Motor	462336	8
3	Circulating Pump	643200	12
4	Raw Water Pump	56256	1
	Total	**5592576**	**100**

Fig No3.4: Energy Consumption and Profile of Category-IV Type Ice Plants



The total energy consumption by category –IV Ice Plants i.e. 11Plants is 5.59 million kWh/ year. From the above table it is observed that the major energy consumption by the Compressor motor consumes 79 % of the total energy consumed and followed by circulating pump, raw water pump and agitator with 8%, 12% and 1% respectively.

Note: The energy consumption in ice plant depends upon operating hours, equipment efficiency and % utilization of the plant.

3.2.3 Availability

At the cluster level, the total energy consumption by ice plants and availability of energy is assed based on information collected in the cluster. **Table 3.5**. give about the total energy consumption details and availability of energy is presented below.

Table 3.5: Energy Consumption and Availability in Cluster

S.No	Category	Unit	Quantity /Year	Availability
1	Electricity	kWh	**38410897**	Available from APEPDCL
2	Diesel	Ltrs	**762220**	Available from Oil Companies

The total Electrical energy consumption by the cluster units per annum is 38.41 Million kWh and the power tariff is ₹3.75 /kWh which is procured from the APEPDCL. The diesel requirement is 762 kL and the cost is ₹38.90 /liter.

3.2.4 Capacity Utilization Factor

The Capacity utilization factor at the plant level and at the equipment level is described below.

- **Plant Level**

The capacity utilization in the Ice plants located in Bhimavaram is depends upon the market requirements of Prawn Export. Based on market requirements the formed ice is removed from the cans and market it. The only empty cans are filled with raw water. If the Market is low the formed ice in the cans are not removed and the plant is not operated fully.

- **Equipments Level**

The equipments in the Ice plant is mainly Refrigeration Compressor, Condenser Water Pump (Optional), Raw Water Pump and Agitator. The main equipment in the Ice plant is Refrigeration motor. The Ice production mainly depends upon the no of stages operation of the Refrigeration compressor Pistons. If one or Two compressor pistons stopped that means the ice formation is required in only few Ice cans and other Ice cans filled with Ice formation.

3.2.5 Good house Keeping and Miscellaneous

The others factors which will influence the higher energy consumption in Ice making plants are as below.

Leakages: Ensure to refrigerant in process should not leak from the pipes and compressors and other parts in process.

Refrigeration Compressors: check the refrigerant charge and seals regularly for correct charging and leaks during the process. This will help to arrest refrigerants leaks during process and improve the refrigeration effect in Ice plant.

Others: Insulation in pipes is one of the energy saving option to reduce the energy loss during the process. Proper insulation to the pipes at evaporation inlet and out let will increase the refrigerant effect.

3.2.6 Data and Information availability

The availability of data and information pertaining to energy procurement and consumption is available in some of the cluster units. However the production data is not available as it is kept confidential.

3.2.7 Any other aspects

Majority of the machine operators and helpers deployed in the cluster units are non technical and illiterates and had been taken based on the past experience and do not have any technical skills and knowledge on energy conservation. This is also one of factor for the inefficiency of the process and energy losses.

3.3. Technology Gap Analysis in Ice Making Plants

All the Ice Making plants in the Cluster are using the Same Refrigeration Compressors with different installed Capacities. The specific energy consumption is varies and it was above the manufactures specifications. This is due to the operation of the compressors, motors and pumps. Various technological gaps were identified in the units and these may be due to lack of awareness of technologies available in the market, lack of knowledge in tapping the potential from saving of energy losses and its monetary benefit, lack of awareness among the workforce.

Thus, the study has found small changes in equipments and lighting system required to be introduced in the cluster. It requires only a retrofit of equipments to the existing machinery so as to make energy consuming components of the machinery efficient and also use of automatic to ensure precise process control. In the Ice Making Units in Bhimavaram the following Technology Gaps are identified during the Technology and Energy Audit.

3.3.1 Technology up gradation

There is a tremendous need for the industry to modernize/upgrade its technology and adopt energy efficient technologies in some of the areas. Further, as per the discussions made with the management, they are interested to adopt the energy efficient motors in their Ice Plants. The sector also faces deficiencies such as the lack of access to technology and technology sharing and the inadequacies of strong organizational structure, professional attitude etc. There are many technologies and energy efficient equipments available in the market which can be sourced from local service providers dealing in these technologies.

3.3.2 Technology Gaps

The difference in existing technology and the technology as needed to improve the energy efficiency in the units is discussed here. The gap between the supply and pull of technology has to be reduced through the linkages of local service providers in terms of energy efficient systems in the units.

Energy Efficient Motors: Motors are installed in the Ice plants to operate the Refrigeration compressors and agitators. Based on detailed studies in the Ice Plants, all the motors in the compressors are inefficient which found between 75-90% operating Efficiency and few motors are several times re winded. The reasons for such low efficiencies are mainly, low loading of the compressor due to less amount of Ice formation and low efficiency of motors.

Now a days energy efficient motors are available at least 95 % of efficiency in the market with latest technology. By implementing the energy efficient motors in the compressors, agitators there will be tremendous energy savings in the Ice plants due to continuous operation of compressors and agitators in the Ice plants.

Energy Efficient Water Pumps: Water pumps are required to pump the raw after into the Ice cans for the formation of the Ice and also Compressor Cooling. The compressor cooling required continuously while refrigeration is in operation and Raw Water pump will operate during the filling of the Ice cans. During the study of the water pumps, it is observed that the efficiency of the Water pump and motor is very low in some Ice plants and in some ice plants the pump are installed at over sized. To over come the efficiency of the pumps and motors it is required to install the energy efficient pumps which have more that 30% efficiency compare to the present pumps. This will help to reduce the energy consumption in the ice plants.

Tube Ice Plants: Few Ice Plants are using the Ice Crushers to crush the Ice into pieces as per client requirements. It is essential to install the Ice Crusher in the Ice plants. The Block Ice having the Specific Energy consumption is very high compare to the tube ice plants even though as per the manufacturers specifications. The tube ice plants specific energy consumption in the range of 55-60 kWh/Ton which comparatively very low as bloc Ice plants which have the specific energy consumption i.e. 80-85 kWh/Ton. It is best suited to install the tube Ice plants in the Cluster to minimize the energy loss. These tube Ice plants can install where the Block Ice is required to cut in to pieces.

Energy Efficient Lighting System: In the Ice Plants runs through out the day in operation requires illumination in the night times and also in few plants requires day time also. Majority of the Ice plants are utilizing the Conventional tube lights in their plants. The conventional tube lights have 52 W capacities.

At present scenario in the Lighting system, energy efficient lighting systems are available with low energy consumption with better illumination levels. By adopting the Energy Efficient

systems in the ice plants, longer life of the lights, better illumination and energy savings is possible in the Ice plants.

3.4 Energy Conservation measures

3.4.1 Install Energy Efficient Motor for Refrigeration Compressor

Installation of Energy Efficient Motor is one of the Technology/equipment identified in Ice Making Cluster, Bhimavaram to reduce energy consumption in Ice plants. The major energy consumed in all the Ice plants is by compressor motor. The details of Technical and Financial viability of replacing energy efficient compressor motor with existing inefficient motor in Ice making cluster at Bhimavaram is discussed below.

Background

All Ice plants require motor to operate Refrigeration compressor to compress the refrigerant. The compressor motor operated continuously till Ice formed. The major energy/power consumption in Ice plant is depends on compressor motor which having higher capacity. If compressor motor has higher efficiency at full and part load conditions, the total power consumption and specific energy consumption in Ice plant will be reduced.

During the energy use and technology audit in ice plants in Bhimavaram, many compressor Motors are inefficient and several times re winded. Due to the reason power consumption and specific energy consumption in ice making plants are high compared to the bench mark of manufacturer specifications. The efficiency of Motor is lower compare to Energy Efficient Motor (EEF1). By installing Energy Efficient Motor in compressor will result considerable energy savings and there by reduction in production cos

Energy Conservation Potential

The Energy Efficient Motor (EEF1) has higher efficiency while operating in part and full load conditions comparing with inefficient or EEF2 motor. The efficiency of EEF1 i.e.93.9% than that of normal motor i.e.85-90%. If the efficiency of motor increases, power consumption will reduce at both part and full load conditions. By installing energy efficient compressor motor in ice plants at least 10% energy savings can achieve during the plant operation.

Technical Specifications

The proposed Energy conservation in Ice plant by installing 60HP Energy Efficient compressor motor with inefficient /re winded motor is considered.

The Technical Specification of proposed energy efficient 60 HP compressor motor is presented below.

Table: 3.6 Technical Specifications of Energy Efficient Motors for Compressors

S.No	Parameter	Unit	Value
1	Capacity of Motor	HP	60
2	Type of Motor	Name	Induction
3	Motor power	kW	45
4	Rated Current	A	77
5	Voltage	V	415
6	PF	%	0.87
7	Frequency	Hz	50
8	Efficiency at ½ Load	%	92
9	Efficiency at ¾ Load	%	93.9
10	Efficiency at full load	%	93.9

Fig No 3.5 Energy Efficient Compressor Motors

It is observed that the efficiency of the energy efficient compressor motor has higher efficiency compared to the existing motor in the cluster.

Availability of Technology /Equipment

The Energy Efficient Motors are available and manufacturing in India by the few major companies. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad, Vijayawada and few in Bhimavaram. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad/Bhimavaram by ordering. The details of manufacturers and suppliers marketing these energy efficient motors are presented in Annexure-2.

Cost Benefit Analysis

Any Energy conservation proposal/project requires cost benefit analysis to implement in industries. Based on observations and measurements taken from ice plants, Cost benefit analysis for replacing energy efficient compressor motor with existing inefficient / re winded motor in Ice Making plants are evaluated and presented below.

Table 3.7 Cost Benefit Analysis for EE Motors for Compressors

S. No	Parameter	Unit	Existing Motor	New motor
1	Capacity of Motor	HP	60	60
2	Capacity of Motor	kW	44.76	44.76
3	Measured power by old motor	kW	41.96	38.13
4	Efficiency of the motor	%	90.5	93.4
5	Loading	%	76%	76%
6	No of Working Hours	hr/day	24	24
7	No. of Working Days	days/year	300	300
8	Total Energy Consumption by Motor	kWh/Year	272160	263710
9	Power Saved by New Motor	kW	1.54	
10	Energy Savings by New motor	kWh/Year	8450	
11	Energy cost	Rs./kWh	3.75	
12	Cost of Energy Saving due to New EE Motor	Rs/Year	31687	
13	Investment cost	Rs	137811	
14	Payback Period	Years	4.3	

From the above table, by replacing 60 HP energy efficient compressor motor with existing 60 HP inefficient/ re winded motor, total energy savings in Ice plant is 8450 kWh/ year and savings in power bill will be Rs.0.31 Lakhs /year. The total investment required to implement the EEF1 motor is Rs.1.37 Lakhs and pay back period will be with in 4.3 years. The energy savings and payback period will be varying with capacity of energy efficient compressor motor installed with replacing existing motor capacity.

Life Cycle Cost

The Life Cycle Cost of Energy Efficient Motor (EEF1) is evaluated based on operating parameters and life of motor. The following table provides details of life cycle cost of energy efficient compressor motor (EEF1).

Table 3.8 Life Cycle Cost of EE motors

S.No	Particulars	Units	Value
1	Capacity of Motor	HP	60
2	Efficiency of motor	%	93.9

S.No	Particulars	Units	Value
3	No of Working hours	Hr/day	24
4	No of Days	Days/Year	350
5	Capital Cost	Rs	137811
6	Annual Maintenance	Rs	5000
7	Life of Motor	Years	15
8	Interest rate	%	10
9	LCC at the end of life	Rs	179483

The life cycle cost of 60HP energy efficient compressor motor will be Rs.1.79 lakhs

Implementation Cost

Another parameter for implementation of Energy conservation proposals/project is implementation cost. The implementation cost of the energy conservation project will be depending up on erection, civil works, retrofitting costs etc.

The cost implementation for installing 60 HP capacity of Energy Efficient Motor (EEF1) in ice plant is calculated based on operating parameters like erecting, replacement and civil works. The implementation cost of replacing EEF1 motor with inefficient and re winded Motor are presented below.

Table 3.9 Implementation Cost of EE motors for Compressors

S. No	Parameter	Unit	Values in lakhs	
1	Capacity of motor	HP	60	150
2	Cost of Equipment	Rs	1.38	3.15
3	Civil Works	Rs	0.01	0.03
4	Electrical works	Rs	0.03	0.06
5	Erection and Commissioning	Rs	0.07	0.16
6	Miscellaneous costs	Rs	0.03	0.06
	Total Cost	**Rs**	**1.52**	**3.47**

Based on above information, the implementation cost of 60 HP Energy Efficient Motor will be Rs.1.52 Lakhs for Ice making plant.

Recommendations

Major ice plants installed with inefficient Motor at the time of Ice plant installation and some of units used re winded Motor several times. In such units can opt for implementing energy efficient compressor motor to their Ice plants. The time required to install or replace with EEF1 motor in the ice plant is with in a week and the energy savings will be while in

operation. The identified Energy Efficient Motor (EEF1) can be use in different categories Ice plants in the cluster depending upon motor capacity required.

Benefits

The following benefits can be expected while installing Energy Efficient Motor with the existing the normal efficient motor /re winded motor.

- Less Maintenance Cost
- Low Running Cost
- Reduction in Energy consumption
- Less break downs
- Reduction in energy consumption leads to reduce the GHG emissions

Limitations

There is no limitation to replace Energy Efficient Motor (EEF1) with the existing inefficient and re winded Motor.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.4.2 Install Energy Efficient Raw Water pump for Raw Water Pumping Applications

Energy Efficient pump is one of the Technology/equipment identified in Ice Making Cluster, Bhimavaram. The efficiency and performance of energy efficient pumps have higher than the normal pump sets. The details of Techno Financial viability, life cost and implementation cost to replace energy efficient pumps with existing inefficient pumps in the Ice making plants in Bhimavaram is discussed below.

Background

All Ice plants require raw water to fill in ice cans used in Ice making Cluster. Raw water is pumped from nearby ponds in Ice making plants. The capacity and type of pump required in ice plants depends on type of use, head and flow required. As per the study in Ice making cluster, Bhimavaram observed that rated capacity is high in some ice plants and efficiency, performance of both motor and pump is low. Due to oversized and inefficient pump and motor results higher power consumption compare to energy efficient water pumps available. By installing energy efficient water pump in ice making plants will result considerable energy savings during plant operation.

Energy Conservation Potential

The energy efficient pumps have higher efficiency in both motors and pumps during the operation compare with normal pumps and motors. The overall efficiency of energy efficient water pump sets is ranging from 50-55% compare to existing pumps sets efficiency 26-28%. To correct the capacity and improve the efficiency of pump sets in ice making plants in Bhimavaram results energy savings in that plants.

Technical Specifications

The proposed Energy conservation in Ice plant by installing 1.5 HP Energy Efficient pump with 3 HP existing pump due to inefficient/ oversized is considered. The Technical Specification of proposed energy efficient pumps with capacity of 3HP pump to implement in Ice making cluster is presented below.

Table: 3.10 Technical Specifications of Energy Efficient pump – (Mono-block)

S. No	Parameter	Unit	Value
1	Type of Pump	Name	Mono-Block
2	Phase		3
3	Rated Flow	M3/hr	26.28
4	Head	M	7
5	Motor Capacity	HP	1.5
6	Speed	Rpm	2900

Fig.3.6 Energy Efficient pump for Raw water Applications-(Mono-block)

The over all efficiency of pump set will be in the range of 50-55% compare to the existing pump set efficiency of 26-28% and the flow and head for energy efficient pump will be higher than the existing pump.

Availability of technology /equipment

The Energy Efficient pumps are available and manufacturing in India and Andhra Pradesh by the few major companies. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad, Vijayawada and few in Bhimavaram. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad/Bhimavaram by ordering. The details of manufacturers and suppliers marketing these pumps are presented in Annexure-2.

Cost Benefit Analysis

Another factor for any implementing Energy Conservation proposal is Cost benefit analysis. The cost benefit analysis of installing energy efficient pump with existing normal or over sized pumps in Ice Making plants are presented below for raw water applications.

Table 3.11 Cost Benefit Analysis of Energy Efficient Raw water Applications

S.No	Particulars	Unit	Old Pump	New Pump
1	Motor capacity	HP	3	1.5
2	Motor capacity	kW	2.2	1.21
3	Pump Head	M	10	10
4	Flow measured	M3/hr	21.6	21.6
5	No of Hours	hrs/day	4	4
6	No of Days	Days/year	300	300
7	Efficiency of Pump set	%	28	50
8	power savings	kW	0.79	
9	Power tariff	Rs./kWh	3.75	
10	power savings	kWh/Year	951	
11	Total Cost of Energy saved	Rs/year	3564	
12	Investment cost	Rs	10000	
13	Payback Period	Year	2.81	

From the above table it is observed that replacing 1.5 HP energy efficient pumps with existing 3 HP normal pump sets for raw water , the total energy savings is 951 kWh/ year and reduction in power bill will be Rs. 3564 /year.

The total investment required for install efficient pump in Ice plant is Rs. 10,000 and the pay back period will be with in the 2.81 years. The energy savings and payback period will be varying with capacity of energy efficient pump installed with replacing existing pump capacity.

Life Cycle Cost

The Life Cycle Cost of Energy Efficient Pump is evaluated based on operating parameters and life of pump. The following table provides details of life cycle cost of energy efficient pump.

Table 3.12 Life Cycle Cost of Energy Efficient Raw water Applications

S.No	Particulars	Units	Value
1	capacity of Pump motor	HP	1.5
2	Head	M	7
3	Flow	m3/hr	26.28
4	Overall efficiency of pump	%	50
5	No of hours operation	hr/day	4
6	No of days	Days/Year	300
7	Capital Cost	Rs	10000
8	Annual maintenance	Rs	2000
9	Life of Pump	Years	10
10	Interest rate	%	10
11	LCC at the end of life	Rs	14000

It is observed that the life cycle cost of energy efficient pump for 1.5 HP pump capacity will be Rs.14,000.

Implementation Cost

Another major parameter for implementation of Energy conservation proposals/project is implementation cost. The implementation cost of energy conservation project will be depending up on erection, civil works and retrofitting cost etc.

The cost of implementation for installing 1.5 HP capacity of Energy Efficient Pump in ice plant is calculated based on operating parameters like erecting, replacement and civil works. The implementation cost of installing energy efficient pump with inefficient and oversized pump is presented below.

Table 3.13 Implementation Cost of Energy Efficient Raw water Applications

S.No	Parameter	Unit	Values
1	Capacity of motor	HP	1.5
2	Cost of Equipment	Rs	10000
3	Civil Works	Rs	1000
4	Electrical works	Rs	1000
5	Erection and Commissioning	Rs	2500
6	Miscellaneous costs	Rs	1000
	Total Cost	**Rs**	**15500**

Based on above information, the implementation cost of 1.5 HP Energy Efficient pump will be Rs.15,500 for Ice making plant.

Recommendations

Major ice plants installed with inefficient pumps and oversized capacity at the time of Ice plant installation raw water applications. In such Ice plants can opt for implementing energy efficient pumps to save energy. The time required installing or replacing efficient water pump with inefficient or oversized pump is with in a week and energy savings will be while in operation. The identified energy efficient pump used for different categories Ice plants in the cluster depending upon the pump capacity required.

Benefits

The following benefits can be expected while installing Energy Efficient pumps with existing normal pump or over sized pump. They are

- Zero Maintenance
- Less Running Cost
- Optimum rate of flow
- Reduce energy consumption
- Reduction in energy consumption leads to reduce the GHG emissions

Limitations

There is no limitation to replace Energy Efficient pumps with existing over sized / inefficient pumps.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.4.3 Install Energy Efficient pump for Water Circulation for Condenser and compressor cooling

Energy Efficient pump for condenser cooling is one of the Technology/equipment identified in Ice Making Cluster, Bhimavaram. The efficiency and performance of energy efficient pumps have higher than normal pump sets. The details of Techno Financial viability, life cost and implementation cost for replacing energy efficient pumps with existing inefficient pumps in the Ice making plants in Bhimavaram is discussed below. The energy efficient

pump required for this application is mono block type, which have higher efficiency with higher heads.

Background

All Ice plants in Bhimavaram cluster using ammonia as a refrigerant in Ice making. These ice plants used refrigeration compressor to compress the refrigerant. During the compression, heat is evolved and dissipated in piston walls. This deposited heat is required for efficient operation of compressor. Almost all refrigerant compressors are water cooled compressor and essential to cool the compressor during the operation. Water pump is required to supply cool water to the compressor for cool the compressor.

Energy Conservation Potential

The compressors in Ice making units run continuously throughout day till ice formed. The heat generated during the operation of compressor should cool by supplying cool water in water jackets provided in compressor. The capacity of the pump required for compressor cooling is 3HP. It also depends up on head and quantity of flow required for compressor. The cool water is supplied through mono block water pump installed in the plant. Due to continue operation of pump for compressor, it is essential mach the capacity and efficiency to minimize the power consumption. During the study in Ice making plants in Bhimavaram, most of ice plants are used oversized and inefficient pumps for the operation.

By adopting energy efficient pumps in condenser cooling system, there will be considerable energy savings. The motor efficiency increases, the power consumption will reduce which leads to the power savings.

Technical Specifications

The proposed Energy conservation in Ice plant by installing 3 HP Energy Efficient with 3HP inefficient water pump is considered. The Technical Specification of proposed energy efficient pump for condenser cooling with capacity of 3HP pump to implement in Ice making cluster is presented below.

Table: 3.14 Technical Specifications of EE Pump for Condenser Pump

S. No	Parameter	Unit	Value
1	Type of Pump	Name	Mono block-horizontal
2	Phase		3
3	Rated Flow	M3/hr	39.6
4	Head	M	10

S. No	Parameter	Unit	Value
5	Type of Motor		TEFC Sq. Cage motor
6	Motor Capacity	HP	3
7	Speed	Rpm	2900

Fig 3.7 Energy Efficient Water Pumps-Mono block

The over all efficiency of pump set will be in the range of 53-58% compare to the existing pump set efficiency of 32-36% and the flow and head for energy efficient pump will be higher than the existing pump.

Availability

The Energy Efficient pumps are available and manufacturing in India and Andhra Pradesh by the few major companies. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad, Vijayawada and few in Bhimavaram. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad/Bhimavaram by ordering. The details of manufacturers and suppliers marketing these pumps are presented in Annexure-2.

Cost Benefit Analysis

Another factor for any implementing Energy Conservation proposal is Cost benefit analysis. The cost benefit analysis of installing energy efficient pump with existing normal or over sized pumps in Ice Making plants are presented below for compressor cooling applications.

Table 3.15 Cost Benefit Analysis of Energy Efficient Pump for Condenser Cooling

S.No	Parameter	Unit	Old Pump	New Pump
1	Motor capacity	HP	5.0	3.0
2	Motor capacity	kW	3.7	2.2
3	Head	mH	14	14
4	Flow measured	LPS	7	7
5	Flow measured	cum/hr	25.2	25.2

S.No	Parameter	Unit	Old Pump	New Pump
6	Efficiency of motor	%	87	87
7	Constant		367	367
8	Water power	kW	0.96	0.96
9	Efficiency of Pump & Motor	%	34.33	52.00
10	Efficiency of Pump	%	39.46	59.77
11	Power Consumption of pump	kW	2.8	2.05
12	Hours of operation	hr/day	24	24
13	No of Days	Days/Year	300	300
14	Power Savings	kW	0.75	
15	Energy Savings	kWh/Year	5371	
16	Power Cost	Rs/kWh	3.75	
17	Energy savings Cost	Rs/Year	20140	
18	Investment	Rs	12000	
19	Payback period	Years	0.60	

From above table it is observed that replacing 3 HP energy efficient pumps with existing 5 HP old and re winded pump set in condenser cooling, the total energy savings is 5371 kWh/ year and reduction in power bill will be Rs. 20140 /year. The total investment required for install efficient pump in Ice plant is Rs. 0.12 lakhs and the pay back period will be with in the 0.6 years. The energy savings and payback period will be varying with capacity of energy efficient pump installed with replacing existing pump capacity.

Life Cycle Cost

The Life Cycle Cost of Energy Efficient Pump is evaluated based on operating parameters and life of pump. The following table provides details of life cycle cost of energy efficient pump.

Table 3.16 Life Cycle Cost of Energy Efficient Pump for Condenser Cooling

S.No	Particulars	Units	Value
1	Capacity of Pump	HP	3
2	Head	M	19
3	Flow	m3/hr	25
4	Overall Efficiency of pump	%	55
5	No of hours Working	hrs/day	24
6	No of days	Days/Year	300
7	Capital Cost	Rs	12000
8	Annual maintenance cost for annum	Rs	600
9	Life of pump	Years	10
10	Interest rate	%	10
11	LCC at the end of life	Rs	13,860

It is observed that the life cycle cost of energy efficient pump for 3 HP pump capacity will be Rs.13,860

Implementation Cost

Another major parameter for implementation of Energy conservation proposals/project is implementation cost. The implementation cost of energy conservation project will be depending up on erection, civil works and retrofitting cost etc.

The cost of implementation for installing 3HP capacity of Energy Efficient Pump in ice plant for compressor cooling is calculated based on operating parameters like erecting, replacement and civil works. The implementation cost of installing energy efficient pump with inefficient and oversized pump is presented below.

Table 3.17 Implementation Cost of Energy Efficient Pump for Condenser Cooling

S.No	Parameter	Unit	Values
1	Capacity of motor	HP	3
2	Cost of Equipment	Rs	12000
3	Civil Works	Rs	600
4	Electrical works	Rs	600
5	Erection and Commissioning	Rs	1200
6	Miscellaneous costs	Rs	500
	Total Cost	**Rs**	**14,900**

Based on above information, the implementation cost of 3HP Energy Efficient pump will be Rs.14,900 for Ice making plant.

Recommendations

Major ice plants installed with inefficient pumps and oversized capacity at the time of Ice plant installation in compressor cooling. In such Ice plants can opt for implementing energy efficient pumps to save energy. The time required installing or replacing efficient water pump with inefficient or oversized pump is with in a week and energy savings will be while in operation. The identified energy efficient pump used for different categories Ice plants in the cluster depending upon the pump capacity required.

Benefits

The following benefits can be expected while installing Energy Efficient pumps with existing normal pump or over sized pump. They are

- Zero Maintenance
- Less Running Cost
- Optimum rate of flow

- Reduce energy consumption
- Reduction in energy consumption leads to reduce the GHG emissions

Limitations

There is no limitation to replace Energy Efficient pumps with existing over sized / inefficient pumps.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.4.4 Install Solar water Pump for raw water applications

Solar water pumping system for raw water supply is another Technology/equipment identified in Ice Making Cluster, Bhimavaram. Solar pumping uses a free, easily accessible and renewable source of energy. The total electrical energy consumed by the water pump is saved while using solar water pump. In Ice plants in Bhimavaram required raw water pump for low heads and flow. Due to the reason one of the best technologies is solar water pump. It has similar performance for low heads and flow compare to the energy efficient pumps. The details of Techno Financial viability, life cost and implementation cost for replacing energy efficient pumps with existing inefficient pumps in the Ice making plants in Bhimavaram is discussed below. The energy efficient pump required for this application is mono block type, which have higher efficiency with higher heads.

Background

All Ice plants require raw water for making Ice. Raw water is pumped from nearby bore wells /sumps in Ice making plants. The capacity and type of pump required in ice plants depends on type of use, head and flow required. As per the study in Ice making cluster, Bhimavaram all ice plants are using electrical operated pump sets in their plants. The total head and flow in ice plants for estimation of pump capacity is low due to all ice plants have bore wells as well as sumps. Due to the reason installing/promoting solar water pumping system in ice making plants, the total energy consumed by the ice plants for raw water applications is eliminated. There by reduction in power bill and production cost.

Energy Conservation Potential

The installation solar Water pumping system in ice plants, the total energy consumed by raw water pumping is eliminated due to free energy utilized by solar water pump I.e. Solar energy.

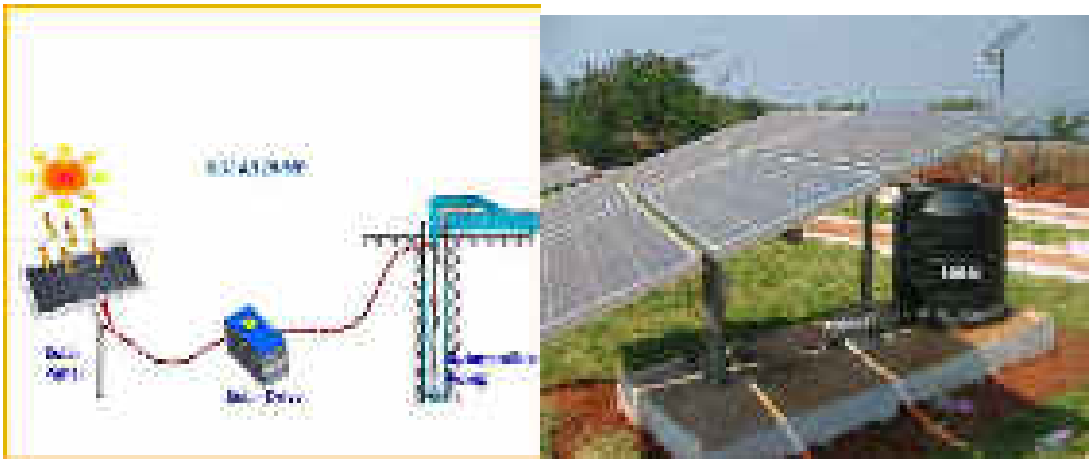
Technical Specifications

The proposed Energy conservation in Ice plant by installing 1400 Wp solar water pumps with inefficient /re winded motor is considered. The Technical Specification of Solar water pumping system for raw water pumping system with capacity of 1400 Wp is presented below.

Table: 3.18 Technical Specifications of Solar Water Pump for Raw Water Applications

S.No	Parameter	Unit	Value
1	Type of Solar panel		Multi- Crystalline Si technology
2	Solar Modules	Wp	1400
3	Head	M	15
4	Flow	M^3/Day	100
5	Type Pump		Mono block
6	Type of motor		Brushless DC
7	Pump efficiency	%	86
8	Motor Efficiency	%	81
9	Life of Solar panel	Years	25

Fig 3.8 Solar Water Pump for Raw Water Applications



Availability of technology/Equipment

The solar water pumps are available and manufacturing in India few major companies. These companies are marketing their products through directly or dealers with in Andhra

Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad by ordering. The details of manufacturers and suppliers marketing these pumps are presented in Annexure-2.

Cost Benefit Analysis

Another factor for any implementing Energy Conservation proposal is Cost benefit analysis. The cost benefit analysis of installing solar water pumps with existing normal or over sized pumps in Ice Making plants are presented below for raw water applications.

Table 3.19 Cost Benefit Analysis of Solar Water Pump for Raw Water Applications

S.No	Parameters	Units	Existing Pump	Solar Pump
1	Installed Capacity	kW	2.2	2.2
2	Head	M	10	15
3	Flow	M3/Day	97	100
4	measured Power	kW or Wp	2.77	1400
5	Working Hr	Hr/Day	6	6
6	Working Days	Days/Year	300	300
7	Power tariff	Rs./kWh	3.75	0
8	Power consumption	kWh/Year	4986	0
9	Energy Saved by solar Pump	kWh/Year	4986	
10	Reduction in Energy Cost	Rs	18697.5	
11	Investment cost -Solar Pump	Rs	200000	
12	MNRE Subsidy	Rs	50000	
13	Total Investment	Rs	150000	
14	Payback Period	Years	8.02	

From above table it is observed that replacing solar water pumps with existing normal pump sets in raw water pumping, the total energy savings is 4986 kWh/ year and reduction in power bill will be Rs. 18697/year. The total investment required for install solar water pump in Ice plant is Rs. 1.50 Lakhs including MNRE subsidy and the pay back period will be with in the 8.02 years. The energy savings and payback period will be varying with capacity of solar water pump installed with replacing existing pump capacity.

Life Cycle Cost

The Life Cycle Cost of solar water pump is estimated based on operating parameters and life of pump. The following table provides details of life cycle cost of solar water pump.

Table 3.20 Life Cycle Cost of Solar Water Pump for Raw Water Applications

S.No	Particulars	Units	Value
1	Solar Photo voltaic capacity	Wp	1400
2	Head	M	15
3	Flow Rate	LPD	89000
4	No of Working hrs	Hrs/day	9
5	No of Days	Days/Year	300
6	Capital Cost	Rs	200000
7	Replacement of components for 5 years	Rs	25000
8	Annual Maintenance	Rs	8000
9	Life of Solar Pump	Years	25
10	Interest rate	%	10
11	LCC at the end of life	Rs	233000

It is observed that the life cycle cost of solar water pump for 1400 Wp capacities will be Rs.2.33 lakhs

Implementation Cost

Another major parameter for implementation of Energy conservation proposals/project is implementation cost. The implementation cost of energy conservation project will be depending up on erection, civil works and retrofitting cost etc.

The cost of implementation for installing 1400 Wp capacity of solar water Pump in ice plant for raw water pumping applications is calculated based on operating parameters like erecting, replacement and civil works. The implementation cost of installing solar water pump with inefficient and oversized pump is presented below.

Table 3.21 Implementation Cost of Solar Water Pump for Raw Water Applications

S. No	Parameter	Cost in Rs.lakhs
1	Plant and Machinery	2.00
2	Civil Works	0.25
3	Electrical works	0.25
4	Erection and Commissioning	0.25
5	Miscellaneous costs	0.25
	Total Cost	**3.00**

Based on above information, the implementation cost of 3HP solar pump will be Rs.3.00 Lakhs for Ice making plant.

Recommendations

Major ice plants installed with inefficient pumps and oversized capacity at the time of Ice plant installation for raw water pumping. In such Ice plants can opt for implementing solar

water pumps to save energy. The time required installing or replacing efficient water pump with inefficient or oversized pump is with in a week and energy savings will be while in operation. The solar water pump used for different categories Ice plants in the cluster depending upon the pump capacity required.

Benefits

The following benefits can be expected while installing solar pumps with existing normal pump or over sized pump. They are

- No energy cost
- Reduced Maintenance cost
- Required less supervision
- Higher life of equipment
- Environment free

Limitations

There is no limitation to replace solar water pumps with existing over sized / inefficient pumps.

Subsidy from Govt. of India

Ministry of New and Renewable Energy, Government of India, provide Capital subsidy on implementation of Solar Water Pumps. The subsidy component will be Rs.30 per Wp or maximum of Rs.50,000 per system.

3.4.5 Install Tube Ice Plant

Installation of Tube Ice plants is one of the Technology/equipment identified in Ice Making Cluster, Bhimavaram which have lower specific energy consumption than block ice. The details of Technical and Financial viability of replacing energy efficient compressor motor with existing inefficient motor in Ice making cluster at Bhimavaram is discussed below.

Background

All Ice plants are producing block ice from Ice plants as per the demand /market. The formed block ice is then crushed into small pieces which are used for prawns/fish transportation. The production capacity of ice plant directly depends on the marketing due to ice can not be stored. Due to the reason the ice plant owners utilizing the only 40-50% capacity utilization. This leads to the specific energy consumption very high due to ideal operation of the ice plant. By considering capacity utilization, specific energy consumption and market requirement tube ice plant is best technology for producing the ice pieces.

Energy Conservation Potential

All ice making plants in Bhimavaram producing block ice and crushed in to pieces by crusher. The tube ice plant produced the ice cubes pieces which is similar to the crushed block ice. The specific energy consumption by the block ice manufacturing in Ice plants in Bhimavaram is ranges from 87-120 kwh/ton and by the tube ice plant is from 55-65 kWh/ton. So by considering tube ice plant at least 20% of energy is saved.

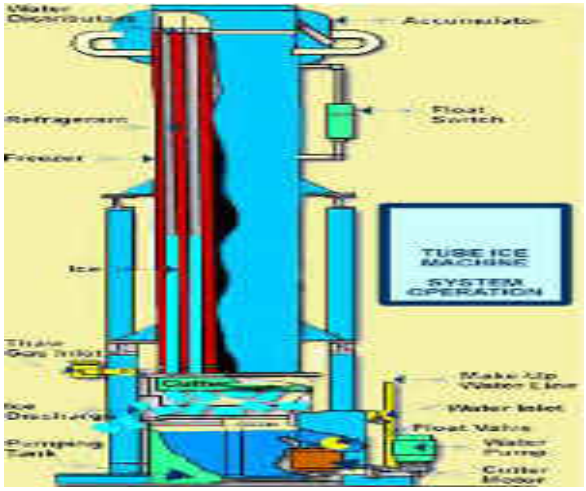
Technical Specifications

The proposed Energy conservation in Ice plant by installing Tube Ice Plant with 15 TPD capacity for poor plant utilization and low capacity plants where crushed ice requirements for marketing is considered. The Technical Specification of proposed tube ice plants is presented below.

Table: 3.22 Technical Specifications of Tube Ice Plant-15 TPD

S.No	Parameter	Unit	Value
1	Refrigerant		Ammonia
2	Type of compressor		KC2 Reciprocating
3	Capacity of Ice plants	TPD	15
4	Motor capacity	HP	60
5	Water Pump	HP	1.5 Duel Starter
6	Cutter	HP	1.5
7	Cooling Tower Capacity	TR	60
8	Cooling tower fan	HP	2 , Induced Draft Duel starter
9	Space Required	Sq.m	200
10	Ice Cubes	Inch	10
11	No of ice Cubes	No	135
12	Sp. Power consumption	kWh/T	55-65

Fig 3.9 Tube Ice Plant



It is observed that specific energy consumption of tube ice plant is 55-65 kWh/ton and block ice plant is 87-120 kWh/ton (from observed 30 ice Plants).

Availability of Technology /Equipment

The Tube ice Plants manufacturers are available and manufacturing in India by the few major companies. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad, Mumbai etc. Ice making plants owners can avail these equipments from Mumbai/Hyderabad by ordering. Details of manufacturers and suppliers of tube Ice plants are presented in Annexure-2.

Cost Benefit Analysis

Any Energy conservation proposal/project requires cost benefit analysis to implement in industries. Based on observations and applications of product from ice plants, Cost benefit analysis for installing tube ice plants for 15TPD in Ice Making plants are estimated and presented below.

Table 3.23 Cost Benefit Analysis of Tube Ice Plant

S.No	Parameters	Units	Present Plant	Tube Ice plant
1	Installed Capacity	TPD	36	15
2	Daily production	TPD	15	12
3	Plant Utilization	%	42	80
4	No of Hrs Working	Hr/day	24	24
5	No of Working Days	Day/year	300	300
6	Annual production	TPY	5250	4200
7	Sp. Energy Consumption	KWh/Ton	90	60
8	Annual Energy consumption	kWh/year	405000	216000
9	Power Tariff	Rs./kWh	3.75	3.75
10	cost of Energy	Rs	1518750	810000
11	Energy Savings	kWh/year	189000	
12	Annual Rs saved	Rs/Yeas	708750	
13	Investment required	Rs	2400000	
14	Payback Period	Years	3.39	

From the above table, by installing tube ice plant in ice plant, total energy savings in Ice plant is 189000 kWh/ year and savings in power bill will be Rs.7.08 lakhs/year. The total investment required to install tube ice plant with a capacity of 15 TPD is Rs.24.00 lakhs and pay back period will be with in 3.39 years.

The energy savings and payback period will be varying with capacity of energy efficient compressor motor installed with replacing existing motor capacity.

Life Cycle Cost

The Life Cycle Cost of Tube ice plant is estimated based on operating parameters and life of plant. The following table provides details of life cycle cost of tube ice plant.

Table 3.24 Life Cycle Cost of Tube Ice Plant

S.No	Particulars	Units	Value
1	Installed Capacity	TPD	15
2	% Utilization	%	80
3	Specific Energy Consumption	kWh/T	60
4	No of Hours Operation	Hrs/day	24
5	No of Days	Days/Year	350
6	Capital Cost	Rs	2400000
7	Repairs	Rs	48000
8	Annual Maintenance	Rs	120000
9	Life of Plant	Years	25
10	Interest rate	%	10
11	LCC at the end of life	Rs	3427252

The life cycle cost of tube ice plant with 15TPD capacity will be Rs.34.27 Lakhs

Implementation Cost

Another parameter for installation of tube ice plant is implementation cost. The implementation cost of energy conservation project will be depending up on erection, civil works, retrofitting costs etc.

The implementation cost for installing Tube ice Plant with 15TPD capacity is calculated based on operating parameters like erecting, replacement and civil works. The details of implementation cost for installing tube ice plant presented below.

Table 3.25 Implementation Cost of Tube Ice Plant

S. No	Parameter	Unit	Values
1	Capacity of motor	TPD	15
2	Cost of Equipment	Rs	2400000
3	Civil Works	Rs	120000
4	Electrical works	Rs	48000
5	Erection and Commissioning	Rs	72000
6	Miscellaneous costs	Rs	48000
	Total Cost	**Rs**	**2688000**

Based on above information, implementation cost of Tube Ice plant with 15TPD capacity will be Rs.26.88 Lakhs

Recommendations

The tube ice plant was recommended in Ice making cluster, Bhimavaram where block ice plant utilization is poor and crushed ice is required. By implementation of Tube ice plant the specific energy consumption will reduce compare to block ice plant.

The Tube ice plant can be use in different categories Ice plants in cluster depending upon capacity required per day.

Benefits

The following benefits can be expected while install Tube Ice plant compare to Block ice plant is

- Less space required
- Low specific energy consumption
- No crusher is required

Limitations

There is no limitation for installing tube Ice Plant in ice Making Cluster.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.4.6 Install Energy Efficient Motor for Agitator

Installation of Energy Efficient Motor in agitator is one of the Technology/equipment identified in Ice Making Cluster, Bhimavaram to reduce energy consumption. Agitator is running in along with compressor during plant operation. Agitator motor is used in the ice plants to agitate the brain solution in Ice tank for re circulation. The motor is used continuously to agitate the brain solution till ice is formed. Due to motor continuous operation, even though small capacity considerable electrical energy consumed during the process. To conserve electrical energy during agitator operation, install energy efficient motor to operate agitator which has higher efficiency. The details of Technical and Financial viability of replacing energy efficient motor in agitator with existing inefficient motor in Ice making cluster at Bhimavaram is discussed below.

Background

All Ice plants require agitator to circulate brain solution continuously in ice tank. The agitator motors consume electrical energy while in operation. The agitator and compressor motor operated continuously till Ice formed. If the agitator motor is inefficient, power consumption will high.

During the energy use and technology audit in ice plants in Bhimavaram, all agitator motors are normal efficiency compare to energy efficient motors. To reduce the power consumption by the agitator motor it is essential to implement energy efficient motor. By installing Energy Efficient Motor in agitator will result considerable energy savings and there by reduction in production cost.

Energy Conservation Potential

The Energy Efficient Motor (EEF1) has higher efficiency while operating in part & full load and continuous operation comparing with inefficient or EEF2 motor. The efficiency of EEF1 i.e.95% is more than that of normal motor i.e.85-90%. If the efficiency of motor increases, power consumption will reduce at both part and full load conditions. By installing energy efficient motor in agitator in ice plants due to continuous operation at least 8-10% energy savings can achieve.

Technical Specifications

The proposed Energy conservation in Ice plant by installing 5HP Energy Efficient agitator motor with inefficient /re winded motor is considered. The Technical Specification of energy efficient 5 HP agitator motor is presented below.

Table: 3.26 Technical Specifications of Energy Efficient Motor for Agitator

S.No	Parameter	Unit	Value
1	Capacity of Motor	HP	5
2	Type of Motor	Name	Induction
3	Motor power	kW	3.7
4	Rated Current	A	7
5	Voltage	V	415
6	PF	%	0.83
7	Efficiency at ½ Load	%	86
8	Efficiency at ¾ Load	%	88.3
9	Efficiency at full load	%	88.3

Fig 3.10 Energy Efficient Motors for Agitator

It is observed that the efficiency of the energy efficient agitator motor has higher efficiency compared to the existing motor in the cluster.

Availability of Technology /Equipment

The Energy Efficient Motors are available and manufacturing in India by the few major companies. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad, Vijayawada and few in Bhimavaram. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad/Bhimavaram by ordering.

The details of manufacturers and suppliers marketing these energy efficient motors are presented in Annexure-2.

Cost Benefit Analysis

The Cost benefit analysis for installing energy efficient motor in agitator is presented below. Based on observations and measurements taken from ice plants, Cost benefit analysis for replacing energy efficient agitator motor with existing inefficient / re winded motor in Ice Making plants are evaluated and presented below.

Table 3.27 Cost Benefit Analysis of Energy Efficient Motor for Agitator

S. No	Parameter	Unit	Existing motor	New EE Motor
1	Capacity of Motor	HP	5	5
2	Capacity of Motor	kW	3.73	3.73
3	Efficiency of the motor	%	85	88.4
4	Measured power	kW	4.13	3.97
5	Loading	%	94	94
6	No of Working Hours	Hr/day	24	24
7	No. of Working Days	days/year	300	300
8	Total Energy Consumption	kWh/Year	29736	28592
9	Power Savings	kW	0.16	

S. No	Parameter	Unit	Existing motor	New EE Motor
10	Power tariff	Rs./kWh	3.75	
11	Total Energy Savings due to EE motor	kWh/year	1144	
12	Cost of energy savings	Rs/Year	4289	
13	Investment cost	Rs	12577	
14	Payback Period	Years	2.93	

From the above table, by replacing 5 HP energy efficient agitator motor with existing 5 HP inefficient/ re winded motor, total energy savings in Ice plant is 1144 kWh/ year and savings in power bill will be Rs. 4289 /year. The total investment required to implement the EEF1 motor is Rs. 12577 and pay back period will be with in 2.93 years. The energy savings and payback period will be varying with capacity of energy efficient compressor motor installed with replacing existing motor capacity.

Life Cycle Cost

The Life Cycle Cost of Energy Efficient Motor (EEF1) is evaluated based on operating parameters and life of motor. The details of life cycle cost of energy efficient agitator motor (EEF1).

Table 3.28 Life Cycle Cost of Energy Efficient Motor for Agitator

S.No	Particulars	Units	Value
1	Capacity of Motor	HP	5
2	Efficiency of motor	%	88.3
3	No of Hours Operation	Hr/day	24
4	No of Days	Days/Year	350
5	Capital Cost	Rs	12577
6	Annual Maintenance	Rs	2000
7	Life of Motor	Years	15
8	Interest rate	%	10
9	LCC at the end of life	Rs	29248

The life cycle cost of 5 HP energy efficient agitators motor will be Rs.29,248

Implementation Cost

The implementation cost of the energy conservation project will be depending up on erection, civil works, retrofitting costs etc. The implementation cost for installing 3 HP capacity of Energy Efficient Motor (EEF1) for agitator in ice plant is calculated based on operating parameters like erecting, replacement and civil works. The implementation cost of replacing EEF1 motor with inefficient and re winded Motor are presented below.

Table 3.29 Implementation Cost of Energy Efficient Motor for Agitator

S. No	Parameter	Unit	Values	
1	Capacity of motor	HP	5HP	3HP
2	Cost of Equipment	Rs	13000	10000
3	Civil Works	Rs	1000	1000
4	Electrical works	Rs	3000	2000
5	Erection and Commissioning	Rs	1000	1000
6	Miscellaneous costs	Rs	3000	2000
	Total Cost	**Rs**	**21000**	**16000**

Based on above information, the implementation cost of 3 HP Energy Efficient Motor will be Rs.16000 for Ice making plant.

Recommendations

Major ice plants installed with inefficient Motor at the time of Ice plant installation and some of units used several time re winded motor. In such units can opt for install energy efficient motor to their Ice plants. The time required to install or replace with EEF1 motor in the agitator is with in a week and the energy savings will be while in operation.

The identified Energy Efficient Motor (EEF1) can be use in different categories Ice plants in the cluster depending upon motor capacity required.

Benefits

The following benefits can be expected while installing Energy Efficient Motor with the existing the normal efficient motor /re winded motor.

- Less Maintenance Cost
- Low Running Cost
- Reduction in Energy consumption
- Less break downs
- Reduction in energy consumption leads to reduce the GHG emissions

Limitations

There is no limitation for replacing Energy Efficient Motor s (EEF1) with the existing inefficient and re winded Motor.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.4.7 Replace New Refrigeration Compressor

Ice Making Units at Bhimavaram, few Ice plants refrigeration compressors are age old and Power Consumption during the compression is high.

Replacing present refrigeration compressor with new efficient refrigeration compressor will result in less power consumption and ice making capacity of plant also increase for same compressor motor.

The Technical and Financial viability detail of replacing new efficient refrigeration compressor in existing refrigeration compressor in Ice making plants at Bhimavaram is discussed below.

Background

Few Ice Plants installed refrigeration compressor at the time of plant installation. Till now the compressors are in operation. These compressors are operating after maintenance while in problems during failures. During the energy use and technology audit in ice plants at Bhimavaram, refrigeration compressor performance is evaluated and the performance of compressors is low compare with manufacturer technical specifications. The Ice plant Power consumption will mainly depend on compressor performance only. Due to low performance of compressor, the power consumption will be high. To reduce the power consumption during the compression of refrigerant, replace old refrigerant compressor with new refrigerant compressor.

Energy Conservation Potential

In Ice Plant compressor are high energy consumed equipment compare all other equipments. It requires higher power to compress the refrigerant at higher temperature and pressure. The compressor performance high, power consumption by the compressor will reduce. Due to higher compressor performance and continuous operation there will be higher energy savings during the operation.

Technical Specifications

The Technical Specification of New efficient refrigeration compressor is presented below.

Table: 3.30 Technical Specifications of New Refrigeration Compressor

S.No	Parameter	Unit	Value
1	Compressor Type	Name	Reciprocating
2	No of Cylinders	No	3
3	Bore and Stroke	mm	160X110

S.No	Parameter	Unit	Value
4	Permissible Speed	RPM	450-1000
5	Swept Volume	m3/hr	398.1
6	Maximum Discharge Pressure	bar	21
7	Compressor Motor requirement	kW	45
8	Ice Making Capacity	Tons/Day	29.3
9	Power Consumption	kW	59.4.

From the above table the new refrigeration compressor ice making capacity is more than the present refrigeration compressor for same power input.

Availability of Technology /Equipment

The New refrigeration compressor is available and manufacturing in India. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority dealers/ suppliers for these equipments are located in Hyderabad, Vijayawada and few in Bhimavaram. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad/Bhimavaram by ordering. The details of manufacturers and suppliers marketing these energy efficient motors are presented in Annexure-2.

Cost Benefit Analysis

The Cost benefit analysis for replacing new refrigeration compressor in existing ice plants is presented below. Based on observations and measurements taken from ice plants, Cost benefit analysis for replacing new refrigeration compressor with existing compressor in Ice Making plants are evaluated and presented below.

Table 3.31 Cost Benefit Analysis of Energy Efficient Motor for Agitator

S.No	Parameter	Unit	Existing Compressor	New Compressor
1	Refrigeration Compressor Model	Name	KC3	KCX3
2	Refrigerant	Name	Ammonia	Ammonia
3	Swept Volume	m3/hr	398.1	398.1
4	Compressor Motor shaft power	kW	45	45
5	Measured Power	kW	46.13	40.5
6	Efficiency of Motor	%	90.5	90.5
7	% Loading	%	93	81
8	Power Consumption for Compressor Cooling	kWh/Year	500	0
9	No of Working Hours	hr/day	24	24
10	No. of Working Days	days/year	300	300
11	Total Energy Consumption	kWh/Year	332636	291600

S.No	Parameter	Unit	Existing Compressor	New Compressor
12	Power Savings	kW	5.63	
13	Power tariff	Rs./kWh	3.75	
14	Total Power Savings by New Compressor	kWh/year	41036	
15	Cost of Energy savings	Rs/Year	153885	
16	Investment cost	Rs	360000	
17	Payback Period	Years	2.34	

From the above table it is observed that due to replacing new refrigeration compressor in ice plant, total energy savings in Ice plant is 41036 kWh/ year and savings in power bill will be Rs. 153885 /year. The total investment required for new compressor is Rs.1.33 Lakhs and Payback period will be with in 2.34 years.

Life Cycle Cost

The Life Cycle Cost of New Refrigeration compressor is evaluated based on operating parameters and life of compressor. The details of life cycle cost of new compressor are presented below.

Table 3.32 Life Cycle Cost of New Refrigeration Compressor

S.No	Particulars	Units	Value
1	New Compressor Model	Name	KCX3
2	Compressor motor Capacity	kW	45
3	Power Consumption by Compressor	kW	40.5
4	New Compressor Ice Making Capacity	TPD	29.3
5	No of Hours Operation	Hr/day	24
6	No of Days	Days/Year	350
7	Capital Cost	Rs	360000
8	Annual Maintenance	Rs	7200
9	Life of Compressor	Years	30
10	Interest rate	%	10
11	LCC at the end of life	Rs	381600

The life cycle cost of New Refrigeration compressor will be Rs.3.81 lakhs

Implementation Cost

The implementation cost of the energy conservation project will be depending up on erection, civil works, retrofitting costs etc. The implementation cost for installing New refrigeration compressor in ice plant is calculated based on operating parameters like erecting, replacement and civil works and presented below.

Table 3.33 Implementation Cost of New Refrigeration Compressor

S. No	Parameter	Unit	Values
1	New Compressor Ice Making Capacity	TPD	29.3
2	Cost of Equipment	Rs	360000
3	Civil Works	Rs	10000
4	Electrical works	Rs	10000
5	Erection and Commissioning	Rs	10000
6	Miscellaneous costs	Rs	10000
	Total Cost	**Rs**	**400000**

Based on above information, the implementation cost of New refrigeration compressor will be Rs.4.00 lakhs in existing Ice making plant.

Recommendations

The New Refrigeration compressor can be implemented where compressors performance are poor in existing ice plants.

Benefits

The following benefits can be expected while installing new compressors in existing ice plants.

- Less Maintenance Cost
- Low Running Cost
- Reduction in Energy consumption
- Less break downs
- Reduction in energy consumption leads to reduce the GHG emissions

Limitations

There is no limitation for replacing new refrigeration compressors in existing ice plants where high power consumption and low ice making is reported.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.4.8 Install Variable Frequency Drives(VFD) for compressor motors

Compressor consumes high energy compare to other equipments in Ice Plants. In Ice making Plants compressors are compress the refrigerant with help of motors. The energy

consumption by the motor depends upon characteristics of refrigerant entering into compressor and loading.

The refrigeration compressor required speed at 400-1000 rpm to compress the refrigerant. During ice formation completed and filling of ice cans, work done by the compressor required less for refrigerant. To reduce the power consumption by compressor during less compression, speed of compressor required to reduce by reducing the either motor speed or switch off the cylinders in compressor.

Background

In all ice plants, the compressors are operated manually while less compression is required during ice formation completed and filling and empting of ice cans. During this time compressors required to operate less speed to save energy. Many operators are not conscious about this savings due to fewer periods of operation and negligence. To over come this VFD is best option to reduce the compressor motor speed and there by compressor speed.

Energy Conservation Potential

As the speed of the motor is reduced, the speed of compressor will reduce results less work done by compressor and there by power required by the compressor reduce with the cube of the speed.

The compressor motor speed reduced by 20%; the corresponding speed reduction in compressor will be 59% of the normal speed; this will reduce the power consumption to (0. 59)^3= 20.5%.

Technical Specifications

The proposed Energy conservation in Ice plant is by installing VFD for Compressor motor is considered. The Technical Specification of energy efficient 5 HP agitator motor is presented below.

Table: 3.34 Technical Specifications of Variable Frequency Drives

S.No	Parameter	Unit	Value
1	Drive Name	Name	VSC Drive
2	Voltage	V	380-480
3	Rated Current	A	90
4	Phase		3
5	Maximum Frequency	Hz	400

S.No	Parameter	Unit	Value
6	Allowable Voltage Fluctuations	Range	10 to10 %
7	Control method	Name	V/F Control
8	Speed Control Range	Range	1:50 V/F mode

Availability of Technology /Equipment

The VFD's are available and manufacturing in India by few major companies. These companies are marketing their products through directly or dealers with in Andhra Pradesh. Majority of dealers/ suppliers for these equipments are located in Cities. Ice making plants owners can avail these equipments from Vijayawada/Hyderabad by ordering. The details of manufacturers and suppliers of VFDs are presented in Annexure-2.

Cost Benefit Analysis

The Cost benefit analysis for installing VFD's is presented below. Based on observations and measurements taken from ice plants, Cost benefit analysis for installing VFD in compressor motor in Ice Making plants are evaluated and presented below.

Table 3.35 Cost Benefit Analysis of VFD for Compressor motor

S.No	Parameter	Unit	With Out VFD	With VFD
1	Capacity of Compressor Motor	kW	45	45
2	Speed of motor	rpm	991	400
3	Power Consumption	kW	50.15	39.5
4	No of Working Hours	hr/day	2	2
5	No. of Working Days	days/year	300	300
6	Total Energy Consumption	kWh/Year	30090	23700
7	Speed Reduction	rpm	591	
8	Power reduction	%	21.2	
9	Power Savings	kW	10.65	
10	Power tariff	Rs./kWh	3.75	
11	Total Power Savings by New Compressor	kWh/year	6390	
12	Cost of Energy savings	Rs/Year	23963	
13	Investment cost	Rs	133000	
14	Payback Period	Years	5.55	

From the above table it is observed that by installing VFD in Compressor motor, total energy savings in Ice plant is 6393 kWh/ year and savings in power bill will be Rs. 23963 /year. The total investment required for VFD is Rs.1.33 Lakhs and pay back period will be 5.5 years.

Life Cycle Cost

The Life Cycle Cost of VFD is evaluated based on operating parameters and life of equipment. The detail of life cycle cost of VFD is presented below.

Table 3.36 Life Cycle Cost of VFD

S.No	Particulars	Units	Value
1	Drive Name	Name	VSC Drive
2	Voltage	V	380-480
3	Rated Current	A	90
4	Speed Control Range	Range	1:50 V/F mode
5	No of Hours Operation	Hr/day	24
6	No of Days	Days/Year	350
7	Capital Cost	Rs	133000
8	Annual Maintenance	Rs	2660
9	Life of Compressor	Years	10
10	Interest rate	%	10
11	LCC at the end of life	Rs	135660

The life cycle cost of VFD for compressor motor will be Rs.1.35 Lakhs

Implementation Cost

The implementation cost of energy conservation project will be depending up on erection, civil works, retrofitting costs etc. The implementation cost for VFD for Compressor motor in ice plant is calculated based on operating parameters like erecting, replacement and civil works and presented below.

Table 3.37 Implementation Cost of VFD for compressors

S. No	Parameter	Unit	Values
1	Drive Name	Name	VSC Drive
2	Cost of Equipment	Rs	133000
3	Civil Works	Rs	5000
4	Electrical works	Rs	10000
5	Erection and Commissioning	Rs	5000
6	Miscellaneous costs	Rs	5000
	Total Cost	**Rs**	**158000**

Based on above information, the implementation cost of VFD for Compressor motor will be Rs.1.58 Lakhs for Ice making plant.

Recommendations

All ice Plants can adopt these VFDs for Compressor motors applications. The VFD can be use in different categories Ice plants based on capacity of compressor motor. The VFDs are available as per the capacity of the motor and no. of speeds required.

Benefits

The following benefits can be expected during the VFD implementation in Compressor motors.

- Low Running Cost
- Reduction in Energy consumption based on speed
- Reduction in energy consumption leads to reduce the GHG emissions

Limitations

There is no limitation for implementing VFDs for compressor motors in Ice making Plants located in Bhimavaram.

Subsidy from Govt. of India

The Development commissioner , Ministry of Small and Medium Enterprises ,Govt of India providing a subsidy for implementation of Energy Efficient technologies in under a scheme of National Manufacturing Competitiveness Program (NMCP) Under XI Plan. The subsidy component will be 25% of project cost and up to 10.00 laks per project.

3.5 Other Energy Saving Proposals

The other energy saving proposals in ice making plants are discussed below.

3.5.1 Improving the compressor performance by Overhauling

In Ice making plants, compressors are main part in whole plant. If the compressor performance is good the power consumed by the compressor motor will be less. Overhauling of compressor is required to reduce the power consumption by compressor and there by reducing in power bills. The details of Technical and Financial viability of Overhauling of compressors are presented and discussed below.

Background

Ice plants require to overhauling the compressors over a period to improve the efficiency. The refrigeration compressors are operated continuously and throughout the year for manufacturing of ice. The specific energy consumption, energy efficiency ratio Coefficient of performance of ice plant is depends on compressor performance. During the energy use

and technology audit in ice plants in Bhimavaram, few refrigeration compressors are found and need to be overhaul to improve compressor performance.

Energy Conservation Potential

The performance of the ice plants in Bhimavaram Ice Plants are poor and specific power consumption is on higher side than equipment supplier guarantee. This may be due to wear and tear of the compressor parts, low condenser efficiency etc. It is recommended to take major overhauling of the compressor for improving the performance of the compressor.

It is also recommended to clean the condenser tubes regularly once in a week to remove algae and fungi and to improve the performance of condenser. It should be noted that, for every 0.55 oC, temperature drop in the cooling tower, the power drawn by the refrigeration compressors reduces by 3%.

Cost Benefit Analysis

Any Energy conservation proposal/project requires cost benefit analysis to implement in industries. By taking annual maintenance of the compressor and improving the performance of the condenser, a minimum of 15% of compressor power consumption will be reduced equivalent to 6.0 kW per hour operation.

Based on observations and measurements taken from ice plants, Cost benefit analysis for overhaul of compressor to improve the performance in compressors in Ice Making plants are evaluated and presented below.

Table 3.38 Energy Saving Potential of Compressor motor

S.No	Parameters	Unit	Value
1	Present refrigeration compressor Motor input power	kW	40.6
2	% Savings	%	15
3	Reduction in Power Consumption	kW	6
4	Operating Hours	Hours	6000
5	Annual Energy Saving	kWh/annum	36,000
6	Energy Charges	Rs./kWh	4
7	Saving Potential	Rs./annum	1,44,000
8	Initial Investment	Rs.	50,000
9	Payback period	Months	4 to 5

From the above table, it is observed that by overhauling the compressor, at least 15% of energy savings is possible during the operation of compressor motor and reduction of power consumption will be 0.6 kW and there by savings will be 36, 000 kWh per year and savings

in power bill will be Rs.1.44 Lakhs /year. The total investment required to overhaul the compressor is Rs. 50, 000 and pay back period will be 4 to 5 months.

Recommendations

All poor compressor performance ice plants can go for overhaul of compressors.

Benefits

The following benefits can be expected while overhauling of compressors.

- Power savings by 0.6kW
- Improve the compressor performance
- Reduction in Energy consumption
- Reduction in energy consumption leads to reduce the GHG emissions

3.5.2 Insulation

Pipes and evaporator tank requires proper insulation to reduce the heat loss during the operation. Suitable insulating material in evaporator tank and pipes results energy savings to avoid the heat loss.

3.6 Availability of Local Service Providers for Implementation Energy Conservation Proposals

The details of availability of local service providers for implementation of energy saving proposals identified are furnished below:

Table 3.39 : Availability of LSP's for implementation of Energy Savings Proposals

S.No	Technology	Local Service Providers	
		Bhimavaram	India
1	Energy Efficient Motors for Compressors and Agitators	Not Available	Available
2	New Efficient Refrigeration Compressors	Available	Available
3	Variable Frequency Drives for Compressor Motor	Not Available	Available
4	Solar Water pumps	Not Available	Available
5	Tube Ice Plant	Not Available	Available
6	Energy Efficient Water Pumps-Mono Block	Available	Available
7	Energy Efficient Water Pumps –Sub merged	Available	Available

3.7 Identified Technologies for DPR Preparation

The Justification for technologies/equipments identified for DPR preparation (e.g. potential, reliability, etc. in the cluster) is based on the detailed studies carried out and considerable potential in all cluster units for energy conservation and efficiency.

As the process and equipments are more or less similar in all cluster units, all the technologies/equipments identified can be replicated as per the requirement and detailed project reports for the specific technologies prepared also can be replicated for different units as per the capacity requirement. The following technologies/equipments were considered for preparation of detailed project report:

Table 3.40: Proposed Technologies/Equipments for preparation of DPR:

S.No	Area	No of DPRs
1	Energy Efficient motors for Compressors	3
2	New Refrigeration Compressors	3
3	VFD for Compressor motor applications	3
4	Solar Water pump for raw water applications	2
5	Tube Ice Plant	3
6	Energy efficient Agitator motor	1
	Total	**15**

3.8 Issues/barrier for implementation of proposals

The following major barriers identified for implementation of the energy savings proposals in Ice making cluster Bhimavaram. They are:

1. Lack of awareness and information among cluster owners on the energy losses, EE technologies and energy conservation concepts. By demonstrating few projects may motivate to take up energy efficiency improvement projects to their industries.
2. All Ice plants are SMEs and doesn't have financial linkages to implement the energy savings proposals to their industries
3. During the interaction the plant owners are ready to implement quick saving proposals after discussing about the technology if provided financial linkages
4. The local service providers are basically experience background in nature but not in technical sound knowledge like efficiency, losses. The LSPs required technology up gradation skills related to the ice making equipments.
5. Production break down during the implementation of the energy saving proposals

4 SMALL GROUP ACTIVITIES /TOTAL ENERGY MANAGEMENT

4.1 Introduction

Energy is one of the most important resources to sustain our lives. At present we still depend a lot on fossil fuels and other kinds of non-renewable energy. The extensive use of renewable energy including solar energy needs more time for technology development.

4.2 Systematic Approach for Energy Conservation by TEM/SGA

In this situation Energy Conservation (EC) is the critical needs in any countries in the world. Of special importance of Energy Conservation are the following two aspects:

1. Economic factors
2. Environmental impacts

4.2.1 Economic factors of Energy Conservation

Energy saving is important and effective at all levels of human organizations – in the whole world, as a nation, as companies or individuals. Energy Conservation reduces the energy costs and improves the profitability.

Notably, the wave of energy conservation had struck the Indian intelligentsia 3 years earlier when a Fuel Policy Committee was set up by the Government of India in 1970, which finally bore fruits three decades hence in the form of enactment of the much awaited Energy Conservation Act, 2001 by the Government of India. This Act made provisions for setting up of the Bureau of Energy Efficiency, a body corporate incorporated under the Act, for supervising and monitoring the efforts on energy conservation in India.

Brief History of energy efficiency movement in India and associated major milestones are as follows.

- 1974: setting up of fuel efficiency team by IOC, NPC and DGTD (focus still on industry)
- 1975: setting up of PCAG (NPC main support provider) : focus expanded to include agriculture, domestic and transport
- 1978: Energy Policy Report of GOI: for the first time, EE as an integral part of national energy policy – provided detailed investigation into options for promoting EE
- Post 1980, several organizations started working in EC area on specific programs (conduct of audits, training, promotion, awareness creation, demonstration projects, films, booklets, awareness campaigns, consultant/product directories)

- Some line Ministries and organizations like BICP, BIS, NPC, PCRA, REC, Ministry of Agriculture, TERI, IGIDR, CSIR, PETS (NPTI)
- State energy development agencies
- Industry associations
- All India financial institutions

The Government of India set up Bureau of Energy Efficiency (BEE) on 1st March 2002 under the provisions of the Energy Conservation Act, 2001. The mission of the Bureau of Energy Efficiency is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Energy Conservation Act, 2001 with the primary objective of reducing energy intensity of the Indian economy. This will be achieved with active participation of all stakeholders, resulting in accelerated and sustained adoption of energy efficiency in all sectors

Private companies are also sensitive to energy costs, which directly affects their profitability and even their viability in many cases. Especially factories in the industrial sectors are of much concern, because reduced costs by Energy Conservation mean the more competitive product prices in the world markets and that is good for the national trade balance, too.

4.2.2 Environmental impacts of Energy Conservation

Energy Conservation is closely related also to the environmental issues. The problem of global warming or climate change is caused by emission of carbon dioxide and other Green House Gases (GHG). Energy Conservation, especially saving use of fossil fuels, shall be the first among the various countermeasures of the problem, with due considerations of the aforementioned economic factors.

4.3 Total Energy Management (TEM)

Every point in factories has potential for Energy Conservation. Total Energy Management is implemented, by all the people's participation, step by step utilizing "Key Step Approach" in a systematic manner, as shown below:

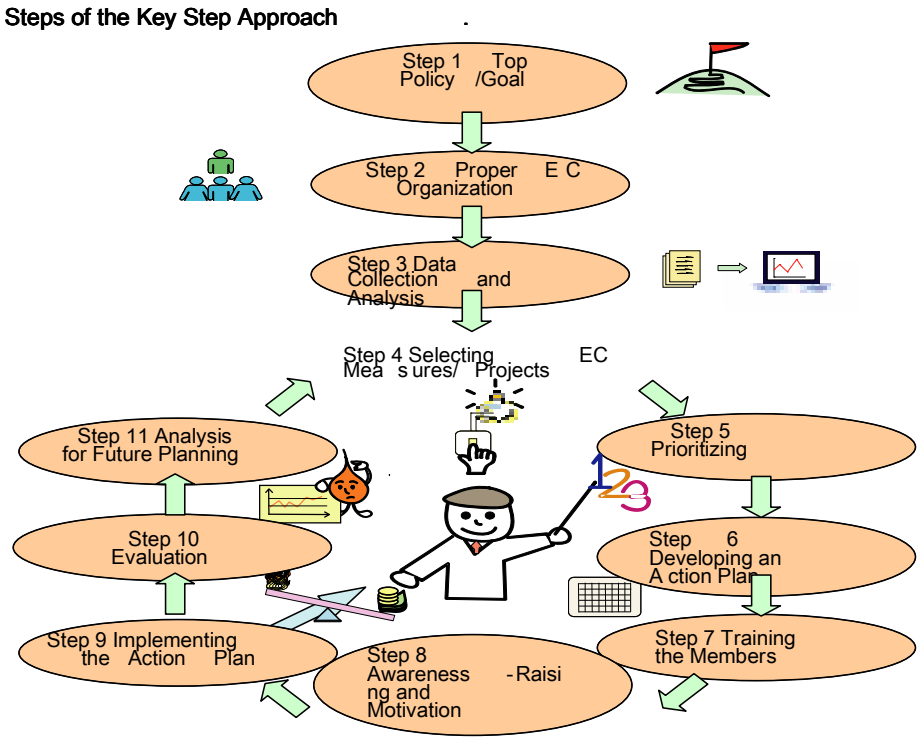
1. Top management policy/Goal
   - Develop a policy statement
   - Set targets
2. Proper EC Organization including Assignment of Energy Manager
   - Establish proper EC organization (utilizing SGA)
   - Assignment of Energy Manager
3. Data collection and Analysis
   - Collect data on current energy use

- Analyze the collected data
- Identify management strength and weakness
- Analyze stakeholders' needs
- Anticipate barriers to implement
- Estimate the future trend

4. Selecting EC Measures/Projects
   - Selecting EC Measures
   - Selecting EC Projects
   - Make out a plan/program
5. Prioritizing
6. Developing an Action Plan
7. Training the related members
8. Awareness-raising and Motivation
9. Implementing the Action Plan (including monitoring and controlling)
10. Evaluation (Management review)
11. Analysis for future planning (Standardization and Dissemination)

The following figure shows these Key Steps for implementing Energy Conservation activities.

Fig No 4.1: Key Step Approach



Each step is explained in this order as below:

Step 1: Top Management policy/Goal

It is the most important for the success of Energy Conservation activities within companies or factories to have clear and official commitment of top management – either the corporate top (senior) management or factory managers. The top (senior) management shall announce explicit commitment to the Energy Management (or Energy Conservation) and behave along this line – for example, participate in EC (Energy Conservation) events and encourage the people there for EC promotion.

This Handbook is primarily meant for Energy Managers for the use of EC promotion within factories, on the assumption that top management has already committed to that. However, there may be cases where top management would learn about Energy Management (or Energy Conservation) by this Handbook, or Energy Managers would make efforts to persuade top management to support or commit to Energy Management (or Energy Conservation) with the help of this Handbook.

1. Develop a policy statement

It is desired that the top (senior) management announces the "Energy Policy Statement". This is very effective to let people inside and outside the company clearly knows the management's commitment to Energy Management (or Energy Conservation). The format of the energy policy statement is various, but it usually includes the goal or objective of the company and the more concrete targets in the field of Energy Management (or Energy Conservation). It often shows the major measures and timetables. The statement shall match the company's mission statement or overall management strategy plan.

2. Set targets

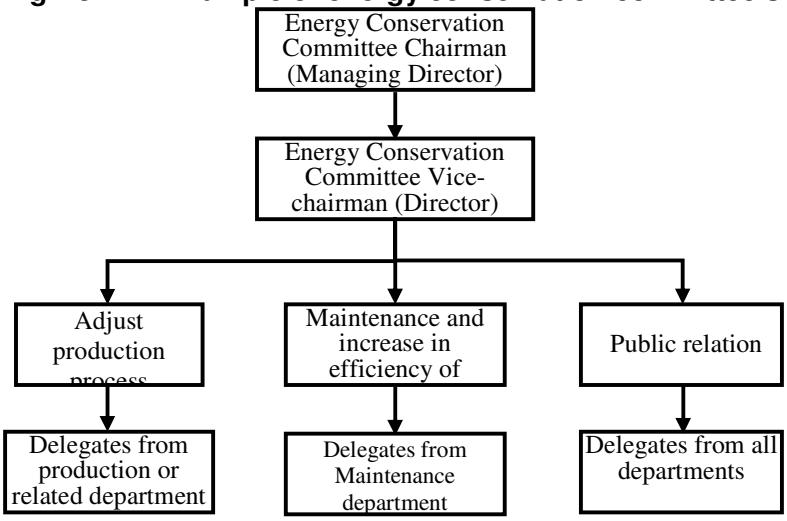
The targets shall be concrete and specific so that everyone can understand it.

Step 2 : Proper EC Organization including Assignment of Energy Manager

In some countries, where the EC Promotion Act is in force, the designated factories have obligation of assigning Energy Managers. In relation to Energy Management, however, the word "Energy Managers" is here used as a Manager or a Coordinator, separate from the above-said legal obligation, who works exclusively for Energy Management (or Energy Conservation) purposes, ranging from gathering energy-related information to drafting EC plans/programs and promoting or coordinating during implementation. To the proper Energy Management, this type of Energy Manager is indispensable. How to position this Energy Manager within the company organization is also an important issue and needs careful decision. In some cases, Energy Committee, with members from the major departments,

may be formed to assure the company-wide or factory-wide cooperation, as shown in the following figure.

Fig No. 4.2: Example of energy conservation committee's Organization



Actually there are many ways of forming EC organization, depending on the situation of factories or institutions, such as the size, kind of business, etc. In any case, it is very effective to utilize SGA (Small Group Activities) and there are also many ways to do that. The important thing is to design and make out the organization carefully to meet the purpose. In practical sense to do that, there may be the following five widely applicable ways of establishing the organization.

- Utilize Line (Formal) Job-related Organization for TEM purpose
- Use TPM Organization for TEM purpose
- Use TQM Organization for TEM purpose
- Add Employee Suggestion System to Energy Conservation Organization for TEM purpose
- Utilize another organization for TEM purpose

The easy and practical way may be starting from easy form of TQM, or QCC (Quality Control Circle) activities.

Furthermore, because TPM is closely related to job-related organization, (1) and (2) may be often give the same kind of results. (An example of this form is shown in Part 3, 2 "How is SGA related to Energy Conservation?" (page 21).

Step 3 : Data collection and Analysis

Before trying to make out any future programs or action plans, it is essential for the company or factory management to understand the current situation in a proper and accurate manner. This includes not only the status of their own operation but also other

relevant information such as competitors' operation, circumstances around the company and their trend in future, positioning the company itself in the local and global markets, and so on. The key steps for this purpose are shown below:

1. Collect data on current energy use and analyze them

The current data of energy consumption shall be obtained by measurement, calculation or estimation for the individual operation units (energy cost centers) with classification of kinds of energy (fuels types, utility types, etc.). The data shall be gathered regularly and arranged/summarized daily, weekly, monthly, by seasons or annually. Then the data shall be checked for the past historical trend and interpreted with relation to operational modes and production scales. That shall also be utilized for the forecast of future trends.

2. Identify Management Strength and Weakness

Then the data shall be compared with the best practice data or benchmarks in the industry. If such reference data are hardly available, the historical data of their own operation and estimated data for the competitors would be utilized for this purpose. At the same time, the strength and the weakness of the company shall be evaluated considering the competitors' situations in the local and global markets. This would serve the purpose of making out a realistic Energy Management plan later.

3. Analyze stakeholders' needs

Stakeholders are top (and senior) management, middle managers, staff/engineers and workers/operators. Other stakeholders in the normal business sense, such as the shareholders and lenders, need not be considered here for the moment. The needs and intention of those stakeholders shall be summarized and taken into consideration.

4. Anticipate barriers to implement

Making out a realistic and practical program also needs consideration of anticipated barriers for the implementation of Energy Management program or action plan. Some possible examples of such barriers are:

-Insufficient understanding and support by top management
-Insufficient understanding and cooperation of managers within factories
-Insufficient awareness of people to get successful results
-Insufficient capability of people due to lack of training
-Insufficient available technology due to lack of information
-Insufficient availability of manpower for EC activities within factories
-Insufficient budget for EC activities due to the company's financial status

5. Estimate the future trend

The future trend of energy supply-demand balance is estimated based on checking and analysis of the historical data. That data of future trend would also be a basis of the program of excellent Energy Management.

In analyzing the collected data and developing ideas of Energy Conservation, it is very often useful to think of the following techniques of finding problems and solutions:

Suppress- Using during the time in which it is not necessary to use. Examples include using electricity before or after working hours or when there is no one working.

Stop - Using equipment when it is not necessary. Examples include using all lightings during break time.

Reduce - Amount, pressure, temperature, speed, or brightness, or quality that exceed requirement. Examples include reducing intensity of lighting if not necessary.

Prevent - Prevent leakage or loss of energy. Examples include reducing space that leads to outside in order to prevent the leakage of heat into air.

Improve - Improve or repair machines to increase efficiency or modify manufacturing process to the one which enables us to conserve energy more. Examples include changing transparent sheet over the roof.

Store - Re-use the discarded energy. Examples include re-using heat from exhaust fume in order to reduce use of electric heater to warm heavy oil.

Change - Change how to use, type of energy, or energy sources to a suitable one from technical or economic point of view. Examples include changing the grade of heavy oil to an appropriate one or changing furnace systems or welding machines to the ones that use gas.

Increase production - Examples include improving production process. This will lead to the reduction of energy usage per production amount.

Step 4 : Selecting EC Measures/Projects

Based on the aforesaid understanding of the current status and position of the company (factory), various EC measures are studied and many EC Projects are proposed. Comparison among these measures and projects are made with consideration of a lot of factors, such as technical, economic, intangible, and so on.Then a plan/program is developed based on these study results. To do this, it is very important to consider the following issues:

The plan/program shall be realistic, practical and attainable with due consideration of many related elements and management resources of the company or factory. It also shall be expressed in terms of the measurable or quantifiable parameters, including Fuel Usage Index, Electricity Usage Index, Energy Usage Index, etc. It usually includes a lot of managerial measures of Energy Management (or Energy Conservation) promotion activities such as motivation techniques, means to improve awareness, training, and so on. In other

words, the following items are often useful in comparing and selecting alternative plans:

1. Effects of energy conservation: Activities that can conserve energy more than others are more promising.
2. Investment amount: Activities that require less investment are more promising.
3. Pay-back period: Activities with short pay-back period for investment amount in equipment are more promising because all energy conservation will be profits after pay-back period.
4. Length of implementation: Activities that can be performed in a short period are more promising because they do not influence production process of the factory.
5. Number of personnel required: Activities that require a large number of personnel tend to be burdensome.
6. Importance to executives and reputation of the company: Some activities provide little financial benefit but cause good image or reputation.
7. Risk of the project: Some activities bring about big financial benefits but involve high risk from various factors. In this case projects have less importance.

Step 5 : Prioritizing

Many EC measures and projects are prioritized based on the internal studies including comparison among their alternatives, in the manner explained in the above.

Step 6 : Developing an Action Plan

The priority consideration then gives birth to the Action Plan. The plan shall be clear, practical and comprehensive with proper schedule and budgeting. Shown below is an example of such a plan.

Table No 4.1: Example of energy saving plan

S. No	Detail of the plan	Length (Months)						Person in charge	Budget	Inspect by
1	Turn off electricity when there is no one around	←					→	Mr.Prayat		
2	Turn off air-conditioner 30 minutes before stop working	←					→	Miss Aom		
3	Reduce welding machine's current according to the specification of the metal used for welding	←					→	Mr. Matthayas		
4	Close welding machine after working	←					→	Miss Thanom		

Step 7 : Training the related members

This issue is very important to secure the success of project Implementation, because the people are the most important resources that determine the success of the plan.

Step 8: Awareness-raising and Motivation

To have the total power of "all members' participation" combined together, it is also very crucial how to raise awareness and motivation of related people within the company (or factory). Shown below is an example of awareness raising plan.

Table No 4.2: Example of awareness raising campaign

S. No	Detail of the plan	Length (Months)						Person in charge	Budget	Inspected by
1	Display the results of energy conservation every month							Mr.Prayat	-	Mr. Laaied
2	Evaluate every month							Miss Aom	-	Mr. Laaied
3	Perform energy conservation activity every 6 months							Mr. Matthayas	-	Mr. Laaied
4	Perform "Finding measures" activity in order to make energy conservation plan							Miss Thanom	-	Mr. Laaied
5	Provide rewards to sections that have achieved high efficiency								-	

Step 9: Implementing the Action Plan (including monitoring and controlling)

The organizational force established in the said planning step shall be utilized fully to ensure smooth implementation of the program. Energy Manager and/or the committee shall continue working to promote the activities and report to top management on the status quo. The actual records of implementation shall be closely watched and monitored.

If some problems arise, or some variance between the planned figures and the actual record is observed, then necessary actions shall be taken immediately.

Step 10: Evaluation (Management Review)

After the program is completed, the report shall be submitted to the top (senior) management. The results shall be assessed and analyzed for any good and bad points. The lesson shall be utilized as a feedback in the subsequent plan/program.

Thus the activities are repeated to form a cyclic movement. The result of evaluation must be announced on the board in order to inform employees, so that they will be given motivation for the next activities. Evaluation can be divided into 2 types as follows.

- Short-term evaluation for the follow-up of the performance
- Long-term evaluation for the evaluation of the whole project that will be used for the future planning

Evaluation can be made in the following 3 levels.

1. Self Audit: Self evaluation that is made in a small group or a department based on the predefined form. (Inspection may be made every month.)
2. Upper Manager Audit: Evaluation that is made by the section/department manager intended to raise performance of the activity. (Inspection may be made every 3 month.)
3. Top Management Audit: Evaluation made by the executives of the organization that will be used for the evaluation of annual bonus. (Inspection may be made every 6 month.)

In some cases, top management could think of adopting external people (outside consultants) to evaluate the results of Energy Conservation activities. Even in those cases, internal evaluation should be made to gain the fruits as much as possible.

Step 11: Analysis for future planning (Standardization and Dissemination)

The successful results and the lessons learned are to be analyzed and arranged into the standard form which can be easily utilized by anyone in the factory. The standardized documents or information are to be disseminated all over the company.

Moreover, Energy Conservation should be incorporated as a part of daily jobs and performed continuously in a systematic manner. For this purpose, activities for energy conservation must be incorporated as a part of company's basic or business plan. If a problem is found as a result of evaluation, improvement or modification will be done and the objectives will be achieved. If the results reach or exceed the objective, information must be gathered in order to set it as a "Work Standard," which will be used in setting a new activity plan.

4.4 Small Group Activities (SGA)

Small Group Activity (SGA) gives employees the problem solving tools they need to eliminate obstacles to Total Productivity, the cumination of zero break-downs, zero defects, and zero waste. Enterprising employees identify the problem, be it in "man, material, method, or machine," and develop cost-effective and practical methods for solving the problem.

4.4.1 Importance of SGA:

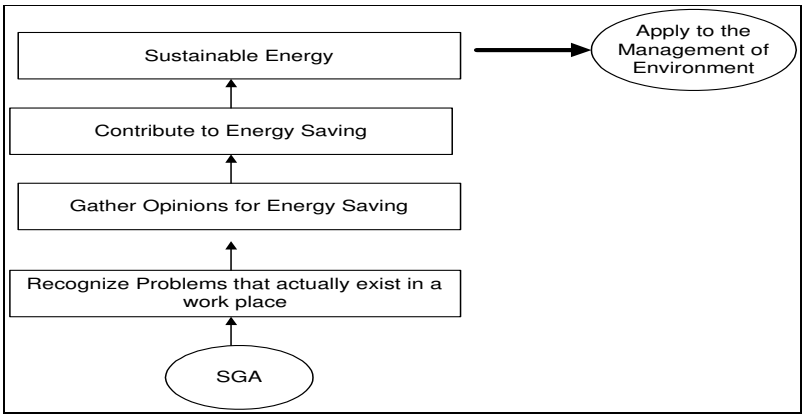
SGA are activities by group of employees at operator (working Group) level. They aim to solve problems that occur at the place taken care of by each employee and put emphasis on participation and team work. Factories can apply small group activities to many kinds of work along with normal work or other measures that are already underway. The burden on

employees will not increase because of small group activities. They are not only bringing benefits to factories but also boosting the knowledge and ability in performing jobs of employees, improving communication among employees, increasing creativity, and make it possible to express their own proposal with less hesitation to management. As a result, employees will start to think "This is our problem." This SGA can be applied to Energy Conservation, too, with successful results, as shown in Figure 13.

4.4.2 How SGA leads to Energy Conservation? :

An excellent example of organizational structure that promotes energy management emphasizing participation is that they form overlapping small groups as in figure 14. The feature of this structure is that a small group for energy management is distributed to various sections as in figure 15, which is a recipe for success of Total Energy Management (TEM) and makes various communications and management of activities more efficient and effective.

Fig.No 4.3 Relationship of SGA and Energy savings



Small group activities for total energy management (TEM) are the activities in which employees of all levels in production or management, starting from the top to the bottom, participate in order to reduce loss related to their own job by improving their job. In order for the activities to succeed, management of all levels must provide support in necessary training and equipment, communication of policies, and the setting of problems to solve.

Small group activities for TEM can be divided into 4 or 5 levels depending on the scale of the organization. This division is in order to emphasize the fact that everyone must improve in their job under the responsibility to each other. It also enables us to make improvement

without overlapping. The following example shows utilizing the existing job-related organization as much as possible.

Fig. No 4.4 Example of Organizational Structure with Overlapping

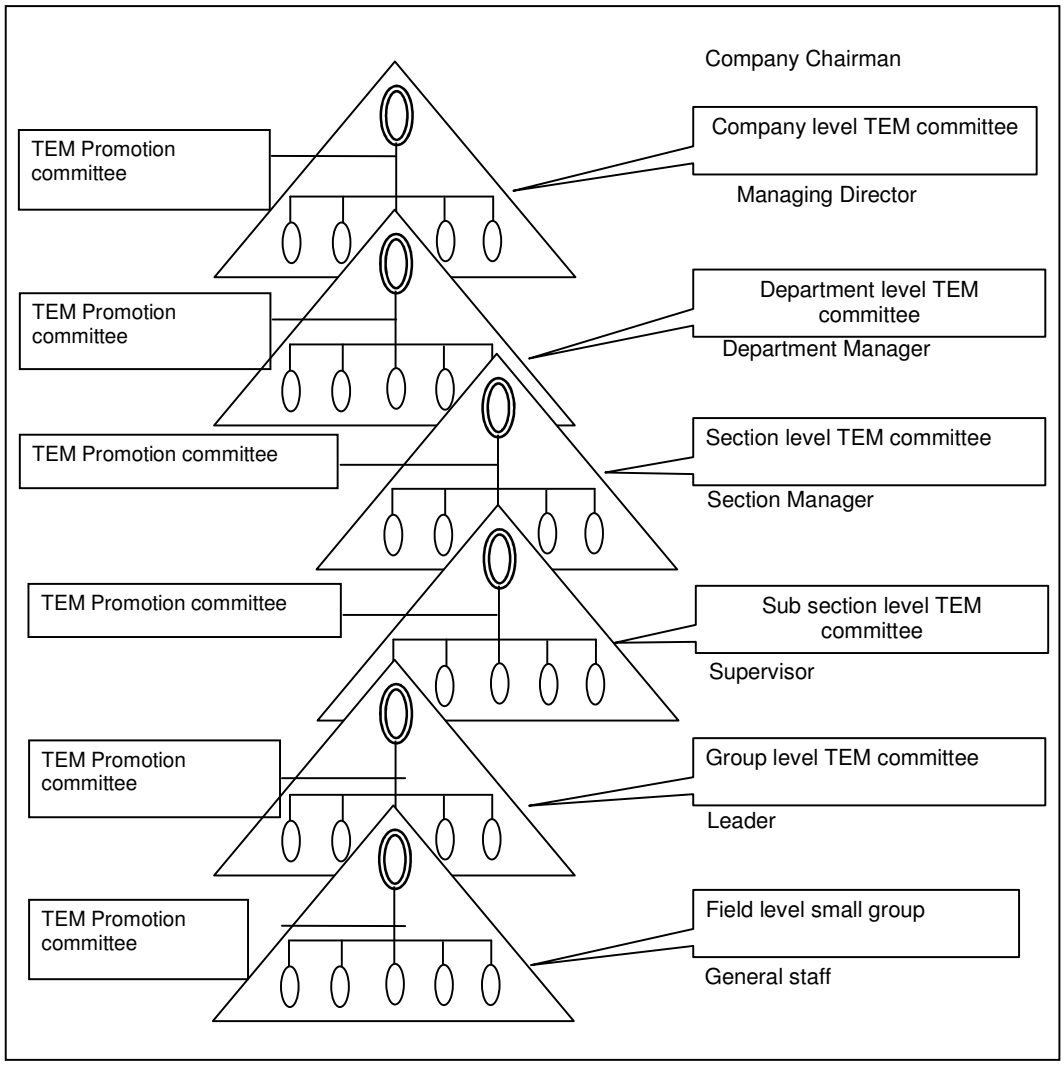
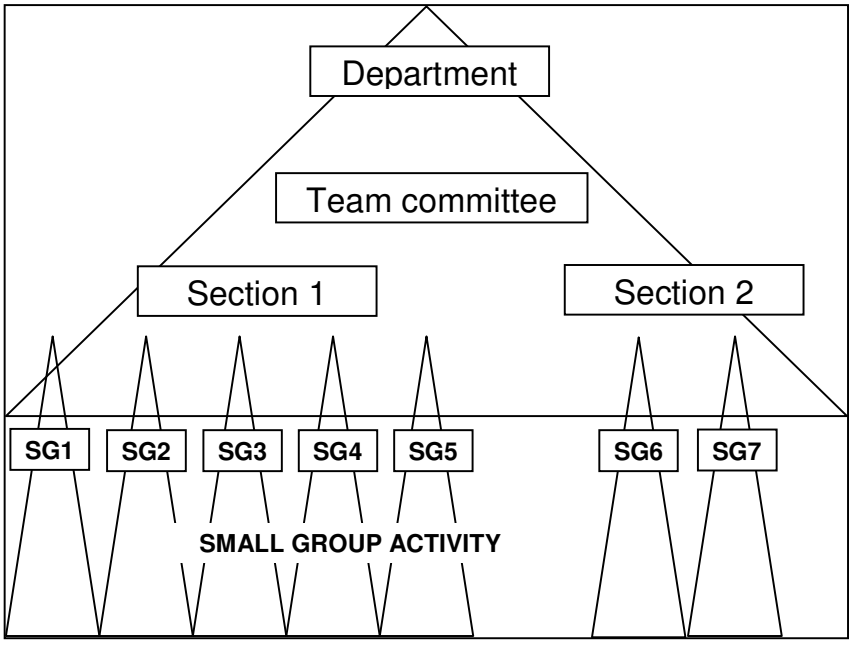


Fig.No 4.5 Positioning of SGA in Main Job Structure



4.4.2.1 Executives level

- Define the policy and target for Total Energy Management
- Follow-up and manage activities to make sure that activities are implemented according to the policy
- Consider opinions and suggestions from the promotion office
- Consider reports from promotion committee from various levels

4.4.2.2 Level of Total Energy Management promotion office

- Make sure that whole activities are done in the correct direction, without delay and smoothly
- Find a suitable method that makes it possible to implement activities continuously and without slowdown
- Listen to opinions and suggestions from small groups in order to use for improving
- Provide advice for Total Energy Management to various groups
- Persons in charge of the office must be those with good personal relationship, friendly, and with spirit of good service

4.4.2.3 Medium level

- Define the policies of each department that are consistent with the policy of the Total Energy Management and the target of the company
- Define numerical targets to sub-groups apart from the target of the company as a whole
- Follow-up the progress in order to provide to sub-groups
- Report the progress along with suggestions and opinions to upper level committee periodically

4.4.2.4 Workers/Operators level

- Implement small group activities with various themes and achieve target
- Report progress and problems encountered during implementation to upper level committee periodically
- Ask for support, suggestions, and opinions from upper level committee

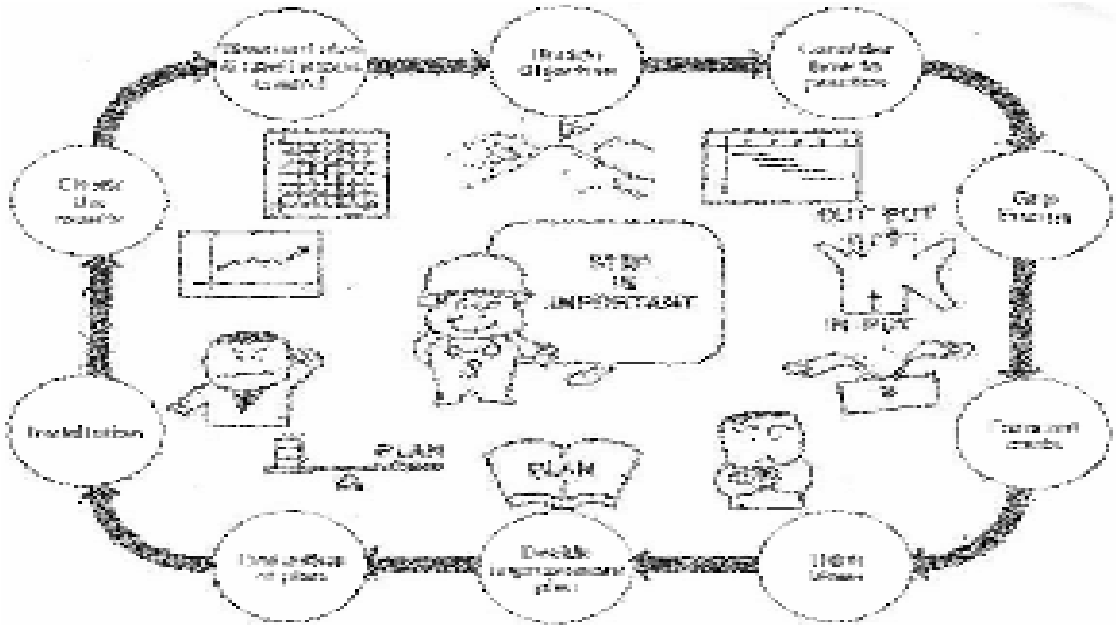
4.4.2.5 Responsibility of Energy Conservation committee

- Gather and analyze information on costs related to energy every month
- Analyze and solve problems related to energy
- Find a method for energy conservation
- Prepare energy conservation plan
- Follow-up the result of implementing the plan
- Perform activities such as public relationship for encouraging employees to participate
- Offer training to small group in each department

4.5 Steps of Small Group Activities for Energy Conservation

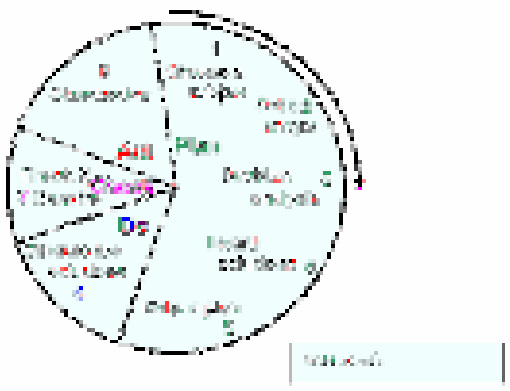
Small group activities for Energy Conservation can be done by using “10 Stages for Success”, based on “PDCA Management Cycle”, as shown below and in pictorial forms

Fig.No:4.6 PDCA Management Cycle



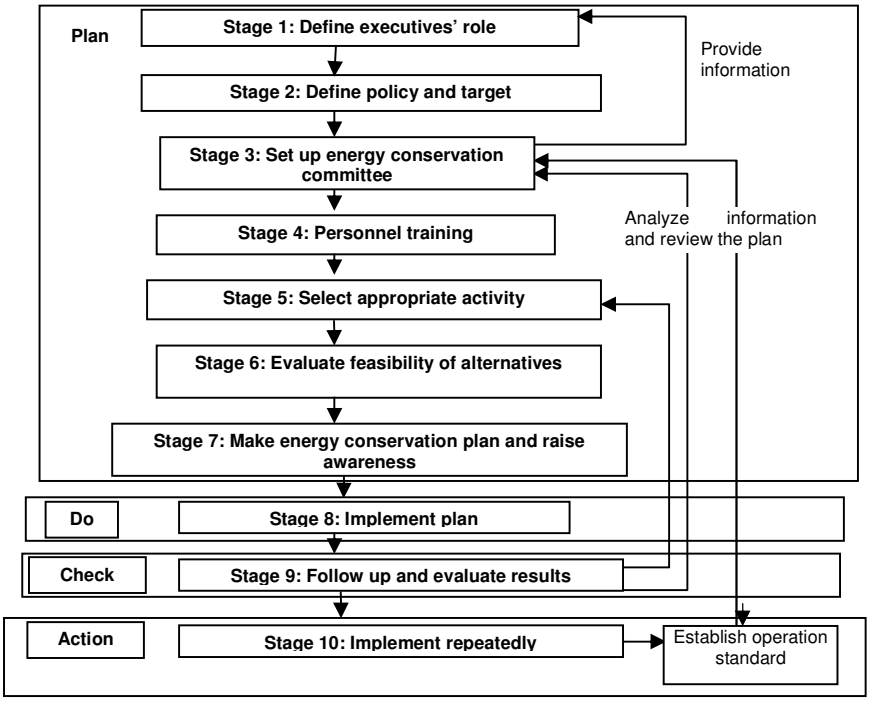
- Plan: Make an efficient plan in order to improve operation
- Do: Implement according to the plan
- Check: Check if implementation was according to the plan
- Act: Judge what to improve, what to learn and what to do from what we have checked

Fig No: 4.7 SGA Circle



Please note that these stages are substantially the same as “Key Steps” explained earlier, but put more stress on utilization of SGA. So readers could read and use either method up to their preference.

Fig:4.8 Ten Stages for Success



4.5.1 Stage 1: Define Executive's Role:

In promoting small group activities, support must be provided such as basic environmental support. Therefore, executives must provide follow up support to employees of their companies.

- Establish a special unit that provides support to small group activities
- Prepare a system for managing small group activities in the company
- Prepare annual plan for small group activities
- Prepare a venue for meeting, consultation, advice or suggestion
- Establish a system for giving rewards to high achieving employees
- Establish a reporting system starting from informing what to do until reporting of the results
- Establish a fair system for evaluating results
- Establish a system for providing support and training to employees

4.5.2 Stage 2: Define Policy and Target

- Executives must announce a policy of supporting small group activities.

- Energy conservation committee must act as an advisor in order to set a numerical target that is consistent with total energy management (TEM) policy and the target of the organization. Specific targets must be set for each group.

We can see that responsibilities in stages 1 and 2 are mainly those of executives and committee. Responsibility of employees will become clearer from stage 3 and afterwards.

4.5.3 Stage 3: Set up Energy Conservation Committee:

The principle of small group activities (SGA) is to divide into groups based on the scope of responsibility. The size of the group will depend on the size of organization. However, size of the group should not be too large. Usually a size of 5 to 10 persons is considered appropriate. It is important to define responsibilities clearly so that every member of the group can have their responsibility and participate in the activities.

4.5.4 Stage 4: Personnel Training:

This stage will help employees to have more knowledge and understanding, have new ideas, and have more belief in their own responsibility.

4.5.5 Stage 5: Select Appropriate Activity

In doing small group activities, each member must be able to think, express their own ideas, and make decisions based on reality and by investigating electrical equipment, machines, and office equipment that exist in the area of their responsibility. Items to consider include size, number, where to use, situation of usage, current situation, and the number of hours usage per day. By this we can evaluate the current situation of energy usage. Also by judging if there are more machines than needed, we can choose suitable activities and real problems for the organization.

4.5.6 Stage 6: Evaluate feasibility of alternatives (Analyze problems and decide on the measures and activities in each point):

Each group will gather ideas on the reasons for the problems, obstacles, and how to solve problems in order to decide on the problems, measures, and importance of activities and thus evaluate on the feasibility of activities to do based on advice from department manager. Basically, the following activities are not suitable for small group activities.

- Highly technical issues
- Issues that require a long time or many people to implement

We have identified the following problems through small group activities.

- Issues on material quality or production that influence energy usage
- Behavior on energy usage
- Efficiency of machines or equipment that uses energy
- Awareness toward environment and energy usage
- Safety costs for energy conservation

4.5.7 Stage 7: Make Energy Conservation Plan and Raise Awareness

Each group must prepare its activity plan. Generally, implementation for small group activities takes 6 months to 1 year. Activities to be implemented should correspond to the objectives of each group. Besides, it might help to listen to opinions of all organizations in order to receive support from all other organizations.

4.5.8 Stage 8: Implement Plan

Implement according to the plan of each group.

4.5.9 Stage 9: Follow Up and Evaluate Results

After implementing the plan, each member of small groups will follow up and evaluate the result by analyzing result, search for strong and weak points of activities, find a way to improve the activities and report on general achievement.

4.5.10 Stage 10: Implement Repeatedly

Energy conservation is an activity that must be implemented repeatedly. Therefore, it is necessary to implement each activity repeated and make improvement to each activity. If we are satisfied with the results, by achieving the objectives of activities, we should provide rewards in order to give motivation for continuing the small group activities and implement creative activities.

Dos and Don'ts in Energy Conservation

- Don't emphasize the mistakes in the past. It is better to talk about the present.
- Don't be worried about the theory or principles. Don't spend too much time in discussion or analysis of problems in meeting rooms.
- Don't think that an activity can be done perfectly from the beginning. It is necessary to do the job continuously by having experiences and judging by ourselves.
- Do start with an activity that requires small amount of investment.
- Do Raise awareness so that all employees understand the necessity and importance of energy conservation and participate in it.
- Do start the activity now without postponing to tomorrow.

4.6 Tools Used Often for Small Group Activities for Energy Conservation

4.6.1 5S:

5S is a contraction derived from the Japanese words **Seiri, Seito, Seiso, Seiketsu,** and **Shitsuke**. It is simple methodology that is also extremely useful in practical and realistic life. 5S is a set of actions to be followed through every day activities to advance the operational surroundings and circumstances. 5S is made in order to provide fortification to every personage in diverse profitable and industrialized fields. 5S is an extremely practical contrivance and skill set for anyone who wants to generate a more prolific environment within the workplace or who wants to make it their profession to make other people's businesses more proficient and productive. 5S occupy a list of products including eyewear, ear protectors and safety gears. Look into these different products that make up the significance of an industrialized security supply. Lean Six Sigma experts promise or guarantee for the efficiency of 5S as an enlightening enhancement to better working surroundings in an association. If you dig up Six Sigma guidance that is paid for by your company, you will be in a position to work for your company and make things better for you as well as for everyone. 5S is very useful in lots of industries and job markets, but can often fail simply because of the lack of recognition concerning changes in the office.

Fig No:4.9 Five S's

5S consists of five steps that are crucial for the completion of 5S. The 5S steps are described as follows-

1. Seiri / **Sort**- This is very logical term in, which identification of the contents take place, data base of the products have been created and, then any kind of sorting take place just to arrange the products and removal of unwanted items. Classification of the products is

necessary, which is called Red Tagging. It is important just to identify factors, right from whether it is needed, existing amount obligatory amount, occurrence of necessity, and so on.

2. Seito / **Systemize**- This step in 5S process consists of removal of unwanted items permanently and one more task that to be take place is decision that means you have to decide that what is required to be in what place. Place the items in such manner that you could retrieve them within 30 seconds of requirement.

3. Seiso / **Brush away**/ **Sweep**- Examine al the items on the daily basis. The process is not that much time consuming, but essential to clean up your workplace and most required in 5S. The conscientiousness to keep the office clean should be circulated between everyone in the group.

4. Seiketsu / **Homogenize**- This important step of 5S involves the visual control, which is important to keep your organization well- organized and clean. It is a complete evaluation to improve the working conditions.

5. Shitsuke / **Self Control**- This step is quite essential, but critical because it involves all the discipline to ensure the 5S standards, it also takes charge of dedication and commitment.

4.6.2 QCC (Quality control circle):

QCC (Quality control circle) means controlling quality through group activities. For this, it is necessary to work hand in hand and achieve objective quality or customers' request. With this, we can find weak points, find the cause of problems, gather ideas for problem solving and systematically prepare quality and thus, solve problems such as material loss, production costs, working hours, or productivity. This is also a very useful tool to tackle with Energy Conservation problem. So many factories or institutions are encouraged to utilize this tool.

5. CONCLUSION

5.1 Conclusion

5.2 Summary

The summery of energy saving proposals are based on Energy use and Technology Audit conducted in Ice Making Plants located in Bhimavaram is presented which include identified energy conservation measures, its energy and monetary benefits, pay back period and expected no of units to be implemented with investment. Based on the 15 identified energy conservation proposals in Ice making Cluster, the total energy saving potential in ice making cluster is 7.32 lakhs kWh/year which is equivalent to 63.03 TOE/year. The total investment required for implementation of energy saving proposals in Ice Making Cluster is Rs.98 Lakhs.

Based on energy saving proposals and interaction made with Ice making plant Owners in ice making cluster at Bhimavaram, total expected energy savings proposals in the cluster is 65 proposals with different Technologies and expected energy savings from these energy conservation technologies are Rs.22.72 Lakhs kWh /year which is equivalent to 196 TOE/Year. The payback period for these energy conservation Technologies will be in the range of 1 year to 14 years depends up on the energy savings and investment.

Table No 5.1: Summary of energy Savings in Ice Making Plants

S.No	Name of DPR	Capacity	Energy Savings per Ice plant			Expected units to implement	Total Savings			
			kWh/ Year	TOE	Investment cost Rs.		TOE	Investment Rs. Lakhs	kWh/ year	Pay back in Yrs
1	Energy Efficient Motor for Compressor	60HP	8450	0.73	137811	10	7.30	13.78	84500	4.35
2	Energy Efficient Motor for Compressor	75 HP	12162	1.05	175390	5	5.25	8.77	60810	3.85
3	Energy Efficient Motor for Compressor	150HP	23182	1.99	315285	2	3.98	6.31	46364	3.63
4	New Refrigeration Compressor	KCX2	21452	1.85	360000	5	9.27	18.00	107260	4.48
5	New Refrigeration Compressor	KCX3	26034	2.25	387285	3	6.75	11.62	78102	3.97
6	New Refrigeration Compressor	KCX6	40561	3.50	437457	2	7.01	8.75	81122	2.88
7	Solar Water Pump	1400 Wp	5282	0.45	277900	5	2.25	13.90	26410	14.03
8	Solar Water Pump	2400Wp	9604	0.83	514364	2	1.66	10.29	19208	14.28
9	Tube Ice Plant	5 TPD	142800	12.28	2400000	3	36.84	72.00	428400	4.48
10	Tube Ice Plant	10TPD	197400	16.97	1900000	3	50.91	57.00	592200	2.57
11	Tube Ice Plant	15 TPD	220500	18.96	2400000	3	56.88	72.00	661500	2.90
12	Variable Frequency Drives for Compressor Motors.	60 HP	6071	0.52	133000	5	2.62	6.65	30355	5.84
13	Variable Frequency Drives for Compressor Motors.	75HP	6674	0.58	172900	5	2.88	8.65	33370	6.91
14	Variable Frequency Drives for Compressor Motors.	150HP	11286	0.98	207480	2	1.95	4.15	22572	4.90
15	Energy Efficient Motor for Agitator	5HP	1266	0.11	12577	10	1.09	1.26		2.65
	Total		**732724**	**63.05**	**9831449**	**65**	**196.64**	**313.11**	**2272173**	**1 – 14**

5.3 Awareness on Energy Conservation and Energy Efficiency technologies in Ice making Cluster -Bhimavaram

In Bhimavaram, Ice making Plants owners and operators doesn't have awareness on energy conservation and about energy efficiency improvement technologies which are applicable to ice making plants. Though the clusters units are in operation since last 4 decades, no single program on energy efficiency either from the local bodies or central government had been conducted in the cluster. The Ice plant owners could not implement EE technologies, as the units are more concerned for uninterrupted production and low investment options.

Annexure 1

Technical Calculations

1. PUMP CALCULATIONS

Step 1: Calculation of the Hydraulic power of pump

Flow of the pump: Q m^3/hr
Head of the pump: H m
Acceleration due to gravity: 9.81 m/s^2

Hydraulic power of pump $= \frac{[Q \times H \times 9.81]}{3600}$

Step 2: Calculate the Efficiency of Pump Set.

Motor Power: Pm kW
Efficiency of Pumps set (Over all Efficiency) =η

I.e. Over all efficiency η $= \frac{[Q \times H \times 9.81]}{[3600 \times Pm]}$

Note: over all efficiency of pump set = motor efficiency x pump efficiency

$\eta_{Pset} = \eta_{motor} \times \eta_{Pump}$

Step 3: Saving calculation for Pump Set.

Measured input power of the old pump set = $P_{old\ pump\ input}$ kW
Measured input power of the new energy efficient pump set = P new pump input kW
Annual energy saved in kWh= (P old pump input kW - P new pump input kW) x Working hour x Annual working days

2. CALCULATIONS FOR MOTOR

Step1: Calculation of Motor Loading.

Rated power of the motor = P'_m hp
Rated power of motor = P'_m x 0.746
= P_m kW
Rated Efficiency of motor = $\eta_{motor\ rated}$
Rated Input Power of the motor = P_m kW ÷ $\eta_{motor\ rated}$
= $P_{m\ input}$ kW
Measured input power = $P_{m\ measured}$ kW

Percentage loading of motor $L_M = \frac{Pm\ measured}{Pm\ input}$ %

Step 2: Calculation of motor efficiency.

Approximate Output hp = % loading x Rated hp
$= L_M \times P'_m$ hp

Motor efficiency $\eta_{\text{motor measured}} = \frac{\%\ \text{Loading} \times P'm\ hp}{Pm\ \text{measured kW}}$

Step3: Saving Calculation by replacing EE motor.

Measured input power of old motor = $P_{\text{oldm measured}}$ kW
Rated power of EE Motor = P'new motor hp
Rated power in kW = P' new motor x 0.746
= P new motor kW

Rated Efficiency = η new motor rated
Rated Input power of the EE motor = Pi/p new motor
= P new motor kW ÷ η new motor rated
Actual input power of EE motor = Pi/p new motor x loading%
= PA i/p new motor

Annual saving in kWh
= ($P_{\text{oldm measured}}$ kW - PA i/p new motor) working Hr x no.of working days

Annexure – 2

Local Service Providers

S.No	Machinery / equipment	Name of the Manufacturer / Supplier	Contact Address	Telephone
1	**MOTORS**	Siemens India LTD	5-9-19 4TH Floor Laxmi Narasignh Estate, Opp.Secretariat, Saifabad, Hyderabad – 500004	(040)-23482500, 23482501
2		Beekay Electrical	S No 6-3-131/4, Opp Sbh Narsapur X Roads, Bala Nagar, Hyderabad – 500037	(040)-64506800 , 9848507027
3		Laxmi Traders	G M Complex, Opp RTC Colony Bus Stop, Main Road, Hayat Nagar, Hyderabad – 500036	9346936977, 9948696021, 9177607477
4		Deccan Electricals	7-2-629 & 630, 1ST Floor, Opp To Bharat Petrol Bump, R P Road, Hyderabad – 500003	
5		Sri Gurudatta Electricals	Shop No 10, Pb No 165 Opp Gandhi Park, Convent Street, Vijaywada – 520001	(0866)-2563811, 2561932
6		Lakshmi Sainadh Engineering Co	12-15-25, Opp Tpet Goods Shed 1, Main Bazar, Vijaywada – 520001	(0866)-6569370
7		Sabari Marketing Services	St Pauls Complex, Nirmala Convent Road, Convent Street, Vijaywada – 520001	(0866)-2482733
8		Supreme Electricals	5-1-464/C, Opp Vivekavardini College, Jambagh Road, Koti, Hyderabad – 95	(040)-66566621 9849221884
9		Agarwal Trading Co	5-1-13,	(040)-

S.No	Machinery / equipment	Name of the Manufacturer / Supplier	Contact Address	Telephone
			Near City Light Hotel, R P Road, Secunderabad, Hyderabad – 500003	27711140, 66331140
10	**RAWWATER PUMPS**	Vasavi Pumps	2-85, Mannan Complex, Beside Big C Mobile, Below Reliance Web World, Chanda Nagar, Hyderabad – 500032	(040)-65281162 9866087564
11		SRI Balaji Pumps & Motors	Siddamsetty Sadan, Hyderbasti Opp Mody Motors, R P Road, Hyderabad – 500003	
12		C.R.I. Pumps Private Limited	76-13-27 By-Pass Road , Joji Nagar, Vijayawada,- 520012	
13		Compton Greaves LTD	No 94, 4TH Floor, Minerva Complex, Nr.park Lane, S D Road, Hyderabad – 500003	0(40)- 40002300, 40002324, 40002347, 40002345
14	**RAWWATER PUMPS**	Laxmi Narasimha Electricals	4-2-82, Behind BPCL Pump, Near Bata Show Room, Old Bhoiguda, Hyderabad – 500003	(040)- 66176907, 27719577
15		Clarion Enviro Technologies	Shop No 2 & 3, Beside Bible House Traffic Police Station Lane,Hyder Basti, R P Road, Hyderabad – 500003	(040)-64535747
16		Balaji Enterprises	Shop No 45, Al Karim Trade Cetre, Ranigunj, Hyderabad – 500003	(040)- 27543355, 27544455
15		Raju Enterprises	Shop No.12 Mk Baig Complex,, Convent Street, Vijayawada – 520001	(0866)- 6657877, 6657979

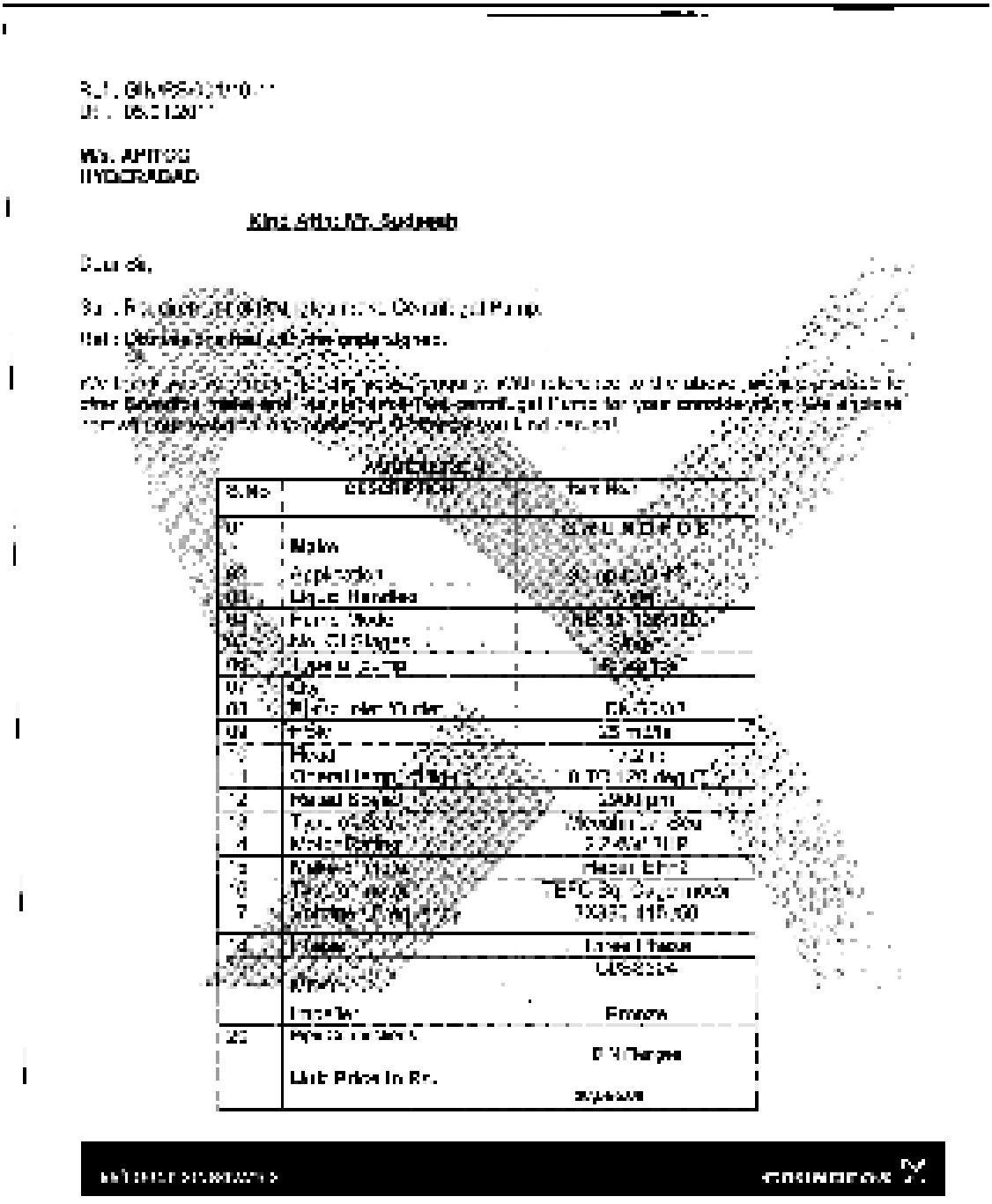
S.No	Machinery / equipment	Name of the Manufacturer / Supplier	Contact Address	Telephone
16		Vinayaka Engineering Company	12-4-6/1, Behind Gandhi Park Tarapet, Sk Ummer Street, Vijayawada – 520001	(0866)- 6667010, 6657887
17		Global Engineers	Shop No 3, 2ND Floor, Mazumdar Complex, Beside Durga Estate, Governerpet, Vijayawada – 520002	(0866)-2572834
18		Sri Kusuma Haranath Engineering Company	12-2-279, Brp Road, Convent Street, Vijayawada – 520001	(0866)- 2566435, 6620118
19	**COMPRESSORS**	Sri Sai Refrigeration	No. 25-30/1/ A, Mayuri Nagar, R. C. Puram, Hyderabad - 500 032,	9963450006 9848887715
20		Compressor Care	Flat 421, Gaddinnaram, Bharadwaja Complex, Dilsukhnagar, Hyderabad – 500036	(040)-66634304
21		Tecumseh Products India Ltd	6-1-103/46/47, Balanagar Township, Bala Nagar, Hyderabad – 500037	(040)- 23078103, 23078104, 23078105
22		Naulakha Refrigeration	No 6, Plaza House, 61/A, M G Road, Hyderabad – 500003	(040)- 27710113, 66381211
23		Trade Links	5-4-76/3, 4, 5 First Floor opp TVS Honda Show Room , MG Road, Ranigunj Secunderabad -500003	
24		Kirloskar Refrigeration	S.No 3-5-907, Flat No. 403/4 Mahavir lok Himayat Nagar Hyderabad -500029	

S.No	Machinery / equipment	Name of the Manufacturer / Supplier	Contact Address	Telephone
25	**TUBE ICE PLANTS**	Vijaya Laxmi Engineers	HNo: 24-110/10/A, Sy No: 552, Laxmi Narayana Colony, IDA, Uppal, Hyderabad – 500013	9052286390
26		Super Refrigerators (India) Ltd	Wh-62, Mayapuri Industrial Area, Phase-1 Delhi - 110 064	(011)-45595079
27		Premier Refrigeration Systems	1, Akurli Industrial Estate, Akurli Road, Kandivli East, Mumbai, Maharashtra - 400 101	(022)-28870304 28874298 28864250
28		Guru Dev Ice Cans Refrigeration Industries	No. 20 Rainbow I. E., Opposite Seepz, Behind Floral Deck Plaza, MIDC, Andheri East, Mumbai,	(022)-28230278 28371274
29	**SOLAR WATER PUMPS**	Microscan Technologies Private Limited	2-1-414/A2, Street No.4, Nallakunta. Hyderabad – 500044	(040)-66683339, 09246577445
30		Veddis Solars	Plot No. 13, MCH No. 2-48/2/13, Telecom Nagar, Gachibowli Hyderabad	(040)-30098766, 9000343938
31		Anu Solar Power Private Limited	No.1-2-288/23/4, Domalgoda, R.K. Mutt Marg, Near Indira Park., Hyderabad	(040)-66682992 40128440
32		Sukruta Agencies	No. 8-3-970, Suite No. 301, 3rd Floor, Sri Sai Complex, Srinagar Colony Main Road, Hyderabad	(040)-40272020 40272021

S.No	Machinery / equipment	Name of the Manufacturer / Supplier	Contact Address	Telephone
33		M V Technologies	6-3-1198/A, Uma Nagar, Kundan Bagh, Hyderabad – 500001	9848125741
34		Deccan Solar Power Industries	6-3-349/24 H 34, Road No 1, Banjara Hills, Hyderabad – 500034	(040)-3356967, 23830616, 23359913
35		Sun Possible	1/3, 1st Floor , Plot No. 57, Laxmi Nagar Colony , Willington Road, Picket , Hyderabad	9951971777

Annexure 3

Quotations



Ms. APITCO
HYDERABAD

Kind Attn:Mr.Sudheer

Dear Sir,

Ref : Quotation for Ball valves as per enquiry.

S.No	Description	Part No.
01	Body	CF8M
02	Ball	CF8M
03	Stem	SS316
04	Seat	PTFE
05	Gland	SS316
06	Gland Flange	SS316
07	Lever Clamp	SS316
08	Lever	SS316
09	Gland Nut	SS316
10	Gland Bolt	SS316
11	Gland Washer	SS316
12	Gland Spring	SS316
13	Gland Stud	SS316
14	Gland Nut	SS316
15	Gland Washer	SS316
16	Gland Spring	SS316
17	Gland Stud	SS316
18	Gland Nut	SS316
19	Gland Washer	SS316
20	Gland Spring	SS316
21	Gland Stud	SS316
22	Gland Nut	SS316
23	Gland Washer	SS316
24	Gland Spring	SS316
25	Gland Stud	SS316
26	Gland Nut	SS316
27	Gland Washer	SS316
28	Gland Spring	SS316
29	Gland Stud	SS316
30	Gland Nut	SS316
31	Gland Washer	SS316
32	Gland Spring	SS316
33	Gland Stud	SS316
34	Gland Nut	SS316
35	Gland Washer	SS316
36	Gland Spring	SS316
37	Gland Stud	SS316
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39	Gland Washer	SS316
40	Gland Spring	SS316
41	Gland Stud	SS316
42	Gland Nut	SS316
43	Gland Washer	SS316
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93	Gland Stud	SS316
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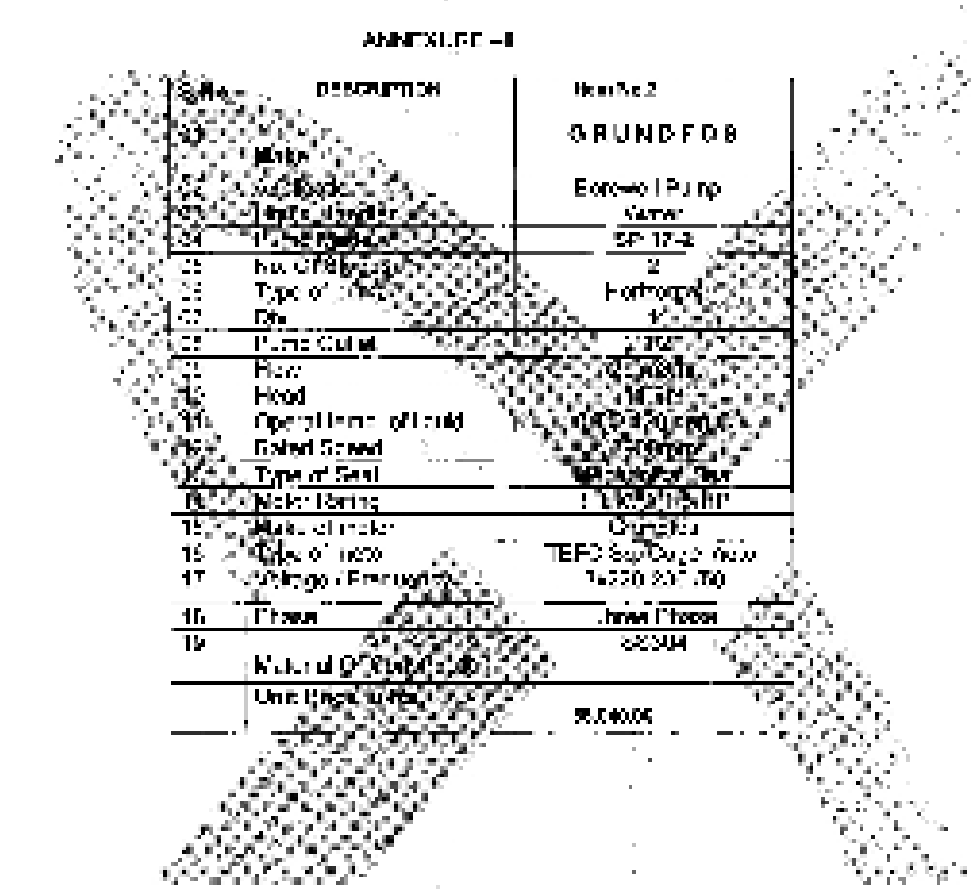
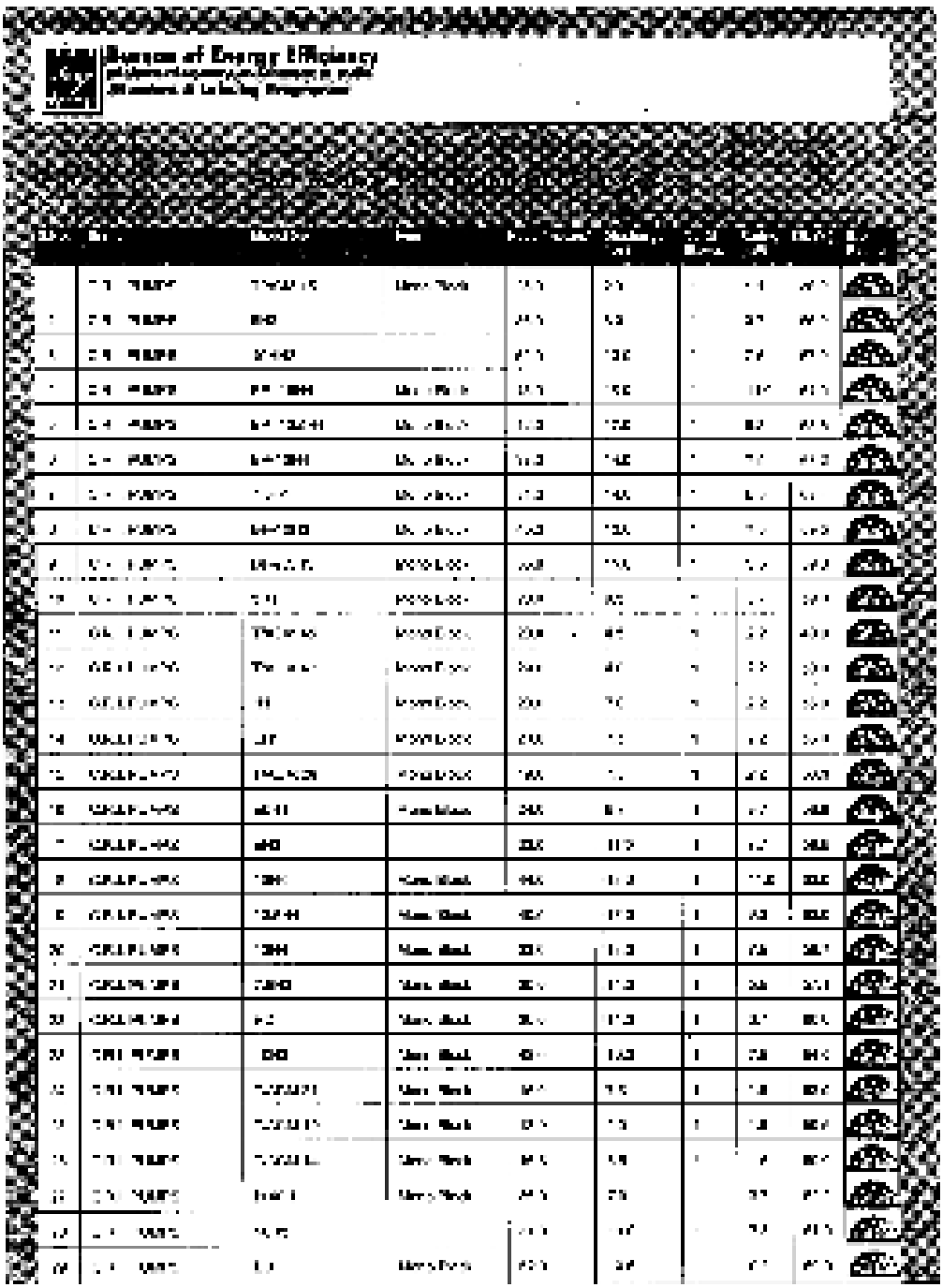

GRUNDFOS

Terms & Conditions :

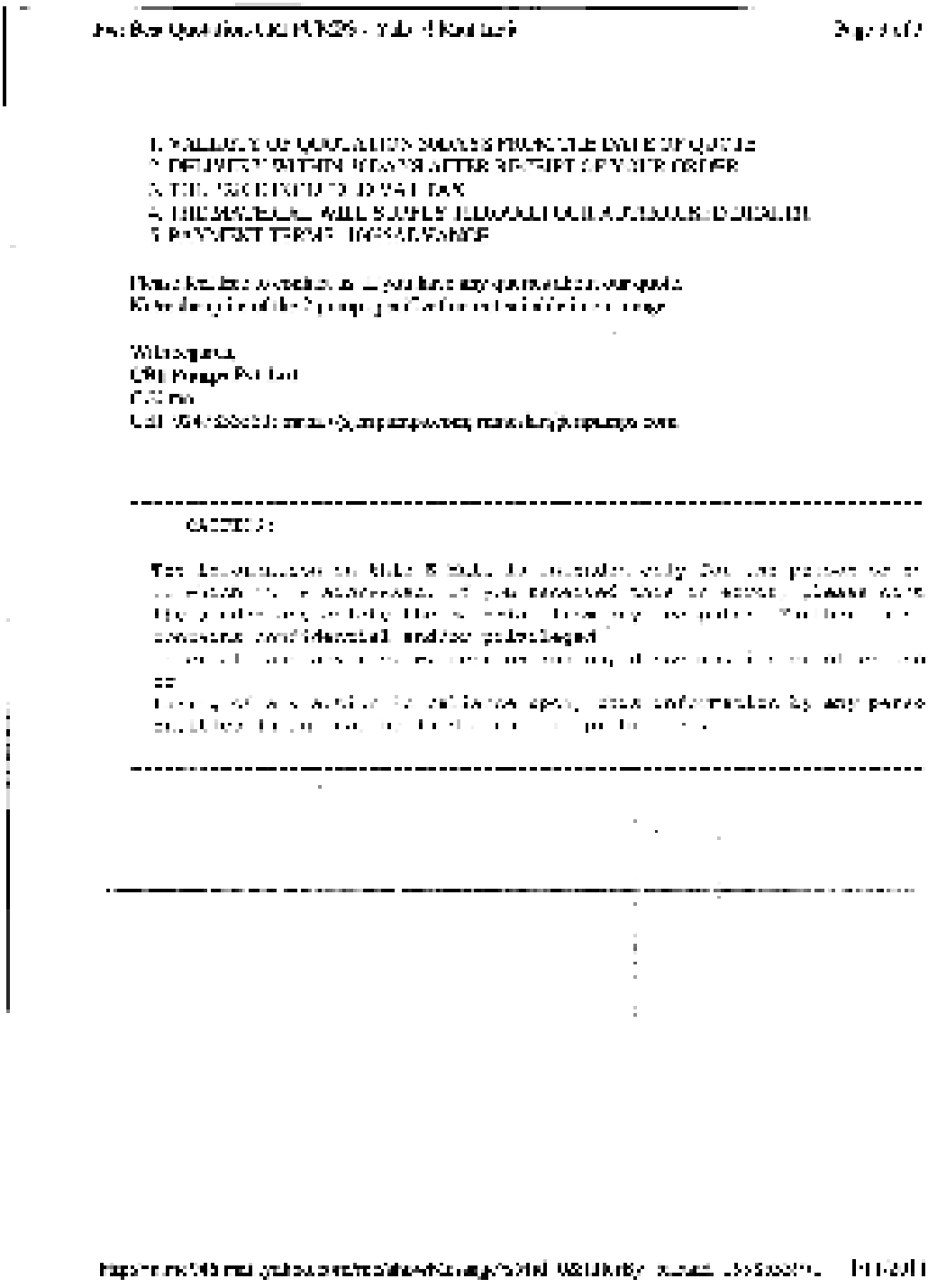
Thanks & Regards,
For Grundfos Pumps India Pvt. Ltd.,

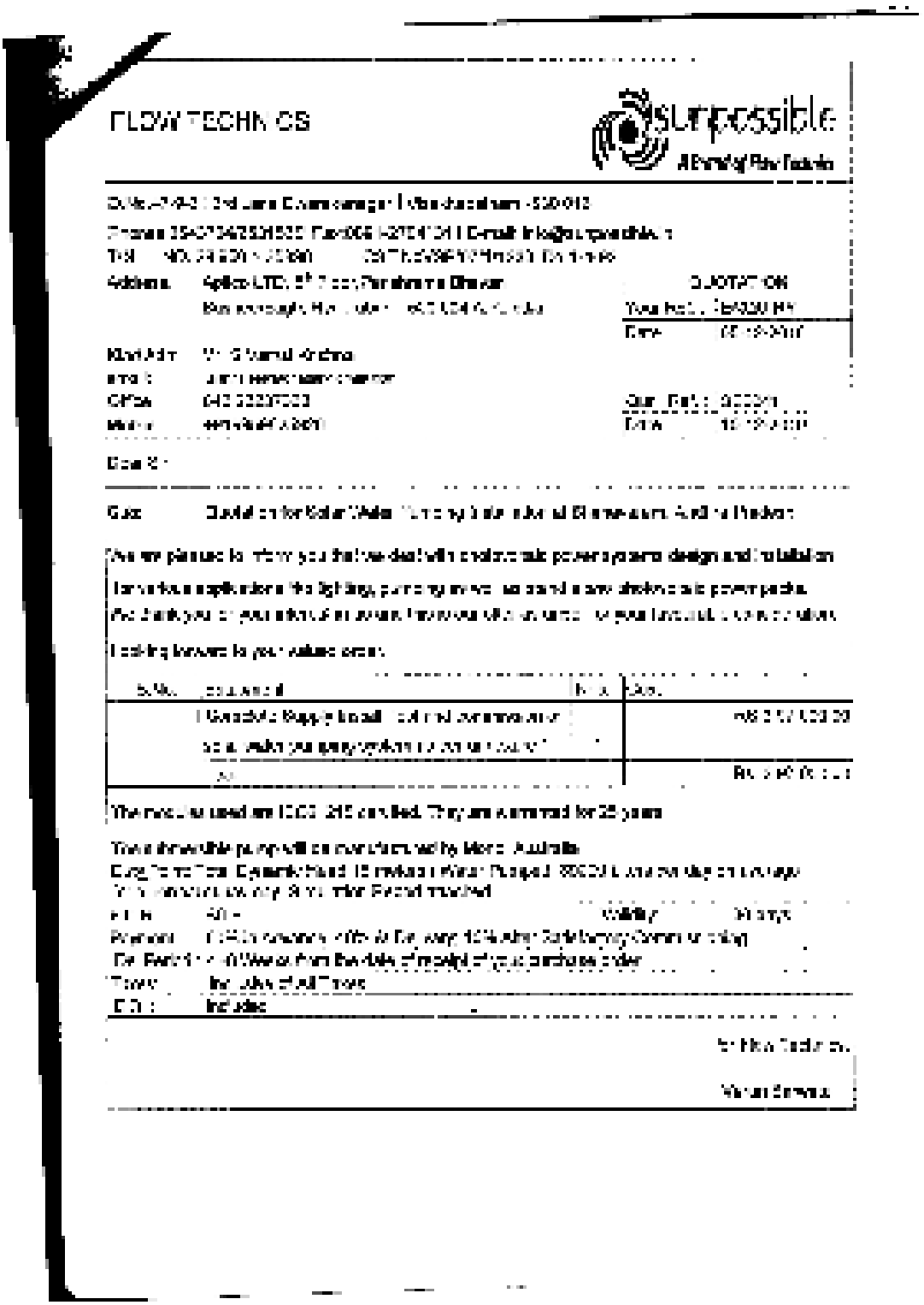


Quotation

RATING	1 HP
RESISTANCE	15MTS
MAXIMUM FLOW	
RANGE	
SECTION OF ELECTRODE SIZE	

TERMS





FLOW TECHNICS

Surpassible

QUOTATION

Date :

Sub :

Dear Sir,

We are pleased to inform you that we deal with centrifugal pumps, power plants design and installation.

Thank you for your enquiry and we are pleased to quote as follows.

S.No.	Description	Unit	Amount

The motor is used are IE3 / IP55 enclosed. They are warranted for 2 years.

Yours faithfully,

Manager

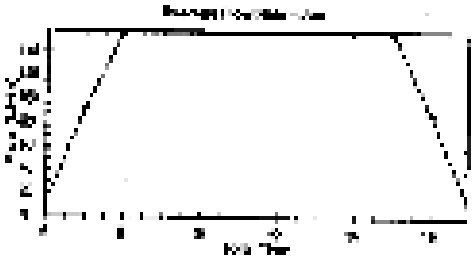
Mono Pumps Computer Aided Solar Simulation

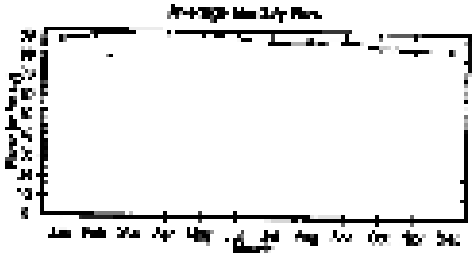
Simulation Number	Revised-1622
System Type	Sun Star
SWDN Site [x]	1420
Array Type	Stationary
Country	India
Location	Madras
Latitude	13.00
Longitude	80.30
Array Tilt Angle	13
Static Head [ft]	15
Pipe Length [m]	0
Pipe Size	2" Rural Class B
Cable Length [m]	50
Cable Size [mm]	3.50
Water Temp [deg C]	25
Sun Max Flow	100.0 %
MPPT Size	Series 5000 Sine
Motor Size	Series 5000
Pump Size	SM151
Drive Ratio	1.0
System Part Number	SS-5000-1622-A

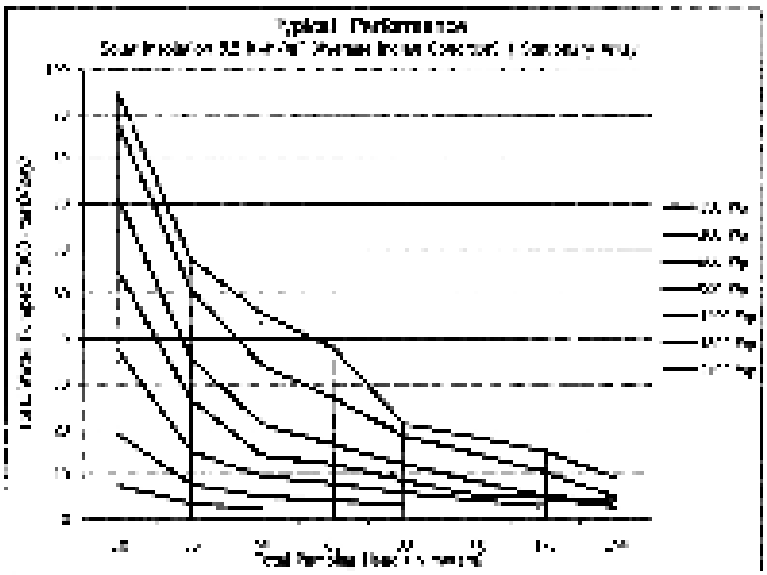
Typical Performance at 1000W/m²	
Flow [Lmin]	118.2
Friction Head [ft]	0.0
Total Head [ft]	15
Pump Speed	2231
Pump Efficiency	59%
Motor Efficiency	91%
Cable Loss	1%
System Efficiency	8.1 %

Month	Daily Flow [m³/day]	Horizontal Irradiation
January	88.4	5.8
February	91.7	6.4
March	92.8	7.0
April	93	7.1
May	91.9	6.8
June	90.5	5.8
July	87.7	5.4
August	91.0	6.5
September	90.1	6.7
October	88.0	5.1
November	84.5	4.8
December	81.1	4.4
Average	88.8	5.8

Notes






Typical Performance

Prithvi Engineering Enterprises

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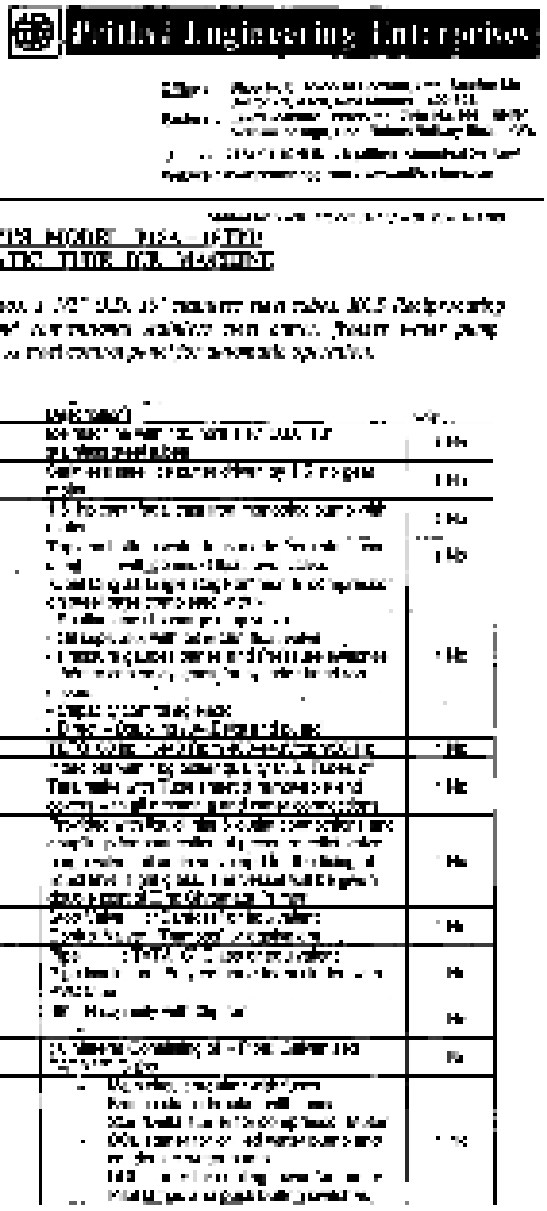

Prithvi Engineering Enterprises

[illegible]

PROPOSED MODIFICATIONS IN EXISTING
AUTOMATIC TUBE ICE MACHINE

[illegible]

[illegible]	[illegible]	[illegible]
Cutter	[illegible]	[illegible]
Grid Assembly	[illegible]	[illegible]
Water Tank	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

Tube ice plant Complete

Tube Ice Maker Only

[illegible]

Ref: Technical Offer

[illegible]

[illegible]

- [illegible]
- [illegible]
- [illegible]

[illegible]

[illegible]

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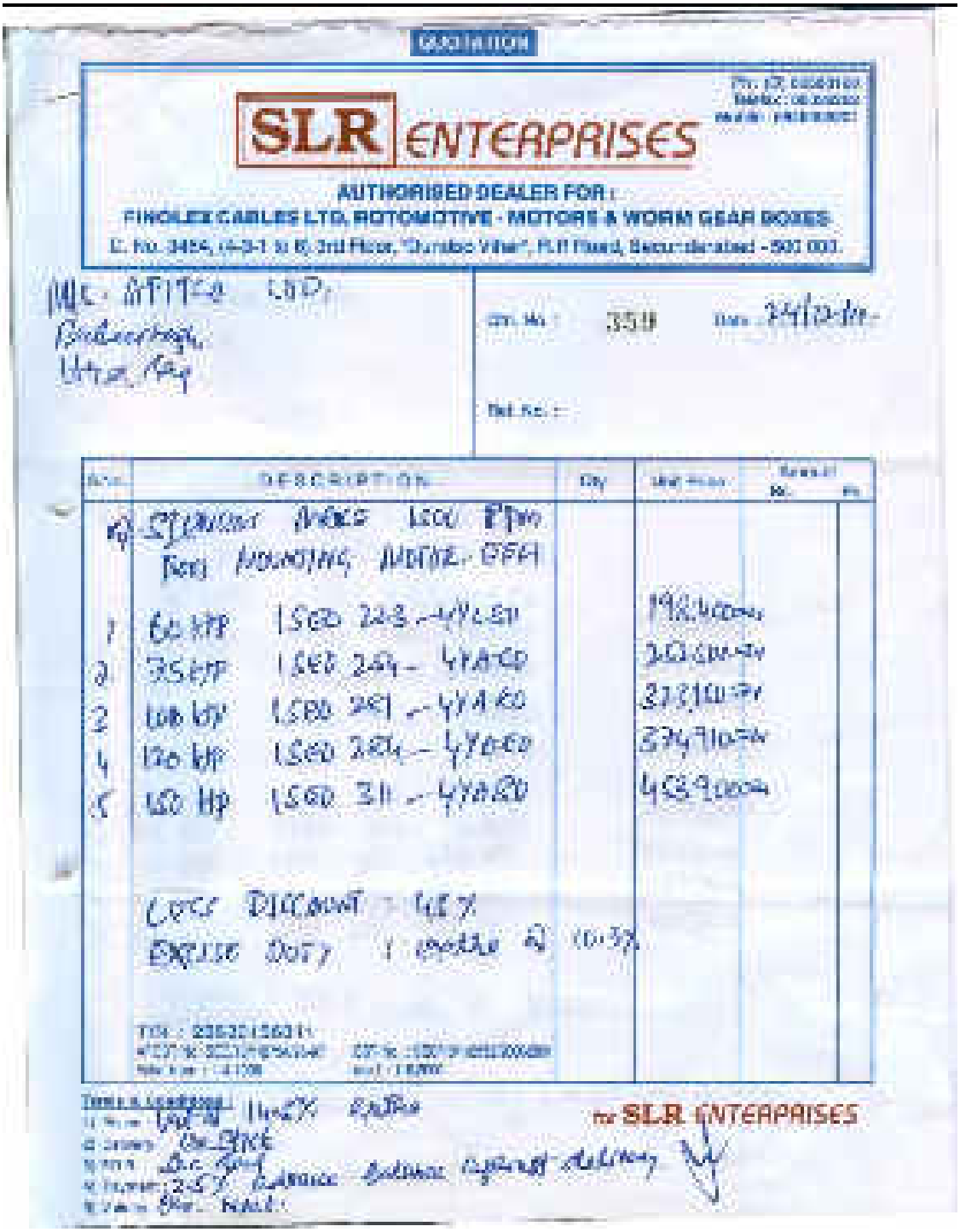


QUOTATION

SLR ENTERPRISES

AUTHORISED DEALER FOR :
FINOLEX CABLES LTD, ROTOMOTIVE - MOTORS & WORM GEAR BOXES

M/s. SITTA LTD,
Bhimavaram.

Qtn. No. : 3558 Date : 24-12-11

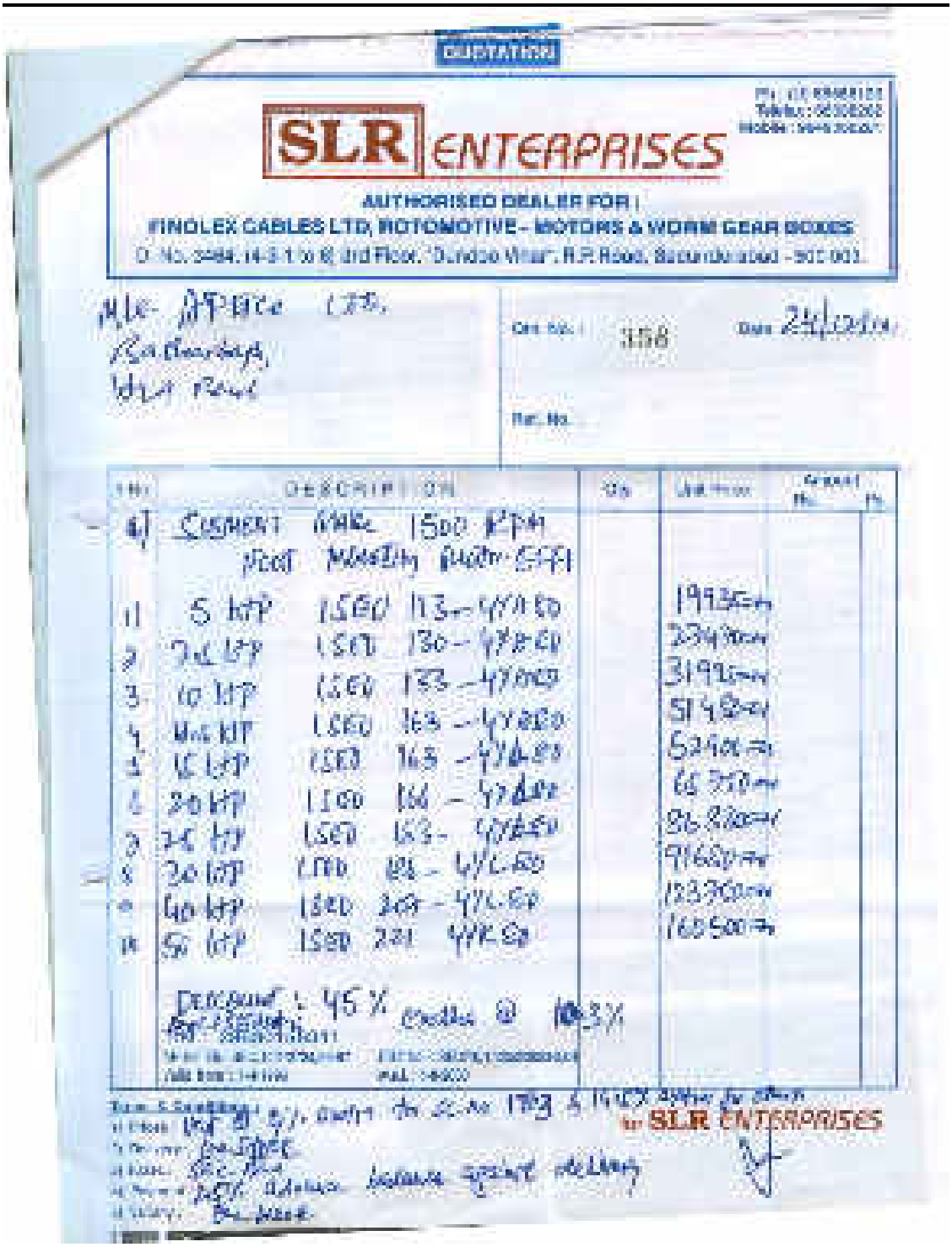
Ref. No. :

Sl.No.	DESCRIPTION	Qty	Unit Price	Rupees Rs.	Ps.
	Q) Standard Make LSCG Type Foot Mounting Motor - CPH				
1	60 HP LSCG 225 - 4YLSU		194400=00		
2	35 HP LSCG 254 - 4YACG		203400=00		
2	100 HP LSCG 281 - 4YACG		323100=00		
4	120 HP LSCG 284 - 4YACG		374910=00		
5	150 HP LSCG 311 - 4YACG		458900=00		
	Less Discount : 4.5%				
	Excise Duty : Inclusive @ 10.3%				

TIN : 28520156311
CST No. : 1[illegible]

Terms & Conditions :
1) Price : Ex-Godown
2) Delivery : Ex-Stock
3) Payment : 25% Advance Balance against delivery
4) Validity : [illegible]

for SLR ENTERPRISES



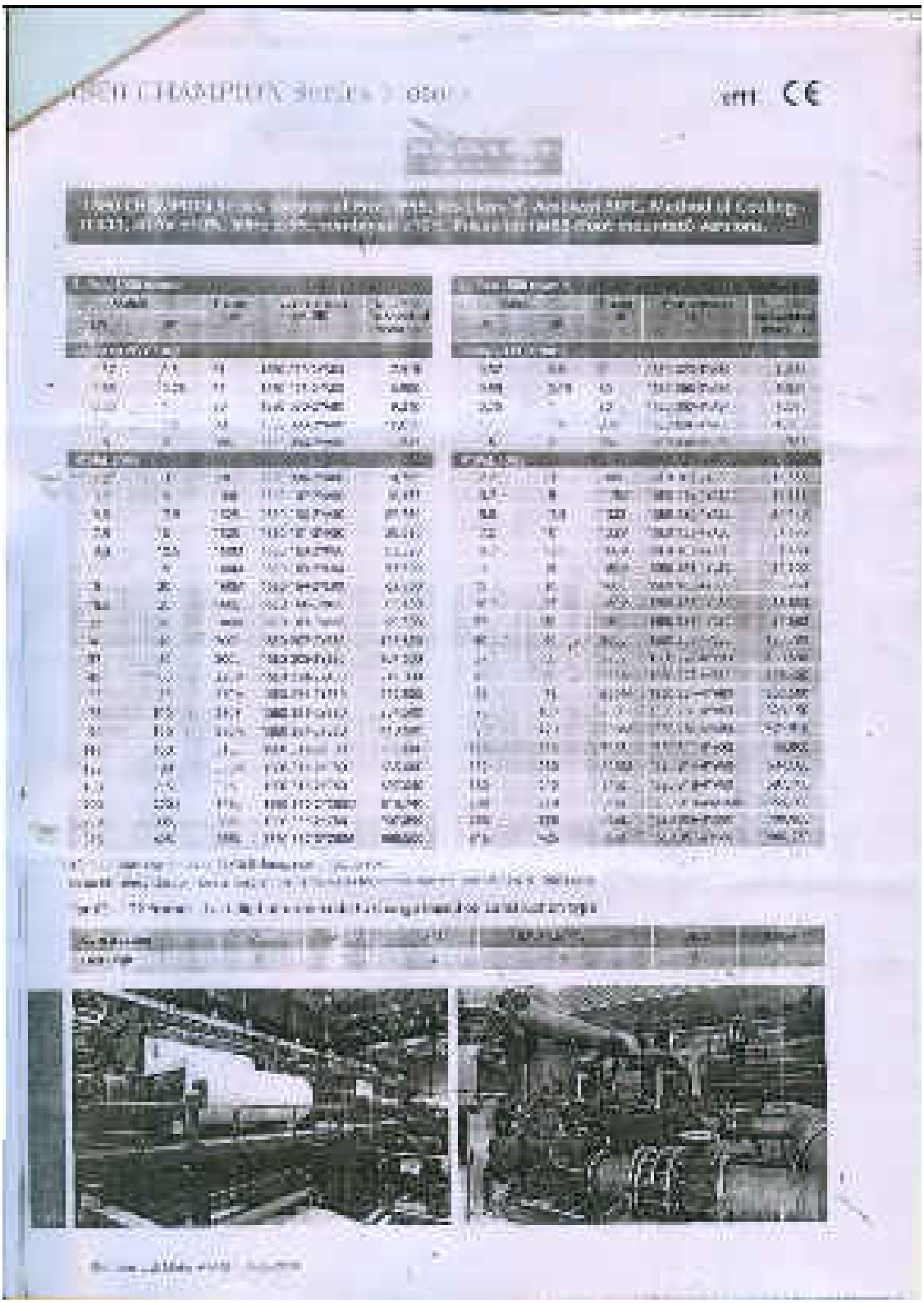
QUOTATION

SLR ENTERPRISES

AUTHORISED DEALER FOR :
FINOLEX CABLES LTD, INOTOMOTIVE - MOTORS & WORM GEAR BOXES

Qtn. No. 358 Date 24/12/14

SLR ENTERPRISES



TO,
Senior Consultant-Energy
APITCO LIMITED,
8TH FLOOR, PARISHRAMA BHAWAN
BASHEERBAGH, HYDERABAD-04

Dear Sir,

Please find our offer for Efficiency Level - 1 Motors as below:

Compton Greaves make, TEFC Squirrel Cage Induction Motor (NFLP),Enclosure confirming to Protection IP 55 Foot mounted (B3), continuously rated (S1) suitable for operation on 415 +/-10 % V, 3 phase 50HZ +/- 5% with an ambient of 50 deg. class F insulation with temperature rise limited to Class B and altitude less than 1000m above m.s.l confirming to IS325.

S.No	HP	kW	RPM	ALP	Net
1	25	18.5	1440	85820	36902.6
2	30	22	1440	91420	39310.6
3	60	45	1440	192240	82663.2

NOTE:
1. THE ABOVE PRICE IS EXCLUSIVE OF TAXES AND DUTIES.
2. THE ABOVE PRICE IS EXCLUSIVE OF TESTING CHARGES & OTHER FEATURES.

Thanks & Regards,

Prashant Reddy
Senior Executive - Sales, LT Motors

Crompton Greaves Limited
Secunderabad Branch
94, Sarojini Devi Rd, Secunderabad 500 003
T: +91 40 4000 2324 M: +91 9966007488 W: www.cgglobal.com

DEEPAK ELECTRICALS & ELECTRONICS
5-2-27, HYDER BASTI, R.P.ROAD, SECUNDERABAD – 500003
PH: 09533564104 / 09912550190 TELE FAX: 040 – 66323959
EMAIL: deepakelectric2010@yahoo.in / deepakelectric19@gmail.com

****

QUOTATION

****

TO,

REF : DEE-PB-52R/10-11
DATE: 27/08/2010

Sr.CONSULTANT-ENERGY
APITCO LIMITED,
8TH FLOOR, PARISHRAMA BHAWAN
BASHEERBAGH, HYDERABAD-04
Ph: 040-2323-7333/2323-7981

Dear Sir,

We thank you very much for your enquiry no.__VERBAL_____ dt.___
As desired, we have the pleasure in quoting our prices as under, subject to the terms & condition of sale.

DESCRIPTION

ABB make AC 3 Phase, 415v +/- 10%, 50 Hz +/- 5% Combined Variation Class 'F' Insulation IP-55 Protection, S1 DUTY,EFF – 1, induction motor, FOOT TYPE, SSE.

S.No	HP	RPM	QTY	FRAME	PRICE PER UNIT
1	25	1475	1	180M	40945.00
2	30	1475	1	180L	43650.00
3	60	1475	1	225M	91770.00
4	25	975	1	200L	55620.00
5	30	975	1	200L	60370.00
6	60	975	1	280S	162130.00
3	60	1475	1	225M	91770.00

Terms & Conditions

Delivery : 10-12 WEEKS FROM DATE OF ORDER.
Excise : EXTRA AT THE TIME OF DELIVERY.
Tax : SALES TAX EXTRA AS APPLICABLE.
Payment : 30% ALONG WITH ORDER AND BALANCE BEFORE DESPATCH OF MATERIAL.
Validity : 15 Days
Guarantee : One year Mfg. Warranty
Price : Firm, FOR Ex. SECUNDERABAD
Freight : TO-PAY BASIS, ON YOUR ACCOUNT (IF ANY)
NOTE : YOU HAVE TO COLLECT THE GOODS FROM OUR OFFICE.

Should we be given an opportunity we shall be too glad to serve you.

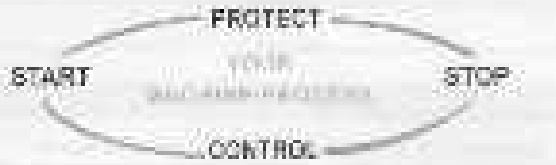
Truly Yours,
For DEEPAK ELECTRICALS & ELECTRONICS
PRAMOD

VSC Plus

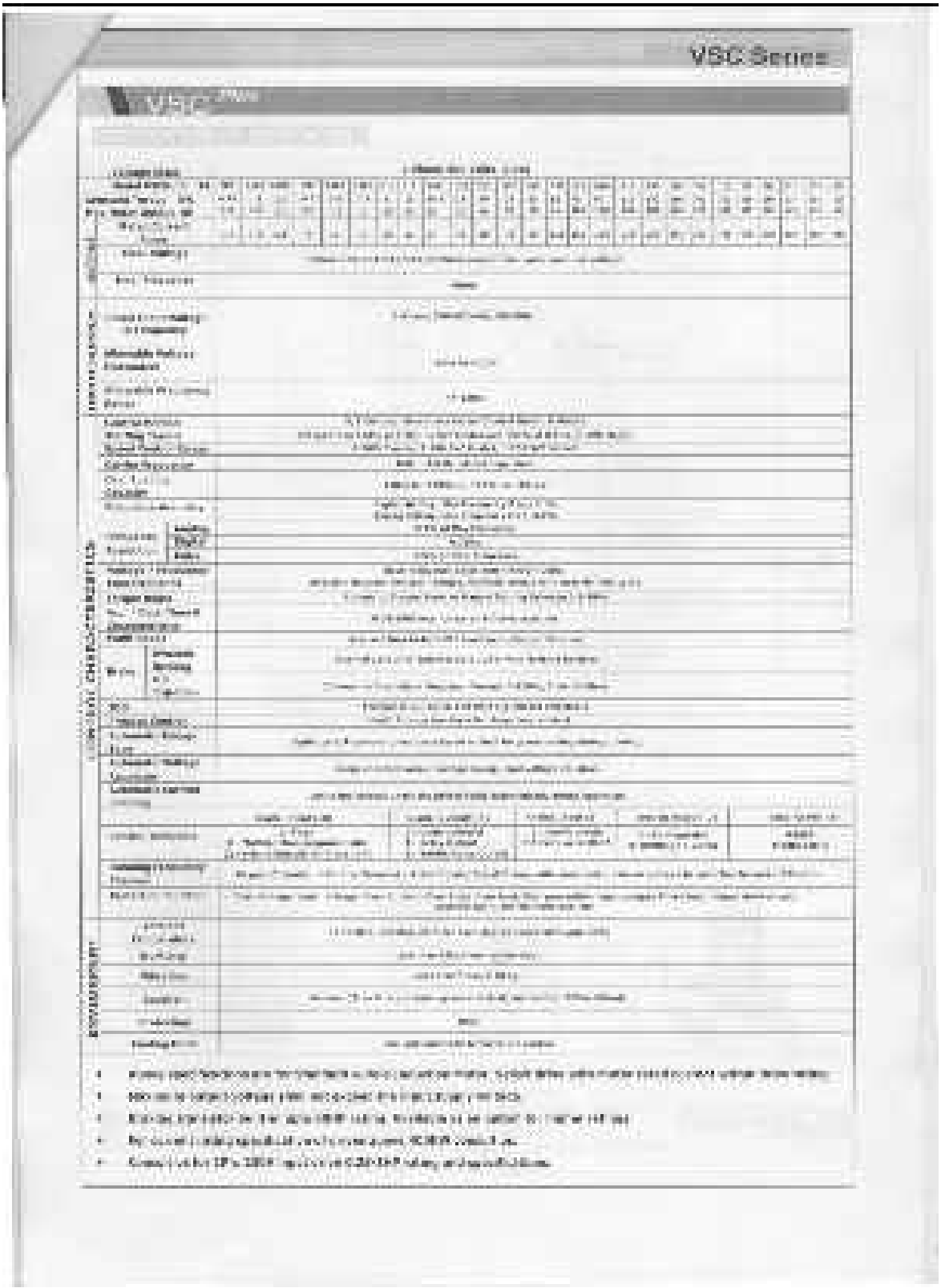
HIGH PERFORMANCE VECTOR CONTROL DRIVE

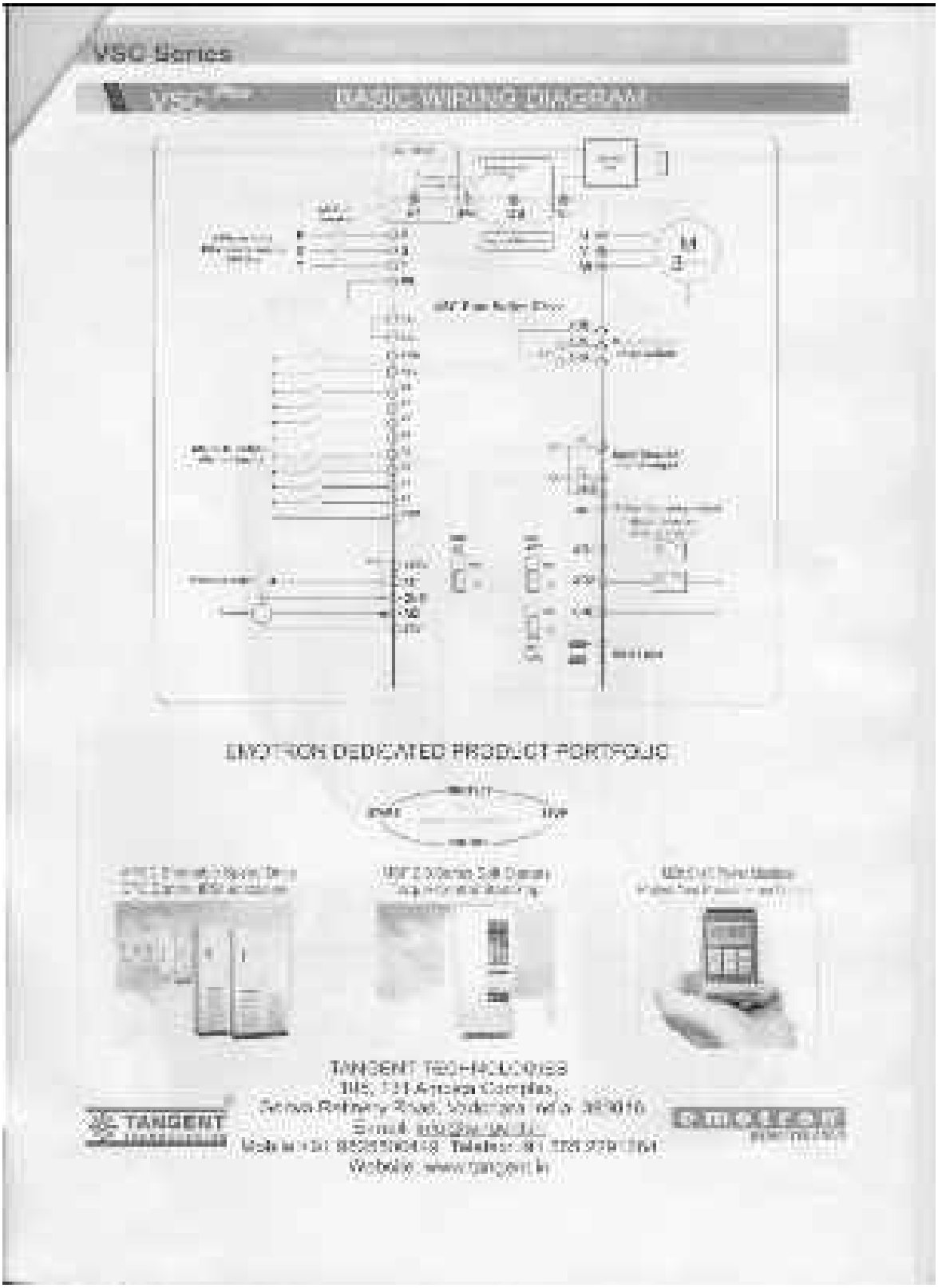
TANGENT Technologies

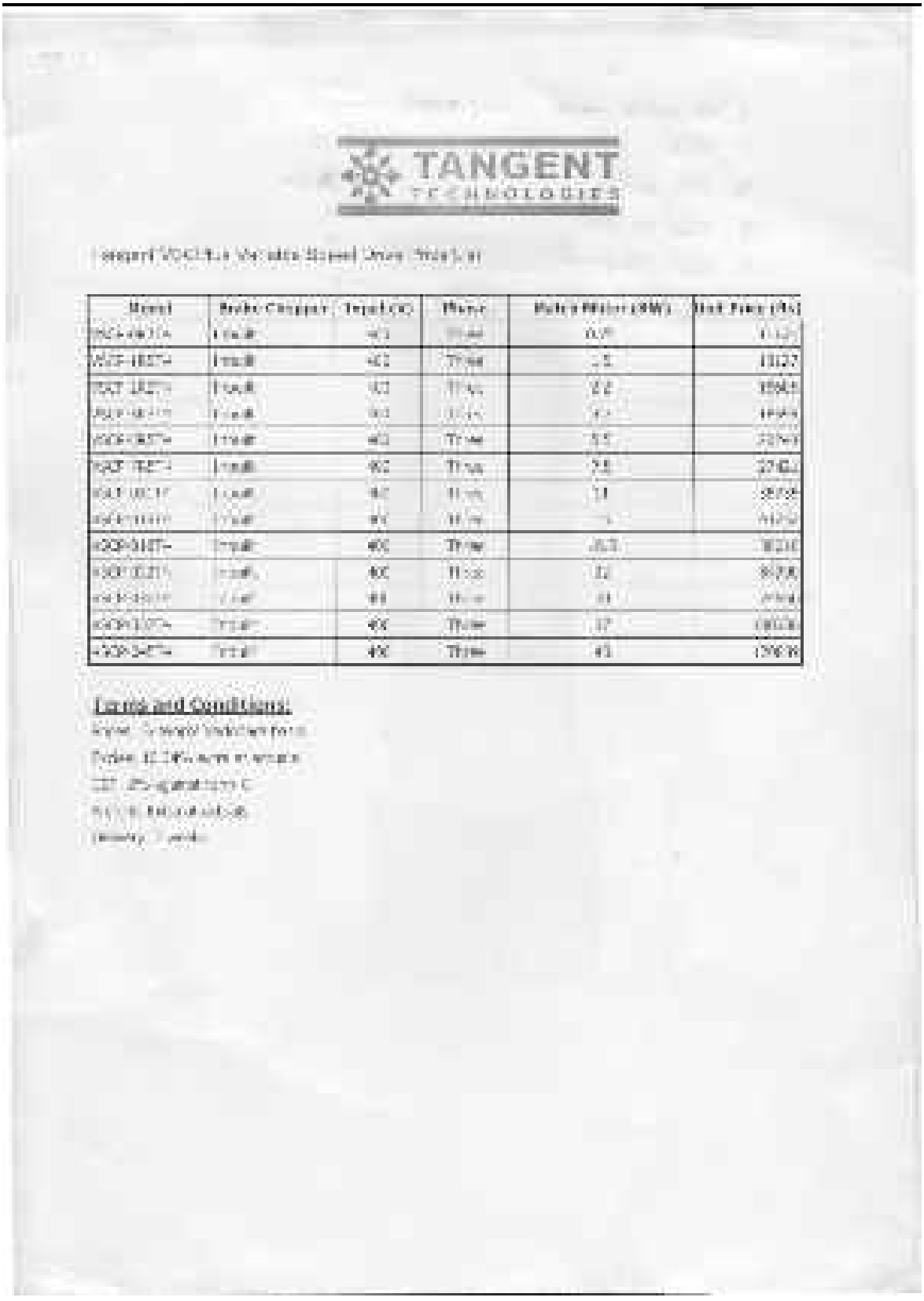
Drive to Optimize Your Process




VSD Series


VBC Series


VSC Series
BASIC WIRING DIAGRAM
EMOTRON DEDICATED PRODUCT PORTFOLIO
TANGENT



Brand	Brake Chopper	Input (V)	Phase	Motor Power (HP)	Unit Price (Rs)

Terms and Conditions:

Trade Links

QUOTATION

TOTAL

OTHER TERMS

Trade Links

QUOTATION

Note : We are also pleased to inform you that the commissioning of the equipment and warranty services for the equipments supplied by us shall be carried out at site on our account.

Annexure-4

Energy Tariff

1. Electrical Energy

RETAIL SUPPLY TARIFF SCHEDULE FOR FY 2010-11

CONSUMER CATEGORY			Rates for 2010-11	
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)			Energy Charge (Rs/unit)
LT I			DOMESTIC	
Slab 1 (0-50)	0.00		0.00	1.45
Slab 2 (51-100)	0.00		0.00	2.80
Slab 3 (101-200)	0.00		0.00	3.05
Slab 4 (201-300)	0.00		0.00	4.75
Slab 5 (>300)	0.00		0.00	5.50
LT II			NON-DOMESTIC CATEGORY / /COMMERCIAL CATEGORY	
Slab 1 (0-50)	0.00		0.00	3.85
Slab 2 (51-100)	0.00		0.00	6.20
Slab 3 (>100)	0.00		0.00	6.50
LT III(A)			INDUSTRY NORMAL	
(i)	Industry Normal	37.00	0.00	4.13
Seasonal Industries	37.00		0.00	4.80
(ii)	Industry Optional	0.00	100.00	4.13

Seasonal industries		0.00	100.00	4.80
(iii)	Pisciculture , Prawn culture with contracted load below 10HP		0.00	0.90
(iv)	Sugarcane	0.00	0.00	0.50

CONSUMER CATEGORY		Rates for 2010-11		
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)			Energy Charge (Rs/unit)
crushing				
(v)	Poultry Farms with more than 1000 birds	37.00	0.00	4.13
(vi)	Mushroom production Farms, Rabbit Farms	37.00	0.00	4.13
(vii)	Floriculture in Green-Houses	37.00	0.00	4.13
LT III(B)		INDUSTRY (OPTIONAL)		
SSI Units with connected load of 75HP to 150HP subject to conditions specified in earlier tariff order	0.00	100.00		4.13
Seasonal industries	0.00	100.00		4.80

LT IV(A)	COTTAGE INDUSTRIES AND DOBHI GHATS with connected load not more than 5KW.	10.00	0.00	1.80
LT IV(B)	Poultry Farms with up to 1000 Birds	10.00	0.00	1.80
LT V(A)			IRRIGATION AND	

CONSUMER CATEGORY		Rates for 2010-11	
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)		Energy Charge (Rs/unit)
ARICULTURE			
With DSM Measures			
Corporate Farmers & IT Assesses	0.00	0.00	1.00
Wet Land Farmers (Holdings >2.5 acre)	*Rs. 210/HP/ Year	0.00	0.20
Dry Land Farmers (Connections > 3 nos.)	*Rs. 210/HP/ Year	0.00	0.20
Wet Land Farmers (Holdings <= 2.5 acre)	0.00	0.00	0.00
Dry Land Farmers (Connections <= 3 nos.)	0.00	0.00	0.00
Without DSM Measures			

Corporate Farmers & IT Assesses	0.00	0.00	2.00
Wet Land Farmers (Holdings >2.5 acre)	*Rs. 525 /HP Year	0.00	0.50
Dry Land Farmers (Connections > 3 nos.)	*Rs. 525 /HP Year	0.00	0.50
Wet Land Farmers (Holdings <= 2.5 acre)	*Rs. 210 /HP Year	0.00	0.20
Dry Land Farmers	*Rs. 210 /HP Year	0.00	0.20

CONSUMER CATEGORY		Rates for 2010-11		
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)			Energy Charge (Rs/unit)
(Connections <= 3 nos.)				
LT V(A)(i)	Salt Farming units with connected load up to 15HP $	0.00	0.00	1.00
LT V(A)(ii)	Rural Horticulture Nurseries	0.00	0.00	1.00
LT V(B)	AGRICULTURE (TATKAL)	0.00	0.00	0.00
LT VI(A)		LOCAL BODIES, STREET LIGHTING AND PWS SCHEMES		
Street Lighting				
Minor Panchayats	0.00	0.00		1.56
Major Panchayats	0.00	0.00		2.08

Nagarpalikas & Municipalities(Gr-3)	0.00	0.00	2.74
Municipalities (Gr 1&2)	0.00	0.00	3.26
Municipalities Selection / Spl. Gr.	0.00	0.00	3.53
Municipal Corporations	0.00	0.00	3.79
LT VI(B)		PWS Schemes	
Minor/ Major Panchayats			
Up to 2500 units/Yr	0.00	0.00	0.20
Above 2500 units/Yr	0.00	0.00	0.50
All Nagarpalikas & Municipalities			
Up to 1000	20.00	0.00	3.75

CONSUMER CATEGORY		Rates for 2010-11		
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)			Energy Charge (Rs/unit)
units				
Balance units		0.00		4.05
Municipal Corporations				
Up to 1000 units	20.00	0.00		4.05
Balance units		0.00		4.60
LT VII(A)	GENERAL PURPOSE	0.00	0.00	4.00
LT VII(B)		Religious Places with Connected Load Up to 1 kW $$		

Up to 200 units	0.00	0.00	2.00
Balance units	0.00	0.00	4.00
LT VIII		TEMPORARY SUPPLY	
Temporary Supply to Agriculture	0.00	0.00	2.30
Temporary Supply(other than Agriculture and irrigation.)	0.00	0.00	6.82
NOTE ON LT CATEGORIES		$ - Units with connected load more than 15 HP shall be billed under LT Category III – Industrial tariff. $$ - With connected load above 1KW shall be charged under LT-VII-general *- Equivalent flat rate tariff.	
HT I(A)		INDUSTRY -GENERAL	
132 KV	0.00	250.00	2.97
33KV	0.00	250.00	3.25

CONSUMER CATEGORY	Rates for 2010-11		
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)		Energy Charge (Rs/unit)
11 KV	0.00	250.00	3.52
Lights and Fans			
132 KV and above	0.00	0.00	4.67
33KV	0.00	0.00	4.70
11 KV	0.00	0.00	4.72
Colony			
132 KV and above	0.00	0.00	4.00
33KV	0.00	0.00	4.00
11 KV	0.00	0.00	4.00
Seasonal Industries			

132 KV and above		0.00	250.00	4.10
33KV		0.00	250.00	4.30
11 KV		0.00	250.00	4.80
HT I(A)	TIME OF DAY TARIFF (06PM to 10PM) (in addition to the above charges)	-	-	1.00
HT I(B)	FERRO ALLOY units— (all voltages)	0.00	0.00	2.65
HT II			NON INDUSTRIAL	
132 KV and above		0.00	250.00	4.10
33KV		0.00	250.00	4.30
11 KV		0.00	250.00	4.80
HT IV			IRRIGATION AND AGRICULTURE	
HT IV-A	Govt Lift Irrigation Schemes.	0.00	0.00	2.60
HT IV-B	Agricultural—not covered under HT-IVA	0.00	0.00	0.00

CONSUMER CATEGORY		Rates for 2010-11		
Fixed Charge (Rs/HP/Month)	Demand Charge (Rs/kVA/Month)			Energy Charge (Rs/unit)
HT V	RAILWAY TRACTION	0.00	0.00	4.45
HT VI	TOWNSHIPS AND RESIDENTIAL COLONIES	0.00	0.00	4.00
HT-Temp	Temporary supply-(all voltages)	#	#	#

Other Tariffs at HT supply :

i. Composite Public Water Supply Schemes : Rs.0.35 per unit.

ii. Rural Electric Supply Co-operative Societies (Resco)

Chipurupalli Resco :Rs.0.60 per unit
Anakapalle Resco :Rs.0.73 per unit
Siricilla Resco :Rs.0.41 per unit
Kuppam Resco :Rs.0.18 per unit

iii. Green Power (optional) :Rs.6.70 per unit.

Iv # 1. 5 times of corresponding HT category tariff for both demand and energy

LT categories			
Category No.	Purpose		Rates for the year 2010-11
I		Domestic	Single Phase
upto 250 W of connected load		Rs.25/Month	
above 250W of connected load		Rs.50/Month	
Three Phase			
Rs.150/Month			
Single Phase			
II	Non-domestic/		Rs.65/Month
Commercial	Three Phase		Rs.200/Month
III (A)(ii) III (B)	Industrial Optional 75–150HP		Recorded demand during the month or 80% of contracted demand whichever is higher and50 Units/kVA of Billing Demand per month
Panchayats			
VI (A)		Rs.2/Point/Month	
Street Lighting	Municipalities		Rs.6/Point/Month
and Corpns.			
VII	General Purpose	Single Phase	Rs.50/Month
Three Phase			Rs.150/Month

Annexure-V

Financial Schemes

The various schemes from Ministry of Micro Small and Medium Enterprises (MSME), Government of Andhra Pradesh and Small Industrial Development Bank of India (SIDBI) are available to Install SMEs, install or upgrade Energy Efficient technologies and marketing. These schemes are availed and implemented through the District Industries Center (DIC), Commissioner of Industries and District Collector and Financial Institutions. The unit's holders are taken the benefits of various schemes from time to time. The details of different financial schemes are

1 .Small Industrial Bank of India (SIDBI)

SIDBI was established in 1990 as a Principal Development Financial Institution for Promotion, Financing, Development of Industries in the small scale sector and for coordinating the functions of other institutions engaged in similar activities. SIDBI has many products and schemes which can be fine tuned to meet the requirements of SMEs. List of some of such products & schemes is as follows.

a. Technology up gradation Fund:

TUFS has been launched with a view to sustaining as well as improving the competitiveness and overall long term viability of the SSI sector. The scheme intends to provide timely and adequate capital at internationally comparable rates of interest in order to upgrade the industry's technology level.

b. Marketing Support for SMEs:

To finance corporate entities to enable them to provide support services and/or infrastructural facilities to small scale sector to improve its marketing capabilities

c. Direct Credit Scheme:

To finance SSIs & Service sector units with project cost upto Rs.25 crore, Medium Sector Enterprises (MSE) and Service sector units with project cost above Rs.25 crore and upto Rs.250 crore.

d. Bills Financing Scheme:

Bills Finance Scheme seeks to provide finance, to manufacturers of indigenous machinery, capital equipment, components sub-assemblies etc.

e. Refinancing Scheme:

SIDBI grants refinance against term loans granted by the eligible PLIs to industrial concerns for setting up industrial projects in the small scale sector as also for their expansion / modernization / diversification.

f. Scheme for Development of Industrial Infrastructure:

The Scheme purpose is to strengthening of existing industrial clusters / estates by providing increased amenities for smooth working of the industrial units. The scheme is to avail setting up of warehousing facilities for SSI products / units and Providing support services viz., common utility centers such as convention halls, trade centers, raw material depots, warehousing, tool rooms / testing centers, housing for industrial workers, etc.

On the basis of experiences of above mentioned schemes it is advisable to devise and implement schemes of similar characteristics through SIDBI for the sustainable development of SMEs.

2 Ministry of Small and Medium Enterprises (MSME)

Ministry of Small and Medium Enterprises (MSME), Government of India implementing various schemes for promote the SME sector towards its growth. The following schemes are available for implementation of Energy Efficient Technologies in SMEs.

a. **Technology Up gradation:** Government of India will provide financial support to the extent of 25% of the project cost for implementation of Energy Efficient Technologies (EET), as per the approved DPR. The maximum amount of assistance will be Rs. 10 Lakh. About 390 units will be supported for implementing EETs in MSMEs.

b. **Quality Up gradation:** Under this activity, MSME manufacturing units will be provided subsidy to the extent of 75% of actual expenditure, towards licensing of product to National/International Standards. The maximum assistance allowed per MSME is Rs. 1.5 Lakh (Average Rs. 0.75 Lakh) for obtaining product licensing/marking to national standards and Rs. 2 Lakh (Average Rs. 1.50 Lakh) for obtaining product licensing/marking to international standards. One MSME unit can apply only once under the scheme. Total 3000 product certification on national standards and 1000 on international standards are proposed to be reimbursed under the scheme. This scheme will include the star rating certification by BEE. All the applications for the star rating will be reimbursed the application processing fees directly to the entrepreneur after the successfully certification from BEE.

3 Government of Andhra Pradesh

Government of Andhra Pradesh providing SSI Certificate and Subsidy through the District Industries Center (DIC) to promote industrial activity in the district. The DIC will issue the SSI to the Industries based on the capacity. It has schemes and other related activities for the SSI unit's i.e. marketing assistance etc., to promote the self-employment schemes with assistance from the local banks.