DETAILED PROJECT REPORT
ON
TUBE ICE PLANT– 20TPD
(BHIMAVARAM ICE MAKING CLUSTER)










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Prepared By

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Engineering Growth

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TUBE ICE PLANT-20 TPD

BEE, 2010

Detailed Project Report on Tube Ice Plant (20 TPD)

Ice Plant SME Cluster, Bhimavaram, Andhra Pradesh (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.:

For more information

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APITCO Limited

Hyderabad

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Lists of Abbreviations

- BEE - Bureau of Energy Efficiency
- DPR - Detailed Project Report
- DSCR - Debt Service Coverage Ratio
- GHG - Green House Gases
- HP - Horse Power
- IRR - Internal Rate of Return
- MoP - Ministry of Power
- MSME - Micro Small and Medium Enterprises
- NPV - Net Present Value
- ROI - Return On Investment
- SIDBI - Small Industrial Development Bank of India
- MoMSME - Ministry of Micro Small and Medium Enterprises

EXECUTIVE SUMMARY

APITCO Ltd. is executing BEE-SME program in Bhimavaram Ice Plants Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Bhimavaram is renowned for the sea food business and is a big hub for fish and prawns culture. The prawns and fish are exported to various countries throughout the world. There are about 80 ice making units in the cluster. The major Energy forms used in the cluster are grid electricity and High Speed Diesel (HSD). Electricity is used for driving the prime movers of compressors, pumps, agitators, drives and for lighting. HSD is used as a fuel in DG sets for generating electricity during failure of grid electricity supply. The cost of energy as a percentage of end product (ice) cost varies anywhere between 48 to 54%. Majority of the industries located in Bhimavaram are engaged in production of ice blocks required for storage and transportation purpose of the sea food.

There are about 80 ice making units in the entire cluster producing ice blocks with the conventional refrigeration systems at lower plant utilization factor. A proposed Tube Ice Plant is suitable for those units which are presently operated under their rated capacity, which significantly reduce operational cost per ton of Ice production. Automatic tube ice machine performs two main functions Freezing and Harvesting. These functions are carried out in a continuous cycle and ensure the steady supply of high quality ice at a rate determined by the user.

The DPR highlights the details of the study, conducted for assessing the potential for reducing electricity consumption by installing tube ice plant in various units of the cluster, i.e. possible electricity savings and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis and schedule of project implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

Sr. No.	Particular	Unit	Value
1	Project cost	`(in Lakh)	17.15
2	Electricity Savings	kWh/annum	191689
3	Monetary benefit	` (in Lakh)	7.19
4	Simple payback period	Years	2.39
5	NPV	` (in Lakh)	10.45
6	IRR	%age	26.90
7	ROI	%age	25.74
8	Average DSCR	Ratio	1.78
9	CO_2 emission reduction	MT/year	155
10	Process down time	Days	Nil

The projected profitability and cash flow statements indicate that the project implementation i.e. installation of Tube Ice Plant will be financially viable and technically feasible solution for the cluster.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 29 selected SMEs clusters. Bhimavaram Ice Making Units Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

Major activities in the BEE -SME program are furnished below:

Activity 1: Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Activity 2: Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Activity 3: Implementation of energy efficiency measures

To implement the technology up-gradation project in the clusters, BEE has proposed to prepare the technology based detailed project reports (DPRs) for a minimum of five technologies in three capacities for each technology.

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

The objective of this activity is to facilitate the uptake of energy efficiency measures through innovative financing mechanisms without creating market distortion.

1 INTRODUCTION

1.1 Brief Introduction about cluster

Bhimavaram is a town in the West Godavari District in the state of Andhra Pradesh, India. It is located 395 kilometers east of state capita Hyderabad. Bhimavaram is renowned for the sea food business and it is a big hub for fish and prawns culture. The prawns and fish are exported to various countries throughout the world. There are about 80 ice making units in the cluster. The major energy forms used in the cluster are grid electricity and HSD oil. Electricity is used for driving the prime movers of compressors, pumps, agitators, drives and for lighting. HSD is used as a fuel in DG sets for generating electricity during failure of grid electricity supply. The cost of energy as a percentage of end product (ice) cost varies anywhere between 48-54%. Majority of the industries located in Bhimavaram are engaged in production of ice blocks, required for storage and transportation purpose of sea food.

1.1.1 Production process

Raw water is pumped from local available water bodies such as pond / stream through raw (electrical operated) water pump to overhead tank .

The production area of the plant has an ice tank made of concrete. The ice tank contains the direct expansion coils, these coils are equally distributed throughout the tank and submerged in brine. The tank is provided with a suitable frame of hard wood to 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.

Raw water is filled into the ice cans from overhead tank. Further water is chilled for 48 hours for complete ice block formation. The specific gravity of brine is maintained at 1180 by adding salt of adequate quantity. Ice cans with fully formed ice blocks are removed from the chilling tank. The cans are emptied from the ice blocks and replaced into the chilling tank with water. The removed ice blocks are further crushed as per the client requirements in to pieces by ice crushers and loaded into plastic crates for transportation.

Process flow chart is finished in Figure 1.1 below:

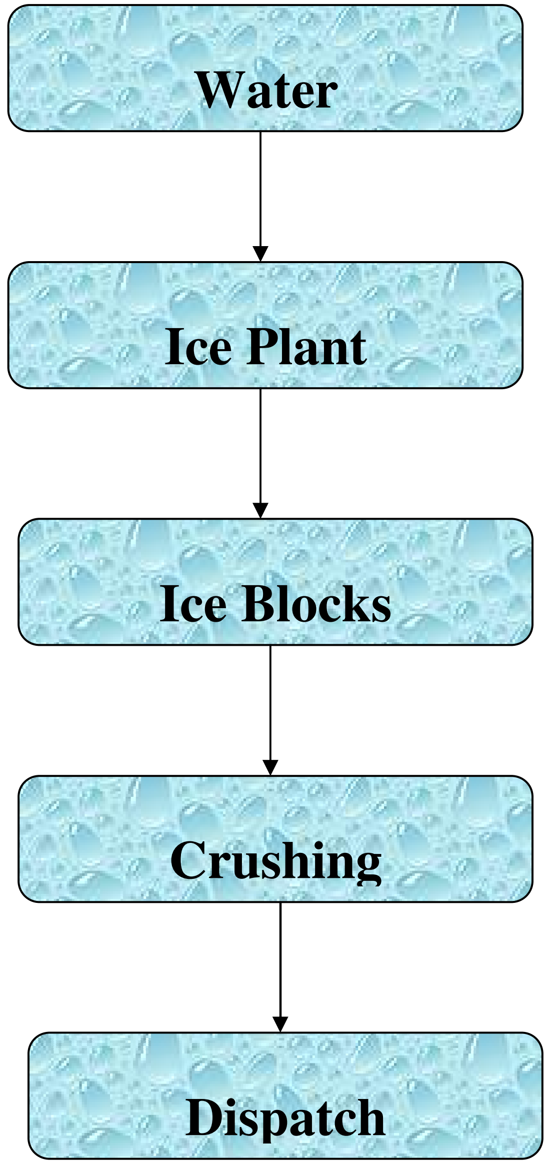


Figure 1: General Process Flowchart of Ice Making Unit

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption of a typical unit in the cluster

The main energy form used in a typical ice making unit in the cluster is electricity and HSD. Electricity is used for driving the prime movers of compressors, pumps, agitators, ice crushers, lighting etc. The HSD is used as fuel in DG sets for electricity generation during power failures and it is used in emergency situations only. The energy consumption of a typical ice making units in the cluster having conventional tube ice plant with production of 16 TPD is furnished in Table 1 below:

Table 1.1: Energy consumption of a Typical Ice Plants

S.No	*Unit Name*	Grid Electricity Consumption (kWh/annum)	HSD Consumption (Liters/annum)	Ice Production (TPD)
1	Gamini Ice factory	504735	5903	16
2	Krishna Teja Ice factory	622725	7283	16
3	Surya Ice factory	469367	5490	16

1.2.2 Average production by a typical unit in the cluster

Total production in atypical unit depends upon plant utilization and requirement. The average production of a typical ice making unit is 16 Tons per day.

1.2.3 Specific Energy Consumption

The major source of energy for ice making is electricity and the specific electricity consumption per ton of ice production for typical units in the cluster is furnished in Table 1.2 below:

Table 1.2: Specific energy consumption for typical units

S.No	*Unit Name*	*Units*	*Specific Energy Consumption*
1	Gamini Ice factory	kWh/ ton	115.50
2	Krishna Teja Ice factory	kWh/ ton	115.00
3	Surya Ice Factory	kWh/ ton	114.9

1.3 Existing technology/equipment

1.3.1 Description of existing technology

There are about 80 ice making units in the entire cluster producing ice blocks with the conventional refrigeration systems. The present ice block refrigeration system is consuming more power due to the following reasons:

- High Power Consumption in Refrigeration Compressor and other equipment like agitator and water pump.
- Lower Ice Plant Capacity Utilization with installed capacity.

As per the detailed studies undertaken in various units of the cluster, the specific power consumption per ton of ice blocks production is varying anywhere between 85 kWh/ton to 120 kWh/ton.

The present ammonia refrigeration system installed for ice blocks production in a typical unit of the cluster are furnished in Table 1.3 below:

Table 1.3 Ice Plant Details

S. No	Parameter	Details	Details	Details
1	Name of Units	Gamini Ice factory	Krishna Teja Ice Factory	Surya Ice factory
2	Make	Kirloskar	Kirloskar	Kirloskar
3	Rated Capacity	45 kW (60 HP) & 75 HP	45 kW (60 HP) & 75 HP	45 kW (60 HP) & 75 HP
4	Type	Reciprocating	Reciprocating	Reciprocating
5	Refrigerant	Ammonia	Ammonia	Ammonia
6	Agitator Motor	3.7 kW (5 HP)	5.6 kW (7.5HP)	5.6 kW (7.5HP)
7	Condenser Water Pump	3.7 kW (5 HP)	3.7 kW (5 HP)	2.2 kW (3HP)

1.3.2 Its role in the whole process

The ammonia refrigeration system is the major equipment of ice making units and produces refrigeration effect for production of ice blocks. The power consumption of the refrigeration compressor is depends on the quantity of the production required and refrigeration time period.

1.4 Establishing the baseline for the equipment to be changed

1.4.1 Design and operating parameters power consumption

The present power consumption of the refrigeration compressor and other auxiliary equipments such as existing pumps and agitator motors in the plant is furnished table 1.4 below:

Table 1.4 Power consumption of various equipments in typical units in the cluster

Unit Name	Compressor	Agitator	Condenser Pump	Raw Water Pump	Total Energy Consumption (kW)	Power Consumption (kWh/Year)
Gamini Ice factory	39.88	3.50	4.04	2.19	49.61	504735
Krishna Teja Ice factory	58.73	3.81	4.04	3.66	70.24	622725
Surya Ice factory	37.10	5.68	1.66	3.66	48.1	469367

The annual power consumption shown in the above table is based on energy bills collected from the respective ice plant and electricity taken from DG set in case of power failure. The total energy consumed by each of the equipment is measured during the observations in the plant and the annual energy consumption will varies with respect to the power bills due to plant operating and utilization conditions.

1.4.2 Electricity consumption

The annual electricity consumption, ice blocks production and specific power consumption of a typical unit of the cluster is furnished below in Table 1.4 below:

Table 1.5 Unit wise – electricity consumption in typical units in the cluster

S. No	*Name of the unit*	*Ice production (tons/annum)*	*Electricity consumption of (kWh/annum)*	*Sp. Electricity consumption (kWh/ton)*
1	Gamini Ice factory	4600	531300	115.50
2	Krishna Teja Ice factory	5700	655500	115.00
3	Surya Ice factory	4300	494070	114.90

1.4.2 Specific electricity consumption

The detailed energy audits studies had been undertaken in various units of the cluster to evaluate the performance of the present ice plant and specific electricity consumption. The specific electricity consumption of the ice plants where found to be 115 kWh/ton of ice blocks production.

1.5 Barriers for adoption of new and energy efficient technology / equipment

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of the tube ice plant in the cluster are:

- Lack of awareness of the new technologies
- There are limited technology suppliers of the tube ice plant manufacturers
- Lack of awareness on tube ice applications

1.5.2 Financial Barrier

The major financial barriers that prevented the implementation of the tube ice plant in the cluster are:

1. Lack of knowledge on the benefit of the tube ice plant with respect to power consumption and applications
2. Higher initial investment

Energy Efficiency Financing Schemes of Small Industries Development Bank of India (SIDBI), if focused on the cluster, it will play a catalytic role in implementation of identified energy conservation projects & technologies. The cluster has significant potential for implementing Tube Ice Plants in addition to the existing Ice plants.

1.5.3 Skilled manpower

Not applicable

1.5.4 Other barrier(s)

Information on the energy efficient technologies are not available among unit owners of the cluster and further unit owners doesn't show interest in energy saving.

2. TECHNOLOGY OPTION FOR ENERGY EFFICIENCY IMPROVEMENTS

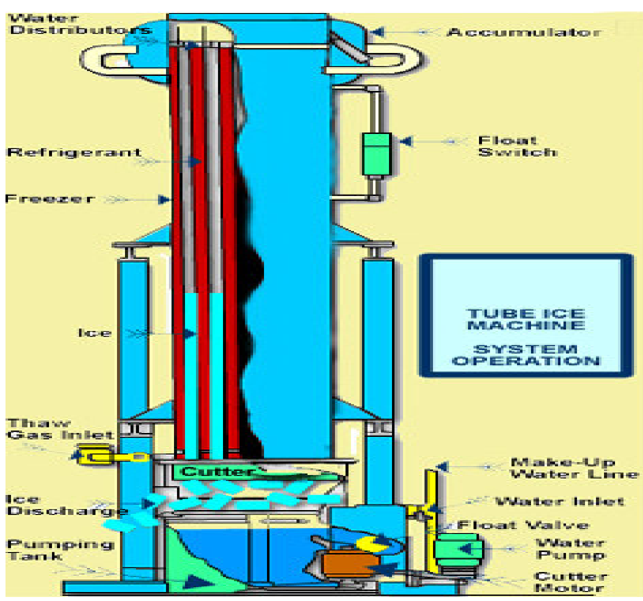
2.1 Detailed description of technology/equipment selected

2.1.1 Description of technology

The main part of the tube ice machine is the ice generator, a vertical shell-and-tube vessel surrounded by a water tank. Special water distributors on top of each tube control an even, spiral supply of water down the insides of the tubes. Excess water is collected in a tank beneath the ice generator and pumped back up to the tank at the top.

Automatic tube ice machine performs two main functions: Freezing and Harvesting. These functions are carried out in a continuous cycle and ensure the steady supply of high quality ice at a rate determined by the user.

Tube ice is formed on the inner surface of vertical tubes and is produced in the form of small hollow cylinders of about 50 x 50 mm with a wall thickness of 10 to 12 mm. The tube ice plant arrangement is similar to a shell and tube condenser with the water on the inside of the tubes and the refrigerant (Ammonia) filling the space between the tubes. The machine is operated automatically on a time cycle and the tubes of ice are released by a hot gas defrost process. As the ice drops from the tubes a cutter chops the ice into suitable lengths, nominally 50 mm, but this is adjustable. Transport of the ice to the storage area is usually automatic, thus, as in the flake ice plant; the harvesting and storage operations require no manual effort or operator attendance.



The discharge system from the plant incorporates an ice crusher, which can be adjusted to give an ice particle size to suit the customer's requirement. The usual operating temperature of this type of plant is -8°C to -10°C. The ice will not always be sub cooled on entering the store but it is usually possible to maintain the store at -5°C since the particle size and shape allow the ice to be readily broken up for discharge.

The production capacity of the tube ice machine is a function of the evaporating temperature, the temperature of the feed water and the length of the freezing cycle. Based on the price of electric power and the purpose for which the ice is to be used, the refrigeration capacity employed and the length of the freezing cycle can be chosen within very wide limits so as to achieve the most economical operation. The following are the benefits of the tube ice plant

- **Highest Electricity Efficiency**: The power consumption will be less per ton of ice production.
- **Labor Cost Savings**: Due to minimal manpower expense related to ice crushing and wastage along with accurate and consistent weight the overall labor expenses are significantly less.
- **Flexible Batch Cycle**: Ice batch in less than 20 minutes ensures no wastage of electricity and thus allows for production planning.
- **Variance in Flake Sizing:** Using customized on-line tube ice flakers, ice can be produced at a required thickness allowing present and future variance in flake sizes.
- **Quality Ice:** The quality of tube ice is better than the water it is made since the impurities present in the water are moved to the center of the ice tube and discharged during defrost ensuring that clean, crystal ice tubes are formed. On the other hand, block ice is manufactured using the outdated method of salt water brine chilling, due to the leaking of ice cans, typically the block ice contains a high degree of salinity, which has an adverse effect on the concrete structure.
- **Lowest Operating Cost**: Production efficiency without brine solution, cans etc; using direct refrigeration principle.
- **Minimal Maintenance:** Machines are known to run with minimal or no maintenance due to inherent plant design and since only world class indigenous components are used.
- **Overall Lowest Investment:** Net present value of tube ice plant is greater than flake or block ice plant.

- **Lowest Space to Production Ratio:** Only area of 100 sq. ft is required for a machine of capacity 40 TPD in production of tube ice. It is one of the most sought after for ice machines where land and building is expensive.
- **Uniform Melt age:** Since the tube ice is consistent in shape, the tubes melt at an equal pace providing a uniform cooling medium.

2.1.2 Technology /Equipment specifications

Ammonia tube ice machine with 135 nos. 1 1/2" O.D. 10' stainless steel tubes, KC3 reciprocating compressor, 75HP electric motors and conventional stainless steel cutter, freezer water pump, completely piped and wired with stainless steel control panel for automatic operation. The detailed specifications of the proposed 20 TPD capacity tube ice plant is furnished below in table 2.1 below:

Table 2.1: Technical Specifications of the Tube Ice Plant – 20 TPD

S. No.	Parameter	Details	Quantity
1	Production capacity	20TPD	1
2	Motor	75 HP	1
3	Ice Freezer and Accumulator	Ice machine with 135 no's 1 ½" O.D. 10' stainless steel tubes	1
4	Cutter	Stainless steel ice cutter driven by 1.5 hp gear motor	1
5	Chilled Water Pump	2 hp centrifugal cast iron mono block pump with motor	1
6	Water Tank	Top and bottom water tank made from stainless with solenoid float level valve.	1
7	KC3 Reciprocating Compressor	Operating as single stage ammonia compressor on steel base completed with - Suction and discharge stop valve Oil separator with oil return float valve - Pressure gauges panel and Pressure switches - -Water cooled systems for cylinder head top covers - Capacity control solenoid - Direct – Coupling / V- Belts 8and guard	1
8	Electrical motor	T9EFC 60 hp, 1,440 Rpm 400-440V/3ph/50 Hz	1
9	Shell & Tube Condenser	fitted out with 10g boiler quality M.S. Tubes of Tata make with Tube sheet & removable end covers with all ammonia and water connections	1
10	Induced Draft Cooling Tower	75TR capacity with 5hp fan	1

The system will also consists of the water and ammonia pipe lines, necessary cabling, panel, control switches etc.

2.1.3 Justification of the technology selected & suitability

At present, the ice blocks are produced and crushed to the required size (flakes) as per the requirements. The following reasons over the existing ice plant for selection of this technology-

- Block/flake ice melts more rapidly than tube ice and so cools the fish more rapidly, but this depends very much upon the circumstances in which the ice is used.
- The 20 TPD tube ice plant consumes 58.52 kW as per the equipments installed at 85% loading and the cycle time would be 20 min and the production will be 277 kg per cycle. (Refer to: The manufacture quotation).
- The specific energy consumption of tube ice plant is 70.42 kWh/ton as per the equipments installed in the 20 TPD Tube Ice plant.
- A greater weight of tube ice than of flake ice, with consequently greater cooling capacity, can be accommodated in a box of fish having limited space for ice, although it will probably melt more slowly than flake ice under similar conditions.
- Flake ice takes up more space than tube ice; it melts quickly and thus should cool the product more quickly, but requires a larger volume for the same cooling capacity and to ensure that cooling is continued for the required length of time.
- Tube ice, on the other hand, will provide more cooling capacity in a small space than flake ice and will continue to cool slowly for a long time in a warm atmosphere too; it should thus be more useful for keeping fish cool in transit, for example chilled fish in uninsulated containers consigned inland.
- The larger the pieces of ice, the greater the possibility of damaging fish. Tube ice is therefore more likely to make indentations than flake ice. Smooth pieces of tube ice should not mark fish so severely as jagged crushed ice.
- Theoretically losses through melting of flake ice in storage should be more severe than with tube ice. In practice this seems not to be so, since the surface of the heap soon forms a thin skin when melt water trickles down, thereby effectively retarding the melting of the remainder.
- Tube ice is often wet on manufacture, and therefore storage should not be refrigerated, since the mass may congeal and the free-running properties are lost. Flake ice, too, can sometimes be wet through faulty manufacture. Caking of either

type can occur at the sides or bottom of a heap if the container or room is not well insulated.

- The tube ice plant will consume less power than block ice production
- More production for the same duration
- Less space required for the same production capacity
- Low GHG emissions
- Low labor cost than the ice blocks production

2.1.4 Superiority over existing technology/equipment

The proposed system is superior to conventional ice block system in terms of capacity utilization of plant, energy consumption, production, operational cost etc.

2.1.5 Availability of the proposed technology/equipment

The tube ice plant suppliers are available in Mumbai and other cities the details of the suppliers are provided in Annexure 6.

2.1.6 Source of technology/equipment for the project

The source of the technology is indigenous and is locally available.

2.1.7 Service/technology providers

Details of energy efficient tube ice plant suppliers had been furnished in Annexure 6.

2.1.8 Terms of sales

The terms and conditions of the equipment supplier for supply of the tube ice plant are furnished in supplier quotation at Annexure 7.

2.1.9 Process down time during implementation

The process down time is not considered due to the plant is replacing the existing system of Ice plant and it installed separately.

2.2 Life cycle assessment and risks analysis

The life of the tube ice plant is considered at 20 years. There is no risk involved as the technology proven and are successfully in operation.

2.3 Suitable plant size for the identified technology/ equipment option

The tube ice plant selected will have the same production capacity of the existing ice plant of 16 TPD.

3. ECONOMIC BENEFITS OF NEW ENERGY EFFICIENT TECHNOLOGY

3.1 Technical benefits

3.1.1 Fuel savings per year

The project activity installation of tube ice plant and will reduce electricity consumption and doesn't have any effect on fuel savings.

3.1.2 Electricity savings per year

The tube ice plant will consume less power and hence reduces electricity consumption. The power savings due to installation of the new tube plant is 191689 kWh per annum.

3.1.3 Improvement in product quality

There is no significant impact on the product quality.

3.1.4 Improvement in production

The installed production capacity of the tube ice plant is 20 TPD and hence there is no significant impact on production improvement.

3.1.5 Reduction in raw material consumption

Raw material consumption is same as present.

3.1.6 Reduction in other losses

The tube ice plant has improved ammonia pipes and receiver and hence the evaporation losses of Ammonia may reduce to certain extent.

3.2 Monetary benefits

The monetary benefit due to installation of new tube ice plant is estimated at ` 7.19 lakh per annum due to reduction in electricity consumption. Details of energy and monetary saving calculation are given at Annexure 2.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

The new tube ice plant is a completely automated plant and will reduce the break downs and ammonia leakages hence working environment may improve.

3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new and energy efficient. The technology implemented will create awareness about energy efficiency and energy saving among the workforce and improves skills of the workers.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

The project activity will reduce effluent generation, as with new pumps, the leakages may reduce.

3.4.2 Reduction in GHG emission such as CO_2, NOx, etc

The major GHG emission reduction source is CO_2. The technology will reduce grid electricity consumption and emission reductions are estimated at 155 tons of CO_2 per annum due to implementation of the project activity.

3.4.3 Reduction in other emissions like SOx

No significant impact on SOx emissions.

4. IMPLEMENTATION/INSTALLATION OF NEW ENERGY EFFICIENT TECHNOLOGY

4.1 Cost of technology/equipment implementation

4.1.1 Cost of technology/equipments

The total cost of the new tube ice plant of 20 TPD production capacities is ` 17.00 lakh as per quotation provided by the vendors.

4.1.2 Other costs such as erection & commissioning costs

No erection and commissioning charges is considered. Details of project cost are furnished in Table 4.1 below:

Table 4.1: Project detail cost

S.No	Particular	Unit	Value
1	Ice Plant and Motor	(` in lakh)	17.00
2	Panel, switch & cabling, nitrogen gas, ammonia gas, conveyer, ice storage etc	(` in lakh)	0.15
3	Total cost of project	(` in lakh)	17.15

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at ` 4.29 lakhs.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which is ` 12.86 lakhs.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10.0% which is prevailing interest rate of SIDBI for energy efficiency related projects. The loan tenure is 5 years and the moratorium period is 6 months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with ` 4.46 lakhs in the first year operation and increases to ` 22.60 at the end of eighth Year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ` 17.15 lakhs and monetary savings due to reduction in electricity consumption is ` 7.19 lakhs and the simple payback period works out to be 2.39 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.0% interest rate works out to be ` 10.45 lakhs

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 26.90 %. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 25.74%. The average DSCR is 1.78.

4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

A sensitivity analysis has been worked out to ascertain how the project financials would behave in different situations like there is an increase in power savings or decrease. For the purpose of sensitive analysis, two scenarios are considered are.

- Increase in power savings by 5%
- Decrease in power savings by 5%

In each scenario, other inputs are assumed as constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Table 4.2: Sensitivity analysis

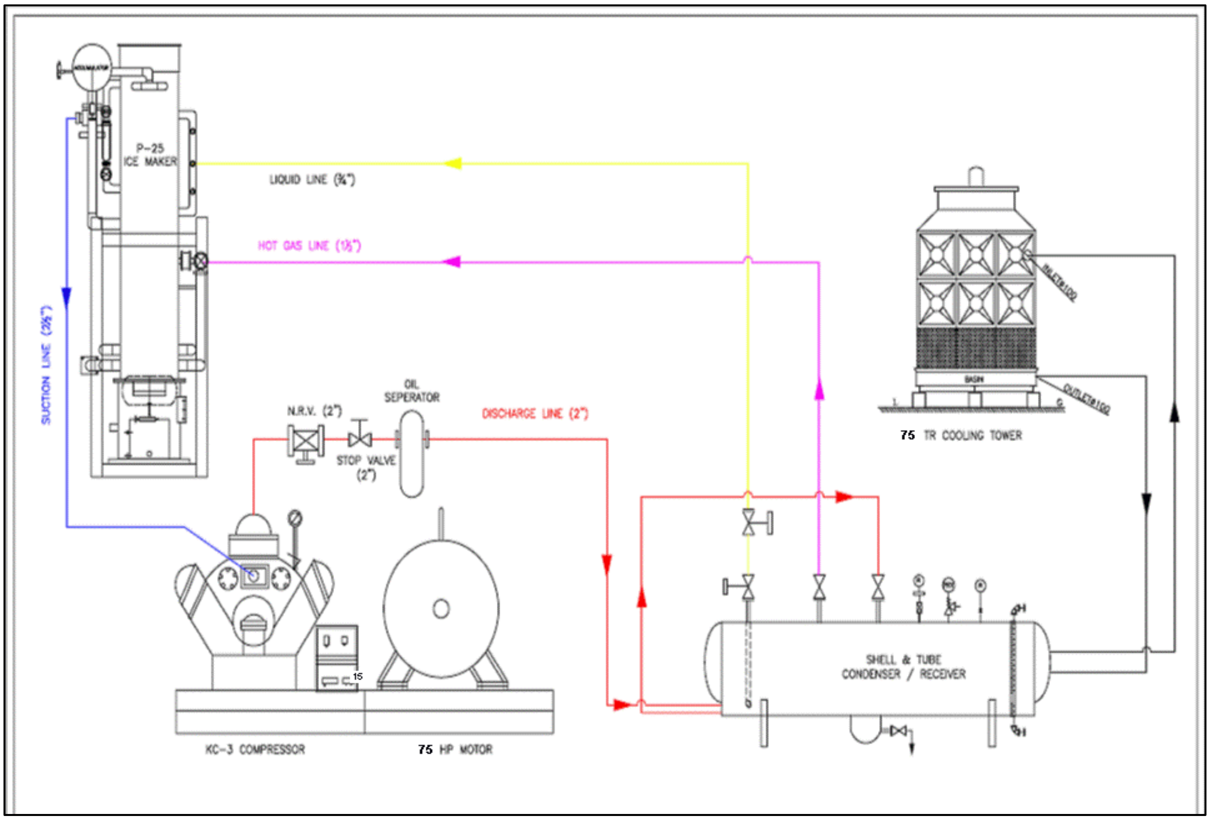
Particulars	*IRR* %	*NPV* ` in lakh	*ROI* %	*DSCR*
Normal	26.90%	10.45	25.74%	1.78
5% increase in power savings	28.97%	11.83	25.99%	1.87
5% decrease in power savings	24.80%	9.07	25.47%	1.69

4.5 Procurement and implementation schedule

The project is expected to be completed in 8 weeks from the date of release of purchase order. The detailed schedule of project implementation is furnished in Annexure 5.

ANNEXURE

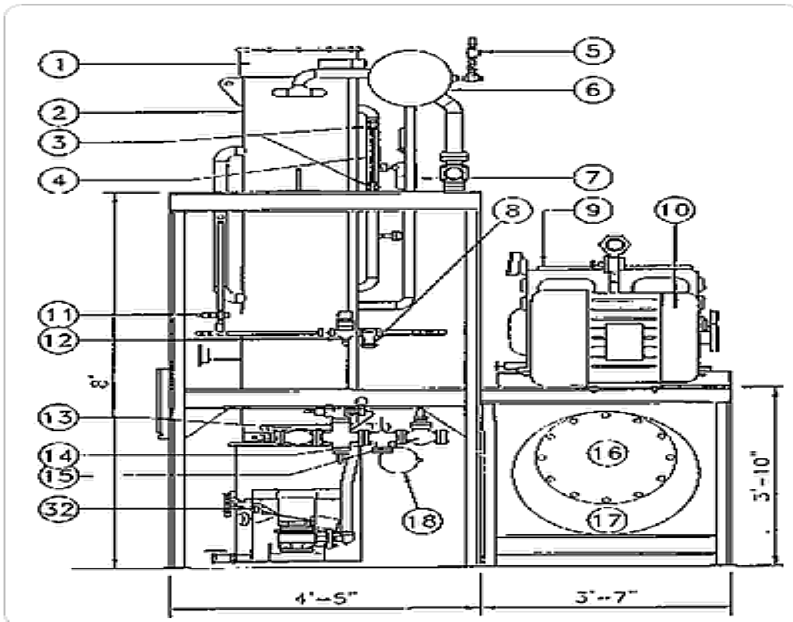
Annexure 1: Process Flow Diagram

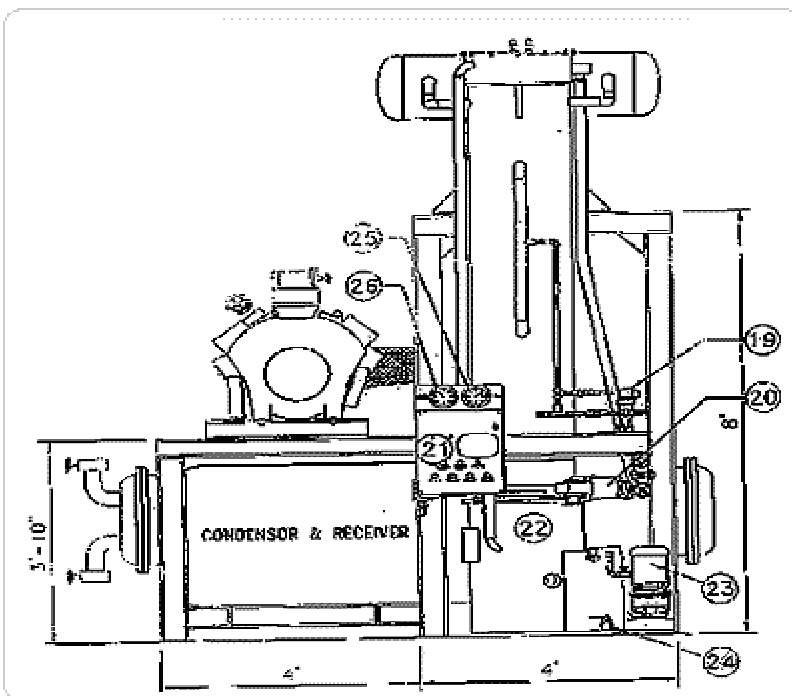


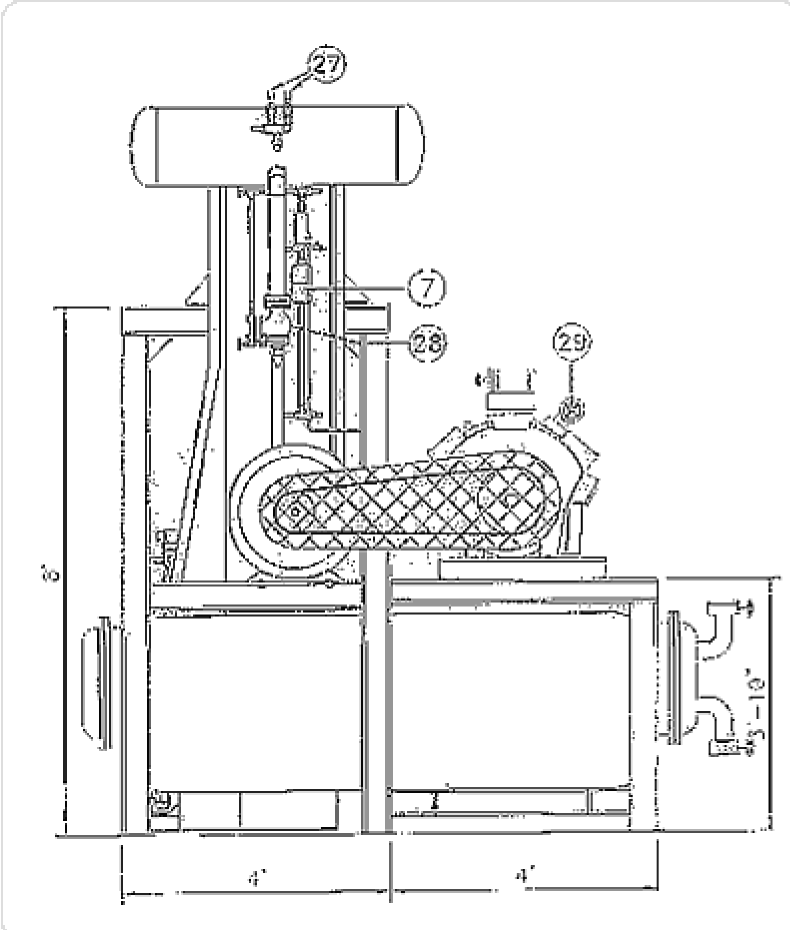
Annexure 2: Detailed Technology Assessment Report – Tube Ice Plant

S.No	Parameters	Units	Present Plant	Tube Ice plant
1	Installed Capacity	TPD	40	20
2	No of Working Days	Day/year	350	350
3	Average Loading of system	%age	30	85
4	Annual production	TPY	4300	5950
5	Sp. Energy Consumption in base case scenario	kWh/Ton		115
6	Total batch time required	min		20
7	Power consumption in Tube Ice Plant at 85% loading	kW		58.52
8	Production of ice per batch	kg/batch		277
9	Time required for production of one ton of Ice	hour		1.20
10	Sp. Energy Consumption in proposed case	kWh/Ton		70.42
11	Power saving	kWh/Ton		44.58
12	Energy Savings for existing production (4300 T/Y)	kWh/year		191689
13	Annual Rs saved	` in Lakh/Year		7.19
14	Investment required	` In Lakh		17.15
15	Payback Period	Years		2.39

Annexure 3: Drawings for Proposed Civil Works Required Tube Ice Plant






27
7
28
29
8'
4'
4'
3'-10"

Annexure 4: Detailed Financial Calculations & Analysis

Assumptions

Name of the Technology	Tube Ice Plant		
Rated Capacity	**20 TPD**		
Details	**Unit**	**Values**	**Basis**
Installed capacity	TDP	20	
No of working days	Days	350	
No of operating hours	Hrs	24	
Proposed Investment			
Tube Ice Plant	` in lakhs	17.00	
Cabling, Civil and Modifications	lump sum	0.15	
Total Investment	` in lakhs	17.15	
Financing pattern			
Own Funds (Internal Accruals)	`in lakhs	4.29	Feasibility Study
Loan Funds (Term Loan)	` in lakhs	12.86	Feasibility Study
Loan Tenure	Years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%	10	SIDBI EE Lending Rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	2	Feasibility Study
Annual Escalation	%	5	Feasibility Study
Estimation of Revenue			
power savings	kWh/annum	191689	Detailed calculations enclosed in DPR
power cost	`/kWh	3.75	
St. line Depn.	%	5.28	Indian Companies Act
IT Depreciation	%	80.00	Income Tax Rules
Income Tax	%	33.99	Income Tax

Estimation of Interest on Term Loan **(` in lakhs)**

Years	*Opening Balance*	*Repayment*	*Closing Balance*	*Interest*
1	12.86	0.90	11.96	1.49
2	11.96	1.80	10.16	1.11
3	10.16	2.20	7.96	0.92
4	7.96	2.50	5.46	0.69
5	5.46	3.20	2.26	0.41
6	2.26	2.26	0.00	0.07
		12.86		

WDV Depreciation **(` in lakhs)**

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	17.15	3.43
Depreciation	13.72	2.74
WDV	3.43	0.69

Projected Profitability `(in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Fuel savings	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19
Total Revenue (A)	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19
Expenses								
O & M Expenses	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
Total Expenses (B)	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48
PBDIT (A)-(B)	6.85	6.83	6.81	6.79	6.77	6.75	6.73	6.71
Interest	1.49	1.11	0.92	0.69	0.41	0.07	0.00	0.00
PBDT	5.36	5.71	5.89	6.10	6.36	6.68	6.73	6.71
Depreciation	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
PBT	4.45	4.81	4.98	5.20	5.46	5.78	5.82	5.80
Income tax	0.00	1.01	2.00	2.07	2.16	2.27	2.29	2.28
Profit after tax (PAT)	4.45	3.80	2.98	3.12	3.29	3.51	3.54	3.52

Computation of Tax `(in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit before tax	4.45	4.81	4.98	5.20	5.46	5.78	5.82	5.80
Add: Book depreciation	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Less: WDV depreciation	13.72	2.74	-	-	-	-	-	-
Taxable profit	(8.36)	2.97	5.89	6.10	6.36	6.68	6.73	6.71
Income Tax	-	1.01	2.00	2.07	2.16	2.27	2.29	2.28

Projected Balance Sheet `(in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Share Capital (D)	4.29	4.29	4.29	4.29	4.29	4.29	4.29	4.29
Reserves & Surplus (E)	4.45	8.25	11.23	14.36	17.65	21.16	24.69	28.21
Term Loans (F)	11.96	10.16	7.96	5.46	2.26	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	20.70	22.70	23.48	24.11	24.20	25.45	28.98	32.50
Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15
Less Accm. Depreciation	0.91	1.81	2.72	3.62	4.53	5.43	6.34	7.24
Net Fixed Assets	16.24	15.34	14.43	13.53	12.62	11.72	10.81	9.91
Cash & Bank Balance	4.46	7.36	9.05	10.58	11.58	13.73	18.17	22.60
TOTAL ASSETS	20.70	22.70	23.48	24.11	24.20	25.45	28.98	32.50
Net Worth	8.74	12.54	15.52	18.65	21.94	25.44	28.98	32.50
Debt Equity Ratio	2.79	2.37	1.86	1.27	0.53	0.00	0.00	0.00

Projected Cash Flow

` (in lakh)

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Sources									
Share Capital	4.29	-	-	-	-	-	-	-	-
Term Loan	12.86								
Profit After tax		4.45	3.80	2.98	3.12	3.29	3.51	3.54	3.52
Depreciation		0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Total Sources	17.15	5.36	4.70	3.89	4.03	4.20	4.41	4.44	4.43

Application									
Capital Expenditure	17.15								
Repayment Of Loan	-	0.90	1.80	2.20	2.50	3.20	2.26	0.00	0.00
Total Application	17.15	0.90	1.80	2.20	2.50	3.20	2.26	0.00	0.00
Net Surplus	-	4.46	2.90	1.69	1.53	1.00	2.15	4.44	4.43
Add: Opening Balance	-	-	4.46	7.36	9.05	10.58	11.58	13.73	18.17
Closing Balance	-	4.46	7.36	9.05	10.58	11.58	13.73	18.17	22.60

IRR

` (in lakh)

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		4.45	3.80	2.98	3.12	3.29	3.51	3.54	3.52
Depreciation		0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Interest on Term Loan		1.49	1.11	0.92	0.69	0.41	0.07	-	-
Cash outflow	(17.15)	-	-	-	-	-	-	-	-
Net Cash flow	(17.15)	6.85	5.82	4.81	4.72	4.61	4.48	4.44	4.43
IRR	26.90%								
NPV	10.45								

Break Even Point

` (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.26	0.27	0.28	0.30	0.31	0.33	0.34	0.36
Sub Total*(G)*	0.26	0.27	0.28	0.30	0.31	0.33	0.34	0.36
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.12
Interest on Term Loan	1.49	1.11	0.92	0.69	0.41	0.07	0.00	0.00
Depreciation *(H)*	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Sub Total (I)	2.48	2.11	1.92	1.69	1.42	1.08	1.02	1.03
Sales (J)	7.19	7.19	7.19	7.19	7.19	7.19	7.19	7.19
Contribution (K)	6.93	6.92	6.90	6.89	6.88	6.86	6.84	6.83
Break Even Point (L= G/I)	35.74%	30.50%	27.85%	24.55%	20.64%	15.79%	14.91%	15.03%
Cash Break Even {(I)-(H)}	22.68%	17.41%	14.73%	11.40%	7.47%	2.59%	1.68%	1.77%
Break Even Sales (J)*(L)	2.57	2.19	2.00	1.76	1.48	1.14	1.07	1.08

Return on Investment

` (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	4.45	4.81	4.98	5.20	5.46	5.78	5.82	5.80	42.30
Net Worth	8.74	12.54	15.52	18.65	21.94	25.44	28.98	32.50	164.31
									25.74%

Debt Service Coverage Ratio ` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	4.45	3.80	2.98	3.12	3.29	3.51	3.54	3.52	21.16
Depreciation	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	5.43
Interest on Term Loan	1.49	1.11	0.92	0.69	0.41	0.07	0.00	0.00	4.69
Total (M)	6.85	5.82	4.81	4.72	4.61	4.48	4.44	4.43	31.28

DEBT

Interest on Term Loan	1.49	1.11	0.92	0.69	0.41	0.07	0.00	0.00	4.69
Repayment of Term Loan	0.90	1.80	2.20	2.50	3.20	2.26	0.00	0.00	12.86
Total (N)	2.39	2.91	3.12	3.19	3.61	2.33	0.00	0.00	17.55
	2.87	2.00	1.54	1.48	1.28	1.92	0.00	0.00	1.78
Average DSCR (M/N)	1.78								

Annexure 5: Details of Procurement and Implementation Plan

Project Implementation Schedule

S. No	Activity	Weeks			
		2	4	6	8
1	Placement of Orders for Equipment				
2	Supply of tube ice plant				
3	Erection and Commissioning				
4	Trial runs				

The process down time is not considered due to the plant is replacing the existing system of Ice plant but separate one.

Annexure 6: Details of Technology/Equipment and Service Providers

Equipment details	Source of technology	Service/technology providers
Tube Ice Plant	Indigenous	Prithvi Engineering Enterprises Shop No.6, Ambika Bhavan, Opp Bhaskar Mall Sector 3, Airoli, Navi Mumbai 400 708
Tube Ice Plant	Indigenous	Chirag Ice Factory Pvt Limited D-29/12, MIDC Industrial Area Turbhe Navi Mumbai-400705

Annexure 7: Quotations/Techno-Commercial Bids for New Technology/Equipment

Prithvi Engineering Enterprises

Office : Shop No 6, Ambhika Bhawan, Opp. Bhosker Mall, Sector - 3, Airoli, New Mumbai - 400 708.
Factory : Laxmi Mahatre Compound, Gala No.-HN - 164/31, Gothewli Village, Opp. Rabale Railway Station (W).
Tel.: 022 - 2764 01 40 ● Email: prithvienginеering@vsnl.net
Website : www.prithviengg.com / www.prithviingen.com

Mobile No:- +91 9867753109 / + 91 9320162109

Sub: Tube Ice Plant

Dear Sir:

Prithvi Engineering Enterprises have been serving its valued clients for more than 15 years. The company was started in mid - 1990s and is largely involved in Air-conditioning and Refrigeration Operations. Our timely Services & Quality has acquired good reputation since last fifteen years.

Prithvi Engineering Enterprises is a completely technological driven company backed by experienced professionals and knowledgeable team. Technological and operational innovation underlined by commitment keeps Prithvi Engineering Enterprises in the frontiers of ice making plant manufacturer. It helped the company raise many an industry benchmark to newer heights amongst commercial ice making plant.

- *Cost efficient State-Of-The-Art ice making plant*
- *To deliver Record Output for clients year after year*
- *To rank among the Some of the Best in the field*

While you choose Prithvi Engineering Enterprises an ice maker as your business partner for the requirement of ice making plant, it is needless to say, come with finest customer support, and quality standards that has surpassed even the highest international norms.

Prithvi Engineering Enterprises manufactures and exports technology driven engineering products like:- Tube Ice Generator, Flake ice plant, Block Ice plant, Condenser, EVAPCO Type Condenser, Ammonia Receiver, Blast freezer, Plate Freezer, Cold Storage, Cold Storage door, Containerized Block Ice Plant, Ice Cans.

*We are the largest manufacturers and suppliers of Tube Ice Plants throughout India with installations in various industries including hospitality, RMC, Seafood Processing, Chicken Processing, Chemical and Dye Manufacturing, etc. Tube Ice Plants are renowned throughout the world for their efficiency and maintenance-free characteristics. We are summarizing the benefits of Tube Ice over Block and Flake Ice and also providing you with the technical detail sheets for the various models. The benefits of **Tube Ice** are:-*

• ***HIGHEST ELECTRICITY EFFICIENCY**-15 to 20% saving over Flake / Block ice.*

• ***LOWEST OPERATING COST-** Production efficiency without brine solution, cans, etc. using direct refrigeration principles.*

• ***LOWEST SPACE to PRODUCTION RATIO** - Only 200 sq.ft. required for 20 TPD machine making the Tube Ice machine one of the most sought after ice machines where land and building is expensive. Entire plant can be easily installed on the terrace of existing processing plants.*

• ***MINIMAL MAINTENANCE** - Machines are known to run with minimal or no maintenance due to inherent plant design and since only world-class indigenous components used.*

• ***FLEXIBLE BATCH CYCLE** - Ice batch in less than 20 minutes ensures no wastage of electricity and allows for production planning.*

• ***LOWEST OVERALL INVESTMENT** - Net Present Value of Tube Ice Plant greatest as compared to Flake/Block ice plant.*

• ***QUALITY ICE** - The quality of the Tube Ice is actually better than the water it is made from since the impurities present in the water are moved to the center of the ice tube and discharged during defrost ensuring that clean, crystal ice tubes are formed. On the other hand, Block Ice is manufactured using the*

Prithvi Engineering Enterprises

Office : Shop No 6, Ambhika Bhawan, Opp. Bhosker Mall, Sector - 3, Airoli, Navi Mumbai - 400 708.
Factory : Laxmi Mahatre Compound, Gala No.-HN - 164/31, Gothawli Village, Opp. Rabale Railway Station (W).
Tel.: 022 - 2764 01 40 ● Email: prithviengineering@vsnl.net
Website : www.prithviengg.com / www.prithvinigen.com

Mobile No:- +91 9867753109 / + 91 9320162109

PRITHVI'S MODEL P10A – 10TPD
AUTOMATIC TUBE ICE MACHINE

Ammonia tube ice machine with 90 nos. 1 1/2" O.D. 10' stainless steel tubes, KC2 Reciprocating compressor, 50HP electric motors and conventional stainless steel cutter, freezer water pump, completely piped and wired with stainless steel control panel for automatic operation.

Sr.	Item	Descriptions	Qty
	Ice Freezer and Accumulator	Ice machine with 90 nos 1 ½" O.D. 10' stainless steel tubes	1 No
	Cutter	Stainless steel ice cutter driven by 1.5 hp gear motor	1 No
	Chilled Water Pump	1.5 hp centrifugal cast iron monobloc pump with motor.	1 No
	Water Tank	Top and bottom water tank made from stainless steel with solenoid float level valve.	1 No
	KC2 Reciprocating Compressor	Operating as single stage ammonia compressor on steel base completed with :- - Suction and discharge stop valve - Oil separator with oil return float valve - Pressure gauges panel and Pressure switches - -Water cooled systems for cylinder head top covers - Capacity control solenoid - Direct – Coupling / V- Belts and guard	1 No
	Electric motor	TEFC 50 hp, 1,440 Rpm 400-440V/3ph/50 Hz	1 No
	Shell & Tube Condenser	fitted out with 10g boiler quality M.S. Tubes of Tata make with Tube sheet & removable end covers with all ammonia and water connections	1 No
	Receiver	Provided with liquid inlet & outlet connections and couplings for connection of pressure relief valve, purge valve, oil drain valve and for the fixing of liquid level sight glass. The vessel will be given double coat of Zinc Chromate Primer.	1 No
	Ammonia shut –off valves and control	Stop Valve : "Danfoss" or equivalent Control Valve:- "Danfoss" or equivalent	1 No
	Ammonia piping and fitting	Pipe : TATA "C" Class or equivalent Pipe insulation : Polyurethane foam claded with PVC tape	1 No
	Induced Draft Cooling Tower	-50 TR capacity with 2hp fan -	1 No
	Condenser water Pipe and fitting	(6 Meters) Consisting of :- Pipe: Galvanized TATA "B" Class	1 No
	Main switch control panel (All the Controls used are of Siemens Make)	- Main circuit breaker with fuses - Branch circuit breaker with fuses - Star /Delta starter for compressor Motor - DOL starter for chilled water pump and condenser water pump - DOL starter for cooling tower fan motor - Pilot lamps and push button switches	1 No

Prithvi Engineering Enterprises

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Tel.: 022 - 2764 01 40 ● Email: prithviengineering@vsnl.net
Website : www.prithviengg.com / www.prithvinigen.com

Mobile No:- +91 9867753109 / + 91 9320162109

Tube ice plant Complete

Model	Capacity	Description	Motor HP/KW	Price/INR/
P5F	3.5 TPD	COMPLETE PACKGED PLANT	15/11.19	₹ 10,00,000.00
P5A	5 TPD	COMPLETE PACKGED PLANT	25/19	₹ 15,00,000.00
P10A	10 TPD	COMPLETE PACKGED PLANT	50/37.3	₹ 19,00,000.00
P15A	15 TPD	COMPLETE PACKGED PLANT	60/44.76	₹ 24,00,000.00
P20A	20 TPD	COMPLETE PACKGED PLANT	75/56	₹ 26,00,000.00
P25A	25TPD	COMPLETE PACKGED PLANT	100/74.6	₹ 29,00,000.00
P30A	30TPD	COMPLETE PACKGED PLANT	110/82	₹ 36,00,000.00
P40A	40TPD	COMPLETE PACKGED PLANT	125/93.25	₹ 43,00,000.00
P55A	60 TPD	COMPLETE PACKGED PLANT	200/149.2	₹ 55,00,000.00
P65A	80 TPD	COMPLETE PACKGED PLANT	250/186.5	₹ 66,00,000.00
P99A	125 TPD	COMPLETE PACKGED PLANT	400/298.4	₹ 80,00,000.00

(All Taxes and Levies including Excise, VAT and CST payable extra at actual)

Tube Ice Maker Only

Model	Capacity	Description	Motor HP/KW	Price/INR/
P5F	3.5 TPD	Ice Maker Only	15/11.19	₹ 9,00,000.00
P5A	5 TPD	Ice Maker Only	25/19	₹ 10,00,000.00
P10A	10 TPD	Ice Maker Only	50/37.3	₹ 12,00,000.00
P15A	15 TPD	Ice Maker Only	60/44.76	₹ 15,00,000.00
P20A	20 TPD	Ice Maker Only	75/56	₹ 17,00,000.00
P25A	25TPD	Ice Maker Only	100/74.6	₹ 20,00,000.00
P30A	30TPD	Ice Maker Only	110/82	₹ 25,00,000.00
P40A	40TPD	Ice Maker Only	125/93.25	₹ 25,00,000.00
P55A	60 TPD	Ice Maker Only	200/149.2	₹ 35,00,000.00
P65A	80 TPD	Ice Maker Only	250/186.5	₹ 46,00,000.00
P99A	125 TPD	Ice Maker Only	400/298.4	₹ 50,00,000.00

Above price does not include (to be provided by customer):

1.1 Consumables: First Charge of refrigerant NH_3 / R22 and compressor oil
1.2 REQUIRED Nitrogen for system flushing
1.3 Water Filtration System, Screw Conveyors & Ice Storage and Delivery System
1.4 Transportation, loading and Crane handling charge
1.5 External electrical transformer and connection
1.6 All civil work at site including storage water tanks
1.7 Other unforeseen items not stated

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

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