DETAILED PROJECT REPORT
ON
TECHNOLOGICAL UPGRADATAION WITH AUTOMATIC AIRFLOW VARIATION IN WITHERING SYSTEM HAVING 16 TROUGHS
(JORHAT TEA CLUSTER)






ENERGY IS LIFE
BEE
CONSERVE IT

Bureau of Energy Efficiency

Prepared By

PCRA

Reviewed By

ISTSL

TECHNOLOGICAL UPGRADATION WITH AUTOMATIC VARIATION IN AIR FLOW IN WITHERING SYSTEM HAVING 16 NOS. OF TROUGH

JORHAT TEA CLUSTER

BEE, 2010

Detailed Project Report on *Technological up gradation with Automatic Variation in Air Flow in Withering System having 16 nos. of trough,* Jorhat Tea Cluster, Assam (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **PCRA/JTC/ SAG/** ____

For more information

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan
R. K. Puram, New Delhi – 110066

Telephone +91-11-26179699
Fax +91-11-26178352
Websites: www.bee-india.nic.in
Email: jsood@beenet.in/ pktiwari@beenet.in

Acknowledgement

We are sincerely thankful to the Bureau of Energy Efficiency, Ministry of Power, for giving us the opportunity to implement the 'BEE SME project in "Jorhat Tea Cluster, Jorhat". We express our sincere gratitude to all concerned officials for their support and guidance during the conduct of this exercise.

Dr. Ajay Mathur, Director General, BEE

Smt. Abha Shukla, Secretary, BEE

Shri Jitendra Sood, Energy Economist, BEE

Shri Pawan Kumar Tiwari, Advisor (SME), BEE

Shri Rajeev Yadav, Project Economist, BEE

Petroleum Conservation Research Association (PCRA) is also thankful to various tea associations like ABITA (Assam Branch of Indian Tea Association), TAI (Tea Association of India), ATPA (Assam Tea Planters Association), NETA (North East Tea Association), etc., for their valuable inputs, co-operation, support and identification of the units for energy use and technology audit studies and facilitating the implementation of BEE SME program in Jorhat Tea Cluster.

We take this opportunity to express our appreciation for the excellent support provided by Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the Detailed Project Report (DPR).

PCRA is also thankful to all the owners of the tea factories, plant in charges and all workers of the tea factories for their support during the energy use and technology audit studies and in implementation of the project objectives.

Petroleum Conservation Research Association

Guwahati

Contents

List of Annexure

List of Table

List of Abbreviation

BEE	Bureau of Energy Efficiency
MSME	Micro Small and Medium Enterprises
CDM	Clean Development Mechanism
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
DSH	De-super Heater
GHG	Green House Gases
IRR	Internal Rate of Return
MT	Million Tonne
MW	Mega Watt
NPV	Net Present Value
ROI	Return on Investment
VFD	Variable Frequency Drive
PLC	Programmable Logic Controller
SCUM	Standard Cubic Meter
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industrial Development Bank of India

EXECUTIVE SUMMARY

Petroleum Conservation Research Association (PCRA) is executing the BEE – SME program for Jorhat Tea Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Jorhat cluster is one of the largest tea clusters in India; accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures/technologies, so as to facilitate maximum replication in other tea clusters in India. The main energy forms used in the cluster units are grid electricity, Natural gas, coal, and Diesel oil mainly to provide power during off – grid period

After drying, the most energy intensive process during tea processing is withering, where the moisture from the green tea leaves plucked from the garden is removed so that the tea leaves becomes flaccid and gets prepared for further processing. The withering process is carried out by blowing air, both at atmospheric as well as elevated temperature by means of axial fans. As the quantity of air required for withering is more during the initial stage and gets reduced as the process of withering progresses, so under the existing condition, this variation in the volume of air is carried out through a manually controlled damper by maintaining a constant speed of the withering fans. .

This DPR highlights the details of the study conducted for replacing the existing system of variation in the air flow rate of 16 numbers of withering trough, with each withering trough fitted with two axial fans run by 2.24 kW, 960 rpm induction motor through an automated variation in the air flow rate by varying the speed of the withering fans, possible Energy saving and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis in different scenarios 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:

S. No	Particular	Unit	Value
1	Project cost	(` in Lakh)	11.18
2	Expected Electricity Savings	kWh/annum	92520
3	Monetary benefit	(` in Lakh)/annum	6.89
4	Simple payback period	Yrs	1.62

S. No	Particular	Unit	Value
5	NPV	(` in Lakh)	15.26
6	IRR	%age	45.82
7	ROI	%age	27.33
8	DSCR	Ratio	2.62
9	CO_2 reduction	Tonne/Annum	95.30
10	Process down time	Days	04

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible solution for Jorhat Tea Cluster.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Gujarat Dairy 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 Briefing about Jorhat Tea Cluster

1.1.1 About Jorhat Tea Cluster

This SME cluster chosen for BEE's SME cluster development program comprises of the tea factories located in the erstwhile undivided Jorhat district of upper Assam that is presently comprised of Jorhat and Golaghat districts. The Jorhat Tea Cluster has about 150 tea factories. Majority of these tea factories have their own plantations, while the tea factories not having their own plantations depends on the tea gardens that does not have tea factories. The tea factories having their own plantation are owned either by group companies like APPL, Williamson & Magor, etc or by families having ownership through inheritance. These tea factories were mostly established during pre – independence period. Whereas the tea factories which does not have their own plantation were established after the late 80's and are owned by first generation entrepreneurs.

Existing Production Process:

The tea factory under Jorhat Tea cluster produces mainly produces CTC (Cut, tear and curl) and Orthodox type of tea. For the production of CTC type of tea the green tea leaves are shredded and then cut, tear and curled in the CTC (cutting, tearing and curling) machine. Whereas for the production of orthodox tea the green tea leaves are twisted through continuous circular motion of the rollers of the rolling machine. But for both these types of tea being manufactured in this cluster, the tea leaves are dried in dryers to remove the moisture before the made tea is finally sorted and packed. The drying process is the most energy intensive and to carry out the drying, the tea factories of this cluster use either coal or natural gas as fuel.

The pictorial representation of the tea manufacturing process that is being presently followed in Jorhat Tea Cluster is depicted in Annexure 1.

Withering:

The green tea leaves plucked from the garden are first withered to remove the surface moisture and partially the internal moisture. Withering promotes the dissipation of heat generated due to continuous respiration. The withering process which takes about 10 hours on an average, reduces the moisture content of green leaves to 55% in case of orthodox tea and to 70% in case of CTC tea production.

In Jorhat tea Cluster two types of withering process is being adopted by the tea factories. The first is the "Open Trough Withering" and second is the "Enclosed Trough Withering". In the first case, the area over the withering trough is kept open and the air from the withering fan passes from the bottom of the withering trough and released to the environment through the tea leaves. In the second case, the area over the withering trough is enclosed and the air from the withering fan is released to the environment through a single outlet after being passed through the tea leaves.

CTC:

In this process the withered tea leaves are shredded in the rotor – vane and then cut torn and curled in the CTC machine. During this process the enzymes of the tea leaves are released in the rotor – vane and the curling of the tea leaves initiates the fermentation process. Most of the juice that comes out of the tea leaves during shredding in the rotor – vane is evaporated due to friction in the CTC machine, for which the moisture content in the tea leaves after CTC is reduced from 70 % to 55 %.

Rolling:

This process after withering is adopted by tea factories to produce orthodox type of tea. The chemical compounds of the tea leaves are released to initiate oxidation in the fermentation process. Rolling twist the leaves and at the same time, breaks the leaf to release enzymes for oxidation.

Fermentation:

This is the least energy intensive step in the entire tea manufacturing process. During the fermentation process the tea leaves are left for oxidation, to which there occurs notable chemical as well as physical change. The color of the tea leaves is changed to reddish brown. The flavor and liquor of the tea leaves is attained in this stage.

Drying:

The fermented tea particles are dried or fired to arrest the fermentation and to reduce the moisture to about 3%. Clean and odorless hot air is passed through the fermented tea particles in dryers.

The temperature of the hot air varies between 90^0 – 160^0C depending on the type of dryer. Drying or firing is a thermal energy intensive operation that also consumes electrical energy to drive blowers and dryers.

Drying is a critical process that decides the final product quality of black tea. Two types of dryers are used in the tea industry: - Endless Chain type (ECP) dryer or Fluidized Bed Dryer (FBD).

In the ECP dryer, tea particles are spread over continuously moving chain – type trays through which hot air flows. The trays move from top to bottom while the hot air is blown from the bottom. The temperature of hot air is about 90^0. The ECP dryer has an advantage to dry both leafy grades and powered grades. In the VFBD, tea particles are pneumatically fluidized by hot air at 140 – 160^0C. Uniform drying is ensured in VFBD and better quality tea could be produced. This is also more energy efficient method compared to ECP dryers with less mechanical controls.

1.2 Energy Performance in Existing Situation

1.2.1 Energy Consumption Profile

For the purpose of tea processing, both electrical as well as thermal energy are required. In the tea factories of Jorhat Tea Cluster, the electrical energy requirement is fulfilled by electrical power available through grid whereas the main source of thermal energy is either coal or Natural Gas.

The summary of the annual energy consumption in different production capacities of the tea factories of this cluster that uses coal as the thermal energy source as revealed during the energy audit is given in Table – 1 below;

Table 1: Annual Energy Consumption by Tea factories using coal

Parameter	Unit	Up to 500 MT of made tea	500 – 1500 MT of made tea	Above 1500 MT of made tea
Annual electrical energy consumption	kWh	221197.4	688252.8	862896.8
Annual coal consumption	MT	390.64	1107.21	1457.63
Annual HSD consumption	KL	27.66	88.69	136.43
Total Annual Energy consumption	MCal	2034504	5869315	7923604
Total Annual Energy consumption in one unit of the different capacity	Kloe	222.5	646.1	866.6
Average annual Made Tea production	MT	450	1000	1900

And the summary of the annual energy consumption of the tea factories of this cluster that uses NG as the thermal energy source is given in Table – 2 below;

Table 2: Annual Energy Consumption by Tea factories using Natural Gas

Parameter	Unit	Up to 500 MT of made tea	500 – 1500 MT of made tea	Above 1500 MT of made tea
Annual electrical energy consumption	kWh	234896.8	656332.6	805998.7
Annual NG consumption	Scum	216602	431594.8	629896.2
Annual HSD consumption	KL	30	92	145
Total Annual Energy consumption	MCal	2581390	5627756	8190163
Total Annual Energy consumption in one unit of the different capacity	Kloe	258.1	562.8	819.0
Average annual Made Tea production	MT	480	960	2100

1.2.2 Average Annual Production

Tea factories are agro based industries, and the operation of the tea factories depends on the availability of the tea leaves in the tea gardens. The tea factories depends on either their own in – house production of green tea leaves or on green tea leaves plucked from tea gardens without factories or both. The peak production season for tea factories in Jorhat Cluster starts with the beginning of spring, i.e., from the month of March – April and lasts till the end of autumn or beginning of winter, i.e., till the month of October – November. During this period most of the tea factories run on round the clock basis as the green tea leaves cannot be stored. The tea factories remain non – operational for about two to three months in a year between the months of December to March.

The average tea production in the tea factories of Jorhat Cluster where Energy Audit was carried out is 1002 tones of made tea per annum.

1.2.3 Specific Fuel Consumption & Specific Electricity Consumption

Similar to any other type of industry, the specific energy consumption in the tea factories of this cluster also depends on the scale of production, which has been evaluated during the energy audit. Thus keeping this into consideration, the tea factories of this cluster is broadly divided into three groups and the specific energy consumption is evaluated separately.

In this context it is noteworthy to mention that bifurcation of the tea factories base on production is specific to this report only and there is no official notification by any authorized bodies in this regard.

The specific energy consumption by the tea factories is given in Table – 3 below;

Table 3: Specific energy consumption by tea factories

Type of tea factory	kWh/ kg of made tea	Kg of coal/ kg of made tea	Liters of HSD/ kg of made tea	Scum of NG/ kg of made tea
Large tea factory	0.55	0.72	0.07	0.32
Medium tea factory	0.65	0.82	0.08	0.39
Small tea factory	0.85	1.02	0.09	0.51

1.3 Existing Technology/Equipment

1.3.1 Description of existing technology

The fresh green leaves plucked from the tea gardens that contain about 77% of moisture are spread over the withering troughs and for the purpose of withering the green tea leaves, air is blown through these leaves by using axial fans. During the process of withering the moisture content of the green leaves is brought down to about 70% in case of CTC type of made tea and 55% in case of orthodox type of made tea.

During the period of energy audit it was revealed that on an average, withering takes about 12 hours. Further it was revealed during the energy audit that more air is blown during the initial stage (about 5000 cubic feet per minute) and after about 4 – 5 hours this air flow rate is reduced to about two – thirds of its initial value. And as during the withering stage both physical as well as chemical changes takes place in the fresh tea leaves plucked from the garden, so in order to carry out proper withering of the green leaves, the volume flow rate of air through the tea leaves needs to be controlled.

Under the present circumstances, controlling the volume flow rate through the green tea leaves spread over the withering trough, is done by means of damper control mechanism. At the initial stage of withering when the volume of air required for withering is more, the damper is kept in fully open condition. In order to take care of the decreased requirement of air flow rate corresponding to the progress in the withering process, the damper is manually kept in partially open position, so that the system resistance gets increased and the air flow rate is decreased.

As under the existing situation, the power consumption by the withering fans both during the period when the requirement of air flow is high as well as during the period when the air flow rate is low is same. For this, if instead of variation in the system resistance by varying the position of the damper, the air flow rate is varied by varying the speed of the withering, then substantial energy can be saved, because going by the law governing the operation of fans, 10% decrease in the speed of the fan will result in the decrease in the power consumption by 27%.

Figure 1: Withering Fan fitted along withering trough

Electrical Energy Charges

Table 4: Average per unit cost of electrical power

Per Unit Cost Of Electrical Energy	
Grid Availability	70%
DG Power	30%
Average cost of grid power	` 5.5 per unit
Average cost of DG	` 12 per unit
Total Unit Cost	5.5 *0.7 + 12 * 0.3 = `7.45/ kWh

1.3.2 Role in process

Withering is the first and the foremost step in tea manufacture. The process of withering involves blowing of air through the freshly plucked tea leaves to evaporate the moisture content in the tea leaves so as to bring about physical as well as chemical change in the tea leaves for subsequent processing stages. The physical change in withering is brought about in the form of loss of moisture and making the tea leaves flaccid. On the chemical front, there occurs bio – chemical changes in the tea leaves during withering, so that further processing of the tea leaves can be initiated.

To attain the aforesaid objectives of withering, withering fans plays a vital role, as the main component of withering, i.e., air, is supplied by means of the fans. For the purpose of withering, axial flow fans are used. The direction of airflow in axial fans is essentially parallel to the axis of the impeller. These fans are used for withering, because for the purpose of withering, the fan must be able to handle large volumes of air.

Figure 2: Tea Leaves spread over Withering Trough

1.4 Baseline establishment for existing technology

The baseline is prepared on the basis of a typical tea factory of Jorhat Cluster by considering that each tea factory will have 16 numbers of withering trough and 32 withering fans as each trough is fitted with two fans of 2.23 kW rated capacity. The baseline energy consumption by the withering fans is as detailed below;

Table 5: Baseline electrical power consumption by the withering fan motors

S. No.	Unit	Measured Average Power consumption by a single motor, kW	Power Consumption by 32 motors, kW
1	Unit1	1.35	43.20
2	Unit 2	1.96	62.72
3	Unit 3	2.13	68.16
4	Unit 4	1.30	41.60
5	Unit 5	2.75	88.00
6	Unit 6	2.35	75.20
7	Unit 7	1.90	60.80
8	Unit 8	1.08	34.56
9	Unit 9	2.08	66.56
10	Unit 10	1.88	60.16
Total		18.78	600.96
Average		***1.88***	***60.10***
Annual Electricity Consumption		***kWh/Year***	***216360***

Considering an average operation of the withering fans for 12 hours per day and for 300 days in a year, the annual baseline energy consumption by the withering fans for a typical tea factory per year is 216360 kWh per annum.

1.4.1 Design and operating parameters

The existing process of withering in the tea factories of Jorhat Cluster is entirely manual, where the amount of withering of the green leaves is monitor manually and based on the amount of wither of the green leaves, the damper position is varied manually to control the air flow rate through the withering troughs. The typical unit of the SME cluster operates for 12 hours per day and 300 days round the year. Specifications are provided in annexure 2.

1.4.2 Operating efficiency Analysis:

During the process of withering, air is blown through the fresh green leaves plucked from tea gardens so that chemical as well as physical changes takes in the green tea leaves and simultaneously moisture is removed from the green tea leaves. Energy is required basically to remove the moisture. As per the industry standard, to make CTC type of tea 170 – 300 kgs of water is removed from 1000 kgs of green leaves, whereas to make orthodox tea, 400 kgs of water is removed per 1000 kgs of green leaves.

Considering the ambient temperature as 30^0C and latent heat of evaporation of water as 540 kcal, the heat that is actually required to evaporate 1 kg of water thus is 610.21 kcal. Thus to obtain the operational efficiency of the withering air system, the actual energy required to evaporate the moisture is divided by the energy put to the withering fans.

1.5 Barriers in adoption of proposed equipment

1.5.1 Technological barrier

- Due to absence of any scientifically designed operator training program, the operation and maintenance protocols for optimum utilization of electrical energy equipment are not followed.
- Though withering after drying is the most energy intensive process during tea manufacturing consuming both electrical as well as thermal energy, yet the awareness level in making these process energy efficient needs enhancement.
- Majority of the unit's entrepreneurs in Jorhat tea cluster do not have any in – depth technical expertise and knowledge on energy efficiency, and are dependent on local technology suppliers or service companies, who normally rely on established and commonly used technology. The lack of technical know – how has made it difficult for the factory owners to identify the most effective technical measures.

- Most of units in Jorhat tea cluster have been established several years ago when energy efficiency was not important issue for the operation of a plant. They are operating with outdated technology and low – end technologies.
- As majority of the entrepreneurs in cluster are not aware of the energy losses in the plant, there may be a strong feeling that the energy efficiency initiatives in manufacturing facility can have a cascading effect of failure in critical production areas directly or indirectly connected if the intended performance of the replaced/ retrofitted equipment falls below design values.
- There is a strong feeling in the tea factory entrepreneurs that, energy efficiency initiatives are difficult and the drive to save energy will affect the quality of made tea and thus will lead to business loss. These can however be overcome by motivating them to attend the awareness programs and use the detailed report on the benefits of the measures identified and cost benefit analysis. Further, sourcing of expertise on maintenance service provider or training by the equipment supplier will definitely overcome the barriers.

1.5.2 Financial barrier

- The cost of new technology is high. There is inadequate data on return on investment from energy saving alone. This creates barriers to financial decision making for acquisition of new technology.
- Banks, although willing to lend to the sector are unable to take decisions about lending in the absence of information about techno economic feasibility of energy saving equipment.

1.5.3 Skilled manpower

- The persons working in the tea factories of Jorhat Cluster generally belongs to a particular tribe working for generations in tea factories and they normally lead an isolated life. For this, though the persons are skilled with regard to the operation of the machineries, but innovations as well as consciousness regarding energy conservations lacks amongst the workforce. This is one of the lacunae of the Jorhat Tea Cluster.
- Specialized training with local service providers for better operation and maintenance of equipments, importance of the energy and its use will create awareness amongst workforce. These programs should be organized with equipment suppliers.

1.5.4 Barrier specific towards adoption of this technology

- As withering is very important to maintain the quality of tea, so shifting from manual mode of varying the air flow rate to automated mode may require some counseling before adoption of this technology.
- Proper training needs to be provided to the workers for operation of this system as the settings for the timer needs to be changed as per the weather.

2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

In this proposed technology the system resistance is put to minimum by removing the damper control mechanism. In absence of the damper control mechanism the flow of air into the withering trough as per the process requirement, is regulated by controlling the speed of the motor of the ID fan by means of Variable Frequency Drives (VFDs).

As the flow of air is directly proportional to the speed of the ID fan, so the air flow to the dryer chamber can be varied adequately by varying the speed of the ID fan.

Now, the speed of the induction motor associated with the ID fan is varied by the VFD through variation in the input frequency to the induction motor, as per the following equation;

$$\text{Speed (N) of the fan} = \frac{120 * \text{Input Frequency in Hz}}{\text{Number of poles of the motor}}$$

As the input power to the induction motor of the ID fan comes via the VFD, so the speed of the ID fan can be easily altered by altering the frequency in the VFD.
Again as per the fan laws,

Fan input power = Constant (K) * $(\text{Speed of the Fan})^3$

Thus going by the Fan Law, if the speed of the fan is reduced by 10% then the power input to the fan can be reduced by 27%.

2.1.1 Details of proposed equipment

During the energy audit it was revealed that the best withering can be done if the difference between the wet bulb temperature and the dry bulb temperature is maintained at 4^0C. As the moisture content in the green tea leaves plucked from the tea garden is high at the initial stage, so it was found during the audit phase that more air is blown through the tea leaves spread over the withering trough at the initial stage, which is about 5000 cubic feet per minute on an average. As withering is progressed, and the green leaves plucked from the garden turns flaccid, the volume of air flow rate is reduced. The rate of reduction of the air flow rate is determined by the condition of the weather.

In this proposed technology, the whole withering system will be made automated and the damper presently being installed to vary the air flow rate will be withdrawn. Depending on the weather condition, the air flow rate will be varied accordingly by varying the speed of the withering fan by means of the VFD and PLC. The operator will do the necessary programming in the PLC, which in turn will govern the output frequency of the VFD. As discussed above, the output frequency from the

VFD will determine the speed of the withering fan. The sequence of operation of this proposed technology is as depicted below;

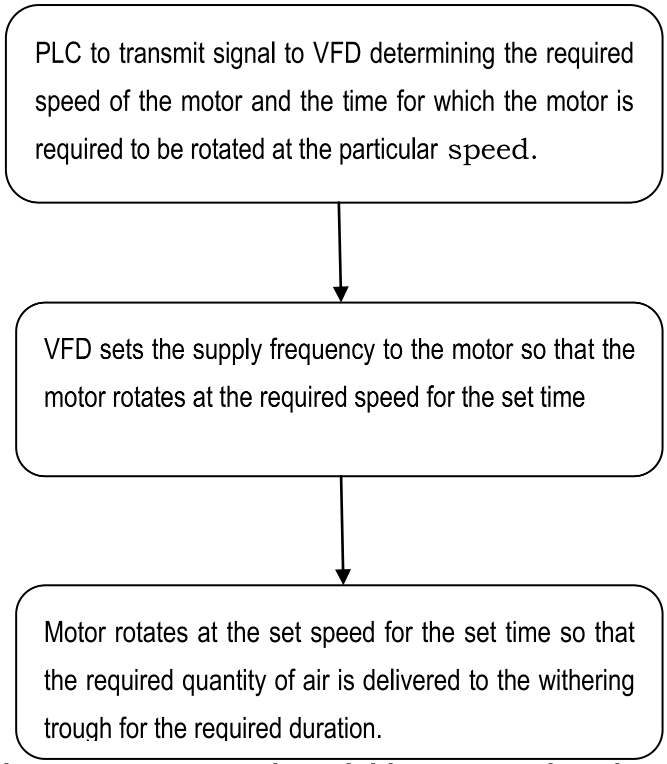


Figure 3: Operation of this Proposed Technology

A Variable Frequency Drive(VFD) actually lowers the motor voltage if the ratio of the drive & driven pulleys is such that the motor actually runs at frequency 85% of the rated 50 Hz , to keep the voltage – frequency ratio constant such that the operational efficiency improves substantially, thereby leading to savings in Input power to the withering fan.

As far the air pressure is concerned, the withering trough Air-flow resistance goes down due to the complete opening of the Dampers which are the major cause for increasing the inlet air resistance of the withering trough. Thus the Hydraulic Power developed by the withering fan is lower (because of the lower flow rate & lower air pressure) .This in turn lowers the motor input Power.

Based on the findings during the energy audit, it was found that proper withering for the maximum duration during the year can be carried out if the withering fan rotates for 6 hours at full rated speed, 4 hours at 87.5% of rated speed, and 2 hours at 75% of rated speed. For this the projection to evaluate the financial justification for the implementation of this proposed technology is done by considering that the withering fan rotates for 6 hours at full rated speed, 4 hours at 87.5% of rated speed, and 2 hours at 75% of rated speed.

Based on this operation parameter and on the basis that 10% reduction in fan speed will result in 27% reduction in power consumption by the fan motor, the electrical energy consumption by the 32 numbers of withering fan motor fitted in 16 numbers of withering trough through adoption of this proposed technology is as tabulated below;

Table 6: Estimated Power Consumption after implementation of the proposed technology

S. No.	Rotation of the withering fan at	Hours of operation per day	Power consumed per day per fan, kWh	Power consumed per year per fan, kWh	Total Power consumed by 32 nos. withering fans per year, kWh
1	Rated Speed	1 hours	1.88	564	18048
2	90% of Rated speed	3 hours	4.11	1233	39456
2	85% of rated speed	4 hours	4.47	1341	42912
3	75% of rated speed	4 hours	2.44	732	23424
Total Power Consumed by the Proposed Technology				***3871***	***123840***
Electricity consumed				***1.075 kW***	***34.4 kW by 32 motors per hour***

2.1.2 Equipment/Technology Specification

The proposed technology will have the following equipments;

- 32 numbers of VFD suitable for 2.23 kW 3Ø, induction motor.
- 01 number of console cubicle housing the PLC suitable for 32 VFD's fitted with motors, cables and accessories.
- Cables of required quantity

.2.1.3 Integration with Existing Equipment

For the purpose of installation of this proposed equipment, the Y/D starter under the existing condition needs to be replaced with the VFD so that the operation of the withering fan motor is controlled by the VFD. Thus this proposed technology of speed reduction of the withering fan motor through installation of VFD can be suitably integrated with the existing system.

2.1.4 Superiority over existing system

The proposed technology, apart from being more energy efficient than the existing one and is technologically superior as it ensures smooth operation of the rotating equipments due to gradual start – up which is not so in case of the existing technology. Use of this equipment reduces the overall plant energy cost. The proposed measures bear better technology than the existing one results both energy saving and technological up gradation.

2.1.5 Source of equipment

The recommended technology is proven one and in various industries on normal basis. These are running successfully and the unit owners had observed the savings in terms of energy.

2.1.6 Availability of technology/equipment

This technology though new to the tea factories in Jorhat Cluster is being in use in other process industries. And as the cost of electrical power for tea factories of this cluster is high so some of the reputed companies marketing this products are targeting the tea factories of this cluster.

2.1.7 Service providers

Details of technology service providers are shown in Annexure 7.

2.1.8 Terms and conditions in sales of equipment

The suppliers have already extended standard warrantee conditions for exchange, replace or repair against manufacturing defects for a period of 12 months after the date of commissioning. Promoters will have to promptly notify the supplier in writing of obvious defects or deficiencies after detection thereof. Replaced parts shall become the property of the supplier upon request of the supplier.

Supplier is not liable or defects or deficiencies which are resulting from the following reasons, as long as they are not resulting from a default of Supplier: Improper, unsuitable or negligent use, handling and/or operation of the system by promoters or by third parties; use of spare parts other than Genuine Parts; normal wear and tear; use of unsuitable consumables (such as, fuel, oil cooling liquid or any other consumables), particularly the use of consumables not conciliated in the operation manuals; improper building ground; chemical, electro- chemical or electric influences.

All conditions associated with this system are standard in nature. No special clause is incorporated. The conditions are very common in most of the plant & machinery sales.

2.1.9 Process down time

04 day is required to install and to give trial run of this proposed burner in place of the existing burner. Thus the process down time required is 04 days.

2.2 Life cycle assessment and risks analysis

Life of the equipment is about 15 years. Risk involves in the installation of proposed project are as follows:

- Proper training to the workers as the flow rate for withering air will be governed through speed variation of the motor governed by the PLC through the VFD.

2.3 Suitable unit for implementation of proposed technology

The measure & technology is suitable for the all tea factories of Jorhat Cluster as well as for tea factories outside this cluster, as all the tea factories has got a hot air blower to push the hot air to the drier. Adoption of this measure will help in building electrical energy efficiency, which is a vital energy consuming area. This measure is suitable for implementation in all the 30 number units of this cluster, where energy audit was carried out.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1 Technical benefit

3.1.1 Fuel saving

There will be no Coal or Natural Gas saving due to the adoption of this technology, though there will be savings in HSD consumption due to reduced load on the DG set. But the exact amount of savings in HSD could not be evaluated due to lack of proper data regarding electrical energy produced from the burning of HSD in the DG.

3.1.2 Electricity saving

Replacement of the damper mechanism to control the flow of hot process air by varying the speed of the motor through VFD controlled mechanism will yield a consistent savings in electricity. The detailed savings in electricity is as tabulated in Table 7 below;

Table 7: Electricity Saving due to adoption of the proposed technology

Existing avg. Input power by 32 nos. of withering motors per hour, kW/ kWh per year	Estimated avg. Input power by 32 nos. of motors per hour after implementation, kW/ kWh per year	Savings in power per hour, kW/ kWh per year	Hours of operation per year, Hrs	Estimated savings in power, kWh
60.1/216360	34.4/123840	25.7/92520	3600	92520

3.2 Monetary benefits

Implementation of project will result in good, consistent monetary benefit. It is estimated that this system will save on an average 92520 kWh of electrical power for the unit. Please refer following table.

Table 8: Monetary benefit (For One Typical Unit of Jorhat Tea Cluster)

Energy and monetary benefit			
1)	Cost of electricity	`/ kWh	7.45
2)	Expected Saving in kWh/ Annum	kWh/ year	92520
3)	Expected Monetary Saving per Annum	`/ annum	689274
4)	Expected Investment Needed for the proposed technology	` (in lacs)	11.18
5)	Simple Payback	Yrs	1.62
		Months	19

*****Further details of total monetary benefit are given in Annexure 3.***

3.3 Social benefits

3.3.1 Improvement in working environment

Use of VFD drive technology in Tea Industry reduces the electrical energy consumption. This improves efficiency of withering section, and thus reduces CO_2 generation.

3.3.2 Improvement in workers skill

Technical skills of persons will definitely be improved. As the training will be provided by equipment suppliers which improve the technical skills of manpower required for operating of the equipment and also the technology implementation will create awareness among the workforce about energy efficiency and energy saving.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

There is no impact in effluent generation due to implementation of the project.

3.4.2 Reduction in GHG emission

Implementation of this technology will reduce the CO2 emissions. Reduction in CO2 emissions will be possible due to Energy saving. This project results in reduction of peak demand and uses off-peak electricity. The Carbon savings would be about 95.30 tonne per annum.

3.4.3 Reduction in other emissions like SOX

Amount of SO_X will be reducing due to improved efficiency of the electrical system.

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of project

4.1.1 Equipment cost

Cost of the proposed technology with standard accessories and mountings, including taxes @5% works out to be ` 1016400.

4.1.2 Erection, commissioning and other misc. cost

The details of project cost is as given in table 9 below-

Table 9: Details of proposed technology project cost

Details of Proposed Technology Project Cost			
S. No.	**Particulars**	**Unit**	**Value**
1	Cost of proposed equipment	` (in Lacs)	10.16
2	Erection & Commissioning cost	` (in Lacs)	0.00
3	Cost of civil work	` (in Lacs)	0.00
4	Other charges (Including Contingency @ 10%)	` (in Lacs)	1.02
5	**Total cost**	` (in Lacs)	11.18

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

Entrepreneur will contribute 25% of the total project cost i.e. ` 2.79 Lakh & financial institutes can extend loan of 75%.

4.2.2 Loan amount.

The term loan is 75% of the total project cost i.e. ` 8.39 Lakh, with repayment of 5 years excluding moratorium of 6 months considered for the estimation purpose.

4.2.3 Terms & conditions of loan

The terms and conditions of the loan with regard to the financial aspect of the loan are;

- Interest rate of the loan is @ 10% per annum on a reducing balance basis, which is SIDBI's interest rate for energy efficient projects.
- Moratorium period of 6 months from the date of disbursement of the loan is considered towards repayment of the loan.
- Depreciation is provided as per the rates provided in the companies act.

4.3 Financial indicators

The financial indicators for this proposed technology is calculated on the following basis;

- For calculating the financial indicators, the subsidy from MoMSME is not taken into consideration.
- It is considered that the motor will be operative for 12 hours a day and for 300 days a year.
- To arrive at a more competitive evaluation, the rise in the energy price is not taken into consideration, as monetary value of the savings is directly proportional to the energy price.
- The cost of maintenance and operation is taken as 2% of the capital cost for installation of this technology with a yearly increase @5%.

4.3.1 Cash flow analysis

The Cash Flow statement is given in Annexure 5

4.3.2 Simple payback period

The estimated payback period is about 1.62 years or about 19 months.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ` 15.26 lakh.

4.3.4 Internal rate of return (IRR)

The after tax IRR of the project works out to be 45.82%.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 27.33%.

4.4 Sensitivity analysis

Sensitivity analysis to assess the cushioning affect of this proposed technology for the withering air system is carried out in the following two scenarios;

a) Optimistic Scenario: Under this scenario the financial projections are evaluated on the basis of 5% increase in the Electricity savings.

b) Pessimistic Scenario: Under this scenario the financial projections are evaluated on the basis of 5% decrease in the Electricity savings.

The result of the sensitivity analysis is as given below;

Table 10: Sensitivity Analysis

Particulars	IRR	NPV `	ROI	DSCR
Normal	45.82%	15.26	27.33%	2.62
5% increase in savings	48.70 %	16.58	27.48%	2.75
5% decrease in savings	42.93 %	13.94	27.16%	2.49

4.5 Procurement and Implementation Schedule

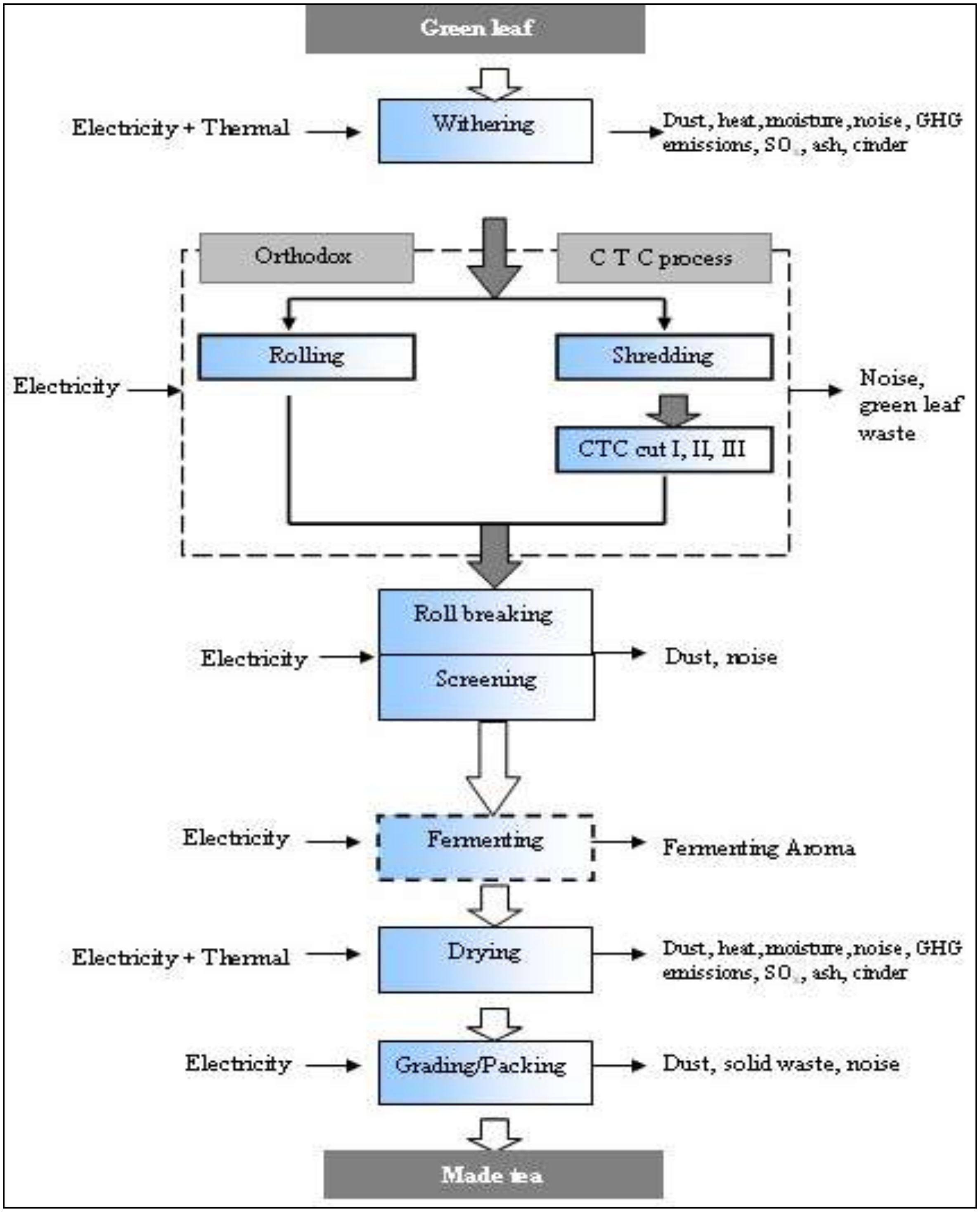
Total time required for procurement and implementation for proposed project are about 10 to 12 weeks and details of procurement and implementation schedules are shown in Annexure 6.

Table 11: Procurement and implementation schedule

S. No.	Activities	Weeks			
		1	-	11	12
1	Order Placement				
2	Delivery				
3	Erection & commissioning				
4	Testing and trial				
5	On site operator training				

Annexure

Annexure 1: Process Flow Diagram



Annexure 2: Energy audit data used for baseline establishment

The specifications of existing damper controlled withering system is as detailed below

SN	Details	Specification
1	Number of withering trough	16
2.	Number of withering fans in each trough	02
3.	Details of the withering fan motors	2.23 kW, 3Ø, induction motor
4.	Mechanism for control of air flow rate	Damper controlled
5.	Average hours of operation of withering fans per day	12 hours per day
6.	Number of working days per year	300 days per year

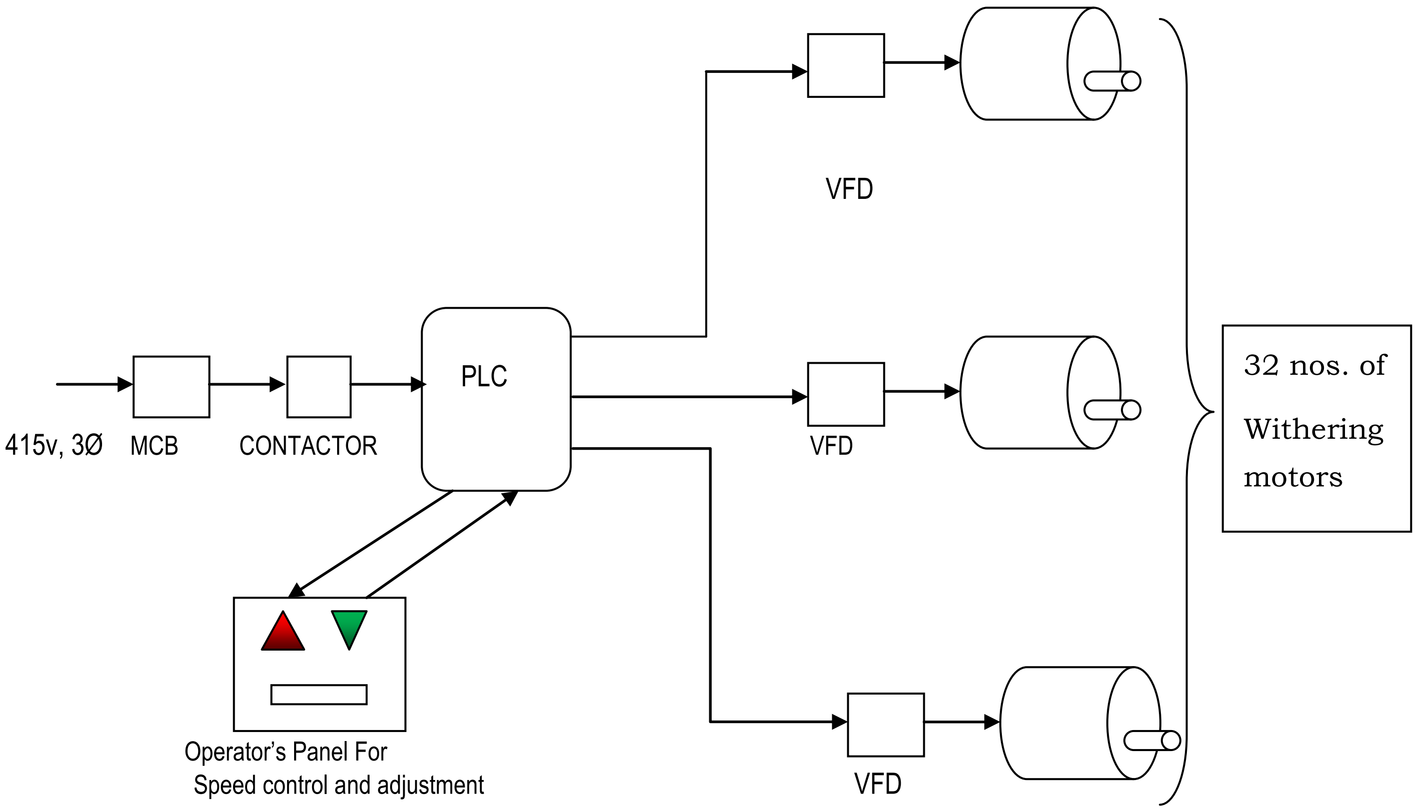
Annexure 3: Detailed technology assessment report

The detailed technology assessment of the technology is as detailed

S. No.	Parameter	Unit	Value
1	Working Hours for Dryer/ Day	Hrs/Day	12
2	Working Days/ Year	Days/ Year	300
3	Actual electrical power Consumption under existing condition	kW/ hour	60.1
4	Expected kW consumption after installation of the proposed technology	kW/ hour	34.4
5	Electricity saving	kW/ hour	25.7
6	Cost of electricity	`/kWh	7.45
7	Expected electricity Saving per Annum	kWh/Annum	92520
8	Expected Monetary Saving per Annum	`(In lacs)/Annum	6.89
9	Expected Investment Needed for replacing existing burner with EE burner.	` (In lacs).	11.18
10	Simple Payback	Yrs	1.62
		Months	19

Annexure 4: Drawings for proposed electrical & civil works

Only electrical work with no civil work is required for the installation of the equipments for this technology. The electrical layout plan for this proposed technology is as pictorially



Annexure 5: Detailed financial analysis

Name of the Technology	VFD CONTROLLED WITHERING AIR SYSTEM		
Rated Capacity	16 NOS. OF WITHERING TROUGH EACH HAVING 2 MOTORS		
	Unit	**Value**	**Basis**
Installed Capacity of each motor	kW of withering motor	2.23	
No of working days	Days	300	
No of Working Hours	Hrs./day	12	
Proposed Investment			
Plant & Machinery	`(in lakh)	10.16	
Civil Work	`(in lakh)	0.00	
Erection & Commissioning	`(in lakh)	0.00	
Investment without IDC	`(in lakh)	10.16	
Misc. Cost	`(in lakh)	1.02	
Total Investment	`(in lakh)	11.18	
Financing pattern			
Own Funds (Equity)	`(in lakh)	2.79	Feasibility Study
Loan Funds (Term Loan)	`(in lakh)	8.39	Feasibility Study
Loan Tenure	Years	7.00	Assumed
Moratorium Period	Months	6.00	Assumed
Repayment Period	Months	90.00	Assumed
Interest Rate	%age	10.00 %	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	2.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Electricity Saving	kW/Year	92, 520	
Cost of Electricity	`/kWh	7.45	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

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

Years	Opening Balance	Repayment	Closing Balance	Interest
1	8.39	0.60	7.79	0.97
2	7.79	1.20	6.59	0.72
3	6.59	1.44	5.15	0.59
4	5.15	1.80	3.35	0.43
5	3.35	2.10	1.25	0.25
6	1.25	1.25	0.00	0.04
		8.39		

WDV Depreciation **` (in lakh)**

Particulars / years	1	2
Plant and Machinery		
Cost	11.18	2.24
Depreciation	8.94	1.79
WDV	2.24	0.45

Projected Profitability

` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Electricity savings	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
Total Revenue (A)	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
Expenses								
O & M Expenses	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.31
Total Expenses (B)	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.31
PBDIT (A)-(B)	6.67	6.66	6.65	6.63	6.62	6.61	6.59	6.58
Interest	0.97	0.72	0.59	0.43	0.25	0.04	0.00	0.00
PBDT	5.70	5.93	6.05	6.20	6.37	6.57	6.59	6.58
Depreciation	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
PBT	5.11	5.34	5.46	5.61	5.78	5.98	6.00	5.99
Income tax	0.00	1.41	2.06	2.11	2.17	2.23	2.24	2.24
Profit after tax (PAT)	5.11	3.93	3.41	3.50	3.62	3.75	3.76	3.75

Computation of Tax

` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	5.11	5.34	5.46	5.61	5.78	5.98	6.00	5.99
Add: Book depreciation	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Less: WDV depreciation	8.94	1.79	-	-	-	-	-	-
Taxable profit	(3.24)	4.15	6.05	6.20	6.37	6.57	6.59	6.58
Income Tax	-	1.41	2.06	2.11	2.17	2.23	2.24	2.24

Projected Balance Sheet

` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Share Capital (D)	2.79	2.79	2.79	2.79	2.79	2.79	2.79	2.79
Reserves & Surplus (E)	5.11	9.04	12.45	15.95	19.57	23.32	27.08	30.83
Term Loans (F)	7.79	6.59	5.15	3.35	1.25	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	15.69	18.43	20.39	22.10	23.61	26.11	29.87	33.63

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	11.18	11.18	11.18	11.18	11.18	11.18	11.18	11.18
Less Accumulated Depreciation	0.59	1.18	1.77	2.36	2.95	3.54	4.13	4.72
Net Fixed Assets	10.59	10.00	9.41	8.82	8.23	7.64	7.05	6.46
Cash & Bank Balance	5.11	8.43	10.99	13.28	15.39	18.48	22.83	27.17
TOTAL ASSETS	15.69	18.43	20.39	22.10	23.61	26.11	29.87	33.63
Net Worth	7.90	11.84	15.24	18.75	22.36	26.11	29.87	33.63
Debt Equity Ratio	2.79	2.36	1.84	1.20	0.45	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	2.79	-	-	-	-	-	-	-	-
Term Loan	8.39								
Profit After tax		5.11	3.93	3.41	3.50	3.62	3.75	3.76	3.75
Depreciation		0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Total Sources	11.18	5.70	4.52	4.00	4.09	4.21	4.34	4.35	4.34

Application									
Capital Expenditure	11.18								
Repayment Of Loan	-	0.60	1.20	1.44	1.80	2.10	1.25	0.00	0.00
Total Application	11.18	0.60	1.20	1.44	1.80	2.10	1.25	0.00	0.00
Net Surplus	0.01	5.10	3.32	2.56	2.29	2.11	3.09	4.35	4.34
Add: Opening Balance	-	0.01	5.11	8.43	10.99	13.28	15.39	18.48	22.83
Closing Balance	0.01	5.11	8.43	10.99	13.28	15.39	18.48	22.83	27.17

IRR **` (in lakh)**

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		5.11	3.93	3.41	3.50	3.62	3.75	3.76	3.75
Depreciation		0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Interest on Term Loan		0.97	0.72	0.59	0.43	0.25	0.04	-	-
Cash outflow	(11.18)	-	-	-	-	-	-	-	-
Net Cash flow	(11.18)	6.67	5.25	4.59	4.53	4.45	4.37	4.35	4.34
IRR	45.82 %								
NPV	15.26								

Break Even Point **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
O & M Expenses (75%)	0.17	0.18	0.18	0.19	0.20	0.21	0.22	0.24
Sub Total(G)	0.17	0.18	0.18	0.19	0.20	0.21	0.22	0.24
Fixed Expenses								
O & M Expenses (25%)	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08
Interest on Term Loan	0.97	0.72	0.59	0.43	0.25	0.04	0.00	0.00
Depreciation (H)	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59
Sub Total (I)	1.62	1.37	1.25	1.09	0.91	0.70	0.66	0.67
Sales (J)	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
Contribution (K)	6.73	6.72	6.71	6.70	6.69	6.68	6.67	6.66
Break Even Point (L= G/I)%	24.02%	20.44%	18.56%	16.24%	13.53%	10.47%	9.97%	10.05%
Cash Break Even {(I)-(H)}%	15.24%	11.66%	9.76%	7.43%	4.71%	1.63%	1.12%	1.18%
Break Even Sales (J)*(L)	1.66	1.41	1.28	1.12	0.93	0.72	0.69	0.69

Return on Investment **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	5.11	5.34	5.46	5.61	5.78	5.98	6.00	5.99	45.28
Net Worth	7.90	11.84	15.24	18.75	22.36	26.11	29.87	33.63	165.71
									27.33 %

Debt Service Coverage Ratio **` (in lakh)**

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	5.11	3.93	3.41	3.50	3.62	3.75	3.76	3.75	23.32
Depreciation	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.59	3.54
Interest on Term Loan	0.97	0.72	0.59	0.43	0.25	0.04	0.00	0.00	3.00
Total (M)	6.67	5.25	4.59	4.53	4.45	4.37	4.35	4.34	29.86

DEBT

Interest on Term Loan	0.97	0.72	0.59	0.43	0.25	0.04	0.00	0.00	3.00
Repayment of Term Loan	0.60	1.20	1.44	1.80	2.10	1.25	0.00	0.00	8.39
Total (N)	1.57	1.92	2.03	2.23	2.35	1.29	0.00	0.00	11.39
DSCR (M/N)	4.25	2.73	2.26	2.03	1.90	3.40	0.00	0.00	2.62
Average DSCR	2.62								

Annexure 6: Procurement and implementation schedule

Week wise break up of implementation Schedule

SN	Activities	Days				
		1	2	3	4	5
1	Fabrication of the jigs and fixtures					
2.	Installation and commissioning					
3	Testing and trial					
4	On site operator training					

Annexure 7: Details of technology service providers

S. No.	Name of Service Provider	Address	Contact Person and No.
1	M/s Magnum Automation Systems	A.T. Road, Lahoal, Dibrugarh Assam	Mr. Jasbir Singh: Phone: +919957574040

Annexure 8: Quotations or Techno-commercial bids for new technology/equipment

Magnum Automation Systems
A.T. Road, P.O.Lahoal-786010, Dist. Dibrugarh,(Assam).
Phone: +919957574040
Email:info.magnumauto@gmail.com

Buyer's name,
M/s XYZ,
..................................,
..................................,

Our Ref No: MAS/....
Dated: 29th June, 2011.

Dear Sir,

Subject: Quotation for the 1) **EE, 2.23kW, VFD based ID FAN DRIVE Controller** for your 16 Nos, Withering troughs, each with 2 fan motors, and operation of all troughs by the sequencing programming of the trough motors including the operation of the airflow diverters via the HMI.

Reference: Your query No. ....

Thanks for the query to us and as required, we are appending below the rates of the ECM noted above, for placement of your Order.

1) To being the cost of design, fabrication of panels, and installation of the ***EE AF FAN DRIVE Controller*** for your ***16 Nos enclosed type Withering Troughs*** with

   a) The fan speed programmed to match the requisite Air flow rate for withering the leaf spread in the troughs in the given time frame.
   b) The air flow diverters (operated by motors) are also controlled by the PLC to change the air flow direction,
   c) And the operation of the troughs is sequenced as programmed by the factory manager.

Equipment details: i) VFD Model No: **CIMR-JT4A0005BAA** of *YASKWA*, Japan MAKE, marketed in India by L&T, having rated Power of **2.23 kW** (ND),
ii) PLC: **LX70-CPU70p2 with necessary accessories,**
iii) HMI: S07TDAA.

All the requisite cables from the trough fan motors will be provided by the Client, if the existing cables are not useable.

The PLC, HMI & Variable Frequency Drives will be housed in an **IP55** protected Panel with necessary protection devices as are prescribed by L&T.

Rate: ₹ **0.605 (Lacs)** per trough
Sales tax (VAT extra): 5%.

Installation & Commissioning at your factory: **INCLUDED**.

TERMS & Conditions of our Offer:

Magnum Automation Systems
A.T. Road, P.O.Lahoal-786010, Dist. Dibrugarh,(Assam).
Phone: +919957574040
Email:info.magnumauto@gmail.com

4) **Delivery**: within *21 days of receipt of Commercial Purchase order* along with Advance.

5) The Customer must place the order in writing especially for EC Products, as the Document may be required for Subsidy claims by BEE, New Delhi.

6) The out state Customer must submit C-Form with the Order.

7) The Electrical equipment supplied must be run within the rated Voltage/Loading range- otherwise the **manufacturer's warranty** will not be enforceable. In the case of **PNG**, the client should ascertain that the fuel supplied is at the right pressure, calorific value, is free from unnatural high %age of Moisture, and other impurities, etc.

8) **The delivery date** promised/mentioned is subject to the ***"Force majeure Clause"*** due to unforeseen circumstances or conditions beyond our Control or within our jurisdiction.

9) **Delivery/transport**: The Client will arrange for the transport of Goods to the place of installation in proper condition with all care necessary for fragile goods.

10) The machine will be ***under our AMC for 12 months from the date of commissioning***, and handing over to you.

11) We are one of the **BEE's Approved manufacturer/supplier for this controller**, and you are free to communicate any problem that you may face from us to **BEE** and/or **ASDA, Guwahati**. Our rates are duly approved by the BEE, New Delhi.

We do hope you will favour us with your valued Order, and it will be our endeavour to give you Excellent products and Services.

Thanking You,

Yours faithfully,
For Magnum Automation Systems,

Jasbir Singh.
Cert.EA.

L&T SWITCHGEAR
SAFE & SURE
Authorised Stockist & ISP www. Intebg.com

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

Petroleum Conservation & Research Association
Office Address :- Western Region
C-5, Keshava Building, Bandra-Kurla Complex; Mumbai – 400051
Website: www.pcra.org

India SME Technology Services Ltd
DFC Building, Plot No.37-38,
D-Block, Pankha Road,
Institutional Area, Janakpuri, New Delhi-110058
Tel: +91-11-28525534, Fax: +91-11-28525535
Website: www.techsmall.com