DETAILED PROJECT REPORT
ON
VARIABLE FREQUENCY DRIVES
FOR DOUBLING MACHINE
(SOLAPUR TEXTILE CLUSTER)











Bureau of Energy Efficiency

Prepared By

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Horizons Beyond Energy

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ISTSL

VARIABLE FREQUENCY DRIVE FOR DOUBLING MACHINE

SOLAPUR TEXTILE CLUSTER

BEE, 2010
Detailed Project Report on Variable Frequency Drives for Doubling Machine
Textile SME Cluster, Solapur, Pune, Maharashtra (India)
New Delhi: Bureau of Energy Efficiency;
Detail Project Report No.**: SLP/TXT/VDM/06**

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Acknowledgement

We sincerely appreciate the efforts of industry, energy auditors, equipment manufacturers, technology providers, consultants and other experts in the area of energy conservation for joining hands with Bureau of Energy Efficiency (BEE), Ministry of Power, and Government of India for preparing the Detailed Project Report (DPR) under BEE SME Program in SMEs clusters. We appreciate the support of suppliers/vendors for providing the adoptable energy efficient equipments/technical details to the SMEs.

We have received very encouraging feedback for the BEE SME Program in various SME Clusters. Therefore, it was decided to bring out the DPR for the benefits of SMEs. We sincerely thank the officials of BEE, Executing Agencies and ISTSL for all the support and cooperation extended for preparation of the DPR. We gracefully acknowledge the diligent efforts and commitments of all those who have contributed in preparation of the DPR.

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List of Abbreviations

kWh	kilo Watt Hour
SME	Small and Medium Enterprises
GHG	Green House Gas
BEE	Bureau of Energy Efficiency
DPR	Detailed Project Report
O&M	Operational & Maintenance
NPV	Net Present Values
ROI	Return on Investment
IRR	Internal Rate of Return
DSCR	Debt Service Coverage Ratio
PBT	Profit Before Tax
PAT	Profit After Tax
SIDBI	Small Industries Development of India
VFD	Variable Frequency Drive
ID	Induced Draft
FD	Force Draft

EXECUTIVE SUMMARY

Zenith Energy Services Pvt. Ltd is executing BEE-SME program in Solapur textile cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Solapur textile cluster is one of the largest textile 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 textile clusters in India.

The main energy forms used in the cluster units are electricity and fuel such as wood and other biomass product. Cluster units have boilers and thermic fluid heaters for hot water generation and are equipped with either forced draft system or induced draft system for supply of combustion and removal of hot flue gases.

A variable frequency drive will control the Doubling machine by speed variation and thus reduces power consumption.

Project implementation i.e. installation of VFD will lead to reduction in electricity consumption by 5640 kWh per year however; this intervention will not have any effect on the existing consumption pattern of fuel.

Total investment, debt equity ratio for financing the project, monetary savings, Internal rate of return (IRR), Net present value (NPV),Debt service coverage ratio (DSCR), Return on investment (ROI) etc. for implementing energy efficient economizer is furnished in Table below:

S.No	*Particulars*	*Unit*	*Value*
1	Project cost	₹(in lakh)	0.31
2	Electricity saving	kWh / year	5640
3	Monetary benefit	₹(in lakh)	0.14
4	Debit equity ratio	ratio	3:1
5	Simple payback period	years	2.21
6	NPV	₹(in lakh)	0.02
7	IRR	%age	13.83
8	ROI	%age	36.43
9	DSCR	ratio	1.45
10	Process down time	day	-

The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible

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. Solapur Textile 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:

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.

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 energy efficiency projects in the clusters

Implementation of energy efficiency measures

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

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 About the solapur textile cluster

The products manufactured in Solapur Textile Cluster are cotton terry towels and bed sheets. The towels and bed sheets are renowned in the country and have good market in India. The main raw material for the units is cotton yarn, which is procured from local spinning mills and agents. The cost of energy (electrical and thermal energy) as percentage of manufacturing cost varies between 8 and 10%.

Majority of the cluster units are of integrated type, where the raw material yarn is processed in-house to the final product. The energy cost is second to the raw materials cost. Majority of the units in the cluster are dependent on local/ run of the mill technologies of low end and with little investment initiatives and technology up-gradation.

The main energy forms used in the cluster units are grid electricity, wood, and small quantity of coal. The electricity is used for power looms, doubling machines, winding machines, hydro extractors, warping machines and lighting. Wood is used as fuel for boilers, thermic fluid heaters, and chulhas for hot water generation. The details of annual energy consumption of a typical unit having a production capacity of 1,20,000 kg of final product of the cluster are furnished in the Table 1.1 below:

Table 1.1 Details of annual energy consumption of a typical unit

Parameter	*Unit*	*Value*
Electricity consumption	kWh/annum	1,97,784
Wood consumption	tonne/annum	144
Production	kg/annum	1,20,000

1.1.1 Production process

The main operational process for production of towels and bed sheets in cluster units are:

Doubling

In the Doubling process, thin single yarn is converted to double yarn for strengthening the yarn by using doubling machine.

Yarn dyeing

Initially, the yarn is soaked in soap water for 24 hours to remove the dirt and other foreign materials and after soaking, the yarn is taken for bleaching. Bleaching is carried out by

soaking the yarn in tanks mixed with bleaching agents and after completion of the process; the yarn is washed with normal water.

The hang dyeing machine tanks are filled with required quantity of normal water and required chemicals and dyeing agents are added. The temperature of the water is raised by oil circulation or direct steam injection. Fire wood is used as fuel. The required colors are added to the yarn and the dyeing process takes about 90 to 120 minutes per batch. After dyeing, the yarn is washed with normal water, and the yarn is taken for soaping for colour fixation in hot water for about 20 minutes in hang dyeing machines. The water is drained to the waste drainage lines. The wet yarn is taken to hydro extractors for removing the water in the yarn and taken for drying in the natural sunlight.

Winding

The yarn after drying is taken for winding in which the yarn is wounded to bobbins and cones. The winded yarn is taken for further process.

Warping

In warping, the winded yarn is wound to beams according to designed pattern (customized designs). Then the beams are taken for Weaving.

Weaving

The beams, which are wound with yarn are taken and placed in power looms where the designed pattern is already set. In power looms, the yarn is converted to final product (Towel or bed sheets) by weaving. The product obtained from weaving is taken for stitching and packing. The general process flow diagram of a typical unit for production of towels and bed sheets is furnished in Figure 1.1.

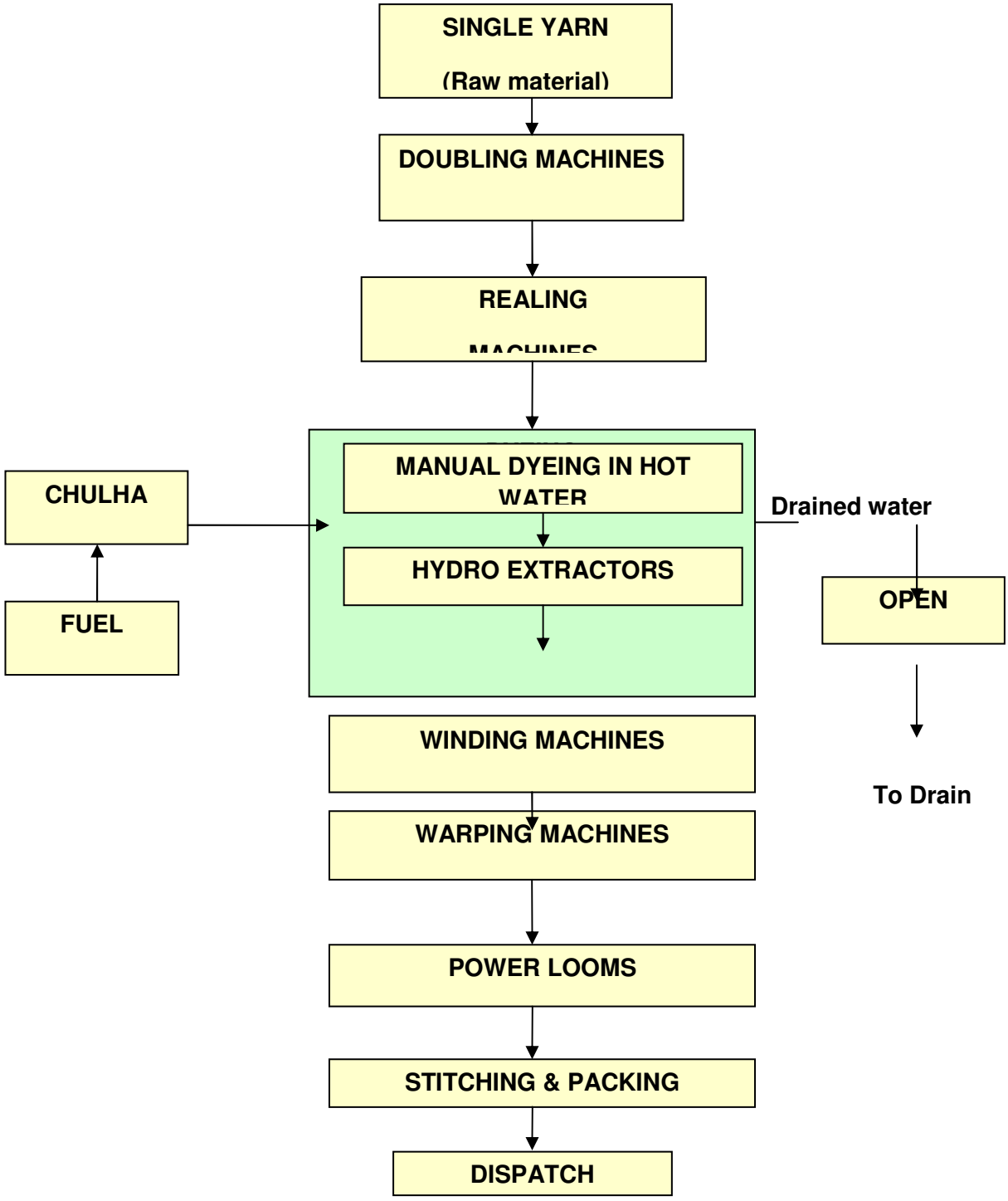


Figure 1.1 Process flow chart of typical textile unit

The production process as depicted above is similar for all textile units in Solapur textile cluster. However, depending on type of product and product quality, the above stated process flow varies as per the requirement of the industry.

1.2 Energy performance in solapur textile cluster

Majority of the industries located in solapur are engaged in manufacturing of towels and bed sheets. The main energy sources for Solapur cluster units are electricity and fuels such as Wood & briquettes. The wood and GN husk briquettes are used as fuel for boilers, thermic fluid heaters and chulhas for hot water generation and electricity is used for operation of prime movers of doubling machine motors, ID & FD fans, pumps, hank dyeing machine drives, power loom drives, winding machine motors, etc. Majority of the units in the Solapur textile cluster are using wood for thermal energy generation due to easy availability and economical point of view.

Energy cost is around 8 to 10 percent of manufacturing cost in typical manufacturing unit, out of which the cost of electrical energy works out to 58 percent of the total energy cost and remaining accounts for thermal energy.

In a typical textile manufacturing unit annual consumption of electrical energy and wood is 1,97,784 kWh and 144 tonnes respectively for average production capacity of 1,20,000 kg of final product.

1.2.1 Specific energy consumption of final product

Specific electrical and thermal energy consumption in textile unit depends upon the final product manufactured in that unit. The electrical and thermal energy consumption of typical textile unit is 1.65 kWh per kg of final product and 1.20 kg of wood per kg of final product respectively (includes all colours dyeing in cold water, medium temperature water and high temperature water)

1.3 Proposed equipment to be upgrade

1.3.1 Description of existing equipment

During energy audit studies in various textile industries in Solapur textile cluster, it was observed that about 500 doubling machines in Solapur Textile cluster of various capacities of 200 spindles, 248, 440 spindles etc. Majority of the doubling machines are very old. The doubling machines are used for combining 2 single yarns to double yarn and enhance the strength of the yarn.

From energy use and technology gap studies in various textile industries in Solapur textile cluster, the following were identified

- Energy efficiency improvement opportunities
- Environment and safety improvement of workers

1.3.2 Role in process

The Doubling machine is one of the most important equipment in producing of cotton terry towels and bed sheets. The doubling machine is used for weaving the yarn to towels and bed sheets..

1.4 Baseline for existing equipment

Energy consumption for Doubling machine would depend on following:

- Load on Doubling machine
- Operational & maintenance practices

1.4.1 Design and operating parameter

Present electricity consumption in Doubling machine is 36,300 kWh having 400 spindles and connected with 7.5 HP motor. The average production is 300 kg/day per machine. The doubling machines are operated for two shifts

1.4.2 Electricity consumption

Electricity consumption for various doubling machine of three typical units in the cluster are separately furnished in Table 1.2 below:

Table 1.2 Electricity consumption in Doubling Machine

S.No.	*Name of unit*	*Unit*	*Value*	*Specific power consumption*
1	Rajashree Industries	kWh	5.1	0.21
2	Balla Textile Mills Pvt Ltd	kWh	6.0	0.25
3	Devsani Textiles	kWh	6.8	0.28

1.5 Barriers for adoption of proposed equipment

The technology and innovations in SMEs are generally different from that of large firms. Technology in the SME sector has an increasingly complex or combinative character, most of the SMEs units in Solapur cluster are labour intensive and utilize local resources. The SME entrepreneurs are generally not willing to invest in state-or-art technology. Major barriers in the up-gradation of technology in the cluster are non availability of technology;

distrust on technology supplier, lack of awareness about energy efficiency among small and medium enterprises, prevents them from adoption of energy efficient technologies. Further, non availability of skilled manpower and exorbitant cost of new technologies also works as the barrier. Details of the other barriers in the implementation of energy efficient technologies / equipments in the Solapur textile cluster are presented in below sections

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of VFD are

- Lack of awareness and information about the VFD and its benefit
- Absence of local VFD supplier
- Dependence on local equipment suppliers, whom doesn't have technical knowledge about VFD and its proper installation
- The main focus of SME owners is on uninterrupted production of the plant by necessary repair work at low costs, than on investing on new technologies.

1.5.2 Financial Barrier

Implementation of the proposed project activity requires investment of ₹ 0.31 lakh per unit. Such investment is not commonly seen in the cluster units for energy efficiency improvement. Further, from the business perspective of SMEs, it is more viable, assured, and convenient to invest on project expansion for improving the production capacity or quality, rather than make piecemeal investment in retrofit and replace options for energy savings. In view of this and given the limited financial strength of the textile mills, it is evident that the owners would not like to take the risk and invest in energy efficiency measures.

However, the financial attractiveness of the project activity may motivate the owners to move forward in taking up initiatives in energy conservation and efficiency.

1.5.3 Skilled manpower

The non-availability of skilled manpower having awareness about energy efficiency and related issues in the cluster is one of the major barriers. Though, the skilled manpower is available in the cluster, they are not aware of energy conservation/efficiency and its importance. Their prime responsibility of worker is to maintain machines and ensure uninterrupted production by minimizing down time as per the targets set by the management.

1.5.4 Other barrier (If any)

Absence of clean environment around doubling machine, as VFD require clean environment for uninterrupted operation.

2 PROPOSED ENERGY EFFICIENT EQUIPMENT

2.1 Detail description of technology

2.1.1 Description of equipment

More than 50% of the total electrical energy consumption in Indian industries is used by rotating equipment. Normally in textile units, majority of the machines are operated on variable speed applications such as ring frames, double frames, auto coners etc. However, In doubling machines, the motor speed will remain constant and spindle speed varies as per bobbin wounded. With using Variable Speed Drive technology the advantage gained in both productivity improvements and reduced energy consumption has been widely documented in the past few years. For example, by operating the motor at various speeds as per the requirement by installing VFD will reduce the power consumption. A demonstration study at one of the doubling machine of the cluster unit reveled about 12% savings had been achieved. The main reason variable speed drives are used is to reduce energy costs and prolong the life of equipment by adjusting motor speed to meet load requirements.

Variable Frequency Drive

A variable frequency drive is an electronic controller that adjusts the speed of an electric motor by regulating the power being delivered. Variable-frequency drives provide continuous control, matching motor speed to the specific demands of the work being performed. Variable-frequency drives are an excellent choice for adjustable-speed drive users because they allow operators to fine-tune processes while reducing costs for energy and equipment maintenance.

Figure 2.1 Variable frequency drive

Working Principle

Single-speed drives start motors abruptly, subjecting the motor to high torque and current surges up to 10 times the full-load current. Variable frequency drives offer a soft start, gradually ramping up a motor to operating speed. VFD minimizes the mechanical and electrical stress on the motors and can reduce maintenance and repair costs and extend the motor life.

Energy savings from variable-frequency drives can be significant. For example with centrifugal fan even a small reduction in motor speed can reduce fans energy use by as much as 50%. For example a 25 hp motor running 23 hours per day (2 hours at 100% speed; 8 hours at 75%: 8 hours at 67%; and 5 hours at 50%) a variable frequency drives can reduce energy use by 45%. Because benefits vary depending on operating speed of the system hence it is important to calculate benefits for each application before specifying a variable frequency drive.

In Solapur Textile Cluster units, the doubling machine motor is operated at constant speed irrespective of the requirement. As the speed is varied as per the spindle speed requirement by optimizing the motor speed will reduce the power consumption per kg of yarn processed.

Considering the above facts and for reducing electricity consumption in the doubling machines, it is suggested to install VFD for doubling machines. The details power consumption of various doubling machines and specific power consumption per kg of yarn is furnished in Annexure 1.

2.1.2 Availability of equipment

The VFD suppliers are available in Pune, which is 200 km from Solapur city and M/s Tangent Technologies is also planning to appoint a dealer at Solapur.

2.1.3 Service/equipment providers

The service providers are available in Pune. Details of service providers are given in Annexure 6.

2.1.4 Technology/equipment specification

Variable frequency drive of VSC plus series suitable for 1 no. 400 V, 50 Hz, 3 phase 2.2 kW/ 3 HP AC Motor

Power Rating: 2.2 kW / 3 HP

- Protection class of VFD:2R2T4
- Brake chopper -Inbuilt
- Sensor less vector control

2.1.5 Justification of technology selected and suitability

As discussed above, operating the motor speed constant irrespective of the requirement is wasteful of energy. If the speed is optimized or adjusted as per the requirement i.e. low speeds during initial stages and maximum in the final stages of doubling will reduce the power consumption. About 12% of the power consumption is estimated based on demonstration carried out in couple of cluster units.

2.1.6 Superiority over existing system

The installation of VFD for doubling machine has the following advantages:

- Reduction in breakdowns and smooth start
- Reduction in breakages and motor burning
- Improved life of the motor and increased production
- Reduction in production cost and maintenance cost due to frequent failures of belts, bearings, yarn breakages
- Improved power factor (0.98 across speed range)
- Maximize power distribution system
- Reduced Inrush current
- Minimize peak demand charges
- Eliminates mechanical shock and stress on power train (couplings, belts, drive shafts, gear boxes, etc.)
- Reduce Utility operating costs
- Allows Load Shedding
- May qualify for utility rebates due increase in power factor
- Controlled acceleration and deceleration
- Eliminates Motor Voltage Imbalance

2.1.7 Terms and conditions in sales & service of VFD

Terms of payment

50% advance with purchase order, and remaining 50% along with taxes and duties against Performa invoice before dispatch.

Excise duty, sales tax & other levies

The quoted prices are exclusive of all taxes, duties, levies such as excise duty, central/local sales tax, octroi, etc. as are applicable at the time of dispatch or imposed by any statutory

authorities subsequently or paid by us, shall be paid by you extra at actual. However CVD is charged at 8% plus 4% on the unit price plus 3% education cess and VAT is charged at 5%.

Warranty

The supplier shall repair or replace at free of cost, on ex – works basis the whole or any portion of material which under normal and proper use and maintenance proves defective in material and/or workmanship within 12 months from the date of commissioning or 18 months from the date of shipment of equipment whichever is earlier, provided prompt notice is given of such defects.

2.1.8 Process down time during Implementation

No process down time is envisaged as installation of VFD is additional and will take 2 to 3 hours for installation.

2.2 Life cycle assesment and risk analysis

Life cycle of VFD is considered as 15 years. Actual capacity and suitable location are two improtant point must be considerd before instalation of VFD.

2.3 Suitable unit for implementation of proposed technology

The proposed VFD is suitable for installing for 5.5 kW motor and is standard as per the capacity of the motor.

3 ECONOMIC BENEFITS OF PROPOSED EUIPMENT

3.1 Technical benefits

3.1.1 Fuel saving

No fuel saving is possible by the implementation of the project activity.

3.1.2 Electricity saving

Present electricity consumption in doubling machine is about 47000 kWh per year hence by the installation of VFD on doubling machine; it will save about 5640 kWh electricity annually.

Table 3.1 Energy and cost benefit of VFD

Parameter	*Unit*	*Value*
Present electricity consumption in doubling machine	kWh/annum	47000
Operational hours	hours/day	12
Operational days per annum	days/annum	300
Electricity saving in doubling machine with VFD	kWh/annum	5640
Cost of electricity	₹/kWh	2.50
Cost savings after implementation	₹ in lakh	0.14

From the above table it is evident that project implementation i.e. installation of VFD for doubling machine is financially viable and technically feasible. Detailed cash flow evaluation and financial parameters are discussed in detail in the next chapter.

3.1.3 Improvement in product quality

Product quality achieved would be same as the present quality. It does not have any impact in improving the quality of the product.

3.1.4 Increase in production

The proposed equipment does not contribute to any increase in production.

3.1.5 Reduction in raw material consumption

Raw material consumption is same even after the implementation of proposed technology.

3.2 Monetary benefits

The monetary benefit due to installation of VFD for doubling machine is estimated ₹ 0.11 lakh per annum due to reduction in electricity consumption.

3.3 Social benefits

3.2.1 Improvement in working environment

As installation of VFD eliminates Mechanical shock and stress on couplings, belts, drive shafts, gear boxes, etc., this may lessen the breakdowns and working environment may improved**.**

3.2.2 Improvement in skill set of workers

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

3.2.3 Impact on wages/emoluments

No impact on wages or emolument of workers.

3.4 Envirinmental benefit

3.4.1 Reduction in effluent generation

The effluent generation due to implementation of the project activity is insignificant.

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

The major GHG emission reduction source is CO_2 and the technology will reduce electricity consumption. The total emission reductions are estimated as 3.8 tonne of CO_2 per annum due to implementation of the project activity.

3.3.3 Reduction in other emissions like Sox

No significant impact on SO_x emissions.

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of equipment implementation

4.1.1 Cost of equipment

The total cost for installation of VFD is estimated at ₹.0.23 lakh, which includes VFD, Panel, switches and cabling.

4.1.2 Other costs

The other cost includes Erection & Commissioning, cost of fabrication (and/or) Interest during implementation is ₹ 0.08 lakh and the details are furnished in Table 4.1 below:

Table 4.1 Details of Project Cost

S.No	Particular	Cost (₹ in lakh)
1	Equipment and machinery	0.23
2	Erection & Commissioning	0.07
3	Interest during implementation	0.01
4	Total cost	0.31

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹ 0.31 lakh. The entrepreneur's contribution is 25% of total project cost, which is ₹ 0.08 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project, which is ₹ 0.23 lakh.

As the overall energy efficiency in the project is more than 15% it qualifies for subsidy of 25% of the project cost as per the NMCP scheme of Ministry of MSME, GoI. 25 % of the project cost in this case works out to ₹0.08 lakh. As the subsidy is normally available after implementation of the project the same has not been taken in the project cost and means of finance. On receipt of subsidy from Ministry of MSME, GoI through the nodal agency the amount of subsidy is generally set off [reduced] from the loan outstanding by the lending bank. Availability of this subsidy will make the project economically more attractive

4.2.3 Terms & conditions of loan

The interest rate is considered at 10.00% which is SIDBI'S Lending rate for energy efficiency projects. The loan tenure is assumed 4 years and the moratorium period is 3 months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above mentioned assumptions, the net cash accruals starting with ₹ 0.05lakh in the first year operation and gradually increases to ₹ 0.13 lakh at the end of fourth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 0.31 lakh and monetary savings due to reduction in electricity consumption is ₹ 0.14 lakh and the simple payback period works out to be 2.21 years (26months).

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.00% works out to be ₹0.02 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 13.83% 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 36.43% for an investment of ₹ 0.31 lakh.

Table 4.2 Financial indicator of project

S. No	Particulars	Unit	Value
1	Simple Pay Back period	months	26
2	IRR	%age	13.83
3	NPV	lakh	0.02
4	ROI	%age	36.43
5	DSCR	ratio	1.45

4.4 Sensitivity analysis

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

- Increase in electricity savings by 5%
- Decrease in electricity 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.

Details of sensitivity analysis for different scenario are furnished in Table 4.3 below:

Table 4.3 Sensitivity analysis in different scenario

Particulars	*DSCR*	*IRR*	*ROI*	*NPV*
Normal	1.45	13.83%	36.43%	0.02
5% increase in electricity savings	1.53	16.51%	37.11%	0.04
5% decrease in electricity savings	1.38	11.12%	35.68%	0.01

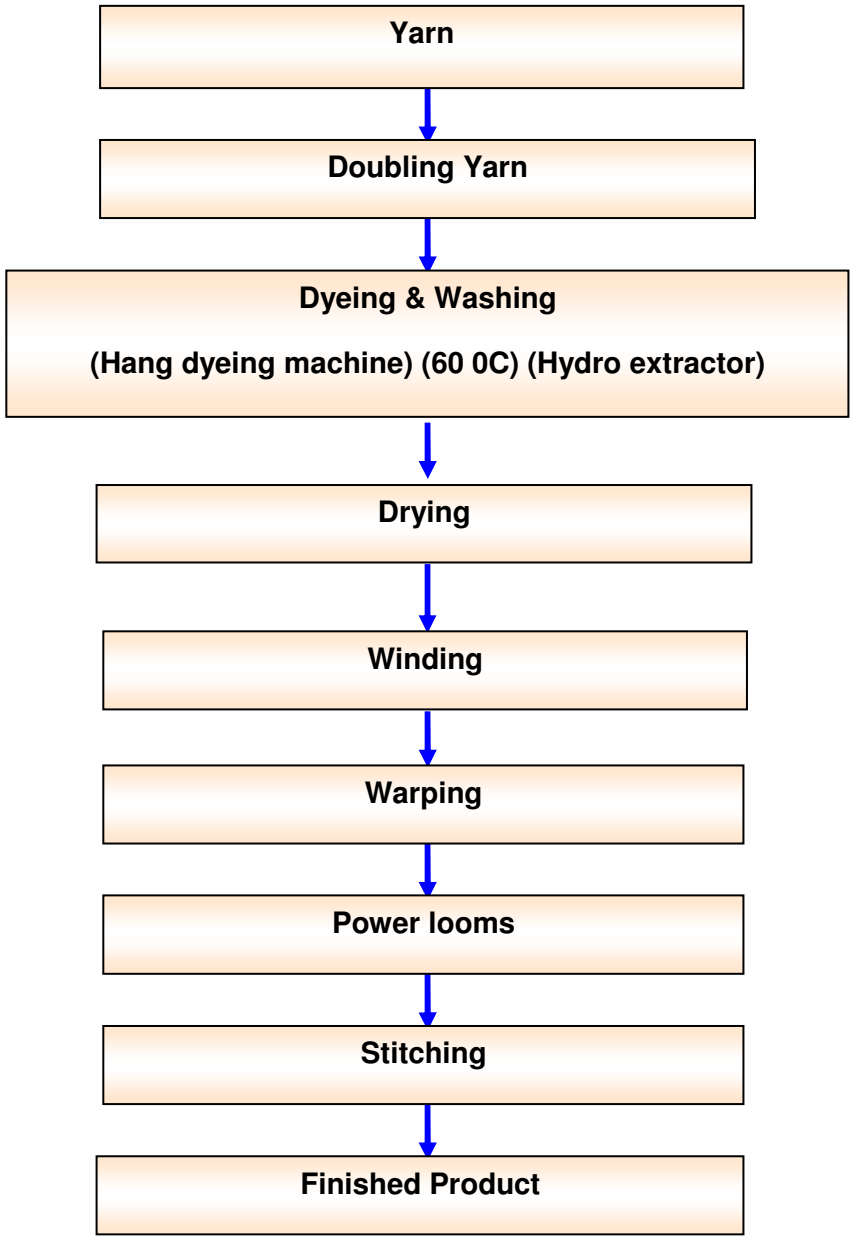
4.5 Procurement and Implementation schedule

The project is expected to be completed in 2 week from the date of financial closure. The detailed schedule of project implementation is furnished in Annexure 6.

Annexure 1 Establishment of baseline

Parameter	*Unit*	*Value*
Present electricity consumption in doubling machine	kWh/annum	36,300
Operational hours	hours/day	12
Operational days per annum	days/annum	300
Electricity saving in doubling machine with VFD	kWh/annum	4,500
Cost of electricity	₹/kWh	2.50
Cost savings after implementation	₹ in lakh	0.11

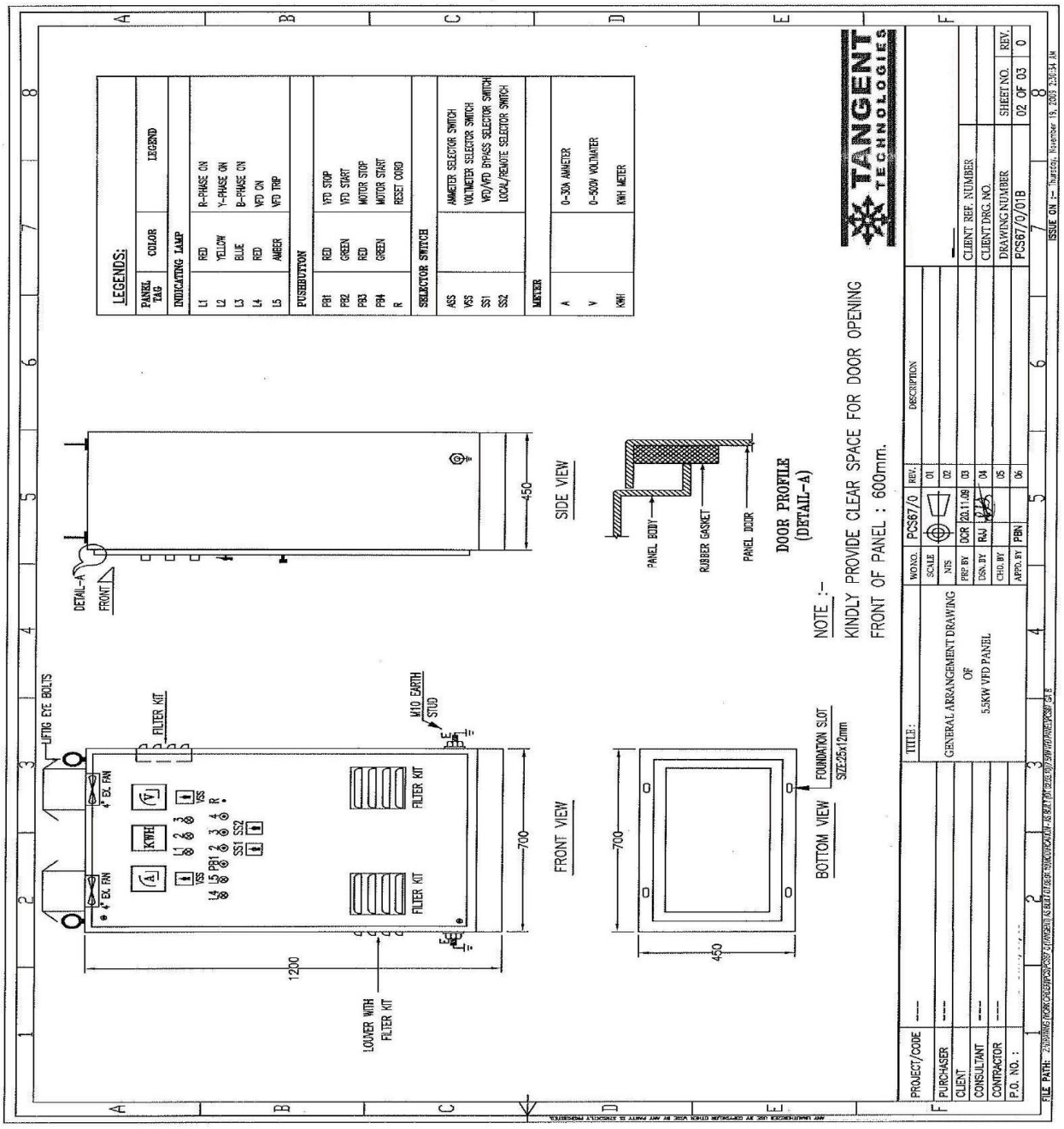
Annexure 2 Process Flow Diagram

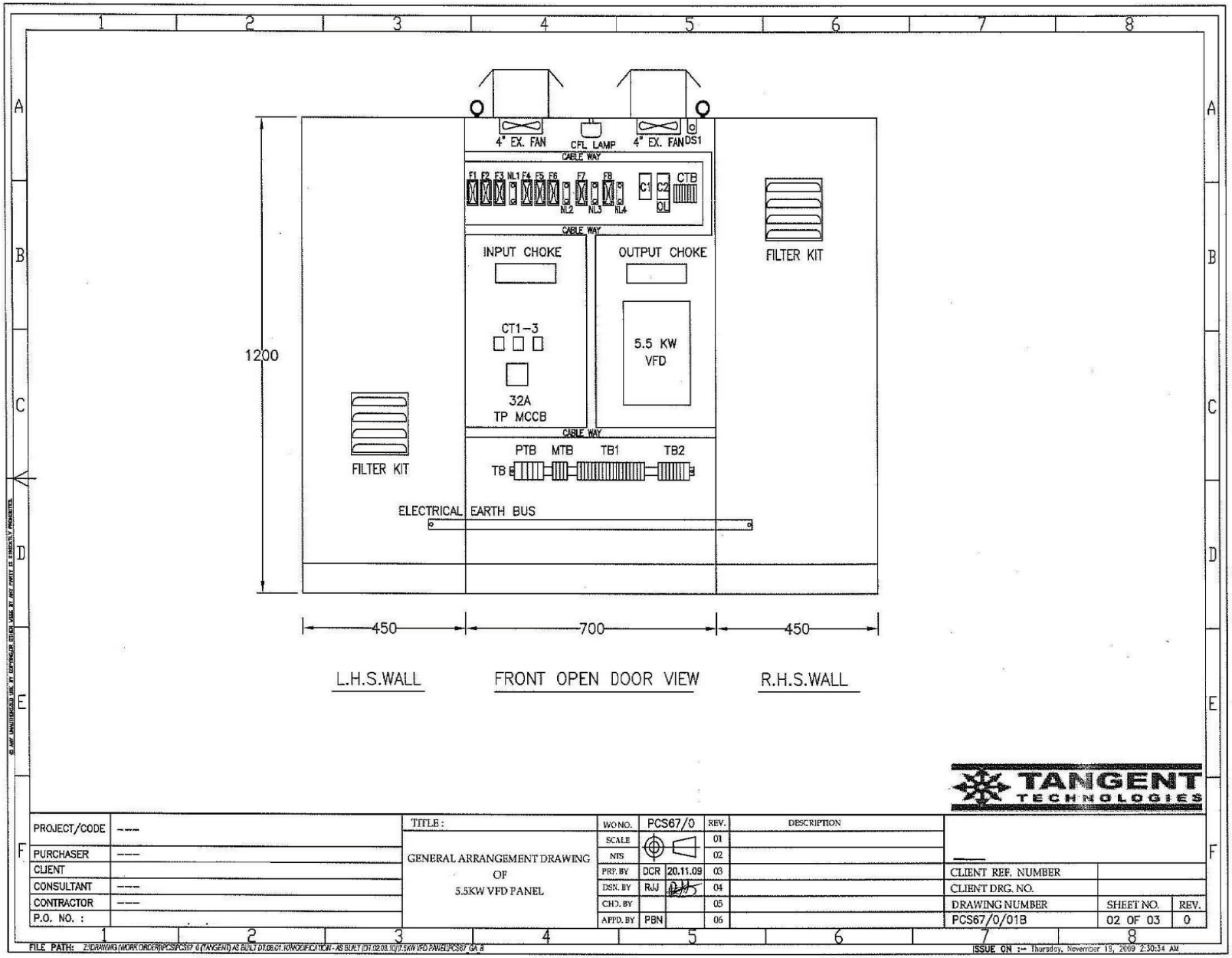


Annexure 3 Technology assessment report

Operating the motor speed constant irrespective of the requirement is wasteful of energy. If the speed is optimized or adjusted as per the requirement i.e. low speeds during initial stages and maximum in the final stages of doubling will reduce the power consumption. About 12% of the power consumption is estimated based on demonstration carried out in couple of cluster units.

Annexure 4 Electrical drawings for proposed equipment





TANGENT TECHNOLOGIES

PROJECT/CODE	---
PURCHASER	---
CLIENT	
CONSULTANT	---
CONTRACTOR	---
P.O. NO. :	

TITLE :

GENERAL ARRANGEMENT DRAWING OF 5.5KW VFD PANEL

WO NO.	PCS67/0	REV.	DESCRIPTION
SCALE		01	
NTS		02	
PRP. BY	DCR 20.11.09	03	
DSN. BY	RJJ	04	
CHD. BY		05	
APPD. BY	PBN	06	

CLIENT REF. NUMBER		
CLIENT DRG. NO.		
DRAWING NUMBER	SHEET NO.	REV.
PCS67/0/01B	02 OF 03	0

FILE PATH: Z:\DRAWING (WORK ORDER)\PCS\PCS67 0 (TANGENT) AS BUILT DT.08.07.10\MODIFICATION - AS BUILT (DT.02.03.10)\7.5KW VFD PANEL\PCS67 GA.dt

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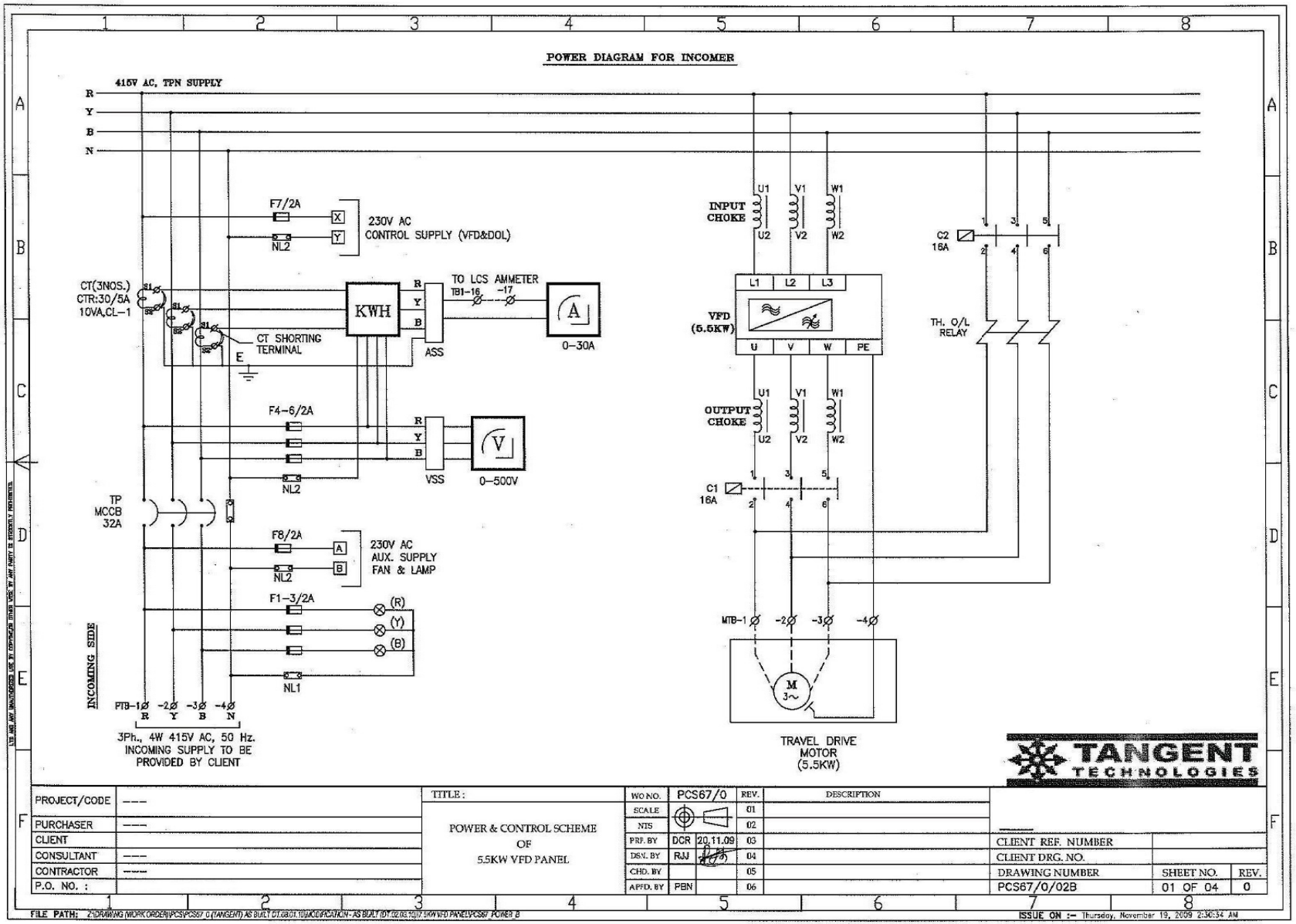
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415V AC, TPN SUPPLY
R
Y
B
N
F7/2A
NL2
230V AC
CONTROL SUPPLY (VFD&DOL)
CT(3NOS.)
CTR:30/5A
10VA,CL-1
KWH
TO LCS AMMETER
TB1-16
-17
ASS
0-30A
CT SHORTING
TERMINAL
E
F4-6/2A
VSS
0-500V
TP
MCCB
32A
F8/2A
230V AC
AUX. SUPPLY
FAN & LAMP
F1-3/2A
(R)
(Y)
(B)
INCOMING SIDE
PTB-1Ø -2Ø -3Ø -4Ø
R Y B N
3Ph., 4W 415V AC, 50 Hz.
INCOMING SUPPLY TO BE
PROVIDED BY CLIENT
INPUT
CHOKE
U1 V1 W1
U2 V2 W2
VFD
(5.5KW)
L1 L2 L3
U V W PE
OUTPUT
CHOKE
C1
16A
C2
16A
TH. O/L
RELAY
MTB-1Ø -2Ø -3Ø -4Ø
M
3~
TRAVEL DRIVE
MOTOR
(5.5KW)
TANGENT
TECHNOLOGIES
PROJECT/CODE ---
PURCHASER ---
CLIENT
CONSULTANT ---
CONTRACTOR ---
P.O. NO. :
TITLE :
POWER & CONTROL SCHEME
OF
5.5KW VFD PANEL
WO NO. PCS67/0
SCALE
NTS
PRP. BY DCR 20.11.09
DSN. BY RJJ
CHD. BY
APPD. BY PBN
REV. DESCRIPTION
01
02
03
04
05
06
CLIENT REF. NUMBER
CLIENT DRG. NO.
DRAWING NUMBER PCS67/0/02B
SHEET NO. 01 OF 04
REV. 0
FILE PATH: Z:\DRAWING (WORK ORDER)\PCS\PCS67_0 (TANGENT) AS BUILT DT.08.01.10\MODIFICATION - AS BUILT (DT.02.03.10)\7.5KW VFD PANEL\PCS67_POWER_B
ISSUE ON :- Thursday, November 19, 2009 2:30:34 AM

Annexure 5 Detailed financial analysis of Variable Frequency Drive

Assumptions

Name of the Technology	Variable frequency drive		
Rated Capacity			
Detail	**Unit**	**Value**	
Installed Capacity	HP	7.5	Feasibility Study
No of working days	Days	300	Feasibility Study
No of Shifts per day	Shifts	2	Feasibility Study
Capacity Utilization Factor	%		Feasibility Study
Proposed Investment			
Plant & Machinery	₹ (in lakh)	0.23	Feasibility Study
Erection & Commissioning (2%)	% on Plant & Equip	0.07	Feasibility Study
Investment without IDC	₹ (in lakh)	0.30	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.01	Feasibility Study
Total Investment	₹ (in lakh)	0.31	Feasibility Study
Financing pattern			
Own Funds (Internal Accruals)	₹ (in lakh)	0.08	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	0.23	Feasibility Study
Loan Tenure	Years	4	Assumed
Moratorium Period	Months	3	Assumed
Repayment Period [excluding moratorium]	Months	36	Assumed
Interest Rate	%	10.00%	SIDBI's rate of interest for energy efficiency project
Estimation of Costs			
O & M Costs	% Plant & Equip	4.00	Feasibility Study
Annual Escalation	%	5.00	Feasibility Study
Estimation of Revenue			
Electricity savings	kWh/year	5640	-
Cost	₹/kWh	2.50	-
St. line Depn.	%	5.28	Indian Companies Act

Estimation of Interest on Term Loan

(₹ in lakh)

Years	*Opening Balance*	*Repayment*	*Closing Balance*	*Interest*
1	0.23	0.06	0.17	0.02
2	0.17	0.08	0.10	0.02
3	0.10	0.08	0.02	0.01
4	0.02	0.02	0.00	0.00
		0.23		

WDV Depreciation:

Particulars / years	*1*	*2*	*3*
Plant and Machinery			
Cost	0.31	0.06	0.01
Depreciation	0.25	0.05	0.01
WDV	0.06	0.01	0.00

Projected Profitability

Particulars / Years	*1*	*2*	*3*	*4*
Revenue through Savings				
Fuel savings	0.14	0.14	0.14	0.14
Total Revenue (A)	0.14	0.14	0.14	0.14
Expenses				
O & M Expenses	0.01	0.01	0.01	0.01
Total Expenses (B)	0.01	0.01	0.01	0.01
PBDIT (A)-(B)	0.13	0.13	0.13	0.13
Interest	0.02	0.02	0.01	0.00
PBDT	0.11	0.11	0.12	0.12
Depreciation	0.02	0.02	0.02	0.02
PBT	0.09	0.09	0.10	0.11
Income tax	-	0.02	0.04	0.04
Profit after tax (PAT)	0.09	0.07	0.06	0.07

Computation of Tax ***(₹ in lakh)***

Particulars / Years	*1*	*2*	*3*	*4*
Profit before tax	0.09	0.09	0.10	0.11
Add: Book depreciation	0.02	0.02	0.02	0.02
Less: WDV depreciation	0.25	0.05	0.01	-
Taxable profit	(0.14)	0.06	0.11	0.12
Income Tax	0.00	0.02	0.04	0.04

Projected Balance Sheet ***(₹ in lakh)***

Particulars / Years	*1*	*2*	*3*	*4*
Liabilities				
Share Capital (D)	0.08	0.08	0.08	0.08
Reserves & Surplus (E)	0.09	0.16	0.23	0.29
Term Loans (F)	0.17	0.10	0.02	0.00
Total Liabilities D)+(E)+(F)	0.34	0.34	0.32	0.37

Assets

Gross Fixed Assets	0.31	0.31	0.31	0.31
Less: Accm. Depreciation	0.02	0.03	0.05	0.06
Net Fixed Assets	0.29	0.28	0.26	0.24
Cash & Bank Balance	0.05	0.06	0.07	0.13
Total Assets	0.34	0.34	0.32	0.37
Net Worth	0.17	0.24	0.30	0.37
Debt Equity Ratio	2.25	1.25	0.25	0.00

Projected Cash Flow: ***(₹ in lakh)***

Particulars / Years	***0***	***1***	***2***	***3***	***4***
Sources					
Share Capital	0.08	-	-	-	-
Term Loan	0.23				
Profit After tax		0.09	0.07	0.06	0.07
Depreciation		0.02	0.02	0.02	0.02
Total Sources	0.31	0.11	0.09	0.08	0.08
Application					
Capital Expenditure	0.31				
Repayment of Loan	-	0.06	0.08	0.08	0.02
Total Application	0.31	0.06	0.08	0.08	0.02
Net Surplus	-	0.05	0.01	0.00	0.06
Add: Opening Balance	-	-	0.05	0.06	0.07
Closing Balance	-	0.05	0.06	0.07	0.13

Internal Rate of Return ***(₹ in lakh)***

Particulars / months	***0***	***1***	***2***	***3***	***4***
Profit after Tax		0.09	0.07	0.06	0.07
Depreciation		0.02	0.02	0.02	0.02
Interest on Term Loan		0.02	0.02	0.01	0.00
Salvage/Realizable value					
Cash outflow	(0.31)	-	-	-	-
Net Cash flow	(0.31)	0.13	0.11	0.09	0.08
IRR	13.83%				

NPV	0.02

Break Even Point ***(₹ in lakh)***

Particulars / Years	***1***	***2***	***3***	***4***
Variable Expenses				
Oper. & Maintenance Exp (75%)	0.01	0.01	0.01	0.01
Sub Total ***(G)***	0.01	0.01	0.01	0.01
Fixed Expenses				
Oper.& Maintenance Exp (25%)	0.00	0.00	0.00	0.00

Interest on Term Loan	0.02	0.02	0.01	0.00
Depreciation *(H)*	0.02	0.02	0.02	0.02
Sub Total (I)	0.04	0.04	0.03	0.02
Sales (J)	0.14	0.14	0.14	0.14
Contribution (K)	0.13	0.13	0.13	0.13
Break Even Point (L= G/I)	32.16%	28.00%	22.35%	16.66%
Cash Break Even {(I)-(H)}	19.83%	15.63%	9.94%	4.21%
Break Even Sales (J)*(L)	0.05	0.04	0.03	0.02

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

Particulars / Years	***1***	***2***	***3***	***4***	***Total***
Net Profit Before Taxes	0.09	0.09	0.10	0.11	0.39
Net Worth	0.17	0.24	0.30	0.37	1.08
					36.43%

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

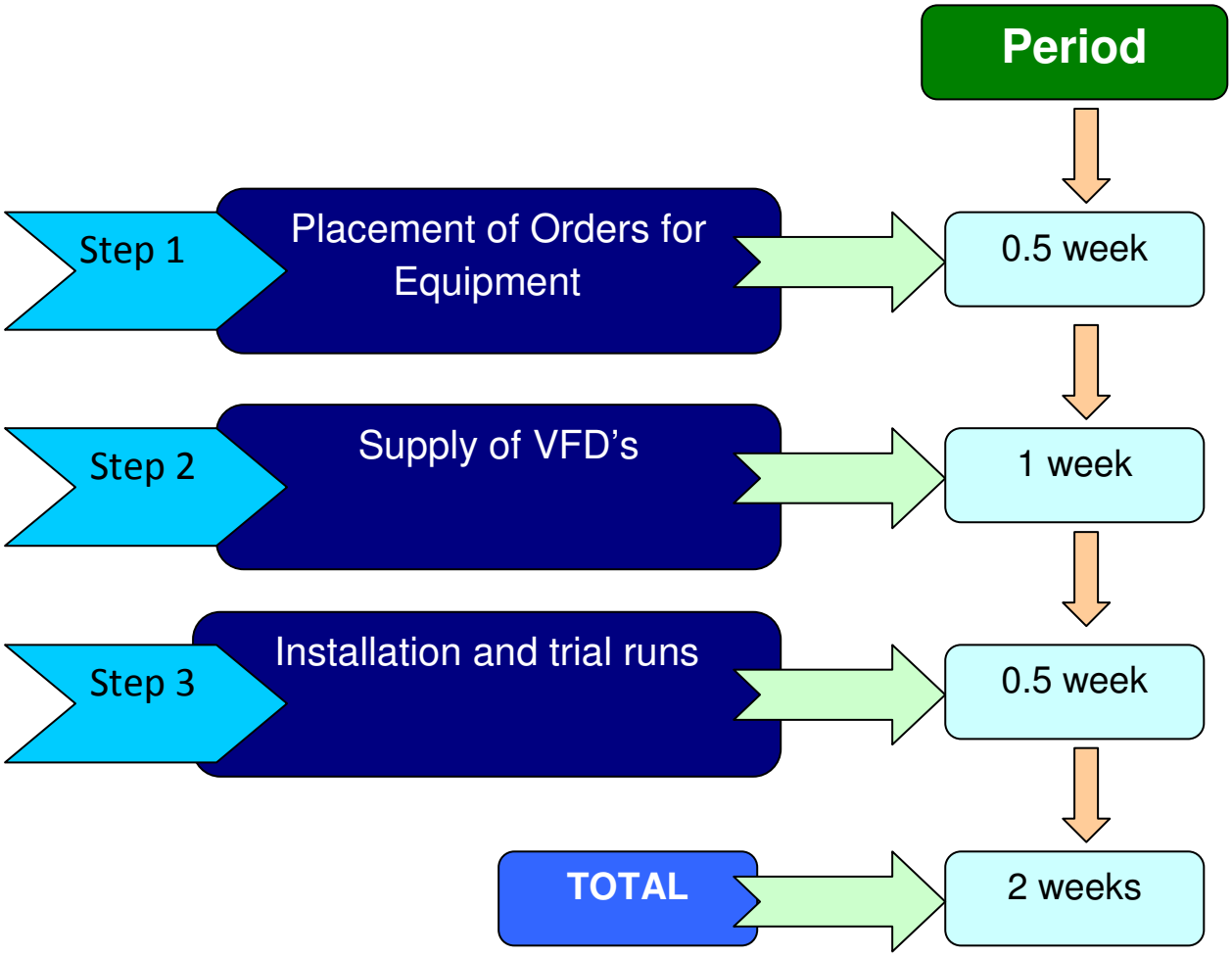
Particulars / Years	***1***	***2***	***3***	***4***	***Total***
CASH INFLOW					
Profit after Tax	0.09	0.07	0.06	0.07	0.29
Depreciation	0.02	0.02	0.02	0.02	0.06
Interest on Term Loan	0.02	0.02	0.01	0.00	0.05
Total (M)	0.13	0.11	0.09	0.08	0.41

DEBT

Interest on Term Loan	0.02	0.02	0.01	0.00	0.05
Repayment of Term Loan	0.06	0.08	0.08	0.02	0.23
Total (N)	0.08	0.09	0.09	0.02	0.28
Average DSCR (M/N)	1.45				

Annexure 6 Details of procurement and implementation plan

Project Implementation Schedule



Annexure 7 Details of equipment and service provider

Equipment details	*Service/technology provider*
Variable Frequency Drive (VFD)	**TANGENT TECHNOLOGIES** 105, 131 Ambica Complex, Gorwa Refinery Road, Vadodara India- 390016 E-mail: info@tangent.in Mobile:+91 9825500449 Telefax:+91 265 2291264 Website: www.tangent.in

Annexure 8 Quotations of proposed equipment

Tangent VSCPlus Variable Speed Drive Price List

Model	Brake Chopper	Input (V)	Phase	Match Motor (KW)	Unit Price (Rs)
VSCP-0R7T4	Inbuilt	400	Three	0.75	11121
VSCP-1R5T4	Inbuilt	400	Three	1.5	13127
VSCP-2R2T4	Inbuilt	400	Three	2.2	15606
VSCP-3R7T4	Inbuilt	400	Three	3.7	18596
VSCP-5R5T4	Inbuilt	400	Three	5.5	22243
VSCP-7R5T4	Inbuilt	400	Three	7.5	27421
VSCP-011T4	Inbuilt	400	Three	11	35735
VSCP-015T4	Inbuilt	400	Three	15	41752
VSCP-018T4	Inbuilt	400	Three	18.5	50018
VSCP-022T4	Inbuilt	400	Three	22	64290
VSCP-030T4	Inbuilt	400	Three	30	74960
VSCP-037T4	Inbuilt	400	Three	37	100306
VSCP-045T4	Inbuilt	400	Three	45	120839

Terms and Conditions:

Prices: Ex Works Vadodara basis

Excise: 10.34% extra at actuals

CST: 2% against form C

Freight: Extra at actuals

Delivery: 2 weeks

Standard application form for financial assistance to existing units
(upto and including Rs. 50 lakh)

I Applicant details

1	Name of Unit	
2	Address for correspondence	
3	Constitution	
4	SSI Registration. No.	
5	Date of Incorporation	
6	Date of Commencement of Operations	
7	Activity / Industry	

	Registered Office	Factory / Service Establishment (existing)	Factory / Service Establishment (proposed)
Full Address			
Contact Person(s)			
Tel No.			
Fax No.			
E mail address			

II Promoters/Directors

Bio-data of all the promoters/directors of the unit (Preferably make separate sheet for each promoter/director)

Promoter/Director	
Name	
Full Address(incl Tel no./ mobile no)	
Age	
Passport No.	
Father's / husband's name	
Qualification	
Experience	
Functional responsibility in the unit	
Relationship with Chief Promoter	
Shareholding in the unit	
Net worth	

Pl. furnish details of any other shareholder having more than 5% in the unit.

III. Products Manufactured

Sl. No.	Product	Installed capacity p.a.	Present capacity utilisation	End use of product	Export orientation
					Yes/ No

IV. Existing Facilities with Banks /FIs incl. SIDBI

a	Name of the Bank(s) / FI, Branch,	
b	Dealing person and contact tel. no.(s)..	
c	Dealing since (each Bank / FI)	

Facilities enjoyed :

Nature of facility (bankwise)	Amount (Rs. lakh)		Rate of interest	Nature of Security and value
	Sanctioned	Outstanding as on ___ ___		
Fund based Basedkfjdffkldkfjdfkjdfkjdfkdjfkdjf				
-Term Loan				
-Working capital				
Non Fund Based				

Are there any defaults ? Yes/No

V. Financial Position of applicant unit/ associate concern

(Rs. lakh)

	Net-worth			Sales			Net profit		
	Y1	Y2	Y3	Y1	Y2	Y3	Y1	Y2	Y3
Applicant unit									
Associate concern I									
Associate concern II									

Details of Associate concerns to be given as per **Annexure I**.

VI. Project Details

6.1. Purpose for which assistance now required :

	Purpose	
1	Indicate whether Expansion /diversification / modernisation and details	Technology Upgradation for Energy Efficiency
2	If new products envisaged give details	N/A
3	Details of expected incremental qualitative / quantitative benefits	Saving in the fuel bill to the extent of 20-25% leading to commensurate improvement in the bottom line of the applicant unit.
4	Expected month/year of implementation	8-10 weeks
5	No. of employees existing and additional	

Cost of Project (Rs. Lakh)

S. No	Details	Total Amount
1	Civil Works	-
2	Plant & Machinery (incl. installation) * -Indigenous -Imported	0.23
3	Professional charges	-
4	Erection & commisioning charge	0.07
5	Preliminary & pre-operative expenses [Loan syndication fee etc.] &	0.01

6	Taxes(CST)	
7	Contigency	-
	TOTAL	0.31
** Details of Plant and machinery/ Misc. fixed assets at* ***Annexure II and III***		

Indicate details of expenditure already incurred, if any and how the expenditure was financed ?

6.3. **Means of Finance**

(Rs. Lakh)

S. No. No.	Details	Total
1	Additional share capital / Internal accruals	0.08
2	Interest free Unsecured Loans	-
3	Term Loan proposed from SIDBI / Banks inclusive of subsidy ####	0.23
	Total	0.31
# ### In terms of existing guidelines of Ministry of MSME , GoI the subsidy amount is received on implementation of the project Say within 3 months therefore the amount of subsidy is included in the term laon amount as bridge loan and funded by the bank On receipt of the subsidy from the GoI it is adjusted towards the loan amount.		

#

6.4 Whether additional Working Capital required for the unit. If yes, amount and arrangements proposed may be indicated:

6.5 **Technology**

S. No.	Item	
1	Any Technical collaboration? If yes, details	
2	Details of main technical professionals employed	
3	Any quality certification obtained ? If yes enclose certificate.	

6.6 **Raw material / Labour/ Utilities**

1	Raw material (Details, arrangement, sources and distance)	
2	Power	Connected Load Utilised load Requirement of power for Additional machines Back-up arrangement (DG)
3	Other critical inputs if any	

6.7 **Marketing & Selling Arrangements**

Items	Applicants remarks
Main Markets (Locations)	
Main buyers, Indicate clearly if the unit is relying on a single buyer	
Indicate competitors	
Whether product has multiple applications	
Distribution channels (e.g. direct sales, retail network, distribution network)	

Marketing team details, if any.	
Orders on hand (enclose copies)	

6.8 **Projected profitability** : Statement to be enclosed as per **Annexure IV**.

6.9 **Others**

Items	
Please indicate the various licenses / consents for the project / unit already obtained from the respective authorities	
Please indicate licenses / consents for the project / unit that are yet to be obtained.	
Category as per pollution control dept. If polluting, pollution control measures taken	
Whether the project is entitled for any govt. subsidy, tax exemptions. Details thereof	
Repayment period (in months) sought including repayment holiday requested, if any,	
Details of Collateral security offered and value (basis).	
List of guarantors for the proposed loan	

Enclose documents as indicated in the check list at Annexure V.

6.10 **Strengths / Weaknesses of the borrower** (such as market standing, product/ service differentiation, technical expertise, infrastructure facilities etc.)

Strengths	

Weaknesses	

DECLARATION

I/We certify that all information furnished by me/ us above and in the appendix/ annexures/ statements and other papers enclosed is true; I/we have no borrowing arrangements for the unit with any bank / FI except as indicated in the application; that there are no overdues / statutory dues/government enquiry/proceedings/prosecution against the unit/associate concerns/ promoters/directors except as indicated in the application; that no legal action has been/ is being taken against the unit/associate concerns/promoters/directors; that I/ we shall furnish all other information that may be required by SIDBI in connection with my/our application and I/ We have no objection to your furnishing the information submitted by me/ us to any agency as you may deem fit in connection with consideration of the assistance. We have no objection to SIDBI/ its representatives making suitable enquiries while considering the application.

Place : **Signature**

Date **Name & Designation**

Annexure I

Details of Associate Concerns

Name , Address & products manufactured	Existing since	Name & Address of existing Banker (s)	Facilities Enjoyed	Share holding of the main promoter(s) of applicant unit

Annexure II

Particulars of machinery proposed for the project

Name of machinery, (model / specification)	Name of manufacturer, contact person, e-mail address telephone no.	Lead time for delivery of machinery	Invoice price (for indigenous machinery) / CIF price (for imported) (Rs. lakh)	Purpose /use of machine	Basis of selection of supplier	Remarks reg. after sale service etc.
Variable Frequency Drive (VFD)	TANGENT TECHNOLOGIES 105, 131 Ambica Complex, Gorwa Refinery Road, Vadodara India- 390016 E-mail: info@tangent.in Mobile:+91 9825500449 Telefax:+91 265 2291264 Website: www.tangent.in	2 Weeks	0.23	Electricity saving	Crediability of the Technolgy Provider	

- Furnish competitive quotations, catalogues / invoice for each machinery proposed to be acquired
- In case of second hand /fabricated machinery, indicate the need / reasons for acquiring such machinery. Also enclose Chartered Engineer's certificate regarding residual value and life in respect of second hand machinery.

Annexure III

Details of Misc. Assets / equipment Proposed

S.No.	Name of item	Supplier	Cost (Rs. lakh)	Purpose/ use of MFA	Remarks

Annexure IV

Profitability projections for the Unit/ Company as a whole*

S.No.	Item	Actuals for previous year	Y1	Y2	Y3	Y4	TOTAL
1	Total Income		0.14	0.14	0.14	0.14	0.56
2	Raw materials						
	Power and fuel						
	Wages and salaries						
	Selling expenses						
	Other expenses		0.01	0.01	0.01	0.01	0.05
	Total Cost		0.01	0.01	0.01	0.01	0.05
3	Profit before depreciation, Interest and taxes (PBDIT) (2 - 1)		0.13	0.13	0.13	0.13	0.51
4	Interest on Term Loan		0.02	0.02	0.01	0.00	0.05
5	Interest on Working Capital						
6	Interest on unsecured loans						
7	Depreciation		0.02	0.02	0.02	0.02	0.06
8	Profit before Tax (3 - 4 - 5 - 6 - 7)		0.09	0.09	0.10	0.11	0.39
9	Tax		-	0.02	0.04	0.04	0.10
10	Profit after Tax (8 - 9)			0.07	0.06	0.07	0.29
11	Dividends/ Withdrawals						
12	Cash Accruals (10 - 11 + 7)		0.11	0.09	0.08	0.09	0.35
13	Repayments of all term liabilities (Principal)		0.06	0.08	0.08	0.02	0.23
14	Debt Service Coverage Ratio ((10+7+4)/(13+4))		1.59	1.14	1.05	4.02	1.46
15	Average DSCR (Total of 10+7+4 for projected period/(Total of 13+4 for projected period)				1.46		

* Please give projections for the entire tenure of SIDBI / Bank loan.

Annexure V

CHECK LIST of documents to be submitted along with the application

S. No.	Documents	Y/N	Reasons for Non-submission
1	SSI Regn. / CA certificate certifying SSI status		
2	Certified copies of Memorandum & Articles of association / Partnership Deed		
3	Audited financial results for the last three years of Applicant unit		
4	Copies of lease deed / sale deed on which the unit is situated		
5	Copies of sanction letters from commercial banks / FIs which have sanctioned assistance to the unit		
6	NOC from pollution control board/consent letter, if applicable		
7	IT Returns/Assessment orders/Sales tax returns of the Applicant Unit/ promoters/directors for 2 years		
8	List of existing plant and machinery		
9	Competitive quotations for machines and Misc. fixed assets proposed to be acquired under the scheme		
10	Duly signed latest net worth statements of promoters/directors & guarantors in SIDBI format; In case of guarantors please furnish, Name, Age, Father's/Husband's name, residential address. Details of similar guarantee, if any, given to other institutions		
11	2 sets of photographs along with signatures of all promoters/directors/guarantors duly certified by a Bank or Gazetted Officer.		
12	Audited financial results for last three years for each associate concerns. If applicable.		
13	Copy of title deed of collateral security and valuation report		

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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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10-5-6/B, My Home Plaza, Masab
Tank HYDERABAD, AP 500 028
Phone: 040 23376630, 31,
Fax No.040 23322517
Website: www.zenithenergy.com

India SME Technology Services Ltd
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Website: www.techsmall.com