

DETAILED PROJECT REPORT ON VARIABLE FREQUENCY DRIVE FOR STENTER MACHINE BLOWER (SURAT TEXTILE CLUSTER)



Bureau of Energy Efficiency

Prepared By



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VFD FOR STENTER MACHINE BLOWER

SURAT TEXTILE CLUSTER

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Detailed Project Report on VFD for Stenter Machine Blower

Textile SME Cluster, Surat, Gujarat (India)

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Zenith Energy Services Pvt. Ltd.

Hyderabad

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LIST OF ABBREVIATIONS

- BEE - Bureau of Energy Efficiency
- DPR - Detailed Project Report
- DSCR - Debt Service Coverage Ratio
- FD - Forced Draft
- GHG - Green House Gases
- HP - Horse Power
- IBR - Indian Boiler Regulation
- IRR - Internal Rate of Return
- ID - Induced Draft
- MoP - Ministry of Power
- NPV - Net Present Value
- ROI - Return On Investment
- SME - Small and Medium Enterprises
- VFD - Variable Frequency Drive
- MoMSME - Ministry of Micro Small and Medium Enterprises

EXECUTIVE SUMMARY

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

Surat is renowned for the synthetic Sarees and dress materials and there are about 450 above industries in the cluster. The major fuels used in the cluster units are Imported Coal, Lignite, Natural gas and Biomass (Groundnut husk briquettes and Wood). Lignite and imported coal are used in boilers for steam generation. Natural gas is used in Stenter (for heat setting) and Natural gas based generators. The cost of energy as a percentage of manufacturing cost varies anywhere between 12 to 15%, which includes electrical as well as thermal energy cost.

This DPR is prepared on installation of variable frequency drives for stenter machine blowers, which will optimized the air flow as per the requirement during the process time i.e., operating at low speed during low temperatures in the chambers for drying the dyed or printed cloth. Installation of VFD for stenter machine blowers for supply the hot air in to the cloth reduces electricity consumption by 33,600 kWh per annum for a set of 4 chamber stenter machines.

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:

S.No	Parameter	Unit	Value
1	Project cost	₹ in lakh	2.03
2	Debit equity ratio	ratio	3:1
3	Monetary benefit	₹ in lakh	1.88
4	Simple payback period	year	1.08
5	NPV	₹ in lakh	5.01
6	IRR	%age	72.43
7	ROI	%age	28.20
8	DSCR	ratio	3.76
9	Process down time during implementation	days	1

The projected profitability and financial indicators shows that the project will be able to earn profit from installation of VFD on stenter machine blower.

ABOUT BEE SME PROGRAMME

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Surat 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 studies

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 of energy efficiency projects in the clusters

Implementation of energy efficiency measures

To implement the technology up gradation projects in 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.

Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

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

1 INTRODUCTION

1.1 Brief about the SME cluster

The products manufactured in Surat Textile Cluster are synthetic sarees and dress materials which are renowned in the country as well as abroad and have good domestic market. The main raw material used for the cluster units is grey cloth which is procured by local weaving units and agents. The cost of energy (electrical and thermal energy) varies between 12 and 15% of total manufacturing cost.

Majority of the cluster units are of integrated type, where the raw material “grey cloth” is processed in-house to the final product like sarees and dress materials. Most of the units of the cluster are working on Job basis, where the textile agents will provide design and grey cloth and the grey cloth is processed as per design provided by the clients. The energy cost is next to the raw materials cost.

Production process

The main process operation for dyeing and printing process of synthetic sarees and dress materials adopted in cluster units are as follows:

Fabric pre-treatment

The main purpose of the fabric pre-treatment process is to remove oil, grease and other materials and to whiten the grey cloth through bleaching. The various process adopted in pre-treatment are scouring, bleaching and shrinking process.

Dyeing

Dyeing is the process of imparting colors to the material through a dye (color). In which a dye is applied to the substrate in a uniform manner to obtain an even shade with a performance and fastness appropriate to its final use. This process is mainly performed in Jet Dyeing Machines and Jigger machines.

Dyeing of fabric is carried out in jet dyeing machines. The temperature of the solution is raised to 50°C. Concentrated dyestuff solution is prepared separately and is added to the liquor. After the addition of dyes, the temperature is raised to 130°C and maintained for about 60 minutes.

After whitening/dyeing, the fabric is unloaded from the machine and taken to the folding and rolling machines for improving the width of cloth, which gets shrunk during the washing and dyeing process.

Printing

In Surat cluster three types printing methods are used. Most of the units are following the flat bed printing, rotary printing and some units follows hand printing. Hand printing is the old method to print the fabric. The flat bed printing has provision for printing 10 to 14 colors simultaneously. The color print paste prepared is fed onto the screens from which it is transferred to the fabric fed in. The fabric after print paste transfer is passed through a drying chamber at 145°C. The dried and printed fabric is taken for further processing.

Drying and Error! Hyperlink reference not valid.Finishing

After printing, the drying process is performed in loop machine, where the temperature is maintained between 130°C to 170°C for better color setting. After passing through the loop machines, the printed fabric is washed in a series of normal water and hot water washing in the presence of chemicals for color setting. After completion of the washing process, the printed and washed fabric is subjected to heat setting process in Stenter and then pressing and finishing treatments.

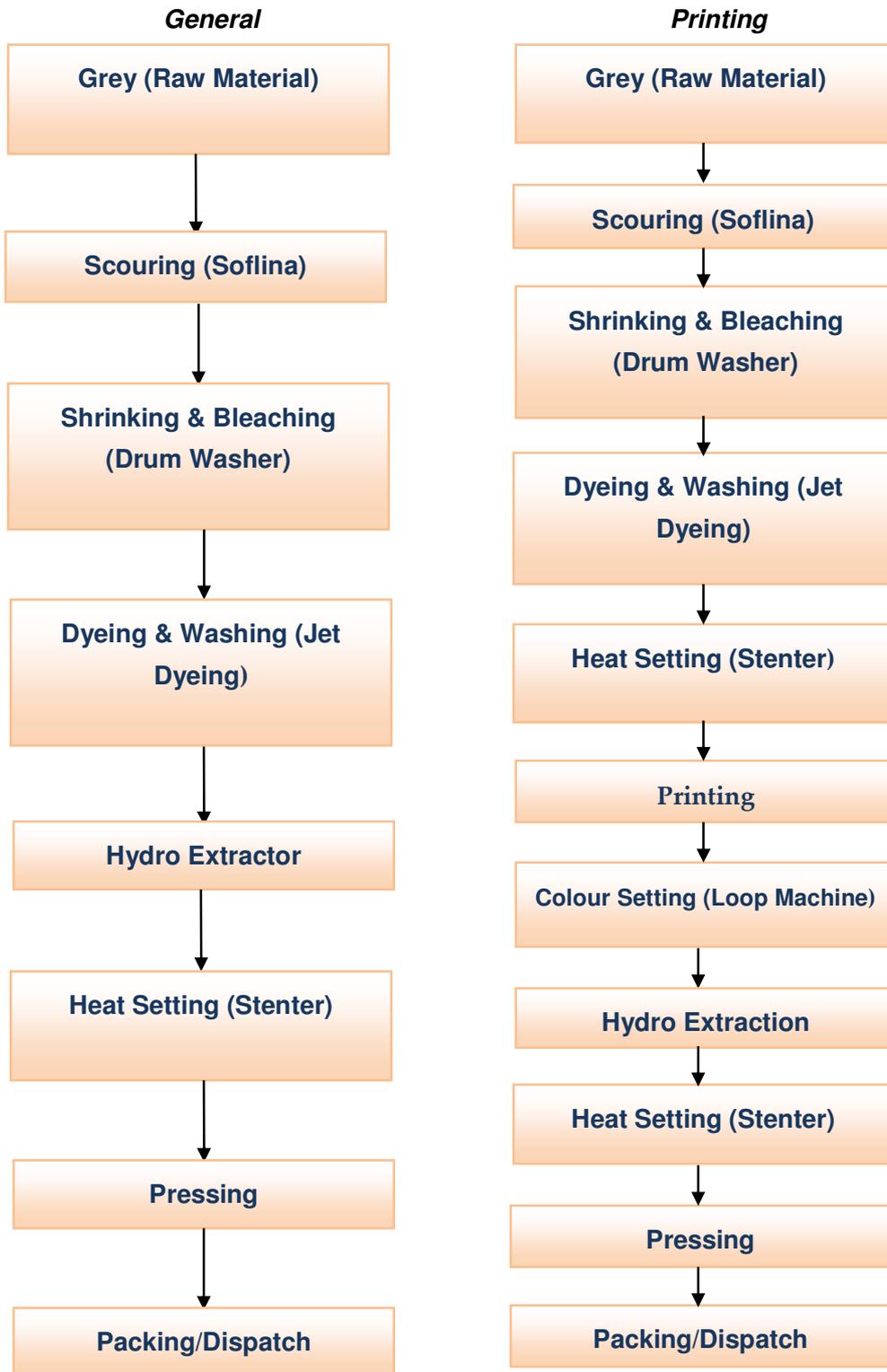


Figure 1: General process flowchart of a typical textile unit

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption of a typical unit

The main energy forms used in a typical unit in the cluster are electricity, coal/lignite and natural gas. Electricity is used for driving the prime movers of pumps, fans, stenter fans, ID and FD fans, conveyers, loop machines drives, lighting etc. Imported coal and lignite are used as fuel in boilers for steam generation whereas natural gas is used as fuel in electricity generation for stenter, printing and loop machines. The energy consumption of a typical unit in the cluster does not have VFD's for stenter machine blowers where damper control is used for flow variation is furnished in Table 1.1 below:

Table 1.1 Energy consumption in a typical unit (Tirupati Prints Pvt. Ltd.)

S.No	Details	Unit	Value
1	Coal/lignite consumption	tonne/year	4320
2	Grid electricity consumption	MWh/annum	1057
3	Production (quantity processed)	mt(In lakh)/year	105

1.2.2 Average production by a typical unit in the cluster

The average production in a typical unit is 105 lakh meter of final product per year.

1.3 Identification of technology/equipment to be upgraded / changed

1.3.1 Description of current technologies used

There are about 8 blowers are connected to the stenter machine in a typical unit in the cluster and are operated by mechanical damper control for reducing the hot air flow though it is not required leading to wasteful of energy. Technical details of existing stenter are furnished in Table 1.2 below:

Table 1.2 Technical details of existing stenter & blower

Technical Details of existing stenter	Unit	Value
Total Chambers	Nos.	4
Temperature (temperature is varied in the different chambers)	°C	150-180
No. of Hours of Operation	hours	24
Total blowers	Nos.	8

Capacity of each blower	kW	5.5
Damper control	%age	40-100

1.3.2 Its role in the whole process

Stenter is used in a typical textile unit for heat setting process. In this process hot air is supplied through the blowers in different chambers of machine. Presently flow of hot air is controlled by mechanical damper which causes wastage of energy.

1.4 Establishing the baseline

1.4.1 Design and operating parameters/fuel consumption

The present power consumption in one blower motor is 3.5 kWh in four chamber capacity stenter machine and connected with 5.5 kW motor for each chamber. This stenter machine is operated for 20 -24 hours in a day.

1.4.2 Electricity Consumption

The power consumption of various stenter machines of three cluster units and is operating without VFD is furnished in Table 1.3 below:

Table 1.3 Electricity consumption in different unit

S. No	Name of the unit	No. of Stenter Machines blowers	Power consumption (kWh/day)
1	Tirupati Prints Pvt. Ltd.	8	542.4
2	Ambica Syntex Pvt. Ltd.	16	1019
3	Trishla silk mills Pvt. Ltd.	6	406

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

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of the energy efficient boiler in the cluster are:

- Lack of awareness about VFD and its benefit
- Lack of awareness of the losses and monetary benefit of energy efficient pumps
- Dependence on local equipment suppliers, who doesn't have technical knowledge about VFD and its proper installation

1.5.2 Financial Barrier

Availing finance is not the major issue. Among the SMEs, the larger units, if convinced are capable of either financing it themselves or get the finance from their banks. The smaller units will require competitive loan and other support to raise the loan. However as most of them have been able to expand their setup and grow, there is readiness to spend for energy efficiency technologies which have good returns. Energy Efficiency Financing Schemes such as SIDBI's, if focused on the cluster, will play a catalytic role in implementation of identified energy conservation projects & technologies.

1.5.3 Skilled manpower

In Surat Textile cluster, the availability of skilled manpower is one of the problems due to more number of units. One local technical persons available at Surat takes care of about 5-10 textile units. Maintenance or repair work of major equipments of textile units like stenter, Jet Dyeing machine, Jigger machine etc, are generally taken care by the equipment suppliers itself.

1.5.4 Other barrier(s)

Information on the energy efficient technologies not available among cluster unit owners, though the suppliers are available locally, the information was not disseminated among cluster units.

2. Technology/equipment for energy efficiency improvements

2.1 Detailed description of equipment selected

2.1.1 Description of equipment

More than 50% of the total electrical energy consumption in Indian industries is used by rotating equipment. Out of which about 65% is consumed by centrifugal or flow related applications such as fans, blowers, compressors, and pumps. 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 lowering fan or pump speed by 15% to 20%, shaft power can be reduced by as much as 30%. The main reason behind use of VFD 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.

Working Principle



Figure 2.1 Variable Frequency Drives

Single-speed drives start motors abruptly, subjecting the motor to high torque and current surges up to 10 times the full-load current. VFD offers a soft start, gradually ramping up a motor to operating speed. VFD lessens mechanical and electrical stress on the motors and reduces maintenance and repair costs and extend the motor life. Energy savings from VFD can be significant. For example with centrifugal fan even a small reduction in motor speed can reduce a fans energy use by as much as 50%. For a 25 horse power 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 varies depending on system variables hence, it is important to calculate benefits for each application before specifying a VFD saving.

In Surat Textile Cluster units, the Stenter Blowers flow is controlled by mechanical dampers. If the flow can be controlled by reducing the speed of the blower motor this would offer a more efficient means of achieving flow control. In fact the saving is greater than that might initially be expected. As the speed of the motor is reduced, the flow will reduce partially, while the power required by the motor reduces with the cube of the speed.

The mechanical constriction of the flow may reduce the load on the motor/fan/pump motor. But the constriction itself is an energy loss, which is obviously an inefficient operation. If the flow or speed can be controlled by reducing the speed of motor, this would offer a more efficient means of achieving flow control. In fact the saving is greater than that might initially be expected. As the speed of the motor is reduced, the required speed/flow will reduce partially, while the power required by the motor reduce with cube of speed, for instance, if the speed is reduced by 10%, the flow reduces by 10% and power consumption reduces by 25%.

Considering the above facts and for reducing electricity consumption in the present stenter machine blowers, it is suggested to install VFD for stenter machine blower motors.

2.1.2 Technology/equipment specifications

Technical specifications for VFD's for stenter blowers are provided in Annexure 4 for all the capacities of VFD's.

2.1.3 Justification & Suitability/integration with existing process

As discussed above, controlling the air flow of blowers by mechanical damper controlling is inefficient and consumes more power. If the flow is controlled by reducing the speed of the motor this would offer a more efficient means of achieving flow control. In fact the saving is greater than that might initially be expected. As the speed of the motor is reduced, the flow will reduce partially, while the power required by the motor reduces with the cube of the speed.

2.1.4 Superiority over existing technology/equipment

The installation of VFD's for fans has the following advantages:

The benefits of installing the drives are multifold as furnished below:

- Reduction in breakdowns and smooth start/stop
- Reduction in breakages and motor burn's
- 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 (.98 across speed range)
- Maximize power distribution system
- Reduced Inrush Currents
- Minimize Peak demand charges
- Eliminates Mechanical Shock and Stress on power train (couplings, belts, drive shafts, gear boxes, etc.)
- Allows load shedding
- May qualify for utility rebates
- Controlled acceleration and deceleration
- Eliminates Motor Voltage Imbalance

2.1.5 Availability of the proposed equipment

The VFD suppliers are available in local and in vadodara, which is 150 KM's from Surat city. Details of equipment suppliers are provided in Annexure 7.

2.1.6 Source of technology/equipment

The technology is locally available.

2.1.7 Service/technology providers

Details of service providers are in Annexure 7.

2.1.8 Terms and condition in sales

Terms of payment

50% Advance with purchase order, and remaining 50% along with taxes and duties against proforma 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 actuals. However CVD is charged at 8% + 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.

2.1.9 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 assessment and risks analysis

The operational life of the VFD is considered to be 15 years.

2.3 Suitable unit/plant size in terms of capacity/production

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

3. ECONOMIC BENEFITS OF NEW ENERGY EFFICIENT BOILER

3.1 Technical benefits

3.1.1 Fuel savings per year

No fuel savings is envisaged due to implementation of the project activity.

3.1.2 Electricity saving

The power savings due to installation of VFD for stenter machine blowers are 15% of present motor power consumption and is estimated as 33,600 kWh per annum (1 kWh saving per two blowers, 24 hours/day and 350 days/year of operation & rounded off) for a set of 4 chamber stenter machine.

3.1.3 Improvement in product quality

There is no significant impact on product quality *directly or indirectly*.

3.1.3 Increase in production

The proposed equipment does not contribute to any increase in production

3.1.4 Reduction in raw material consumption

No significant impact on the reduction of raw materials consumption *directly or indirectly*.

3.15 Reduction in other losses

There is no significant reduction in other losses *directly or indirectly*.

3.2 Monetary benefits

The monetary benefit due to installation of new energy efficient boiler is estimated ₹ 1.88 lakh per annum due to reduction in electricity consumption.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

As installation of VFD eliminates Mechanical Shock and Stress on couplings, drive shafts, etc., this may lessen the breakdowns and working environment may improve

3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new and energy efficient. The training provided by equipment suppliers will improve the technical skills of manpower for better operation and

maintenance; hence the technology implemented will create awareness among the workforce and improves the skill.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

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

3.4.2 Reduction in GHG emission such as CO₂, NO_x, etc

The major GHG emission reduction source is CO₂. The technology will reduce grid electricity consumption and emission reductions are estimated at 28 tonne of CO₂ per annum due to implementation of the project activity.

3.4.3 Reduction in other emissions like SO_x

No significant impact on SO_x emissions.

4 FINANCIAL ANALYSIS OF NEW ENERGY EFFICIENT EQUIPMENT

4.1 Cost of equipment implementation

4.1.1 Cost of equipments

Total cost for installation of VFD is estimated at ₹ 1.78 lakh (8 VFD*0.22 lakh), after considering taxes which includes VFD, Panel, switches and cabling.

4.1.2 Other costs

The total cost of implementation of VFD is estimated at ₹ 1.85 lakh. The above cost includes cost of equipment / machinery, cost of fabrication (and/or) commissioning charges and the details are furnished below:

Table 4.1 Details of project cost

S. No.	Details	Cost (₹ in lakh)
1	Plant equipment and machinery and electrical works	1.78
2	Erection & Commissioning	0.25
3	Interest during implementation (preliminary & pre- operative expenses)	0.00
4	Total	2.03

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at ₹ 0.51 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project, which is ₹ 1.52 lakh.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with ₹ 1.59 lakh in the first year operation and increases to ₹ 8.17 lakh at the end of eighth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 2.03 lakh and monetary savings due to reduction in fuel consumption is ₹ 1.88 lakh and the simple payback period works out to be 1.08 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.00% interest rate works out to be ₹ 5.01 lakh

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 72.43%. 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 28.20%.

4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

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

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

In each scenario, other inputs are assumed as constant. The financial indicators in each of the above situation are indicated along with standard indicators are shown in Table 4.2 below:

Table 4.2 Sensitivity analysis at different scenarios

Particulars	IRR(%age)	NPV(₹ in lakh)	ROI (%age)	DSCR
Normal	72.43	5.01	28.20	3.76
5% decrease in electricity savings	68.47	4.66	28.01	3.57
5% increase in electricity savings	77.01	5.39	28.24	3.95

4.5 Procurement and implementation schedule

The project is expected to be completed in 1 week from the date of financial closure. The detailed schedule of project implementation is furnished in Annexure 6.

Annexure**Annexure 1: Base line for saving calculation**

<i>Particulars</i>	<i>Unit</i>	<i>Value</i>
Total Chambers	Nos.	4
Total hours of Operation	hour	24
Total blowers	Nos.	8
Rated Power	kW	5.5
Power Consumption	kWh	3.3
Daily electricity consumption	kWh	633
Annual electricity consumption	kWh	221550

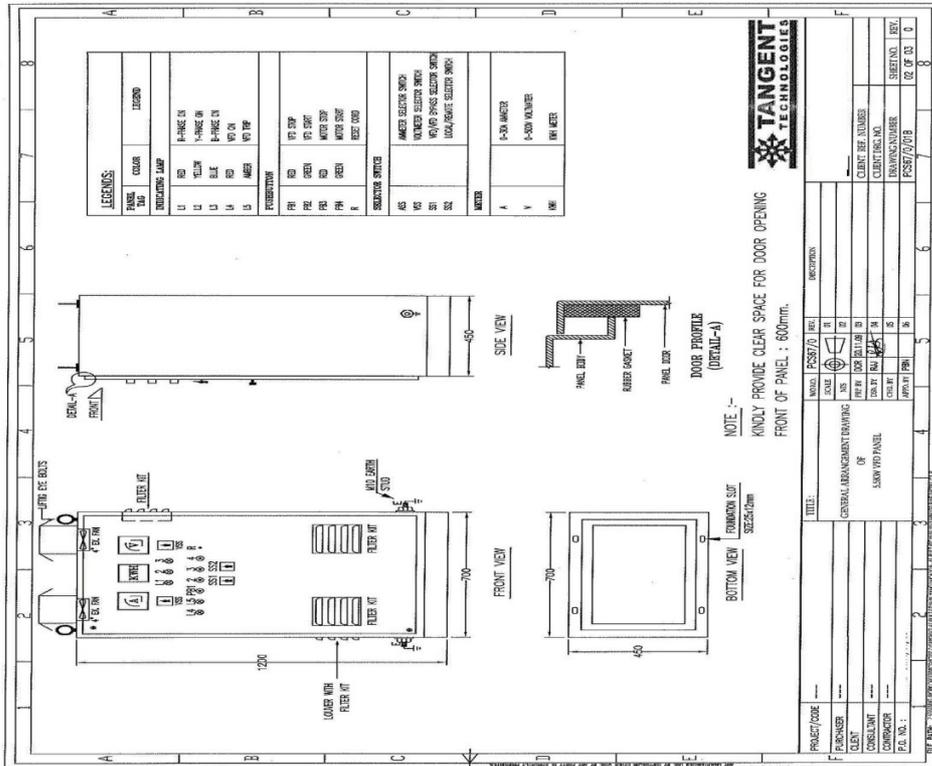
Annexure 2: Process flow diagram

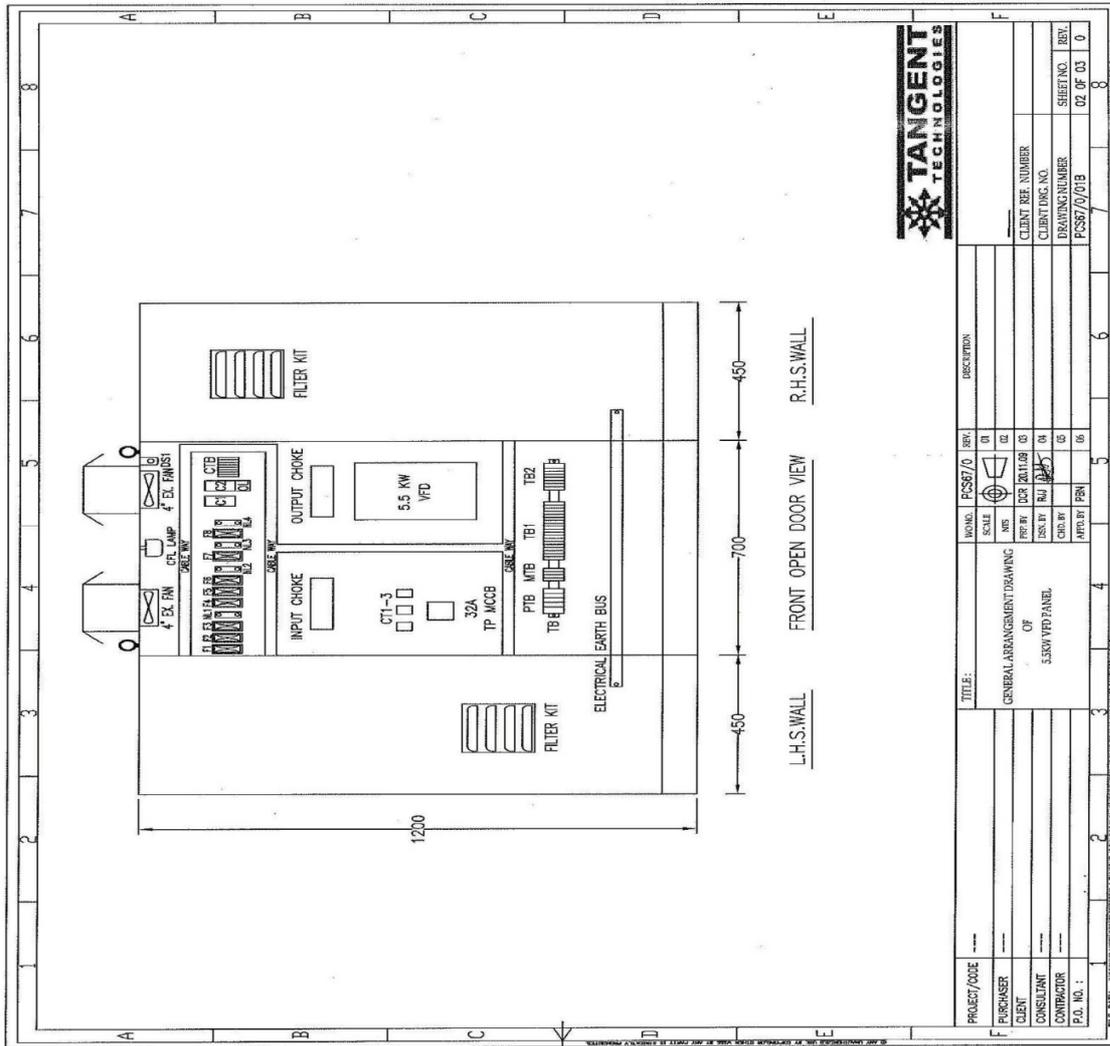


Annexure 3: Detail technical assessment report

<i>Particulars</i>	<i>Unit</i>	<i>Value</i>
Total Chambers	Nos.	4
Total hours of Operation	hour	24
Total blowers	Nos.	8
Rated Power	kW	5.5
Power Consumption	kWh	3.3
savings	%age	15
Average power savings (Each blower)	kWh	0.5
Total Power savings for 8 blowers	kWh	4.0
Power saving per annum	kWh/annum	33600
Monetary saving per annum for 4 VFD	₹ in lakh	1.88
Investment for 4 VFD	₹ in lakh	1.90
Simple payback period	year	1.08

Annexure 4: Detail of Technical Drawing
The electrical line diagrams are enclosed

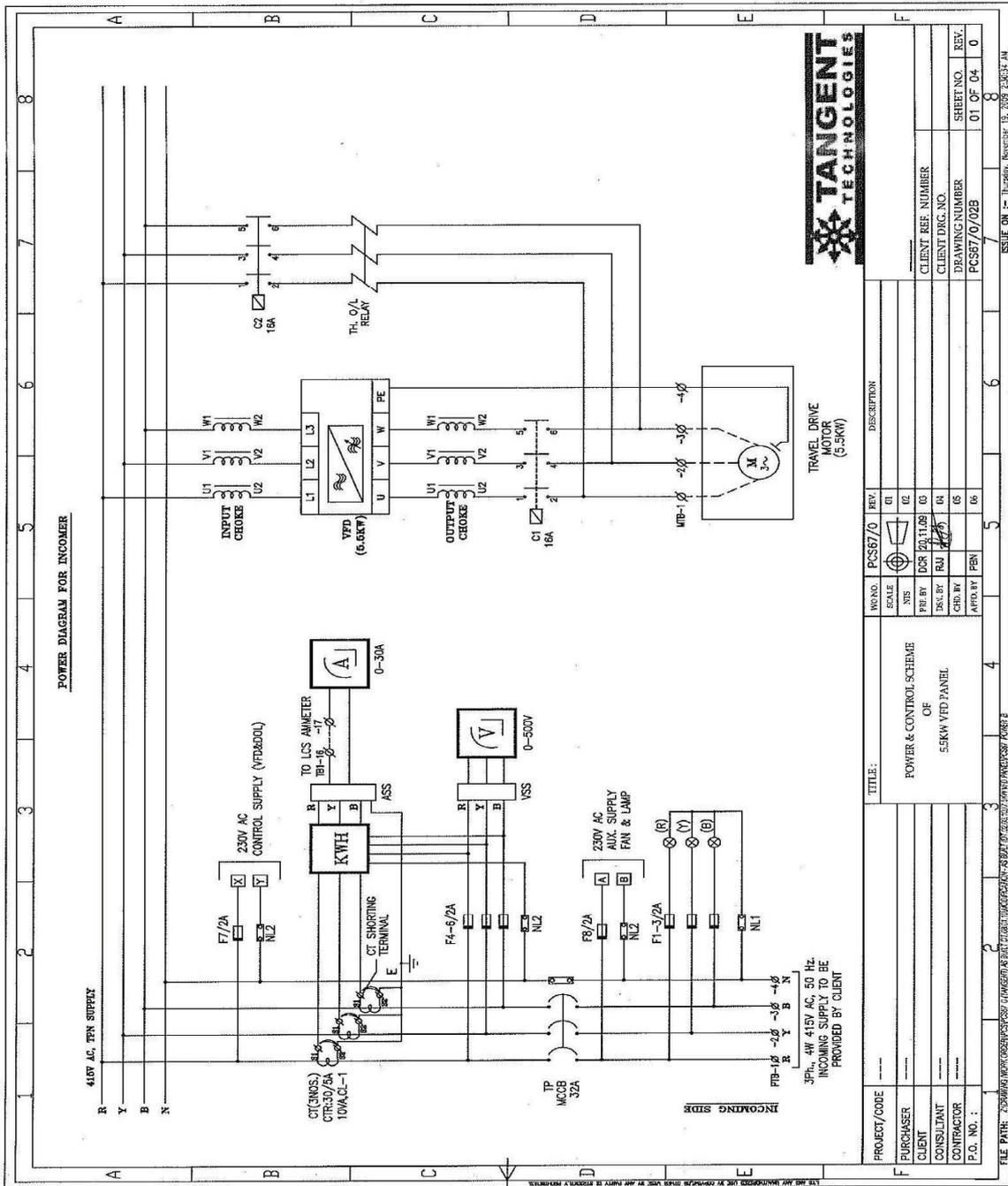




PROJECT CODE	NO. OF	ISSUE	DESCRIPTION
PURCHASER	SCALE		
CLIENT	DATE		
CONSULTANT	PREP BY	DATE	
CONTRACTOR	CHECK BY	DATE	
P.O. NO. :	APPROVED BY	DATE	

TITLE:	GENERAL ARRANGEMENT DRAWING OF 5.5KW VFD PANEL
CLIENT REF. NUMBER	
DRAWING NUMBER	PS567/0/018
SHEET NO.	02 OF 03
REV.	0

ISSUE NO.	01
ISSUE DATE	2019-03-27



NO.	NO.	REV.	DESCRIPTION
1	PC567/0	01	
2		02	
3		03	
4		04	
5		05	
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99		99	
100		100	

ISSUE ON 17-11-2020, REVISED 19-03-2024

The technical specifications for VFD's for stenter blowers are provided for all the capacities of VFD have and is furnished below:

Voltage Class		3 Phase 400 Volts Class																										
Model VSCP-□□□T4		0R7	01R5	02R2	3R7	05R5	07R5	011	015	018	022	030	037	045	055	075	090	110	132	160	200	220	250	280	315	355	400	
Constant Torque	kW	0.75	1.5	2.2	4.0	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220	250	280	315	355	400	
Max Motor Output	HP	1.0	2.0	3.0	5.0	7.5	10	15	20	25	30	40	50	60	75	100	120	150	180	220	270	300	335	375	425	475	535	
OUTPUT	Rated Current Amps.	2.3	3.8	5.1	9	13	17	25	32	37	45	60	75	90	110	152	176	210	253	304	380	426	470	530	600	660	750	
	Max. Voltage	3Phase 380/400/415/440/480Volts proportional upto input line voltage																										
	Max. Frequency	400Hz																										
INPUT SUPPLY	Rated Input Voltage & Frequency	3-Phase, 380-480Volts, 50/60Hz.																										
	Allowable Voltage Fluctuation	-10% to +10%																										
	Allowable Frequency Range	47-63Hz.																										
CONTROL CHARACTERISTICS	Control Method	V/F Control, Sensorless Vector Control Mode1 & Mode2																										
	Starting Torque	Not less than 180% at 0.3Hz. in SVC Mode2 and 150% at 0.5Hz. in SVC Mode1																										
	Speed Control Range	1:50V/F mode, 1:100 SVC Mode1, 1:200 SVC Mode2																										
	Carrier Frequency	1kHz - 16kHz; Model dependant																										
	Over Loading Capacity	150% for 120Secs., 180% for 10Secs.																										
	Frequency Accuracy	Digital Setting : Max Frequency X +/- 0.1% Analog Setting: Max Frequency X +/- 0.2%																										
	Frequency Resolution	Analog	0.1% of Max Frequency																									
		Digital	0.01Hz.																									
		Pulse	0.5% of Max. Frequency																									
	Voltage / Frequency Characteristics	Base Frequency adjustable from 0-400Hz. Selection Between Constant Torque, Variable Torque with user defined curve																										
	Torque Boost	Automatic Torque Boost or Manual Setting between 0.1-30%																										
	Acc. / Decl. Time & Characteristics	0.01-3600secs, Linear or S-Curve selection.																										
	Multi-Speed	Realised thru In-built PLC function or Control Terminal																										
	Brake	Dynamic Braking	Internal upto 30% External upto 125% with Braking Resistor																									
		DC Injection	Optional at Start-Up or Stopping: Current: 0-150%, Time: 0-60sec																									
	JOG	Frequency 0.1-50Hz, and time 0.1-60secs selectable																										
	Process Control	Inbuilt Process functions for closed loop control																										
	Automatic Energy Save	Optimize V/F curve automatically based on load for power saving during running																										
	Automatic Voltage Regulator	Keeps constant output voltage during input voltage variation																										
	Automatic Current Limiting	Limits the current under the preset value automatically during operation																										
Control Terminals	Digital Input (10)					Digital Outputs (4)				Analog Input (2)				Analog Output (2)				Serial Comm. (1)										
	2 - Fixed					2 - Open Collector				2 - Configurable				2 - Configurable				RS485										
	8 - Multifunction programmable (2 - Programmable for Pulse I/P)					1 - Relay Output 1 - 24VDC Pulse Output				0-10VDC or 4-20mA				0-10VDC or 4-20mA				Modbus RTU										
Running Frequency Channel	Keypad Operation / Control Terminal / Pulse Input / Serial Comm. with combined provision and can be switched between 2 Control.																											
Protection Function	Over Voltage, Under Voltage, Over Current, Over Load, Over heat, Stall prevention, input/output Phase loss, output short circuit, External fault, analog input loss, etc.																											
ENVIRONMENT	Ambient Temperature	-10 to 50°C (derated @2% for each degree above 50°C upto 60°C)																										
	Humidity	Less than 95% (non condensing)																										
	Vibration	Less than 5.9m/s ² (0.6g)																										
	Location	Indoors (Free form corrosive gases and dust) and within 1000m altitude																										
	Protection	IP20																										
Cooling Mode	Fan with automatic temperature control																											
<ul style="list-style-type: none"> • Above specifications are for Standard 4-Pole Induction Motor. Select drive with motor rated current within drive rating. • Maximum output voltage shall not exceed the input supply voltage. • Braking transistor built-in upto 60HP rating. Available as an option for higher ratings. • For current rating specification of drives above 400KW consult us. • Consult us for 1Ph. 230V input drive 0.25-3HP rating and specifications. 																												

**Annexure 5: Detailed financial calculations & analysis for financial indicators –
Assumption**

Name of the Technology	Variable Frequency Drive for stenter blower		
Rated Capacity	5.5 kW		
Details	Unit	Value	Basis
No of working days	Days	350	
Proposed Investment			
Plant & Machinery	₹ (in lakh)	1.78	
Erection & Commissioning	₹ (in lakh)	0.25	
Total Investment	₹ (in lakh)	2.03	
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	0.51	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	1.52	Feasibility Study
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	51	Assumed
Interest Rate	%	10.00%	SIDBI Lending rate
Estimation of Costs			
O & M Cost	% on Plant & Equip	4	Feasibility Study
Annual Escalation	%	5	Feasibility Study
Estimation of Revenue			
Power Saving	KWh	33600	
Cost	₹/KWh	5.6	
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	1.52	0.06	1.46	0.14
2	1.46	0.12	1.34	0.14
3	1.34	0.18	1.16	0.13
4	1.16	0.24	0.92	0.11
5	0.92	0.56	0.36	0.07
6	0.36	0.36	0.00	0.01
		1.52		

WDV Depreciation

Particulars / years	1	2
Plant and Machinery		
Cost	2.03	0.41
Depreciation	1.62	0.32
WDV	0.41	0.08

Projected Profitability

₹ in lakh

Particulars / Years	1	2	3	4	5	6	7	8
Revenue through Savings								
Power savings	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
Total Revenue (A)	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
Expenses								
O & M Expenses	0.08	0.09	0.09	0.09	0.10	0.10	0.11	0.11
Total Expenses (B)	0.08	0.09	0.09	0.09	0.10	0.10	0.11	0.11
PBDIT (A)-(B)	1.80	1.80	1.79	1.79	1.78	1.78	1.77	1.77
Interest	0.14	0.14	0.13	0.11	0.07	0.01	0.00	0.00
PBDT	1.66	1.66	1.66	1.68	1.71	1.77	1.77	1.77
Depreciation	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
PBT	1.55	1.55	1.56	1.57	1.61	1.66	1.67	1.66
Income tax	0.00	0.45	0.57	0.57	0.58	0.60	0.60	0.60
Profit after tax (PAT)	1.55	1.10	0.99	1.00	1.02	1.06	1.06	1.06

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	1.55	1.55	1.56	1.57	1.61	1.66	1.67	1.66
Add: Book depreciation	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Less: WDV depreciation	1.62	0.32	-	-	-	-	-	-
Taxable profit	0.04	1.33	1.66	1.68	1.71	1.77	1.77	1.77
Income Tax	0.01	0.45	0.57	0.57	0.58	0.60	0.60	0.60

Projected Balance Sheet

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Reserves & Surplus (E)	1.54	2.64	3.63	4.63	5.65	6.71	7.78	8.84
Term Loans (F)	1.46	1.34	1.16	0.92	0.36	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	3.51	4.49	5.30	6.06	6.52	7.22	8.29	9.35

Assets								
Gross Fixed Assets	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03
Less: Accm. Depreciation	0.11	0.21	0.32	0.43	0.54	0.64	0.75	0.86
Net Fixed Assets	1.92	1.82	1.71	1.60	1.49	1.39	1.28	1.17
Cash & Bank Balance	1.59	2.67	3.59	4.46	5.03	5.84	7.01	8.17
Total Assets	3.51	4.49	5.30	6.06	6.52	7.22	8.29	9.35
Net Worth	2.05	3.15	4.14	5.14	6.16	7.22	8.28	9.34
Dept equity ratio	0.71	0.43	0.28	0.18	0.06	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	0.51	-	-	-	-	-	-	-	-
Term Loan	1.52								
Profit After tax		1.54	1.10	0.99	1.00	1.02	1.06	1.06	1.06
Depreciation		0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Total Sources	2.03	1.65	1.20	1.10	1.11	1.13	1.17	1.17	1.17
Application									
Capital Expenditure	2.03								
Repayment of Loan	-	0.06	0.12	0.18	0.24	0.56	0.36	-	-
Total Application	2.03	0.06	0.12	0.18	0.24	0.56	0.36	-	-
Net Surplus	-	1.59	1.08	0.92	0.87	0.57	0.81	1.17	1.17
Add: Opening Balance	-	-	1.59	2.67	3.59	4.46	5.03	5.84	7.01
Closing Balance	-	1.59	2.67	3.59	4.46	5.03	5.84	7.01	8.17

Calculation of Internal Rate of Return

₹(in lakh)

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		1.54	1.10	0.99	1.00	1.02	1.06	1.06	1.06
Depreciation		0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Interest on Term Loan		0.14	0.14	0.13	0.11	0.07	0.01	-	-
Cash outflow									
Net Cash flow	(2.03)	-	-	-	-	-	-	-	-
IRR	72.43%								

NPV	5.01
-----	------

Break Even Point

₹(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08
Sub Total (G)	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.08
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
Interest on Term Loan	0.14	0.14	0.13	0.11	0.07	0.01	0.00	0.00
Depreciation (H)	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Sub Total (I)	0.27	0.27	0.26	0.24	0.20	0.14	0.13	0.14
Sales (J)	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
Contribution (K)	1.82	1.82	1.81	1.81	1.81	1.80	1.80	1.80
Break Even Point (L= G/I)	14.61%	14.81%	14.28%	13.14%	11.20%	7.98%	7.47%	7.56%
Cash Break Even {(I)-(H)}	8.72%	8.92%	8.38%	7.22%	5.27%	2.04%	1.51%	1.59%
Break Even Sales (J)*(L)	0.25	0.25	0.24	0.22	0.18	0.14	0.13	0.13

Return on Investment

₹(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	1.55	1.55	1.56	1.57	1.61	1.66	1.67	1.66	12.82
Net Worth	2.05	3.15	4.14	5.14	6.16	7.22	8.28	9.34	45.47
									28.20%

Debt Service Coverage Ratio

₹(in lakh)

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	1.54	1.10	0.99	1.00	1.02	1.06	1.06	1.06	6.71
Depreciation	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.64
Interest on Term Loan	0.14	0.14	0.13	0.11	0.07	0.01	0.00	0.00	0.60
Total (M)	1.79	1.34	1.23	1.22	1.20	1.18	1.17	1.17	7.95

Debt

Interest on Term Loan	0.14	0.14	0.13	0.11	0.07	0.01	0.00	0.00	0.60
Repayment of Term Loan	0.06	0.12	0.18	0.24	0.56	0.36	0.00	0.00	1.52
Total (N)	0.20	0.26	0.31	0.35	0.63	0.37	0.00	0.00	2.12
	9.01	5.15	3.96	3.50	1.90	3.17	0.00	0.00	3.76
Average DSCR (M/N)	3.76								

Annexure 6: Details of procurement and implementation plan with schedule/timelines

Project Implementation Schedule – VFD’s

S. No.	Activities	Days							
		1	2	3	4	5	6	7	8
1	Supply of the VFD’s	■	■	■					
2	Panels and cabling				■	■			
3	Providing connections to the motor terminals					■	■		
4	Commissioning and trial runs						■	■	

The process down time is considered for stenter blowers

S. No.	Activities	Days							
		1	2	3	4	5	6	7	8
1	Panels and Cabling					■	■	■	
2	Commissioning and trial runs								■

The process down time is considered for only one day, as panel’s installation and cabling will not affect the machine operation, when all the equipments are kept ready, then connections are provided and hence process down time is considered only for one day

Annexure 7: Details of technology/equipment and service providers

Equipment details	Source of technology	Service/technology providers
Variable Frequency Drive		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 or Techno-commercial bids for new technology/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



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(Ministry of Power, Government of India)

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