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Cluster: Morbi
Report ID: MB/02/DPR

Detailed Project Report
On
Retrofitting VFD to Air compressor

Wintel Vitrified Pvt. Ltd.

Morbi (Gujarat)

Prepared for

Bureau of Energy Efficiency

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For more information

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Last but not least, the interactions and deliberations with numerous ceramic units, Industry Associations, technology providers and who were directly or indirectly involved throughout the study were exemplary and the whole exercise was thoroughly a rewarding experience for TERI.

The Energy and Resources Institute (TERI)
New Delhi

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List of abbreviations

BEE	:	Bureau of Energy Efficiency
CO_2	:	Carbon Dioxide
D/E	:	Debt /Equity
DPR	:	Detailed Project Report
DSCR	:	Debt Service Coverage Ratio
EE	:	Energy Efficient
GEF	:	Global Environmental Facility
GHG	:	Green House Gas
HSD	:	High Speed Diesel
IDC	:	Investment without interest defer credit
IGDPR	:	Investment Grade Detailed Project Report
IRR	:	Internal Rate of Return
kW	:	Kilo Watt
kWh	:	Kilo Watt Hour
LSPs	:	Local Service Providers
MGO	:	Minimum Guaranteed Offtake
MSME	:	Micro, Small and Medium Enterprises
MT	:	Metric Tonne
NG	:	Natural Gas
NPV	:	Net Present Value
O&M	:	Operation and Maintenance
PCB	:	Pollution control board
PGVCL	:	Paschim Gujarat Vij Company Limited
RE	:	Renewable Energy
ROI	:	Return On Investment
SCM	:	Standard Cubic Meter
SME	:	Small and Medium Enterprises
SPP	:	Simple Payback Period
TERI	:	The Energy and Resources Institute
Toe	:	Tonnes of oil equivalent
UNIDO	:	United Nations Industrial Development Organization
VFD	:	Variable Frequency Drive
WACC	:	Weighted Average Cost of Capital

Executive summary

The overall aim of the GEF-UNIDO-BEE project 'Promoting Energy Efficiency (EE) and Renewable Energy (RE) in selected MSME clusters in India' is to develop and promote a market environment for introducing energy efficiency and enhancing the use of renewable energy technologies in process applications in selected energy-intensive MSME clusters in India. This would help in improving the productivity and competitiveness of the MSME units, as well as in reducing the overall carbon emissions and improving the local environment.

Under the GEF-UNIDO-BEE Project, TERI has been entrusted to undertake Capacity building of Local Service Providers (LSPs) to BEE. The Scope of Work under the project

- Organizing 4 one-day training/ capacity building workshops for LSPs in each cluster.
- Development of 10 bankable DPRs for each cluster, based on mapping technology needs with capacities of local technology suppliers/service providers, and also replication potential and applications to banks in each cluster.

Brief introduction of the MSME unit

Name of the unit	M/s Wintel Vitrified Pvt. Ltd.
Constitution	Private Limited
MSME Classification	Medium
No. of years in operation	11
Address: Registered Office:	8-A,National Highway,Nava Jambudia, Morbi – 363642, (Gujarat) India.
Industry-sector	Ceramic
Products manufactured	Vitrified tile
Name(s) of the promoters/ directors	Mr. Gopal Bhai Mr. Dinesh Bhai
Existing banking arrangements along with the details of facilities availed	NA

A detailed assessment study was undertaken in the identified area with the use of the sophisticated handheld instruments. Energy consumption pattern and production data were collected to estimate the specific energy consumption of the unit. The unit level baseline of the unit was also estimated using the historical data. The total energy consumption of the unit during last 12 months was 4083 toe which is equivalent to 1316 lakh rupees. The total CO_2 emission during this period is estimated to be 16,004 tonnes. Electricity, natural gas and coal were considered for CO_2 emission estimation.

Accepted/ recommended technology implementation

The recommended technology considered after discussion with the plant personnel for implementation in the unit is given below.

Technology	Annual energy saving Electricity (kWh)	Investment[1] (Rs lakh)	Monetary savings (Rs lakh/ year)	Simple payback period (Years)	Emission reduction (tonnes of CO_2)
Retrofit the VFD on under loaded air compressor	68,457	2.17	4.35	0.5	56

Other benefits

- The proposed project is not expected to bring in any change in process step or operating practices therefore no change expected in the product quality.
- Implementation of the selected technology in the unit may result in reduction in CO_2 emissions.

Cost of project & means of finance

S. No.	Particulars	Unit	100% equity	D/E- 70:30	D/E- 50:50
1	Cost of Project	Rs. In Lakh	2.17	2.25	2.23
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	160.95	150.95	153.73
4	NPV	Rs. In Lakh	9.35	8.82	8.97
5	DSCR	-	-	8.43	11.76

[1]Investment including (i) VFD hardware cost– Rs. 1.8 lakh, and (ii) taxes and miscellaneous – Rs. 0.37 lakh

1.0 Details of the unit

1.1 Particulars of unit

Table 1.1: Particulars of the unit

1	Name of the unit	M/s Wintel Ceramics Pvt. Ltd.	
2	Constitution	Private Limited	
3	MSME Registration No/UAN	Yes (physically verified)	
4	PCB consent No. available	Yes (physically verified)	
5	Date of incorporation / commencement of business	2007	
6	Name of the Contact Person	Mr Ambrish Kundariya	
7	Mobile / Ph. No	918048841613	
8	Email		
9	Address: Registered Office	8-A,National Highway, Nava Jambudia, Morbi – 363642, (Gujarat) India.	Owned
10	Factory	8-A,National Highway, Nava Jambudia, Morbi – 363642, (Gujarat) India.	Owned
11	Industry / Sector	MSME/Manufacturing	
12	Products Manufactured	Manufacturer of fabricated metal products, except machinery and equipment	
13	No of hours of operation/shift	12	
14	No of shifts/ day	2	
15	No of days/year	350	
16	Installed Capacity	4000 boxes per day	
17	Whether the unit is exporting its products (Yes/ No)	No	
18	Quality Certification, if any	Yes	

2.0 Energy profile

2.1 Process flow diagram

Manufacturing of ceramic item uses wide range of raw material combination to produce different shape, size and colour. It requires both electrical and thermal energy at different stages of the process to operate the ball mill, casting/moulding, kilns, cutting & finishing machines and utilities such as motors, pumps air compressor etc. Ceramic manufacturing process primarily consists of mould preparation, body material preparation, shaping, drying and firing. Typical process flow chart is shown with figure 2.1.

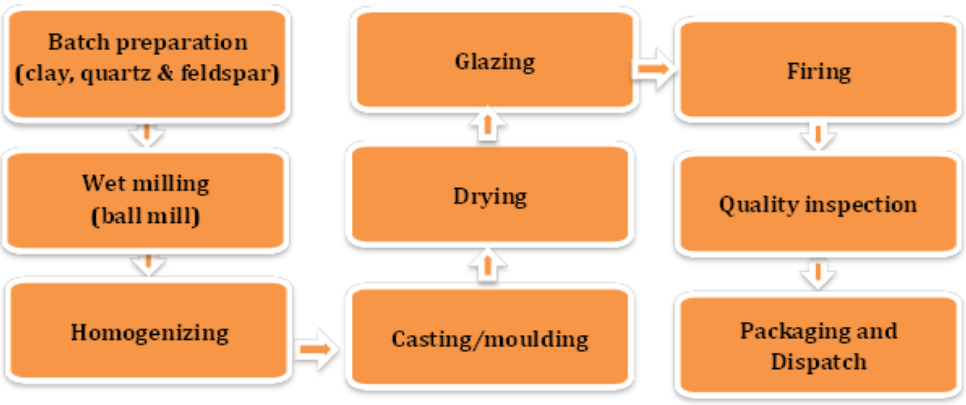

Figure 2.1: Process flow chart

2.2 Details of technology identified

The details of the Compressed air system installed in the unit are given in table 2.2.

Table 2.2: Details of compressed air system

Specification/Parameters	Compressor – 1	Compressor - 2
Type of Compressor	Screw	Screw
Make	ELGI	Kaeser
Model No.	E-30	BSD 72
Lubricating/non-lubricating	Lubricating	Lubricating
Rated Pressure, Bar	8.0	8.0
Design FAD (m^3/Minute)	5.18	8.15
Rated motor capacity (kW)	30	37
Operation	Yes	Yes

2.3 Energy used and brief description of their usage pattern

The unit uses grid power supplied by Paschim Gujarat Vij Company Limited under the tariff category of HTP-1. Table 2.3 provides the details of energy uses.

Table 2.3: Energy used and description of use

S No	Energy source	Description of use
1	Electricity	Motive power for different drives in different process sections and utilities

S No	Energy source	Description of use
2	Coal	Kiln
3	Natural gas	Kiln

2.4 Energy sources, availability & tariff details

Different energy sources, availability of listed energy types and their respective tariffs are given in table 2.4.

Table 2.4: Energy sources, availability and tariffs

Source	Remarks	Price
Electricity (PGVCL)	HTP-1	Demand charges: • For first 500 kVA of billing demand: Rs. 150/- per kVA per month • For next 500 kVA of billing demand: Rs. 260/- per kVA per month Energy charges: @ Rs. 4.20/kWh Power factor penalty: • 1% of energy charges for every point drop in PF between 0.85 to 0.90 • 2% of energy charges for every point drop in PF below 0.85 Power factor rebate: • 0.5% of energy charges for every point increase in PF over 0.95.
Natural gas	Gujarat Gas Ltd.	• Minimum Guaranteed Offtake (MGO): Rs. 32.70/SCM • Non - Minimum Guaranteed Offtake (Non-MGO): Rs. 35.97/SCM

2.5 Analysis of electricity consumption

Table 2.5: Electricity consumption profile

Month & Year	Total electricity consumption (kWh)	Sanctioned load/demand (kVA)	Power factor	Recorded demand, (kVA)	Demand charges (Rs)	Energy charges (Rs)	Monthly bill (Rs)
Dec-17	676,780	1,700	0.98	1,482	433,950	2,842,476	4,494,584
Jan-18	619,600	1,700	0.98	1,505	444,875	2,602,320	4,164,537
Feb-18	693,400	1,700	0.98	1,521	452,475	2,912,280	4,550,014
Mar-18	547,550	1,700	0.98	1,481	433,475	2,299,710	3,671,875
Total	**7,611,990**	**-**	**-**	**-**	**5,294,325**	**31,970,358**	**50,643,028**

Figure 2.5 presents contract demand, recorded maximum demand and the energy consumption of the unit.

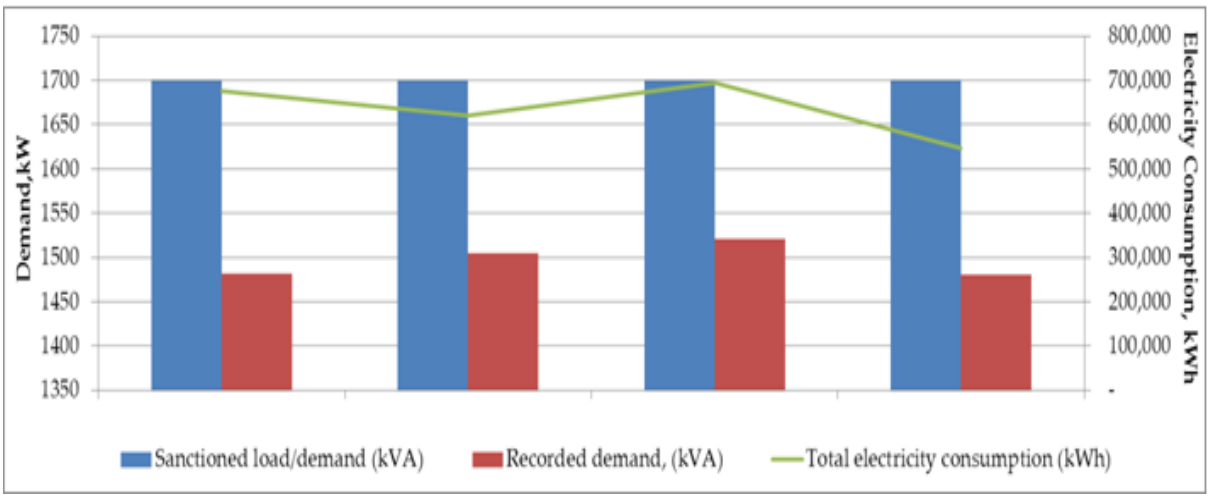

Figure 2.5: Demand pattern and energy consumption profile

2.6 Analysis of other energy forms/ fuels

The analysis of the other fuels/forms of energy used in the unit is given in table 2.6.

Table 2.6: Analysis of other energy/ fuel consumption

Parameters	Natural Gas (SCM)	Coal (T)
Consumption unit/year	2,340,000	3,120
Calorific value per unit	8,650	4,500
Equivalent toe per year	2,024.1	1,404
Price (Rs per unit)	26.6	6,000
Total price per year	62,236,200	18,720,000

The share of various energy forms used in the unit is given in figure 2.6.

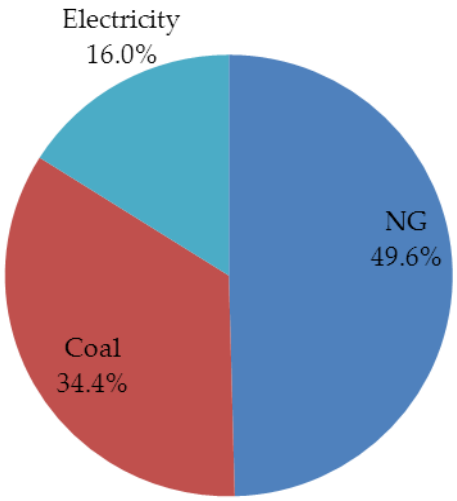

Figure 2.6: Percentage share of various fuel types in the unit

The plant is consuming about 7,611,990 kWh of electricity per year. The annual consumption of the coal is 3120 MT and Natural gas is 2,340,000 SCM. The total energy consumption of the unit during last 12 months is estimated to be 4,082.7 toe which is equivalent to 1,316 lakh rupees. The total CO_2 emission during this period is estimated to be 16,004 tonnes. Electricity, coal and natural gas were considered for CO_2 emission estimation.

3.0 Proposed technology for energy efficiency

Based on the measurements, observations/findings during detailed assessment study conducted in the unit, the following technology has been identified for energy efficiency improvement. The detail is given below.

3.1 Retrofit the VFD on under loaded air compressor

3.1.1 Background

To cater to compressed air requirement of the ceramic manufacturing process, Unit has installed two rotary screw type air compressors. The details of the Compressed air system installed in the unit are given in table 3.1.1.

Table 3.1.1: Details of compressed air system

Specification/Parameters	Compressor – 1	Compressor - 2
Type of Compressor	Screw	Screw
Make	ELGI	Kaeser
Model No.	E-30	BSD 72
Lubricating/non-lubricating	Lubricating	Lubricating
Rated Pressure, Bar	8.0	8.0
Design FAD (m^3/Minute)	5.18	8.15
Rated motor capacity (kW)	30	37
Operation	Yes	Yes

The operational parameters of the air compressor system were measured during the detailed assessment study.

3.1.2 Observations and analysis

During the detailed assessment study of the compressed air system, free air delivery test of the compressed air system was conducted for evaluating the existing performance. Air compressors were operated using load/unload control load/ unload control also known as constant speed control, which allows the motor to run continuously, but unloads the compressor when the discharge pressure is adequate. During the study free air delivery test of the compressed air system was conducted for evaluating the existing performance of the compressed air system. The loading and unloading pattern of the compressor is shown in figure 3.1.2.

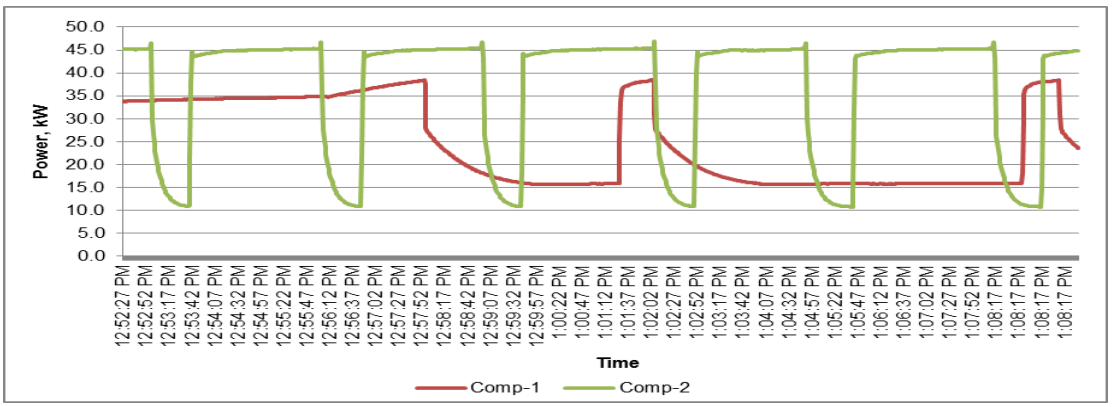

Figure 3.1.2: Loading and unloading pattern of air compressor

The analysis of the collected/measured data of compressed air system is shown in table 3.1.2

Table 3.1.2: Performance analysis of the existing compressed air system

Particulars	Unit	Comp – 1	Comp - 2	Cumulative
Installed Capacity	m^3/min	5.18	8.15	13.33
Actual Free Air Delivery (FAD)	m^3/min	5.17	8.15	13.33
Average load time of compressor in Business As Usual Scenario	hrs	14.23	18.01	16.12
Average un-load time of compressor in Business As Usual Scenario	hrs	9.77	5.99	7.88
Percentage loading of the compressor	%	59.3	75.0	67.2
Actual Air supplied to the plant	m^3/min	3.07	6.12	9.19

The loading of the compressor – 1 and compressor - 2 is estimated to be 60% and 75% respectively. The loading of the compressed air system is estimated to be 67%.

3.1.3 Recommendation

It is recommended to retrofit the variable frequency drive to compressor – 1 (ELGI make) and operate the compressor – 2 at full capacity. VFD operated screw compress has two functions; one it varies rpm of compressor based on pressure variation at the load end and it also reduces no load power consumption during unloading condition by bringing the motor to halt. Such operation prevents consumption of power during unload condition.

The other advantages of installation of VFD based screw compressor are as follows:

- By using VFD in screw air compressors, the operating pressure of air compressor can be precisely controlled and there is no need to maintain a range of pressure as required in the existing system. This leads to reduction in average operating pressure of the compressor hence reduction in power consumption.
- The leakage in the compressed air system is proportional to the operating pressure. Since there is a significant reduction in operating pressure, volume of air leakage would also reduce.

3.2 Cost benefit analysis

The estimated saving in annual operation cost by retrofitting the VFD on the existing compressor is estimated to be Rs. 4.34 lakhs. The investment requirement is Rs 2.17 lakh with a simple payback period of 0.5 year. The detailed calculations of the recommended energy conservation measures for DPR are provided in table 3.2.

Table 3.2a: Performance analysis of the existing compressed air system

Description	Unit	Values
Designed FAD	m^3/min	13.33
Operational FAD	m^3/min	13.33
Total on load operation	%	67.17
Total no load operation	%	32.8
Total cumulative operating hours	hr	24
Cumulative load hours	hr	16.1
Idle running hours	hr	7.9
Existing air requirement of the plant	m^3/min	9.19

Table 3.2b: Cost benefit analysis for recommended energy savings measures

Parameters	Units	Value
Actual Air Requirement without arresting leakages	M^3/Min	9.19
Average load power	kW	80.3
No load power consumption (average)	kW	28.1
Present Annual power consumption (on load + no load)	kWh	5,30,755
VFD internal losses	kW	1.6
Proposed annual power consumption using VFD/VSD	kWh	4,62,298
Reduction in annual operating energy	kWh	68,457
Energy Cost	Rs/kWh	6.35
Annual Monetary savings	Rs/Year	4,34,703
Total investment[2]	Rs	2,17,800
Simple Payback Period	Years	0.5

3.3 Pre-training requirements

The training would be required on operation of Variable frequency drive (VFD). Best practices to be adopted for housekeeping near location of installation.

3.4 Process down time for implementation

The estimated process down time required for implementation of recommended measure is estimated to be 1 day after commissioning and testing.

3.5 Environmental benefits

3.5.1 CO_2 reduction[3]

Implementation of the selected energy conservation measures in the unit may result in reduction in CO_2 emissions due to reduction in overall energy consumption. The estimated reduction in GHG emission by implementation of the recommended energy conservation measures is 56 tonne of CO_2 per year.

3.5.2 Reduction in other pollution parameters (gas, liquid and solid)

There is not significant impact on the reduction in other pollution parameters including gas, liquid and solid.

[2] Quotation – 1 has been considered for estimation of investments
[3] Source for emission factor: 2006 IPCC Guidelines for National Greenhouse Gas Inventories & for electricity; CO_2 Baseline Database for the Indian Power Sector, user guide version 12.0, May 2017 (CEA)

4.0 Project financials

4.1 Cost of project and means of finance

4.1.1 Particulars of machinery proposed for the project

The particulars of machinery proposed for the project is given in table 4.1.1.

Table 4.1.1: Particulars of machinery proposed for the project

S. No.	Name of machinery (Model/ specification)	Name of manufacturer, contact person	Advantage	Disadvantage
1	ELGI Retrofit Variable Speed Drive ELVD030R X0181170	ELGI Equipments Ltd ELGI Industrial Complex, Singanallur, Coimbatore–641005, India	OEM	-
2	Model : SJ700i–300 HFEF2 Rating : 30 kW / 40 HP	A square solution Devashray Industrial Estate, Block No. : C, Shed No. : 5/A, Beside Baroda Express Highway, Phase-IV, Vatva GIDC, Ahmedabad-382445. M. 9924233227, 9662216459/69. www.asquaresolutions.co.in	-	New supplier

4.1.2 Means of finance

The means of finance for the project is shown in table 4.1.2.

Table 4.1.2: Means of finance

S. No.	Details	100% equity	D/E- 70:30	D/E- 50:50
1	Additional (Share) Capital	2.17	0.65	1.09
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	1.52	1.09
5	Others	-	-	-
	Total	**2.17**	**2.17**	**2.17**

4.2 Financial statement (project)

4.2.1 Assumptions

The assumptions made are provided in table 4.2.1.

Table 4.2.1: Assumptions made

Details	Unit	100% equity	D/E-70:30	D/E-50:50
General about unit				
No of working days	Days	300		
No of shifts per day	Shifts	2		
Annual operating hours	Hrs/year	7,200		

Details	Unit	100% equity	D/E-70:30	D/E-50:50
Installed production capacity	tonnes/year		-	
Production in last financial years	tonnes/year		-	
Capacity utilization factor	%		-	
Proposed investment (Project)				
Total cost of the project	Rs. (in Lakh)	2.17	2.17	2.17
Investment without interest defer credit (IDC)	Rs. (in Lakh)	2.17	2.17	2.17
Implementation time	Months	6.0	6.0	6.0
Interest during the implementation phase	Rs. in lakhs	-	0.08	0.06
Total investment	Rs. in lakhs	2.17	2.17	2.17
Financing pattern				
Own funds	Rs. in lakhs	2.17	0.73	1.14
Loan funds (term loan)	Rs. in lakhs	-	1.52	1.09
Loan tenure	Years	-	5.0	5.0
Moratorium period (No EMI (interest and principal amount))	Months	-	6.0	6.0
Total repayment period	Months	-	66.0	66.0
Interest rate	%	-	10.5	10.5
Estimation of costs				
Operation & maintenance costs	%		5.0	
Annual escalation rate of O&M	%		5.0	
Estimation of revenue				
Reduction in energy cost	Rs Lakh/year		4.4	
Total saving	Rs Lakh/year		4.4	
Straight line depreciation	%		16.21	
IT depreciation	%		80.0	
Income tax	%		33.99	
Period of cash flow analysis	Years		5.0	

4.2.2 Payback

The simple payback period on the investments made are shown in table 4.2.2.

Table 4.2.2: Payback

Details	100% equity	D/E- 70:30	D/E- 50:50
Total project cost (Rs. In lakh)	2.17	2.25	2.23
Cash flow as annual saving (Rs. In lakh/year)	4.35	4.35	4.35
O&M Expenses for first year (Rs. In lakh/year)	0.11	0.11	0.11
Net Cash flow (Rs. In lakh/year)	4.24	4.24	4.24
SPP (months)	6.14	6.37	6.30
Considered (month)	6.10	6.40	6.30

4.2.3 NPV and IRR

The NPV and IRR calculations are shown in table 4.2.3.

Table 4.2.3a: NPV and IRR (100% equity)

Particulars / years	0	1	2	3	4	5
			(Rs. in lakhs)			
Profit after tax	-	3.89	1.71	2.46	2.44	2.43
Depreciation	-	0.35	0.35	0.35	0.35	0.35
Cash outflow	2.17	-	-	-	-	-
Net cash flow	-2.17	4.24	2.06	2.82	2.79	2.79
Discount rate % @ WACC	9.25	9.25	9.25	9.25	9.25	9.25
Discount factor	1.00	0.92	0.84	0.77	0.70	0.64
Present value	-2.17	3.88	1.73	2.16	1.96	1.79
Net present value	**9.35**					
Simple IRR considering regular cash flow	**160.95%**					

Table 4.2.3b: NPV and IRR (D/E- 70:30)

Particulars / years	0	1	2	3	4	5
			(Rs. in lakhs)			
Profit after tax	-	3.80	1.66	2.38	2.38	2.39
Depreciation	-	0.36	0.36	0.36	0.36	0.36
Cash outflow	2.25	-	-	-	-	-
Net cash flow	-2.25	4.16	2.02	2.74	2.74	2.76
Discount rate % @ WACC	10.09	10.09	10.09	10.09	10.09	10.09
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62
Present value	-2.25	3.78	1.67	2.06	1.87	1.70
Net present value	**8.82**					
Simple IRR considering regular cash flow	**150.95%**					

Table 4.2.3c: NPV and IRR (D/E- 50:50)

Particulars / years	0	1	2	3	4	5
			(Rs. in lakhs)			
Profit after tax	-	3.82	1.67	2.40	2.39	2.40
Depreciation	-	0.36	0.36	0.36	0.36	0.36
Cash outflow	2.23	-	-	-	-	-
Net cash flow	-2.23	4.18	2.04	2.76	2.76	2.76
Discount rate % @ WACC	9.86	9.86	9.86	9.86	9.86	9.86
Discount factor	1.00	0.91	0.83	0.75	0.69	0.62
Present value	-2.23	3.81	1.69	2.08	1.89	1.73
Net present value	**8.97**					
Simple IRR considering regular cash flow	**153.73%**					

4.3 Marketing & selling arrangement

The marketing and selling arrangements of the unit are given in table 4.3.

Table 4.3: Marketing & selling arrangements

Items	Remarks
Main Markets (locations)	Pan India
Locational advantages	-
Any USP or specific market strength	-
Whether product has multiple applications	NA
Distribution channels (e.g. direct sales, retail network, distribution network)	Direct sales
Marketing team details, if any.	NA

4.4 Risk analysis and mitigation

The risk analysis and mitigation for the proposed options are given in table 4.4.

Table 4.4: Risk analysis and mitigation

Type of risk	Description	Mitigation
Technology	The equipment/technology provided by the supplier may not be of high quality, which may result in underperformance.	The equipment/technology should be procured from standard/reputed vendors only.
Market /Product	Demand of the product manufactured by the unit may change resulting in lower capacity utilization.	Regular vigilance/tab on the market scenario by the SME will help in better understanding of new substitute product. The unit may modify the product line based on the emerging market trend.
Policy/ Regulatory	Changes in government regulation/policy related to pollution and taxes & duties can affect the viability of the unit.	Local industrial association may play a role in discussing these issues with the relevant governmental bodies on a regular basis, so that any concerns of the unit are brought to their notice.

4.5 Sensitivity analysis

A sensitivity analysis for various scenarios which may affect the return on investment is given in table 4.5.

Table 4.5: Sensitivity analysis

S. No.	Scenario	D/E ratio	Payback period (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
1	10% increase in estimated savings	100% equity	5.60	10.47	179.09	-	38.30
		70:30	5.80	9.92	168.37	9.24	43.84
		50:50	5.70	10.08	171.35	12.90	42.07
2	10% reduction in estimated savings	100% equity	6.80	8.23	142.98	-	36.32
		70:30	7.10	7.73	133.67	7.61	42.70
		50:50	7.00	7.87	136.26	10.62	40.62

S. No.	Scenario	D/E ratio	Payback period (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
3	10% rise in interest rates	70:30	6.40	8.61	149.97	8.24	43.28
		50:50	6.30	8.81	153.02	11.49	41.38
4	10% reduction in interest rates	70:30	6.30	9.05	151.92	8.63	43.38
		50:50	6.30	9.13	154.44	12.04	41.45

5.0 Conclusions & recommendations

The DPR prepared for the retrofitting VFD on the existing under screw compressed air system based on the performance assessment study conducted at unit and the acceptance of the unit management. The brief of selected energy conservation measure is given below.

5.1 List of energy conservation measures

The brief summary of the energy conservation measures are given in table 5.1.

Table 5.1: Summary of the energy conservation measures

Technology	Annual energy saving Electricity (kWh)	Investment (Rs lakh)	Monetary savings (Rs lakh/ year)	Simple payback period (Years)	Emission reduction (tonnes of CO_2)
Retrofit the VFD on under loaded air compressor	68457	2.17	4.35	0.5	56

The measure has an estimated investment of 2.17 lakh rupees and can yield a savings of 4.35 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 56 tonnes of CO_2. The financial indicators provided above in the table shows the project is financially viable and technically feasible.

5.2 Summary of the project

The summary of the project is given in table 5.2.

Table 5.2: Summary of the project

S. No.	Particulars	Unit	100% equity	D/E- 70:30	D/E- 50:50
1	Cost of Project	Rs. In Lakh	2.17	2.25	2.23
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	160.95	150.95	153.73
4	NPV	Rs. In Lakh	9.35	8.82	8.97
5	DSCR	-	-	8.43	11.76

5.3 Recommendations

The financial indicators provided above show the project is financially viable and technically feasible. It is recommended that the implementation of the identified the energy conservation measures may be undertaken by the unit.

6.0 Financing schemes for EE investments for MSME sector

Government of India has many schemes to provide concessional finance for EE technologies among MSMEs. Some major government schemes are summarised in table 6.1.

Table 6.1: Major government schemes

Name of the scheme	Brief Description and key benefits
ZED assessment and certification	Assessment process, fee and subsidy are as follows: Online (e-Platform) self-assessment: Nil fee Desk Top assessment : Rs 10,000 per SME Complete assessment : Rs 80,000 ZED rating per SME; Rs 40,000 for additional ZED defence rating; Rs 40,000 for re-rating The rating costs will include cost of Rs 10,000/- as certification cost by QCI. Subsidy for Micro, Small and Medium Enterprises are 80%, 60% and 50% respectively.
Credit Linked Capital Subsidy Scheme (CLCSS) (2000-ongoing)	15% capital subsidy of cost of eligible plant and machinery / equipment for adoption of proven technologies for approved products / sub-sectors for MSE units subject to ceiling of INR 15 lakhs
Credit Guarantee Fund Scheme for Micro and small Enterprises (in partnership with SIDBI) (2000-ongoing)	This scheme was launched by MoMSME and SIDBI to alleviate the problem of collateral security and enable micro and small scale units to easily adopt new technologies. Under the scheme, collateral free loans up to Rs 1 crore can be provided to micro and small scale units. Additionally, in the event of a failure of the SME unit which availed collateral free credit facilities to discharge its liabilities to the lender, the Guarantee Trust would guarantee the loss incurred by the lender up to 75 / 80/ 85 per cent of the credit facility.
Technology and Quality Up gradation Support to MSMEs (TEQUP) (2010-ongoing)	The benefits available to SMEs under TEQUP include—technical assistance for energy audits, preparation of DPRs and significant capital subsidy on technologies yielding an energy savings of over 15%. The scheme offers a subsidy of 25% of the project cost, subject to a maximum of Rs. 10 lakhs. TEQUP, a scheme under NMCP, focuses on the two important issues in enhancing competitiveness of the SME sector, through EE and Product Quality Certification.
Technology Upgradation Fund Scheme (TUFS) (1999-ongoing)	Interest subsidy and /or capital subsidy for Textile and Jute Industry only. 1. To facilitate Technology Up gradation of Small Scale (SSE) units in the textile and jute industries. Key features being: • Promoter's margin -15%; • Subsidy – 15% available on investment in TUF compatible machinery subject to ceiling of Rs 45 lakh; • Loan amount – 70% of the cost of the machinery by way of Term Loan

Name of the scheme	Brief Description and key benefits
	• Interest rate: Reimbursement of 5% on the interest charged by the lending agency on a project of technology upgradation in conformity with the Scheme • Cover under Credit Guarantee Fund Scheme for Micro and Small Enterprises (CGMSE) available 2. To enable technology upgradation in micro and small power looms to improve their productivity, quality of products and/ or environmental conditions • 20% margin subsidy on investment in TUF compatible specified machinery subject to a ceiling of Rs 60 lakhs or Rs 1crore (whichever is applicable) on subsidy amount to each unit – released directly to the machinery manufacturer.
Tax incentives	• Accelerated depreciation is provided to the customers / users of the energy saving or renewable energy devises under the direct tax laws. • Under indirect taxes, specific concessional rates of duty are only available to CFLs and not to all energy efficient products • A further waiver of import tariffs and taxes for EE technology imports are dealt on a case to case basis, meaning higher costs for those imported technologies that are not available in the domestic markets at present.

Two financing schemes have been created by Bureau of Energy Efficiency (BEE) under The National Mission for Enhanced Energy Efficiency (NMEEE) for financing of energy efficiency projects - Venture Capital for Energy Efficiency (VCFEE) and Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE). These funds seek to provide appropriate fiscal instruments to supplement the efforts of the government for creation of energy efficiency market. Highlights of these two schemes are provided in the table 6.2.

Table 6.2: BEE's VCFEE and PRGFEE scheme

Venture Capital for Energy Efficiency (VCFEE)	• This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase. • A single investment by the fund shall not exceed Rs 2 crore • Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or Rs 2 crore, whichever is less
Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)	• A PRGF is a risk sharing mechanism lowering the risk to the lender by substituting part of the risk of the borrower by granting guarantees ensuring repayment of part of the loan upon a default event. • Guarantees a maximum 50% of the loan (only principal). In case of default, the fund will: o Cover the first loss subject to maximum of 10% of the total guaranteed amount o Cover the remaining default (outstanding principal) amount on

Venture Capital for Energy Efficiency (VCFEE)	• This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase. • A single investment by the fund shall not exceed Rs 2 crore • Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or Rs 2 crore, whichever is less
	partial basis upto the maximum guaranteed amount • PFI shall take guarantee from the PRGFEE before disbursement of loan to the borrower. • The Guarantee will not exceed Rs 300 lakh per project or 50% of loan amount, whichever is less. • Maximum tenure of the guarantee will be 5 years from the date of issue of the guarantee

Indian Renewable Energy Development Agency (IREDA), a non-banking financial institution established by the government also extends financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation. The detailed financing guidelines for energy efficiency projects are provided in table 6.3.

Table 6.3: IREDA's financing guidelines

Eligible companies who can apply	Private Sector Companies/ firms, Central Public Sector Undertaking (CPSU), State Utilities/ Discoms/ Transcos/ Gencos/ Corporations, Joint Sector Companies which are not loss making.
Minimum loan amount	• Rs. 50 lakh
Type of projects considered for term loans	• Replacement / retrofit of selected equipment with energy efficient equipment • Modification of entire manufacturing processing • Recovery of waste heat for power generation
Incentive available	• Rebate in central excise duty • Rebate in interest rate on term loan • Rebate in prompt payment of loan instalment
Interest rate	• 10.60% to 11.90% depending upon the grading of the applicant with prompt payment rebate of 15 bps if payment is made on / before due dates • Interest rates are floating and would be reset on commissioning of the project or two years from the date of first disbursement. Thereafter, the rates will be reset after every two years. • Rebate of 0.5% in interest rates are available for projects set up in North Eastern States, Sikkim, J&K, Islands, Estuaries. Rebates of 0.5% in interest rates are also available for projects being set up by SC/ST, Women, Ex Servicemen and Handicapped categories involving project cost of upto Rs. 75.00 lakh.
Loan	Upto 70% of the total project cost. Promoter's contribution should be Minimum 30% of the total project cost
Maximum debt	3:1

equity ratio	The project cash flow should have a minimum average Debt Service Coverage Ratio of 1.3
Maximum repayment period	12 years with moratorium of maximum 12 months
Procurement procedures	The borrower is required to follow the established market practices for procurement and shall demonstrate that the quality goods and services are being purchased at reasonable and competitive prices. Wherever the loan is sanctioned against international lines of credit such as the World Bank, Asian Development Bank, KfW, etc., the relevant procedures will have to be followed and requisite documents will have to be submitted by the borrower

Small Industries Development Bank of India (SIDBI) has several schemes and focused lines of credit for providing financial assistance for energy efficiency and cleaner production projects for SMEs. Highlights of some of the major financial assistance schemes/projects managed by SIDBI are given in table 6.4.

Table 6.4: Major EE financing schemes/initiatives of SIDBI

End to End Energy Efficiency (4E) Program	Support for technical /advisory services such as: • Detailed Energy Audit • Support for implementation • Measurement & Verification Financing terms: • Terms loans upto 90% • Interest rate upto 3% below normal lending rate.
TIFAC-SIDBI Revolving Fund for Technology Innovation (Srijan Scheme)	To support SMEs for up-scaling and commercialization of innovative technology based project at flexible terms and interest rate. Preference accorded to sustainable technologies / products. Soft term loan with an interest of not more than 5%.
Partial Risk Sharing Facility for Energy Efficiency (PRSF) Project (supported by World Bank)	Sectors covered: • Large industries (excluding thermal power plants) • SMEs • Municipalities (including street lighting) • Buildings Coverage: • The minimum loan amount Rs 10 lakh and maximum loan amount of Rs 15 crore per project. • The extent of guarantee is 75% of the loan amount
JICA-SIDBI Financing Scheme	• The loan is used to provide SMEs with funds necessary to invest in energy-saving equipment (and some medical equipment) in the form of two-step loans through SIDBI or three-step loans through intermediary financial institutions.

	• Project uses an Energy Saving Equipment List approach • Equipment/machinery with energy saving potential less than 10% is not eligible. • Interest rate: As per credit rating and 1% below the normal lending rate • Separate technical assistance component which is used for wetting of loan applications, holding seminars to raise awareness of energy saving among SMEs and to improve the ability of financial institutions to screen loan applications for energy-saving efforts
KfW-SIDBI Financing Scheme	Coverage a) SMEs for energy efficiency projects b) SMEs and clusters for cleaner production and emission reduction measures, waste management and Common Effluent Treatment Plant (CETP) facilities Interest rate As per credit rating and 1% below the normal lending rate Eligible criteria 3 t CO_2 emission reduction per year per lakh invested List of eligible equipment/technology and potential suppliers developed for guidance

State Bank of India (SBI) has been provided a green line of credit by Japan Bank for International Cooperation (JBIC) for financing of energy efficiency investments. Highlights of the line of credit are given in table 6.5.

Table 6.5: JBIC-SBI Green Line

Key Features

- Amount : USD 90 million
- Repayment Schedule: First repayment on May 30, 2017 and final repayment date May 30, 2025 (equal instalment)

Eligibility Criteria

- Projects contributing to preservation of global environment, i.e. significant reduction of GHG emissions
- Acceptance of JBIC-MRV ('J-MRV") by the project proponent in terms of the numerical effect of the environment preservation. To ensure effective GHG reduction emissions in Green financed projects, JBIC reviews such effects through simple and practical Measurement Reporting Verification (MRV) process both in (a) prior estimation and (b) ex-post monitoring.
- Procurement in line with the "Guidelines for Procurement under Untied Loans by Japan Bank for International Cooperation"

Canara bank has a dedicated scheme for financing EE investment among SME sector as mentioned in table 6.6.

Table 6.6: Canara bank scheme of EE SME loans

Purpose	**For acquiring/adopting energy conservation/savings equipment/ measures by SMEs**
Eligibility	Units under Small and Medium Enterprises Cost of energy for the unit should constitute not less than 20% of the total cost of production Unit should possess energy audit report issued by an approved energy Consultant/Auditor. Borrowal a/cs-ASCC code S1 or S2 during previous review. Current account holders having dealings exclusively with us satisfactorily for a period of last one year
Maximum loan	Maximum Rs 100 lakhs in the form of term loan
Security	Prime: Assets created out of loan Collateral: Upto Rs.5 lakhs – NIL Above Rs.5 lakhs, as determined by the bank
Repayment	Maximum 5-7 years including moratorium of 6 months
Guarantee cover	Cover available under CGMSE of CGTMSE available for eligible loans
Margin	10% of the project cost
Rate of interest	1% less than the applicable rate
Upfront fee	1% of the loan
Insurance cover	Assets acquired and charged as security to Bank to be insured
Special offer, if any	**Grants :** Bank provides 25% of the cost of Energy Audit / Consultancy charges with a maximum of Rs 25000/- to the first 100 units on a first come first served basis which is in addition to the grant of Rs 25000/- being provided by IREDA(First 100 units)

Among the private sector banks in India, Yes Bank is also active in financing of renewable energy and energy efficiency projects. The bank has an MOU with SIDBI for providing funding for EE through PRSF.

Most commercial banks charge interest rate between from 11% to 13% from MSMEs depending upon general criteria such as credit ratings, references, past lending record, balance sheet for last 3 years and so on. Interest rebate is offered for a few customers whose collateral value is around 125% of the loan amount. Further 0.5% concession in interest rate was offered to women entrepreneurs

Annexures

Annexure 1: Budgetary offers / quotations

Quotation – 1: ELGI Equipments Ltd.

RETROFIT VFD OFFER

by ELGi

Elgi Equipments Ltd, Elgi Industrial Complex, Singanallur, Coimbatore – 641 005, India.
Tel.:+91-422-2589555 Fax: +91-422-2576849 Email: enquiry@elgi.com Visit us at:www.elgi.com

Think Long Run

Technical Specifications

VARIABLE SPEED DRIVE - MODEL

ELGI Variable Speed Drive **VSD_Model** is designed specifically for regulating the speed and thereby the capacity of the screw air compressors so that the compressor delivers the exact volume of air demand. This is achieved by constantly monitoring the system pressure and then regulating the frequency / speed of the motor by using a PID control.

Product Type	:	Variable Speed Drive
Application	:	Air Compressor
Line Voltage	:	3 X 380-500V ± 10% AC
Supply Frequency	:	48-62% ± 1%
Enclosure	:	IP 54
Overload Torque	:	150-160%
True power factor	:	0.90 at rated load
Displacement power factor	:	> 0.98
Control Type	:	Built in PIC

Think Long Run

Commercial Offer

Sl No	Description	Model	ITEM CODE	HSN CODE	Qty	Unit Price
1	Elgi Retrofit Variable Speed Drive	ELVD030R	X0181170	85389000	01	1,80,000/-

Terms of Business

1. Price : FOR Ex Works Coimbatore
2. P&F Charges : 3% Extra
3. GST : 18% on VFD and commissioning charges
5. Payment : 80% Advance and balance against Dispatch Documents
6. Delivery : 4 to 6 Weeks
7. Validity : 30 days from the date of this offer
8. Warranty : 18 months from the date of dispatch or 12months from the date of commissioning whichever occurs earlier
9. Commissioning charges : Rs.10,000/- EXTRA
10. Scope : FD Panel & Pressure transmitter is ELGI"S scope.
    All power cable between Motor, VFD is in customers Scope.

ELGI EQUIPMENTS LIMITED

Gopal Trivedi | Sr. Engineer - After Sales (Spares)
ELGI | Ahmedabad | Cell No : +91 74900 24975

Quotation – 2: A Square Solutions

A SQUARE SOLUTIONS
Solutions for all kinds of Industrial Electronics

Lenze HITACHI

Offer Price / Quotation

Devashray Industrial Estate, Block No. : C, Shed No. : 5/A, Beside Baroda Express Highway,
Phase-IV, Vatva GIDC, Ahmedabad-382445. M. 9924233227,9662216459/69. www.asquaresolutions.co.in
Email:- info@asquaresolutions.co.in

The Energy & Resources Institute		QU. NO DATE INQ REF DATE	: E-Mail
		ADD REF	DD045
Kind attn:-	Mr. Nilesh	E-mail : Nilesh.Shedge@teri.res.in	
Cell:-	+91-9579448627		

Sl. No.	Description	Qty	Rate	Total
	Hitachi Make AC Drive			
1	**Model : SJ700I - 750 HFEF2**	1	1,56,156	**1,56,156**
	Rating : 75 KW / 100 HP			
2	**Model : SJ700I - 1100 HFEF2**	1	2,37,952	**2,37,952**
	Rating : 110 KW / 150 HP			
3	**Model : SJ700D - 220 HFEF3**	1	67,504	**67,504**
	Rating : 22 KW / 30 HP			
4	**Model : SJ700I - 370 HFEF2**	2	1,02,102	**2,04,204**
	Rating : 37 KW / 50 HP			
5	**Model : SJ700I - 300 HFEF2**	2	83,283	**1,66,566**
	Rating : 30 KW / 40 HP			
6	**Model : SJ700D - 185 HFEF3**	1	63,017	**63,017**
	Rating : 18.5 KW / 25 HP			
7	**Model : WJ200 - 055 HFC**	2	29,040	**58,080**
	Rating : 5.5 KW / 7.5 HP			
	Total	10		**9,53,479.00**

Terms & Conditions :

		Our Bank Details
Excise :	Extra As Applicable	Bank : Kotak Mahindra Bank
P&F:	Extra @ 2%	Branch : Navrangpura, Ahmedabad
VAT/CST:	Extra @ 2% against C form	A/c. No.: 3711175883
Payment :	100% Advance Against PI	A/c. Type : Current Account
Freight :	Extra As Applicable	MICR : 380485003
		IFSC : KKBK0000812

Above Rate is Net Of Discount.

FOR A SQUARE SOLUTIONS

AUTHORISED SIGNATORY

Vashi Electricals Pvt. Ltd.

An ISO 9001 : 2008 Company

A-6, Plot No. 74, Shree Ganesh Complex, Behind Gupta Compound, Dapode Road, Mankoli Naka, Gundavali Village, Taluka Bhiwandi - 421305. Dist. Thane
Tel.: 02522-661600, Fax : 02522-661699 Email : sales@vashielectricals.com, Website : www.vashielectricals.com

Bonfiglioli

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Business Terms & Conditions :

1. Discount _____ @ on above pricelist.
2. Excise duty exclusive. First dealer invoice to enable you to claim Cenvat credit will be issued on receipt of special request.
3. Taxes as applicable.
4. Goods are supplied subject to Mumbai Jurisdiction only.
5. This price list supersedes all our previous prices and is subject to alteration without any notice.
6. Municipal Levis Octroi extra if applicable.

PAYMENT TRANSFER FACILITY

ICICI Bank Roaming A/c No.: 015105001078	State Bank of India A/c. No.: 33644082057
ICICI IFSC Code for RTGS/NEFT : ICIC0000151	State Bank of India IFSC Code : SBIN0014177
Branch : Vashi – Navi Mumbai.	Branch : Thane (W)

Vashi Electricals Pvt. Ltd.

SYN' Series Single Phase 200-240VAC +/-10% Variable Frequency Drives

	KW	HP	Rated Current (in AMPS)	List Price
SYN 103 220 01AF	0.2	0.25	1.4	15800
SYN 103 220 03AF	0.4	0.5	2.3	15800
SYN 103 220 05AF	0.75	1	4.2	15800

S2 U' Series Single Phase 200-240VAC+/-10% Variable Frequency Drives

	KW	HP	Rated Current (in AMPS)	List Price
S2U-230-S02F	0.2	0.25	1.8	14118
S2U-230-S03F	0.4	0.5	2.6	14118
S2U-230-S07F	0.75	1	4.3	14889
S2U-230-S11F	1.5	2	7.5	23445
S2U-230-S13F	2.2	3	10.5	26954

AgilE' Series Three Phase 380-480VAC +/-10% Variable Frequency Drives

	KW	HP	Rated Current (in AMPS)	List Price
AGL402 02 1 FA	0.25	0.33	0.8	23531
AGL402 03 1 FA	0.37	0.5	1.2	23531
AGL402 05 1 FA	0.55	0.75	1.5	25242
AGL402 07 1 FA	0.7	1	2.1	25242
AGL402 09 1 FA	1.1	1.5	3	27810
AGL402 11 1 FA	1.5	2	4	29949
AGL402 13 1 FA	2.2	3	5.5	34227
AGL402 15 2 FA	3	4	7.5	43640
AGL402 18 2 FA	4	5.4	9.5	43640
AGL402 19 3 FA	5.5	7.5	13	62465
AGL402 21 3 FA	7.5	10	17	66742
AGL402 22 3 FA	9.2	12.5	20	77010
AGL402 23 3 FA	11	15	30	77010

Active' Series Three Phase 380-480VAC +/-10% Variable Frequency Drives

Model	KW	HP	Rated Current (in AMPS, with keypad KP500)	List Price
ACT 401 05FA	0.55	0.75	1.8	37546
ACT 401 07FA	0.75	1	2.4	42586
ACT 401 09FA	1.1	1.5	3.2	42586
ACT 401 11FA	1.5	2	3.8	42586
ACT 401 12FA	1.85	2.5	4.2	47172
ACT 401 13FA	2.2	3	5.8	47172
ACT 401 15FA	3	4	7.8	56567
ACT 401 18FA	4	5	9	56567
ACT 401 19A	5.5	7.5	14	67103
ACT 401 21A	7.5	10	18	71915
ACT 401 22A	9.2	12.5	22	81812
ACT 401 23A	11	15	25	98157
ACT 401 25A	15	20	32	111958
ACT 401 27A	18.5	25	40	154408
ACT 401 29A	22	30	45	188776
ACT 401 31A	30	40	60	216290
ACT 401 33A	37	50	75	273222
ACT 401 35A	45	60	90	304094
ACT 401 37A	55	75	110	313538
ACT 401 39A	65	90	125	329156
ACT 401 43A	75	100	150	458457
ACT 401 45A	90	120	180	527466
ACT 401 47A	110	150	210	560155
ACT 401 49A	132	175	250	632796

Vashi Electricals Pvt. Ltd.

An ISO 9001 : 2008 Company

A-6, Plot No. 74, Shree Ganesh Complex, Behind Gupta Compound, Dapode Road, Mankoli Naka, Gundavali Village, Taluka Bhiwandi - 421305. Dist. Thane
Tel.: 02522-661600, Fax : 02522-661669 Email : sales@vashielectricals.com, Website : www.vashielectricals.com

SALES TEAM

PRODUCT MANAGER	Areas	Contact No.
YATIN CHAVAN	MUMBAI - WESTERN	9225932811
MANISH SHAH	MUMBAI - CENTRAL	7506440735
ANKIT AGARWAL	KOLKATA	8298084888
SUDARSHAN	BANGLORE	9880823125
MANISH K.	MADHYA PRADESH	9300020088
MANISH B.	GURGAON	9582632801

BUSINESS MANAGER	Areas	Contact No.
UMESH AGGRAWAL	CHANDIGARH	9582632785
RITESH DHOLAKIA	NASIK	9225932804
HARESH PATIL	BARODA	7567266999
AMAR PATIL	PUNE	9225932801
GIRISH DANDEKAR	NAGPUR	9225932870
ANURAG SINGH (ASM)	HYDERABAD	8886050001
SAMEER PATEL	AHMEDABAD	9825033186

Annexure 2: Instruments used

Instruments	Model/ Make	Application	Accuracy
Power analysers	Fluke: 435, Krykard ALM 10,	Electrical Parameters Harmonics analysis, power logging	± 0.5%
Infrared thermometer	Testo: 845, Comark: KM848	Surface Temperature	±0.75% of mv
Anemometer	Testo: 425	Air Velocity	±(0.03 m/s +5% of mv)