

Detailed Project Report On Optimization of compressed air system

AKP Ferrocast Private Limited
Belgaum (Karnataka)

Prepared for

Bureau of Energy Efficiency
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List of abbreviations

BEE	Bureau of Energy Efficiency
CFM	Cubic feet per minute
CO ₂	Carbon Dioxide
D/E	Debt /Equity
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
EE	Energy Efficient
FIs	Financial Institutions
FTL	Fluorescent Tube Light
FAD	Free Air Delivery
GEF	Global Environmental Facility
HESCOM	Hubli Electricity Supply Company Limited
HSD	High Speed Diesel
IDC	Interest Defer Credit
IGDPR	Investment Grade Detailed Project Report
IRR	Internal Rate of Return
kV	Kilo vault
kVA	kilovolt-ampere
kW	Kilo Watt
kWh	Kilo Watt Hour
LDO	Light Diesel Oil
LSPs	Local Service Providers
MSME	Micro, Small and Medium Enterprises
NPV	Net Present Value
O&M	Operation and Maintenance
RE	Renewable Energy
ROI	Return On Investment
Rs	Rupees
TERI	The Energy and Resources Institute
Toe	Tonnes of oil equivalent
UNIDO	United Nations Industrial Development Organization
USP	Unique Selling Proposition
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 AKP Ferrocast (P) Ltd.
Constitution	Private Limited
MSME Classification	Small
No. of years in operation	10
Address: Registered Office:	689, Udyambag, Belgaum, Karnataka-590 008
Industry-sector	Ductile & Grey Iron Castings
Products manufactured	Construction & Mining, Valves, Separation Technology
Name(s) of the promoters/ directors	Mr. Parag Bhandare Mr. Gautam Bhandare

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 719.3 toe which is equivalent to 607.8 lakh rupees. The total CO₂ emission during this period is estimated to be 5,613 tonnes. Electricity and HSD were considered for CO₂ 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 (Rs lakh) ¹	Monetary savings (Rs lakh/ year)	Simple payback period (Years)	Emission reduction (tonnes of CO ₂)
Optimization of compressed air system	2,13,732	15.76	16.3	1.0	175.3

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 CO₂ 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	15.76	15.76	15.76
2	D/E Ratio	-	-	70:30	50:50
3	Project IRR	%	75.1%	71.0%	72.2%
4	NPV	Rs. In Lakh	28.5	25.9	26.6
5	DSCR	-	-	2.1	0.9

¹ Investment including the (i) Distribution network pipeline- Rs. 10.03 lakh, (ii) VFD – Rs. 4.58 lakh and (iii) Installation, Taxes and other misc. cost – Rs. 1.15 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 AKP Ferrocast Private Limited	
2	Constitution	Private Limited	
3	MSME Registration No/UAN	-	
4	PCB consent No.	-	
5	Date of incorporation / commencement of business	2008	
6	Name of the Contact Person	Mr Balasubramaniam	
7	Mobile / Ph. No	+91-9480808968	
8	Email	parag@akpferrocast.com	
9	Address: Registered Office	689, Udyambag, Belgaum, Karnataka-590 008	Owned
10	Factory	689, Udyambag, Belgaum, Karnataka-590 008	Owned
11	Industry / Sector	MSME/Manufacturing	
12	Products Manufactured	Construction & Mining, Valves, Separation Technology	
13	No of hours of operation/shift	12	
14	No of shifts/ day	03	
15	No of days/year	350	
16	Installed Capacity	11,400 per year	
17	Whether the unit is exporting its products (Yes/ No)	No	
18	Quality Certification, if any	NA	

2.0 Energy profile

2.1 Process flow diagram

The major steps of process are mould sand preparation, charge preparation followed by melting, pouring, knockout and finishing. The steps are explained below.

2.1.1 Sand preparation plant

The major equipment installed is sand siever, sand mixer and sand transport belts and elevators. Electricity is used to run all rotary machines in sand preparation plant. Fresh sand is mixed with adhesives in sand mixer then it is pressed in mould casing by pressing machine. In casing some amount of burnt sand is reused with fresh sand.

2.1.2 Core preparation and moulding

For core preparation, fresh sand is used. Cores are baked in LDO fired ovens. After hardening of core it is mounted in mould. In mould preparation fresh and burnt sand is pressed by machines which operate on pneumatic in mould casing. Upper and lower half of mould is assembled together and then it gets ready to pouring.

2.1.3 Melting

Melting of charge is done with help of induction furnace. Induction furnace runs on medium frequency three phase electrical supply. Once melt attained required temperature and metallurgy, the liquid melt is poured into the earlier prepared sand moulds using ladles.

2.1.4 Knockout and finishing

Mould is left to cool for certain time, then it follows to a vibrator with grated surface, it knocks-out the sand and the casting is send for finishing, which involves shot blasting and machining job.

The process flow diagram for major product and steel grade casting produced in the foundry is given in figure 2.1.4.

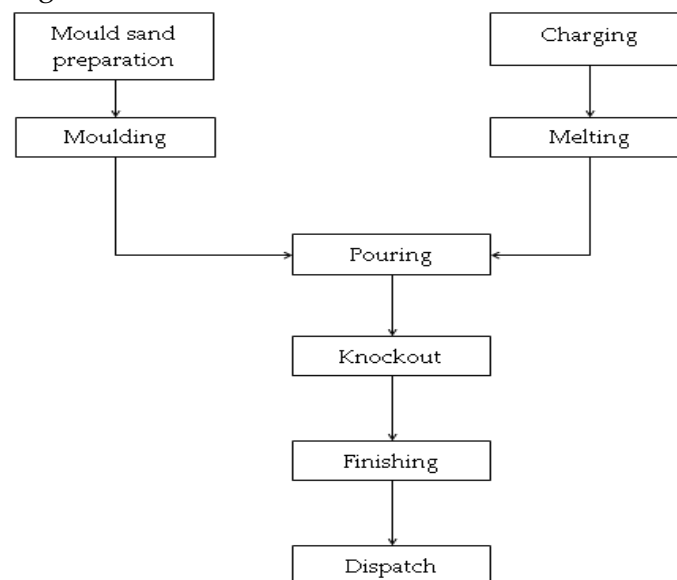


Figure 2.1.4: Process flow chart

2.2 Details of technology identified

The details of the existing technology installed in the unit are given in Table 2.2.

Table 2.2: Details of existing technology

Specification/Parameters	Compressor - 1	Compressor - 2	Compressor - 3	Compressor - 4
Type of Compressor	Screw	Screw	Screw	Screw
Make	Atlas Copco	Atlas Copco	Atlas Copco	Atlas Copco
Model No.	GA 45+	GA75+FF	GA45+	GA45AWP
Lubricating/non-lubricating	Lubricating	Lubricating	Lubricating	Lubricating
Rated Pressure, Bar	7.5	7.5	7.5	7.5
Rated motor capacity (kW)	45	75	45	45
Operation	Yes	Yes	Yes	Yes

2.3 Energy used and brief description of their usage pattern

The unit uses grid power supplied by Hubli Electricity Supply Company Limited (HESCOM) under tariff category HT-2(a). 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
2	HSD	Core making process

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

Particular	HT-2(a)
Demand charges	Rs. 200/kVA/month
Energy charges	Rs. 6.6/kWh (For first One lakh units) Rs. 6.8/kWh (for balance units)

If the Consumer is availing power at voltage higher than 13.2 KV, he will be entitled to a rebate as indicated below:

- 33/66 kV: 2 Paise/unit of energy consumed
- 110 kV: 3 Paise/unit of energy consumed
- 20 kV: 5 Paise/unit of energy consumed

2.5 Analysis of electricity consumption

Table 2.5: Electricity consumption profile

Month & Year	Total electricity consumption (kWh)	Sanctioned load/demand (kW)	Power factor	Recorded demand, kVA	Demand charges (Rs)	Energy charges (Rs)	Monthly bill (Rs)
Nov-17	911,700	3,000	0.99	2,813	562,600	6,298,081	7,213,221

Month & Year	Total electricity consumption (kWh)	Sanctioned load/demand (kW)	Power factor	Recorded demand, kVA	Demand charges (Rs)	Energy charges (Rs)	Monthly bill (Rs)
Dec-17	105,930	3,000	0.99	2,763	552,600	7,320,949	828,335
Jan-18	128,240	3,000	0.99	2,819	563,800	7,798,703	879,906
Feb-18	928,800	3,000	0.99	2,813	562,600	6,416,584	7,338,358
Average	518,668	3,000	0.99	2,802	560,400	6,958,579	4,064,955
Total	6,224,010	-	-	-	6,724,800	83,502,951	48,779,460

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	HSD (Liters)
Consumption unit/year	200,000
Calorific value per unit	9,202
Equivalent toe per year	184
Price (Rs per unit)	60
Total price per year	12,000,000

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

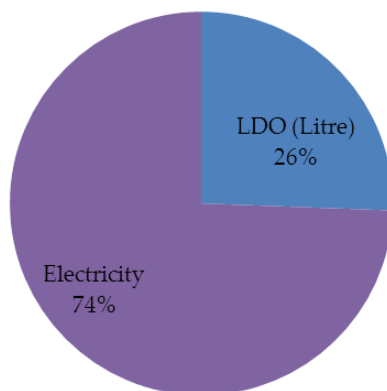


Figure 2.6: Percentage share of various fuel types in the unit

The total energy consumption of the unit during last 12 months was 719.3 toe which is equivalent to 607.8 lakh rupees. The total CO₂ emission during this period is estimated to be 5,613 tonnes. Electricity and HSD were considered for CO₂ 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 Optimization of compressed air system

3.1.1 Background

The compressed air demand of the plant is catered by four screw type compressed air system. The operating parameters were captured during the study with portable instruments.

Table 3.1.1: Design specifications of air compressors

Specification/Parameters	Compressor - 1	Compressor - 2	Compressor - 3	Compressor - 4
Type of Compressor	Screw	Screw	Screw	Screw
Make	Atlas Copco	Atlas Copco	Atlas Copco	Atlas Copco
Model No.	GA 45+	GA75+FF	GA45+	GA45AWP
Lubricating/non-lubricating	Lubricating	Lubricating	Lubricating	Lubricating
Rated Pressure, Bar	7.5	7.5	7.5	7.5
Rated motor capacity (kW)	45	75	45	45
Operation	Yes	Yes	Yes	Yes

3.1.2 Observations and analysis

The plant is operating compressor -1 and compressor - 3 in normal plant operation. The demand assessment of the fixed speed compressors was conducted during the normal plant operation. The results of the study is given in table 3.2.1a

Table 3.1.1: Demand assessment of compressed air system

Particulars	Unit	Comp-1	Comp-3	System level
Installed Capacity	M ³ /Min	8.94	14.82	23.76
Actual Free Air Delivery (FAD)	M ³ /Min	8.94	14.82	23.76
Percentage loading of the compressor	%	59.3	75.0	69.1
Actual Air supplied to the plant	M ³ /Min	5.30	11.12	16.42
Compressed Air Demand against the installed capacity	%	59.3	75.0	-
Estimated Air Leakages Cumulative	%		20.69	20.69
Estimated air leakages	M ³ /Min		4.92	4.92
Actual Air Utilization in the plant	M ³ /Min		11.51	11.51

The actual demand of the plant is estimated to be 69% of the rated capacity of combination of air compressor - 1 and compressor - 3. During the study free air delivery test and leakage test were conducted in order to evaluating the existing performance of the compressed air system. On evaluating with the existing recorded data and quantifying the under loaded time of the compressed air system it was observed that compressed air leaked from the system. The graphical representation of leakage test conducted in the plant is given in figure 3.1.2.

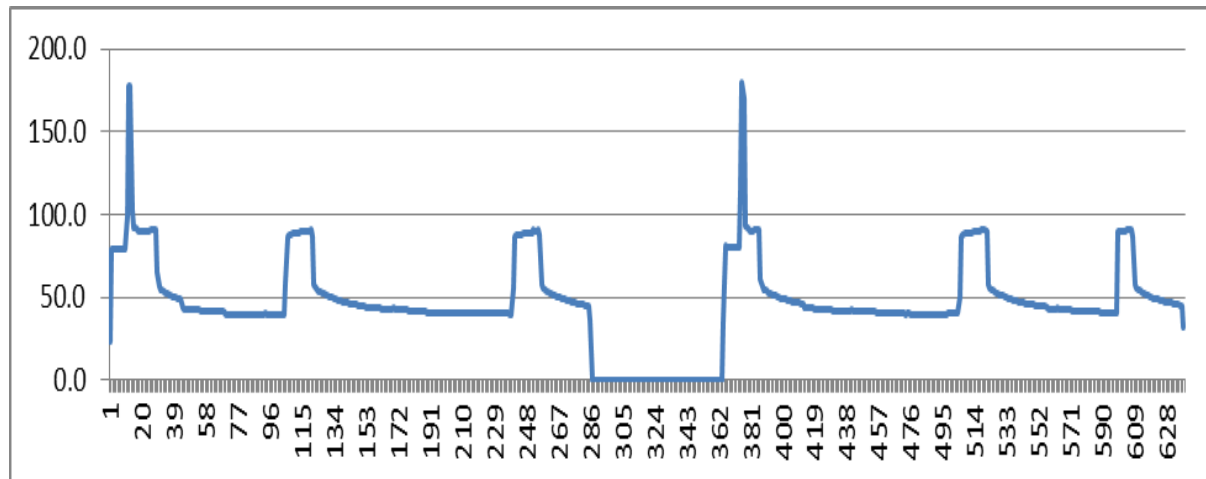


Figure 3.1.2: Leakage test

Leaks are significant source of energy wastage in a compressed air system. Compressed air leaks can also contribute to problems with system operations, including:

- Fluctuating system pressure, which can cause air tool and other air-operated equipment to function less efficiently, which possibly affects the production.
- Excess compressor capacity, resulting in necessary increase in cost.
- Decreased service life and increased maintenance of supply equipment (including the compressor package) due to unnecessary cycling and increased run time.

By installing seam less pipes with suitable application specific nozzles, taking the necessary maintenance practices and periodic inspection of distribution network, it would be possible to reduce the air leakages significantly. Although leaks can occur in any part of the system, the most common problem areas are: couplings, hoses, tubes, pipe joints, valves, thread sealants, and point of use devices. Leakage rates are a function of the supply pressure in an uncontrolled system and increase with higher system pressures. Leakage rates are also proportional to the square of the orifice diameter.

Table 3.2.3a: Leakage rates for different supply pressure

Leakage rates ^a (cfm) for different supply pressure and approximately equivalent orifice sizes						
Pressure (psig)	Orifice Diameter (inches)					
	1/64	1/32	1/16	1/8	1/4	3/8
70	0.3	1.2	4.8	19.2	76.7	173
80	0.33	1.3	5.4	21.4	85.7	193
90	0.37	1.5	5.9	23.8	94.8	213
100	0.41	1.6	6.5	26.0	104	234
125	0.49	2.0	7.9	31.6	126	284

For well-rounded orifices, multiply the values by 0.97, and for sharp-edged orifices, multiply the values by 0.61.

3.1.3 Recommendation

It is recommended to install restrict the existing leakage by replacing existing pipe line with seamless aluminium pipes and installed VFD in one of the 75 kW compressor which can cater the variable load of the system.. VFD operated screw compress has two functions; one it varies rpm of compressor based on pressure variation at the load or perform 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 annual energy saving by optimization of compressed air system includes the replacement of compressed air distribution network with seamless piping and installation of variable frequency drive to manage the demand is 213,732 kWh which is equivalent to about Rs. 16.28 lakhs. The investment requirement is Rs 15.75 lakh with a simple payback period of 1.0 years. The detailed calculations of the recommended energy conservation measures for DPR are provided in table 3.2

Table 3.2: Cost benefit analysis for recommended energy savings measures

Description	Unit	System level
Designed FAD	M ³ /Min	23.76
Operational FAD	M ³ /Min	23.76
Total on load operation	%	69.12
Total no load operation	%	40.7
Existing air requirement of the plant	M ³ /Min	16.42
% Leakages of the compressor	%	20.69
% Leakage acceptable limit in Industrial scenario	%	10.00
Estimated avoidable leakages	M ³ /Min	2.54
Actual Air Utilization in the plant (with leakages)	M ³ /Min	16.42
Actual Air Utilization in the plant (without leakages @ 10 % permissible)	M ³ /Min	13.88
Energy Conservation Opportunity		
Actual Air Requirement without arresting leakages	M ³ /Min	13.88
Specific power consumption	kW/m ³ /min	5.40
Present Annual power consumption (on load + no load)	kWh	7,53,508
Average load power	kW	128.4
No load power consumption (average)	kW	39.1
Proposed annual power consumption using VFD/VSD	kWh	5,39,776
Reduction in annual operating energy	kWh	2,13,732
Energy Cost	Rs/kWh	7.62
Annual Monetary savings	Rs/Year	16,28,637
Cost of implementation towards VFD retrofitting	Rs	4,58,457
Cost of implementation towards new distribution network	Rs	10,02,768
Other misc. charges	Rs	1,14,614

Description	Unit	System level
Total investment ²	Rs	15,75,839
Simple Payback Period	Years	1.0

3.3 Pre-training requirements

NA

3.4 Process down time for implementation

The estimated process down time required for implementation of recommended measure is estimated to be 2 days after commissioning and testing.

3.5 Environmental benefits

3.5.1 CO₂ reduction³

Implementation of the selected energy conservation measures in the unit may result in reduction in CO₂ emissions due to reduction in overall energy consumption. The estimated reduction in GHG emission by implementation of the recommended energy conservation measures is 175.3 tonne of CO₂ 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.

3.6 Social benefits

3.6.1 Improvement in working environment

Not envisaged

3.6.2 Increase in manpower skills

Not envisaged

3.6.3 Increase in wages/salary of workers

Not envisaged

3.6.4 Health & safety of plant & personnel

Not envisaged

² Quotation – 1 and 3 has been considered for estimation of investments

³ Source for emission factor: 2006 IPCC Guidelines for National Greenhouse Gas Inventories & for electricity: CO₂ 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	Dis-advantage
1	Pneumatic Piping system <ul style="list-style-type: none"> • 90Mm X 5.8 mtr Alu. Pipe • 90mm Connector • 90mm Equal Elbow • 90mm Equal Tee • 90mm X 3" Adaptor • 3" Ball Valve • 90mm Pipe Clip • 20mm X 4mtr Alu. Pipe • 20mm X 1/2" Adaptor • 20 MM ELBOW • 20mm Pipe Clip • 1/2" Ball Valve • 90mm X " Saddle • 3" Flange 	Avadhesh Agencies 13, Vijay Plot, Gondal Road, Opp Dharti Honda Show Room Rajkot - 360 002 Email: bmbarai@hotmail.com Cell : 98240 41849	<ul style="list-style-type: none"> • Excellent air quality meeting ISO 8573 class 1 • No rusting assurance • Experience in the sector 	-
2	Pneumatic Piping system for compressed air system	Global Airtech Systems 219, Akshar Arcade, Opp. Mamnagar Fire Station, Nr. Vijay Char Rasta, Navrangpura, Ahmedabad - 380 017	<ul style="list-style-type: none"> • Good business practices • Transparent in dealing • 24x7 customer assistance • After sale services • Customer centric approach • On time delivery 	
3.	VFD	Vashi Electricals Private Limited	<ul style="list-style-type: none"> • Experience in VFD retrofitting 	

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	15.76	4.73	7.88
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	11.0	7.9
5	Others	-	-	-

S. No.	Details	100% equity	D/E- 70:30	D/E- 50:50
Total		15.76	15.76	15.76

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			7200
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)	15.8	15.8	15.8
Investment without interest defer credit (IDC)	Rs. (in Lakh)	15.8	15.8	15.8
Implementation time	Weeks	6	3	3
Interest during the implementation phase	Rs. in lakhs	-	0.1	0.0
Total investment	Rs. in lakhs	15.8	15.8	15.8
Financing pattern				
Own funds	Rs. in lakhs	15.8	4.8	7.9
Loan funds (term loan)	Rs. in lakhs	-	11.0	7.9
Loan tenure	Years	-	5.0	5.0
Moratorium period (No EMI (interest and principal amount))	Months	-	3.0	3.0
Total repayment period	Months	-	60.0	60.0
Interest rate	%	-	10.5%	10.5%
Estimation of costs				
Operation & maintenance costs	%			5
Annual escalation rate of O&M	%			5
Estimation of revenue				
Reduction in energy cost	Rs. (in lakh)/ year			16.3
Total saving	(Rs Lakh/year)			16.3
Straight line depreciation	%			16.2
IT depreciation	%			80.0
Income tax	%			34.0
Period of cash flow analysis	Years			5

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)	15.8	15.8	15.8
Cash flow as annual saving (Rs. In lakh/year)	16.3	16.3	16.3
O&M Expenses for first year (Rs. In lakh/year)	0.8	0.8	0.8
Net Cash flow (Rs. In lakh/year)	15.5	15.5	15.5
SPP (months)	12.2	12.3	12.2
Considered (month)	12.2	12.3	12.2

4.2.3 NPV and IRR

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

Particulars / years	0	1	2	3	4	5
(Rs.in lakhs)						
Profit after tax	0	12.94	7.52	7.79	7.63	7.57
Depreciation	0	2.55	2.55	2.55	2.55	2.55
Cash outflow	15.76	0	0	0	0	0
Net cash flow	-15.76	15.50	10.08	10.35	10.18	10.13
Discount rate % @ WACC	9.3	9.3	9.3	9.3	9.3	9.3
Discount factor	1	0.915	0.838	0.767	0.702	0.643
Present value	-15.76	14.19	8.44	7.94	7.15	6.51
Net present value	28.46					
Simple IRR considering regular cash flow	75.14%					

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	0	12.37	7.08	7.27	7.25	7.36
Depreciation	0	2.57	2.57	2.57	2.57	2.57
Cash outflow	15.83	0	0	0	0	0
Net cash flow	-15.83	14.93	9.64	9.84	9.82	9.93
Discount rate % @ WACC	10.1	10.1	10.1	10.1	10.1	10.1
Discount factor	1	0.908	0.825	0.749	0.680	0.618
Present value	-15.83	13.56	7.95	7.37	6.68	6.13
Net present value	25.86					
Simple IRR considering regular cash flow	71.01%					

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

Particulars / years	0	1	2	3	4	5
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Particulars / years	0	1	2	3	4	5
	(Rs.in lakhs)					
Profit after tax	0	12.53	7.21	7.42	7.36	7.42
Depreciation	0	2.56	2.56	2.56	2.56	2.56
Cash outflow	15.81	0	0	0	0	0
Net cash flow	-15.81	15.10	9.77	9.98	9.92	9.99
Discount rate % @ WACC	9.9	9.9	9.9	9.9	9.9	9.9
Discount factor	1	0.910	0.828	0.754	0.686	0.625
Present value	-15.81	13.74	8.09	7.53	6.81	6.24
Net present value	26.60					
Simple IRR considering regular cash flow	72.18%					

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

Type of risk	Description	Mitigation
		basis, so that any concerns of the unit are brought to their notice.

4.4 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	2.2	11.6	48.9%	-	44.2%
		70:30:00	2.2	11.2	48.9%	2.1	47.0%
		50:50:00	2.2	11.3	48.9%	0.9	46.2%
2	10% reduction in estimated savings	100% equity	2.7	9.3	48.9%	-	43.3%
		70:30:00	2.7	9.0	48.9%	2.1	46.6%
		50:50:00	2.7	9.1	48.9%	0.9	45.6%
3	10% rise in interest rates	70:30:00	2.4	9.9	48.9%	2.1	46.8%
		50:50:00	2.4	10.1	48.9%	0.9	45.9%
4	10% reduction in interest rates	70:30:00	2.4	10.3	48.9%	2.1	46.8%
		50:50:00	2.4	10.4	48.9%	0.9	45.9%

5.0 Conclusions & recommendations

The DPR prepared for the optimization of compressed air system includes the replacement of compressed air distribution network with seamless piping and installation of variable frequency drive to manage the demand. 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)
Optimization of compressed air system	2,13,732	15.76	16.3	1.0	175.3

The measure has an estimated investment of 15.76 lakh rupees and can yield a savings of 16.3 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 175.3 tonnes of CO₂. 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	15.76	15.76	15.76
2	D/E Ratio	-	-	70:30	50:50
3	Project IRR	%	75.1%	71.0%	72.2%
4	NPV	Rs. In Lakh	28.5	25.9	26.6
5	DSCR	-	-	2.1	0.9

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	<p>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.</p>
Credit Linked Capital Subsidy Scheme (CLCSS) (2000-ongoing)	<p>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</p>
Credit Guarantee Fund Scheme for Micro and small Enterprises (in partnership with SIDBI) (2000-ongoing)	<p>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.</p>
Technology and Quality Up gradation Support to MSMEs (TEQUP) (2010-ongoing)	<p>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.</p>
Technology Upgradation Fund Scheme (TUF) (1999-ongoing)	<p>Interest subsidy and /or capital subsidy for Textile and Jute Industry only.</p> <ol style="list-style-type: none"> To facilitate Technology Up gradation of Small Scale (SSE) units in the textile and jute industries. Key features being: <ul style="list-style-type: none"> 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
	<ul style="list-style-type: none"> • 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 <p>2. To enable technology upgradation in micro and small power looms to improve their productivity, quality of products and/ or environmental conditions</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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)	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> ○ Cover the first loss subject to maximum of 10% of the total guaranteed amount ○ Cover the remaining default (outstanding principal) amount on

Venture Capital for Energy Efficiency (VCFEE)	<ul style="list-style-type: none"> 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
	<p>partial basis upto the maximum guaranteed amount</p> <ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Rs. 50 lakh
Type of projects considered for term loans	<ul style="list-style-type: none"> Replacement / retrofit of selected equipment with energy efficient equipment Modification of entire manufacturing processing Recovery of waste heat for power generation
Incentive available	<ul style="list-style-type: none"> Rebate in central excise duty Rebate in interest rate on term loan Rebate in prompt payment of loan instalment
Interest rate	<ul style="list-style-type: none"> 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	<p>Support for technical /advisory services such as:</p> <ul style="list-style-type: none"> • Detailed Energy Audit • Support for implementation • Measurement & Verification <p>Financing terms:</p> <ul style="list-style-type: none"> • Terms loans upto 90% • Interest rate upto 3% below normal lending rate.
TIFAC-SIDBI Revolving Fund for Technology Innovation (Srijan Scheme)	<p>To support SMEs for up-scaling and commercialization of innovative technology based project at flexible terms and interest rate.</p> <p>Preference accorded to sustainable technologies / products. Soft term loan with an interest of not more than 5%.</p>
Partial Risk Sharing Facility for Energy Efficiency (PRSF) Project (supported by World Bank)	<p>Sectors covered:</p> <ul style="list-style-type: none"> • Large industries (excluding thermal power plants) • SMEs • Municipalities (including street lighting) • Buildings <p>Coverage:</p> <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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.

	<ul style="list-style-type: none"> • 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	<p>Coverage</p> <ol style="list-style-type: none"> 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 <p>Interest rate</p> <p>As per credit rating and 1% below the normal lending rate</p> <p>Eligible criteria</p> <p>3 t CO₂ emission reduction per year per lakh invested</p> <p>List of eligible equipment/technology and potential suppliers developed for guidance</p>

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

<p><u>Key Features</u></p> <ul style="list-style-type: none"> • Amount : USD 90 million • Repayment Schedule: First repayment on May 30, 2017 and final repayment date May 30, 2025 (equal instalment) • <p><u>Eligibility Criteria</u></p> <ul style="list-style-type: none"> • 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 : Avadhesh Agencies

Avadhesh Agencies						
13, Vijay Plot, Gondal Road, Opp Dharti Honda Show Room RAJKOT - 360 002 Email: bmburai@hotmail.com Cell : 98240 41849						
TERI		QUOTATION				
		195				
		DATE- 19.5.2018				
Sno	D E S C R I P T I O N	HSN CODE	Qty.	Rate	DISC	Total
1	90Mm X 5.8 mtr Alu. Pipe	7609	20	13050	5%	247950
2	90mm Connector	7609	16	6930	5%	105336
3	90mm Equal Elbow	7609	16	9830	5%	149416
4	90mm Equal Tee	7609	4	14430	5%	54834
5	90mm X 3" Adaptor	7609	16	5040	5%	76608
6	3" Ball Valve	84812000	8	10395	5%	79002
7	90mm Pipe Clip	39174000	80	230	5%	17480
8	20mm X 4mtr Alu. Pipe	7609	13	515	5%	6360
13	20mm X 1/2" Adaptor	7609	26	650	5%	16055
14	20 MM ELBOW	7609	26	705	5%	17414
15	20mm Pipe Clip	39174000	40	115	5%	4370
17	1/2" Ball Valve	84812000	13	430	5%	5311
20	90mm X " Saddle	7609	13	2995	5%	36988
35	3" Flange		4	8600	5%	32680
		Total Material Value after Discount				849804
		Transportation				Extra
		Installation Charges @ Rs.225.00 per meter plus GST 18%				EXTRA
		GST 18%				152965
		Total Project cost including taxes				1,002,768.13
TERMS & CONDITIONS:						
1	Payment Terms:-For material -25% advance with PO and balance against proforma.					
	Payment Terms:-For installation -50% advance against proforma balance payment after work completion.					
2	Delivery Term :3-4weeks after confirmation of PO.					
4	Any extra material require will be charge extra as per mentioned terms and conditions					
5	After work completion any material left will be taken back.					



AVADHESH AGENCIES

Auto Parts Wholesellers • House of Pneumatics

E : bmbbarai@hotmail.com | T : 0281-246 1854, 248 2560

13 - Vijay Plot, Gondal Road, Rajkot - 360 002. | M.: 98240 94945



COMPARISON SHEET FOR MS & AL PIPING FOR COMPRESSED AIR			
SR. NO.	MS	GI	Alu Pipe
1	INITIAL COST	MINIMUM	20% Higher than MS
2	LIFE	10-15 years	10-15 years
3	Air quality	worst	Slightly better than MS in initial few years but becomes almost same after 2-3 years of operation
4	Leakage	Most prone to leakages within a few years of operation, in general 5-7% leakges start within five years of operation	Most prone to leakages within a few years of operation, in general 5-7% leakges start within five years of operation
5	Pressure drop	maximum, due to rusting and rough surface	maximum, due to rusting and rough surface
6	Down Stream Equipment	Because of high corrossion rate , the air quality is not good resulting in frequent breakdown of pneumatic cylinders, valves and othe accessories	Because of high corrossion rate , the air quality is not good resulting in frequent breakdown of pneumatic cylinders, valves and othe accessories
7	Installation	Needs long time and lots of labour is involved almost 40-50%	Needs long time and lots of labour is involved almost 40-50%
8	Fire Hazard	maximum, during welding and repair works	Not in case of thread joints but in case of welded joints fire hazard is as good as in case of MS
9	Maintenace cost of piping system	Needs leakage test every six months and painting atleast once a year	Needs leakage test every six months and painting atleast once a year
10	Modularity	Non modular, normally not usable after you shift your plant or change location of	Non modular, normally not usable after you shift your plant or change location of equipments



Quotation – 2 : Global Airtech systems



GLOBAL AIRTECH SYSTEMS

Office:- 219, Akshar Arcade, Opp.Memnagar Fire Station, Nr.Vijay Cross Road, Ahmedabad-380014.
 Tel:- 079-26563142, Email:- info@globalairtechsystems.com; Web : www.globalairtechsystems.com
 Mobile- 9824035330.

To,

M/s. Oswal Pottery Works
 Navagam Road
 Opp. Sunrise Pottery
 Amarapar
 Thangadh

Date: 19-03-2018
 Ref No: QA/2018/15

Kind Attn : Mr Kiritbhai

Ref. - Reference to Personal discussion with our Mr Nisarg Patadiya at your plant

Sub. : Offer for “Atlas Copco” Make “AIRNET” Pipes

Sr No.	HSN Code	Part No.	Description	SIZE mm	Qty.	Rate/Each	Total
1	76082000	2811400005	Pipe	40 MM	25	5,424.00	135600.00
2	39174000	2811402220	Pipe Clip	40 MM	50	166.00	8300.00
3	39174000	2811400380	Elbow	40 MM	10	2,403.00	24030.00
4	39174000	2811400580	Equal Tee	40 MM	2	3,787.00	7574.00
5	76090000	2811441780	Nipple Socket	40X40	25	4,340.00	108500.00
6	39174000	2811420780	Reduction Tee	40X25	25	2,968.00	74200.00
7	76082000	2811200010	Pipe	25 MM	10	3,355.00	33550.00
8	39174000	2811202220	Pipe Clip	25 MM	25	134.00	3350.00
9	76090000	2811101780	Alluminium Nipple Socket	20X2	25	1,637.00	40925.00
10	76090000	2811441780	Alluminium Nipple Socket	40X40	5	4,340.00	21700.00
							457729.00
Add: Pkg & Fwd @ 3%							13731.87
							471460.87
GST @ 18%							84862.96
[A]..							556323.83
Round Off:							0.17
Rupees: Five lacs Fifty Six Thousand Three Hundred Thirty Four Only.							Total: 5,56,324.00
Note: Local Fabrication in your scope., Angle support will be provided by you. during installation, if required other material then charge will be extra							

Important Terms:

- Freight Extra at actual
- Installation charge will be extra RS 50000 + GST 18% (Per Day)
- Price Ex. Ahmedabad
- Delivery: 3 to 4 week after receipts of your order.
- Payment: 100% advance against Proforma Invoice.
- Validity: 30 days
- Atlas Copco (India) Ltd will not be responsible nor will it be held liable for any loss or damages arising to the buyer, as a result of delay, if any, in delivery / commissioning of the machine/s and /or the products of the Company due to site in availability or reasons beyond the control of ACIL) or for any product deficiency arising by reason of improper or wrongful use by the buyers of the machinery and/ or the products of the Company.

Yours Faithfully,
 For, Global Airtech Systems

Nisarg Patadiya
 Mob No.9925002791
 Authorized Signatory

Quotation – 3 : Vashi Electricals Pvt. Ltd.



Vashi Electricals Pvt. Ltd.

An ISO 9001 : 2008 Company



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



BONFIGLIOLI Price List w.e.f. 1st Jan. 2015.

INDEX

- 1) SYN' & S2U Series Single Phase 200-240VAC +/-10% Variable Frequency Drives
- 2) AGILE' Series Three Phase 360-480VAC +/-10% Variable Frequency Drives
- 3) Active' Series Three Phase 360-480VAC +/-10% Variable Frequency Drives

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 10S 220 01AF	0.2	0.25	1.4	15800
SYN 10S 220 03AF	0.4	0.5	2.3	15800
SYN 10S 220 05AF	0.75	1	4.2	15800

S2U' 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 360-480VAC +/-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 360-480VAC +/-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	37548
ACT 401 07FA	0.75	1	2.4	42588
ACT 401 09FA	1.1	1.5	3.2	42588
ACT 401 11FA	1.5	2	3.8	42588
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	56587
ACT 401 18FA	4	5	9	56587
ACT 401 19A	5.5	7.5	14	87103
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	188778
ACT 401 31A	30	40	60	218290
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	329158
ACT 401 43A	75	100	150	458457
ACT 401 45A	90	120	180	527488
ACT 401 47A	110	150	210	580155
ACT 401 49A	132	175	250	632798

Annexure 2: Instruments used

Instruments	Model/ Make	Application	Accuracy
Power analysers	Fluke: 435, Fluke: 43B,	Electrical Parameters Harmonics analysis, power logging	$\pm 0.5\%$
Infrared thermometer	Testo: 845, Comark: KM848	Surface Temperature	$\pm 0.75\%$ of mv
Anemometer	Testo: 425, Airflow: TA45	Air Velocity	$\pm(0.03 \text{ m/s} + 5\% \text{ of mv})$