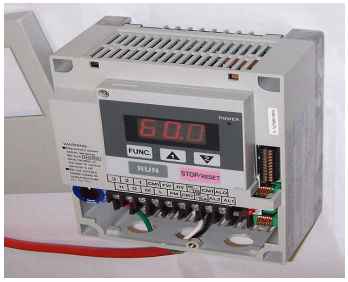
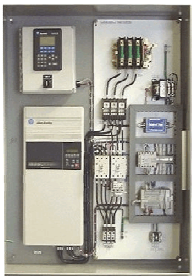
DETAILED PROJECT REPORT
ON
VARIABLE FREQUENCY DRIVE ON GRINDING MACHINE
(MORBI CERAMIC CLUSTER)










ENERGY IS LIFE
BEE
CONSERVE IT

Bureau of Energy Efficiency

Prepared By

Energy
Environment
let's conserve

Reviewed By

ISTSL

VARIABLE FREQUENCY DRIVES ON GRINDING MACHINE

MORBI CERAMIC CLUSTER

BEE, 2010

Detailed Project Report on Variable Frequency Drives on Grinding Machine

Ceramic SME Cluster, Morbi, Gujarat (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **MRV/CRM/VGM/11**

For more information

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

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

Acknowledgement

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

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

Contents

List of Annexure

List of Table

List of Figures

List of Abbreviation

BEE	Bureau of Energy Efficiency
SME	Small and Medium Enterprises
DPR	Detailed Project Report
GHG	Green House Gases
CDM	Clean Development Mechanism
DSCR	Debt Service Coverage Ratio
NPV	Net Present Value
IRR	Internal Rate of Return
ROI	Return on Investment
SCM	Standard Cubic Meter
MWh	Mega Watt hour
SIDBI	Small Industrial Development Bank of India
VFD	Variable Frequency Drives

EXECUTIVE SUMMARY

SEE-Tech Solution Pvt. Ltd. is executing BEE-SME program in Morbi Ceramic Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Morbi cluster is one of the largest ceramic clusters in India; accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient measures/technologies, so as to facilitate maximum replication in other ceramic clusters in India. The main energy forms used in the cluster units are grid electricity, Natural gas, charcoal, lignite and small quantity of diesel oil.

Ball mill/Blunger is a batch type grinding process and used in all type of ceramic manufacturing industry. As per the process requirement motor should run at full speed during the start of batch and after a particular time period it rotates at less speed (RPM). The speed of the motor can be reduced by installing variable frequency drive (VFD) on Ball Mill/Blunger motor and operating speed can be programmed based on time. Few of the units have already implemented this project successfully; however most of the units are yet to implement this project.

VFD is a specific type of adjustable-speed drive which reduces the speed of motor according to the requirement which results in reduction in electricity consumption in ball mill/Blunger to the extent of 15%. This concept is applicable to glaze preparation ball mill in glaze section also.

This DPR highlights the energy, environment, economic and social benefits of use of variable frequency drives in grinding section in all type of ceramic manufacturing industry.

Total investment required and financial indicators calculated such as debt equity ratio, monetary saving, IRR, NPV, DSCR and ROI etc for proposed technology is furnished in Table below:

S.No	Particular	Unit	Value
1	Project cost	₹(in lakh)	4.64
2	Electricity saving	kWh/year	66047
3	Monetary benefit	₹(in lakh)	2.541
4	Debit equity ratio	ratio	3:1
5	Simple payback period	years	1.82
6	NPV	₹(in lakh)	2.22
7	IRR	%age	29.08

S.No	Particular	Unit	Value
8	ROI	%age	34.52
9	DSCR	ratio	2.00
10	Process down time	days	1

The projected profitability and cash flow statements indicate that the installation of VFD in grinding machine is financially viable and technically feasible solution.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Morbi Ceramic Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

***Major activities in the BEE -SME program are furnished below*:**

Energy use and technology audit

The energy use technology studies would provide information on technology status, best operating practices, gaps in skills and knowledge on energy conservation opportunities, energy saving potential and new energy efficient technologies, etc for each of the sub sector in SMEs.

Capacity building of stake holders in cluster on energy efficiency

In most of the cases SME entrepreneurs are dependent on the locally available technologies, service providers for various reasons. To address this issue BEE has also undertaken capacity building of local service providers and entrepreneurs/ Managers of SMEs on energy efficiency improvement in their units as well as clusters. The local service providers will be trained in order to be able to provide the local services in setting up of energy efficiency projects in the clusters

Implementation of energy efficiency measures

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

Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

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

1 INTRODUCTION

1.1 Brief Introduction about cluster

Morbi SME Cluster is one of the largest ceramic clusters in India and mainly famous for manufacturing of ceramic tiles. Over 70% of total ceramic tiles product comes from Morbi cluster. This cluster is spread over a stretch of about 10km on the Morbi–Dhuva Highway.

There are approximately 479 ceramic units in this cluster which are engaged in manufacturing of wall tiles, vitrified tiles, floor tiles, sanitary wares, roofing tiles and others product. There are around 50 more ceramic units coming up in Morbi cluster.

Primary raw materials required for manufacturing of tiles are various types of clay, quartz, calcite/wool astonite, frits & Glazes. Most of the raw materials are easily available in Gujarat and in the neighboring state of Rajasthan. Some of the units use raw material produced at another plant. The main reason for growth of ceramic cluster in Morbi is easy availability of raw material viz; clay suitable for ceramic tiles.

The main form of energy used by the cluster units are grid electricity, Natural Gas, charcoal, lignite, and diesel oil. Major consumptions of energy are in the form of Natural Gas and lignite. Details of total energy consumption at Morbi ceramic cluster are furnished in Table 1.1 below:

Table 1.1 Details of annual energy consumption

S. No	*Type of Fuel*	*Unit*	*Value*	*% contribution*
1	Electricity	GWh/year	1,200	8.23
2	Natural Gas	SCM/year	660,000,000	46.32
3	Charcoal	tonne/year	165,000	8.55
4	Lignite	tonne/year	1,320,000	36.84
5	Diesel	litre/year	800,000	0.06

Classification of Units

The ceramic units can be broadly categorized into four types based on product manufactured

- Floor tiles unit
- Sanitary ware unit
- Vitrified tiles unit
- Wall tiles unit

Further the ceramic cluster is classified into three type based on capacity of unit viz small scale, medium scale and large scale unit.

Products Manufactured

There are many types of ceramic product manufactured from four different types of units. Details of product manufactured and number of units engaged in manufacturing of such products are given in Table 1.2 below:

Table 1.2 Details of types of product manufactured

S. No	Type of Product	No. of unit	%age share
1	Wall Tiles	178	37
2	Vitrified Tiles	36	8
3	Floor Tiles	52	11
4	Sanitary Wares	43	9
5	Spray dryer Mud manufacturing	40	8
6	Roofing Tiles (seasonal operation)	120	25
7	Third firing manufacturing (Producing pictures on tiles)	10	2
8	Total	479	

Capacity wise production

Capacity wise production breakup is furnished in Table 1.3 below:

Table 1.3 Production wise unit breakups

Type of product	No. of Units.				Production (m^2/day or MT[a]/day)			
Scale of Unit	Small	Medium	Large	Total	Small	Medium	Large	Total
Wall Tiles	43	100	35	178	2,500	3,500	7,500	13,500
Floor Tiles	8	38	6	52	3,000	4,000	7,000	14,000
Vitrified Tiles	NA	22	4	26[b]	NA	5,760	11,520	17,280
Sanitary Wares	10	24	9	43	4	8	14	26

[a]- In case of sanitary wares, production is measured in MT.
[b]- During audit no SSI vitrified tiles units were covered, therefore production data are not available for these units.

Energy usages pattern

Average monthly electricity consumption in ceramic unit ranges from 1 lakh to 2 lakh kWh depending on the size of the unit. In thermal energy, solid fuel such as lignite, charcoal, Indonesian coal, briquette, etc are used in spray dryer and natural Gas is used in kiln in all almost all units. Solid fuel consumption in spray dryer ranges from 80 to 160 kg/MT and. natural Gas consumption in kiln varies from 1.01 to 1.4 SCM/m^2 of tiles produced.

General production process for ceramic cluster

The units of Morbi ceramic cluster are involved in the manufacturing of 4 different types of products such as floor tiles, wall tiles, vitrified tiles and sanitary wares. Production process for manufacture of wall, floor and vitrified tiles is nearly the same except some differences in process parameters while the manufacturing process of sanitary wares inter alia involves manual moulding whereas in case of tiles, press is used to form the biscuits. General production processes for manufacturing of ceramic products is are following:

Wet Grinding

The raw material such as clay, feldspar, quartz, calcite etc. are mixed with water in a proper proportion and grind in a ball mill to make homogeneous mixture. Ball Mill is a batch type of process. After completion of one batch of ball mill, slurry is sent to the underground tanks containing the agitator motor in each tank to maintain the uniformity of mixture. Mainly blungers are used for mixing and grinding in case of wall and floor tiles, while ball mills are used for grinding in case of vitrified tiles.

Spray Drying

After preparation of slurry of required density it is stored in the underground tanks in which it is agitated to maintain uniformity of slurry. The slurry is then pumped through a hydraulic pump into the spray dryer where it is sprayed through nozzles. The material is dried in spray dryer to remove the moisture added during the grinding process in a ball mill. The moisture in the raw material is brought down to about 5–6 % from 35-40%. The product from spray dryer is stored in silos. Hot flue gases at a temperature of about 550 – 600 °C is used as the heating source which is generated by combustion of lignite, Indonesian coal, saw dust, briquette, natural gas etc.

Pressing/Moulding

The product from spray dryer is then sent to the press section which is pneumatically operated where the required sizes of biscuit tiles are formed. In case of sanitary ware manual moulding is carried out by hand held hose.

Drying

After pressing/moulding products containing about 5–6% moisture is dried to about 2–3% moisture in a dryer. In some units, hot air from kiln cooling zone exhaust is used in dryers and additional fuel firing is provided if required whereas in case of wall and floor tiles, fuel firing is done continuously.

Glazing

After drying, biscuit tiles are send for glazing on a glaze line. Glaze is prepared in ball mills. Glazing is required for designing on tiles. In case of sanitary ware the dried wares are glazed in several spray glazing booths, where compressed air is used.

Firing and Baking

After glazing product are then sent for final firing in kiln where temperature of 1100-1150 ^{o}C is maintained in the kiln. Natural gas is used for combustion in kiln. In some units hot air from gasifier is utilized for combustion.

Sizing

Tiles coming out of kiln are sent for sizing and calibration in case of wall and floor tiles. The tiles are cut in proper sizes so that all tiles have similar dimensions. After sizing the finished product is ready for dispatch.

Polishing

Polishing is required for vitrified tiles. It utilizes 40-45% of total electricity consumption of plant. After kiln the vitrified tiles are passed through polishing line. Polishing line consist of sizing, calibration and polishing machines.

General production process flow diagram for manufacturing of ceramic product is shown in Figure 1.1.

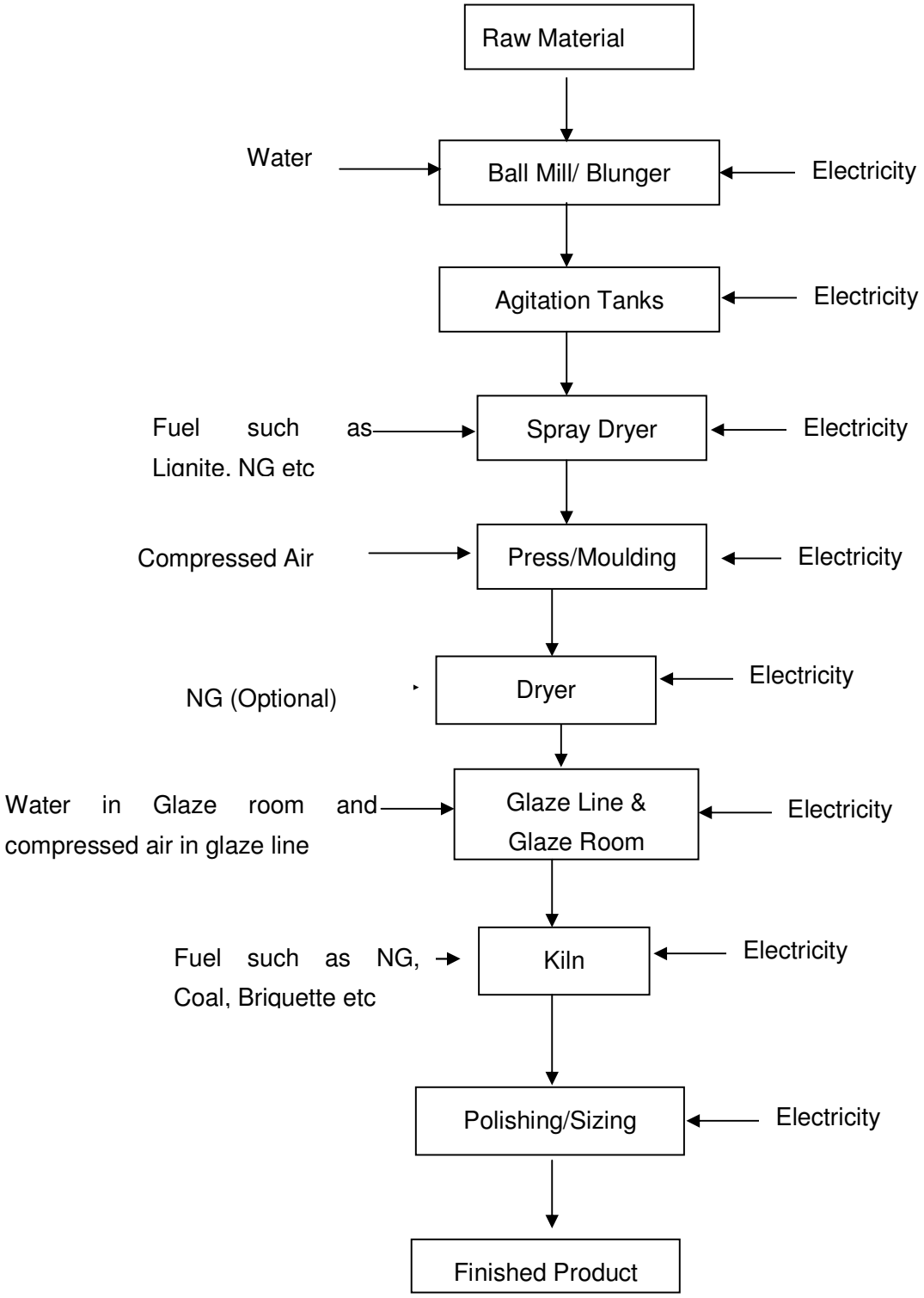


Figure 1.1Process flow diagram

1.2 Energy performance in existing system

1.2.1 Fuel consumption

Average fuel and electricity consumption in a typical ceramic unit is given in Table 1.4 below:

Table 1.4 Average fuel and electricity consumption

Energy	*Electricity (MWh per year)*			*Natural gas (SCM per year)*			*Solid Fuel [lignite] (Tonne per year)*		
Scale of Unit	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*	*Small*	*Medium*	*Large*
Wall Tiles	900	1500	2400	750,000	1,050,000	2,250,000	2,400	2,880	3,600
Floor Tiles	900	1500	2400	900,000	1,200,000	2,100,000	3,600	4,200	4,800
Vitrified Tiles	NA	6000	12000	NA	2,700,000	6,000,000	NA	6,000	9,000
Sanitary Wares	2400	450	900	120,000	240,000	420,000	NA	NA	NA

1.2.2 Average annual production

Annual production in terms of m^2/year is taken in case of tiles and in terms of MT/year in case of sanitary wares is given in the following Table 1.5 below:

Table 1.5 Average annual production

S. No.	*Type of Industry*	*Production (m^2/year) or MT/year*		
		Small scale	*Medium scale*	*Large scale*
1	Vitrified Tiles	750,000	1,050,000	2,250,000
2	Wall Tiles	900,000	1,200,000	2,100,000
3	Floor Tiles	NA	1,728,000	3,456,000
4	Sanitary Wares	1200	2400	4200

1.2.3 Specific energy consumption

Specific energy consumption both electrical and thermal energy per m^2 or MT of production for different type of ceramic products are furnished in Table 1.6below:

Table 1.6 Specific energy consumption

S. No.	*Type of Industry*	*kWh/m² or kWh/piece[c]*	*SCM/m² or SCM/ piece[c]*
1	Vitrified Tiles	3.71 - 5.01	1.51 - 3.11
2	Wall Tiles	0.61 - 2.47	0.68 - 1.65
3	Floor Tiles	1.51 - 1.92	1.28 - 1.8
4	Sanitary Wares	0.78 - 1.73	1.10 - 1.49

Equipment wise specific energy consumption

The specific energy consumption of the equipments used in the ceramic industry is given in Table 1.7 below wherever possible.

Table 1.7 Equipment wise specific energy consumption

S.No	Equipment	Electrical energy		Thermal energy	
		Unit	Vale	Unit	value
1	Ball Mill/Blunger	kWh/MT	4 -12		-
2	Agitation process	kWh/m³/hr	0.2 - 0.8		-
3	Spray Dryer	-	-	kg/MT	80 - 160
4	Press	kWh/m²	0.22- 0.4		-
5	Dryer	kWh/m²	0.011	SCM/m²	0 - 0.63
6	Glaze line + Glaze ball mill	kWh/MT	2 - 9		-
7	Kiln	kWh/m²	0.36 - 1.26	SCM/m²	1.01 -1.4
8	Polishing line/sizing	kWh/m²	1.74 - 2.35		-

[c] *In sanitary ware production is measured in term of pieces only.*

1.3 Existing technology/equipment

1.3.1 Description of existing technology

Grinding process is required in all types of ceramic products manufacturing industries. Ball Mills /Blunger are used in ceramic units for grinding of raw material. Ball mill and blunger is batch process equipment. One batch time varies from 5 to 6 hours depending on the type of product, batch capacity and the quality of the raw material.

In Ball Mill, different sizes of balls are used as a grinding media. There are two motors installed on ball mill, one is break motor and another is main motor for rotating the ball mill through a belt. Break motor is of small capacity and used only for starting of ball mill i.e. to provide the starting torque and during unloading of raw material from ball mill after completion of batch. This means that the operating duration of break motor is very less. Main electricity consumption in ball mill is only due to the main motor. Loading on the motor continuously decreases with the increase in time of one batch of ball mill.

Similar to ball mill blunger is used in case of manufacturing of wall tiles for the grinding of the raw material. In blunger, there is only one motor connected with impeller for grinding of the raw material. It is also a batch process and one batch time varies from 5 to 6 hours.

Ball mills are also used in ceramic industries for preparation of glaze material. Working hours of one batch of glaze preparation ball mill is about 12 to 14 hours.

1.3.2 Role in process

It is the most important part of the entire ceramic manufacturing process. The composition and grinding of the raw material determines the quality of the final product. The grinding of raw material is carried out by ball mills or blungers.

1.4 Baseline establishment for existing technology

1.4.1 Design and operating parameters

Average annual electricity consumption of ball mills and blunger for different types of ceramic products are given in Table 1.8 below:

Table 1.8 Electricity consumption in ball mill and blunger

S. No.	*Type of ceramic product*	*Type of grinding machine*	*Unit*	*Value*
1	Wall and Floor Tiles	Blunger	kWh/year	487023

S. No.	Type of ceramic product	Type of grinding machine	Unit	Value
2	Vitrified Tiles	Ball Mill	kWh/year	351331
3	Vitrified Tiles	Ball Mill	kWh/year	102009

1.4.2 Operating efficiency

Since operating efficiency of the motors depends upon load on the motor. Load on ball mill and blunger decreases with time due formation of uniform mixture of slurry hence efficiency of motor also decreases with time. Variation in efficiency of motors at different loads is given in Annexure 1.

1.4.3 Specific electricity consumption

Specific electrical energy consumption in ball mill and blunger are given in Table 1.9 below:

Table 1.9 Specific electricity consumption in grinding equipment

S. No.	Type of ceramic product	Type of grinding machine	Unit	Value
1	Wall and Floor Tiles	Blunger	kWh/MT	6
2	Vitrified Tiles	Ball Mill	kWh/MT	15
3	Vitrified Tiles	Ball Mill	kWh/MT	20

1.5 Barriers in adoption of proposed equipment

1.5.1 Technological barrier

In Morbi cluster, overall technical understanding on ceramic manufacturing is good and rapidly increasing. Important equipments like kiln, polishing machine hydraulic machine and grinding machine etc are bought from Italy (Sacmi) and China (Modena), which are leading suppliers of these equipments worldwide. Many of the unit owners are frequently visiting international ceramic fairs and ceramic process equipment suppliers, thus keeping them informed. It has been observed that at cluster level there is committed interested for leadership and following up is quick. In general, there is readiness to adopt provided delivery, outcome and results are demonstrated.

However the first change is still a challenge, upon success, later on duplication and adaptation is extremely prevalent in the cluster. The technologies need to be demonstrated within the cluster. While carrying out the audits and presenting the Energy audit reports to the units, in the discussion with the plant owners & other personnel, many of them agreed with many of the identified energy saving measures and technologies but they demanded demonstration of the energy saving technologies in any plant and thereafter they have readiness to follow.

1.5.2 Financial barrier

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

1.5.3 Skilled manpower

In Morbi ceramic cluster, the availability of skilled manpower is one of the problems due to more number of units. One local technical persons available at Morbi takes care of about 5-10 ceramic units. Maintenance or repair work of major equipments of ceramic units like kiln, grinding machine etc, are generally taken care by the equipment suppliers itself as they station one of their experienced technical representative at Morbi for the maintenance work.

Specialized and focused training of the local service providers on better operation and maintenance of the equipments, importance of the energy and its use and energy conservation measures will improve awareness among the unit owners and workforce. Original equipment suppliers should also participate in these programs.

1.5.4 Other barrier (If any)

Many of the new technology provider's (especially some foreign technology leaders) have not shown keen interest in implementation of their new innovative technologies. This appears to be because of fear of duplication.

.

2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

2.1.1 Detailed of proposed equipment

Ball mill/Blunger is a batch type grinding process and used in all type of ceramic unit. As per the process requirement motor should run at full speed during the start of batch and after a particular time period it rotates at less speed. Very few units have already implemented this project successfully; however most of the units are yet to implement this project. The speed of the motor can be reduced by installing variable frequency drive on Ball Mill/Blunger motor and operating speed can be programmed based on time. A VFD is a system for controlling the rotational speed of an alternating current (AC) electric motor by controlling the frequency of the electrical power supplied to the motor. A variable frequency drive is a specific type of adjustable-speed drive which controls the speed of motor according to the requirement. This will result in saving in electricity consumption to the extent of 15% in ball mills and blunger. This concept is applicable to glaze preparation ball mill in glaze section also.

2.1.2 Equipment/technology specification

INVERTER - D -700 - Three Phase Drive (I/P 400 V 3ф, O/P 400 V 3ф)

Flux Vector Control with In-Built Brake Unit 150% O/L for 60 sec. & 200% O/L for 0.5 sec.

Other technical details are mentioned in quotation shown in Annexure 8.

2.1.3 Integration with existing equipment

For implementation of this project, we have to design one circuit system where we put the variable frequency on the motor of the grinding so that the speed can be varying according to the timing of one batch.

This technology has been selected because of the following reasons

- It helps in reduction in electricity consumption in grinding process
- Meeting the desired output of the grinding material for the manufacturing of the good quality product.
- Results are already seen in few ceramic industries where this project is implemented and in operation.
- It results in reduction in GHG emissions

2.1.4 Superiority over existing system

This project results in saving in electricity consumption in the grinding process. It also improves the grinding quality of the raw material by adjusting the speed of the motor through variable frequency drive.

2.1.5 Source of equipment

This technology is already in use in few ceramic industries at Morbi. These units practically observed the savings achieved after implementation of this project in their plant.

2.1.6 Availability of technology/equipment

As Gujarat is the major hub of industrial units, VFD can be easily available at Morbi itself. Most of the persons located at Morbi deals in supply of VFD.

2.1.7 Service providers

Details of technology service providers are shown in Annexure 7.

2.1.8 Terms and conditions in sales of equipment

Warranty period of one year from the date of invoice against any manufacturing defects will be provided. Further details of term and condition are provided in Annexure 8.

2.1.9 Process down time

Process down time is not required. In any ceramic unit, more than one blunger or ball mill is installed for operating alternatively. This project will be installed on the motor of grinding machines one by one.

2.2 Life cycle assessment and risks analysis

Life of the equipment is about 10 years. Risk involves in the installation of proposed project are as follows:

- Lack of initiative of the unit owner
- Fear of affecting the quality of product because of replacement.
- Availability of skilled manpower in industry

2.3 Suitable unit for Implementation of proposed technology

Suitable unit for implementation of this technology has been selected which engage in manufacturing of wall tiles having the production capacity of about 4044 m^2 per day and electricity consumption about 1,254,228 kWh per year.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1 Technical benefit

3.1.1 Fuel saving

Implementation of this project does not resulting in reduction in fuel consumption in ceramic industry.

3.1.2 Electricity saving

Implementation of this project results about 15% saving in electricity of present electricity consumption in grinding machine. Presently electricity consumption in grinding machine is 440,310 kWh per year hence installation of this project will save about 66,047 kWh of electricity per year.

3.1.3 Improvement in product quality

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

3.1.4 Increase in production

Implementation of this project will not lead to any increase in production.

3.1.5 Reduction in raw material

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

3.1.6 Reduction in other losses

Reduce wear and tear loss in machine due to reduction in speed of motor during unloading period.

3.2 Monetary benefits

Implementation of proposed project saves about 66047 kWh of electricity per year hence total monetary benefit is ₹ 2.54 lakh per year. Detail of monetary saving is furnished in table 3.1 below:

Table 3.1 Energy and monetary benefit

S.No	*Parameter*	*Unit*	*Value*
1	Present electricity consumption in a unit	kWh/year	440310
2	Electricity consumption after project implemented	MWh/year	374263

3	Total working days	days/year	330
4	Total operating hours	hr/days	24
3	Total electricity saving	kWh/year	66047
5	Cost of electricity	₹ /kWh	3.85
6	Total monetary benefit	₹ in lakh/year	2.54

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

3.3 Social benefits

3.3.1 Improvement in working environment

No improvement on the working environment in the plant.

3.3.2 Improvement in workers skill

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

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

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

3.4.2 Reduction in GHG emission

Implementation of this project will result in saving of electricity consumption of about 66,047 kWh per year. This will leads to about 52 tCO_2 emission reduction per year from one ceramic unit. Similarly, there are about 400 ceramic tiles units at Morbi and implementation of this project in all the ceramic units will reduce the significant amount of CO_2 emissions per year. Hence proposed project can generate extra income though carbon credit.

3.4.3 Reduction in other emissions like SO_X

Significant amount of SO_X will be reducing due to decrease in electricity consumption.

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of project

4.1.1 Equipment cost

Total cost of VFD will be about ₹ 3.63 lakh.

4.1.2 Erection, commissioning and other misc. cost

Other cost includes cost of commissioning, implementation during implementation and man power cost etc. Details of total project cost requires for implementation of proposed technology are furnished in Table 4.1 below:

Table 4.1 Details of proposed technology project cost

S.No	Particular	Unit	Value
1	Cost of VFD equipment	₹ (in lakh)	3.63
2	Erection & Commissioning cost	₹ (in lakh)	0.36
3	Interest during implementation	₹ (in lakh)	0.10
4	Taxes(VAT)	₹ (in lakh)	0.18
4	Other misc. cost	₹ (in lakh)	0.36
5	Total cost	₹ (in lakh)	4.64

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹ 4.64 lakh. The entrepreneur's contribution is 25% of total project cost, which is ₹ 1.16 lakh.

4.2.2 Loan amount.

The term loan is 75% of the total project cost, which is ₹ 3.48 lakh.

4.2.3 Subsidy by Government

As the overall energy efficiency in the project is more than 15% it qualifies for subsidy of 25 % of the project cost as per the NMCP scheme of Ministry of MSME, GoI. 25 % of the project cost in

this case works out to ₹ 1.16 lakh. As the subsidy is normally available after implementation of the project the same has not been taken in the project cost and means of finance. On receipt of subsidy from Ministry of MSME, GoI through the nodal agency the amount of subsidy is generally set off [reduced] from the loan outstanding by the lender bank. Availability of this subsidy will make the project economically more attractive.

4.2.4 Terms & conditions of loan

The interest rate is considered at 10% which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 4 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial indicators

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 5years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below.

The project is expected to achieve monetary savings of ₹ 2.54 lakh per year.

- The Operation and Maintenance cost is estimated at 5% of cost of total project with 3% increase in every year as escalations.
- Interest on term loan is estimated at 10%.
- Depreciation is provided as per the rates provided in the companies act.

Considering the above mentioned assumptions, net cash accruals starting with ₹ 1.57 lakh in the first year operation and gradually increases to ₹ 3.97 lakh at the end of sixth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 4.64 lakh and monetary savings is ₹ 2.54 lakh hence the simple payback period works out to be 1.82 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ₹ 2.22 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 29.08%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 34.52%.

Details of financial indicator are shown in Table 4.2 below:

Table 4.2 Financial indicators of proposed technology/equipment

S.No	Particulars	Unit	Value
1	Simple Pay Back period	Month	22
2	IRR	%age	29.08
3	NPV	lakh	2.22
4	ROI	%age	34.52
5	DSCR	Ratio	2.00

4.4 Sensitivity analysis

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

- Optimistic scenario (Increase in fuel savings by 5%)
- Pessimistic scenario (Decrease in fuel savings by 5%)

In each scenario, other inputs are assumed as a constant. The financial indicators in each of the above situation are indicated along with standard indicators.

Details of sensitivity analysis at different scenarios are shown in Table 4.3 below:

Table 4.3 Sensitivity analysis at different scenarios

Particulars	DSCR	IRR	ROI	NPV
Normal	2.00	29.08%	34.52%	2.22
5% increase in fuel savings	2.11	32.00%	34.97%	2.57
5% decrease in fuel savings	1.90	26.13%	34.03%	1.90

4.5 Procurement and implementation schedule

Total procurement period for implementation of this technology requires 5 weeks and their details are shown in Annexure 6.

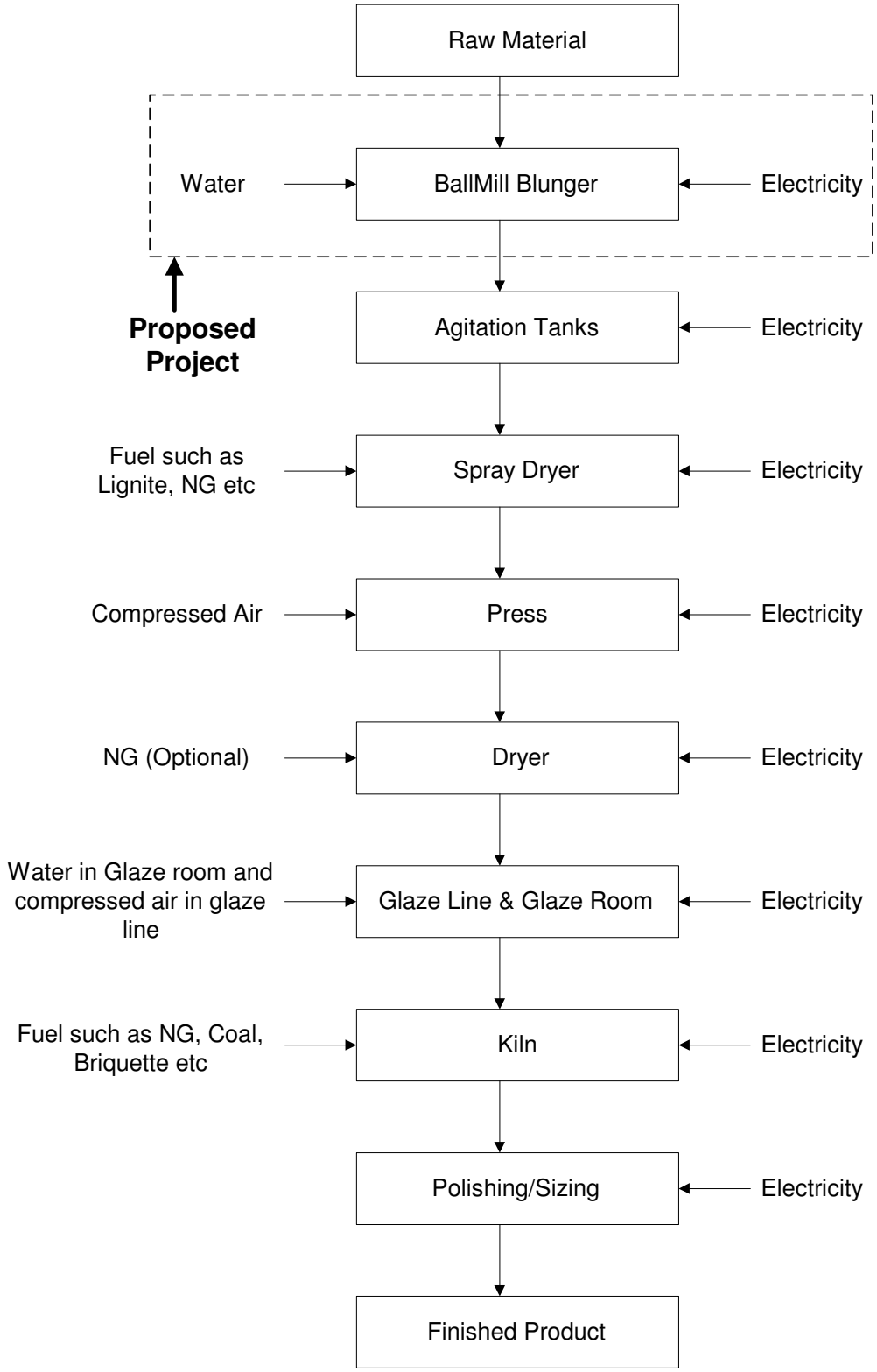
Annexure

Annexure -1: Energy audit data used for baseline establishment

Efficiency variation of the motor of blunger at different loads is as follows.

S. No.	Name of Motor	Rated KW	Measured KW	% Loading	Efficiency %age
1	Ball Mill No. 1	37.5	11.05	26	64.06
2	Ball Mill No. 2	37.5	4.70	51	73.56
3	Blunger No. 1	7.5	3.2	35	63.6
4	Blunger No. 4	7.5	3.67	40	67.66
5	Blunger No. 2	7.5	4.1	45	70.54
6	Blunger No. 3	7.5	4.8	52	73.99
7	Blunger No. 5	7.5	5.43	59	76.24
8	Blunger No. 6	7.5	6.1	67	78.01
9	Blunger No. 7	7.5	7.04	77	79.79

Annexure -2: Process flow diagram after project implementation

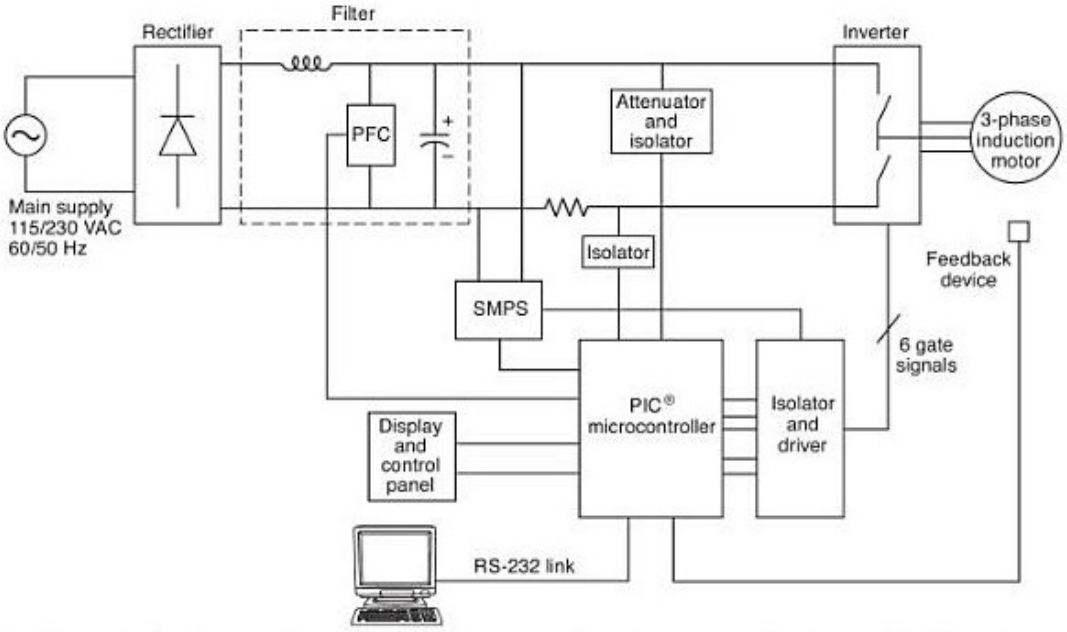


Annexure -3: Detailed technology assessment report

S. No.	Particular	Unit	Existing Technology	Proposed Technology
1	Blungers in ceramic unit of installed capacity of 7.5 KW each	No	7	7
2	Ball mills in ceramic unit of installed capacity of 37.5 and 7.5 KW.	No	2	2
3	Saving in electricity consumption after implementation of this project	%age	-	15
4	Electricity Consumption in grinding process	kWh/year	440310	374263
5	Working days in a year	days	330	330
6	Cost of electricity	₹/kWh	3.85	3.85
7	Energy cost for grinding process	₹ in lakh/year	16.95	14.40
8	Electricity saving in grinding process	kWh /year		66047
9	Monetary Saving in grinding process	₹ in lakh/year		2.54

Annexure -4 Drawings for proposed electrical & civil works

Detail diagram of functioning and connection of variable frequency drive is shown below.



Annexure -5: Detailed financial analysis

Assumption

Name of the Technology	***VFD***		
Rated Capacity	***-***		
Details	***Unit***	***Value***	***Basis***
Installed Capacity	-		Feasibility Study
No of working days	Days	330	Feasibility Study
No of Shifts per day	Shifts	3	Feasibility Study
Capacity Utilization Factor	%		Feasibility Study
Proposed Investment			
Plant & Machinery	₹ (in lakh)	3.63	Feasibility Study
Erection & Commissioning	₹ (in lakh)	0.36	Feasibility Study
Investment without IDC	₹ (in lakh)	3.99	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.10	Feasibility Study
Taxes(VAT)	₹ (in lakh)	0.18	Feasibility Study
Other charges(Contingency)	₹ (in lakh)	0.36	Feasibility Study
Total Investment	₹ (in lakh)	4.64	Feasibility Study
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	1.16	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	3.48	Feasibility Study
Loan Tenure	years	4	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	54	Assumed
Interest Rate	%	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%	3.00	Feasibility Study
Estimation of Revenue			
Electricity saving	kWh/year	66047	
Cost of electricity	Rs. / kWh	3.85	
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

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

Years	Opening Balance	Repayment	Closing Balance	Interest
1	3.48	0.30	3.18	0.31
2	3.18	0.72	2.46	0.29
3	2.46	0.84	1.62	0.21
4	1.62	0.96	0.66	0.12
5	0.66	0.66	0.00	0.02
		3.48		

WDV Depreciation

Particulars / years	1	2	3	4
Plant and Machinery				
Cost	4.09	0.82	0.16	0.03
Depreciation	3.27	0.65	0.13	0.03
WDV	0.82	0.16	0.03	0.01

Projected Profitability ***₹ (in lakh)***

Particulars / Years	1	2	3	4	5	Total
Revenue through Savings						
Fuel savings	2.54	2.54	2.54	2.54	2.54	12.71
Total Revenue (A)	2.54	2.54	2.54	2.54	2.54	12.71
Expenses						
O & M Expenses	0.23	0.24	0.25	0.25	0.26	1.23
Total Expenses (B)	0.23	0.24	0.25	0.25	0.26	1.23
PBDIT (A)-(B)	2.31	2.30	2.30	2.29	2.28	11.48
Interest	0.31	0.29	0.21	0.12	0.02	0.94
PBDT	2.00	2.02	2.09	2.17	2.26	10.54
Depreciation	0.24	0.24	0.24	0.24	0.24	1.22
PBT	1.75	1.77	1.84	1.93	2.02	9.31
Income tax	0.00	0.46	0.67	0.73	0.77	2.63
Profit after tax (PAT)	1.75	1.31	1.18	1.20	1.25	6.69

Computation of Tax ***₹ (in lakh)***

Particulars / Years	*1*	*2*	*3*	*4*	*5*
Profit before tax	1.75	1.77	1.84	1.93	2.02
Add: Book depreciation	0.24	0.24	0.24	0.24	0.24
Less: WDV depreciation	3.27	0.65	0.13	0.03	-
Taxable profit	(1.28)	1.36	1.96	2.15	2.26
Income Tax	-	0.46	0.67	0.73	0.77

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

` *(i*

Particulars / Years	*1*	*2*	*3*	*4*	*5*
Liabilities					
Share Capital (D)	1.16	1.16	1.16	1.16	1.16
Reserves & Surplus (E)	1.75	3.06	4.24	5.44	6.69
Term Loans (F)	3.18	2.46	1.62	0.66	0.00
Total Liabilities D)+(E)+(F)	6.09	6.68	7.02	7.26	7.85

Assets						
Gross Fixed Assets	4.64	4.64	4.64	4.64	4.64	4.64
Less: Accm. Depreciation	0.24	0.49	0.73	0.98	1.22	0.24
Net Fixed Assets	4.39	4.15	3.90	3.66	3.41	4.39
Cash & Bank Balance	1.70	2.53	3.12	3.60	4.43	1.70
TOTAL ASSETS	6.09	6.68	7.02	7.26	7.85	6.09
Net Worth	2.91	4.22	5.40	6.60	7.85	2.91
Dept equity ratio	1.09	0.58	0.30	0.10	0.00	1.09

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

Particulars / Years	*0*	*1*	*2*	*3*	*4*	*5*
Sources						
Share Capital	0.00	1.00	2.00	3.00	4.00	4.00
Term Loan	4.64	4.64	4.64	4.64	4.64	
Profit After tax	1.09	0.58	0.30	0.10	0.00	1.25
Depreciation		0.24	0.24	0.24	0.24	0.24
Total Sources	4.64	2.00	1.56	1.42	1.44	5.49
Application						
Capital Expenditure	4.64					

Repayment of Loan	-	0.30	0.72	0.84	0.96	0.66
Total Application	4.64	0.30	0.72	0.84	0.96	0.66
Net Surplus	-	1.70	0.84	0.58	0.48	4.83
Add: Opening Balance	-	-	1.70	2.53	3.12	3.60
Closing Balance	-	1.70	2.53	3.12	3.60	4.43

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

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***
Profit after Tax		1.75	1.31	1.18	1.20	1.25
Depreciation		0.24	0.24	0.24	0.24	0.24
Interest on Term Loan		0.31	0.29	0.21	0.12	0.02
Salvage/Realizable value						
Cash outflow	(4.64)	-	-	-	-	-
Net Cash flow	(4.64)	2.31	1.84	1.63	1.56	1.51
IRR	**29.08%**					

NPV	**2.22**

Break Even Point ***₹ (in lakh)***

Particulars / Years	*1*	*2*	*3*	*4*	*5*
Oper. & Maintenance Exp (75%)	0.17	0.18	0.18	0.19	0.20
Sub Total (G)	0.17	0.18	0.18	0.19	0.20
Fixed Expenses					
Oper. & Maintenance Exp (25%)	0.06	0.06	0.06	0.06	0.07
Interest on Term Loan	0.31	0.29	0.21	0.12	0.02
Depreciation *(H)*	0.24	0.24	0.24	0.24	0.24
Sub Total (I)	0.62	0.59	0.51	0.43	0.33
Sales (J)	2.54	2.54	2.54	2.54	2.54
Contribution (K)	2.37	2.36	2.36	2.35	2.35
Break Even Point (L= G/I)	26.00%	24.94%	21.79%	18.12%	14.07%
Cash Break Even {(I)-(H)}	15.66%	14.58%	11.41%	7.71%	3.64%
BREAK EVEN SALES (J)*(L)	0.66	0.63	0.55	0.46	0.36

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*Total*
Net Profit Before Taxes	1.75	1.77	1.84	1.93	2.02	9.31
Net Worth	2.91	4.22	5.40	6.60	7.85	26.98
						33.44%

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*Total*
Cash Inflow						
Profit after Tax	1.75	1.31	1.18	1.20	1.25	6.69
Depreciation	0.24	0.24	0.24	0.24	0.24	1.22
Interest on Term Loan	0.31	0.29	0.21	0.12	0.02	0.94
TOTAL **(M)**	2.31	1.84	1.63	1.56	1.51	8.86

Debt

Interest on Term Loan	0.31	0.29	0.21	0.12	0.02	0.94
Repayment of Term Loan	0.30	0.72	0.84	0.96	0.66	3.48
TOTAL (N)	0.61	1.01	1.05	1.08	0.68	4.42
Average DSCR (M/N)	2.00					

Annexure:-6 Procurement and implementation schedule

S. No.	Activity	No. of Weeks				
		1	2	3	4	5
1	Order for supply of VFD to vendor					
2	Receipt of the VFD at client site					
3	Installation and connections for the VFD circuit					
4	Installation of VFD in one day shut down time					

Annexure -7: Details of technology service providers

Name of Service Provider	***Address***	***Contact Person and No.***	***Email ID***
Crystal Controls	309, Abhishree complex, Opp. Star India Bazar, Nr. Jodhpur Char Rasta, satellite, Ahmedabad – 15	Mr. Dhanji Ghinaiya - 09714714192, 079 – 26923306	dghinaiya@gmail.com
Sathguru Drives & Controls	1-A, Second Street, Bharathi Nagar, Kamarajar Road, Coimbatore, Tamil Nadu, India, 641 001.	Mr. S.P.Manokaran (91-9843059659) (91)-(422)-2593737	sathguru@vsnl.com
Hi - Rel Electronics Limited	B - 117/118 , G. I. D. C. Electronics Zone, Sector No. 25, Gandhinagar, Gujarat India, 382 044.	Mr. Laxman Senghani 09725010815	laxman@hirel.net

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

CRYSTAL CONTROLS
309, ABHISHREE COMPLEX, OPP. STAR INDIA BAZAR, NR. JODHPUR CHAR RASTA, SATELLITE, AHMEDABAD - 15.
TELEFAX : (079) 2692 3306 **(M)** 98241 30299, 97147 14192 **E-MAIL :** crystalcontrols@gmail.com

Ref.: CC/ENE/qnt/0152/09-10 **Dt.: 25/03/2010**

To,
See-Tech Solution Pvt. Ltd.
Nagpur, Maharashtra.

Kind Attn. : Mr. Milind Chittawar
Subject : Quotation for Mitsubishi makes AC Drives.

Respected Sir,

This has reference to our telephonic discussion for above-mentioned requirement.

We are please to introduce ourselves as System Integrator for **Mitsubishi / Messung Automation** products.

We hope our product is in line with your requirement and prices quoted are attractive.

	Mitsubishi AC Drive Price List		
	3.1.2 INVERTER - D -700 - Three Phase Drive (I/P 400 V 3ϕ, O/P 400 V 3ϕ) (Flux Vector Control With In-Built Brake Unit 150% O/L for 60 sec. & 200% O/L for 0.5 sec.)		
1	FR-D740-012-EC	CAPACITY: 0.4 KW (0.5 HP) O/P CURRENT 1.2 AMPS	21000
2	FR-D740-022-EC	CAPACITY: 0.75 KW (1.0 HP) O/P CURRENT 2.2 AMPS	21300
3	FR-D740-036-EC	CAPACITY: 1.5 KW (2.0 HP) O/P CURRENT 3.6 AMPS	26500
4	FR-D740-050-EC	CAPACITY: 2.2 KW (3.0 HP) O/P CURRENT 5.0 AMPS	29900
5	FR-D740-080-EC	CAPACITY: 3.7 KW (5.0 HP) O/P CURRENT 8.0 AMPS	36500
6	FR-D740-120-EC	CAPACITY: 5.5 KW (7.5 HP) O/P CURRENT 12.0 AMPS	40000
7	FR-D740-160-EC	CAPACITY: 7.5 KW (10.0 HP) O/P CURRENT 16.0 AMPS	45000
	3.1.2 INVERTER - E -700 - Three Phase Drive (I/P 400 V 3ϕ, O/P 400 V 3ϕ) (Advance Flux Vector Control With In-Built Brake Unit 150% O/L for 60 sec. & 200% O/L for 03 sec.)		
1	FR-E740-016-EC	CAPACITY: 0.4 KW (0.5 HP) O/P CURRENT 1.6 AMPS	29000
2	FR-E740-026-EC	CAPACITY: 0.75 KW (1.0 HP) O/P CURRENT 2.6 AMPS	29500
3	FR-E740-040-EC	CAPACITY: 1.5 KW (2.0 HP) O/P CURRENT 4.0 AMPS	33000
4	FR-E740-060-EC	CAPACITY: 2.2 KW (3.0 HP) O/P CURRENT 6.0 AMPS	37500
5	FR-E740-095-EC	CAPACITY: 3.7 KW (5.0 HP) O/P CURRENT 9.5 AMPS	42500
6	FR-E740-120-EC	CAPACITY: 5.5 KW (7.5 HP) O/P CURRENT 12.0 AMPS	52500
7	FR-E740-170-EC	CAPACITY: 7.5 KW (10.0 HP) O/P CURRENT 17.0 AMPS	65000
8	FR-E740-230-EC	CAPACITY: 11 KW (15.0 HP) O/P CURRENT 23.0 AMPS	78000
9	FR-E740-300-EC	CAPACITY: 15 KW (20.0 HP) O/P CURRENT 30.0 AMPS	81000

	3.1.2 INVERTER - E -700 - Three Phase Drive (I/P 400 V 3ϕ, O/P 400 V 3ϕ) (Real Sensorless Vector Control, Torque Control, Communication Option, PLG, 200% O/L for 3 sec.)		
1	FR-A740-00052IN	CAPACITY: 1.5 KW (2.0 HP) O/P CURRENT 4.0 AMPS	62000
2	FR-A740-00083IN	CAPACITY: 2.2 KW (3.0 HP) O/P CURRENT 6.0 AMPS	72000
3	FR-A740-00126IN	CAPACITY: 3.7 KW (5.0 HP) O/P CURRENT 9.0 AMPS	75000
4	FR-A740-00170IN	CAPACITY: 5.5 KW (7.5 HP) O/P CURRENT 12.0 AMPS	90000
5	FR-A740-00250IN	CAPACITY: 7.5 KW (10.0 HP) O/P CURRENT 17.0 AMPS	95000
6	FR-A740-00310IN	CAPACITY: 11 KW (15.0 HP) O/P CURRENT 23.0 AMPS	102000
7	FR-A740-00380IN	CAPACITY: 15 KW (20.0 HP) O/P CURRENT 31.0 AMPS	112000
8	FR-A740-00470IN	CAPACITY: 18.5 KW (25.0 HP) O/P CURRENT 38.0 AMPS	151000
9	FR-A740-00620IN	CAPACITY: 22 KW (30.0 HP) O/P CURRENT 44.0 AMPS	165000
10	FR-A740-00770IN	CAPACITY: 30 KW (40.0 HP) O/P CURRENT 57.0 AMPS	187000
11	FR-A740-00930IN	CAPACITY: 37 KW (50.0 HP) O/P CURRENT 71.0 AMPS	245000
12	FR-A740-01160IN	CAPACITY: 45 KW (60.0 HP) O/P CURRENT 86.0 AMPS	290000
13	FR-A740-01800IN	CAPACITY: 55 KW (75.0 HP) O/P CURRENT 110.0 AMPS	340000
14	FR-A740-02160IN	CAPACITY: 75 KW (100.0 HP) O/P CURRENT 144.0 AMPS	475000
15	FR-A740-02600IN	CAPACITY: 90 KW (120.0 HP) O/P CURRENT 180.0 AMPS	545000
16	FR-A740-03250IN	CAPACITY: 110 KW (150.0 HP) O/P CURRENT 216.0 AMPS	675000
17	FR-A740-03610IN	CAPACITY: 132 KW (175.0 HP) O/P CURRENT 260.0 AMPS	900000
18	FR-A740-04320IN	CAPACITY: 160 KW (200.0 HP) O/P CURRENT 325.0 AMPS	1050000
19	FR-A740-04810IN	CAPACITY: 185 KW (250.0 HP) O/P CURRENT 361.0 AMPS	1275000
20	FR-A740-05470IN	CAPACITY: 220 KW (300.0 HP) O/P CURRENT 432.0 AMPS	1410000
21	FR-A740-06100IN	CAPACITY: 250 KW (330.0 HP) O/P CURRENT 481.0 AMPS	1560000
22	FR-A740-06830IN	CAPACITY: 280 KW (375.0 HP) O/P CURRENT 547.0 AMPS	1660000
23	FR-A740-07700IN	CAPACITY: 315 KW (420.0 HP) O/P CURRENT 610.0 AMPS	2290000
24	FR-A740-08660IN	CAPACITY: 355 KW (475.0 HP) O/P CURRENT 683.0 AMPS	2890000
25	FR-A740-09620IN	CAPACITY: 400 KW (525.0 HP) O/P CURRENT 770.0 AMPS	3230000
26	FR-A740-10940IN	CAPACITY: 450 KW (600.0 HP) O/P CURRENT 866.0 AMPS	3650000
27	FR-A740-12120IN	CAPACITY: 500 KW (675.0 HP) O/P CURRENT 962.0 AMPS	3800000

Note: Please consider 40 % discount in above prices and all prices are in INR.

Terms and Conditions:

Payment Terms	: Against proforma invoice before dispatch.
Taxes	: Excise at actual + 2 % CST (Out of Gujarat) 5% VAT for Gujarat
Packing/ Forwarding	: 1 %
Octroi	: Extra at actual (if applicable)
Delivery Period	: 3-4 weeks after receiving Purchase order.
Dispatch Through	: Through courier to pay bases from Ahmedabad
Validity	: 30 days

Warranty: Instruments offered by us are warranted for a period of one year from the date of invoice against any manufacturing defects.

Your prompt and positive action regarding this matter will enable us to serve you better.

Thanking You.

Yours Sincerely

For, **CRYSTAL CONTROLS**

Dhanji Ghinaiya
097147 14192

Bureau of Energy Efficiency (BEE)
(Ministry of Power, Government of India)
4th Floor, Sewa Bhawan, R. K. Puram, New Delhi – 110066
Ph.: +91 – 11 – 26179699 (5 Lines), Fax: +91 – 11 – 26178352
Websites: www.bee-india.nic.in, www.energymanagertraining.com

SEE-Tech Solutions Pvt. Ltd
11/5, MIDC, Infotech Park,
Near VRCE Telephone Exchange,
South Ambazari Road,
Nagpur – 440022
Website: www.letsconserve.org

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