DETAILED PROJECT REPORT
ON
ENERGY CONSERVATION IN POLISHING SECTION
(MORBI CERAMIC CLUSTER)










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ENERGY CONSERVATION IN POLISHING SECTION

MORBI CERAMIC CLUSTER

BEE, 2010
Detailed Project Report on Energy Conservation in Polishing Section
Ceramic SME Cluster, Morbi, Gujarat (India)
New Delhi: Bureau of Energy Efficiency;
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Acknowledgement

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

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

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List of Abbreviation

BEE	Bureau of Energy Efficiency
EE	Energy Efficient
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

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.

Polishing section is the major electricity consuming section in vitrified tiles industry. About 40 - 50% of total electricity consumption is consumed by the polishing section only. Polishing process is required only in the manufacturing of vitrified tiles only. The motors installed at the polishing machines are having a rated efficiency of about 70%. Also it was observed that the loading of polishing machine is found less than 50%. Replacement of the existing motors of polishing machine by energy efficient motors gives significant amount of electricity savings.

This DPR highlights the energy, environment, economic and social benefits of use of energy efficient motors in polishing machine which is used in vitrified tiles 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)	25.79
2	Electricity saving	MWh/year	502.9
3	Monetary benefit	₹(in lakh)	20.37
4	Debit equity ratio	ratio	3:1
5	Simple payback period	years	1.26
6	NPV	₹(in lakh)	36.98
7	IRR	%age	56.57
8	ROI	%age	33.44
9	DSCR	ratio	3.33
10	Procurement & Implementation Time	week	4

The projected profitability and cash flow statements indicate that the proposed project implementation is financially viable and technically feasible.

ABOUT BEE'S SME PROGRAM

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

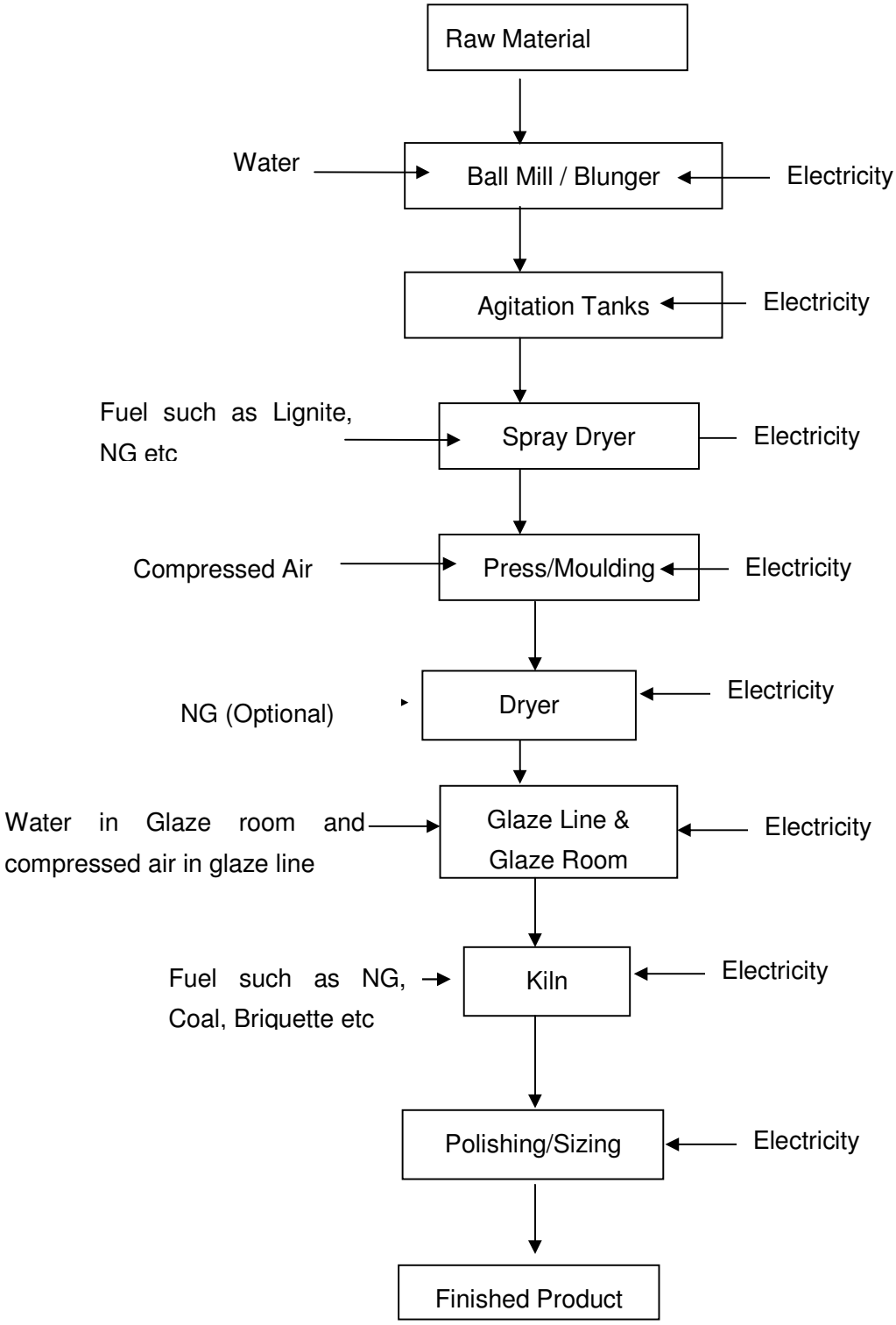

Figure 1.1Process flow diagram

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

Polishing process is required only in the manufacturing process of vitrified tiles only and it is the major electricity consuming section in vitrified tiles industry. About 40 - 50 % of total electricity is consumed by the polishing section. Polishing machine operates only for about 18 to 20 days in a month depending on the production. Polishing machines assembled with all the components is directly purchased by the ceramic unit owners from the vendors. The motors installed at the polishing machines are having a rated efficiency of about 85%. Also it was observed that the loading the polishing machine is found less than 50%. Replacement of the existing motors of polishing machine by energy efficient motors gives significant amount of electricity savings.

1.3.2 Role in process

In polishing section, final finishing of the vitrified tiles has been carried out. Polishing line consist of sizing, calibration and polishing machines.

1.4 Baseline establishment for existing technology

1.4.1 Design and operating parameters

Electricity consumption of the polishing section is given in Table 1.8 below:

Table 1.8 Electricity consumption in polishing machine

S. No.	*Energy Type*	*Unit*	*Value*	
			Min	*Max*
1	Electricity	kWh/year	2108808	6580310

1.4.2 Specific electricity consumption

Specific electrical energy consumption in polishing section is given in Table 1.9 below:

Table 1.9 Specific electricity consumption in polishing machine

S. No.	*Section*	*Unit*	*Value*	
			Min	*Max*
1	Polishing section	kWh/m^2	1.37	2.28

Specific electricity consumption of the sub sections of the polishing section is given in Annexure- 1.

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 etc are bought from Italy (Sacmi) and China (Modena), which are leading suppliers of these equipments world wide. 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, polishing 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.

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2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

2.1.1 Detailed of proposed equipment

It was observed that the loading of the machines of polishing section is less than 50 %. Efficiency of standard efficiency motors decreases significantly with the decrease in loading of the induction motors. It is observed that the motors installed on the polishing machines have rated efficiency of about 85% only. Therefore, there is more scope of saving in electricity consumption by replacement of the existing motors of the polishing machines by the energy efficient motors. New units can install energy efficient motors from beginning because payback period for incremental cost is usually small.

2.1.2 Equipment/technology specification

Technical specifications of the motors is given in the quotations attach in Annexure 8. The motors are readymade available in the market. Only have to choose the correct one i.e. suitable size.

2.1.3 Integration with existing equipment

The cluster has not yet tasted energy efficient (EE) motors therefore it is important to begin with EE motors. Polishing motors in vitrified tile plants consume 40% to 45% of total electricity. Therefore saving potential from this technology is very high. Here some of the Industrialists have indicated that they may not be able to implement this technology in their existing plants as the investment has been already made but they will definitely consider implementation of EE motors in new plants. There are about 50 new plants coming up at Morbi.

2.1.4 Superiority over existing system

This project results in saving in electricity consumption in the polishing section which is the major consumer of electricity in vitrified tiles manufacturing industry. It helps to save the electricity consumption which is consuming more due to inefficiency of the existing motors.

2.1.5 Source of equipment

Energy efficient motors are already in use in most of the industries in India and got results in electricity saving by replacement of the conventional motors by the energy efficient motors.

2.1.6 Availability of technology/equipment

Suppliers of energy efficient motors are easily available at Gujarat. Even most of the suppliers also start approaching by taking initiative from their side with industrialist to create the awareness about the energy efficiency.

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 will be provided after the sale of the motor.

2.1.9 Process down time

Polishing machine in ceramic industry operates for about 18 to 20 days in a month. Proposed project only requires the replacement of the existing motors by the new energy efficient motors and this can be done easily during the non operation period of the polishing machine.

2.2 Life cycle assessment and risks analysis

Life of the equipment is about 10 to 15 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 are vitrified unit having the production capacity of about 5929 m^2 per day and having total electricity consumption is about 54,58,560 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

In most of the ceramic unit motors installed on the polishing machines having rated efficiency is of about 70%. During electrical measurements, it has been observed that the load on most of the machines of polishing section is less than 50%. Since efficiency of motor decreases with decrease in load of the motor. Therefore, there is huge potential of electricity saving by just replacing existing conventional motors of the polishing machines by new energy efficient motors. Implementation of this project reduces the electricity consumption of polishing section by about 5,02,908 kWh per year of total electricity consumption in polishing section.

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

There is no other reduction losses

3.2 Monetary benefits

Implementation of proposed project saves about 5,02,908 kWh electricity per year hence, total monetary benefit is ₹ 20.36 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	MWh/year	2108.08

S.No	Parameter	Unit	Value
2	Electricity consumption after project implemented	MWh/year	1605.90
3	Total working days	days/year	250
4	Total operating hours	hr/days	24
3	Total electricity saving	MWh/year	502.90
5	Cost of electricity	₹ /kWh	4.05
6	Total monetary benefit	₹ in lakh/year	20.36

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 5,02,908 kWh per year. This will leads to about 402 tCO_2 emission reduction per year from one ceramic unit. Similarly, there are about 25 vitrified 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 new energy efficient motors will be about ₹ 20.21 lakh.

4.1.2 Erection, commissioning and other misc. cost

Other cost includes cost of commissioning, implementation during implementation and man power cost. 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 motors	₹ (in lakh)	20.21
2	Erection & Commissioning cost	₹ (in lakh)	1.01
3	Interest during implementation	₹ (in lakh)	0.53
4	Taxes(VAT)	₹ (in lakh)	1.01
4	Other misc. cost	₹ (in lakh)	3.03
5	Total cost	₹ (in lakh)	25.79

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ₹ 25.79 lakh. The entrepreneur's contribution is 25% of total project cost, which is ₹ 6.45 lakh.

4.2.2 Loan amount.

The term loan is 75% of the total project cost, which is ₹ 19.34 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 ₹ 6.45 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 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial indicators

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 6 years. 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 ₹ 20.37 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 ₹ 15.83 lakh in the first year operation and gradually increases to ₹ 59.19 lakh at the end of sixth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ₹ 25.79 lakh and monetary savings is ₹20.37 lakh hence the simple payback period works out to be 1.26 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ₹ 36.98 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 56.57%. 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 33.44%.

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	15
2	IRR	%age	56.57
3	NPV	lakh	36.98
4	ROI	%age	33.44
5	DSCR	Ratio	3.33

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	3.33	56.57%	33.44%	36.98
5% increase in fuel savings	3.50	60.38%	33.66%	40.23
5% decrease in fuel savings	3.16	52.75%	33.19%	33.74

4.5 Procurement and implementation schedule

Total procurement period for implementation of this technology requires 4 weeks and their details are shown in Annexure 6.

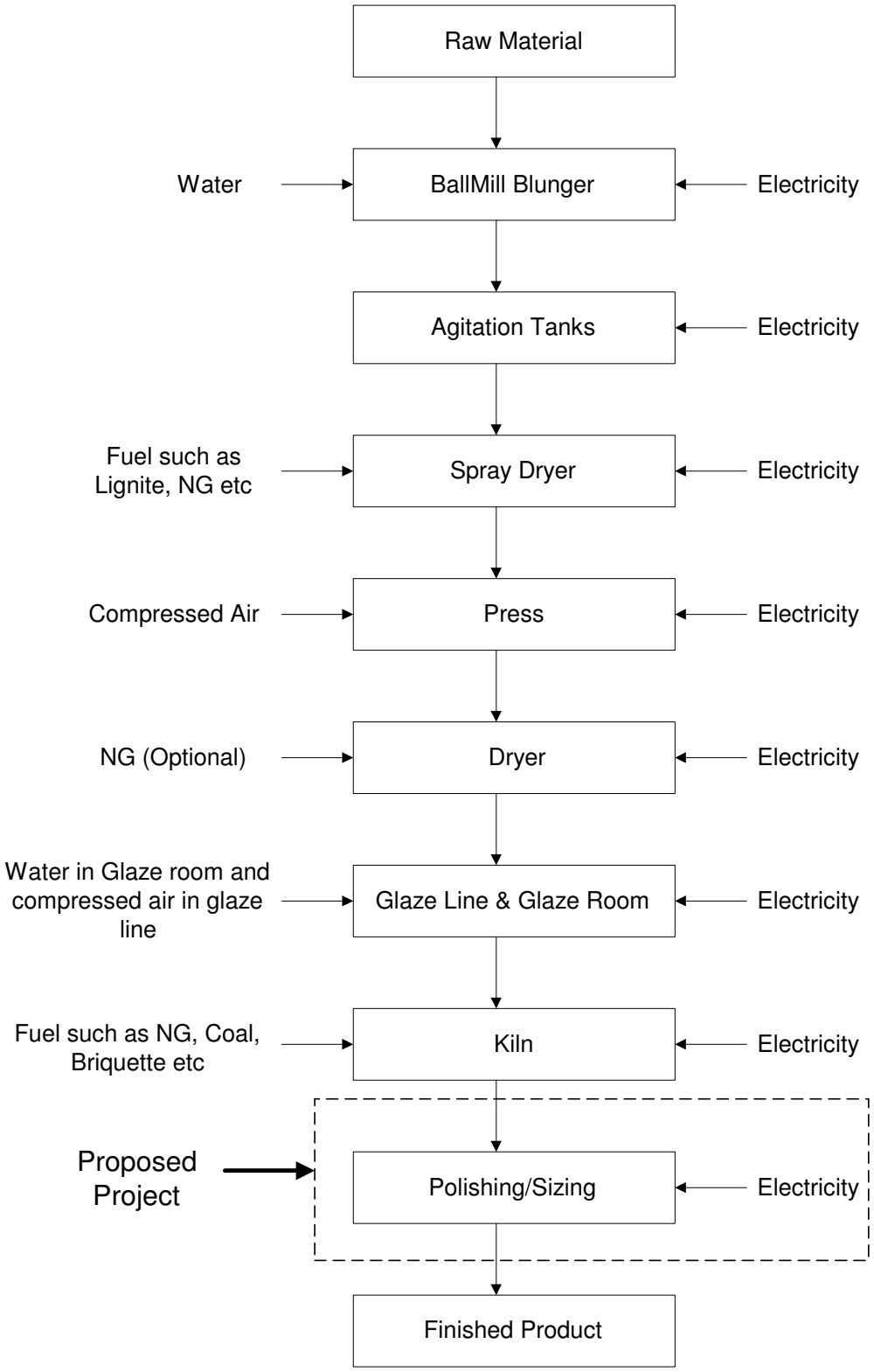
Annexure

Annexure -1: Energy audit data used for baseline establishment

Specific electricity consumption of sub section of polishing section is given below.

S. No.	Section	Specific Electricity Consumption (kWh/year)	
		Min	Max
1	Sizing	117997	674611
2	Rough Grinding	182218	628462
3	Calibration	349056	1136554
4	Polishing	1158120	4644432

Annexure -2: Process flow diagram after project implementation



Annexure -3: Detailed technology assessment report

During electrical measurements, it was observed that the loading of the most of the machines of polishing section is less than 50 %. Efficiency of motors decreases with the decreasing in loading of motors.

Also the motors installed on the polishing machines are of rated efficiency of about 85 % only. Therefore, there is more scope of saving by replacement of the existing conventional motors of the polishing machines by the energy efficient motors. The saving potential by replacement of the conventional existing motors by the energy efficient motors is given below.

S. No.	Equipment Name	Connected load (kW)	Measured Machine load (kW)	Electricity Consumption kWh/year	Saving in electricity Consumption kWh/year
1	Rough Grinding	96.56	46.2	199,584	70,042
2	Calibration 1	118.32	47.51	205,258	61,177
3	Calibration 2	118.32	33.28	143,798	38,986
4	Polishing 1	174.4	50.95	220,118	94,932
5	Polishing 2	174.4	100.4	433,728	117,387
6	Polishing 3	174.4	129.7	504,274	70,581
7	Sizing	114.72	93.06	402,048	49,803
Total		971.12	501.1	2,108,808	502,908

S. No.	Particular	Unit	Existing Technology	Proposed Technology
1	Installed connected load of polishing section.	kW	971.12	971.12
2	Present average operating efficiency of the polishing machine motors	%age	70	86.4

S. No.	Particular	Unit	Existing Technology	Proposed Technology
3	Electricity Consumption in polishing section	kWh/year	21,08,808	16,05,900
4	Working days in a year	days	250	250
5	Cost of electricity	₹ / kWh	4.05	4.05
6	Energy cost of polishing section	₹ in lakh /year	85.4	65.04
7	Electricity Saving in polishing section	kWh/year	-	5,02,908
8	Monetary Saving in polishing section	₹ in lakh /year		20.36

Annexure -4 Drawings for proposed electrical & civil works

Not applicable.

This project requires the replacement of the existing motors by the new energy efficient motors.

Annexure -5: Detailed financial analysis

Assumption

Name of the Technology			
Rated Capacity			
Details	***Unit***	***Value***	***Basis***
Installed Capacity	MW		Feasibility Study
No of working days	Days		Feasibility Study
No of Shifts per day	Shifts		Feasibility Study
Capacity Utilization Factor	%age		Feasibility Study
Proposed Investment			
Plant & Machinery	₹ (in lakh)	20.21	Feasibility Study
Erection & Commissioning	₹ (in lakh)	1.01	Feasibility Study
Investment without IDC	₹ (in lakh)	21.22	Feasibility Study
Interest During Implementation	₹ (in lakh)	0.53	Feasibility Study
Taxes(VAT)	₹ (in lakh)	1.01	Feasibility Study
Other charges(Contingency)	₹ (in lakh)	3.03	Feasibility Study
Total Investment	₹ (in lakh)	25.79	Feasibility Study
Financing pattern			
Own Funds (Equity)	₹ (in lakh)	6.45	Feasibility Study
Loan Funds (Term Loan)	₹ (in lakh)	19.34	Feasibility Study
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10.00	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	3.00	Feasibility Study
Estimation of Revenue			
Electricity saving	kWh/year	502900	
Cost of electricity	₹ / kWh	4.05	
Cost of Natural gas	₹ / SCM	15	
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	19.34	1.50	17.84	1.74
2	17.84	3.36	14.48	1.63
3	14.48	3.84	10.64	1.27
4	10.64	4.08	6.56	0.88
5	6.56	4.20	2.36	0.47
6	2.36	2.36	0.00	0.07
7		19.34		

WDV Depreciation

Particulars / years	1	2	3	4	5
Plant and Machinery					
Cost	21.75	4.35	0.87	0.17	0.03
Depreciation	17.40	3.48	0.70	0.14	0.03
WDV	4.35	0.87	0.17	0.03	0.01

Projected Profitability

Particulars / Years	1	2	3	4	5	6
Revenue through Savings						
Fuel savings	20.37	20.37	20.37	20.37	20.37	20.37
Total Revenue (A)	20.37	20.37	20.37	20.37	20.37	20.37
Expenses						
O & M Expenses	1.29	1.33	1.37	1.41	1.45	98.44
Total Expenses (B)	1.29	1.33	1.37	1.41	1.45	98.44
PBDIT (A)-(B)	19.08	19.04	19.00	18.96	18.92	429.01
Interest	1.74	1.63	1.27	0.88	0.47	45.37
PBDT	17.33	17.41	17.73	18.08	18.45	383.64
Depreciation	1.36	1.36	1.36	1.36	1.36	81.45
PBT	15.97	16.05	16.36	16.72	17.09	302.19
Income tax	0.00	4.73	5.79	6.10	6.26	130.23
Profit after tax (PAT)	15.97	11.31	10.58	10.62	10.83	171.95

Computation of Tax ***₹ (in lakh)***

Particulars / Years	1	2	3	4	5	6
Profit before tax	15.97	16.05	16.36	16.72	17.09	17.44
Add: Book depreciation	1.36	1.36	1.36	1.36	1.36	1.36
Less: WDV depreciation	17.40	3.48	0.70	0.14	0.03	-
Taxable profit	(0.07)	13.93	17.03	17.94	18.42	18.81
Income Tax	-	4.73	5.79	6.10	6.26	6.39

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***
Liabilities						
Share Capital (D)	6.45	6.45	6.45	6.45	6.45	6.45
Reserves & Surplus (E)	15.97	27.28	37.86	48.48	59.30	70.36
Term Loans (F)	17.84	14.48	10.64	6.56	2.36	0.00
Total Liabilities D)+(E)+(F)	40.26	48.22	54.95	61.49	68.12	76.81

Assets						
Gross Fixed Assets	25.79	25.79	25.79	25.79	25.79	25.79
Less: Accm. Depreciation	1.36	2.72	4.09	5.45	6.81	8.17
Net Fixed Assets	24.43	23.07	21.71	20.35	18.98	17.62
Cash & Bank Balance	15.83	25.15	33.24	41.15	49.13	59.19
Total Assets	40.26	48.22	54.95	61.49	68.12	76.81
Net Worth	22.42	33.73	44.31	54.93	65.75	76.80
Dept equity ratio	0.80	0.43	0.24	0.12	0.04	0.00

Projected Cash Flow: ***₹(in lakh)***

Particulars / Years	***0***	***1***	***2***	***3***	***4***	***5***	***6***
Sources							
Share Capital	6.45	-	-	-	-	-	-
Term Loan	19.34						
Profit After tax		15.97	11.31	10.58	10.62	10.83	11.05
Depreciation		1.36	1.36	1.36	1.36	1.36	1.36
Total Sources	25.79	17.33	12.67	11.94	11.98	12.19	12.41
Application							
Capital Expenditure	25.79						
Repayment of Loan	-	1.50	3.36	3.84	4.08	4.20	2.36
Total Application	25.79	1.50	3.36	3.84	4.08	4.20	2.36
Net Surplus	-	15.83	9.31	8.10	7.90	7.99	10.05
Add: Opening Balance	-	-	15.83	25.15	33.24	41.15	49.13
Closing Balance	-	15.83	25.15	33.24	41.15	49.13	59.19

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

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***
Profit after Tax		15.97	11.31	10.58	10.62	10.83	11.05
Depreciation		1.36	1.36	1.36	1.36	1.36	1.36
Interest on Term Loan		1.74	1.63	1.27	0.88	0.47	0.07
Salvage/Realizable value	-	-	-	-	-	-	-
Cash outflow	(25.79)	-	-	-	-	-	-
Net Cash flow	(25.79)	19.08	14.31	13.21	12.86	12.65	12.48
IRR	56.57%						

NPV	36.98

Break Even Point ***₹ (in lakh)***

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*
Variable Expenses						
Oper. & Maintenance Exp (75%)	0.97	1.00	1.03	1.06	1.09	1.12
Sub Total (G)	0.97	1.00	1.03	1.06	1.09	1.12
Fixed Expenses						
Oper. & Maintenance Exp (25%)	0.32	0.33	0.34	0.35	0.36	0.37
Interest on Term Loan	1.74	1.63	1.27	0.88	0.47	0.07
Depreciation *(H)*	1.36	1.36	1.36	1.36	1.36	1.36
Sub Total (I)	3.43	3.33	2.98	2.59	2.19	1.80
Sales (J)	20.37	20.37	20.37	20.37	20.37	20.37
Contribution (K)	19.40	19.37	19.34	19.31	19.28	19.25
Break Even Point (L= G/I)	17.67%	17.17%	15.39%	13.43%	11.36%	9.36%
Cash Break Even {(I)-(H)}	10.65%	10.14%	8.35%	6.37%	4.30%	2.29%
Break Even Sales (J)*(L)	3.60	3.50	3.14	2.73	2.31	190.74%

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***Total***
Net Profit Before Taxes	15.97	16.05	16.36	16.72	17.09	17.44	99.63
Net Worth	22.42	33.73	44.31	54.93	65.75	76.80	297.94
							33.44%

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***Total***
Cash Inflow							
Profit after Tax	15.97	11.31	10.58	10.62	10.83	11.05	70.36
Depreciation	1.36	1.36	1.36	1.36	1.36	1.36	8.17
Interest on Term Loan	1.74	1.63	1.27	0.88	0.47	0.07	6.06
Total **(M)**	19.08	14.31	13.21	12.86	12.65	12.48	84.59

Debt

Interest on Term Loan	1.74	1.63	1.27	0.88	0.47	0.07	6.06
Repayment of Term Loan	1.50	3.36	3.84	4.08	4.20	2.36	19.34
Total (N)	3.24	4.99	5.11	4.96	4.67	2.43	25.40
Average DSCR (M/N)	3.33						

Annexure:-6 Procurement and implementation schedule

S. No.	Activities	Weeks			
		1	2	3	4
1	Order for supply of the energy efficient motors				
2	Receipt of the energy efficient motors at client site				
3	Replacement of the existing motors by new motors during the non operating period				

Annexure -7: Details of technology service providers

S.No.	Name of Service Provider and address	Contact Person mobile no. and email ID
1.	ABB Ltd ABB Limited, RN Kalkaji	Mr. Dinesh Mistry 09724334560 dinesh.c.mistry@in.abb.com
2.	LUBI Group of industries Near Kalyan Mills, Naroda Road, Ahmedabad - 380 025 INDIA.	Mr. Ruturaj Rajaji 09825040538 mktsales@lubipumps.com, rporecha@lubipumps.com, expsales@lubipumps.com
3.	National Electrical Industry 2 nd floor , vimla complex, Old Sharda Mandir Rlwy Crossing, Ahmedabad-380006, Gujrat ,India	Mr.Anuj Patel 9898084805 neind@vsnl.com, elmo.neind@gmail.com
4.	BHARAT BIJLEE LTD. Arth, 8-Rashmi Society, Behind A. K. Patel House, Mithakhali, Cross Road, Ahmedabad - 380 009	Mr. Varma (sr. manager) 09869271084 anil.varma@bharatbijlee.com bblahmedabad@ahd.bharatbijlee.com
5.	Siemens Ltd Arth, 8-Rashmi Society, Behind A. K. Patel House, Mithakhali, Cross Road, Ahmedabad - 380 009	Mr. Arvind Mehta 9825506565 amey.pataskar@siemens.com, prajwal.khapekar@siemens.com
6.	Crompton Greaves Limited. CG House, 6th Floor, Dr. annie Besant Road, Worli, Mumbai - 400 030,	Mr. Suyog Deshpande 9545591550 suyog.deshpande@cgglobal.com

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

CE

Bharat Bijlee

eff2

TEFC MOTORS (Standard Motors)

For foot mounted (B3 construction) Induction Motors suitable for 415V ±10%, 50Hz ±5%, combined variation ±10%, 3 phase supply, Insulation Class F, Degree of Protection IP55, Ambient Temperature 50° C, Conforms to IS:325.

3000 rpm 2 Pole					
kW	HP	Frame	Type	Price	Excise
0.18	0.25	63	MA063213	6620	273
0.25	0.35	63	MA063233	6810	281
0.37	0.50	71	MA071213	7240	298
0.55	0.75	71	MA071233	8000	330
0.75	1.00	80	MA080213	8270	341
1.10	1.50	80	MA080233	9060	373
1.50	2.00	90S	MA09S233	10030	413
2.20	3.00	90L	MA09L253	12830	529
3.70	5.00	100L	MA10L213	15758	649
5.50	7.50	132S	MA13S233	24150	995
7.50	10.00	132S	MA13S253	26650	1098
9.30	12.50	132M	MA13M293	43430	1789
11.00	15.00	160M	MA16M213	46560	1918
15.00	20.00	160M	MA16M253	54560	2248
18.50	25.00	160L	MA16L273	74020	3050
22.00	30.00	180M	MA18M213	82510	3399
30.00	40.00	200L	MA20L233	117160	4827
37.00	50.00	200L	MA20L253	149590	6163
45.00	60.00	225M	MA22M233	192500	7931
55.00	75.00	250M	MA25M213	259140	10677
75.00	100.00	280S	MA28S213	337320	13898
90.00	120.00	280M	MA28M233	391040	16111

1500 rpm 4 Pole					
kW	HP	Frame	Type	Price	Excise
0.12	0.16	63	MA063413	6820	281
0.18	0.25	63	MA063433	7250	299
0.25	0.35	71	MA071413	7390	304
0.37	0.50	71	MA071433	7650	315
0.55	0.75	80	MA080413	8510	351
0.75	1.00	80	MA080433	8580	353
1.10	1.50	90S	MA09S433	9360	386
1.50	2.00	90L	MA09L453	10240	422
2.20	3.00	100L	MA10L433	13530	557
3.70	5.00	112M	MA11M433	17310	713
5.50	7.50	132S	MA13S433	23860	983
7.50	10.00	132M	MA13M473	27860	1148
9.30	12.50	160M	MA16M4A3	43470	1791
11.00	15.00	160M	MA16M4C3	44610	1838
15.00	20.00	160L	MA16L4K3	55430	2284
18.50	25.00	180M	MA18M433	78180	3221
22.00	30.00	180L	MA18L473	83310	3432
30.00	40.00	200L	MA20L433	112390	4630
37.00	50.00	225S	MA22S413	144380	5948
45.00	60.00	225M	MA22M433	175050	7212
55.00	75.00	250M	MA25M413	240390	9904
75.00	100.00	280S	MA28S413	307710	12678
90.00	120.00	280M	MA28M433	357020	14709

1000 rpm 6 Pole					
kW	HP	Frame	Type	Price	Excise
0.25	0.35	71	MA071633	8380	345
0.37	0.50	80	MA080613	9030	372
0.55	0.75	80	MA080633	9240	381
0.75	1.00	90S	MA09S633	9940	410
1.10	1.50	90L	MA09L653	10960	452
1.50	2.00	100L	MA10L633	14620	602
2.20	3.00	112M	MA11M633	17490	721
3.70	5.00	132S	MA13S633	25550	1053
5.50	7.50	132M	MA13M673	28460	1173
7.50	10.00	160M	MA16M633	45960	1894
9.30	12.50	160L	MA16L663	54310	2238
11.00	15.00	160L	MA16L673	57190	2356
15.00	20.00	180L	MA18L613	81700	3366
18.50	25.00	200L	MA20L613	106380	4383
22.00	30.00	200L	MA20L633	115590	4762
30.00	40.00	225M	MA22M623	180190	7424
37.00	50.00	250M	MA25M603	242750	10001
45.00	60.00	280S	MA28S613	309310	12744
55.00	75.00	280M	MA28M633	350890	14457

750 rpm 8 Pole					
kW	HP	Frame	Type	Price	Excise
0.37	0.50	90S	MA09S813	9960	410
0.55	0.75	90L	MA09L853	10930	450
0.75	1.00	100L	MA10L813	13420	553
1.10	1.50	100L	MA10L833	16350	674
1.50	2.00	112M	MA11M813	18950	781
2.20	3.00	132S	MA13S813	25060	1032
3.70	5.00	160M	MA16M813	39530	1629
5.50	7.50	160M	MA16M833	45890	1891
7.50	10.00	160L	MA16L873	58270	2401
9.30	12.50	180M	MA18M813	79260	3266
11.00	15.00	180L	MA18L833	83490	3440
15.00	20.00	200L	MA20L833	117950	4860
18.50	25.00	225S	MA22S813	152190	6270
22.00	30.00	225M	MA22M833	183690	7568
30.00	40.00	250M	MA25M813	247030	10178
37.00	50.00	280S	MA28S823	315710	13007
45.00	60.00	280M	MA28M853	366280	15091

Frame size 90S - 225M are with side terminal box with type "MA". These frames are also available in Top Terminal Box with Cast Iron Bodies with type "MX".

EFF2 will be punched on name plate as per S 12615 2004 for

2 Pole- 0.37kW - 90kW

4 Pole-0.37kW - 90kW

6 Pole- 0.37kW - 55kW

8 Pole-0.37kW - 45kW

CE

Bharat Bijlee

eff1

TEFC ENERGY EFFICIENT MOTORS

For Foot mounted (B3 construction) Induction Motors suitable for 415V ±10%, 50Hz ±5%,combined variation ±10%, 3 phase supply, Insulation Class F, Degree of Protection IP55,Ambient Temperature 50° C, Conforms to IS:325

3000 rpm 2 Pole					
kW	HP	Frame	Type	Price	Excise
0.37	0.50	71	MH071A3	8330	343
0.55	0.75	71	MH071B3	9200	379
0.75	1.00	80	MH080A3	9530	393
1.10	1.50	80	MH080B3	10410	429
1.50	2.00	90S	MH09S2A3	11530	475
2.20	3.00	90L	MH09L2B3	14750	608
3.70	5.00	100L	MH10L2B3	18120	747
5.50	7.50	132S	MH13S2B3	27750	1143
7.50	10.00	132S	MH13S2C3	30660	1263
9.30	12.50	160M	MH16M2B3	49940	2058
11.00	15.00	160M	MH16M2C3	53550	2206
15.00	20.00	160M	MH16M2D3	62740	2585
18.50	25.00	160L	MH16L2C3	85130	3507
22.00	30.00	180M	MH18M2B3	90760	3739
30.00	40.00	200L	MH20L2A3	128880	5310
37.00	50.00	200L	MH20L2B3	164550	6779
45.00	60.00	225M	MH22M2B3	211750	8724
55.00	75.00	250M	MH25M2B3	272100	11211
75.00	100.00	280S	MH28S2B3	354180	14592
90.00	120.00	280M	MH28M2B3	410590	16916
110.00	150.00	315S	MH31S2B3	517540	21323
125.00	170.00	315M	MH31M2A3	607490	25029
132.00	180.00	315M	MH31M2B3	636600	26228
150.00	200.00	315L	MH31L2A3	673020	27728
160.00	215.00	315L	MH31L2B3	697350	28731
180.00	240.00	315L	MH31L2C3	733810	30233
* 200.00	270.00	315L	MH31L2D3	817720	33690
* 250.00	335.00	355L	MH35L2B3	907180	37376
* 315.00	425.00	355L	MH35L2C3	988310	40718

* These ratings are sutiable for Ambient Temperature 45 °C

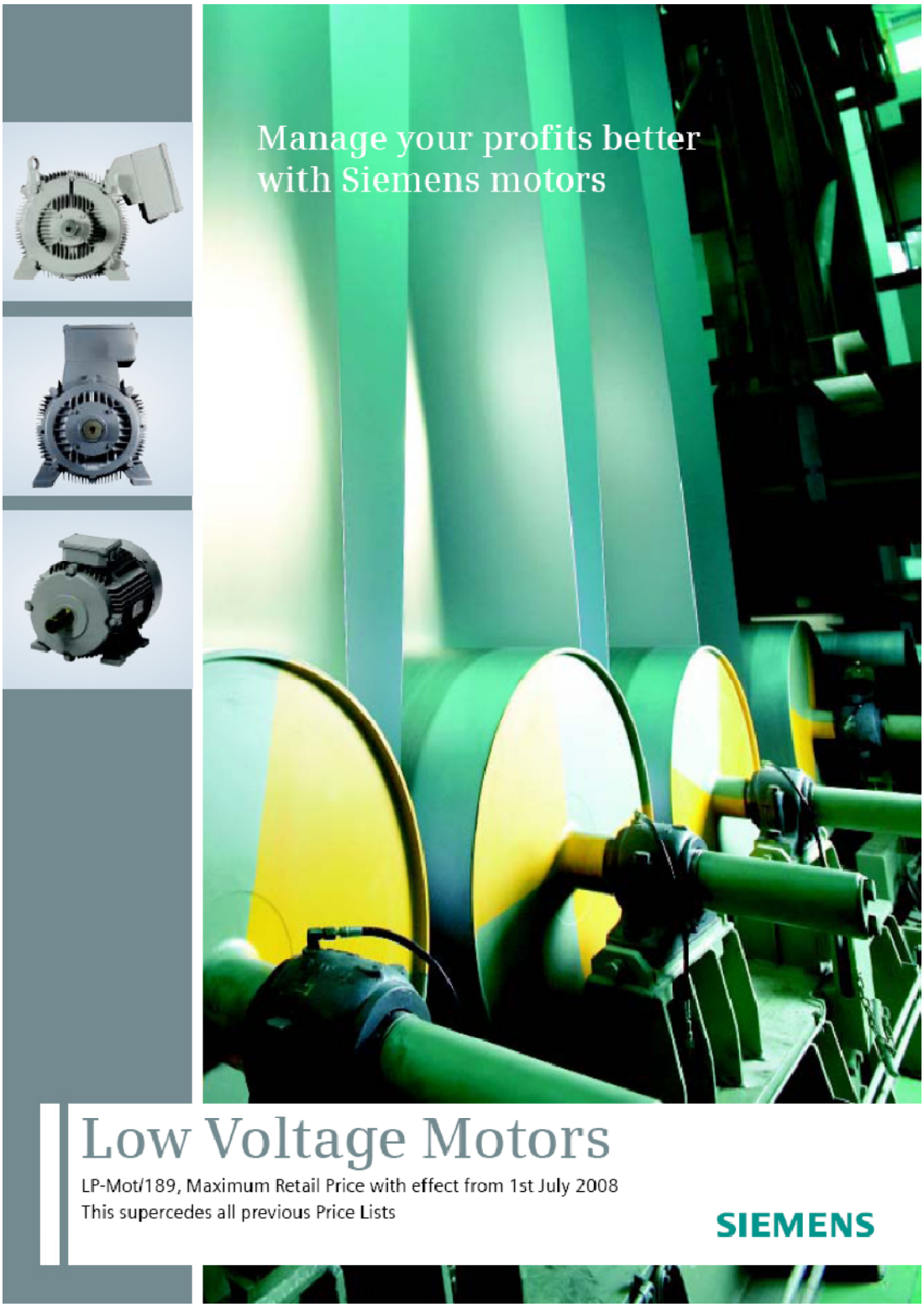
1500 rpm 4 Pole					
kW	HP	Frame	Type	Price	Excise
0.37	0.50	71	MH071A3	8800	363
0.55	0.75	80	MH080A3	9800	404
0.75	1.00	80	MH080B3	9870	407
1.10	1.50	90S	MH09S4A3	10770	444
1.50	2.00	90L	MH09L4A3	11770	485
2.20	3.00	100L	MH10L4A3	15570	641
3.70	5.00	112M	MH11M4A3	19920	821
5.50	7.50	132S	MH13S4A3	27450	1131
7.50	10.00	132M	MH13M4A3	32050	1321
9.30	12.50	160M	MH16M4C3	49980	2059
11.00	15.00	160M	MH16M4K3	51290	2113
15.00	20.00	160L	MH16L4B3	63750	2627
18.50	25.00	180M	MH18M4A3	86000	3543
22.00	30.00	180L	MH18L4B3	91640	3776
30.00	40.00	200L	MH20L4A3	123630	5094
37.00	50.00	225S	MH22S4A3	158820	6543
45.00	60.00	225M	MH22M4A3	192560	7933
55.00	75.00	250M	MH25M4A3	252410	10399
75.00	100.00	280S	MH28S4A3	323100	13312
90.00	120.00	280M	MH28M4A3	374860	15444
110.00	150.00	315S	MH31S4A3	453850	18699
125.00	170.00	315M	MH31M4A3	519210	21391
132.00	180.00	315M	MH31M4B3	532430	21936
150.00	200.00	315L	MH31L4A3	575440	23708
160.00	215.00	315L	MH31L4B3	597500	24617
180.00	240.00	315L	MH31L4C3	666380	27455
200.00	270.00	315L	MH31L4D3	760630	31338
250.00	335.00	355L	MH35L4B3	801270	33012
315.00	422.00	355L	MH35L4C3	959620	39536
355.00	480.00	355L	MH35L4D3	1235380	50898
400.00	540.00	400M	MH40M4B3	1694940	69832
450.00	600.00	400M	MH40M4C3	1749430	72077
500.00	670.00	400M	MH40M4D3	1816890	74856
560.00	750.00	400L	MH40L4C3	1913520	78837
630.00	850.00	400L	MH40L4D3	1970350	81178

eff1

Increased Safety Ex 'e', Non Sparking Ex 'n' can be offered upto 355 Frame.For Price & frame size refer to Marketing Office

Eff1 will be punched on name plate as per IS 12615: 2004 for

2 Pole -0.37kW to 160 kW
4Pole -0.37kW to 160kW
6 Pole -0.37kW to 132 kW
8Pole -0.37kW to 110kW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Low Voltage Motors
LP-Mot/189, Maximum Retail Price with effect from 1st July 2008
This supercedes all previous Price Lists
SIEMENS

EFF 2 CE

CHAMPION Series. Degree of Prot. IP55, Ins Class 'F'. Ambient 50°C
415V ±10%, 50Hz ± 5%, combined ±10%. Prices for IMB3 (foot mounted) versions.

2 - Pole 3000 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
kW	HP			
240VΔ / 415VY 50Hz				
0.18	0.25	63	1LA0 060-2YA80	5,960
0.25	0.35	63	1LA0 063-2YA80	6,130
0.37	0.5	71	1LA0 070-2YA80	6,500
0.55	0.75	71	1LA0 073-2YA80	7,210
0.75	1	80	1LA0 080-2YA80	7,460
1.1	1.5	80	1LA0 083-2YA80	8,150
1.5	2	90S	1LA0 090-2YA80	9,040
415VΔ 50Hz				
2.2	3	90L	1LA0 096-2YA80	11,580
3.7	5	100L	1LA0 107-2YA80	14,260
5.5	7.5	112M	1LA0 114-2YA80	21,880
7.5	10	132S	1LA0 131-2YA80	24,170
9.3	12.5	132M	1LA0 133-2YA80	39,410
11	15	160M	1LA0 161-2YC80	42,210
15	20	160M	1LA0 165-2YC80#	49,450
18.5	25	160L	1LA0 166-2YC80#	67,110
22	30	180M	1LA0 183-2YA80#	74,990
30	40	200L	1LA0 207-2YB80	106,360
37	50	200L	1LA0 208-2YB80#	135,970
45	60	225M	1LA0 223-2YB80	174,270

4 - Pole 1500 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
kW	HP			
240VΔ / 415VY 50Hz				
0.12	0.16	63	1LA0 060-4YA80	6,250
0.18	0.25	63	1LA0 063-4YA80	6,590
0.25	0.35	71	1LA0 070-4YA80	6,700
0.37	0.5	71	1LA0 073-4YA80	6,950
0.55	0.75	80	1LA0 080-4YA80	7,690
0.75	1	80	1LA0 083-4YA80	7,770
1.1	1.5	90S	1LA0 090-4YA80	8,530
1.5	2	90L	1LA0 096-4YA80	9,280
415VΔ 50Hz				
2.2	3	100L	1LA0 106-4YA80	12,260
3	4	100L	1LA0 107-4YA80	12,530
3.7	5	112M	1LA0 113-4YA80	15,800
5.5	7.5	132S	1LA0 130-4YA80	21,690
7.5	10	132M	1LA0 133-4YA80	25,300
11	15	160M	1LA0 163-4YA80	40,150
15	20	160L	1LA0 166-4YA80	50,040
18.5	25	180M	1LA0 183-4YA80	70,760
22	30	180L	1LA0 186-4YA80	75,380
30	40	200L	1LA0 207-4YA80	101,860
37	50	225S	1LA0 221-4YA80	130,590
45	60	225M	1LA0 224-4YA80	158,460

Temperature rise limited to 75K & @ Temp. rise limited to 95K.

Note: Efficiency class will be stamped on the name-plates for motors covered under IS:12615 - 2004 only.

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Money saving motors

EFF1 CE

CHAMPION Series. Degree of Prot. IP55, Ins Class 'F'. Ambient 50°C
415V ±10%, 50Hz ± 5%, combined ±10%. Prices for IMB3 (foot mounted) versions.

All our standard designs in frames 250 and above now conform to EFF1 as per standards

2 - Pole 3000 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
kW	HP			
415VΔ 50Hz				
55	75	250M	1SE0 254-2YB80	234,020
75	100	280S	1SE0 281-2YB80	305,490
90	120	280M	1SE0 284-2YB80	353,940
110	150	315S	1SE0 311-2YC80	466,050
132	180	315M	1SE0 314-2YC80	573,240
160	215	315L	1SE0 318-2YC80	627,710
200	270	315L	1SE0 319-2YC80@	733,170
250	335	355L	1SE0 356-2YC80	820,100
315	425	355L	1SE0 357-2YC80#	904,840

4 - Pole 1500 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
kW	HP			
415VΔ 50Hz				
55	75	250M	1SE0 254-4YA80	218,450
75	100	280S	1SE0 281-4YA80	279,570
90	120	280M	1SE0 284-4YA80	324,420
110	150	315S	1SE0 311-4YA80	408,600
132	180	315M	1SE0 314-4YA80	479,230
160	215	315L	1SE0 318-4YA80	535,790
200	270	315L	1SE0 319-4YA80@	685,150
250	335	355L	1SE0 356-4YB80	732,940
315	425	355L	1SE0 357-4YB80	862,680

6 - Pole 1000 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
kW	HP			
415VΔ 50Hz				
37	50	250M	1SE0 254-6YA80	219,180
45	60	280S	1SE0 281-6YA80	280,850
55	75	280M	1SE0 284-6YA80	317,300
75	100	315S	1SE0 311-6YA80	390,540
90	120	315M	1SE0 314-6YA80	491,740
110	150	315L	1SE0 318-6YA80	548,060
132	180	315L	1SE0 319-6YB00	637,870
160	215	355L	1SE0 356-6YB80	694,580
200	270	355L	1SE0 357-6YB80	762,690
250	335	355L	1SE0 358-6YB80	822,000

8 - Pole 750 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
kW	HP			
415VΔ 50Hz				
30	40	250M	1SE0 254-8YB80	223,590
37	50	280S	1SE0 281-8YB80	285,930
45	60	280M	1SE0 284-8YB80	331,610
55	75	315S	1SE0 311-8YB80	398,420
75	100	315M	1SE0 314-8YB80	501,410
90	120	315L	1SE0 318-8YB80	563,270
110	150	315L	1SE0 319-8YB80	593,050
132	180	355L	1SE0 356-8YB80	731,980
160	215	355L	1SE0 357-8YB80	807,950
200	270	355L	1SE0 358-8YB80	844,710

Temperature rise limited to 75K & @ Temp. rise limited to 95K.

Note: Efficiency class will be stamped on the name-plates for motors covered under IS:12615 - 2004 only.

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CE

1PQ8 Series - Separately Cooled. Degree of Prot. IP55, Ins Class 'F'. 415V ±10%, 50Hz ± 5%, combined ±10%. Cooling IC 416.
Prices for IMB3 (foot mounted) versions. Amb. 40°C (Temp rise 105K)

2 - Pole 3000 rev/min			
Output kW	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz			
250	315	1PQ8 315-2PC70	982,720
315	315	1PQ8 317-2PC70	1,151,810
355	355	1PQ8 353-2PC70	1,401,320
400	355	1PQ8 355-2PC70	1,462,640
500	355	1PQ8 357-2PC70	1,585,870

4 - Pole 1500 rev/min			
Output kW	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz			
250	315	1PQ8 315-4PB70	892,600
315	315	1PQ8 317-4PB70	1,028,160
355	355	1PQ8 353-4PB70	1,176,970
400	355	1PQ8 355-4PB70	1,286,030
500	355	1PQ8 357-4PB70	1,460,090
560	400	1PQ8 403-4YP70	1,646,800
630	400	1PQ8 405-4PB70	1,798,310
675 *	400	1PQ8 407-4PB00	1,966,720
760 *	450	1PQ8 453-4PD00	on Enquiry
850 *	450	1PQ8 455-4PD00	on Enquiry
950 *	450	1PQ8 457-4PD00	on Enquiry
1060 *	500	1PQ8 458-4PD00	on Enquiry
1180 *	500	1PQ8 459-4PD00	on Enquiry

6 - Pole 1000 rev/min			
Output kW	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz			
200	315	1PQ8 315-6PB70	885,700
250	315	1PQ8 317-6PB70	944,860
315	355	1PQ8 355-6YP70	1,252,100
400	355	1PQ8 357-6PB70	1,432,560
450	400	1PQ8 403-6AD70	on Enquiry
500	400	1PQ8 405-6AD70	on Enquiry
560	400	1PQ8 407-6AD70	on Enquiry
630	450	1PQ8 453-6AD70	on Enquiry
670 *	450	1PQ8 455-6AD00	on Enquiry
760 *	450	1PQ8 457-6AD00	on Enquiry
850 *	500	1PQ8 458-6AD00	on Enquiry
950 *	500	1PQ8 459-6AD00	on Enquiry

New

8 - Pole 750 rev/min			
Output kW	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz			
160	315	1PQ8 315-8PB70	930,850
200	315	1PQ8 317-8PB70	967,510
250	355	1PQ8 355-8YP70	1,252,300
315	355	1PQ8 357-8PB70	1,428,540
355	400	1PQ8 403-8PD70	on Enquiry
400	400	1PQ8 405-8PD70	on Enquiry
450	450	1PQ8 407-8PD70	on Enquiry
500	450	1PQ8 453-8PD70	on Enquiry
560	450	1PQ8 455-8PD70	on Enquiry
630	450	1PQ8 457-8PD70	on Enquiry
670 *	500	1PQ8 458-8PD00	on Enquiry
750 *	500	1PQ8 459-8PD00	on Enquiry

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CE

1PQ0 Series - SEPARATELY COOLED. Degree of Prot. IP54, Ins Class 'F'. Ambient 50°C
415V ±10%, 50Hz ± 5%, combined ±10%. Prices for IMB3 (foot mounted) versions.
Cooling IC 416

2 - Pole 3000 rev/min

Output kW	Output HP	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz				
11	15	160M	1PQ0 164-2YC80	69,600
15	20	160M	1PQ0 165-2YC80#	76,120
18.5	25	160L	1PQ0 166-2YC80#	95,920
22	30	180M	1PQ0 183-2YA80#	106,450
30	40	200L	1PQ0 207-2YB80	148,890
37	50	200L	1PQ0 208-2YB80#	180,810
45	60	225M	1PQ0 223-2YB80	226,110
55	75	250M	1PQ0 254-2YB80	292,860
75	100	280S	1PQ0 281-2YB80	380,030
90	120	280M	1PQ0 284-2YB80	433,320
110	150	315S	1PQ0 311-2YC80	558,470
132	180	315M	1PQ0 314-2YC80	676,320
160	215	315L	1PQ0 318-2YC80	736,220
180	240	315L	1PQ0 319-2YC80@	860,740
250	335	355L	1PQ0 356-2YC80	962,800
315	425	355L	1PQ0 357-2YC80#	1,062,290

4 - Pole 1500 rev/min

Output kW	Output HP	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz				
11	15	160M	1PQ0 163-4YA80	68,880
15	20	160L	1PQ0 166-4YA80	79,730
18.5	25	180M	1PQ0 183-4YA80	103,260
22	30	180L	1PQ0 186-4YA80	108,360
30	40	200L	1PQ0 207-4YA80	145,700
37	50	225S	1PQ0 221-4YA80	178,040
45	60	225M	1PQ0 224-4YA80	208,710
55	75	250M	1PQ0 254-4YA80	275,730
75	100	280S	1PQ0 281-4YA80	351,540
90	120	280M	1PQ0 284-4YA80	400,840
110	150	315S	1PQ0 311-4YA80	495,280
132	180	315M	1PQ0 314-4YA80	572,950
160	215	315L	1PQ0 318-4YA80	635,140
180	240	315L	1PQ0 319-4YA80@	804,370
250	335	355L	1PQ0 356-4YB80	860,470
315	425	355L	1PQ0 357-4YB80	1,012,790

6 - Pole 1000 rev/min

Output kW	Output HP	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz				
7.5	10	160M	1PQ0 163-6YB80	70,280
11	15	160L	1PQ0 166-6YB80	81,380
15	20	180L	1PQ0 186-6YA80	106,870
18.5	25	200L	1PQ0 206-6YA80	139,830
22	30	200L	1PQ0 207-6YA80	148,920
30	40	225M	1PQ0 223-6YA80#	213,940
37	50	250M	1PQ0 254-6YA80	276,530
45	60	280S	1PQ0 281-6YA80	352,950
55	75	280M	1PQ0 284-6YA80	393,010
75	100	315S	1PQ0 311-6YA80	475,410
90	120	315M	1PQ0 314-6YA80	586,700
110	150	315L	1PQ0 318-6YA80	648,640
132	180	315L	1PQ0 319-6YB00	747,410
160	215	355L	1PQ0 356-6YB80	815,440
200	270	355L	1PQ0 357-6YB80	895,400
250	335	355L	1PQ0 358-6YB80	965,030

8 - Pole 750 rev/min

Output kW	Output HP	Frame size	Type reference (MLFB)	Unit MRP for standard motor Rs.
415VΔ 50Hz				
7.5	10	160L	1PQ0 166-8YB80	82,540
11	15	180L	1PQ0 186-8YB80	108,490
15	20	200L	1PQ0 207-8YB80	151,210
18.5	25	225S	1PQ0 220-8YB80	185,640
22	30	225M	1PQ0 223-8YB80	217,560
30	40	250M	1PQ0 254-8YB80	281,380
37	50	280S	1PQ0 281-8YB80	358,510
45	60	280M	1PQ0 284-8YB80	408,760
55	75	315S	1PQ0 311-8YB80	484,090
75	100	315M	1PQ0 314-8YB80	597,360
90	120	315L	1PQ0 318-8YB80	665,360
110	150	315L	1PQ0 319-8YB80	698,120
132	180	355L	1PQ0 356-8YB80	859,340
160	215	355L	1PQ0 357-8YB80	948,530
200	270	355L	1PQ0 358-8YB80	991,690

Temperature rise limited to 75K & @ Temp. rise limited to 95K.

The MRP is inclusive of the blower and inverter grade insulation scheme.

Insulated bearings are mandatory for 1PQ0 motors in frames 280 and above when operated in constant torque modes below 5Hz of frequency. Please refer to extras for Accessories & prices of insulated bearings.The insulated bearings are NOT included in these Prices.

690V Y Design available against requirement.Pls. Contact your nearest Sales Office

EFF2 CE

Superbreed. Degree of Prot. IP55, Ins Class 'F'. Ambient 45°C
415V ±10%, 50Hz ± 5%, combined ±10%. Prices for IMB3 (foot mounted) versions.

2 - Pole 3000 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard Motor Rs.
kW	HP			
240VΔ / 415VY 50Hz				
0.18	0.25	63	1LA0 060-2YA80	5,960
0.25	0.35	63	1LA0 063-2YA80	6,130
0.37	0.5	71	1LA0 070-2YA80	6,500
0.55	0.75	71	1LA0 073-2YA80	7,210
0.75	1	80	1LA0 080-2YA80	7,460
1.1	1.5	80	1LA0 083-2YA80	8,150
1.5	2	90S	1LA0 090-2YA80	9,040
2.2	3	90L	1LA0 096-2YA80	11,580
415VΔ 50Hz				
3.7	5	100L	1LA0 107-2YA80	14,260
5.5	7.5	112M	1LA0 114-2YA80	21,880
7.5	10	132S	1LA0 131-2YA80	24,170
9.3	12.5	132M	1LA0 133-2YA80	39,410
11	15	160M	1LA0 163-2YC80	42,210
15	20	160M	1LA0 164-2YC80	49,450
18.5	25	160L	1LA0 166-2YC80	67,110
22	30	180M	1LA0 183-2YA80	74,990
30	40	200L	1LA0 206-2YB80	106,360
37	50	200L	1LA0 207-2YB80	135,970
45	60	225M	1LA0 223-2YB80	174,270
55	75	250M	1LA0 253-2YB80	236,170
75	100	280S	1LA0 280-2YC80	308,300
90	120	280M	1LA0 283-2YC80	357,190
110	150	315S	1LA0 310-2YC80	470,330
132	180	315M	1LA0 313-2YC80	578,500
160	215	315L	1LA0 316-2YC80	633,470
200	270	315L	1LA0 317-2YC80	739,890
250	335	355L	1LA0 356-2YC80	820,100
315	425	355L	1LA0 357-2YC80	904,840

4 - Pole 1500 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard Motor Rs.
kW	HP			
240VΔ / 415VY 50Hz				
0.12	0.16	63	1LA0 060-4YA80	6,250
0.18	0.25	63	1LA0 063-4YA80	6,590
0.25	0.35	71	1LA0 070-4YA80	6,700
0.37	0.5	71	1LA0 073-4YA80	6,950
0.55	0.75	80	1LA0 080-4YA80	7,690
0.75	1	80	1LA0 083-4YA80	7,770
1.1	1.5	90S	1LA0 090-4YA80	8,530
1.5	2	90L	1LA0 096-4YA80	9,280
415VΔ 50Hz				
2.2	3	100L	1LA0 106-4YA80	12,280
3	4	100L	1LA0 107-4YA80	12,530
3.7	5	112M	1LA0 113-4YA80	15,800
5.5	7.5	132S	1LA0 130-4YA80	21,690
7.5	10	132M	1LA0 133-4YA80	25,300
11	15	160M	1LA0 163-4YA80	40,190
15	20	160L	1LA0 166-4YA80	50,040
18.5	25	180M	1LA0 183-4YA80	70,760
22	30	180L	1LA0 186-4YA80	75,380
30	40	200L	1LA0 207-4YA80	101,860
37	50	225S	1LA0 220-4YA80	130,590
45	60	225M	1LA0 223-4YA80	158,460
55	75	250M	1LA0 253-4YA80	220,450
75	100	280S	1LA0 280-4YA80	282,140
90	120	280M	1LA0 283-4YA80	327,390
110	150	315S	1LA0 310-4YA80	412,350
132	180	315M	1LA0 313-4YA80	483,630
160	215	315L	1LA0 316-4YA80	540,710
200	270	315L	1LA0 317-4YA80	691,440
250	335	355L	1LA0 356-4YB80	739,660
315	425	355L	1LA0 357-4YB80	870,600

For 63 - 132 frames - Last digit of order code to change based on construction type

Construction	IMB3	IMB5/V1	IMB14	IMV1 with Canopy	IMB35	IMB34
Last digit	0	1	2	4	6	7

Important Note: Please contact nearest sales office for availability of the product

EFF 2 CE

Superbreed. Degree of Prot. IP55, Ins Class 'F'. Ambient 45°C
415V ±10%, 50Hz ± 5%, combined ±10%. Prices for IMB3 (foot mounted) versions.

6 - Pole 1000 rev/min					8 - Pole 750 rev/min				
Output		Frame size	Type reference (MLFB)	Unit MRP for standard Motor Rs.	Output		Frame size	Type reference (MLFB)	Unit MRP for standard Motor Rs.
kW	HP				kW	HP			
240VΔ / 415VY 50Hz									
0.18	0.25	71	1LA0 070-6YA80	6,960					
0.25	0.35	71	1LA0 073-6YA80	7,220					
0.37	0.5	80	1LA0 080-6YA80	8,220					
0.55	0.75	80	1LA0 083-6YA80	8,470					
0.75	1	90S	1LA0 090-6YA80	9,050					
1.1	1.5	90L	1LA0 096-6YA80	9,990					
1.5	2	100L	1LA0 106-6YA80	13,310					
415VΔ 50Hz					**415VΔ 50Hz**				
2.2	3	112M	1LA0 113-6YA80	15,930					
3.7	5	132S	1LA0 131-6YA80	23,320					
5.5	7.5	132M	1LA0 134-6YA80	25,890	5.5	7.5	160M	1LA0 164-8YB80	41,330
7.5	10	160M	1LA0 163-6YB80	41,470	7.5	10	160L	1LA0 166-8YB80	52,610
11	15	160L	1LA0 166-6YB80	51,550	11	15	180L	1LA0 186-8YB80	75,520
15	20	180L	1LA0 186-6YA80	74,040	15	20	200L	1LA0 207-8YB80	106,880
18.5	25	200L	1LA0 206-6YA80	96,540	18.5	25	225S	1LA0 220-8YB80	137,480
22	30	200L	1LA0 207-6YA80	104,800	22	30	225M	1LA0 223-8YB80	166,530
30	40	225M	1LA0 223-6YA80	163,230	30	40	250M	1LA0 253-8YB80	225,640
37	50	250M	1LA0 253-6YA80	221,190	37	50	280S	1LA0 280-8YB80	288,550
45	60	280S	1LA0 280-6YA80	283,430	45	60	280M	1LA0 283-8YB80	334,650
55	75	280M	1LA0 283-6YA80	320,210	55	75	315S	1LA0 310-8YB80	402,070
75	100	315S	1LA0 310-6YA80	394,120	75	100	315M	1LA0 313-8YB80	506,010
90	120	315M	1LA0 313-6YA80	496,250	90	120	315L	1LA0 316-8YB80	568,440
110	150	315L	1LA0 316-6YA80	553,090	110	150	315L	1LA0 317-8YB80	598,490
132	180	315L	1LA0 317-6YA80	643,720	132	180	355L	1LA0 356-8YB80	738,690
160	215	355L	1LA0 356-6YB80	700,950	160	215	355L	1LA0 357-8YB80	815,360
200	270	355L	1LA0 357-6YB80	769,690	200	270	355L	1LA0 358-8YB80	852,460
250	335	355L	1LA0 358-6YB80	829,540					

For 63 - 132 frames - Last digit of order code to change based on construction type

Construction	IMB3	IMB5/V1	IMB14	IMV1 with Canopy	IMB35	IMB34
Last digit	0	1	2	4	6	7

Important Note: Please contact nearest sales office for availability of the product

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