# DETAILED PROJECT REPORT
# ON
# ENERGY EFFICIENT MOTOR - CRUSHER SECTION
# (ORISSA SPONGE IRON CLUSTER)

ENERGY IS LIFE
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## Bureau of Energy Efficiency

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ISTSL

# ENERGY EFFICIENT MOTOR FOR CRUSHER SECTION-25HP

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## ORISSA SPONGE IRON CLUSTER

BEE, 2011
Detailed Project Report on Efficient Motors in Crusher Section
Sponge Iron Cluster, Orissa, (India)
New Delhi: Bureau of Energy Efficiency;
Detail Project Report No.: **Orissa/Sponge/EEP/01**

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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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**Lists of Abbreviations**

| | |
|---|---|
| BEE | - Bureau of Energy Efficiency |
| DPR | - Detailed Project Report |
| DSCR | - Debt Service Coverage Ratio |
| GHG | - Green House Gases |
| HP | - Horse Power |
| IRR | - Internal Rate of Return |
| MoP | - Ministry of Power |
| MoSME | - Micro Small and Medium Enterprises |
| NPV | - Net Present Value |
| ROI | - Return On Investment |
| SIDBI | - Small Industrial Development Bank of India |
| SME | - Small and Medium Enterprises |

## *EXECUTIVE SUMMARY*

Bureau of Energy Efficiency (BEE) appointed Andhra Pradesh Industrial Technical Consultancy Organisation Limited as the executing agency for Orissa Sponge Iron Cluster under BEE's SME programme. Under this project, the executing agency carried out studies in the Sponge Iron Cluster of Orissa. Out of a total of 107 Sponge Iron Units, energy efficiency study was conducted in selected 30 units.

Based on the energy audits, the executing agency submitted their report to BEE in form of a cluster manual with recommendations for energy conservation & savings potentials in the Sponge Iron Cluster units. The recommendations made in the cluster manual are listed below:

- Power Generation from Waste Heat Recovery System
- Fuel Economizer for Raw material preheating
- Preheating kiln for Raw material preheating
- Energy Efficient Motors

The DPR highlights the details of the study conducted for assessing the potential for reducing electricity consumption by installing new efficient motor for in various units of the cluster, possible electricity savings and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of project Implementation.

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) | 0.65 |
| **2** | Electricity Savings | kWh/annum | 6814 |
| **3** | Monetary benefit | (in Lakh) | 0.27 |
| **4** | Simple payback period | Months | 2.45 |
| **5** | NPV | (in Lakh) | 0.22 |
| **6** | IRR | %age | 21.49 |
| **7** | ROI | %age | 31.24 |
| **8** | Average DSCR | Ratio | 1.72 |

The projected profitability and cash flow statements indicate that the project implementation i.e. installation of energy efficient motor will be financially viable and technically feasible solution for the cluster.

## *ABOUT BEE'S SME PROGRAM*

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 29 selected SMEs clusters. Orissa Sponge Iron 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:***

***Activity 1: 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.

***Activity 2: 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

***Activity 3: 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.

***Activity 4: 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

Orissa is one of the States in India. It is located between the parallels of 17.49'N and 22.34'N latitudes and meridians of 81.27'E and 87.29'E longitudes. It is bounded by the Bay of Bengal on the east; Madhya Pradesh on the west and Andhra Pradesh on the south

The following resources are available in Orissa State.

## 1.1 Natural Resources

The state is a rich in minerals and natural resources. It is often said that Orissa has everything under the sky, meaning its forest and agricultural wealth, lots under the earth, an obvious reference to its mineral reserves and a coastline that is a dream come true. Bauxite, chrome, iron ore, coal, manganese, etc mineral are available in Orissa .The state's unique geographical position also endows it with abundant forest resources

### 1.1.1. Iron Ore

Orissa's iron reserves have always invited attention. The total Iron Ore reserves in the state is estimated at 4177 million tones ore which is 33.91% of the country's deposit. The Iron Ore mining operations in the State are open cast and mechanized. Most of the mechanized mines have crushing and screening facilities. At present 46.06milion tonnes of iron ore (2004-05) are produced in the sate. In view of growing world wide demand for steel, there has been a major surge of interest in this sector. Due to rich in Iron ore deposits in the state, reputed national /International steel makers have shown interest to establish steel plants in the State.

Due to availability of rich iron ore in the state many mineral resource base industries are established i.e. Iron making in the stale like Rourkela Steel Plant (RSP), aluminium plants by INDAL and National Aluminium Company (NALCO), three charge chrome plants at Bahmanipal, Bhadrak and Choudwar by Orissa Mining Corporation (OMC), Ferro Alloys Corporation (FACOR) and Indian Charge Chrome Ltd. (ICCL). At Theruvalli in Rayagada district, Indian Metals and Ferro-Alloys (IMFA) had set up a plant for production of charge chrome / ferro chrome

### 1.1.2 Coal

There are 57 Gondawana & 14 Tertiary coalfields for the national inventory of coal and Orissa state has only two coalfields. Yet their shares in the reserve are so far established in the country amounts to 24.78%. The geographical reserves in the two coal fields under the state are given below.

- IB River Coal Field - 22.23 bt
- Talcher Coal Field - 35.78 bt

Due to availability of rich content of Iron Ore and coal, many Sponge Iron Plants are established in Orissa State under SME and large Industries. These industries are spread over all parts of Orissa state where raw material are available.

## 1.2 Energy performance in existing situation

### 1.2.1 Fuel and electricity consumption of a typical unit in the cluster

The following energy is required for manufacturing of sponge Iron from Iron Ore.

- Thermal Energy
- Electrical Energy

Major energy consumption in Sponge Iron Plants is thermal followed by electrical energy

**Thermal Energy**

All sponge Iron units are operated the rotary kiln and operated with coal based. Coal is used as a fuel for heating the Iron Ore and as well as reaction agent in process. The Temperature required for heating of Iron Ore is 700-900 C which is below the Iron melting point. The required coal for major sponge Iron Plants are procured from Mahanadi Coal and few plants are used both local and imported coal mix.

**Electrical Energy**

Another form of energy required for the Sponge Iron Plant is electrical energy. The electrical Energy is used to operate the different equipments involved in Sponge Iron Plants. The electrical energy is used to prepare the raw material, rotating the kilns and cooler kilns. The source of electrical energy is from Western Electricity Supply Company of Orissa Ltd (WESCO). The energy consumption of a typical Sponge Iron Manufacturing unit in the cluster using low efficiency motors is furnished in Table 1.1 below:

**Table 1.1: Energy consumption of typical units**

| S.No | Name of Industries | TPD | 50 | 100 | Annual Production | Annual Electrical energy consumption (millions of kWh) | Annual Coal consumption (Tons/annum) |
|---|---|---|---|---|---|---|---|
| **1** | Bajrang Ispat Limited | **100** | 2 | | 29900 | 2.89 | 40210 |
| **2** | Bhagbati Steels Pvt Ltd | **50** | 1 | | 11200 | 0.8 | 15062 |
| **3** | Jaganath Sponge Private Limited | **50** | 1 | | 14800 | 1.56 | 20086 |
| **4** | Kendriya Ispat Pvt .Ltd | **50** | 1 | | 11850 | 1.45 | 15936 |

| S.No | Name of Industries | TPD | 50 | 100 | Annual Production | Annual Electrical energy consumption (millions of kWh) | Annual Coal consumption (Tons/annum) |
|---|---|---|---|---|---|---|---|
| **5** | Maa Shakamburi Sponge ltd. | **100** | | 1 | 29651 | 2.9 | 46124 |
| **6** | Maa Tarani Industries Private Ltd | **100** | 2 | | 27400 | 3.47 | 36848 |
| **7** | Maha Kali Ispat Private Limited | **50** | 1 | | 14000 | 2.2 | 19000 |
| **8** | Meta Sponge Private Limited | **100** | 2 | | 26400 | 3.25 | 35503 |
| **9** | Pavan jay Sponge Limited | **100** | 2 | | 27200 | 3.14 | 36579 |
| **10** | Shri Balaji Metallics Pvt Ltd | **100** | 2 | | 28900 | 3.48 | 38533 |
| **11** | Swastik Ispat Pvt Ltd | **50** | | | 11200 | 1.6 | 15348 |
| **12** | Utkal Metallic Limited | **100** | 2 | | 25689 | 3.12 | 34547 |
| **13** | Vishal Metallic Limited | **100** | | 1 | 28000 | 4.1 | 44091 |

### 1.2.2 Average production by a typical unit in the cluster

The average production in a year in the above Sponge Iron Manufacturing Unit with installed capacity of 50 TPD is varies from 11200 to 14000 tons & Manufacturing Unit with installed capacity of 100 TPD is varies from 25000 to 30000 tons of Sponge Iron per annum depending up on the market requirements.

### 1.2.3 Specific Energy Consumption

The major sources of energy for Sponge Iron Cluster are Thermal & Electrical energy and the specific energy consumption per ton of Sponge Iron production for the above units in the cluster is furnished in Table 1.2 below:

**Table 1.2: Specific energy consumption for typical unit**

| S.No. | Name of Industries | TPD | 25 | 50 | 100 | Annual Production | Over all Specific energy consumption |
|---|---|---|---|---|---|---|---|
| **1** | Bajrang Ispat Limited | **100** | | 2 | | 29900 | 0.41 |
| **2** | Bhagbati Steels Pvt Ltd | **50** | | 1 | | 11200 | 0.41 |
| **3** | Jaganath Sponge Private Limited | **50** | | 1 | | 14800 | 0.42 |
| **4** | Kendriya Ispat Pvt .Ltd | **50** | | 1 | | 11850 | 0.41 |
| **5** | Maa Shakamburi Sponge ltd. | **100** | | | 1 | 29651 | 0.48 |
| **6** | Maa Tarani Industries Private Ltd | **100** | | 2 | | 27400 | 0.41 |
| **7** | Maha Kali Ispat Private Limited | **50** | | 1 | | 14000 | 0.42 |
| **8** | Meta Sponge Private Limited | **100** | | 2 | | 26400 | 0.41 |

| S.No. | Name of Industries | TPD | 25 | 50 | 100 | Annual Production | Over all Specific energy consumption |
|---|---|---|---|---|---|---|---|
| **9** | Pavan jay Sponge Limited | **100** | | 2 | | 27200 | 0.41 |
| **10** | Shri Balaji Metallics Pvt Ltd | **100** | | 2 | | 28900 | 0.41 |
| **11** | Swastik Ispat Pvt Ltd | **50** | 2 | | | 11200 | 0.42 |
| **12** | Utkal Metallic Limited | **100** | | 2 | | 25689 | 0.41 |
| **13** | Vishal Metallic Limited | **100** | | | 1 | 28000 | 0.49 |

## 1.3 Existing technology/equipment

### 1.3.1 Description of existing technology

The motors presently installed for driving the Crusher in the units are very old and inefficient. As per the detailed studies undertaken in various units of the cluster and based on the discussions with the plant engineers, the motors installed for crushers application are re-winded a number of times due to failure and is a common practice for all SME owners. It is well known fact that the re-winded motors will have less efficiency and hence increasing power consumption.

Power costs will certainly continue to rise and further escalate motor operating expense. So the question of how repair affects motor efficiency is an important one. Some claim a rewound motor is never as efficient as the original; others say a well-executed rewind can be better than the original design. These differences in perception suggest there may be several factors involved. Armed with the right information, understanding the factors that affect rewind performance does not need to be complicated. The ability of the repair shop to analyze and replace those parts, which most influence losses, such as the stator core, the windings, and the rotor, will affect the outcome of a rewind.

A detail of existing Crusher motor is given in the Table 1.3 below:

**Table 1.3 Existing motor specifications**

| S.No | Details | Crusher motor |
|---|---|---|
| **1** | Rated HP | 25 |
| **2** | Voltage | 415 |
| **3** | Rated Amps | 30 |
| **4** | Frequency | 50 Hz |
| **5** | Power Consumption (kW) | 17KW |
| **6** | RPM | 975 |

### 1.3.2 Its role in the whole process

All Sponge Iron plants required iron ore and coal for production of sponge iron. The size of iron ore and coal from the mines are available in the form of lumps. It is essential to reduce the size up to 8-18mm size of iron ore and coal of size 5-18mm which is required for the reduction in rotary kilns. Coal and iron ore crushers are installed in all plants to reduce the required size of raw materials. The crushers are operated by motors and the capacity of motor depends on the capacity of raw material process. The operation of crusher depends on the rate of production in the plant and operated around 10- 12 hours in a day

## 1.4 Establishing the baseline for the equipment

### 1.4.1 Design and operating parameters

The present power consumption of a motor is 19.89 kW. The motor is operated for 12 hours in a day.

### 1.4.2 Electricity consumption in existing system

The electricity consumption of Crusher motors in the two selected Plants of 50 TPD & 100 TPD Sponge Iron Units is furnished in Table 1.4 below:

**Table 1.4 Electricity consumption**

| S. No | Name of the unit | TPD | HP | Actual Power consumption in Kwh |
|---|---|---|---|---|
| 1 | Balaji Metallics Pvt Ltd | 100 | 25 | 19.89 |
| 2 | Kendriya Ispat Pvt Ltd | 50 | 25 | 18.54 |

### 1.4.2 Operating efficiency of the existing motor

The detailed energy audit studies had been undertaken in various units of the cluster to evaluate the motor efficiencies. Based on the age and number of the times, the motor is re winded, the efficiency of the motor will be around 85%, against 92.2% efficiency standard motors available.

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

### 1.5.1 Technological Barriers

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

- Dependence on local equipment suppliers and availability of the motors at lower cost.
- Lack of awareness of the energy efficient motors.

### 1.5.2 Financial Barrier

The replacement of bigger size motors requires high investment and the repair and rewinding of the motor will cost very less. Hence, many of the owners don't show interest due to high initial investment and lack of financial strength to invest. Further, the lack of awareness of the losses and monetary benefit of energy efficient motors also one of the major factor for implementing the energy efficient motors.

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. The cluster has significant potential for implementing energy efficiency motors.

### 1.5.3 Skilled manpower

Not applicable

### 1.5.4 Other barrier(s)

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

## 2. TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

### 2.1 Detailed description of technology/equipment selected

#### 2.1.1 Description of equipment

The project activity is replacement of inefficient motors with new energy efficient motors. The new motor will have overall efficiency of more than 92.2% at full load. The high efficiency of the energy efficient is due to the following special features:

These motors are available in TEFC construction for use in safe areas and also in flameproof enclosure for use in Hazardous areas.

- Low loss special grade of thinner laminations. This reduces the Iron loss even at partial loads.
- Thicker conductors and more copper contents reduce copper loss due to lower resistance.
- Longer core length, reduced and uniform air gap between stator and rotor to reduce stray losses.
- Special design of fan and fan cover to reduce windage losses

Considering the above facts and for reducing electricity consumption of the motors, it is suggested to install energy efficient motors.

**Advantage**

**Best performance even at partial loads:**

The benefits of using Energy Efficient Motors (EEF1) are maximum in continuous duty applications like Crushers, Sheller fans, ID fans etc

In many applications the load factor of the motor will be range of 60% to 80%. The efficiency curve of standard motor is dropping in nature i.e., there is a sharp fall in efficiency at partial loads. But the energy efficient motors have a flat efficiency curve and hence the fall in efficiency is marginal. Thus energy saving is significant even in part loads.

#### 2.1.2 Technology /Equipment specifications

The detailed specification of the motor suggested is furnished in table 2.1 below:

**Table 2.1: Energy Efficient motor Specifications**

| S. No | Parameter | Unit | Value |
|---|---|---|---|
| **1** | Rated Capacity | HP | 25 |
| **2** | Rated Current | Amps | 30 |
| **3** | Speed | RPM | 975 rpm |
| **4** | Efficiency | percentage | 92.2 % |
| **5** | Power Factor | Percentage | 0.89 |

### 2.1.3 Justification of the technology selected & Suitability

The Crusher motors are major energy consuming equipment in Sponge Iron Units Cluster. Based on the detailed energy audits conducted for motors installed in the cluster units, the motors are old and re winded number of times leading reduction in efficiency and high power consumption. Whereas, the new energy efficient motors will have overall efficiency of 92.2 %( at full load). The following are the reasons for selection of this technology

The following benefits are possible for selection of this technology

- Energy efficient motors will reduce electricity consumption
- It reduces the GHG emissions
- Lower payback period for Continuous Operation
- High power factor
- Flat efficiency curve for at all loads
- Higher Motor life

### 2.1.4 Superiority over existing technology/equipment

The following are the superior features of energy efficient motors over existing motors

- Improved efficiency is available from 60% to 100% load. The efficiency curve is almost flat resulting in higher energy savings as in most of the cases the motor is not always fully loaded
- The special design features also result in lower operating temperatures which enhance the life of motor and reduce the maintenance costs.

- These motors have inherently low noise and vibration and help in conservation of environment.
- These motors are with highest power factor in the industry due the special exclusive design.
- The higher power factor reduces the currents in the cables supplying power to motor and this reduces cable loss,
- Improving the system efficiency sometimes by even 2%, sometimes this allows even a lower cable size saving tremendously on capital costs.
- Saving is also made by reducing capacitors required to improve power factor

### 2.1.5 Availability of the proposed technology/equipment

The energy efficient motor suppliers are available at Bhubaneswar and Rourkela. All the major energy efficient motors suppliers like Crompton Greaves, SIEMENS, NGEF, etc are manufacturing energy efficient motors. The details of the suppliers are provided in Annexure-4.

### 2.1.6 Source of technology/equipment for the project

The source of the technology is indigenous and is locally available.

### 2.1.7 Service/technology providers

A detail of energy efficient motors suppliers has been furnished in Annexure 4.

### 2.1.8 Terms of sales

No any specific terms and conditions

### 2.1.9 Process down time during implementation

The process down time for installation of energy efficient motor is considered two days for dismantling the existing motor and installation of new motor and providing electrical connections to the motor.

## 2.2 Life cycle assessment and risks analysis

The life of the energy efficient motor is considered at 20 years. There is no risk involved as the motor are technology proven and are successfully in operation in other industries of the country.

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

The motors are selected similar to the existing capacity of the motor and actual power drawn at full load based on energy audits carried out plus 20% margin to overcome sudden load and also as recommended by the Crusher supplier.

# 3. ECONOMIC BENEFITS OF NEW ENERGY EFFICIENT TECHNOLOGY

## 3.1 Technical benefits

### 3.1.1 Fuel savings per year

No fuel saving is possible

### 3.1.2 Electricity savings per year

The efficiency of the new energy efficiency motor is more than the existing motor and hence reduces electricity consumption. The power savings due to installation of new energy efficient motor is 6814 kWh per annum.

### 3.1.3 Improvement in product quality

There is no significant impact on the product quality.

### 3.1.4 Increase in production

There is no significant effect on production capacity.

### 3.1.5 Reduction in raw material consumption

Not Applicable

### 3.1.6 Reduction in other losses

Due to improved power factor of new energy efficient motor, the distribution losses may also reduce.

## 3.2 Monetary benefits

The monetary benefit due to installation of new energy efficient motors is estimated as Rs. 0.27 lakhs per annum due to reduction in electricity consumption:

## 3.3 Social benefits

### 3.3.1 Improvement in working environment in the plant

As installation of new efficient motor may lessen the breakdowns and hence working environment may improve.

### 3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new and energy efficient motor will create the awareness among the workforce on energy efficiency in motors and how it will reduce the power consumption.

### 3.4 Environmental benefits

#### 3.4.1 Reduction in effluent generation

None

#### 3.4.2 Reduction in GHG emission such as CO2, NOx, etc

The major GHG emission reduction source is $CO_2$. The technology will reduce grid electricity consumption and emission reductions are estimated at 12 tons of $CO_2$ per annum due to implementation of the project activity.

#### 3.4.3 Reduction in other emissions like SOx

No significant impact on SOx emissions.

# 4. INSTALLATION OF NEW ENERGY EFFICIENT MOTOR

## 4.1 Cost of technology/equipment implementation

### 4.1.1 Cost of technology/equipments

The total cost for motor is estimated at 0.66 lakh, which includes motor cost and other charges and discounts as per the Quotation in Annexure 5.

### 4.1.2 Other costs

Other charges include cabling and panel modification. Project cost details are furnished in Table 4.1 below:

**Table 4.1: Project detail cost**

| S No. | Particular | Unit | Value |
|---|---|---|---|
| 1 | New Energy Efficient motor | Rs in Lakh | 0.65 |
| 2 | Panel, Switch & Cabling, Elec. and Modifications etc. | Rs in Lakh | 0.01 |
| 3 | Total Investment | Rs in Lakh | 0.66 |

## 4.2 Arrangement of funds

### 4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at 0.17 lakh.

### 4.2.2 Loan amount

The term loan is 75% of the total project, which is 0.50 lakh.

### 4.2.3 Terms & conditions of loan

The interest rate is considered at 10.0% which is prevailing interest rate of SIDBI for energy efficiency related projects. The loan tenure is 5 years and the moratorium period is 6 months.

## 4.3 Financial indicators

### 4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with 0.18 lakh in the first year operation and increases to 0.49 at the end of Fifth year.

### 4.3.2 Simple payback period

The total project cost of the proposed technology is Rs.0.65 lakhs and monetary savings due to reduction in electricity consumption is Rs. 0.27 lakhs and the simple payback period works out to be Two Year & Four Months

### 4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.0% interest rate works out to be 0.22 lakh.

### 4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 21.49%. 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 31.24%. The average DSCR is 1.72

## 4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

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

- Increase in power savings by 10%
- Decrease in power savings by 10%

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

**Table 4.2: Sensitivity analysis**

| Particulars | DSCR | IRR |
|---|---|---|
| **Normal** | 1.72 | 21.49% |
| **10% increase in power savings** | 1.88 | 25.76% |
| **10% decrease in power savings** | 1.55 | 17.09% |

## 4.5 Procurement and implementation schedule

The project is expected to be completed in 2 weeks from the date of release of purchase order. The detailed schedule of project implementation is furnished in Annexure 5.

***ANNEXURE***

**Annexure 1: Detailed technology assessment report – EE Motor**

| Parameter | Unit | Crusher Motor |
|---|---|---|
| **Present installed capacity** | hp | 25 |
| **Present installed capacity** | kW | 18.65 |
| **Present Power consumption** | kW | 19.89 |
| **Motor load factor** | | 90.31 |
| **Estimated efficiency at present operating Conditions** | % | 86 |
| **Proposed capacity of New Motor** | kW | 18.65 |
| **Proposed efficiency of energy efficiency motor (eff1)** | % | 92.2 |
| **Expected Power Consumption of New Motor** | kW | 18.27 |
| **Reduction Power consumption** | kW | 1.62 |
| **No of days operation (assumption)** | Days | 350 |
| **Working hours per day** | hours | 12 |
| **Energy Charges** | Rs./kWh | 3.9 |
| **Estimated savings potential** | kWh/annum | 6814 |
| **Estimated cost savings** | Rs./annum | 26573 |
| **Initial Investment** | Rs. | 65000 |
| **Payback Period** | Years | 2.45 |

## Annexure 2: Detailed financial calculations & analysis

**Assumptions**

| *Name of the Technology* | *Energy Efficient Electric Motor* | | |
|---|---|---|---|
| *Rated Capacity* | **25 HP** | | |
| *Details* | *Unit* | *Value* | *Basis* |
| **Installed Capacity** | HP | 25 | |
| **No of working days** | Days | 350 | |
| **No of Shifts per day** | Shifts | 1 | |
| **Capacity Utilization Factor** | %age | | |
| ***Proposed Investment*** | | | |
| **Plant & Machinery** | Rs. (in lakh) | 0.65 | |
| **Panel, Switch & Cabling etc.** | Rs. (in lakh) | 0.01 | |
| **Total Investment** | Rs. (in lakh) | 0.66 | |
| ***Financing pattern*** | | | |
| **Own Funds (Equity)** | Rs. (in lakh) | 0.17 | Feasibility Study |
| **Loan Funds (Term Loan)** | Rs. (in lakh) | 0.50 | Feasibility Study |
| **Loan Tenure** | Years | 5 | Assumed |
| **Moratorium Period** | Months | 3 | Assumed |
| **Repayment Period** | Months | 63 | Assumed |
| **Interest Rate** | %age | 10.00% | SIDBI Lending rate |
| ***Estimation of Costs*** | | | |
| **O & M Costs** | % on Plant & Equip | 2.00 | Feasibility Study |
| **Annual Escalation** | %age | 5.00 | Feasibility Study |
| ***Estimation of Revenue*** | | | |
| **Electricity Saving** | kWh/Year | 6814 | |
| **Cost of electricity** | Rs./kWh | 3.9 | |
| **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*** **Rs. (in lakh)**

| *Years* | *Opening Balance* | *Repayment* | *Closing Balance* | *Interest* |
|---|---|---|---|---|
| **1** | 0.50 | 0.02 | 0.47 | 0.05 |
| **2** | 0.47 | 0.09 | 0.38 | 0.05 |
| **3** | 0.38 | 0.09 | 0.28 | 0.04 |
| **4** | 0.28 | 0.09 | 0.19 | 0.03 |
| **5** | 0.19 | 0.09 | 0.09 | 0.02 |
| **6** | 0.09 | 0.09 | 0.00 | 0.01 |
| | Total | 0.50 | | |

***WDV Depreciation*** **Rs. (in lakh)**

| *Particulars / years* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| ***Plant and Machinery*** | | | | | | |
| **Cost** | 0.66 | 0.53 | 0.11 | 0.02 | 0.00 | 0.00 |
| **Depreciation** | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **WDV** | 0.53 | 0.11 | 0.02 | 0.00 | 0.00 | 0.00 |

***Projected Profitability*** **Rs. (in lakh)**

| *Particulars / Years* | *1* | *2* | *3* | *4* | *5* | *6* | *Total* |
|---|---|---|---|---|---|---|---|
| **Fuel savings** | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 1.59 |
| **Total Revenue (A)** | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 1.59 |
| ***Expenses*** | | | | | | | |
| **O & M Expenses** | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.08 |
| **Total Expenses (B)** | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.08 |
| **PBDIT (A)-(B)** | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 1.52 |
| **Interest** | 0.05 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 | 0.19 |
| **PBDT** | 0.20 | 0.21 | 0.21 | 0.22 | 0.23 | 0.24 | 1.32 |
| **Depreciation** | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.21 |
| **PBT** | 0.17 | 0.17 | 0.18 | 0.19 | 0.20 | 0.21 | 1.12 |
| **Income tax** | 0.00 | 0.03 | 0.07 | 0.07 | 0.08 | 0.08 | 0.34 |
| **Profit after tax (PAT)** | 0.17 | 0.14 | 0.11 | 0.11 | 0.12 | 0.13 | 0.78 |

***Computation of Tax*** **Rs. (in lakh)**

| *Particulars / Years* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| **Profit before tax** | 0.17 | 0.17 | 0.18 | 0.19 | 0.20 | 0.21 |
| **Add: Book depreciation** | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Less: WDV depreciation** | 0.53 | 0.11 | 0.02 | 0.00 | 0 | 0 |
| **Taxable profit** | 0.00 | 0.10 | 0.19 | 0.22 | 0.23 | 0.24 |
| **Income Tax** | 0.00 | 0.03 | 0.07 | 0.07 | 0.08 | 0.08 |

***Projected Balance Sheet*** **Rs. (in lakh)**

| *Particulars / Years* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|
| | | | | | | |
| **Share Capital (D)** | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| **Reserves & Surplus (E)** | 0.17 | 0.30 | 0.42 | 0.53 | 0.65 | 0.78 |
| **Term Loans (F)** | 0.47 | 0.38 | 0.28 | 0.19 | 0.09 | 0.00 |
| ***Total Liabilities* (D)+(E)+(F)** | **0.80** | **0.85** | **0.87** | **0.89** | **0.91** | **0.94** |
| ***Assets*** | **1** | **2** | **3** | **4** | **5** | **6** |
| **Gross Fixed Assets** | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 | 0.66 |
| **Less Accm. Depreciation** | 0.03 | 0.07 | 0.10 | 0.14 | 0.17 | 0.21 |
| **Net Fixed Assets** | 0.63 | 0.59 | 0.56 | 0.52 | 0.49 | 0.45 |
| **Cash & Bank Balance** | 0.18 | 0.26 | 0.31 | 0.37 | 0.43 | 0.49 |
| **TOTAL ASSETS** | **0.80** | **0.85** | **0.87** | **0.89** | **0.91** | **0.94** |
| **Net Worth** | 0.33 | 0.47 | 0.58 | 0.70 | 0.82 | 0.94 |
| **Debt Equity Ratio** | 2.86 | 2.29 | 1.71 | 1.14 | 0.57 | 0.00 |

***Projected Cash Flow*** **Rs. (in lakh)**

| *Particulars / Years* | *0* | *1* | *2* | *3* | *4* | *5* | *6* |
|---|---|---|---|---|---|---|---|
| ***Sources*** | | | | | | | |
| **Share Capital** | 0.17 | - | - | - | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Term Loan** | 0.50 | | | | | | |
| **Profit After tax** | | 0.17 | 0.14 | 0.11 | 0.11 | 0.12 | 0.13 |
| **Depreciation** | | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Total Sources** | **0.66** | **0.20** | **0.17** | **0.15** | **0.15** | **0.15** | **0.16** |
| ***Application*** | | | | | | | |
| **Capital Expenditure** | 0.66 | | | | | | |
| **Repayment Of Loan** | - | 0.02 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| **Total Application** | **0.66** | **0.02** | **0.09** | **0.09** | **0.09** | **0.09** | **0.09** |
| **Net Surplus** | - | 0.18 | 0.08 | 0.05 | 0.06 | 0.06 | 0.07 |
| **Add: Opening Balance** | **-** | **-** | **0.18** | **0.26** | **0.31** | **0.37** | **0.43** |
| **Closing Balance** | **-** | 0.18 | 0.26 | 0.31 | 0.37 | 0.43 | 0.49 |

***IRR*** **Rs. (in lakh)**

| ***Particulars / months*** | ***0*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** |
|---|---|---|---|---|---|---|---|
| **Profit after Tax** | | 0.17 | 0.14 | 0.11 | 0.11 | 0.12 | 0.13 |
| **Depreciation** | | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Interest on Term Loan** | | 0.05 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 |
| **Cash outflow** | (0.66) | - | - | - | - | - | - |
| **Net Cash flow** | (0.66) | 0.25 | 0.22 | 0.19 | 0.18 | 0.17 | 0.17 |
| **IRR** | **21.49%** | | | | | | |
| **NPV** | **0.22** | | | | | | |

***Break Even Point*** **Rs. (in lakh)**

| ***Particulars / Years*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** |
|---|---|---|---|---|---|---|
| ***Variable Expenses*** | | | | | | |
| **Oper. & Maintenance Exp (75%)** | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| **Sub Total*(G)*** | **0.01** | **0.01** | **0.01** | **0.01** | **0.01** | **0.01** |
| ***Fixed Expenses*** | | | | | | |
| **Oper. & Maintenance Exp (25%)** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Interest on Term Loan** | 0.05 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 |
| **Depreciation *(H)*** | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| **Sub Total (I)** | **0.09** | **0.09** | **0.08** | **0.07** | **0.06** | **0.05** |
| **Sales (J)** | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 |
| **Contribution (K)** | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 |
| **Break Even Point (L= G/I)** | 34.26% | 33.34% | 29.65% | 25.97% | 22.28% | 18.60% |
| **Cash Break Even {(I)-(H)}** | 20.64% | 19.72% | 16.03% | 12.35% | 8.66% | 4.98% |
| **Break Even Sales (J)*(L)** | 0.09 | 0.09 | 0.08 | 0.07 | 0.06 | 0.05 |

***Return on Investment*** **Rs. (in lakh)**

| ***Particulars / Years*** | ***1*** | ***2*** | ***3*** | ***4*** | ***5*** | ***6*** | ***Total*** |
|---|---|---|---|---|---|---|---|
| **Net Profit Before Taxes** | 0.17 | 0.17 | 0.18 | 0.19 | 0.20 | 0.21 | 0.91 |
| **Net Worth** | 0.33 | 0.47 | 0.58 | 0.70 | 0.82 | 0.94 | 2.90 |
| | | | | | | | **31.24%** |

***Debt Service Coverage Ratio*** **Rs. (in lakh)**

| *Particulars / Years* | *1* | *2* | *3* | *4* | *5* | *6* | *Total* |
|---|---|---|---|---|---|---|---|
| ***Cash Inflow*** | | | | | | | |
| **Profit after Tax** | 0.17 | 0.14 | 0.11 | 0.11 | 0.12 | 0.13 | 0.78 |
| **Depreciation** | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.21 |
| **Interest on Term Loan** | 0.05 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 | 0.19 |
| **Total (M)** | **0.25** | **0.22** | **0.19** | **0.18** | **0.17** | **0.17** | 1.18 |

***DEBT***

| *Particulars / Years* | *1* | *2* | *3* | *4* | *5* | *6* | *Total* |
|---|---|---|---|---|---|---|---|
| ***Cash Inflow*** | | | | | | | |
| **Interest on Term Loan** | 0.05 | 0.05 | 0.04 | 0.03 | 0.02 | 0.01 | 0.19 |
| **Repayment of Term Loan** | 0.02 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.50 |
| **Total (N)** | **0.07** | **0.14** | **0.13** | **0.12** | **0.11** | **0.10** | 0.69 |
| **Average DSCR (M/N)** | **1.72** | | | | | | |

***Sensitivity Analysis***

| Factors | Variation* | IRR | DSCR |
|---|---|---|---|
| **power savings** | 0% | 21.49% | 1.72 |

| Factor | Variation | Variation | IRR | DSCR | Variation | Variation |
|---|---|---|---|---|---|---|
| | **IRR** | **DSCR** | | | **IRR** | **DSCR** |
| | -10% | -10% | | | +10% | +10% |
| **power savings** | 17.09% | 1.55 | 21.49% | 1.72 | 25.76% | 1.88 |

## Annexure 3: Details of procurement and implementation plan

### Project Implementation schedule

| S. No | Activity | Weeks | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| 1 | Placement of Orders for Equipment | | | | |
| 2 | Supply of motor | | | | |
| 3 | Installation of the motor | | | | |
| 4 | Trial runs | | | | |

### Process down time

| S. No | Activity | Weeks | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| 1 | Dismantling of the existing motor | | | | |
| 2 | Electricity connections and modification of the pipe lines | | | | |
| 3 | Installation of the motor | | | | |
| 4 | Trial runs | | | | |

The process down time is considered for only two days.

**Annexure 4: Details of technology/equipment and service providers**

| *Equipment details* | *Source of technology* | *Service/technology providers* |
|---|---|---|
| **Energy Efficient motors** | | **M/s .CROMPTON GREEVES LIMITED Bhubaneswar Branch** Jan path Tower ,3rd Floor, Ashok Nagar , Unit II ,Bhubaneswar -751009, Orissa |

## ANNEXURE 5: QUOTATIONS OR TECHNO-COMMERCIAL BIDS FOR NEW TECHNOLOGY/EQUIPMENT

**Crompton Greaves Limited**
**Bhubaneswar Branch**
Janpath Tower, 3rd Floor, Ashok Nagar Unit II, Bhubaneswar 751 009, Orissa, India
T: +91 674 253 1128 F: 674 253 3521

To,
APTICO LTD

K.A. Mr.S.Vamsi Krishna

Our Ref: YE/BBS:SK/AL/11-12
Date:14.10.2011
Your ref: Nil
Date: 08.10.2011

Dear Sir,
We thankfully acknowledge your enquiry for LT motor. Please find below our techno - commercial bid & price bid.

**Technical Specifications:**

| | | |
|---|---|---|
| 1 | Enclouser/ Type: | TEFC/SCR |
| 2 | Motor Type: | 3 phase |
| 3 | Application: | Standard |
| 4 | Supply Voltage: | 415V +/- 10% |
| 5 | Frequency: | 50Hz +/- 10% |
| 6 | Duty: | S1 |
| 7 | Insulation Class | "F" Class with temprature rise limited to class "B". |
| 8 | Rotor Type: | SCR |
| 9 | Ambient/ Temp. Rise: | 50/70 |
| 10 | Protection Class: | IP 55 |
| 11 | Manufacturing Standard: | IS 325 |
| 12 | Altitude: | <= 1000m above MSL |

**Price Bid**

| Sl | Item Detail | RPM | Frame | Qty | Mtg | ALP | Unit Price | Total Price |
|---|---|---|---|---|---|---|---|---|
| 1 | 25 hp, 6 pole, SCR Motor (EFF1) | 975 | ND200L | 1 | B3 | 138490 | 58165.80 | 58165.80 |
| 2 | 40hp, 6pole Motor,SCR (EFF1) | 980 | ND225M | 1 | B3 | 235130 | 98754.60 | 98754.60 |
| 3 | 50hp, 6pole Motor,SCR (EFF1) | 980 | ND250M | 1 | B3 | 316230 | 132816.60 | 132816.60 |
| 4 | 60 hp, 6 Pole, SCR Motor (EFF1) | 980 | ND280S | 1 | B3 | 378780 | 159087.60 | 159087.60 |

**Commercial term & Condition:**

| | | |
|---|---|---|
| 1 | FOR: | Freight Paid upto your nearest transporter godawn. |
| 2 | Excise Duty | Charged Extra at actual, however present Excise Duty will be @10.3%. |
| 2 | CST | CST will be charged Extra @2% against C' form (Your RP Required for despatch of motors) |
| 3 | Payment Term: | 25% advance along with the order & balance against proof of LR. |
| 4 | Delivery: | Within 12 weeks after getting your technocommercial order. |
| 5 | Insurance: | It will be covered by you. |
| 7 | Validity of our offer | **30 days** |
| 8 | Warranty | 18 months from date of dispatch or 12 months from the date of comissioning which ever is earlier. |
| 9 | LD Clause | We do not accept this clause. |
| 10 | Authorization: | In case of finalization of order on CGL, it will be executed through any of our authorised dealer. |

Hope you will find the offer in line with your requirement.
Thanking you & looking for better mutual business relation.
**For Crompton Greaves Ltd.**

**Siladitya Khuntia**
LT Motor Division
**Mob - 9776009188**

**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

**APITCO Limited**
8th FLOOR, PARISRAMA BHAVAN,
BASHEERBAGH, HYDERABAD 500 004
Phones: +91- 040-23237333, 23237981,
Fax: +91-40-23298945
e-mail: hyd1_apitco@bsnl.in
Website: www.apitco.org

**India SME Technology Services Ltd**
DFC Building, Plot No.37-38,
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