# DETAILED PROJECT REPORT

ON

# INSTALLATION OF FLUE GAS ANALYSER TO REDUCE EXCESS AIR AND OPTIMISING FURNACE COMBUSTION EFFICIENCY

# (BATALA, JALANDHAR, LUDHIANA











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## Bureau of Energy Efficiency (BEE)

**Prepared By**

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# INSTALLATION OF FLUE GAS ANALYSER TO REDUCE EXCESS AIR AND OPTIMISING FURNACE COMBUSTION EFFICIENCY

**BATALA, JALANDHAR, LUDHIANA FOUNDRY CLUSTER**

***BEE, 2011***

**Detailed Project Report on installation of flue gas analyser to reduce excess air and optimising furnace combustion efficiency**

Foundry SME Cluster, Batala, Jalandhar , Ludhiana (Punjab) (India)

New Delhi: Bureau of Energy Efficiency

Detail Project Report No.: **BJL/FUR/ EXA/01**

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Confederation of Indian Industry

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***Contents***


*List of Annexure* *vii*

*List of Tables* *vii*

*List of Figures* *viii*

*List of Abbreviation* *viii*

*Executive summary* *ix*

*About BEE'S SME program* *xi*

**1. INTRODUCTION ... 1**

1.1. Brief Introduction about the Cluster ... 1

1.1.1. Energy Usage Pattern ... 1

1.1.2. Classification of Units ... 1

1.1.3. Production Wise Unit Breakup ... 2

1.1.4. Products Manufactured ... 2

1.2. Process Flow diagram of a Foundry Cluster ... 2

1.3. Energy performance in existing situation ... 4

1.3.1. Average Production ... 4

1.3.2. Energy Consumption ... 4

1.3.3. Specific Energy Consumption ... 5

1.4. Proposed Technology/Equipment ... 5

1.4.1. Description about the existing technology ... 5

1.5. Establishing the Baseline for the Proposed Technology ... 6

1.5.1. Losses in Existing Technology ... 7

1.6. Barriers in adoption of proposed technology ... 7

1.6.1. Technological Barrier ... 7

1.6.2. Financial Barrier ... 7

1.6.3. Skilled Manpower ... 8

**2. PROPOSED TECHNOLOGY ........ 9**
2.1. Detailed Description of Technology ........ 9
2.1.1. Description of Technology ........ 9
2.1.2. Benefits of Optimizing Combustion Efficiency of Furnace by Reducing Excess Air ........ 10
2.1.3. Technology Specification ........ 11
2.1.4. Suitability or Integration with Existing Process and Reasons for Selection ........ 11
2.1.5. Availability of Technology ........ 11
2.1.6. Source of Technology ........ 9
2.1.7. Terms and Conditions after Sale ........ 9
2.1.8. Process down Time during Implementation ........ 9
2.2. Life Cycle Assessment ........ 9
2.3. Suitable Unit for Implementation of the Identified Technology ........ 9

**3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY ........ 10**
3.1. Technical Benefits ........ 10
3.1.1. Electricity savings per year ........ 10
3.1.2. Fuel consumption savings per year ........ 10
3.1.3. Improvement in product quality ........ 10
3.1.4. Improvement in production ........ 10
3.1.5. Reduction in raw material consumption ........ 10
3.1.6. Reduction in other losses ........ 10
3.2. Monetary Benefits ........ 10
3.3. Social Benefits ........ 11
3.3.1. Improvement in Working Environment in the Plant ........ 11
3.3.2. Improvement in Skill Set of Workers ........ 11
3.4. Environmental Benefits ........ 11

**4. INSTALLATION OF THE PROPOSED TECHNOLOGY....12**

4.1. Cost of Technology Implementation....12

4.1.1. Technology Cost....12

4.1.2. Other Cost....12

4.2. Arrangements of Funds....12

4.2.1. Entrepreneur's Contribution....12

4.2.2. Loan Amount....12

4.2.3. Terms & Conditions of Loan....12

4.3. Financial Indicators....12

4.3.1. Cash Flow Analysis....12

4.3.2. Simple Payback Period....13

4.3.3. Net Present Value (NPV)....13

4.3.4. Internal Rate of Return (IRR)....13

4.3.5. Return on Investment (ROI)....13

4.4. Sensitivity analysis in realistic, pessimistic and optimistic scenarios....13

4.5. Procurement and Implementation Schedule....14

***List of Annexure***

Annexure 1: Energy audit data used for baseline establishment ............................15

Annexure 2: Detailed Technology Assessment Report..........................................16

Annexure 3: Detailed Financial Calculations .........................................................17

Annexure 4: Procurement and implementation schedule .......................................21

Annexure 5: Break-up of Process down Time .......................................................22

Annexure 6: Details of technology service providers .............................................23

Annexure 7: Quotations or Techno-commercial bids for new technology /equipment ..........................................................................................24

***List of Tables***

Table 1.1 Production Wise Unit Breakups.......................................................... 2

Table 1.2 Annual Production Capacities ............................................................ 4

Table 1.3 Annual Energy Consumption (Electricity) ............................................ 4

Table 1.4 Annual Energy Consumption (Coal & Furnace Oil) ............................. 5

Table 1.5 Specific Energy Consumption ............................................................ 5

Table 1.6 Baseline Establishment........................................................................ 6

Table 3.1 Monetary savings...................................................................................10

Table 3.2 Proposed Flue Gas Composition.........................................................11

Table 4.1 Details of Proposed Technology Installation Cost ...............................12

Table 4.2 Financial Indicators of Proposed Technology......................................13

Table 4.3 Sensitivity Analysis in Different Scenarios...........................................14

Table 4.4 Procurement and Implementation Schedule.......................................14

## *List of Figures*


Figure 1.1 Process flow diagram of Typical foundry Units.................................... 3

Figure 1.2 Production Capacity BJL Foundry cluster............................................ 4

Figure 2.1 Combustion efficiency.........................................................................10


### *List of Abbreviations*

| | |
|---|---|
| BEE | Bureau of Energy Efficiency |
| SME | Small and Medium Enterprises |
| DPR | Detailed Project Report |
| GHG | Green House Gases |
| PF | Power Factor |
| EEF | Energy Efficient Motor |
| CDM | Clean Development Mechanism |
| DSCR | Debt Service Coverage Ratio |
| NPV | Net Present Value |
| IRR | Internal Rate of Return |
| ROI | Return on Investment |
| MT | Metric Tonne |
| SIDBI | Small Industries Development Bank of India |

## EXECUTIVE SUMMARY

Confederation of Indian Industry is executing BEE-SME program in Batala, Jalandhar and Ludhiana Foundry Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Batala, Jalandhar and Ludhiana Foundry cluster, is one of the largest Foundry 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 Foundry clusters in India. The main energy forms used in the cluster units are grid electricity & fuel.

Most of the Industrial installations in the country have large electrical loads which are severely inductive in nature, such as motors, large machines etc which results in a high power consumption. Also many foundry units have cupola or rotary furnaces that use coke or furnace oil as fuel. There are particular parameters mentioned set for the exhaust. Deviation from the standards would lead to excess fuel consumption. This can be taken care by having a flue gas analyzer and monitoring the exhaust parameters.

Monitoring of the exhaust flue gas parameters with a flue gas analyzer and setting of the damper settings improves the furnace efficiency. In this case reducing the percentage oxygen content from excess 9% to optimum 6 % would lead to fuel saving by optimising furnace combustion efficiency. It helps in reducing the fuel consumption. Project implementation will lead to reduction in fuel bill by ` 0.48 Lakh per year.

This DPR highlights the details of the study conducted for the Flue gas Analyzer in melting Furnace, possible Energy saving and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis in different scenarios and schedule of Project Implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table.

| S. No. | Particular | Unit | Value |
|---|---|---|---|
| 1 | Project cost | `(in lakh) | 1.00 |

| S. No. | Particular | Unit | Value |
|---|---|---|---|
| 2 | Monetary benefit | `( in lakh) | 0.48 |
| 3 | Debit equity ratio | Ratio | 3:1 |
| 4 | Simple payback period | years | 2.07 |
| 5 | NPV | (in lakh) | 0.76 |
| 6 | IRR | %age | 30.97 |
| 7 | ROI | %age | 26.12 |
| 8 | Process down time | weeks | 0.5 |
| 9 | DSCR | Ratio | 1.97 |
| 10 | $Co_2$ reduction | Tonne/year | 6.4 |

***The projected profitability and cash flow statements indicate that the project implementation will be financially viable and technically feasible.***

# ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve energy performance in 29 selected SMEs clusters. Batala, Jalandhar and Ludhiana Foundry Cluster is one of them. The BEE's SME Programme intends to enhance 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 of energy efficiency projects in the clusters.

***__Activity 3:__ Implementation of Energy Efficiency Measures***

To implement the technology up gradation projects in 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

## 1.1. Brief Introduction about the Cluster

Indian foundry industry is very energy intensive. The energy input to the furnaces and the cost of energy play an important role in determining the cost of production of castings. Major energy consumption in medium and large scale foundry industry is the electrical energy for induction and Arc furnaces. Furnace oil is used in rotary furnaces. In Small foundry industry, coal is used for metal melting in Cupola furnaces. The energy costs contribute about 25 - 30% of the manufacturing cost in Indian foundry industry.

There are approximately 450 units, engaged in Foundry Cluster (automobile parts, agricultural implements, machine tools, diesel engine components, manhole covers, sewing machine stands, pump-sets, decorative gates and valves) production. The major locations wherein the units are spread are G.T. Road, Industrial area, Focal Point in Batala. In Jalandhar Dada Colony Industrial Area, Focal point, Focal Point Extn, Udyog Nagar, I.D.C, Kapurthala Road & Preet Nagar. In Ludhiana Focal Point Phase 5 to 8, Janta Nagar, Bhagwan Chowk Area & Industrial area – A/B. .

Availability of Electricity in Batala – across Dhir Road, GT Road is an issue; power is available from the grid for maximum 12/14 hours a day. There are some units in Jalandhar and Ludhiana having induction furnace in the range of 500 kg to 1 ton capacity whereas other units which are using local scrap as well as have high melting temperatures are having cupola and rotary furnace and has a capacity of minimum 5 ton per day.

The foundry produces a wide variety of castings such as manhole covers, pipe and pipe fittings, sanitary items, tube well body, metric weights, automobile components, railway parts, electric motor, fan body etc. 90% of the castings produced are from the SSI sector.

### 1.1.1. Energy Usage Pattern

Major energy sources being used in foundry cluster are electricity and fuels such as Coal, Furnace Oil, and Diesel. Electrical energy is being used in melting of iron in induction furnaces, operation of electrical utilities and thermal energy is being used in cupola furnaces operation.

### 1.1.2. Classification of Units

Broadly units are classified with respect to production capacity;

- Large Scale Units

- Medium Scale Units
- Small Scale Units

### 1.1.3. Production Wise Unit Breakup

Foundry cluster at Batala, Jalandhar and Ludhiana can be broken into three categories viz. small, medium and large size unit. Table 1.2 shows that production wise breakup of Foundry cluster.

**Table 1.1 Production Wise Unit Breakups**

| S. No. | Type of Unit | Production Capacity |
|---|---|---|
| 1 | Large scale unit | More than 1500 MT |
| 2 | Medium scale unit | 250 to 1500 MT |
| 3 | Small scale unit | Less than 250 MT |

### 1.1.4. Products Manufactured

Foundry SME cluster at Batala, Jalandhar and Ludhiana produces a wide variety of castings such as manhole covers, pipe and pipe fittings, sanitary items, tube well body, metric weights, automobile components, railway parts, electric motor, fan body etc.

## 1.2. Process Flow diagram of a Foundry Cluster

The manufacturing process is described as below;

***Melting Section:***

The raw material is melted in melting furnace. The melting furnace can be an induction furnace or rotary or arc furnace or cupola furnace. Molten metal from the melting furnace is tapped in Ladles and then transferred to the holding furnaces. Typically the holding furnaces are induction furnaces. The holding furnace is used to maintain the required molten metal temperature and also acts as a buffer for storing molten metal for casting process. The molten metal is tapped from the holding furnace whenever it is required for casting process.

***Sand Plant:***

Green sand preparation is done in the sand plant. Return sand from the molding section is also utilized again after the reclamation process. Sand Muller's are used for green sand preparation. In the sand millers, green sand, additives and water are mixed in appropriate proportion. Then the prepared sand is stored in bunkers for making moulds.

***Pattern Making:***

Patterns are the exact facsimile of the final product produces. Generally these master patterns are made of Aluminum or wood. Using the patterns the sand moulds are prepared.

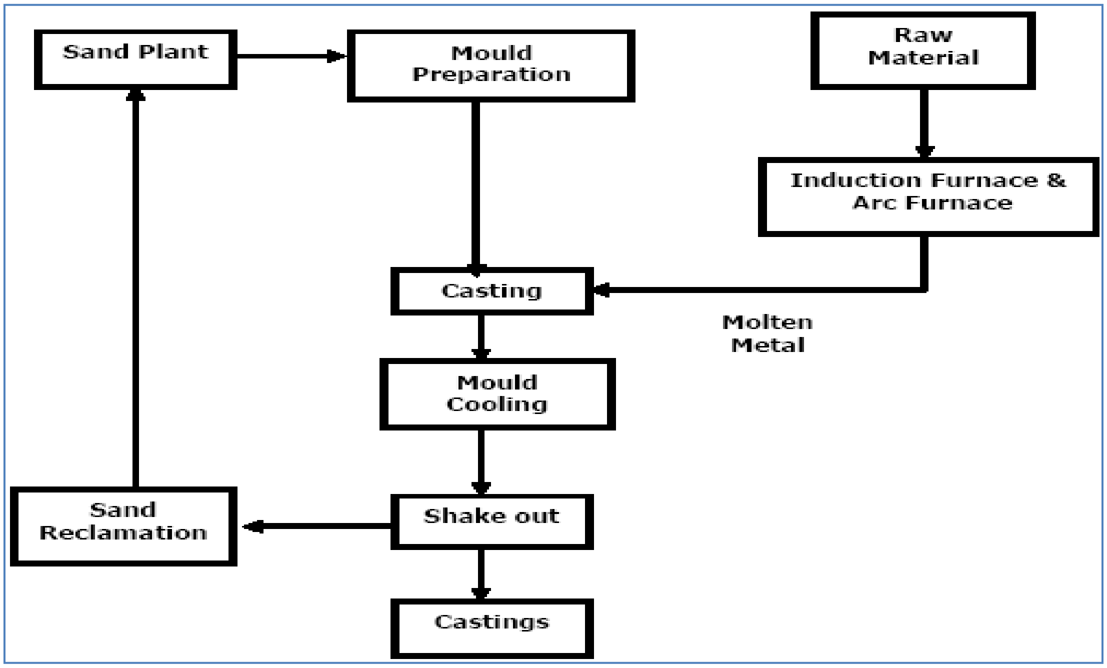


**Figure 1.1 Process flow diagram of Typical foundry Units**

***Mould Preparation:***

In small-scale industries still the moulds are handmade. Modern plants are utilizing pneumatic or hydraulically operated automatic molding machines for preparing the moulds. After the molding process if required the cores are placed at the appropriate position in the moulds. Then the moulds are kept ready for pouring the molten metal.

***Casting:***

The molten metal tapped from the holding furnace is poured into the moulds. The molten metal is allowed to cool in the moulds for the required period of time and the castings are produced. The moulds are then broken in the shake out for removing the sand and the used sand is sent back to the sand plant for reclamation and reuse. The castings produced are sent to fettling section for further operations such as shot blasting, heat treatment etc. depending upon the customer requirements.

## 1.3. Energy performance in existing situation

Major energy sources being used in foundry cluster are electricity and fuels such as Coal, Furnace Oil, and Diesel. Electrical energy is being used in melting of iron in induction furnaces, operation of electrical utilities and thermal energy is being used in cupola furnaces operation.

### 1.3.1. Average Production

The Average Production of the Foundry Units in above mentioned category during Year 2009-10 are as follows;

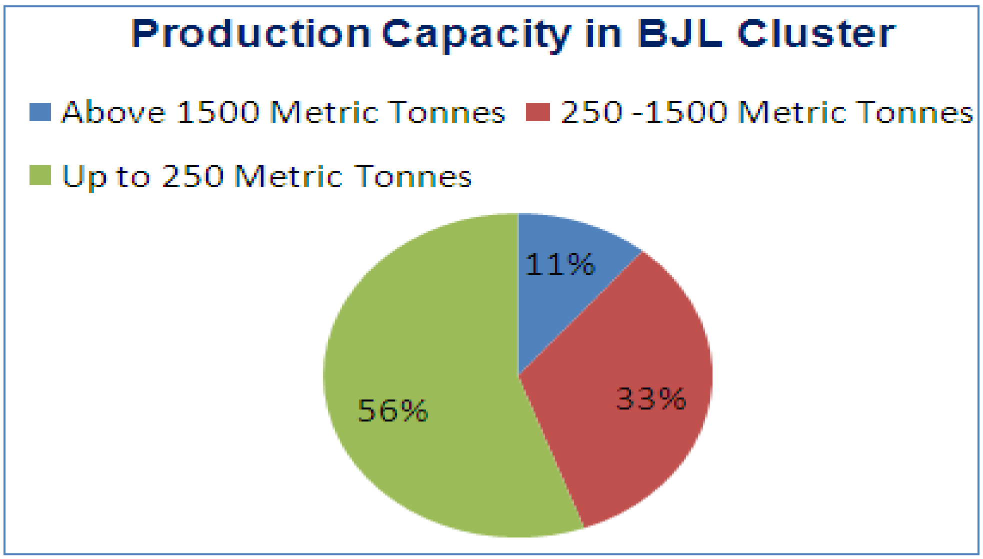


**Figure 1.2 Production Capacity BJL Foundry cluster**

**Table 1.2 Annual Production Capacities**

| S. No. | Production Capacities | % of Units |
|---|---|---|
| 1 | Above 1500 Metric Tonne | 11 |
| 2 | 250 to 1500 Metric Tonne | 33 |
| 3 | Below 250 Metric Tonne | 56 |

### 1.3.2. Energy Consumption

Energy consumption (electrical) in a typical Foundry plant for different types of products is given in Table 1.3 below:

**Table 1.3 Annual Energy Consumption (Electricity)**

| Electricity Consumption Pattern | Unit Consumed in kWh | Total Unit Consumption kWh |
|---|---|---|
| Blower Motor for Cupola | 962100 | |
| Rotary Motor for Rotary Furnace | 330000 | 26.92 Lakhs |
| Melting material in Induction Furnace | 1400000 | |

**Table 1.4 Annual Energy Consumption (Coal & Furnace Oil)**

| Thermal Energy Consumption Pattern | Consumption per Year |
|---|---|
| Coal for Cupola | 5000 Metric Tonnes |
| Furnace Oil for Rotary Furnace | 17.8 Lakhs Litter |

### 1.3.3. Specific Energy Consumption

Specific energy consumption of Foundry units depends upon the production capacity & their corresponding power consumption. Specific energy consumption also depends on type of furnace. A brief summary of specific energy consumption depending upon type of furnace is shown in below table;

**Table 1.5 Specific Energy Consumption**

| S. No | Types of Furnace | Types of Fuel | Specific Fuel Consumption / One kg Molten Material | Cost of Fuel in ` |
|---|---|---|---|---|
| 1 | Cupola | Coal | 0.2 kg | 2.6 |
| 2 | Rotary Furnace | Furnace Oil | 0.15 Lt | 4.20 |
| 3 | Induction Furnace | Electricity | 0.6 kWh | 3.0 |

**Assuming Coal rate Rs.15.0 /kg*

**Assuming F.O rate Rs. 28.0 /Lt.*

**Assuming electricity rate Rs 5.0/kWh*

## 1.4. Proposed Technology/Equipment

### 1.4.1. Description about the existing technology

During energy audit in the foundry units at Batala, Jalandhar and Ludhiana region, it was found that maximum units are using Blast Copula for melting. The installed furnace is utilized for melting the material at temperature of 1300 to 1500$^{o}$C. Cupola is the most common type of melting furnace used for the production of grey iron castings in all foundries. Some of the contributing factors that were identified for this poor energy performance are listed below.

- Incorrect blast rate
- Lower blast air pressure
- Incorrect distribution of air between the top and lower tuyeres
- Turbulent (non-linear) entry of air into the cupola

- Incorrect sizing of cupola parameters such as tuyere area, well depth, and stack height among others
- Poor operating and maintenance practices
- Presence of excess oxygen in exhaust gas
- Poor control of feed materials (shape, size, weight, sequence)

### 1.5. Establishing the Baseline for the Proposed Technology

Presently all the Foundry units in Batala, Jalandhar and Ludhiana are operating with conventional cupola furnace. Coal is being used in cupola furnaces in foundry sector. Flue gas analyses were carried out on site of cluster units to check the excess air levels of furnace. Results of flue gas analysis are mentioned below;

- **Flue Gas Analysis:**

Parameters

| | |
|---|---|
| Excess Oxygen % | 9.95 % |
| Excess Air % | 90 % |
| Flue Gas Temp. $^0$C | 250-300 |

It can be interpreted from the above that furnace is being operated at higher oxygen levels than the recommended value. Presently Foundry units in Batala, Jalandhar and Ludhiana are operating blast cupola furnaces without any flue gas analyzer. Installation of a flue gas analyzer will help optimize the combustion efficiency by reducing excess air.

**Table 1.6 Baseline Establishment**

| S. No. | Parameters | Unit | Value |
|---|---|---|---|
| 1. | Oxygen % in Flue Gases | % | 9.95 |
| 2. | Excess Air in Flue Gases | % | 90.0 |
| 3. | Temperature of Flue gases | $^0$C | 250 - 300 |
| 4. | Raw Material | Tonne / batch | 2.38 |
| 5. | Coal Consumption (` 15/Kg) | Kg/batch | 384.8 |
| 6. | Raw Material rejection | Kg/batch | 160 |
| 7. | ***Cost per batch*** | ***`/ batch*** | ***5772*** |
| 8. | Annual Production Cost | `( in lakh)/ year | 14.43 |
| 9. | Annual Coal Consumption | Tonne / Annum | 96.2 |

### 1.5.1. Losses in Existing Technology

- **Losses due to lower $CO_2$ level**

When the $CO_2$ content of the flue gas is low (less than 8 percent) heat is lost in flue gases. Low carbon dioxide content may be caused by;

- ✓ Small burner nozzle
- ✓ Air leakage into the furnace or boiler
- ✓ Under-firing in the combustion chamber

- **Losses due to higher oxygen level**

Higher oxygen level in flue gas indicates that these utilities are fed with more air than the actual requirement for complete burning. It means higher loss due to heat carried away by the flue gases, because with each unit volume of oxygen about 3.5 volume of nitrogen gas is also coming with the air and carrying away the heat from the furnace as flue gases. On the other side forced draft fan is doing more work and consuming much power to supply this excess amount of air.

## 1.6. Barriers in adoption of proposed technology

### 1.6.1. Technological Barrier

- Lack of awareness and information of the loss in terms of coal consumption of conventional cupola and a divided blast cupola furnace
- Due to lack of technical knowledge and expertise, conventional cupola furnaces are used in the Foundry units.
- In this cluster, like many others, there is lack of leadership to take up the energy efficiency projects in the plant.

### 1.6.2. Financial Barrier

Availing finance is not the major issue. Among the SMEs, the larger units, if convinced they 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.

### 1.6.3. Skilled Manpower

In Foundry cluster at Batala, Jalandhar and Ludhiana, the availability of skilled manpower is one of the limitations; this issue gets further aggravated due to more number of Foundry units as compared to the availability of skilled manpower. For major equipments of Foundry units like Cupola furnace for maintenance or the repair works of these equipments take care by the equipment suppliers itself.

# 2. PROPOSED TECHNOLOGY

## 2.1. Detailed Description of Technology

### 2.1.1. Description of Technology

Combustion flue gas analysis has been used by power plant operators for decades as a method of optimizing the fuel/air ratio. By measuring the amount of excess oxygen and/or CO in the flue gases resulting from combustion, plant operators can ensure that their facility works at the best heat rate efficiency and avoids unnecessary NOx and greenhouse gas emissions. The theoretical ideal, or the stoichiometric point, is that in which all fuel is reacted with available oxygen in the combustion air, with none of any of the two reactants left over. Operating furnaces never attain this ideal, however, and the best operating point usually will result in 1-3 per cent excess air, and 0-200PPM of CO. This optimum operating point is different for every furnace, and also varies for differing loads, or firing rates. A higher firing rate induces greater turbulence through the burner(s), providing better mixing of fuel and air, and enabling operation with a lower excess $O_2$ before unburned fuel (represented by CO) appears, or “breaks through”. Again, this ideal $O_2$ operating point will vary with firing rate, so a function generator is usually developed from test data to assign the ideal $O_2$ control point based upon an index of firing rate, such as fuel flow or steam flow.

Large furnace operators will typically dynamically control oxygen to the optimal level via the distributed control system. Control of CO is more difficult, since target levels are usually in the PPM range, and making fan or damper adjustments small enough to control at these low levels is difficult. Many operators will make manual adjustments based upon the CO signal, or use the measurement as a feed forward signal to adjust the $O_2$ control set point upwards or downwards.

Combustion flue gas analysis has long been a key tool for optimizing the combustion of large power generation boilers. Innovative customers have exploited reliable analyzers to achieve new goals, such as NOx reduction, and slag prevention. The measurement of Oxygen has been dominated by the in situ $ZrO_2$ probe, which provides a point measurement requiring an array of probes across a flue gas duct in order to arrive at a good average reading. Good granularity is afforded by this array, opening a furnace diagnostic capability to detect burner and coal mill problems. The Measurement of CO is most commonly made with infra red technology in either an extractive configuration, across duct line-of–sight configuration, or dual pass probe configuration. CO is typically found in low PPM levels, so automatic control on CO is more difficult. New tunable diode laser technology has the capability of measuring $O_2$, CO and NOx. As with the traditional Infra-red technology, across duct line-of-sight configurations inherently average across a flue gas duct, minimizing the need for multiple instruments, but affording poor granularity within a given optical path.

New installation locations are being attempted, with hotter zones ahead of the economizer producing less abrasive fly ash. Variable insertion probe mounts afford the ability to find the ideal location within a flue gas duct.

Innovative customers use flue gas analyzer to detect leaks in air heaters or duct transitions, and also modify heat rate calculations of in-leakage. Gas turbines do not use flue gas analysis internally, but are increasingly using them to measure the final oxygen from a duct burner ahead of a heat recovery steam generator.

Continued research into fuel cell sensing technology has yielded a new sensor for the measurement of CO in PPM levels.

*Maximum benefit from the use of flue gas analyzers results from close collaboration between instrument suppliers, plant instrument engineers who implement them and operations personnel that use them on a daily basis.*

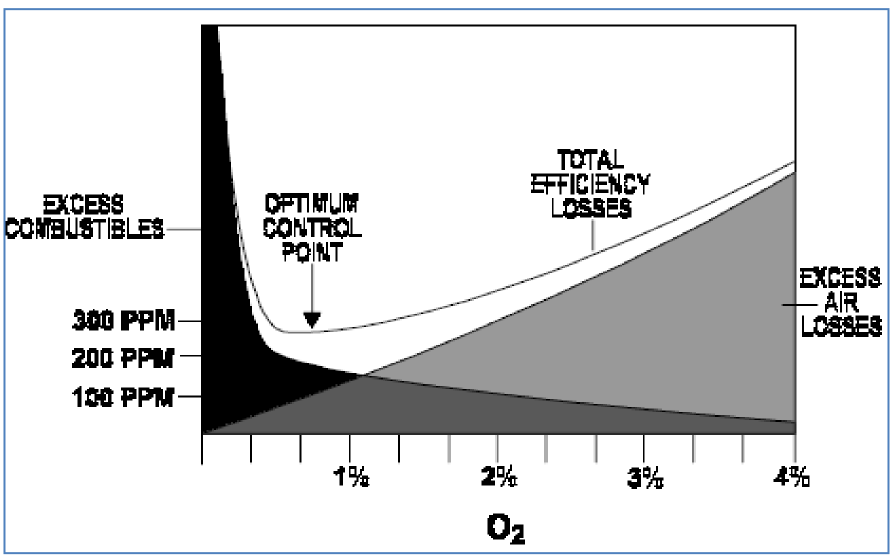


**Figure 2.1 Combustion efficiency**

### 2.1.2. Benefits of Optimizing Combustion Efficiency of Furnace by Reducing Excess Air

By monitoring flue gas from flue gas analyzer and correspondingly / simultaneously controlling excess air quantity by the damper at the blower side, coal consumption would be reduced detailed calculation are at annexure 2. And since extra unwanted air would be avoided, it will result in higher furnace temperature, hence high melting temperature. Implementation of above project gives a good energy saving potential in fuel. This project needs investment cost only for the flue gas analyzer, and then setting the damper.

- **Standard Bench Mark Values for coal Furnaces:**

| | |
|---|---|
| Air required per Kg of coal | 10.8% |
| Flue gas per Kg of coal | 11.7% |
| $CO_2$ in Flue gas | 10-13% |
| Excess air | 30 to 60% |

### 2.1.3. Technology Specification

For implementation of the proposed project, the technical specifications are provided in Annexure 7.

### 2.1.4. Suitability or Integration with Existing Process and Reasons for Selection

This is the simplest and widely accepted measure for energy cost reduction in the Foundry industry. It does not affect the process but improves the process efficiency since these furnaces save fuel consumption.

**Advantages:-**

- Optimum well capacity
- Less losses
- High efficiency
- Wide range with good efficiency
- Optimum blower specifications (quantity and pressure)
- Optimum ratio of the air delivered
- Minimum pressure drop and turbulence of the combustion air

### 2.1.5. Availability of Technology

Now days when energy cost is high, it is poor practice to use a conventional cupola furnace. As far as technology is concerned Flue gas Analyzers are available in local/ national market. It is well proven technology which is adopted in many of the other similar and dissimilar units.

### 2.1.6. Source of Technology

Local vendors can arrange Flue gas Analyzer at order. Local service providers are also available at Batala, Jalandhar and Ludhiana. More details of service provider are given in annexure 6.

### 2.1.7. Terms and Conditions after Sale

Warranty period of one year will be provided from the date of invoice against any manufacturing defects. Details are provided in Annexure 7.

### 2.1.8. Process down Time during Implementation

Technology provider will bring the complete setup for the proposed project from their site and make all the arrangements for implementation at the client's site. And the process will be effected for a period of 3 days, when all the required is at the client's site.

## 2.2. Life Cycle Assessment

Life of the proposed flue gas analyzer will be around 5 to 10 years which depends on the operating conditions and maintenance at client's side.

## 2.3. Suitable Unit for Implementation of the Identified Technology

For estimation of the saving potential on implementation of this project, here the Foundry units engaged in making castings, having furnaces can be considered.

## 3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

### 3.1. Technical Benefits

#### 3.1.1. Electricity savings per year

Project of Installation of flue gas analyzer will not result in savings of electricity consumption but will lead to reduction in the fuel consumption.

#### 3.1.2. Fuel savings per year

The fuel consumption will reduce by 3.21 tonne per annum.

#### 3.1.3. Improvement in product quality

This project is not contributing to any improvement in product quality but the production environment and efficiency.

#### 3.1.4. Improvement in production

This project is not contributing for increasing in production in Foundry units.

#### 3.1.5. Reduction in raw material consumption

This project is not contributing for increasing in raw material consumption of Foundry units.

#### 3.1.6. Reduction in other losses

This project does not contribute to any reduction in any loss.

### 3.2. Monetary Benefits

Annual monetary savings with installation of Flue Gas Analyzer will be `0.48 Lakhs per year with reduction in consumption of Coal is estimated to be about 3.21 tonne per year.

**Table 3.1 Monetary savings**

| S. No. | Parameters | Units | Existing System | Proposed System |
|---|---|---|---|---|
| 1. | Raw Material | Tonne / batch | 2.38 | 2.38 |
| 2. | Coal Consumption (` 15/Kg) | Kg/batch | 384.8 | 372.0 |
| 3. | Raw Material rejection | Kg/batch | 160 | 160 |
| 4. | *Cost per batch* | *`/ batch* | *5772* | *5579* |
| 5. | Annual Production Cost | `( in lakh)/ year | 14.43 | 13.95 |
| 6. | Annual Coal Consumption | Tonne/ year | *96.2* | *92.99* |
| 7. | Annual Production | Tonne/ year | 555 | |
| 8. | Annual Coal Consumption reduction | Tonne/ year | 3.21 | |
| 9. | Monetary savings | `( in lakh)/ year | 0.48144 | |

**Table 3.2 Proposed Flue Gas Composition**

| S. No. | Parameters | Units | Value |
|---|---|---|---|
| 1. | Oxygen % in Flue Gases | % | 6.00 |
| 2. | Excess Air in Flue Gases | % | 40.0 |
| 3. | Temperature of Flue gases | $^{0}$C | 300 |
| 4. | Difference on Excess Air | % | 50.0 |
| 5. | Fuel Savings | % | 3.34 |
| 6. | Coal Savings | Tonne/ Annum | 3.21 |
| 7. | Monetary savings | `/Annum | 48143.53 |

### 3.3. Social Benefits

#### 3.3.1. Improvement in Working Environment in the Plant

The proposed system will burn the fuel efficiently, so less fuel would be required every batch thus working environment in the plant will be cleaner when compared to the existing system.

#### 3.3.2. Improvement in Skill Set of Workers

The technical skills of workers will definitely improve. Training on the regular maintenance will help in improving the technical understanding of the workers.

### 3.4. Environmental Benefits

The major GHG reduction would be in $CO_2$ reduction. Emission reductions are estimated around 6.4 tons of $CO_2$ per annum.

# 4. INSTALLATION OF THE PROPOSED TECHNOLOGY

## 4.1. Cost of Technology Implementation

The cost of technology quoted by the vendor is ` 0.97 lakh.

**Table 4.1 Details of Proposed Technology Installation Cost**

| S. No. | Particular | Cost in ` |
|---|---|---|
| 1 | Equipment cost | 94780 |
| 2 | Taxes @ 2.0% | 1896 |
| 3 | Other cost | 3000 |
| 4 | Total Cost | 99676 |

### 4.1.1. Technology Cost

Cost of the project is about `1.00 Lakhs which includes the purchase of Flue Gas Analyzer.

### 4.1.2. Other Cost

Other costs required will be `0.03 Lakh which includes commissioning, manpower cost, transportation etc.

## 4.2. Arrangements of Funds

### 4.2.1. Entrepreneur's Contribution

Entrepreneur will contribute 25% of the total project cost which is `0.25 Lakhs.

### 4.2.2. Loan Amount

Remaining 75% cost of the proposed project will be borrowed from bank, which is ` 0.75 Lakhs.

### 4.2.3. Terms & Conditions of Loan

The interest rate is considered at 10% which is normal rate of interest for energy efficiency 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 8 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below. The cost of equipment considered is inclusive of hot water storage tanks also.

- The Operation and Maintenance cost is estimated at 4 % of cost of total project with 5 % 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.

Based on the above assumptions, profitability and cash flow statements have been prepared and calculated in Annexure-3.

#### 4.3.2. Simple Payback Period

The total project cost of the proposed technology is ` 1.00 Lakhs and monetary savings due to reduction in Coal consumption is ` 0.48 Lakhs hence, the simple payback period works out to be 2.07 years.

#### 4.3.3. Net Present Value (NPV)

The Net present value of the investment at 10% works out to be `0.76Lakhs.

#### 4.3.4. Internal Rate of Return (IRR)

The after tax Internal Rate of Return of the project works out to be 30.97%. 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 26.12%.

**Table 4.2 Financial Indicators of Proposed Technology**

| S No | Particular | Unit | Value |
|---|---|---|---|
| 1 | Simple Payback | Year | 2.07 |
| 2 | NPV | ` In Lakh | 0.76 |
| 3 | IRR | %age | 30.97 |
| 4 | ROI | %age | 26.12 |
| 5 | DSCR | Ratio | 1.97 |

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

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 rupees savings or decrease in rupees savings. For the purpose of sensitive analysis, two following scenarios have been considered.

- **Optimistic scenario (Increase in monetary savings by 5%)**
- **Pessimistic scenario (Decrease in monetary 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.

**Table 4.3 Sensitivity Analysis in Different Scenarios**

| Scenario | Monetary Benefit( `Lakh/year) | IRR (%) | NPV(in Lakh) | ROI (%) | DSCR |
|---|---|---|---|---|---|
| **Pessimistic** | 0.46 | 28.59 | 0.67 | 25.86 | 1.87 |
| **Base** | 0.48 | 30.97 | 0.76 | 26.12 | 1.97 |
| **Optimistic** | 0.51 | 33.32 | 0.85 | 26.35 | 2.08 |

### 4.5. Procurement and Implementation Schedule

Procurement and implementation schedule required for implementation of this technology is about 7 weeks and 3 days required as a process break down. Details of procurement and implementation schedules are shown in Table 4.4 below

**Table 4.4 Procurement and Implementation Schedule**

| S. No. | Activities | Weeks | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | **Identification of furnace** | | | | | | | |
| 2 | **Planning and material order** | | | | | | | |
| 3 | **Procurement** | | | | | | | |
| 4 | **Commissioning** | | | | | | | |

**ANNEXURES**

**Annexure 1: Energy audit data used for baseline establishment**

- **Flue Gas Analysis:**

Parameters

| | |
|---|---|
| Excess Oxygen % | 9.95 % |
| Excess Air % | 90 % |
| Flue Gas Temp. $^0C$ | 250-300 |

| S. No. | Parameters | Unit | Value |
|---|---|---|---|
| 1. | Oxygen % in Flue Gases | % | 9.95 |
| 2. | Excess Air in Flue Gases | % | 90.0 |
| 3. | Temperature of Flue gases | $^0C$ | 250 - 300 |
| 4. | Raw Material | Tonne / batch | 2.38 |
| 5. | Coal Consumption (` 15/Kg) | Kg/batch | 384.8 |
| 6. | Raw Material rejection | Kg/batch | 160 |
| 7. | ***Cost per batch*** | ***₹/ batch*** | ***5772*** |
| 8. | Annual Production Cost | `( in lakh)/ year | 14.43 |
| 9. | Annual Coal Consumption | Tonne / Annum | 96.2 |

.

## Annexure 2: Detailed Technology Assessment Report

| S. No. | Parameters | Units | Existing System | Proposed System |
|---|---|---|---|---|
| 1. | Raw Material | Tonne / batch | 2.38 | 2.38 |
| 2. | Coal Consumption (` 15/Kg) | Kg/batch | 384.8 | 372.0 |
| 3. | Raw Material rejection | Kg/batch | 160 | 160 |
| 4. | ***Cost per batch*** | ***` batch*** | ***5772*** | ***5579*** |
| 5. | Annual Production Cost | `( in lakh)/ year | 14.43 | 13.95 |
| 6. | Annual Coal Consumption | **Tonne/ year** | ***96.2*** | ***92.99*** |
| 7. | **Annual Production** | **Tonne/ year** | **555** | |
| 8. | Annual Coal Consumption reduction | **Tonne/ year** | **3.21** | |
| 9. | **Monetary savings** | **`( in lakh)/ year** | **0.48144** | |

| S. No. | Parameters | Units | Value |
|---|---|---|---|
| 1. | Oxygen % in Flue Gases | % | 6.00 |
| 2. | Excess Air in Flue Gases | % | 40.0 |
| 3. | Temperature of Flue gases | $^0C$ | 300 |
| 4. | Difference on Excess Air | % | 50.0 |
| 5. | Fuel Savings | % | 3.34 |
| 6. | Coal Savings | Tonne/ Annum | 3.21 |
| 7. | Monetary savings | `/Annum | 48143.53 |

## Annexure 3: Detailed Financial Calculations

| Name of the Technology | Flue Gas Analyzer | | |
|---|---|---|---|
| **Details** | **Unit** | **Value** | **Basis** |
| No. of Operating Days | Days | 250 | |
| No. of Shifts/ Hours | No. / Hours | 1 / 8 | |
| **Proposed Investment** | | | |
| Plant & Machinery | ` (in lakh) | 0.97 | |
| Civil Work | ` (in lakh) | 0.00 | |
| Erection & Commissioning | ` (in lakh) | 0.03 | |
| Misc. Cost | ` (in lakh) | 0.00 | |
| Total Investment | ` (in lakh) | 1.00 | |
| **Financing pattern** | | | |
| Own Funds (Equity) | ` (in lakh) | 0.25 | Feasibility Study |
| Loan Funds (Term Loan) | ` (in lakh) | 0.75 | Feasibility Study |
| Loan Tenure | Years | 5.00 | Assumed |
| Moratorium Period | Months | 6.00 | Assumed |
| Repayment Period | Months | 66.00 | Assumed |
| Interest Rate | %age | 10.00% | |
| **Estimation of Costs** | | | |
| O & M Costs | % on Plant & Equip | 4.00 | Feasibility Study |
| Annual Escalation | %age | 5.00 | Feasibility Study |
| **Estimation of Revenue** | | | |
| Coal Savings | Tonne/Year | 3.21 | |
| Cost of Coal | `/Tonne | 15000 | |
| 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 | 0.75 | 0.04 | 0.71 | 0.09 |
| 2 | 0.71 | 0.11 | 0.60 | 0.07 |
| 3 | 0.60 | 0.15 | 0.45 | 0.05 |
| 4 | 0.45 | 0.19 | 0.26 | 0.04 |
| 5 | 0.26 | 0.19 | 0.07 | 0.02 |
| 6 | 0.07 | 0.07 | 0.00 | 0.00 |
| | | 0.75 | | |

***WDV Depreciation*** **`(in lakh)**

| Particulars / years | 1 | 2 |
|---|---|---|
| **Plant and Machinery** | | |
| Cost | 1.00 | 0.20 |
| Depreciation | 0.80 | 0.16 |
| WDV | 0.20 | 0.04 |

***Projected Profitability*** **` (in lakh)**

| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Electricity savings | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 |
| Total Revenue (A) | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 |
| **Expenses** | | | | | | | | |
| O & M Expenses | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 |
| Total Expenses (B) | 0.04 | 0.04 | 0.04 | 0.05 | 0.05 | 0.05 | 0.05 | 0.06 |
| PBDIT (A)-(B) | 0.44 | 0.44 | 0.44 | 0.44 | 0.43 | 0.43 | 0.43 | 0.43 |
| Interest | 0.09 | 0.07 | 0.05 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 |
| PBDT | 0.35 | 0.37 | 0.38 | 0.40 | 0.42 | 0.43 | 0.43 | 0.43 |
| Depreciation | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| PBT | 0.30 | 0.32 | 0.33 | 0.35 | 0.36 | 0.38 | 0.38 | 0.37 |
| Income tax | 0.00 | 0.07 | 0.13 | 0.14 | 0.14 | 0.15 | 0.15 | 0.14 |
| Profit after tax (PAT) | 0.30 | 0.25 | 0.20 | 0.21 | 0.22 | 0.23 | 0.23 | 0.23 |

***Computation of Tax*** **` (in lakh)**

| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Profit before tax | 0.30 | 0.32 | 0.33 | 0.35 | 0.36 | 0.38 | 0.38 | 0.37 |
| Add: Book depreciation | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Less: WDV depreciation | 0.80 | 0.16 | - | - | - | - | - | - |
| Taxable profit | (0.44) | 0.21 | 0.38 | 0.40 | 0.42 | 0.43 | 0.43 | 0.43 |
| Income Tax | - | 0.07 | 0.13 | 0.14 | 0.14 | 0.15 | 0.15 | 0.14 |

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

| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Share Capital (D) | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| Reserves & Surplus (E) | 0.30 | 0.55 | 0.75 | 0.96 | 1.18 | 1.41 | 1.64 | 1.87 |
| Term Loans (F) | 0.71 | 0.60 | 0.45 | 0.26 | 0.07 | 0.00 | 0.00 | 0.00 |
| Total Liabilities (D)+(E)+(F) | 1.26 | 1.40 | 1.45 | 1.47 | 1.51 | 1.66 | 1.89 | 2.12 |
| **Assets** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Gross Fixed Assets | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Less Accumulated Depreciation | 0.05 | 0.11 | 0.16 | 0.21 | 0.26 | 0.32 | 0.37 | 0.42 |
| Net Fixed Assets | 0.94 | 0.89 | 0.84 | 0.79 | 0.73 | 0.68 | 0.63 | 0.58 |
| Cash & Bank Balance | 0.32 | 0.51 | 0.61 | 0.69 | 0.77 | 0.98 | 1.26 | 1.55 |
| TOTAL ASSETS | 1.26 | 1.40 | 1.45 | 1.47 | 1.51 | 1.66 | 1.89 | 2.12 |
| Net Worth | 0.55 | 0.80 | 1.00 | 1.21 | 1.43 | 1.66 | 1.89 | 2.12 |
| Debt Equity Ratio | 2.85 | 2.40 | 1.80 | 1.05 | 0.30 | 0.00 | 0.00 | 0.00 |

***Projected Cash Flow*** **` (in lakh)**

| Particulars / Years | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Sources** | | | | | | | | | |
| Share Capital | 0.25 | - | - | - | - | - | - | - | - |
| Term Loan | 0.75 | | | | | | | | |
| Profit After tax | | 0.30 | 0.25 | 0.20 | 0.21 | 0.22 | 0.23 | 0.23 | 0.23 |
| Depreciation | | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Total Sources | 1.00 | 0.35 | 0.30 | 0.25 | 0.26 | 0.27 | 0.28 | 0.28 | 0.28 |

| Particulars / Years | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Application** | | | | | | | | | |
| Capital Expenditure | 1.00 | | | | | | | | |
| Repayment Of Loan | - | 0.04 | 0.11 | 0.15 | 0.19 | 0.19 | 0.07 | 0.00 | 0.00 |
| Total Application | 1.00 | 0.04 | 0.11 | 0.15 | 0.19 | 0.19 | 0.07 | 0.00 | 0.00 |
| Net Surplus | - | 0.32 | 0.19 | 0.10 | 0.08 | 0.09 | 0.21 | 0.28 | 0.28 |
| Add: Opening Balance | - | - | 0.32 | 0.51 | 0.61 | 0.69 | 0.77 | 0.98 | 1.26 |
| Closing Balance | - | 0.32 | 0.51 | 0.61 | 0.69 | 0.77 | 0.98 | 1.26 | 1.55 |

***IRR*** **` (in lakh)**

| Particulars / months | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| Profit after Tax | | 0.30 | 0.25 | 0.20 | 0.21 | 0.22 | 0.23 | 0.23 | 0.23 |
| Depreciation | | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Interest on Term Loan | | 0.09 | 0.07 | 0.05 | 0.04 | 0.02 | 0.00 | - | - |
| Cash outflow | (1.00) | - | - | - | - | - | - | - | - |
| Net Cash flow | (1.00) | 0.44 | 0.37 | 0.31 | 0.30 | 0.29 | 0.28 | 0.28 | 0.28 |
| IRR | 30.97 % | | | | | | | | |
| NPV | 0.76 | | | | | | | | |

***Break Even Point*** **` (in lakh)**

| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **Variable Expenses** | | | | | | | | |
| O & M Expenses (75%) | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| Sub Total(G) | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.04 | 0.04 |
| **Fixed Expenses** | | | | | | | | |
| O & M Expenses (25%) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Interest on Term Loan | 0.09 | 0.07 | 0.05 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 |
| Depreciation (H) | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| Sub Total (I) | 0.15 | 0.13 | 0.12 | 0.10 | 0.08 | 0.07 | 0.07 | 0.07 |
| Sales (J) | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 |
| Contribution (K) | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.44 | 0.44 | 0.44 |
| Break Even Point (L= G/I)% | 33.06% | 28.67% | 26.00% | 22.49% | 18.52% | 15.24% | 14.95% | 15.17% |
| Cash Break Even {(I)-(H)}% | 21.40% | 16.97% | 14.27% | 10.72% | 6.69% | 3.37% | 3.03% | 3.19% |
| Break Even Sales (J)*(L) | 0.16 | 0.14 | 0.13 | 0.11 | 0.09 | 0.07 | 0.07 | 0.07 |

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

| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Total |
|---|---|---|---|---|---|---|---|---|---|
| Net Profit Before Taxes | 0.30 | 0.32 | 0.33 | 0.35 | 0.36 | 0.38 | 0.38 | 0.37 | 2.79 |
| Net Worth | 0.55 | 0.80 | 1.00 | 1.21 | 1.43 | 1.66 | 1.89 | 2.12 | 10.67 |
| | | | | | | | | | 26.12% |

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

| Particulars / Years | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Cash Inflow** | | | | | | | | | |
| Profit after Tax | 0.30 | 0.25 | 0.20 | 0.21 | 0.22 | 0.23 | 0.23 | 0.23 | 1.41 |
| Depreciation | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.32 |
| Interest on Term Loan | 0.09 | 0.07 | 0.05 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 | 0.26 |
| Total (M) | 0.44 | 0.37 | 0.31 | 0.30 | 0.29 | 0.28 | 0.28 | 0.28 | 1.99 |

***DEBT***

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Interest on Term Loan | 0.09 | 0.07 | 0.05 | 0.04 | 0.02 | 0.00 | 0.00 | 0.00 | 0.26 |
| Repayment of Term Loan | 0.04 | 0.11 | 0.15 | 0.19 | 0.19 | 0.07 | 0.00 | 0.00 | 0.75 |
| Total (N) | 0.12 | 0.18 | 0.20 | 0.22 | 0.20 | 0.08 | 0.00 | 0.00 | 1.01 |
| DSCR (M/N) | 3.56 | 2.06 | 1.51 | 1.34 | 1.43 | 3.70 | 0.00 | 0.00 | 1.97 |
| Average DSCR | 1.97 | | | | | | | | |

## Annexure 4: Procurement and implementation schedule

| S. No. | Activities | Weeks | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 1 | Identification of furnace | | | | | | | |
| 2 | Planning and material order | | | | | | | |
| 3 | Procurement | | | | | | | |
| 4 | Commissioning | | | | | | | |

**Annexure 5: Break-up of Process down Time**

| S No | Activities | Weeks | | |
|---|---|---|---|---|
| | | 1/7 | 6/7 | 7/7 |
| 1 | Identification of furnace | | | |
| 2 | Installation of a flue gas analyzer | | | |
| 3 | Testing & Trial | | | |

**Annexure 6: Details of technology service providers**

| S. No. | Source of product | Details of Local vendor / service provider |
|---|---|---|
| 1. | PRISM AUTOMATION PVT. LTD | Mr Deepak Verma<br>S.C.O.: 51, LEVEL-SECOND, SECTOR 47-C, CHANDIGARH-160037<br>Cell: 9316120696, 9316520696, PHONE: 0172-3200696,<br>E-mail: info@prismautomation.in ; prism35@rediffmail.com |
| 2. | INDICA ENGINEERS | Mr Aman Tuli<br>Plot no – 182/74, Industrial Area, Ph – 1, Chandigarh. Tel - 0172- 5062182, Email – indica9@rediffmail.com |

**Annexure 7: Quotations or Techno-commercial bids for new technology /equipment**

# PRISM AUTOMATION PVT. LTD

**S.C.O.: 51, LEVEL-SECOND, SECTOR 47-C, CHANDIGARH-160037**
**Cell: 9316120696, 9316520696, PHONE: 0172-3200696, TELE FAX: 0172-5047696**
**E-mail: info@prismautomation.in ; prism35@rediffmail.com , Web Site: www.prismautomation.in**

## QUOTATION

| | |
|---|---|
| **To,**<br>**M/s CII**<br>**CHANDIGARH**<br><br>**KIND ATTN: MR. ANKIT NAGAR** | **Our Quotation No :- PAPL/11-12/348**<br>**Dated : 27.7.2011**<br><br>**Your Enquiry No:- VERBAL** |

Dear Sir,
We thank you for above referred enquiry. We are pleased to offer our TECHNO-COMMERCIAL OFFER as hereunder. We are confident that the same will be in line with your requirement.

| S.NO | DESCRIPTION | QUANTITY | UNIT PRICE |
|---|---|---|---|
| **1.** | **TESTO 340 - FLUE GAS ANALYSER**<br>**Item Code 0632 3340**<br>testo 340 flue gas analyser, rechargeable battery and calibration protocol included, equipped with $O_2$ sensor & Pressure-/Flow Measurement. A second measurement module must be fitted in testo 340; The instrument will not be able to function otherwise. Three additional measurement modules can be fitted | **1 NO.** | ₹ **94780/-** |
| **2.** | **CO ($H_2$ COMPENSATED) MEASUREMENT MODULE**<br>**Item Code 0393 1100**<br>CO ($H_2$ compensated) measurement module, 0 to 10,000 ppm | **1 NO.** | ₹ **60500/-** |
| **3.** | **NO MEASUREMENT MODULE**<br>**Item Code 0393 1150**<br>NO measurement module, 0 to 3,000 ppm | **1 NO.** | ₹ **65181/-** |

| S.NO | DESCRIPTION | QUANTITY | UNIT PRICE |
|---|---|---|---|
| **4.** | **$SO_2$ MEASUREMENT MODULE**<br>**Item Code 0393 1250**<br>$SO_2$ measurement module, 0 to 5,000 ppm | **1 NO.** | ₹ **71880/-** |
| **5.** | **TRANSPORT CASE FOR TESTO 340**<br>**Item Code 0516 3400**<br>Transport case for analyzer and probes | **1 NO.** | ₹ **18500/-** |
| **6.** | **MAINS UNIT**<br>**Item Code 0554 1096**<br>Mains unit 100 240V for mains operation or battery charging | **1 NO.** | ₹ **5650/-** |
| **7.** | **Flue gas probe, modular, 700 mm immersion depth, incl. probe stop, thermocouple NiCr-Ni (TI) Tmax 500°C and hose 2.2 m** | **1 NO.** | ₹ **32900/-** |
| **8.** | **"Easy Emission" software with USB cable to connect instrument to PC** | **1 NO.** | ₹ **24700/-** |
| **9.** | **SPARE PARTICLE FILTERS (10OFF)**<br>**Item Code 0554 3385**<br>SPARE PARTICLE FILTERS (10OFF) T33X RANGE | **1 NO.** | ₹ **2500/-** |

**COMMERCIAL TERMS**

| | |
|---|---|
| **Payment Terms :- 40% advance , balance against Proforma Invoice** | **Freight: To Pay** |
| **Delivery :- WITH IN 2-3 WEEKS** | **S.T/C.S.T:- 2% AGAINST FORM C** |
| **Excise Duty: NIL** | **P&F:- NIL** |

**Thanking & assuring you our best services all the time.**

**We now wait to receive your valued order.**

**Yours Truly,**

**For Prism Automation Pvt. Ltd**

**DEEPAK VERMA**

**09316120696**

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