DETAILED PROJECT REPORT
ON
MEDIUM FREQUENCY FURNACE IN PLACE OF MAIN FREQUENCY FURNACE
(BATALA, JALANDHAR, LUDHIANA FOUNDRY CLUSTER)











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Bureau of Energy Efficiency (BEE)

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MEDIUM FREQUENCY FURNACE IN PLACE OF MAIN FREQUENCY FURNACE

BATALA, JALANDHAR, LUDHIANA FOUNDRY CLUSTER

BEE, 2011

Detailed Project Report on Medium Frequency Furnace in place of Main Frequency Furnace
Foundry SME Cluster, Batala, Jalandhar , Ludhiana (Punjab) (India)

New Delhi: Bureau of Energy Efficiency

Detail Project Report No.: **BJL/CAP/PF/01**

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We take this opportunity to express our appreciation for the excellent support provided by Foundry Unit Owners, Local Service Providers, and Equipment Suppliers for their active involvement and their valuable inputs in making the program successful and in completion of the Detailed Project Report (DPR).

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CII – AVANTHA Centre for Competitiveness for SMEs
Confederation of Indian Industry
Chandigarh

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List of Abbreviations

BEE	Bureau of Energy Efficiency
SME	Small and Medium Enterprises
DPR	Detailed Project Report
GHG	Green House Gases
DSCR	Debt Service Coverage Ratio
NPV	Net Present Value
IRR	Internal Rate of Return
ROI	Return on Investment
ROI	- Return on Investment
MoP	- Ministry of Power
MSME	- Micro Small and Medium Enterprises
MoMSME	- Ministry of Micro Small and Medium Enterprises
SIDBI	- Small Industrial 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.

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 power consumption. This means loss and wastage of energy and due to which heavy penalties imposed by state electricity boards. This can be taken care by replacing existing main frequency induction furnace with medium frequency induction furnace.

An Induction Furnace is the main energy consumers in any Foundry unit. Main frequency furnace has higher heat loss. This is explicable from the fact that low frequency furnace has lower power density at melting and larger heat loss due to long melting time. Heat efficiency of medium frequency furnace is higher than that of main frequency furnace. The medium frequency furnace can be operated with three times higher power density than the main frequency furnace. This speeds up the melting rate, reduces the cycle and the associated heat losses. This leads to increased operating efficiency of the furnace and accordingly reduces specific energy consumption.

Implementation of medium frequency induction furnace will reduce required energy consumption cost. Project implementation would reduce power consumption by 202.50 MW per year.

This DPR highlights the details of the study conducted for assessing the potential for replacement of existing main frequency furnace by new medium frequency 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 for three different scenarios and schedule of Project Implementation.

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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)	30.08
2	Power saving	MW/Year	202.50
3	Total monetary benefit	`(in lakh)/year	10.13
4	Debit equity ratio	Ratio	3 : 1
5	Simple payback period	Years	2.97
6	NPV	`(in lakh)	6.09
7	IRR	%age	15.96
8	ROI	%age	23.80
9	DSCR	Ratio	1.35
10	Process down time	Days	4
11	CO_2 emission reduction	Tonne/year	164

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.

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.

Classification of Units

Broadly units are classified with respect to production capacity;

- Large Scale Units
- Medium Scale Units
- Small Scale Units

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 1.1 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

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.

A general process flow diagram of foundry cluster is shown in figure below:

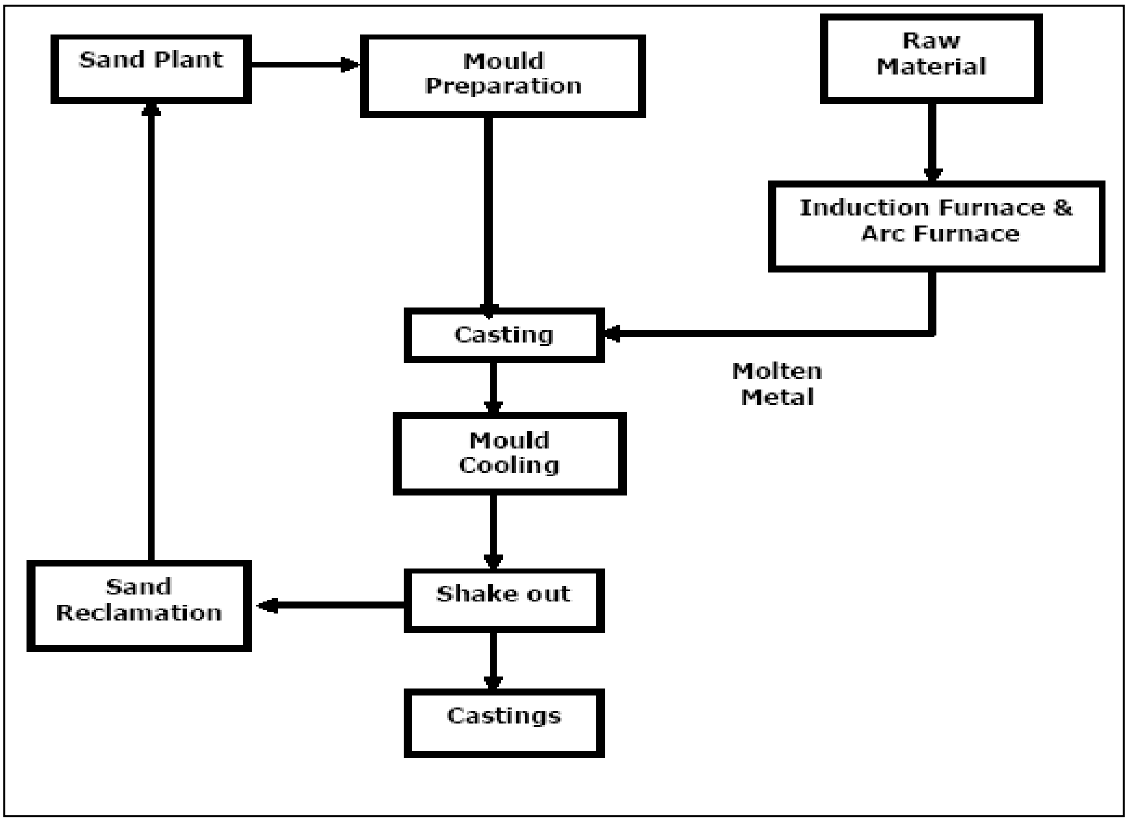

Figure 1.1: Process Flow diagram of a Foundry Cluster

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 Millers 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.

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.

1.2 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.

1.2.1 Average Production

The Average Production of the Foundry Units is represented in figure 1.2 below during Year 2009-10 are as follows;

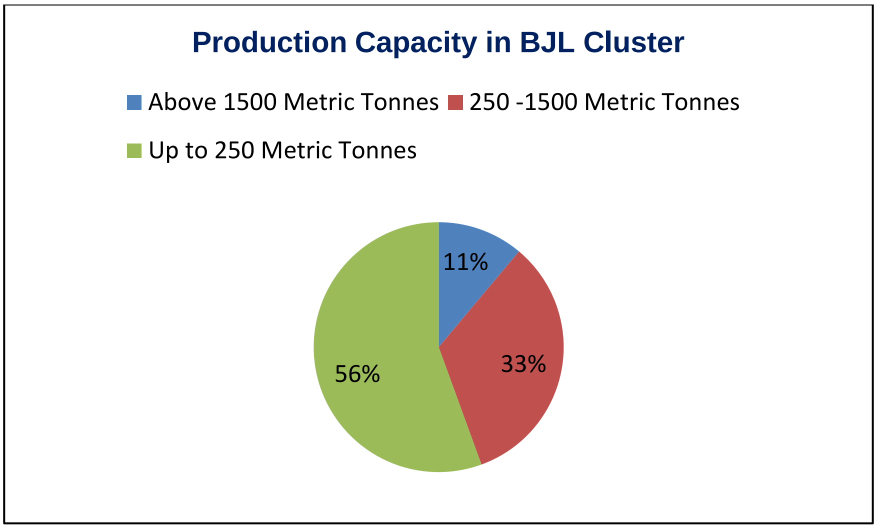

Figure 1.2: Production Capacity BJL Foundry cluster

1.2.2 Energy Consumption

Energy consumption (electrical) in a typical Foundry plant for different types of products is given in Table 1.2 below:

Table 1.2: Annual Energy Consumption

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

Table 1.3: Annual Thermal Energy Consumption

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

1.2.3 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 1.3: Annual Thermal Energy Consumption

Sl. No	Types of Furnace	Types of Fuel	Specific Fuel Consumption / One kg Molten Material	In Terms of Rupees
1	Cupola	Coal	0.2 kg	` 3.00
2	Rotary Furnace	Furnace Oil	0.15 Lt	` 4.20
3	Induction Furnace	Electricity	0.72 kWh	` 3.60

*Assuming Coal rate ` 15.0/kg
*Assuming F.O rate ` 28.0 /Lt.
*Assuming electricity rate ` 5.0/kWh

1.3 Proposed Technology/Equipment

1.3.1 Description about the existing technology

An Induction Furnace is the main energy consumers in any Foundry unit. Main frequency furnace has higher heat loss, where as medium frequency furnace has higher electrical loss. This is explicable from the fact that low frequency furnace has lower power density at melting and larger heat loss due to long melting time. The temperature of the molten metal is in the range of 1400 – 1600 deg C.

1.4 Establishing the Baseline for the Proposed Technology

Presently almost all the Foundry plants at Batala, Jalandhar and Ludhiana are operating with main frequency furnace. Operating condition and specific energy consumption of existing main frequency furnace has been furnished in table 1.4 below:

Table 1.4: Base line for proposed technology

S.No	Parameters	Details
1	Total annual production	2250 tonne
2	Temperature of molten metal	1400 – 1600 ^{o}C
3	Frequency	50 Hz
4	Specific power consumption	680-690 kWh/ton

1.5 Barriers in adoption of propose technology

1.5.1 Technological Barrier

- Lack of awareness and information of the loss in terms of specific power consumption for Main Frequency Furnace and Medium Frequency Furnace
- Due to lack of technical knowledge and expertise, Main Frequency Furnace is 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.

1.5.2 Financial Barrier

Implementation of the proposed project activity requires an investment of ` 30.08 Lakh, which is a significant investment for small industries and not commonly seen in the cluster for the implementation of energy efficiency projects. Also implementation of proposed technology requires regular maintenance and checkups which requires technically skilled and competent workman.

1.5.3 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.

2 PROPOSED TECHNOLOGY

2.1 Detailed Description of Technology

2.1.1 Description of Technology

Foundry units at Batala, Jalandhar and Ludhiana have Main Frequency furnaces installed in the foundry units. In a large size foundry industry main frequency furnace were found to be in operation. The specific power consumption of main frequency furnace was 690 units/ton of molten metal.

Induction furnace can be basically classified into two types depending upon the operating frequency.

- Medium frequency furnace – over 500 Hz
- Main frequency furnace – 50 Hz

The typical specific power consumption between the Main Frequency furnace and the Medium Frequency furnace is given below.

- Main frequency induction furnace - 680 - 690 units/ton
- Medium frequency induction furnace - 590 - 600 units /ton

(Source: IREDA Investor manual for energy efficiency)

Heat efficiency of medium frequency furnace is higher than that of main frequency furnace. The medium frequency furnace can be operated with three times higher power density than the main frequency furnace. This speeds up the melting rate, reduces the cycle and the associated heat losses. This leads to increased operating efficiency of the furnace. Main frequency furnace has higher heat loss, where as medium frequency furnace has higher electrical loss. This is explicable from the fact that low frequency furnace has lower power density at melting and larger heat loss due to long melting time, while medium frequency furnace have higher power density. Heat loss is less due to short melting time and primary electrical loss is higher due to frequency conversion.

The other advantages of medium frequency furnace over main frequency furnaces are

- Absence of molten heel and hence increased productivity
- Reduced start up time
- Less melting time and hence reduced losses

Implementation of the project would reduce the specific power consumption of about 95 units/ton vis-à-vis existing operation.

2.1.2 Technology Specification

Technical specification of proposed medium frequency furnace is as below:

A. APPLICATION REQUIREMENTS			
1.	Alloy to be melted	Steel	Iron
2.	Melt temperature	1650^{O} C	1480^{O} C
B. CHARACTERISTICS OF RECOMMENDED POWER UNIT			
1.	Rated KW	250 KW	
2.	Maximum KW	250 KW	
3.	Nominal Furnace Frequency	1000 Hz	
4.	Line Power Factor	0.95 and above	
5.	KVA required at input of VIP POWER TRAK-R	280 KVA on load	
6.	Melt Rate at 250 KW **	445 Kg/hr – Steel 490 Kg/hr – Iron	
7.	Power Connection	460 V, 3 Phase, 50 Hz	

2.1.3 Suitability or Integration with Existing Process and Reasons for Selection

This is the simplest and widely accepted measure for energy cost reduction in all the industries. It does not affect the process but improves the process efficiency since these types of furnaces have low specific power consumption

Medium-frequency induction furnace operations are a key casting industry process used for melting metals, maintaining molten metal at prescribed temperatures, and warming and adjustment of components Induction furnaces feature the following;

- High thermal efficiency in which substances being processed generates heat through electromagnetic induction leading to energy saving.
- Improved working environments because the heat source is electricity, which reduces heat, noise, dust, and carbon dioxide emission.
- Thanks to quick heating, mental surface oxidation is reduced and the introduction of foreign matter limited, improving product quality and productivity.
- Electrical heating controls facilitate temperature control, stabilizing product quality and saving energy.

2.1.4 Availability of Technology

Now days when energy cost is high, it is poor practice to use Main Frequency Furnaces. As far as technology is concerned Medium Frequency Furnaces are available in local/ national

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market. It is well proven technology which is adopted in many of the other similar and dissimilar units. Local vendors can arrange Medium Frequency Furnaces at order. Local service providers are also available at Batala, Jalandhar and Ludhiana. More details of service provider are given in annexure 5.

2.1.5 Source of Technology

Proposed technology is successfully implemented in other cluster and units get benefited with this. The source of technology is indigenous and locally available.

2.1.6 Terms and Conditions after Sale

Warranty period of one year will be provided from the date of invoice against any manufacturing defects.

2.1.7 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. Total process breakdown period would be 3 to 4 days.

2.2 Life Cycle Assessment

Life of the proposed Medium Frequency Furnaces will be around 10 to 15 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 Main Frequency 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 Medium Frequency Furnaces in place of Main Frequency Furnaces will result in savings of electricity consumption in Foundry units. Total electricity saving would be about 202.5 MW per year.

3.1.2 Improvement in product quality

This project is not contributing to any improvement in product quality.

3.1.3 Improvement in production

This project is not contributing for increasing in production in Foundry units. But it reduces the specific power consumption for producing the same casting.

3.1.4 Reduction in raw material consumption

Raw material consumption will be the same after the implementation of the proposed project.

3.1.5 Reduction in other losses

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

3.2 Monetary Benefits per year

Monetary benefit after implementation of this technology is shown in Table 3.1 below.

Table 3.1: Energy cost saving

S. No.	Particular	Details
1	Power consumption in base case scenario	1552.5 MW/Year
2	Power consumption in proposed case scenario	1350 MW/Year
3	Total power saving	202.5 MW/year
4	Rate of electricity	` 5/kWh
5	Total annual monetary benefit	` 10.13 lakh

3.3 Social Benefits

3.3.1 Improvement in Working Environment in the Plant

There is no significant impact of this project in the working environment in the plant.

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. The technology will reduce grid electricity consumption and emission reductions are estimated at 164 tons of Co_2 per annum.

4 INSTALLATION OF THE PROPOSED TECHNOLOGY

4.1 Cost of Technology Implementation

4.1.1 Technology Cost

Cost of the equipment is ` 25.85 lakh which includes the cost of the power unit, melting furnace etc. as per the quotation provided by the vendors at Annexure 6.

4.1.2 Other Cost

Other costs required will be ` 4.23 lakh which includes taxes, commissioning, manpower cost, transportation etc. Details breakups are provided in the Table 4.1 below:

Table 4.1 Details of Proposed Technology Installation Cost

S. No.	Particular	Cost ` in (Lakhs)
1	Power Unit	16.75
	Melting Furnace	8.00
	Optional (Energy Meter, Switches)	1.10
	Total Equipment cost	***25.85***
2	Excise Duty @ 10%	2.59
	Education Cess on Excise duty @ 2%	0.05
	Higher Education Cess on Excise duty @ 1%	0.03
	CST @ 2% against Form 'C'	0.57
	Applicable Taxes	***3.23***
3	***Misc cost***	***1.00***
4	***Total Cost***	***30.08***

4.2 Arrangements of Funds

4.2.1 Entrepreneur's Contribution

Entrepreneur will contribute 25% of the total project cost which is ` 7.52 Lakh.

4.2.2 Loan Amount

Remaining 75% cost of the proposed project will be borrowed from bank which is ` 22.56 Lakh.

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 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 ` 30.08 Lakh and monetary savings due to reduction in electricity consumption is ` 10.13 Lakh hence, the simple payback period works out to be 2.97 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10% works out to be ` 6.09 Lakh.

4.3.4 Internal Rate of Return (IRR)

The after tax Internal Rate of Return of the project works out to be 15.96%. 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 23.80%.

Table 4.2 Financial Indicators of Proposed Technology

S No	Particular	Unit	Value
1	Simple Payback	Years	2.97
2	NPV	` In Lakh	6.09

S No	Particular	Unit	Value
3	IRR	%age	15.96
4	ROI	%age	23.80
5	DSCR	Ratio	1.35

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 power savings by 5%)
- Pessimistic scenario (Decrease in power 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	IRR (%)	NPV (in Lakh)	ROI (%)	DSCR
Pessimistic	14.11	4.15	23.35	1.28
Base	15.96	6.09	23.80	1.35
Optimistic	17.77	8.03	24.19	1.42

4.5 Procurement and Implementation Schedule

Procurement and implementation schedule required for implementation of this technology is about 7 weeks and 3 to 4 days required as a process break down. Further detail breakups of procurement and implementation schedules are shown in Annexure 4.

ANNEXURES

Annexure -1: Energy audit data used for baseline establishment

S.No	Parameters	Details
1	Total annual production	2250 tonne
2	Total annual power consumption	1552.50 MW
3	Operating temperature range	1400- 1600 ^{O}C
4	Specific energy consumption	690 kW/tonne

Annexure -2: Detailed Technology Assessment Report

S. No.	Particular	Unit	Value
1	No. of operating days	Days	250
2	Annual Production	Tonne	2250
3	Power required in base case scenario	kWh/tonne	690
4	Power required in proposed case scenario	kWh/tonne	600
5	Power saving	kWh/tonne	90
6	Annual power saving	MWh/Year	202.50
7	Rate of Electricity	`/ kWh	5
8	Total monetary saving	`in lakh	10.13
9	Total investment required	`in lakh	30.08
10	Simple payback period	Years	2.97

Annexure -3: Detailed Financial Calculations

Name of the Technology	Medium Frequency Furnace		
Rated Capacity	**250 kW**		
Details	**Unit**	**Value**	**Basis**
Installed Capacity	kW	250	
No of Annual working days	Days	250	
Proposed Investment			
Plant & Machinery	` (in lakh)	29.08	
Erection & Commissioning	` (in lakh)	0.60	
Misc. Cost	` (in lakh)	0.40	
Total Investment	` (in lakh)	30.08	
Financing pattern			
Own Funds (Equity)	` (in lakh)	7.52	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	22.56	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			
Electricity Saving	MWh/Year	202.50	
Cost of electricity	`/MWh	5000	
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	22.56	1.13	21.43	2.62
2	21.43	3.38	18.05	1.99
3	18.05	4.51	13.54	1.60
4	13.54	5.64	7.90	1.10
5	7.90	5.64	2.26	0.53
6	2.26	2.26	0.00	0.07
		22.56		

WDV Depreciation `(in lakh)

Particulars / years	1	2
Plant and Machinery		
Cost	30.08	6.02
Depreciation	24.07	4.81
WDV	6.02	1.20

Projected Profitability ` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Electricity savings	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Total Revenue (A)	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Expenses								
O & M Expenses	1.20	1.26	1.33	1.39	1.46	1.54	1.61	1.69
Total Expenses (B)	1.20	1.26	1.33	1.39	1.46	1.54	1.61	1.69
PBDIT (A)-(B)	8.92	8.86	8.80	8.73	8.66	8.59	8.51	8.43
Interest	2.62	1.99	1.60	1.10	0.53	0.07	0.00	0.00
PBDT	6.31	6.87	7.20	7.64	8.13	8.52	8.51	8.43
Depreciation	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
PBT	4.72	5.28	5.61	6.05	6.54	6.93	6.92	6.84
Income tax	0.00	0.70	2.45	2.60	2.76	2.90	2.89	2.87
Profit after tax (PAT)	4.72	4.58	3.16	3.45	3.78	4.04	4.03	3.98

Computation of Tax ` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	4.72	5.28	5.61	6.05	6.54	6.93	6.92	6.84
Add: Book depreciation	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
Less: WDV depreciation	24.07	4.81	-	-	-	-	-	-
Taxable profit	(17.76)	2.06	7.20	7.64	8.13	8.52	8.51	8.43
Income Tax	-	0.70	2.45	2.60	2.76	2.90	2.89	2.87

Projected Balance Sheet ` (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Share Capital (D)	7.52	7.52	7.52	7.52	7.52	7.52	7.52	7.52
Reserves & Surplus (E)	4.72	9.30	12.46	15.92	19.69	23.73	27.76	31.74
Term Loans (F)	21.43	18.05	13.54	7.90	2.26	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	33.67	34.87	33.52	31.33	29.47	31.25	35.28	39.26
Assets	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross Fixed Assets	30.08	30.08	30.08	30.08	30.08	30.08	30.08	30.08
Less Accumulated Depreciation	1.59	3.18	4.77	6.35	7.94	9.53	11.12	12.71
Net Fixed Assets	28.49	26.91	25.32	23.73	22.14	20.55	18.96	17.38
Cash & Bank Balance	5.18	7.97	8.21	7.60	7.33	10.70	16.32	21.88
TOTAL ASSETS	33.67	34.87	33.52	31.33	29.47	31.25	35.28	39.26
Net Worth	12.24	16.82	19.99	23.44	27.21	31.25	35.28	39.26
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	7.52	-	-	-	-	-	-	-	-
Term Loan	22.56								
Profit After tax		4.72	4.58	3.16	3.45	3.78	4.04	4.03	3.98
Depreciation		1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
Total Sources	30.08	6.31	6.17	4.75	5.04	5.37	5.63	5.62	5.57
Application									
Capital Expenditure	30.08								
Repayment Of Loan	-	1.13	3.38	4.51	5.64	5.64	2.26	0.00	0.00
Total Application	30.08	1.13	3.38	4.51	5.64	5.64	2.26	0.00	0.00
Net Surplus	-	5.18	2.79	0.24	-0.60	-0.27	3.37	5.62	5.57
Add: Opening Balance	-	-	5.18	7.97	8.21	7.60	7.33	10.70	16.32
Closing Balance	-	5.18	7.97	8.21	7.60	7.33	10.70	16.32	21.88

IRR **` (in lakh)**

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		4.72	4.58	3.16	3.45	3.78	4.04	4.03	3.98
Depreciation		1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
Interest on Term Loan		2.62	1.99	1.60	1.10	0.53	0.07	-	-
Cash outflow	(30.08)	-	-	-	-	-	-	-	-
Net Cash flow	(30.08)	8.92	8.16	6.35	6.14	5.90	5.69	5.62	5.57
IRR	15.96 %								
NPV	6.09								

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

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
O & M Expenses (75%)	0.90	0.95	0.99	1.04	1.10	1.15	1.21	1.27
Sub Total(G)	0.90	0.95	0.99	1.04	1.10	1.15	1.21	1.27
Fixed Expenses								
O & M Expenses (25%)	0.30	0.32	0.33	0.35	0.37	0.38	0.40	0.42
Interest on Term Loan	2.62	1.99	1.60	1.10	0.53	0.07	0.00	0.00
Depreciation (H)	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59
Sub Total (I)	4.51	3.89	3.52	3.03	2.49	2.04	1.99	2.01
Sales (J)	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13
Contribution (K)	9.22	9.18	9.13	9.08	9.03	8.97	8.92	8.86
Break Even Point (L= G/I)%	48.85%	42.42%	38.55%	33.41%	27.55%	22.72%	22.34%	22.72%
Cash Break Even {(I)-(H)}%	31.63%	25.12%	21.15%	15.91%	9.96%	5.02%	4.52%	4.78%
Break Even Sales (J)*(L)	4.95	4.30	3.90	3.38	2.79	2.30	2.26	2.30

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

Particulars / Years	1	2	3	4	5	6	7	8	Total
Net Profit Before Taxes	4.72	5.28	5.61	6.05	6.54	6.93	6.92	6.84	48.90
Net Worth	12.24	16.82	19.99	23.44	27.21	31.25	35.28	39.26	205.49
									23.80%

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

Particulars / Years	1	2	3	4	5	6	7	8	Total
Cash Inflow									
Profit after Tax	4.72	4.58	3.16	3.45	3.78	4.04	4.03	3.98	23.73
Depreciation	1.59	1.59	1.59	1.59	1.59	1.59	1.59	1.59	9.53
Interest on Term Loan	2.62	1.99	1.60	1.10	0.53	0.07	0.00	0.00	7.90
Total (M)	8.92	8.16	6.35	6.14	5.90	5.69	5.62	5.57	41.16

DEBT

Interest on Term Loan	2.62	1.99	1.60	1.10	0.53	0.07	0.00	0.00	7.90
Repayment of Term Loan	1.13	3.38	4.51	5.64	5.64	2.26	0.00	0.00	22.56
Total (N)	3.74	5.37	6.11	6.74	6.17	2.32	0.00	0.00	30.46
DSCR (M/N)	2.38	1.52	1.04	0.91	0.96	2.45	0.00	0.00	1.35
Average DSCR	1.35								

Annexure:-4 Procurement and implementation schedule

Procurement and Implementation Schedule

S. No.	Activities	Weeks						
		1	2	3	4	5	6	7
1	Identification of faulty or less capacitors	■						
2	Planning and material order		■					
3	Procurement			■	■	■		
4	Commissioning						■	■

Annexure -5: Details of technology service providers

Energy Conservation measure	Source of product	Details of Local vendor / service provider
1. Medium Frequency Induction Furnace	INDUCTOTHERM (INDIA) PVT. LTD.	Ajit Chaturvedi Regional Sales Head Mobile# 91 93111 50284 B-444, Pacific Business Park, Sahibabad Industrial Area, Site-IV, Ghaziabad-201010 (U.P.) E-mail: ajitc@inductothermindia.com Phone: 0120-2771068, 2771069, 3143028.
2. Medium Frequency Induction Furnace	M/S ENCON INTERNATIONAL (P) LTD.	Mr. R.P. Sood 14/6, Mathura Road, Faridabad - 121 003 (Haryana) Tel: +91-129-2275307 Fax: +91-129-2276448 E mail: encon@ndb.vsnl.net.in
3. Medium Frequency Induction Furnace	ADVANCE HEATING SYSTEMS	d1/23 (back side) Mayapuri ind. area, phase-ii, New Delhi -110064 Tel: 91-11-5139315 Email:advanceheat@yahoo.com
4. Medium Frequency Induction Furnace	INDUSTRIAL FURNACE & CONTROLS	Vempu road, Bangalore -560021 Tel:+ 91-80-3329840 Fax: + 91-80-3329840 E-mail: ifc1@vsnl.com Website http://www.indfurnace.com
5. Medium Frequency Induction Furnace	MACRO FURNACES PVT. LTD.	16/2, mathura road, faridabad -121002 Tel:+ 91-129-5260004 Fax: + 91-129-5260146 E-mail: aastha10@rediffmail.com

Annexure–6: Quotations/Techno-commercial bids for new technology/equipment

INDUCTOTHERM
(INDIA) PVT. LTD.
An Inductotherm Group Company

ISO 9001
BUREAU VERITAS
Certification

M/s. CII Avantha
Confederation of Indian Industries,
Block-3, Sector 31/A,
CHANDIGARH - 160030
Phone: 9872600687
Kind Attn: Mr. Gagandeep Mohey

18th July, 2011

Sub: Your requirement of Induction Furnace

Dear Sir,

This is in reference to your discussions with our Mr. Ajit Chaturvedi, in connection with your requirement of Medium Frequency Induction Melting Furnace. We really appreciate your interest in Inductotherm Induction Melting Furnace.

As per our discussion, we are pleased to enclose herewith following preliminary quotations for your perusal:

- **Quotation No. QDE11278 for 1 No.250 KW/1000 HZ VIP POWER TRAK-R-PI with 2 Nos. 300Kg DURALINE FURNACES.**

We are also enclosing herewith technical specification sheet, scope of supply, standard terms & conditions and other relevant literatures.

Trust our offer is in line with your requirement. If you need any further information/assistance from our side, please feel free to contact our **Mr. Ajit Chaturvedi, Regional Sales Head (Cell#9311150284).**

Thanking you,

Sincerely,

S.R.SUBRAMANIAN
NATIONAL SALES MANAGER (MELTING)
Cell # 09344130922
Encl: Quotation consists of price sheet, technical specification, bulletins, standard terms & conditions (TAC-03).

INDUCTOTHERM Induction Melting | INDUCTOHEAT Induction Heating | THERMATOOL Induction Welding

Regd Office & Works:
Shri Kishorebhai D. Vyas Building, Ambli-Bopal Road, Bopal, Ahmedabad - 380 058. Ph.: (02717) 23 1961. Fax: (02717) 23 1266/68
E-mail: iil@inductothermindia.com Website: www.inductothermindia.com
Branches & Service Centres: Bangalore, Chennai, Coimbatore, Delhi, Dhanbad, Hyderabad, Jaipur, Kolhapur, Kolkata, Ludhiana, Mumbai, Muzaffarnagar, Pune, Raipur, Rajkot, Rourkela

ENERGY IS LIFE
BEE
CONSERVE IT

CII - Avantha
CHANDIGARH

Pricing

INDUCTOTHERM
Quotation # QDE11278
Date: 18th July, 2011

250KW /1000 Hz VIP POWER-TRAK-R-PI		
A.	**Power Unit** **One (1) No. 250KW/1000Hz Power & Control System** *with internal water circulating system, manual furnace changeover arrangement and one hydraulic power supply unit.*	Rs.16,75,000
B.	**Melting Furnace** **Two (2) Nos. 300Kg DURALINE FURNACES** *with hydraulic tilting arrangement, standard set of water cooled copper tubing, and water cooled leads (without lid).*	Rs.8,00,000
C.	**Optional**	
1.	Two (2) Nos. Handle operated Furnace Selector Switches	Rs.80,000
2.	One (1) No. Energy Meter	Rs.30,000

All the above quoted prices are ex-works, Bopal (Ahmedabad). They do not include any applicable excise duty or sales tax. Packing, Forwarding and Insurance charges will be extra.

Presently excise duty @ 10%, education cess @ 2% on excise duty, secondary & higher education cess @ 1% on excise duty and CST @ 2% against form "C" will be applicable on Induction Furnace. However, duties and taxes ruling at the time of delivery will be applicable.

The quoted prices are strictly valid for Thirty (30) days. Thereafter, you have to obtain fresh quotation. The quoted prices are valid only if the equipment is to be installed and commissioned in India by Inductotherm (India) Pvt. Ltd.

Delivery will be within [3] Three to [4] Four months. Other terms and conditions are as per the enclosed Standard Terms and Conditions (Bulletin No. TAC-03).

Sincerely,

S.R.SUBRAMANIAN
NATIONAL SALES MANAGER (MELTING)
Cell # 09344130922

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CHANDIGARH

Technical Specifications

INDUCTOTHERM
Quotation # QDE11278
Date: 18th July, 2011

250 KW/1000 HZ VIP POWER-TRAK-R-PI

A. APPLICATION REQUIREMENTS

1.	Alloy to be melted	Steel	Iron
2.	Melt temperature	1650^{O} C	1480^{O} C

B. CHARACTERISTICS OF RECOMMENDED POWER UNIT

1.	Rated KW	250 KW
2.	Maximum KW	250 KW
3.	Nominal Furnace Frequency	1000 Hz
4.	Line Power Factor	0.95 and above
5.	KVA required at input of VIP POWER TRAK-R	280 KVA on load
6.	Melt Rate at 250 KW **	445 Kg/hr – Steel 490 Kg/hr – Iron
7.	Power Connection	460 V, 3 Phase, 50 Hz

C. CHARACTERISTICS OF RECOMMENDED MELTING FURNACE

1.	Nominal capacity (Steel capacity)	300 Kg
2.	Style of Furnace	Duraline
3.	Pouring Mechanism	Hydraulic tilt
4.	Furnace Lining *(Recommended - to be provided by the customer)*	Silica .... Iron Mgo...... Steel

** The above melt rate is based on a nominal furnace size for second heat when lining is hot, charge is dense and bus runs proper. The voltage should be steady within allowable range. Cooling water should be as per our specification. Melt rates will be for the weight of charge and does not include time for initial charging, pouring, superheating, deslagging or chemical analysis. Please note that slag consumes nearly double the power.

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CHANDIGARH

Scope of Supply

INDUCTOTHERM
Quotation # QDE11278
Date: 18th July, 2011

A. POWER UNIT

I. ELECTRICAL PANEL

1. CABINET

Metal cabinet, duly painted fitted with panel doors, which are gasketed and equipped with locks. In addition, micro switches are provided which illuminate a lamp on the monitor board and shut off power to prevent injury to personnel when the lift off panel or doors are opened.

Power connections are easily made through the top **and** water connections are through the side of the cabinet.

2. PROTECTION

a) Fast acting MCCB mounted in the cabinet to serve as isolation from the plant power line. It is equipped with a manual ON/OFF switch.

b) Fast acting semi-conductor fuses.
Instantaneous fast acting MCCB is used for circuit protection.

3. RECTIFIER SECTION WITH FILTER

a) High power diodes with snubbers for rectification.
This rectifier is designed to minimize line harmonics compared to phase controlled rectifier.

b) Air core encapsulated current limiting reactor(s).

c) DC capacitors located in capacitor section.

This design of converter and filter section reduces losses compared to iron core current limit reactor(s) and helps to provide constant DC voltage to the voltage fed inverter.
This design helps to achieve the conversion efficiency not less than 96%

4. INVERTER SECTION

a) This section contains inverter panel containing high power inverter SCRs with snubbers, anti parallel didoes and DI/DT reactors. This helps to provide full power throughout the melt cycle.

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CHANDIGARH

Scope of Supply

INDUCTOTHERM
Quotation # QDE11278
Date: 18th July, 2011

5. CAPACITOR SECTION

a) This section contains required DC filters and medium frequency AC Capacitors.

b) One pressure switch, installed in each capacitor

c) One indicating lamp located on the monitor board to notify the operator, when the capacitor pressure switch has been actuated.

6. GROUND/METAL LEAK DETECTOR

One sensing ground/metal leak detector ready to sense and indicate any ground and metal leak. Consisting of indicating lamp, milliammeters, probe disconnect switch to disconnect the probe from the power supply.

7. CONTROL & MONITOR SYSTEM

a) Three direct reading instruments, including frequency meter, kilowatt meter and furnace volt meter.

b) One main control board for controlling of the equipment, which eliminates electronic complexity and simplifies maintenance. This board is located in a compartment. A cooling fan with heat exchanger is provided for temperature control.

c) ON/OFF push buttons are provided on the control door.

d) One power control knob is provided on the control door to set the desired power level.

f) One circuit monitor for monitoring and indicating functional parameters, such as water pressure,water temperature and other electrical faults.

8. INTERNAL CLOSED WATER SYSTEM (Inside the cabinet)

This contains one feed manifold with temperature and pressure switches and one drain manifold with temperature sensors for different paths of cooling system

II. INTERNAL CLOSED WATER SYSTEM (Outside the cabinet)

This structure contains one plate type water to water heat exchanger, expansion/air separator tank, one mono block non-ferrous pump with starter and one deionizer cartridge for continuous purification of internal water.

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Scope of Supply

INDUCTOTHERM
Quotation # QDE11278
Date: 18th July, 2011

III. HYDRAULIC POWER UNIT

One hydraulic pumping unit (without oil and starter) to supply pressurized fluid to the tilting cylinders complete with pump, pump motor, fluid reservoir, pressure relief valve, pressure gauge, return line filter and filter air breather cap all mounted on a common base with seamless pipes and fittings.

B. MELTING FURNACE

DURALINE FURNACE

Hydraulically tilted coreless melting furnace for housing and providing rigid support to the induction coil. Constructed out of cast aluminium alloy side plates, top and bottom made out of refractory with stainless steel fibre reinforcement. This coreless Duraline without shunts design helps in reducing energy loss.

Included in each furnace will be:

1. A set of shrouded hydraulic cylinders with check valve for the hydraulic tilting of the furnace.
2. Manually operated hydraulic direction control valve for tilting.
3. Leak detector assembly with stainless steel probe wires and hardware.
4. Set of flexible water-cooled power leads for connection between the power induction coil and power supply unit. Water-cooled leads are with sleeves for protection against metal splash.
5. Furnace is mounted on the pair of self-aligning, pillow block type pivot bearings.

Refractory melt-out former is not in our scope of supply as it is easily available in the market and you need this material as consumable.

INTERCONNECTING ARRANGEMENT

A suitable size of air/water cooled copper conductor is provided to connect the power panel with the crucible.

C. DRAWINGS & MANUALS

Equipment layout drawings, wiring and water diagrams, equipment outline, furnace cross section drawing and an operating and maintenance manual.

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Customer's Scope of Supply

INDUCTOTHERM
Quotation # QDE11278
Date: 18th July, 2011

Necessary Requirements at Customers end:

Procurement and installations of following equipment and systems is customer's responsibility.

1. Power line up to furnace transformer.
2. Furnace Transformer
3. Power line from transformer to panel
4. 433V, 3 Phase/50 Hz power supply to all the auxiliaries like external pumps, cooling tower, internal water pump and hydraulic power unit with suitable starter.
5. Cooling water system including RCC / Plastic water tanks, cooling tower, pumps, plate type heat exchanger (mentioned in our drawing as PHE2), D.M. or soft water treatment unit, piping, fittings as suggested by our Project Engineering Department.
6. Overhead tank for emergency water supply to coil, in case of failure of water system.
7. Complete civil work like furnace platform, foundations, overhead tank, underground tank etc. Supplier will provide necessary foundation layout drawing/load data.
8. Pressurized air supply, if required.
9. Overhead crane, pouring ladles/system, pyrometer, charging device, ramming tools and other misc. equipment/tools required to start/run the system.
10. Consumables like hydraulic oil, distilled water, asbestos/silica paper/board, coil grouting material, ramming mass etc.
11. Statutory of electricity board, factory inspectorate, pollution control and any other statutory requirements.
12. Lining former.

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

Confederation of Indian Industry
CII – AVANTHA Centre for Competitiveness
Block No.3, Dakshin Marg
Sector 31-A, Chandigarh - 160030
Tel: 0172-5080784 (D) / 2666517-19
Fax: 0172-2606259 / 2614974
E-mail: harinder.singh@cii.in
Website: www.ciicfc.org

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