DETAILED PROJECT REPORT
ON
BOGIES BRASS ANNEALING FURNACE (60KW)
(JAGADHRI BRASS & ALUMINIUM CLUSTER)

Bureau of Energy Efficiency

Prepared By

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ISTSL

BOGIES BRASS ANNELING FURNACE
(60 kW CAPACITY)

JAGADHRI BRASS AND ALUMINIUM CLUSTER

BEE, 2010

Detailed Project Report on Bogies Brass Annealing Furnace (60 kW Capacity)

Brass & Aluminium SME Cluster, Jagadhri, Haryana (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **JAG/MET/GAS (A)/01**

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Zenith Energy Services Pvt. Ltd.

Hyderabad

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Lists of Abbreviations

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

EXECUTIVE SUMMARY

Zenith Energy Services Pvt. Ltd. is executing BEE-SME program in Jagadhri Brass & Aluminium Cluster, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

Jagadhri is renowned for the brass utensils, sheets, coils, strips and also & Stainless steel utensils, there are about 150 to 200 brass and aluminium industries in the cluster. The brass & copper sheets, strips, coils and aluminium utensils produced in Jagadhri cluster are renowned in the country. Majority of the industries have been in operation for the last 15 to 30 years. The main raw materials are brass, copper and aluminium scrap is being procured from local agents.

The major Energy forms used in the cluster are electricity and fuels like Coke, Wood, and Furnace Oil etc. Electricity is used for driving the prime movers of pumps, fans, drives, rolling machine motors, induction and annealing furnaces and for lighting. Coke and Furnace oil is used for brass and aluminium melting in Pit Furnaces. Presently, wood is used as a fuel in Annealing furnaces.

The cost of energy as a percentage of manufacturing cost varies anywhere between 3 to 5%, which includes electrical as well as thermal. Majority of the industries located in Jagadhri uses coke and furnace oil as energy in process for pit melting and a very few units are using electricity for wood Gasifiers for melting. Pit melting process requires large amount of thermal energy, inducing a high share of energy cost. The energy cost is next to the raw materials cost.

This DPR is prepared for installation of Electrical Annealing Furnaces for annealing Brass material for reducing energy/production cost. The DPR highlights the details of the study conducted for assessing the potential for possible reduction in energy/production cost and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of Project Implementation.

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 below:

S.No	Particular	Unit	Value
1	Project cost	`(in Lakh)	9.25
2	Annual Wood Consumption in base case	Tonne / year	221.1
3	Electricity Consumption in proposed case	kWh/ Year	120000
4	Monetary saving due to fuel change	`/ Tonne	379
5	Monetary benefit	`(in Lakh)/annum	4.55
6	Simple payback period	years	2.03
7	NPV	`(in Lakh)	7.38
8	IRR	%age	31.85
9	ROI	%age	26.18
10	Average DSCR	Ratio	2.00
11	Estimated CO_2 reduction	tonne CO_2/year	265.40
12	Process down time	Week	2

The projected profitability and cash flow statements indicate that the project implementation i.e. installation of electrical furnace for annealing of brass metal 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 the energy performance in 29 selected SMEs clusters, Jagadhri Brass & Aluminium Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation and technology up-gradation through studies and pilot projects in these SMEs clusters.

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

Energy use and technology audit

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

Capacity building of stake holders in cluster on energy efficiency

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

Implementation of energy efficiency measures

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

Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

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

1 INTRODUCTION

1.1 Brief Introduction about cluster

Jagadhri is renowned for the brass utensils, sheets, coils, strips and also Aluminium & Stainless steel utensils, there are about 150 -200 brass and aluminium industries in the cluster. The brass & copper sheets, strips, coils and aluminium utensils produced in Jagadhri cluster are renowned in the country. The main raw materials are brass, copper and aluminium scrap is being procured from local agents.

The cost of energy as a percentage of manufacturing cost varies anywhere between 3 to 5%. Majority of the industries located in Jagadhri uses coke and furnace oil as energy in process for pit melting and a very few units are using electricity for wood gasifier for melting. Pit melting process requires large amount of thermal energy, inducing a high share of energy cost. The energy cost is next to the raw materials cost.

1.1.1 Production process

The main process operation for Brass melting and products manufacturing adopted in cluster units are as follows:

Brass Melting

Pit Furnace is a common type of furnace used in all cluster units for melting the scrap brass in the crucibles. Coke is used as fuel. The pit furnace is a rectangular pit lined with refractories and the crucible is inserted in the furnace and coke is fired underneath and side of the pit furnace. The outer side of the furnace is lined with red bricks. After feeding Furnace Oil and inserting crucible in the pit and the firing of the coke is started. The normal time for each batch of melting is two and half hours and subsequently the batch time reduces by about 20 minutes to 30 minutes than the initial batch.

Annealing

Different types of Annealing process are used in the cluster:

a) Wood fired annealing

b) Oil fired annealing

The temperature required for annealing and re-heating the brass billets is 600 to 650 ^{o}C and Aluminium billets is 400-450 ^{o}C. The brass & aluminium sheets, billets and brass coils are heat treated for about 10 to 12 hours in a day.

Wood fired annealing

Wood Fired Annealing Furnace is a common type of annealing furnace found in the cluster and is normally installed in smaller and medium size units. The wood fired furnace is used for heat treatment of the brass and aluminium sheets and circles and also reheating of the billets before hot rolling. The wood is used as fuel and the production capacity of the wood fired furnace in the cluster units is varying from 2000 kg to 4000 kg per batch. The annealing furnaces are of very old design and are constructed with red bricks and only the hearth of the furnace is constructed with the refractory bricks. The design of the annealing furnace is more or less identical in all cluster units.

Oil fired annealing furnace

The brass coils is heat treated for about 8 to 10 hours in a day. The furnace oil is used as fuel and the production capacity of the oil fired bell furnace in the cluster units is varying from 3000 kg to 4000 kg per batch. The annealing furnaces are bell type furnace fabricated with insulation steel drum and asbestos. The design of the bell annealing furnace is more or less identical in all the coil plant units.

Hot Rolling

The primary function of the Hot rolling is to reheat aluminium billets or hot casted billets nearly to their melting point, then roll them thinner and longer sheets through rolling machine driven by motors having capacity around 60 to 100 HP and annealing up the lengthened brass or aluminium sheets and used for the next process.

Cold Rolling

Cold rolling is carried out to allow desirable metal qualities that cannot be obtained by hot working such as eliminating shrinkage errors for higher dimensional accuracy of the metal. Furthermore, to have smoother surface of the final products, enhance strength and hardness. As such, the metal must be heated from time to time (annealed) during the rolling operation to remove the undesirable effects of cold working and to increase the workability of the metal.

Shearing

In the shearing process, the sheets are cut to required size out of larger sheets such as roll sheets. Shears are used as the intermediate or finished step in preparing for cold rolling or circle cutting processes.

Pressing

Pressing is a metal forming process in which sheet metal is stretched into the desired part shape. A tool pushes downward on the sheet metal, forcing it into a die cavity in the shape of the desired part. The tensile forces applied to the sheet cause it to plastically deform into a utensil-shaped part. Pressing is most effective with ductile metals, such as aluminum, brass, copper, and mild steel. Examples of parts formed with Pressing include milk tanks, cans, cups, kitchen utensil sinks, pots and pans.

The Pressing processes machine either in cam or hydraulic type is used having capacity 25 HP to 63 HP motors.

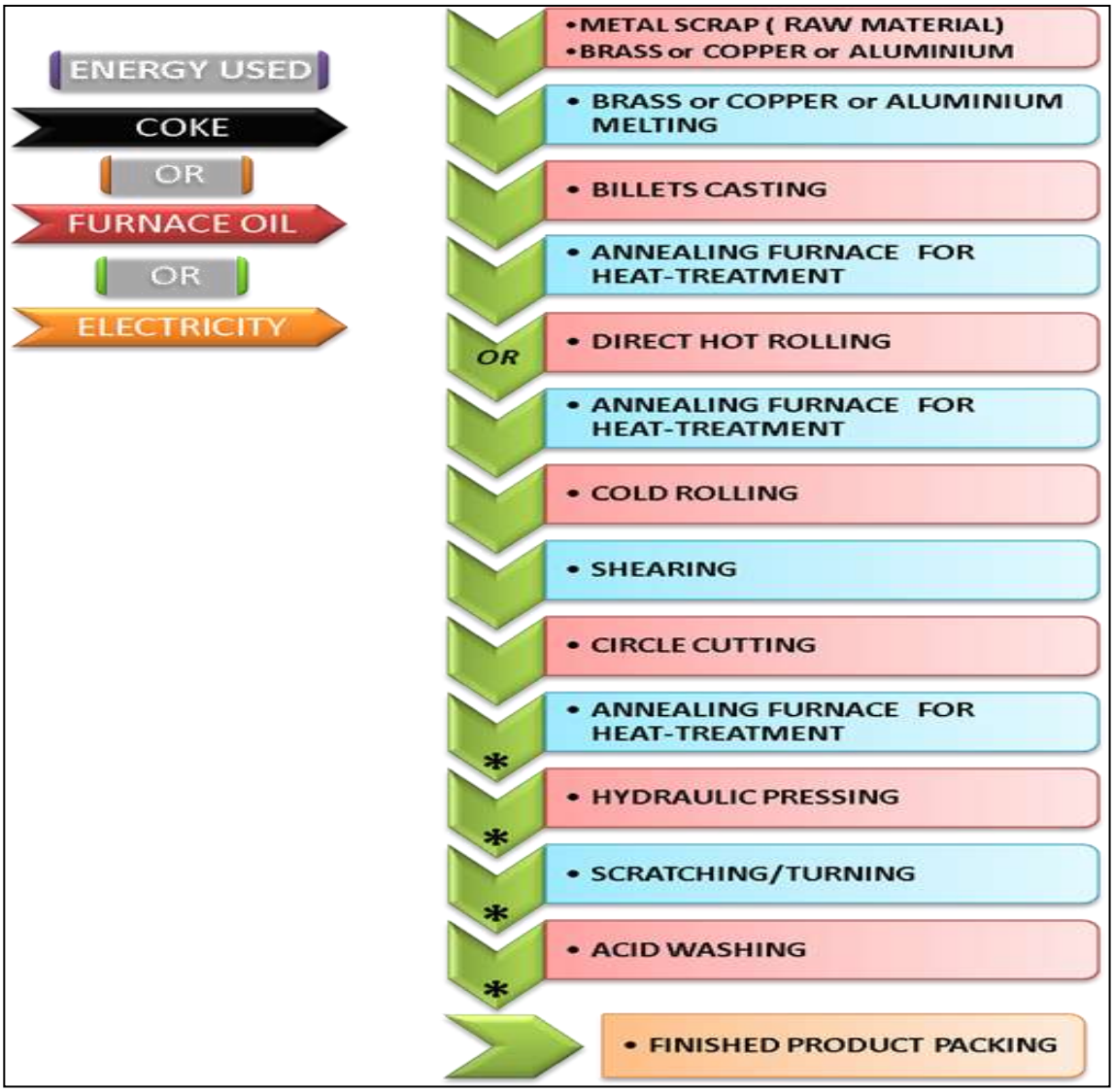


Figure 1.1: General Process Flowchart

For Product / Utensils Manufacturing

1.2 Energy performance in existing situation

1.2.1 Fuel and electricity consumption of a typical unit

The main energy forms used in a typical unit in the cluster are electricity, coke and wood. Electricity is used for driving the prime movers of blowers, hot and cold rolling machines, shearing machines and press. Coke is used as fuel in Pit Furnaces for brass melting and wood is used as fuel for annealing furnaces. The energy consumption of a typical unit in the cluster having wood fired annealing furnace for heat treatment of brass is furnished in Table 1.1 below:

Table 1.1: Energy consumption of a typical unit (Ahuja Metal Industries)

S.No	Details	Unit	Value
1	Wood consumption	tonne/annum	240
2	Grid Electricity consumption	MWh/annum	170
3	Coke consumption	tonne/annum	96

1.2.2 Average production by a typical unit in the cluster

The average production in a year in a typical unit is 720 tonne

1.2.3 Specific Energy Consumption

The main energy forms used in the aluminium processing units are electricity, furnace oil and wood. The Specific energy consumption for electrical and thermal energy per tonne of Production for a typical unit is furnished in Table 1.2 below:

Table 1.2: Specific energy consumption for a typical unit (Ahuja Metal Industries)

S. No.	Type of Fuel	Units	Specific Energy Consumption
1	Coke Consumption	tonne/ tonne of production	0.133
2	Grid Electricity consumption	MWh/ tonne of production	0.236
3	Wood consumption	tonne/ tonne of production	0.333

Equipment wise Specific Energy Consumption

The specific energy consumption of the equipments used in the Jagadhri Aluminium & Brass Industries is given in Table 1.3 below wherever possible.

Table 1.3 Equipment wise Specific Energy Consumption

S.No.	Equipments	Minimum SEC	Maximum SEC	Average SEC (for whole cluster)
1	Pit Furnace	0.11	0.15	0.13
2	Annealing Furnace	0.15	0.26	0.20

1.3 Existing technology/equipment

1.3.1 Description of existing technology

Wood Fired Annealing Furnace is a common type of annealing furnace found in the cluster and is normally installed in smaller and medium size units. The wood fired furnace is used for heat treatment of the brass sheets and circles and also reheating of the billets before hot rolling. The wood is used as fuel and the production capacity of the wood fired furnace in the cluster units is varying from 2000 kg to 4000 kg per batch. The temperature required for annealing and re-heating the billets is 600 to 650 ^{o}C. The brass sheets are heat treated for about 10 hours in a day. The annealing furnaces are of very old design and are constructed with red bricks and only the hearth of the furnace is constructed with the refractory bricks. The design of the annealing furnace is more or less identical in all cluster units. The major drawbacks of the existing wood furnaces are:

- There is no proper provision for supplying of combustion air and the combustion air intake also flue gas exit takes place from the front door through which material is being fed.
- Inadequacies in maintaining and controlling uniform furnace temperature resulting in uneven surface hardness
- Excess temperature resulting in oxide formation on the surface of the products, the temperature in the furnace was found to be more than required due to lack of monitoring of fuel feeding to the furnace.
- Low efficiency of the furnaces

1.3.2 Its role in the whole process

The wood fired annealing furnace is used for heat treatment of the brass sheets and circles. The furnace is also used for pre-heating of the billets before hot rolling. The heat treatment is carried out for improving the physical properties of the metal such as for increasing the

strength, malleability etc. the brass sheets and circles are heat treated for about 10 hours per batch and the temperature is maintained about 600 to 650 ^{o}C.

1.4 Establishing the baseline for the equipment to be changed

1.4.1 Design and operating parameters

Wood is used as fuel for annealing furnace. The furnace is constructed by the local masonries and doesn't have name plate details. The capacity of the furnace in the cluster varies from 2 tons to 4 tons respectively. The wood consumption depends on the following parameters such as quantity of brass to be annealed, temperature required, wood heating value and design of the pit furnace. The operating parameters of the annealing furnace collected for a typical unit during the field visit is furnished in Table 1.4 below:

Table 1.4 Details of Operating parameter

S. No.	Particular	Units	Value
1	Quantity of Brass annealed	kg/ batch	4000
2	Average wood consumption	kg/ batch	737
3	Temperature maintained	^{0}C	600
4	Efficiency of the pit furnace	% age	11

1.4.2 Fuel & Electricity consumption and Operating Efficiency

The operating efficiency of the wood fired annealing furnace in various units had been evaluated during energy use and technology audits, the efficiencies of the furnaces are found to be in the range of 7 to 12% in various units of the cluster. The details of wood consumption and efficiencies of annealing furnaces for 3 typical units are furnished below in Table 1.4 below:

Table 1.4 Energy Consumption & Efficiency of three typical units in the cluster

S. No	Name of the unit	Wood Consumption (tonne/annum)	Electricity Consumption (MWh/annum)	Efficiency of annealing furnace (% age)
1	Ahuja Metal Industries	240	170	11.1
2	Usha Enterprises	180	159	7.0
3	Arun metals	240	159	8.2

1.5 Barriers for adoption of new technology/equipment

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of the electrical furnace in the cluster are:

- Though, a few number of units had been implemented electrical annealing furnace, the implementation was limited to bigger size units and was not penetrated in the smaller size units, this may be lack of awareness of the technology among small unit owners
- Lack of knowledge of the technical benefits among small unit owners

1.5.2 Financial Barrier

- Though, many SME owners are interested to install electrical furnaces for brass annealing, due to high initial investment and the SME owners could not implement in the cluster.
- Further, lack of awareness of the losses and monetary benefit of the electrical furnace was also one of the major barrier that prevented implementation of the Bogie furnace in cluster units
- Energy Efficiency Financing Schemes such as SIDBI's, if taken up in the cluster, many SME owners may be taken up the technology due to financial attractiveness of the technology.

1.5.3 Skilled manpower

Lack of skilled manpower was also one of the major barriers in the cluster.

1.5.4 Other barrier(s)

The power supply is intermittent in Jagadhri and the cluster units are facing severe power cuts. It is well known fact, the continuous power supply is required otherwise, if the power supply fails during heat treatment in the electrical furnaces, the heat treatment to be repeated from the normal temperature and hence leads to high power consumption. Hence, there is a fear among SME owners of the losses and this was also one of the major barriers that prevented implementation.

2. DESCRIPTION OF PROPOSED TECHNOLOGY/EQUIPMENT

2.1 Detailed description of technology/equipment selected

2.1.1 Description of technology

The electrical annealing furnace essentially consists of the following systems:

Furnace

The outer casing is fabricated out of thick commercial grade mild steel plates reinforced with angles and channels. The furnace casing will be provided with adequate holes for insertion of thermocouples for temperature sensing.

Lining

The furnace side walls, roof, door & rear wall shall be lined with ceramic fiber insulation. However, the hearth and bogie shall be lined with refractory and insulation bricks.

Heating Elements

Heating elements made in coil form wound on ceramic tubes placed in high alumina element holding bricks shall be provided on both sides of the furnace. The heating elements are designed at low surface load to ensure longer service life.

Air Circulation

Suitable number of centrifugal fan with air cooled bearings and drive motor is provided at the top of the furnace to force the hot air and ensure uniform distribution of heat. The impeller and shaft of the fan is fabricated out of AISI 304.

Baffle

Suitable baffle fabricated out of AISI 304 is provided to guide the forced hot air from the circulation fan and ensures desired temperature uniformity.

Bogie

The Bogie will be strong and robust construction fabricated from Mild Steel plates suitably stiffened with rolled steel section and carried on wheels running into antifriction bearings. The top of the Bogie will be lined with fire bricks backed by insulation bricks.

Door

Rise and fall type, manually operated door is provided with the furnace. Approximate height above Bogie is 600 mm.

2.1.2 Technology /Equipment specifications

Simple electrically heated bogie type furnace with air circulation is suitable for general heat treatment like annealing, normalizing and annealing of non ferrous metals upto 550 ^{O}C temperature. However, actual method of heat treatment depends on both mechanical and metallurgical requirements of the components being treated. The technical specifications of the proposed electrical annealing furnace for brass annealing are furnished in Table 2.1 below:

Table 2.1 Technical specification of Electrical annealing furnace

S.No	*Parameter*	*Details*
1	Width	550 mm
2	Length of Bogie	2000 mm
3	Connected Load	60 kW
4	Max. working temperature	600 ^{o}C
5	No. of Door	1
6	Type of Door operation	Manual, Rise & Fall type
7	Bogie Haulage	Manual
8	No. of Fan	2
9	Material for Impeller & Shaft	S.S. 304
10	Type of Control	Automatic On/Off
11	Heating Elements	Kanthal Wire
12	No. of Zone	1
13	No. of Baffle	1
14	Material for Baffle	S.S. 304
15	No. of Control Panel	1
16	Energy Meter	1
17	Type of current	415 +/-5%V, 3 phase, 50 HZ

2.1.3 Justification & Suitability of the technology selected

The energy cost in electrical annealing furnaces is low comparatively with wood fired furnaces due to more efficiency of electrical heating, less manpower cost and low energy cost. Further,

the parameters can be critically controlled in the electrical furnaces. Overall, energy cost per tonne of brass annealing is low than the wood fired furnaces. The following are the reasons for selection of this technology:

- Less energy cost per tonne of annealing
- It starts up instantaneously thereby reducing the time to reach working temperature.
- Due to circulation of heat through fans in the furnace, more uniform temperature is achieved.
- Avoids overheating of the metal and hence improves the quality.
- The required temperature can be critically controlled

2.1.4 Superiority over existing technology/equipment

The following are the benefits of the Electrical annealing furnace:

- Reduces energy cost per ton of brass
- Reduces dependency on the manpower
- Lower payback periods
- Avoids overheating and hence improvement in the quality of the material
- Uniform temperature is maintained
- Avoids human error

2.1.5 Availability of the proposed technology/equipment

The annealing electrical furnace suppliers are available in Delhi, which is 250 kms from Jagadhri. The detail of the local service provider is furnished in Annexure 7.

2.1.6 Source of technology/equipment for the project

The technology is indigenous and is locally available.

2.1.7 Service/technology providers

The service providers are available in Delhi.

2.1.8 Terms of sales

For erection & commissioning:

- 50% payable prior to commencement of Erection work by DD payable at Delhi.
- 30% payable on completion of Erection work by DD payable at Delhi.

- 20% payable on commissioning by DD payable at Delhi.

Performance Guarantee

The guarantee covers free replacement, ex-our works, any component found defective due to bad workmanship or faulty raw materials, provided defects are not due to damage during transit, bad storage, misuse, improper use, use of improper atmosphere or any utility, location & environmental damages and mishandling or overloading of the equipment at Customer's site or due to normal wear & tear.

The Guarantee does not cover on equipment parts like heat resisting steel parts (like retorts, conveyors, baskets, trays, fixtures, etc.) thermocouples, heating elements, electrical and other fragile items and all such parts which are subject to normal wear and tear in usage and application. If any maintenance due to such cause, customer will be required to attend to the same. If any service visit required in such events including the guarantee period, the visits shall be on chargeable basis and also no guarantee for any product or process characteristics though every effort would be made to adjust equipment parameters within the range possible to achieve factors Notwithstanding any conditions stated herein, there shall be no liability on us for loss of production, loss of profit, loss of use, loss of contracts or for any other consequential or indirect loss whatsoever. This Guarantee will be valid for a period of 12 months from the date of Commissioning or 18 Months from the date of dispatch of the equipment, whichever is earlier.

After Sales Service

During the warranty period as said above, the seller shall depute their Service Engineer(s) free of cost to the works of the buyer, as and when necessary. However, the buyer shall bear the expenses on boarding and lodging of the Service Engineer(s) during stay at buyer's place, the local conveyance and to and fro travel expenses. Thereafter, our regular service charge will be charged besides to and fro air/rail fare boarding and lodging, conveyance and any other incidental expenses

2.1.9 Process down time during implementation

Process down time is considered for installation of new electrical furnace for annealing is two week.

2.2 Life cycle assessment and risks analysis

The life of the proposed equipment is considered at 15 years.

2.3 Suitable unit in terms of capacity

The proposed Bogie furnace has capacity 4000 kg per batch and can be installed in all the brass units having wood fired annealing furnaces. The normal batch time is 8 hours.

3. ECONOMIC BENEFITS OF NEW ENERGY EFFICIENT TECHNOLOGY

3.1 Technical benefits

3.1.1 Fuel savings per year

Installation of electrical annealing furnace will replace the existing wood fired annealing furnace in which wood is used as a fuel. Hence, about 221.1 tonne per year of wood consumption can be replaced by 120000 kWh of electricity.

3.1.2 Electricity savings per year

No electrical savings is envisaged by electrical annealing furnace, as the electrically operated annealing furnace replace the existing wood fired annealing furnace, hence total electricity consumption increases by 120000 kWh per year.

3.1.3 Improvement in product quality

The project activity is installation of new electrical annealing furnace, due to better control and uniform temperature in the furnace, the product quality may improve to certain extent.

3.1.4 Increase in production

The electrical annealing furnaces will take less time for annealing with respect to wood fired and hence, more production may be achieved per day.

3.1.5 Reduction in raw material consumption

The electrical annealing furnace reduces oxidation losses and no impact on the raw material consumption.

3.1.6 Reduction in other losses

There is no significant reduction in other losses.

3.2 Monetary benefits

The installation of new Bogie furnace reduces production cost and monetary savings due to reduction in production cost is ` 4.55 lakh per annum.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

The project activity is Bogie furnace and the process of melting is closed and no heat is dissipated outside and hence the working environment will improve considerably.

3.3.2 Improvement in skill set of workers

The technology selected for the implementation is new. Implementation, operation & maintenance of technology will create awareness among workers and hence it improves skills of the workers

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

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

3.4.2 Reduction in GHG emission such as CO_2, NOx, etc

CO_2 emission is one of the major sources of GHG emission. Implementation of proposed technology will definitely reduce the CO_2 emission. Since proposed technology will replace about 221.1 tonne wood annually which is equivalent to 362.60 tCO_2 but at the same time it consumes about 120 MWh of electricity which is equivalent to 97.20 tCO_2. Hence, total emission reduction due to project activity will 265.40 tCO_2 or 265 CER.

3.4.3 Reduction in other emissions like SOx

As the project activity reduces wood consumption, the SOx emissions also reduces to some extent.

4. IMPLEMENTATION OF PROPOSED EQUIPMENT

4.1 Cost of technology/equipment implementation

4.1.1 Cost of technology/equipments

The total cost for installation of Bogie furnace for brass annealing for a 4000 kg per batch capacity is estimated at ` 8.75 lakh, which includes the cost of Bogie furnace, DM water plant, Electrical panels and Controls, cables and connections and supply of equipment etc.

4.1.2 Other costs

The civil works, erection, commissioning charges and trial operation for the bogie furnace is estimated at ` 0.5 lakh. The details of the item wise cost are furnished in Table 4.1 below:

Table 4.1 Total Project cost

S.No	Particular	Unit	Value
1	Bogie furnace - Brass annealing	` in lakh	8.75
2	Civil Works, cabling, panel, controls etc and Erection & Commissioning	` in lakh	0.50
3	Investment without IDC	` in lakh	9.25
4	Interest During Implementation	` in lakh	0.00
5	Total Investment	` in lakh	9.25

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at ` 2.31 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which works out at ` 6.94 lakh.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10.00% which is prevailing interest rate of SIDBI for energy efficiency projects. The loan tenure is 5 years and the moratorium period is 6 months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with ` 2.90 lakh in the first year operation and increases to ` 14.75 lakh at the end of eighth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ` 9.25 lakh and monetary savings due to reduction in energy/production cost is ` 4.55 lakh and payback period works out to be 2.03 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.0% interest rate works out to be ` 7.38 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 31.85%. Thus the project is financially viable. The average DSCR works out at 2.00.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 26.18%.

4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

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

- Increase in monetary savings by 5%
- Decrease in monetary savings by 5%

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

Table 4.2 Sensitivity analysis at different scenario

Particulars	IRR %	NPV ` in lakh	ROI %	DSCR
Normal	31.85	7.38	26.18	2.00
5% increase in monetary savings	34.23	8.26	26.41	2.10
5% decrease in monetary savings	29.44	6.51	25.92	1.89

As can be seen from above, the project is highly sensitive to fuel savings, the debt service coverage ratio works out to be 1.89 times in worst scenario, which indicates the strength of the project.

4.5 Procurement and implementation schedule

The project is expected to be completed in 12 weeks from the date of financial closure and release of work order to the supplier. The detailed schedule of project implementation is furnished in Annexure 6.

ANNEXURES

Annexure 1: Evaluation of efficiency of furnace

Ahuja Metal Industries

S.No	Parameter	Units	Details
1	Fuel used	-	Fire wood
2	Quantity of metal Annealing	kg/day	5,400
3	specific heat of brass	kCal/kg ^{o}C	0.092
4	Initial temperature of brass	^{o}C	30
5	Final temperature of brass	^{o}C	600
6	Heat output	kCal/day	2,83,176
7	Quantity of fire wood consumption	kg/day	800
8	Calorific value of fire wood	kcal/kg	3,200
9	Heat input	kCal/day	25,60,000
10	Efficiency	% age	11.1

2) Usha Enterprises

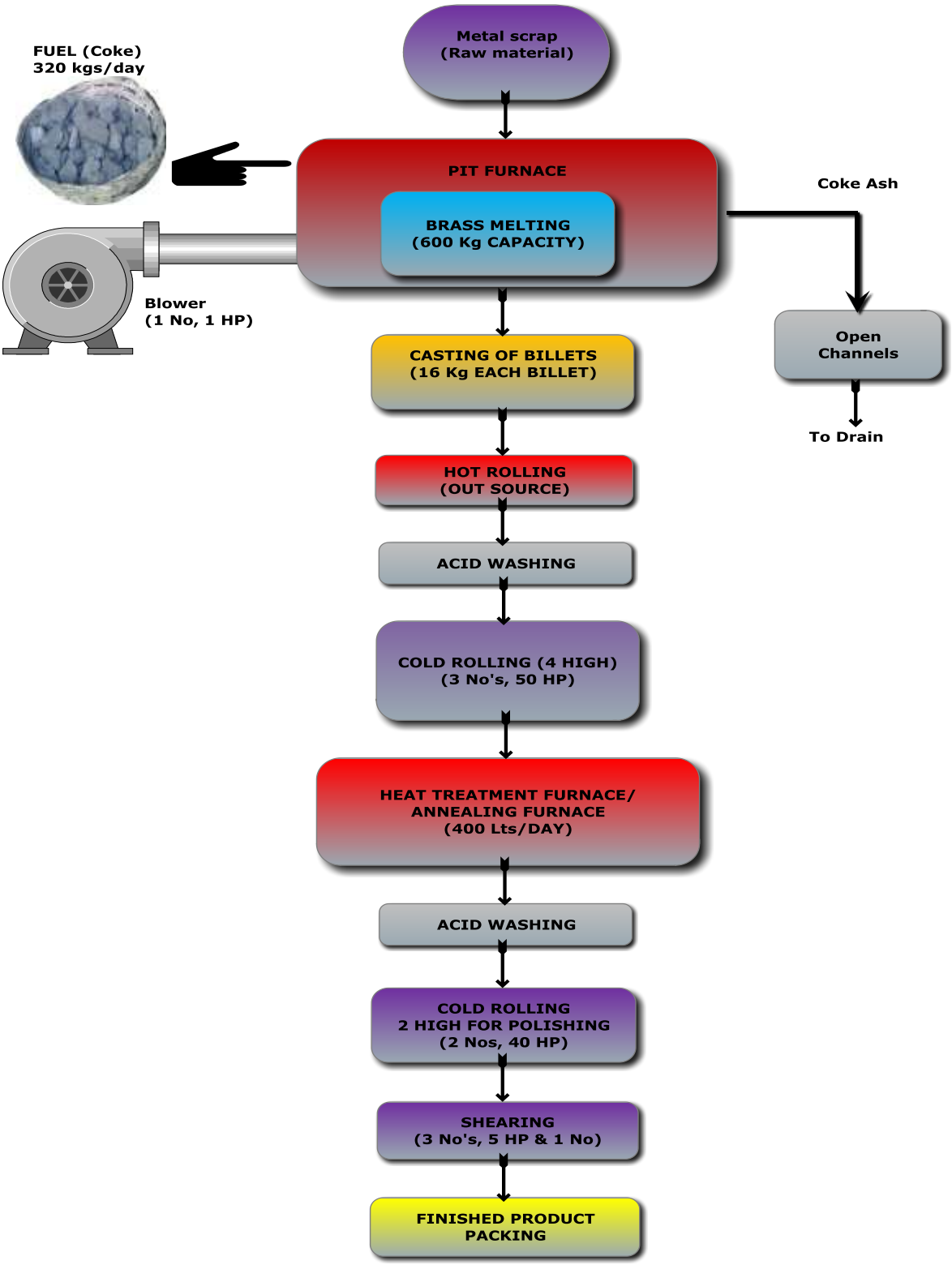
S.No	Parameter	Units	Details
1	Fuel used	-	Fire wood
2	Quantity of metal Annealing	kg/day	2,000
3	specific heat of brass	kCal/kg ^{o}C	0.092
4	Initial temperature of brass	^{o}C	30
5	Final temperature of brass	^{o}C	600
6	Heat output	kCal/day	1,04,880
7	Quantity of fire wood consumption	kg/day	500
8	Calorific value of fire wood	kcal/kg	3,200
9	Heat input	kCal/day	16,00,000
10	Efficiency	% age	7.0

3) Arun metals

S.No	Parameter	Units	Details
1	Fuel used	-	Fire wood
2	Quantity of metal Annealing	kg/day	4,000
3	specific heat of brass	kCal/kg ^{o}C	0.092
4	Initial temperature of brass	^{o}C	30
5	Final temperature of brass	^{o}C	600
6	Heat output	kCal/day	2,09,760
7	Quantity of fire wood consumption	kg/day	800
8	Calorific value of fire wood	kcal/kg	3,200
9	Heat input	kCal/day	25,60,000
10	Efficiency	% age	8.2

Projected Baseline (According to Audit Data)						
		Production Base				
	Name	Kg per Day Treated	Amount of Fuel	Weighted Average		SEC
				Fuel	Brass	
Unit 1	Ahuja Metal Industries	5400	800	747	4057	0.1842105
Unit 2	Usha Enterprises	2000	500			
Unit 3	Arun Metals	4000	800			
	For 2000Kg Per Day		368			
	For 4000Kg Per Day		737			

Annexure 2: Process flow diagram



Annexure 3: Detailed technology assessment report

The cost benefit analysis of installing annealing furnace for brass annealing is furnished below:

S.No	Parameter	Unit	Value
1	Present quantity of brass Annealing	kg/batch	4,000
2	Wood consumption per batch (10 hrs/batch)	kg/batch	737
3	Cost of wood	`/kg	4.5
4	Fuel cost per batch	`/batch	3316
5	Fuel cost for 4000 kg capacity	`	3316
	Bogie Furnace		
1	Quantity of brass Annealing per batch	kg/batch	4,000
2	Electricity consumption for bogie furnace (8 hrs/batch)	kWh/batch	400
3	Cost of electricity	`/batch	4.5
4	Electricity cost per batch	`/tonne	1,800
	Cost Benefit analysis		
1	Monetary savings due to bogie Furnace	`/batch	1,516
2	Monetary savings due to bogie Furnace per tonne	` /Tonne	379
3	No. batches per day	no.	1
4	No. of days of operation per annum	days	300
5	Total production per annum	Tons	1200
6	Monetary savings per annum	` in lakh	4.55
7	Investment required	` in lakh	9.25
8	Payback period	year	2.03

Annexure 4: Technical drawings of the bogie furnace

Not available with the Vendor/technology provider

Annexure 5: Detailed financial calculations & analysis

Assumptions

Name of the Technology	**Bogie furnace - Brass annealing**		
Rated Capacity	**60 kW**		
Details	***Unit***	***Value***	***Basis***
Installed Capacity	kW	60	
No of working days	Days	300	
No of operating hours	Hours/day	8	
Proposed Investment			
Bogie furnace - Brass annealing	` (in lakh)	8.75	
Civil Works, cabling, panel, controls etc and Erection & Commisioning	` (in lakh)	0.50	
Investment without IDC	` (in lakh)	9.25	
Interest During Implementation	` (in lakh)	0.00	
Total Investment	` (in lakh)	9.25	
Financing pattern			
Own Funds (Equity)	` (in lakh)	2.31	Feasibility Study
Loan Funds (Term Loan)	` (in lakh)	6.94	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%	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Monetary savings per ton of Brass Annealing	`/ tons	379	
Annual production	tons	1200	
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 lakhs)**

Years	*Opening Balance*	*Repayment*	*Closing Balance*	*Interest*
1	6.94	0.48	6.46	0.80
2	6.46	0.96	5.50	0.60
3	5.50	1.20	4.30	0.50
4	4.30	1.44	2.86	0.36
5	2.86	1.80	1.06	0.21
6	1.06	1.06	0.00	0.03
		6.94		

WDV Depreciation **(` in lakhs)**

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	9.25	1.85
Depreciation	7.40	1.48
WDV	1.85	0.37

Projected Profitability

(Rs` in lakhs)

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Revenue through Savings								
Fuel savings	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Total Revenue (A)	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Expenses								
O & M Expenses	0.37	0.39	0.41	0.43	0.45	0.47	0.50	0.52
Total Expenses (B)	0.37	0.39	0.41	0.43	0.45	0.47	0.50	0.52
PBDIT (A)-(B)	4.18	4.16	4.14	4.12	4.10	4.08	4.05	4.03
Interest	0.80	0.60	0.50	0.36	0.20	0.03	0.00	0.00
PBDT	3.38	3.56	3.64	3.76	3.89	4.04	4.05	4.03
Depreciation	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
PBT	2.89	3.07	3.16	3.27	3.41	3.56	3.56	3.54
Income tax	0.00	0.71	1.24	1.28	1.32	1.37	1.38	1.37
Profit after tax (PAT)	2.89	2.36	1.92	1.99	2.08	2.18	2.19	2.17

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Profit before tax	2.89	3.07	3.16	3.27	3.41	3.56	3.56	3.54
Add: Book depreciation	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Less: WDV depreciation	7.40	1.48	-	-	-	-	-	-
Taxable profit	(4.02)	2.08	3.64	3.76	3.89	4.04	4.05	4.03
Income Tax	-	0.71	1.24	1.28	1.32	1.37	1.38	1.37

Projected Balance Sheet

articulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Liabilities								
Share Capital (D)	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
Reserves & Surplus (E)	2.89	5.25	7.17	9.16	11.24	13.42	15.61	17.78
Term Loans (F)	6.46	5.50	4.30	2.86	1.06	0.00	0.00	0.00
Total Liabilities D)+(E)+(F)	11.66	13.06	13.78	14.33	14.61	15.74	17.92	20.09

Assets	**1**	**2**	**3**	**4**	**5**			
Gross Fixed Assets	9.25	9.25	9.25	9.25	9.25	9.25	9.25	9.25
Less: Accm. Depreciation	0.49	0.98	1.47	1.95	2.44	2.93	3.42	3.91
Net Fixed Assets	8.76	8.27	7.78	7.30	6.81	6.32	5.83	5.34
Cash & Bank Balance	2.90	4.79	5.99	7.03	7.80	9.42	12.09	14.75
TOTAL ASSETS	11.66	13.06	13.78	14.33	14.61	15.74	17.92	20.09
Net Worth	5.20	7.56	9.48	11.47	13.55	15.74	17.92	20.09
Dept equity ratio	2.79	2.38	1.86	1.24	0.46	0.00	0.00	0.00

Projected Cash Flow:

Particulars / Years	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Sources									
Share Capital	2.31	-	-	-	-	-	-	-	-
Term Loan	6.94								
Profit After tax		2.89	2.36	1.92	1.99	2.08	2.18	2.19	2.17
Depreciation		0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Total Sources	9.25	3.38	2.85	2.41	2.48	2.57	2.67	2.67	2.66
Application									
Capital Expenditure	9.25								
Repayment of Loan	-	0.48	0.96	1.20	1.44	1.80	1.06	0.00	0.00
Total Application	9.25	0.48	0.96	1.20	1.44	1.80	1.06	0.00	0.00
Net Surplus	-	2.90	1.89	1.21	1.04	0.77	1.61	2.67	2.66
Add: Opening Balance	-	-	2.90	4.79	5.99	7.03	7.80	9.42	12.09
Closing Balance	-	2.90	4.79	5.99	7.03	7.80	9.42	12.09	14.75

Calculation of Internal Rate of Return **(Rs` in lakhs)**

Particulars / year	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Profit after Tax		2.89	2.36	1.92	1.99	2.08	2.18	2.19	2.17
Depreciation		0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Interest on Term Loan		0.80	0.60	0.50	0.36	0.20	0.03	-	-
Cash outflow	(9.25)	-	-	-	-	-	-	-	-
Net Cash flow	(9.25)	4.18	3.45	2.90	2.84	2.77	2.70	2.67	2.66
IRR	31.85%								

NPV	7.38

Break Even Point

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.39
Sub Total (G)	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.39
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.13
Interest on Term Loan	0.80	0.60	0.50	0.36	0.20	0.03	0.00	0.00
Depreciation *(H)*	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Sub Total (I)	1.38	1.19	1.09	0.96	0.80	0.64	0.61	0.62
Sales (J)	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55
Contribution (K)	4.27	4.26	4.24	4.23	4.21	4.19	4.18	4.16
Break Even Point (L= G/I)	32.37%	27.90%	25.59%	22.70%	19.12%	15.21%	14.66%	14.88%
Cash Break Even {(I)-(H)}	20.94%	16.42%	14.08%	11.15%	7.52%	3.56%	2.97%	3.13%
Break Even Sales (J)*(L)	1.47	1.27	1.16	1.03	0.87	0.69	0.67	0.68

Return on Investment

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Total*
Net Profit Before Taxes	2.89	3.07	3.16	3.27	3.41	3.56	3.56	3.54	26.45
Net Worth	5.20	7.56	9.48	11.47	13.55	15.74	17.92	20.09	101.02
									26.18%

Debt Service Coverage Ratio

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*Total*
Cash Inflow									
Profit after Tax	2.89	2.36	1.92	1.99	2.08	2.18	2.19	2.17	13.42
Depreciation	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	2.93
Interest on Term Loan	0.80	0.60	0.50	0.36	0.20	0.03	0.00	0.00	2.50
TOTAL (M)	4.18	3.45	2.90	2.84	2.77	2.70	2.67	2.66	18.85

DEBT

Interest on Term Loan	0.80	0.60	0.50	0.36	0.20	0.03	0.00	0.00	2.50
Repayment of Term Loan	0.48	0.96	1.20	1.44	1.80	1.06	0.00	0.00	6.94
Total (N)	1.28	1.56	1.70	1.80	2.00	1.09	0.00	0.00	9.44
Average DSCR (M/N)	2.00								

Annexure 6: Details of procurement and implementation plan with schedule/timelines

Project Implementation Schedule – Bogie furnace

S. No.	Activities	Weeks							
		1	2	3	4	5/6	7/8	9/10	11/12
1	Release of work orders								
2	Fabrication work								
3	Gas lines, platform construction and civil works								
4	Delivery, Commissioning and Trial Runs								

Process Breakdown

S. No.	Activities	Weeks							
		1	2	3	4	5/6	7/8	9/10	11/12
1	Civil works								
2	Gas lines, plat form construction and								
3	Electrical cabling								
4	Commissioning and Trial Runs								

Annexure 7: Details of technology/equipment and service providers with contact nos.

Equipment details	Source of technology	Service/technology providers
Bogie Furnace	Indigenous	Simplicity Engineers P Ltd. B-99 Mayapuri, Phase I, New Delhi – 110064 Contact person : Radha Krishnan Contact no : 9999767630 Tel: (011) 28115978/28116979/ 28113048 Fax: (011) 28116273 / 28117273 E-Mail: simplicity@vsnl.com Website: www.simplicityfurnaces.net

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

Simplicity Engineers P Ltd.
B-99 Mayapuri, Phase I,
New Delhi – 110064

Tel: (011) 28115978/28116979/28113048
Fax: (011) 28116273 / 28117273
E-Mail: simplicity@vsnl.com
Website: www.simplicityfurnaces.net

OFFER NO.22598
DATED : 26.10.2010

QUOTATION FOR SIMPLICITY ELECTRICALLY HEATED BOGIE HEARTH FURNACE FOR ANNEALING

SIMPLICITY ELECTRICALLY HEATED BOGIE TYPE FURNACE WITH AIR CIRCULATION IS SUITABLE FOR GENERAL HEAT TREATMENT LIKE ANNEALING , NORMALISING OF STEELS AND ANNEALING OF NON FERROUS METALS UPTO 550 DEG.C. HOWEVER ACTUAL METHOD OF HEAT TREATMENT DEPENDS ON BOTH MECHANICAL AND METALLURGICAL REQUIREMENTS OF THE COMPONENTS BEING TREATED.

SCOPE OF SUPPLY :

Furnace:

The outer casing is fabricated out of thick commercial grade mild steel pates reinforced with angles and channels. The furnace casing will be provided with adequate holes for insertion of thermocouples for temperature sensing.

Lining :

The furnace side walls, roof, door & rear wall shall be lined with ceramic fibre insulation. However, the hearth and bogie shall be lined with refractory and insulation bricks.

Heating Elements :

Heating elements made in coil form wound on ceramic tubes placed in high alumina element holding bricks shall be provided on both the sides of the furnace. The heating elements are designed at low surface load to ensure longer service life.

Air Circulation:

Suitable number of centrifugal fan with air cooled bearings and drive motor is provided at the top of the furnace to force the hot air and ensure uniform distribution of heat. The impeller and shaft of the fan is fabricated out of AISI 304.

Baffle :

Suitable baffle fabricated out of AISI 304 is provided to guide the forced hot air from the circulation fan and ensures desired temperature uniformity.

Bogie :

The Bogie will be strong and robust construction fabricated from Mild Steel plates suitably stiffened with rolled steel section and carried on wheels running into antifriction bearings.

The top of the Bogie will be lined with fire bricks backed by insulation bricks.

Door

Rise and fall type, manually operated door is provided with the furnace.

EXCLUSIONS:

- Civil engineering work of any nature. Only the foundation lay-out drawings shall be supplied by us wherever necessary.
- Supply and laying of electrical cables from the main supply to the panel board and from panel board to the furnace equipments and all auxiliaries wherever required.
- upply and laying of all utility connections like oil / gas / cooling water and or any other utility connections as required by the equipments from the source of supply to the furnace equipments and their auxiliaries wherever required.
- Storage Tank, Service Tank, Pipe Lines to the equipments and auxiliaries wherever required.
- Rails, Tracks
- Flue Ducts, Chimney and any other Exhaust Arrangement as may be required.
- Trays, Baskets, Fixtures.
- Coiler, Decoiler, Crane, Compressor and any other support equipments as may be required.
- Unloading at site and shifting of materials from stores to the erection site
- While installation, Crane facility, Erection Tools and Tackles, Gas Cutting Set, Welding Set, Compressed Air, Casual Labour, etc as and when required.
- The equipments are to be installed by you in position and connected to all utilities according to the requirements.
- Any other item not specifically mentioned in our offer.

TECHNICAL DATA

Clear Height above Bogie	600 mm
Width	1500 mm
Length of Bogie	2000 mm
Connected Load	60 KW
Max. working temperature	600 Deg.C.
No. of Door	1 No.
Type of Door operation	Manual, Rise & Fall type
No. of Bogie	1 No.
Bogie Haulage	Manual

No. of Fan	2 Nos.
Material for Impeller & Shaft	S.S. 304
Type of Control	Automatic Hi-Low through PID Controller and Zonal Thyristor
Heating Elements	Kanthal Wire
No. of Zone	1 No.
No. of Baffle	1 No.
Material for Baffle	S.S. 304
No. of Control Panel	1 No.
Energy Meter	1 No.
Type of current	415 +/-5%V, 3 Ph. 50 c/s.
PRICE FOR THE FURNACE DESCRIBED AS ABOVE WITH CONTROL PANEL	RS. 8,75,000.00 EACH
COMMISSIONING CHARGES	RS. 30,000.00 P. UNIT

For SIMPLICITY ENGINEERS PVT. LTD.

RADHA KRISHAN

DELIVERY : 4 – 5 MONTHS FROM THE DATE OF TECHNICALLY & COMMERCIALLY CLEAR ORDER.

TERMS AND CONDITIONS

PRICES: Prices quoted are Ex-our Works, Packing & Forwarding @ 4%, Insurance & Freight, etc. shall be extra at actuals.

DUTIES & TAXES: EXCISE DUTY: Excise Duty shall be charged extra as applicable at the time of dispatch. The present rate of Excise Duty is @ 10% and 2% Education Cess and 1% S&H Cess on Excise Duty.

SALES TAX: Central Sales Tax / VAT will be charged extra as applicable at the time of dispatch. The present rate of C.S.T. is @ 2% against Form C or otherwise 12.5%. Present VAT rate for Local Sales is 12.5%.

In case the client wishes to claim any exemption on the levy of Duty / Tax, they should produce the necessary documents as applicable to concerned department prior to supplies.

DELIVERY: The equipment can be offered for delivery within _4-5___ months from the date of acceptance of your technically (drawing approval as applicable) and commercially clear order along with advance.

PAYMENT: FOR SUPPLIES

25% of the Order Value along with Purchase Order by DD payable at Delhi.
25% of the Order Value after submission of the Layout Drawings by DD payable at Delhi.
Balance 50% of the Order Value along with 100% Taxes and Duties and other levies against Proforma Invoice prior to dispatch of materials at our works, by DD payable at Delhi.

FOR ERECTION & COMMISSIONING:

50% payable prior to commencement of Erection work by DD payable at Delhi.
30% payable on completion of Erection work by DD payable at Delhi.
20% payable on commissioning by DD payable at Delhi.

In case there is a delay in taking delivery of the equipments beyond two weeks of our offering the equipments for inspection, our balance payment must be released immediately. Similarly, after receipt of equipment, if there is a delay in commissioning for availability of site and provision of utilities or for any other reason, our balance payment should be released within 60 days of despatch. We shall, however, dispatch the equipments on your clearance and extend our assistance for commissioning of the equipments.

ERECTION & COMMISSIONING: We shall depute our technician for the Erection & Commissioning work for which we shall charge you extra as mentioned in the Price Schedule.

During Erection & Commissioning of the equipments, the services of unskilled labour, Gas Cutting / Welding Sets with consumables, Standard Tools, Chain Pulley / Crane, suitable Material Handling Facilities, Compressor, Water Supply, Power Supply and / or any other utility, Oil / Gas supply have to be provided by the Client free of cost, as and when required by our Erection Team. The Client shall also arrange for free lodging arrangement for our Erection Team.

INSPECTION: When inspection prior to dispatch is required, visual inspection of various equipments can be arranged at our works / sub-vendors at client's cost. An advance notice will be given for the date of inspection and if inspection is not carried out within 7 days of specified date, the inspection requirement shall be deemed to have been waived off by the client unconditionally. We will, at our discretion proceed with the dispatch and negotiate for payment. All materials dispatched shall however, be fully tested under no load condition.

THIRD PARTY INSPECTION: The charges of inspection by any third party inspecting agency is not included in our offer. Inspection by third party has to be specifically clarified prior to placement of orders. All third party inspection charges are to be borne by the purchaser. Additionally, we shall be charging a sum of Rs.2,000/- per day for the days of inspection visit by the representative of the agency to cover our cost for co-ordinating and attending to them while such visits.

FORCE MAJEURE: We shall be under no liability under any contract arising out of our Quotation / Offer wherever fulfillment out of our and / or our sub-contractors and / or suppliers obligations are hindered or prevented by causes beyond our / their control such as War, Strikes, Lockouts, Fire, Accidents, Epidemics, Failure of supply of Electricity or other Power, shortage of materials or labour or Orders of the Government or other duly Constituted Authority.

All Delivery Schedules are subject to delays by customers for payment, drawing approval and other obligations by customer.

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

Zenith Energy Services Pvt. Ltd
10-5-6/B, My Home Plaza, Masab
Tank HYDERABAD, AP 500 028
Phone: 040 23376630, 31,
Fax No.040 23322517
Website: www.zenithenergy.com

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