DETAILED PROJECT REPORT
ON
GAS FIRED RADIATION FURNACE FOR ANNEALING
HOWRAH CLUSTER











Bureau of Energy Efficiency

Prepared By

Reviewed By

GAS FIRED RADIATION FURNACE FOR ANNEALING

HOWRAH GALVANIZING AND WIRE DRAWING CLUSTER

BEE, 2010

Detailed Project Report on implementation of Gas Fired Radiation Furnace for Annealing

Galvanizing and Wire Drawing SME Cluster,

Howrah, West Bengal (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No: ***HWR/WDG/GRF/15***

For more information

Bureau of Energy Efficiency
Ministry of Power, Government of India
4th Floor, Sewa Bhawan, Sector - 1
R. K. Puram, New Delhi -110066

Ph: +91 11 26179699 Fax: 11 26178352
Email: jsood@beenet.in
pktiwari@beenet.in
WEB: www.bee-india.nic.in

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Dr. Ajay Mathur, Director General, BEE

Smt. Abha Shukla, Secretary, BEE

Shri Jitendra Sood, Energy Economist, BEE

Shri Pawan Kumar Tiwari, Advisor (SME), BEE

Shri Rajeev Yadav, Project Economist, BEE

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Indian Institute of Social Welfare and Business
Management Kolkata

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List of Abbreviation

BEE	Bureau of Energy Efficiency
CDM	Clean Development Mechanism
DPR	Detailed Project Report
DSCR	Debt Service Coverage Ratio
FO	Furnace Oil
GHG	Green House Gases
IRR	Internal Rate of Return
MT	Million Ton
MW	Mega Watt
NPV	Net Present Value
ROI	Return on Investment
SHC Coal	Semi Hard Coke Coal
MSME	Micro Small and Medium Enterprises
MoMSME	Ministry of Micro Small and Medium Enterprises
SIDBI	Small Industrial Development Bank of India

EXECUTIVE SUMMARY

IISWBM, Kolkata is executing BEE-SME program in the Galvanizing and Wire Drawing Cluster of Howrah, supported by Bureau of Energy Efficiency (BEE) with an overall objective of improving the energy efficiency in cluster units.

One of the identified sectors was Galvanizing and Wire-drawing in Howrah district of West Bengal. There are about 100 SMEs in Galvanizing and Wire-drawing sector of Howrah Cluster comprising about 50% galvanizing units and 50% wire drawing units. The units are constantly under threat of closure due to poor energy efficiency along with pollution issues and variability in demand. Improvement in energy efficiency would largely ensure sustainable growth of the sector, which needs a mechanism to identify technology and techniques for improving energy efficiency in these highly unorganized and so far uncared for industrial units.

Many wire-drawing units have furnaces to perform annealing. Conventionally, for annealing copper or aluminium, electric furnaces are used, whereas for annealing MS wire wood fired furnaces are used. While separate DPR has been prepared for the wood fired furnace which has been found to be improved by incorporating air pre-heating system, the present DPR deals with the alternative energy source for the annealing furnace in place of electricity because the price of electricity is highest amongst all fuels and for heating purpose it would wise to limit its use as far as possible. Traditionally for annealing copper or aluminium, electric furnaces has been used because of the need of precision control of temperature over time and clean environment to avoid contamination of the copper/aluminium wire to be drawn. Recently technological breakthrough has made it possible to meet both the ends even with the use of LPG or natural gas in specially designed furnaces. The high investment needs to be justified through economic benefits as envisaged in this DPR.

Total electricity consumption in typical wire drawing unit is 295310 kWh per year. After using of proposed technology i.e. using of gas fired radiation furnace instead of electrical furnace for annealing would lead to saving of 99600 kWh electricity per year. Annual percentage savings is 34% of the total electricity consumption.

This DPR also highlights the availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis in different scenarios and schedule of project implementation

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National

Manufacturing and Competitiveness Programme". The key indicators of the DPR including the Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table:

S.No	Particular	Unit	Value
1	Project cost	₹ (In lakh)	14.42
2	Electricity savings	kWh/year	99600
3	Monetary benefit	₹ (In lakh)	5.87
4	Simple payback period	Years	2.46
5	NPV	₹ (In lakh)	6.82
6	IRR	%age	23.39
7	ROI	%age	25.15
8	DSCR	Ratio	1.66
9	Process down time	Days	15
9	CO_2 reduction	Ton /year	75

The projected profitability and cash flow statements indicate that the project implementation i.e. using of gas fired radiation furnace instead of electric furnace will be financially viable and technically feasible solution for wire drawing units in the cluster.

ABOUT BEE'S SME PROGRAM

The Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters. Howrah Galvanizing and Wire Drawing Cluster is one of them. The SME Programme of BEE intends to enhance the awareness about energy efficiency in each cluster by funding/subsidizing need based studies 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 stakeholders 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

The Galvanizing and Wire-drawing cluster in Howrah district of West Bengal is a very large cluster. There are about 100 SMEs in the Howrah Cluster and comprising of about 50% galvanizing units and 50% wire drawing units. The units are constantly under threat of closure due to poor energy efficiency along with pollution issues and variability in demand. Improvement in energy efficiency would largely ensure sustainable growth of the sector. It needs a mechanism to identify technology and techniques for improving energy efficiency in this highly unorganized and so far uncared for industrial units.

The major raw materials for the Galvanizing industry are zinc, ammonium chloride, hydrochloric acid, and di-chromate powder. On the other hand, the raw materials used in Wire-drawing units are MS / Copper / Aluminium Wires of gauges varying from 14 to 4 gauge i.e. 1.6 to 5.1 mm dia., while Uni-Lab powder (of Predington company based in Bombay) or Grommet–44 is used for lubrication (eg.).

The main form of energy used by the cluster units are grid electricity, Furnace Oil, coal, LPG and Diesel oil. Major consumptions of energy are in the form of Furnace Oil and Diesel. Details of total energy consumption at Howrah cluster are furnished in Table 1.1a and 1.1b:

Table 1.1a Details of annual energy consumption in the wire drawing units

S. No	Type of Fuel	Unit	Value	% contribution
1	Electricity	GWh/year	2.24	76
2	Wood	Ton/year	300	5
3	LPG	Ton/year	70.5	19

Table 1.1b Details of annual energy consumption in the galvanizing units

S. No	Type of Fuel	Unit	Value	% contribution
1	Electricity	MWh/year	867.3	13
2	Diesel	kl/year	19.2	2
3	Furnace Oil	kl/year	731.7	62.5
4	Coal	Ton/year	1161	18.5
5	Wood	Ton/year	600	4

Classification of Units

The Galvanizing and Wire Drawing units can be broadly classified on the basis of the following criteria:

1) Product wise
2) Production capacity wise

Products Manufactured

The galvanizing units can be classified on the basis of products into five basis groups. Those are:

a) Units producing transmission tower structures
b) Units producing fastener items
c) Units producing angles and channels
d) Units working on scrap iron
e) Units producing wires

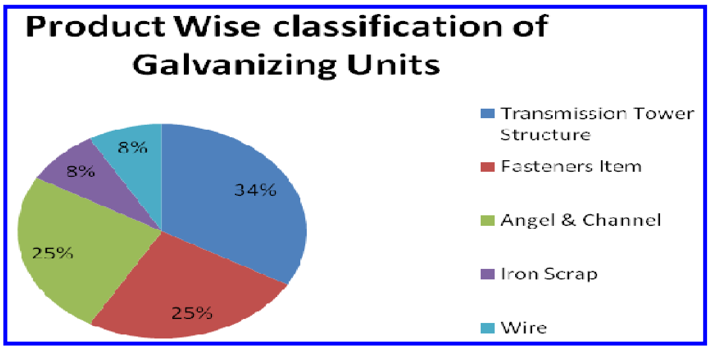


Figure 1.1: Product Wise Classification of Galvanizing Units

Similarly, the wire drawing units are mainly classified into the following categories on the basis of products manufactured as units, which produce:

a) MS wire
b) Copper Wire
c) High carbon wire
d) Aluminium wire

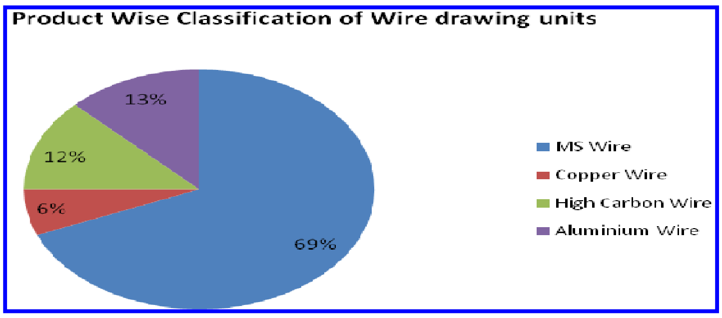


Figure 1.2: Product Wise Classification of Wire-drawing Units

Capacity wise production

In both Wiredrawing and Galvanizing units in Howrah, the production capacity has been found to vary more than 10 folds. In the units, where detailed audit has been performed, there are Wire-drawing units producing as low as 241 Ton/year to as high as 3500 Ton/year. Similarly, the production from Galvanizing units, where audit was performed, has been found to be within the range of 890 to 7500 Ton per annum. Both the Galvanizing and the Wire Drawing units have been classified on the basis of production into three categories, namely 1-500 TPA (calling micro scale), 500-1000 TPA (small scale) and above 1000 TPA (medium scale) capacities. It may be noted that this classification is purely based on the range of capacity that has been observed in the galvanizing and wire drawing sector in Howrah cluster and has no reference to the existing classification of micro, small and medium industries reported elsewhere.

The distribution of units of Galvanizing and Wire Drawing industries has been depicted in Figures 1.3 and 1.4 below:

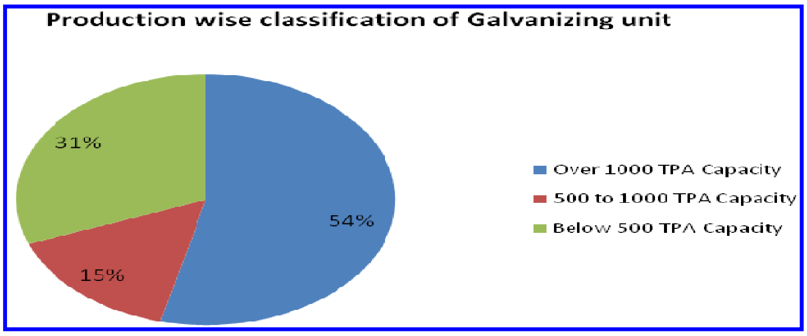


Figure 1.3: Production Wise Classification of Galvanizing Units

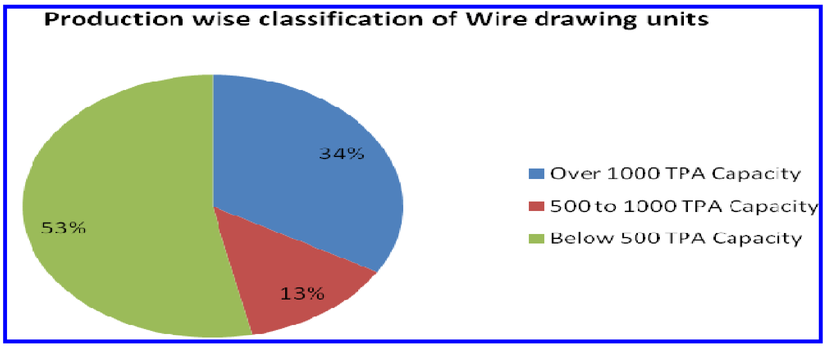


Figure 1.4: Production Wise Classification of Wire-drawing Units

Energy usages pattern

Average yearly electricity consumption in Wire Drawing unit ranges from 82 thousands to 7 lakh kWh depending on the size of the unit. In thermal energy, solid fuel such as wood and gaseous fuel like LPG are used in annealing furnaces in some of the units. The LPG consumption in a typical unit is about 135000 kg/year. The wood consumption in a typical unit is about 300 Ton/year.

Average monthly electricity consumption in a galvanizing unit ranges from 60 thousands to 3 lakh kWh depending on the size of the unit and type of operations performed. In thermal energy, furnace oil is primarily used in the galvanizing furnaces since it is reasonably cheap. The use of FO ranges from 0.5 to 4.5 lakh liters/year. The use of diesel oil ranges from 1.3 to 19.2 kilolitre/year and is used in either drying the job or pre-heating flux solution. SHC coal is also used for the purpose of drying the job and ranges from 1.5 to 8 lakh kg/year. Wood is used in some larger units, which have facilities for running processes other than galvanizing. It can typically use 6 lakh kg/year of wood.

General production process for the wire drawing units

The wire about to be drawn is first put into an annealing furnace. The annealed wire is then put into drums for coiling wires. Thereafter, the wire is put through dies of various sizes interspersed by sets of coiler drums.

These drums are driven by electric motors that are of induction type. The chemical used for lubricating the wire through the die is mainly wire-drawing powder (as it is commonly termed in the wire-drawing industry). The finished products of MS Wires are stacked on a steeper from where finished goods are dispatched to the end customers, after dipping in to a rust-preventive oil solution, which protects the final product from corrosion for up to one-and-half month. The finished wire products are mainly supplied to downstream industries such as galvanizers, electrical manufactures and the local market.

General production process flow diagram for drawing wires is shown in Figure 1.5.

General production process for the galvanizing units

In a typical galvanizing unit, the production process involves seven stages as is shown in the schematic diagram in Figure 1.6. First the job or the raw material, which is to be galvanized is dipped in dilute acid solution and termed acid pickling. Then after the acid pickling process, the job is rinsed in plain water to remove any acid layer present on the job surface. Thereafter, the job is moved onto a SHC coal or diesel based drying bed or flux solution for preheating and drying purpose. This helps produce a uniform layer of zinc on the job surface when the job is dipped in the zinc bath. Then after the drying process is over, the job is dipped into the zinc bath for galvanizing where a layer of molten zinc is deposited uniformly over the job surface.

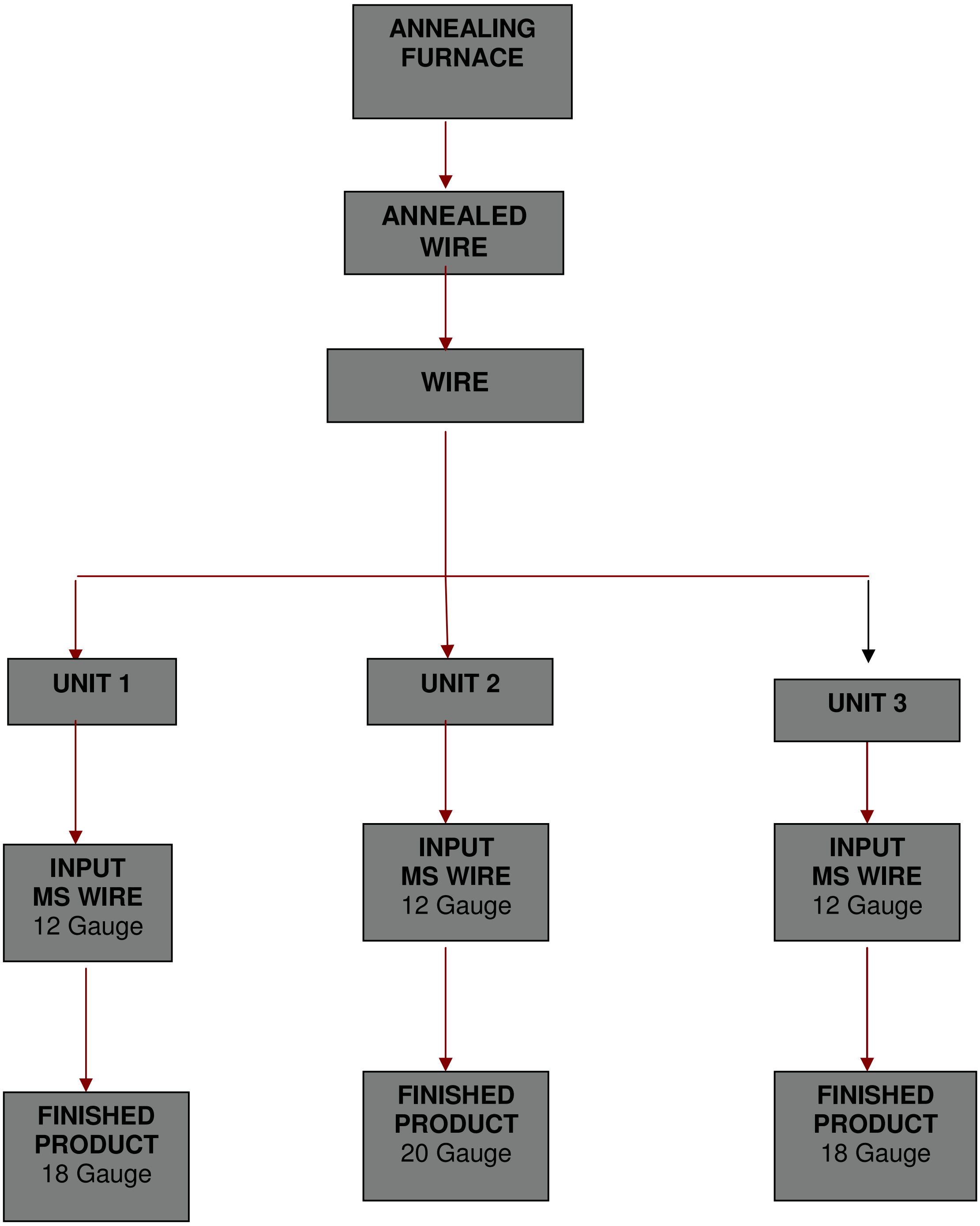


Figure 1.5 Process flow diagram for a typical wire drawing unit

When the job is taken out of the zinc bath, ammonium chloride powder (the fluxing agent) is sprayed over the job to remove the impurities and other dust particles remaining over the surface. Then the job is dipped in plain cold water for cooling. This process is termed as water quenching. After completion of the water-quenching process, the job is dipped into dichromate solution to give a glazing effect to the job galvanized. The description of the above galvanizing process is depicted in the following process flow diagram.

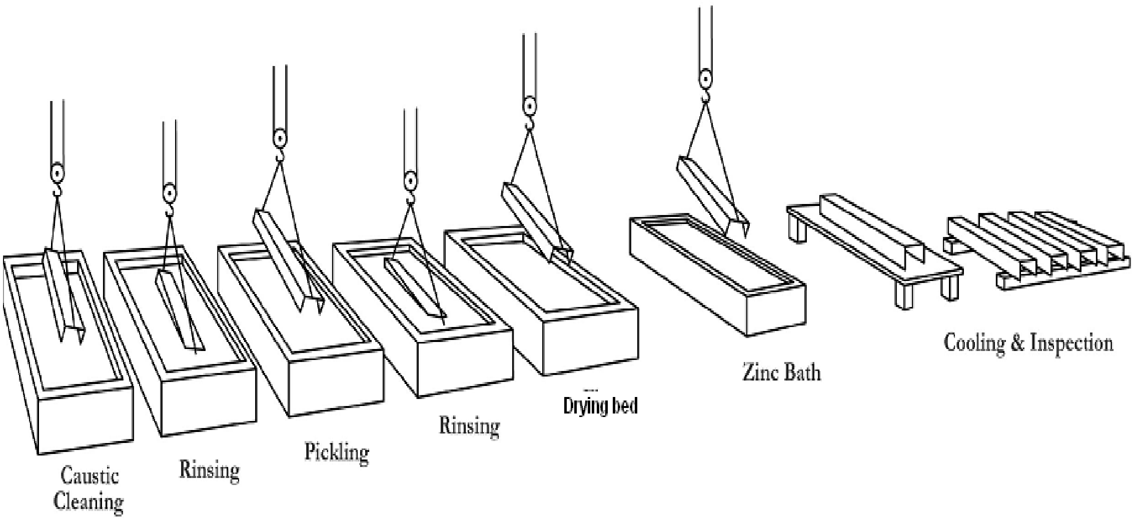


Fig 1.6: Process Flow diagram of galvanizing unit

1.2 Energy performance in existing system

1.2.1 Fuel consumption

Average fuel and electricity consumption in typical wire drawing units is given in Table 1.2 and that of galvanizing units is given in Table 1.3. A small unit is defined to be a unit with production between 500 and 1000 TPA and medium to be greater than 1000 TPA. The micro units are defined to have capacity less than 500 TPA.

Only the larger wire drawing industries have furnaces and also perform annealing. Among the wire drawing units audited, only one, which was also larger used wood for annealing. Further, most of the wire drawing units produce MS wires.

Table 1.2 Average fuel and electricity consumption in typical wire drawing units

Energy	Micro	Small	Medium		
Scale of Unit	Electricity	Electricity	Electricity	LPG	Wood
	kWh/ yr	kWh/ yr	kWh/ yr	Ton/yr	Ton/yr
MS wire	101486	209216	266889	NA	300
Copper wire	NA	NA	295310	70.5	NA
High carbon wire	NA	NA	1088751	NA	NA
Aluminium wire	NA	NA	266889	NA	NA

Table 1.3 Average fuel and electricity consumption in typical galvanizing units

Energy	Small			Medium				
Scale of Unit	Electricity	Furnace Oil	Diesel Oil	Electricity	Furnace Oil	Diesel Oil	SHC coal	Wood
	kWh/ yr	l/yr	l/yr	kWh/ yr	l/yr	l/yr	kg/yr	kg/yr
Transmission Tower Structure	NA	NA	NA	59346	85195	NA	NA	NA
Fasteners Item	107670	132000	19200	109883	112500	NA	21000	NA
Angle & Channel	NA	NA	NA	35491	165000	NA	150000	NA
Wire	NA	NA	NA	302013	165000	7040	NA	600000

1.2.2 Average annual production

Annual production in terms of TPA is taken in case of wire drawing units. The micro units are defined to have production less than 500 TPA, small to be between 500 and 1000 TPA and medium to have production higher than 1000 TPA.

Table 1.4 Typical average annual production in wire drawing units

S. No.	Type of Industry	Production (in TPA)		
		Micro scale	Small scale	Medium scale
1	MS wire	100	600	2000
2	Copper wire	NA	NA	1000
3	High carbon wire	NA	NA	1000
4	Aluminium wire	100	NA	700

Table 1.5 Typical average annual production in galvanizing units

S. No.	Type of Industry	Production (in TPA)		
		Micro scale	Small scale	Medium scale
1	Transmission Tower Structure	NA	NA	1969

S. No.	Type of Industry	Production (in TPA)		
2	Fasteners Item	200	890	4320
3	Angel & Channel	150	NA	3750
4	Wire	NA	NA	3650

1.2.3 Specific energy consumption

Specific energy consumption both electrical and thermal energy per Ton of production for galvanizing and wire drawing units are furnished in Table 1.6 below:

Table 1.6: Specific Energy Consumption in Galvanizing and Wire-drawing Units

		Specific Energy Consumption			Unit
		Min	Max	Average	
Galvanizing	Electrical	5.12	120	46.15	kWh/Ton
	Thermal	200370	579600	385978	kCal/Ton
Wire Drawing	Electrical	30	868	308	kWh/Ton
	Thermal	135	511	323	kCal/Ton

Specific energy consumptions are found to vary widely for wire-drawing and galvanizing processes in the Howrah cluster as shown in the above table. This is because of the variation in size of units, size & type of job, fuels types and volume of process, as, for example, some of the Galvanizing units, manufacturing the microwave tower and high-tension electricity transmission towers, have extensive fabrication activity as a part of the process.

1.3 Existing technology/equipment

1.3.1 Description of existing technology

In a wire drawing plant, annealing is a key part. This improves workability of the material during drawing process. The process of annealing is done in a furnace, which is fired in some of the cases of the cluster by wood for annealing MS wire and electricity by others annealing copper or aluminium. Traditionally for annealing copper or aluminium, electric furnaces has been used because of the need of precision control of temperature over time and clean environment to avoid contamination of the copper/aluminium wire to be drawn. The electric furnaces in the units typically use nichrome coils weighing 1 kg to 1.25 kg, twelve in numbers giving a total rating of 66 kW electrical heating capacity of the furnace and consumed about 99600 kWh per year out of the 295310 kWh per year for the entire unit (i.e. a share of ₹ 8.14 lakh out of a total of ₹ 24.13 lakh). Thus these furnaces use a very costly fuel and the expenditure towards fuel can be reduced by as much as 15-20% upon replacing with gas fired radiation furnaces.

Existing furnace specifications are shown in Table 1.7 below

Table 1.7 Cluster specifications of electric furnace for annealing

S. No.	Parameter	Detail of electric furnace
1	Manufacturer	Local
2	Dimensions	1.82 m dia, 1.27 m height
3	Average fuel consumption	40500–99600 kWh per year
4	Temperature	150 to 500 deg C

Energy charges

In some areas of Howrah, such as, Jangalpur, electricity is supplied by the West Bengal State Electricity Distribution Company Limited (WBSEDCL) at the following tariff rates:

Table 1.8 Electricity charges for WBSEDCL

S. No.	Unit consumed, kWh	Energy Charges, ₹/kWh
1	Upto 500	4.63
2	Next 1500	5.81
3	Above 2000	6.07

Recently introduced tariff includes a Fixed Charge of ₹ 15/kVA for LT supply up to 30 kVA contract demand. Demand charge is ₹ 220/kVA both for LT above 30 kVA contract demand and HT supply. Thus the energy charge for a typical unit with contract demand of 240 kVA and average monthly energy consumption of 24609 kWh is ₹ 8.17 / kWh.

In some areas of Howrah, such as, Liluah, electricity is supplied by CESC at the following tariff rates

Table 1.9 Electricity charges for CESC

S. No.	Unit consumed, kWh	Energy Charges, ₹/kWh
1	For first 500	4.43
2	For next 1500	4.87
3	For next 1500	5.20
4	For above 3500	5.49

Recently introduced tariff includes a Fixed Charge of ₹ 15/kVA for LT supply up to 30 kVA contract demand. Demand charge is ₹ 220/kVA both for LT above 30 kVA contract demand and HT supply. Thus the energy charge for a typical unit with contract demand of 71.8 kVA and average monthly energy consumption of 8972 kWh is ₹ 7.04 / kWh.

1.3.2 Role in process

The process of annealing is a type of heat treatment process wherein a material is altered, causing changes in its properties such as strength and ductility. In this process, the material is heated to above the point of re-crystallization, maintaining a suitable temperature for a considerable period of time and then very slow cooling. Annealing is used to improve ductility, soften material, relieve internal stresses, refine the grain structure by making it homogeneous, and improve cold working properties. In the context of wire drawing, the wires after annealing become more capable of withstanding high stresses while being drawn.

The heat treatment will be performed by firing gas in the furnace that is presently heated with electricity.

1.4 Baseline establishment for existing technology

1.4.1 Design and operating parameters

The present furnace is of 66 kW rating and runs for about 2 to 4 hours every batch and two batches every day. It consumes about 99600 kWh per year. It has a capacity of 800 kg but typically produces about 600 kg in each batch.

Table 1.10 Present electric furnace specifications for annealing

S. No.	Parameter	Detail of electric furnace
1	Manufacturer	Local
2	Dimensions	1.82 m dia, 1.27 m height
3	Average fuel consumption	99600 kWh/yr
4	Temperature	500 deg C
5	Capacity	600 kg per batch

Electricity consumption in the annealing furnaces depend on the following parameters

a) Condition of the walls and insulation

b) Size of the job to be annealing

Fuel requirement in the typical wire drawing plant depends on the production. Detail of electricity consumption in a typical unit is given in Table 1.11 below:

Table 1.11 Electricity consumption at a typical wire drawing unit

S. No.	Energy Type	Value (kWh/yr)	Tariff (₹/kWh)	Total (₹)
1	Electricity	295310	8.17	2412683

1.4.2 Operating efficiency analysis

Operating efficiency for present electrical furnace is found to be in the range of 15% to 25%. The Annexure 1 shows a typical calculation for operating efficiency of the furnace using the direct method.1.5

1.5 Barriers in adoption of proposed equipment

1.5.1 Technological barrier

In Howrah cluster, the technical understanding of the wire drawing process has been found to be excellent with several committed technical personnel having detailed know-how of the processes involved. However, traditional thinking and applying what others in the business are doing is a trend found to be prevalent over innovative thoughts. For example, although there is a huge potential for using gas in annealing furnace, no unit was found to use the same either for annealing the job cupper or aluminium, electricity is currently being used both for annealing resistance furnace as well as induction furnace. Indeed there is committed effort on the part of the management in such units to grasp alterations which may give them benefits however with the caveat that the advantages be proven without any doubt.

People are generally reluctant to invest in an experimental scheme particularly if the sufficient savings are not guaranteed. Hence, finding the first person, who is willing to implement gas fired radiation furnace for annealing would be the clue to widespread application of economically viable energy efficiency practices in the cluster. While carrying out the audits and presenting the energy audit reports to the units, in the discussion with the plant owners & other personnel, many of them agreed to implement the identified energy saving measures and technologies. Use of gas fired radiation furnace for annealing is not very popular, rather involves significant investment, the idea though was welcome, and the units showed a tendency to change their existing annealing furnace from electrical mode to gas fired mode.

1.5.2 Financial barrier

Finance for gas fired radiation furnace for annealing could be an issue for two reasons: (1) smaller units prefer cheaper solutions rather than long-term cost-effective energy efficient technologies, (2) even medium sized units look for proven technologies successfully implemented in the cluster. A mention must be made of SIDBI whose schemes have attracted attention, can potentially encourage them to take meaningful risk and can play a catalytic role in the implementation of the measures.

1.5.3 Skilled manpower

Technical personnel employed in the units are generally skilled works but not engineers to be able to fully appreciate the maintenance practices for higher energy efficiency. Thus the production process remains traditional. This is one of the main hindrances in adopting newer technology. Specialized training among the workforce and local experts is necessary, after installation of gas fired radiation furnace for annealing, to circumvent the problem significantly. Such training in other units would accelerate effective dissemination process to harness the replication potential in the various units. The gains obtained by one plant can inspire other units to follow suit.

2. PROPOSED EQUIPMENT FOR ENERGY EFFICENCY IMPROVEMENT

2.1 Description of proposed equipment

2.1.1 Details of proposed equipment

Traditionally for annealing copper or aluminium, electric furnaces has been used because of the need of precision control of temperature over time and clean environment to avoid contamination of the copper/aluminium wire to be drawn. Recently technological breakthrough has made it possible to meet both the ends even with the use of LPG or natural gas in specially designed furnaces. The main shell of the oven would be rectangular in shape, fabricated out of rolled Mild Steel sheets duly reinforced with adequate structural rolled steel for rigidity and sturdy construction. The baffle of the furnace shall be fabricated from SS-310 material. The furnace would be lined with ceramic wool blankets of suitable density to minimize the heat loss. It is proposed to install two nos. RAD-HEAT Gas Heating Elements using LPG/NG in the furnace. The total heating load of the elements shall be 80 kW and will be fully automated to control the temperature in a clean environment. The elements shall be made out from SS-310 material to ensure long life and radiation heating. All necessary and possible measures would be taken to minimize the heat loss. The process flow diagram after project implementation is shown in Annexure 2.

2.1.2 Equipment/technology specification

The furnaces will use two nos. RAD-HEAT Gas Heating Elements using LPG/NG in the furnace. The ceramic wool lining will be held in double walls of the furnace. Furnace's sidewalls up to trolley height will be lined with firebrick backed by insulation bricks. To minimize the heat loses from the trolley base, a sand sealing arrangement shall be provided. The details of technical specifications are given below.

Table 2.1 Technical specification of gas fired radiation furnace

S. No	Parameter	Detail
1	Manufacturer	Encon Thermal Engineers. (P) Ltd.
2	Dimensions of furnace	2000 mm(L) x 1200 mm(W) x 1200 mm(R)
3	Maximum temperature required	550 deg C
4	Temperature variation	1.5 deg C
5	Skin temperature	20 deg C above ambient
6	Heating cycle detail	From ambient to 550 deg C in 3-4 hours, Soaking at 550 deg C for 2-2.5 hours, Cooling in open air for 2 hours
7	Temperature uniformity device	Through circulation fan
8	Power supply	230 Volts, 1 phase 50 Hz

S. No	Parameter	Detail
9	Temperature control	Automatic On/Off through temperature controller
10	Fuel	LPG

2.1.3 Integration with existing equipment

This apparatus could be installed separately and would not effect the operation of the furnace in any way. However, if space is a limitation, production need to be suspended for about 15 days to replace the existing electric furnace with gas fired radiation furnace.

The following are the reasons for selection of this technology

- It will gainfully reduce the total amount of electricity required.
- It reduces the GHG emissions
- This project is also applicable for getting the carbon credit benefits.

2.1.4 Superiority over existing system

Use of this technology reduces the amount of electricity required. It can amount to a saving of ₹ 587430 per year for the company with paybacks of about 29 months.

2.1.5 Source of equipment

There are many vendors for such technology. It has successfully been adopted and implemented throughout the country and benefits reaped been established beyond doubt. There are no concerns of scarcity of such devices and the prices are reasonable as well.

2.1.6 Availability of technology/equipment

Suppliers of this technology are available at Faridabad, Hariyana. .

2.1.7 Service providers

Details of technology service providers name are shown in Annexure 7.

2.1.8 Terms and conditions in sales of equipment

50% of the charges would have to be paid upfront and the rest along with the taxes would have to be paid while sending the proforma invoice prior to dispatch. Further, the warranty period extends upto 18 months from the point of delivery for any inherent manufacturing defect or faulty workmanship.

2.1.9 Process down time

The down time might be fifteen days for making changes to replace the furnace. Detail of break up for process down time is given in Annexure 6.

2.2 Life cycle assessment and risks analysis

Life of the equipment is about 15 years. Risk involves in the implementation of proposed project is to avoid any leaks on the RAD-HEAT Gas Heating Elements using LPG/NG in the furnace to avoid mixing of the flue gas with the job being heat treated. Such leaks can affect the combustion process severely.

2.3 Suitable unit for Implementation of proposed technology

Suitable unit for implementation of this technology is wire drawing units as many of them are having electric furnace as precision control of temperature with time is necessary for annealing copper or aluminium in a clean environment. All of them need electricity for annealing the job (wire) before drawing and are suitable for replacement with gas fired radiation furnace. Some units are using wood as contamination need not be stringently controlled in case of MS wires and such furnaces are out of scope of the present DPR. The production capacity of a typical unit is about 1000 Ton per year and having total electricity consumption of about 295310 kWh per year.

3. ECONOMIC BENEFITS FROM PROPOSED TECHNOLOGY

3.1 Technical benefit

3.1.1 Fuel saving

This technology is not any contribution to saving of oil.

3.1.2 Electricity saving

Using gas fired radiation furnace would save high grade energy more than 99600 kWh of electricity over a year.

3.1.3 Improvement in product quality

The quality of the product would still remain the same. It shall have no impact on the annealing process but merely make it more efficient.

3.1.4 Increase in production

The production will remain the same as in present.

3.1.5 Reduction in raw material

Raw material consumption is same even after the implementation of proposed technology.

3.1.6 Reduction in other losses

Used nichrome wires are periodically thrown out in existing electric furnaces which could be avoided if it is replaced by the gas fired annealing furnace.

3.2 Monetary benefits

The monetary benefits of the unit are mainly due to gas fired radiation furnace by 99600 kWh/ yr. This amounts to monetary savings of ₹ 5.87 lakh/yr. A detailed estimate of the saving has been provided in the Table 3.1.

3.3 Social benefits

3.3.1 Improvement in working environment

Reduction in electricity consumption would probably not change the working environment apart from making the management happier.

Table 3.1 Energy and monetary benefit

S.No	Parameter	Unit	Value
1	Present electricity consumption in a unit	kWh/year	295310
2	Cost of electricity	₹ /kWh	8.17
3	Savings by using gas fired radiation furnace	kWh/year	71901
4	Monetary savings due to gas fired radiation furnace	₹ /year	587430
5	Total monetary benefit	₹ /year	587430

Further details of total monetary benefit are given in Annexure 3.

3.3.2 Improvement in workers skill

The workers would probably not find too much of a difference in the day-to-day operation of the device. Hence their skills are probably going to be unaffected.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

There would be less effluent generation since there would less fuel burned in the furnace.

3.4.2 Reduction in GHG emission

The measure helps in reducing CO_2 emission since it reduces 99600 kWh of electricity annually which leads to the reduction of 105 Ton/yr of CO_2 as 1.05 ton of CO_2 would be reduced for a reduction of 1 kWh of electricity.

4 INSTALLATION OF PROPOSED EQUIPMENT

4.1 Cost of project

4.1.1 Equipment cost

The cost of gas fired radiation furnace is ₹ 11.75 lakh as per the quotation provided by the vendor also mention at the Annexure 8.

4.1.2 Erection, commissioning and other misc. cost

The installation & other costs could amount to a further ₹ 2.67. Detail of project cost is given in the Table 4.1 below:

Table 4.1 Details of proposed technology project cost

S. No	Particular	Unit	Value (lakh)
1	Cost of gas fired radiation furnace	₹ in lakh	11.75
2	Cost of Installation	₹ in lakh	0.75
3	Taxes & other misc. cost	₹ in lakh	1.92
4	Total cost	₹ in lakh	14.42

4.2 Arrangements of funds

4.2.1 Entrepreneur's contribution

The total cost of the gas fired radiation furnace is ₹ 11.75 lakh. The entrepreneur shall have to pay 25% of the total amount upfront i.e. ₹ 3.60 lakh. The rest could be arranged as loans.

4.2.2 Loan amount

Loan amount would be 75% i.e. ₹ 10.81 lakh. There are loans available for buying such equipments from SIDBI and from the MSME of the Government of India, which have 25% subsidy in some schemes.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10%, which is SIDBI's rate of interest for energy efficient projects. The loan tenure is 5 years excluding initial moratorium period is 6 months from the date of first disbursement of loan.

4.3 Financial indicators

4.3.1 Cash flow analysis

Profitability and cash flow statements have been worked out for a period of 8 years. The financials have been worked out on the basis of certain reasonable assumptions, which are outlined below.

The project is expected to achieve monetary savings of ₹ 5.87 lakh/yr.

- 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.

Considering the above mentioned assumptions, the net cash accruals starting with ₹ 3.15 lakh in the first year operation and gradually increases to ₹ 16.27 lakh at the end of eighth year.

4.3.2 Simple payback period

The total cost of implementing the proposed technology is ₹ 14.42 and monetary savings is ₹ 5.87 lakh. Hence the simple payback period works out to be 2.46 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment works out to be ₹ 6.82 lakh.

4.3.4 Internal rate of return (IRR)

The Internal rate of return of the project would be 23.39%.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 25.15%.

Details of financial indicator are shown in Table 4.2 below:

Table 4.2 Financial indicators of proposed technology/equipment

S. No	Particulars	Unit	Value
1	Simple Pay Back period	Month	30
2	IRR	%age	23.39
3	NPV	₹(In lakh)	6.82
4	ROI	%age	25.15
5	DSCR	Ratio	1.66

4.4 Sensitivity analysis

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

- Optimistic scenario (Increase in fuel savings by 5%)
- Pessimistic scenario (Decrease in fuel savings by 5%)

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

Details of sensitivity analysis at different scenarios are shown in Table 4.3 below:

Table 4.3 Sensitivity analysis at different scenarios

Particulars	IRR (%age)	NPV(₹ in Lakh)	ROI (%age)	DSCR
Normal	23.39	6.82	25.15	1.66
5% increase in fuel savings	26.25	8.38	25.55	1.78
5% decrease in fuel savings	20.48	5.26	24.68	1.54

4.5 Procurement and implementation schedule

Procurement and implementation time required for implementation of proposed technology is about 9 weeks and their details are given in Annexure 6.

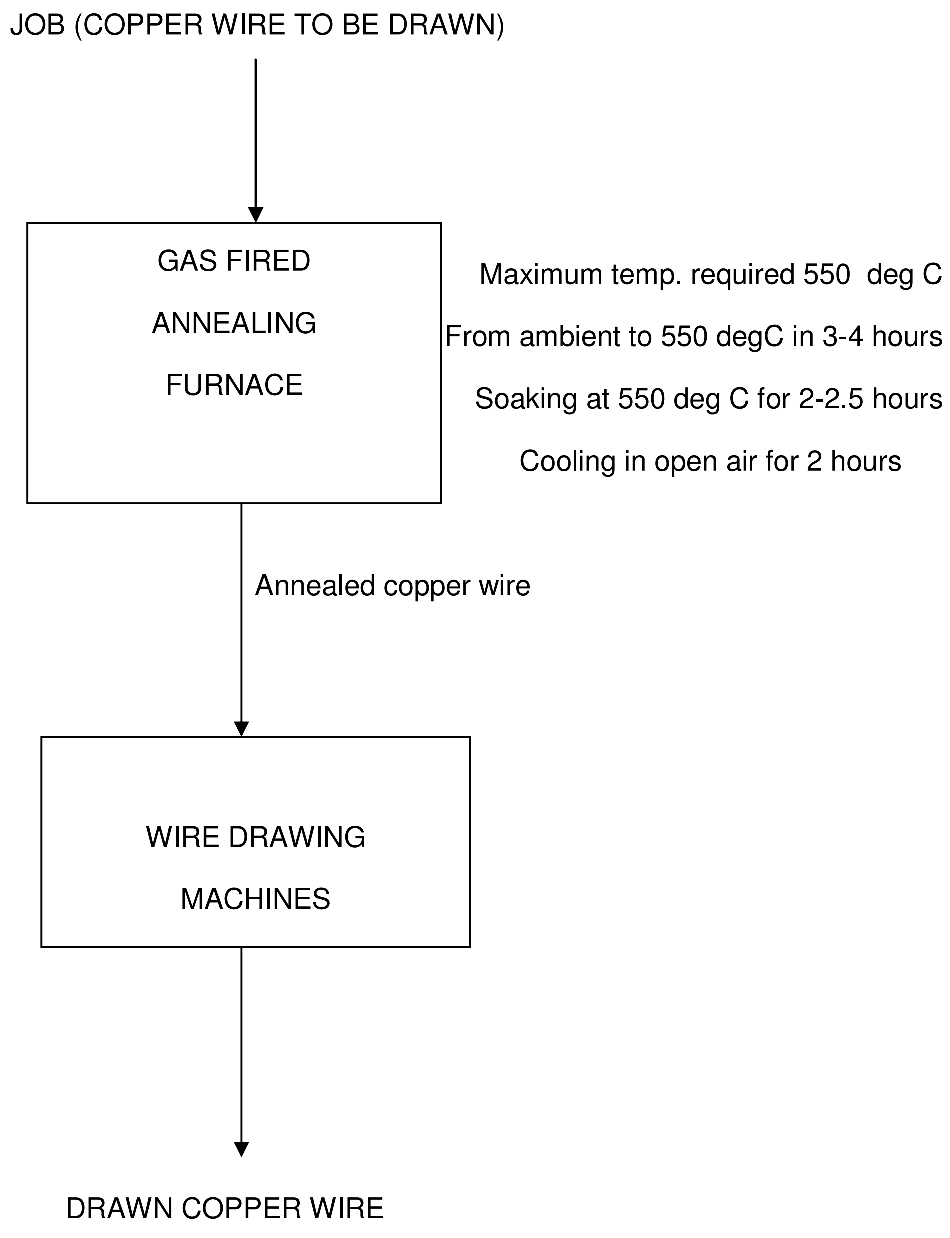
ANNEXURE

Annexure -1: Energy audit data used for baseline establishment

Calculation of efficiency of the furnace by the direct method

Particular	Unit	Value
Production	Kg/batch	700
Operation batch	batch/day	2
Operating day	Days/yr	300
Specific heat of copper	kcal/kg/deg C	0.092
Copper furnace temperature	deg C	500
Ambient temperature	deg C	30
Heat output	kcal/kg	30268
Power input	kWh/batch	166
Calorific value of electricity	kcal	860
Heat input	kcal/kWh	142760
Furnace efficiency	%age	21

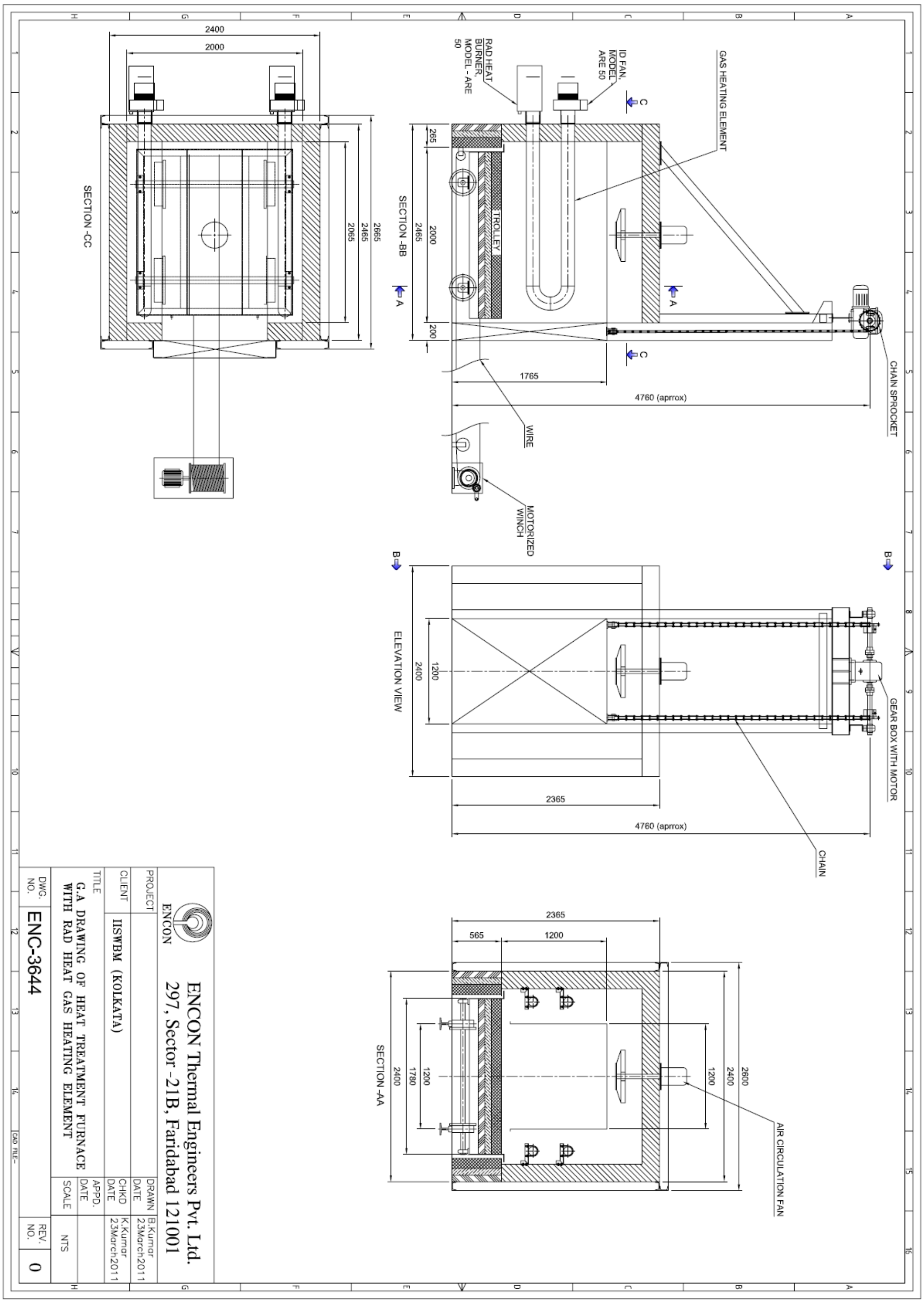
Annexure -2: Process flow diagram after project implementation

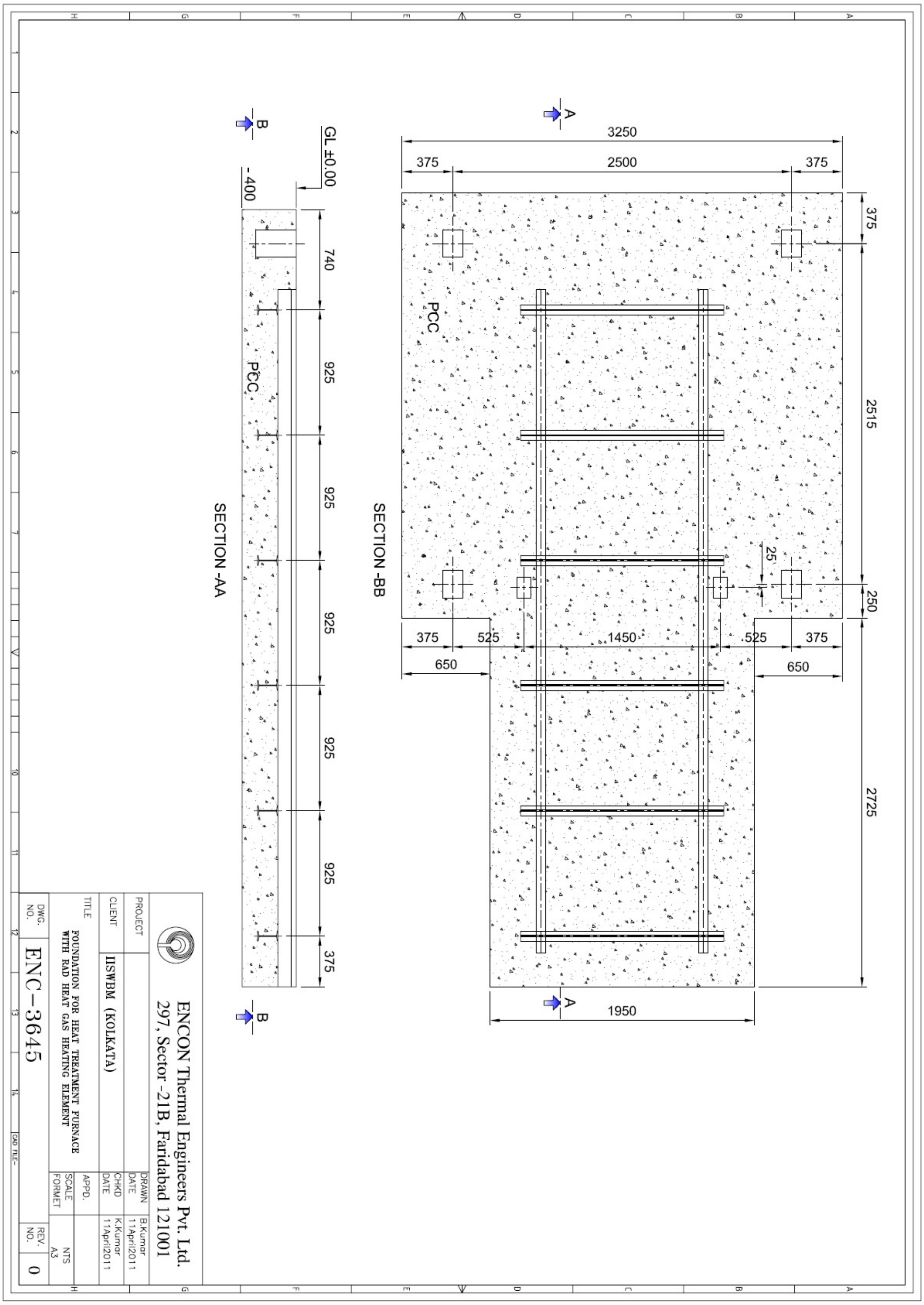


Annexure -3: Detailed technology assessment report

Particulars	Units	Value
Existing electric furnace		
Present rate consumption of electricity in electric furnace	KWh/batch	166
No of batch per day	batch/day	2
Number of days in year	days/yr	300
Electricity consumed	kWh/yr	99600
Cost of electricity unit	₹/kWh	8.17
Cost of electricity	₹/yr	813732
Proposed gas fired radiation furnace		
Consumption of LPG per batch	kg/batch	9
Consumption of LPG per year	kg/yr	5400
Cost of LPG per kg	₹/kg	41
Cost of LPG per year	₹/yr	221400
Consumption of electricity per batch	kWh/batch	1
Consumption of electricity per year	kWh/yr	600
Cost of electricity per year	₹/yr	4902
Total cost	₹/yr	226302
Saving per year	₹/yr	587430
Cost of gas fired radiation furnace	₹	1441525
Life of the furnace	Yrs	15
Pay back	month	30
efficiency of Proposed furnace	%age	55
Calorific value of LPG	kcal/kg	6100

Annexure -4 Drawings for proposed electrical & civil works





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Annexure -5: Detailed financial analysis

Assumption

Name of the Technology	Gas fired Radiation furnace		
Details	**Unit**	**Value**	**Basis**
No of working days	Days	300	
No of Batches per day	Batches	2	
No. Of Operating Hours per day	Hrs.	12	
Proposed Investment			
Equipment cost	Rs. (In lakh)	11.75	
Installation cost	Rs. (In lakh)	0.75	
Other cost	Rs. (In lakh)	1.92	
Total investment	Rs. (In lakh)	14.42	
Financing pattern			
Own Funds (Equity)	Rs. (In lakh)	3.60	Feasibility Study
Loan Funds (Term Loan)	Rs. (In lakh)	10.81	Feasibility Study
Loan Tenure	yr	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%/yr	10	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4	Feasibility Study
Annual Escalation	% age	5	Feasibility Study
Estimation of Revenue			
Saving in Electricity	liter/yr	99600	
Gas consumption	Kg/Year	5400	
Cost	Rs./kg	41	
Additional electricity consumption	kWh/Year	600	
Cost of Electricity	Rs./kWh	8.17	
St. line Depn.	% age	5.28	Indian Companies Act
Depreciation in the first year	% age	80	Income Tax Rules
Income Tax	% age	33.99	Income Tax

Estimation of Interest on Term Loan

Years	Opening Balance	Repayment	Closing Balance	Interest
1	10.81	0.90	9.91	1.25
2	9.91	1.80	8.11	0.91
3	8.11	2.00	6.11	0.73
4	6.11	2.15	3.96	0.52
5	3.96	2.50	1.46	0.29
6	1.46	1.46	0.00	0.05
		10.81		

WDV Depreciation

Particulars / years	1	2
Plant and Machinery		
Cost	14.42	2.88
Depreciation	11.53	2.31
WDV	2.88	0.58

Projected Profitability

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Fuel savings	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87
Total Revenue (A)	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87
Expenses								
O & M Expenses	0.58	0.61	0.64	0.67	0.70	0.74	0.77	0.81
Total Expenses (B)	0.58	0.61	0.64	0.67	0.70	0.74	0.77	0.81
PBDIT (A)-(B)	5.30	5.27	5.24	5.21	5.17	5.14	5.10	5.06
Interest	1.25	0.91	0.73	0.52	0.29	0.05	-	-
PBDT	4.05	4.36	4.51	4.69	4.89	5.09	5.10	5.06
Depreciation	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
PBT	3.29	3.60	3.75	3.93	4.13	4.33	4.34	4.30
Income tax	-	0.70	1.53	1.59	1.66	1.73	1.73	1.72
Profit after tax (PAT)	3.29	2.90	2.22	2.33	2.46	2.60	2.61	2.58

Computation of Tax

₹ (in lakh)

Particulars / Years	1	2	3	4	5	6	7	8
Profit before tax	3.29	3.60	3.75	3.93	4.13	4.33	4.34	4.30
Add: Book depreciation	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Less: WDV depreciation	11.53	2.31	-	-	-	-	-	-
Taxable profit	(7.48)	2.05	4.51	4.69	4.89	5.09	5.10	5.06
Income Tax	-	0.70	1.53	1.59	1.66	1.73	1.73	1.72

Projected Balance Sheet

Particulars / Years	1	2	3	4	5	6	7	8
Liabilities								
Share Capital (D)	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60
Reserves & Surplus (E)	3.29	6.19	8.41	10.74	13.20	15.81	18.41	20.99
Term Loans (F)	9.91	8.11	6.11	3.96	1.46	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	16.81	17.91	18.12	18.31	18.27	19.41	22.02	24.60

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	14.42	14.42	14.42	14.42	14.42	14.42	14.42	14.42
Less Accm. depreciation	0.76	1.52	2.28	3.04	3.81	4.57	5.33	6.09
Net Fixed Assets	13.65	12.89	12.13	11.37	10.61	9.85	9.09	8.33
Cash & Bank Balance	3.15	5.01	5.99	6.93	7.66	9.56	12.93	16.27
TOTAL ASSETS	16.81	17.91	18.12	18.31	18.27	19.41	22.02	24.60
Net Worth	6.89	9.79	12.01	14.34	16.81	19.41	22.02	24.60
Debt Equity Ratio	2.75	2.25	1.70	1.10	0.41	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	3.60	-	-	-	-	-	-	-	-
Term Loan	10.81								
Profit After tax		3.29	2.90	2.22	2.33	2.46	2.60	2.61	2.58
Depreciation		0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Total Sources	14.42	4.05	3.66	2.98	3.09	3.23	3.36	3.37	3.34
Application									
Capital Expenditure	14.42								
Repayment Of Loan	-	0.90	1.80	2.00	2.15	2.50	1.46	-	-
Total Application	14.42	0.90	1.80	2.00	2.15	2.50	1.46	-	-
Net Surplus	-	3.15	1.86	0.98	0.94	0.73	1.90	3.37	3.34
Add: Opening Balance	-	-	3.15	5.01	5.99	6.93	7.66	9.56	12.93
Closing Balance	-	3.15	5.01	5.99	6.93	7.66	9.56	12.93	16.27

IRR

₹ (in lakh)

Particulars / months	0	1	2	3	4	5	6	7	8
Profit after Tax		3.29	2.90	2.22	2.33	2.46	2.60	2.61	2.58
Depreciation		0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Interest on Term Loan		1.25	0.91	0.73	0.52	0.29	0.05	-	-
Cash outflow	(14.42)	-	-	-	-	-	-	-	-
Net Cash flow	(14.42)	5.30	4.57	3.71	3.61	3.51	3.41	3.37	3.34
IRR	23.39%								

NPV	6.82

Break Even Point

Particulars / Years	1	2	3	4	5	6	7	8
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.43	0.45	0.48	0.50	0.53	0.55	0.58	0.61
Sub Total(*G*)	0.43	0.45	0.48	0.50	0.53	0.55	0.58	0.61
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.14	0.15	0.16	0.17	0.18	0.18	0.19	0.20
Interest on Term Loan	1.25	0.91	0.73	0.52	0.29	0.05	0.00	0.00
Depreciation *(H)*	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Sub Total (I)	2.15	1.82	1.65	1.45	1.22	0.99	0.95	0.96
Sales (J)	5.87	5.87	5.87	5.87	5.87	5.87	5.87	5.87
Contribution (K)	5.44	5.42	5.40	5.37	5.35	5.32	5.29	5.27
Break Even Point (L= G/I)	39.54%	33.61%	30.51%	26.96%	22.87%	18.62%	18.02%	18.31%
Cash Break Even {(I)-(H)}	25.55%	19.57%	16.41%	12.79%	8.64%	4.32%	3.65%	3.85%
Break Even Sales (J)*(L)	2.32	1.97	1.79	1.58	1.34	1.09	1.06	1.08

Return on Investment

₹ (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	3.29	3.60	3.75	3.93	4.13	4.33	4.34	4.30	31.66
Net Worth	6.89	9.79	12.01	14.34	16.81	19.41	22.02	24.60	125.88
									25.15%

Debt Service Coverage Ratio

. (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	3.29	2.90	2.22	2.33	2.46	2.60	2.61	2.58	15.81
Depreciation	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	4.57
Interest on Term Loan	1.25	0.91	0.73	0.52	0.29	0.05	0.00	0.00	3.74
Total (M)	5.30	4.57	3.71	3.61	3.51	3.41	3.37	3.34	24.11

DEBT

Interest on Term Loan	1.25	0.91	0.73	0.52	0.29	0.05	0.00	0.00	3.74
Repayment of Term Loan	0.90	1.80	2.00	2.15	2.50	1.46	0.00	0.00	10.81
Total (N)	2.15	2.71	2.73	2.67	2.79	1.51	0.00	0.00	14.55
	2.47	1.69	1.36	1.35	1.26	2.26	0.00	0.00	1.66
Average DSCR (M/N)	1.66								

Annexure:-6 Procurement and implementation schedule

S. No.	Activities	Weeks								
		1	2	3	4	5	6	7	8	9
1	Ordering the gas fired radiation furnace									
2	Civil foundation work									
3	Electrical connection and wiring									
4	LPG pipeline to gas bank to gas train									
5	Gas bank									
6	Installing gas fired radiation furnace									

Break up of shutdown period of plant required for operation of gas fired radiation furnace

S.No	Activity	Day
1	Prepare the pathway	0
2	Install the gas fired radiation furnace	15

Day wise break up of shut down period for installation of gas fired radiation furnace

S.No	Activity	Week	
		1	2
1	LPG pipeline		
2	Installation of gas fired radiation furnace		
3	Instrumentation and trial		

Annexure -7: Details of technology service providers

S.No.	Name of Service Provider	Address	Contact Person and No.
1	Encon Thermal Engineers Pvt. Ltd.	297, Sector-21B, Faridabad-121001 (Haryana)	Mr. Krishna Kumar Mobile : +91 997-149-9074 Phone : + 91 129 4041185 / 4047847 Fax : + 91 129 4044355 Email : kk@encon.co.in Web : www.encon.co.in
2	Nutech Control Devices	37/1, Chakraberia RD(North), Bhowanipur, Kolkata - 700025	Mr. Sanjeev Doshi Phone : 9748744733 Email : nutechcd@yahoo.co.in

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

ENCON Thermal Engineers. (P) Ltd

297, Sector- 21B Faridabad – 121 001 (Haryana) India
Tel: +91(129) 4047847, 2439458, Fax: +91 (129) 4044355
E-mail: sales@encon.co.in   Website: www.encon.co.in

ENCON YOUR ANSWER TO THE CONTINUED NEED FOR "ENERGY – CONSERVATION"

Ref.: ENCON/2010-11/21B/KK
April 11, 2011

M/s. IISWBM, Management House
College Square West, Kolkata - 700 073, INDIA.
Ph. +91 94331 53009; Fax +91 33 22413975 (pp.)

Kind Attn.: Mr. Binoy Krishna Choudhury, PhD. (IIT) & Fellow (IEI)
Subject: Your requirement of **'LPG Fired Heat Treatment Furnace'**

Dear Sir,

We refer your email dated 6th April, 2011 and subsequent discussions held with the undersigned regarding above subject.

As discussed, we are attaching herewith our detailed techno-commercial offer for the same for your kind perusal.

Instead of round furnace, we quoted you a rectangular furnace for ease of installation of our Rad-Heat Gas Heating Element which is our new innovation. You can cut down in energy costs 15-20% vis-à-vis to electricity by using our gas heating element. However savings depends on tariff of LPG and electricity in that region. The same system we have installed at Vijay Industries, Agra which is running trouble free last 3 years.

We hope you will find the above in line of your requirement. Still, should you require any further information / clarification from our end, please feel free to contact us.

Yours faithfully,
for ENCON Thermal Engineers (P) Ltd.

Krishna Kumar
DGM-Technical
Cell: + 91 9971499074
Encl.: As Above

TECHNICAL SPECIFICATION OF THE PROPOSED HEAT TREATMENT FURNACE WITH RAD-HEAT GAS HEATING ELEMENTS

Effective dimension of the furnace	: 2000mm (L) X1200mm (W) X 1200mm (H)
Maximum temperature required	: 550 ^{0}C
Temperature Variation.	: ±1.5° C
Skin Temperature	: 20^{0}C above ambient
Heating cycle details	: From ambient to 550^{0}C in 3-4 Hours
	: Soaking at 550^{0}C FOR 2 – 2.5 Hours
	: Cooling in open air for 2 Hours
Weight of the material per batch	: 600Kg. (Copper)
Temperature uniformity device	: Through circulation fan
Power supply	: 230 Volts, 1 Phase 50 Hz.
Temp. Control	: Automatic On/Off through Temp Controller
Fuel	: LPG
Connected load	: 80 kW

SCOPE OF SUPPLY: -

The scope will cover design, engineering, manufacturing, supply, erection and commissioning of the oven consisting of the following main components.

1. **FURNACE SHELL:**
   The main shell of the oven would be rectangular in shape, fabricated out of rolled Mild Steel sheets duly reinforced with adequate structural rolled steel for rigidity and sturdy construction. The construction of the shell would be such that it can withstand the operational stresses and thermal expansion that may be developed due to the operating temperature. The baffle of the furnace shall be fabricated from SS-310 material.

2. **FURNACE LINING:**
   The furnace would be lined with ceramic wool blankets of suitable density to minimize the heat loss. The ceramic wool lining will be held in double walls of the furnace. Furnace's sidewalls up to trolley height will be lined with firebrick backed by insulation bricks. To minimize the heat loses from the trolley base, a sand sealing arrangement shall be provided.

3. **AIR CIRCULATION FAN:**
   One no. Air circulation fans of suitable design and capacity shall be provided at the top of the working chamber to ensure a high rate of uniform circulation of the hot air inside the working chamber.

4 RAD-HEAT HEATING ELEMENTS:

It is proposed to install two nos. RAD-HEAT Gas Heating Elements in the furnace. All the elements shall be housed on the side walls (One no. on each side) of the furnace.

GAS HEATING ELEMENT

The total heating load of the elements shall be 80 kW. The elements shall be made out from SS-310 material.

The element can be energized by NG or LPG. A 5-ampere Electric connection will be required to fully automate the system.

Minimum recommended gas pressure for LPG is 37 mbar.

5. AUTOMATIC TEMPERATURE INDICATOR CUM CONTROLLER:

The furnace would be provided with two thermocouples and digital type temperature indicator cum controllers. The temperature would be measured and controlled by these automatic digital temperature controllers having range of 0-1000 °C. The thermocouples would be complete with protected heat resisting sheath with junction head and adequate length of compensating lead.

Each element will be controlled independently.

6. CONTROL PANEL:

The temperature measuring and controlling equipments of suitable connected load will be arranged in a cubical cabinet type having following instruments & control devises of approved makes.

I) MCCB of suitable capacity.
II) Ampere meter and voltmeter of suitable capacity.
III) Contractors, Switches, Fuses, Push buttons and indicating lamps.
IV) On- Off switch of the burners and fan motors.
V) Temp indicator cum controllers – 2Nos.
VI) Thermocouple –2 Nos.

7. GAS TRAIN:

We are supplying gas train with this system, which will provide required flow rate and pressure to the burner.

8. DOORS LIFTING ARRANGEMENT:

We shall be providing one no. MS fabricated door of lifting & lowering type. The lowering and lifting of the door can be done through motorized mechanical winch system.

.9. TROLLEY & TROLLEY DRIVE SYSTEM:

We shall be supplying one no. MS fabricated trolley for charging the material inside the furnace. The movement of trolley shall be given through motorized mechanical winch system. The trolley will be lined with firebrick backed by insulation bricks.

Rails for trolley shall be in client scope.

NOTE: THE ACTUAL PRODUCTS MAY LOOK DIFFERENT AS THE PHOTOGRAPHS ARE FOR INDICATIVE PURPOSE ONLY

QUOTATION

Cost of the above System	**: Rs.11, 75,000.00** **(Rupees Eleven Lac Seventy Five Thousand only)**

TERMS & CONDITIONS:

Prices	: Prices quoted are ex-works, Baghola, Distt: Palwal (Haryana)
Excise Duty	: 10.30%
Sales Tax	: 2% against form 'C' Otherwise 12.5% shall be charged.
Packing & Forwarding	: 2% & 2% respectively
Payment Terms	: 30% advance along with P.O. : 70% against Performa Invoice prior to dispatch.
Delivery	: 4-6 weeks from the date of confirmed order along with advance.
Warranty/ Guarantee	: 18 months from the date of the material supplied or 12 months from date of commissioning. Whichever is earlier.
Exclusion	: 1. Civil foundation work. 2. Electrical connections and wiring from main line to control panel and from control panel to the individual system shall be client's scope. 3. LPG pipeline from gas bank to gas train and from gas train to the individual burner shall be in the client's scope. 4. Welding set, cutting set, men power & tools and tackle will be provided by the client for erection and commissioning. 5. Gas Bank
Supervision Charges	: To & fro charges along with Boarding/ Lodging for one person along with Rs. 5000/- per day.
Validity	: 45 Days.

Yours faithfully,
for ENCON Thermal Engineers (P) Ltd.

Krishna Kumar
DGM-Technical

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

Indian Institute of Social Welfare and Business Management
MANAGEMENT HOUSE
College Square West,
Kolkata – 700 073
Website: www.iiswbm.edu

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