DETAILED PROJECT REPORT
ON
HOT AIR GENERATOR
(VAPI CHEMICALS & DYES CLUSTER)



Bureau of Energy Efficiency

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HOT AIR GENERATOR

VAPI DYES & CHEMICALS CLUSTER

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Detailed Project Report on Hot Air Generator

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Zenith Energy Services Pvt. Ltd.

Hyderabad

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List of Abbreviation

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
MoMSME	Ministry of Micro Small and Medium Enterprises
NPV	Net Present Value
ROI	Return on Investment
SME	Small and Medium Enterprises
SIDBI	Small Industries Development Bank of India
HAG	Hot Air Generator

EXECUTIVE SUMMARY

Zenith Energy Services Pvt. Ltd is executing BEE - SME program in Vapi Dyes & Chemicals cluster, supported by Bureau of Energy Efficiency with an overall objective of improving the energy efficiency in cluster units. Since Vapi cluster is one of the largest clusters in Dyes & Chemicals sector in India, accordingly this cluster was chosen for energy efficiency improvements by implementing energy efficient technologies, so as to facilitate maximum replication in other Dyes & Chemicals clusters in India.

Vapi Dyes & Chemicals cluster is famous for the production of Organic/Inorganic chemicals, Specialty chemicals, Disperse dyes, Dye Intermediates, Reactive dyes, Acid dyes, Direct dyes etc. In fact majority of the chemical units in the cluster are manufacturing two or three types of products as per the demand for the products in the market.

The raw material is different for the industries and depends on the product manufactured in the respective industry. Main energy forms used in the cluster units are Wood, Imported Coal, LDO, Furnace Oil, Ground Nut Briquettes and Natural Gas as fuels for Boilers, Thermopacs, Tray Dryers & Spray Dryers and HAG. Electricity is used to run reactors, motors, pumps, centrifuges, blowers, fans, & Air Compressors etc.

During energy use and technology audit studies in various chemicals & dyes industries in Vapi various chemicals & dyes cluster, it has been observed that most of the units are using in efficient hot air generators to generate hot air for drying of the product whose efficiency is low in the range of 25 to 30% only.

Installation of new hot air generators having efficiency more than 50% hence its installation would lead to reduce of fuel consumption for generation of hot air.

This DPR highlights the details of the study conducted for assessing the potential for replacement of inefficient hot air generator by new energy efficient hot air generator, possible energy saving, and its monetary benefit, availability of the technologies/design, local service providers, technical features & proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, sensitivity analysis for three different scenarios and schedule of Project Implementation

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:

Sr. No.	Particular	Unit	Value
1	Project cost	` (in Lakh)	6.78
2	Fuel saving (Wood)	tons/year	150
3	Electricity consumption	kWh/Year	14000
4	Monetary benefit	`(in Lakh)	4.45
5	Debit equity ratio	Ratio	3:1
6	Simple payback period	Year	1.52
7	NPV	`(in Lakh)	9.44
8	IRR	% age	46.64
9	ROI	% age	27.11
10	DSCR	Ratio	2.61
11	Process down time	Days	7
12	CO_2 emission reduction	Tons/year	198

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

ABOUT BEE SME PROGRAMME

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 25 selected SMEs clusters; Vapi Dyes & Chemicals Cluster is one of them. The BEE's SME Programme intends to enhance the energy efficiency awareness by funding/subsidizing need based studies in SME clusters and giving energy conservation recommendations. For addressing the specific problems of these SMEs and enhancing energy efficiency in the clusters, BEE will be focusing on energy efficiency, energy conservation, and technology up gradation through studies and pilot projects in these SMEs clusters.

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

Activity 1: Energy use and technology studies

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

Activity 2: Capacity building of stake holders in cluster on energy efficiency

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

Activity 3: Implementation of energy efficiency measures

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

Activity 4: Facilitation of innovative financing mechanisms for implementation of energy efficiency projects

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

1 INTRODUCTION

1.1 About the SME cluster

The products manufactured in Vapi Dyes & Chemicals Cluster are Organic/Inorganic chemicals, Specialty chemicals, Disperse dyes, Dye Intermediates, Reactive dyes, Acid dyes, Direct dyes etc. In fact majority of the chemical units in the cluster are manufacturing two or three types of products as per the demand for the products in the market. The cost of energy (electrical and thermal energy) as percentage of manufacturing cost varies between 8 and 10%.

The raw material is different for the industries and depends on the product manufactured in the respective industry.

The main energy forms used in the cluster units are Wood, Imported Coal, LDO, Furnace Oil, Ground Nut Briquettes & Natural Gas as fuels for Boilers, Thermopacs, Tray Dryers & Spray Dryers. Electricity is used to run reactors, motors, pumps, centrifuges, blowers, fans, & Air Compressors etc.

The details of annual energy consumption of a typical unit having a production capacity of approximately 603 tons per annum of M/s Swapnil Organics Ltd are furnished in the Table 1.1 below:

Table 1.1 Annual Energy consumption of a typical unit

S.No	Particular	Unit	Value
1	Electricity consumption	kWh/annum	5,67,795
2	Wood consumption	Tonne/annum	505
3	Production	Kg/annum	603,000

Production process

The process adopted by different units in the Vapi cluster varies with the type of product manufactured in the unit. However, the general processes & operations involved in a typical dyes & chemical manufacturing are as indicated below:

a) Raw material selection/ preparation

b) Preparation of solution

c) Precipitation

d) Filtration

e) Drying

f) Pulverization

g) Packing

The process flow diagram of a typical unit producing dyes & chemicals is shown above. The brief description of process is explained below:

Raw material selection/preparation

Raw materials are selected in various proportions to prepare the required product or to the customer requirements.

Preparation of solution

Solution is prepared by mixing different proportions of solute and solvent in a reactor vessel with the help of varying thermal inputs like steam or chilled water to make a chemical reaction (i.e. endothermic or exothermic reactions) and this process will continue until the required raw product is produced. In this step, both thermal energy and electrical energy is used in the reactor vessel for maintaining temperature and pumping & mixing of solution during the process to undergo chemical reaction.

Precipitation

Precipitation is the process of formation of solid particles from soluble raw product. In this process, solid blocks/ crystals are prepared from sludge raw product. This sludge raw product is produced from solution in reactor vessel as mentioned in previous step. In some units, electrical energy is used to prepare solid cakes by means of hydraulic presses.

Filtration

After precipitation, the solid/ crystal product is filtered by various filtration methods for next drying process, usually by electrically operated hydraulic filter presses.

Drying

The filtered pigment/ dyes contain moisture, which is removed by means of hot air generators. Both thermal and electrical energy is used in hot air generators.

Pulverization

Pulverization is the process of making crystal pigments/ dyes into powder form. Pulverizers use electrical energy.

Packing

The final product or solid pigments/ dyes are packed in appropriate packing without exposes to atmosphere because some products are flammable.

Production process

The detailed process flow diagram of a typical unit is furnished below.

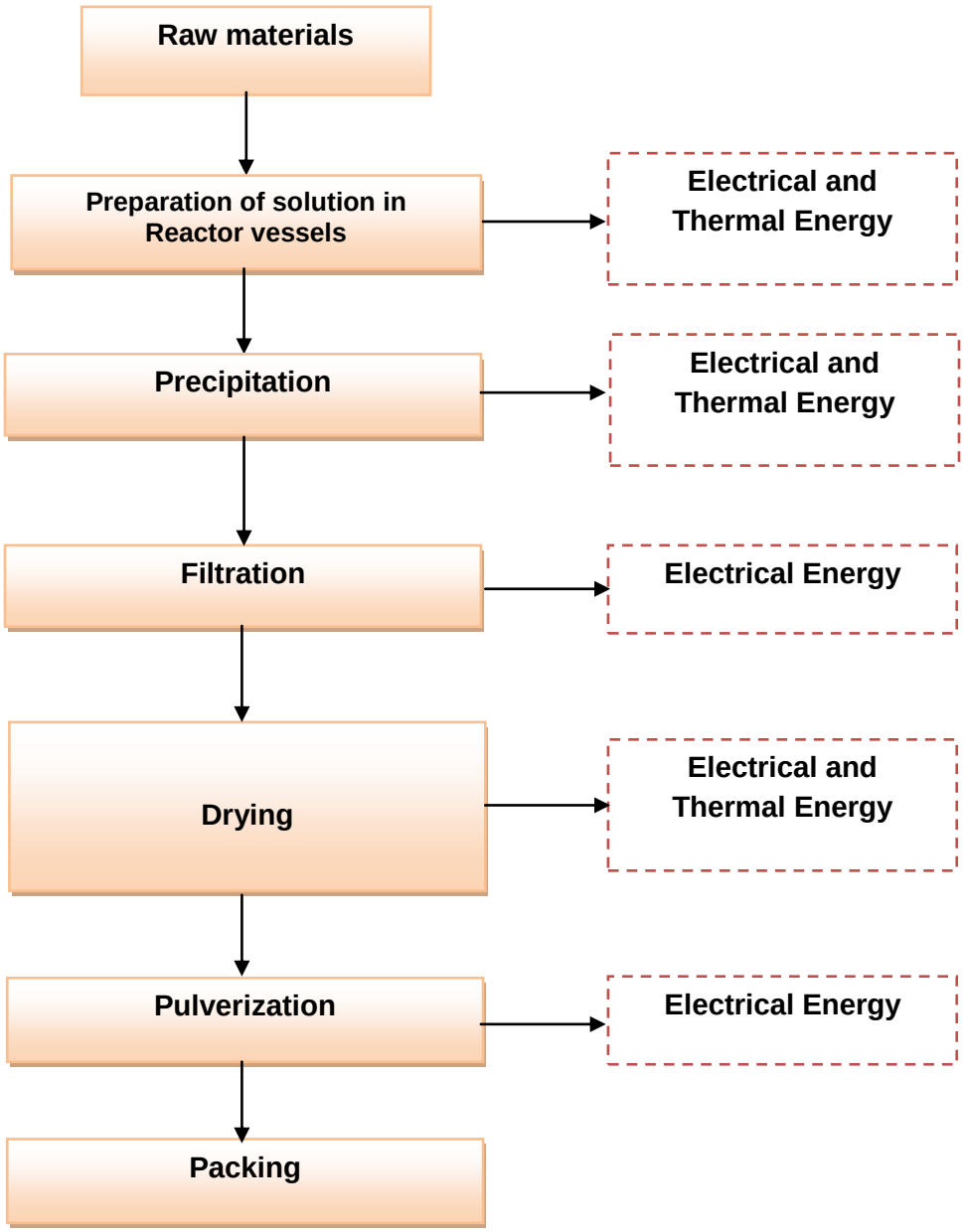


Figure 1.1 General Process Flow Diagram

The production process as depicted above is not similar for all units in Vapi Dyes & Chemicals cluster. However, depending on type of product and product quality, the above stated process flow varies as per the requirement.

1.2 Energy performance in Vapi Dyes & Chemicals cluster

The main energy sources for Vapi cluster units are Wood, Imported Coal, LDO, Furnace Oil, Ground Nut Briquettes & Natural Gas as fuels for boilers, Thermopacs, Tray Dryers & Spray Dryers. Electricity is used to run reactors, motors, pumps, centrifuges, blowers, fans & Air Compressors etc.

Energy cost is around 8 to 10 percent of manufacturing cost in typical manufacturing unit, out of which the cost of thermal energy works out to 42 percent of the total energy cost and remaining accounts for electrical energy.

In typical manufacturing unit, the annual electricity and wood consumption is 5,67,795 kWh and 505 tonnes respectively. Average production capacity of typical chemical & dyes manufacturing unit is around 603 tonnes per annum.

1.2.1 Specific energy consumption

Specific electrical and thermal energy consumption in chemical & dyes units depends on the final product manufactured. Specific electrical and thermal energy consumption of a typical unit of Vapi chemical & dyes cluster is 0.94 kWh/kg of final product and 0.83 kg of wood /kg of final product respectively.

The average specific fuel consumption per kg of the product for typical units is furnished below in Table 1.2.

Table 1.2 Specific fuel consumption

S.No	*Name of unit*	*Wood Consumption kg*	*Production kg*	*Specific energy consumption kg of wood /kg of final product*
1	M/s Nandosal Chem Industries Pvt .Ltd	505000	603000	0.83
2	M/s Nitin Dye - Chem Pvt Ltd	360000	300000	1.2
3	M/s Durga dye chem	135000	100000	1.35

1.3 Identification of technology/equipment

1.3.1 Description of technology/equipment to be replaced

During energy use and technology audit studies in various chemicals & dyes industries in Vapi various chemicals & dyes cluster, it has been observed that most of the units are using in efficient hot air generators to generate hot air for drying of the product whose efficiency is low. The performance of various existing hot air generators are evaluated and analyzed for various losses are furnished in Annexure 1.



Figure 1.2 HAG operations at typical chemicals & dyes industry

From energy use and technology gap audit studies in various chemicals & dyes industries in Vapi chemicals & dyes cluster, the following were identified:

- Energy efficiency improvement opportunities
- Environment and working conditions improvement
- Design flaws in the conventional hot air generator
- Operational & maintenance practices in conventional hot air generator

Technical gap analysis in wood fired hot air generator

Some of the cluster units have installed hot air generators. The hot air is required for tray dryers. The hot air generators are of local make, single pass system, and wood fired. A detailed study had been carried out for assessing the efficiency of the hot air generator. The efficiencies are found to be low i.e., in the range of 20 -37 % only. The low efficiency of the hot air generators is due to the following reasons:

- **Uncontrolled combustion and manual feeding of wood**
- **Poor heat transfer efficiency**: The hot air generator is of single pass system and heat transfer between the flue gas and air is low. Due to poor heat transfer area and short time contact time between flue gas and hot air leads to high flue gas losses and hence leads to inefficiency of the hot air generator system.
- **Heat loss from charging door**: The charging door is always kept open due to various reasons; those are human error and non compatibility of wood lags in combustion chamber. Grate/combustion chamber is not sufficient for burning bigger size logs.
- **There is no control on fuel firing**: In Conventional/existing hot air generator there is no control system of fuel firing in combustion chamber
- **Poor insulation on hot air generator**
- **No waste heat recovery and flue gases are vented out without any waste heat recovery**

From the above mentioned analysis it is clear that the performance of the existing conventional hot air generator is poor in terms of energy, environment, and social aspects. Based on above, it is recommended to replace the present conventional hot air generator with new hot air generator. The new hot air generator will have efficiency more than 50%.

1.3.2 Role in process

For production of chemicals & dyes, the process requires hot air for drying the product. The hot air generator is used for hot air generation.

1.4 Establishing the baseline for the technology/equipment

Energy consumption in hot air generator would depend on below mentioned things

- Inlet air temperature
- Quantity of hot air required
- Climate conditions
- Operational & maintenance practices in hot air generator
- Type of wood and its calorific value

Energy use and technology audit studies were conducted in various units of Vapi chemicals & dyes cluster, the baseline energy consumption of present inefficient hot air generators and the performance of the same is carried out and attached in Annexure 1.

1.4.1 Energy audit methodology adopted

The following methodology was adopted to evaluate the performance of HAG:

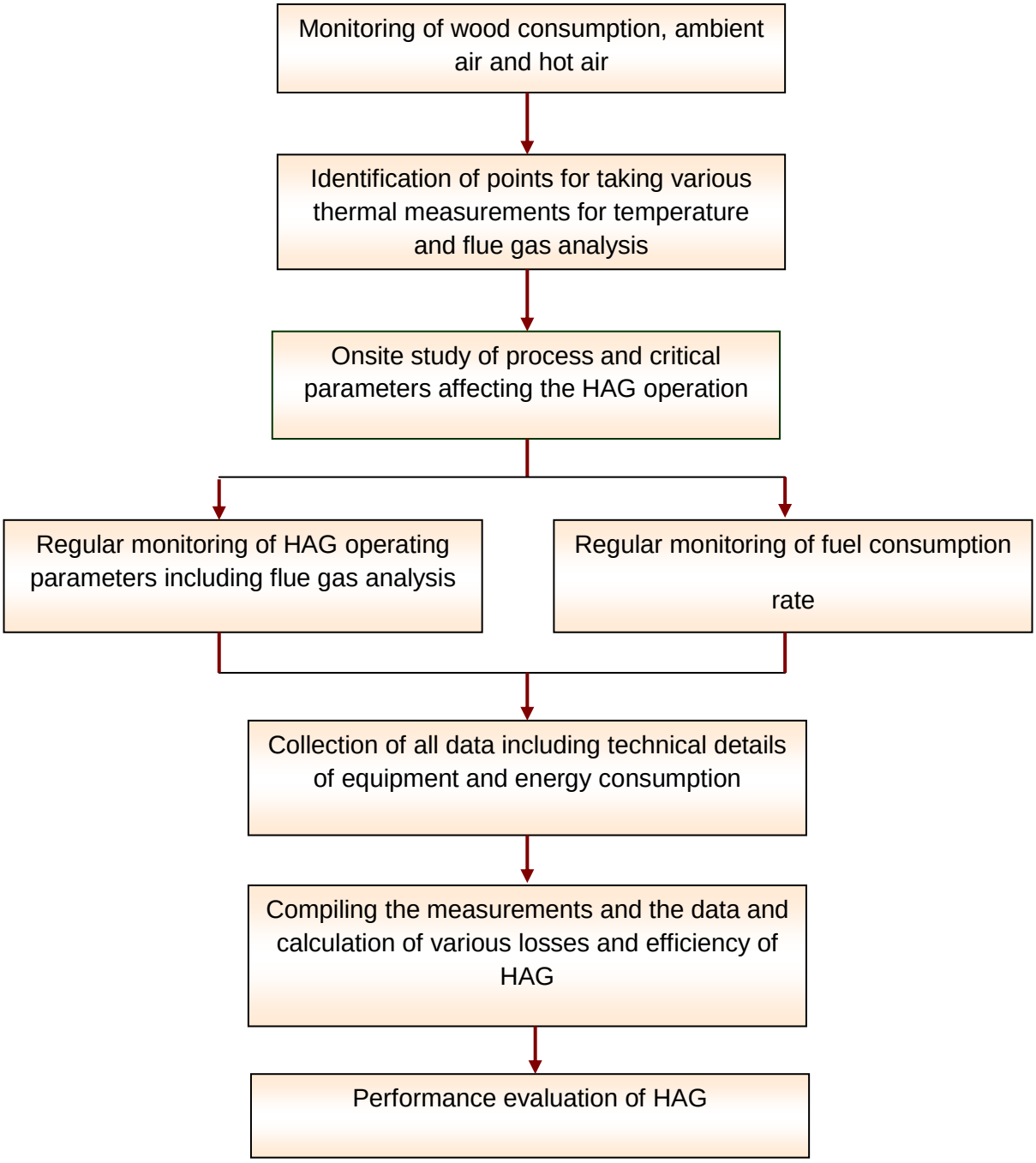


Figure 1.3 Energy audit methodology

1.4.2 Operating Efficiency

The operating efficiency of the existing HAG is 27% and details of operating parameters recorded and efficiency of the HAG of different units is furnished in Annexure 1.

1.5 Barriers in adoption of proposed technology / equipments

Major barriers in the up gradation of technology in the cluster are

- Non availability of technology
- Distrust on technology supplier
- Lack of information about energy efficiency among all unit still persists

The other barriers identified for implementation of energy efficient in Vapi chemicals & dyes cluster are presented in below sections.

1.5.1 Technological Barrier

The major technical barriers that prevented the implementation of new hot air generator are:

- Lack of awareness and information about the new and emerging energy efficient technologies available in the market.
- Dependence on local equipment suppliers for uninterrupted after sales service
- The majority of the unit owners / entrepreneurs do not have in-depth technical expertise
- The lack of technical know-how made it impossible for the unit owners to identify the most effective technical measures.

1.5.2 Financial Barrier

Some major financial barriers which prevent the implementation of proposed technology are:

- Implementation of the proposed project activity requires considerable investment of Rs 6.78 lakh, which is a significant investment and not commonly seen in the cluster for energy efficiency.
- The majority of the unit owners are of the view that it makes business sense for them to invest in enhancing production capacity rather than making investment in energy efficiency.

However, the financial attractiveness of the project activity may motivate the owners to move forward in taking up initiatives in energy conservation and efficiency.

1.5.3 Manpower skill

The non-availability of skilled manpower in the cluster is one of the major barriers. Though, the skilled manpower is available in the cluster, they are not aware of energy conservation / efficiency and its importance.

The training with equipment suppliers for importance of energy use and conservation will create awareness among workforce thereby make them aware about efficient use of energy and its conservation.

1.5.4 Other barrier (if any)

The non-availability of local suppliers for new energy efficient HAG

2 TECHNOLOGY/EQUIPMENT FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detail description of equipment

2.1.1 Description of technology

The new energy efficient wood fired hot air generator is a packaged, horizontal, 3 pass solid fuel fired hot air generator with fully wet back for high energy efficiency. The hot air generator is of natural draft and suitable for firing all kinds of solid fuels. The hot air generator is manually fired and simple designed for ease in operation and maintenance.



Figure 2.1: Energy efficient HAG

The proposed energy efficient hot air generator mainly consists of the following elements.

- Fire Chamber & Inside fire work
- Outside Insulation
- Control panel with fuse, temperature controls and contactors
- Flue Pipes
- ID fan & Air Blower

Comparison of Inefficient hot air generator with new energy efficient hot air generator

The technical, economical, environmental and safety aspects of the present inefficient hot air generator and new energy efficient hot air generator are compared on life cycle of equipment, and same is presented in Table 2.1 below:

Table 2.1 Comparison of Inefficient HAG with Energy efficient HAG

S. No	Details	Inefficient HAG	Energy efficient HAG
1	Wood consumption	High	Low
2	Environment pollution	High	Low
3	Safety of workers	Poor	Good
4	Maintenance cost	High	Low
5	Operational cost	High	Low
6	Availability of local service providers	Yes	Yes / limited
7	Draught system	Natural	Induced
8	Fuel combustion	Partial	Complete
9	Waste heat recovery	No	Yes
10	Heat losses through grate and surface	High	Low
11	Radiation losses	More due to insulation damage	Less
12	Radiation heat in combustion chamber	Not Utilized	Utilized in transfer of heat
13	Capacity utilization	Low	Optimum
14	Combustion chamber	Conventional	Water walled
16	Operation and maintenance	Less easy	Easy
17	Heat transfer between hot gasses and cold air	Less (Single path flue gas);Heat transfer efficiency is less	More(Three path flue gas);Heat transfer efficiency is more

From the above table it is evident that energy efficient hot air generator has significant advantages over existing conventional hot air generator w.r.t. energy, environmental, economic & safety aspects. Hence, it is justifiable to install energy efficient hot air generator in place of conventional hot air generator.

2.1.2 Technology /Equipment specifications

Equipment specification of new wood fire energy efficiency HAG is furnished in Table 2.2 below:

Table 2.2: Technical specifications

Details	Units	Value
Model	---	AHA-1500-C
Capacity	kCal/hr	1,50,000
Blower model	NA	25-200
Blower capacity	hp	7.5
Fuel consumption	Kg/hr	75
ID Fan model	NA	22-280
ID Fan motor	hp	1.5
ID Fan control	NA	ON-OFF
Total connected electrical load	hp	11.5
Electric supply	NA	AC 3 phase, 415V, 50 Hz
Hot air pipe outlet dimensions	in*in	16*16
Diameter of flue gas outlet	in	12 dia

2.1.3 Justification of the technology selected & Suitability

New proposed equipment is used for hot air generation which is earlier generated by conventional hot air generator. Hence new proposed equipment is completely suitable with existing process.

2.1.4 Superiority over existing technology/equipment

The new energy efficiency HAG is superior over the existing HAG for the following:

- Higher efficiency than conventional HAG
- Low operation and maintenance cost
- Life of the equipment is multifold than the present HAG

2.1.5 Availability of the proposed technology/equipment

The technology/equipment identified for implementation is available in Ahmedabad. Though, the local service providers are available, they don't have technical capability of fabricating the energy efficient designed hot air generator.

2.1.6 Source of technology/equipment for the project

Technology/Service provider selected for implementation of the proposed energy efficiency project is having experience in producing and supplying of energy efficient hot air generator, hot air generators. Details of equipment supplier are given in Annexure 7.

2.1.7 Terms of sales

There is no specific term and condition for the supply of HAG however, a general term and condition from supplier is given in the quotation in Annexure 8.

2.1.8 Process down time during implementation

For implementation of the project activity, it is proposed to take about 7 days may be required as a process down time. Details of complete procurement and implementation schedules are given in Annexure 6.

2.2 Life cycle assessment and risks analysis

The total operational life of the proposed energy efficient HAG is considered to be 10 years.

2.3 Suitable unit/plant size for proposed equipment

The cluster has hot air generators of different capacities ranging from 0.5 - 2 lakh kCal/hr. Hence, for the existing hot air generators of 0.5 - 2 lakh kCal/hr capacity, a 1.5 lakh kCal/hr rated capacity hot air generator is suggested for the cluster units.

3 ECONOMIC BENEFIT OF NEW ENERGY EFFICIENT PUMPS

3.1 Technical benefit

3.1.1 Fuel saving

Based on the detailed studies carried out in various units of Vapi chemicals & dyes cluster, the average wood consumption in a typical unit is 305 tonnes per annum. Whereas, the estimated wood consumption of proposed energy efficient hot air generator for the same production would be 155 tons per annum thereby, wood saving would be 150 tonnes per annum.

3.1.2 Electricity saving

Project implementation will lead to saving of electricity consumption, as the energy efficient hot air generator is of Forced/Induced draft.

3.1.3 Improvement in production quality

Product quality achieved would be same as the present quality. It does not have any impact in improving the quality of the product.

3.1.4 Increase in production

The proposed equipment does not contribute to any increase in production.

3.1.5 Reduction in raw material consumption

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

3.1.6 Reduction in other losses

There is no other reduction loss.

3.2 Monetary benefits

Annual monetary savings due to implementation of energy efficient HAG in place of the conventional HAG is ` 4.45 lakh per annum. Detailed Energy & monetary benefit analysis of energy efficient HAG is presented in annexure 3.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

The energy measures identified will utilize state-of-the-art technologies to ensure energy efficiency and energy conservation of non renewable wood. The replacement of inefficient hot air generator with energy efficient hot air generator will reduce the fuel consumption and will

improve the work condition and environment. As the project activity will have less radiation losses.

3.3.2 Improvement in skill set of workers

The training provided by equipment suppliers will improve the technical skills of manpower for better operation and maintenance of hot air generator. Hence the technology implemented will create awareness about energy conservation among the worker and improves skill set of 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

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

Implementation of this project will lead to reduction in CO_2 emissions due to reduction in overall fuel consumption. Implementation of this project will result in saving of 150 Tonne of wood per year while consume 14000 kWh of electricity per year thereby; reduce 198 tonne CO_2 emissions per year from one unit. Similarly, there are many similar type of unit in Vapi, and if all units will implement this project then significant amount of CO_2 emission reduction possible per year.

3.4.3 Reduction in other emissions like SOx

No significant impact on SOx emissions.

3.4.4 Reduction of deforestation

Reduction in wood consumption will automatically reduce the deforestation.

4 INSTALLATION OF NEW ENERGY EFFICIENT EQUIPMENT

4.1 Cost of project

4.1.1 Cost of equipment

The total cost of equipment and machinery is estimated ` 5.40 lakh, which includes hot air generator, refractory lining, insulation, induced draft fan, chimney, electrical works, and control panel with temperature controllers as per the quotation provided by the supplier given at Annexure 8.

4.1.2 Other costs

Other cost includes civil work and all applicable taxes. Details of total cost of installation of the proposed system are furnished in table 4.1 below:

Table 4.1: Details of project cost

S.No	Details	Cost (`in lakh)
1	Energy efficient HAG	5.40
2	Civil work	0.30
3	All applicable taxes	0.73
4	Erection and commission cost	0.35
5	Total Investment	6.78

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The total cost of the proposed technology is estimated at ` 6.78 lakh. The entrepreneur's contribution is 25% of total project cost, which is ` 1.70 lakh.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which is ` 5.09 lakh.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10% which is normal 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

Considering the above mentioned assumptions, the net cash accruals starting with ` 3.45 lakh in the first year operation and gradually increases to ` 18.40 lakh at the end of eighth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ` 6.78 lakh and monetary savings due to reduction in electricity consumption is ` 4.45 lakh hence the simple payback period works out to be 1.52 year.

4.3.3 Net Present Value (NPV)

The net present value of the investment at 10% works out to be ` 9.44 lakh.

4.3.4 Internal rate of return (IRR)

The after tax internal rate of return of the project works out to be 46.64%. Thus the project is financially viable.

4.3.5 Return on investment (ROI)

The average return on investment of the project activity works out at 27.11%.

Details of financial indicator are shown in Table 4.2 below:

Table 4.2: Financial indicator of project

S.No	Particulars	Unit	Value
1	Simple Pay Back period	Year	1.52
2	IRR	%age	46.64
3	NPV	` in lakh	9.44
4	ROI	%age	27.11
5	DSCR	Ratio	2.61

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. Following two scenarios has been considered

- Increase in monetary benefit by 5%

- Decrease in monetary benefit 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 4.3: Sensitivity analysis in different scenario

Particulars	*NPV*	*IRR*	*ROI*	*DSCR*
Normal	9.44	46.64	27.11	2.61
5% increase in monetary benefit	10.29	49.71	27.28	2.75
5% decrease in monetary benefit	8.58	43.56	26.92	2.47

4.5 Procurement and implementation schedule

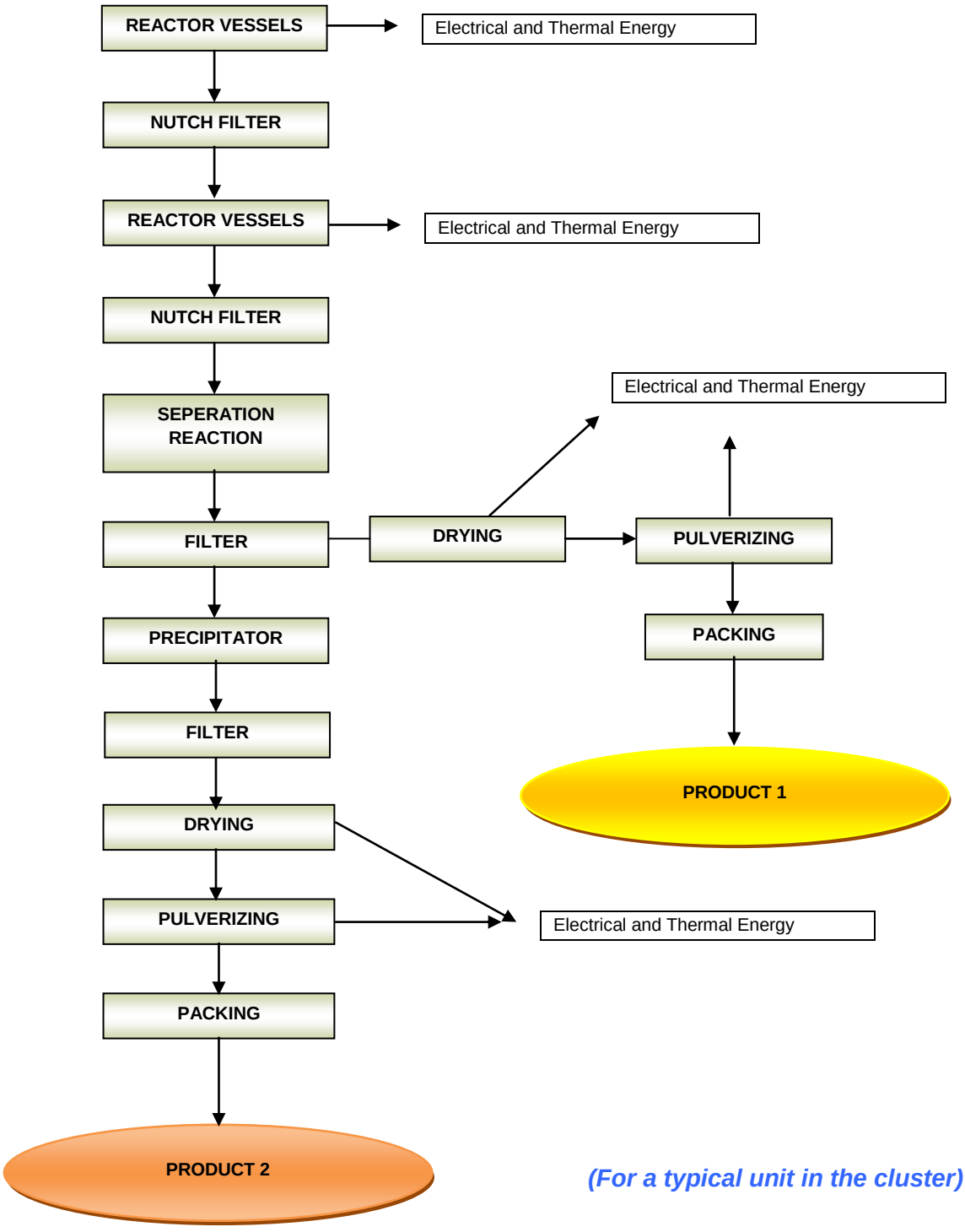
The project is expected to be completed in 10 weeks from the date of financial closure. The detailed of procurement and implementation schedule of project implementation is furnished in Annexure 6.

Annexure – 1 Efficiency of the existing Pumps

Unit 1 - (M/s Nandosal Chem Industries Pvt Ltd))

S.No	Particular	Details	unit
1	Fuel used	Wood	
3	Quantity of hot air generated for 3 hrs	kg	13,875
4	Rise in Temp	^{0}C	140
5	Specific heat	kcal/kg ^{0}C	0.24
6	Heat output for 3 hours	kcal	457,459
7	Wood consumption for 3 hours	kg	450.0
8	Calorific value of wood	kcal/kg	3,800
9	Heat input	kcal	1,710,000
10	Efficiency of HAG	%age	27

Annexure – 2 Process flow diagram



(For a typical unit in the cluster)

Annexure 3 Detailed technology assessment report

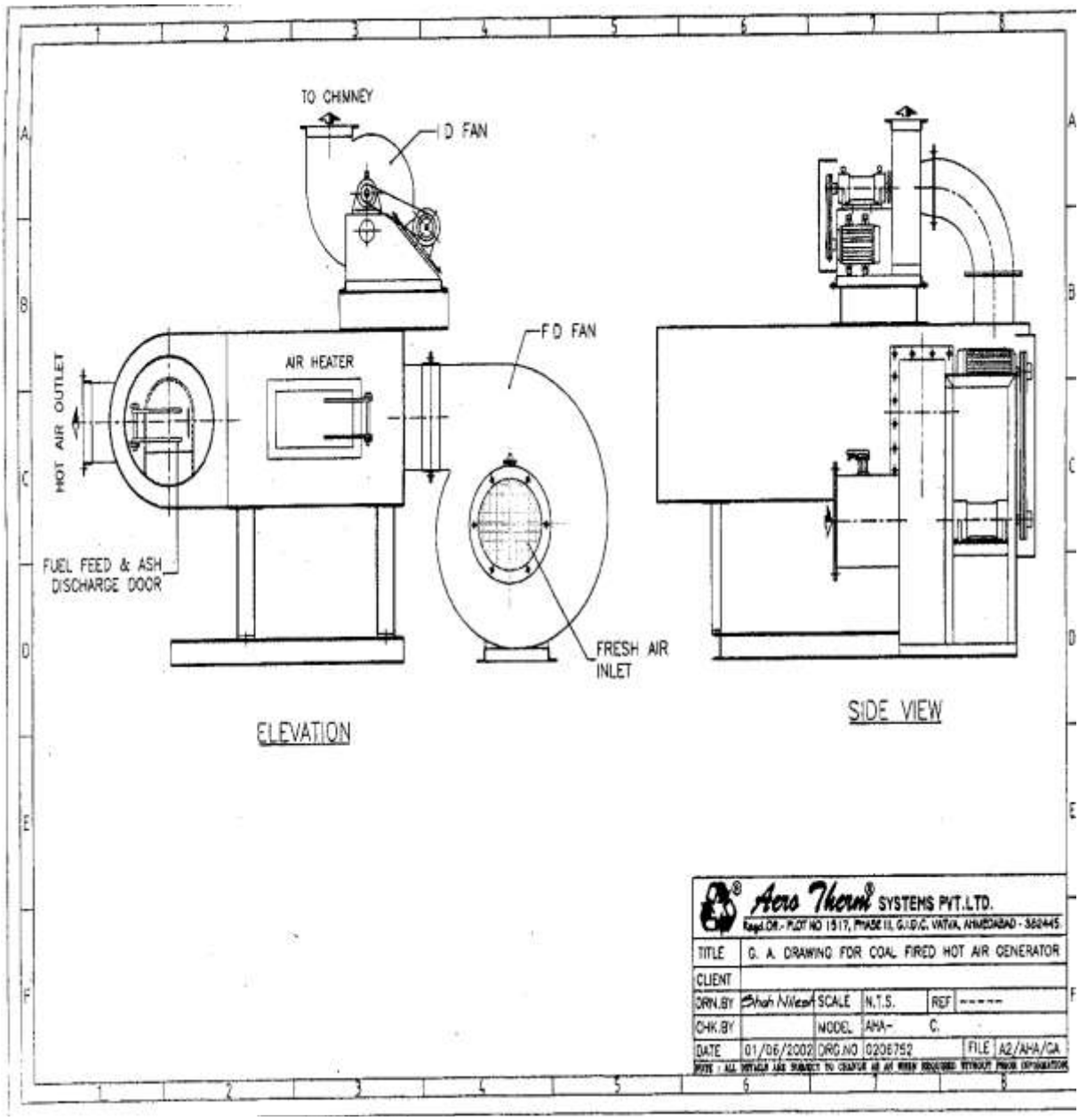
Performance evaluation of proposed HAG

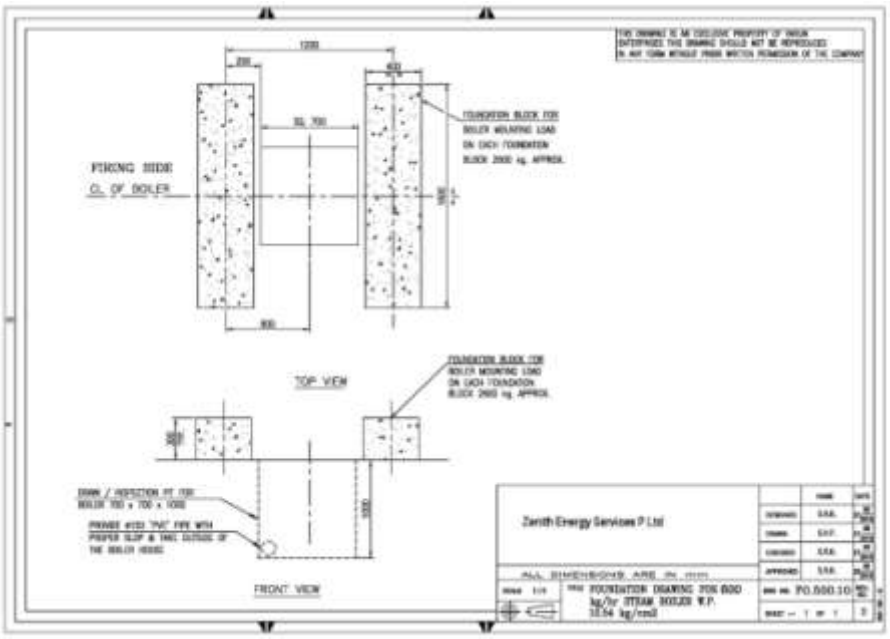
S.No	Particular	Details	unit
1	Total Heat output	kcal/hr	150,000
2	Wood consumption	kg/hr	75
3	Calorific value of wood	kcal/kg	3,800
4	Heat input	Kcal/hr	285,000
5	Proposed Efficiency	% age	53

Energy and monetary benefit

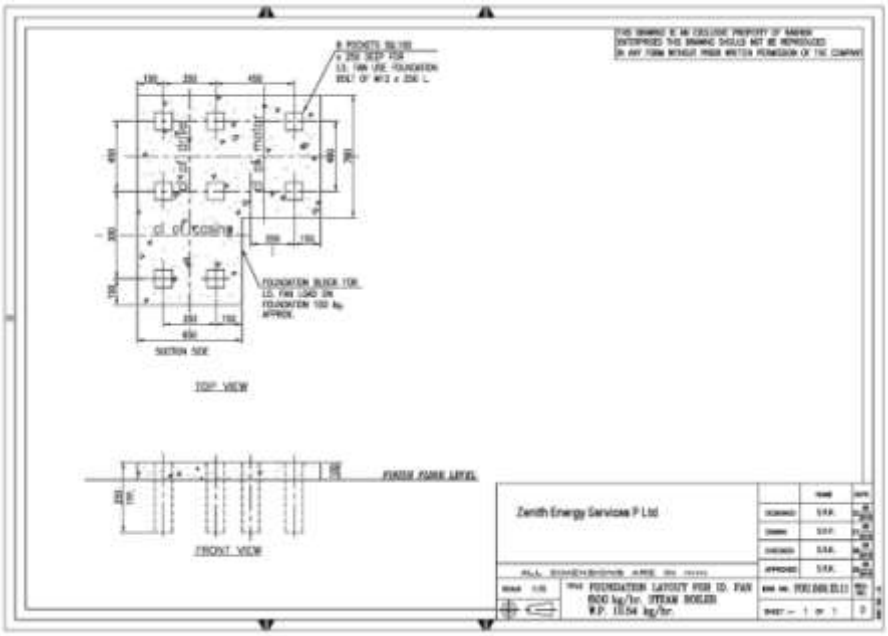
S.No	Particular	Unit	Value	
			Existing HAG	Proposed HAG
3	Efficiency of HAG	%age	27%	53%
4	Calorific value of wood	kCal/kg	3800	3800
5	Wood consumption	Tonne/annum	305	155
6	Saving of wood consumption	Tonne/annum		150
7	Electricity consumption	kWh/annum		14000
8	Cost of wood	` / Tonne		3500
9	Cost of electricity	` / kWh		5.7
10	Monetary saving	` in lakh		4.45
11	Cost of project	` in lakh		6.78
12	Simple payback period	Years		1.52

Annexure – 4 Drawings for proposed electrical & civil works





With Induced Draft Fan foundation



Annexure – 5 Detail financial calculations

Assumption

Name of the Technology	**Energy Efficient HAG**		
Rated Capacity	**1,50,000 kCal/hr**		
Details	***Unit***	***Value***	***Basis***
No of Operating Hours	Hrs.	6	
Total operating days	Days	350	
Proposed Investment			
Plant & Machinery	` (in lakh)	5.30	
Civil work	` (in lakh)	0.30	
Erection & commissioning	` (in lakh)	0.35	
Applicable taxes	` (in lakh)	0.73	
Total Investment	` (in lakh)	6.78	
Financing pattern			
Own Funds (Equity)	` (in lakh)	1.70	
Loan Funds (Term Loan)	` (in lakh)	5.09	
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10.00%	
Estimation of Costs			
O & M Costs	% on Plant & Equip	5.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Total monetary benefit	`/annum in lakh	4.45	Refer: Annexure 3
St. line Depn.	%age	5.28	Indian Companies Act
IT Depreciation	%age	80.00	Income Tax Rules
Income Tax	%age	33.99	Income Tax

Estimation of Interest on Term Loan

` (In lakh)

Years	***Opening Balance***	***Repayment***	***Closing Balance***	***Interest***
1	5.09	0.36	4.73	0.51
2	4.73	0.84	3.89	0.47
3	3.89	0.84	3.05	0.39
4	3.05	1.08	1.97	0.30
5	1.97	1.25	0.71	0.20
6	0.71	0.72	-0.01	0.07
		5.09		

WDV Depreciation **` (in lakh)**

Particulars / years	*1*	*2*
Plant and Machinery		
Cost	6.78	1.36
Depreciation	5.42	1.08
WDV	1.36	0.27

Projected Profitability **` (in lakh)**

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Fuel savings	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45
Total Revenue (A)	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45
Expenses								
O & M Expenses	0.34	0.36	0.37	0.39	0.41	0.43	0.45	0.48
Total Expenses (B)	0.34	0.36	0.37	0.39	0.41	0.43	0.45	0.48
PBDIT (A)-(B)	4.11	4.10	4.08	4.06	4.04	4.02	4.00	3.97
Interest	0.51	0.47	0.39	0.30	0.20	0.07	-	-
PBDT	3.60	3.62	3.69	3.75	3.84	3.95	4.00	3.97
Depreciation	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
PBT	3.25	3.26	3.33	3.40	3.48	3.59	3.64	3.62
Income tax	-	0.86	1.25	1.28	1.31	1.34	1.36	1.35
Profit after tax (PAT)	3.25	2.40	2.08	2.12	2.18	2.25	2.28	2.27

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Profit before tax	3.25	3.26	3.33	3.40	3.48	3.59	3.64	3.62
Add: Book depreciation	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Less: WDV depreciation	5.42	1.08	-	-	-	-	-	-
Taxable profit	(1.82)	2.54	3.69	3.75	3.84	3.95	4.00	3.97
Income Tax	-	0.86	1.25	1.28	1.31	1.34	1.36	1.35

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

Particulars / Years	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Liabilities								
Share Capital (D)	1.70	1.70	1.70	1.70	1.70	1.70	1.70	1.70
Reserves & Surplus (E)	3.25	5.65	7.72	9.84	12.02	14.27	16.55	18.82
Term Loans (F)	4.73	3.89	3.05	1.97	0.71	-0.01	-0.01	-0.01
Total Liabilities (D)+(E)+(F)	9.67	11.23	12.46	13.50	14.43	15.96	18.24	20.51

Assets	1	2	3	4	5	6	7	8
Gross Fixed Assets	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78
Less Accm. Depreciation	0.36	0.72	1.07	1.43	1.79	2.15	2.51	2.86
Net Fixed Assets	6.42	6.06	5.71	5.35	4.99	4.63	4.27	3.92
Cash & Bank Balance	3.24	5.16	6.76	8.16	9.44	11.33	13.97	16.59
TOTAL ASSETS	9.67	11.23	12.46	13.50	14.43	15.96	18.24	20.51
Net Worth	4.94	7.34	9.42	11.54	13.72	15.97	18.25	20.51
Debt Equity Ratio	2.79	2.29	1.80	1.16	0.42	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	1.70	-	-	-	-	-	-	-	-
Term Loan	5.09								
Profit After tax		3.25	2.40	2.08	2.12	2.18	2.25	2.28	2.27
Depreciation		0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Total Sources	6.78	3.60	2.76	2.43	2.48	2.54	2.61	2.64	2.62
Application									
Capital Expenditure	6.78								
Repayment Of Loan	-	0.36	0.84	0.84	1.08	1.25	0.72	-	-
Total Application	6.78	0.36	0.84	0.84	1.08	1.25	0.72	-	-
Net Surplus	-	3.24	1.92	1.59	1.40	1.29	1.89	2.64	2.62
Add: Opening Balance	-	-	3.24	5.16	6.76	8.16	9.44	11.33	13.97
Closing Balance	-	3.24	5.16	6.76	8.16	9.44	11.33	13.97	16.59

IRR **` (in lakh)**

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		3.25	2.40	2.08	2.12	2.18	2.25	2.28	2.27
Depreciation		0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Interest on Term Loan		0.51	0.47	0.39	0.30	0.20	0.07	-	-
Cash outflow	(6.78)	-	-	-	-	-	-	-	-
Net Cash flow	(6.78)	4.11	3.23	2.82	2.78	2.73	2.68	2.64	2.62
IRR	46.64%								

NPV	9.44

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.36
Sub Total*(G)*	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.36
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.08	0.09	0.09	0.10	0.10	0.11	0.11	0.12
Interest on Term Loan	0.51	0.47	0.39	0.30	0.20	0.07	0.00	0.00
Depreciation *(H)*	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Sub Total (I)	0.95	0.92	0.84	0.76	0.66	0.54	0.47	0.48
Sales (J)	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45
Contribution (K)	4.20	4.18	4.17	4.16	4.14	4.13	4.11	4.09
Break Even Point (L= G/I)	22.67%	21.98%	20.14%	18.30%	15.87%	13.03%	11.47%	11.66%
Cash Break Even {(I)-(H)}	14.14%	13.42%	11.56%	9.69%	7.23%	4.35%	2.76%	2.91%
Break Even Sales (J)*(L)	1.01	0.98	0.90	0.81	0.71	0.58	0.51	0.52

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	3.25	3.26	3.33	3.40	3.48	3.59	3.64	3.62	27.57
Net Worth	4.94	7.34	9.42	11.54	13.72	15.97	18.25	20.51	101.68
									27.11%

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	3.25	2.40	2.08	2.12	2.18	2.25	2.28	2.27	14.27
Depreciation	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	2.15
Interest on Term Loan	0.51	0.47	0.39	0.30	0.20	0.07	0.00	0.00	1.94
Total (M)	4.11	3.23	2.82	2.78	2.73	2.68	2.64	2.62	18.36

DEBT

Interest on Term Loan	0.51	0.47	0.39	0.30	0.20	0.07	0.00	0.00	1.94
Repayment of Term Loan	0.36	0.84	0.84	1.08	1.25	0.72	0.00	0.00	5.09
Total (N)	0.87	1.31	1.23	1.38	1.45	0.79	0.00	0.00	7.03
	4.73	2.46	2.30	2.01	1.89	3.38	0.00	0.00	2.61
Average DSCR (M/N)	2.61								

Annexure – 6 Details of procurement and implementation plan

Details of procurement and implementation –Energy Efficient Hot Air Generator

S. No	Activity	Weeks				
		1 - 2	2 - 4	4 - 6	6 - 8	8 - 10
1	Collection of quotations and order finalization					
2	Designing by the supplier as per the requirement					
3	Fabrication at the equipment supplier workshop					
4	Delivery					
5	Commissioning , Trial runs and Insulation					

Break up of process down time

S. No.	*Activities*	*Days*						
		1	*2*	*3*	*4*	*5*	*6*	*7*
1	Time required for dismantling or re-location of the existing hot air generator							
2	Civil works and curing							
3	Installation							
4	Commissioning, Trial & Insulation							

Note: The Process down time is considered for item 1, 3 and 4 only. As the civil foundations and installation of water storage tanks and water distribution lines are laded during plant in operation

Annexure – 7 Details of equipment service providers

Equipment details	Service/technology providers
Energy efficient Pumps	***Aero Therm Systems Pvt Ltd*** Plot No:1517, Phase-III, GIDC, Vatwa, Ahmedabad-382445, India Ph.No: +91-79-25890158, 25895243 Email: contact@aerothermsystems.com www.aerothermsystems.com

Annexure – 8 Quotations or Techno-commercial bids

Aero Therm® SYSTEMS PVT. LTD.
Regd. Office : Plot No. 1517, Phase-III, GIDC, Vatwa, Ahmedabad-382445. INDIA.
Phone : +91-79-25890158, 25895243 • Fax : +91-79-25834987
Email : contact@aerothermsystems.com • Website : www.aerothermsystems.com

EMAIL MSG. : ZENITH-ENERGY-02 8TH APRIL, 2011

TO : **M/S. ZENITH ENERGY.,**
10-5-6/B, MY HOME PLAZA,
MASABTANK, HYDERABAD – 500 028. A.P.
PH: 040-23376630/23376631 EXT. 206
040-23315810/23315812
FAX: 040-23322517
E MAIL: krishna@zenithenergy.com

KIND ATTN : **MR. KRISHNA**

SUB : HOT AIR GENERATOR – 1.5 LAC KCAL/HR

REF : OUR OFFER ZENITH-ENERGY-01 DT. 06-04-2011 FOR AHWG-15-C

WE ACKNOWLEDGE WITH THANKS RECEIPT OF YOUR EMAIL MSG. DT. 07-04-2011 REGARDING YOUR REQUIREMENT OF COAL/WOOD FIRED HOT AIR GENERATOR OF 1.5 LAC KCAL/HR AND ARE PLEASED TO ENCLOSE HEREWITH OUR DETAIL OFFER ON FOLLOWING:

-1. THREE PASS COAL / WOOD FIRED INDIRECT AIR HEATER
MODEL : AHA – 1500 – C

OUR STANDARD TERMS & CONDITION, SCOPE OF SUPPLY, LIST OF OUR VALUED CLIENTS ARE ENCLOSED HEREWITH FOR YOUR KIND CONSIDERATION.

WE HOPE YOU WILL FIND OUR ABOVE OFFER IN LINE WITH YOUR REQUIREMENT AND NOW LOOK FORWARD TO RECEIVE YOUR VALUED ORDER AT AN EARLIEST.

THANKS N REGARDS.

UPEN VADHER
[DIRECTOR TECH.]
[M: +91 98250 08720]
[: +91 98244 08720]

NIRAV VADHER
[DIRECTOR]
[M: +91 9714985544]

CC TO: KIND ATTN: SHRI PRASAD N V RAYALI
M/S. REVOLVE ENGINEERS PVT. LTD.,
PLOT NO. 52, D. NO. 7-1-282/C/1/52/C,
LINGAIAH NAGAR
BALKAMPET, HYDERABAD - 500 016
PH: 040 – 44545100-111 TELEFAX: 44545125
M: 9848160583 EMAIL: water@revolveengineers.com

TERMS AND CONDITIONS

PRICE	:	QUOTED PRICES IS EACH, UNPACKED, EX-WORKS, AHMEDABAD. MATERIAL WILL BE DESPATCH IN OPEN CONDITION BY SPECIAL CHARTED TRUCK ON DOOR DELIVERY FREIGHT TO-PAY BASIS. UNLOADING, PLACEMENT, ERECTION WILL BE DONE BY YOU AT YOUR COST. ANY ROAD PERMIT/OCTROI/GOVT. LEVIES WILL BE PAID BY YOU.
EXCISE DUTY	:	ALL APPLICABLE EXCISE DUTY WILL BE CHARGED EXTRA AT THE RATE PREVAILING AT THE TIME OF DELIVERY. KINDLY FURNISH US YOUR ECC DETAIL TO AVAIL MODVAT BENEFIT. - PRESENT RATE OF E D IS 10%* + 2 % EDU. CESS + 1 % SECONDARY HIGHER EDU. CESS (I.E. 10.30%) WILL BE CHARGED EXTRA. (*) C. E. NOTI. NO. 06/2010 C.E. DT. 27/02/2010
TAXES	:	ALL APPLICABLE TAXES WILL BE CHARGED EXTRA AT THE RATE PREVAILING AT THE TIME OF DELIVERY. - PRESENT RATE OF CST IS 2% AGAINST FORM-C.
PAYMENT	:	1/3RD AS ADVANCE ALONG WITH FIRM ORDER AND BALANCE AGAINST PERFORMA INVOICE PRIOR TO DESPATCH. ALL PAYMENT WILL BE BY DEMAND DRAFT PAYABLE AT AHMEDABAD. RTGS DETAILS: OUR HDFC BANK A/C NO. 03002320001959. HDFC BSR/IFSC CODE. HDFC 0000300 MICE.CODE 380240008
DELIVERY	:	WITHIN **10 - 12 WEEKS TIME** FROM THE DATE OF RECEIPT OF YOUR FIRM ORDER WITH SECURITY DEPOSIT AND TECHNICALLY AND COMMERCIALLY CLEAR ORDER.
INSPECTION	:	YOU WILL DEPUTE YOUR TECHNICAL PERSON FOR VISUAL INSPECTION AT OUR WORKS AT YOUR COST PRIOR TO DESPATCH, IF REQUIRED BY YOU.
GUARANTEE	:	OUR EQUIPMENT WILL BE GUARANTEED FOR A PERIOD OF 12 MONTHS FROM THE DATE OF DESPATCH AGAINST FAULTY WORKMANSHIP AND DEFECTIVE MATERIAL.
COMMISSIONING	:	WE WILL DEPUTE OUR ENGINEER FOR FIRST COMMISSIONING AFTER ALL NECESSARY ELECTRICAL, ALL PIPING & CHIMNEY CONNECTION COMPLETE BY YOU. YOU HAVE TO PROVIDE 1ST CLASS TO-FRO RLY. FARE + LODGING & BOARDING FREE OF COST TO OUR ENGINEER DURING THE STAY + RS. 2,500-00 PER DAY. (FROM START TO FINISH OF THE JOURNEY).
VALIDITY	:	OUR OFFER IS VALID FOR **15 DAYS** FOR ACCEPTANCE AND THEN AFTER SUBJECT TO OUR WRITTEN CONFIRMATION.

Vikas Dalia

2

TECHNICAL SPECIFICATION

THREE PASS COAL/WOOD FIRED FULLY AUTOMATIC INDIRECT AIR HEATER

M O D E L	:	**AHA - 1500 - C**
CAPACITY	:	1,50,000 KCAL/HR
AIR TEMP. AT OUTLET	:	130 DEG C
OPERATING TEMPERATURE	:	130 DEG C (dT = 30 DEG C)
BLOWER MOTOR HP	:	7.5 HP
I D FAN MODEL	:	22 - 280
I D FAN MOTOR	:	1.5 HP
FUEL	:	WOOD / COAL
FUEL CONSUMPTION	:	75 KG/HR
TOTAL CONNECTED ELECT. LOAD	:	11.5 HP
CONTROL	:	ON - OFF
ELECTRIC SUPPLY	:	AC 3 PHASE 415 V 50 HZ

NOZZLE DETAILS

- HOT AIR OUTLET	:	16" X 16"
- FLUE GAS OUTLET	:	12" DIA.

PRICE DETAIL

- PRICE OF THE OFFERED EQUIPMENT	:	**RS. 5,40,000-00 EACH UNIT.**
		RS. FIVE LAC FORTY THOUSAND ONLY.
- MS FABRICATED CYCLONE WITH DUCT.	:	**RS. 55,000-00 EXTRA.**

NOTE: DUCTING WITH INSULATION BETWEEN AIR HEATER AND DRYERS WILL BE DONE BY YOU.

3

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