ENERGY EFFICIENT BOILER
(CAPACITY – 1 TPH)

VELLORE RICE MILLS CLUSTER

BEE, 2010

Detailed Project Report on Energy Efficient Boiler (1000 kg/hr)

Rice Mills SME Cluster, Vellore, Tamilnadu (India)

New Delhi: Bureau of Energy Efficiency;

Detail Project Report No.: **VEL/RM/EEB/03**

For more information

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Zenith Energy Services Pvt. Ltd.

Hyderabad

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List of Abbreviations

- BEE - Bureau of Energy Efficiency
- DPR - Detailed Project Report
- DSCR - Debt Service Coverage Ratio
- FD - Forced Draft
- GHG - Green House Gases
- HP - Horse Power
- IBR - Indian Boiler Regulation
- IRR - Internal Rate of Return
- ID - Induced Draft
- MSME - Micro Small and Medium Enterprises
- MoP - Ministry of Power
- MoMSME - Ministry of Micro Small and Medium Enterprises
- NPV - Net Present Value
- RBI PLR - Reserve Bank of India Prime Lending Rates
- ROI - Return On Investment
- SIDBI - Small Industrial Development Bank of India

EXECUTIVE SUMMARY

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

There are about 340 rice mills in the cluster spreaded in Arni in Thiruvannamalai District and Arcot in Vellore Districts. These rice mills are engaged in production of boiled, steam and raw rice. The major Energy forms used in the cluster are electricity and fuels like Firewood, GN Shell and Rice husk. Electricity is used for driving the prime movers of rice mill machinery such as paddy cleaners, rice graders, hullers, separators, whiteners, silky etc. The fuels are used in the boilers and dryers.

The cost of energy as a percentage of processing cost of paddy varies anywhere between 4-5%, which includes electrical as well as thermal. Majority of the rice mills in the cluster are producing ponni rice and require thermal energy in the form of steam and hot air.

Boilers are one of the important equipment of the rice milling industry in thermal energy section and are used for steam generation for cooking of paddy by direct injection of steam in the tanks. There are very few units, where the steam is used for dryers for drying paddy. The major types of fuels used in the boilers are GN husk, wood and rice husk. The rice husk is used where the mills are producing steamed rice or exclusively raw rice

The new multi fuel fired boiler is a packaged, horizontal 3 pass solid fuel boiler fully wet back solid fuel fired boiler has higher efficiency than existing boiler. The new boiler is of natural draft and suitable for firing all kinds of solid fuels.

Installation of proposed equipment i.e. energy efficient boiler of 1 TPH capacity would lead to save about 348 ton solid fuel per year.

The DPR highlights the details of the study conducted for assessing the potential for reducing fuel consumption by installing new efficient boilers in various units of the cluster, possible fuel savings and its monetary benefit, availability of the technologies/design, local service providers, technical features and proposed equipment specifications, various barriers in implementation, environmental aspects, estimated GHG reductions, capital cost, financial analysis, and schedule of Project Implementation.

This bankable DPR also found eligible for subsidy scheme of MoMSME for “Technology and Quality Upgradation Support to Micro, Small and Medium Enterprises” under “National Manufacturing and Competitiveness Programme”. The key indicators of the DPR including the

Project cost, debt equity ratio, monetary benefit and other necessary parameters are given in table below:

S. No	Particular	Unit	Value
1	Project cost	`(in Lakh)	10.96
2	Fuel Savings (Wood)	Tonnes/annum	348
3	Monetary benefit	` (in Lakh)/Annum	10.44
4	Simple payback period	Year	1.05
5	NPV	` (in Lakh)	27.97
6	IRR	%age	74.44
7	ROI	%age	28.40
8	Average DSCR	Ratio	3.99
9	CO_2 reduction	Ton/annum	Nil
10	Process down time	Weeks	3

The projected profitability and cash flow statements indicate that the project implementation i.e. installation of energy efficient boiler will be financially viable and technically feasible solution for the cluster units.

ABOUT BEE'S SME PROGRAM

Bureau of Energy Efficiency (BEE) is implementing a BEE-SME Programme to improve the energy performance in 29 selected SMEs clusters. Vellore Rice Mills 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 audit

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

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

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

Activity 3: 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.

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

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

1 INTRODUCTION

1.1 Brief Introduction about cluster

Rice is the staple food of majority of Indians and specifically in Southern Indian. Paddy is the one major crop cultivated in the Southern states especially in the state of Tamilnadu. The Rice comes out of milling of paddy. Hence rice milling is an important activity in the state.

Rice mills are the lifeline for the economic development of rural India. The rice mills are generally located in the rural areas and near to paddy growing area.

There are about 340 rice mills in the cluster spreaded in Arni in Tiruvannamalai District and Arcot in Vellore Districts. These rice mills are engaged in production of boiled, steam and raw rice. The major Energy forms used in the cluster are Electricity and Fuels like Firewood, GN Shell and Rice husk. Electricity is used for driving the prime movers of rice mill machinery such as screeners, paddy cleaners, rice graders, hullers, separators, whiteners, cones etc. The fuels are used in the boilers and dryers.

The cost of energy as a percentage of processing cost of paddy varies anywhere between 4 to 5% of the cost of paddy, which includes electrical as well as thermal. Majority of the rice mills in the cluster are producing ponni rice and require thermal energy in the form of steam and hot air.

1.1.1 Production process

The milling process in larger commercial mills combines a number of operations that produces higher quality and higher yields of rice from paddy. The process involves:

Soaking, Cooking and Drying

The raw paddy procured is directly feeded to the tanks and soaked in normal water for about 12 hours. After completion of the soaking process, the water is drained from the tanks. Then the soaked paddy is cooked by direct injection of steam to the paddy. The cooked paddy is then dried by using natural sunlight or bed dryer for reducing the moisture content from 24 to 18%.

The paddy containing moisture content of 18% is dried in the hot air dryer for about 16 to 18 hours and the final moisture content is reduced to 8.5 to 9.0% and then the paddy is taken to the raw mill for further processing.

Pre-cleaning

When paddy comes into the mill it contains foreign material such as straw, weed seeds, soil and other inert material. If this is not removed prior to hulling the efficiency of the huller and the milling recovery are reduced.

Most pre-cleaners separate three groups of materials:

- The first separation is done by scalping or removing the objects that are larger than the grain. Either a flat oscillating screen or a rotary drum screen that allows the grain to pass through but retains straw can do this.
- The second separation retains the grains but allows broken grains, small stones and weed seeds to pass through. An air aspirator may also be incorporated to remove the dust and the light empty grains

Huller

The objective of a hulling/dehusking operation is to remove the husk from the paddy grain with a minimum of damage to the bran layer and, if possible, without breaking the brown rice grain. Since, the structure of the paddy grain makes it necessary to apply friction to the grain surface to remove the husk; it leads to breaking of some of the rice.

The paddy is fed into the center of the machine through a small hopper. A vertically adjustable cylindrical sleeve regulates the capacity and equal distribution of the paddy over the entire surface of the rotating disc, paddy is forced between the two discs and as a result of pressure and friction most of the paddy is dehusked (hulled).

Whitening, polishing & Silky

In the process of whitening, the silver skin and the bran layer of the brown rice are removed. During polishing of the whitened rice, the bran particles still sticking to the surface of the rice are removed and the surface of the rice is slightly polished to give it a glazed appearance. For further whitening if required as per the market demand or for export market, the polished rice is further processed in the silky machine for additional polishing.

Rice grader

After polishing, the white rice is separated into head rice and, large and small broken rice by a sifter. Head rice is normally classified as kernels, which are 75-80% or more of a whole kernel. The sifter is made up of a series of oscillating or cylindrical screens through which the rice passes. The output from the bottom screen is the very fine broken tips and is called the “brewers”.

Elevators

The elevator buckets are made of MS material. Due to heavy weight of the buckets, the elevator motors consume more power.

The detailed process flow diagram of the unit is furnished below.

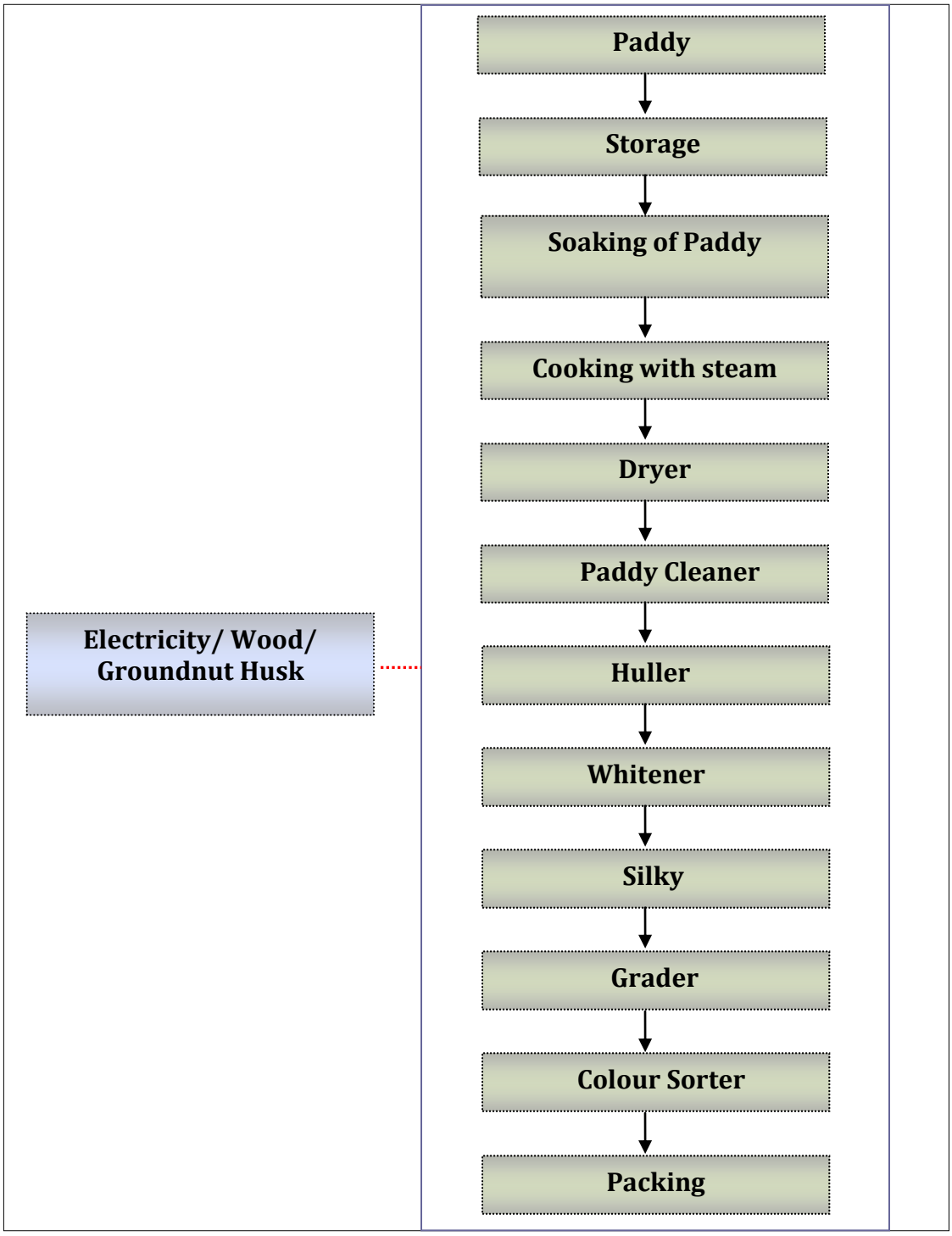


Figure 1: General Process Flowchart of a typical unit

1.2 Energy performance in existing situation

1.2.1 Fuels and electricity consumption

The main energy forms used in a typical rice mill of the cluster are electricity, rice husk, wood and GN husk. Electricity is used for driving the prime movers of rice mill machinery like fans, paddy cleaner, separator, grader, whitener, huller, silky, sortex and air compressors, lighting etc. Rice husk, GN husk and wood are used as fuels in boiler and hot air dryer. The energy consumption of a typical rice mill in the cluster having local make inefficient boiler and production capacity of the unit is 15 TPD is furnished in Table 1.1 below:

Table 1.1: Energy consumption of a typical unit (Sri Dhanalakshmi Modern Rice Mill)

S.No.	Details	Unit	Value
1	Grid Electricity consumption	kWh/annum	4,20,336
2	Wood Consumption	Tons/annum	1,320
3	Paddy processing (330 days)	Tons/annum	4,950

1.2.2 Average production by a typical unit in the cluster

The average production in a year in a typical rice mill of the cluster is 4,950 tons/annum of paddy processing.

1.2.3 Specific Energy Consumption

The specific energy consumption both electrical and thermal energy per ton of paddy processing are furnished in Table 1.2 below:

Table 1.2: Specific energy consumption for a typical unit (Sri Dhanalakshmi Modern Rice Mill)

S. No.	Type of Fuel	Units	Specific Energy Consumption
1	Wood consumption	Ton of wood/ Ton of rice	0.27
2	Grid Electricity consumption	kWh/ Ton of rice	84.92

1.3 Existing technology/equipment

1.3.1 Description of existing technology

There are about 340 rice milling units in the Vellore rice mills cluster. Majority of the rice mills are producing steamed and boiled rice. All the units have boilers and are used for steam generation required for cooking of paddy and also for drying of paddy (few units).

The detailed energy use and technology audit studies in various rice mills of the cluster, it was observed that most of boilers installed are inefficient. The performances of boilers in the

various cluster units were evaluated and the details are furnished in present Annexure 1.

Technical specification of existing boiler

The boiler is locally fabricated and doesn't have name plate details. The boiler is of fire tube, natural draft, wood fired and manually fired boiler. No pressure and temperature gauges were installed for the boiler. The boiler is operated for about 4 to 5 hours in a day and steam generated is used for paddy cooking by directly injecting the steam.

From energy use and technology gap audit studies in various units of the cluster, the following were identified:

- Energy efficiency improvement opportunities
- Environment and working conditions improvement
- Design flaws in the conventional boiler
- Operational & maintenance practices in the present conventional boilers

The following technology gaps were identified and furnished below:

Poor heat transfer efficiency:

The present boiler is of single pass system. The heat transfer is poor due to low heat transfer area and short time contact time between flue gas and oil and hence leads to inefficiency and leading to high flue gas losses.

Heat loss from charging door:

The fuel charging door remains more or less open during the entire operation due to various reasons;

No Waste Heat Recovery

Though, the waste heat recovery system doesn't have potential in smaller size boilers, as the boiler is of single pass system, hence there exists enormous potential in flue gases of the boiler. The temperature of the flue gases is found to be in the range of 240 to 270 ^{0}C, as the boiler is of single pass system. The high temperature flue gases is vented to the atmosphere without any waste heat recovery

Loading of the boiler:

The loading of the boiler is less than 50% and hence considerable reduction in thermal efficiency of the boiler.

Fuel firing control:

There is no control over fuel firing in combustion chamber

Poor Instrumentation:

For majority of the boilers installed in the rice milling units doesn't have either steam pressure meters or temperature meters. The capacity of the boiler is also not provided by the equipment supplier

From the above mentioned analysis it is clear that the performance of the existing boiler is poor in terms of Energy, Environment and Social aspects. Existing inefficient boilers installed in most of the rice mills has poor efficiency, generating more GHGs (Green House Gases), etc. Based on the above facts, the present inefficient boiler required to be replaced with new energy efficient boiler.

1.3.2 Its role in the whole process

The boilers are one of the important equipment of the rice milling industry and are used for steam generation for cooking of paddy by direct injection of steam in the tanks. There are very few units, where the steam is used for dryers for drying paddy.

1.4 Establishing the baseline

1.4.1 Design and operating parameters

No name plate details are available for the boiler. Based on the detailed studies carried out in the rice milling unit, the present fuel consumption of the Boiler is 1000 kg/day having paddy production capacity of 15 tons/day. The steam generation is evaluated based on the consumption of water for specific time interval. The boiler is operated for 4 - 5 hours in a day.

S. No	Amount of Steam Produced (Kg/hr)	Wood Consumption Per Batch	Wood Consumption Annually(2 batchX330 days)
1	1000	750 kg	495 tonne

1.4.2 Fuel Consumption

The major types of fuels used in the boilers are GN husk, wood and rice husk. The rice husk is used where the mills are producing steamed rice or exclusively raw rice. Total fuel consumption is depends upon the total operating days as well as operating parameters. The fuel consumption (wood) of present boilers of three typical units in the Cluster is furnished in table 1.3 below

Table 1.3 Fuel Consumption and Efficiency of three typical rice mill units

S. No	Name of the unit	Wood Consumption (Tons/annum)	Efficiency of the Boiler (% age)

1	Sri Dhanalakshmi Modern Rice Mill	1,320	21.39
2	Sri Padmaraj Mullaikudi Modern Rice Mill	625	20.19
3	MVS Modern Rice Mill	412.5	21.45

1.5 Barriers for adoption of new and energy efficient technology / equipment

1.5.1 Technological Barriers

The major technical barriers that prevented the implementation of new boilers are:

- Lack of awareness and information among the technologies available in the market.
- Dependence on local equipment suppliers for uninterrupted service and hence adopting low end inefficient technologies
- The majority of the owners do not have knowledge or technical expertise and hence adopting in efficient technologies which are locally available
- The lack of technical know-how made it impossible for the owners to identify the most effective technical measures.
- Distrust on technology suppliers and decisions are taken based on successful stories in the cluster units

1.5.2 Financial Barrier

- Lack of awareness of the losses and monetary benefit of energy efficient Boiler
- The majority of the unit owners have a feeling that the accruable benefits are more investing in the trading or purchasing of the paddy than in investing in energy efficiency.
- The unit owner in the cluster doesn't approach for the loans, as they have strong feeling that getting loans requires huge documentation and complex.

1.5.3 Skilled manpower

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.

1.5.4 Other barrier(s)

Information on the energy efficient technologies not available among cluster unit owners, though the suppliers are available locally, the information was not disseminated among

cluster units.

2 EQUIPMENT OPTION FOR ENERGY EFFICIENCY IMPROVEMENTS

2.1 Detailed description of technology/equipment selected

2.1.1 Description of technology

The project activity is replacement of present inefficient boiler with new energy efficient Boiler. The new Boiler will have overall efficiency of more than 70%.

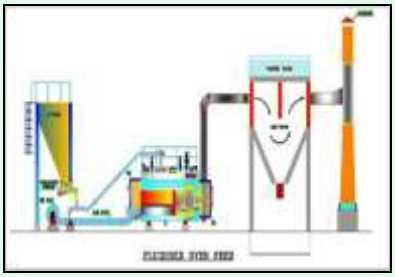
The new multi fuel fired boiler is a packaged, horizontal 3 pass solid fuel boiler fully wet back solid fuel fired boiler for high efficiency. The boiler is of natural draft and suitable for firing all kinds of solid fuels. The boiler is manually fired and designed for easy operation and maintenance.

- Packaged shell type with an internal furnace. No external refractory furnace. Hence is compacted and requires less space and maintenance.
- Works automatically like an oil fired boiler – less manpower is required
- High efficiency. In a Rice Mill, Husk can be saved.
- Quick steaming and no need for fire bar cleaning or ash removal from the furnace.
- The grate and ash ports for fuel feeding and ash removal
- Refractory for better radiation
- Control panel with fuse, temperature controls and contactors
- Insulation and mild steel cladding

Comparison of Inefficient boiler with Energy efficient boiler

The technical, economical, environmental and safety aspects of the present inefficient boiler and Energy efficient boiler are compared on life cycle of equipment, same is presented in Table 2.1 below:

Table 2.1: Comparison of Inefficient boiler with Energy efficient boiler

S.No	Parameter	Inefficient Boiler	Efficient Boiler
			

1	Fuel consumption	High	Low
2	Environment pollution	High (due to more fuel consumption)	Low (*Complete combustion & less fuel consumption*)
3	Safety of workers	Poor	Good
4	Maintenance	High	Low
5	Operational cost	High	Low
6	Availability of local service providers	Yes	Yes
Technical comparison between boiler & energy efficient boilers			
7	Draught system	Natural	Forced draft
8	Fuel combustion	Partial(due to inefficient combustion chamber design)	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	Utilization of heat	Less (Single/two pass system)	Maximum (three pass system)
13	Capacity utilization	Low	Optimum
14	Combustion chamber	Conventional	Water walled
16	Operation and maintenance	Less easy	Easy
17	Time required for attaining the water	More due to higher capacity	Less, as optimum size boiler selected

2.1.2 Technology/equipment specifications

Technical specification of new energy efficient boiler is furnished in Table 2.2 below:

Table 2.2: Technical specification of new boiler

S. No	Parameters	Unit	Value
1	Boiler type	---	Multi tubular 3 pass
2	Fuel used	Type	Paddy Husk
3	Combustion draft	Type	Forced

4	Condition of steam	-----	Saturated
5	Capacity	TPH	1
6	Efficiency	%age	70+/-2
7	Working pressure	kg/cm² (g)	10.54
8	Evaporation capacity	kg/hr	1000
9	Feed water pump	Cum/hr	1
		HP	1
10	Blower	Mm Wc	100
		HP	1

Further details of technical specification are given at Annexure 7.

2.1.3 Justification of the technology selected & its suitability

The efficiency of the present boiler installed is of low efficiency (21.39%) and efficiency of the new boiler is 70% under ideal conditions. Replacing the present Boiler with new energy efficient boiler will reduce fuel consumption and reduces production cost. The boiler selection is made based on the steam requirement for the process.

2.1.4 Superiority over existing technology/equipment

The new energy efficiency Boiler is superior to the existing boiler for the following:

- Reduced fuel consumption
- Faster steam generation
- Reduced radiation losses due to better insulation and refractory lining and due to better design of the grate
- No cleaning of the bars for removal of ash
- Waste heat recovery system for pre-heating boiler feed water

2.1.5 Availability of the proposed technology/equipment

The details of the boiler suppliers are provided in Annexure 6.

2.1.6 Source of technology/equipment for the project

The technology is locally available in Chennai, which is 120 km from Arni

2.1.7 Service/technology providers

The service providers are available in Chennai

2.1.8 Terms of sales

A complete detail of term of sale such as performance guarantee, scope of supply, delivery payments etc. are given at the Annexure 8.

2.1.9 Process down time

Process down time is considered for installation of this equipment is about 3 weeks and break ups are given in Annexure 6.

2.2 Life cycle assessment and risks analysis

The life of the Boiler is considered at 20 years.

2.3 Suitable unit in terms of capacity/production

Technology is suitable for unit having production capacity 15 TPD.

3 ECONOMIC BENEFITS OF NEW ENERGY EFFICIENT EQUIPMENT

3.1 Technical benefits

3.1.1 Fuel savings per year

Based on the detailed studies carried out in a typical rice mill of the cluster, the average wood consumption is 495 tons/annum and efficiency of the existing boiler is 21.39%. The estimated fuel consumption of proposed energy efficient boiler for the same production is 147 tons (Considering 70 % efficiency of new boiler) and hence, fuel savings is estimated at 348 tons per annum.

No electricity savings are considered, as the proposed energy efficient boiler requires electricity for blowers and pumps.

3.1.2 Improvement in product quality

There is no significant impact on product quality.

3.1.3 Increase in production

The present boilers are of single pass system and hence takes more time for steam generation and where as new energy efficient boiler will take less time due to better heat transfer and hence steam generation is faster than the existing boilers and cooking price takes lesser time.

3.1.4 Reduction in raw material consumption

No significant impact on the raw materials consumption.

3.1.5 Reduction in other losses

Not applicable

3.2 Monetary benefits

The monetary benefit due to installation of new energy efficient Boiler is estimated ` 10.44 lakh per annum due to reduction in fuel consumption. Details of monetary saving are furnished at Annexure 4.

3.3 Social benefits

3.3.1 Improvement in working environment in the plant

The replacement of inefficient boiler with energy efficient boiler 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 technology selected for the implementation is new and energy efficient. The training provided by equipment suppliers will improve the technical skills of manpower for better operation and maintenance; hence the technology implemented will create awareness among the workforce and improves the skill.

3.4 Environmental benefits

3.4.1 Reduction in effluent generation

The project activity will reduce effluent generation due to better control of boiler feed water parameters.

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

The project activity uses GN husk as fuel, which is a renewable source of energy and no GHG emission reductions will occur.

3.4.3 Reduction in other emissions like SOx

The project activity i.e., installation of energy efficient boiler reduces GN husk consumption and hence no significant impact on SO_x emissions.

4 INSTALLATION OF NEW EQUIPMENT

4.1 Cost of technology/equipment implementation

4.1.1 Cost of technology/equipments

The total cost of the boiler is estimated at ` 10.46 lakh, which includes boiler, pumps, insulation, chimney, and control panel with temperature controllers and applicable taxes as per the quotation provided at Annexure 8.

4.1.2 Other costs

Other cost includes civil work and electrical work, installation charges etc. Details of project cost are given in Table 4.1 below:

Table 4.1 Details of Project Cost

S.No.	Details	Cost (` in lakh)
1	New Energy Efficient Boiler	10.46
2	Civil and Electrical works	0.50
5	Total Investment	10.96

4.2 Arrangement of funds

4.2.1 Entrepreneur's contribution

The entrepreneur's contribution is 25% of total project cost, which works out at ` 2.74 lakhs.

4.2.2 Loan amount

The term loan is 75% of the total project cost, which is ` 8.22 lakhs.

4.2.3 Terms & conditions of loan

The interest rate is considered at 10.0% which is prevailing interest rate of SIDBI for energy efficient projects. The loan tenure is 5 years and the moratorium period is 6 months.

4.3 Financial indicators

4.3.1 Cash flow analysis

Considering the above discussed assumptions, the net cash accruals starting with ` 8.36 lakhs in the first year operation and increases to ` 45.89 lakhs at the end of eighth year.

4.3.2 Simple payback period

The total project cost of the proposed technology is ` 10.96 lakhs and monetary savings due

to reduction in fuel consumption is ` 10.44 lakhs and the simple payback period works out to be 1.05 years.

4.3.3 Net Present Value (NPV)

The Net present value of the investment at 10.00% interest rate works out to be ` 27.97 lakh.

4.3.4 Internal rate of return (IRR)

The after tax Internal Rate of Return of the project works out to be 74.44%. 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 28.40%. The average DSCR is 3.99.

4.4 Sensitivity analysis in realistic, pessimistic and optimistic scenarios

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

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

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

Table 4.2 Sensitivity analysis

Particulars	IRR %	NPV ` (In lakh)	ROI ` (In lakh)	DSCR
Normal	74.44%	27.97	28.40	3.99
5% decrease in fuel savings	70.48%	26.06	28.20	3.80
5% increase in fuel savings	78.02%	29.81	28.64	4.18

4.5 Procurement and implementation schedule

The project is expected to be completed in 8 weeks from the date of financial closure. The detailed schedule of project implementation is furnished in Annexure 6.

Annexure

Annexure 1: Efficiency Evaluation of the existing boilers

Sri Dhanalakshmi Modern Rice Mill

S.No.	Parameter	Unit	Value
1	Quantity of steam generated	kg per batch	1200
2	Boiler feed water temperature	^{o}C	30
3	Wood consumption	kg per batch	1000
4	Calorific value of wood	kCal/kg	3500
5	Heat input	kCal/batch	35,00,000
6	Enthalpy of steam	kCal/kg	654
7	Boiler feed water temperature	^{o}C	30
8	Heat output	kCal/batch	7,48,800
9	Efficiency	%age	21.39

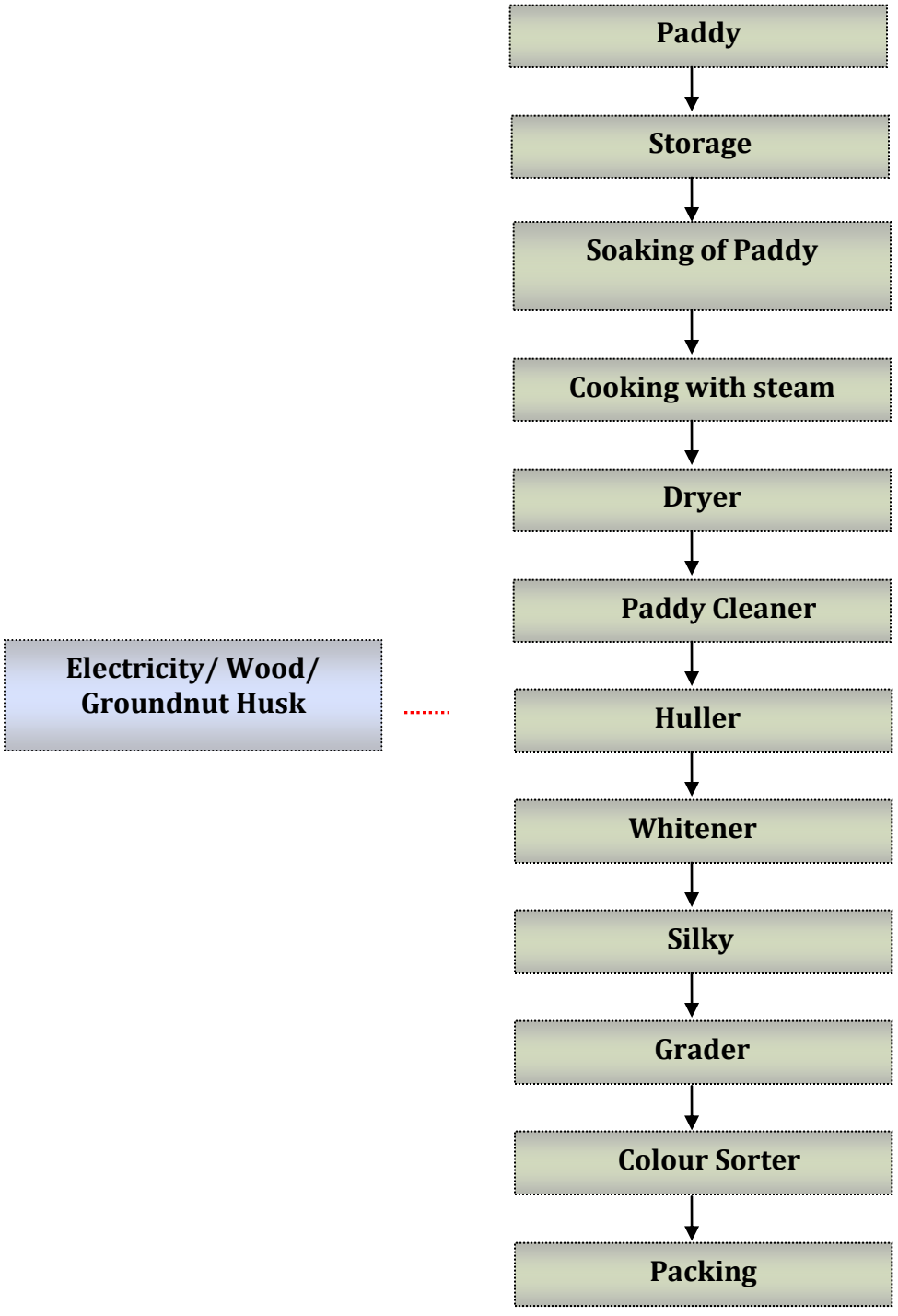
S Padmaraj Mullaikudi Modern Rice Mill

S.No.	Parameter	Unit	Value
1	Quantity of steam generated	kg per batch	1100
2	Boiler feed water temperature	^{o}C	30
3	Groundnut husk consumption	kg per batch	850
4	Calorific value of groundnut husk	kCal/kg	4000
5	Heat input	kCal/batch	34,00,000
6	Enthalpy of steam	kCal/kg	654
7	Boiler feed water temperature	^{o}C	30
8	Heat output	kCal/batch	6,86,400
9	Efficiency	%age	20.19

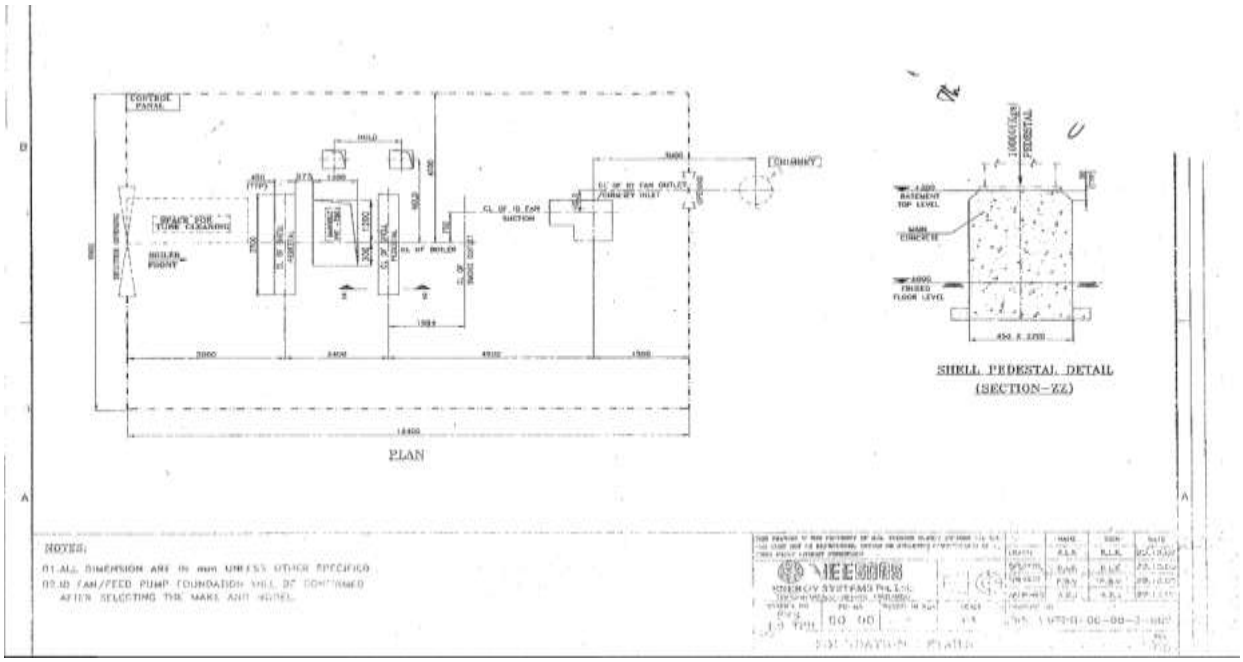
MVS Modern Rice Mill

S.No.	Parameter	Unit	value
1	Quantity of steam generated	kg per batch	1100
2	Boiler feed water temperature	^{o}C	30
3	Groundnut husk consumption	kg per batch	800
4	Calorific value of groundnut husk	kCal/kg	4000
5	Heat input	kCal/batch	32,00,000
6	Enthalpy of steam	kCal/kg	654
7	Boiler feed water temperature	^{o}C	30
8	Heat output	kCal/batch	6,86,400
9	Efficiency	%age	21.45

Annexure 2 Process flow diagram



Annexure 3 Drawings for proposed civil works required



Annexure 4 Detail technical assessment report

S.No.	Parameter	Unit	value
1	Present Ground Nut Husk consumption	Tons/year	495
2	Efficiency of existing boiler	%age	21.45
3	Rated efficiency of new boiler	%age	70
4	Ground Nut Husk consumption	Tons/year	147
5	Ground Nut Husk saving	Tons/year	348
6	Cost of Nut Husk	` /tons	3000
7	Monetary benefit	` (In lakh)/Year	10.44
8	Project cost	` (In lakh)	10.96
9	Simple payback period	Year	1.05
10	No. of Operating Days	Days/ Year	330
11	No. of Batches per Day	Batch	2
12	Operating Hours Per Batch	Hrs	4 to 5

Annexure 5 Detailed financial calculations & analysis

Assumption

Name of the Technology	**ENERGY EFFICIENT BOILER**		
Rated Capacity	**1 TPH**		
Details	***Unit***	***Value***	***Basis***
Installed Capacity	TPH	1	
No of working days	Days	330	Feasibility Study
No of operating hours	hours	12	Feasibility Study
Proposed Investment			
Equipment cost	` (in lakh)	9.96	
Cabling, Civil works and Modification	` (in lakh)	1.00	
Total Investment	` (in lakh)	10.96	
Financing pattern			
Own Funds (Equity)	` (in lakh)	2.74	
Loan Funds (Term Loan)	` (in lakh)	8.22	
Loan Tenure	years	5	Assumed
Moratorium Period	Months	6	Assumed
Repayment Period	Months	66	Assumed
Interest Rate	%age	10.00%	SIDBI Lending rate
Estimation of Costs			
O & M Costs	% on Plant & Equip	4.00	Feasibility Study
Annual Escalation	%age	5.00	Feasibility Study
Estimation of Revenue			
Fuel saving	Tons/annum	348	
Cost	`/Ton	3000	
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	8.22	0.60	7.62	0.95
2	7.62	1.44	6.18	0.70
3	6.18	1.68	4.50	0.54
4	4.50	1.74	2.76	0.37
5	2.76	1.86	0.90	0.19
6	0.90	0.90	0.00	0.03
		8.22		

WDV Depreciation **` (in lakh)**

Particulars / years	***1***	***2***
Plant and Machinery		
Cost	10.96	2.19
Depreciation	8.77	1.75
WDV	2.19	0.44

Projected Profitability **` (in lakh)**

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Fuel savings	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
Total Revenue (A)	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
Expenses								
O & M Expenses	0.44	0.46	0.48	0.51	0.53	0.56	0.59	0.62
Total Expenses (B)	0.44	0.46	0.48	0.51	0.53	0.56	0.59	0.62
PBDIT (A)-(B)	10.00	9.98	9.96	9.93	9.91	9.88	9.85	9.82
Interest	0.95	0.70	0.54	0.37	0.19	0.03	-	-
PBDT	9.05	9.28	9.42	9.56	9.71	9.85	9.85	9.82
Depreciation	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
PBT	8.47	8.70	8.84	8.98	9.14	9.28	9.27	9.24
Income tax	0.10	2.56	3.20	3.25	3.30	3.35	3.35	3.34
Profit after tax (PAT)	8.38	6.15	5.64	5.73	5.83	5.93	5.92	5.91

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit before tax	8.47	8.70	8.84	8.98	9.14	9.28	9.27	9.24
Add: Book depreciation	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Less: WDV depreciation	8.77	1.75	-	-	-	-	-	-
Taxable profit	0.28	7.53	9.42	9.56	9.71	9.85	9.85	9.82
Income Tax	0.10	2.56	3.20	3.25	3.30	3.35	3.35	3.34

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

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Liabilities								
Share Capital (D)	2.74	2.74	2.74	2.74	2.74	2.74	2.74	2.74
Reserves & Surplus (E)	8.38	14.52	20.16	25.89	31.72	37.65	43.58	49.48
Term Loans (F)	7.62	6.18	4.50	2.76	0.90	0.00	0.00	0.00
Total Liabilities (D)+(E)+(F)	18.74	23.44	27.40	31.39	35.36	40.39	46.32	52.22

Assets	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Gross Fixed Assets	10.96	10.96	10.96	10.96	10.96	10.96	10.96	10.96
Less Accm. Depreciation	0.58	1.16	1.74	2.31	2.89	3.47	4.05	4.63
Net Fixed Assets	10.38	9.80	9.22	8.65	8.07	7.49	6.91	6.33
Cash & Bank Balance	8.36	13.64	18.17	22.75	27.30	32.90	39.41	45.89
TOTAL ASSETS	18.74	23.44	27.40	31.39	35.36	40.39	46.32	52.22
Net Worth	11.12	17.26	22.90	28.63	34.46	40.39	46.32	52.22
Debt Equity Ratio	2.78	2.26	1.64	1.01	0.33	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	2.74	-	-	-	-	-	-	-	-
Term Loan	8.22								
Profit After tax		8.38	6.15	5.64	5.73	5.83	5.93	5.92	5.91
Depreciation		0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Total Sources	10.96	8.96	6.72	6.21	6.31	6.41	6.50	6.50	6.48
Application									

Capital Expenditure	10.96								
Repayment Of Loan	-	0.60	1.44	1.68	1.74	1.86	0.90	-	-
Total Application	10.96	0.60	1.44	1.68	1.74	1.86	0.90	-	-
Net Surplus	-	8.36	5.28	4.53	4.57	4.55	5.60	6.50	6.48
Add: Opening Balance	-	-	8.36	13.64	18.17	22.75	27.30	32.90	39.41
Closing Balance	-	8.36	13.64	18.17	22.75	27.30	32.90	39.41	45.89

IRR

` (in lakh)

Particulars / months	***0***	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Profit after Tax		8.38	6.15	5.64	5.73	5.83	5.93	5.92	5.91
Depreciation		0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Interest on Term Loan		0.95	0.70	0.54	0.37	0.19	0.03	-	-
Cash outflow	(10.96)	-	-	-	-	-	-	-	-
Net Cash flow	(10.96)	9.90	7.42	6.76	6.68	6.61	6.53	6.50	6.48
IRR	74.44%								

NPV	27.97

Break Even Point

` (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***
Variable Expenses								
Oper. & Maintenance Exp (75%)	0.33	0.35	0.36	0.38	0.40	0.42	0.44	0.46
Sub Total*(G)*	0.33	0.35	0.36	0.38	0.40	0.42	0.44	0.46
Fixed Expenses								
Oper. & Maintenance Exp (25%)	0.11	0.12	0.12	0.13	0.13	0.14	0.15	0.15
Interest on Term Loan	0.95	0.70	0.54	0.37	0.19	0.03	0.00	0.00
Depreciation *(H)*	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Sub Total (I)	1.64	1.39	1.24	1.08	0.90	0.74	0.73	0.73
Sales (J)	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
Contribution (K)	10.11	10.09	10.08	10.06	10.04	10.02	10.00	9.98
Break Even Point (L= G/I)	16.19%	13.77%	12.31%	10.71%	9.01%	7.43%	7.26%	7.35%
Cash Break Even {(I)-(H)}	10.47%	8.04%	6.57%	4.96%	3.25%	1.66%	1.47%	1.55%
Break Even Sales (J)*(L)	1.69	1.44	1.29	1.12	0.94	0.78	0.76	0.77

Return on Investment

` (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Net Profit Before Taxes	8.47	8.70	8.84	8.98	9.14	9.28	9.27	9.24	71.93
Net Worth	11.12	17.26	22.90	28.63	34.46	40.39	46.32	52.22	253.30
									28.40%

Debt Service Coverage Ratio

` (in lakh)

Particulars / Years	***1***	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***Total***
Cash Inflow									
Profit after Tax	8.38	6.15	5.64	5.73	5.83	5.93	5.92	5.91	37.65
Depreciation	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	3.47
Interest on Term Loan	0.95	0.70	0.54	0.37	0.19	0.03	0.00	0.00	2.78
Total (M)	9.90	7.42	6.76	6.68	6.61	6.53	6.50	6.48	43.90

DEBT

Interest on Term Loan	0.95	0.70	0.54	0.37	0.19	0.03	0.00	0.00	2.78
Repayment of Term Loan	0.60	1.44	1.68	1.74	1.86	0.90	0.00	0.00	8.22
Total (N)	1.55	2.14	2.22	2.11	2.05	0.93	0.00	0.00	11.00
	6.39	3.47	3.04	3.16	3.22	7.05	0.00	0.00	3.99
Average DSCR (M/N)	3.99								

Annexure 6 Details of procurement and implementation schedule

Project Implementation Schedule

Details of procurement and implementation –Energy Efficient Boiler

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*	*weeks*						
		1	*2*	*3*	*4*	*5*	*6*	*7*
1	Time required for dismantling or re-location of the existing boiler							
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 laid during plant in operation.

Annexure 7 Details of technology/equipment service providers

Equipment details	Source of technology	Service/technology providers
Energy Efficient Boiler	Indigenous	**M/s. Veesons Energy Systems Pvt Ltd.** MURUGESAN.A Sr.Engineer / Proposals Veesons Energy Systems Pvt. Ltd., C14/2, Industrial Estate, Trichy - 620 0015 Cell : 98424 50431 Phone : 2501010/11/15
Energy Efficient Boiler	Indigenous	**M/s Thermodyne technologies pvt ltd** No. 18, ayodhya colony, Velachery, Chennai-600042. Phone: 22437201 Fax : 91-44-22437200 E-mail : thermodyne@thermodyne.in
Energy Efficient Boiler	Indigenous	**M/s Thermax Ltd** Prasanna A. Hiwase Chinchwad, MIDC Pune, Maharashtra Cell: 9960478685 Email ID: phiwase@thermaxindia.com

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

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ENERGY SYSTEMS PVT. LTD.

VESPL/H.O/45/Q/502-A/2010-2011 16.12.2010

M/S ZENITHENERGY
10-5-6/B,MY HOME PLAZA
MASABTANK,
HYDERABAD - 500 028
A.P.,INDIA

kind attn : Mr.Krishna (09440234294.)

email : Krishna@zenithenergy.com

Dear Sir,

Sub : Your Requirement of Steam Boiler - Submission of offer - Reg.
REF : YOUR EMAIL DATED 14-12-2010.

'=WE THANKFULLY ACKNOWLEDGE THE RECEIPT OF YOUR VALUABLE ENQUIRY AND ONCE AGAIN THANK YOU FOR THE KEEN INTEREST YOU HAVE SHOWN IN OUR RANGE OF PRODUCTS. BASED ON YOUR EMAIL, WE ARE PLEASED TO SUBMIT OUR OFFER VIDE ANNEXURE AS GIVEN BELOW.

ANNEXURE - 1	:	MAIN SPECIFICATION
ANNEXURE - 2	:	PRICE SCHEDULE AND COMMERCIAL TERMS
ANNEXURE - 3	:	SCOPE OF SUPPLY
ANNEXURE - 4	:	EXCLUSIONS
ANNEXURE - 5	:	PERFORMANCE CRITERIA AND BATTERY LIMITS

We hope our offer will be in line with your requirement both commercially and technically. We shall be pleased to furnish you any further information/clarification after hearing from your good selves.

Thanking you and assuring you of our best attention and Services at all times.

Yours faithfully
For VEESONS ENERGY SYSTEMS PVT.LTD.,

(K.NAGARAJAN)
COUNTRY MANAGER

Encl.: As Above

BOILER ENGINEERS
Regd. Office & Works
C-14/2, INDUSTRIAL ESTATE, TIRUCHIRAPPALLI-620 015
Tel: 0431 - 2501010/11/15 Fax: 0431-2501414
E-mail: mdo@veesons.com
Website: http://www.veesons.com

BUREAU VERITAS Certification
UKAS
008
AN ISO CERTIFIED COMPANY

VEESONS ENERGY SYSTEMS PVT. LTD.

ANNEXURE – I

TECHNO COMMERCIAL OFFER

I. MAIN SPECIFICATION

1.0.	Type of Boiler	: Horizontal Multitubular 3 pass - wet back Fluidised front feed Smoke tube Package Boiler.
2.0.	Design, Fabrication, Inspection & Testing Code	: IBR 1950 with latest Amendments.
3.0.	Model	: FFF
4.0.	Evaporation Capacity	: 1000 Kg/hr (F&A 100°C)
5.0.	Max Working Pressure (Safety valve set off)	: 10.54 Kg/cm^2(g) / 150 PSI (g)
6.0.	Fuel	: Paddy husk
7.0.	Gross Calorific Value (GCV)	: 3275 K.cal/Kg
8.0.	Type of feeding	: Fluidised Front Feeding
9.0.	Mode of combustion	: Forced draught

ANNEXURE - 2

VEESONS ENERGY SYSTEMS PVT. LTD.

PRICE SCHEDULE AND COMMERCIAL TERMS

1.0 PRICE SCHEDULE :

1.1 STANDARD SUPPLY

1.1.1 Supply of 'VEESONS' Horizontal Multitubular fluidised front feed smoke tube steam Boiler of Model FFF as detailed SCOPE OF SUPPLY in Sl.No.III. STANDARD) Rs.9,96,000/-

2.0 COMMERCIAL TERMS :

2.1.	Basis of Price	: Ex-Works, Trichy.
2.2.	Taxes and duties	: Extra as applicable at the time of despatch / invoicing. At present rates applicable are,
	a) Central excise duty(CED)	: 10.30 % (At present exempted if agrowaste is used as fuel)
	b) Sales Tax (VAT)	: 4 %
2.3.	Packing & Forwarding	: 2% on basic Price.
2.4.	Guidance of Erection and Commissioning	: 2% on basic price.
2.5.	Transportation & Transit Insurance	: Buyer's Scope.
2.6.	Terms of payment	: 50 % advance alongwith order. Balance payment plus taxes and Duties 7days before readiness of boiler against proforma invoice.
2.7.	Delivery period	: Within 45-60 Days from the date of receipt of your technically & commercially clear Purchase order along with full advance.
2.8.	Validity	: Our offer is valid for 30 days from the date offered, afterwards subjected to market fluctuations.

ANNEXURE – 3

SCOPE OF SUPPLY

Horizontal Multi-tubular wet back fluidised front feed three pass Forced draught smoke tube boiler.

01. MAIN BOILER

1.1. Boiler consists of shell, flue and smoke tubes assy. Necessary valves and fittings, mountings, Instruments and man holes as per IBR requirements.

1.2. Platform, handrails and Ladder

1.3. Air nozzles assy with distributor plate - 1 Assy.

1.4. Lining of boiler.

1.5. Ferrules for II nd and III RD pass entry.

02. AUXILLARIES

2.1 Feed water Pump With Motor - 2 Assy
2.2 FD Fan with motor - 1 Assy.

03. PIPING AND DUCTING WORKS

3.1 IBR Piping between boiler and feed water pumps	- 2 Nos.
3.2 Blow Down line up to blow down valve	- 1 No.
3.3 Drain lines for Water level gauges	- 2 Nos.
3.4 Drain line for Automatic Water level Controller	- 1 No.
3.5 Air Ducting from FD fan to in built furnace	- 1 Assy.
3.6 Secondary Air piping from FD fan to front chamber and rear internal reversing chamber	- 1 Assy.

04. FUEL FEEDING SYSTEM

4.1 Variable frequency Vibratory feeder with automatic fuel feeding controller	- 1 Assy
4.2 Fuel feeding piping from FD fan to furnace	- 1 Assy

05. VALVES AND FITTINGS

5.1 Main steam stop valve	: 1 No.
5.2 Air vent valve	: 1 No.
5.3 Feedline NRV	: 2 Nos.
5.4 Feedline Globe valve	: 2 Nos.
5.5 Blow down valve	: 1 No.
5.6 Syphon tube with threaded flange	: 1 set.
5.7 Isolation valve for steam pressure gauge	: 1 No.
5.8 Water level gauge with protection glass assy	: 2 Nos.
5.9 suction strainer	: 1 No.
5.10 Isolation valve for AWLC	: 2 Nos.
5.11 Drain valve for AWLC	: 1 No.

Contd..2

..2..

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06. INSTRUMENTS,CONTROLS AND SAFETIES

6.1	Automatic Water Level Controller	- 1 Assy.
6.2	Steam pressure switch for Combustion control	- 1 No.
6.3	Main steam pressure gauge	- 1 No.
6.4	Single post Safety Valve	- 2 Nos.
6.5	Fusible plug	- 2 Nos.

07. ELECTRICALS

Fully pre-wired control panel consists of necessary switches, MCB's contactors, fuses, Timers and etc.

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ANNEXURE - 4

EXCLUSIONS

4.1 Chimney and flue gas ducting from Boiler to chimney

4.2 Water Treatment plant, Water storage tank and inter connecting water piping upto feed pump.

4.3 Any HRU/ Ash room / Dust collector and fuel storage bunker.

4.4 Insulation of boiler.

4.5 Piping - Steam, Blowdown and drain, and its supports.

4.6 Transport and Transit Insurance.

4.7 Unloading, erection of boiler and accessories and IBR formalities at site.

4.8 All civil and necessary foundation work for boiler and other accessories.

4.9 All electrical works including supply of power, control cables and cabling works.

4.10 Any other items which are not specifically mentioned in supplier's standard scope.

ANNEXURE - 5

VEESONS ENERGY SYSTEMS PVT. LTD

PERFORMANCE CRETERIA AND BATTERY LIMITS :

PERFORMANCE CRITERIA

FUEL :

The output and other performance parameters of the boiler specified in this offer hold good only if fuel of the following specification is charged to the boiler. Any variation in the specifications of fuel will alter the performance parameters.

Gross Calorific Value : 3275 Kcal/kg (Max Moisture content 10 % by weight)
(Paddy Husk)

WATER :

The performance parameters of the boiler under this offer are based on filtered and treated water of the following quality being available.

SPECIFICATION OF FEED WATER TO BOILER :

Residual hardness as CaCo3	ppm	:	5 Max.
pH Value		:	8.5 to 9.5
Oil content	ppm	:	Nil
Oxygen (O2)	ppm	:	Nil
Free Co2	ppm	:	Nil
Bound Co2	ppm	:	5 Max.
Total dissolved solids	ppm	:	400 Max.

SPECIFICATION OF WATER IN BOILER :

Total hardness as CaCo3	ppm	:	5 Max.
Alkalinity	ppm	:	15 to 20 % TDS
pH value		:	10.5 to 11
Sodium sulphite (Na2 So3)	ppm	:	50 Max. (Undissolved)
P2 O5	ppm	:	15 to 30
Oxygen (O2)	ppm	:	Nil
Total dissolved solids	ppm	:	Less than 3500

To enable us to submit an offer for water treatment system it is essential to have either your sample of raw water or its analysis.

VEESONS ENERGY SYSTEMS PVT. LTD

BATTERY LIMITS

Steam

- Upto outlet Flange of Main steam stop valve
- Upto outlet Flange of Air vent valve
- Upto outlet Flange of Safety Valve

Water

- From suction Flange of feed water pump

Drain

- Upto water level gauge glass drain cock
- Upto AWLC Drain

Blow down

- Upto outlet of blow down valve

Electrical

- From input terminal upto output terminal of control panel.
- Input & Output terminal on Individual load points.

Fuel

- From inlet of Vibratory Feeder

Flue Gas

- Upto outlet of Boiler.

Air

- From inlet flange of FD Fan.

MAKES OF BOUGHTOUT ITEMS

FAN	:	M/S.VINTECH / VEESONS
FEED PUMP	:	M/S.BE / M/S.JHONSON / VINCI
MOTORS	:	M/S.CROMPTON / KIRLOSKAR / ELGI/ HAVELS
BLOWDOWN VALVE	:	M/S.LEVCON/UTAM
WATER LEVEL GAUGE	:	M/S.RUSHAS / UTAM / M/S SHARP
SAFETY VALVE	:	M/S.FAINGER
MSSV	:	M/S.UTAM / M/S.SHARP / RUSHAS
STEAM PR.GAUGE	:	M/S.FIEBIG / H-GURU
NON RETURN VALVE	:	M/S.EXPERT.
AWLC	:	M/S.ENGINEERING DEVICES/MALHOTRA
FORGED STEEL VALVES	:	M/S.HYDRO TECH / UTAM /SHARP
CONTROL PANEL	:	M/S.VEESONS
PRESSURE SWITCH	:	M/S.INDFOS / SANMUR

NOTE : VEESONS SHALL HAVE OPTION TO SUPPLY BOUGHT OUT ITEMS OF ANY MAKE AS MENTIONED ABOVE