

Detailed Project Report On Energy Efficiency in Kiln

Savion Ceramic
Morbi (Gujarat)

Prepared for

Bureau of Energy Efficiency
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This DPR has been originally prepared by TERI as a part of 'Capacity Building of LSPs' activity under the GEF-UNIDO-BEE project 'Promoting Energy Efficiency and Renewable Energy in selected MSME clusters in India'.

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“Capacity Building of Local Service Providers”

For more information

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The Energy and Resources Institute (TERI)
New Delhi

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List of abbreviations

BEE	:	Bureau of Energy Efficiency
CO ₂	:	Carbon Dioxide
D/E	:	Debt /Equity
DPR	:	Detailed Project Report
DSCR	:	Debt Service Coverage Ratio
EE	:	Energy Efficient
GEF	:	Global Environmental Facility
GHG	:	Green House Gas
IDC	:	Investment without interest defer credit
IGDPR	:	Investment Grade Detailed Project Report
IRR	:	Internal Rate of Return
kW	:	Kilo Watt
kWh	:	Kilo Watt Hour
LSPs	:	Local Service Providers
MGO	:	Minimum Guaranteed Offtake
MSME	:	Micro, Small and Medium Enterprises
MT	:	Metric Tonne
NG	:	Natural Gas
NPV	:	Net Present Value
O&M	:	Operation and Maintenance
PCB	:	Pollution control board
PGVCL	:	Paschim Gujarat Vij Company Limited
RE	:	Renewable Energy
ROI	:	Return on Investment
SCM	:	Standard Cubic Meter
SME	:	Small and Medium Enterprises
SPP	:	Simple Payback Period
TERI	:	The Energy and Resources Institute
Toe	:	Tonnes of oil equivalent
UNIDO	:	United Nations Industrial Development Organization
WACC	:	Weighted Average Cost of Capital

Executive summary

The overall aim of the GEF-UNIDO-BEE project 'Promoting Energy Efficiency (EE) and Renewable Energy (RE) in selected MSME clusters in India' is to develop and promote a market environment for introducing energy efficiency and enhancing the use of renewable energy technologies in process applications in selected energy-intensive MSME clusters in India. This would help in improving the productivity and competitiveness of the MSME units, as well as in reducing the overall carbon emissions and improving the local environment.

Under the GEF-UNIDO-BEE Project, TERI has been entrusted to undertake Capacity building of Local Service Providers (LSPs) to BEE. The Scope of Work under the project,

- Organizing 4 one-day training/ capacity building workshops for LSPs in each cluster.
- Development of 10 bankable DPRs for each cluster, based on mapping technology needs with capacities of local technology suppliers/service providers, and also replication potential and applications to banks in each cluster.

Brief introduction of the MSME unit

Name of the unit	M/s Savion Ceramic
Constitution	Partnership
MSME Classification	Medium
No. of years in operation	8
Address: Registered Office:	No. 8- A, National Highway, At. Lakad Dhar, Matel Road, Dhuva, Rajkot - 363621 (Gujarat), India
Industry-sector	Ceramic
Products manufactured	Wall Tiles
Name(s) of the promoters/ directors	Mr Nilesh Patel Mr Dhaval Patel Mr Satish Patel Mr Vinod Patel
Existing banking arrangements along with the details of facilities availed	NA

A detailed assessment study was undertaken in the identified area with the use of the sophisticated handheld instruments. Energy consumption pattern and production data were collected to estimate the specific energy consumption of the unit. The unit level baseline of the unit was also estimated using the historical data. The plant is consuming about 2,927,520 kWh of electricity per year. The annual consumption of the NG is about 27,05,153 SCM. The total energy consumption of the unit during last 12 months is estimated to be 2,695 toe which is equivalent to 959.4 lakh rupees. The total CO₂ emission during this period is estimated to be 7,385 tonnes. Electricity and NG were considered for CO₂ emission estimation.

The unit manufactures the ceramic wall tiles and the total annual production of the unit during 2017-18 is estimated to be 1.6 million boxes. The major source of energy is electricity and natural gas.

Accepted/ recommended technology implementation

The recommended technology considered after discussion with the plant personnel for implementation in the unit is given below.

Technology	Annual energy saving	Investment (Rs lakh) ¹	Monetary savings	Simple payback period (Years)	Emission reduction (tonnes of CO ₂)
	NG (SCM)		(Rs lakh/year)		
Automation of kiln combustion system and improvement in surface insulation	54,615	15.7	17.5	0.9	95.6

Other benefits

- The proposed project is not expected to bring in any change in process step or operating practices therefore no change expected in the product quality.
- Implementation of the selected technology in the unit may result in reduction in CO₂ emissions.

Cost of project & means of finance

S. No.	Particulars	Unit	100% equity	D/E- 70:30	D/E- 50:50
1	Cost of Project	Rs. In Lakh	15.7	15.7	15.7
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	82.2	78.1	79.3
4	NPV	Rs. In Lakh	31.6	28.9	29.7
5	DSCR	-	-	2.1	0.9

¹ Investment including the (i) kiln combustion system automation – Rs. 6.3 lakh, (ii) Ceramic modules/insulation – Rs. 7.8 lakh and (iii) Taxes and other misc. cost – Rs. 1.6 lakh

1.0 Details of the unit

1.1 Particulars of unit

Table 1.1: Particulars of the unit

1	Name of the unit	M/s Savion Ceramic	
2	Constitution	Partnership	
3	MSME Registration No/UAN	24-009-12-05070	
4	PCB consent No.	-	
5	Date of incorporation / commencement of business	2010	
6	Name of the Contact Person	Mr Nilesh Bhai Patel	
7	Mobile / Ph. No	+91- 9925511115	
8	Email	info@q-bo.in	
9	Address: Registered Office	No. 8- A, National Highway, At. Lakad Dhar, Matel Road, Dhuva, Rajkot - 363621 (Gujarat), India	Owned
10	Factory	No. 8- A, National Highway, At. Lakad Dhar, Matel Road, Dhuva, Rajkot - 363621 (Gujarat), India	Owned
11	Industry / Sector	MSME/Manufacturing	
12	Products Manufactured	Wall tiles	
13	No of hours of operation/shift	8	
14	No of shifts/ day	3	
15	No of days/year	350	
16	Installed Capacity	13,500 MTS	
17	Whether the unit is exporting its products (Yes/ No)	No	
18	Quality Certification, if any	NA	

2.0 Energy profile

2.1 Process flow diagram

Manufacturing of ceramic item uses wide range of raw material combination to produce different shape, size and colour. It requires both electrical and thermal energy at different stages of the process to operate the ball mill, casting/moulding, kilns, cutting & finishing machines and utilities such as motors, pumps air compressor etc. Ceramic manufacturing process primarily consists of mould preparation, body material preparation, shaping, drying and firing. Typical process flow chart is shown with figure 2.1.

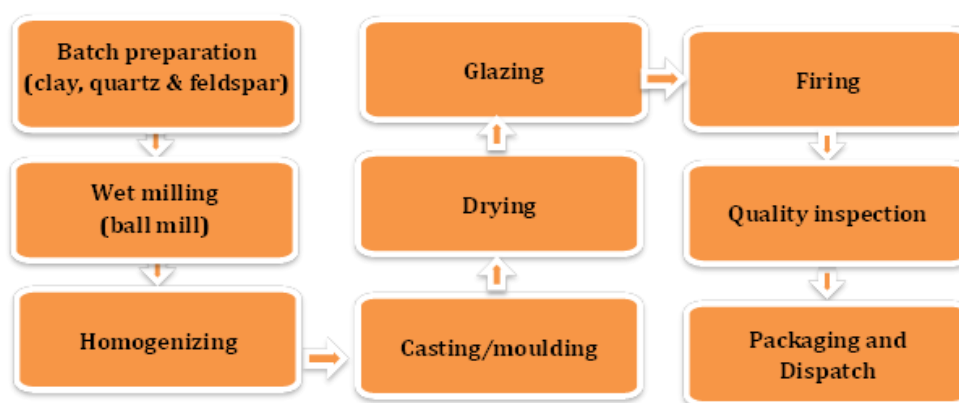


Figure 2.1: Process flow chart

2.2 Details of technology identified

The details of the kiln installed in the unit are given in table 2.2.

Table 2.2: Details of kiln

Parameters/ Equipment ID	Value
Equipment	kiln
Type	Roller kiln
Make	Local
Fuel type	NG
PHZ	39 mt
Firing Zone	38 mt
Cooling Zone	58 mt

2.3 Energy used and brief description of their usage pattern

The unit uses grid power supplied by Paschim Gujarat Vij Company Limited under the tariff category of HTP -1. Table 2.3 provides the details of energy uses.

Table 2.3: Energy used and description of use

S No	Energy source	Description of use
1	Electricity	Motive power for different drives in

S No	Energy source	Description of use
		different process sections and utilities
2	NG	Kiln

2.4 Energy sources, availability & tariff details

Different energy sources, availability of listed energy types and their respective tariffs are given in table 2.4.

Table 2.4: Energy sources, availability and tariffs

Source	Remarks	Price
Electricity (PGVCL)	HTP-1	Demand charges: <ul style="list-style-type: none"> For first 500 kVA of billing demand: Rs. 150/- per kVA per month For next 500 kVA of billing demand: Rs. 260/- per kVA per month Energy charges: @ Rs. 4.20/kWh Power factor penalty: <ul style="list-style-type: none"> 1% of energy charges for every point drop in PF between 0.85 to 0.90 2% of energy charges for every point drop in PF below 0.85 Power factor rebate: <ul style="list-style-type: none"> 0.5% of energy charges for every point increase in PF over 0.95
Natural gas	Gujarat Gas Ltd.	<ul style="list-style-type: none"> Minimum Guaranteed Offtake (MGO): Rs. 32.70/SCM Non - Minimum Guaranteed Offtake (Non-MGO): Rs. 35.97/SCM

2.5 Analysis of electricity consumption

Table 2.5: Electricity consumption profile

Month & Year	Electricity consumption (kWh)	Contract Demand (kVA)	Maximum Demand (kVA)	Minimum Billing Demand (kVA)	Demand Charges, Rs./month	Energy Charges, Rs./month	Power factor (PF)	Total electricity bill (Rs)
Mar-18	2,66,952	600	548	510	87,480	10,89,013	0.99	19,14,597
Apr-18	2,71,576	600	591	510	98,660	11,06,357	0.99	19,57,745
May-18	1,72,168	600	377	510	77,600	6,96,962	0.99	12,47,475
Average	2,69,264	600	570	510	93,070	10,97,685	0.99	19,36,171
Total	32,31,168	-	-	-	-	-	-	2,32,34,052

2.6 Analysis of other energy forms/ fuels

The analysis of the other fuels/forms of energy used in the unit is given in table 2.6.

Table 2.6: Analysis of other energy/ fuel consumption

Parameters	NG
Consumption unit/year	27,05,153
Calorific value per unit	8,935
Equivalent toe per year	2,417
Price (Rs per unit)	32.1

Total price per year	8,69,25,989
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The share of various energy forms used in the unit is given in figure 2.6.

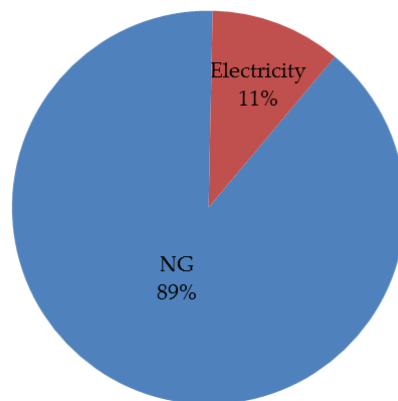


Figure 2.6: Percentage share of various fuel types in the unit

The plant is consuming about 2,927,520 kWh of electricity per year. The annual consumption of the NG is about 27,05,153 SCM. The total energy consumption of the unit during last 12 months is estimated to be 2695 toe which is equivalent to 959.4 lakh rupees. The total CO₂ emission during this period is estimated to be 7,385 tonnes. Electricity and NG were considered for CO₂ emission estimation.

3.0 Proposed technology for energy efficiency

Based on the measurements, observations/ findings during detailed assessment study conducted in the unit, the following technology has been identified for energy efficiency improvement. The detail is given below.

3.1 Automation of kiln combustion system and improvement in surface insulation

3.1.1 Background

To dry the glazed product in the tile unit, the roller type tunnel kiln is most commonly used in which the heat for the drying is mainly supplied by the combustion of natural gas and hot air recovered from the preheating zone of the kiln. The details of the kiln in the unit are given in table 3.1.1.

Table 3.1.1: Details of kiln

Parameters/ Equipment ID	Value
Equipment	kiln
Type	Roller kiln
Make	Local
Fuel type	NG
PHZ	39 mt
Firing Zone	38 mt
Cooling Zone	58 mt

Fuel fired kilns depend on a variety of means to control the burner air-to-fuel ratio. These systems vary considerably, but all of them require a suitable optimization of the flow and pressure. The operational parameters of the kiln including the temperature profiling in various zones, flue gas analysis, surface imaging and fuel and electricity consumption were measured during the detailed assessment study and analysis of the past one year data.

3.1.2 Observations and analysis

To analyse the combustion efficiency of the kiln, flue gas analysis conducted during the normal plant operation and observed that the oxygen level in the exhaust chimney duct is in the range of 15.1-17.8% (average of time series measurement is estimated to be 16.5%). The kiln is divided into the zones and each zone fuel supply is cut off after attending the set/desired temperature. The detailed analysis of the dry flue gas losses in the kiln is given in table 3.1.2.

Table 3.1.2: Estimation of dry flue gas losses

Operating Parameters	Unit	Value
Fuel		PNG
Fuel CV	kCal/kg	8,935
Operating parameters		
O ₂ % in flue gas	%	16.5
Flue Gas Temperature	°C	168
CO ₂ % in flue gas	%	2.4

Operating Parameters	Unit	Value
Ambient air Conditions		
DBT	°C	37.9
RH	%	59.5
WBT	°C	30.7
Specific Humidity	kg/kg of air	0.025
Fuel Analysis		
Carbon	%	74.7
Hydrogen	%	25.0
Sulphur	%	-
Oxygen	%	-
Nitrogen	%	0.8
Moisture	%	-
Ash	%	-
Total	%	100.5
Combustion air analysis		
Theo. Air required	kg/kg of fuel	17.37
% Excess air	%	366.67
Total air supplied	kg/kg of fuel	81.04
Excess air quantity	kg/kg of fuel	63.67
Flue Gas Constituents		
H ₂ O formation due to H ₂ in fuel	kg	2.25
H ₂ O from moisture in fuel	kg	-
H ₂ O from moisture in air	kg	2.04
N ₂ in air supplied	kg	62.24
O ₂ in excess air	kg	14.77
Total flue gas generated	kg	81.30
Total DFG generated	kg	77.01
Energy saving analysis		
Dry flue gas losses	kCal/SCM	2,304.3
Percentage heat loss in waste gases	%	26.0

As fuel supply is cut off in the respective zone but combustion is continued supplied in the respective zone which further increasing the oxygen level in exhaust gases. Excess air supply for combustion of fuel always increases fuel combustion. To enhance cooling rate additional cool air is supplied and also to remove part of this air before entering into the firing zone, multiple hot air removal port system has been incorporated in the cooling zone. Thus, a substantial amount of energy could be saved by preventing excess air in kilns, through improved controls of the combustion process, recovering and recycling heat generated by firing, as well as through improved designs of kilns and other equipment/machinery.

To assess surface heat loss of the kiln, an insulation survey (using thermal imager) was conducted. Kiln surface temperature was measured to be 103 °C -147 °C. The highest temperature was observed on the front and back panel (firing zone) which is in the range of 140 °C - 150 °C. The total heat loss due to surface is estimated to be 80,409 kCal per hour. The hot spots observed in the furnaces are shown in thermal images in figure 3.1.2.

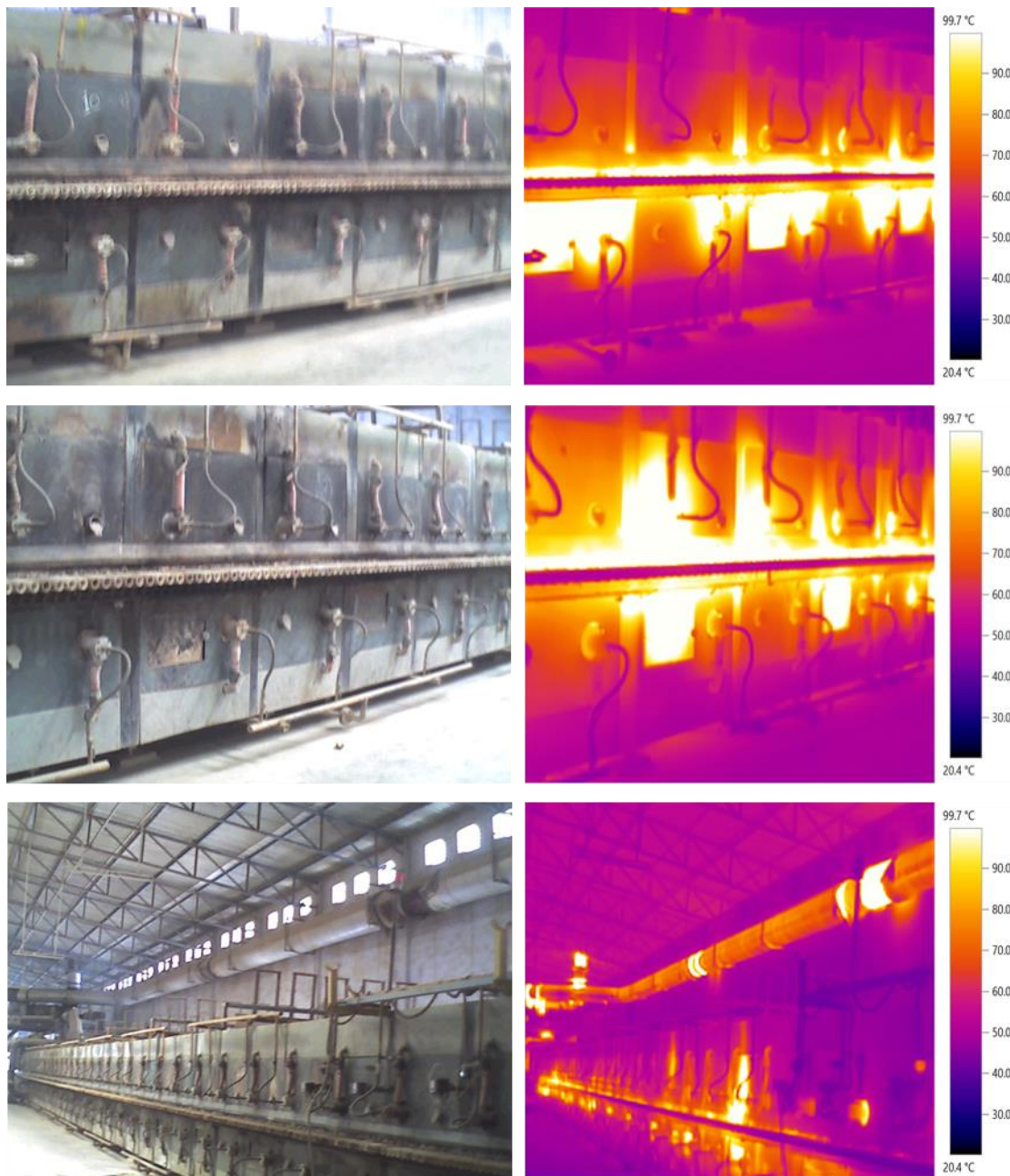


Figure 3.1.2: Thermal imaging of kiln

3.1.3 Recommendation

The combustion schematic shown in figure 3.1.3 is an arrangement that shows a proportional control system. It is designed, in its most basic form, to provide constant ratio control, i.e., a set ratio of air-to-gas regardless of firing rate. And it only works due to the flow law that we defined above. This combustion system consists of the following bits of hardware:

- Combustion air fan: Fan delivers combustion air to the burner system at a reasonably

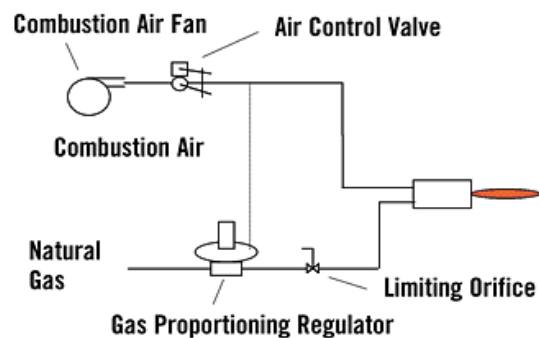


Figure 3.1.3: Combustion schematic diagram

constant pressure.

- Motor operated air control valve: Valves modulates the flow of air to the burner.
- Gas proportioning regulator/ratio regulator: This device is the “heart” of the system. Developed decades ago, it is still an accurate and economical means of controlling the proportion of gas to air.
- Limiting orifice: This device introduces a pressure drop in a flow line to allow for balancing or adjusting flow rate. In laymen’s terms, it is a needle valve.

The improvement in the radiation heat loss from furnace surfaces can be achieved by reinforcing its insulation. This includes (i) covering of internal wall surface with ceramic fibre insulation, and (ii) covering external wall surface with ceramic fibre or rock wool insulation.

3.2 Cost benefit analysis

The estimated annual energy saving by Automation of kiln combustion system and improvement in surface insulation is 54,615 SCM which is equivalent to about Rs. 17.5 lakhs. The investment requirement is Rs 15.6 lakh with a simple payback period of 1.7 years. The detailed calculations of the recommended energy conservation measures for DPR are provided in table 3.2

Table 3.2: Cost benefit analysis for recommended energy savings measures

Parameters	Unit	Existing	Proposed
Dry flue gas losses	kCal/SCM	2,304.3	1,658.8
Percentage heat loss in waste gases	%	26.0	19.0
Reduction in heat loss in waste gases	%	-	7.0
Reduction in fuel consumption by optimization of combustion	SCM/Hour	-	3.9
Surface temperature of firing zone	°C	107	90
Surface heat loss	kCal/hour	80,409	57,497
Reduction in fuel consumption by optimization of surface insulation	SCM/hour	-	2.6
Annual reduction in gas consumption	SCM/Year	-	54,615
Annual monetary benefits (@ Rs 32 per SCM)	Rs/year	-	17,47,667
Investment towards PLC/Servo Motor Based Automation	Rs	-	6,26,660
Investment towards Ceramic modules/insulation	Rs	-	7,84,610
Other fabrication & Misc. charges @ 25 %	Rs	-	1,56,665
Total investment ²	Rs	-	15,67,935
Simple payback period	Years	-	0.9

3.3 Pre-training requirements

The training would be required on preventive maintenance of combustion system of the kiln.

² Quotation - 1 & 2 has been considered for estimation of investments

3.4 Process down time for implementation

The estimated process down time required for implementation of recommended measure is estimated to be 5 days after commissioning and testing.

3.5 Environmental benefits

3.5.1 CO₂ reduction³

Implementation of the selected energy conservation measures in the unit may result in reduction in CO₂ emissions due to reduction in overall energy consumption. The estimated reduction in GHG emission by implementation of the recommended energy conservation measures is 95.6 tonne of CO₂ per year.

3.5.2 Reduction in other pollution parameters (gas, liquid and solid)

There is not significant impact on the reduction in other pollution parameters including gas, liquid and solid.

³ Source for emission factor: 2006 IPCC Guidelines for National Greenhouse Gas Inventories & electricity: CO₂ Baseline Database for the Indian Power Sector, user guide version 12.0, May 2017 (CEA)

4.0 Project financials

4.1 Cost of project and means of finance

4.1.1 Particulars of machinery proposed for the project

The particulars of machinery proposed for the project is given in table 4.1.1.

Table 4.1.1: Particulars of machinery proposed for the project

S. No	Name of machinery (Model/ specification)	Name of manufacturer, contact person	Advantage	Disadvantage
1	PLC/Servo Motor Based Automation system	Yantra automation Pvt Ltd 101,102,103, Plot No 84, survey no.40, Ambedkar Road, Sangamwadi, Pune-411001.	Reputed service provider	Not based in cluster
2	Ceramic modules	Altoni Union J-384, MIDC, Near Quality Circle, Bhosari, Pune-411026, Maharashtra, India	Reliable service	Not based in cluster

4.1.2 Means of finance

The means of finance for the project is shown in table 4.1.2.

Table 4.1.2: Means of finance

S. No.	Details	100% equity	D/E- 70:30	D/E- 50:50
1	Additional (Share) Capital	15.7	4.7	7.8
2	Internal Accruals	-	-	-
3	Interest free unsecured loans	-	-	-
4	Term loan proposed (Banks/FIs)	-	11.0	7.8
5	Others	-	-	-
	Total	15.7	15.7	15.7

4.2 Financial statement (project)

4.2.1 Assumptions

The assumptions made are provided in table 4.2.1.

Table 4.2.1: Assumptions made

Details	Unit	100% equity	D/E- 70:30	D/E- 50:50
General about unit				
No of working days	Days		350	
No of shifts per day	Shifts		3	
Annual operating hours	Hrs/year		8,400	
Installed production capacity	tonnes/year		-	
Production in last financial years	tonnes/year		-	
Capacity utilization factor	%		-	
Proposed investment (Project)				

Details	Unit	100% equity	D/E- 70:30	D/E- 50:50
Total cost of the project	Rs. in lakhs	15.7	15.7	15.7
Investment without interest defer credit (IDC)	Rs. in lakhs	15.7	15.7	15.7
Implementation time	Months	3.0	3.0	3.0
Interest during the implementation phase	Rs. in lakhs	-	0.07	0.05
Total investment	Rs. in lakhs	15.7	15.7	15.7
Financing pattern				
Own funds	Rs. in lakhs	15.7	4.8	7.9
Loan funds (term loan)	Rs. in lakhs	-	11.0	7.8
Loan tenure	Years	-	5.0	5.0
Moratorium period (No EMI (interest and principal amount))	Months	-	3.0	3.0
Total repayment period	Months	-	60.0	60.0
Interest rate	%	-	10.5	10.5
Estimation of costs				
Operation & maintenance costs	%		5.0	
Annual escalation rate of O&M	%		5.0	
Estimation of revenue				
Reduction in energy cost	Rs lakh/year		17.5	
Total saving	Rs lakh/year		17.5	
Straight line depreciation	%		16.21	
IT depreciation	%		80.0	
Income tax	%		33.99	
Period of cash flow analysis	Years		5.0	

4.2.2 Payback

The simple payback period on the investments made are shown in table 4.2.2.

Table 4.2.2: Payback

Details	100% equity	D/E- 70:30	D/E- 50:50
Total project cost (Rs. In lakh)	15.7	15.7	15.7
Cash flow as annual saving (Rs. In lakh/year)	17.5	17.5	17.5
O&M Expenses for first year (Rs. In lakh/year)	0.8	0.8	0.8
Net Cash flow (Rs. In lakh/year)	16.7	16.7	16.7
SPP (months)	11.3	11.3	11.3
Considered (month)	11.3	11.3	11.3

4.2.3 NPV and IRR

Table 4.2.3a: NPV and IRR (100% equity)

Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	14.15	7.89	8.59	8.43	8.37
Depreciation	-	2.54	2.54	2.54	2.54	2.54
Cash outflow	15.68	-	-	-	-	-
Net cash flow	-15.68	16.69	10.44	11.14	10.97	10.91
Discount rate % @ WACC	9.30	9.30	9.30	9.30	9.30	9.30
Discount factor	1.00	0.92	0.84	0.77	0.70	0.64

Particulars / years	0	1	2	3	4	5
Present value	-15.68	15.28	8.74	8.54	7.70	7.01
Net present value	31.60					
Simple IRR considering regular cash flow	82.24%					

Table 4.2.3b: NPV and IRR (D/E- 70:30)

Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	13.58	7.45	8.07	8.06	8.17
Depreciation	-	2.55	2.55	2.55	2.55	2.55
Cash outflow	15.75	-	-	-	-	-
Net cash flow	-15.75	16.13	10.00	10.63	10.61	10.72
Discount rate % @ WACC	10.10	10.10	10.10	10.10	10.10	10.10
Discount factor	1.00	0.91	0.83	0.75	0.68	0.62
Present value	-15.75	14.65	8.25	7.96	7.22	6.62
Net present value	28.94					
Simple IRR considering regular cash flow	78.09%					

Table 4.2.3c: NPV and IRR (D/E- 50:50)

Particulars / years	0	1	2	3	4	5
	(Rs. in lakhs)					
Profit after tax	-	13.74	7.58	8.22	8.16	8.23
Depreciation	-	2.55	2.55	2.55	2.55	2.55
Cash outflow	15.73	-	-	-	-	-
Net cash flow	-15.73	16.29	10.13	10.77	10.71	10.78
Discount rate % @ WACC	9.90	9.90	9.90	9.90	9.90	9.90
Discount factor	1.00	0.91	0.83	0.75	0.69	0.63
Present value	-15.73	14.83	8.39	8.12	7.35	6.73
Net present value	29.69					
Simple IRR considering regular cash flow	79.28%					

4.3 Marketing & selling arrangement

The marketing and selling arrangements of the unit are given in table 4.3.

Table 4.3: Marketing & selling arrangements

Items	Remarks
Main Markets (locations)	Pan India
Locational advantages	-
Any USP or specific market strength	-
Whether product has multiple applications	NA
Distribution channels (e.g. direct sales, retail network, distribution network)	Direct sales
Marketing team details, if any.	NA

4.4 Risk analysis and mitigation

The risk analysis and mitigation for the proposed options are given in table 4.4.

Table 4.4: Risk analysis and mitigation

Type of risk	Description	Mitigation
Technology	The equipment/technology provided by the supplier may not be of high quality, which may result in underperformance.	The equipment/technology should be procured from standard/reputed vendors only.
Market /Product	Demand of the product manufactured by the unit may change resulting in lower capacity utilization.	Regular vigilance/tab on the market scenario by the SME will help in better understanding of new substitute product. The unit may modify the product line based on the emerging market trend.
Policy/Regulatory	Changes in government regulation/policy related to pollution and taxes & duties can affect the viability of the unit.	Local industrial association may play a role in discussing these issues with the relevant governmental bodies on a regular basis, so that any concerns of the unit are brought to their notice.

4.5 Sensitivity analysis

A sensitivity analysis for various scenarios which may affect the return on investment is given in table 4.5.

Table 4.5: Sensitivity analysis

S. No.	Scenario	D/E ratio	Payback period (months)	NPV (Rs lakh)	IRR (%)	DSCR	ROI (%)
1	10% increase in estimated savings	100% equity	11.3	31.6	8.2	-	30.4
		70:30:00	11.3	31.5	8.2	0.0	30.7
		50:50:00	11.3	31.5	8.2	0.0	30.6
2	10% reduction in estimated savings	100% equity	11.3	31.6	8.2	-	30.4
		70:30:00	11.3	31.5	8.2	0.0	30.7
		50:50:00	11.3	31.5	8.2	0.0	29.2
3	10% rise in interest rates	70:30:00	11.3	31.4	8.2	0.0	30.7
		50:50:00	11.3	31.5	8.2	0.0	30.6
4	10% reduction in interest rates	70:30:00	11.3	31.5	8.2	0.0	30.7
		50:50:00	11.3	31.6	8.2	0.0	30.6

5.0 Conclusions & recommendations

The DPR prepared for the automation of kiln combustion system and improvement in surface insulation based on the performance assessment study conducted at unit and the acceptance of the unit management. The brief of selected energy conservation measure is given below.

5.1 List of energy conservation measures

The brief summary of the energy conservation measures are given in table 5.1.

Table 5.1: Summary of the energy conservation measures

Technology	Annual energy saving	Investment (Rs lakh)	Monetary savings	Simple payback period (Years)	Emission reduction (tonnes of CO ₂)
	NG (SCM)		(Rs lakh/year)		
Automation of kiln combustion system and improvement in surface insulation	54,615	15.7	17.5	0.9	95.6

The measure has an estimated investment of 15.7 lakh rupees and can yield a savings of 17.5 lakh rupees per year. The total annual reduction in emission by implementation of recommended measure is estimated to be 95.6 tonnes of CO₂. The financial indicators provided above in the table shows the project is financially viable and technically feasible.

5.2 Summary of the project

The summary of the project is given in table 5.2.

Table 5.2: Summary of the project

S. No.	Particulars	Unit	100% equity	D/E- 70:30	D/E- 50:50
1	Cost of Project	Rs. In Lakh	15.7	15.7	15.7
2	D/E Ratio	-	-	7:3	1:1
3	Project IRR	%	82.2	78.1	79.3
4	NPV	Rs. In Lakh	31.6	28.9	29.7
5	DSCR	-	-	2.1	0.9

5.3 Recommendations

The financial indicators provided above show the project is financially viable and technically feasible. It is recommended that the implementation of the identified the energy conservation measures may be undertaken by the unit.

6.0 Financing schemes for EE investments for MSME sector

Government of India has many schemes to provide concessional finance for EE technologies among MSMEs. Some major government schemes are summarised in table 6.1.

Table 6.1: Major government schemes

Name of the scheme	Brief Description and key benefits
ZED assessment and certification	<p>Assessment process, fee and subsidy are as follows: Online (e-Platform) self-assessment: Nil fee Desk Top assessment : Rs 10,000 per SME Complete assessment : Rs 80,000 ZED rating per SME; Rs 40,000 for additional ZED defence rating; Rs 40,000 for re-rating The rating costs will include cost of Rs 10,000/- as certification cost by QCI. Subsidy for Micro, Small and Medium Enterprises are 80%, 60% and 50% respectively.</p>
Credit Linked Capital Subsidy Scheme (CLCSS) (2000-ongoing)	<p>15% capital subsidy of cost of eligible plant and machinery / equipment for adoption of proven technologies for approved products / sub-sectors for MSE units subject to ceiling of INR 15 lakhs</p>
Credit Guarantee Fund Scheme for Micro and small Enterprises (in partnership with SIDBI) (2000-ongoing)	<p>This scheme was launched by MoMSME and SIDBI to alleviate the problem of collateral security and enable micro and small scale units to easily adopt new technologies. Under the scheme, collateral free loans up to Rs 1 crore can be provided to micro and small scale units. Additionally, in the event of a failure of the SME unit which availed collateral free credit facilities to discharge its liabilities to the lender, the Guarantee Trust would guarantee the loss incurred by the lender up to 75 / 80/ 85 per cent of the credit facility.</p>
Technology and Quality Up gradation Support to MSMEs (TEQUP) (2010-ongoing)	<p>The benefits available to SMEs under TEQUP include –technical assistance for energy audits, preparation of DPRs and significant capital subsidy on technologies yielding an energy savings of over 15%. The scheme offers a subsidy of 25% of the project cost, subject to a maximum of Rs. 10 lakhs. TEQUP, a scheme under NMCP, focuses on the two important issues in enhancing competitiveness of the SME sector, through EE and Product Quality Certification.</p>
Technology Upgradation Fund Scheme (TUF) (1999-ongoing)	<p>Interest subsidy and /or capital subsidy for Textile and Jute Industry only.</p> <ol style="list-style-type: none"> To facilitate Technology Up gradation of Small Scale (SSE) units in the textile and jute industries. Key features being: <ul style="list-style-type: none"> Promoter's margin -15%; Subsidy - 15% available on investment in TUF compatible machinery subject to ceiling of Rs 45 lakh; Loan amount - 70% of the cost of the machinery by way of Term Loan

Name of the scheme	Brief Description and key benefits
	<ul style="list-style-type: none"> • Interest rate: Reimbursement of 5% on the interest charged by the lending agency on a project of technology upgradation in conformity with the Scheme • Cover under Credit Guarantee Fund Scheme for Micro and Small Enterprises (CGMSE) available <p>2. To enable technology upgradation in micro and small power looms to improve their productivity, quality of products and/ or environmental conditions</p> <ul style="list-style-type: none"> • 20% margin subsidy on investment in TUF compatible specified machinery subject to a ceiling of Rs 60 lakhs or Rs 1crore (whichever is applicable) on subsidy amount to each unit - released directly to the machinery manufacturer.
Tax incentives	<ul style="list-style-type: none"> • Accelerated depreciation is provided to the customers / users of the energy saving or renewable energy devises under the direct tax laws. • Under indirect taxes, specific concessional rates of duty are only available to CFLs and not to all energy efficient products • A further waiver of import tariffs and taxes for EE technology imports are dealt on a case to case basis, meaning higher costs for those imported technologies that are not available in the domestic markets at present.

Two financing schemes have been created by Bureau of Energy Efficiency (BEE) under The National Mission for Enhanced Energy Efficiency (NMEEE) for financing of energy efficiency projects - Venture Capital for Energy Efficiency (VCFEE) and Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE). These funds seek to provide appropriate fiscal instruments to supplement the efforts of the government for creation of energy efficiency market. Highlights of these two schemes are provided in the table 6.2.

Table 6.2: BEE's VCFEE and PRGFEE scheme

Venture Capital for Energy Efficiency (VCFEE)	<ul style="list-style-type: none"> • This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase. • A single investment by the fund shall not exceed Rs 2 crore • Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or Rs 2 crore, whichever is less
Partial Risk Guarantee Fund for Energy Efficiency (PRGFEE)	<ul style="list-style-type: none"> • A PRGF is a risk sharing mechanism lowering the risk to the lender by substituting part of the risk of the borrower by granting guarantees ensuring repayment of part of the loan upon a default event. • Guarantees a maximum 50% of the loan (only principal). In case of default, the fund will: <ul style="list-style-type: none"> ○ Cover the first loss subject to maximum of 10% of the total guaranteed amount ○ Cover the remaining default (outstanding principal) amount on

Venture Capital for Energy Efficiency (VCFEE)	<ul style="list-style-type: none"> This fund is to provide equity capital for energy efficiency projects in Government buildings and Municipalities in the first phase. A single investment by the fund shall not exceed Rs 2 crore Fund shall provide last mile equity support to specific energy efficiency projects, limited to a maximum of 15% of total equity required, through Special Purpose Vehicle (SPV) or Rs 2 crore, whichever is less
	<p>partial basis upto the maximum guaranteed amount</p> <ul style="list-style-type: none"> PFI shall take guarantee from the PRGFEE before disbursement of loan to the borrower. The Guarantee will not exceed Rs 300 lakh per project or 50% of loan amount, whichever is less. Maximum tenure of the guarantee will be 5 years from the date of issue of the guarantee

Indian Renewable Energy Development Agency (IREDA), a non-banking financial institution established by the government also extends financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/conservation. The detailed financing guidelines for energy efficiency projects are provided in table 6.3.

Table 6.3: IREDA's financing guidelines

Eligible companies who can apply	Private Sector Companies/ firms, Central Public Sector Undertaking (CPSU), State Utilities/ Discoms/ Transcos/ Gencos/ Corporations, Joint Sector Companies which are not loss making.
Minimum loan amount	<ul style="list-style-type: none"> Rs. 50 lakh
Type of projects considered for term loans	<ul style="list-style-type: none"> Replacement / retrofit of selected equipment with energy efficient equipment Modification of entire manufacturing processing Recovery of waste heat for power generation
Incentive available	<ul style="list-style-type: none"> Rebate in central excise duty Rebate in interest rate on term loan Rebate in prompt payment of loan instalment
Interest rate	<ul style="list-style-type: none"> 10.60% to 11.90% depending upon the grading of the applicant with prompt payment rebate of 15 bps if payment is made on / before due dates Interest rates are floating and would be reset on commissioning of the project or two years from the date of first disbursement. Thereafter, the rates will be reset after every two years. Rebate of 0.5% in interest rates are available for projects set up in North Eastern States, Sikkim, J&K, Islands, Estuaries. Rebates of 0.5% in interest rates are also available for projects being set up by SC/ST, Women, Ex Servicemen and Handicapped categories involving project cost of upto Rs. 75.00 lakh.
Loan	Upto 70% of the total project cost. Promoter's contribution should be Minimum 30% of the total project cost
Maximum debt	3:1

equity ratio	The project cash flow should have a minimum average Debt Service Coverage Ratio of 1.3
Maximum repayment period	12 years with moratorium of maximum 12 months
Procurement procedures	The borrower is required to follow the established market practices for procurement and shall demonstrate that the quality goods and services are being purchased at reasonable and competitive prices. Wherever the loan is sanctioned against international lines of credit such as the World Bank, Asian Development Bank, KfW, etc., the relevant procedures will have to be followed and requisite documents will have to be submitted by the borrower

Small Industries Development Bank of India (SIDBI) has several schemes and focused lines of credit for providing financial assistance for energy efficiency and cleaner production projects for SMEs. Highlights of some of the major financial assistance schemes/projects managed by SIDBI are given in table 6.4.

Table 6.4: Major EE financing schemes/initiatives of SIDBI

End to End Energy Efficiency (4E) Program	<p>Support for technical /advisory services such as:</p> <ul style="list-style-type: none"> • Detailed Energy Audit • Support for implementation • Measurement & Verification <p>Financing terms:</p> <ul style="list-style-type: none"> • Terms loans upto 90% • Interest rate upto 3% below normal lending rate.
TIFAC-SIDBI Revolving Fund for Technology Innovation (Srijan Scheme)	<p>To support SMEs for up-scaling and commercialization of innovative technology based project at flexible terms and interest rate.</p> <p>Preference accorded to sustainable technologies / products. Soft term loan with an interest of not more than 5%.</p>
Partial Risk Sharing Facility for Energy Efficiency (PRSF) Project (supported by World Bank)	<p>Sectors covered:</p> <ul style="list-style-type: none"> • Large industries (excluding thermal power plants) • SMEs • Municipalities (including street lighting) • Buildings <p>Coverage:</p> <ul style="list-style-type: none"> • The minimum loan amount Rs 10 lakh and maximum loan amount of Rs 15 crore per project. • The extent of guarantee is 75% of the loan amount
JICA-SIDBI Financing Scheme	<ul style="list-style-type: none"> • The loan is used to provide SMEs with funds necessary to invest in energy-saving equipment (and some medical equipment) in the form of two-step loans through SIDBI or three-step loans through intermediary financial institutions.

	<ul style="list-style-type: none"> • Project uses an Energy Saving Equipment List approach • Equipment/machinery with energy saving potential less than 10% is not eligible. • Interest rate: As per credit rating and 1% below the normal lending rate • Separate technical assistance component which is used for wetting of loan applications, holding seminars to raise awareness of energy saving among SMEs and to improve the ability of financial institutions to screen loan applications for energy-saving efforts
KfW-SIDBI Financing Scheme	<p>Coverage</p> <ul style="list-style-type: none"> a) SMEs for energy efficiency projects b) SMEs and clusters for cleaner production and emission reduction measures, waste management and Common Effluent Treatment Plant (CETP) facilities <p>Interest rate</p> <p>As per credit rating and 1% below the normal lending rate</p> <p>Eligible criteria</p> <p>3 t CO₂ emission reduction per year per lakh invested</p> <p>List of eligible equipment/technology and potential suppliers developed for guidance</p>

State Bank of India (SBI) has been provided a green line of credit by Japan Bank for International Cooperation (JBIC) for financing of energy efficiency investments. Highlights of the line of credit are given in table 6.5.

Table 6.5: JBIC-SBI Green Line

<p><u>Key Features</u></p> <ul style="list-style-type: none"> • Amount : USD 90 million • Repayment Schedule: First repayment on May 30, 2017 and final repayment date May 30, 2025 (equal instalment) <p><u>Eligibility Criteria</u></p> <ul style="list-style-type: none"> • Projects contributing to preservation of global environment, i.e. significant reduction of GHG emissions • Acceptance of JBIC-MRV (“J-MRV”) by the project proponent in terms of the numerical effect of the environment preservation. To ensure effective GHG reduction emissions in Green financed projects, JBIC reviews such effects through simple and practical Measurement Reporting Verification (MRV) process both in (a) prior estimation and (b) ex-post monitoring. • Procurement in line with the “Guidelines for Procurement under Untied Loans by Japan Bank for International Cooperation”
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Canara bank has a dedicated scheme for financing EE investment among SME sector as mentioned in table 6.6.

Table 6.6: Canara bank scheme of EE SME loans

Purpose	For acquiring/adopting energy conservation/savings equipment/measures by SMEs
Eligibility	Units under Small and Medium Enterprises Cost of energy for the unit should constitute not less than 20% of the total cost of production Unit should possess energy audit report issued by an approved energy Consultant/Auditor. Borrowal a/cs-ASCC code S1 or S2 during previous review. Current account holders having dealings exclusively with us satisfactorily for a period of last one year
Maximum loan	Maximum Rs 100 lakhs in the form of term loan
Security	Prime: Assets created out of loan Collateral: Upto Rs.5 lakhs – NIL Above Rs.5 lakhs, as determined by the bank
Repayment	Maximum 5-7 years including moratorium of 6 months
Guarantee cover	Cover available under CGMSE of CGTMSE available for eligible loans
Margin	10% of the project cost
Rate of interest	1% less than the applicable rate
Upfront fee	1% of the loan
Insurance cover	Assets acquired and charged as security to Bank to be insured
Special offer, if any	Grants : Bank provides 25% of the cost of Energy Audit / Consultancy charges with a maximum of Rs 25000/- to the first 100 units on a first come first served basis which is in addition to the grant of Rs 25000/- being provided by IREDA(First 100 units)

Among the private sector banks in India, Yes Bank is also active in financing of renewable energy and energy efficiency projects. The bank has an MOU with SIDBI for providing funding for EE through PRSF.

Most commercial banks charge interest rate between from 11% to 13% from MSMEs depending upon general criteria such as credit ratings, references, past lending record, balance sheet for last 3 years and so on. Interest rebate is offered for a few customers whose collateral value is around 125% of the loan amount. Further 0.5% concession in interest rate was offered to women entrepreneurs

Annexures

Annexure 1: Copy of certificates from competent authorities

U.F.O
JUL 2010

DISTRICT INDUSTRIES CENTER, RAJKOT
(Government of Gujarat)
M.S. BUILDING, 1ST FLOOR, BLOCK NO. 1/2, RACE COURSE ROAD, RAJKOT,
Ph. 02812476376, Fax No. 02812476293 (E-Mail : gm-dic-raj@gujarat.gov.in)

No/DIC/RAJ/EM/Part-2/ 1955/99839 Form No. 334

**ENTREPRENEURS' MEMORANDUM FOR SETTING UP MICRO, SMALL OR MEDIUM ENTERPRISE
ACKNOWLEDGEMENT FOR PART - II**

M/s SAVION CERAMIC HAS FILED MEMORANDUM FOR A MANUFACTURING ENTERPRISE AT THE ADDRESS NH 8A, MATEL ROAD, LAKADDHAR At Village : LAKADDHAR, At Taluka : WANKANER, At District RAJKOT FOR THE ITEM/ITEMS INDICATED BELOW AND THE ACTIVITY HAS COMMENCED FROM THE DATE - 11/05/2010 AS STATED IN FORM NO. 334 AND ALLOCATED ENTREPRENEURS' MEMORANDUM NO. AS BELOW :

MAIN ITEMS MANUFACTURED
MANUFACTURE OF CERAMIC BUILDING MATERIAL, OTHER THAN BRICKS, FLOORING BLOCKS, ROOFING TILES, WALL TI
DETAILS OF THE ITEMS MANUFACTURED

Sr.No.	Items Manufactured	CAPACITY PER ANNUM	
		QTY	UNIT
1	CERAMIC GLAZED TILES	13500	MTS

NOTE THE ISSUE OF THIS ACKNOWLEDGEMENT DOES NOT BESTOW ANY LEGAL RIGHT. THE ENTERPRISE IS REQUIRED TO SEEK REQUISITE CLEARANCE/LICENCE/PERMIT REQUIRED UNDER STATUTORY OBLIGATION STIPULATED UNDER THE LAWS OF CENTRAL GOVERNMENT/STATE GOVERNMENT/UI ADMINISTRATOR/COURT ORDERS.

DATE OF CHANGE OF CATAGORY FROM MICRO/SMALL TO SMALL/MEDIUM OR VICE VERSA

DATE OF ISSUE 28/06/2010

NATURE OF ACTIVITY (MANUFACTURING-1, SERVICES-2) 1

CATEGORY OF ENTERPRISE (MICRO-1, SMALL-2, MEDIUM-3) 2

ENTREPRENEURS MEMORANDUM NUMBER (PART - II) 24 - 009 - 12 - 05070

(First two digit = State, Next three digit = District code, sixth digit = Nature of Activity, seventh digit = category of enterprise and last five digit are for Entrepreneurs' Memorandum

DATE: 28/06/2010
PLACE: RAJKOT

OFFICE SEAL

To,
M/s. SAVION CERAMIC
VADGASIYA ASHISH MAGANBHAI
8-A NATIONAL HIGHWAY,
LAKADDHAR SR. NO. 162, LAKADDHAR, WANKANER, RAJKOT

**GENERAL MANAGER
DISTRICT INDUSTRIES CENTER,
RAJKOT.**

Annexure 2: Budgetary offers / quotations

Quotation 1: Yantra Automation Pvt. Ltd.



Date: - 24 MAR 2018
Ref: YAPL/MOR/MAR 18/AB/3541

YANTRA AUTOMATION PVT LTD
101,102,103, Plot No 84, survey no.40,
Ambedkar Road, Sangamwadi, Near
RTO OFFICE, PUNE-411001 INDIA
Phone: 020-26053200

To,
The Energy & Resources Institute, (TERI)

Kind Attention: Mr. Vivek Sharma,
Email: vivek.sharma@teri.res.in
Mobile: 09850366248

Sub: Quotation for RA Hardware.

Dear Sir,

Please find enclosed herewith our offer for RA make Hardware

We are the largest authorized distributor and channel partner of Rockwell Automation (Allen Bradley) products in India. Rockwell is one of the largest manufacturers of Automation products in the world.

We have forwarded you our prices and now look forward to receive your valuable purchase order. Please feel free to call us in case you need any further technical/Commercial clarifications/Information.

Please note that this quotation is valid for 30 Days from the date shown above. All typographical and clerical errors are subject to correction. I hope these prices meet with your approval and look forward to hearing from you. Please do not hesitate to contact in case of any assistance.

Assuring you our best attention

Yours Sincerely

Atul Jain
Sr. Sales Engineer
Yantra Automation Pvt. Ltd.
9689949782



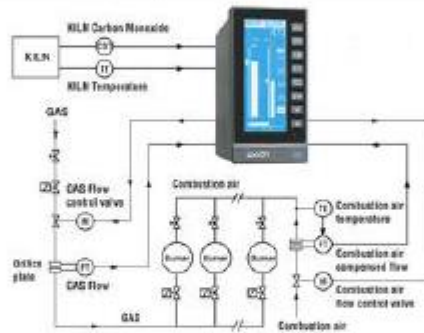


YANTRA AUTOMATION PVT LTD
 101,102,103, Plot No 84, survey no.40,
 Ambedkar Road, Sangamwadi, Near
 RTO OFFICE, PUNE-411001 INDIA
 Phone: 020-26053200

Date: - 24 MAR 2018
 Ref: YAPL/MOR/MAR 18/AB/3541

Bill of Material:

Product	Description	Qty	Unit Price
20F1ANC170ANONNNNN	PowerFlex 753 AC Drive, with Embedded I/O, Air Cooled, AC Input with Precharge, no DC Terminals, Open Type, 170 Amps, 400 VAC, 3 phase, Filtered, CM Jumper Removed, None, Blank (No HIM) 35 adjustable temperature sensors (thermopairs), that control 10 servo motors and 22 electrovalves	1	337,380
20-750-2262C-2R	PF750-24V I/O Module-2AI,2AO,6DI,2RO (RealTek RTL8019AS device)	10	5,580
20-HIM-A6	Burner Servomotor SQN91.140B2793	10	12,500



Terms and Conditions:

Price Basis:	Ex works Pirangut godown.
Duties & Taxes:	GST At actual.
Delivery :	6 to 8 weeks from receipt of your Techno-commercial clear P.O
Payment :	30% Advance & balance against Proforma Invoice.
Warranty:	12 months from the date of Yantra invoice.
Validity:	30 Days from the date of offer.
Transit Insurance:	In your scope.
P & F :	2% Extra
Freight :	Extra at actual
Note:	MOQ will be applicable if any.



Quotation 2: Altoni Union

J-384, M.I.D.C., BHOSARI, PUNE - 411 026. PHONE : 27130135 FAX : 020-27130151
E-mail : altoniunion@gmail.com Website : www.refractorysolutions.in



COMPLETE REFRACTORY SOLUTIONS

UNION

QUOTATION NO: AU/18-19/0128

Date: 19/04/2018

To : The Energy & Resources Institute

Kind Attn : Mr. Vivek Sharma

Sub : Quotation for tempering furnace

Dear Sir,

With reference to the above, we are pleased to quote our prices and terms of sales here below for your kind consideration.

(A) Material

Sr.No.	Description	Quantity	Unit	Price/Unit (Rs)
1.	MODULES Density: 160 Kg/M3, Grade: S (1300 Deg.C.) 'UNIFRAX' Make Size: 305 x 305 x 75mm	-	Nos	225.00
2.	MORTAR 'UNIFRAX' Make	-	Kgs	110.00
3.	COATING ZL	-	Kgs	520.00

(B) Labour Charges

Sr.No.	Description	Quantity	Unit	Price/Unit (RS)
1.	Application charges for Module lining	1	LumSum	40429.00

TERMS OF SALES

Price basis: The prices quoted are on the basis of Ex-our works at J-384, M.I.D.C., Bhosari, Pune-411026.

Taxes: VAT 12.5% on item no 1 and 3 & VAT 5% on item no 2 will be charged extra. For Labour Charges Service Tax 12.36% will be charged extra.

Delivery: Within 15 To 20 days from the date of receipt of your confirmed order.

Payment: 50% advance along with PO and remaining 50% against proforma invoice prior to dispatch.

Time Period: 7 days to complete the work.

Validity: 30 days. Thereafter subject to our confirmation.

We trust, you will find our offer suitable and quite competitive for the quality product offered and await your valued response.

Thanking You.

Yours Faithfully,
For ALTONI UNION.,

Authorized Signatory.

Annexure 3: Instruments used

Instruments	Model/ Make	Application	Accuracy
Power analysers	Fluke: 435, Fluke: 43B,	Electrical Parameters Harmonics analysis, power logging	± 0.5%
Flue gas analyser	Testo: 330-2LL	Flue gas O ₂ , CO, CO ₂ & Temperature	±0.1vol%, 1ppm, 1ppm, 0.1°C
Thermal imager	875-2/Testo	Surface Temperature & Image	± 2%
Digital Temperature indicator	Comark: N1001, Testo: 925	Temperature	± 1%
Anemometer	Testo: 425, Airflow: TA45	Air Velocity	±(0.03 m/s +5% of mv)
Differential pressure meter	Testo: 512	Air pressure	0.5% full-scale value / ±1 digit
Temperature data logger	175-T3/Testo	Temperature	± 0.5%