Environmental and Social Review

(ESR)

for

FaL-G Bricks/Blocks Project

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1. INTRODUCTION

1.1 Background

Burnt clay brick production in brick kilns is one of the prime construction related activity in India. More than 100,000 kilns operating in various parts of the country supply the required burnt clay bricks to the construction sector. Production of burnt clay bricks requires consumption of coal leading to green house gas emissions. The primary raw material used for bricks is the soil, which is often taken from prime agricultural land, causing land degradation as well as economic loss due to diversion of agricultural land. Use of traditional technologies in firing the bricks results in significant local air pollution. The burnt clay brick industry in India produces over 180 billion clay bricks annually with a strong impact on soil erosion and unprocessed emissions. At the same time, the thermal power plants in India continue to produce a huge amount of fly ash, disposal of which poses significant challenges for the power plants. Production of building materials, particularly bricks using fly ash is considered to be one of the solutions to the ever-increasing fly ash disposal problem in the country. Although there exist several technologies for producing fly ash bricks, the one that is gaining popularity is the FaL-G technology, which is developed and marketed by the Institute of Solid Waste Research and Ecological Balance (INSWAREB).

FaL-G bricks offer a viable, energy efficient and environment friendly alternative. FaL-G technology can be used in plants with an annual brick production capacity from 3 million bricks (tiny sector) to 30 million bricks (mechanized sector). FaL-G bricks and blocks are alternative building materials to the traditional burnt clay bricks and are substitutes to the traditional burnt bricks used for construction. Production process of FaL-G bricks and blocks does not involve sintering. Thus, by substituting the burnt clay bricks, FaL-G bricks and blocks completely eliminates the burning of fossil fuels required in the clay brick production process and ultimately contributes to the reduction of greenhouse gas emissions. Since the FaL-G activity reduces green house gas emissions, it has the potential to benefit from the emerging carbon market.

The project aims to promote the use of FaL-G bricks and blocks as alternative building materials in selected clusters of the country, especially in the states of Andhra Pradesh, Tamilnadu and Delhi. To achieve this, Eco-Carbon Private Limited (ECPL), the project entity, intends to facilitate setting up of about 300 FaL-G plants in various parts of the country. ECPL intends to sell the carbon credits generated from these plants to the Community Development Fund (CDCF) of the World Bank and pass on the benefits to the individual FaL-G entrepreneurs. The technology has several intrinsic positive environmental and social benefits. In order to further enhance the environmental and social benefits of the project, ECPL has carried out an Environmental and Social Review (ESR) of the project activities and developed an Environmental and Social Management Plan (ESMP), which will be implemented in the project. The environmental and social aspects of the project activities including the various regulatory requirements are presented in the following sections.

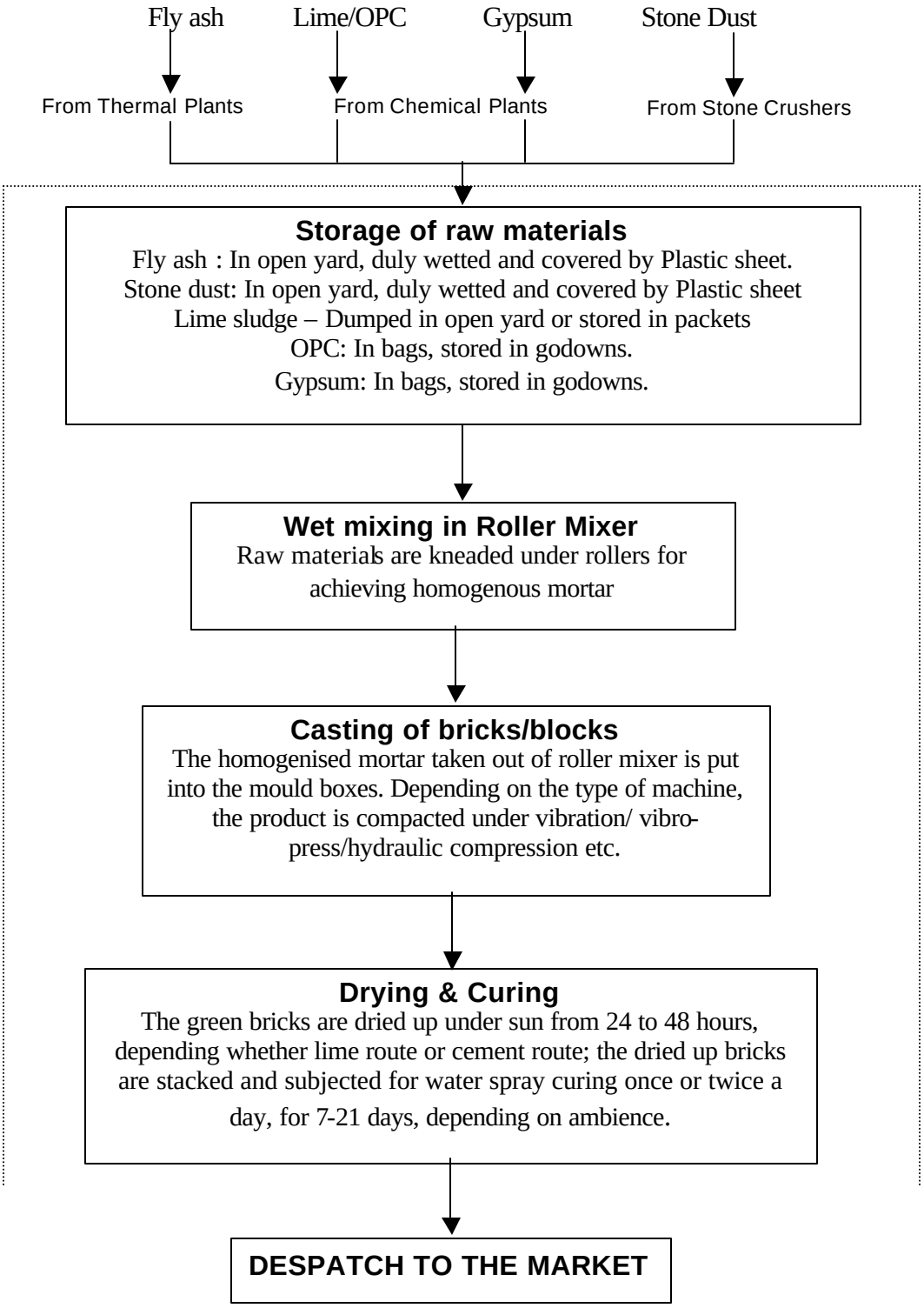
1.2 Overview of Technology

The FaL-G technology works with the strength of fly ash, lime and gypsum chemistry. The slow chemistry of fly ash and lime is maneuvered by tapping ettringite phase to its threshold limits through sufficient input of gypsum. Therefore, FaL-G does not require heavy duty-press or

autoclave, which are otherwise required in case of only fly ash and lime. The FaL-G process completely eliminates the thermal treatment (except open air drying) and does not require combustion of any fossil fuel.

The ingredients of the FaL-G bricks and blocks, fly ash, lime, and gypsum, are well-known minerals that are widely used in industries. All these materials are available in form of wastes and bi-products from industrial activities and are available in adequate quantities in the areas, where the project activities are located. In certain cases, where by-product lime is not available in adequate quantity, ordinary Portland cement (OPC) is used as the source of lime, producing the same quality of bricks and blocks. The technology is proved to be environmentally safe and sound.

The schematic FaL-G process is provided in the following diagram.



2. LEGAL AND REGULATORY ASPECTS

2.1 Regulatory Requirements

Given the scale of operations, the FaL-G plants are likely to be small/micro enterprises. Due to the scale of operation and size of investments involved in the FaL-G plants, the individual micro enterprises do not require any environmental clearance from Ministry of Environment and Forests (MoEF). But the individual units are required to obtain No Objection Certificates (NOCs) and/or Consents to establish and operate from the respective State Pollution Control Boards. In certain states, like Andhra Pradesh, this category/size of units are accorded special status and many of the regulatory licenses are given as part of a single-window clearance.

While there are no specific regulations focusing on the FaL-G units in particular, the details of applicability of prime legislation for protection of the environment for FaL-G unit are summarized below in Table 2.1.

Table 2.1:

Environmental aspects associated with FaL-G Units

S.N	Environmental Aspect	Related Statutes	Applicability to FaL-G unit
1	Air	The Environment Protection Act, 1986	Control and limit the air emission during transportation, unloading, storage, handling of raw materials and operation of machinery
		The Air (Prevention and Control of Pollution) Act, 1981, amended in 1987	
		The Factories Act, 1948, amended in 1987	Safe operation of machinery, accidents and Occupational health hazards
		The Motor Vehicles Act, 1938, amended in 1988 and Rules, 1989	Safety during transportation
2		The Public Liability Insurance Act, 1991 and Rules 1991	Security for Workers

2.2 Applicable Standards

The various environmental standards are described in the following paragraphs.

National Ambient Air Quality (NAAQ) : National Ambient Air Quality (NAAQ) have been prescribed by CPCB vide Gazette Notification dated 11th April 1994. The prescribed Indian standards are given below in Table 2.2.

Table 2.2: Ambient Air Quality Standards for Different Landuses

Pollutant	***Time Weighted Average***	***Concentration in Ambient Air (mg/m^3)***		
		Industrial Area	***Residential, Rural & Other Areas***	***Sensitive Areas***
Sulphur Dioxide (SO_2) ($\mu g/m^3$)	Annual Average*	80	60	15
	24 Hours**	120	80	30
Oxides of Nitrogen (NOx) ($\mu g/m^3$)	Annual Average*	80	60	15
	24 Hours**	120	80	30
Suspended Particulate (SPM) ($\mu g/m^3$)	Annual Average*	360	140	70
	24 Hours**	500	200	100
Respirable Particulate Matter (Size less than 10 microns) ($\mu g/m^3$)	Annual Average*	120	60	50
	24 Hours**	150	100	75
Lead (Pb) ($\mu g/m^3$)	Annual Average*	1.0	0.75	0.50
	24 Hours**	1.5	1.0	0.75
Carbon monoxide (CO) ($\mu g/m^3$)	8 Hours	5000	2000	1000
	1 Hour**	10000	4000	2000

NOTE

* Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform interval.

* 24 hourly/8 hourly values should be met 98% of the time in a year. However 2% of the time, it may exceed but not on two consecutive days.

Ambient Noise Standard : Ambient standards with respect to noise have been notified by the MoEF vide gazette notification dated 14th February 2000. It is based on the A weighted equivalent noise level (L_{eq}). The standards are presented below in Table 2.3.

Table 2.3: Ambient Noise Standards for different Landuses

Area Code	**Category of Area**	**Limits in dB (A) Leq**	
		Day time*	**Night Time**
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone**	50	40

**Day time is from 6 am to 10 pm, Night time is 10.00 pm to 6.00 am*

***Silence zone is defined as area up to 100 meters around premises of hospitals, educational institutions and courts. Use of vehicle horns, loud speakers and bursting of crackers are banned in these zones.*

2.3 Clearances under various statutes

Though there are no specific directives for the FaL-G units, given the statutory environmental rules and regulations it necessitates individual units to obtain clearances and NOCs as applicable unless *they are granted exemption under the SSI single-window clearance (or its equivalent) in a particular state*:

3. IMPACT IDENTIFICATION & ASSESSMENT

3.1 Identification of Environmental and Social Issues

3.1.1 Identification of Environmental issues

The project promotes an eco-friendly technology for production of alternative building materials. By avoiding use of fossil fuel in the production process of the alternative building material, the project contributes to conservation of energy and fossil fuel (coal). By displacing burnt clay bricks in the walling materials market, the project contributes to reduction of environmental degradation such as land degradation and air pollution caused by the clay brick industry. Furthermore since the alternative building material is manufactured using industrial wastes and bi-products as raw materials, the environmental impacts associated with improper disposal of such industrial wastes are mitigated by the project. The project is therefore considered environmentally benign. On social front, the project creates business opportunities for the small and micro enterprises. In contrast to the seasonal production-operations in the clay brick industry, FaL-G plants have the advantage of continuous year-wide operation, and hence provide yearlong employment opportunity for the skilled artisans and create self-help livelihood opportunities for the illiterate poor.

There are however certain environmental and social issues pertaining to the operation of the FaL-G plants, especially those pertaining to the handling of different materials and the occupational health and safety issues of the workers. These issues have been identified in the following table 3.1.

Table 3.1 Potential Impacts of FaL-G activities

S. No.	Activity	Potential Impacts
1.	Setting up of FaL-G Units	• Impact on neighbouring community • Impact on sensitive land uses • Impact of increased traffic movement
2	Transportation of Raw Materials	• Degradation of ambient air quality due to vehicular emissions • Degradation of ambient air quality due to flying up of materials from vehicles if not covered properly • Traffic hazard due to spillage of materials from transporting vehicles. • Dust nuisance to public • Increased noise pollution due to vehicular movements

S. No.	Activity	Potential Impacts
3	Unloading of Raw Materials	• Degradation of ambient air quality due to particulate emissions • Increased exposure to dust by the workers • Safety of workers during unloading • Occasional dust nuisance to public
4	Storage of raw materials	• Degradation of ambient air quality due to dust emissions from storage areas •
5	Handling of raw materials	• Health hazards due to exposure of workers to dust while handling raw materials at the site •
6	Mixing, Moulding & Compression	• Degradation of ambient air quality due to operation of diesel engine • Accidental hazards of workers due to working near mechanical equipments • Direct exposure of workers to exhausts from diesel engines

3.1.2 Identification of Social Issues

The FaL-G technology offers several positive social benefits. These include employment opportunity for workers, longer employment in a year compared to seasonal employment in conventional brick plants, business opportunity or the small entrepreneurs. Some of the incidental adverse impacts of the project include the possibility of employment of child and bonded labour, possibility of wage disparity between male and female workers. Though there is not even a single case of HIV reported so far out of over 20000 workers working in over 1800 plants, risk of HIV/AIDS among the migrant workers need to be guarded. These issues have been assessed in the subsequent sections.

3.2 Assessment of Environmental and Social Impacts

Generally, the environmental impacts can be categorized as either primary or secondary. Primary impacts are those, which are attributed directly by the project, and secondary impacts are those, which are indirectly induced and typically include the associated investment and changed patterns of social and economic activities by the proposed actions. In this chapter only direct impacts have been considered.

The environmental impacts may include all those that are beneficial or adverse, short or long term (acute or chronic), temporary or permanent, direct or indirect, and local or regional. The adverse impacts may include all those leading to, harm to living resources, damage to human health, hindrance to other activities, impairment of quality for use, reduction of amenities, damage to physical structures, etc.

For each identified potential environmental impact, the associated environmental risk is assessed based on its nature, duration, likelihood, significance and level. The impact rating for various parameters of the FaL-G units has been carried on the basis of the qualitative criteria listed in Table 3.2

Table 3.2: Basis of rating of impacts

Impact Rating		Criteria
Nature of impact	Beneficial	Positive
	Adverse	Negative
Duration of impact	Short term	Impacts confined to a stipulated time
	Long term	Impacts continue till the end of project life or even beyond
Likelihood of occurrence	Low	<10%
	Medium	50-60%
	High	70-80%
	Very high	80-100%
Significance of impact	Slight	Very difficult to notice impacts
	Minor	Noticeable impacts only
	Localized	Noticed by adjacent locality and may have direct impacts
	Major	Have direct sustainable impacts
	Massive	Ability to change the system
Potential impact level	Low	Practically has no impact
	Medium	Have Impact in local area
	High	Have impact in region

3.3 Environmental Aspects and Potential Impacts

3.3.1 Land Use

Land requirement for FaL-G unit is varied from 0.5 to 1.0 hectare and confined to one place mainly, unlike red brick unit. As such FaL-G units could be operational on wide type of land, preferably flat. It should be ideal if FaL-G unit is located at notified industrial areas.

3.3.2 Raw materials

The raw materials used for manufacturing of bricks by using FaL-G technology are:

- Fly ash – produced as waste material from coal based thermal power plant;
- Lime – Produced as waste material from paper and other industries;
- Gypsum – produced as by product from fertilizers and aluminium plant;
- Sand – sourced from riverbed;
- Stone dust – produced as rejects from stone crushers; and
- OPC – product from cement plant, which is used as a substitute of lime.

It is evident that about 85 –100% of the total raw materials are either waste material or by-product, barring sand. Only OPC is used in case of non-availability/non-suitability of Lime. Hence, there is lot of saving of natural resources like fertile soil and coal, if compared with red bricks activity.

3.3.3 Waste Materials/By-products

The main advantage of FaL-G technology is the use of waste materials/byproducts produced elsewhere. Disposal of fly ash in thermal power plant and lime from paper and other industry is a potential problem of disposal. No waste material is generated from the FaL-G activity. Waste materials arising from breakage of bricks are recycled in the process itself.

3.3.4 Local Assets

The project development is entirely within the premises. Except for groundwater, there are no local claimants or competing users of natural resources. Land may also be considered to have competing users. However the FaL-G entrepreneurs either own the land or purchase the same through private negotiations. Therefore impact on local assets is not considered to be a significant issue.

3.3.5 Water Resources

Water requirement is about 500 – 1000 m3 per million of bricks in case of using FaL-G unit. In most of the cases, the source is ground water. The magnitude of the impact depends on the water balance on the region.

3.3.6 Air Pollution

Emission of Green House Gases

In a FaL-G unit the anticipated main green house gas is CO_2 emanating from:

- Operation of Diesel Generators in case of non-availability of grid power;
- Operation of diesel driven machinery,
- Vehicular movement.

As per the estimation made by TERI, CO_2 emission from FaL-G technology is:

- In case of power from grid - 0.0033 tons/m^3 of bricks (equivalent. To 44 KWh); and
- In case of Diesel engines - 0.0032 tons/m^3 of bricks (equivalent to 12 litre of diesel)

Emissions of Other Pollutants

The other sources of the air emission from the operation of FaL-G unit are:

- Transportation, Handling and storage of raw materials;
- Operation of Diesel Generators in case of non-availability of power;
- Operation of diesel driven machinery, if any;
- Vehicular movement.

Considerable number of presently operated units are taking adequate precaution during transportation. However, some more precautions need to be taken during handling and storage of raw materials in order to contain dispersion of fine dust in the atmosphere. Though impacted area is very small as quantity involved is small and height of release is almost ground level.

The units operated based on grid power do not have emissions. However those units which depend on diesel engines for running their machinery do emit particulate matter (PM) , SO_2, NOx & CO which depends upon the quantity of HSD used. SO_2 emission shall be equivalent to 0.1% sulphur content in commercial available HSD. As per the present norms in India, HSD is supplied with 'S' at 0.035% for metros and 0.05% for non-metros. Quantity of NOx and CO emitted depends upon the temperature and efficiency of diesel-operated generator and machinery.

3.3.7 Noise

The noise level in units operated based on grid power is negligible. Both stationary and mobile noise generating sources can adversely affect the ambient noise levels. Since the noise from mobile sources shall be intermittent as well as transient, most of the potential impacts shall be due

to the continuous and stationary sources such as diesel generators & engines, pumps, motors and other rotating equipment. As per the estimation, the resultant noise level emitted from the operation of FaL-G unit is about 90-100 dB(A) which shall be attenuated and mingled with ambient noise level within 200-300 m from the source.

3.3.8 Waste Water

During operation of FaL-G unit, anticipated water discharges may arise mainly from:

- Wastewater:

Domestic water requirement is about 100-200 liter/day/person and out of which about 60 – 80% water is returned back as wastewater.

- Storm water

During rainy season, the rainy water is produced as storm water, which needs to be discharged separately. Presently, no system was used for discharge of wastewater by any FaL-G unit.

3.3.9 Soil

The anticipated main sources of soil contamination during the operation of FaL-G unit are the accidental release of oil being stored, in diesel engine based operations, but impacts are confined to premises of unit. It is not possible to quantify the same as it depends upon type and number of machines, which are being used. At present, no system was found to be implemented to avoid soil contamination due to accidental spillage, if any. Empty bags are either being used for storing fly ash/lime/gypsum or sold in the market.

3.3.10 Terrestrial Ecology

During operation of a FaL-G unit, the terrestrial ecology may be affected due to settlement of suspended dust carried by air as:

- Impact on fertility of soil due to settlement of dust; and
- Impact on growth of plants.

It is proved by study that the fly ash can be used as fertilizer to increase the production of crops particularly rice, wheat and cereals. But it cannot be used in any quantity for better production. Depending on the type of crops, an optimum amount of fly ash can be used for better production. The residual impacts on near-by flora would be

- Confined to very insignificant area, as there is no process stack.

3.3.11 Health and Safety of workers

During visits to units, it was found that system needs improvement for the following:

- Transportation of raw materials;
- Provision of Personal Protective Equipments (PPE);
- Training to Workers;
- Health Check-up and maintenance of records of workers;

- Installation and operation of Dust suppression measures;
- Storage and handling of raw materials;
- Housekeeping; and
- Provision of green belt/plantation.

Though there are no reports of occupational ill-health to the workers in the plants operating over the last one decade, the impact on health of workers is a point of concern than that of local habitants during handling of raw materials and resultant exposure to dust.

3.3.12 Specific health hazards of raw materials

Fly ash: It is produced as waste material from coal based thermal power plant. Bhaba Atomic Research Centre, Bombay is of the opinion that most of the Indian coals have very low levels of radioactivity, which is well below the hazardous limit. Hence radioactivity of Fly Ash may not be a limiting factor for its application. The radioactivity levels in coal and the slightly enhanced levels in coal ash do not constitute a safety hazard. The levels of radioactivity are within the range found in other natural products. The doses resulting from using the ash in various products are comparable to doses from other human activities and from other natural sources. These doses from the radionuclides in ash are much less than the 300 mrem/yr received from normal background radiation. Agencies such as TIFAC have carried out several studies and have concluded that the radiation level present in fly ash is not an issue of concern.

Lime: It is a produced from acetylene industry in the form of calcium hydroxide sludge. Direct physical contact of lime may be irritating to skin. (Quicklime causes blisters, and the latter are different than burns).

Gypsum: A by-product of aluminium floride industry, generated in the form of anhydrite. When anhydrite is fully booked, there is a program to use the byproduct of fertiliser industry, phosphogypsum, after refinement and calcinations. . . Phosphate rock is mined extensively around the world, mainly for use in fertilizers. "After use in fertilizer plants, the by-product PG is given free of cost to the construction industry. According to a report by the United Nations Scientific Commission for Emissions due to Atomic Radiation, the radium concentration is as high as 46 picocurie per gramme (pCi/g) in the phosphate rock from Morocco, while that of India has only 4 pCi/g (a picocurie is one-trillionth of a curie, a unit for measuring radioactivity). EPA has revised the standard to permit use but has set a safe limit of 10 pCi/g. Similarly, the international limit prescribed by EURATOM (European Atomic Commission) is 13.5 pCi/g. Till date, there is no unanimity on the "safe limit" for radioactive exposure due to PG. However, since their levels are very low in India, it is not considered to be a significant issue of concern.

Stone dust: It is produced as reject from stone crushers. Stone dusts or chips may cause congestion and irritation in nasal and respiratory passages. Excessive exposure to particulate (dust) over an extended period of time may result in the development of pulmonary diseases.

3.3.13 Summary

Based on the preceding discussion, the impacts of FaL-G unit are summarized in the table below. Adopting various environmental mitigation measures could further help to reduce the adverse environmental impacts.

Table 3.3: Summary of Environmental Impacts from FaL-G units

S. No.	Environmental Aspect	Main Sources of Risk	Impacts				
			Nature	Duration	Likelihood	Significance	Potential
1	Land Use	Alteration of land use for Industrial Activity	Adverse	Long term	Medium	Localized	Low
2	Raw materials	Use of sand & OPC	Adverse	Long term	Medium	Minor	Low
3	Waste materials	Use of fly ash, lime, Gypsum and stone dust	Beneficial	Long term	Very high	Major	High
4	Local asset	Use of ground water and Use of land for industrial activity	Adverse	Long term	Medium	Localized	Low
5	Water Resources	Use of water @ 500 – 1000 m^3 per million of bricks	Adverse	Long term	Medium	Localized	Medium
6	Air quality	Release of CO_2	Adverse	Long term	Medium	Localized	Low
		Release of PM, SO_2, NOx, CO & HC	Adverse	Long term	Medium	Localized	Medium
7	Noise	Operation of diesel engines, pumps and vehicular movement	Adverse	Long term	Medium	Localized	low
8	Waste water	Discharge of Domestic waste water and storm water	Adverse	Long term	Medium	Localized	low
9	Soil contamination	Contamination due to Spillage of lubricating oil and HSD	Adverse	Long term	Medium	Localized	Low
10	Terrestrial ecology	Emission of pollutants	Adverse	Long term	Medium	Minor	Low
11	Health and Safety of workers	Handling of raw materials and Emission of air pollutants	Adverse	Long term	High	Localized	low
12	Specific health issues of raw materials	Exposure to Radioactive radiation	Adverse	Long term	Low	Minor	Low

3.4 Assessment of Social issues

3.4.1 Worker's Housing

The workers in a typical FaL-G plant are generally divided into three categories: i) those who commute to work place from their nearby residences, ii) those who come and stay as bachelors, and iii) those who come and stay with families in workplace. Workers in the first category do not require any housing accommodation. Workers in the second category are usually provided with dormitory places at work site, who go to their homes once in a month or two to join their families. For the third category, the employer generally provides residential accommodation to an extent of

over 8 m^2. The units employing workers of the third category are expected to be about 20-30%. This is not considered to be a significant issue considering the size of investment and the scale of operations proposed in the project. However, sanitation facilities, which usually do not exist at such sites is an issue of concern.

3.4.2 HIV/AIDS

Workers in the brick industry are generally migrant and most of them are singles. The risk of HIV/AIDS among such workers cannot be ruled out and therefore it is desirable to pay attention in the project.

3.4.3 Employment of Child Labour

Employment of child labour is common in the clay brick industry as the workers involved in the clay bricks activity migrate with families having an urge to earn at all age levels. . Since FaL-G activity does not hold workers' families in captivity, and is more mechanical the chances of employment of child labour is low. However specific provisions are required to ensure that entrepreneurs do not employ child labour.

3.4.4 Disparity in wage payment

Disparity of wages between male and female workers is very common in the informal sector. In FaL-G units wages are linked to production and therefore is not considered to be an issue.

3.4.5 Land acquisition and related involuntary displacement

Unlike the traditional clay brick units, FaL-G units require a very small amount of land and in all cases the land is either owned by the entrepreneur or is purchased by the entrepreneurs as a private transaction with the price being negotiated between the two parties. This is therefore not considered to be a significant issue.

3.5 FaL-G vis-à-vis Burnt Clay Brick Manufacture

FaL-G products are promoted as substitutes for the conventional burnt clay bricks. It is therefore important to compare the two on various aspects before large-scale adoption of this technology. When compared with conventional brick manufacture, FaL-G presents substantial advantages. The following table provides a summary of comparison between these competing technologies from the environmental and occupational health & safety perspective.

Table3.4: Comparison of FaL-G and Burnt Clay Brick Units

S.N.	Issue	FaL-G unit	Conventional clay brick Kiln unit
Environment			
1	**Air Emission**	**Source of Emission:** • Transportation and unloading of raw materials; • Storage and handling of raw materials; • Operation of diesel engines • Transportation of bricks	**Source of Emission:** • Handling of sand and soil; • Handling of coal; • Combustion of coal; • Removal of bricks from kiln; • Removal and handling of ash from kiln; • Transportation and storage of coal;

S.N.	Issue	FaL-G unit	Conventional clay brick Kiln unit
			and • Transportation of bricks
1. a	**Type of Emission** Parameters emitted into atmosphere	• Particulate matter (PM) from transportation and unloading of raw materials; • PM, Sulphur dioxide (SO_2), Oxides of Nitrogen and Carbon dioxide (CO_2) from vehicles used for transportation; • PM, Sulphur dioxide (SO_2), Oxides of Nitrogen and Carbon dioxide (CO_2) from operation of diesel engines; and • PM from storage and handling of raw materials.	• Particulate matter (PM) from transportation and unloading of raw materials; • PM from storage and handling of raw materials. • PM, Sulphur dioxide (SO_2), Oxides of Nitrogen and Carbon dioxide (CO_2) from bricks firing in kiln; • Particulate matter (PM) from removal of bricks from kiln; and • Particulate matter (PM) from removal and handling of ash from kiln.
1.b	**Management**	Air Emission can be controlled by providing • Closed / covered storage of raw materials; • Mechanized handling of raw materials; • Water spraying system. • Stack height of diesel engine as per recommended by CPCB/SPCB • Green belt/plantation	Air Emission can be controlled only by providing stack height of kiln as per recommended by CPCB/SPCB, or by changing the firing technology. Other methods of controlling the air emission are not feasible due to scattered nature of activity
2	**Waste Water Discharge**	**Sources** • storm water	**Sources** • storm water
		Management • It is possible to provide separate drainage system for storm water; and • Septic tank and soak pit can be provided	**Management** • It is not possible to provide separate drainage system for storm water; because the soil is excavated from the same place for making bricks thus making that piece of land them low-lying compared to nearby land • Only soak pits could be the better & cost effective option.
3	**Loss of soil / Agriculture land**	Nil	For brick size of 9”x4”x3” : • Loss of Soil – 1770 m^3 per million of bricks per annum; and • Loss of Land – 0.116 hectare per million of bricks per annum.
4	**Land Fertility**	FaL-G brick units can be established on waste land with very little or no adverse impact on land fertility	• **Extraction of Soil** - Soil particularly topsoil at a depth of one to one -and -a -half meter is not simply the physical material on

S.N.	Issue	FaL-G unit	Conventional clay brick Kiln unit
			the earth surface. Probably, its most important component is living organisms within it. Healthy soil may contain 100 billion bacteria per gram with 15000 to 20000 different species of bacteria. Fungi are also very important – especially mycorrhiza which forms close associations with plant roots. One kilometer of fungi hyphae have been detected in one gram of soil. Hence affect the land fertility in long term; and • **Land Covered by Kiln** – This land becomes unusable as the burning process used to fire clay bricks changes the chemistry and biology of soil. The heat penetrates the soil up to few centimeters. As a result, fungal and bacterial population decreases immediately – and substantially – in the top of 2.5 cm of the soil. Repeated burning permanently diminishes bacterial population by more than 50 percent and also decreases soil respiration. Similarly long term burning reduces total nitrogen and carbon and potentially mineralized nitrogen content in 0-15 cm soil layer.
5	**Solid Waste Generation and its disposal**	Negligible	• Ash and unburnt coal from kiln which varies from 25%-40% as per ash content in the coal; • Some of this coal-ash is used for covering the bricks in kiln for thermal insulation; and • Excess ash is disposed off haphazardly.
6	**Heat Emission**	Nil	Brick firing is carried out at 1000 ^{o}C. Residual heat of the process is partly used to raise the temperature of bricks waiting for firing and: • Loss of heat through radiation; • Loss of heat through convection; and • Emission into atmosphere along with gases through stack.

S.N.	Issue	FaL-G unit	Conventional clay brick Kiln unit
7	**Noise Emission**	**Sources** • Pan Mixer; • Compression machine; • Diesel Engines if used • Vehicular movement.	**Sources** • Vehicular movement.
		Management • All machinery have inbuilt noise abatement measures and emit noise within prescribed limit of CPCB/SPCB; • Regular preventive maintenance reduces noise level; • Provision of green belt/plantation further reduces the noise level.	
8	**Public Nuisance**	Create practically no public nuisance due to: • Activities are confined to fenced area; • Transportation of raw materials in closed/ covered vehicles; • Storages of raw materials are in open area/shaded area/bags/ Silos, within fenced area; • many units are in an industrial area or are secluded from habitation causing little noise and air pollution nuisance; • Plantation in the premises; and	Activities are spread over large open area hence create public nuisance.
Occupational Health and Housekeeping			
1	**Health Status**	Health status record of permanent employees is possible to be maintained.	The entire workforce used is on contract for one season only. Hence it is not possible to keep the health status record.
2	**Green Belt/plantation**	In most of the cases, units are located on purchased land and all the processes take place at one location. Hence, green belt development/ plantation is possible which helps in trapping air and noise pollution.	In most of the cases, units are located at leased land and also all the processes take places at different locations. Hence, green belt development/plantation is not possible. In addition, any possibility for greening is reduced by weaning of soil.
3	**Environment safety Management System**	Due to semi-mechanized and mechanized process at one place, implementation of environment/ safety management system is warranted.	Due to manual process at different places, implementation of environment/ safety management system is not being observed. .

Above impact analysis shows that FaL-G bricks offer a viable, energy efficient and environment friendly alternative that would contribute in reduction of emission of green house gases. As such there are no specific environmental regulations marked for the FaL-G units. However, considering the various operational aspects, many of the regulations applicable to the SSI were found to be closely applicable for the FaL-G units. Overall adverse impact on environment by FaL-G bricks units has been much less than that of clay bricks kiln technology. However, there is scope for further reduction of adverse environmental impact through adequate mitigation measures discussed under environmental plan. Proper regulatory and monitoring mechanisms need to be established to ensure the adoptability of these measures. Awareness generations and capacity building of the FaL-G unit owners, workers and users would ensure better implementation of these measures.

Table 3.5: Estimate of annual expenditure for implementing Environment Monitoring Plan at each MIP

ITEM	Qty	Unit Cost (Rs)	Total Rs.	
			Recurring every year	One time cost during project period
Stack height adjustments to Diesel engine	1	1000		1000
Personal protection gadgets	12	1000	12,000	
HDPE Tarpaulins for covering Raw Materials	10	700	7,000	
Total Cost implication per year			**19,000**[1]	**1000**

The next chapter deals with how FaL-G units participating in the CDCF project will handle residual adverse impacts and explains how this will be ensured during the project implementation and operation.

[1] In addition the entrepreneurs will incur an one-time expense of about Rs 1,000 towards adjustment of stack heights for the engines

4. ENVIRONMENTAL MANAGEMENT PLAN

4.1 OVERVIEW

As part of the CDCF project, significant residual impacts identified in the previous chapter are mitigated to the extent possible, giving due regard to the scale of operations of the individual micro enterprises, through a systematic environmental management plan. This plan describes measures to be adopted for reducing/managing environmental impacts of each activity in the process, and assigns responsibility of implementation and monitoring/reporting to the stakeholder best placed to carry it out. This plan is supplemented with independent monitoring of a representative sample of plants to ensure and improve implementation of the plan. A separate budget for the activities that require a specific financial allocation has also been prepared and included in the overall financial analysis of the project.

4.2 Environmental Impacts Summary

From the preceding discussion, following inferences may be made:

- Major polluting activities are unloading, storage and handling of raw materials;
- Dust is the major pollutant emitted from the FaL-G unit;
- Raw materials especially fly ash may create public nuisance, if not properly transported;
- Proper storage and water spraying of raw materials are the crucial requirement of EMP;
- Personal protective equipments should be provided to each worker;
- Health check up of workers should be carried out on regular basis i.e. once in a year; and
- Compliance to the various statutory laws as applicable to SSI sector should be a mandatory and minimum requirement of EMP.

4.3 Contents of the EMP

The EMP has been developed to minimize the residual impacts of the FaL-G activity, particularly to:

- Prevent air pollution; and
- Minimize the occupation health impacts.

In the subsequent pages, the activity wise detailed EMP is presented, which includes

- description of the agreed measures, responsibilities and instruments for the environmental management for each FaL-G unit
- Guidelines for audit and monitoring of FaL-G plant
- Estimates of Associated costs

4.3.1 Activity-wise Environmental Management Plan

Table 4.1 Environmental Management and Responsibilities

S. No.	Activities	Management Measures to be implemented	Prime / Implementation Responsibility	Monitoring Responsibility	Monitoring / Reporting Method
1	Location of Industry	As per criteria delineated by MoEF/Local administrative authorities (as appropriate) applicable to SSI sector: As far as possible, prime agricultural land / forest land may not be converted into an industrial site; • Land acquired should be minimum for conducting the production. However, if additional land is available and sufficient to provide a green belt the same would be developed as good practice. • Enough space may be provided for storing solid wastes, if any. The space and the waste can be made available for possible reuse in future; • Layout and form of the project must conform to the production and storage needs of raw materials. If additional land is available, landscape of the area without unduly affecting the scenic features of that place may be done as good practice; • At least 200 m distance from estuary boundaries, if any should be maintained; • At least 500 m distance from flood plain or modified flood plain or flood control systems should be maintained;	MIP to obtain and keep copies of relevant clearances, including NOCs and/or Consents from respective Pollution Control Boards or the single window clearance for the SSI sector, as may be applicable in their respective states. MIP shall be responsible to obtain and maintain all applicable regulatory clearances for the duration of the project.	ECPL/ Independent agency	Verify validity of clearances for the specified duration as permitted by the licence issuing authority. The applicable licenses, as issued by the statutory authorities, would be made available to the representatives of DNA, DOE, CDCF and ECPL on demand.
2	Transportation of raw materials	• Fly ash should be transported covered by at least with tarpaulins and water should be sprinkled before the load is covered. • Lime, OPC and Gypsum should be transported covered with tarpaulins. • Sand/Stone dust should be sprinkled with water properly before transporting the material to plant.	MIP / Transport Contractor	Independent agency	Site inspections and discussion with the workers and owner

S. No.	Activities	Management Measures to be implemented	Prime / Implementation Responsibility	Monitoring Responsibility	Monitoring / Reporting Method
3a)	Handling of raw materials	• One set of Gloves, boots and nose masks should be provided once in a year to each worker to be involved for unloading and handling of materials; • Water should be sprinkled at the time of unloading for suppression of dust	Project proponent (ECPL), limits his responsibility to the extent of delivering the implements to the workers and educate them about the safety issues.	Independent agency	Observations during site visits
3b)		• Gypsum, Lime and OPC bags should be transported through trolleys from godowns to machine site; • As a Good Practice, all the internal roads / ways should be paved and should be kept clean	MIP	ECPL / Independent agency	Observations during site visits
4	Storage of raw materials/Oil/lubricating oil	• Fly ash must be stored covered with tarpaulin • Lime should be stored in paved area and covered • Water spray system should be provided for spraying during handling of raw materials at storage site, if the raw material is not wet. • Oil and waste oil should be stored in proper enclosure • Leakage of lubricating oil from machinery should be minimized by implementing preventive maintenance and should be collected in a container, if any; • Entry should be restricted.	MIP To provide these facilities in the plant	ECPL may provide a notional layout with these elements. Independent agency.	Checklist

S. No.	Activities	Management Measures to be implemented	Prime / Implementation Responsibility	Monitoring Responsibility	Monitoring / Reporting Method
5	Mixing, & casting	• Those units using diesel for operation of their machines, attempt should be made to use HSD as fuel as it contains least Sulphur (0.1%) content as compare to FO and LDO in case of usages of diesel driven machines; • Wherever engines are directly fitted to the production machines, maintaining stack heights may not be tenable due to vibrations. However, proper care must be taken to orient the exhaust vertically into the air, at not less than 2meter height from the ground. • The stack height should be provided as per the formula; H (m)= 14 $(Q)^{0.23}$, where Q is release of SO_2 in kg/hr prescribed by CPCB -, this can be adhered to as a good practice, wherever is feasible. • CPCB document CUPS/13/1984-85 may also be referred while calculating the height of stack **If DG sets are used** • Air Emission from operation of DG set should be as per notification no G.S.R. 371(E) dated 17 May 2002 of Ministry of Environment & Forests which is applicable for the DG set having capacity less than 900 kw; • Noise level emitted from DG set less than 1000 kVA should be less than 75 dB (A) at 1 m distance as per notification no G.S.R. 371(E) dated 17 May 2002 of Ministry of Environment & Forests; • Leakage of lubricating oil should be avoided and should be collected in a container, if it is there; • Rubber padding/noise isolators and silencers to modulate the noise generated by machines should be provided, wherever possible; • In general, noise-generating items such as fans, blowers, compressors, pumps, motors etc. should be so specified as to limit their speeds to generate minimum noise levels. Static and dynamic nd dynamic balancing of equipment should be insisted upon and will be verified during inspection and installation; • All rotating items should be well lubricated and provided with enclosures as far as possible to reduce noise transmission; • Preventive maintenance should be carried out on regular basis and records of the same should be maintained; • Provision of personal protective equipment (PPE) like ear	MIP	ECPL/ Independent agency	Observations on site; checking permits/clearances obtained

S. No.	Activities	Management Measures to be implemented	Prime / Implementation Responsibility	Monitoring Responsibility	Monitoring / Reporting Method
		balancing of equipment should be insisted upon and will be verified during inspection and installation; • All rotating items should be well lubricated and provided with enclosures as far as possible to reduce noise transmission; • Preventive maintenance should be carried out on regular basis and records of the same should be maintained; • Provision of personal protective equipment (PPE) like ear muff/plugs, helmets, goggles; masks, boots should be provided to the workers; and • Random checking of the system should be carried out and corrective actions should be taken and implemented regularly.			
6	Curing	As a good practice, attempt should be made to recycle the water to the maximum extent.	MIP	Independent agency	Observations on site
7	Spillage of oil, if any	• Leakage of lubricating oil from machinery should be minimized by implementing preventive maintenance and should be collected in a container, if any; • In case of spillage of oil and waste oil, impacted area should be cordon off and covered with sand; • Sand dust should be removed and disposed off;	MIP	ECPL	Observations on site
8	Use of Water	• As a good practice, continuous attempt should be made to optimize the use of water; • Continuous attempt should be made to avoid wastage and leakage of water	MIP	ECPL/ Independent agency	Observations on site
9	Treatment and As good practice Disposal of waste water	• Septic tank should be provided for receiving toilet waste. • If accidentally, process wastewater is generated from curing or spillage of water during mixing of raw materials, it may be diverted to a tank rather than discharged. • This water can be used for water spraying and for greenbelt/plantation if any (see below)	MIP (to ensure cleanliness of the drainage system)	ECPL/ Independent agency	Observations on site

S. No.	Activities	Management Measures to be implemented	Prime / Implementation Responsibility	Monitoring Responsibility	Monitoring / Reporting Method
		• As a good practice, soak pit should be provided, wherever land use permits, for allowing domestic waste water to soak and recharge the ground water			
10	Disposal of solid waste	• Lubricating waste oil, if any should be collected separately in drums and shall be sold to authorized (by respective SPCB) external agency for further treatment; • Litter, fuel, oil drums, used grease cartridges should be collected and removed properly; and • Empty bags should be either recycled or disposed off.	MIP	ECPL / Independent Agency	Observations on site; discussions with MIP
11	Occupational Health	• Gloves and boots should be the minimum PPEs to be provided to each worker handling the raw material or involved in manufacturing; • A worker, suffering by seasonal bronchitis should not be allowed to work for unloading and handling of raw materials; • Workers and supervisors should be properly trained about the health hazards, safety measures and their remedial measures. Health Checkup should be must for all permanent employees every year and records of the same should be maintained; • Supervisors should be trained in providing first-aid specific to the details as provided in MSDS and first aid kit should be placed at workplace; and • Adequate arrangements like bathrooms and water supply should be made to facilitate workers to have bath or wash.	MIP/Contractor ✓ Health record of each worker should be maintained (even contract workers who put up at least one year of service) ✓ Display posters of First Aid measures to be taken in case of accidents at prominent places	Project Proponent/Independent agency	Observations on site; and discussions with Project Proponent, MIP and workers
12	House-keeping	• Restroom, toilets and bathroom for the workers should be provided; • Proper ventilation system should be provided at working place; and • Dustbins should be located at appropriate places • Display notice boards at appropriate locations	MIP	Project Proponent	Observations on site

S. No.	Activities	Management Measures to be implemented	Prime / Implementation Responsibility	Monitoring Responsibility	Monitoring / Reporting Method
13	Greenbelt/ Plantation	• As a good practice, wherever surplus land is available, a green belt can be developed around the plant-site to improve aesthetics as well as arrest any occasional dust emissions.	MIP	Independent agency	Observations on site
14	Building Management System and Implementation capacity	• Material Handling and Safety procedure relating to occupational health should be documented as a booklet and provided to each worker; • Conduct meeting and explain the contents of the booklet at regular intervals	ECPL	Independent agency	Observations on site; discussions with workers and MIP
15		. This is already available suiting to local logistics and to the satisfaction of workers who are already living there. Better, we do not poke our nose in to these issues where the budgets are high and we cannot support them.	MIP	Independent Agency/ECPL	Observations at site
16	HIV/AIDS	• Conduct awareness program on HIV/AIDS	ECPL	Independent Agency	
17	Child Labour	• Do not employ child/bonded labour in FaL-G units	MIP	ECPL/Independent Agency	Observations at site/Insurance records for workers
18	Wage disparity	• Ensure that there is no difference between wages of male and female workers	MIP	ECPL/Independent Agency	Observations/interviews at site

Note: *The spirit of the SSI schemes in India is to facilitate the proliferation of small scale units in the direction of employment generation and sustainability. In view of this aspect, either the NOC (for 5 years) under SSI registration scheme or the 'Deemed Clearance' under Single Window Clearance Scheme, facilitates the SSI units to function without any interference and pressures from statutory authorities.*

4.3.2 Guidelines for Audit and Monitoring of FaL-G Plants

ECOCARBON / INSWAREB would

- ☞ Provide guidance on plant layout water management and stacking of raw materials so as to meet the environment norms as well as optimize movement of material and production costs.
- ☞ Ensure that measures are taken for mitigation of environment, social and health problems.

An independent entity is needed for verification of some of the above factors. Besides the above, there are some other factors that may need independent verification. These are technical, environmental, social, health and legal issues not covered by INSWAREB or Eco Carbon, and may need a third party verification. An independent entity may be needed also because sponsors do not want to take up this responsibility and, more over, third party verification brings in the satisfaction of due diligence.

INDEPENDENT MONITORING AND EVALUATION

The tasks that an independent entity may need to carry out may be:

ENVIRONMENTAL:

- ☞ Visit about 20 % of the project participants randomly selected in the first year.
- ☞ Check for proximity (to be defined by minimum distance in exact meters in order to avoid controversies later on) to residential areas including rural villages and advise additional mitigation measures if necessary.
- ☞ During the annual audit and other visits, record arrival of raw material, its transportation, unloading and storage for conformity to EMP.
- ☞ During the annual audit and other visits, check if diesel generators are installed and compliance to pollution control norms and other issues like spillage of oil, etc.
- ☞ Check if adequate mitigation measures are in place for waste water management.
- ☞ Verify the distribution of personal protective equipment for workers as prescribed and conduct of training for their use.
- ☞ During each subsequent year visit another 20% of total participants, but with 5% from previous year where they may have suggested measures for better environmental management.
- ☞ Provide comprehensive report regarding housekeeping, workers' safety, water harvesting, water and sanitation facilities for workers and plantation for all the plants visited.

SOCIAL:

- ☞ Random check 20% of the units every year for compliance to statutory responsibilities.
- ☞ Within the above 20%, pay special attention to safety norms in the act and in the EMP.

HEALTH:

- ☞ Check maintenance of health records during the above.
- ☞ Random check 25% of the units every year and assess frequency and adequacy of IEC on HIV/AIDS undertaken
- ☞ Random check 25% of the units every year for records on the number of HIV/AIDS cases referred to the hospitals/clinics

- ☞ Random check 25% of the units every year on the number of workers covered under group health insurance scheme and number of workers availing health-cover benefits

QUALIFICATIONS, CAPABILITY AND CAPACITY OF MONITORING AGENCY/IES

One or more independent entities may be appointed that fulfill the required minimum criteria.

QUALIFICATIONS:

- ☞ Knowledge of engineering, technology involved and testing procedures.
- ☞ Knowledge of finance and accounts related to annual audit of Eco Carbon.
- ☞ Knowledge of environmental, social, health and factory regulatory norms.
- ☞ Knowledge of local language.

CAPABILITY:

- ☞ Experience in conducting surveys and do the analysis.
- ☞ Experience in training and managing workshops.
- ☞ Experience in reporting.
- ☞ Ability to build good relationship with staff of Eco Carbon and the units.
- ☞ Must follow norms of wages, environment, etc., within the organization.

CAPACITY:

- ☞ Availability of experienced and adequately trained manpower.
- ☞ Availability of equipment, computers, etc.

4.3.3 Community Benefit Plan

The Community Benefit Plan has provisions for workers' insurance (health and accident) and provisions for proper water and sanitation facilities for the workers at site. Table 4.2 below provides a summary of the costs for the CBP. The details have been spelt out in a separate document. .

Table 4.2: Budget Estimate for CBP

ITEM	Quantity	Unit Cost (Rs)	Total	
			Recurring every year	One time cost during project period
Insurance	12	193	2,316	
HIV Awareness program	1	1000	1,000	
Health Check Up	12	250	3,000	
Monitoring CBP-Manday costs + travelling	2	600	1,200	
Toilet & pit				15,000
Drinking water				5,000
Washing bathing facility				25,000
Total Cost			**7,516**	**45,000**

Notes:

1. *Rooms for workers may be required if there are resident workers but the amount is not applicable to all. Hence not taken here.*

2. *The cost calculation is based on the standard norms. Cost effective designs for toilets and latrines could further reduce the cost, if the cleanliness and diligent maintenance are assured in selection and material-use.*