Frankfurt School
FS-UNEP Collaborating Centre
for Climate & Sustainable Energy Finance

Mission Report

ADVISORY SUPPORT AND CAPACITY BUILDING TO IDCOL IN FINANCING ITS ENERGY EFFICIENT BRICK KILN PROJECTS

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ABBREVIATIONS

BABMA	Bangladesh Auto Brick Manufacturers' Association
BBMOA	Bangladesh Brick Manufacturers Owners Association
BTK	Bull's Trench Kiln
CCAC	Climate and Clean Air Coalition
DoE	Department of Environment
EE	Energy Efficient
FCK	Fixed Chimney Kiln
HHK	Hybrid Hoffman Kiln
IDCOL	Infrastructure Development Company Limited
SLCP	Short-lived Climate pollutant
UNEP FI	UN Environment Finance Initiative

1. INTRODUCTION

The Climate and Clean Air Coalition (CCAC) financing of short-lived climate pollutants (SLCPs) mitigation initiatives is global in scope. The CCAC has a mandate to address SLCPs by raising awareness, enhancing and developing new national and regional actions, promoting best practices, and improving the scientific understanding of SLCP impacts and mitigation strategies. In its effort to promote global action on SLCPs, the CCAC established the CCAC Finance Initiative, which is a cross-cutting initiative aimed to stimulate the financing of SLCP mitigation interventions at pace and scale.

CCAC, UN Environment Finance Initiative (UNEP FI) and Frankfurt School of Finance & Management join hands to implement the project titled 'Technical assistance for financing brick kiln improvements in Bangladesh'. The main objectives of the project are:

a. to provide targeted technical assistance to a small group of financial institutions (FIs) to tackle barriers to SLCP finance that will, in particular, reduce emissions of black carbon and other SLCPs, as well as air pollution, in the target country
b. to create a roadmap for transition to modern brick kiln technologies

Infrastructure Development Company Limited (IDCOL) has approached the CCAC Finance Initiative in order to provide technical assistance (TA) to address the considerable barriers limiting the uptake of lower emission kilns, whilst providing attractive energy efficient (EE) brick kiln financing. IDCOL is a government owned non-bank financial institution. Since its inception in 1997, IDCOL has played a leading role providing finance for medium to large-scale infrastructure, renewable energy and energy efficient projects in Bangladesh. As part of its Green Brick Program, IDCOL proposes to invest USD 50 million over the next 5 years to catalyse the renewal of the stock of kilns in operation in Bangladesh, replacing the incumbent, polluting technologies with modern EE such as Tunnel kiln.

The project is aimed at primarily working with IDCOL, brick kiln owners/investors, suppliers/manufacturers and policy makers to provide TA and advisory supports for promoting up take of EE brick kiln technologies in Bangladesh. It will be achieved by:

- Investigating technical, financial and operational aspects of efficient technologies (such as HHK and tunnel kiln) available in the local market;
- Providing advisory and capacity building supports to IDCOL in the appraisal of its efficient brick kiln finance projects;
- Creating awareness to suppliers, manufacturers, brick sector association members, policy makers as well as other financial institutions interested to promote efficient brick kiln technologies.

This report contains an overview of current local brick market, policy landscape and lessons learnt during the project mission that took place in Bangladesh during October 2017.

2. BRICK SECTOR OVERVIEW

Bangladesh's brick sector consists of roughly 6,637 kilns[1] and contributes about one percent to the country's gross domestic product (GDP), whilst generating employment for roughly one million people. Clay brick is the main construction material for buildings in Bangladesh. However, insufficient regulations have led to a proliferation of unqualified, mostly small businesses, operating on the back of outmoded technologies, which in turn has contributed to severe industrial pollution and poor labour standards.

In 2011 the brick sector in Bangladesh consumed 203 tons of coal, producing 576 tons of CO2, per million bricks manufactured. With about 17 billion bricks produced annually, the industry's annual CO2 emissions are estimated to be 9.8 million tons[2].

The pace of shift toward modern and environmental-friendly brick making technologies has picked up after the Department of Environment (DoE) started encouraging entrepreneurs to use improved technologies, instead of issuing environmental clearance certificates for conventional kilns. By February 2017, over 4,200 brick kilns have been converted into modern kilns, meaning still some 2,500 kilns are using the old FCK technology. Of the converted kilns, more than 95% have been converted into zigzag or improved zigzag kilns, the rest to HHK and tunnel kilns.

According to the latest statistics, to date only 134 HHKs and 47 Tunnel kilns have been installed, less than 3% of total brick kilns operating in Bangladesh. Accordingly, strict enforcement of the directive would therefore compromise the supply of bricks to the Bangladeshi construction industry, with additional negative consequences on the labour market.

2.1. POLICY LANDSCAPE AND BARRIERS

Since 1998 government regulation have been employed in an attempt to reduce pollution from the sector. The Brick Burning (control) Act of 1989 that set standards for fuel used in combustion was amended twice, in 1992 and 2001, before it was finally replaced by the **Brick Making and Brick Field Establishment (Control) Act 2013.**

Prior to 2004, most of the kilns in Bangladesh were Bull's Trench kilns (BTKs), a relatively primitive design developed over 150 years ago. BTKs are highly polluting and energy inefficient. After the promulgation of the Brick Burning Rules in 2002, most BTKs were converted to Fixed Chimney kilns (FCKs), an improvement on the BTK, which are more energy efficient and as a result produce less emissions.

In 2010, the Government of Bangladesh issued a notification banning the operation of FCK in favour of more energy efficient and lower polluting kilns, such as the Zig-Zag, Vertical Shaft Brick Kiln (VSBK), Hybrid-Hoffman Kiln (HHK) and Tunnel Kiln by 2012. This policy proved hard to implement and deadline was later extended by six months until March 2014 and again by another three months until June the same year.

However, the number of most modern brick kilns, such has HHK and tunnel kilns has not increased in line with the expectation. The 2010 notification faced three critical barriers that suppressed the uptake of the HHK and Tunnel kilns:

[1] According to figures released by the Bangladesh Environment Ministry 2016
[2] World Bank. 2011. Introducing energy efficient clean technologies in the brick sector of Bangladesh, Washington, DC

- Traditional kiln owners (represented by Bangladesh Brick Manufacturers Owners Association or BBMOA), had insufficient awareness of the modern kiln technologies available
- Traditional kiln owners have limited capacity to access the finance necessary for the considerable capital expenditure to transition to more efficient kiln technologies.
- Additionally, newer entrepreneurs being attracted to the market (represented by Bangladesh Auto Brick Manufacturers' Association or BABMA), lacked the technical expertise and operational track-record to successfully operate brick kilns.

The inability to develop energy efficient, clean, and modern brick sector in Bangladesh can be considered a result of a general lack of (i) awareness of available modern technologies, (ii) technological and operational capacity, and (iii) targeted finance and attractive lending terms.

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3. INTRODUCTORY MISSION TO BANGLADESH

An introductory and fact-finding mission was undertaken by two members of the project team, with Mr. Hirak Al-Hammad of The Frankfurt School of Finance & Management accompanied by John Volsteedt, Technical Consultant, travelling to Dhaka, Bangladesh from 8 October 2017 until 17 October 2017. During this time, spent primarily with the IDCOL-Small Infrastructure Team, meetings were held with stakeholders (Annex 1) from the clay brick sector having an interest in the successful roll-out of "Auto-Kiln" technologies. In addition, the mission included two field trips to two "auto-kiln" factories, one in operation, the second under construction.

This mission, besides providing excellent insight into the structures of IDCOL, as well as their specific requirements in terms of the overall objectives of the project in terms of technical assistance, also provided a broader insight into the Clay Brick sector within Bangladesh and the challenges of addressing SLCP within this sector. A sector still dominated by a largely low-tech, in-efficient and polluting manufacturing base.

The introduction of the Auto-Kiln technologies does address some of the issues associated with the sector, although there are certain associated risks and socio-economic impacts.

A brief summary and of the mission is contained in the points below.

3.1. STAKEHOLDERS ENGAGEMENT

These engagements, facilitated by IDCOL through arranged meetings, extended to the following stakeholders;

3.1.1 BANGLADESH AUTO BRICK MANUFACTURERS ASSOCIATION

Dr. B. N. Dulal, Secretary General of the Bangladesh Auto Brick Manufacturers Association (BABMA) is also Chairman of First Auto Bricks Ltd, a clay brick manufacturing company. Dr Dulal represents around 35 members. The organisation itself has an office staff of 3 persons.

The discussion with Dr Dulal is summarised into the following points with some observations.

- The association does not represent tunnel kiln operators, with the term "Auto Kiln," which comes from the Brick Making an d Brick Field Establishment (Control) Act 2013, also including Hybrid Hoffman Kilns.
- Since 2003 there has been a steady growth within the Association, although Tunnel Kiln representation is still limited at around 5 factories.
- Government does not seem to have a clear plan for the "traditional" producers.
- Dialogue does take place with Government, although it appears as though it Is not structured with any definite plan or goal in place.
- The Association focuses on communication with its members, primarily on communicating regulatory updates such as the within the Brickfield Establishment Regulations.
- An observation is that the Association lacks an understanding of the Clay Brick Market System and how to influence stakeholders within the entire market system in effecting change and growth.
- A further observation would be that the Association should/could, with additional resources, play a pivotal role in developing an industrialised sector. Effective guidance may be provided through this project.

3.1.2 Department of Environment

A meeting with the Mr. Masud Iqbal, Director at Department of Environment – Ministry of Environment & Forests as well as Mr. Abdul Wahab raised the following points and observations.

- Government does not have any clear plans for engagement with the traditional brick producers.
- Government does not have any clear plans in protecting the informal brick industry, with the understanding this potentially allows the introduction of new building materials and technologies.
- Government clearly sees the brick sector as still polluting and damaging to the environment in spite of numerous projects over the years.
- There is an understanding of the socio-economic implications associated with job losses with the advent of industrialisation within the sector or introduction of alternative building materials.
- Government does, however, see a need for a clay brick working group, although what the objectives of this group could be are unclear.
- An observation, is that like with the Association, there is no clear understanding of including the entire market system in addressing the challenges associated with changing the sector constructively towards achieving Governments environmental targets. This exposes the brick producers to alone effect change.
- A further observation, as with the Association, Government could benefit in developing a stakeholder engagement process that is inclusive across the market system.

3.1.3 Technology Service Providers

A meeting with a group of 5 technology service providers provided valuable insight into their organisational structure between themselves being agents based in Bangladesh and the parent company providing the actual technology. The service providers themselves offer varying levels of engineering and manufacturing support necessary for the design, construction and operation of a brick factory.

This meeting group represented 4 Chinese technology providers as well as one Spanish technology provider. A larger grouping exists within Bangladesh and will be approached through a survey questionnaire (Annex 2) distributed by IDCOL.

Some pertinent points and observations from meeting with the suppliers;

- A range of services is on offer to brick makers through a growing network of agent companies representing parent companies.
- These parent companies offer a range of technologies across the clay brick manufacturing spectrum.
- The international footprint of the parent companies varies, but is generally not only limited to China.
- It is apparent that the European suppliers, one represented at the meeting and with one known other represented within Dhaka, are going to have currency challenges.
- An observation is that the suppliers see the sector as an opportunity growth sector.
- A further observation is that it was enlightening to see how open the suppliers were in discussion, which would bode well if any initiative included stakeholder engagement with suppliers.

3.2. SITE VISITS

Two site visits were held, one at Stone Brick Ltd in the Manikganj district, an operational tunnel kiln factory. The second was at Makrail Auto Green Bricks Ltd in the Faridpur district, a tunnel kiln project still under construction.

3.2.1 STONE BRICK

This is an operational, 80 Million units per annum factory, with tunnel driers and 3 Chinese supplied tunnel kilns.

- Designed production volumes are not being met. This mainly due to just coming out of the monsoon season resulting in overly wet clay, poorly performing driers and subsequent high waste.
- Two out of three kilns were operational as a consequence of the underperforming driers, although an oversight may be that two kilns now only provide two thirds of the heat energy required for the driers.
- A quick walk through tour reveals a sound layout, good clay processing machinery, and no obvious flaws in quality of work in terms of construction and installation.
- About 80% of the energy derived from coal is added to the clay body as coal fines. This is in line with the trend of maximising the internal fuel for efficiency and emissions.
- The remaining 20% energy is added as additional coal, gravity fed through fire holes on top of the kiln. This is done in a primitive manner with no installed burner units, but rather by hand feeding.
- In spite of a high level of mechanisation, there is little automation with manual labour evident in the three phases of brick handling, green brick, dry brick and fired brick.
- The driers are a unit of 18 tunnels with dedicated drier cars which are passed through the tunnels over 72 hours, carrying the initially wet then dry product. The dry product is packed over on kiln cars for firing.
- The driers provided the only significant area of concern in that this method of drying is outdated, and potentially not suited to the high moisture contents found in Bangladesh.
- Further, the energy input into the drier appears to be very low, with both the observed temperature and airflow seaming inadequate.
- The kiln electronic supervisory, control and data acquisition (SCADA) system appears sound and, importantly, well understood by the operational staff met.
- Specific Energy Consumption is around 2.2 MJ/Kg fired brick, about mid-range compared to international benchmarks.
- An observation, substantiated through further discussions following the site visit, are that Stone Bricks needs to re-engage with the engineer / designer and determine the soundness of the design in terms of airflows, available heat and production levels.
- Further guidance may be found via external experts in terms of mitigating any possible design flaws or inherent challenges imposed by the Bangladesh climate and nature of the clay raw materials.

Figure 1 Manual offloading packing of kiln cars

Figure 2 Product damaged during firing due to excessive moisture remaining after drying

Figure 3 Kiln control room

3.2.2 MAKRAIL AUTO GREEN BRICKS

This second site, with a lower production total at only around 24 Million units per annum, is technology wise more advanced. The intention is to focus on high end, high value products and thereby achieve a return on investment through higher volume products.

Unfortunately, the site is still under construction, however all the brick manufacturing, drying and firing equipment is installed.

Figure 4 Extrusion die

- The layout is open and free flowing, and with the high value products in mind, good thinking in terms of raw material preparation and the installed equipment.
- Green brick extrusion appears standard but some high void dies were observed indicating an intention to extrude products with a high % perforation.
- This coupled with the excellent application of single layer, racked drying through a tunnel dryer with recirculation and initial steam tempering of the ware, should result in good drying performance.
- The highly mechanised factory has again a high level of manual labour during the three phases of brick handling.
- The kiln is a modular pre-fabricated unit from China, fired with top and bottom side burners. This should provide an extremely clean, highly controllable burn, again necessary for the envisaged high value product being produced.
- The gas from coal unit will be challenging to operate as a negative and adds an element of risk to the factory management in that it is a process requiring a high level of management on its own.
- The observable technologies installed demonstrate a high level of capability in both design and installation.
- A question to ask and to follow with this project would be the depth of operational capability as well as the soundness of a high capital value project versus low production volume albeit high value product.

Figure 5 Tunnel drier and recirculation units

Figure 6 Gas fired side burners

3.2.3 GENERAL OBSERVATIONS

Further general observations following the opportunity to engage with clay brick producers are also noted.

- The owner and engineer from a third project still in the design phase displayed a high level of knowledge relating to ceramics in general, as well as an excellent knowledge of available technologies and trends internationally.
- This project is engaging both Chinese and European technologies in order to achieve the desired levels of performance, such as a Chinese kiln and European burners, Bernini from Italy.
- This project further illustrates the possible trend of investors in high tech factories coming from outside the established clay brick sector circles, but with the necessary level of skills and funding required. In this case, they are an established glass producing company.

- There will be room for high tech highly automated factories, as in the last case where they are looking for a high level of automation (robots) to "older" style tunnel kilns where there is still a high level of manual labour.
- Tunnel kilns will be suited for the introduction of new product formats and lightweight products, although some work will be required to stimulate demand on the demand side of the market sys-tem. Something thorough stakeholder engagement could accomplish in this project.
- The observed high rise developments lend themselves to lightweight products which will enhance the cost effectiveness of these developments within the construction sector. Currently solid bricks of standard dimensions are utilised for infill walling between concrete columns.

Figure 7 Stone produced from crushed brick

- A possible conundrum exists with the established demand for stone in Bangladesh being met through the production of solid bricks which are then crushed for stone. Industrialising the sector for this purpose may not be the best utilisation of resources, and may be a further topic for consideration in this project.

3.3. IDCOL – SMALL INFRASTRUCTURE TEAM

In spite of the deliverables to IDCOL out of this project, the following points have been noted in terms of the IDCOL team assessing clay brick projects.

- The technical capacity and understanding of the team is sound, and with the willingness to learn, realising a solid understanding of the range of clay brick technologies available should be accomplished within the expectations of this project
- Clarity around the term "Auto Kiln" as used in the regulations is required as the regulations may themselves be outdated in some aspects, particularly with regards to the limitation on permissible area of a factory.
- Tunnel kilns, on their own stacked up against some of the other technologies may not be substantially energy efficient, but they do bring significant reduction of air emissions and other aspects of efficiency to clay brick production, and are the preferred technology globally where industrialised production methods are required.
- It may be prudent to investigate the Vietnamese case, of how that country developed their production from traditional methods through interim technologies to tunnel kiln technologies with a claimed stock of over 250 tunnel kilns.
- The focus of IDCOL should remain the sound business and technical evaluation and funding of viable auto kiln projects, establishing a sound base on which the sector, through growing economic forces, can implement the desired long term changes.

Annex 1: List of stakeholders

Govt. institution	Name & Designation	Contact
Department of Environment	Masud Iqbal Md. Shameem, PhD Director	shameem@doe.gov.bd www.doe.gov.bd
Department of Environment	M A Wahab Consultant/Project Coordinator, SLCP Project	wahab_irb@hotmail.com

Financial institution	Name & Designation	Contact
IDCOL	Mahmood Malik Executive Director & CEO	mmalik@idcol.org
IDCOL	Nazmul Haque Director (Investment) and Head of Advisory	nhaque@idcol.org
IDCOL	Mohammed Zahidul Haque Vice President & Unit Head, Industrial & EE Finance (IEEF)	zahidhaque@idcol.org

Kiln suppliers	Product details	Contact
SS Khan Power Engineering Ltd.	Auto-kiln machinery; country of origin: China	khanpowertec@gmail.com
Sunshine Industries	Auto-kiln machinery; country of origin: Spain	businessdev@kclbd.com
China Mengda International Co., Limited.	Auto-kiln machinery; country of origin: China	zzlawei@yahoo.com
Wuhan Promotion Engg. Co., Ltd.	Auto-kiln machinery; country of origin: China	zhaofor@163.com

Association	Name & Designation	Contact
BABMA	Dr. B. N. Dulal Secretary General	bndulal2010@yahoo.com

Annex 2: Auto-kiln supplier survey

1. Company Details (Details of the Bangladesh based entity or technology representative)	
1.1 Company Name:	
1.2 Primary Contact Person:	
1.3 Local Telephone:	
1.4 Mobile Telephone	
1.5 Address (Physical)	
1.6 Address (Postal)	
1.7 Email	

2. Technology Supplier Details (Details of the primary technology supplier. Where a local agent represents more than one supplier, please complete one form per supplier)	
2.1 Company Name:	
2.2 Primary technology type/s:	Clay Preparation Equipment ☐ Clay Souring / Reclaiming [3] ☐ Green Brick Extrusion[4] ☐ Green Brick Handling[5] ☐ Setting Machines ☐ Robots Dryers ☐ Chamber ☐ Tunnel Kiln ☐ Tunnel ☐ Other_____
2.3 Other technology not above:	
2.4 Country of Origin:	
2.5 Company Website:	

[3] Clay storage facility post-clay preparation with any associated reclaiming equipment.
[4] Equipment associated with the shaping or extrusion process of the wet product or "green brick."
[5] Equipment associated with the handling of the wet product prior to drying.

3. Track Record and reference projects	
3.1 Local Agency	
3.1.1 Number of implemented projects in Bangladesh	Under Development:
	Operational:
3.1.2 Details of current or recent projects (If more than one project please provide additional details separately)	Name of Company:
	Nearest Location:
	Capacity (Units per Annum):
	Investment Value and year:
	Contact Person (Name):
	Contact Person (Number):
	Contact Person (Email):

Track Record and reference projects continued	
3.2 Technology Supplier	
3.2.1 Number of implemented projects:	Home Country:
	Internationally:
	Countries:
	Main global areas:
3.2.2 International collaboration under license: (With which company)	
3.2.3 Describe a flagship project: (Location, capacity, Kcal/Kg)	Location: Capacity: Specific energy consumption Kcal/Kg:

4. Project Design	
4.1 Raw materials testing capacity[6] (In house or contracted)	
4.2 Describe some aspects of materials testing that will influence project design, eg • Particle size distribution • Plasticity • Modulus of rupture • Drying sensitivity • Firing curve	
4.3 Describe some possible aspects unique to Bangladesh in considering design • High moisture of clay • High ambient humidity • Predominant fuel source is coal • Automation versus manual	

[6] Physical and chemical properties of the raw material as well as test firing of materials

5. Land, Water and Energy (Assuming a typical project size)	
5.1 Typical project capacity (Units per annum)	
5.2 Typical area of land required	Total land area required (Acres)
	Land area clay storage (Acres)
	Land area factory buildings (Acres)
	Land area other, offices, stock holding (Acres)
5.3 Typical water requirement (Kiloliters per 1000 units produced)	
5.4 Typical installed electrical supply capacity (Available MW)	
5.5 Typical installed electrical capacity (Demand MW)	
5.6 Typical backup generator capacity	

6. Clay preparation and storage	
6.1 Describe a typical process flow applicable to Bangladesh clay's	
6.2 Preferred clay processing machinery supplier[7]	
6.2 Recovery of clay from souring area	Mechanised (Reclaimer): ☐ Front End Loader[8]: ☐

7. Green Brick Production	
7.1 Describe typical installed green brick production equipment applicable to Bangladesh clay's taking available raw material and final product into account • Mixing • Extrusion • Cutting	
7.2 Possible product formats (Dimensions and % perforation[9])	Product 1
	Product 2
	Product 3

[7] If third party supplier is used
[8] Wheeled motor driven loader
[9] The percentage total void in an extruded green brick

	Product 4
7.3 Green brick handling options	Direct Set ☐ (Setting green bricks directly onto kiln cars) Drier cars ☐ (Setting green bricks onto drier specific cars) Drier racks ☐ (Setting green bricks onto a racking, stackable system)
7.4 Which of the options above in 7.3 are preferred for Bangladesh	

8. Drying and Firing	
8.1 Describe a typical installed drying and firing system applicable to Bangladesh, eg • Dryer configuration • Dryer heat source • Kiln configuration • Burner types	
8.2 Describe an evolutionary timeline for your drier / kiln system (Briefly, how the design has evolved)	
8.3 Fuel type options	Coal blowing: ☐ Pumped pulverised: ☐ Burner pulverised: ☐ Coal feeding: ☐ Mechanised: ☐ Manual: ☐ Coal gasification: ☐ Other:
8.4 Typical kiln car design (Dimensions, deck (bulk or kiln car refractories, tracks per car)	Dimensions: Deck (bulk or kiln car refractories: Tracks per car:
8.5 Typical burner configuration	% internal fuel[10]:
	Top burners:
	Side burners:

9. Performance (Typical expected performance for Bangladesh conditions)	
9.1 Typical expected drying time	
9.2 Typical expected firing cycle	
9.3 Typical designed dry brick moisture content	
9.4 Typical drying and firing specific energy consumption (kcal/Kg)	

[10] Crushed fuel added to the clay body prior to extrusion as a source of carbon for firing.

9.5 Typical air to clay mass ratio	Driers:	
	Kiln:	
9.6 Stack emissions (known results)	Particulate matter:	
	CO:	
	CO2:	
9.7 Typical manpower required	Labour:	
	Management:	
	Maintenance/Engineering:	

10. Project Delivery (Typical expected delivery for Bangladesh conditions)		
10.1 Typical project timeline	Total months	
10.2 Typical Milestones	Site preparation (Months from start of project)	
	Civils for structures	
	Civils for equipment	
	Large machinery installation	
	Raw materials storage and handling	
	Fuel storage and handling	
	Dryer installation	
	Kiln installation	
	Kiln car manufacture	
	Kiln car finishing	
	Brick handling equipment and conveyors	
	Firing equipment	
	Stack and emissions control	
	Sub-Systems (fans, ducting, kiln car handling etc)	
	Monitoring and control systems	
	Pre-commissioning testing	
	Commissioning cycle and start-up	
	Initial production	
	Full production	
	Training and handover	
	On-site support	
10.3 Documentation available	Maintenance:	
	Operation:	
11. Subscribed Standards		
11.1 ISO 9001 or equivalent	Are the equipment manufactures/suppliers certified	
11.2 Safety equipment	(Is equipment and machinery installed compliant with local safety standards, eg All machine guarding already installed?)	

11.3 List applicable local standards for Steel	
11.4 List applicable local standards for Construction	
11.5 List applicable local standards for Electrical Installation	

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