Pre Feasibility Report Industrial Rooftop Solar PV Project Ramjas School, R K Puram, Delhi

Latitude: 28°33' N Longitude: 77°10' E Elevation: 253 m

Location of the facility:	Ramjas School, RK Puram, New Delhi
Purpose of Initiative:	Green Initiative and energy security
Date:	August 21, 2013
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1. EXECUTIVE SUMMARY

The highlights of PR-Fonroche Pre-feasibility report for setting up solar PV roof top project are as under –

Install a Solar PV solution on Ramjas School, RK Puram, New Delhi rooftop for savings over the life of the project while achieving greater energy security with a green initiative.
There are two proposal for installing the solar PV project at the school building as follows –
Case – I: 29.4 kWp: If PV is not required to be operated in parallel with the available DG (Could be opted if power cuts are minimal)
Case –II: 26.46 kWp: If PV is required to be operated in parallel with the available DG (Could be opted if power cuts are high during the day time)

Table – 1 Highlights of Pre – Feasibility Report

Sr. No.	Particulars	Details
1	Proposed Location of Solar PV roof top project	Ramjas School R K Puram New Delhi
2	Likely Capacity of Solar PV project – Case I	29.4 kW_p
3	Estimated Yearly Generation of Power – Case I	49110[1] kWh p.a.
4	Likely Capacity of Solar PV project – Case II	26.46 kW_p
5	Estimated Yearly Generation of Power – Case II	44170[2] kWh p.a.
6	Project Life Time	25 years
7	Module Technology proposed	Crystalline

[1] This generation is from the PVsyst simulation. This may vary if different components are used during plant construction.
[2] This generation is from the PVsyst simulation. This may vary if different components are used during plant construction.

2. INTRODUCTION

Ramjas RK Puram is a fully fledged 3 section school with a total strength of more than 1900 students, with around a 100 Staff on roll. Ramjas RK Puram is very consciously gearing to face the next millennium for the children with us today will be adults in a very different world and we need to prepare them for it. The need to develop an open, flexible, inter disciplinary and global curriculum has never been greater. Keeping this in mind they review the school program periodically and incorporate these learning skills.

Educational institutes are the base of any society. These institutes behave as role model for the society in more than one way. The growing need for sustainable future looks at these institute to take the step forward to initiate the sustainability at its own campuses.

In India and around the world many institutes have realized the need of campus sustainability. These institutes are focused to be carbon neutral by using various innovative technical solutions and creating awareness among the students.

Various steps taken to be carbon neutral and sustainable are waste management programs, transportation programs, biodiversity programs, energy consumption and energy generation using renewable sources of energy.

Institutes like – IIT Bombay, TERI, Sikkim University, University of Birmingham, South Carolina University, Arizona University, etc have taken many initiatives for sustainable campus. Many universities and schools in The USA and Canada have installed roof-top solar solutions to fulfill the energy needs of the campus and also for energy security.

BENEFITS OF SOLAR PV INSTALLATION:

PV systems provide Green, Renewable power by exploiting the solar energy radiated from the sun. Benefits derived from Solar Energy can be summarized as under:

Energy Cost Management:

- One time investment in solar energy acts as long-term hedge against regularly rising power cost, as there is practically no recurring expenditure thereafter.
- Solar energy can also reduce dependency on ever increasing and expensive diesel for DG sets.

RPO/CSR Responsibilities:

- Government has made it mandatory that DISCOMs, captive power producers and open access consumers fulfill their Renewable Power Obligation (RPO) by using a percentage of total consumption through solar energy.
- Solar energy can also position a company as a “Green & Environment Friendly”.

Income Tax Savings:

- According to IT Act one can claim 96% of the total plant and machinery value (as on company"s books) of solar PV plant as depreciation over two years, thereby reducing the income tax payable.

Ramjas School, RK Puram has sufficient rooftop space to setup solar plant to cater to its needs. Thus, it is advised that they put up rooftop solar project on the. Also, the Solar PV project will lead to tremendous PR equity which comes with such environmental leadership.

With this mandate, Technical team from PR Fonroche visited the RK Puram facility of Ramjas School on 09th August, 2013.

Subsequently, a detailed analysis of the site and available rooftops were done with help of –

- Meteonorm 7 data set and PVsyst tool
- Suitable technology for the application

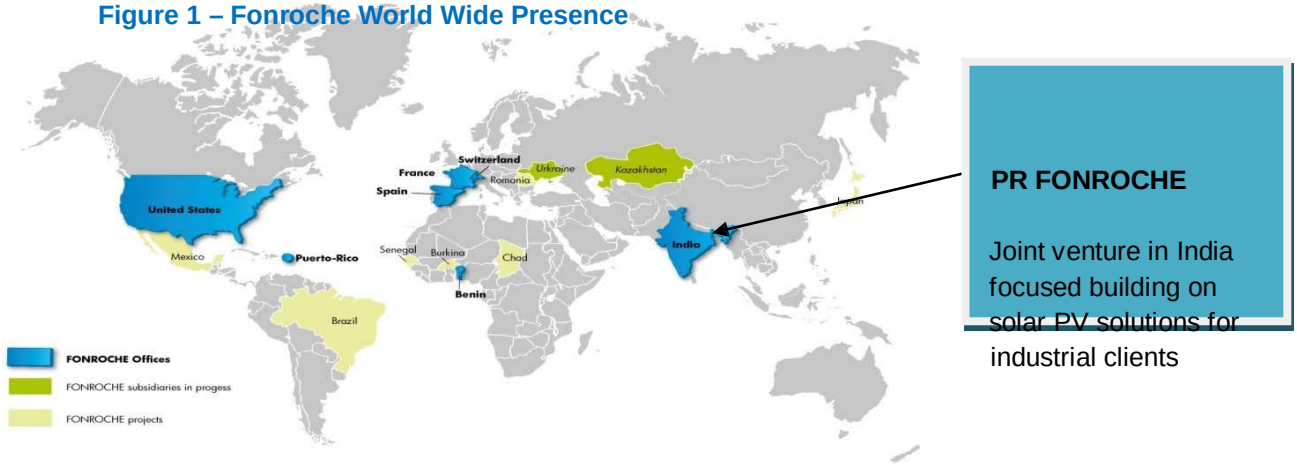
3. ABOUT PR – FONROCHE

PR Fonroche -- a joint venture between Fonroche Energie S.a.S., (France) and PR Clean Energy (India) – aims to build either On-site or Off-site Solar PV solutions for industrial clients to solve both power and RPO needs.

Fonroche Energie S.a.S. is a renewable energy project developer from France. With presence in 5 continents, revenues of more than € 251 million and over 250 MW of their own project-assets worldwide it is the largest non government backed solar developer in France. PR Clean Energy is a renewable energy developer from India, with experience in both wind (59MW) and solar PV (20MW).

PR Fonroche is the Joint Venture between the two to build high-quality solar PV solutions in India.

Figure 1 – Fonroche World Wide Presence



3.1 PR – FONROCHE SOLAR PV CAPABILITIES:

PR Fonroche has an accomplished team of professionals at various levels with vast experience and knowledge in solar power both in India and abroad. The team‟s key achievements are showcased below:

Overseas:

- Largest non government backed solar developer in France.
- 250+ MW of their own project assets worldwide.
- More than 60 MW of rooftop projects executed worldwide.
- Handled complex solutions for Airport at Nice, France.

India:

- Executed a 20 MW solar project in Rajasthan and another more than 20 MW under pipeline in AP tender.
- First to commission 20 MW project in NVVN phase – I, Batch - II.
- Obtained A-ve (3rd highest grade) credit rating for the 20MW project companies from CARE
- Key tie ups with reputed EPC companies in place.

4. PROJECT EVALUATION PROCESS:

A holistic and professional approach has been adopted to analyze and assess the infrastructure and feasibility of a rooftop solar PV solution with the help of a detailed questionnaire and site visit by the technical team and followed by thorough study with help of tools like PVSyst and database like Meteonorm 7 etc.

4.1 Pre Feasibility Scope

Ramjas School has approximately 260 square meter of rooftop space which can be used for the solar PV project installation and is good enough to set up 30 kWp (approx.) solar PV plant while their load demand is approximately 65kW. A rooftop installation will provide an Onsite solar PV plant without the need for accessing the grid. The approvals required for onsite projects are minimal and typically do not take considerable time.

This Pre Feasibility Report thus evaluates the possibility of Ramjas School setting up a Solar PV plant, capacity of the plant and time frame for completing the same.

Ramjas School has a DG set for operating in case of grid outages. There are certain technical constraints on the size of PV system that could be operated in parallel with the DG sets. The constraint on the size of the PV plant is imposed by two factors namely- 1) The minimum load at which a DG should operated 2) Reverse feeding of power from PV into the DG sets leading to nuisance tripping of the DG.

Table 2 – Analysis of different criteria for selection of installation area

Criteria	Ramjas school	Remarks
Uniformity of the Roof	Flat	The non-uniformity increases the cost of structure and reduces the potential installation size due to increased spacing to avoid shadows
Shadows	To be confirmed from school	Upcoming building construction could create shadows for the plant which is to be confirmed during next visit and from school administration.
Available Roof Area	260 m2	More the area, more is the size of the installation
Roof Bearing Capacity	To be tested, But seems high	The higher the bearing capacity the safer is the installation
Installation Size	29.4 kWp or 26.4 kWp	Sizing is based on CAPEX constraints, DG capacity, electrical load and available roof top space for solar PV installation

4.2 Load Profile

The primary data of importance in case of off-grid projects (i.e. without battery backup) is the current load profile data so as to assess the minimum sizing of PV capacity. The minimum capacity is sized considering the space available, total demand and other power sources being used. The load profile data of the unit has been provided.

Table 3 – Analysis of different criteria for selection of installation area

Criteria	**Ramjas School RK Puram New Delhi**
Primary power source	DisCom grid
Backup Source	DG set (85.5 kVA)
Peak load	65kW
Average load	65kW

For Ramjas School PR Fonroche proposes following two options –

Case – I: Solar PV offsets grid power, without being operated in parallel with DG.
Ramjas School has approx. 260 square meter of rooftop which is suitable to set-up a 30kWp system approx. So the first solution proposed is of 29.4 kWp which will work only with the grid i.e. DG should not operate while the solar power is being fed to the School.
Capacity: 29.4 kWp

Case – 2: Solar power injection in parallel with the DG set
Ramjas School has a demand of 65kW and a DG set of 85.5 kVA. The DG set usage restricts the solar power injection into the system due to technical limitations. For safe DG operation the solar power capacity should be limited to 30% of the DG capacity. Capacity higher than this may trip the DG or it will operate at low efficiency. This limits solar project capacity to 26.46 kWp for School. In this case the Solar PV will work in parallel with grid and during the absence of the grid it will work in parallel with the DG set offsetting a certain percentage of diesel consumption.
Capacity: 26.46 kWp

4.3 Solar Radiation & Energy Yield Assessment

Meteonorm 7 dataset and PV – SYST software has been used to assess the solar resource and energy yield prediction for the site. The results are presented in table – 4 below.

Table 4 – Solar Resource & Energy Yield Data

Parameters	Values	Inference
Global Horizontal Irradiance	1977 kWh/m^2	**High Insolation**
Specific Energy Yield	Case –I: 1670 kWh/kWp/year Case –I: 1669 kWh/kWp/year	**High generation**

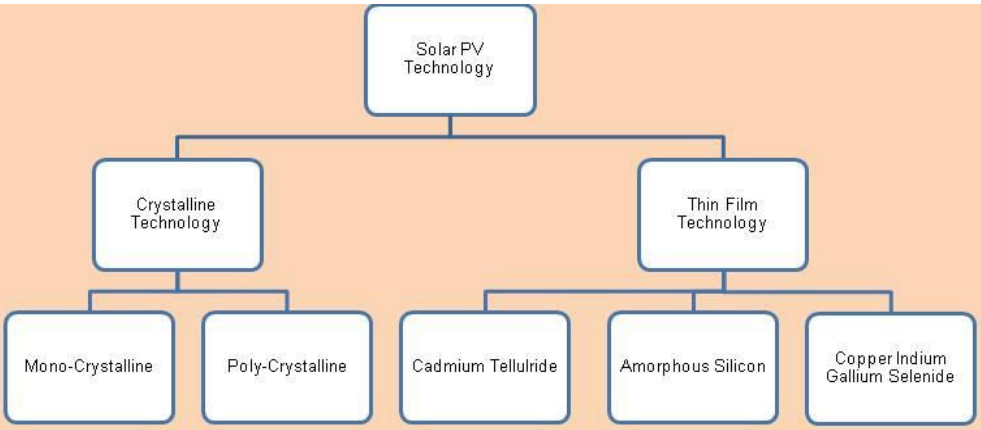
Average insolation in India is around 5.5 kWhr/m2/day and anything above this considered as high insolation which is good for setting up a Solar PV project. As well, wind speed, temperature range and humidity are within the nominal range. The detailed PVSyst report is attached at the end of pre feasibility report as Annexure – 1.

All these parameters indicate that setting up a Solar PV solution at the said location will generate sufficient solar energy.

4.4 Technology Selection

Solar cells are thin wafers of materials (mostly silicon) which convert solar energy into electrical energy. Each cell produces a voltage of 0.5 Volts. The current generated by these cells depend on the insolation (solar radiation) falling on them. Cells are interconnected together into different configuration (series & parallel) are encapsulated inside an enclosure to form what is called a module. Based on the raw materials used for the production solar cells are classified as follows:

Figure 2 – Review of Solar PV Technologies



Module Efficiency	13%-19%	11%-15%	9% - 11%	5%-8%	10% - 12%
Surface Area per kWp	5-8 m2	7-9 m2	9-11 m2	13-20 m2	8-10 m2
Cost per Watt Peak	1.25$	0.68$	0.82$	0.70$	.0.76$
Temperature coefficient of Power	-0.45%/°C	-0.45%/°C	-0.31%/°C	-0.31%/°C	-0.31%/°C
Spectral Selectivity	Broader Band	Broader Band	Narrow Band	Narrow Band	Narrow Band
Effects of Shadow	Creation of Hot Spots*	Creation of Hot Spots*	Tolerant	Tolerant	Tolerant
Weight per watt	0.078 kg	0.085 kg	0.032 kg	0.09kg	0.14 kg

The various criteria involved in the selection of technology for both site specific and non site specific factors have been laid down as follows in Table – 5 & 6 respectively:

Table 5 - Site Specific Criteria

Parameter	Ramjas school Site Condition	Favorable Technology
Availability of Space	Constraint (Roof Top System)	Crystalline
Humidity	Low	Either
Ambient Temp. conditions	High	Thin Film
Shadows	To be confirmed from school	Either
Presence of Pollutants	Less	Either
Load bearing Capacity	High	Either (But thin film is lighter)

Table 6 - Non Site Specific Criteria

Parameter	Values	Favorable Technology
Long Term Performance Data	Required	Either
Bankability	Prime	Either

We can see that either technology is suitable considering all the parameters though the crystalline technology provides better space utilization hence we recommend crystalline technology.

4.5 Civil & Mechanical Scope

Since the roof type is identified to be flat roof, we can opt between two kinds of installations. One is directly installing on the roof at a lower height (as shown in left side of Figure 4 below) and the other is raising the structure at a height above the roof level and then mounting the panels on the top (as also shown in right side of Figure 3 below).
Lower height installation will cost comparatively less due to reduced cost of structure and will be easy for operation & maintenance, but roof will not be useable for any other purpose. While raised height structure installation will be comparatively costlier, roof space can be utilized for any purpose like laying pipeline etc.

Figure 3 – Lower height and Raised height installation options:

4.6 Evacuation Feasibility

The power from solar plant will be synchronized with the grid and the power will be consumed in priority. When there is a grid outage the PV will work in synchronization with DG set and will offset the Diesel consumption. The point of interconnection will be at the LT panel inside the school premises. The electrical installation diagram of the school premises will be required for providing the detailed evacuation plan.

4.7 Socio-Environmental Risks

The proposed site of installation is free from any source of environmental disturbances to a great extent. Since the whole vicinity is being owned and guarded by Ramjas School, the project can be claimed to be free from risk due to social ailments.

So from both environmental and social aspects the project is free from any sort of risks.

4.8 General Project Timeline

General project timelines for a Rooftop Solar PV project is as shown in Table – 7 below. Normally, delays are due to approvals, drawing approval, etc.

Table 7 - General Project Timeline

ACTIVITY	Time in Weeks
	1 2 3 4 5 6 7 8 9 10 11
Submission of Feasibility Report to Client	
Client Finalizes Project Structure	
Submission of Final Proposal	
Client Final Approval	
Contract Signing	
Plant Design	
Equipment Procurement	
Plant Construction	

5. PLANT COST:

The project cost break-up is given in the following table –

Table 8 – Project Costing

Sr. No	Component	Cost (Rs.)
1	Plant Capex for 29.4 kWp @ Rs. 80,000 per kWp Plant Capex for 26.46 kWp @ Rs. 80,000 per kWp	23,52,000 21,16,800
2	Statutory Permit Cost	80,000
3	PRF Fee	86,125
	Total Cost	**Case –I: 25,18,125** **Case –II: 22,82,925**

Project Fund required – Rs. 49 Lacs (This includes labour, material, installation, Insurance and Maintenance contract)

These are indicative numbers and are subject to changes depending on size, project location, market scenario and currency fluctuations.

Considering the school's financial constraints the proposed project should be of approx. 29 kWp or 26 kWp to avoid any kind of cost overruns as per the two cases.

6. NEXT STEPS

Next steps to take this project ahead from our side would be as shown in figure 5 below:

Figure 4 – Next Step

a. Discussion and answering all clarifications on pre feasibility report, followed by its Approval.
b. Entering into an understanding to enable exchange of all required information to enable us prepare technical and financial proposal.
c. Submitting Final Proposal.
d. Work Order to PR Fonroche

ANNEXURES

PVsyst Simulation reports –

Case – I
„PRF - IPV - SS - Ramjas School - PVsyst Simulation - 29.4 kWp system using Trina Modules – 21 Aug 2013"

Case – II
„PRF - IPV - SS - Ramjas School - PVsyst Simulation - 26.46 kWp system using Trina Modules – 21 Aug 2013"