National Electric Power Regulatory Authority
Islamic Republic of Pakistan

Registrar

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No.NEPRA/UTS-01/777-779
January 21, 2014

Subject: **Determination of National Electric Power Regulatory Authority in the Matter of Upfront Tariff for Solar Power Plants**

Dear Sir,

Please find enclosed herewith the subject Determination of the Authority along with Annex-I, II, III & IV (45 pages).

2. The Determination is being intimated to the Federal Government for the purpose of notification of the approved tariff in the official gazette pursuant to Section 31(4) of the Regulation of Generation, Transmission and Distribution of Electric Power Act (XL of 1997) and Rule 16(11) of the National Electric Power Regulatory Authority Tariff (Standards and Procedure) Rules, 1998.

3. Please note that only Order of the Authority at para 21 of the Determination relating to the reference tariff, adjustments, indexations and terms and conditions along with Annex-I, II, III & IV needs to be notified in the official Gazette.

Enclosure: As above

(Syed Safeer Hussain)

Secretary
Ministry of Water & Power
'A' Block, Pak Secretariat
Islamabad

CC:

1. Secretary, Cabinet Division, Cabinet Secretariat, Islamabad.
2. Secretary, Ministry of Finance, 'Q' Block, Pak Secretariat, Islamabad.

National Electric Power Regulatory Authority

(NEPRA)

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Determination

In the matter of Upfront Generation Tariff for Solar PV Power Plants

January 21st, 2014

Commentators

1. Fauji Fertilizer Company Limited
2. Renewable Resources (Pvt) Limited
3. Roshan Power (Pvt) Limited
4. Precision Advocate
5. Mr. Akhtar Ali, Energy Consultant, Karachi
6. Zypher Power (Pvt) Limited

This determination is being given in accordance with the Regulation 3 of the Upfront Tariff (Approval & Procedure) Regulations, 2011 (vide S.R.O. 757(1)2011). An applicant can opt for the Upfront Generation Tariff for Solar PV Power Plant once notified in the Official gazette pursuant to section 31(4) of the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997 (XL of 1997).

Authority

21/1/2014

(Habibullah Khilji)
Member

21/1/14

(Maj (R) Haroon Rashid)
Member

21 01 2014

(Khawaja Muhammad Naeem)
Vice Chairman

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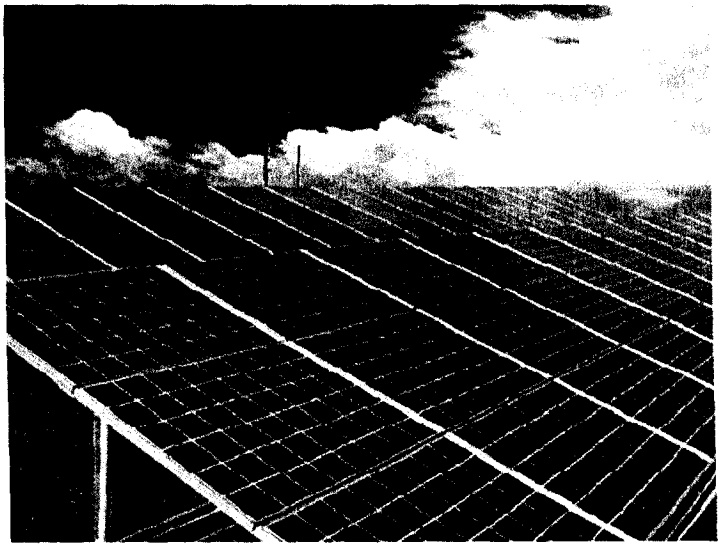
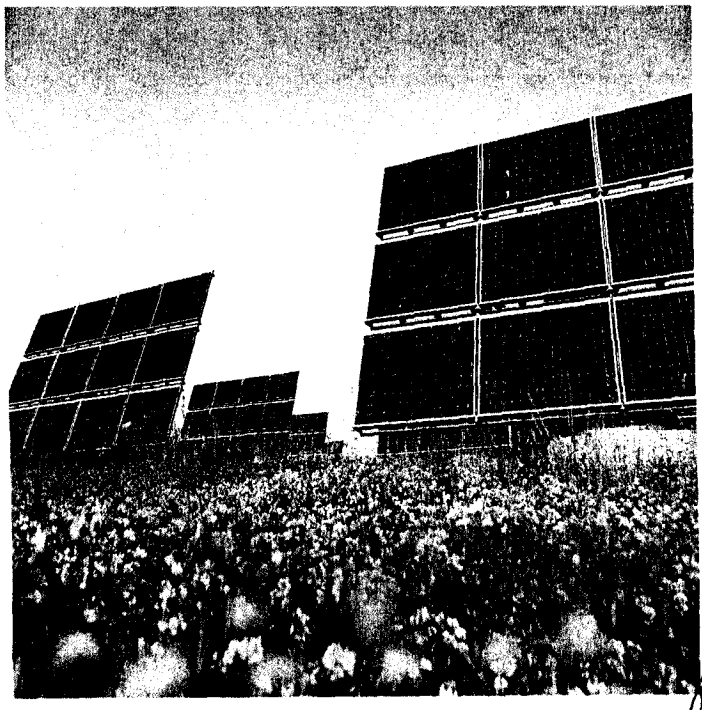
21.01.14

SOLAR ENERGY





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Background

1.1 Pakistan is facing acute electricity shortage. The gap between the estimated peak demand and the recorded peak supply of electricity in 2013 was around 5,000 MW. This shortage of electricity supply is not only adversely affecting the daily life of the people but also hampering the economic activities in Pakistan. Electricity in Pakistan is generated mainly on furnace oil substantial quantity of which is imported. The oil prices in the international market vary frequently thus resulting in corresponding variation in fuel prices in the country. This situation along with the rapid depleting reserves of natural gas has raised very serious issues with respect to reliable supply of electricity posing threats to energy security in the country. In the FY 2012-13, the electricity generation through thermal source was 63%, whereas it was 33% through hydro and remaining 4% was through nuclear and import. Pakistan's internal oil production meets approximately one sixth of the country's current oil requirements. Almost one third of the country's total energy requirement is met through import of oil.

1.2 Availability of energy in any country has a strong relationship with its economic and social stability. The per capita energy consumption is an index used to measure the prosperity of any society. Pakistan is basically an energy deficient country. Pakistan's per capita energy consumption, 3,894 kWh as against the world average of 17,620 kWh, gives it a ranking of 100 amongst the nations of the world.

1.3 Pakistan being in the Sunny Belt is ideally located to take advantage of solar energy technologies. The annual average solar irradiation of Pakistan is around 5.5 kWh/m2. Pakistan lies within latitude 23.45º to 36.75ºN and longitude 61º to 75.5ºE. This mean global irradiation falling on horizontal surface is about 200-250 watt per m^2 per day. Balochistan province is particularly rich in solar energy. It has an average daily global insulation of 19 to 20 MJ/m2 per day with annual mean sunshine duration of 8 to 8.5 hours a day and these values are among the highest in the world. For daily global irradiation up to 23MJ/m2, 24 (80%) consecutive days are available in this area. Such conditions are ideal for PV and other solar energy applications. Pakistan can make use of this freely available and widely distributed solar energy for improving the socio-economic conditions of the people living in remote areas and to reduce the poverty level. Harnessing the sun's power is considered an attractive alternative because it is a renewable resource, which causes no pollution. In contrast to conventional fuels, its use eliminates the need for refining,

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transporting and conveying fuels and power over long distances. The provinces of Sindh and Balochistan are ideal for utilization of solar energy. In Balochistan, 77% of the population is living in the rural areas. The population density is very thin. About 90% of the villages are yet to be electrified. These villages are separated by large distances with absolutely no approach roads. Transmission lines are very expensive in this area and there is no chance of grid connection in the near future. In remote area, houses are mostly `kacha hut type' and light is their only requirement. Most of the houses consist of one room only. The electric requirement for each house varies from 50 watt to 100 watt maximum. Solar energy is the only and best solution for these areas. 100 solar homes project has been completed in nine villages in all four provinces and now 26,000 houses are being electrified in Balochistan and Sindh provinces.

1.4 Solar technology is being used in Pakistan for stand alone rural telephone exchanges, repeater stations, highway emergency telephones, cathodic protection, refrigeration for vaccine and medicines in the hospitals etc. The Public Health Department has installed about 20 solar water pumps for drinking purposes in different parts of Balochistan. Both the private and public sectors are playing their roles in the popularization and up-grading of photovoltaic activities in the country. A number of companies are not only involved in trading photovoltaic products and appliances but also manufacturing different components of PV systems. They are selling PV modules, batteries, regulators, invertors, as well as practical low power gadgets for load shedding such as photovoltaic lamps, battery chargers, garden lights etc. A commercial scale solar cell manufacturing facility has also been set up by the private sector.

1.5 Generally, the entire Pakistan has a high potential for solar energy. The annual average horizontal solar irradiation per day in these areas is more than 5.48 kWh/m2. For comparison, the highest solar irradiation measured in Japan is in Naha of Okinawa Prefecture, in which the annual average solar irradiation is around 4.5 kWh/m2. The existing projects installed through the national budget as well as with the collaboration of international organization/donor agencies except for the system installed by Japan's grant aid are off-grid system. As Pakistan receives high solar irradiation in most parts of the country and has enough available space for installation of solar power generation system, therefore has high potential for solar power generation.

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2. Solar PV

2.1 Photovoltaic also called solar cell, is electronic device that convert sunlight directly into electricity. PV is one of the fastest growing renewable energy technologies and it is expected that it will play a major role in the future global electricity generation mix. Solar PV system is also one of the most "democratic" renewable technologies. Currently, they are within the reach of individuals, co-operatives and small-businesses who want to access their own generation and lock-in electricity prices. PV technology offers a number of significant benefits, including:

- Solar power is a renewable resource that is available everywhere in the world.
- Solar PV technologies are small and highly modular and can be used virtually anywhere, unlike many other electricity generation technologies.
- Unlike conventional power plants using coal, nuclear, oil and gas; solar PV has no fuel cost and relatively low operation and maintenance (O&M) costs. PV can therefore offer a price hedge against volatile fossil fuel prices.
- PV, although variable, has a high coincidence with peak electricity demand driven by cooling in summer and year round in hot countries.

2.2 The applications of solar PV power systems can be split into four main categories: off-grid domestic; off-grid non-domestic; grid-connected distributed; and grid-connected centralised. The main components of a PV power plant are PV modules, mounting (or tracking) systems, inverters, transformers and the grid connection. Solar PV modules are made up of PV cells, which are most commonly manufactured from silicon but other materials are available. Cells can be based on either wafers (manufactured by cutting wafers from a solid ingot block of material) or "thin film" deposition of material over low cost substrates. In general, silicon-based crystalline wafers provide high efficiency solar cells but are relatively costly to manufacture, whereas thin film cells provide a cheaper alternative but are less efficient. Since different types of PV modules have different characteristics (in terms of efficiency, cost, performance in low irradiation levels, degradation rate), no single type is preferable for all projects. In general, good quality PV modules are expected to have a useful life of 25 to 30 years, although their performance will steadily degrade over this period. PV cell technologies are usually classified into three generations depending on the basic material used and the level of commercial maturity:

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- First-generation PV systems (fully commercial) use the wafer-based crystalline silicon (c-Si) technology, either single crystalline (sc-Si) or multi-crystalline (mc-Si).
- Second-generation PV systems (early market deployment) are based on thin-film PV technologies and generally include three main families: 1) amorphous (a-Si) and micromorph silicon (a-Si/μc-Si); 2) Cadmium-Telluride (CdTe); and 3) Copper- Indium-Selenide (CIS) and Copper-Indium- Gallium-Diselenide (CIGS).
- Third-generation PV systems include technologies, such as concentrating PV (CPV) and organic PV cells that are still under demonstration or have not yet been widely commercialised, as well as novel concepts under development.

2.3 Below are the key characteristics, strengths and weaknesses of the different PV technologies:

- First-generation solar cells dominate the market with their low costs and the best commercially available efficiency. They are a relatively mature PV technology, with a wide range of well-established manufacturers. Although very significant cost reductions occurred in recent years, the costs of the basic materials are relatively high and it is not clear whether further cost reductions will be sufficient to achieve full economic competitiveness in the wholesale power generation market in areas with modest solar resources.
- Second-generation thin-film PV technologies are attractive because of their low material and manufacturing costs, but this has to be balanced by lower efficiencies than those obtained from first-generation technologies. Thin-film technologies are less mature than first-generation PV and still have a modest market share, except for utility-scale systems. They are struggling to compete with very low c-Si module prices and also face issues of durability, materials availability and materials toxicity (in the case of Cadmium).
- Third-generation technologies are yet to be commercialized at any scale. Concentrating PV has the potential to have the highest efficiency of any PV module, although it is not clear at what cost premium. Other organic or hybrid organic/conventional (DSSC) PV technologies are at the R&D stage. They offer low efficiency, but also low cost and weight, and free-form shaping. Therefore, they could fill niche markets (e.g. mobile applications) where these features are required.

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2.4 In locations with a high proportion of direct irradiation including some regions of India, single or dual-axis tracking systems can be used to increase the average total annual irradiation. Tracking systems follow the sun as it moves across the sky. They are generally the only moving parts employed in a PV power plant. Single-axis trackers alter either the orientation or tilt angle only, while dual-axis tracking systems alter both orientation and tilt angle. Dual-axis tracking systems are able to track the sun more precisely than single-axis systems. Depending on the site and precise characteristics of the solar irradiation, trackers may increase the annual energy yield by up to 27% for single-axis and 37% for dual-axis trackers. Tracking also produces a smoother power output plateau as shown in Figure 4. This helps meet peak demand in afternoons, which is common in hot climates due to the use of air conditioning units. Almost all tracking system plants use crystalline silicon modules. This is because their higher efficiency reduces additional capital and operating costs required for the tracking system (per kWp installed). However, relatively inexpensive single-axis tracking systems have recently been used with some thin film modules. Support structures should adhere to country specific standards and regulations, and manufacturers should conform to ISO 9001:2000

3 Solar Electricity Generation System Installed by Japan's Grant Aid

3.1 Under Japan's grant aid program, two systems were installed in Islamabad, namely, one system at the Planning Commission (PC) and the other system at the Pakistan Engineering Council (PEC). The capacity of the system is 178 kW each and the both systems were completed in March 2012. Since then, they are operating as the first grid-connected solar power generation systems in Pakistan. The purposes of this grant aid project are to promote clean energy introduction by demonstrating grid-connected solar generation, build technical experience on solar system and its grid connection, and to contribute in mitigating greenhouse gas emission.

4 NEPRA Initiative for Determination of Upfront Tariff for Solar Power Plants

4.1 NEPRA being regulator of the power sector is cognizant of the fact that renewable energy needs to be encouraged in order to reduce the demand supply gap as well as reduction in the import bill due to less generation on RFO. This will further help in stabilizing the economy as well as reduction in pressure on exchequer. NEPRA has already announced the Upfront Tariff for Coal, Wind and baggase based power projects.

4.2 AEDB as per its mandate under Section 8 of AEDB Act, 2010, requested NEPRA to develop and announce the Upfront Tariff for Solar PV projects. Accordingly AEDB was advised vide letter dated 31-5-2012 to submit a detailed working, cost, models and basis for development of Upfront Tariff for Solar Power Plants under NEPRA Upfront Tariff (Approval & Procedure) Regulations, 2011. Chairman NEPRA and Member Tariff, after discussion meeting with Alternative Energy Development Board (AEDB), constituted the working group for development of the Upfront Tariff for Solar Power Plants. DG Tariff & DG Technical were nominated from the NEPRA. In this regard AEDB was informed vide letter No. NEPRA/R/UTS/9930 dated 7th November 2012. AEDB vide letter dated 12th December 2012 requested to convene the meeting of the working group on 15th December 2012. AEDB informed that the Punjab government has issued Letter of Intent to some companies for setting up solar power projects; therefore a nominee from the concerned department of Punjab government may also be called for discussion meeting. Meeting with reference to Feed-in-Tariff for On-Grid Solar Power Projects in Pakistan was held with the AEDB on 19th December 2012 at AEDB head office Islamabad. Following participated:

NEPRA

i. Husnnain Zaigham, DG Technical
ii. Syed Insaf Ahmad, DG Tariff

AEDB

i. Arif Alauddin, Chief Executive Officer
ii. Syed Naveed H Bokhari, Director Solar
iii. Syed Aqeel H Jafri, Deputy Director (P)
iv. Irfan Yousu, Deputy Director (CDM)
v. Muhammad Qadeer, Support Officer

Donor Agency / GIZ

i. Ali Yasir, Component Manager
ii. Areeb Hussain, Technical Advisor

Private Sector

i. Lt Gen (R) Shujaat Dar, Advisor of SSPPL

4.3 During the meeting AEDB's consultants GIZ gave a presentation on their "working paper for solar PV upfront tariff development". GIZ gave an overview of the global solar PV power project costs, feed in tariff mechanism and average capacity factors. GIZ in their presentation suggested a tariff number of 23.2934 USc/kWh as Upfront Tariff number. According to GIZ, the number was calculated on the basis of NEPRA cost plus tariff procedure

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assuming global averages for capital cost, operational cost and power production, whereas the financing parameters were taken from the wind upfront tariff announced by NEPRA and recent market statistics.

4.4 In the meeting it was agreed to adopt the GIZ's working paper, model and the parameters stated therein for initiating consultative process for determination of solar upfront tariff. AEDB however showed its inability to verify and authenticate the production numbers without reliable solar resource potential data. NEPRA was requested to suggest the solar resource potential data acceptable to them for verification.

5 Proposed Tariff by GIZ

5.1 GIZ proposed Feed-in-Tariff/Upfront Tariff of US¢ 28.3440/ kWh comprising US¢ 26.9268/ kWh for first ten years and US¢ 12.7106/ kWh for the remaining 15 years for electricity delivered by the eligible facility at the interconnection point on LIBOR based financing.

5.2 The above proposed tariff was worked out on the basis of following assumptions:

i. Project cost per MW comprised as under:

Cost Head	Amount (US$)
EPC (Per MW)	2,000,000
LC Confirmation	24,000
Provincial Infrastructure Development	14,400
Sub-total EPC	**2,038,400**
Non-EPC cost	150,000
Project Development Cost	60,000
Insurance	27,518
Financial Charges	62,788
IDC	53,234
Grand Total	**2,391,941**

ii. The debt equity ratio is 75:25

iii. 6-month LIBOR @ 0.75% with spread of 4.60%.

iv. Internal Rate of Return (IRR) 17% per annum.

v. Annual energy production 1,489,200 kWh per MW per annum based on capacity factor of 17%.

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vi. Reference exchange rate Rs. 95/US$, reference US CPI (Urban consumers) 228.62 and reference WPI manufactures 169.99 both for the month of June 2012.

vii. Per MW OPEX structure is as follows:

Cost Head	Amount (in US$)
Fixed O&M	35,879
Insurance	27,000

viii. The useful life of the project is 25 years on Build-Own-Operate (BOO) basis, which would also be the length of the contract for the electricity produced.

ix. The construction period of the project after financial close would be a maximum of 09 months.

x. There will be no adjustment or true-ups in the tariff at Commercial Operation Date.

xi. IPPs are exempted from all taxes and duties; exemptions are also given from taxation of profit and gains derived from electric power generation under Energy Purchase Agreement.

xii. IPPs will be given guaranteed grid access.

xiii. Immediate land allocation for the projects.

xiv. The upfront tariff will be based on the cost of generation.

5.3 The indexations / escalation on the relevant tariff component as per the power policy to be applicable to the projects opting for upfront tariff.

5.4 A generation facility that would meet following requirements will be eligible for award of Upfront tariff:

i) the electricity will be generated utilizing solar PV as the sole renewable energy resource.

ii) the generation facility will be interconnected to the distribution facilities of a distribution company or the transmission facilities of the national grid company

iii) the minimum installed capacity of the generation facility is 1 MW, provided the Authority allows a deviation up to 10%.

iv) The maximum installed capacity of the generation facility is 10 MW, provided, the Authority allows a deviation up to 10%.

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v) The project comprising the generation facility is undertaken on build-own-operate (BOO) basis

5.5 The GIZ's proposal was submitted for consideration of the Authority; the Authority decided to initiate consultative process with the stakeholders on the basis of working submitted by GIZ. Accordingly advertisement was published in the national newspapers on 7th February 2013 for comments / input / views.

5.6 AEDB vide letter dated 14th February 2013 (received on 15th February 2013) however refused to endorse the proposal / model / document submitted by GIZ to NEPRA in this regard. According to AEDB, in the advertisement it was stated that "this document is prepared to support NEPRA in taking suo moto action for announcing Feed in Tariff / Upfront Tariff." AEDB stated that if NEPRA is basing its suo moto proceedings on this document, it is NEPRA's own discretion / decision and should be without any reference to AEDB as AEDB does not endorse all input/output numbers used / calculated. Accordingly AEDB requested NEPRA to rectify this statement by acknowledging that the working / methodology / model for proposed solar Upfront Tariff was not attributed to a position taken by AEDB. In the aforementioned letter AEDB further stated that "AEDB believes that US Cents 23.2934 / kWh being considered by NEPRA is extremely high and proposes NEPRA to reconsider these number in light of the global / regional tariffs which will be significantly lower. AEDB also requested NEPRA to focus on decentralized solar applications.

5.7 The AEDB's stance was viewed in the light of its role defined in the Alternative Energy Development Board Act 2010 with respect to assisting and facilitating development and generation of Alternative Renewable Energy to achieve sustainable economic growth with transfer of technology for development of indigenous technological base through a diversified energy generation. Under Section 8(d)(iv) AEDB's role has also been described as "undertaking technical, financial, and economic evaluation of the alternative or renewable energy proposals as well as providing assistance in filing of the required licensing applications and tariff petitions to National Electric Power Regulatory Authority (NEPRA)". Shying away from the responsibilities enshrined in the AEDB Act 2010 to assist and facilitate the Authority is not appreciated. In the past AEDB itself has been requesting NEPRA to take suo moto action and announce the Upfront Tariff for Solar PV Power Projects. Accordingly AEDB was advised vide letter dated 31-5-2012 to submit a

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detailed working in this respect in accordance with the NEPRA Upfront Tariff (Approval & Procedure) Regulations, 2011.

5.8 Since AEDB did not provide any study or report in support of its stance regarding the GIZ's working, therefore the Authority was constrained to adopt the working submitted by GIZ for initiating consultative process in order to develop the Upfront Tariff for Solar Power Plants. Accordingly the advertisement was published for comments / views of the stakeholders.

6 Comments from the Stakeholders

6.1 In response thereof the comments in the matter were received from the following stakeholder:

1. Fauji Fertilizer Company Limited
2. Renewable Resources (Pvt) Limited
3. Roshan Power (Pvt) Limited
4. Precision Advocate
5. Mr. Akhtar Ali, Energy Consultant, Karachi
6. Zypher Power (Pvt) Limited

6.2 **Fauji Fertilizer Company Limited** (FFC) appreciated the initiative taken by NEPRA for determining Feed In Tariff of upfront solar power projects. According to FFC this will substantially reduce procedural processes and time frame required for tariff approvals. FCC submitted following comments:

a. **Equity IRR:** As per the assumptions set out under the FiT a 17% IRR has been assumed for the purpose of development of the return on equity component. Given (a) the nascent nature of the solar PV sector in Pakistan, (b) non-availability of bankable concession documents, (c) circular debt issues adversely impacting the local power sector (d) Pakistan's sovereign debt rating and its impact on required rate of return for equity holders (as determined through various recognized return models) (e) uncertainti8es surrounding gird availability, land acquisitions issues, etc., and (f) IRR allowed under other upfront tariff determination issued by NEPRA to renewable energy projects, it is evident that an IRR of 17% is below par for solar PV investors. In light of the above it is kindly prayed that NEPRA allow an IRR of at least 18% to solar PV developers in line with that allowed to wind power developers under the upfront tariff allowed to them.

b. **Spread over LIBOR:** As per the assumptions set out under the FiT a spread of 4.6% over LIBOR has been assumed for the purpose of computing the interest during construction and interest charge component of tariff during the loan repayment term. Given (a) the geo-political condition, (b) prevailing credit rating of Pakistan, and (c) circular debt issues, international lenders have gone to the extent of asking for a spread of 5.25% over LIBOR. It is therefore submitted that as a bare minimum, the FiT should be developed based on the same assumptions regarding spread over LIBOR as those allowed to other renewable energy projects, such as wind power projects – spread of 4.75% over LIBOR has been assumed under the wind upfront tariff proposed by NEPRA.

c. **Option for KIBOR Based Financing:** Unlike the upfront tariff recently published for wind power projects, the Fit published by NEPRA for solar PV projects assumes 100% foreign source financing to be secured by Solar PV project developers.

d. The Authority is kindly requested to consider issuing a variant of the current FiT based on 100% local source (KIBOR) financing thereby allowing the solar PV developers to opt for one of the two tariff's (LIBOR / KIBOR based) or a mix of the two – as has been allowed to wind power developers under their respective upfront tariff.

e. **Pre-Commercial Operation Sale of Electricity.** Wind power projects have, under the upfront tariff been, allowed to commence sale of electricity even prior to achievement of commercial operations. No such allowance has been granted to solar PV based power projects under the FiT. NEPRA is kindly requested to permit pre-commercial operation sale of electricity to solar PV based power projects in line with the concession granted to other renewable energy projects.

f. **Coverage against Adverse Climatic Conditions:** NEPRA had, while withdrawing the wind risk coverage offered to wind power projects, allowed windpower projects coverage against adverse climate changes that affect the energy production capability of wind farms (ref: Para 8 (v) of the upfront tariff determination for wind power projects dated Oct. 6,2011). Keeping in view that power generation through solar PV is also dependent on prevailing climatic conditions and could materially be affected by adverse climatic charges; NEPRA is kindly requested to allow similar coverage to solar PV based power generation projects.

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g. **True up possibility not existing:** Wind power Projects have been provided the true up possibility which does not exist under the FiT for solar Power Projects. NEPRA is requested to allow the true up possibility at least for the first 500 MW.

h. **Nine months COD after financial close:** The nine months COD after financial close very tight considering our experience on wind power projects and complexities of dealing with numerous government agencies. Since mostly the delays occur in signing of EPA, we recommended that COD limit must be lined with singing EPA and approvals of design and equipment of solar power plant by NTDC/DISCO.

i. **Bankable Concession Agreements:** Bankable concession agreements are a requirement for the success of any infrastructure project and the associated tariff regime. It has been observed in the past, the upfront tariff's issued by NEPRA have not been successful due to non-availability of bankable concession agreements. Therefore, it is recommended that NEPRA issue directive to the Alternate Energy Development Board (AEDB) and power purchaser for development of a bankable Implementation Agreement ("IA") and the Energy Purchase Agreement ("EPA") for solar PV power projects especially given the fact that these documents would most likely require approvals from various ministries and the Economic Coordination Committee.

j. **Payment Structure under the EPA:** It has been noted in the past that there are typically differences in opinion on the interpretation of NEPRA's tariff orders between projects developers and the power purchaser. This leads to unnecessary delays in finalizations of the EPA. Given the fact that NEPRA is the sole regulatory authority having discretion on the tariff to be charged by power producers for sale of electricity, it is requested that the payment, invoicing and indexation / escalation mechanism to be specified in the EPA (Section 9 and Schedule 1 of the EPA) be included a as part of the FiT proposed by NEPRA.

k. **EPA with Distribution Companies:** The EPA is a complicated bankable document developed between the power purchaser (namely, Water and Power Development Authority ("WAPDA"), Central Power Purchasing Agency ("CPPA") and National Transmission and Despatch Company ('NTDC") the power producers and their lenders over the last 17 years. The original power purchase agreement ("PPA") developed as part of the feed-in tariff introduced in 1994 was the brain child of Thomas S. West (Founder and Managing Partner of the West Firm, PLLC). Mr. West had extensive experience in oil,

gas and energy sectors along with in depth knowledge of lender retirements for non-recourse project financing of power sector projects. The PPA created by Mr. West was used not only by all the power projects falling under the 1994 Power Policy but also by projects that came under the subsequent Power Policy, 2002. The same PPA, after incorporation of changes necessitated due to differences in technology, was adopted by the wind power projects that came under the RE Policy 2005. Due to WAPDA/CPPA/NTDC's history associated with negotiating and executing the PPA, the power purchaser has over the years gained considerable knowledge, understanding and comfort with the PPA; the power purchaser even has specific contracting teams that are cognizant of the requirements and reason for the PPA being framed the way it stands today. On the other hand, distribution companies ("DISCOS") do not have any first hand experience of executing power purchaser agreements directly with power producers. The time required to explain and negotiate the EPA with DISCOS can be detrimental to the development of solar PV projects. Therefore, NEPRA is kindly requested to instruct AEDB to prepare a standardized draft of the EPA for solar PV based power projects which should be amended only to cater for project specifics without any deliberation over other contractual clauses.

l. **Construction Period and Grid Availability:** As per the standard draft of the EPA for other renewable energy projects, the power purchaser is required to ensure that the grid is available for evacuation of power from the respective power generation facility 180 days prior to the scheduled date of achievement of commercial operation. The 180 day period is acceptable to the power purchaser as the total construction period for wind power projects typically ranges between 15 to 18 months, allowing the power purchaser a lead time of 9 to 12 months for making necessary arrangements for ensuring availability of grid by the time stipulated under the EPA.

m. **Assurance of Grid availability at interconnection point:** The grid should be made available at the point of interconnection of the solar power plant at seller's door step given that the total construction period of a solar PV based power project has been assumed as 9 months under the FiT, NEPRA is kindly requested to direct the power purchaser to adhere to the same standard of making the grid available 180 days prior to the scheduled date for achievement of commercial operations as agreed with wind power projects in order to ensure timely completion of testing and commissioning activities.

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n. **EPC Cost specified on Per MW Basis:** As per the table set out under Para 2 of the FiT published by NEPRA, the EPC cost line item has been specifically stated as "(Per MW)", whereas no such qualification has been stipulated against the other "Cost Head" provided in the aforementioned table. NEPRA is kindly requested to clarify that all the costs stipulated in said table are specified on per MW basis.

o. **Indexation & Escalations:** The FiT specified that 6-month LIBOR @ 0.75% per annum has been assumed for the purpose of the FiT, whereas the "Working Paper for Solar PV Upfront tariff Development" available on NEPRA web-site specifies that quarterly indexations and escalations should be applied to LIBOR (and other tariff components). Kindly clarify:

(a) The indexation/escalations to be applied to the various components of tariff, and
(b) Reason for use of 6-month LIBOR while quarterly (3-monthly) indexation is to be applied on interest charge component.

p. **Eligibility for opting for FiT:** As Para 5 of the FiT published by NEPRA, it appears that only those project would be eligible to opt for FiT that are (a) currently holding a valid letter of intent ("LOI") issued by AEB, and b) have not been granted a tariff by NEPRA under the cost plus regime. NEPRA is kindly requested to consider that (a) projects that are subsequently awarded LOI's by AEDB should also be entitled to opt for the FiT, an (b) projects that have already been awarded tariff under the cost plus regime can opt for FiT now since they pursued the cost plus option only due to the fact that there was no other option available at the time. To bring the record straight we wish to bring to your notice that FFC is already in contact with AEDB on the matters of land allocation for Solar PV based plant and we intend to very soon also apply for LOI.

q. **Addendum/Amendment to Grid Code:** The Grid Code currently does not encompass solar PV based power generation facilities to be connected to the national grid. As was the case for connecting wind power generation facilities, certain amendments/addendums to the Grid Code were necessitated to ensure seamless integration of wind power generation facilities with the national grid, said addendums/amendments were made by NEPRA keeping in view the requirements an limitations of win power generation facilities. Similarly, an addendum/ amendment to the Gird Code would be necessary for connecting solar PV based power generation facilities to the national grid, NEPRA is, therefore, requested to kindly propose the amendments / addendums to be

made to the Grid Code for review by potential solar PV developer and their technical consultants.

r. **Clarifications**

i) We understand that this FiT is only for PV based solar projects. Since solar thermal based plants are also becoming competitive and have significant capacity advantages over the PV based plants alone and also separately consider solar thermal based power projects.

ii) We are in the process of collecting the solar data through our own solar irradiance meters, however, so far we have not been able to collect data for one full year. Based on whatever data we could gather the assumed 17% capacity factor is on the higher side. NEPRA is requested to provide data to support this assumption.

6.3 **Renewable Resources (Pvt) Limited**, a consulting firm for the Renewable Energy Projects and also exclusive partner of Lahmeyer International (Germany), believed that the feed in tariff is the key to develop solar energy in Pakistan. The company submitted following comments on the upfront solar tariff:

a. Annual energy production assumed by NEPRA is 1,489,200 kWh/annum with capacity factor of 17% is higher.

b. Generally assessments are carried out on the satellite data due to unavailability of ground measurements. Having been experienced to work on 10 MW solar PV project in Kasur as technical consultants where no ground irradiance data was available. To mitigate the risk factor in energy estimation due to irradiance obtained from satellite sources, a solar measuring equipment was installed in January, 2012 within project site (Kasur, Punjab). Mast picture is enclosed with this letter. Comparative analysis of satellite data and ground measurements revealed that actual solar irradiance was even lesser than conventionally used satellite data. Details of the data can be shared if required.

c. Based on facts, the capacity factor practically achievable is lowers than 17%. Therefore higher production with higher capacity factor proposed by NEPRA is not practically achievable. It needs to be in range of 15% to 16% depending upon the location and equipment.

d. Considering the Working Paper of Solar upfront Tariff, constant tariff during first 10 years and then for next 15 years shows aging factor of PV plant is not

considered in the assessment of Capacity factor. Aging/degradation is a fundamental aspect in relation to the performance of PV cell which is generally 0.8% reduction in the energy output per annum and cumulates to 20% at the end of project life cycle. It is an important factor which is missed in the assessment.

e. Therefore annual aging/derating factor should be considered in the determination of capacity factor in line with the prudent

6.4 **Roshan Power (Pvt) Limited** (the "Project Company") is the Letter of Interest ("LOI") holder of a 10 MW solar power project (the "Project") in Kasur; Punjab an LOI issued by Punjab Power Development Board (PPDB). According to the project company, the proposed upfront tariff, though a good initiative by the National Electric Power Regulatory Authority ("Authority") to curtail the project development timeline, is based on certain assumptions which could make the project unviable. Preliminary comments are hereby being submitted by the Project Company with an aim to assist the Authority in reaching a decision which would address the concerns of all stakeholders. The company submitted following comments:

a. The Project Company has carried out a complete bankable feasibility study as well as an international bidding process for the EPC of the Project. Based on our findings it is our opinion that Project costs assumed under the proposed Upfront Tariff is on the lower side especially in case of the EPC Costs and Project Development Costs.

b. The Project capacities allowed in the proposed upfront tariff range from 1 MW to 100 MW. In case of Solar PV, the non-EPC and Project development costs will vary substantially and standard costs proposed will be higher on a per MW basis for smaller projects.

c. Project of larger size may require provision of additional equipment, which should be accounted for in the proposed upfront tariff.

d. Annual energy production assumed under the proposed tariff is 1,489,200 kWh/annum based on a capacity factor of 17%, which in our opinion is aggressive. Generally, solar assessments are carried out on the satellite data due to unavailability of ground measurements. The Project Company installed an international standard measurement station in January 2012 and has recently assessed the 12 months data. Comparative analysis of satellite data and ground measurements has revealed that actual solar irradiance was even lesser than

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conventionally used satellite data. Details of the data and analysis can be shared if required. Based on facts, the capacity factor practically achievable is lower than 17%.

e. Solar PV panels have an aging/degradation factor on account of which, there is a constant decrease in output with life. Aging/degradation is a fundamental aspect in relation to the performance of Solar PV plants and is generally in the range 0.8-1.2% per annum, which cumulates to 20% at the end of project life cycle. Degradation is very important parameter and it seems the same has not been considered in the proposed tariff.

f. The EPC Cost should be increased by at least 25% and should be based on the installed capacity of the plant.

g. The Project Development Cost should be increased to at least US$ 200,000 per MW especially for smaller projects.

h. The Tariff should be based on an annual capacity factor of 14% to 15% depending upon equipment and location.

i. The annual degradation of solar equipment should either be incorporated in the tariff or directions issued that the matter be addressed in the energy purchase agreement based on manufacturers' recommendations.

j. In case the power purchaser requires interconnection at a voltage other than 11 kV, cost for additional sellers' interconnection equipment should be adjusted in the tariff.

6.5 **Precision Advocate** submitted following comments on the upfront solar tariff:

a. NEPRA mainly held the public hearing for soliciting views of experts, public representatives in respect of proposal which was mainly put up by GIZ, as provided on its website, further endorsed by AEDB. Alternative and Renewable Energy Resources (ARE) need to be promoted in Pakistan, as our dear homeland is blessed with requisite ARE resources, including solar (ideal irradiation) in abundance. However, being a poor country both availability and affordability of power is important. Hence, while availability of power is an urgent requirement under the current shortage scenario, it's availability is also desirable at affordable rates. Here NEPRA's attention is invited to the fact that it has itself restricted NTDC to implement a least cost expansion plan as per the provisions of its licence; responsible to transmit power all over the country except for the area served by KESC.

b. A comparison of costs undertaken by United States Energy Information Administration (EIA) between a 150 MW PV solar project and 500 MW hydro project showed that their levelized cost per kWh is 15.27 cents and 8.89 cents, respectively. This comparison assumed 2012 overnight capital cost of $4,755 per kW for solar and $3,078 per kW for hydro; capacity factor of 25% for solar and 53% for hydro; and commissioning of both projects in 2017. The comparison also assumed hydro to have seasonal storage so that it can be despatched within a season. Though EIA assumes much higher costs for both technologies; the capital cost of 500 MW solar project may be estimated to about $3 per Watt, if so then per kWh levelized cost of both technologies will be equal.

c. As per NEPRA's estimates, it is like $ 239 cents /W estimated at a cost of $ 2,391/KW, though lesser than the one quoted in some older analysis of US Energy. But the capacity plant factor is only 17 % instead of 25 % as mentioned therein. So the levelized estimated cost of solar electricity becomes about 24 cents/KWH, instead of 15.27 cents quoted therein. There are a number of indexation factors which will escalate the real costs further once reaching to payment time. According to the tariff determination system in vogue, the tariff for the first ten years may then become 32-35 cents + escalations and then fall to something like 15 cents after 10 years of front-end loading period expires. Hence, this might become the real cost of the solar electricity (on the assumptions selected) which should be compared to hydropower cost of 8.8 cents as quoted by different experts. On the other hand, if the cost of $ 2.3/W is the cost and the plant factor is around 30% or above (which is more likely the case for Pakistan, particularly in the south, where rains and clouds are less frequent and days are longer), the cost of electricity from solar should be around 10-12 cents/KWh or lesser, on levellized basis. These issues need to be taken full cognizance by NEPRA.

d. On the other hand, one must consider that besides the benefits of power generation in case of dam projects, they also provide additional benefits. The benefits of water storage in these dams even if they are for few months are tremendous. We have noted that Pakistan was not self- sufficient in food commodities like Wheat, Rice, Sugar Cane, Milk etc. in 1951 while its population then, was only around 20 million for West portion. Now the same items are quite sufficient, rather surplus (being exported and also smuggled) after consumption of a population of 185 million. The per capita consumption has also increased now due to higher standard of living of quite many. This has happened mainly due to a planned and better organized distribution of water

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for irrigation through the canal system and making utility of the mega storages like Tarbela, Mangla, Chashma, complemented by the barrages and small storages. So the benefits to irrigation need to be quantified in their real values and added for the purposes of our analysis. Alternatively, a reasonable/sizable portion of overall cost of the dams should be subtracted for analysis and estimation of cost of production of electricity from the proposed mega dams/Hydro power plants for cost-benefit analysis.

e. While people of this country would like to see solar plants being promoted, we need to learn from best practices around the world. Nowhere these solars have been promoted initially through utility scale solar IPP installations. Mostly, Solar Home Systems (SHS) have been promoted with direct subsidies to the installers of these systems with regimes for net-metering of surplus power injected in to the grid by the consumers through local utilities. NEPRA should take priority steps to promote such regimes for installation of SHS by the consumers, which are hundreds of them able to fund the same and provide requisite support to their local distribution companies in these times of shortages. By taking this strategic move, indigenous solar industry will get promoted and Pakistan would be better equipped to scale up its SHS to utility scale solar plants, leading to acceptable cost benchmarks etc. as well. This strategy will also result into do away with the line losses and the associated 25% cost as per existing figures and make the Solar systems viable. In view of the above, NEPRA is requested to keep the upfront tariff at the calculated minimum optimized, and look reasonable in comparison to other technologies. NEPRA is, once again urged to promote usage of SHS by laying out the regime for utility compulsory acquisition of surplus power from consumer owned SHS. The organizations promoting the instant initiative remain available for providing any further assistance to the Authority in order to support an informed decision in the matter.

6.6 **Mr. Akhtar Ali from Karachi** forwarded the following comments on upfront solar tariff:

a. We should have an appetite for Solar PV of around 100 MW at the prevailing PV prices, which compares with a corresponding figure of 1000 MW of Solar PV installed capacity by 2013 in India.

b. The proposed tariff should be and can be brought down to around US$ 0.20 per kWh, for the following reasons; current Solar bids in India are at the rate of US$ 0.15 per kWh. In the U.S. in the states which have comparable solar intensity as in Pakistan, i.e. California, Florida, Texas and Hawaii, Solar PV

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FIT rates are around US$ 0.15-0.17 per kWh. California is known as paradise for renewable energy in terms of supportive policies. In Germany FIT is at US$ 0.2243 per kWh, at very low solar intensity, almost half than that in Pakistan.

c. Solar PV module prices are continuously coming down. In Germany, solar PV Crystalline modules sold (spot market) at a rate of US$ 0.78 per Watt (p); for Chinese modules, the corresponding price was US$ 0.53 per Watt(p). both the Chinese and the German prices came to one-third of its level prevailing in Jan 2010. Upward-tariff policy has to take into account this factor and tie the tariff to these prices.

d. Balance of the System (BOS) cost is generally as much as module prices. BoS to Module prices ratio has gone up (1:2) recently due to reduction in Solar PV prices, as corresponding cost reductions could not have been made in BoS. By this account, the total installed cost should be around or under 2.0 US$ per Wp. Similarly Chinese prices should be around or under US$ 1.05 per Wp.

e. If DISCOs are allowed to invite international bids for the purchase of Solar PV electricity, it is quite possible that bids in the range of US$ 0.16-0.18 per kWh may be obtained as opposed to the proposed US$ 0.2329 per kWh. It would be possible if foreign companies without the heavy baggage of local parties are involved. Local parties get credit at higher prices and beef up costs to save equity, as it is widely known. A foreign company would easily get a loan at less than 3% over LIBOR than the assumed spread of 4.5% also it would be more than happy to earn 12-15 % on its equity as opposed to a tax-free RoE of 17% offered by us, on an equity that does not exist at all. Based on the afore-mentioned, it should not be impossible for bidders to come up with the prices of US$ 0.15-0.18 per kWh. Standard PPA terms should be developed as soon as possible for Solar, PV, as these influence costs as well. A clear definition should reduce project risks which would directly affect price offerings.

f. An open auction of Solar PV projects should be invited by DISCOs around a Reference Tariff of US$ 0.20 per kWh asking for discounts. This has enabled India to achieve remarkable savings. An incentive for local content up to 10-15% of the main tariff may be provided.

6.7 **Zepher Power (Pvt) Limited** requested to consider the following factors for determination of upfront tariff for solar projects:

a. Standard solar cells typically experience and oxidation reaction when first exposed to light, meaning they lose up to 33% production capacity within days

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of being installed. The amount of light-induced degradation has a substantial impact on the total electricity that a system can produce over its lifetime. There would be system degradation 0.5% - 0.7 % per annum of solar project.

b. There would be system availability of 98% of solar project.

c. There would be inflation in O&M cost per annum in solar project. NEPRA allowed the inflation in O&M cost in the wind power projects. We request NEPRA to keep the same in the solar upfront tariff.

7 Issues

Having considered the submissions of the stakeholders, following issues have emerged from the proceedings:

1) Solar Irradiation
2) Plant Capacity Factor
3) EPC Cost
4) Non-EPC and Project Development costs
5) Insurance Cost
6) Finance Fees & Charges
7) Interest During Construction
8) Operation & Maintenance Cost
9) Insurance Cost
10) Total Project Cost
11) Project Financing
12) Indexations

8 Solar Irradiation

8.1 Site selection and planning of PV power plants requires reliable solar resource data. Power production depends linearly on the plane of array irradiance, at least to a first approximation. The solar resource of a location is usually defined by the values of the global horizontal irradiation which includes both direct normal irradiation and diffuse horizontal irradiation. GHI is the total solar energy received on a unit area of horizontal surface. It includes energy from the sun that is received in a direct beam (direct irradiation) and from all directions of the sky when irradiation is scattered off the atmosphere (diffuse irradiation). The yearly sum of the GHI is of particular relevance for PV power plants, which are able to make use of both the diffuse and beam components of solar irradiance.

8.2 Irradiation is measured in kWh/m2, and values are often given for a period of a day, a month or a year. A high long term average annual GHI is typically of most interest to PV project developers. Average monthly values are important when assessing the proportion of energy generated in each month. Long term annual average values of GHI and DNI can be obtained for a site by interpolating measurements taken from ground based sensors or indirectly from the analysis of satellite imagery. Ideally, historical values of daily or hourly irradiation with a special resolution of 10 km or less are required to generate regional solar atlases.

Satellite Derived Data

8.3 Satellite-derived data can offer a wide geographical coverage and can often be obtained retrospectively for historical periods in which no ground-based measurements were taken. This is especially useful for assessing long term averages. A combination of analytical, numerical and empirical methods can offer half-hourly data with a nominal spatial resolution down to 2.5 km, depending on the location and field of view of the satellite. One advantage of satellite resource assessment is that data is not susceptible to maintenance and calibration discontinuities. The same sensor is used to assess locations over a wide area. This can be particularly useful in comparing and ranking sites as bias errors are consistent. A comparison of the GHI values shows that statistics obtained from satellite readings correspond well with ground-measured data. But it is not so in the case of DNI values. Currently, it is not so clear if this dissonance is due to the satellite methodology or the poor maintenance of ground-based measurement stations, but is likely to be a combination of both.

8.4 Solar Irradiance is a measure of how much solar power you are getting at your location. This irradiance varies throughout the year depending on the seasons. It also varies throughout the day, depending on the position of the sun in the sky, and the weather. Solar insolation is a measure of solar irradiance over a period of time - typically over the period of a single day. This irradiance calculator takes data collated over a 22 year period to provide monthly average insolation figures. This information is then used to calculate the average daily power generation a photovoltaic system will produce in any given month.

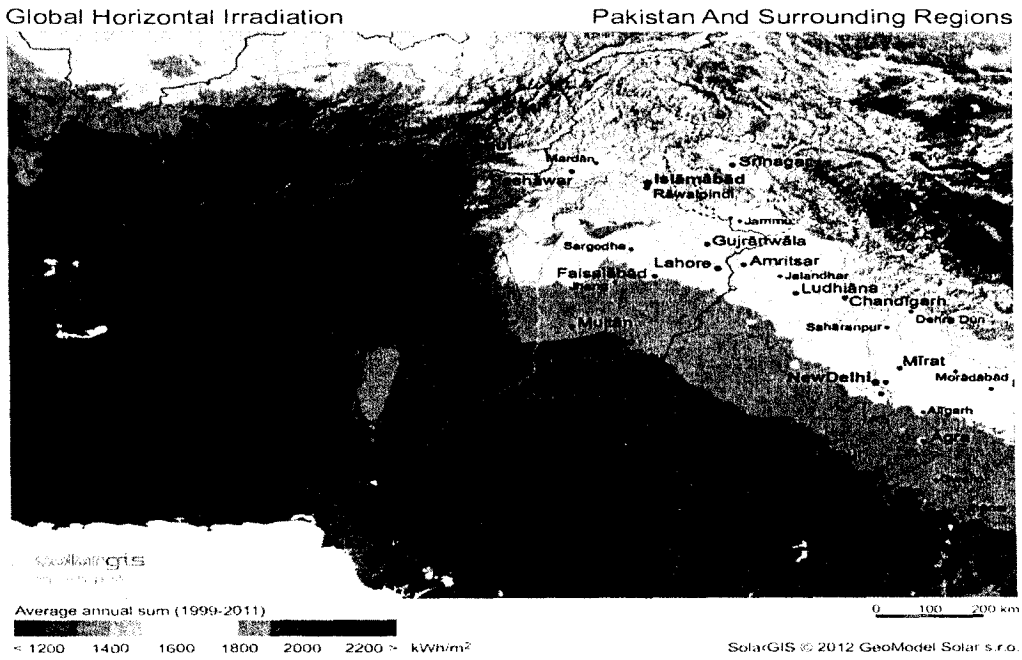
Variability in Solar Irradiation

8.5 In terms of irradiation, the solar resource is inherently intermittent. In any given year, the total annual global irradiation on a horizontal plane varies from the long term average due to climatic fluctuations. This means that though the plant owner may not know the energy yield to expect in any given year, he can have a good idea of the expected yield averaged over the long term. To

help lenders understand the risks and perform a sensitivity analysis, it is important to quantify the limits of the inter-annual variation. This can be achieved by assessing the long-term irradiation data (in the vicinity of the site) sourced from nearby MET stations or satellites. At least 10 years of data are usually required to give a reasonably confident assessment of the variation. Research papers show that for southern Europe (including Spain), the coefficient of variation (standard deviation divided by the mean) is below 4%.

Solar Irradiance in Pakistan

8.6 Pakistan receives high levels of irradiance across the board. However, there is a significant change of irradiance from North to South. The map below divides Pakistan into 4 main irradiance bands – yellow, pale orange, dark orange and ochre; the irradiation intensity increases with the depth of colour.



The highest levels of irradiance are found in Balochistan, Sindh and southern Punjab. Northern Punjab, ICT, FATA, KPK, Azad Kashmir receive lower irradiance.

Rationale for Proposing a Tiered Tariff Structure

8.7 A tiered tariff is a tool to balance competing interests of IPPs and the Government and general public. In this case, it is in the interest of the IPP to build his solar power plant in the area with the best natural resource profile to maximize his return. The government's interest is to receive energy generation

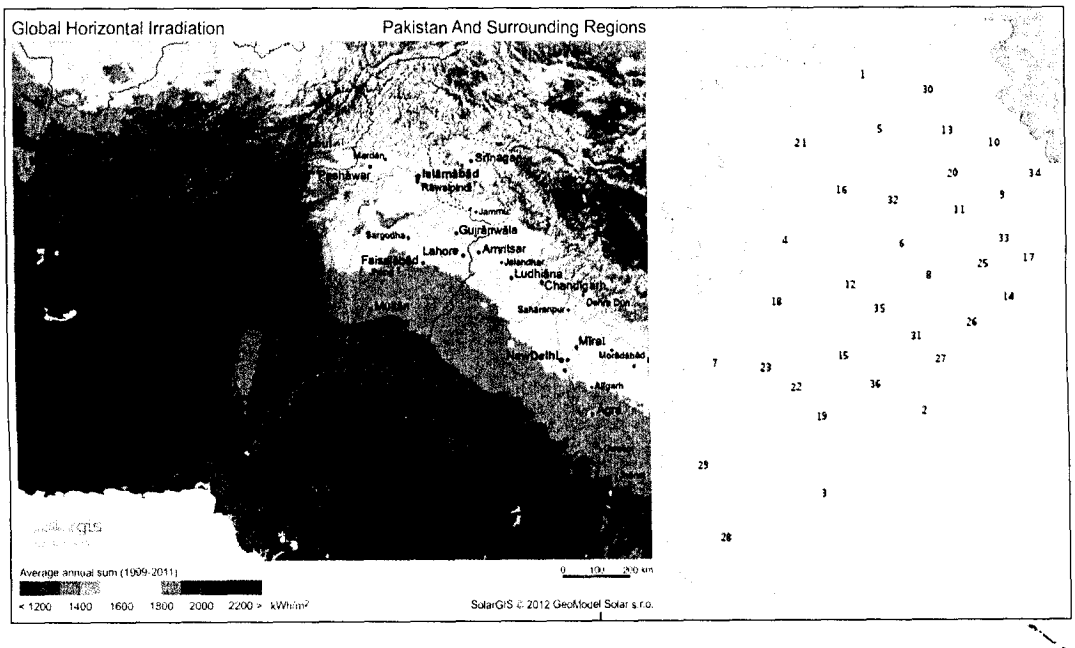
close to the load centers, thereby reducing the required investment in T&D infrastructure and minimizing transmission losses.

8.8 To provide a simple, robust and confident tier structure, the number of tiers should be kept in check. The Authority believes that, given the solar irradiance profile of Pakistan, the following two tiered structure is ideal:

South Region = high sun regions (dark orange and ochre bands on the insolation map)	**North Region = lower sun regions (yellow and light orange bands on the insolation map)**
• Balochistan • Sindh • Southern Punjab (including Cholistan)	• Northern Punjab • Federally Administered Tribal Areas • Kyber Pakhtunkhwa • Islamabad Capital Territory • Azad Kashmir • Gilgit-Baltistan

Punjab – Division into North and South

8.9 Given the irradiance profile of the country, there is a clear division of Punjab in lower irradiance and higher irradiance areas.



Method of division	Main advantage	Main disadvantage	Verdict
Latitude/Longitude	Simplicity; rigidity	Disregards all real-world parameters	Least preferred option due to over-simplification
Natural contours	Usually undisputed and pre-dating present borders	Not always available	Not available; rivers run north to south
Administrative Regions	Easy to implement w.r.t. permits, approvals etc.	Possible mismatch with irradiance boundaries	Slight mismatch, but best fit for purpose

Administrative regions are the intuitive approach, since the determination, approval and enforcement of a tariff is, in essence, an administrative act. The boundaries of the administrative regions of Punjab do not match the solar irradiance boundary perfectly. However, the advantages of the administrative region method outweigh this discrepancy clearly. A list of administrative regions for inclusion in South Region is provided below. All other districts will be included in North Region.

South Region districts – southern Punjab

District	Map reference
Rahim Yar Khan	28
Rajanpur	29
Dera Ghazi Khan	7
Muzaffargarh	23
Multan	22
Lodhran	19
Vehari	36
Bahawalnager	2

9. Plant Capacity Factor

9.1 The capacity factor is a measure of operating efficiency which indicates the ability of a generating plant to deliver its full capacity. It is simply the generator's actual energy output for a given period divided by the theoretical energy output if the machine had operated at its full rated power output for the same period. It is indirectly an indicator of the reliability of supply.

9.2 Capacity factor is a measure of how often an electric generator runs for a specific period of time. It compares how much electricity a generator actually produces with the maximum it could produce at continuous full power operation during the same period. For example, if a 1 MW generator produced 5,000 MWh over a year, its capacity factor would be 0.57 because 5,000 MWh equals 57% of the amount of electricity the generator could have produced if it operated the entire year (8,760 hours) at full capacity and produced 8,760 MWh of electricity. Generators with relatively low fuel costs are usually operated to supply base load power, and typically have average annual capacity factors of 80% or more. Generators with lower capacity factors may indicate they are in operation during peak demand periods and/or have high fuel costs, or their operation depends on the availability of the energy source, such as hydro, solar, and wind energy.

9.3 The capacity factor of a conventional nuclear or coal fired power plant is under management control and may be over 80%, whereas the capacity factor of a solar power plant will be much less than the conventional power plant and depends on the sun shine hours which vary from month to month. The Authority sought energy estimates based on Meteonorm data by AEDB duly verified by IfE Germany. Based on the verified energy estimates, the Authority has decided to adopt plant capacity factors of 16.78% for north region and 17.5% for south region of the rated out of the installed solar panels. In case the actual output exceeds the minimum output, the excess energy will be charged as per the table provided in the Terms & Conditions to this determination.

10. EPC Cost

10.1 The absolute cost and structure of PV modules varies by technology. Conventional c-Si PV modules are the most expensive PV technology, with the exception of CPV modules, but they also have the highest commercial efficiency. However, CIGS modules are approaching the efficiency levels of c-Si modules and are cheaper. Accurate data on global average PV module prices are difficult to obtain and in reality there is a wide range of prices, depending on the cost structure of the manufacturer, market features and module efficiency. Balance of system cost is one of the other major cost components. The BOS costs and installation comprise the remaining capital costs for a PV system. The BOS costs largely depend on the nature of the installation. The inverter is one of the key components of a PV system. It converts the DC electricity from the PV modules into AC electricity. Inverter sizes range from small textbook-sized devices for residential use to large container-sized

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solutions for utility-scale systems. The size and numbers of inverters required depend on the installed PV capacity and system design options. Inverters are the primary power electronics components of a PV system and typically account for 5% of total installed system costs. Combiner box and miscellaneous electrical components include all remaining installation components, including combiner boxes, wires/conductors, conduits, data monitoring systems, and other miscellaneous hardware. Combiner boxes are the only PV system-specific product included in this category and they are sourced from dedicated manufacturers who supply pre-engineered systems. Other miscellaneous electrical hardware (e.g. wires, electrical conduits, overcurrent protection) are commodity products and can be sourced virtually anywhere. Site preparation and system installation are major components of the BOS and installation costs. System design, management and administrative costs include system design, legal, permitting, financing and project management costs. For residential and small-scale PV systems, these costs are typically included in the total PV installed prices quoted by companies. For large-scale installations these costs might be managed directly by the promoter or sub-contracted to a service provider. When PV system costs are quoted in literature, these costs are typically included in overhead costs and profit margins. These soft costs depend significantly on local conditions. In the United States (2010), they accounted for an average 37% of total system costs (GTM Research, 2011).

10.2 GIZ assumed an EPC cost of US$ 2.0384 million per MW of PV solar power plant. It is fact that solar PV prices have drastically came down over the years and are expected to go down further in the coming years. The EPC cost also depends on the scale of the project. In view of all these factors and current price trend, the Authority considers that US$ 1.693 million per MWp (offshore & onshore) for PV solar power plant is reasonable estimate and accordingly EPC cost of US$ 16.927083 million is approved for the 10 MWp solar PV power plant.

11. Non-EPC and Project Development Costs

11.1 Non EPC and project development costs generally include land and its development cost, administrative and staff accommodation building, project vehicles, standby generator, all kind of studies, regulatory fees, independent engineer fees, administrative expenses etc. etc. GIZ assumed non EPC and project development cost of US$ 210, 000 per MW. GIZ estimate is based on the global average values and number quote by local investors. After examining the information available and discussions with the prospective

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investors, the Authority considers that US 1.32 million for non-EPC and project development cost for a 10 MWp solar PV power plant is reasonable and the same is being approved.

12 Insurance during Construction

12.1 GIZ assumed insurance cost @ 1.35% of the EPC cost (US$ 27,518/MW) as per NEPRA standards. GIZ ignored that NEPRA standard regarding insurance during construction was established for projects with constructions period of two years for entirely different technologies. For solar power plants, the construction period is approximately 8 months only and the nature of equipment is such that much less insurance cost is expected as compared to conventional power plants. Accordingly, the Authority assessed an amount of US$ 126,953 (0.75% of EPC cost) as insurance during construction for the 10 WMp solar power plant.

12.2 Cost of insurance during construction shall be adjusted at the time of COD on actual basis on production of documentary evidence subject to maximum of 0.75% of the EPC cost.

13 Financing Fees and Charges

13.1 GIZ assumed financing charges @ 3.5% of the debt amount. In line with the upfront coal tariff, the Authority approved 3.5% of the debt amount (US$ 480,985) as financing fees and charges which will be subject to adjustment at the time of COD on actual basis with maximum of 3.5% of the debt amount.

14 Interest during Construction (IDC)

14.1 On the basis of 8 months construction period, LIBOR of 0.31% and a premium of 450 basis points and debt equity ratio of 75:25, the Authority assessed IDC of US$ 150,105. The IDC will be reestablished at the time of COD with actual LIBOR, actual debt equity ratio and actual premium with maximum of 450 basis points. In case of KIBOR, the maximum allowed premium will be 350 basis points.

15. Operation & Maintenance Cost

15.1 The number of grid-connected solar photovoltaic (PV) systems is expected to increase dramatically over the coming decades. This increase in the number of PV units leads to an increased focus by utilities and other solar generating firms on achieving the highest level of performance and reliability from the

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solar asset. In addition to the typical focus of thinking about up -front costs of a solar plant, determining a plan and budget for operations and maintenance (O & M) is essential in assessing the business case for a PV facility.

15.2 Low maintenance cost is one of the principal drivers of the solar power energy. Unlike conventional electrical generation there are no rotating parts and no high pressure steam and water systems and therefore less equipment exposed to inherent wear and repair processes that typically require the generating unit to be off load, unavailable for costly investment maintenance. The maintenance requirements of a solar project typically are O&M on the electrical systems and cabling, connectors of modules, inverter equipment will typically require changeover of certain parts after 10 years. Solar modules have a typical lifetime of 25-30 years. Regular cleaning of modules and measuring equipment is important as is ground maintenance to ensure the solar panels do not become shaded by vegetation or land mass collection.

15.3 GIZ assumed O&M cost of US$ 35,879/MW on the basis of 1.5% of the project cost. On the basis of the feedback and input from the stakeholders and information received from the prospective investors, the Authority considers that 1.5% of the EPC cost is a reasonable estimate of the O&M cost for solar PV power plants and accordingly annual US$ 253,906 per annum has been assessed as O&M cost for the 10 MWp solar PV power plant.

16. Insurance during Operation

16.1 During the plant operation period of 25 years, GIZ assumed insurance cost @ 1.35% of the EPC cost (US$ 27,000/MW) for each year. The actual insurance cost of most of the thermal IPPs is less than 1% of their EPC cost. It is generally considered that due to entirely different nature of the plants, insurance cost of PV Solar plants are less than the conventional thermal power plants. Therefore, the Authority assessed US$ 169,271 (1% of the EPC cost) as insurance cost for the upfront solar tariff.

16.2 The annual operating insurance cost will be subject to adjustment on actual basis on production of authenticated documentary evidence subject to maximum of 1% of the EPC cost in Pak Rupees using the exchange rate prevailing on the 1st day of the insurance coverage period.

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17 Total Project Cost

17.1 On the basis of discussion in the preceding paragraphs, the summary of approved project cost for upfront solar tariff based on a 10MWp solar power plant on the rated capacity of the solar PV panels installed is provided hereunder:

Description	Approved (US$)
EPC Cost	16,927,083
Non EPC & Project Development Cost	1,320,000
Insurance during construction	126,953
CAPEX	**18,328,255**
Financing Fees & Charges	482,318
Interest During Construction	150,521
Total Project Cost	**19,006,875**

18. Project Financing & Cost of Capital

18.1 Based on the above project cost, following capital structure for the upfront solar tariff has been assumed:

Description	Million (US$)
Foreign Debt	14,255,157
Equity	4,751,719
Total Project Cost	19,006,875
Debt: Equity Ratio	75:25

18.2 Minimum equity for the project will be 20%. There will not be any maximum limit for financing of the project through equity. However, the equity exceeding 30% of the total project cost will be considered as debt.

18.3 The Authority has decided to allow 18% return on equity portion of the project financing. Cost of debt has been allowed on the basis of 0.31% LIBOR plus a premium of 450 basis points on foreign financing. In case of project financing through local debt, interest cost will be allowed on the basis of KIBOR plus a premium of 350 basis points. Savings, if any, in the premium will be shared by the power purchaser and the power producer in the ratio of 60:40 respectively.

19. Indexations

19.1 The following indexation will apply on the reference components the determined tariff:

Component	Indexation
O&M-Local	Local CPI (General)
O&M-Foreign	PKR/US$, US CPI
Insurance	Actual with maximum of 1% of EPC cost
Return on Equity	PKR/US$
Principal Repayments (Foreign Loan)	PKR/US$ or the applicable currency
Interest Payments	LIBOR/KIBOR, PKR/US$

20. Feedback from the Government of Punjab

20.1 In the Energy Meeting held on 31st July 2013, it was informed by the Government of Punjab that it has reached an understanding with the investors for setting up of solar PV power plants in Punjab on tariffs in the range of US Cents 13/14 per kWh which were relatively lower than NEPRA's working. Government of Punjab was requested vide letter No. NEPRA/CM/11/13 dated 16-8-2013 to provide details of the above proposal to NEPRA for finalizing upfront tariff as early as possible. Follow up letters were also sent on 6th September and 30th September 2013. Government of Punjab was also requested vide letter No. NEPRA/TRF-UTS/13149-52 dated 27-11-2013 and letter No. NEPRA/TRF-100-UTS/13282-84 dated 29-11-2013 to provide requisite information otherwise the Authority will be constrained to announce the solar tariff on the basis of available information. However no information was provided by the Government of Punjab.

20.2 NEPRA vide letter No. NEPRA/R/132-135 dated 02-01-2014 sent the basis, assumptions, working and tariff to the Government of Punjab with a request to provide comments on the proposed upfront solar tariff within seven (7) days and non reply will be considered as if the Government of Punjab do not have any reservations on the proposed upfront solar tariff. Since no comments were received from the Government of Punjab, therefore, the Authority has decided to announce the upfront tariff for solar projects on the basis of available information.

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21. Order

I. The Authority hereby determines and approves the following upfront tariff and adjustments/indexations for solar power generation for delivery of electricity to the power purchaser based on a 10MWp solar power plant on the rated capacity of the solar PV panels installed:

Specified Reference Tariff

Description	North Region		South Region		Indexations
	Year 1-10	Year 11-25	Year 1-10	Year 11-25	
	Rs./kWh	Rs./kWh	Rs./kWh	Rs./kWh	
Fixed O&M	1.8137	1.8137	1.7391	1.7391	CPI , US CPI, US$/PKR
Insurance	1.2091	1.2091	1.1594	1.1594	Actual on annual basis
Debt Service – Foreign	12.8872	-	12.3570	-	US$/PKR & LIBOR
Return on Equity	6.1097	6.1097	5.8583	5.8583	US$ /PKR
Total	**22.0197**	**9.1325**	**21.1138**	**8.7568**	

Note:

i. The above tariff will be applicable for 25 years commencing from the date of the commercial operations.

ii. The reference Component wise tariff is attached at Annex-I for North and Annex II for South regions. Debt Servicing Schedules for north and south regions are attached at Annex-III and Annex-IV respectively.

II. One Time Adjustment at COD

i). The Authority has assessed Equipment, Procurement and Construction (EPC) cost US$ 16.927083 million. The reference exchange rate has been assumed as Rs. 105/US$. Since the exact timing of payment to EPC contractor is not known at this point of time, therefore, an adjustment for relevant foreign currency fluctuation for the portion of payment in the relevant foreign currency will be made. In this regard the sponsor will be required to provide all the necessary relevant details along with documentary evidence. The adjustment shall be made only for the currency fluctuation against the reference parity values.

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ii). Cost of insurance during construction shall be adjusted at the time of COD on actual basis on production of documentary evidence subject to maximum of 0.75% of the EPC cost.

iii) Financing fees shall be adjusted at the time of COD as per actual subject to maximum of 3.5% of the total financing.

III. Adjustment in Insurance as per actual

i) The actual insurance cost for the minimum cover required under contractual obligations with the Power Purchaser not exceeding 1% of the EPC cost will be treated as pass-through. Insurance component of reference tariff shall be adjusted annually as per actual upon production of authentic documentary evidence according to the following formula:

Insurance (Adj) $= AIC / P_{(Ref)} * P_{(Act)}$

Where;

AIC	=	Adjusted Insurance Component
$P_{(Ref)}$	=	Reference Premium Rs. 13.33 million.
$P_{(Act)}$	=	Actual Premium or 1% of the EPC cost in Pak Rupees on exchange rate prevailing on the 1st day of the insurance coverage period which ever is lower

IV. Indexations:

The following indexations shall be applicable to the reference tariff;

i) Indexation of Return on Equity (ROE)

After COD, ROE component of tariff will be quarterly indexed on account of variation in PKR/US$ parity according to the following formula:

ROE(Rev) = ROE(Ref) * ER(Rev)/ ER(Ref)

Where;

ROE (Rev)	=	Revised ROE Component of Tariff
ROE (Ref)	=	ROE Component of Tariff established at the time of COD
ER (Rev)	=	The revised TT & OD selling rate of US dollar as notified by the National Bank of Pakistan

ER (Ref) = Reference Exchange Rate at the time of COD

ii) **Indexation applicable to O&M**

The O&M component of tariff will be adjusted on account of local Inflation (CPI) and foreign inflation (US CPI) and exchange rate quarterly on 1st July, 1st October, 1st January and 1st April based on the latest available information with respect to CPI notified by the Pakistan Bureau of Statistics (PBS), US CPI issued by US Bureau of Labor Statistics and revised TT & OD selling rate of US Dollar notified by the National Bank of Pakistan as per the following mechanism:

$L\ O\&M_{(REV)}$	=	70% of Rs. 1.8135/kW/Hour * $CPI_{(REV)}$ / $CPI_{(REF)}$
$F\ O\&M_{(REV)}$	=	30% of Rs. 1.8135/kW/Hour * US $CPI_{(REV)}$ / US $CPI_{(REF)}$ * $ER_{(REV)}/ER_{(REF)}$
Where:		
$L\ O\&M_{(REV)}$	=	the revised applicable O&M Local Component of tariff
$F\ O\&M_{(REV)}$	=	the revised applicable O&M Foreignl Component of tariff
$CPI_{(REV)}$	=	the revised Consumer Price Index (General) published by Pakistan Bureau of Statistics.
$CPI_{(REF)}$	=	the reference Consumer Price Index (General) of 191.21 of November 2013
US $CPI_{(REV)}$	=	the revised US CPI (All Urban Consumers) published by US Bureau of Labor Statistics
US $CPI_{(REF)}$	=	the reference US CPI (All Urban Consumers) of 233.069 of November 2013
$ER_{(REV)}$	=	the revised TT & OD selling rate of US dollar published by National Bank of Pakistan
$ER_{(REF)}$	=	the reference TT & OD selling rate of RS. 105/US dollar

iii) **Indexation for LIBOR Variation**

The interest part of fixed charge component will remain unchanged throughout the term except for the adjustment due to variations in interest rate as a result of variation in 3 months LIBOR according to the following formula;

$\Delta I = P_{(REV)} * (LIBOR_{(REV)} - 0.31\%) /4$

Where:

ΔI = the variation in interest charges applicable corresponding to variation in 3 months LIBOR. Δ I can be positive or negative depending upon whether $LIBOR_{(REV)}$ is > or < 0.31%. The interest payment obligation will be enhanced or reduced to the extent of ΔI for each quarter under adjustment applicable on quarterly basis.

$P_{(REV)}$ = The outstanding principal (as indicated in the attached debt service schedule to this order) on a quarterly basis on the relevant quarterly calculation date. Period 1 shall commence on the date on which the 1st installment is due after availing the grace period.

V. Terms and Conditions of Tariff:

The above tariff and terms and conditions, stipulated hereunder, shall be incorporated in the Energy Purchase Agreement between the Power Purchaser and the Power Producer, the draft standardized version of which along with the Implementation Agreements should be finalized by AEDB in consultation with the stakeholders within 45 days of the publication of this determination.

i. All plant and equipment shall be new and shall be designed, manufactured and tested in accordance with the latest IEC standards or other equivalent standards.

ii. The verification of the new machinery will be done by the independent engineer at the time of the commissioning of the plant duly verified by the power purchaser.

iii. The Energy Purchase Agreement should stipulate terms and conditions, regarding periodic physical inspection of the plant and equipment, ensuring that the power plant is properly maintained and continues to supply energy for the entire tariff control period of 25 years.

iv. Plant Capacity factors for north and south regions will be 16.78% and 17.5% respectively.

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v. In case the actual output exceeds the minimum output, the excess energy will be charged in accordance with the following mechanism:

Net Annual Plant Capacity Factors	% of the prevalent tariff
Above 16.78%/17.50% to 17.78%/18.50%	75%
Above 17.78%/18.50% to 18.78%/19.50%	50%
Above 18.78%/19.50% to 18.78%/20.50%	25%
Above 19.78%/20.50% to 18.78%/21.50%	20%
Above 20.78%/21.50%	10%

vi. The risk of lower solar irradiation will be on the power producer.

vii. The choice to opt for this tariff will only be available up to 6 months from the date of its determination by the Authority.

viii. The sponsors interested in availing Upfront tariff will submit unconditional formal application to NEPRA for approval by the Authority in accordance with the NEPRA Upfront Tariff (Approval and Procedure) Regulations 2011.

ix. The applicant will have to achieve financial close by March 31, 2015. The upfront tariff granted to the applicant will no longer remain applicable/valid, if financial close is not achieved by the applicant by March 31, 2015 or generation license is declined to the applicant.

x. The targeted maximum construction period after financial close is 8 months. No adjustment will be allowed in this tariff to account for financial impact of any delay in project construction. However, the failure of the applicant to complete construction within 8 months of financial close will not invalidate the tariff granted to it.

xi. The eligibility criteria for opting upfront solar tariff will be as under:

a. The projects holding Letter of Intent (LOI) from AEDB/provincial Government agencies.

b. The projects whose proposed plant & machinery is confirmed to be new as per undertaking/affidavit to be provided by the project sponsors along with their applications to the Authority for acceptance of upfront tariff.

c. The projects having completion of grid connectivity study and its approval by the power purchaser.

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d. The projects opting for upfront tariff will dispatch power at 11 kV system

xii. On the basis of IfE Germany validation of the energy estimates, the degradation not exceeding 0.7%/annum of initial power will be provided in the Energy Purchase Agreement.

xiii. Pre COD sale of electricity to the power purchaser, if any, shall be allowed subject to the terms and conditions of EPA, at the applicable tariff excluding principal repayment of debt component and interest component.

xiv. In the Upfront Tariff no adjustment for certified emission reductions has been accounted for. However, upon actual realization of carbon credits, the same shall be distributed between the power purchaser and the power producer in accordance with the Policy for Development of Renewable Energy for Power Generation 2006, as amended from time to time.

xv. This tariff will only be valid for approvals given for the first 50 MW. Projects under this tariff shall not exceed 10 MWp (minimum 1MWp) in terms of installed plant capacity except as provided in Para VI.

xvi. The decision to opt for upfront tariff once exercised will be irrevocable.

xvii. Debt part of the project financing has been assumed on foreign financing. However, the debt part of the project can also be financed through local financing or mix of local and foreign financing and the debt servicing component will be adjusted accordingly.

xviii. The adjustment/indexation of upfront tariff will be made on the basis of benchmarks assumed by the Authority for Upfront Tariff in accordance with the indexation mechanism stipulated hereinabove, and a single Upfront Tariff will be applicable for all solar PV projects coming under the Upfront Tariff regime. No project specific adjustments shall be taken into account.

xix. No provision for income tax, workers profit participation fund and workers welfare fund, any other tax, custom/excise duty or other duty, levy, charge, surcharge or other governmental impositions, payable on the generation, sales, exploration has been accounted for in the tariff. If the company is obligated to pay any tax the exact amount will be reimbursed by CPPA/DISCO on production of original receipts. However, withholding tax on dividend will not be pass through under the upfront solar tariff in line with the coal upfront tariff.

xx. General assumptions, which are not covered in this determination and National Electric Power Regulatory Authority Upfront Tariff (Approval & Procedure) Regulations, 2011, may be dealt with as per the standard terms of the Energy Purchase Agreement.

VI. Existing Tariff Petitions

The Access Solar (Pvt) Limited is the only project company which has filed a tariff petition for determination of solar tariff for its 11.52 MWp proposed power plant at Pind Dadan Khan, Punjab. The petition has been admitted and is pending for the decision. If the upfront solar tariff specified above is acceptable to them, they will have the first right to opt for the upfront solar tariff as they fulfill the criteria for opting the upfront solar tariff.

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Upfront Solar Tariff
Reference Tariff Table (North Region)

Year	O&M	Insurance	Return on Equity	Debt Servicing	Total Tariff	
	Rs./kWh	Rs./kWh	Rs./kWh	Rs./kWh	Rs./kWh	US¢/kWh
1	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
2	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
3	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
4	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
5	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
6	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
7	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
8	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
9	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
10	1.8137	1.2091	6.1097	12.8872	22.0197	20.9712
11	1.8137	1.2091	6.1097	-	9.1325	8.6976
12	1.8137	1.2091	6.1097	-	9.1325	8.6976
13	1.8137	1.2091	6.1097	-	9.1325	8.6976
14	1.8137	1.2091	6.1097	-	9.1325	8.6976
15	1.8137	1.2091	6.1097	-	9.1325	8.6976
16	1.8137	1.2091	6.1097	-	9.1325	8.6976
17	1.8137	1.2091	6.1097	-	9.1325	8.6976
18	1.8137	1.2091	6.1097	-	9.1325	8.6976
19	1.8137	1.2091	6.1097	-	9.1325	8.6976
20	1.8137	1.2091	6.1097	-	9.1325	8.6976
21	1.8137	1.2091	6.1097	-	9.1325	8.6976
22	1.8137	1.2091	6.1097	-	9.1325	8.6976
23	1.8137	1.2091	6.1097	-	9.1325	8.6976
24	1.8137	1.2091	6.1097	-	9.1325	8.6976
25	1.8137	1.2091	6.1097	-	9.1325	8.6976
Levelized	**1.8137**	**1.2091**	**6.1097**	**8.7238**	**17.8563**	**17.0060**

Installed Capacity (MWp)	10.000
Minimum Annual Energy (GWh)	14.699
CPI (General) November 2013	191.210
US CPI (All Urban Consumers) November 2013	233.069
Exchange Rate (Rs./US$)	105.000

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Upfront Solar Tariff
Reference Tariff Table (South Region)

Year	O&M	Insurance	Return on Equity	Debt Servicing	Total Tariff	
	Rs./kWh	Rs./kWh	Rs./kWh	Rs./kWh	Rs. per kWh	¢ per kWh
1	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
2	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
3	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
4	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
5	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
6	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
7	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
8	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
9	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
10	1.7391	1.1594	5.8583	12.3570	21.1138	20.1083
11	1.7391	1.1594	5.8583	-	8.7568	8.3398
12	1.7391	1.1594	5.8583	-	8.7568	8.3398
13	1.7391	1.1594	5.8583	-	8.7568	8.3398
14	1.7391	1.1594	5.8583	-	8.7568	8.3398
15	1.7391	1.1594	5.8583	-	8.7568	8.3398
16	1.7391	1.1594	5.8583	-	8.7568	8.3398
17	1.7391	1.1594	5.8583	-	8.7568	8.3398
18	1.7391	1.1594	5.8583	-	8.7568	8.3398
19	1.7391	1.1594	5.8583	-	8.7568	8.3398
20	1.7391	1.1594	5.8583	-	8.7568	8.3398
21	1.7391	1.1594	5.8583	-	8.7568	8.3398
22	1.7391	1.1594	5.8583	-	8.7568	8.3398
23	1.7391	1.1594	5.8583	-	8.7568	8.3398
24	1.7391	1.1594	5.8583	-	8.7568	8.3398
25	1.7391	1.1594	5.8583	-	8.7568	8.3398
Levelized	**1.7391**	**1.1594**	**5.8583**	**8.3649**	**17.1216**	**16.3068**

Installed Capacity (MWp)	10.000
Minimum Annual Energy (GWh)	15.330
CPI (General) November 2013	191.210
US CPI (All Urban Consumers) November 2013	233.069
Exchange Rate (Rs./US$)	105.000

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Upfront Solar Tariff
Debt Servicing Schedule (North Region)

Period	Foreign Debt					Annual Principal Repayment Rs./kWh	Annual Interest Rs./kWh	Annual Debt Servicing Rs./kWh
	Principal USD	Repayment USD	Mark-up USD	Balance USD	Debt Service USD			
	14,255,157	279,612	171,418	13,975,544	451,031			
	13,975,544	282,975	168,056	13,692,569	451,031			
	13,692,569	286,378	164,653	13,406,192	451,031			
	13,406,192	289,821	161,209	13,116,371	451,031			
1	14,255,157	1,138,786	665,337	13,116,371	1,804,123	8.13	4.75	12.8872
	13,116,371	293,306	157,724	12,823,064	451,031			
	12,823,064	296,833	154,197	12,526,231	451,031			
	12,526,231	300,403	150,628	12,225,828	451,031			
	12,225,828	304,015	147,016	11,921,813	451,031			
2	13,116,371	1,194,557	609,565	11,921,813	1,804,123	8.53	4.35	12.8872
	11,921,813	307,671	143,360	11,614,143	451,031			
	11,614,143	311,371	139,660	11,302,772	451,031			
	11,302,772	315,115	135,916	10,987,657	451,031			
	10,987,657	318,904	132,127	10,668,753	451,031			
3	11,921,813	1,253,060	551,062	10,668,753	1,804,123	8.95	3.94	12.8872
	10,668,753	322,739	128,292	10,346,014	451,031			
	10,346,014	326,620	124,411	10,019,394	451,031			
	10,019,394	330,547	120,483	9,688,847	451,031			
	9,688,847	334,522	116,508	9,354,325	451,031			
4	10,668,753	1,314,428	489,694	9,354,325	1,804,123	9.39	3.50	12.8872
	9,354,325	338,545	112,486	9,015,780	451,031			
	9,015,780	342,616	108,415	8,673,164	451,031			
	8,673,164	346,736	104,295	8,326,428	451,031			
	8,326,428	350,905	100,125	7,975,523	451,031			
5	9,354,325	1,378,802	425,321	7,975,523	1,804,123	9.85	3.04	12.8872
	7,975,523	355,125	95,906	7,620,398	451,031			
	7,620,398	359,395	91,635	7,261,002	451,031			
	7,261,002	363,717	87,314	6,897,285	451,031			
	6,897,285	368,091	82,940	6,529,194	451,031			
6	7,975,523	1,446,328	357,794	6,529,194	1,804,123	10.33	2.56	12.8872
	6,529,194	372,517	78,514	6,156,677	451,031			
	6,156,677	376,997	74,034	5,779,681	451,031			
	5,779,681	381,530	69,501	5,398,151	451,031			
	5,398,151	386,118	64,913	5,012,033	451,031			
7	6,529,194	1,517,162	286,961	5,012,033	1,804,123	10.84	2.05	12.8872
	5,012,033	390,761	60,270	4,621,272	451,031			
	4,621,272	395,460	55,571	4,225,812	451,031			
	4,225,812	400,215	50,815	3,825,597	451,031			
	3,825,597	405,028	46,003	3,420,569	451,031			
8	5,012,033	1,591,464	212,659	3,420,569	1,804,123	11.37	1.52	12.8872
	3,420,569	409,898	41,132	3,010,671	451,031			
	3,010,671	414,827	36,203	2,595,843	451,031			
	2,595,843	419,816	31,215	2,176,028	451,031			
	2,176,028	424,864	26,167	1,751,164	451,031			
9	3,420,569	1,669,405	134,717	1,751,164	1,804,123	11.92	0.96	12.8872
	1,751,164	429,973	21,058	1,321,191	451,031			
	1,321,191	435,143	15,887	886,047	451,031			
	886,047	440,376	10,655	445,671	451,031			
	445,671	445,671	5,359	(0)	451,031			
10	1,751,164	1,751,164	52,959	(0)	1,804,123	12.51	0.38	12.8872

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Upfront Solar Tariff
Debt Servicing Schedule

Period	Foreign Debt					Annual Principal Repayment Rs./kWh	Annual Interest Rs./kWh	Annual Debt Servicing Rs./kWh
	Principal USD	Repayment USD	Mark-up USD	Balance USD	Debt Service USD			
	14,255,157	279,612	171,418	13,975,544	451,031			
	13,975,544	282,975	168,056	13,692,569	451,031			
	13,692,569	286,378	164,653	13,406,192	451,031			
	13,406,192	289,821	161,209	13,116,371	451,031			
1	14,255,157	1,138,786	665,337	13,116,371	1,804,123	7.80	4.56	12.3570
	13,116,371	293,306	157,724	12,823,064	451,031			
	12,823,064	296,833	154,197	12,526,231	451,031			
	12,526,231	300,403	150,628	12,225,828	451,031			
	12,225,828	304,015	147,016	11,921,813	451,031			
2	13,116,371	1,194,557	609,565	11,921,813	1,804,123	8.18	4.18	12.3570
	11,921,813	307,671	143,360	11,614,143	451,031			
	11,614,143	311,371	139,660	11,302,772	451,031			
	11,302,772	315,115	135,916	10,987,657	451,031			
	10,987,657	318,904	132,127	10,668,753	451,031			
3	11,921,813	1,253,060	551,062	10,668,753	1,804,123	8.58	3.77	12.3570
	10,668,753	322,739	128,292	10,346,014	451,031			
	10,346,014	326,620	124,411	10,019,394	451,031			
	10,019,394	330,547	120,483	9,688,847	451,031			
	9,688,847	334,522	116,508	9,354,325	451,031			
4	10,668,753	1,314,428	489,694	9,354,325	1,804,123	9.00	3.35	12.3570
	9,354,325	338,545	112,486	9,015,780	451,031			
	9,015,780	342,616	108,415	8,673,164	451,031			
	8,673,164	346,736	104,295	8,326,428	451,031			
	8,326,428	350,905	100,125	7,975,523	451,031			
5	9,354,325	1,378,802	425,321	7,975,523	1,804,123	9.44	2.91	12.3570
	7,975,523	355,125	95,906	7,620,398	451,031			
	7,620,398	359,395	91,635	7,261,002	451,031			
	7,261,002	363,717	87,314	6,897,285	451,031			
	6,897,285	368,091	82,940	6,529,194	451,031			
6	7,975,523	1,446,328	357,794	6,529,194	1,804,123	9.91	2.45	12.3570
	6,529,194	372,517	78,514	6,156,677	451,031			
	6,156,677	376,997	74,034	5,779,681	451,031			
	5,779,681	381,530	69,501	5,398,151	451,031			
	5,398,151	386,118	64,913	5,012,033	451,031			
7	6,529,194	1,517,162	286,961	5,012,033	1,804,123	10.39	1.97	12.3570
	5,012,033	390,761	60,270	4,621,272	451,031			
	4,621,272	395,460	55,571	4,225,812	451,031			
	4,225,812	400,215	50,815	3,825,597	451,031			
	3,825,597	405,028	46,003	3,420,569	451,031			
8	5,012,033	1,591,464	212,659	3,420,569	1,804,123	10.90	1.46	12.3570
	3,420,569	409,898	41,132	3,010,671	451,031			
	3,010,671	414,827	36,203	2,595,843	451,031			
	2,595,843	419,816	31,215	2,176,028	451,031			
	2,176,028	424,864	26,167	1,751,164	451,031			
9	3,420,569	1,669,405	134,717	1,751,164	1,804,123	11.43	0.92	12.3570
	1,751,164	429,973	21,058	1,321,191	451,031			
	1,321,191	435,143	15,887	886,047	451,031			
	886,047	440,376	10,655	445,671	451,031			
	445,671	445,671	5,359	(0)	451,031			
10	1,751,164	1,751,164	52,959	(0)	1,804,123	11.99	0.36	12.3570

NATIONAL ELECTRIC POWER REGULATORY AUTHORITY
NEPRA AUTHORITY