Project design document form
(Version 11.0)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Patrind Hydropower Project
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	Version 07
Completion date of the PDD	14/06/2019
Project participants	Star Hydro Power Limited
Host Party	Islamic Republic of Pakistan
Applied methodologies and standardized baselines	ACM0002 “Consolidated baseline methodology for grid-connected electricity generation from renewable sources” (version 12.3)
Sectoral scopes	Sectoral scope: 1 - Energy industries (renewable / non-renewable sources)
Estimated amount of annual average GHG emission reductions	269,278 tCO_2e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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The Patrind Hydropower Project is a new 150 MW run of river hydro project in Northern Pakistan. The Project is located on the boundary of the provinces of Khyber-Pakhtunkhwa (KP) and Azad Jammu & Kashmir (AJ&K) and utilizes the waters of the river Kunhar that rises in KP and flows into the river Jhelum. The purpose of the Project is to provide zero-emissions renewable electricity to the grid and also provide local and global environmental benefits as well as strong local socioeconomic benefits. It is only the second hydropower independent power producer (IPP) in Pakistan.

Pakistan's electricity grid is very hydrocarbon intensive. Power shortages and an increasing demand/supply gap means that cheaper thermal generation plants are used to mitigate power shortages. A recent report from the Asian Development Bank (ADB) on Rental Power Projects in Pakistan (published January 2010[1]) states that the current total installed power generation capacity is at about 20 GW. However, out of this base, the effective summer capacity is around 17.5 GW, and the winter capacity is a mere 14.6 GW. Computed power demand is 19.7 GW, thereby creating a deficit of between 2.2 and 5.1 GW at various times during the year. The Patrind project can help reduce this deficit using renewable technologies rather than using thermal plants. The CDM mechanism has attracted foreign investors to develop and finance this clean, renewable electricity plant in northern Pakistan particularly because the CDM helps the project overcome various investment barriers.

The gross capacity of the Project is 150 MW while net capacity after auxiliary consumption is 147 MW. Based on average hydrology, it is expected to generate 632,628 MWh of energy annually. A surface type powerhouse will accommodate three vertical Francis units, each of 50 MW capacity. An intake structure is proposed slightly upstream of a weir, within the same river bend, leading to the headrace tunnel. The power from the Project will be evacuated through a double circuit 132 KV transmission line (to be constructed by the power purchaser).

The project activity is the installation of a new grid-connected renewable power plant. Two emergency diesel generator sets (500kW and 160kW) are on-site to supply stand-by emergency power to the 400 V station service systems and also to allow black start of the plant. The black start is undertaken only when grid supply is not available at the transmission line, which is an extremely rare occurrence. This means that emergency electricity will initially be supplied from the grid when the generators fail and emergency diesel generators will only come online when there is also a failure in the grid supply. The diesel consumption will be measured through fuel purchase receipts.

The baseline scenario is as follows: The electricity delivered to the grid would have otherwise been generated by the operation of predominantly fossil-fuel fired grid-connected power plants and by the addition of new predominantly fossil fuel thermal generation sources, as reflected in the combined margin calculations described in section B.6 of this PDD. This baseline approach is defined by the approved consolidated baseline and monitoring methodology ACM0002 "*Consolidated baseline methodology for grid-connected electricity generation from renewable sources*". The implementation of this hydropower plant will result in the reduction of 269,278 tonnes CO_2e per annum.

<u>Contribution to Sustainable Development</u>

Sustainable development

The Project Activity will create employment opportunities for manual labour, contractors, stakeholders and manufacturers. Traditionally, the Provinces where the Project is located are at the tail end of the electricity network and therefore always suffer from lack of quality and reliability of supply. This is the major reason that these areas have not seen any significant industrial and commercial activities despite having been electrified for a long time.

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[1] http://www.pepco.gov.pk/ABD_Report.pdf

The project will improve clean power availability in the vicinity and thus will trigger economic development in the region, resulting in social uplift, poverty alleviation, and reduction in out migration of communities for financial reasons.

The construction and operation activities of these projects will stimulate the development and improvement of other infrastructure facilities in the region and will lead to greater community empowerment.

Environmental benefits
The activity is environmentally beneficial as it uses a plentiful renewable energy source without consuming any of the depleting fossil fuels such as coal, gas or oil and therefore results in power generation with zero greenhouse gas emissions.

The project also promotes environmental benefits through avoiding the associated pollution from extraction, processing, storage and transportation of fossil fuels used in thermal generation.

National economy
By displacing thermal generation with a non-emitting source such as hydropower the project will result in a positive impact on the Balance of Payments.

The project is being developed by the private sector with 100% equity and debt raised using the private capital and financing arrangements. The developer is solely responsible for repayment obligations for the debt component. Therefore, the projects will not add any further external debt burden.

A.2. Location of project activity

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Location of the project activity

The project is located in Patrind village near Lohar Gali, Muzaffarabad, on the border between the provinces of Khyber-Pakhtunkhwa (KP) and Azad Jammu and Kashmir (AJ&K). The exact location of the project is Patrind village near Lohar Gali, Muzaffarabad.

Coordinates of the Weir site is:

- Latitude: 34°20'31.9" N
- Longitude:-73°25'42.9" E

The power house is located at the right bank of River Jehlum, Near Thuri Park, Lower Chatter, Muzaffarabad.
Coordinate for the Power House site is;

- Latitude: 34º20’06.67’’ N
- Longitude: 73º27’08.03’’ E

The whole scheme lies in the West, North West and East of Patrind village. Figure 1 provides the project’s exact location.

Host Party(ies)

Islamic Republic of Pakistan

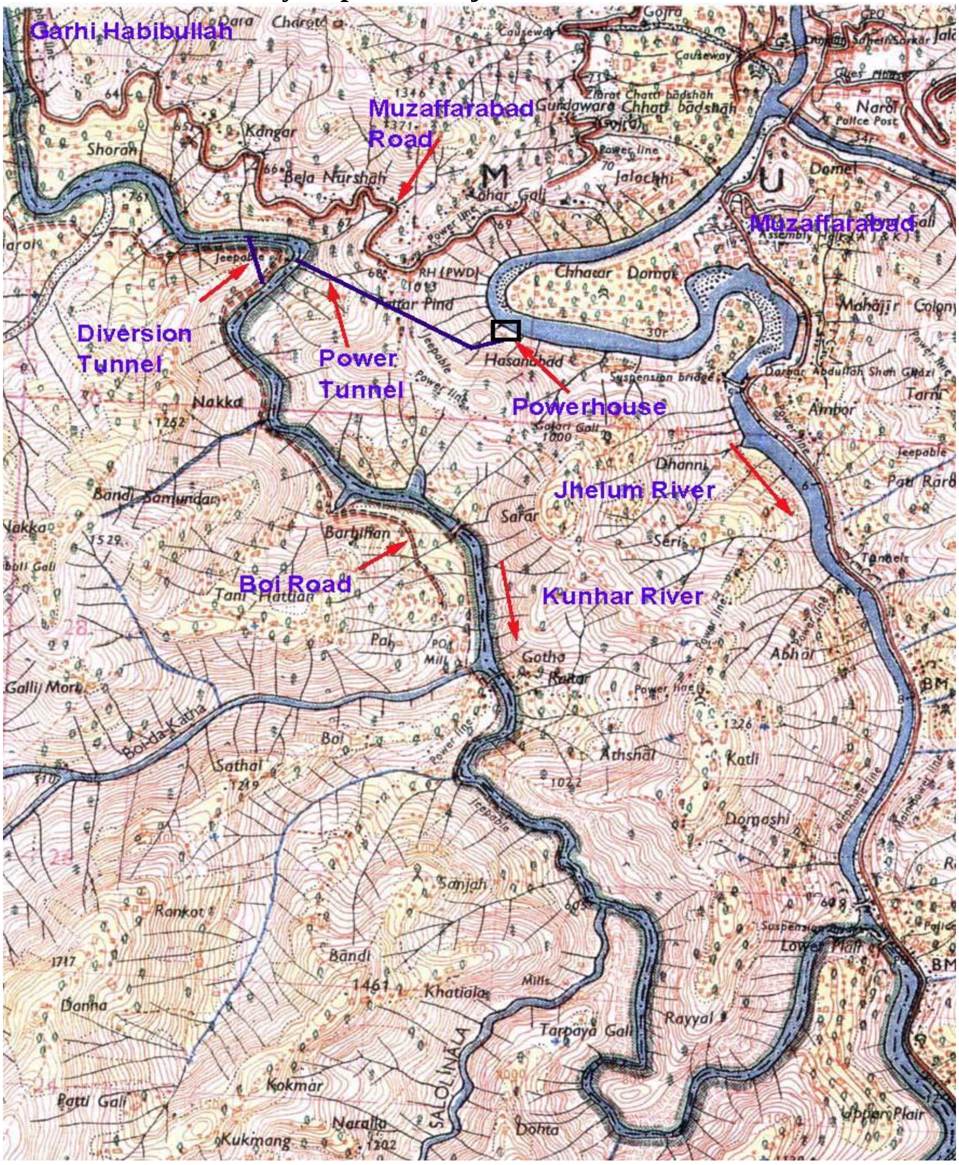
Region/State/Province etc

Khyber-Pakhtunkhwa(KP) and Azad Jammu & Kashmir(AJ&K)

City/Town/Community etc

Patrind village, near Lohar Gali (Weir site)
Lower Chatter, Muzaffarabad (Power House)

Figure 1: Location of the Patrind Hydropower Project



A.3. Technologies/measures

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<u>Technology employed by the project activity</u>

The gross capacity of the Project is 150 MW while net capacity after auxiliary consumption is 147 MW and based on average hydrology, it is expected to generate 632,628 MWh of energy annually. The technology employed is ~~a~~ hydropower run of river system with surface type powerhouse accommodating three vertical Francis turbine units, each of 50 MW capacity. Intake structure, is constructed at slightly upstream of the weir left abutment, comprising of an Intake gate and five trashrack chambers/slots, leading to the headrace tunnel. The headrace tunnel passes through the Lohar Gali ridge towards the Jhelum River. It opens into a vertical pressure shaft connected to an underground surge shaft and cavern through link tunnel. Horizontal pressure tunnel (Penstock) extends from the lower bend of the vertical pressure tunnel and opens in a manifold which divides into three branch pipes for conveyance and equal distribution of water to the generating units installed in the powerhouse.

A GIS type switchyard is constructed and commissioned on roof top of the powerhouse. The power from the Project is evacuated through a new double circuit 132 KV transmission line (an interim arrangement is in place for now that connects power house to Muzzaffarabar Grid Station) to the city of Mansehra and a single circuit tie-in with existing Muzaffarabad-Hattian Bala 132 KV transmission line. Figure 2 shows the main

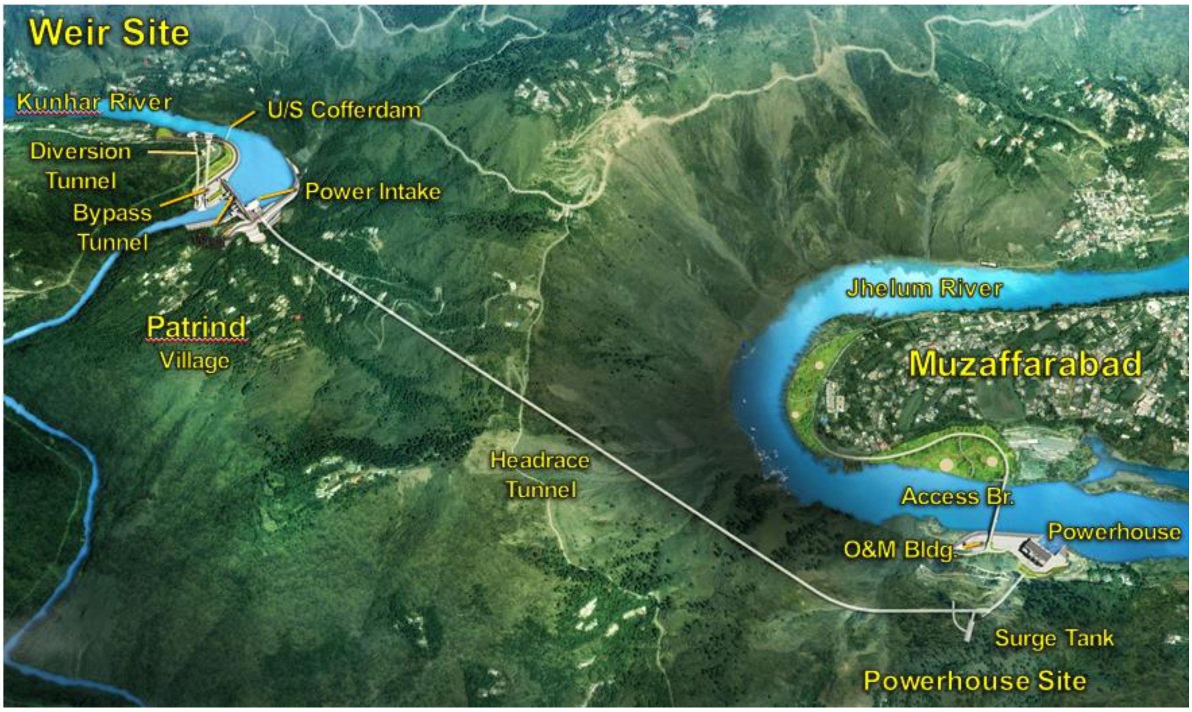
structures of the project. There is one monitoring point for the purposes of electricity generation quantity at the power plant itself.

The lifetime of the power generating equipment is considered to be 30 years based on the manufacturers' specification of the Francis turbines, which have also been successfully been deployed and are generating electricity in large hydro power projects in Pakistan such as Ghazi Barotha (1,450 MW – run of river), Mangla (1,000MW – dam), Tarbela (3,478MW – dam) and Warsak (243MW – dam but power generation by run of river system).

The electricity generated from the project is supplied to the national electricity grid system of Pakistan. Energy meters with non-volatile data storage system are installed and used in accordance with the Power Purchase Agreement signed between the project developer and the National Transmission and Despatch Company (NTDC). Furthermore, a team specifically responsible for CDM Management for the collection, recording and storage of the data required to calculate the greenhouse gas emission reductions from the project activity will be organized by the project participant for transparent operation of the project.

The project is based on the Build Own Operate and Transfer (BOOT) concept, with an envisaged construction period of 51 months. Construction is expected to begin in January 2013 and thus the plant is expected to be operational in April 2017.

Figure 2: Main structures



The Weir

The Crest elevation of the Weir is 756.5 masl which is approximately 43.5m high from the river bed. There are two radial type overflow gates (12.0m wide x 10.4m high) with flap type gates installed on them to accommodate flood water & floating debris etc. and two radial type underflow gates (7.0m wide X 11.6m high) for carrying out sediments flushing settled in the rearranged sandtrap (OHDS). The weir also accommodates a bridge having deck at elevation 769.0 masl.

Power Intake

The box culvert type power intake is located on the left bank of river Kunhar just upstream of the weir. One intake gate is provided having dimensions of 7.0m wide x 7.0m high. The facility is also equipped with five sets of trashracks having size of 7.0m wide x 12.0m high.

Optimal Hybrid Desander System (OHDS)/ Rearranged Sandtrap

Optimal hybrid desander system (OHDS)/ Rearranged Sandtrap is adopted for the Complex replacing the sand trap as being more efficient and new technology. OHDS is composed of a by-pass tunnel and a modified pool. By-pass tunnel of horse shoe type having width of 7.5m and length 175.5m; is provided at upstream of the upstream cofferdam that will carry-out flushing of most of the suspended sediments while inflow is more than 200m^3/sec and the pond between upstream cofferdam and the weir will be used as the sand trap for settling down particles that will crossover the cofferdam with size ranging between 0.20 to 0.50mm. This modified pond is 80.0m wide, 20.0m high and 311.0m long.

Headrace Tunnels

From Power intake section at Weir site a circular type headrace tunnel having 7.0 m internal diameter and a length of 2,193.86m, leads to a vertical shaft along with connection to the surge shaft via link tunnel.

Surge Shaft and Penstock

Orifice type surge tank with surge chamber is excavated, constructed and commissioned at the start of vertical pressure tunnel connected via Link tunnel to control the water hammering and speed rise phenomena. Surge shaft is a vertical tunnel having 12-meter diameter with height of 39 meters within the mountain. Elevation of surge shaft bottom and top are El 735.029m and 775.04m respectively.

Surge chamber is replacing the conventional surge tank due to the geological conditions of the rock mass which is used to accommodate excessive pressure rise and control sudden variations in the power output. Chamber is of horse shoe shape with width of 15.0m, height of 10.0m.

A horizontal pressure shaft of 62.321m length and 8.5 m diameter connecting to the vertical pressure shaft of diameter 8.5m is proposed in hill mass on the right bank of river Jhelum.

Horizontal pressure shaft further connects to the steel lined portion having diameter of 5.5m and length of 102.53m. The steel penstock trifurcates into branches; each having diameter of 3.2 m and length 73.24m.

Powerhouse
A surface type powerhouse accommodating three vertical Francis turbine units, each of 50 MW capacity, is successfully constructed and commissioned on the right bank of river Jhelum River.

Switchyard
A Gas Insulated Switchgear (GIS) system is constructed on Power house roof top. The power from the Complex is evacuated through 132 kV double circuit transmission line connecting Power house to the Rampura, Muzaffarabad Grid Station.

Project Main Features

- Total Capacity of Project 150 MW
- Total Net Capacity of Project 147 MW
- Average Energy Production 632,628 MWh
- Rated effective Head 107.529 m
- Design Discharge 153.66 m^3/sec
- Reservoir Submergence Area 59.78 Hectares
- Reservoir Capacity 6.14 million m^3
- Weir Type Concrete Gravity Dam
- Weir Height 43.5 m from the weir foundation
- Crest Elevation 769.00 masl
- Gates (Radial) 5(Including By-pass tunnel outlet gate)
- Size of Gate 12 m x 10 m
- Bottom/Low level Outlet 1
- Size of Bottom/Low level Outlet 700 mm diameter

<u>Scenario existing prior to the start of the project activity</u>

The scenario existing prior to the start of the project activity is the same as the baseline scenario. At present no electricity generation equipment or plants exist at the project site. The project is a brand new renewable energy plant.

The electricity delivered to the grid would have otherwise been generated by the operation of predominantly fossil-fuel fired grid-connected power plants and by the addition of new predominantly fossil fuel thermal generation sources, as reflected in the combined margin calculations described in section B.6 of this PDD. This baseline approach is defined by the approved consolidated baseline and monitoring methodology ACM0002 *"Consolidated baseline methodology for grid-connected electricity generation from renewable sources"* (version 12.3).

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Islamic Republic of Pakistan (host)	Star Hydro Power Limited	No

A.5. Public funding of project activity

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This project activity does not involve any public funding from Annex I countries, nor from the host country.

A.6. History of project activity

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We confirm that the proposed CDM project activity is neither registered as a CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA). Also the proposed CDM project activity is not a project activity that has been deregistered.

A.7. Debundling

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Not applicable

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines

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The project activity uses an existing approved consolidated baseline and monitoring methodology ACM0002 version 12.3, titled "Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources".

The methodology refers to the latest approved versions of the following tools:

- Tool to calculate the emission factor for an electricity system (Version 03.0.0);
- Tool for the demonstration and assessment of additionality (Version 07.0.0);
- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion (Version 02).

B.2. Applicability of methodologies and standardized baselines

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ACM0002 version 12.3 is applicable to grid-connected renewable power generation project activities that install a new power plant at a site where no renewable power plant was operated prior to the implementation of the project activity (Greenfield plant) as is the case of the Patrind Hydropower Project.

The proposed project activity meets all applicability conditions required by the methodology, as follows:

1. The project involves the construction of a run-of-river hydro power plant with a small new reservoir and its power density is 262 W/m2 (thus above the 4 W/m2 criterion – see later for calculation);

2. The project activity displaces fossil fuel based electricity generation in the national grid;

3. The project does not involve switching from fossil fuels to renewable energy at the site of the project activity;

4. The geographic and system boundaries for the relevant electricity grid can be clearly identified and information and characteristics of the grid is available.

Therefore, the proposed project activity complies with the applicability conditions of the methodology.

B.3. Project boundary, sources and greenhouse gases (GHGs)

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The spatial extent of the project boundary includes the project site and all power plants connected physically to the electricity system that the project is connected to. ACM0002 version 12 states that project participants shall only account CO_2 emissions from electricity generation in fossil fuel fired power that is displaced due to project activity for the baseline determination. Therefore, only CO_2 from combustion in fossil fuel fired

units connected to the national grid is considered in the baseline. The emission sources and gases are included in the project boundary for the purpose of calculating baseline emissions and project emissions are presented in the table below:

	Source	GHG	Included?	Justification/Explanation
Baseline	Emissions from fossil fuel fired power generation supplied to the national grid (gas, oil, diesel and coal)	CO_2	Included	Carbon dioxide emissions from grid electricity generation through combustion of hydrocarbons in the baseline
		CH_4	Not Included	Not relevant as CH_4 is not identified in baseline methodology
		N_2O	Not Included	Not relevant as N_2O is not identified in baseline methodology
Project activity	Run-of-the river hydroelectric power generation	CO_2	Included	Carbon dioxide emissions from diesel standby generator which will only be used in the case of emergency. Operating hours and subsequent emissions to be recorded when runs are carried out through fuel purchase receipts.
		CH_4	Not Included	Zero emissions from project activity
		N_2O	Not Included	Zero emissions from project activity

B.4. Establishment and description of baseline scenario

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The baseline scenario prescribed by the ACM0002 version 12 identifies two options for defining the baseline scenario, depending on whether the project activity is a new project or a modification or retrofit of an existing generation facility. Since the proposed project activity is the installation of a new grid- connected renewable power plant, the following definition of the baseline scenario is applied:

> "Electricity delivered to the grid by the project activity would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in the "*Tool to calculate the emission factor for an electricity system*"."

The project activity is generation of electricity from a new run-of-river hydropower plant which is a renewable energy source. The electricity generated from the project activity will be fed into the fossil fuel intensive national grid through an interconnection facility at the site, without any project emissions or leakage. The baseline scenario is calculated as a combined margin (CM) consisting of the combination of the operating margin (OM) and build margin (BM) factors, calculated using the steps described in ACM0002 version 12.3 which is outlined in detail in Section B6.

ACM0002 assumes that the project activity replaces the weighted average of the ratio of emissions in the system represented by the Operating Margin (OM) which is the ratio of emissions from generation of all power generating projects in the defined system over the latest three (3) year period excluding the least cost / must run projects; and the Build Margin (BM) which is the ratio of emissions attributable to the higher of the (i) generation (MWh) from five (5) most recent power projects built or (ii) generation (MWh) of the most recently built power plants equating to 20% of the most current annual system generation. Both the OM and BM are the ratio of generation (MWh) with emissions (t CO2) and are 'weighted' using specific or default weighting factor of OM (0.5) and BM (0.5).

The CM, based on the weighted average carbon emission factor of 0.42565 tCO2/ MWh is calculated using the OM of 0.6013 the BM of 0.250 for this PDD. All calculations are based on the official data available in the public domain and taken from the "Pakistan Energy Yearbook 2009" published by the Hydrocarbon Development Institute of Pakistan, Ministry of Petroleum & Natural Resources, and Government of Pakistan.

B.5. Demonstration of additionality

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In accordance with ACM0002 version 12.3, the baseline methodology procedure requires us to apply the following steps as per the "Tool for the demonstration and assessment of additionality":

1. Step 1: Identification of alternatives to the project activity consistent with current laws and regulations
2. Step 2: Investment analysis
3. Step 3: Barrier analysis
4. Step 4: Common practice analysis

Step 1a: Define alternative scenarios to the proposed CDM project activity

The alternative scenarios to be considered include:

a) The project activity not implemented as a CDM project;
b) The continuation of the current situation (business as usual/ the additional power generated under the project would be generated in existing and new grid-connected power plants, which are mainly thermal, in the electricity system);
c) All other plausible and credible alternatives to the project activity that provide an increase in the power generated at the site, which are technically feasible to implement.

<u>a)</u> *The project activity not implemented as a CDM project*

Without the revenues from the CDM the project would not be possible for the following main reasons which are elaborated further in Step 3 (barriers analysis):

- Failure to attract any investors
- Failure to secure any funding or loans

The only other large hydropower Independent Power Producer (IPP) in Pakistan is a Registered CDM project (The 84 MW New Bong Escape Hydropower Project, Azad Jammu and Kashmir (AJK), Pakistan, Reference Number 2098).

<u>b)</u> *The continuation of the current situation (business as usual/ the additional power generated under the project would be generated in existing and new grid-connected power plants, which are mainly thermal, in the electricity system)*

This scenario is the baseline scenario as defined by ACM0002 version 12. It is the most likely scenario as Pakistan currently is facing huge power shortages. A recent report from the Asian Development Bank (ADB) on Rental Power Projects in Pakistan (published January 2010[2]) states that the current total installed power generation capacity is at about 20 GW. However, out of this base, the effective summer capacity is around 17.5 GW and winter capacity are a mere 14.6 GW. Computed power demand is 19.7 GW, thereby creating a deficit of between 2.2 and 5.1 GW at various times during the year. The deficit is largely due to lower availability of plants, significant generation and transmission losses, increase in consumption and usage patterns, and lack of supply-side measures in terms of introducing new generation units. Demand forecasts for 2013 show a peak demand of 27 GW – over the past 10 years electricity demand has surged by about 5.4% on Cumulative Average Growth Rate (CAGR).

The emergence of IPPs in the 1990s has increased dependence on thermal generation as they are all fossil-fuel based. The existing capacity of thermal generation in Pakistan accounts for 65% of the countries installed capacity.

According to the Private Power and Infrastructure Board, 2.5 GW of IPPs are expected to come online to attempt to start bridging the demand gap between 2010 and 2012. The government has also been working to increase the supply in short run through rental power projects (mainly thermal) of around 1 – 1.5 GW,

[2] http://www.ppib.gov.pk/ADB/ADB%20Report.pdf

expected to come online in 2011-2012 as a stop-gap arrangement for 3-5 years, with a contractual life of 5-7 years. These rental power projects involved thermal generation.

c) *All other plausible and credible alternatives to the project activity that provide an increase in the power generated at the site, which are technically feasible to implement*

There are no other plausible and credible alternatives to the hydropower project activity at the site for the following reasons:

a) *Suitability of the site for conventional power plants*
The site does not have the space or land required for an alternative power plant other than a hydropower project (e.g. a coal, gas or oil-fired project). The remote location of the site in the mountains of Northern Pakistan is not suited to conventional power plants as transportation of fossil fuels to the site would not be possible due to bad road infrastructure. Conventional power plants would instead be better placed at other more accessible locations where the plants would be more cost-effective to build.

b) *Suitability of the site for other types of renewable energy projects*
The harsh terrain of the site is not suited to other types of renewable energy generation, such as wind energy which generally requires flatter expanses of land or solar energy. No geothermal sources of energy at the site exist. Moreover, there is very little wind, solar and geothermal development currently in Pakistan.

c) *No comparable project options available from small CCGT gas or DG set oil-based generation projects*
Small CCGT gas of DG set oil-based generation projects that are built by the private sector in Pakistan would not consider to be a sustainable option even if they could be built at the project site. They would also not be able provide a comparable quantity of energy as the 150 MW hydropower project activity.

d) *No comparable project options available from small hydel projects*
Small hydel IPPs would similarly not provide a comparable quantity of energy as the 150 MW hydropower project activities.

e) *No possibility of implementation of large public sector hydropower projects*
Large public sector hydropower projects that are currently in the pipeline are facing long delays of 15-20 years due to high investment costs and environmental and social issues, such as displacement of entire villages and flooding of large expanses of land. Displacement of the entire town or a number of villages is not a popular decision for any democratic government or ruling political party and therefore it is unlikely for current or any government in Pakistan to take such political risks. Furthermore, the compensation costs related to relocation is very high. Thus, these types of hydropower project are very unlikely to be a plausible alternative.

Outcome of Step 1a: The only realistic, plausible and credible alternative scenario is considered to be b) – continuation of the current situation where the additional power generated under the project would be generated in existing and new grid-connected power plants, which are mainly thermal, in the electricity system. This is the defined as the baseline scenario.

Step 1b: Consistency with mandatory applicable laws and regulations

The alternative identified above (scenario b)) that will result in generation of additional power from existing and new grid-connected power plants, which are mainly thermal, is the current situation in Pakistan and is in line with all mandatory applicable laws and regulations, including the Power Policies of the Government of Pakistan.

Outcome of Step 1b: Scenario b) is the only alternative scenario and it is in line with all mandatory applicable laws and regulations.

Step 2: Investment Analysis

The PPs have decided to opt for barriers analysis instead of investment analysis. The reasons for this are described below in Step 3.

Step 3: Barrier Analysis

As mentioned above in Step 1, the main alternative scenario to the project activity is 'continuation of the current situation'. This is also defined as the baseline scenario and it does not face any significant barriers as it is the current situation in Pakistan. This is the only plausible alternative scenario. Step 3 of the tool states *"determine whether the proposed project activity faces barriers that: (a) Prevent the implementation of this type of proposed project activity; and (b) Do not prevent the implementation of at least one of the alternatives."*

The identified barriers are only sufficient grounds for demonstration of additionality if they would prevent potential project proponents from carrying out the proposed project activity undertaken without being registered as a CDM project activity.

The following arguments explain the barriers that face the CDM project activity (but not the baseline scenario) and how the registration of the CDM project activity will alleviate the barriers that prevent the proposed project from occurring in the absence of the CDM. Each barrier type is taken in turn below.

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed CDM project activity

Investment barriers: Lack of access to capital

Investment in hydropower projects in Pakistan faces high risks (see below) and thus there is a lack of access to private development capital.

i. Current situation – No private capital available

There are currently 21 hydropower plants in Pakistan that are dispatching energy to the national grid which are all financed by the government (i.e. public sector). There is currently only one planned hydropower project in Pakistan that was funded by the private sector. This is the CDM-registered 84MW New Bong Escape Hydropower Project in Azad Jammu and Kashmir, which is still under construction. The Patrind Project would be the second private-sector hydropower project and will also only go ahead with CDM revenue.

Other IPP projects are apparently in the development pipeline according to the Private Power and Infrastructure Board[3] but none are at an advanced stage like the Patrind Hydropower Project (please see the report entitled "Pakistan Hydel Power Potential" published by PPIB in 2004, which contains reference to projects undertaken by the private sector – pages 24 and 54). The lack of investment in hydropower projects by IPPs is evidence that there is a major barrier to securing private sector finance for investment in hydropower in Pakistan. This is demonstrated by the low penetration of private sector hydropower in Pakistan. This is due to the high risks associated with investing in Pakistan, including political risk and risks associated with ongoing conflicts.

To undertake IPP projects, obtaining loans from the banks is a necessity, and therefore it is not possible to implement IPP projects without financing from the banks. In the early stages of Patrind Project development (second half of 2008), Korea Water Resources Corporation (K-water) approached Korean Development Bank and Standard Chartered Bank for financing, however due to high country risk posed by Pakistan, financing was not granted. As can be seen from the letter from Shinhan Bank, one of the leading banks in Korea, the banks are reluctant to invest in Pakistan due to high country risk, and even if the banks invest, they require very high interest rate which makes the project commercially not viable.

[3] PPIB website (www.ppib.gov.pk)

ii. Country risk

Pakistan's country risk classification according to the OECD's *Country Risk Classifications of the Participants to the Arrangement on Officially Supported Export Credits* is 7 (the highest possible risk) as of July 2010. The table below compares this risk classification with other selected countries. This is a major, indeed overwhelming, barrier to investment. The OECD's Arrangement on Officially Supported Export Credits states that in relation to Minimum Premium Rates (MPR) for Country and Sovereign

Credit Risk, countries with a risk classification of 7 (e.g. Pakistan) shall be subject to premium rates in excess of the MPRs established for the category, due to the high level of risk.

Country Risk Classifications of the Participants to the Arrangement on Officially Supported Export Credits

Country name	Previous Classification (July 2009)	Current Classification (July 2010)
Afghanistan	7	7
Bahrain	3	3
Bangladesh	6	6
Germany	0	0
India	3	3
Malaysia	2	2
Oman	2	2
Pakistan	7	7
Saudi Arabia	2	2
Sri Lanka	6	6
UAE	3	3
Zimbabwe	7	7

Hydropower Projects, which are capital-intensive, usually have long payback periods and due to the high-country risk classification, Pakistan has not been able to attract a lot of foreign investment for such long-term projects. Foreign direct investment activity is low in Pakistan particularly due to:

- Security threats to foreign interests in Pakistan;
- Political instability;
- Inadequate infrastructure;
- History of disputes between foreign investors and the Pakistani government;
- Piracy of intellectual property; and
- Historical resistance to adoption of new policies by federal and regional bureaucracies.

Furthermore, the negotiations for the Concession Agreements and tariff for the Patrind Hydropower Project are routinely delayed by the Government of Pakistan and Provincial governments despite the PP's efforts and follow ups. This result in delays and further costs that are not anticipated which can be mitigated by the additional CDM revenues available for the project.

Credit ratings for Pakistan

Rating Body	Rating (as of Feb 2012)	Remarks
Moody's	B3	Inadequate for investment
Standard & Poor's	B-	Inadequate for investment

The Project also faces additional investment risks due to its particular location within Pakistan. According to Control Risks Group (http://www.crg-online.com/Country.aspx?cn=144), Pakistan as a country and the particular location of Khyber Pakhtunkhwa where the certain parts of the Project including weir are located face certain high and extreme risks:

Risk ratings for Pakistan according to Control Risks Group

Risk	Pakistan overall	Khyber Pakhtunkhwa
Political	Medium	High
Operational	High	High
Security	High	Extreme
Terrorism	High	High
Travel	High	Extreme

Due to the high risks discussed in this section, there is a lack of private capital available for projects in Pakistan, particularly for projects in the Khyber Pakhtunkhwa region. The potential CDM status of the Project enables it to attract financing from a combination of institutions that have a desire to invest in CDM projects in developing countries despite the relatively high risks when compared to economies in transition and developed countries.

iii. <u>No available financing</u>

Loans are not available from the banks for such projects as the Patrind Project, unless investors put up a portion of the investment as equity. For risky projects such as this, banks demand around 25% equity.
The Prudential Regulations of the State Bank of Pakistan (SBP) through Circular No 25 explains the special permission of an 80:20 debt to equity ratio for Infrastructure Project Financing (see http://www.sbp.org.pk/bpd/2003/C25.htm). Furthermore, the *Policy for Development of Renewable Energy for Power Generation (2006)* allows the same 80:20 ratio for financing. The intention of SBP is to allow a thin capitalization of 80:20 so that private projects in Pakistan could attract foreign equity investment. Despite the regulatory support from SBP, there has been no such project that enjoyed 80:20 capitalization. The debt-to-equity ratio of the Project, which is 75%:25% again indicates the difficulty in securing equity financing. Thus, given the risks of the project, it is very difficult to find investors willing to put up 25% of the investment (i.e. US$ 109 million).

The fact that the financing for such huge projects in Pakistan is difficult is evident as the multilateral banks (MLBs) are willing to consider the financing for the project below a competitive margin of 4.75% only due to the presence of the Government of Korea's state-owned K-water as a major sponsor (having credit rating of A from S&P and A1 from Moody's) as well as the CER revenue from this being a CDM project. If same project would have to be financed based on local sponsors and no CER revenue, the MLBs would not have agreed on such terms given the risk profile of the country and local sponsors.

However, with the CDM, certain investors and banks with a CDM mandate/ objective are willing to invest equity and/or loan in this project. With financing support from the 'CDM banks' – i.e. the Korea Export-Import Bank (KEXIM) and those Multilateral Banks (MLBs) involved in financing this project, feasible interest rates and loan terms have been secured for this project and the equity investors have decided to go ahead with the project on this basis.

It has been shown above that the high risks of the Project result in high interest costs for commercial loans in Pakistan. These high interest costs are prohibitive, especially in light of Pakistan's desire to keep power tariffs affordable for consumers and thus very low per capita.

iv. <u>High capital requirement</u>

In Pakistan, power projects are typically venturing on a Build-Own-Operate-Transfer (BOOT) basis. For BOOT ventures, usually 70-80% debt financing is required for IPPs in Pakistan. Given the high level of debt financing and higher capital costs, as summarised above, it becomes difficult to arrange project financing keeping in view the investment risks in Pakistan (see section on country risk).

The Patrind Project in particular faces a barrier in accessing capital because of its relatively high capital requirement (and long construction phase). The capital cost required for the Patrind Hydropower Project is currently estimated at US$ 436 million or approximately US$ 2.9 million per MW installed capacity. This is more than double the previous New Bong Project which cost US$ 1.23 million per MW in CAPEX installed capacity (see Registered CDM project No. 2098). Due to technical complexities, the Patrind Project has a

construction phase of 4 years and 3 months which is much longer than most hydropower projects. This increases the project risk and the potential for delays and also means a longer wait before revenue is generated (and thus a slower return on investment).

This high capital cost for the Project is due to:

- Large scale (larger than the previous New Bong project and relatively large in comparison to future possible run-of-river hydropower IPPs[4]);
- A high CAPEX/MW figure of US$ 2.9 million/MW due to the unique technical complexities of the project (elaborated further below).

Such a high capital cost is only available from foreign investors, which in turn have invested in this Project on the basis of its CDM potential. This is elaborated further below. The foreign investors in this project not only have access to capital but access to the technology and the expertise required (the shareholders in the project are also the EPC and O&M contractors).

Technological risk, the most important factor that results in high capital requirement, is elaborated further below. In hydropower development, the choice of water turbine depends on the site conditions, notably on the head of water h and the water flow rate *Q*. Kaplan turbines are suited for low h and large Q such as run-of-river sites and Francis turbines are usually preferred for large *Q* and large h, e.g. dams. Although the Project is a run-of-river type project, because the Project uses the natural elevation difference between river Kunhar and river Jhelum, it is able to achieve a large h, and therefore the Project utilizes Francis turbines which are suitable for large head and large flow rate. The use of natural elevation difference leads to the necessity of construction of long headrace tunnels which increases the technical expertise and skill required for such construction. To date, no qualified EPC contractor is available in domestic market in Pakistan to conduct such construction for hydropower project, therefore the project relies on foreign EPC companies for construction to meet the technical expertise and experience required for such a project. The use of foreign EPC companies resulted in an increased capital cost and relatively high capital expenditure per MW (see earlier). Francis Turbines are used in large size hydropower projects developed by Water and Power Development Authority (WAPDA) of Pakistan such as the run-of-river Ghazi Barotha Prject (1,450MW) and Tarbela Dam (3,500MW).
However, these projects are all publically owned and currently, there are no private hydropower projects in Pakistan that are run-of-river type with headrace tunnels that utilize the natural elevation difference to increase the head of water, which enables the site to use Francis turbines.

The Patrind Project is therefore the first private sector-initiated project in Pakistan that is run-of-river type with headrace tunnels that utilize the natural elevation difference to increase the head of water, which enables the site to use Francis turbines. Therefore, there is significant technical risk in developing the Project. Long construction period, lack of local expertise, environment and resettlement issues etc constitute a significant technological risk in developing the Project. This is also the first project since the implementation of Pakistan Power Policy 2002 and there are no previous experiences to benchmark, especially when it comes to coordinating with the Pakistani Government. However, the additional revenues and international experience from the CDM provide a buffer around these risks.

As mentioned above, Tarbela and Ghazi Barotha are using Francis Turbines but both the projects are owned and operated by the public sector. These two hydro power projects are not comparable as every site has its own dynamics. Developing a project in the public sector is comparatively easy: In private project development all the issues are to be negotiated at each and every stage of the project with different stakeholders by the investor. The issues at times delay the overall implementation of the project. The case of New Bong Escape is one of the recent examples in the sector where the sponsors took almost 13 years to achieve financial close and go into the construction phase.

Moreover, Hydropower projects also have the following innate technological constraints compared to thermal IPPS:

- More Capital intensive compared to thermal

[4] http://www.ppib.gov.pk/list.htm

- Longer gestation and construction Period
- More Construction Risks (inflation, cost overruns, delays, geological surprises, floods, extreme weather, socio-political)
- No clarity/ consensus on net hydel profit and water use charges (in case a project like Patrind falls in two ‘provinces’)
- No “off-the-shelf” or standard machines similar to thermal plants
- Very site specific. Usually a number of options for developing each site
- High percentage of civil works (70-75%) - difficult to estimate end costs
- Operational Risks (hydrological risk, multiple uses, future developments/diversions)
- Environmental & resettlement issues
- Land acquisition is one of the main issues as the land being a provincial subject without clear framework for IPPs.
- Generally located in remote area, lack of basic infrastructure (access roads, tunnels, electricity, telephone, colony, potable water, manpower)
- Dedicated and expensive delivery infrastructure required
- Extra thermal capacity for backup in low water season
- Hydropower generation varies with availability of water & head
- Limited International experience in Private Hydropower Projects
- Specific Tariff & Security Documents issues
- Project Agreements (Implementation Agreement (IA), Power Purchase Agreement (PPA)) are different and complex

Moreover, the project team needs to devise special techniques for the underground excavation works especially for the tunnel boring as Pakistan lacks technology and expertise in carrying out such activities. The delay in other public sector projects due to lack of expertise for tunnel excavation is one of the reasons that enhance the risk of the Patrind project as well.
The complex technology has its own risks and limitations. The construction of the headrace tunnel by itself is a risky business where the rock type to be encountered during the execution is unknown and the geological uncertainty in the underground structures makes things even more complex. Furthermore, to protect the turbines from erosion, to increase the operational life and to reduce the maintenance frequency of the runner and its associated auxiliaries, sand traps (silting basins) have been included in the design of the Complex and their construction, operation and maintenance further complicate the project. The sand trap system is mainly composed of the two sand trap chambers, outlet chamber, and flushing tunnel. The sand trap will be designed to retain sediment grain size greater than 0.20 mm. The approximate length of sand trap is 140 meters. Therefore, projects such as these would need much more contingency to hedge any difficulties arising in the midst of construction activities.

Due to the above-mentioned technological challenges, construction duration can easily be delayed which will result in penalty payable to the power purchaser (PP). If there is a delay in commercial operation due to a delay in construction, a penalty of US$12,250 per day will be levied and expected revenue from power supply will be lost. If the construction is delayed by more than 400 days, the concession agreements with the Pakistani Government will be terminated and the project owner has to give up the project.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

Investment barrier

The following sections explain further on how the identified investment barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity).

While it is acknowledged that all infrastructure projects in Pakistan are affected by the country risk, scarce foreign direct investment and local savings, the degree of risk varies from project to project. For example, thermal projects are less capital intensive on per kilowatt basis (which can normally be set up at half the cost), and can be put into operation much more quickly than hydropower project, thereby, lowering their exposure to country risk. Therefore, the investment barrier does not prevent the continuation of the current situation

where the additional power generated under the project would be generated in existing and new grid-connected power plants, which are mainly thermal, in the electricity system.

During recent past the following thermal IPPs were commissioned/constructed and funded by local lenders/banks only. The reference tariff can be downloaded from National Electric Power Regulatory Authority (NEPRA)'s web Site: http://www.nepra.org.pk/

- Atlas Power
- Attock Generation Limited
- Saif Power Limited
- Sapphire Electric Company Limited
- Nishat Power Limited
- Nishat Chunian Limited
- Liberty Power

Moreover, alternative thermal projects, especially the simple cycle projects provide lenders with tangible assets that can be pledged as security and seized and relocated in the event of default. The combustion turbine/power island represents the majority of project assets. The class of turbines typically used to provide incremental capacity in Pakistan is relatively easy to relocate. This provides lenders with a recourse option unavailable to those who would fund a hydro project, and lowers the overall project risk profile accordingly.

Alternative projects such as thermal power projects are not exposed to any civil/geological risks and have a relatively low content of civil works compared to hydropower projects. Such projects not only enjoy easy site access but typically present few challenges with regard to site topography and conformation. Civil works are largely a matter of clearing and grading.

The time period to develop and construct an alternative thermal project is significantly less than that required to develop and construct a hydropower project. A typical simple cycle thermal project can be developed in 3-4 years including construction, whereas a hydropower project could take more than 10 years for development and construction.

Consequently, risk associated with time is significantly reduced. Similarly, hydropower projects under public sector are not under obligation to complete the project in given timeframe as required for this project under the terms of Power Purchase Agreement (PPA). Therefore, the risks do not prevent the continuation of the current situation where the additional power generated under the project would be generated in existing and new grid-connected power plants, which are mainly thermal, in the electricity system.

As the above barrier analysis demonstrates, the various barriers identified for hydropower including the Patrind Hydropower Project have much less impact on the continuation of the current situation. All the identified barriers not only have the potential to significantly impact hydropower development but have actually and practically affected the Patrind Hydropower Project. As the table below shows, hydroelectric power capacity in Pakistan has decreased by 15MW from 2004 to 2009, while thermal power capacity has increased by 543MW during the same period and total capacity has increased by 528MW. Therefore, increase in Pakistan's power capacity is mostly attributed to thermal power plants.

Installed Capacity of Electricity Generation as on 30th June (Unit: MW)			
YEAR	**2004**	**2009**	**Increase/Decrease**
Hydel	6,496	6,481	-15
Thermal	12,299	12,842	543
Nuclear	462	462	-
Total	**19,257**	**19,785**	**528**

Source: Pakistan Energy Yearbook 2009.

The CDM enables the Barriers to be overcome

The CDM status of the Project enables development capital to be secured despite the general lack of private capital and the high project risks stemming from investment barriers.

Reduction of Investment Barriers: Financing of the Patrind Hydropower Project

Star Hydro Power Ltd. (SHPL), the project participant carrying out the project, is a special purpose company with the sole aim to develop the Patrind Hydropower Project. It was incorporated in 2006 as a joint venture between Emirates Trading Company and TransAsia Gas International LLC, both subsidiaries of Al-Ghurair Group, UAE. However, due to high country risks (see above) and difficulty in finding lenders for the project, the Al-Ghurair Group decided to pull out of the investment on 30th April 2009 by selling 49% of SHPL shares to the Korean consortium followed by the sales of the remaining 51% of shares to the Korean consortium on 10th September 2009. This is because Al-Ghurair Group, UAE, is a private company sensitive to investment barriers mentioned above as well as financial returns and could not secure enough funding and carry the political and commercial risks arising from the project. This resulted in Al-Ghurair Group's selling and transferring the ownership to the Korean consortium. Korea Water Resources Corporation (K-water) leading the Korean consortium, however, is a state-owned entity driven by Korea's low carbon green growth policy and was in a position to take on the risk.

Therefore, initially a group of 3 interested Korean parties acquired SHPL in September 2009 by injecting equity through their special investment vehicle KDS Hydro Pte. Ltd. based in Singapore, and jointly owned SHPL. The consortium consists of Korea Water Resources Corporation (K-water) (80% stake and largest shareholder), Daewoo Engineering & Construction Co., Ltd. (10% share) and Sambu Construction Co., Ltd. (10% share). As of July 2012, Sambu Construction withdrew from the consortium and sold the shares (10%) to Daewoo E&C. Together the Korean consortium hold equity that is equal to 25% of the total project cost. The CDM aspect of this project was central to the Korean parties' decision to invest.

Moreover, Shinhan BNP Paribas Global Infrastructure Fund (GIF), the investment trust managed by Shinhan BNP Paribas Asset Management Co. Ltd. has participated in the project as a financial investor, by investing in the Patrind Project. The investment decision was made based on the expectation that the project cash flow will benefit from the sale of Certified Emission Reductions (CER) under the CDM. In short, GIF's investment decision on the project was made under the assumption that the additional revenues from CER are feasible and will benefit the cash flows of the project.

Table below summarises the changes in the composition of SHPL shares following the acquisition of SHPL from the Al-Ghurair Group by the Korean consortium in September 2009.

Entity	K-water	Daewoo E&C	Sambu Construction	GIF*
September 2009	80%	10%	10%	0%
Since July 2012	80%	20%	0%	0%
From commercial operation date (after construction)	53%	20%	0%	27%

* GIF has invested in K-water Exchangeable Bond. The bond has an embedded option to exchange the bond for K-water's holding share of SHPL after construction.

The lenders of the Project that provide the remaining 75% financing cost as debt are four multilateral banks: Export-Import Bank of Korea (KEXIM) (providing 33.6% of the loan), Asian Development Bank (ADB) (providing 29.7% of the loan), and the International Finance Corporation and Islamic Development Bank (together providing 36.7% of the loan).

The acquisition and the investment decision made by K-water which is the largest shareholder of the project are in line with the Korean Government's current strategy to promote development of CDM projects in overseas countries. As an agency of the Korean Government, K-water has an expressed desire and preference to invest in CDM projects, and this is reflected in K-water's 2006 sustainability report announcing the development of CDM projects as part of their 'high-priority long-term master plan for sustainable management' (http://english.kwater.or.kr/EngUser/html/corpo/2006_SMReport.pdf). Similarly, the lender providing the largest loan, KEXIM, has the intention to promote overseas CDM projects to support the government strategy (see MoU between KEXIM and the Ministry of Knowledge and Economy). Moreover,

KEXIM is investing in the project using its Carbon Fund, a fund solely for CDM projects. K-water also has established an MoU with the Carbon Fund on 30 September 2009 and
is currently in negotiation with the Fund for the transaction of the primary Certified Emission Reductions (CERs).

The companies participating in the project have the following characteristics:

PPs	Company	Nature of company	Organization and ownership	Financial information in 2009
Project company	Star Hydro Power Limited (SHPL)	Special purpose company to develop Patrind Hydropower Project	Initially owned by Al-Ghurair Group (UAE) and ownership transferred to Korean consortium in September 2009	Asset: US$ 2 m Liability: US$ 0.1 m Equity: US$ 1.9 m Revenue: US$ 0.0 m Net Income: US$ 0.1 m
Share-holders	Korea Water Resources Corporation (K-water)	O&M contractor and own 80% of project during construction, and 53% of project after construction.	Korean government owned organisation (established by Korean Water Resources Corporation Act and heavily influenced by national policy)	Asset: US$ 11.4 bn Liability: US$ 2.6 bn Equity: US$ 8.8 bn Revenue: US$ 1.7 bn Net Income: US$ 0.1 bn
	Daewoo Engineering & Construction Co., Ltd. (E&C)	EPC contractor and currently own 20% of project	Owned by Korea Development Bank (KDB), a Korean government affiliated bank.	Asset: US$ 7.6 bn Liability: US$ 5.0 bn Equity: US$ 2.6 bn Revenue: US$ 6.1 bn Net Income: US$ 0.1 bn
	Sambu Construction Co., Ltd.	EPC contractor and initially owned 10% of project. Transferred the shares to Daewoo E&C in July 2012. (Sambu Construction is currently no longer the EPC contractor).	Private company	Asset: US$ 0.8 bn Liability: US$ 0.5 bn Equity: US$ 0.3 bn Revenue: US$ 0.7 bn Net Income: US$ 0.0 bn
	Shinhan BNP Paribas Global Infrastructure Fund (GIF)	Financial investor and own 53% of project after construction.	Fund established from public and private investors for equity participation, subordinate debt and mezzanine investment in global infrastructure projects.	N/A
Financial Institutions (Lenders)	Export-Import Bank of Korea (KEXIM)	Main lender, US$110m (33.6% of the loan)	Korean government owned bank (established by Export-Import Bank of Korea Act and heavily influenced by national policy).	N/A
	Asian Development Bank (ADB)	Other lender, US$97M (29.7% of the loan)	Multilateral financing institution	N/A
	International Finance Corporation (IFC) & Islamic Development Bank (IDB)	Other lenders, combined US$120M (36.7% of the loan)	Member of World Bank Group (IFC); Multilateral development financing institution (IDB)	N/A

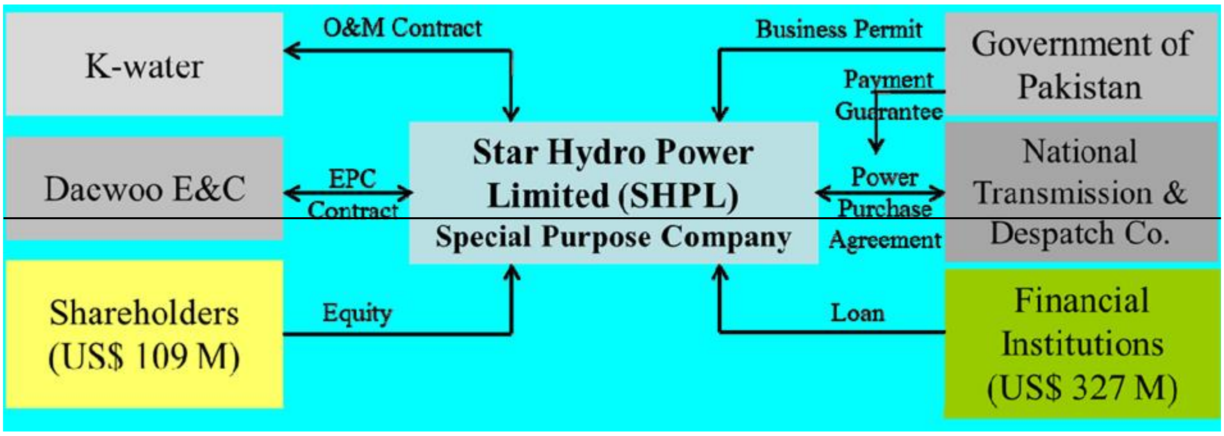
As indicated by the above table, the capital available and the nature of the different companies involved are necessary for development of this type of complex hydropower project without government funding. It is

highly unlikely that other sources of capital can be found elsewhere in Pakistan. All other hydropower projects in the country were developed with government or donor money except the first hydropower IPP of New Bong Escape (see Pakistan Energy Yearbook 2009).

Table and figure below summarise the investment and project financing structure of the Patrind Hydropower Project.

Shareholders (25% of total project funding)		**Financial Institutions / Lenders (75% of total project funding)**	
Entity	**Amount (Million US$)**	**Entity**	**Amount (Million US$)**
K-water (53%)	58	KEXIM (33.6%)	110
Daewoo E&C (20%)	22	ADB (29.7%)	97
Global Infrastructure Fund (GIF, 27%) *	29	IFC (18.35%)	60
		IDB (18.35%)	60
Total	**109**	**Total**	**327**

* GIF loan to K-water which will be paid back through SHPL shares after start of commercial operation



The foreign investors have invested in this Project on the basis of its CDM potential and thus CER revenue. The CDM potential of the Project is important because it aligns with the investment criteria and objectives of the financiers (see below) and it increases the financial returns of the Project, thus off- setting some of the risks to an acceptable level.

CDM Investment Criteria

Since February 2008, the Korean government has created an institutional framework to move towards becoming a green economic power. In 2009, Korea enacted a Framework Act on Low Carbon Green Growth and released a National Strategy for Green Growth and Five-Year Plan for Green Growth. In particular, the Framework Act represents a milestone in the national development strategy and the legal foundation of Korea's green growth policies, approaching green growth in a comprehensive and systematic manner.
The National Strategy for Green Growth envisages three main objectives and ten policy directions, based on a consensus between social, business, academic and government stakeholders. The three objectives include i) mitigation of climate change and the strengthening of the country's energy independence, ii) creation of new growth engines, and iii) improvement of the quality of people's lives and the enhancement of Korea's international standing. Since 2011, Korea has initiated the greenhouse gas (GHG) and energy target management scheme whereby energy-intensive companies need to report their GHG inventory on an annual basis to the government as well as their GHG emission reduction plans and performance. From 2015, Korea will start the Korean Emissions Trading Scheme (KETS).

K-water and KEXIM as Korean government owned institutions have therefore taken leadership in developing low-carbon development projects abroad, including Pakistan Patrind Hydropower Project despite investment and financial risks. Actually, this project is the first overseas investment of the main sponsor, K-water. And KEXIM specifically mentions in its support letter addressed to K-water dated July 24th, 2009 that "*current KEXIM policy does not allow financing to a project in a high political risk country such as*

Pakistan" and "strongly recommend that the Project seeks the CDM under the Kyoto Protocol of the UNFCCC such that it can provide additional source of revenues to the Project and also provide a good rationale for KEXIM to provide financing to the Project". From the four banks that are financing this project, KEXIM is the largest contributor and therefore plays the most important role.
Moreover, KEXIM facilitated the participation of ADB, IFC and IDB in the project. Therefore, it can be stated that the main sponsor and the main lender of this Project are participating in this Project due to the CDM factor.

As stated earlier, the banks such as Korean Development Bank and Standard Chartered Bank refused to fund Patrind Project. As a last resort, K-water approached Export-Import Bank of Korea (KEXIM) which is an official export credit agency providing comprehensive export credit and guarantee programs to support Korean enterprises in conducting overseas business, but was again rejected due to high country risk. KEXIM normally provides the most favourable financial conditions to Korean enterprises as its main purpose is to support export-led economy and facilitate economic cooperation with foreign countries. Then with the new government's announcement and roll out of the national Low Carbon Green Growth Strategy, KEXIM re-evaluated this project from a CDM perspective that contributes to Korea's Low Carbon Green Growth Strategy and decided to consider financing the project in July 2009.
The main shareholder in the Project is K-water. K-water invested in the Project in collaboration with KEXIM which has a Carbon Fund earmarked solely for CDM projects. KEXIM would not have been interested or involved in this activity were it not to be intended as a CDM project. Documentary evidence of this is available from e-mail exchanges at the time of the investment between KEXIM and K-water (the main PP) and an original support letter to K-water from KEXIM on cooperation in financing (see support letter dated July 24th, 2009). The CDM scheme therefore allows a major investment barrier for the project to be removed – as financing is dependent on KEXIM's loan. Without KEXIM's cooperation, it would not be possible for the Project to be financed.

Furthermore, the EPC contractors would not be able to commence construction in that there are practically no commercial financial institutions (except KEXIM) which can issue performance bonds and advance payment bonds for projects in Pakistan.

The other loans are provided by ADB, IFC and IDB. All three of these institutions have an expressed desire to promote investment in CDM projects. The ADB and the IFC routinely funds CDM projects and co-financed the previous New Bong Escape project[5]. The CDM potential of the Project was important in enabling the Project to meet the loan criteria of these banks and secure financing. For example, in the support letter from ADB dated 7 December 2011, ADB explicitly mentions that "*an integral feature of the Project's attractiveness to ADB is its potential to create revenue from the sale of Certified Emission Reductions pursuant to the Kyoto Protocol's Clean Development Mechanism. The proposed terms and conditions of the ADB Loan for the Project have been determined on the assumption that revenues from Certified Emission Reductions are available for the Project and form an integral part of the Project's cash flows*".

Documentary evidence to support the barriers analysis

1. Details of KEXIM's Carbon Fund
2. Statistics from the Energy Yearbook on lack of private sector hydropower projects
3. Minimum Premium Risk for Pakistan compared to other foreign country investments by KEXIM
4. Memorandum of Understanding between Ministry of Knowledge and Economy and KEXIM on the promotion of CDM projects overseas
5. E-mail communication and letter of support (dated 24th July 2009) between KEXIM and K- water regarding the need for a CDM component of the Patrind Hydropower Project
6. Patrind Hydro Power Project in Pakistan Support Letter from Shinhan BNP Paribas Asset Management Co. Ltd. (dated 27th January 2012)
7. Lessons from the Independent Private Power Experience in Pakistan (May 2005), World Bank & Energy and Mining Sector Board Discussion Paper

[5] http://www.ifc.org/ifcext/spiwebsite1.nsf/2bc34f011b50ff6e85256a550073ff1c/bf2cc3241c0ed54a852576ba000e2d39?opendocument

8. Asian Development Bank (ADB) project loan Support Letter (dated 7th December 2011)
9. MoU between K-water and KEXIM's Carbon Fund (dated 30th September 2009)
10. Letter from Shinhan Bank (dated 6th November 2012)

Outcome of Step 3: It is thus concluded that the project activity faces significant investment barriers that are alleviated through registration under the CDM.

The "Tool for the demonstration and assessment of additionality" states that "*If the CDM alleviates the identified barriers that prevent the proposed project activity from occurring, proceed to Step 4, otherwise the project activity is not additional*"

Step 4: Common practice analysis

According to the Additionality Tool, the project participants shall provide an analysis of any other activities that are operational and that are similar to the proposed project activity. "*Projects are considered similar if they are in the same country/region and/or rely on a broadly similar technology, are of a similar scale, and take place in a comparable environment with respect to regulatory framework, investment climate, access to technology, access to financing etc.*"

It follows the latest tool for the demonstration and assessment of additionality (Ver 6), a stepwise approach to define and calculate the share of plants which are similar to the proposed project activity as a basis for the demonstration that the project activity is not common practice.

Sub-step 4a: Analyze other activities similar to the proposed project activity:

Step 1: Calculate applicable output range as +/-50% of the design output or capacity of the proposed project activity.
The project capacity is 150MW hence the output range for this project activity to be considered in the common practice analysis is between 75MW and 225MW.

Step 2: In the applicable geographical area, identify all plants that deliver the same output or capacity, within the applicable output range calculated in Step 1, as the proposed project activity and have started commercial operation before the start date of the project. Note their number N_{all}. Registered CDM project activities shall not be included in this step.

There are 18 thermal power stations, one (1) nuclear power station and one (1) hydroelectric power station within the applicable output range calculated in Step 1[6]. Therefore, N_{all} is equal to 20. The list of identified power plants is presented below:

Power Plant	Installed Capacity (MW)	Type
Chashma	184	Hydro
KANUPP	137	Nuclear
SPS Faisalabad	132	Thermal
NGPS Multan	195	Thermal
GTPS Kotri	174	Thermal
FBC Lakhra	150	Thermal
GTPS Korangi Town	125	Thermal
GTPS Site	100	Thermal
Korangi CCP	220	Thermal
Attock Gen	165	Thermal
Atlas Power	214	Thermal
Engro Energy Ltd.	217	Thermal

[6] Hydrocarbon Development Institute of Pakistan, "Pakistan Energy Yearbook 2010", Pages 91, 97-98, Ministry of Petroleum & Natural Resources

Power Plant	Installed Capacity (MW)	Type
Fauji Kabirwala	157	Thermal
Gul Ahmed, Karachi	136	Thermal
Habibullah	129	Thermal
Kohinoor Energy, Lahore	131	Thermal
Nishat Power	200	Thermal
Saba Power	134	Thermal
Southern Electric	135	Thermal
Tapal Energy, Karachi	126	Thermal

Step 3: Within plants identified in Step 2, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.

As defined above, the different technology N_{diff} has been identified. Here, different technologies other than the project activity have been defined as the source of input energy other than hydro power.

Moreover, all hydroelectric power stations (non-CDM projects) that currently supply electricity to the national grid are owned by public sector, and there are **no non-CDM private hydro power projects** that supply electricity to the grid at present[7]. These existing hydro power projects are very distinct from IPPs as the investment climate especially with regard to securing financing in light of the country risks would differ significantly hence considered in N_{diff} project. In case of IPPs all the financial arrangements have to be made by the sponsors and the priority of the financiers is always the financial credibility of the developer before the investment. Furthermore, due to the regulatory framework IPP work entirely differently as they have to execute various concession agreements with the government to take up the Project. On the other hand, lenders require a certain number of conditions precedents to be fulfilled before financial close which in itself is time consuming and difficult procedure to undertake.
All the government departments take an IPP as a private Company and getting things done like land acquisition, environmental approvals, generation license etc is a very difficult and time taking procedure. Only after fulfilling regulatory and legal requirement the Government of Pakistan issues the government Guarantee, the most important condition precedent for the drawdown from the lenders. On the other hand, the public sector projects are fully backed and supported by the government and no such stringent concessionary and legal procedures are involved in their development. The lenders/banks take a public sector project much leniently as compared to IPPs and the requirement of conditions president for the drawdown is also on the lower side. Hence N_{diff} can be considered as 20.

Step 4: Calculate factor $F=1-N_{diff}/N_{all}$ representing the share of plants using technology similar to the technology used in the proposed project activity in all plants that deliver the same output or capacity as the proposed project activity.

According to the Additionally Tool, the proposed project activity is not "common practice" in the Pakistan electricity sector as the share of Plants $F = 1 - (N_{diff} / N_{all})$ using a technology similar to the technology used in the proposed project activity is Zero and this below the defined threshold of 0.2. Also, the criteria $N_{all} - N_{diff}$, which calculates the total number of plants that are similar to the proposed project activity yields a value of Zero and thus is also below the defined limit of 3. The table below shows both conditions are fulfilled. Therefore, at the time of Project Starting Date, there are no similar operational plants in Pakistan and the proposed project activity is not common practice.

Parameters	Values/Results
N_{all}	20
N_{diff}	20
$F = 1 - (N_{diff} / N_{all})$	0
$N_{all} - N_{diff}$	0

Sub-step 4b: Discuss any similar options that are occurring:

[7] PPIB website (www.ppib.gov.pk)

All activity in Pakistan is currently focussed on fossil-fuel fired thermal energy projects. According to the PPIB, there are 23 commissioned private sector IPP fossil-fuel fired projects, supplying electricity to the grid. These projects use fossil-fuel technologies and are not comparable to hydro power projects in terms of technology used.
The Patrind project will be Pakistan's second IPP hydro power project. The first project (currently under construction) is the 84 MW New Bong Escape project, which was registered under the CDM on 31st January 2009. Apart from the Patrind Hydropower and the New Bong Escape CDM project, there are no other private hydro power projects in Pakistan.

However, Private Power Infrastructure Board (PPIB) has announced several hydro power IPP projects which are summarised in Table 2 below. None of the IPPs listed have begun construction or achieved financial close and there are no guarantees that they will be completed by the scheduled completion date, if they are to be completed at all (see PPIB website for details of delayed projects). Many of these projects have serious issues with local land, resettlement, tariff issues and lack of capital due to high country risk and high capital cost and are not expected to supply energy until at least 2014.

Expected future hydro power IPPs announced by the PPIB

No.	Name	MW	Location	Expected completion date
1	Rajdhani Hydro Power Project	132	Poonch River Near Mangla, AJK	Jun 2014
2	Gulpur Hydro Power project	100	Poonch River/Gulpur, AJK	Jun 2014
3	Kotli Hydel Project	100	Poonch River/Kotli, AJK	Dec 2014
4	Sehra Hydel Project	130	Poonch River, AJK	Dec 2014
5	Karot Hydel Project	720	Jehlum River, AJK	Aug 2015
6	Madian Hydropower Project	157	Swat River, KP	Dec 2015
7	Asrit-Kedam Hydel Project	215	Near Kalam/Swat River, KP	Dec 2015
8	Azad Pattan Hydel Project	222	Jehlum River/Sudhnoti, AJK	Aug 2016
9	Kalam-Asrit Hydel Project	197	Swat River, KP	Dec 2016
10	Chakothi-Hattian Project	139	Muzaffarabad, AJK	Dec 2016
11	Shogosin Hyderopower Project	127	Luthko River/Chitral, KP	Dec 2016
12	Shushgai Zhendoli Hydel Project	102	Turkho River/Chitral, KP	Dec 2016
13	Gabral-Kalam Hydropower Project	101	Gabral/Swat Rives, KP	Dec 2016
14	Suki Kinari Hydropower Project	840	Kunhar River/Mansehra, KP	Jun 2017
15	Kohala Hydropower Project	1,100	Jehlum River/Kohala, AJK	Dec 2017
16	Kaigah Hydel Project	548	Kaigah/Indus River, KP	Dec 2017

The common practice test requires the project participants to "*describe whether and to which extent similar activities have already diffused in the relevant geographical area.*" Thus, under this definition, we have shown that the Patrind project is not common practice in the region or the country. The only other hydro power projects are fundamentally different (public sector only), plus one which is a CDM project (i.e. the New Bong Escape project).

Steps 4a and 4b have thus been satisfied. **It is concluded that the project activity is additional.**

Evidence of prior consideration of the CDM

As per the CDM Glossary of Terms, the start date is defined as the

"earliest date at which either the implementation or construction or real action of a project activity begins."

The start date shall be considered

"to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts

have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project."
The start date of the Patrind Hydropower Project is 20/09/2010. This is the earliest date of real action – the date of signing the EPC contract.

In accordance with Version 04 of the Guidelines on the Demonstration and Assessment of Prior Consideration of the CDM, the PPs advised the Pakistan DNA and the UNFCCC on 8th September 2010 and on 4th February 2011 respectively in writing of the commencement of the Project Activity within six months of the start date. The notification is visible on the UNFCCC website for the "Patrind Project" dated 4th February 2011, which is within six months of the 20th September 2010 start date.

Project timeline to date showing key milestones

Dates	Remarks	Documentary evidence available
04.2007	Invitation to Korea Electric Power Corporation (KEPCO) by the Embassy of Pakistan in Korea to invest into power sector in Pakistan	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development Department), January 2009
05.2007 ~ 06. 2007	K-water and KEPCO reviewed the project data	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development Department), January 2009
07.2007 ~ 10.2007	K-water reviewed the FSR prepared by SHPL and conducted a site survey	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development Department), January 2009
11.2007 ~ 02.2008	K-water reviewed the basic design and conducted the value engineering	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development Department), January 2009
02.2008	Formation of a MOU among Korean consortium (Daewoo Engineering & Construction Co., Ltd., Sambu Construction Co., Ltd., K-water)	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development Department), January 2009
03.2008	Basic design review, discussion and negotiation for business condition, K-water's internal document on the first CDM eligibility study communicated between K-water personnel on 04.03.2008.	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development Department), January 2009
05.2008	Preliminary contract draft submitted to KEXIM, ADB and SCB	Basic Information Report for Patrind Project (Business Plan Report for K-water Investment Committee, prepared by K-water Overseas Business Development

Dates	Remarks	Documentary evidence available
		Department), January 2009
23.12.2008-26.12.2008	E-mail communication between Eco-Frontier and SHPL regarding CDM eligibility of the project.	e-mail communication between Eco-Frontier and SHPL
20. 01. 2009	K-water Investment Committee approval of business plan	Pakistan Patrind Hydropower Project Business plan
29. 01.2009	K-water Board of Director Meeting regarding finalisation of investment decision	Board of Director Meeting Decision (Ref. 2009-3)
30.04.2009	Korean consortium entered into the Shareholders Agreement with the intend to establish a special investment vehicle (SIV)	Shareholders Agreement by and among Korea Water Resources Corporation, Daewoo Engineering & Construction Co., Ltd., and Sambu Construction Co., Ltd., 30 April 2009
30.04.2009	Investment decision made by Korean consortium to acquire 49% share of SHPL made	Share Purchase Agreement among Star Hydro Power Limited, Emirates Trading Agency LLC, Transasia Gas International LLC, and KDS Hydro PTE., Ltd., 30 April 2009
24.07.2009	Letter of Support from KEXIM to K-Water regarding CDM investment	Letter of Support dated 24.07.2009
10.09.2009	Investment decision made by Korean consortium to acquire 51% share of SHPL made	Share Purchase Agreement among Star Hydro Power Limited, Emirates Trading Agency LLC, Transasia Gas International LLC, and KDS Hydro PTE., Ltd., 10 September 2009
08.10.2009	Request for Proposal (RFP) issued by SHPL for CDM advisory service to ERM.	RFP sent to ERM Korea by SHPL on 8 October 2009
18.11.2009	LOI issued to ERM to engage in further discussions and negotiations for CDM advisory services	LOI issued to ERM by SHPL on 18 November 2009
30. 06. 2010	Letter of Support issued to SHPL by Pakistani Government	Letter of Support
05.08.2010	CDM Feasibility Study completed by ERM	FSR submission via e-mail to SHPL by ERM, 05 August 2010
11. 08. 2010	Environmental Approval from Azad Jammu & Kashmir	Letter from Environmental Protection Agency
20.09.2010	EPC contract between SHPL and DAEWOO & SAMBU JV (Start date)	J.V of Daewoo E&C and Sambu Construction was selected as EPC Contractor
14. 04. 2011	Environmental Approval from Khyber Pakhtunkhwa	Letter from Environmental Protection Agency
29. 07. 2011	Investment contract with GIF (to purchase 27% of shares in SHPL)	Investment contract
13. 12. 2011	Loan agreement with ADB, IFC, IDB and KEXIM	Loan agreement
08. 03. 2012	Power Purchase Agreement executed between SHPL and Power Purchaser	Power Purchase Agreement
09. 07. 2012	Withdrawal of Sambu Construction from Korean consortium (and subsequent transferal of 10% shares to Daewoo E&C)	Shareholders' Agreement and Register of Members and Share Ledger
31.12.2012 (expected)	Financial close	As per the lenders' exhaustive list of around 225 condition precedents (CPs) at least 12 months will be required for fulfilment of these CPs.
01.01.2013	Construction start date	Works on Preliminary Construction

Dates	Remarks	Documentary evidence available
(expected)		have been started as of November 2010 for construction of roads and bridges

As shown in the above Table, the Korean consortium approached Eco-Frontier, a local Korean consultancy, for CDM advice for the project prior to the investment decision date on 30th April 2009. Therefore, it is demonstrated here that the Korean consortium considered the CDM as part of the project prior to the investment decision, as well as the start date.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

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The baseline scenario is the continuing operation of the existing thermal intensive grid and future expansion mainly through increase in capacity of the system by the addition of new fossil fuel-based generation sources. In the project scenario, the same electricity demand is met with the incremental contribution of the Project's electricity generation. Because the Project uses renewable sources to produce electricity, there are no additional emissions from the Project activity and emissions attributable to an equivalent thermal plant are saved.

Following the Methodology ACM0002, the baseline emission factor is calculated as guided in "Tool to calculate the emission factor for an electricity system" (the Tool) including of a combined margin (CM), consisting of the simple average of the operating margin emission factor (OM) and build margin emission factor (BM) by utilizing an ex-ante 3 years data period. The PPs have followed the latest version of the Tool at the time of writing – Version 02.2.1 (EB63).

The baseline emission factor is calculated using following the "Tool to calculate the emission factor for an electricity system" including six steps of:

Step 1: Identify the relevant electricity systems

For the purpose of determining the electricity emission factor, no connected electricity system was identified, therefore the project electricity system is defined as the Pakistan National Electricity system - the Water and Power Development Authority (WAPDA). This is in line with Step 1 of the Tool. The DNA of Pakistan has not published a delineation of the project electricity system but the PPs have determined that the electricity system will be WAPDA based on the location of the project. The grid boundary is clearly defined in the Pakistan Energy Yearbook (2009) and the PPs have followed this approach.

The operating margin emission factor is calculated using one of the following options to determine the CO_2 emission factor(s) for net electricity imports from a connected electricity system within the same host country:

(a) 0 tCO_2/MWh; or
(b) The weighted average operating margin (OM) emission rate of the exporting grid, determined as described in Step 4 (d) below; or
(c) The simple operating margin emission rate of the exporting grid, determined as described in Step 4 (a), if the conditions for this method, as described in Step 3 below, apply to the exporting grid; or
(d) The simple adjusted operating margin emission rate of the exporting grid, determined as described in Step 4 (b) below.

Some imports are from connected electricity systems located in Iran: the emission factor is 0 tonnes CO_2 per MWh for these imports, in line with the Tool.

Step 2: Choose whether to include off-grid power plants in the project electricity system

The project participants choose:

Option I: "Only grid power plants are included in the calculation". This option is chosen to calculate the operating margin and build margin emission factor.

Step 3: Select a method to determine the operating margin (OM)

The calculation of the operating margin emission factor ($EF_{grid,OM,y}$) should be based on one of the following methods:

(a) Simple OM; or
(b) Simple adjusted OM; or
(c) Dispatch data analysis OM; or
(d) Average OM.

The simple OM method is chosen because the low-cost/ must-run resources constitute less than 50% of the total WAPDA grid generation in average of the five most recent years. The table below supports this fact.

Year	Electricity (GWh)			Low-cost/Must-run	
	Total	Hydro	Nuclear	GWh	%
2004-05	76,434	25,671	2,795	28,466	37.24
2005-06	84,644	30,862	2,484	33,346	39.40
2006-07	88,624	31,953	2,288	34,241	38.64
2007-08	85,812	28,707	3,077	31,784	37.04
2008-09	82,474	27,784	1,618	29,402	35.65
Total 5 years	**417,987**	**144,977**	**12,262**	**157,239**	**37.62**

Source: Pakistan Energy Yearbook 2009.

Notes:

i) For the purpose of determining the electricity emission factor, the project electricity system is defined as the Pakistan National Electricity system (Water and Power Development Authority- WAPDA);
ii) The WAPDA grid imported electricity from Iran since October 2002; and
iii) Total generation does not take into account electricity generation from the KESC grid or IPPs connected to other grids than WAPDA.

In calculating the simple OM, the *ex-ante* option–a 3-year generation-weighted average, based on the most recent data available at the time of submission of the CDM-PDD to the DOE for validation, is chosen. The years chosen are 2007, 2008 and 2009, which constitute the most recent available data from the Pakistan Energy Yearbook 2009.

Step 4: Calculate the operating margin emission factor according to the selected method

The simple OM emission factor is calculated as the generation-weighted average CO_2 emissions per unit net electricity generation (tCO_2/MWh) of all generation power plants serving the system, not including low-cost/ must-run power plants/units.

The simple OM may be calculated based on the net electricity generation and a CO_2 emission factor for each power unit (Option A); or based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system (Option B).

Option B can only be used if (a) the necessary data for Option A is not available; (b) only nuclear and renewable power generation are considered as low-cost/ must-run power sources and the quantity of electricity supplied to the grid by these sources is known; and (c) off-grid plants are not included in the calculation.
(a), (b) and (c) are all met by this project:

(a) Data on net electricity generation, the average efficiency of each power unit and the fuel type(s) used in each power unit are not available for all power units (particularly the IPPs). Thus, Option A cannot be adopted for the Project;
(b) Based on the Pakistan Energy Yearbook, only nuclear and renewable power generations are considered as low-cost/ must-run power sources. The quantity of electricity supplied to the grid by low-cost/ must-run power sources is known; and
(c) Off-grid power plants are not included in the calculation.

Therefore, Option B is selected to calculate the simple OM emission factor.

The OM will be calculated based on the total net electricity generation of all power plants serving the system and the fuel types and total fuel consumption of the project electricity system.

$$\mathbf{EF}_{grid,OMsimple,y} = \frac{\sum_i(\mathbf{FC}_{i,y} \times \mathbf{NCV}_{i,y} \times \mathbf{EF}_{CO_2,i,y})}{\mathbf{EG}_y} \qquad (1)$$

Where:

$EF_{grid,OMsimple,y}$ = Simple operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
$FC_{i,y}$ = Amount of fossil fuel type *i* consumed in the project electricity system in year *y* (mass or volume unit)
$NCV_{i,y}$ = Net calorific value (energy content) of fossil fuel type *i* in year *y* (GJ / mass or volume unit)
$EF_{CO2,i,y}$ = CO_2 emission factor of fossil fuel type *i* in year *y* (tCO_2/GJ)
EG_y = Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year *y* (MWh)
i = All fossil fuel types combusted in power sources in the project electricity system in year *y*
y = The relevant year as per the data vintage chosen in Step 3

Pakistan has imported electricity from Iran since 2002. As stated in the Tool, electricity imported from a connected electricity system will be treated as one power plant. However, since this is imported from connected electricity systems located in another host country, the emission factor is 0 tonnes CO_2 per MWh.

The data used to calculate the emission factor is taken from the Pakistan Electric Power Yearbook 2009 (and previous versions to 2007).

The net calorific values of the fuels are obtained from the Pakistan Energy Statistical Yearbook/IPCC. The emission factors and oxidation factors of the fuels adopted are obtained from Table 1.3 and Table 1.4 of the "2006 IPCC Guidelines for National Greenhouse Gas Inventories", Volume 2, Chapter 1, and Pages 1.21-1.24 where local data was not available.

Note that:

- For the thermal non-IPPs (public sector power plants) $FC_{i,y}$ was summed for each fossil type (natural gas, fuel oil, diesel oil and coal) for 2007 – 2009. Data was taken from the Pakistan Energy Yearbook 2009, tables G22, G23 and G24. The mass/volume units were converted to TJ using NCVs taken from the latest IPCC guidelines; and similarly, the CO_2 emission factors for these fuel types were taken from the IPCC guidelines as local data was not available.
- However, for the IPPs, $FC_{i,y}$ was not available, only the net electricity generated per plant. Thus, the efficiencies taken from Annex 1 of the tool were used to calculate fuel

consumption in TJ. Please see Annex 3 and the attached spreadsheet for details of the calculation.

Based on the calculation, $\mathbf{EF_{grid,OMsimple,y} = 0.6013}$. A detailed calculation is presented in Annex 3.

Step 5: Calculate the build margin (BM) emission factor

In terms of vintage of data, the project participants choose Option 1 to calculate the BM emission factor $EF_{grid,BM,y}$ of the Project. Option 1 requires that for the first crediting period, one calculates the build margin emission factor ex-ante based on the most recent information available on units already built for sample group m at the time of the PDD submission to the DOE for validation. For the second crediting period, the build margin emission factor should be updated based on the most recent information available on units already built at the time of submission of the request for renewal of the crediting period to the DOE. For the third crediting period, the build margin emission factor calculated for the second crediting period should be used. This option does not require monitoring the emission factor during the crediting period.

As per the procedure in Step 5, the first step is to identify the set of five power units, excluding those units already registered as CDM project activities that started to supply electricity to the grid most recently ($SET_{5\text{-}units}$) and determine their electricity generation:

- Liberty Power (Sep 2001)
- Attock Generation (Mar 2009)
- GE Energy Rental (Mar 2007)
- Ghazi (Apr 2004)
- Malakand III (Nov 2008)

The total annual electricity generation for 2009 was 9,922 GWh ($AEG_{SET\text{-}5\text{-}units}$) for $SET_{5\text{-}units}$. (See supporting Excel file). This corresponds to 12.03% of AEG_{total} – the total annual electricity generation of project electricity system (excluding CDM project activities).

In order to calculate $AEG_{SET\text{-}\geq 20\%}$ (the electricity generation of the most recently built plants that comprise 20% of AEG_{total}), a further 4 plants need to be included. The new set, $SET_{\geq 20\%}$, further includes the following plants:

- Uch Power (Oct 2000)
- Japan Power (Mar 2000)
- Rousch (Dec 1999)
- Chashma (May 2001)

$AEG_{SET\text{-}\geq 20\%}$ is calculated to be 18,983 GWh, or 23.02% of AEG_{total} (see Annex 3 and supporting Excel file).

The set that comprises the larger annual electricity generation, SET_{sample}, is thus $SET_{\geq 20\%}$. Out of the plants in $SET_{\geq 20\%}$, some plants (Uch Power, Japan Power, Rousch and Chashma) were commissioned more than 10 years ago. Therefore, in accordance with the Tool, the set needs to be expanded to include any CDM project activity plants in the project electricity system, and the plants that are older than 10 years are to be excluded. However, there are no CDM project activity plants in the WAPDA grid that are currently supplying electricity.

In accordance with the Tool, the sample group of power units used to calculate the build margin is $SET_{sample\text{-}CDM\text{-}>10yrs}$. This is the same set as $SET_{\geq 20\%}$, as there are no CDM project activities in the set, and the older plants (Uch Power, Japan Power, Rousch and Chashma) are added back in to the set in order to reach 20% of AEG_{total}.

In order to calculate the build margin, since there are plants in $SET_{sample\text{-}CDM\text{-}>10yrs}$ that started supplying electricity more than 10 years ago, the Tool requires the PPs to follow Option A2 from the guidance in Step 4(a).

The build margin emission factor is calculated as follows:

$$\mathbf{EF}_{grid,BM,y} = \frac{\sum_m (\mathbf{EG}_{m,y} \times \mathbf{EF}_{EL,m,y})}{\sum_m (\mathbf{EG}_{m,y})} \qquad (2)$$

Where:

$EF_{grid,BM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EG_{m,y}$ = Net quantity of electricity generated and delivered to the grid by power unit *m* in year y (MWh)
$EF_{EL,m,y}$ = CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
m = Power units included in the build margin
y = Most recent historical year for which power generation data is available.

$$\mathbf{EF}_{EL,m,y} = \frac{\mathbf{EG}_{CO_2,m,i,y} \times 3.6}{\eta_{m,y}} \qquad (3)$$

Where:

$EF_{EL, m, y}$ = CO_2 emission factor of power unit m in year *y* (tCO_2/MWh)
$EG_{CO2,m,i,y}$ = Average CO_2 emission factor of fuel type *i* used in power unit m in year *y* (tCO_2/GJ)
$\eta_{m,y}$ = Average net energy conversion efficiency of power unit m in year *y* (ratio)
m = All power units serving the grid in year *y* except low-cost/must-run power units
y = The relevant year as per the data vintage chosen in Step 3

As per Step 4 (a) above, for the IPPs, emissions were calculated based on their efficiencies (taken from the Tool Annex 1, as no public data was available, and the result is more conservative). For the thermal plants, data was taken from the Pakistan Energy Yearbook Tables 2009 G.1, G.2, G.3, and G.13.

Based on the calculation, the result is:

$EF_{grid,BM,y}$ = 0.250. A detailed calculation is presented in Annex 3 and in the supporting Excel file.

Step 6: Calculate the combined margin (CM) emissions factor.

The combined margin emissions factor is calculated as follows:

$$\mathbf{EF}_{grid,CM,y} = EF_{grid,OM,y} \times W_{OM} + EF_{grid,BM,y} \times W_{BM} \qquad (4)$$

Where:

$EF_{grid,CM,y}$ = Build margin CO_2 emission factor in year *y* (tCO_2/MWh)
$EF_{grid,OM,y}$ = Operating margin CO_2 emission factor in year *y* (tCO_2/MWh)
w_{OM} = Weighting of operating margin emissions factor (%)
w_{BM} = Weighting of build margin emissions factor (%)

The following default values should be used for w_{OM} and w_{BM}:
The values used are: w_{OM} = 0.5 and w_{BM} = 0.5 for the first crediting period.

Based on the calculation, the result is: $EF_{grid,CM,y}$ = (0.6013×0.5)+(0.250×0.5) = **0.42565 tCO_2/MWh**

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$\mathbf{EF}_{grid,CM,y}$
Data unit	tCO_2/MWh
Description	Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the Tool to calculate the emission factor for an electricity system.
Source of data	Pakistan Energy Yearbook 2009.
Value(s) applied	0.42565
Choice of data or measurement methods and procedures	The emission factor for the Pakistan grid (combined emission factor) has been calculated as weighted average of the generation weighted average of Simple Operating margins for 2007, 2008 and 2009 and the Build margin as for methodology ACM0002. The emission factor has been calculated ex-ante and fixed throughout the CDM crediting period. The justification for using the simple operating margin and the methodological choices underlying the calculation of the operating and the build margin are detailed in Appendix 4.
Purpose of data	Calculation of baseline emission
Additional comment	None

Data/Parameter	$\mathbf{FC}_{i,y}$
Data unit	Metric tonnes for oil; mmcft for gas, litres for diesel
Description	Amount of fossil fuel type *i* consumed by the project electricity system in year *y*
Source of data	Pakistan Energy Yearbook, Ministry of Minerals & Natural Resources
Value(s) applied	Values used for 2007, 2008 and 2009 (See Annex 3)
Choice of data or measurement methods and procedures	Based on requirements from ACM0002, the required data has been collected from government official sources. Data is only available for public sector power plants. For IPPs fuel consumption was estimating using efficiency values (see below).
Purpose of data	Calculation of baseline emission
Additional comment	None

Data/Parameter	**$NCV_{i,y}$**
Data unit	GJ/mass or volume unit
Description	Net calorific value (energy content) per mass or volume unit of fuel *i* in year *y*
Source of data	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1
Value(s) applied	41.4 GJ/tonne for diesel 39.8 GJ/tonne for oil 0.89 TJ/MMCFT for gas 21.6 GJ/tonne for coal Note that the density of diesel is taken as 0.89 kg/litre as per the IPCC Guidelines. Also note that the density of natural gas is taken as 0.6728 kg/m^3 as per API, 2009.
Choice of data or measurement methods and procedures	Data is not available from local sources and the IPCC figures are more appropriate.
Purpose of data	Calculation of baseline emission
Additional comment	None

Data/Parameter	**$EF_{CO2,i,y}$**
Data unit	tCO_2/TJ
Description	CO_2 emission factor of fossil fuel type *i* used in year *y*
Source of data	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 1
Value(s) applied	Natural gas: 54.3 tCO_2/TJ Fuel oil: 75.5 tCO_2/TJ Diesel oil: 72.6 tCO_2/TJ Coal: 94.6 tCO2/TJ
Choice of data or measurement methods and procedures	Data is not available from local sources
Purpose of data	Calculation of baseline emission
Additional comment	None

Data/Parameter	**EG_y**
Data unit	MWh
Description	Net electricity generated and delivered to the grid by all power sources serving the system, not including low-cost / must-run power plants / units, in year *y* (MWh)
Source of data	Pakistan Energy Yearbook (2007-2009)
Value(s) applied	Values used for 2007, 2008 and 2009 (See Annex 3)
Choice of data or measurement methods and procedures	Based on requirements from Methodology ACM0002, the required data has been collected from government official sources.
Purpose of data	Calculation of baseline emission
Additional comment	None

Data/Parameter	$\eta_{m,y}$
Data unit	%
Description	Average net energy conversion efficiency of power unit m in year *y*
Source of data	The default values provided in the Tool to Calculate the Emission Factor of an Electricity System (Annex 1) were used in the absence of publically available data
Value(s) applied	Refer to Annex 3
Choice of data or measurement methods and procedures	This data from the Tool was used for the IPPs only in the WAPDA grid, as details on their fuel consumption are not available. The average efficiency data was used to calculate their fuel consumption based on known energy generation and year of commissioning.
Purpose of data	Calculation of baseline emission
Additional comment	None

B.6.3. Ex ante calculation of emission reductions

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Baseline Emissions

The formula to calculate the baseline emissions as per ACM0002 is as follows:

$$\mathbf{BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}} \qquad (5)$$

Where:

BE_y = Baseline emissions in year y (tCO_2/yr)

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity in year y (MWh/yr)

$EF_{grid,CM,y}$ = Combined margin CO_2 emission factor for grid connected power generation in year y calculated using the latest version of the Tool to calculate the emission factor for an electricity system. (tCO_2/MWh)

The baseline emission factor is calculated as presented in section B.6.2. The factor is:

$EF_{grid,CM,y}$ = 0.42565

The estimated quantity of net electricity generation that is produced and fed into the grid as a result of the implementation of the CDM project activity is:

$EG_{PJ,y}$ = $EG_{facility,y}$ (for greenfield renewable energy plants) = 632,628 MWh/yr. This value is calculated using average hydrology data for the river over recent years, a plant utilisation factor, a loss factor, and a known installed capacity of 150 MW. A summary of the model output is given in the below table.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total Average Energy
Average (MWh)	8,455	10,700	28,542	64,780	101,100	103,250	104,030	92,006	52,600	31,332	21,033	14,800	632,628

Therefore, the baseline emissions of the project are:

$$\mathbf{BE_y = EG_{PJ,y} \cdot EF_{grid,CM,y}} = 632{,}628 \times 0.42565 = \mathbf{269{,}278\ (tCO_2/yr)}$$

Project Emissions

The project emissions from the water reservoirs of hydro power plants are calculated based on power density.

The power density of the project activity (PD) is calculated as follows:

$$\mathbf{PD} = \frac{\mathbf{Cap}_{PJ} - \mathbf{Cap}_{BJ}}{\mathbf{A}_{PJ} - \mathbf{A}_{BJ}} \qquad (6)$$

Where:

PD	= Power density of the project activity (W/m^2)
Cap_{PJ}	= Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL}	= Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	= Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL}	= Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

Cap_{PJ} = 150x10^6 (W)
Cap_{BL} = 0
A_{PJ} = 57.2 x10^4 (m^2)
A_{BL} = 0

$$\mathbf{PD} = \frac{\mathbf{Cap}_{PJ} - \mathbf{Cap}_{BJ}}{\mathbf{A}_{PJ} - \mathbf{A}_{BJ}} = 262\ (\mathrm{W/m^2})$$

The power density of the project activity (PD) is greater than 10 W/m^2, therefore, according to ACM0002:

$$\mathbf{PE}_{HP,y} = 0$$

However, if the emergency diesel generator sets are operated, then the project emissions (PE) will be the CO_2 emissions from the fossil fuel combustion (FC) of the diesel generators (DG) in year *y* which can be calculated as below:

$$\mathbf{PE}_{FC,DG,y} = \sum \mathbf{FC}_y \times \mathbf{COEF}_y$$

Where:

$PE_{FC,DG,y}$ = CO_2 emissions from diesel fuel combustion (FC) in emergency DG use during the year *y* (tCO_2/yr);

FC_y = Quantity of diesel fuel combusted during year *y* (*y* mass or volume unit/yr), which will be calculated from fuel purchase receipts as below:
= Fuel P

where:
Fuel P: Fuel purchased in reporting period (*y*)

$COEF_y$ = CO_2 coefficient of diesel in year y (tCO_2/mass or volume unit/yr)

For the emission factor of the diesel generator, refer to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

Leakage Emissions

According to ACM0002, no leakage emissions are considered since the main emissions potentially giving rise to leakage in the context of the electric sector projects are emissions arising from activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing and transport). These emissions sources are thus neglected.

Emission Reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad (7)$$

Where:

ER_y = Emission reductions in year *y* (tCO_2e/yr)
BE_y = Baseline emissions in year *y* (tCO_2/yr)
PE_y = Project emissions in year *y* (tCO_2e/yr)

In a year where emergency diesel generator has not been used, the project emissions are equal to 0. Therefore, the emission reductions of the project are presented as below:

$$ER_y = BE_y - PE_y = BE_y = EG_{grid,CM,y} - EF_{grid,CM,y} = 269,278\ (tCO_2/yr)$$

However, in a year where emergency diesel generator has been used, the project emissions are ΣFC_y X $COEF_y$ and therefore emission reductions of the project in year y are presented as below:

$$ER_y = 269,278\ (tCO_2/yr) - \sum FC_y \times COEF_y$$

B.6.4. Summary of ex ante estimates of emission reductions

Year	Baseline emissions ($t\ CO_2e$)	Project emissions ($t\ CO_2e$)	Leakage ($t\ CO_2e$)	Emission reductions ($t\ CO_2e$)
Year 1(2017-2018)	269,278	0	0	269,278
Year 2(2018-2019)	269,278	0	0	269,278
Year 3(2019-2020)	269,278	0	0	269,278
Year 4(2020-2021)	269,278	0	0	269,278
Year 5(2021-2022)	269,278	0	0	269,278
Year 6(2022-2023)	269,278	0	0	269,278
Year 7(2023-2024)	269,278	0	0	269,278
Total	1,884,946	0	0	1,884,946
Total number of crediting years	7 years			
Annual average over the crediting period	269,278	0	0	269,278

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

Data/Parameter	EG_y
Data unit	GWh/yr
Description	Quantity of net electricity generation supplied by the project plant / unit to the grid in year y
Source of data	Metered on site by the metering system as per the description in the PPA
Value of data applied for the purpose of calculating expected emission reductions in section B.5	632,628 MWh/yr for an *ex-ante* estimate of emission reductions was used, based on a 7-year crediting period.

Measurement methods and procedures	This value will be measured by using energy meters. The meters will be integrated type with non-volatile data storage. All requirements for metering will be in accordance with the PPA and a summary of the relevant part of the PPA is extracted as follows: 1) A metering system and a back-up metering system will be installed; in addition, there will be magnetic media and a sequential event recorder; 2) Testing of the metering system will be part of the complex commissioning procedures; 3) Inaccuracy of the metering system to be not greater than 0.5% ; 4) Joint sealing of metering system after any inspection or examination; 5) Joint reading with power purchaser's representative on the last business day of each month.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The metering system and the back-up metering system will be under continuous surveillance and in the event of greater than specified inaccuracy of 0.5% recalibration is specified. Sealing of the metering system will be checked regularly. The readings of the Back-Up Metering System shall be used to calculate the correct amount of Net Electrical Output, unless a test of such Back- Up Metering System, reveals that the Back-Up Metering System is inaccurate by more than 0.2% As there is no determined regular calibration frequency, PP decided to fix calibration frequency as 1 year.
Purpose of data	Baseline emission calculations
Additional comment	Further details of the data collection, recording and storage procedures and the QA/QC procedures are contained in the Monitoring Plan in Section B.7.2

Data/Parameter	CAP_{PJ}
Data unit	W
Description	Gross (Total) installed capacity of the hydro power plant after the implementation of the project activity
Source of data	Project site
Value(s) applied	150MW
Measurement methods and procedures	As per the project technical characteristics, the gross installed capacity is 150 MW, and this is not expected to change. It will be monitoring nevertheless on an annual basis.
Monitoring frequency	Yearly
QA/QC procedures	Not necessary – see comment below.
Purpose of data	Project emission calculations
Additional comment	As per the project technical characteristics, the gross installed capacity is 150 MW, and this is not expected to change. It will be monitoring nevertheless on an annual basis.

Data/Parameter	A_{PJ}
Data unit	m^2
Description	Reservoir area (surface area at full reservoir level)
Source of data	Direct measurement
Value(s) applied	572,000
Measurement methods and procedures	Measures from topographical surveys, maps, satellite pictures, contour line of the reservoir at full water on the surveying pap and planimeter, etc.
Monitoring frequency	Yearly
QA/QC procedures	See QA/QC procedure for Patrind HPP(Monitoring of reservoir area)
Purpose of data	Project emission calculations
Additional comment	None

Data/Parameter	FC_y
Data unit	Mass or volume unit per year (e.g. ton/yr or m^3/yr)

Description	Quantity of diesel combusted in emergency generator operation during the year y
Source of data	Fuel purchase records and receipts
Measurement methods and procedures	Record fuel purchase receipts during the reporting period
Monitoring frequency	Recorded when the diesel fuel is purchased
QA/QC procedures	Calculated fuel consumption quantities can be cross-checked with available purchase invoices from the financial records.
Purpose of data	Project emission calculations
Additional comment	For the emission factor of the diesel generator, refer to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf)

B.7.2. Sampling plan

>>
Not applicable

B.7.3. Other elements of monitoring plan

>>
The purpose of the monitoring plan is to ensure that the required data is accurately monitored and recorded for the calculation of the emission reductions achieved by the project.

The operational and management structure as well as monitoring procedures are described as below:

Operational and Management Structure

Star Hydro Power Limited proposes to appoint a CDM Management Team with the responsibility of managing the collection, recording and storage of the data required to calculate the greenhouse gas emission reductions from the project activity. The data that is required to be monitored is described in detail in Section B.7.1. The team consists of three key positions and will be supported by the company's Quality Assurance Officer. An outline of responsibilities and roles of these three key positions are described in the table below:

Position and Reporting body	Responsibilities
CDM Monitoring Officer (Reports to the General Manager of the Project)	• Manages the collection, recording and storage of data; • Reviews the monitoring reports prepared and investigates any irregularities; • Ensures ongoing compliance with the CDM monitoring plan; • Supervises meter calibration requirements; • Calculates Emission Reductions; • Prepares annual (or biannual) Emission Reduction Report; and • Prepares Baseline Emission Factor report at the end of each crediting period.
Site supervisor (Reports to the CDM Monitoring Officer)	• Responsible for the completeness and reliability of the data; • Responsible for carrying out meter calibration; • Responsible to ensure that there is no irregularities in meter function and data recording in between shifts; and • Responsible for preparation of quarterly metered net electricity generation data reports.
Quality Assurance Officer (Reports to the CDM Monitoring Officer)	• Undertakes regular internal audits of the project; and • Ensures compliance with Company Quality Assurance Procedures.

Monitoring Procedure

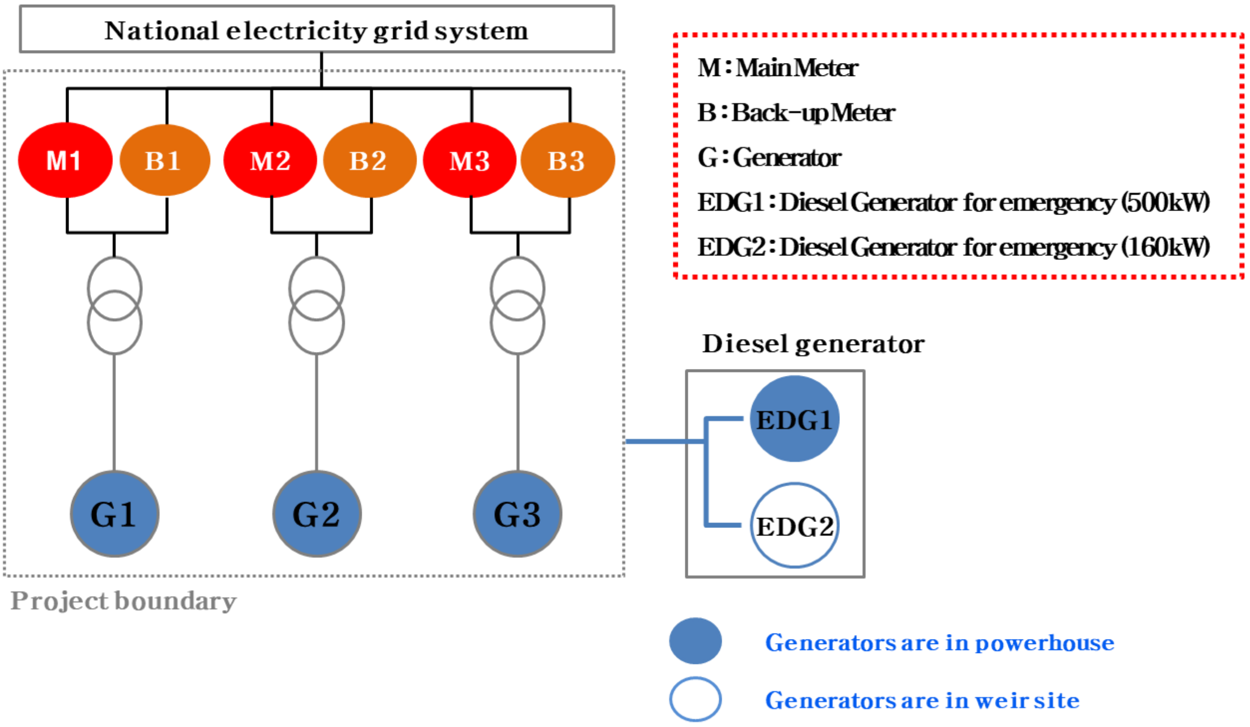
Training

Everyone included in the CDM Management Team shall receive appropriate training providing an overview of the CDM, clear explanation of responsibilities and importance of each role in detail. A copy of the project monitoring plan will be distributed to all of the CDM Management Team during the training, and additional copies will be readily available at appropriate locations on site. The General Manager of the Project will be ultimately responsible to ensure that the required capacity and internal training is made available to assigned staff, to enable them to undertake the tasks allocated for each role. All staff involved in any of the procedures will be trained before the start of the crediting period in order to perform the tasks specified in the table above.

Metered Net Electricity Export Data

A transparent system for the collection, computation and storage of data will be established including adequate record keeping and data monitoring system. An electronic data recording system capable of recording the Net Electrical Output measured by the metering System on a **continuous basis** and capable of storing such recordings for a period of not less than ninety days will be installed.

The watt-hour meters (Main & Backup meter) for measuring both amounts of electricity exported to the grid and imported from the grid are installed in each single-line. And the auxiliary power consumed for powerhouse and weir site is supplied internally from the generated electricity during the generator's operation. Otherwise, the auxiliary power is directly supplied from the national electricity grid system. Also, two emergency diesel generators (500kW and 160kW) are installed on each on-site to supply standby emergency power about the internal consumption of the project site.



A **Monthly report** of metered net electricity export data will be generated by the Site Supervisor, and saved in electronic and paper form. For electronic- based and paper-based data entry and recording systems, there must be clarity in terms of procedures and protocols for collection and entry of data, usage of the spreadsheets and any assumptions made, so that compliance with requirements can be assessed by the DOE. Stand-by process and systems, e.g. paper-based systems, must be outlined and used in the event of, and to provide for, the possibility of systems failures. The CDM Monitoring Officer will review the Monthly report and cross check the data against the invoices for the quantity of electricity exported and sold to the national grid. Any discrepancies will be investigated as described in the "Review of Reports and Treatment of Uncertainty". The auxiliary loads and losses (gross metered electricity generation minus net generated

electricity) will be recorded in the quarterly report, to be used in the event of meter failure, as described in the "Emergency Preparedness".

Calibration of Meters

The calibration and maintenance of meters will be carried out as per the agreed Section 7.6 "Repair, Replacement or Recalibration of Metering System and Back-Up Metering System" of PPA. The CDM Monitoring Officer will ensure that a manufacturer's test certificate accompanies all purchased meters. Meters will be calibrated prior to synchronization of the project and recalibrated as required. The Power Purchaser shall test the accuracy of the Metering System at any time when the readings of electrical energy from the Metering System and the Back-Up Metering System differ by an amount greater than one-fifth of one percent (0.2%). In such an event, the Power Purchaser shall test the accuracy of the Metering System and recalibrate the Metering System, if necessary. A report summarizing meter calibration requirements will be prepared by the CDM Monitoring Office on project commissioning, and updated with each recalibration.
Regular metering system calibrations are performed annually in accordance with the PPA.

Emission Reductions

Emission reductions will be calculated using the project and baseline emission data. Emission reductions occurring as a result of the project activity will be summarized in a biannual report that will be prepared by the Site Supervisor. The report will be generated using a template, approved by the CDM Monitoring Officer, to ensure that the data is reported consistently and can be compared to previous quarters. The biannual report will be reviewed by the CDM Monitoring Officer and submitted to the General Manager of the project.

Review of Reports and Treatment of Uncertainty

When reviewing the Metered Net Electricity Export Data and Emission Reductions report, the CDM Monitoring Officer will examine the report for data anomalies and compare the report with previous months for consistency.

If any discrepancies are found they will be investigated and corrected. The discrepancies and corrective actions will be recorded in an appendix to the relevant report. If the corrective actions result in any adjustments to monitoring data, then the relevant report will be revised after the adjustments have been made. The company's Quality Assurance Officer will undertake an internal audit of the project activity every three months to ensure the operational and maintenance regime of the project and data collection and recording practices are complaint with the content of this Project Design Document. The results of the audit will be summarised in a report, which will be sent to the General Manager of the Project for review. The report will also list any corrective actions required to ensure project compliance.

Emergency Preparedness

The project has the necessary provisions for emergency preparedness to deal with any unforeseen events such as fire or an electrical blackout. The emergency situations are adequately covered in the Section 5.8. of PPA under 'Emergency Set-up and Curtailment Plans' which specifies that Star Hydro Power Limited shall cooperate with the power purchaser in developing 'emergency procedures for the complex' including without limitation 'recovery from local or widespread electrical blackout and voltage reduction in order to effect load curtailment'.

Data Archiving

Data monitored and required for verification and issuance will be archived and maintained for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occurs later.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

>>

20th September 2010

C.2. Expected operational lifetime of project activity

>>
30 years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

>>
Renewable

C.3.2. Start date of crediting period

>>
08/11/2017

C.3.3. Duration of crediting period

>>
7 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>
The first Environmental Impact Assessment (EIA) report was prepared by Pakistan Engineering Services (Pvt.) Ltd. and was submitted to the government of North-West Frontier Province (now known as Khyber Pakhtunkhwa) and the government of Azad Jammu and Kashmir for approval in 2009.
However, due to the relocation of the power house and the weir, revision of EIA was necessary. The EIA and Resettlement Plan (RP) study was conducted in March 2010 and updated in June 2010 in line with the relevant guidelines of Asian Development Bank (ADB), International Finance Corporation (IFC) as well as the Pakistan Environmental Protection Act 1997. The Resettlement Plan (RP) was further updated as per specific requirements of ADB's Environmental Compliance Team and was finalized in March 2011.

It is important to note that the EIA approval from EPA-AJK has already been obtained whilst the project company is in contact with the KP government to obtain the same.

The Project has also undergone a comprehensive environmental and social assessment of compliance with the World Commission on Dams criteria and has completed its validation in October 2012.

A summary of the EIA and Resettlement Plan is presented below.

Description of the natural environment

The project is located in area of Kunhar river where is mountainous and rugged with high relief amplitude and steep slopes. The landforms include valley slopes and terraces containing shale, slate, phyllite and scree.

Besides numerous small streams (nullahs) and springs, Kunhar and Jhelum are the major rivers in the project area. Daily flows of Kunhar river at the proposed weir site vary from an average maximum of 10,000 cusecs (285 cumecs) to average minimum of 850 cusecs (24 cumecs) with an annual average of 3,671 cusecs (104 cumecs).

The climate of the project area is pleasant, characterized by mild summers and cold winters.
The project region has flora in abundance. A variety of flora from Dhaman grass to spruce trees including herbs, weeds, grasses, plants, flowers and trees is found. The region has subtropical pine forests supporting broad leaved species as snatha and temperate forests supporting coniferous species such as fir. The forest wealth in the region is shrinking due to illegal deforestation.

The project area is characterised by animal biodiversity promoted by variations in altitude, topography and climate providing wildlife habitats for mammals, reptiles, amphibians, insects and birds.

Kunhar is a cold-water river that is swift, turbid and has low primary fish productivity. As the river is not productive it is not fished on commercial scale. Apart from opportunistic fishing, fish does not form part of any of the local communities' diets. In describing aquatic ecology and fish of the river basin it is stated that Kunhar river is a tributary of the river Jhelum.
Since there are not many industrial activities in the region, the water quality, air quality, soil quality and noise are not currently adversely affected.

Description of socio-economic aspects

There are 8 villages in the vicinity of the weir site and 5 villages around the powerhouse site.

At annual growth rate of 2.99% and 1.82% applied to the Tehsils of Muzaffarabad and Abbottabad. The present (2010) population of these villages totals 11,974. The household size ranges from 5 to 9 people per household.

The per capita income in the project area is below the national level. Farming and livestock rearing are the major occupations of the local population followed by forest and construction labour. The people of the project area raise sheep, goats, donkeys, mules, buffaloes and cows. Donkeys and mules are kept for carrying loads while cows and buffaloes for milk. Agriculture in the Muzaffarabad and Abbottabad districts is the dominant economic activity. The majority of the farmers have their own simple irrigation systems using water from streams and springs. Wheat, maize and rice are the major crops. Fisheries are not considered at the commercial scale due to the cold-water river. Some people own shops located around villages while others work in the transport business.
Socio–economic indicators point to a poor standard of living, poor health, and inadequate status of community water supply, sanitation and education. Women face problems due to restricted mobility, lack of decision making, limited productive employment opportunities and lack of awareness about health and hygiene. The availability of health services in terms of hospitals, clinics, dispensaries and of medicines is not satisfactory in the surveyed villages around weir and powerhouse sites. It is reported that a 60.7% to 82.4% literacy ratio is found in villages around the powerhouse site and 46.5% to 72.8% in the villages around weir site.

Mosques and graveyards exist in each village of the project area. There are no sites of archaeological or historical importance in the project area.

Compensation and Resettlement

In total 744.25 kanals (37.58 ha) of riverbed, farmland and wasteland will be acquired permanently for constructing the Patrind Hydropower Project while 158.2 kanals (7.97 ha) will be acquired temporarily for the construction camp, storage camp and temporary disposal of excavated material in the vicinity of the weir site and powerhouse site.

The project's implementation will directly affect 28 houses displacing 242 persons. During field surveys, persons/ communities affected by the project were individually as well as collectively interviewed to gather their opinion for resettlement and relocation. All owners of land and of houses directly affected
by the project showed their interest in receiving cash compensation. None of them opted to receive land for land compensation or land for construction of new houses. As a result, no resettlement sites have been identified or investigated.

The resettlement and environmental cost of the project is estimated at Rs. 174.86 million (US$ 2.1 million). The cost of land subject to submergence by the headpond is Rs. 85.71 million (US$ 1 million) and is the largest component of the environmental cost of the total environmental budget.

The cost of permanent land acquisition of Rs. 108.73 million (62%) is the largest component of the environmental costs followed by Rs. 42.10 million (24%) for cost of houses, Rs. 15.52 million (8.87%) for cost of temporary land and Rs. 7.46 million (4 %) for economic trees existing in the project area.

The key findings and mitigation measures for the development are as follows:

Phase	**Impacts**	**Mitigation Measures**
General Management	Environment and Social Performance	The Environmental and Social Management Plan should be included in the contracts awarded by the company for implementation of the proposed project. The company should ensure adherence to the environmental legislation and regulations. The company and its contractors should put as much effort as possible to employ local labour force. The company should make the upmost effort to ensure that the near-by communities of the project area have access to electricity supply after completion of the project.
	Compensation and Resettlement	The Resettlement Plan (RP) has been developed and made part of the report to provide framework to address the involuntary resettlement issues and to guide through the compensation assessment and disbursement process. The company should follow the RP for addressing the involuntary resettlement issues primarily pertaining to land acquisition and compensation for houses and other economic assets.
Construction Phase	Erosion	The affected areas should be planted with grass cover, tiny bushes and trees. Land construction slope should be kept as flat as is reasonably possible. Slope rounding, terracing or contouring to minimize erosion and to promote plant growth will be adopted.
	Excavated material	Maximum use of excavated material would be made for the construction of various civil works e.g. bulk fill, coarse aggregate, stone rip rap, construction of roads and embankments. The surplus excavated material will be disposed of in an environmentally sound manner.
	Water resources	Provide sound construction management to avoid river pollution and compliance with NEQS.
	Noise and air pollution	Equipment that is expected to produce noise levels above NEQS/ WB Guidelines should preferably be operated during the day time and under confined conditions. This should be made part of the construction planning schedule.
	Hazards to workers health/safety	Personal protective equipment and field clinic for workers and provision of protection against accidents. Data on water-borne diseases to be collected on regular basis including baseline data on malaria conditions.
	Flora and Fauna	Ensure fair/ negotiated compensation to tree owners Planting of trees as part of annual tree plantation campaigns of the government department.
Operation Phase	Impairment of downstream water quality from flow restrictions	Provides water releases into Kunhar river downstream of weir to meet minimal ecological flow throughout the year.
	Community health hazard	Public health and safety measures will also be undertaken such as barriers and warning signs at required places. All safety, health, environmental and other safety notices and signs shall be clearly displayed and written in both Urdu and English.

All recommended mitigation measures are included in the Environmental Management and Monitoring Plan (EMMP) which will be part of the construction contract(s). Based on the review of the latest draft of the EIA report, the project is considered to be environmentally and socially viable if the project activities are carried out as planned and the mitigation measures described in the EMMP are thoroughly implemented throughout the project's life cycle.

D.2. Environmental impact assessment

>>

During the Project implementation, environmental and social impacts are experienced primarily during the construction phase. The operation phase will mostly have insignificant impacts on the social, physical and biological environment of the area. This has been confirmed during field surveys for the environmental and social assessment.

The overall findings of the EIA and Resettlement Plan shows that the project is environmentally and socially viable provided that the proposed activities are carried out as mentioned in the EIA report, and that the mitigation measures are completely and effectively implemented.

It is recommended that the Environmental and Social Management Plan (EMMP) should be made a part of the EPC Contract awarded by the PP for implementation of the project. The PP should follow the EMMP and RP for addressing the Patrind Hydropower Project EIA and RP voluntary resettlement issues pertaining to land acquisition and compensation for houses and other economic assets by adhering to the relevant environmental legislation and regulations.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

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The stakeholder consultation meetings took place on 27th September 2010 in Azad Jammu & Kashmir and in Khyber Pakhtunkhwa on 28th September 2010. Invitation Letters were sent to a total of nine stakeholders including the power purchaser, environmental protection departments and wildlife and forestry departments of the governments of the Khyber Pakhtunkhwa and Azad Jammu & Kashmir. Public notices inviting general public to the stakeholder meetings were published in the two nationwide (English and Urdu languages) and two local newspapers.

The copies of the Project Idea Note (PIN) and the copies of the feasibility studies of the Project were made available with the offices of EPDs of AJ&K and KP. In order to generate appropriate awareness about the contents and schedule of the consultative meetings in the likely affected communities, advertising banners/hoardings were displayed in all the major communities living in the vicinity of the project activity regions. In addition to the published material, the management of Star Hydro Power made telephone calls to the important people belonging to the likely affected communities to ensure their participation.

Each meeting started with an introductory presentation conducted by Mr. Ali Shan of SHPL and Mr. Manzar Naeem Qureshi of Hagler Bailly Limited about the project and the aim of such public consultation followed by question and answers sessions. The proceedings of both meetings were recorded in audio format and the minutes of meeting were scribed by SHPL personnel.

In all, 71 people from local communities attended the meeting in AJ&K on 27th of September 2010 and 114 people from the likely affected areas with the project activity in KP attended the meeting on 28th of September 2010. In addition, the following representatives from different organisations participated in the meetings:

Participation Date	**Name**	**Organization**
27th September 2010	Mr. Mohammad Ahsan	Director EPA, AJ&K

Participation Date	Name	Organization
27th September 2010	Mr. Javed Ayub	Director Wildlife and Fisheries
27th September 2010	Mr. Shafiq Abbasi	Assistant Director EPA
27th September 2010	Mr. Arshad Iqbal	Assistant Director EPA
27th September 2010	Mr. Won-Cheol Park	Deputy CEO, SHPL
27th September 2010	Col. (R) Ali Shan	GM Admin & HR, SHPL
27th September 2010	Mr. Sohail Alam	Finance Manager, SHPL
27th September 2010	Mr. Atif Ali Shah	Manager Civil, SHPL
27th September 2010	Mr. Abdul Wahab	Accounts Executive, SHPL
28th September 2010	Mr. Noman Rasheed	Assistant Director, EPA, KP
28th September 2010	Mr. Naveed Anjum	Monitoring Inspector, EPA, KP
28th September 2010	Mr. Abrar Ahmed	Monitoring Inspector, EPA, KP
28th September 2010	Col. (R) Ali Shan	GM Admin & HR, SHPL
28th September 2010	Mr. Sohail Alam	Finance Manager, SHPL
28th September 2010	Mr. Atif Ali Shah	Manager Civil, SHPL
28th September 2010	Mr. Abdul Wahab	Accounts Executive, SHPL

E.2. Summary of comments received

>>

A summary of the comments received at the meeting held at AJ&K is outlined as below:

1. In view of excessive hurdles and requirements in the development of hydro power projects implementation, why don’t we go for other projects like coal projects which are available in abundance in Pakistan?
2. Who are the beneficiaries of the CDM revenues?
3. No poverty alleviation plan is mentioned in EIA and no baseline survey on fisheries has been conducted. The project sponsors should take these issues into consideration.
4. How this project will be helpful to the ordinary citizens of the region. How the local unemployed youth can take the benefits from this project?

A summary of the comments received at the meeting held at KP is outlined as below:

1. Concern about the water availability after construction of weir. The water shortages can adversely affect a nearby nursery and tea orchards during low water months. The village Batangi Lower should also be included in the survey to see if it can be affected by the project. Also, the houses downstream of the weir are very close and can be face additional hazards during earthquake.
2. Inquiry about the exact details of how many number of affected households, exact location of submerging areas and part of road shall go under water by constructing the weir.
3. Concern about potential pollution caused due to the project, that all environmental aspects should be monitored before starting the project. All complaints of the local communities should be resolved properly.
4. Security issues due to the project location in terms of the colony and compound for project construction personnel.
5. Concerns regarding the crushing plant planned in populated area.
6. Request for another meeting in Deedal Meera, Dalola and Sarati with more detailed information about the construction schedule and the exact number of affected households and areas. SHPL also needs to mark the rise in water level that would be assumed after construction of weir by some highlighters and placing colouring markers in order to demonstrate to the concerned villagers that how much water would rise after weir construction.

E.3. Consideration of comments received

>>
Due account has been taken of the comments received at AJ&K is outlined as below:

1. In view of excessive hurdles and requirements in the development of hydro power projects implementation, why don't we go for other projects like coal projects which are available in abundance in Pakistan?

   Only renewable energy projects can be opted under CDM. The projects such as run-of-the-river are not common in Pakistan therefore these could be good candidates for development under CDM and CDM revenue can off-set a part of additional costs that arise from such barriers.

2. Who are the beneficiaries of the CDM revenues?

   The revenues will be shared with the project participants. In indirect manner it may help the country in the shape of foreign exchange.

3. No poverty alleviation plan is mentioned in EIA and no baseline survey on fisheries has been conducted. The project sponsors should take these issues into consideration.

   The community development plan is under consideration by SHPL and will be finalized with the help of government authorities.

4. How this project will be helpful to the ordinary citizens of the region. How the local unemployed youth can take the benefits from this project?

   The construction activities will allow the opening of new jobs for the skilled and unskilled labour. Similarly, the Project Company, SHPL will prefer to hire local staff for operation of the project.

Due account has been taken of the comments received at KP is outlined as below:

1. Concern about the water availability after construction of weir. The water shortages can adversely affect a nearby nursery and tea orchards during low water months. The village Batangi Lower should also be included in the survey to see if it can be affected by the project. Also, the houses downstream of the weir are very close and can be face additional hazards during earthquake.

   A minimum of 70.6 cusec amount of water shall be available even in low flow season which is considered adequate for usage by the locals. As per the calculation of the SHPL engineers, this amount is sufficient during low flow season. Due to number of water streams and water to be released from the river Kunhar, the minimum required amount of water shall be available for consumption by locals (even though they are not directly dependent on river water for usage in winter season). Sufficient water will be discharged during low water months to meet the downstream needs.

2. Inquiry about the exact details of how many number of affected households, exact location of submerging areas and part of road shall go under water by constructing the weir.

   Only one house will be needed to relocate while no other major structures will be submerged by rise of water. However, a survey by the technical advisor is under progress which shall exactly locate the level of water rise and such point will be physically highlighted by various highlighters and coloured markers etc.

3. Concern about potential pollution caused due to the project, that all environmental aspects should be monitored before starting the project. All complaints of the local communities should be resolved properly.

   All the necessary steps will be taken to preserve the local environment and all the necessary steps will be taken for satisfaction of the local communities.

4. Security issues due to the project location in terms of the colony and compound for project construction personnel.
   All staff colonies including staff from Pakistan and Korea shall be built in AJ&K part and therefore people on KP side need not to worry about privacy aspects.

5. Concerns regarding the crushing plant planned in populated area.

   The area designated for crushing is not located in populated area so people should not worry and should not feel endangered by crushing activity since selection of location has been made after due consideration.

6. Request for another meeting in Deedal Meera, Dalola and Sarati with more detailed information about the construction schedule and the exact number of affected households and areas. SHPL also needs to mark the rise in water level that would be assumed after construction of weir by some highlighters and placing colouring markers in order to demonstrate to the concerned villagers that how much water would rise after weir construction.

   SHPL will send technical personnel to these villages in order to share the exact details with the public and they will elaborate all technical details including rise of water after Weir construction etc.
   Furthermore, it is relevant to mention here that the meeting in relation to EIA public hearing from EPA-KP was held at Deedal Meera on 1st February 2011 in order to satisfy demand of holding such a meeting there. Like in the CDM consultative meeting, even a larger number of people attended the meeting since the advertisement for EIA public hearing was published in leading nationwide and local newspapers both in English and Urdu.

SECTION F. Approval and authorization

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In the proposed project, the Star Hydro Power Limited is the project participant and parties involved are Pakistan. PP has already obtained letter of approval from the DNA of Pakistan (08/05/2012).

Appendix 1. Contact information of project participants

Organization name	Star Hydro Power Limited
Country	Pakistan
Address	House No. 534, Margallah Road, Sector F-10/2, Islamabad
Telephone	+92 51 221 2610-11, +92 51 221 2615
Fax	+92 51 221 2616
E-mail	Mufeez@patrind.com
Website	http://www.patrind.com/
Contact person	Mufeez Sadiq

Appendix 2. Affirmation regarding public funding

There is no public funding involved in financing of the project and no Official Development Assistance Funding is involved.

Appendix 3. Applicability of methodologies and standardized baselines

No further information.

Appendix 4. Further background information on ex ante calculation of emission reductions

The below tables summarise the data and calculations to calculate the WAPDA Grid EF. Please see attached spreadsheet for more information.

A. Last 5 years grid data for WAPDA

National grid in Pakistan 2004-2009

Year	Electricity (GWh)			LC/MR	
	Total	**Hydro**	**Nuclear**	**GWh**	**%**
2004-05	76,434	25,671	2,795	28,466	37.24
2005-06	84,644	30,862	2,484	33,346	39.40
2006-07	88,624	31,953	2,288	34,241	38.64
2007-08	85,812	28,707	3,077	31,784	37.04
2008-09	82,474	27,784	1,618	29,402	35.65
Total 5 years	417,987	144,977	12,262	157,239	37.62

Sources: Pakistan Energy Year Book 2009, Table 5.1

Note: For the purpose of determining the electricity emission factor, the project electricity system is defined as the Pakistan National Electricity system (Water and Power Development Authority-WAPDA); Calculations in column D exclude plants from the KESC grid and IPPs attached to KESC (Tapal Energy and Gul Ahmed)
Total generation does not take into account electricity generation from the KESC grid

Check: LC/MR must be less than 50% of a total electricity generation, and then can use simple OM for calculate EF_{OM} value

B. OM calculation

Fuel Consumption Calculations for Thermal WAPDA non-IPPs - Tables G22, G23, G24, Pakistan Energy Yearbook 2009

2007

Fuel type	Units	Quantity	Conversion factor	Quantity (TJ)
Coal	Thousand metric tonnes	164.00	21.60	3,542.40
Furnace Oil	Thousand metric tonnes	2,094.00	39.80	83,341.20
Diesel	Thousand litres	2,220.00	0.04	81.80
Gas	MMCFT	167,282.00	0.89	148,195.10

2008

Fuel type	Units	Quantity	Conversion factor	Quantity (TJ)
Coal	Thousand metric tonnes	162.00	21.60	3,499.20
Furnace Oil	Thousand metric tonnes	2,088.00	39.80	83,102.40
Diesel	Thousand litres	926.00	0.04	34.12
Gas	MMCFT	155,004.00	0.89	137,318.03

2009

Fuel type	Units	Quantity	Conversion factor	Quantity (TJ)
Coal	Thousand metric tonnes	121.00	21.60	2,613.60
Furnace Oil	Thousand metric tonnes	2,189.00	39.80	87,122.20
Diesel	Thousand litres	13,434.00	0.04	494.99
Gas	MMCFT	145,621.00	0.89	129,005.63

Fuel Consumption Calculations for WAPDA IPPs - Pakistan Energy Yearbook 2009 Table 5.11, 2008 Table 5.11, 2007 Table 5.11; Table G.3 and Table G.13

2007

Generator name	Type of power station	Fuel type	Generation GWh	Efficiency %	Fuel consumption GWh	Fuel consumption TJ
Japan Power (Mar 2000)	Diesel engine	Fumace Oil	528	37.5%	1,408	5,069
Liberty Power (Sep 2001)	Combined cycle/ gas turbine	Natural Gas	1,305	60.0%	2,175	7,830
Rousch (Dec 1999)	Combined cycle/ gas turbine	Natural Gas	3,090	46.0%	6,717	24,183
Attock Generation (Mar 2009)	Combined cycle	Furnace Oil	0	46.0%	0	0
GE Energy Rental (Mar 2007)	Gas turbine	Natural gas	213	37.5%	568	2,045
Southern Electric	??	Furnace Oil		46.0%	0	0
Saba Power	Steam turbine	Furnace Oil	868	37.5%	2,315	8,333
Kohinoor Energy, Lahore	Diesel engine/ steam turbine	Furnace Oil		37.5%	0	0
KAPCO, Kot Addu	Combined cycle/ gas turbine	Natural gas	8,183	46.0%	17,789	64,041
HUBCO, Hub	Steam turbine	Furnace Oil	7,212	37.5%	19,232	69,235
Habibullah	Combined cycle/ gas turbine	Natural gas	966	46.0%	2,100	7,560
Kel	??	Furnace Oil	806	46.0%	1,752	6,308
Fauji Kabirwala	Combined cycle/ gas turbine	Natural gas	1,184	46.0%	2,574	9,266
AES Pak Gen. M. Garg	Steam turbine	Furnace Oil	1,943	37.5%	5,181	18,653
AES Laipir M. Garg	Steam turbine	Furnace Oil	1,356	37.5%	3,616	13,018
SEPCOL	Diesel engine	Furnace Oil	539	37.5%	1,437	5,174
A.E.L.	Gas engine	Natural Gas	0	39.5%	0	0
Atlas Power	??	Natural Gas	0	60.0%	0	0

2008

Generator name	Type of power station	Fuel type	Generation GWh	Efficiency %	Fuel consumption GWh	Fuel consumption TJ
Uch Power (Oct 2000)	Combined cycle/ gas turbine	Natural gas	3,932	46.0%	8,548	30,772
Japan Power (Mar 2000)	Diesel engine	Fumace Oil	458	37.5%	1,221	4,397
Liberty Power (Sep 2001)	Combined cycle/ gas turbine	Natural Gas	3,561	60.0%	5,935	21,366
Rousch (Dec 1999)	Combined cycle/ gas turbine	Natural Gas	2,764	46.0%	6,009	21,631
Attock Generation (Mar 2009)	Combined cycle	Furnace Oil	0	46.0%	0	0
GE Energy Rental (Mar 2007)	Gas turbine	Natural gas	956	37.5%	2,549	9,178
Southern Electric	??	Furnace Oil		46.0%	0	0
Saba Power	Steam turbine	Furnace Oil	812	37.5%	2,165	7,795
Kohinoor Energy, Lahore	Diesel engine/ steam turbine	Furnace Oil		37.5%	0	0
KAPCO, Kot Addu	Combined cycle/ gas turbine	Natural gas	8,354	46.0%	18,161	65,379
HUBCO, Hub	Steam turbine	Furnace Oil	6,658	37.5%	17,755	63,917
Habibullah	Combined cycle/ gas turbine	Natural gas	888	46.0%	1,930	6,950
Kel	??	Furnace Oil	812	46.0%	1,765	6,355
Fauji Kabirwala	Combined cycle/ gas turbine	Natural gas	1,079	46.0%	2,346	8,444
AES Pak Gen. M. Garg	Steam turbine	Furnace Oil	1,925	37.5%	5,133	18,480
AES Laipir M. Garg	Steam turbine	Furnace Oil	1,623	37.5%	4,328	15,581
SEPCOL	Diesel engine	Furnace Oil	329	37.5%	877	3,158
A.E.L.	Gas engine	Natural Gas	0	39.5%	0	0
Atlas Power	??	Natural Gas	0	60.0%	0	0

2009

Generator name	Type of power station	Fuel type	Generation GWh	Efficiency %	Fuel consumption GWh	Fuel consumption TJ
Uch Power (Oct 2000)	Combined cycle/ gas turbine	Natural gas	4,368	46.0%	9,496	34,184
Japan Power (Mar 2000)	Diesel engine	Fumace Oil	256	37.5%	683	2,458

Liberty Power (Sep 2001)	Combined cycle/ gas turbine	Natural Gas	1,623	60.0%	2,705	9,738
Rousch (Dec 1999)	Combined cycle/ gas turbine	Natural Gas	3,328	46.0%	7,235	26,045
Attock Generation (Mar 2009)	Combined cycle	Furnace Oil	478	46.0%	1,039	3,741
GE Energy Rental (Mar 2007)	Gas turbine	Natural gas	913	37.5%	2,435	8,765
Southern Electric	??	Furnace Oil		46.0%	0	0
Saba Power	Steam turbine	Furnace Oil	702	37.5%	1,872	6,739
Kohinoor Energy, Lahore	Diesel engine/ steam turbine	Furnace Oil		37.5%	0	0
KAPCO, Kot Addu	Combined cycle/ gas turbine	Natural gas	7,545	46.0%	16,402	59,048
HUBCO, Hub	Steam turbine	Furnace Oil	8,256	37.5%	22,016	79,258
Habibullah	Combined cycle/ gas turbine	Natural gas	984	46.0%	2,139	7,701
Kel	??	Furnace Oil	873	46.0%	1,898	6,832
Fauji Kabirwala	Combined cycle/ gas turbine	Natural gas	1,253	46.0%	2,724	9,806
AES Pak Gen. M. Garg	Steam turbine	Furnace Oil	2,038	37.5%	5,435	19,565
AES Laipir M. Garg	Steam turbine	Furnace Oil	1,806	37.5%	4,816	17,338
SEPCOL	Diesel engine	Furnace Oil	48	37.5%	128	461
A.E.L.	Gas engine	Natural Gas	137	39.5%	347	1,249
Atlas Power	??	Natural Gas	7	60.0%	12	42

Total Fuel Consumption for Thermal non-IPP Plants in WAPDA Grid

Fuel type	Units	2007	2008	2009
Coal	TJ	3,542	3,499	2,614
Furnace Oil	TJ	83,341	83,102	87,122
Diesel	TJ	82	34	495
Gas	TJ	148,195	137,318	129,006

Total Fuel Consumption for Thermal IPPs connected to WAPDA Grid

Fuel type	Units	2007	2008	2009
Coal	TJ	-	-	-
Furnace Oil	TJ	125,789	119,683	136,391
Diesel	TJ	-	-	-
Gas	TJ	145,360	163,720	156,578

Totals (All Thermal Plants in WAPDA)

Fuel type	Units	2007	2008	2009
Coal	TJ	3,542	3,499	2,614
Furnace Oil	TJ	209,131	202,785	223,513
Diesel	TJ	82	34	495
Gas	TJ	293,555	301,038	285,583

OPERATING MARGIN: Average data for 3 years (2007-2009)

Fuel type and year	Variable Unit	Fuel consumption (1)	Power Generation (2)	CO2 emissions
		Unit as per column D	GWh	tonnes
2007				
Natural gas	TJ	293,555	29,414	15,940,043
Fuel oil	TJ	209,131	24,526	15,789,362
Diesel oil	TJ	82	136	5,939
Coal	TJ	3,542	136	335,111
2008				
Natural gas	TJ	301,038	26,559	16,346,371
Fuel oil	TJ	202,785	26,492	15,310,281
Diesel oil	TJ	34	643	2,477
Coal	TJ	3,499	136	331,024
2009				
Natural gas	TJ	285,583	22,621	15,507,178
Fuel oil	TJ	223,513	29,407	16,875,220
Diesel oil	TJ	495	674	35,936
Coal	TJ	2,614	113	247,247
Total			**160,856**	**96,726,189**
			$EF_{OM,y}$ (tCO_2/MWh)	**0.6013**

Sources (1):	Tables G22, G23, G24, Pakistan Energy Yearbook 2009
Sources (2):	Pakistan Energy Yearbook 2009 Table 5.11, 2008 Table 5.11, 2007 Table 5.11
Note:	Electricity generation from the KESC grid is not taken into account

C. BM calculation

BUILD MARGIN - recent plants

Total of electricity produced in 2009 (AEG,total) =	82,474 GWh
BM Threshold >20% =	16,495 GWh

List of the 5 most recent power plants (SET,5-units)

Generator name	Capacity	Generation type	Fuel Type	Generation in 2009
	MW			GWh
Liberty Power (Sep 2001)	235	Combined Cycle	Natural Gas	1,623
Attock Generation (Mar 2009)	163	Combined Cycle	Furnace Oil	478
GE Energy Rental (Mar 2007)	150	Gas turbine	Natural gas	913
Ghazi (Apr 2004)	1,450	Hydro Power	n/a	6,488
Malakand III (Nov 2008)	81	Hydro Power	n/a	420
			Total generation	**9,922**
			% of generation	**12.03%**

List of the most recent power plants that comprise 20% of energy generation (SET,≥20%)

Generator name	Capacity	Generation type	Fuel Type	Generation in 2009
	MW			GWh
Uch Power (Oct 2000)	586	Combined Cycle	Natural gas	4,368
Japan Power (Mar 2000)	135	Diesel Generator	Fumace Oil	268
Liberty Power (Sep 2001)	235	Combined Cycle	Natural Gas	1,623
Rousch (Dec 1999)	450	Combined Cycle	Natural Gas	3,328
Attock Generation (Mar 2009)	163	Combined Cycle	Furnace Oil	478
GE Energy Rental (Mar 2007)	150	Gas turbine	Natural gas	913
Chashma (May 2001)	184	Hydro Power	n/a	1,097
Ghazi (Apr 2004)	1,450	Hydro Power	n/a	6,488
Malakand III (Nov 2008)	81	Hydro Power	n/a	420
			Total generation	**18,983**
			>20% of electricity generation	**23.02%**

Sources: Pakistan Energy Yearbook 2009, Tables G.1, G.2, G.3, G.13

BUILD MARGIN CALCULATION

Generator name	Fuel Type	Generation (2) GWh	Efficiency (3) %	Fuel consumption GWh	Fuel consumption TJ	CO_2 emission factor tCO_2/TJ (1)	CO_2 emissions tCO_2
Uch Power (Oct 2000)	Natural gas	4,368	46.0%	9,496	34,184	54.3	1,856,210
Japan Power (Mar 2000)	Fumace Oil	256	37.5%	683	2,458	75.5	185,549
Liberty Power (Sep 2001)	Natural Gas	1,623	60.0%	2,705	9,738	54.3	528,773
Rousch (Dec 1999)	Natural Gas	3,328	46.0%	7,235	26,045	54.3	1,414,255
Attock Generation (Mar 2009)	Furnace Oil	478	46.0%	1,039	3,741	75.5	282,436
GE Energy Rental (Mar 2007)	Natural gas	913	37.5%	2,435	8,765	54.3	475,929
Chashma (May 2001)	n/a	1,097					
Ghazi (Apr 2004)	n/a	6,488					
Malakand III (Nov 2008)	n/a	420					
TOTAL		**18,971**					**4,743,152**
						$EF_{BM,y}$(tCO_2/MWh)	**0.250**

Sources (1):	Revised 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Table 1.4
Sources (2):	Table G.13, Pakistan Energy Yearbook 2009
Sources (3):	Efficiency of the plants are referenced from Annex 1 of the Tool

D. CM calculation

COMBINED MARGIN

$CM = (W_{OM} \times OM) + (W_{BM} \times BM)$

W_{OM} = 0.5 (Weighting of operate margin emission factor) **Default value**

W_{BM} = 0.5 (Weighting of build margin emission factor) **Default value**

	Weight	Emission factor
OM	0.5	0.6013
BM	0.5	0.250
Baseline combined margin (CM)		**0.42565**

Appendix 5. Further background information on monitoring plan

All relevant information was provided in the SECTION B.7.

Appendix 6. Summary report of comments received from local stakeholders

All relevant information was provided in the SECTION E.

Appendix 7. Summary of post-registration changes

1. Emergency diesel generator capacity.
2. Coordinates of weir site.
3. Technology employed by the project activity.
4. Power system diagram of Patrind hydropower plant (added)
5. Combined margin(CM) emission factor($EF_{grid,CM,y}$) (added)
6. Measurement methods and procedures of the reservoir area.
7. Start dates of crediting period.

No.1~6 applies for PRC with issuance track at the first verification stage. No.7 has already been completed. (Date of responded the secretariat by email: 24/09/2018)

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for CDM project activities" (EB 66, Annex 8).

Version	*Date*	*Description*
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document