

巴基斯坦卡洛特电力有限公司 KAROT POWER COMPANY (Pvt.) LIMITED

REF, NO. TGSAILKPCL2015399

August 10, 2015

Registrar National Electric Power Regulatory Authority NEPRA Tower Attaturk Avenue (East), Sector G-5/1, Islamabad

Subject: <u>Karot Power Company (Pvt) Ltd ("Company")</u>, <u>Application for Modification of the</u> <u>Generation License of 732 MW Karot Hydropower Project</u>

Dear Sir,

I, Mr. Sheng Zhen Dong being the duly authorized representative of Karot Power Company (Private) Limited by virtue of Board Resolution, hereby apply to National Electric Power Regulatory Authority for modification of its 732 MW Karot Hydropower Project's Generation License No. IGSPL/37/2013 dated November 26th 2013.

As you are already aware, the project is being designed with underground powerhouse with a capacity of 732 MW With 4x183MW Turbines & Concrete Dam. At this initial stage the overall project design can be seamlessly modified such as power house construction will be on surface level instead of underground and Asphalt concrete rock filled dam (ACCRD) instead of Concrete gravity Dam, that is due to latest Seismic Risk studies and increase in ratio of floods and earth quacks in future.

The company, pursuant to Regulation 10(2) of the NEPRA licensing (Application and Modification Procedure) Regulations, 1999, hereby seeks to apply for a modification of the Generation License granted to the Company to cater for the change in power house design (from underground to surface level).

I certify that the documents-in-support attached with this modification are prepared and submitted in conformity with the provisions of the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, and undertake to abide by the terms and provision of the above-said regulations. I further undertake and confirm that the information provided in the attached documents in support is true and correct to the best of my knowledge and belief.

A bank draft of the sum of Rupees 699,880 non-refundable license modification fees calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations1999 is also attached herewith.



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Best regards,

Yours sincerely,

Mr. Sheng Zhendong

Chief Executive Officer

Karot Power Company (Private) Limited

CC:

- 1. Managing Director, PPIB;
- 2. Senior Executive Director, PPIB;



巴基斯坦卡洛特电力有限公司 KAROT POWER COMPANY (Pvt.) LIMITED

REF NO.: KPCL/BOARD/OUT/2015/002

BOARD RESOLUTION

"RESOLVED THAT Karot Power Company Private Limited (a company incorporated under the laws of Pakistan with its registered office located at House No. 05, St # 72, F-8/3 Islamabad, Pakistan) (the Company) be and is hereby authorized to file application for modification in Generation License of its 720 MW hydro power generation project to be located at Karot, District Rawalpindi, Province of Punjab, Pakistan (the Project) and in relation thereto, enter into and execute all required documents, make all filings and pay all applicable fees, in each case, of any nature whatsoever, as required."

"FURTHER RESOLVED THAT in respect of filing a modification of Generation License for submission to National Electric Power Regulatory Authority, **MR. SHENG ZHEN DONG** (Chief Executive) be empowered and authorized for and on behalf of the Company to:

- (i) review, execute, submit, and deliver the generation license modification and any related documentation required by National Electric Power Regulator Authority for the modification of generation license, including any contact, documents, power of attorney, affidavits, statements, letters, forms, applications, deeds, guarantees, undertakings, approvals, memoranda, amendments, letters, communications, notices, certificates, requests, statements and any other instruments of any nature whatsoever;
- (ii) represent the Company in all negotiations, representations, presentations, hearings, conferences and /or meetings of any nature whatsoever with any entity (including, but in no manner limited to National Electric Power Regulatory Authority, any private parties, companies, partnerships, individuals, governmental and/or semi-governmental authorities and agencies, ministries, boards, departments, regulatory authorities and/or any other entity if any nature whatsoever);
- (iii) sign and execute the necessary documentation, pay the necessary fees, appear before the National Electric Power Regulatory Authority as needed, and do all acts necessary for completion and processing of the modification of generation license;
- (iv) appoint or nominate any one or more officers of the Company or any other person or persons, singly or jointly, in their discretion to communicate with, make presentations to and attend the National Electric Power Regulatory Authority hearings;
- (v) do all such acts, matters and things as may be necessary for carrying out the purposes aforesaid and giving full effect to the above resolution."

"AND FURTHER RESOLVED THAT MR. SHENG ZHEN DONG (Chief Executive), be and is hereby authorized to delegate all or any of the above powers in respect of the forgoing to any other officials of the Company as deemed appropriate

Mr. Sheng Zhendong Chief Executive Officer

Modification in Generation License 732 MW Karot Hydropower Project



August 2015



Karot Power Company (Private) Limited House No. 05, Street 72 Sector F-8/3, Islamabad www.karotpower.com

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Section 01 Introduction and Background

1.1 Introduction

Karot Power Company (Private) Limited (KPCL) is in the process of developing a 720 MW hydropower project to be located near the Karot Bridge at Tehsil Kahuta, District Rawalpindi, Punjab (the "Project"). The Project is being developed under the guidelines of Policy for Power Generation Projects 2002 (the "Policy") issued by the Government of Pakistan.

1.2 Project Background

KPCL was granted a generation license by NEPRA in June 2010 for its 732 MW (gross) hydro-based generation facility to be located at Karot village, District Rawalpindi, in the province of Punjab.

The feasibility study of the Project was conducted by SMEC and was approved by the Panel of Experts organized by PPIB in the year 2009. Thereafter KPCL filed a tariff petition to NEPRA on the basis of the approved feasibility study for determination of feasibility stage tariff. KPCL later on filed a Motion for Leave for Review to NEPRA to reconsider some of the items disallowed under the Feasibility Stage Tariff determination.

KPCL has now filed EPC stage tariff petition to NEPRA.

1.2 Layout of the document

Application for modification in Generation License includes all the information required under NEPRA Licensing (Application and Modification Procedure) Regulations, 1999, and is structured under the following sections:

Section 1 Introduction and Background – This includes an introduction to the project and its background.

Section 2 Text of Proposed Modification – This section contains the detailed description with regard to modification in Generation License. Each modification is separately discussed under this section.

Section 3 Reasons Supporting Modification – This section provides reasons in support to the modification in Generation License.

Section 4 Impact on Tariff, Service Quality and Performance – This section provide impact of the proposed modification on tariff, quality of service and performance by the licensee of its obligations under the license.

Section 02 Text of Proposed Modification

2.1 Concrete Gravity Dam to Asphalt Concrete Core Rockfill Dam

Feasibility Stage - Concrete Gravity Dam

A Concrete Gravity Dam with 91 meters height and 320 meters crest length with integrated spillway and deep sluices for flushing of sediment was proposed in the feasibility study. Consolidation grouting was proposed for the foundation. Spillway was proposed for passing floods. Both power intake and diversion tunnels are located on the right. Two diversion tunnels are foreseen on the right bank for passing 10-year return period flood.

Given below are the key features of Concrete Gravity Dam proposed in the feasibility study:

- a) Dam Height 91 m, above foundation
- b) Full reservoir level at EL 461.0 masl;
- c) Diversion discharge of 1,500 m3/s for the low flow season;
- d) PMF of 28,500 m3/s for spillway and flushing gates;
- e) Deep outlets for flushing with sill elevation below the power intake;

EPC Stage - Asphalt Concrete Core Rockfill Dam

Due to poor geological and seismic conditions at project site, Asphalt Concrete Core Rockfill Dam has been recommended. Geo-stress is high in the region, and the rocks are soft, therefore building a Concrete Gravity Dam under such conditions is not feasible. Geological risk is high and the stability of surrounding rocks is quick weathering and weakening. Rock masses for concrete gravity dam foundation have engineering geological problems i.e. low bearing capacity and sliding stability, coupled with relatively large demand for concrete aggregate. Asphalt Concrete Core Rockfill Dam is more adaptable to the geological conditions and its antiseismic feature is better.

2.2 Under Ground Power House to Surface Power House

Feasibility Stage - Under Ground Power House

An underground powerhouse was previously selected and proposed for 4 Vertical Francis units. Powerhouse was oriented with longitudinal axis north 30° east. Power House cavern was to be 25 m wide and 135 m long excluding the service bay area. A longitudinal section through powerhouse indicates that the natural surface in powerhouse area varies from 510 to 515m.

The spacing between units was initially planned to be 25.7m and these were to be on right side of the powerhouse cavern looking upstream. The turbine axis was set at an elevation of 375 m. The machine hall floor level was set at 395 m and the bottom level of draft tube was 362m. The draft tube length was 31 m and its outlet dimension was planned to be 12 m x 10 m. In the initial plan there were six levels in the powerhouse. One crane will be erected in the machine hall.

Access tunnel some 600m long were initially planned to connect ground level to powerhouse machine hall at level at EL 395m. The invert of the access tunnel portal was planned to be EL 415m. Four vertical bus-bar shafts would evacuate energy from each unit to a surface switchyard located at an elevation of 510 m to the west of the cavern.

EPC Stage - Surface Power House

As a result of additional investigations, surface powerhouse has been recommended for the project. Surface powerhouse is more suitable, keeping in view power geological and seismic conditions at project site.

The layout of selected design of the project comprising Asphalt Concrete Core Rockfill Dam and surface powerhouse is shown in the picture below:



Section 03 Reasons Supporting Modification

Feasibility study of Karot Hydropower project was conducted in 2009. Subsequently additional investigations were conducted in order to update the results of feasibility study. These additional investigations revealed poor geological and seismic conditions at project site. Due to these geological and seismic risks, design of the project has been changed from Concrete Gravity Dam to Asphalt Concrete Core Rock Fill Dam and underground powerhouse to a surface powerhouse.

Table below provides details of subsequent/additional investigations conducted by Project Company:

	Studies	
nems	Feasibility	Supplementary
Study of regional structural stability, seismic risk analysis (Item)	1	1
Boreholes (numbers/m)	17/1822	20/2345.6
Adits (numbers/m)	0	1/225
Seismic reflection survey (sections)	13	0
Resistivity measuring (points)	13	0
Sonic wave test in borehole (m)	0	1419
Digital video in borehole (m)	0	1317.9
Rock tests in laboratory (group)	50	70
Rock tests on site (group)	0	10
Measurement of geo stress (borehole)	0	1

Given below are some of the pictures taken while conducting additional investigations:

Snaps of Drilling on water and Audits



Snaps of Geostress tests and Drilling on land



Table below shows hydrology and sediment information provided in the in the feasibility study and results subsequent/additional investigations, which was then made part of the bidding documents;

Hydrology and Sediment	Feasibility	Bidding Documents	
	Data		
Durant	1969~2004	1969~2010	
RUNOT	Mean annual flow of the dam site		
	821m³/s	819m³/s	
	Da	ta	
	Karot (1969~1978) Azad Pattan (1979~2004)	Karot (1969~1978) Azad Pattan (1979~2010)	
	Frequency	/ Analysis	
Flood	Gumbel; Log Pearson Type-III; Log normal	Pearson Type-III	
	Floc	od	
	13478~30184 m ³ /s (10000 years return period) 28440 m ³ /s (PMF)	29600 m³/s (5000 years return period)	
	Data		
Rating Curves	River cross section surveyed by WAPDA in 1976	1:500 topography map (May 2012)	
	Method		
	By Manning formula and assumed parameters	By Manning formula & in- situ measured data	
	Dai	a	
	1970~2004 of Karot station and Azad Pattan	1970~2010 of Karot station and Azad Pattan	
Sediment	Annual total sedi	ment discharge	
	36,640,000 t	38,120,000 t	
	Bed L	oad	
	4,740,000 t	4,970,000 t	

Engineering geology revealed following:

- Soft rocks: saturated compressive strength of 8~30MPa
- Loose sandstone: exposed in boreholes, randomly in the dam site area
- High geo-stress: lateral stress coefficient σ_H/σ_z up-to 6.6
- Scarce concrete aggregate around dam site area

Table below shows the condition of rocks revealed through engineering geology:

3.2 Dam Structure

Rocks condition

ACCRD is more adaptable to the geological conditions, anti-seismic feature is better, the excavated materials can be used as dam construction material:

Furthermore following will be the benefits of Asphalt concrete core rock-fill dam as proposed by EPC contractor.

- Excavated materials for dam construction material
- Smaller quantity demand of concrete aggregate
- More adaptable to the geological conditions
- Better guaranteed construction period
- Better controlled investment

3.3 Surface Power House

Surface powerhouse has been recommended by the preferred EPC contractor to avoid large cavern, geological risk is smaller, and the investment can be better controlled.

Surrounding rock of carven is mainly poor to very poor rocks (Q<4), maximum excavation span will be 25m. Therefore surrounding rock is instable, and the geologic risk is extremely high. Following are some of the key reasons for change to surface powerhouse:

- Geo-stress is high in the region, and the rocks are soft.
- When building a underground powerhouse under such condition, there are many problems i.e. stability of surround rocks and quick weathering and weakening, with a high geologic risk.
- Rock masses for concrete gravity dam foundation have engineering geological problems i.e. low bearing capacity and sliding stability, coupled with relatively large demand for concrete aggregate.
- Terrain of river bend on right bank is suitable for layout of diversion-type ground powerhouse
- Bearing capacity of rocks can meet requirements of ground powerhouse
- Variation amplitude of tailrace water level is large and earthquake intensity is high. These can be well solved by engineering measures: tube structure and antiseepage-curtain-drainage system.

Section 04 Impact on Tariff, Service Quality and Performance

Change in design from Concrete Gravity Dam to Asphalt concrete Core Rock fill dam and from underground powerhouse to surface powerhouse will have no impact on quality of service and performance by the licensee of its obligations under the license. The new design is more suitable to geological and seismic conditions at project site. Furthermore change in design will enhance/improve quality of service and performance of the Licensee.

KPCL has approached NEPRA for determination of tariff. Tariff petition in this regard has been submitted to NEPRA on 2nd April 2015, for determination of EPC stage tariff.

The company further certifies that quality of service and the performance of the company of its obligations under the Generation License will not be affected.

SCHEDULE-I

MODIFICATIONS IN SCHEDULE 1 OF THE GENERATION LICENSE

Pursuant to the design change (from underground to surface level) the following needs to modified and incorporated:

a) Selected project layout

Stated in Generation License

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a) Selected project layout

Proposed Modification



Stated in Generation License

b) Plan view of the Dam



b) Plan view of the Dam

Proposed Modification





Stated in Generation License



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hall and draft tube Gate Gallery d) Powerhouse Transverse Section through machine stated in Generation License



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d) Powerhouse Transverse Section through machine Proposed Modification hall and draft tube Gate Gallery



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Proposed Modification

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f) Powerhouse Plan

Stated in Generation License



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B). Plant Configuration

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Description	Stated in Generation License	Proposed Modification
(vi)Turbine Make & Model	Harbin Engineering Company China/Dong Fang Electric Corporation/ Hangzhou Equipment Works(HEE China) Chang-Song Electro Mechanical Equipment Company Limited China / VA Tech Hydro Gmbh, Austria or Equivalent	Harbin Electric Machinery Co., Ltd. China Dong Fang Electric Machinery Co., Ltd. China Zhe Fu Holding Group Co., Ltd. China
(vii)Expected Commissioning and Commercial Operation Date (COD) of the Generation Facility	July 01, 2017 (Tentative)	December 31, 2020 (Tentative)

(C). Main Design Features;

Description	Stated in Generation License	Proposed Modification
(i) Design Discharge	1200 Cumecs	1248Cumecs
(ii) Gross Head	79.00 Meter	79.5 m
(iii) Rated Net Head	67.00 Meter	65m
(iv) Dam Height	91 Meter above foundation	95.5m
(v) Dam Type	Concrete gravity dam	Asphalt Concrete Core
	-	Rockfill dam
(vi) Design Flood	28,500 Cumecs	29600 Cumecs

(D). Spill Way

Description	Stated in Generation License	Proposed Modification
(i) Spillway type	Over flow with radial gates	Over flow with radial gates
(ii) No. of gates	8.00	6
(iii) Gate size	7x15 m	9m×10m
(iv) Spillway discharging capacity	28,500 Cumecs (PMF)	29600 Cumecs

(E). Low level Sluicing Gates

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Description	Stated in Generation License	Proposed Modification
(i) No. of gates	6.00	2
(ii) Gates Type	Radial	Radial
(iii). Gate Size	(6.2m x 11 m) each	(8m×9m) each

(F). Diversion Tunnels

Description	Stated in Generation License	Proposed Modification
(i) No of Tunnels	2.00	3.00
(ii) Tunnel Diameter	10.00 Meter	12.5 Meter
(iii) Tunnel Length	450 Meter	447 Meter (Average length)

(G). Head Race Power Tunnels:

Description	Stated in Generation License	Proposed Modification
(i) No of tunnels	4.00	4
(ii) Tunnel Diameter	10.00 Meter	7.9~9.6m
(iii) Tunnel Length	160 Meter	303~330m
(iv) No of pressure shaft	4.00	N/A
(v) Diameter	7.4 Meter	N/A

(H). Tail Race Tunnels:

Description	Stated in Generation License	Proposed Modification
(i) No of tunnels	4.00	N/A
(ii) Tunnel Diameter	10.00 Meter	N/A
(iii) Tunnel Length	470 Meter	N/A

(I). Power House:

Description	Stated in Generation License	Proposed Modification
(i) Powerhouse type	Cavern/Underground	Surface Level
(ii) Switchyard	Open outdoor	Open/outdoor

(j). Plant Characteristics:

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Description	Stated in Generation License	Proposed Modification
(ii) Mean Annual Energy (Gross)	3436 GWh	3206 GWh
(iii) Plant Factor	54.5%	50.83%
(iv) Generator	4 No Turbo Unit	4 vertical Francis Units
(v) Generator Capacity	180MW/200 MVA	180MW/225MVA

ANNEX 1

Text of the Proposed Modification:

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Karot Power Company (Private) Limited was issued Generation License by NEPRA on 26th November 2013. Generation License provides for Concert Gravity Dam and Underground Powerhouse. Design of the project has been changed from Concrete Gravity Dam to Asphalt Concrete Core Rock Fill Dam and Underground Powerhouse to Surface Powerhouse, due to geological and seismic risks at project site.

Penal of Experts of Private Power Infrastructure Board has also approved this change in design.

In relation hereto, please find attached herewith the modifications in Schedule I of the Generation License.