



PEDO

**PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
GOVERNMENT OF KHYBER PAKHTUNKHWA PESHAWAR**

Office of Project Director, Zafar House near PSO Pump, Balach, Chitral. +92 333 4737 190



No. 3250/PEDO/PD Lawi HPP

Dated: 20 / 11 / 2019

✓ To

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

Subject: 69 MW Lawi Hydropower Project, District Chitral, Khyber Pakhtunkhwa, Application for Generation License

1. I, Niamat Khan, Project Director, Lawi Hydropower Project of Pakhtunkhwa Energy Development Organization (PEDO) being the duly Authorised representative of PEDO by virtue of authority letter No. 8992/PEDO/CEO/Lawi HPP dated 15th November 2019, hereby apply to National Electric Power Regulatory Authority for the grant of a Generation Licence to PEDO for 69 MW Lawi Hydropower Project, pursuant to the Regulation of Generation, Transmission and Distribution of Electric Power Act, 1997.
2. I, certify that the documents-in-support attached with this application 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 provisions of the above mentioned 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.
3. A BANK DRAFT for the sum of Rupees **452,060-** (Rs. Four Hundred Fifty-Two Thousand and Sixty Only) being the non-refundable licence application fee calculated in accordance with Schedule II to the National Electric Power Regulatory Authority Licensing (Application and Modification Procedure) Regulations, 1999, is also attached herewith.

Engr. Niamat Khan
Project Director,
Lawi Hydropower Project.

- Chief Executive Officer, PEDO, Peshawar.

Engr. Niamat Khan
Project Director,
Lawi Hydropower Project.



P E D O

PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
Government of Khyber Pakhtunkhwa Peshawar



No. 8992 PEDO/CEO/Lawi HPP
Dated Peshawar the 15/11/2019

TO WHOM IT MAY CONCERN

Mr. Niamat Khan S/o Sherbaz Khan bearing CNIC No 17201-15948182-9 is hereby appointed as authorized representative of Pakhtunkhwa Energy Development Organization (PEDO), for the purpose of filing an application for Determination of Tariff for Lawi Hydropower Project and to submit before NEPRA, an application for grant of Generation License for the said project. He is also authorized to attend any meeting(s) and discussion related to the determination of tariff and grant of generation license and to provide any information& documents needed in this regard.


(Zahid Akhtar Sabri)
Chief Executive Officer
PEDO

Check List for Examination of
New Generation Facility (Hydel) - License Application

Name of Company: Pakhtunkhwa Energy Development Organization (PEDO)

Capacity: 69 MW

Prepared/Updated on: 12.11.2019

Regulation #	Information/Documents Required	Compliance		Remarks
		Yes	No	
3(1)	Authorization from Board Resolution / Power of Attorney	Yes		Authority letter and Affidavit are attached with the application.
3(3)	Application fee (including Indexation)	Yes		A Demand Draft amounting Rs.452,060/- In favour of NEPRA is attached with the Application.
3(4)	Three copies of Application	Yes		Three copies of the Application for the Generation Licence with supporting documents are hereby submitted please.
3(5)(a)(i)	Certificate of incorporation	Yes		PEDO is a public sector organization therefore it is not applicable/required.
3(5)(a)(ii)	Memorandum and articles of association	Yes		PEDO is public sector organization and is exempt under Section 24 of NEPRA therefore it is not applicable/required
3(5)(a)(iii)	Annual Return statements or in lieu thereof		No	PEDO is public sector organization, therefore it is not required to submit Annual Return Statement.
3(5)(b)	Profile of experience of the applicant its management, staff and its members in power sector.	Yes		Experience Profile of the Applicant and its management staff is attached.
3(5)(c)	CVs of applicant's Senior Management and Technical professionals	Yes		The requisite CVs are attached.
3(5)(d)(i)	Cash balance & bank certificates	Yes		PEDO is public sector organization, therefore it is not applicable / required
3(5)(d)(ii)	Expression of interest to provide credit or financing along with sources and details thereof	Yes		Funded by Government of Khyber Pakhtunkhwa from its own resources
3(5)(d)(iii)	Latest financial statements	Yes		PEDO is public sector organization, therefore it is not applicable / required
3(5)(d)(iv)	Employment records of Engineers & Technical Staff	Yes		Requisite employment records of the existing Engineering and Technical staff of the Applicant are attached with the Application.
3(5)(d)(v)	Profile of Sub-contractors	Yes		Profiles of following Contractors are enclosed:- <ul style="list-style-type: none"> • M/s Sichuan Province Geological Engineering Complex • M/s Sarwar & Company. • M/s Sillian Technical Import & Export Co. • M/s Chongqing Luyong Engineering Design Co.
3(5)(d)(vi)	Verified references w.r.t. experience of the Applicant and its sub-Contractors	Yes		<ul style="list-style-type: none"> • PEDO being the Government entity and have already constructed several Hydropower Projects in KPK and also operating and maintain the completed HPPs is known to

				<p>NEPRA. Therefore, to provide any reference concerning its experience is not required.</p> <ul style="list-style-type: none"> • However the Lawi HPP is being implemented / constructed through International EPC Contractors and the award of Contract has been made by fulfilling the PEC rules through ICB and after complete verification of Contractors.
3(5)(e)	Encumbrance on assets	Yes		Funding by Government of Khyber Pakhtunkhwa
3(5)(f)	Technical and financial proposal for Operation, maintenance, planning and development of the generation facility.	Yes		<ul style="list-style-type: none"> • The Operation and Maintenance Contracting of the Plant shall be initiated a few months before the Commissioning and Testing stage of the Project and the stipulated completion date of the Project is November 2021 therefore it is quite early for this activity. • However EPC executed and work in progress under the EPC signed with consortium of SICHUAN-SARWAR-SILIAN-CHONGQING LUYANG JV.
3(5)(g)(a)	Type of Technology	yes		Details provided in Prospectus
3(5)(h)	Feasibility Report	Yes		Attached
3(5)(i)	Prospectus	Yes		Attached

Check List for Examination of
New Generation Facility (Hydel) - License Application

Name of Company: Pakhtunkhwa Energy Development Organization (PEDO)

Capacity: 69 MW

Prepared/Updated on: 12.11.2019

Regulation # Schedule III	Information/Documents Required	Compliance		Remarks
		Yes	No.	
1.	Location (Location maps, site map)	yes		LAWI hydropower is located on Shishi River, a Left tributary of Chitral River near Drosh Town in District Chitral. The weir is located on the Shishi River near Lao Nissar village, which is 15km from river mouth. The power house is located on the left bank of the upstream Chitral River, about 1.8km distance from where Shishi River and Chitral River join together.
2.	Plant: run of river, storage, weir	yes		Run of River, located on Shishi River, which is the left bank tributary of River Chitral.
3.	Head: Minimum, maximum	Yes		<ul style="list-style-type: none"> Maximum Net Head: 398.50 meters Minimum Net Head: 377.35 meters
4.	Technology: Francis, Pelton, etc. Size, number of units.	Yes		Pelton Turbines with 4 Jets, Three Units 23 MW each, total Installed Capacity is 69 MW
5.	Tunnel (if proposed): length, diameter	Yes		Length: 12,117 m Diameter: 4.3 m
6.	ESSA (Environmental and Social Soundness Assessment)	Yes		Approval Letter Attached
7.	Detailed feasibility report	Yes		Copy Attached
8.	Resettlement issues	No		Settled
9.	Consents	Yes		EIA and land acquisition already approved. Customs and other duties at concessionary rates will be applicable as per GOP/ Govt of Khyber Pakhtunkhwa Policy.
10.	Infrastructure development	Yes		<ul style="list-style-type: none"> Included in EPC Contract at Section 1.2.4.13 (Buildings & Infrastructures), Page 41 of 128 of the Employer's Requirement (Copy Attached). Access Road to Intake Structures. (18 km)
11.	Interconnection with National Grid Co. distance and name of nearest grid, voltage level (single line diagram)	Yes		As per policy, the 132 kV Transmission Line of Golen Gol HEPP will be connected with the 132 kV switchyard

				of Lawi HPP through Loop in and Loop out system to evacuate the Generated Power from Lawi HPP, therefore direct connection with nearest grid is eliminated.
12.	Project cost, information regarding sources and amounts of equity and debt.	yes		<ul style="list-style-type: none"> • Project Cost as per the approved PC-1 is Rs. 20,087.50 Million. • Financial Plan & Mode of Financing as per (PC-1) is 10% of the cost from Annual Development Program (ADP) and 90% from Hydel Development Fund (HDF)
13.	Project schedule, expected life	yes		<ul style="list-style-type: none"> • Construction Period: 60 months. • Project life 30 years,
14.	Peaking/base load operation	yes		Base load
15.	Plant characteristics: generation voltage, power factor, frequency, automatic generation control, ramping rate, control metering and instrumentation	Yes		<ul style="list-style-type: none"> • Generation Voltage: 11 KV • Power Factor: 85% • Frequency: 50 CPS • Automatic Generation Control through Speed Governors as per the load requirement and availability of potential Energy at source. • Interconnection at 132 kV voltage level with PESCO Grid by Loop in and Loop out system through 132 kV Transmission Line of Golen Gol HEPP. (Modalities are under process to get the approval of the concerned quarter of WAPDA/PESCO/NTDC), will be completed in due course of time.
16.	System studies load flow, short circuit, stability.	Yes		Selection of Consultants to carry out the system studies including Load flow, Short Circuit Stabilities and Interconnection with PESCO/NTDC is in its advance stage and the selected Consultant shall complete all these studies / requirements within shortest possible time.
17.	Training and development	Yes		Details are provided in Contract at Section 1.1.6 (Training Program) (See Page 6&7 of 128 of Employer's Requirement (Copy Attached).

Article – 1

Definitions

1.1 In this Licence:

- a. “Act” means the Regulation of Generation Transmission and Distribution of Electric Power Act, 1997 as amended or replaced from time to time;
- b. “Applicable Documents” mean the Act, the rules and regulations framed by the Authority under the Act, any documents or instruments issued or determinations made by the Authority under any of the foregoing or pursuant to the exercise of its powers under the Act, the Grid Code, the applicable Distribution Code, if any, or the documents or instruments made by the Licensee pursuant to its generation licence, in each case a binding nature applicable to the Licensee or, where applicable, to its affiliates and to which the Licensee or any of its affiliates may be subject;
- c. “Applicable Law” means the Act, relevant rules and regulations made there under and all the Applicable Documents;
- d. “Authority” means the National Electric Power Regulatory Authority constituted under Section 3 of the Act;
- e. “Bus Bar” means a system of conductors in the generation facility/Hydel Power Plant of the Licensee on which the electric power of all the generators is collected for supplying to the Power Purchaser;
- f. “Carbon Credits” mean the amount of carbon dioxide (CO₂) and other greenhouse gases not produced as a result of generation of electric power by the generation facility/ Hydel Power Plant of the Licensee and other environmental air quality credits and related emissions reduction credits or benefits (economic or otherwise) related to the generation of electric power by the generation facility/ Hydel Power Plant, which are available or can be obtained in relation to the generation facility/Hydel Power Plant after the COD;

- g. "Commercial Operations Date (COD)" means the day immediately following the date on which the generation facility/Hydel Power Plant of the Licensee is Commissioned;
- h. "Commissioned" means the successful completion of commissioning of the generation facility/ Hydel Power Plant for continuous operation and dispatch to the Power Purchaser;
- i. "Commissioning Tests" means the tests to be carried out pursuant to provisions of EPA;
- j. "CPPA-G" means Central Power Purchasing Agency (Guarantee) Limited or any other entity created for the like purpose;
- k. "Distribution Code" means the distribution code prepared by concerned XW-DISCO and approved by the Authority, as it may be revised from time to time with necessary approval of the Authority;
- l. "Energy Purchase Agreement (EPA)" means the energy purchase Agreement, entered or to be entered into by and between the power purchaser and the Licensee, for the purchase and sale of electric energy generated by the generation facility/Hydel Power Plant, as may be amended by the parties thereto from time to time;
- m. "Grid Code" means the grid code prepared by NTDC and approved by the Authority, as it may be revised from time to time by NTDC with the approval by the Authority;
- n. "Generation Rules" mean the National Electric Power Regulatory Authority Licensing (Generation) Rules, 2000 as amended or replaced from time to time;
- o. "Hydel Power Plant" means a generation facility using water flows of canal or rivers for generation of electric power;
- p. "IEC" means "the international Electro-technical Commission and its successors or permitted assigns;
- q. "IEEE" means the Institute of Electrical and Electronics Engineers and its successors or permitted assigns;
- r. "Licensee" means **Pakhtunkhwa Energy Development Organization (PEDO)** and its successors or permitted assigns;

- s. "Licensing Regulation" mean the National Electrical Power Regulatory Authority Licensing (Application & Modification Procedure) Regulations, 1999 as amended or replaced from time to time;
 - t. "Net Delivered Energy" means the net electric energy expressed in kWh generated by the generation facility/Hydel Power Plant of the Licensee at its outgoing Bus Bar and delivered to the Power Purchaser;
 - u. "NTDC" means National Transmission and Despatch Company Limited and its successors or permitted assigns;
 - v. "PESCO" means Peshawar Electric Supply Company Limited and its successors or permitted assigns;
 - w. "Policy" means the Policy for Development of Renewable Energy for Power Generation, 2006 of Government of Pakistan as amended from time to time;
 - x. "SCADA System" means the supervisory control and data engaged in the distribution of electric power".
 - y. "XW DISCO" means "an Ex-WAPDA distribution company engaged in the distribution of electric power".
- 1.2 Words and expressions used but not defined herein bear the meaning given thereto in the Act or in the Rules.

Article – 2

Application of Law

This Licence is issued subject to the provisions of the Rules, as amended from time to time.

Article – 3

Generation Facilities

- 3.1. The location, size (capacity in MW), technology, interconnection arrangements technical limits, technical functional specifications and other details specific to the

generation facility/Hydel Power Plant of the licensee are set out in Schedule - I to this Licence.

- 3.2. The net capacity/Net Delivered Energy of the generation facility/Hydropower Plant of the Licensee is set out in Schedule-II hereto. The Licensee shall provide the final arrangement, technical and financial specifications and other specific details pertaining to its generation facility/ Hydel Power Plant before its COD.

Article – 4

Term of Licence

- 4.1 The Licence shall become effective from the date of its issuance and will have a term of thirty (30) years from COD of the generation facility/Hydel Power Plant of the Licensee.
- 4.2 Unless suspended or revoked earlier, the licensee may apply for renewal of this licence ninety **(90) days** prior to the expiry of the term as stipulated in the Licensing Regulations.

Article – 5

Licence Fee

The Licensee shall pay to the Authority the Licence as stipulated in the National Electric Power Regulatory Authority (Fee) Rules, 2002 as amended or replaced from time to time.

Article – 6

Tariff

The Licensee shall charge only such tariff which has been determined, approved or specified by the Authority.

Article – 7

Competitive Trading Arrangement

7.1 The Licensee shall participate in such manner as may be directed by the Authority from time to time for development of the Competitive Trading Arrangement. The Licensee shall in good faith work towards implementation and operation of the aforesaid Competitive Trading Arrangement in the manner and time period specified by the Authority. Provided that, any such participation shall be subject to any contract entered into between the Licensee and another party with the approval of the Authority.

7.2 Any variation and modification in the above mentioned contracts for allowing the parties thereto to participate wholly or partially in the Competitive Trading Arrangement shall be subject to mutual agreement of the parties thereto and such terms and conditions as may be approved by the Authority.

Article – 8

Maintenance of Records

For the purpose of sub-rule (1) of Rule 19 of the Generation Rules, copies of records and data shall be retained in standard and electronic form and all such records and data shall, subject to just claims of confidentiality, be accessible by the authorized officials of the Authority.

Article – 9

Compliance with Performance Standards

The Licensee shall comply with the relevant provisions of the National Electric Power Regulatory Authority Performance Standards (Generation) Rules, 2009 as amended from time to time.

Article – 10

Compliance with Environmental Standards

- 10.1 The generation facility/Hydel Power Plant of the Licensee shall comply with the environmental and safety standards as may be prescribed by the relevant competent authority from time to time.
- 10.2 The Licensee shall provide a certificate on a bi-annual basis, confirming that the operation of its generation facility/Hydel Power Plant is in confirming with required environmental standards as prescribed by the relevant competent authority.

Article – 11

Power off take Point and Voltage

The Licensee shall deliver the electric power to the power to the Power Purchaser at the outgoing bus bas of its generation facility/Hydel Power Plant. The Licensee shall be responsible for the up-gradation (step up) of generation voltage up to the required dispersal voltage level.

Article – 12

Performance Data

- 12.1. The Licensee shall install SCADA System or compatible communication system at its generation facility/Hydel Power Plant as well as at the side of the Power Purchaser.
- 12.2. The Licensee shall transmit the data for the flow of water and electric power output data of its generation facility/Hydel Power Plant to the control room of the Power Purchaser.

Article – 13

Provision of Information

In accordance shall transmit the data for the flow of water and electric power output data of its generation facility/Hydel Power Plant to the control room of the Power Purchaser.

Article – 14

Emissions Trading/Carbon Credits

The Licensee shall process and obtain expeditiously the Carbon Credits admissible to the generation facility/Hydel Power Plant. The Licensee shall share the said proceeds with the Power Purchaser as per the Policy.

Article – 15

Design & Manufacturing Standards

The Generation facility/Hydel Power Plant of the Licensee shall be designed, manufactured and tested according to the latest IEC or IEEE or any other equivalent standard. All the plant and equipment of the generation facility/Hydel Power Plant shall be unused and brand new.

Article – 16

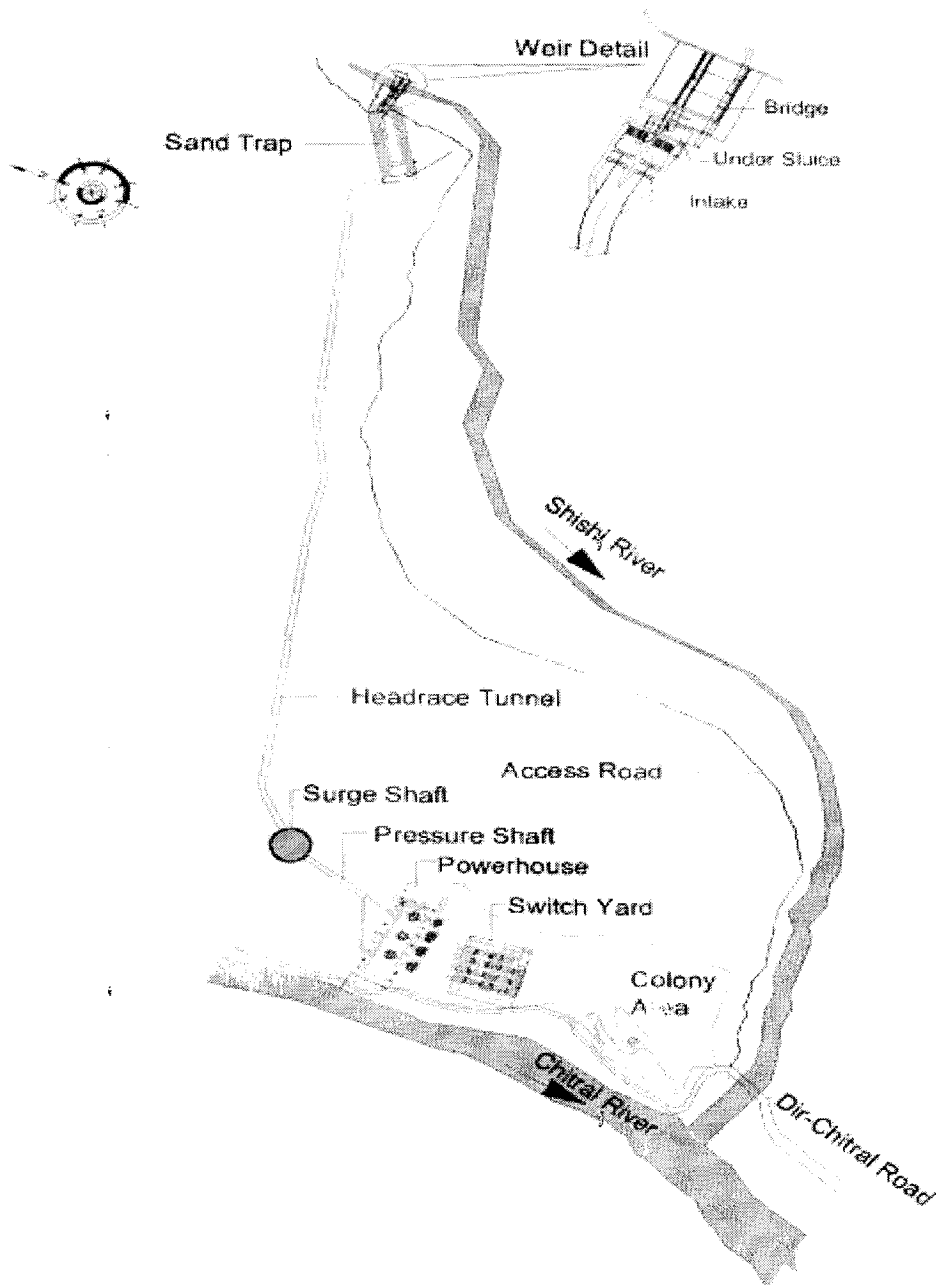
Power Curve

The Power Purchaser shall verify the power curve of the generation facility/Hydel Power Plant of the Licensee, as part of the Commissioning Tests according to the latest IEC or IEEE or any other equivalent standard and shall be used to measure its performance.

SCHEDULE-I

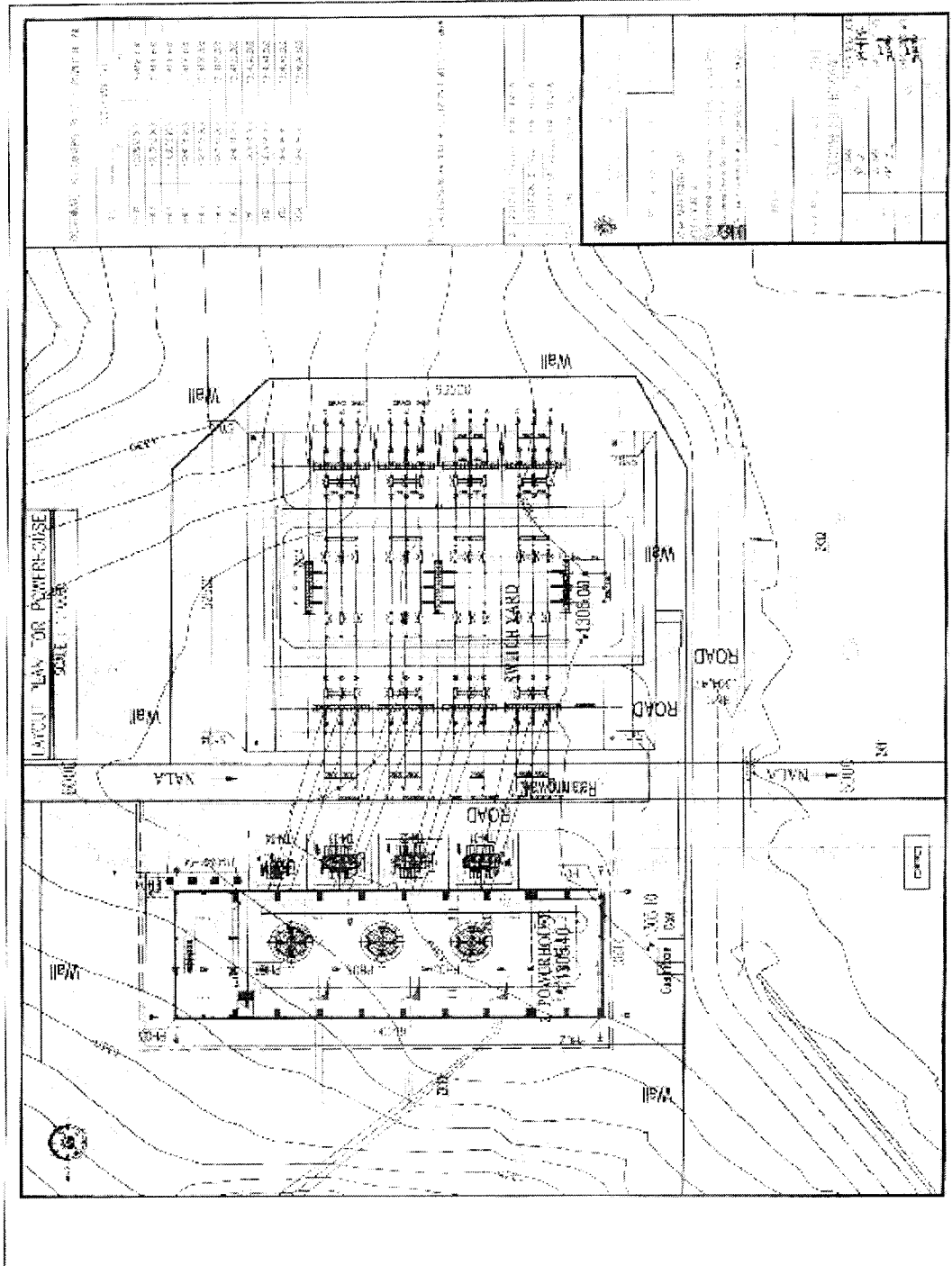
The Location, Size (i.e. Capacity in MW), Type of Technology, Interconnection Arrangements, Technical Limits, Technical/Functional Specifications and other detail specific to the Generation Facilities of the Licensee and described in this Schedule

Location
of the Generatoin Facility/Hydro Power Plant of
PEDO

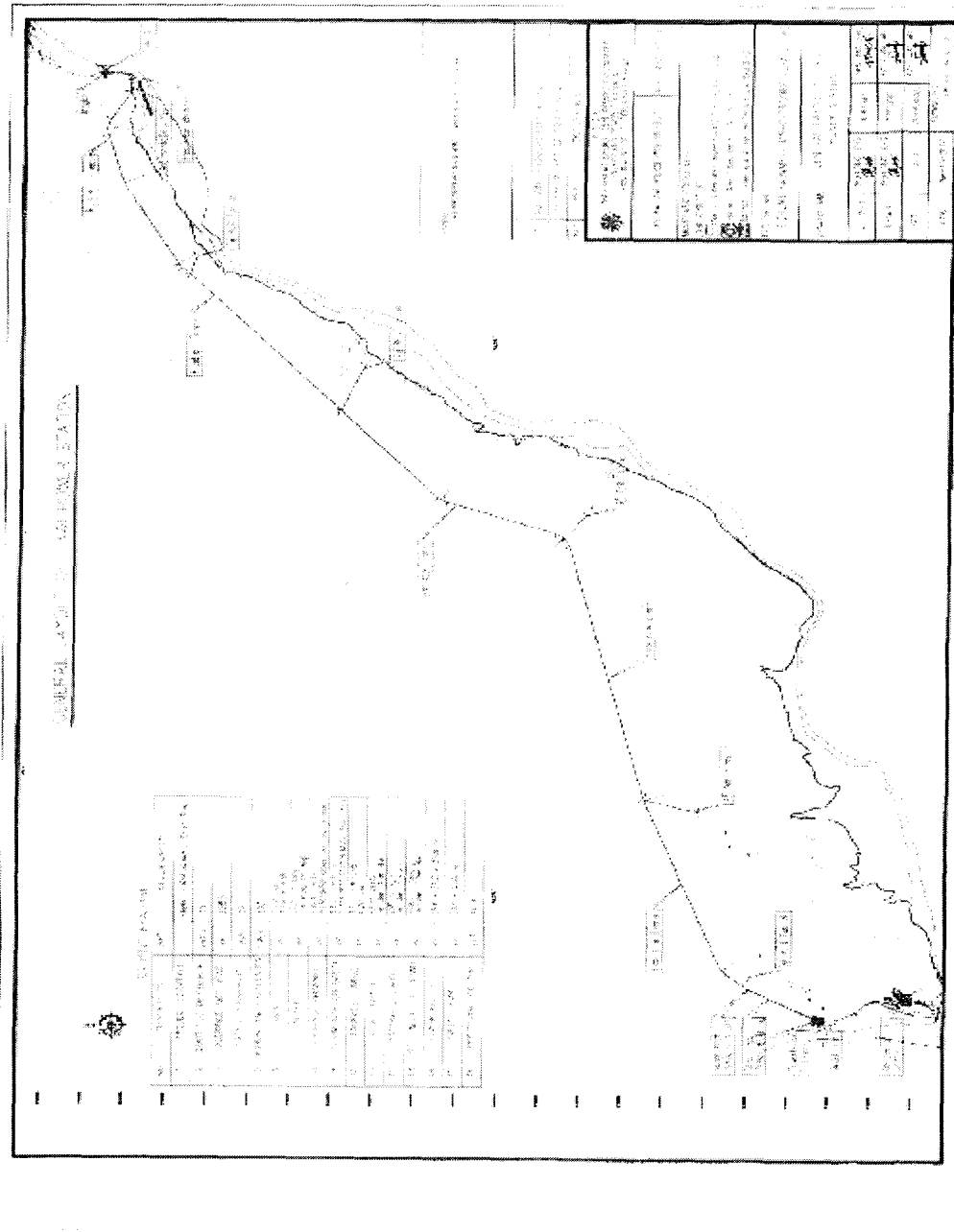


Power

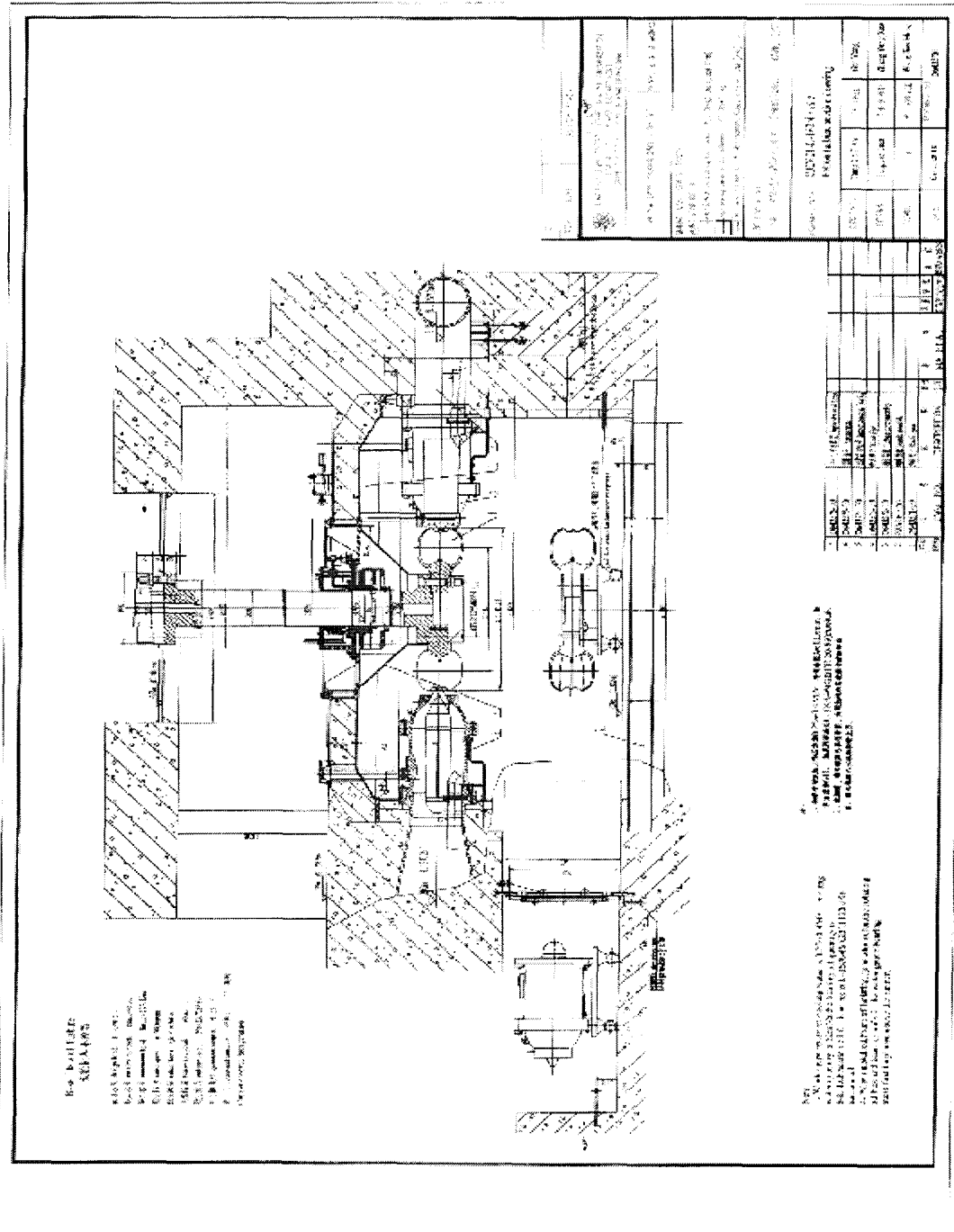
House Layout Plan of the Generation Facility/Hydropower Plant PEDO



General Layout of Power Station of the Generation Facility/Hydropower Plant PEDO



Pelton Turbine Setting of the Generation Facility/Hydro Power Plant of PEDO



**Details of Generatoin Facility/Hydro power
Plant of PEDO**

(A). General Information

i.	Name of the License/Company	Pakhtunkhwa Energy Development Organization (PEDO)
ii.	Registered/ Business Office of the Licensee/ Company	PEDO House, 38/B-2, Phase V, Hayatabad, Peshawar
iii.	Location of the Generation Facility	Near Drosh, District Chitral. Khyber Pakhtunkhwa
iv.	Type of Geneartoin Facility	Hydropwer Plant

(B). Configuration etc.

i.	Size/ Installed Capacity (Gross) of the Generation Facility	69.00 MW
ii.	Type of Storage etc.	Run of River Hydropower Plant
iii.	Water Source	Shishi River
iv.	Type of Technology	Three (03) Vertical Shaft impulse Turbines
v.	Number of Units & Size (MW)	3x23 MW
vi.	Turbine Make & Model	
vii.	COD of the Generatoin Facility	November 01, 2021
viii.	Expected Life of the Generation Facility from COD	Thirty (30) Years

(C). Main Design Features

i.	Design Discharge Q	20 m ³ /sec
ii.	Gross Head	414 m
iii.	Installed elevation of generating unit	1297.2 m
iv.	Rated net head	398.50 m
v.	Head Loss	15.5 m
vi.	Maximum Head	414 m
vii.	Minimum Head	377.35

(D). Weir Structure

i.	Weir Type	Concrete Weir
ii.	Height of over flow section from riverbed	2.2 m
iii.	Height from weir top (road level) to riverbed	8.2 m
iv.	depth below riverbed	8.4 m
v.	Crest width overflow section	60 m
vi.	Design Flood (500year return period)	872 m ³ /sec

(E). Intake Structure

i.	Intake orientation	Parallel to river flow
ii.	Location	Right bank of river
iii.	Invert level of intake structure	1707.20 m asl
iv.	Width, height of orifice	9 m x 4 m

(F). Connecting Tunnel

i.	Structure	Connecting channel
ii.	Height	3 m
iii.	Width	4.5
iv.	length	296.15 m
v.	Invert level	1707.20 m asl

(G). Sand Trap

i.	Location	Right bank , 200 m downstream of weir
ii.	No. of Chambers	Double chamber
iii.	Working length	68 m
iv.	Working width (single chamber)	17.9 m
v.	Working depth	6.75 m
vi.	Total Width	17.9 m
vii.	Total Length	90 m

(H). Headrace tunnel

i.	Internal Height	4.3 m
ii.	Internal Width /radius	2.15 m
iii.	Cross Sectional area	15.73 m ²
iv.	Total Length	12,116 m

(I). Surge Tank (Shaft Type)

i.	Internal Diameter	9 m
ii.	Cross Sectional area	63.59 m ²
iii.	Height	70 m

(J). Pressure Shaft

i.	Internal Diameter	3 m
ii.	Cross Sectional area	7.069 m ²
iii.	length	236 m

(K). Penstock Tunnel

i.	Internal Diameter	2.5 m
ii.	Cross Sectional area	4.91 m ²
iii.	Length	776 m

(L). Tailrace

i.	Type	Box channel
ii.	Width	4 m
iii.	Height	3 m
iv.	Length	104.86 m

(M). Plant Characteristics

i.	Generation Voltage	11 kV
ii.	Frequency	50Hz
iii.	Power Factor	0.85
iv.	Automatic Generation Control	
v.	Ramping Rate	
vi.	Time required to Synchronize to Grid and loading the Complex full load.	

SCHEDULE – II

The Total Installed Gross Capacity (MW), De-Rated Capacity at Reference Site Conditions (MW), Auxiliary Consumption (MW) and the Net Capacity at Reference Site Conditions (MW) of the Generation Facility of Licensee are given in this Schedule

SCHEDULE-II

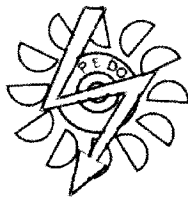
1)	Total Installed Gross Capacity of the Generation Facility (3x23 MW Pelton Turbines)	69.00 MW
2)	Derated Capacity of the Plant	69.00 MW
3)	Total Auxiliary Consumption of the Generation Facility at Reference Site Conditions	0.69 MW
4)	Net Capacity of the Generation Facility at Reference Site Conditions	68.31 MW
5)	Mean Annual Energy of the Generation Facility	303 GWh

Note:

All the above figures are indicative as provided by the Licensee. The Net Capacity/Energy available to Power Purchaser for dispatch will be determined through procedure(s) contained in the Energy Purchase Agreement or any other applicable Document(s).

**PAKHTUNKHWA ENERGY DEVELOPMENT
ORGANIZATION
(PEDO)**

GOVERNMENT OF KHYBER PAKHTUNKHWA



**Development Activities in
Hydro Power Sector of
Khyber Pakhtunkhwa**

November 2019

CONTENTS

1. Introduction

- i. Objectives of the Organization
- ii. Role of PEDO
- iii. PEDO Organization
- iv. Achievements by PEDO

2. PEDO Projects

- Project under Feasibilities Studies
- Project with Completed Feasibility Studies
- Hydropower Projects under Construction
- Solar and other under Construction Project
- Recently Completed Projects

➤ **KHYBER PAKHTUNKHWA HYDEL DEVELOPMENT ORGANIZATION (PEDO)**

1. INTRODUCTION

Khyber Pakhtunkhwa; Province of Pakistan is blessed with huge hydropower potential. This potential remained focus of interest to private investors and international funding agencies. Most of the hydel projects of Pakistan including Tarbela and Warsak hydropower stations are located in KP.

Pakhtunkhwa Energy Development Organization (PEDO), since its inception in 1986, has been instrumental in identifying and exploiting hydel potential in Khyber Pakhtunkhwa. The organization is under the administrative control of Energy and Power Department of Provincial Government and is governed by the Board of Directors. PEDO has so far identified a number of promising hydel potential sites of more than 6000 MW capacity, which can be developed in a systematic manner either through Public sector or Private sector.

i. Objectives of the Organization

- Prepare comprehensive plan for development of the power and energy resources of the province.
- Frame schemes related to Generation, Transmission and Distribution of power, construction, maintenance and operation of powerhouses.
- Advisory body for the Government of KP in power sector matters regarding hydropower development.
- Conducting feasibility studies, surveys of hydel potential sites etc.
- Implementation of Provincial Hydel Power Policy to promote private sector investment in generation, transmission and distribution of power.

ii. Role of PEDO

The Provincial Government has entrusted a dynamic role to PEDO, which mainly oriented towards private sponsors participation in power sector projects besides developing projects in public sector. PEDO has established a dedicated Directorate to provide one window facility to private sponsors.

iii. PEDO Organization

A Board of Directors comprising Eleven (11) members under the chairmanship governs affairs of PEDO. Following are the members of the PEDO Board of Directors as of to date followed by organizational structure of the PEDO on the next page.

Chairman

Nisar Muhammad

Members include

- | | | | |
|-----|------------------------------|-----|---------------------------|
| 1- | CEO PESCO | 2- | Abdullah Shah |
| 3- | Abdul Siddique | 4- | Faiz Muhammad |
| 5- | Arbab Khudad | 6- | Syed Mussawar Shah |
| 7- | Hassan Nasir | 8- | Secretary Energy & Power |
| 9- | Secretary Finance Department | 10- | Secretary Home Department |
| 11- | Chief Executive Officer PEDO | | |

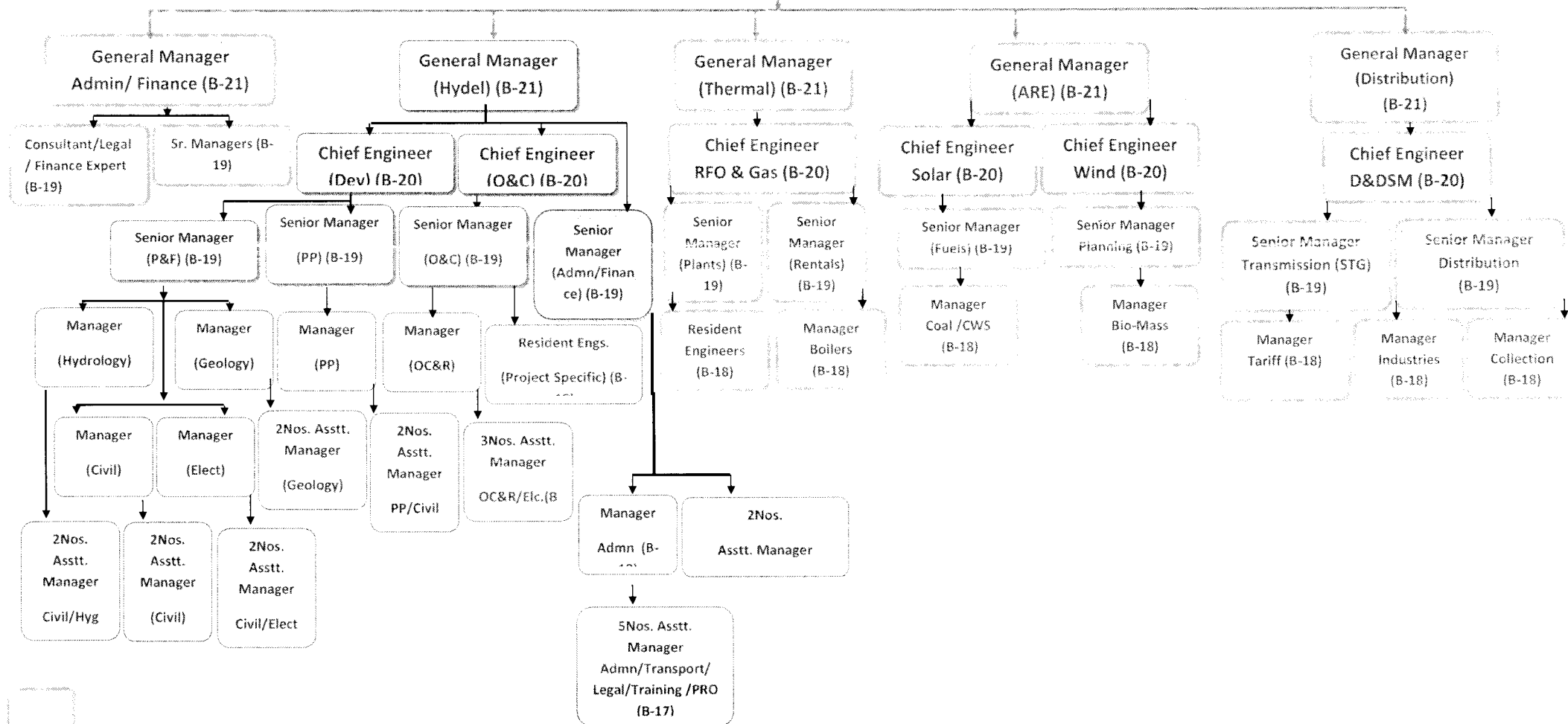


PEDO ORGANOGRAM

PEDO BOARD OF DIRECTORS



CHIEF EXECUTIVE OFFICER (CEO) (MP-1/Market Based Package)



New Creations

Existing Posts

Note: I. Organogram is showing posts up to Asstt. Manager only. II. The PMUs/PDs under independent PC-I/PC-II will fall under respective General Managers. III. The existing posts of Director Finance/Admn will continue as Sr. Manager Finance/Admn for the Hydel Wing of PEDD. IV. The Existing Ministerial Staff of the Hydel Wing of PEDD will also continue with same nomenclature. V. The grades has been prepared according to the hierarchy of Posts. VI. Supporting staff with the new GMs is shown in the Budget Working Paper.

iv. Achievements by PEDO

PEDO, with the assistance of GTZ (German Agency for Technical Cooperation), has compiled a Master Plan for rural electrification in the Northern mountainous areas of KP with particular emphasis on those areas which were not connected to the National Grid System. The Master Plan entails a total potential of more than 6000 MW that has been identified for public and private sector development. The hydropower potential sites are mainly located in the Northern districts of K.P i.e. Chitral, Dir, Swat, Indus Kohistan and Mansehra.

2. PEDO PROJECTS

As tabulated, following are PEDO's projects at various stages.

Projects under Feasibility Studies

S/No	Name of Project	District	Capacity (MW)
1	Gabral Kalam HPP	Swat	88
2	Kari Muskhur HPP	Chitral	491
3	Torecamp- Goduber HPP	Chitral	409
4	356 MHPPs	All Districts of KPK	34.74
5	Access to Clean Energy Canal (10 MHPPs)	Charsadda / Mardan	81 KW

Projects with Completed Feasibility

S/No	Name of Project	District	Potential (MW)
1	Patrak-Shringal HPP	Dir	22.0
2	Nandihar HPP	Batagram	12.3
3	Arkari Gol HPP	Chitral	99.0
4	Istaro Boni HPP	Chitral	72.0
5	Mujigram-Shaghore HPP	Chitral	64.3
6	Naran Dam HPP	Mansehra	188.0
7	Balakot HPP	Mansehra	300.0
8	Sharmai HPP	Dir	150.0
9	Shushgai HPP	Chitral	144.0
10	Shogosin HPP	Chitral	132.0
11	Gahrait-Swir Lasht HPP	Chitral	377.0
12	Toren More Kari HPP	Chitral	350.0
13	Laspur Marigram HPP	Chitral	230.0

S/No	Name of Project	District	Potential (MW)
14	Barikot Patrak HPP	Dir	47.0
15	ShigoKach HPP	Dir	102.0
16	Ghor Band HPP	Shangla	20.8
17	Batakundi HPP	Mansehra	96.0
18	Jameshill More Lasht	Chitral	260.0

Under Construction Hydropower Projects

S/No	Name of Project	District	Capacity (MW)
1	Lawi HPP	Chitral	69
2	Kalkot- Barikot HPP	Swat	47
3	Ptrak- Sheringal HPP	Dir	22
4	Koto HPP	Dir	40.8
5	Karora HPP	Shangla	11.8
6	Jabori HPP	Mansehra	10.2
7	Balakot HPP	Mansehra	300
8	Gorkin-Matilthan HPP	Swat	84

Solar and Other Under Construction Projects

S/No	Project Name	Capacity
1	Electrification of 100 Villages through Solar Alternate Energy, Phase-I	300 Watt each (2900 Solar Units)
2	Solarization of Chief Minister's Secretariat/Chief Minister's House	400 KWatt (Estimated)
3	Solarization of Civil Secretariat (Remaining Departments of Civil Secretariat)	400 KWatt (Estimated)
	Solarization Schools & Health Facilities	600 Watt per Class
5	Solar Electrification of 4000 Masajid in Khyber Pakhtunkhwa	2.6 KWatt (2000 Masajid)
		1.6 KWatt (2000 Masajid)
6	Solar Electrification of 440 in PK-10 & PK-11 in District Peshawar.	2.7 KWatt each (440 Masajid)
7	Electrification of Un-Electrified Villages through Solar/Alternate Energy, Phase-II (Additional 1000 SHS)	200 Watt each (1000 Solar Units)

S/No	Project Name	Capacity
8	Solarization of Administration Headquarters Offices in Charsadda (Feasibility)	N/A
9	356-Mini Micro HPP	34.74
10	Access to Clean Energy (Streams)	37.41
11	Access to Clean Energy (Canals)	15.72

Recently Completed Projects

S/No	Project Name	MW
1	Ranolia HPP Dubair District Kohistan	17
2	Daral Khwar Hydropower Project	36.6MW
3	Machai HPP	2.6
4	Electrification of Un-Electrified Villages through Solar/Alternate Energy, Phase-II.	200 Watt each (2750 Solar Units)



LAWI HYDROPOWER PROJECT



Sarhad Hydel Development Organization (SHYDO), Govt. of Khyber Pakhtunkhwa, Peshawar.

JOINT VENTURE OF



Associated Consulting Engineers - ACE (Pvt.) Ltd.



Engineering General Consultants - EGC (Pvt.) Ltd.



Technical Engineering And Management - TEAM Consultants

PROJECT OFFICE:

House No. 180, Street-06, Sector J-1

Phase - II, Hayatabad Peshawar.

Ph. No. 091-5811182

Fax. No. 091-5811183

Mr. Bashir Ahmad

Project Director

LAWI Hydropower Project

SHYDO, Peshawar

Ref. No. LE/100-02/12/10

Date: 18-10-2012

Subject: Review of Feasibility Report (Draft) for Lawi Hydropower Project

Dear Sir,

Please find enclosed herewith 02 No. copies of above mentioned report for your kind review and comments, if any.

According to contract agreement and the scope of work mentioned therein, we were provided the Feasibility Study Report of Lawi Hydropower Project (69 MW) for review and comments. Accordingly we have gone through the document carefully and diligently in which our experts in different fields took part and they have put forward their views by going through the report. It has been found that a lot of hard work has been put in by WAPDA, especially in the fields of Layouts, Geology and Geotechnical Studies, Seismic Evaluation and Economic and Financial Analysis. However, there are certain areas where improvements are desirable which we have discussed in the enclosed Review Report.

Our main observations are as follows:

1. Although storage for 4-hour peaking has been mentioned in the Feasibility Report, yet only 2-hour peaking has been suggested by daily emptying and refilling the tunnel which is not desirable for safety reasons. On the other hand, we are also not in favor of providing storage space by raising the weir height which would otherwise entail environmental impacts including relocation of people.
2. The weir has been located in a narrow valley, obviously to reduce cost. However, at the proposed location, open space is not available for the construction of desander, and as such an underground desander has been proposed. Since the cost of underground desander would be much higher, an investigation is required to explore the possibility of shifting the weir to a place such that the valley opens up some distance downstream of the weir where a surface type desander can be constructed.
3. Provision of a surge tank seems desirable to augment the safety factor. However the degree on necessity of a surge tank may be studied further during detailed design.



Design Office: 3rd Floor, 36 - Civic Center, M- Block, Model Town Extension, Lahore, Pakistan

Phone: +92 42 352 036 54-55

Fax: +92 42 352 012 56

Email: ace3hpp@yahoo.com



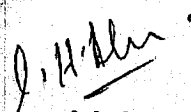


4. The powerhouse location as proposed is such that it partly rests on alluvium and partly on rock. Further study is required to found the powerhouse on uniform base, preferably on rock so as to avoid differential settlement.

Detailed comments are contained in the Review Report.



Assuring you of our best professional services at all times,

Yours faithfully,

For  **Muhammad Aslam Bhatti**
Project Manager / Team Leader

Please Review

File

LAWI HYDRO POWER PROJECT				
Section	Action	Info	Copy	Initial
PM/TL				
DPM	✓			
OM/ Admin	✓			
Proj Acc				
Answer				
File				

Copy to:

1. Project Coordinator, Lawi HPP, ACE – Lahore.
2. Project file.

— *enclosure as above*

Feasibility Review Report (Final)
Lawi Hydropower Project
(October, 2012)

TABLE OF CONTENTS

Section #	Description	Page
-	Introduction	1
1.	Surveying and Mapping	3
2.	Hydrology and Sedimentation	4
3.	Engineering Geology and Geotechnical	6
4.	Seismic Hazard Evaluation	13
5.	Project Alternatives and Optimization	14
6.	Hydraulic Structures	16
7.	Hydropower Engineering	18
8.	Structural Analysis	20
9.	Electro-Mechanical Equipment	21
10.	Environment	27
11.	Construction Planning	28
12.	Cost Estimate	29
13.	Financial and Economic Analysis	30

INTRODUCTION

INTRODUCTION

General

Lawi Hydropower Project is located about 40 Km South of Chitral City. Chitral City is northern most district of Khyber Pakhtoonkhwa Province. Lawi Hydropower Project is of installed capacity of 69 MW. Its weir is located on Shishi river which is a tributary of Chitral river. It joins Chitral river on its left bank. About 1.3 Km upstream of confluence of Shishi river and Chitral river the powerhouse of Lawi Hydropower Project is located.

The gross head of Lawi Hydropower Project is 413 m and a design discharge of 20 m³/s is to generate 303 GWh. A low head concrete weir is proposed on Shishi river near Lao Nassar village to divert water through an intake structure. The water from intake structure is directed through a connecting tunnel to sedimentation ponds. The sedimentation ponds are located underground as open space near the intake is not available. After the sedimentation ponds the clean water is directed to low pressure tunnel which is 11.3 Km long and passes through the hill located on the right bank of Shishi river. At the downstream end there is a surge chamber followed by a long shaft, the upper part of which is concrete lined while the lower part is steel lined. The vertical shaft is 338 m long and is of 3 m diameter. Then there is horizontal pressure tunnel which is steel lined and is 684 m long. At the powerhouse the tunnel feeds three penstocks connected to three pelton turbines. The releases from the powerhouse will be carried to Chitral river through a concrete lined tailrace canal.

The feasibility report is well written and consists of detailed study especially in the fields of environment, geology and geotechnical, hydropower and economic and power analysis.

In accordance with the contract, this report was provided to ACE and Partners for review and comments.

The detailed comments follow this introduction, however, some comments which have a major bearing on the Project are stated below:

- It has been noted that the proposed 4 hour peaking is not possible with the present set up of design. There is no storage upstream of the weir. If tunnel storage is used, that is sufficient only for 2 hour peaking operation. Also frequent emptying and refilling of tunnel is not desirable from safety considerations. To cater for peaking the weir height has to be increased to create sufficient storage to provide for full 4 hour peaking operation, however this raising is also not desirable as it will affect population whose relocation will become necessary. If above mentioned two steps are not acceptable, then the Project should be declared as a non-peaking Project.
- The layout plans need to be studied in conjunction with other existing powerhouses and those under construction between the weir and the confluence of Shishi river with Chitral river. The construction of Lawi Hydropower Project will starve the downstream powerhouses even though they are of small sizes.

- The vertical pressure shaft after the surge chamber is of 338 m height. Its top 238 m height is concrete lined whose thickness at the base is only 0.45 m which prima facie, seems inadequate. At the top of the shaft this thickness can be retained but it should gradually increase as it goes down.
- Since gauge data is not available at the weir site and powerhouse site, tail water levels have to be calculated using cross-sections and discharges both at weir site and powerhouse site.
- Surface powerhouse is proposed near the confluence of left nullah of Chitral River about 1.3 Km upstream of Shishi-Chitral Rivers junction. It has been described to found the powerhouse building partially on alluvium and partially on rock. Due to heavy dead, live and moving loads, differential settlement is apprehended.
- There are projects which are similar to Lawi Hydropower Scheme where pelton wheels are prescribed but unlike Lawi Project no surge tank is provided. There is need to further study the issue to establish the necessity of a surge tank.

The detailed comments follow hereafter:

SECTION

1

SURVEYING AND MAPPING

SECTION – 1

SURVEYING AND MAPPING

5.5 Details of Topographic Survey

Under this section, toposurvey is said to have been carried out at 1:2000 and 1:500 scales with 5 m and 2 m contour intervals but in WAPDA Report no map of 2 m contour interval has been included. All the maps show 5 m contour interval which is too large to show details of ground variations in area of important structures i.e. weir and powerhouse. It may be mentioned that the weir crest itself is only 5 m high above the natural ground level.

HYDROLOGY AND SEDIMENTATION

SECTION – 2

HYDROLOGY AND SEDIMENTATION

Feasibility Report addressing the Hydrology and Sedimentation study of the Lawi HPP contains two sections, i.e. Hydrology and Sediment Transport Studies.

Hydrology Section covers the catchment description, climatology of the watershed, flow study and Flood study for the weir site.

Sediment Transport Study describes the available data, bed material, assessment of bed load, suspended load, total sediment load for the weir site and expected life of the Lawi reservoir.

Study carried out so far, contains the following shortcoming which need to be addressed accordingly.

- (1) Page S-1, 'NWFP' wherever used in the report may be replaced with 'KPK'.
- (2) Page 3-1, 2nd last para, lowest level of Shishi Valley 1663 m does not match with that given in the main report (1661 m).
- (3) Page 3-1, elevations given in 2nd para are not consistent with first para.
- (4) Page 3-2, Fig 3.1, Shishi river is wrongly pointed out with the arrow.
- (5) Climatological data used for the analysis is older (up to 2001), latest data needs to be incorporated, say up to 2010.
- (6) Page 3-9, Fig 3.10, Chitral mean monthly rainfalls are wrongly labeled with Drosh.
- (7) Page 3-11, Table 3.3, one column for 'data years' needs to be added.
- (8) Page 3-12, Fig 3.13, locations for Climatological stations and staff gauge stations are wrongly shown / placed.
- (9) Page 3-14, Fig 3.14, label of y-axis orientation needs correction.
- (10) In comparison with Fig 3.17 & 3.18, coefficient of determination could be further reduced by using correlation between mean monthly flows instead of daily flows. Hence mean monthly regression model is recommended for the assessment of monthly flows at weir site.
- (11) Legend is missing in Fig 3-20.
- (12) Table 3.6, Mean annual flow in cumecs is missing.
- (13) Flow data was generated up to 2006. Updating is needed.
- (14) In the flow study, Low Flow Analysis is missing.
- (15) Page 3-38, 3.6.3, first line requires re-writing.
- (16) The data of Kalam was used to generate flow data at Shishi gauging site. Any adjustment for different hydro-meteorological characteristics?
- (17) Page 3-40, while estimating flood data at Shishi from Chitral data, value of n was computed as 0.95 which was reduced to 0.5 saying it will produce safer peak discharge. Hence, flood magnitudes computed by frequency analysis are underestimated.
- (18) Page 3-42, Fig 3.54, title of the figure is incorrectly written. It is not rainfall data. It is flood data.
- (19) In Table 3.9, Watershed area of Shishi at Drosh is incorrectly reported as 3177 km² and hence all calculations in the respective row require revision.

- (20) Fig 3.59, only show flood magnitudes up to 10,000 years.
- (21) In Table 3.11, a column for data years needs to be added.
- (22) As long term flood data is not available at Shishi gauging station, floods needs to be estimated using rainfall data.
- (23) For sediment studies, data of Chitral gauging station was used up to 2002. Requires updating.
- (24) For the assessment of bed load at the weir site, observed bed load rating curve of Utror along Kalam river was used. It is unlikely that both sites have similar longitudinal slopes, bed armoring layer, bed material and river bed width.
- (25) Computed bed load for the weir site (83.7 Tons) looks on the lower side. Some standard guide lines say 'Modified Einstein Guide lines' for the assessment of bed load needs to be followed.
- (26) Page 4-10, Fig 4.9, label on y-axis should have been 'bed load' instead of 'suspended load'.
- (27) Page 4-15, 2nd para, last line, unit of total sediment load of 158,254 AF is actually Tons.
- (28) Total sediment load is mentioned as 158,254 Tons, whereas, suspended and bed loads as 154005, 83.6 Tons, respectively. Sum doesn't come equal to the total sediment load.
- (29) Title of Fig 4.13 should be total sediment load and not 'suspended load'.
- (30) Title of Fig 4.14 is likewise incorrect.
- (31) Computed trap efficiency of the reservoir for first year (69.6%) is too high. It should be around 22%.
- (32) The computed life of the reservoir without any flushing option is reported as 50 years, which looks too high. Trap efficiency becomes zero from 12th year (Table 4.11), but calculations carried on upto 50 years. Life of the reservoir without any flushing option needs re-calculations.

SECTION

3

**ENGINEERING GEOLOGY AND
GEOTECHNICAL**

SECTION – 3 ENGINEERING GEOLOGY / GEOTECHNICAL

REVIEW COMMENTS

A Site visit was conducted on 16 July, 2012 by Project Manager, Senior Engineers, Geologists and Hydropower Experts of Consultants JV. Mr. Bashir Ahmad, Project Director, SHYDO accompanied the team to show the site and to make the team members familiar with the Project. A second visit was performed on 18th and 20th September, 2012 by the Sr. Engineers, Geologists and experts of various disciplines of Consultants to see in detail the rock conditions at weir site and especially at powerhouse location. On the basis of information gained and our review of the Feasibility Report, the following comments are made:

6.3.2 Weir Site and Intake

1. On Page 6-9, it is stated that Rhyolite is the dominating rock unit on right and left banks for abutting the weir, whereas rock unit shown on geological maps (DWG Nos. 6.01 and 6.21) is Gawuch Formation consisting of green colour calcareous phyllites with occasional bands of schists followed by limestone intruded by diorite, granodiorite and granite. No rhyolite is shown on these maps. Site visit report confirm the presence of rhyolite with other soft materials as given in the Feasibility Report.
2. Eight cross-section lines across the Shishi nullah are shown in DWG 6-02. Section No. 6.6 is the selected one wherein weir structure and flushing gates are shown (DWG 6-11). Contrary to the above statement in this section and in some other sections, rock is exposed at the right abutment only whereas left abutment falls over alluvium (ABGM) of Lao Nassar Nullah. The same statement has been repeated in the last paragraphs of page 6-9 where rock is stated to be exposed at about 55 m from the Shishi River on the left bank with stable slope which is not proved by any drawing.
3. Cut slopes in rock and alluvium shown in DWG 6-11 and DWG 6-45 do not tally with each other.
4. Transverse sections in DWGs S-002 and 6-47 show NSL as 1670 masl near left abutment. Longitudinal sections in DWG S-002 and Section B-B in DWG 6-47 have been drawn at the centre of the weir where NSL is 1661. If a similar longitudinal section is drawn close to the left abutment, it will show 14 m deep cut all along the section indicating requirement of proper cut slope during construction. Therefore, a few more such sections are required to be developed using new detailed topo survey to estimate the quantities of cut and backfill material.
5. Shishi fault is running mostly along the right bank of weir site, intake and reservoir. The fault is neither shown on the geologic map (DWG 6-02) nor on Plots of Joints (DWG 6-03). Layout plan of weir, intake and sedimentation ponds are drawn at a larger scale on DWG 9-1. Plotting of Shishi fault on this drawing could clear the exact location of the fault viz-a-viz the structures.
6. Locations of three boreholes marked on toposheet No. 2 of Topographic Survey Map prepared by SAK Consultants do not tally with coordinates given in Table 6.4.1.

6.3.4 Headrace Tunnel

About 80% of the headrace tunnel is proposed to pass through Lawi Formation (DWG 6-21 & 6-22) consisting of thinly laminated phyllites and schist with some marble and metadiorites/granodiorites. On the western side of the alignment rocks of Kesu-Boni-Zom Pluton (Kbp) consisting of foliated diorite and granodiorite exist. The Kbp rocks are less affected by the faults and are of better quality than Lawi Formation. Both types of rocks need to be checked thoroughly and if possible a major part of headrace tunnel could be shifted towards north. Locations of sand trap and intake cannot be changed until and unless they are studied during design stage.

6.3.7 Powerhouse

1. Under Section 6.3.7.1, it is stated that powerhouse will be located mainly on granodiorite rock and partially on overburden. The related DWG Nos. 6-33 to 6-42 also support this statement. The powerhouse should be located on uniform foundation material to avoid differential settlement.
2. While plotting the powerhouse layout on the above drawings, drill hole data has not been used. For example, borehole BHP-3 drilled at the right corner of the structure is not shown. This hole indicates ABGM upto 24 m depth showing bedrock at El. 1238 whereas powerhouse foundation is at El. 1244 that is 6 m above.
3. Coordinates of BHP-1 do not tally with the location of borehole shown on the contour plan of powerhouse prepared by SAK Consultants. This creates confusion about the foundation conditions under the structures.
4. With the help of surface geology and borehole data, bedrock profile at the corner and base of the powerhouse need to be developed. Projection of powerhouse in DWG 6-37 A (Section 3-3) gives wrong impression of foundation rock.
5. In DWG 6-48 and 6-50, side slopes of the excavation pit are shown vertical upto 27 m depth whereas major joints and foliation planes dip at 70° to vertical towards and opposite to the pit. The cut slope needs to be kept gentle to minimize generation of slides and to avoid any mishap during excavation and construction.
6. Upstream and downstream directions are not shown on plan and sections of DWG 6-48. Both plotted sections P1-P1 and P2-P2 are in opposite direction to the section lines shown on plan.

6.4 Results of Field Investigations and Laboratory Testing

6.4.1 Core Drilling

As stated under this section, the borehole logs are presented in Appendix-C but this Appendix-C has not been supplied. It is believed that standard logs are available with SHYDO / WAPDA. These logs are required to curtail additional drilling programme. However, our comments on the data supplied to us are as below:

1. Brief Borehole logs are given in Tables 6.4.2, 6.4.3, 6.4.4 and Table 6.4.7 where only brief results of logs scattered over 4 different tables are presented.
 - o For Water Pressure Tests (WPT) generally 5 readings under different pressures are taken. Depth-wise or otherwise, rock conditions vary from place to place. Therefore, flow patterns (Laminar, turbulent dilation etc.) are not same everywhere. Only maximum values are given in Table 6.4.3 which may not be representative for those rock columns where tests were performed and consequently their use may be misleading.
2. Following important information which is required depth-wise is missing.
 - a. Percentage core recovery for each run is not given.
 - b. Run-wise RQD is necessary to assess degree of fracturing / jointing in any particular zone. In Table 6.4.7, average values for full depths are given which cannot be used in design of structures for any particular depth i.e. tunnels, powerhouse, shaft etc.
 - c. Type of drilling fluid i.e. clean water or mud. This information is required to assess rock condition (collapses during drilling).
 - d. Depth of weathering. This information is required to plan excavation for cut slopes and to estimate support system in underground excavations.

6.4.2 Surface Geological Mapping

The scale used for the geological mapping of project components is 1:2000. Weir site and intake area are very close to Shishi fault and have steep slopes towards the valley. To depict all the details of structural features and zones of weakness this scale is rather small. The reasonable scale for mapping would be 1:500 or 1:1000 with contour interval of 2 m.

6.4.3 Borrow Area Investigations

Very few samples of fine and coarse concrete aggregates were collected from nullah beds and fans at the foot of the hills. These samples were tested in WAPDA laboratory CMTL Lahore. We note that detailed exploration has not been carried out to establish the extent of different types of materials. Quite a number of test pits will be required for collection of samples for fine and coarse aggregates. The report conceives that sufficient material is available to meet the construction requirement of the Project. We have to select the areas on the basis of laboratory test results.

6.4.4 Laboratory Tests

Appendix C-4 containing CMTL Laboratory test results on concrete, drill core and borrow area samples, is missing in the report. Brief results which are given in Table 6.4.6 are not very useful. Original CMTL report is required to evaluate the results for review and further use in the design.

6.5 GEOTECHNICAL DESIGN

6.5.1 Weir Site

6.5.1.3 Foundation Condition

For the left abutment of weir, it is stated that first 3 meter depth comprises overburden below which rock is highly weathered, foliated and closely jointed rhyolite. The selected section No. 6-6 on DWG 6-11 does not show any rock. Other sections also show no rock at the left abutment as already commented above in Section 6.3.2.

6.5.1.9 (a) Design of Cut Slope

It is stated that "Weir Structure consists of 6 m height, 7 m length of crest body with 30 m length of upstream floor. This is entirely different from description of weir given under Section 9.4.2 and shown on the drawings 9.3, 9.4 and S-002.

6.5.1.9 (b) Geotechnical Investigations

Three holes, one on the right bank, one on the left bank and one in the river bed were drilled. These holes are in the reservoir about 50 m to 70 m upstream of weir axis and intake. New drilling is required at the weir site to confirm the subsurface foundation material and its characteristics.

6.5.2 Design of Tunnels, Shaft and Powerhouse Complex

6.5.2.2 Field Investigation Data Evaluation – Geological Mapping

Geological mapping for the weir and powerhouse areas was carried out at 1:1000 scale but is shown at a scale of 1:4000 in DWG 6.02 and 6.33. On these maps, everything is shown except location of Shishi fault and Karakoram Thrust which are very important. However, the faults are shown at a very small scale (1:60000) on GSP, Sheet in DWG 6.01 which does not serve the purpose. Re-mapping of the weir site area especially for the fault zones will be required on a larger scale.

6.5.5 Rose Diagram Study (Weir, Tunnels and Powerhouse)

Eleven (11) joints were measured on right bank of weir site covering a stretch of about 200 m downstream and 200 m upstream of the structure. Data of all these joints have been used for preparing the rose diagram. For cut slope design only those joints which are at or close to the structure are valid. Rose diagram of all the joints give a general idea of the main direction and dip of the discontinuities and not for any particular place. Same is the case for powerhouse and other structures. Twenty nine (29) joint sets have been used for plotting the rose diagram of powerhouse area (Fig 6.5.4.15 and 6.5.4.16). This may not serve the purpose except getting a general idea. A new exercise is required to exclusively deal with the structure areas only.

6.5.10.1 Rock Classification (Application)

1. The areas occupied by the intake tunnel and sand trap are located on the right bank of Shishi river and right limb of an anticline in the close vicinity of Shishi fault. The rocks consisting mainly of rhyolite, are highly deformed with pronounced fracturing and jointing, shears and structural discontinuities categorizing the rock as "Poor Rock" and fall in the

Rock Class – E & F. Under such poor rock conditions, horse-shoe section of the tunnel is proposed in Table 6.5.4.2. For poor to very poor rock condition a circular section is safest for support as suggested by Corps of Engineers in Manual No. EM 1110-2-2901 dated 15-09-1978 "Tunnel and Shafts in Rock". Therefore for the intake tunnel (70 m) and next headrace tunnel (1000 m), a circular section is recommended instead of horse-shoe section.

2. For the remaining 10,300 m length of headrace tunnel if TBM is decided for construction then this part will also be circular otherwise any of the two shapes circular / horse shoe could be adopted on economical basis.

6.5.11 Excavation Methods

1. Two methods for underground excavation TBM (using Tunnel Boring Machine) and NATM (New Austrian Tunneling Method) have been discussed thoroughly. Their advantages and disadvantages are given in Tables 6.5.9.1 and 6.5.9.2. Use of both methods within and outside Pakistan has also been mentioned in the Report.
2. Both methods have their advantages and disadvantages. If NATM is cheaper than TBM, it takes more time in its operation for excavation and for providing supports and concreting which compensates the high of cost TBM procurement.
3. Because of remote area, transportation problems are always there especially during winter. In case of breakdown of machinery, import / procurement of spare parts from within Pakistan or from foreign country will be a problem. Therefore, NATM for excavation of tunnels and shafts is recommended. NATM method has been used for Lowari Tunnel and is being used at Golan Gol Hydropower Project.

6.5.21 Design of Cut Slopes for Surface Powerhouse

6.5.21.6 Analysis of Cut Slopes

Under this section, it is mentioned that rock has to be cut to accommodate the powerhouse entirely on rock foundation. In earlier chapters and in the drawings powerhouse is shown on both rock and alluvium. It is not clear which statement is correct, therefore, the conflict needs to be resolved.

PROPOSED INVESTIGATIONS

Under this Section of the Feasibility Report, recommendations for further investigations leading to Design Stage have been briefly described. These include drilling, geological mapping, scan line survey, excavation of 3 exploratory adits, performance of rock mechanics tests in the adits, rock pull out tests, installation of Strong Motion Accelerographs, Seismic Neotectonic Studies. The proposed investigations are definitely required. However, we would like to add some more drilling as tabulated below:

DESIGN STAGE INVESTIGATIONS

Location	No. of Holes	Estimated Drilling (m)	Purpose
1. DRILLING			
Weir	3	90	To investigate the depth of bedrock and characteristics of the nullah alluvium. Previous holes are in the reservoir.
Tunnel T0 – T1	1	100	To determine the rock conditions at the location of inlet. This area is unstable consisting of scree/talus material/fault zone.
Sand Trap T1-T2 and Shishi Fault	2	80	One hole in the gouge zone of Shishi Fault other in the centre of sand trap.
Headrace Tunnel T2-T5 (MKT Zone) (Surge Tank)	2	400	To investigate the type of gouge, contact between solid rock and fault.
	2	140	
Powerhouse	2	80	At both ends of the long axis of the powerhouse.
Tailrace	1	20	To check the thickness of alluvium, hole will be drilled at a short distance from the inlet of the tailrace.
Additional	3	600	To investigate the quality of rock above crown at least at 3 different locations along the tunnel if new alignment towards NW, as suggested is adopted.
2. TEST PITS			
Reservoir and Lao Nissar Nullah	3	6	To investigate quality of coarse aggregate.
	4	12	To investigate quality of fine aggregate.
Terraces and Sand Bars of Chitral River near Powerhouse	8	24	To investigate quality and quantity of coarse and fine aggregates required for concrete.
3. SURFACE SAMPLES			
Valley Slopes, Shishi, Chitral River and other nullah	<ul style="list-style-type: none"> • Quite a number of bolder samples of different rocks will be collected to perform quality and strength tests in the laboratory. Fresh rock samples will be collected from adits and boreholes. • Limestone samples will be collected from available sources (8 to 10 Km upstream of powerhouse) 		

MISCELLANEOUS

1. Geological maps of all the structure areas are shown at 1:4000 scale which is too small to show all the details especially presence of Shishi fault and Karakorum Thrust. A scale of 1:1000 preferably 1:500 with 1 m preferably 0.5 m contour interval should be used for weir, intake and powerhouse areas. Topo-maps used for geological mapping are of reasonable scale. Both Faults should have been easily plotted on these maps along with joints.

2. Appendix-C and Appendix-C.4 containing proper borehole logs and complete laboratory test results have not been received except brief data which is not sufficient for present assignment and later for use in the design. These Appendices should be available with SHYDO, otherwise with WAPDA.
3. Coordinates of boreholes given in Table 6.4.1 mostly do not tally with the locations shown on the topo-maps.
4. On a number of drawings coordinates or grids, roads and other reference points are missing due to which location of any structure on one drawing cannot be confirmed from other drawing neither can be transferred from one drawing to another.
5. On topo-maps prepared by SAK Consultants no nullah names are given.

SEISMIC HAZARD EVALUATION

SECTION - 4

SEISMIC HAZARD EVALUATION

7.2.1.3 Local Tectonic Features

The major faults of the Chitral area which can influence the seismic hazard for Lawi Hydropower Project include Shishi Fault, Main Karakoram Thrust, Reshun Fault and Tirich Mir fault (Figure-7.3). Closest of the site are the Shishi Fault and Main Karakoram Thrust. Shishi fault is parallel to the Main Karakoram Thrust and sense of movement along this fault appears to be of normal faulting and crossing the Shishi river at the location of the intake structure while Main Karakoram Thrust passes very close to the Project and crosses the tunnel alignment near the intake structure as stated in the report.

These faults are not identified in the field nor presented on geology map of weir site (DWG 6-02, 6-03). However they are marked on regional geological map of scale 1: 150,000 (DWG 6-01). Exact identification, mapping and characterization of these faults is required for which additional mapping at a large scale 1:500, 1:1000 is recommended in the area for project structures.

7.4 Historical Earthquake Record

Major historical earthquake record presented in the report shows:

Intensity of IX to X in Taxila	(> 200 Km from project site and near to the MBT)
Intensity of VIII to IX at Attock	(> 200 Km from project site and near to the MBT)
Intensity of VII-VIII in Kunar	(< 100 Km from project site, Kunar is in Afghanistan)

On January 20, 1902, a damaging earthquake was reported in Chitral area. This event was felt as far as in Punjab and Simla. Another earthquake in 1929 has also been reported to cause heavy destruction in Drosh and Chitral. Similarly, another earthquake on February 6, 1939 caused damage at Drosh. The intensities are not assessed in the Report. The data about damages will need to be collected during neotectonic investigations.

7.4.1 Instrumental Earthquake Record

Instrumental data is based on as collected and recorded by regional seismic networks and local networks.

Local network of seismic stations was established at Tarbela dam in 1973 to monitor the microseismic activity around Tarbela. Another microseismic network was established around Islamabad by PAEC in 1976. The earthquake data by these two local networks was collected and included in the regional catalogue (Appendix-D).

The regional networks recorded 3392 earthquakes between 1904 to 2006 having magnitude equal to or greater than 4. The majority of these earthquakes originated from the very active deep Hindukush seismic zone present NW of project site. Another cluster of earthquakes is related to the Indus-Kohistan seismic zone (MMT) present SE of the project site which was involved in 2005 earthquake of Kashmir and Hazara.

Earthquake data for the years after 2005 needs to be obtained and included in the list to establish the seismic zone (low to severe damage) in which the project area is lying.

**PROJECT ALTERNATIVE AND
OPTIMIZATION**

SECTION – 5

PROJECT ALTERNATIVES AND OPTIMIZATION

8.2 Project Alternative Layouts

In discussing all the seven alternatives, role of Shishi Fault and Main Karakoram Thrust (MKT) have been expressed for selecting the location and optimization of the Project components / structures. In support of various statements, seven alternatives are shown on Figures 8.1 to 8.7 but in no figure any fault is shown.

8.3.1 Diversion Dam / Weir

The present studies indicate that the locations of weir and intake are not at reasonable places. Since these locations are affected by Lao Nassar nullah which is a seasonal nullah which brings a lot of debris after every 4 to 5 years during rainy season. A large sediment fan has been formed at the mouth of nullah. The fan provides the foundation for left abutment of weir. The weir axis may have to be relocated.

8.3.3 Headrace Tunnel

As commented earlier under Section 6.3.4, the proposed layout of headrace tunnel is mostly through Lawi Formation. On the northern side of Lawi Formation (JD1) is Kesu-Boni-Zom Pluton (Kbp). The rocks of Kbp formation are more compact, less shattered and less foliated containing negligible phyllites and schists as compared to JD1 Formation. It is recommended that both types of rock should be thoroughly checked again and alignment of headrace tunnel shifted on the northern side as much as possible. From the sand trap, the tunnel can proceed straight westward and then after crossing JD1 formation turn south west through Kbp upto the proposed location of powerhouse. This will bring the tunnel farther away from MKT.

8.3.6 Powerhouse

Surface Powerhouse

Surface powerhouse is proposed near the confluence of a left bank dry nullah of Chitral river about 1.3 Km upstream of Shishi-Chitral junction. In the previous chapters, it is described to found the powerhouse building partially on alluvium and partially on rock. Due to heavy dead, live and concentrated moving loads, differential settlement is apprehended. Therefore, it is recommended to excavate further into the rock toward pressure shaft and keep the foundation on uniform rock only.

Careful study of the joints (Nos. 1, 2, 3, 4, 12, 13, 18) plotted in DWG 6-34 shows that the joints are very steeply dipping ranging from 73° to vertical with strikes NE almost parallel to the pressure tunnel. These joints are mostly in harmony with the MKT. The longer axis of the powerhouse as shown on drawing is in the EW direction. We suggest to keep the longer axis perpendicular to the Main Karakoram Thrust/ pressure tunnel i.e. in the NW direction.

Furthermore, we would recommend to shift the powerhouse to the location of borehole BHP-1 (if the location of borehole marked on the map is correct) keeping the foundation on rock with adjustment of pressure tunnel or further upstream of Chitral river. This will bring the powerhouse farther away from Karakoram Thrust.

General

1. Underground Powerhouse

Along the slopes of the Chitral and Shishi Valleys, major joints are in the form of high angle relief joints with foliations. These joints have the potential of toppling failure and minor slides as is evidenced by big and small boulders which are piled up at the foot of the mountain.

For the surface powerhouse 25 to 27 m deep excavations are to be made which will require proper cut slopes, of the order of 2V:1H. Heavy rock bolting, anchoring and shotcreting will be required to stabilize the excavated face. Even then, toppling failure at higher level due to earthquakes, cannot be ruled out. An underground powerhouse will, of course, be safer than a surface powerhouse although more costly. At Detail Design Stage, comparison of underground and surface powerhouse by more precise analysis would need to be made.

2. Plant Factor

The Project has been designed for 51% plant factor which appears high compared to many recently proposed Hydropower Power Projects. Projects with Plant factors as low as 35% have been found economically and financially viable. Usual method is first to develop a "Flow-Duration" Curve, and then to compare Benefit Cost Ratios of say 30%, 40% and 50% plant factor schemes. A curve is then drawn between Plant Factor and Benefit Cost Ratios, and the most optimum scheme chosen.

SECTION

6

HYDRAULIC STRUCTURE

SECTION – 6

HYDRAULIC STRUCTURES

Volume – I Executive Summary and other Volumes

Para 9.9, page 9-6 Headrace Tunnel

1. In the heading it is written "Free Flow" but in the fifth line it is written pressure tunnel. If it is free flow tunnel then 30 m of head is a dead loss. The evidence elsewhere in the report suggests that the tunnel is pressure tunnel as it should be.

Layout Plan: (Fig 8.1, Project Layout Alternative 1 and Executive Summary, Description of the Project, Page S-1 last para). The layout plans should be studied in conjunction with other existing powerhouses and those under construction between the weir and the confluence of Shishi River with Chitral river. The construction of Lawi Hydropower project will starve the downstream powerhouses even though they are of small sizes.

Volume-II Main Report

P: 8-8 It is mentioned that the Net head for Lawi HPP is 406m whereas this is the average Gross head.

P: 9-3 Overflow Section: Design flood should be of 1000 year return period.

P: 9-3 Overflow Section: Downstream length of the stone apron is not sufficient, it should be longer. Medium stone size is not given which should be determined on the basis of Isbach Chart which is dependent on the velocity.

P: 9-3 Construction Stages of Weir: The flood during construction should be taken on the basis of 10 year return period and not 5 years.

P:9-7 Concrete Lined Pressure Shaft: For a height of shaft (238 m) the lining thickness at the base (0.45m), prima facie, seems inadequate. At the top of the shaft this thickness can be retained but it should gradually increase as we go down.

P: 12-1 (12.1 Mode of Plant Operations): 4 hour peaking is not possible with the present set up of design. There is no storage upstream of the weir. If tunnel storage is used, that is only sufficient for 2 hour peaking. Also frequent emptying and refilling of tunnel is not desirable from safety considerations. To cater for peaking, the weir height has to be increased to create sufficient storage to cater for full 4 hour peaking operation. If there is fear of sedimentation that can be overcome by providing flushing outlets in the main body of the weir. However, a raised weir will create environmental and resettlement problems. Question arises as to whether or not peaking operation is at all necessary.

Drawings: On drawing 1-3 of Volume-III there are certain discrepancies which are as follows:

1. On page 9-7 the height of surge shaft is 70 m while on above drawing it is 80 m.

2. On page 9-7 the height of pressure shaft is $238+100=338$ m while on the drawing it is shown as 332.5 m.
3. On page 9-9 length of tailrace channel is 130 m while on above mentioned drawing it is 120 m.
4. On page 9-8 length of powerhouse is 56 m while in above mentioned drawing it is 40 m.
5. On drawing 6-11 gate size of flushing gate is 4.0 m x 3.0 m while on drawing 6-45 it is 2.5 x 2.0 m.
6. Figure S002: Top of upstream and downstream stone apron should be at NSL

General Comments (Section Drawing 9-2 (Weir Layout Plan) and Drawing 6-44 (Weir Typical Sketch))

Tail water: (Page 8-7, Para 8.4.2.2) since gauge data is not available, tail water levels have to be calculated using cross sections and discharges for both the weir site and the powerhouse site. Rating Curve at the weir site has not been provided.

Dead Storage Level: (Section-4, Sediment Transport Studies) In sediment studies dead storage level has not been indicated.

SECTION

7

HYDROPOWER ENGINEERING

SECTION-7 HYDROPOWER ENGINEERING

The following sections of Feasibility study report were reviewed:

- A. Executive Summary
- B. Section-1 Introduction
- C. Section-8 Project Layout Alternatives and Optimizations
- D. Section-9 Project Preferred Layout
- E. Section-12 Power and Energy Estimations
- F. Section-13 Quantities and Cost Estimates

The review comments / observations are elaborated below:

A. Executive Summary

In the Power & Energy Estimation it is mentioned that Loss of Head due to friction of waterway is calculated as 4.5 m which actually is 14.5 m as found from Section-12:

B. Introduction

1. Under the Project Area part of the Section it is stated that 1200 m long steel penstock of 4 m diameter is proposed which is not right as instead it comprises of 332 m long concrete lined pressure shaft of 3 m diameter and 684 m long steel lined pressure tunnel of 2.5 m dia.
2. In the Salient Features part of this Section the valley width at weir site in Lao Nissar is 170 m which could be lesser i.e. around 100 m.

C. Project Alternatives and Optimizations

1. In the Table 8.2 Comparison of Peaking and Run-Off river Options, with different discharges, total benefits in Mill. Rs. And Total Costs in Mill. US \$ are given, the currency units need to be the same. Also annual costs in Pak. Rupees need to be given to check the calculated Ben. /Cost ratios.
2. In the Table 8.3 Comparison of three alternatives for turbine number of units, It would have been better if cost comparison of three alternative units nos. 2,3 and 4 were also added in this table.
3. In the Optimization of Waterway part of this section, the rates of the items seem outdated as the study is more than 5 years old.

D. Project Preferred Layout

1. The Intake is designed for 20 m³/s discharge which is plant discharge, flushing discharge needed for sand evacuation from sedimentation basin will also be needed, so the Intake need to be re-designed by adding 20% flushing discharge i.e. the revised design discharge for Intake will be 24 m³/s. It also appears from the Report that 20 or 24 m³/s discharge does not include any peaking operation enhancement provision.

2. In the Headrace Tunnel title, it is mentioned as Free Flow tunnel, which instead should be Low Pressure Tunnel as mentioned in other sections of the report.
3. In the Inlet Valve part main data, it is mentioned that Design head is 505 m while net head of the project is 398 m.

E. Power and Energy Estimations

1. The tailwater of Lawi project will outfall in Chitral river for which 5000 years return period flood and water level for that flood is selected, according to which the centerline of turbine is finalized which is at a higher elevation. It is proposed to use 500 years return period flood of Chitral river and gate(s) be installed at the outfall structure which can be closed in case of higher than say 500 years floods in Chitral river. With that selection and arrangement the centerline of turbine can be set at a lower level to gain more head and more regular power & energy generation from this project.
2. The head losses of the project need to be re-calculated for confirmation.

SECTION

8

STRUCTURAL ANALYSIS

SECTION – 8

STRUCTURAL ANALYSIS

Powerhouse

1. Codes and Standards

No mention of the codes for substructure

2. Reinforcing Steel

Preferable to use same grade to minimize mistakes at site.

3. Design Loads

General: Partition and equipment and similar loads are not computed by software. Roof finish loads appear low. 50psf is equivalent to only 4 inches of finishes.

Earthquake load: The response to MCE needs to be shown.

4. Load Combinations

Recent versions of ACI 318 have reduced the live and dead load factors considerably.

5. Computer Model

Usually powerhouse superstructures do not have concrete walls but do have bracing beams. The provision of shear walls in the superstructure appears superfluous making the structure too rigid.

The powerhouse configuration is not clear. Plan and section drawings may help visualize better. Dimensions of the powerhouse are not evident. Sketch 'A' showing beams and columns shows supports not related to beams and columns. In sketch 'B' configuration at the roof is not clear.

Stability Analysis of Weir

Supporting sketches are not available to assess the values.

Retaining walls

1. The base width given does not equal to the sum of heel width, toe width and stem thickness.
2. The stem thickness is too low compared with the height of the wall. Will require excessive reinforcement.

SECTION

9

ELECTRO-MECHANICAL EQUIPMENT

SECTION – 9

ELECTRO-MECHANICAL EQUIPMENT

The main electric installation equipment proposed consist of three vertical shaft synchronous generators, generator switchgear, medium and high voltages bus bars, step up transformers and 132kV out door switchyard. The details of above stated electrical equipment are given below:

- Three vertical shaft generators each of 27.4MVA capacity at generation voltage of 11 kV
- Three Unit-Transformers each of 30MVA capacities with voltage ratio of 11/132kV
- One 3MVA 132/11kV Service Station transformer
- Two No. 500kVA, 11kV Transformers for supply to 0.4kV station bus
- Three unit auxilliary supply Transformers each of 200kVA capacities with voltage ratio of 11/0.4kV
- Three No. 200kVA, 11kV transformers for station auxiliaries
- Two No. 200kVA, 11kV transformers for intake supply
- Control, protection and measuring devices for the Hydropower Plant including 132kV switchyard
- 132kV outdoor switchyard for interconnection of the power plant with outgoing transmission lines
- 132kV double-circuit transmission line having a length of about 50km from Lawi HPP to the proposed 132kV switchyard to Dir grid station at Chuklatan through Lowari Pass

Comments

The following comments are made regarding powerhouse electrical equipment, switchyard, transmission line and interconnection with existing National Grid.

A. Electrical Equipment for Powerhouse

1. Three vertical shaft generators, each of 27.4 MVA (23MW) capacity have been rightly selected relating to vertical shaft Pelton Turbine of 23.728MW capacity.
2. Three step up transformers, each of 30MVA capacity with voltage ratio of 11/132kV have also been correctly proposed.
3. A large size 3MVA, 132/11kV transformer has been proposed for station services and colony requirement. Normally for safe operation of station services transformer is not combined with the colony transformer.
4. The sizes of transformers proposed for intake supply, station auxiliaries and station services have been checked and considered OK for 69MW Powerhouse.
5. The rating and functioning features calculated and prescribed for control, protection and measuring devices have been checked and found workable for the proposed plant of 69MW.

B. Synchronization of Generators

The synchronization of electrical generators have been proposed through 132kV breakers and synchronization equipment. The system is considered workable and practical.

C. Powerhouse Equipment

1. 3-MVA, 132/11kV Service Transformer

Because of 3MVA capacity service transformer for providing power to Power Station, colony and intake service has been proposed to be installed in 132kV switchyards. The placement of this transformer at 132kV switchyard instead of inside in power station will involve extra expenditure.

2. Unit Auxiliary Transformers

Auxiliary transformers of 200kVA, 11/0.4kV capacity have been proposed for power supply to the auxiliaries of respective generating units. The size and type of auxiliary transformers meet the requirements.

3. Medium and Low Voltage Installations

The station services transformer of 132/11kV of 3MVA capacity has been planned to feed 0.4kV bus bar through 500kVA transformers. Further an emergency diesel generator set of 250kVA capacity will also feed the 0.4kV bus to meet emergent requirement. The said arrangements for medium and low voltage supplies is considered reasonable and dependable.

4. DC Power Supply

DC power supply proposed for different functions in powerhouse has been based on a duplicate supply design. The two independent set of 220V battery system, each with separate distribution switchgear will feed the local DC distribution switchgear.

The proposed double battery system would provide power to complete plant control system, i.e. the local control system and DC equipment such as motors for black start purpose. The proposed DC system is considered complete and meets the DC system requirement.

5. Plant Control Unit Control and Alarm System

Plant Control and Alarm System consisting of following elements has been specified for Lawi Power Station:

- i. Plant Control System
- ii. Unit Control System Company of Six Units
- iii. Data Communication System

The above stated computerized control system have been rightly prescribed for successful operation of different sections of power plant.

6. Protection Equipment

Protection equipment comprising modern electronic relays for the protection of main electrical equipment like generators, transformers, transmission lines and 11kV feeders have been rightly proposed.

D. 132kV Outdoor Switchyard

An outdoor 132kV switchyard with 7 bays has been proposed for the Lawi Power Station. This has been checked and studied. Following comments are made:

Switchable Reactors

For the switching in of 132kV lines switchable shunt reactors have been proposed. The size and rating for this equipment require load flow studies and power system planning etc. WAPDA power system planning department may be contacted for detailed studies.

E. 11kV Power to Intake Structures

An overhead 11kV line being controlled at power Station has been proposed to be constructed upto Intake structure for running of pumps etc. Additionally, a 50kVA diesel generator set has also been proposed to meet with emergencies etc.

Transmission Line

The surplus power after meeting the demands of local villages like Drosh and Chitral etc has been planned to be transferred to the point of demand (National Grid). Following four interconnection options have been explored:

- Option – I Connection with 132kV grid station at Jutilasht (Chitral)
- Option – II In / out of Golen Gol – Temergara 132kV (D/C) Transmission line at Lawi and at proposed 132kV grid station at Dir.
- Option – III Interconnection of Lawi HPP at proposed upgraded 132kV Dir grid station at Chukiatan.
- Option – IV Option II plus 132kV transmission line (D/C) upto temergara.

Considering the first two options as not technically viable because of cross flow of power and less reliability, only third and fourth options have been discussed and compared. Finally the third option has been recommended for the interconnection and transfer of surplus power to existing National Network.

Option III includes connection of the Lawi HPP with the proposed 132kV Dir grid station with double circuit transmission lines besides the in / out of double circuit of the Golen Gol HPP transmission line at Lawi grid station and at 132kV proposed Dir grid station. This option has been considered reliable power dispersal scheme over Lowari Pass even if one transmission line collapses due to ice, over loading or slide.

Our comments are that the third option can be further revised and made more economical and reliable. Our proposal is as detailed below:

As the double circuit T/L from Golen Gol to Temergarah is 195km long and passing through Awari Pass heights and other mountainous regions, the adoption of its in / out at Lawi and Dir will cause a lot of problems like over reactance and voltage fluctuations. It is therefore proposed that a double circuit 132kV transmission line from Lawi HPP to Temergarah grid station be constructed. Its length will be 132km as compared to 195km of T/L from Golen Gol HPP. However, switchable shunt reactors may be installed at Lawi HPP for the safe energisation of 132kV transmission line.

Routing

For the routing of D/C 132kV T/L from Lawi to Dir, the existing route of 33kV T/L may be followed. For further routing from Dir to 132kV Temergarah G/S, the route of existing 66kV T/L between Dir and Temergarah can be adopted.

Selection of Conductors and Earthwire

Conductor

The selection of conductor deer (429/100) for higher region and conductor Rail (484/34) for the lower regions is considered best possible selection in consideration of very sever ice loading and strong winds.

Earthwire

Because of additional loading due to snow in the winter, the selection of galvanized steel wire of 95mm, diameter of 10mm in lower height and steel wire of 120mm and 150mm for higher sections through Lowari Pass have rightly been proposed.

Tower Configuration

As much as possible WAPDA's standard configuration shall be used to avoid confusions and field work difficulties. The standard basic bodies and leg extension shall be followed under the prevalent situations. However, the tower configuration would be altered / changed to meet the behavior of conductors and earth wire in different zones under the condition with and without ice.

The above decisions / policy arrived at for the line routing, selection of conductor / earthwire and 132kV towers between Lawi, Dir and Tamergarah grid stations is considered practical and workable in existing mountainous areas.

Tower Erection and Stringing Works

The transport and erection of insulator strings in the present mountainous areas etc will be mostly manual and must be carried out through skilled and experienced linemen etc.

The stringing work will have to be done along several successive sections of tension towers at the same time.

NPP Transmission System Security Planning Criteria

The national power plan states the transmiision system security planning criteria in use for the main transmission system in Pakistan. For the purpose of verifying system design, two different pre-disturbances are defined:

Normal Condition State:

The system has adequate facilities in service to supply all customers.

Emergency Condition State:

The system is subjected to load shedding due to insufficient transmission capacity or unusual load or generator patterns.

According to the normal condition state planning criteria used in NPP, the system should sustain the following disturbances without load interruption and without losing synchronism of generator:

1. A permanent three-phase fault on any primary transmission line (e.g. line, bus section, transformer, circuit breaker) cleared normally (within 5 cycle).
2. Stuck-breaker failure upon line to ground fault on any element, with delayed trip according to the stuck-breaker scheme.
3. Shut down of one pole of an HVDC system
4. Line to ground fault on both circuits of a double circuit tower line, cleared normally.

Transient stability studies for the proposed transmission lines need to be got conducted from concerned department of NTDC.

Power System Characteristics

Transmission Line

The SF6 circuit breakers used for the 132kV system must have a capability of clearing the first zone fault within a time of 60ms or 3 cycles.

Conclusions

Balance power from Lawi HPP shall be transmitted through new 132kV transmission line (D/C) to Dir – Temergarah 132kV transmission line (D/C) at acceptable voltage drop & power losses of 10% and 2.9% respectively.

As such, option III is the preferred choice as it ensures reliable power dispersal at moderate investment. Line routing is suggested along Chitral river valley, crossing the Lowari Pass to Dir. In the Lowari Pass section severe climatic conditions must be expected. Regions with danger of snow slide or even avalanches shall be avoided or shall be crossed in free span. Due to bad and uncompacted soil conditions of the route much effort must be expected for tower foundation. Special foundation methods e.g. piles or internally connected tower feet as well as protective measures against earth and snow slide would be necessary.

Additional loadings from ice, snow and wind on conductors and towers have been recalculated from the available data, from observations and from comparison with lines in similar topography. To make the design easier the line has been split up into three zones presenting zone I with the lowest and zone III with the most severe climatic loads.

Towers are considered as bolted lattice steel constructions with separate footing and shall follow WAPDA's standard configuration as much as possible.

Recommendations

It is recommended to route the line in a way to give due regard to environmental aspects as much as possible and to minimize the impact on arable land.

Fearful tower spotting on base of longitudinal profiles and soil investigation should be carried out prior to detailed calculations of towers and conductor design.

Measures against snow and earth slides should be taken from the beginning of the erection works. Erection and stringing work in the extreme mountainous sections demand experienced contractors having experience in similar areas.

Final design of the line should be carried out on basis of longitudinal profiles, calculations of sag and conductor stresses and geotechnical investigations. Special attention must be given to problematic foundations in mountainous/unstable grounds.

SECTION

10

ENVIRONMENT

SECTION – 10 ENVIRONMENT

General Comments

1. The report is a desk study rather than a proper EIA which has been prepared after delineation of study and Project area and primary data collection.
2. In the entire study area of the EIA has been defined.

Section-Wise Comments

Physical Environment

- a) Base line regarding air, water, noise etc has not been developed. In fact monitoring has not been carried out in the area to develop the base line situation.
- b) In the Section 10.3.3 (Land Acquisition), there is a ambiguity about land requirement as entire land has been shown in Government/Private Section. However, as per standard practice both Government and private land cannot be mixed. In environmental cost section, it has been mentioned that entire land required for the project is private.
- c) Water availability has been defined but the present (before Project) water uses of the area have not been mentioned.

3. Ecological Resources

- a) The ecological zoning of entire Chitral has been mentioned and discussed but the existing different ecological species in the project area have not been mentioned.
- b) Similarly fauna/Avi fauna of Chitral District has been discussed instead of Project/Study area.

4. Socio-Economic

For the primary data collection census survey village profile has not been conducted and only a sample survey has been carried out which is not enough in case of EIA.

5. Environmental Impacts

The impacts on Environment are mostly generalized and are specific to project activities. As the baseline section is updated the impacts should also be updated accordingly.

CONSTRUCTION PLANNING

SECTION – 11

CONSTRUCTION PLANNING

14.8.1.2 Intake Tunnel T0 – T1

1. As proposed in the second para of this section, the tunnel shall be excavated from the sand trap side i.e. one face only. This is possible after excavations for the sand trap have been completed. Adit A-1, shaft or access tunnel will be used during excavation of sand trap. The same access will be used for entry into the tunnel T0-T1 and for removal of muck. This will mean a long approach to the tunnel as compared to the one from the portal on the river side. No reason for not opening the tunnel from the portal side is given. We think it can immediately be started simultaneous with the construction of Weir. Layout of upstream coffer dam can be adjusted accordingly.
2. Total time for 70 m long tunnel has been estimated as 30 days. Experience for the excavation of Adits at Basha Dam and recently at Neelum-Jhelum HPP shows that it may take twice that time by the quickest available drilling and blasting method.

14.8.1.3 Headrace Tunnel T2 to T5

1. Only two faces are proposed to be opened, one from Adit A-1 through sand trap and second at Adit A-2 through surge chamber. Both parts will meet at point T4 located at about middle of the tunnel. One part of tunnel will be 5.8 Km and the other 5.5 Km long.
2. If at all possible, we may consider to make two shafts one at Sherati Gol and other at Lawi Gol and create 4 more faces which will facilitate mucking and construction processes. In this case if work is stopped at one face due to breakdown of machinery or for other reasons, work will continue at other faces and will not hamper the progress.
3. Time required for the construction from sand trap to surge chamber is 46 months for each part of the tunnel. Since both parts are started together, time required for head race tunnel will be about 4 years. This can be reduced to half if more faces are opened and efficient mucking system is employed.
4. The type of mucking system i.e. use of conveyer belts or mucking trolleys is not given in the Report. This will also affect the rate of progress.

14.8.1.8 to 14.8.1.10 Surge Tank Shaft, Pressure Shaft and Pressure Tunnel

Construction period estimated for these structures is on the lower side. Considering difficult approach, excavation and mucking process, the time has to be doubled or increased 1.5 times of that estimated.

SECTION

12

COST ESTIMATE

SECTION – 12

COST ESTIMATE

Quantities and Cost Estimates

The rates of the project components are 5 years old that needs to be reviewed and revised cost estimate based on revisions in the project structures as mentioned here to fore using updated prices need to be prepared.

FINANCIAL AND ECONOMIC ANALYSIS

SECTION – 13

FINANCIAL AND ECONOMIC ANALYSIS

15.1 The approach and methodology of the analysis is acceptable and in line with standard practices acceptable to WAPDA/SHYDO. However, the present analysis has been carried out in year 2006 at price level prevailing then and needs revision and updating considering the following important factors;

1. Huge hike in prices of material as well as in operational costs has occurred over the last six years (almost 110% increase in prices).
2. About 55% increase in currency exchange rate has been observed over the same period. In the feasibility Report, one US\$ equivalent to Rs 60 has been used whereas Rs 95 is the prevailing rate.
3. The analysis needs to include updated/revised cost of RAP, based on the existing situation under the current guidelines of ADB and World Bank.

15.2 DISCREPANCIES IN COSTS CONSIDERED FOR THE ANALYSIS

Break-up of cost shows foreign component in estimates of civil works. The Consultant note that the cost of civil works under similar projects does not contain any foreign component. Contrary to the analysis, it is mentioned in the Report in para 15.10.2 that the financial cost excludes the cost of transmission lines.

Price escalation is considered @ 6% on local costs which is on lower side and needs updates (14% is used in Naltar-V Hydropower Project).

O&M cost is taken as 1% of the capital cost in the financial analysis which is again on lower side. In similar hydropower projects, O&M comes to between 2 and 2.5%. A detailed cost estimate of management set-up needs to be estimated for such expenses.

15.3 ECONOMIC ANALYSIS

Economic benefits have been considered on the basis of avoiding costs for establishing alternate thermal plant, considering generation from steam plant using furnace oil. This is the only scenario considered in the feasibility study for establishing economic viability of the project, ignoring the fact that a large part of thermal generation is from HSD or single/combined cycle gas plants. There is need to re-do the analysis considering benefits on the basis of avoiding costs of HSD or Gas turbine as thermal plants as well. The following observations need also to be taken into account:

1. While estimating the economic benefits, location of alternative plant (steam operative) has not been mentioned and it is said in the report that the plant will run in integrated mode with the National Grid. In another paragraph, it is mentioned that the proposed Lawi Project will supply power to the population of Chitral (there is no mention of integrating with the national grid). If this be the case, then the analysis is not realistic and needs to be redone, working out benefits as of a standalone alternative.

2. Long Run Marginal Cost (LRMC) of WAPDA for generating power need also to be worked out for economic analysis.
3. Optimization and NPV analysis need also to be made part of the economic analysis.

15.4 FINANCIAL ANALYSIS

Financial analysis presented in the report is scanty. There is no scenario discussed for the funding arrangements except assuming that the funds are readily available. FIRR is calculated as 11.65% and the project is declared financially viable, whereas prevailing interest rate of any commercial bank has been more than 13% over the last six years. Even, the interest rate announced by P&D Department of GoPakistan is declared as 13.65% vide notification. The financial analysis also needs revision considering the following to be included in the analysis:

1. Scenarios based on interest rate of 13.65% needs to be developed for testing financial viability of the project comparing the returns with prevailing interest rate being offered by the commercial banks in Pakistan.
2. Two part loan scenario (local and foreign components) needs to be developed for a viable option.
3. Statements showing profit and loss accounts, balance sheet, amortization schedule etc. needs to be included in the financial analysis.

15.4.1 Tariff

No tariff is computed based on project costs, except escalating the existing tariff of WAPDA, it needs to be determined. It is pointed out that under the Power Policy 2002, two part tariff should be calculated which is missing in the report.

15.4.2 Other Parameters

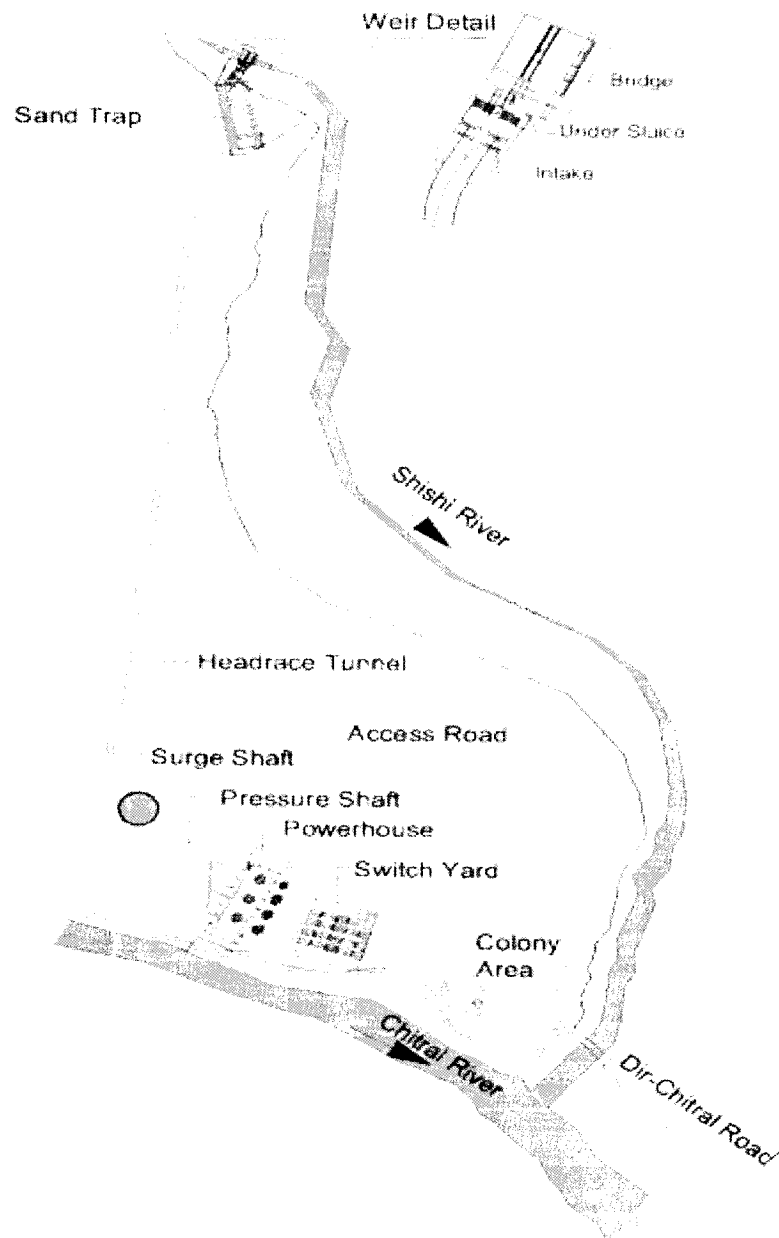
The following aspects may also be included as part of the financial analysis:

- a. Power Market analysis
- b. Impact of delay in implementation
- c. Employment analysis

In general, the approach and methodology is acceptable and appreciable, except it needs revision and updating.

Pakhtunkhwa Energy Development Organization (PEDO)
Government of Khyber Pakhtunkhwa
Lawi Hydropower Project 69 MW
Drosh, District Chitral

Prospectus



PROSPECTUS OF LAWI HYDROPOWER PROJECT (69 MW)

1. Project Brief

a. Introduction

LAWI hydropower is located on Shishi River, a Left tributary of Chitral River near Drosh Town in District Chitral, Khyber Pakhtunkhwa. The weir is located on the Shishi River near Lao Nissar village, which is 15km from river mouth. The power house is located on the left bank of the upstream Chitral River, about 1.8km distance from where Shishi River and Chitral River join together. The total installed capacity of LAWI HPP is 69MW, design flow $20\text{m}^3/\text{s}$, rated head 398.5m, the annual average power generation 303GWh, annual utilization hours 4391h, 3 sets of vertical shaft 4 jet double regulated Pelton turbines and vertical shaft generators. The civil works is divided into five parts: weir, headrace system, power house and switch yard, residential colony and access road. The weir is composed of overflow section, under sluice section, retaining wall, stilling basin and d/s apron, access road (or bridge) to weir site. Headrace system consists of intake structure, connecting tunnel, sedimentation basin, pressure headrace tunnel, surge shaft, pressure shaft, and steel lined pressure tunnel. Residential colony comprises of office buildings, hostels, mosques, markets and schools.

b. Background

The Pakhtunkhwa Energy Development Organization-PEDO, Govt. of Khyber Pakhtunkhwa, Pakistan has allocated funds through its own resources, towards the development of 69 MW LAWI Hydropower Project (LHPP) "the Project" on Engineering Procurement and Construction (EPC) mode. "The works" include detailed Engineering designing of all the components of the project from water to wire, supply, construction, erection/installation, testing and commissioning of all Civil Structures and Electro-Mechanical Equipment of the LHPP including Infrastructure Works. The construction period of the project is 60 months.

The Board further resolved to authorize the Project Director LAWI HPP to sign the contract agreement with EPC Contractor. Finally, the Letter of Acceptance was issued on 10th September, 2015 to JV.

After the approval of PEDO board the meeting was held on in KPK House under the Chairmanship of the Minister of E&P where it was decided to go ahead with the signing of the EPC Contract Agreement, in parallel to the approval of revised PC-1.

Accordingly, the Chinese Contractor arrived in Pakistan and the agreement for the EPC Contract of 69 MW LAWI HPP was signed with the Sichuan, Sarwar & Co., Silian and Chongqing Luyang JV at PEDO House on 26th October, 2016.

The Project Director LAWI Hydropower Project issued to the EPC Contractor order to commence the works on November 3, 2016 and to complete the said works within 60 months as per contract.

Feasibility Review by Management Consultants (2012)

M/s Associated Consulting Engineers – ACE (Pvt.) Ltd. and Partners have been appointed as the Management Consultants. The scope of the Consultancy Services Agreement includes supervision, coordination and technical input for continuous and diligent services to oversee the execution of Lawi Hydropower Project. The services

also include support to the Project starting with the review of Feasibility Report, to assist in selection of the EPC Contractor, upto the Final Commissioning of the Project.

It is stated that generally the study is of good quality. However, deficiencies and needed improvements pointed out by ACE and Partners Specialists (in their respective fields) are explained in the forthcoming sections.

Feasibility Review Report was accordingly prepared by ACE and Partners and submitted to the client October 2012.

c. Project Objective

Primary objective of the Project is to generate 69 MW hydropower with average annual energy production of 303 GW.

d. Project Components

The Project consists of an intake; weir and diversion works; connection tunnel; sand trap and headrace tunnel; penstock; powerhouse and tailrace, switchyard; Employer's offices and Colony, and access roads.

e. Salient Project Features

Main components of the Project include Weir, Intake Structure, Connecting Tunnel Sand Trap, Headrace Tunnel, Surge Chamber, Penstock, Powerhouse, 132kV Transmission Line and 132 KVA Switch Gear.

Location of Project	Drosh Town, Chitral District
Water Source	Shishi River
Total Installed Capacity	69 MW
Dam Type	Low height concrete diversion weir
Design Net Head	394m
Design Flow	20 m ³ /s
Weir Type	concrete weir
Weir width (overflow section)	60 m long; 10.6 m high (from foundation bed)
Sand Trap Length	90.00 m long; Double Chamber
Tunnel Length / Diameter	12.16 Km Long / 4.30m
Surge Shaft	Height 70 m, Dia 9 m
Pressure Shaft (Penstock)	236 m (vertical), 780m (horizontal), Dia 3m/2.5m
Mean Annual Energy	303 GWh
Turbine	Pelton
Nos. of Turbines	3
No. Of Generator	3
Turbine Capacity	23 MW (6.66m ³ /s)
Power House	66.60 m×21.20m×26m (Surface type)
Power Factor	0.85

f. Salient Contract Features and Milestones

• Contract Cost	Rs.16.337 Billion (inclusive of (Rs.1.160 billion as Provincial Sum)
• Date of Issuance of Letter of Acceptance	09 October, 2015
• Date of Signing of Contract	26 October, 2016
• Date of Commencement	03 November, 2016
• Stipulated Date of Completion	01 November, 2021
• Time for Completion	60 Months
• Defect Liability Period	24 Months

Main Environmental Aspects

Lawi Hydropower Project is one of small and medium sized hydropower projects proposed in the valley systems of Khyber Pakhtunkhwa. Such schemes will help to extend the national power supply and distribution systems to remote areas at the same time project will help in the supply Pakistan's overall energy needs.

Environmental impacts of the scheme during construction and during operations have been considered and discussed in Initial Environmental Examination (IEE) report which has been prepared to discuss and justify the impacts on the environment because of the projects. The report has determined that there would not be any significantly negative impact on the environment. Rather, considering the fact that there would be zero carbon emission, this project would offset equivalent carbon emissions from equivalent thermal capacity project. There will be some very negligible effect on the environment because of the construction activities, but the positive effects because of the project during the construction and during operation outnumber the negative impacts of the project. IEE for the project has been duly approved by the competent authority.

Environmental Mitigation

The main mitigation measures included in the Environmental Management Plan (EMP) are as indicated below:

The success to achieve sustainability for any project depends on the successful and complete implementation of the Environmental Management Plan. The knowledge of the guidelines, the legal and administrative framework for the environmental quality and sustainability is the first step in this direction. Therefore, the main concern of the EMP will be focused for the present operational activities and will be designed so that any future changes in the project and consequent impacts may be added to the plan.

The environmental management plan and its requirements have been described in following Table. The table identifies the effects of the construction of different project components on various environmental parameters. It also spells out mitigation/enhancement actions. The table also defines the responsibilities of Contractor in the implementation and monitoring of the mitigation actions.

ENVIRONMENTAL MANAGEMENT PLAN FOR CONSTRUCTION PHASE

Sr. No.	Environment al Impact	Description	Mitigation Strategy	Responsibilities	Key Performance Indicator
1.	Land Productivity and Use	Borrow or excavated material will cause the loss of some of the fertile plough layer and a drop in the elevation thus resulting in the decrease of land productivity.	Where the use of agricultural land is unavoidable for borrow of earth material, the top 30 cm of the plough layer will be stripped and stockpiled for redressing the land after the required borrow material has been removed. In case deep ditching is carried out, the top 1 m layer of the ditching will be stripped and stockpiled.	Contractor - EPA - Supervision consultant	Minimum Usage of Agriculture Land
2.	Soil Erosion and Land Sliding	If hillside or valley side slopes are left unprotected these will be subject to a natural weathering and become increasingly prone to soil erosion and land sliding. Soil erosion may also occur at quarry areas, if unmanaged blasting is carried out. - The reduction in vegetative cover will reduce the binding capacity of soil and enhanced erosion	Good engineering practices will help control soil erosion both at construction sites and in peripheral areas, particularly in borrow and dumping areas and on long haul tracks. - The plantation for slope protection will constitute fast growing indigenous trees with deep root system for anchoring the soil material and under growth of bushes and creeping grasses having capability of developing mesh of shallow fibrous roots	Contractor - EPA - Supervision consultant	Minimize Solid Erosion and Contamination

3.	Soil Contamination	Land might be contaminated by the spillage of chemicals like fuels, solvents, oils, paints and other construction chemicals and concrete	The contractor will be required to train its workforce in the storage and handling of materials like furnace oil, diesel, petrol and chemicals, etc., that is potentially hazardous.	Contractor - EPA - Supervision consultant	Avoid the spillage of chemicals
4.	Depletion of the river flow	There is no river water used by the peoples because all irrigating channel have been washed away by flood.	Minimum discharge of about 7.9m ³ /s will be allowed to discharge from weir	Contractor - EPA - Supervision consultant	Little to no impact on the ecological biodiversity downstream
5.	Use of Local Water Supplies	Local water supplies through the springs may be affected due to implementation of project both in quantity as well as quality	As per Local Government Act, the contractor will seek approval from the local government for exploitation of the water resources	Contractor - EPA - Supervision consultant	No Complaints from the locals on water availability

6.	Contamination of Surface and Ground Water Resources	If waste material is not properly disposed of, seepage of polluted water during monsoon season will pollute surface as well as groundwater quality.	<p>Wastewater effluent from contractors' workshops and equipment washing-yards will be passed through gravel/sand beds to remove oil/grease contaminants before discharging it into natural streams.</p> <p>- Similarly, the wastewater effluent from the campsite will be treated before disposal into a stream. According to local laws, the BOD5 concentration in sewage must be brought down to less than 80 mg/l before being discharged into a natural stream with a capacity to dilute the effluent further by 10 times.</p>	<p>Contractor</p> <ul style="list-style-type: none"> - EPA - Supervision consultant 	To avoid contamination of surface and groundwater
7.	Dust Smoke and other Pollutes from Plants and Equipment	The emission or dust from the batching plant or construction machinery can be very harmful for the site worker and the local population	<p>Regular spraying of water should be undertaken to minimize the dust pollution</p> <p>- All vehicles, machinery, equipment and generators used during construction activities will be kept in good working condition to minimize the exhaust emissions.</p> <p>- Proper PPE should be issued to the site worker and make sure the worker wears the PPE properly during working on site.</p>	<p>Contractor</p> <ul style="list-style-type: none"> - EPA - Supervision consultant 	To minimize air pollution

8.	Smoke from Burning of Waste	Smoke from Burning of Waste Material or Burning Firewood	Cutting and burning trees or shrubs for fuel shall be prohibited. Gas Cylinders should be used in the labor camp for cooking purposes.	Contractor - EPA - Supervision consultant	To avoid burning of waste material
9.	Noise pollution	Construction activities particularly blasting site near the powerhouse area	All working activities should be restricted within the day time particularly blasting.	Contractor - EPA - Supervision consultant	To minimize noise pollution
10.	Impact on Flora	Project will impact about 82 trees and during construction activities the Contractor's workers may damage the vegetation and trees	It is estimated that against cutting of about 82 trees proponent will make a provision of compensatory plantation at the ratio of 1:3 with the help of local forest department. As such, the total compensatory plantation comes to about 246 trees more over to minimize the impacts on flora. - Relevant contract clauses included to control cutting of trees/vegetation	Contractor - EPA - Supervision consultant	To minimize the impact on flora

11.	Impact on Fauna	<p>Impacts on Impact on Fauna</p> <ul style="list-style-type: none"> - Unmanaged blasting activities may harm birds. - During the construction phase, there will be adverse impacts on the mammals and reptiles of the area, due to construction activities involving excavation, blasting, access roads, and movement of labor. - Birds will try to find shelter and food somewhere else at project area and will tend to move away from the project area due to the activities - There is no definite record about fish is available however diversion will impact aquatic ecosystem. - No rare fish species found in the river which need protection. 	<p>Blasting and other noise generating activities will not be carried out during the night.</p> <ul style="list-style-type: none"> - Hunting, poaching and harassing of wild animals will be strictly prohibited and Contractor will be required to warn its labor accordingly. - Staff working on the project should be given clear orders, not to shoot, snare or trap any bird. - If possible nests of bird, on trees need to be uprooted, shifted to other nearby trees. - The weir intake structure will be designed and constructed to allow the minimum mean monthly 7.9 m³/s flow to always be maintained in Panjkora River for the maintenance of riparian as well as aquatic eco system of down stream. - Fishing will be prohibited. - Fish ladder shall be constructed for fish movement across weir. 	<p>Contractor</p> <ul style="list-style-type: none"> - EPA - Supervision consultant 	<p>To minimize the impact on Fauna</p>
-----	------------------------	---	--	---	--

SOCIAL MANAGEMENT PLAN FOR CONSTRUCTION PHASE

Sr. No.	Environment al Impact	Description	Mitigation Strategy	Responsibilities	Key Performance Indicator
1.	Land Acquisition	It is estimated that the project will involve acquisition of about 55 kanals of agricultural land and 332 kanals of waste land. By and large this is the proprietary land.	Cash compensation for acquired land at replacement value.	Construction contractor	To provide compensation to the affectees
2.	Impacts on Local Communities/ Work force	Potential for local opportunities	<p>The local people be offered project related jobs on priority basis - The project will arrange skills development and training program to local people in handing equipment and machinery required for the project</p> <p>- The project to boost local economy by injecting money and enacting instrumental role in emergence of new vocations and professions</p>	Construction contractor	To provide unskilled jobs to the locals and provide health facilities in the are
		Local communities access to the health facilities	The contractor to establish health facilities in the camp during construction phase.	Construction contractor	
		Diseases incidences and interaction with labor	A comprehensive Health and safety plan to be implemented - Creation of grievance redressed mechanism to protect rights and livelihood of community	Construction contractor	

		Blockage of roads during the construction	Alternate access to local communities during construction work, - Scheduling for road blockade - Alternate options for patients in emergencies	Construction contractor	
3.	Safety Hazards	Conflict between workers and local community to increase	Contractor's camps to maintain a reasonable distance from local population - Restriction on mobility of workers in local community - Priority in jobs for the local people with expertise required by the project injecting money and enacting instrumental role in emergence of new vocations and professions	Construction contractor	To minimize the disturbance (hindrance in free movement) to people in the Project Area
		Local communities access to the health facilities	- Local communities access to the health facilities - The contractor to establish health facilities in the camp during construction phase.	Construction contractor	
		Blockage of roads during the construction	Alternate access to local communities during construction work, - Scheduling for road blockade - Alternate options for patients in emergencies	Construction contractor	
4.	Gender Issues	The rural women normally are actively participate in other outdoor socio-	The Contractor will have to select the specific timings for the construction activities particularly	Construction contractor	To minimize the disturbance (hindrance in free movement) to people in

		<p>economic activities such as livestock rearing, bringing of potable water, etc which may also be affected by the project activities. - The induction of outside labor may create social and gender issues due to the unawareness of local customs and norms</p>	<p>near the settlements, so as to cause least disturbance to the local population particularly women considering their peak movement hours.</p> <p>- Contractor will warn the staff strictly not to involve in any unethical activities and to obey the local norms and cultural restrictions particularly with reference to women.</p>		the Project Area
--	--	---	---	--	------------------

CONCLUSION

In order to meet the objectives, the following parameters shall be monitored:

1. Water quantity used on project
2. Water quality for camp utilities and drinking use to meet NEQS
3. Conservation of water and energy on project
4. Diesel and Petrol used on project
5. Air and Noise quality
6. Dust and smoke generation
7. Road traffic control during project construction work
8. Soil Conservation to prevent oil and chemical spills
9. Chemical and oil storage to prevent accidental spill
10. Waste Disposal

Non-hazardous waste:

Combustible waste, Plastic, wood, metal, food, sewage, etc

Hazardous waste:

Used Oil & Filters, Chemicals, Medical waste, Oil/Chemical drums

11. Sewage treatment before disposal
12. Vehicles maintenance and washing in designated areas
13. Control of oil and oily water discharge to river
14. Fire prevention and inspection of firefighting equipment to use in emergency
15. Effect on health of workers due to environmental pollution
16. Use of personal protective equipment for health and safety of employees
17. Clinic, ambulance inspections and verify alertness of staff through drills
18. Hygiene in camps and food safety

Socio Economic Effects of the Project

Lawi Hydropower Project will play its due role in the socio economic uplift of the people of the adjoining areas in particular and Khyber Pakhtunkhwa and the country in general. Since it is an indigenous resource based project without any fuel element being considered as pass through, the project will contribute in bridging the gap of price differential, which currently Power Purchaser is forced to pay. This will help in easing out the issue of circular debt etc.

The cost of project is approximately 20.088 billion. Majority of the cost would be incurred in local currency, thus saving precious foreign exchange. In addition to this, most of the cost of EPC relates to the local component, which entails support to local contractor and industry especially cement and steel.

Project cost and Tariff

Capital Cost of the project at present on the basis of approved revised PC-01 is 20.088 billion. The currently envisaged financing structure is based on a debt equity ratio of 80:20. Project life for the purpose of the tariff is estimated to be 30 years. However, in effect it would be 50 years. The sponsors will transfer the project to the Power Purchaser at the end of concession term. However, in case Power Purchaser decides to further lease out the project, the sponsors will have the first right. The real benefits of the project will be available when the debt is retired and the project becomes debt free. At that time, electricity from the project will be available at a very nominal price.

TECHNICAL EVALUATION REPORT
FEBRUARY, 2015

1. INTRODUCTION

1.1. General

The Pakhtunkhwa Energy Development Organization (PEDO), Government of Khyber Pakhtunkhwa, Pakistan ("the Employer") has allocated funds through its own resources, towards the development of 69 MW LAWI HYDROPOWER PROJECT DISTRICT CHITRAL (LHPP) "the complete Power Plant" on Engineering, Procurement and Construction (EPC) mode. "The Works" include detailed Engineering design, supply, construction, erection/installation, testing and commissioning of all Civil Structures and Electro-Mechanical Equipment of the Power Plant including other infrastructure works. Bidding was open to all eligible bidders. The construction period of the Project is 60 months. The project is located along Shishi River near Drosh, in District Chitral, Khyber Pakhtunkhwa, Pakistan. The key information of the bidding process has been prepared and Basic data sheet is attached as **Appendix-1**.

The bids for Lawi Hydropower Project (2nd time bidding) were annuled by PEDO on June 9, 2014 and invited sealed bids (3rd time) on EPC basis (Technical and Financial) through single stage- two envelop system, from eligible International firms licensed by the Pakistan Engineering Council in the appropriate category for the Works which was advertised in leading local English/Urdu newspapers as well on PEDO website on June 13, 2014.

The Peshawar High Court upon the application of M/s SINOTEC stayed the bidding process on June 19, 2014. The Court dismissed the petition of M/s SINOTEC against the retendering by the Pakhtunkhwa Energy Development Organization (PEDO) on November 20, 2014. Besides ordering the dismissal of petition, the Court also ordered vacation of stay order issued on the bidding process.

Addendum No.1 regarding clarifications to certain aspects of the technical requirements and minor changes in some clauses of bidding documents was issued vide No. 1781/PEDO/PD LAWI HPP dated December 15, 2014.

A pre-bid meeting was held in the committee room of the PEDO House, Peshawar on December 18, 2014 for clarification of Bidding Documents. Five (05) prospective bidders out of ten (10) firms who purchased the Bidding Documents up to that date attended the pre-bid meeting. The Minutes of Pre-Bid Meeting / Addendum No. 2 were circulated to those who had purchased the Bidding Documents; vide No. 1786/PEDO/PD LAWI HPP dated December 24, 2014.

1.2. Submission of Bids

The closing date for the submission of bids was extended from January 05, 2015 to January 20, 2015 upon request from prospective bidders which was further extended to January 21, 2015 due to local holiday as announced by the Provincial Government on January 20, 2015. The receipt of bids by the Pakhtunkhwa Energy Development Organization (PEDO) was closed at 14:30 hours local time on January

21, 2015 as scheduled. Out of eleven (11) firms who purchased the bidding documents before bid submission date, four (04) bidders submitted their bids.

1.3. Bid Opening and Evaluation Committee

In accordance with the provision of Standard Bidding Documents of Pakistan Engineering Council (PEC) the following 'Bids Opening and Evaluation Committee' was constituted vide Notification No. 2717-22 / SHYDO / CEO dated June 16, 2014, for undertaking and completing the 'Bids Opening and Evaluation Process' of the Technical as well as Financial Bids of Contractors under PEDO Projects.

Members of the Bids Opening and Evaluation Committee are follows:

- | | | |
|------|--|----------|
| i. | Project Director / Director Concerned | Convener |
| ii. | Director (Finance / Admin.) | Member |
| iii. | Deputy Director concerned | Member |
| iv. | Assistant Director concerned | Member |
| v. | Project Manager / Team Leader of Management Consultant | Member |

As per the Bidding Procedure (i.e. Single Stage Two Envelopes System), the Prospective Bidders submitted the Technical and Financial Bids (which were Sealed in separate envelopes) to the 'Bids Opening and Evaluation Committee' on January 21, 2015 in the committee room of PEDO House at 15:00 hrs.

The following FOUR (4) Bidders submitted their Bids:

1. M/s CLIC JV
2. M/s DESCON-ZOEC JV
3. M/s SICHUAN-SARWAR-SILIAN-CHONGQING LUYANG JV
4. M/s LIMAK-ZKB JV

In the presence of the Authorized Representatives of all the four Bidders, the 'Bids Opening and Evaluation Committee' turn by turn received the Bids and at same time opened the Technical Bids.

The Sealed Financial Bids were signed by all the members of the Committee and kept under Lock and Key Control. The Record of Bid Opening was prepared and is attached as **Appendix-2**.

2. EVALUATION FOR COMPLETENESS OF BIDS

2.1. List of Bidders

The names of the bidders and their nationalities are shown in the following table.

No.	Name of Bidders	Nationality
JV No. 01.	M/s DESCON Engineering	Pakistan
	M/s Zhejiang Orient Engineering Co.	China
JV No. 02.	M/s CLIC	China
	M/s Habib Rafiq (Pvt.) Ltd	Pakistan
JV No. 03.	M/s Sichuan Province Geological Complex	China ✓
	M/s Sarwar & Co.	Pakistan ✓
	M/s Sillian Technical Import & Export Co.	China ✓
	M/s Chongqing Luyong Engineering Design Co.	China
JV No. 04.	M/s LIMAK	Turkey
	M/s Zahir Khan & Brothers	Pakistan

2.2. Bid Documents

The technical proposals submitted were examined to verify that the bidders had submitted all the documents and information required by the bidding documents. The following were verified:

- (a) Covering Letter
- (b) Letters of Bids duly filled, signed and sealed, in accordance with Clause IB.17.
- (c) Schedules (A to I) to Bid duly filled and signed, in accordance with the instructions contained therein.
- (d) Schedule of Prices completed in accordance with Clauses IB.11 and IB.12 in separate sealed envelope.
- (e) Bid Security furnished in accordance with Clause IB.15.
- (f) Power of Attorney in accordance with Clause IB 17.5.
- (g) Joint Venture Agreement.
- (h) Documentary evidence established in accordance with Clause IB.13 that the Bidder is eligible to Bid and is qualified to perform the Contract if its Bid is accepted (past performance and present commitments to be filled in as per schedule I to Bid).
- (i) Documentary evidence established in accordance with Clause IB.14 that the Plant and ancillary Services to be supplied by the Bidder are eligible Plant and Services and conform to the Bidding Documents.

- (j) Bidders applying for eligibility for domestic preference in bid evaluation shall supply all information & evidence to establish the claim for domestic preference required to satisfy the criteria for eligibility as described in Clause IB.27. The particulars for domestic Goods prescribed in Appendix C to these Instructions shall also be filled in to substantiate claim for domestic preference.
- (k) Any other documents prescribed in Particular Conditions of Contract or Technical Provisions to be submitted with the Bid.

2.3. Conformity to Bid Documents

All the four bids generally conform to the Bid Documents with minor deviations. Accordingly, all bidders are responsive for detailed evaluation as per clause IB 24.

The results of checking for completeness of bid documents are presented in **Appendix-3**.

3. DETERMINATION OF SUBSTANTIVE RESPONSIVENESS OF BIDS

3.1. Eligibility of Bidders

In Clauses IB 2.1 and IB 14.2 of the Instructions to Bidders of the bidding documents, it is specified that the bidders shall be duly licensed by Pakistan Engineering Council (PEC) in category CA, and the bidder and goods and the services to be supplied shall be from an eligible source country. All bidders submitted evidence which indicated that they are registered with PEC in the said category and are from eligible country of origin. The bidder LIMAK-ZKB JV attached latest PEC registration certificate i.e. for the year 2015. Other three bidders attached the certificate for the year 2014. Out of these three, DESCON-ZOEC JV and CLIC JV have provided the proof of application for renewal of the PEC certificate while no such proof was attached by the bidder M/s Sichuan-Sarwar-Silian-Chongqing Luyong JV. Client asked for clarification in this regard from M/s Sichuan-Sarwar-Silian-Chongqing Luyong JV and the bidder provided latest PEC registration certificate for the year 2015.

3.2. Qualification of Bidders

The bidding documents require, in Clauses IB 13 & IB 14 of the Instructions to Bidders, that each bidder submit with the bid evidence of its technical capability, financial capacity and previous experience in similar works by completing the forms and schedules provided in the bidding documents. All bidders submitted due forms and schedules according to Section 3 and 4 of Part 1 of the Bidding Documents and were found satisfactory. The detailed review of the information to determine whether the bidder was qualified to perform the requirements of the contract was carried out in accordance with the provisions of the bidding documents. The respective evaluated data of Technical Bids is attached as **Appendices 4A, 4B & 4C**.

Qualifications of sub-contractors / manufacturers of substantively responsive bidders will be finalized before signing of the contract.

The findings are briefly narrated below:

a) Bidder No. 1 – DESCON-ZOEC JV:

The financial capacity of M/s DESCON is adequate. The JV partners i.e. M/s DESCON and M/s ZOEC fulfill the requirement of annual construction turnover. The bidder has listed one EPC/Turnkey project which satisfies the specified requirements as per the table under IB.26.2 (c) ii. Also the sub-contractor for tunnel construction i.e. M/s Hussain Khan & Co. showed eleven (11) years experience in the field of tunneling against the requirement of ten (10) years. However, M/s DESCON-ZOEC JV provided inadequate experience for design of tunnels (i.e. 5 years) against the requirement of 10 years. The JV also did not provide any information regarding MOU/ agreement with the sub-contractors. A query was generated in this regard. Accordingly the bidder provided their replies which are made part of the report attached as **Appendix-7**. The JV after scrutiny of clarification replies is considered responsive.

b) Bidder No. 2 - CLIC JV:

The financial capacity is satisfactory. Bidder showed adequate experience in design and construction of Hydropower Projects. Also the JV has completed a Hydropower project on EPC/ Turnkey basis as required. His proposed manufacturers of main power plant equipment meet the manufacturing prescribed criteria. Although, the designer partner has shown a number of projects showing experience in design of tunneling however, CLIC JV has shown inadequate experience in construction of tunnels. The JV is generally considered responsive.

c) Bidder No. 3 – Sichuan-Sarwar-Silian-Chongqing Luyong JV:

The financial capacity is adequate. Bidder has produced evidence of completing two (2) Hydropower Projects on EPC/Turnkey basis within the last fifteen years which fulfills the given criteria. Also sufficient experience in design and construction of tunnels and powerhouses has been mentioned. The authorized manufacturer's manufacturing experience has also been properly documented.

d) Bidder No. 4 – ZKB-LIMAK JV

The bidder has shown adequate financial capacity. M/s LIMAK has shown two (2) projects on EPC/Turnkey basis which fulfills the criterion for specific experience. However, the JV has produced only six (6) years relevant experience against the requirement of ten (10) years for tunnel/ powerhouse design and construction. The bidder has provided two optional sub-contractors. Out of these, the sub-contractor M/s Chongqing Water Turbine works Co. Ltd produced authorization and other required documents while the required documentation regarding sub-contractor M/s Andritz Hydro were missing. Therefore, the bidder is evaluated considering Chongqing Water Turbine works Co. Ltd as only sub-contractor.

3.3. Compliance with Commercial Terms and Conditions

3.3.1. Bid Validity and Bid Security

The bid validity period of at least 180 days from the date of bid opening was specified in Part-1 of Bidding Documents in IB.16 of Instructions to Bidders and bid security validity of 28 days beyond the bid validity period was specified in Bidding Documents in IB.15 of Instructions to Bidders. All bidders offered the bid security validity period as required. Bidders are considered responsive under IB.24 (c) for bid evaluation.

3.3.2. Terms of Payment and Reservations to Commercial Conditions

No bidder has expressed any reservation to the terms and conditions of the bidding documents regarding payments. All bidders did not raise any reservation regarding liquidated damages, functional guarantees and the corresponding penalties, performance security, insurance and other stipulations for the transportation of goods, warranty conditions, and after sales service.

3.3.3. Time for Completion/Contract Execution Schedule

The contract execution schedules and sequence of delivery of major units of plant (Schedules A – G) specified in Part I section 3, were evaluated and compared with the requirements of the bidding documents. The schedules submitted by the bidders are generally in order. All the bidders proposed contract execution schedules which meet the completion requirement of 1825 days for the total scope of work.

3.4. Compliance With Technical Requirements

The responsiveness for major technical requirements for design, works, plant, supply and installation of Lawi HPP was examined for all the bidders and is as follows.

- i. **DESCON-ZOEC JV:** M/s DESCON-ZOEC JV is generally compliant with the requirements. Certain submissions were missing in the JV's bid i.e. Employer's Field Facilities and Environmental Protection & Miscellaneous, Part III section 2.8, 2.9, 2.10 and 2.11 and also did not provide description regarding certain E&M installations and equipment. A clarification was raised in this regard and the bidder provided replies which are attached as **Appendix-7**. The JV after scrutiny of clarification replies is considered responsive.
- ii. **CLIC JV:** M/s CLIC JV did not describe details related to Employer's Field Facilities and Environmental Protection & Miscellaneous, Part III section 2.8, 2.9, 2.10 and 2.11. Certain submissions i.e. head loss calculation, Power & Energy calculation, E&M equipment details etc. were also missing. The Client has asked the bidder for the clarifications. After scrutiny of the bidder's provided replies, he is considered responsive to Technical requirements. However, the Contractor has provided minor deviations regarding certain Employer's Requirements. The detailed replies are attached as **Appendix-8**.
- iii. **Sichuan-Sarwar-Sillan-Chongqing Luyong JV:** The Bid submitted by the bidder lacked certain information regarding technical requirements for Civil and Electro-mechanical works/ equipment as specified in the Bid Document. Also the

bidder provided a deviation note for technical compliance in respect of Turbine efficiency (i.e. 91.6% against the requirement of 92%). A clarification was generated and bidder's replies in this regard have been thoroughly scrutinized. The bidder generally accepted to conform to the Bidding Documents however he did not accept the requirement of 92% turbine efficiency and insisted on turbine efficiency 91.6%. Detailed replies of bidder are attached as **Appendix-9**.

- iv. **LIMAK-ZKB JV:** The bid submitted by M/s LIMAK-ZKB JV generally complies with the technical requirements. Certain submissions regarding Civil & Electro-mechanical works/ equipment were missing. The bidder was asked to clarify/ provide the missing information through a clarification letter. Bidder submitted his replies after scrutiny of which he is generally considered responsive to the technical requirements.

Results of compliance with technical requirements are tabulated in **Appendix-5**.

3.5. Substantive Responsiveness Of Bids

As discussed in detail above about the eligibility of Bidders and Goods, Bidders qualification and their compliances with Commercial and Technical Requirements, the Committee has used this data in considering the substantive responsiveness or otherwise of all the four (04) bidders.

3.6. Responsive Bidders

Using the information as stated, the Committee considers all the four bidders as responsive. The list of responsive bidders is as follows:

- i. M/s DESCON-ZOEC JV
- ii. M/s CLIC JV
- iii. M/s SICHUAN-SARWAR-SILIAN-CHONGQING LUYANG JV
- iv. M/s LIMAK - ZKB JV

4. DETAILED EVALUATION FOR TECHNICAL REQUIREMENTS

4.1. Evaluation of Technical Requirements (Civil Works) of Responsive Bids

The scope of engineering designs, execution of works, technical information, and data submitted by the bidders for civil works were scrutinized in detail and comparisons were carried out with the technical requirements of the bidding documents. All Four (04) bidders chosen for detailed evaluation submitted substantially complete information and generally satisfied the technical requirements of the bidding documents. Because of the nature of the civil works and electro-mechanical equipment involved, many clarifications and additional information were sought to assess the technical acceptability and capability of the bidders, and also to assess the completeness of the scope of plant, installation and works.

Following requirements were scrutinized in the bidders' documents for compliance:

- a) Specific Works data

- b) Proposed Organization for the Project
- c) Method of performing Works
- d) Proposed Programme of Works
- e) Personnel
- f) Deviations from Technical & Contractual Provisions
- g) Specific Operation/Plant and Equipment Details
- h) Specified JV Agreement
- i) Past Performance and Present Commitments

All the bidders have provided these documents which generally conform to the requirements of the Bidding Documents. Some minor deficiencies were observed which will be clarified before signing the contract with the successful bidder.

The technical proposals of the four (04) bidders considered for detailed evaluation were scrutinized in detail, the compliance or other wise of Section 1.2.3 and 1.2.4, Part III by each of the four (04) bidders has been described below. The results of the scrutiny containing the salient Technical Features of Bids (technical proposals - Civil) are tabulated and attached as **Appendix-6A**.

The proposals of all the four (04) Bidders give the scope of civil construction works as well as supply and erection of electro-mechanical equipment, methodology, implementation schedule supported by relevant drawings including the other ancillary equipment connected thereto. However due to the complex nature of the project (EPC-Turnkey Project) and in the absence of detailed design, the listed items in **Appendix 6A & 6B** should be taken as indicative only. Bidder must take the responsibility to provide the full equipment / materials for construction of the project on EPC-Turnkey Basis.

4.2. Evaluation of Technical Requirements (E&M Equipment) of Responsive Bids

4.2.1. Bidder DESCON-ZOEC JV

a) Turbines

The turbine has been sufficiently described. However, the turbine regulation detail was not been defined. Also the turbine runaway speed was given as 853RPM against the required speed of 900RPM in the Bid Documents.

b) Governor System

Governor system has been sufficiently described which is in line with the Employer's Requirements.

c) Powerhouse Crane

Bidder provided relevant information regarding powerhouse crane in his submitted Bid.

d) Generators

The information provided by the bidder regarding generators lacks certain key features including generator efficiency, runaway speed and protection class etc.

e) Transformers/ Switchyard

The bidder has discussed in detail about the specifications of different types of transformers required at site and the 132Kv switchyard facility.

The bidder did not touch the following Civil as well as Electro-Mechanical Systems as required for the project in his submitted Bid.

- i. Employer's field facilities
- ii. Field Utilities
- iii. Earthing System
- iv. Project signs

Clarifications were sought by the Client in this respect. The JV committed to comply with all the requirements as specified in the Bid Documents.

4.2.2. Bidder M/s CLIC JV**a) Turbines**

The turbine has been sufficiently described. However, the turbine regulation detail was not been defined. Also the bidder has mentioned 6 Jet pelton turbine which differs from the one mentioned in the Bid Documents (i.e. 4 Jet Pelton Turbine).

b) Governor System

Governor system has been sufficiently described which is in line with the Employer's Requirements.

c) Powerhouse Crane

Powerhouse crane has been adequately described regarding lifting capacity and its conformity with FEM standards. However, the radius of beam needed clarification from the bidder. Also clarification was sought regarding provision of a mobile crane with prescribed specifications. In this respect the bidder did not accepted to supply mobile crane. However, this issue shall be sorted out before award of Contract.

d) Auxiliary System

Bidder provided sufficient information about the proposed auxiliary system which conforms to the project requirements.

e) Generators

Sufficient information has been provided regarding generators.

f) Excitation and Voltage Regulation System

Bidder has provided adequate information regarding Excitation and Low/ Medium/ High voltage regulation which normally conforms to the Bid Document requirements.

g) Transformers

The main as well as auxiliary transformers have been sufficiently described as to its main features. However, the bidder did not specify the temperature rise and power factor for the transformers. Also under Auxiliary Transformers, the bidder opted for On-Load tap changer and transformer impedance as 4% which needs to be further clarified by the bidder.

The bidder also provided sufficient information regarding Control and alarm system, Telecommunications and hydraulic Steel Works. However, he had to conform to the requirements regarding Elevators, Earthing Systems and Transmission.

Clarifications were sought by the Client in this respect. The JV generally committed to comply with all the requirements as specified in the Bid Documents. However, he insisted to use earthing resistance of < 1 ohm.

4.2.3. Bidder M/s Sichuan-Sarwar-Silian-Chongqing Luyong JV**a) Turbines**

The turbine has been sufficiently described. However, the bidder has quoted a deviation note regarding turbine efficiency and has proposed turbine efficiency of 91.6% against the efficiency of 92% mentioned in bidding documents.

b) Governor System

Governor system has been sufficiently described which is in line with the Employer's Requirements.

c) Powerhouse Crane

Bidder provided relevant information regarding powerhouse crane in his submitted Bid.

The bidder has discussed auxiliary systems, Generators, main transformers, auxiliary transformers and switchyard in the submitted Bid. However, information regarding elevators, workshop equipment & tools, service station transformers, telecommunication and transmission line needed to be substantiated as per the employer's requirements.

The bidder provided justification regarding turbine efficiency of 91.6%. However, he committed to comply with all the requirements as specified in the Bid Documents.

4.2.4. Bidder M/s LIMAK-ZKB JV**a) Turbines**

The turbine has been sufficiently described. However, the turbine regulation detail was not been defined. Also the bidder has mentioned 6 Jet pelton turbine and discharge rate of 6.59 cum/sec. which differs from the one mentioned in the Bidding Documents (i.e. 4 Jet Pelton Turbine and 6.67cum/sec of discharge).

b) Governor System

Governor system has been sufficiently described which is in line with the Employer's Requirements.

c) Powerhouse Crane

Powerhouse crane has been adequately described regarding lifting capacity and its conformity with FEM standards. However, the radius of beam needed clarification from the bidder. Also clarification was needed regarding provision of a mobile crane with prescribed specifications.

d) Auxiliary System

Bidder provided sufficient information about the proposed auxiliary system which conforms to the project requirements.

e) Generators

Sufficient information has been provided regarding generators. Certain information i.e. generator efficiency, protection class, temperature rise etc. are however needs substantiation.

f) Excitation and Voltage Regulation System

Bidder has not provided information regarding Excitation system and has barely touched Low/ Medium/ High voltage regulation. Clarification in this regard has been sought from the bidder.

g) Transformers

The main as well as auxiliary transformers have been sufficiently described as to its main features. However, the bidder did not specify the temperature rise and power factor for the transformers. Also under Auxiliary Transformers, the bidder opted for On-Load tap changer and transformer impedance as 4% which needs to be further clarified by the bidder.

The bidder also provided sufficient information regarding Control and alarm system, Telecommunications and hydraulic Steel Works. However, he had to conform to the requirements regarding Elevators, Earthing Systems and Transmission line.

In reply to the clarifications asked by the Client, the bidder committed to comply with all the requirements as specified in the Bid Documents.

4.3. Clarification and Discussions

The initial findings of the detailed evaluation of the technical documents submitted by the responsive bidders were sent to respective bidders for clarifications point by point. The additional documents submitted by the bidders in response to these clarifications have been considered and duly incorporated in the report, which generally conform to the technical requirement. However, minor issues still need to be further clarified by the bidders, which can be done before finalization of the contract with the successful bidder.

The bidder's replies to the clarification letters are attached as Appendix 7 to 10.

5. CONCLUSIONS AND RECOMMENDATIONS

On the basis of the analysis of the technical proposals presented in this report and discussion on each item of evaluation as enumerated hereto fore, the Bids Opening & Evaluation Committee concludes that the original Technical Bids of the Bidders M/s DESCON -ZOEK JV, M/s CLIC JV, M/s SICHUAN-SARWAR-SILIAN-CHONGQING LUYANG JV and M/s LIMAK-ZKB JV are considered responsive to the requirements of bidding documents. Qualification status of these bidders is as stated below:

Sr No.	Bidder / JV Name	Qualification Status (Technical)
1.	DESCON-ZOEK JV	Qualified
2.	CLIC JV	Qualified
3.	Sichuan-Sarwar-Silian-Chongqing Luyong JV	Qualified
4.	LIMAK-ZKB JV	Qualified

These responsive Bidders have been qualified technically on the grounds that they have undertaken to fully comply with the complete requirements as specified in the Employer's Requirements of the bidding documents without change in bid price.

In light of the above, the Bids Opening & Evaluation Committee recommends for opening the Financial Bids of all the four bidders being technically responsive.

Sr No.	Member	SIGNATURE
1	Director Panning & Facilitation	<i>[Signature]</i>
2	Director Finance / Administration	<i>m. [Signature]</i> 16/02/15
3	Project Director Lawi HPP	<i>N. [Signature]</i> 16/2/15
4	Deputy Director Lawi HPP	<i>[Signature]</i> 16/2/15
5	Assistant Director Lawi HPP	<i>[Signature]</i> 16/2/15
6	Project Manager MC (ACE)	<i>[Signature]</i> 16/2/2015

APPENDIX – 1

SALIENT FEATURES

LAWI HYDROPOWER PROJECT

SALIENT FEATURES OF THE PROJECT

Location		Gross Head	
Pakistan, Khyber Pakhtunkhwa Province (KP), Chitral District, on Shishi River , Left tributary of Chitral River.		Maximum	413 m
		Minimum	377 m
Organization		Discharge	
Pakhtunkhwa Energy Development Organization (PEDO)		Design discharge	20 m ³ /s
Hydrology		Powerhouse- Machine Hall	
Catchment area at weir site	394 Km ²	Length	56.0 m
Mean monthly discharge	13 m ³ /s	Width	19.85 m
Design Flood (return period 500 year)	872 m ³ /s	Height	26.0 m
Diversion Weir		Tallrace canal	
Weir height above riverbed	5 m	Length	130 m
Length of weir	65 m	Cross-section	5 m x 2 m
Connecting Tunnel		Hydro-Mechanical Equipment	
Tunnel diameter	5 m	Pelton turbines	3 Nos.
Tunnel length	40 m	Speed	500 rpm
Sedimentation Basins (Underground)		Discharge/unit	6.67 m ³ /s
No. of Chambers	2	Electrical Equipment	
Size of Chamber	7.5(W)x7.0(H) m	Generators	3 Nos.
Chamber length	70 m	Speed	500 rpm
Collection Chamber(canal)		Installed Capacity	
No. of Chambers	1	Plant Capacity	69 MW
Size of Chamber	4.0(W)x5.0(H) m	Capacity per unit	23 MW
Chamber length	23 m	Energy	
Headrace Tunnel (Low Pressure)		Mean annual energy	303 GWh
Tunnel diameter	4 m	Plant factor annual	51 %
Tunnel length	11.30 km	Surge Shaft	
Surge Shaft		Surge shaft internal diameter	10 m
		Height	70 m
Concrete Lined Pressure Shaft		Steel Lined Pressure Tunnel	
Diameter	3.0 m	Diameter	2.5 m
Length	332 m	Length	684 m

APPENDIX – 2

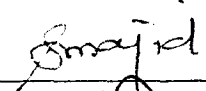


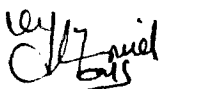

BID OPENING DATA

ATTENDANCE SHEET


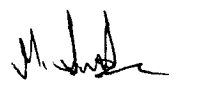
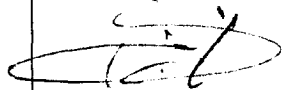
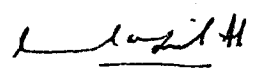
Receipt of Technical & Financial Proposals and Opening of Technical Proposals for
Construction of Lawi Hydropower Project (69MW)

JANUARY 21, 2015

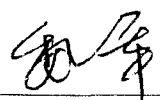
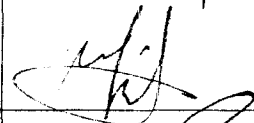
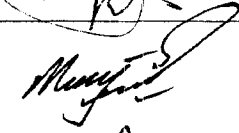
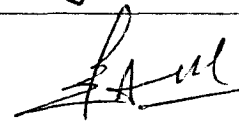
PEDO:

S.No.	Name	Designation	Signature
1	Wajid Nawaz	Dis (P&F)	
2	Niamat Khan	PD Lawi	
3	Narinder Kumar	Deputy Director	
4	JUNAID IQBAL	ASSISTANT DIRECTOR LAWI HPP	
5	MOHAMMAD BASHIR KHAN	G.M/Director (F/A)	

MANAGEMENT CONSULTANTS (ACE):

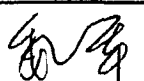


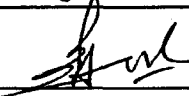
S.No.	Name	Designation	Signature
1	MUHAMMAD ASLAM BHATTI	PM/TL	
2	Muhammed Aslam	PE	
3	Syed Nabeel Ahmad	PE (Contracts)	
4	NAWAZISH ALI	SENIOR ENGINEER	

BIDDERS:-

S.No.	Name of Bidder	Name of Representative	Signature
1	elic JV	Wei Jun	
2	Descon - ZeeC Joint venture.	M. Faisal Rehman.	
3	Sichuan, Sanur, Silian, Chong Bingling JV	M. Mujahid	
4	ZKB - Limak JV	Ijaz Ahmed C.O.S.	
5			
6			
7			
8			
9			
10			
11			

**Receipt of Technical and Financial Proposals and Opening of Technical Proposals for
Construction of Lawi Hydropower Project (69MW)**

Annexure -I

S.No.	Name of Bidder	Name of Representative	Signature	No. of Copies of Bid Received	Bid Security Amount (Rupees / US Dollars)	Expiry of Bid Security (16-08-2015)	Financial Bid Properly Sealed (Yes / No)	Remarks
1	elic JV	Wei Jun		01 original + 04 Copies	200,000,000/- Astrari Bank	16-08-2015	Yes	Nil
2	Descon 2011 JV	M. T. ... Rehman		01 original + 04 Copies	Rs. 200 Million UBL	09-09-15	Yes	Nil
3	Sichuan ... Sichuan & ... JV	M.		01 original + 04 Copies	USD 2 Million UBL	16-08-15	Yes	Nil
4	ZKB-Limak JV	Jiaz Ahmed		01 original + 04 Copies	Rs. 200 Million MCB	20-10-15	Yes	Nil
5								
6								
7								
8								
9								
10								
11								

LAWI HYDROPOWER PROJECT (69 MW)

BIDS SUBMISSION CHECKLIST

Date: 21-01-2015, Time 3:00 pm

Name of Bidder: DESCON-ZOEC Joint Venture

S. No.	Checklist	Remarks
1	Is Outer Envelope of Bid Properly Sealed?	YES
2	Is Form of Bid Completed and Signed?	YES
3	Expiry Date of Bid	01-09-2015
4	Is documentary Authority for Signing Enclosed?	YES
5	Amount of Bid Security (as Required)	200 Million Rs.
6	Describe any "Substitution", "Withdrawal" or "Modification" Submitted.	No
7	Describe any Alternative Bid made	No
8	Additional Comments	Nil
9	Are All Addenda Acknowledged?	YES
10	Name of Bidder of His Representative who attended the Bid Opening	M. Faiz Rehman

Member of Bid Opening and Evaluation Committee

Signature

Project Director (Lawi HPP)

Director (P&F)

Director (F&A)

Deputy Director (Lawi HPP)

Assistant Director (Lawi HPP)

Project Manager, Management Consultant (ACE)

Contract Specialist, Management Consultant (ACE)

Bidder / Representative of Bidder

[Signature]

[Signature]
21.1.2015

[Signature]

[Signature]

[Signature]
21.1.15

[Signature]

[Signature]


[Signature]

LAWI HYDROPOWER PROJECT (69 MW)

BIDS SUBMISSION CHECKLIST

Date: 21-01-2015, Time 3:00 pm

Name of Bidder: CLIC Joint Venture

S. No.	Checklist	Remarks
1	Is Outer Envelope of Bid Properly Sealed?	Yes
2	Is Form of Bid Completed and Signed?	Yes
3	Expiry Date of Bid security	16-08-2015
4	Is documentary Authority for Signing Enclosed?	Yes
5	Amount of Bid Security (as Required)	200,000,000
6	Describe any "Substitution", "Withdrawal" or "Modification" Submitted.	No
7	Describe any Alternative Bid made	No
8	Additional Comments	Nil
9	Are All Addenda Acknowledged?	Yes
10	Name of Bidder or His Representative who attended the Bid Opening	Wei Jun 

Member of Bid Opening and Evaluation Committee

Signature

Project Director (Lawi HPP)

Director (P&F)

Director (F&A)

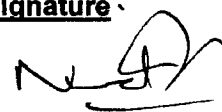
Deputy Director (Lawi HPP)

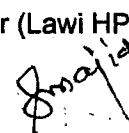
Assistant Director (Lawi HPP)


Project Manager, Management Consultant (ACE)

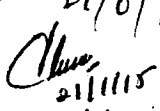
Contract Specialist, Management Consultant (ACE)

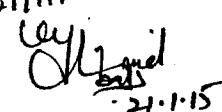
Bidder / Representative of Bidder

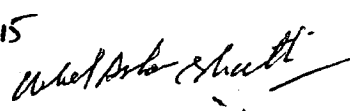


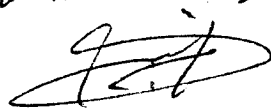
 21.1.2015

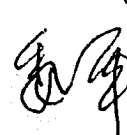
 21/01/15

 21/1/15

 21.1.15







LAWI HYDROPOWER PROJECT (69 MW)

BIDS SUBMISSION CHECKLIST

Date: 21-01-2015, Time 3:00 pm

Name of Bidder: *Sichuan, Sarwar, Silian and chongqing*

S. No.	Checklist	Remarks
1	Is Outer Envelope of Bid Properly Sealed?	YES
2	Is Form of Bid Completed and Signed?	YES
3	Expiry Date of Bid	16.08.2015
4	Is documentary Authority for Signing Enclosed?	NO
5	Amount of Bid Security (as Required)	US\$ 2.00 Million
6	Describe any "Substitution", "Withdrawal" or "Modification" Submitted.	No.
7	Describe any Alternative Bid made	No.
8	Additional Comments	No Authority letter with bid submitter
9	Are All Addenda Acknowledged?	YES
10	Name of Bidder of His Representative who attended the Bid Opening	Muhammad Mujahid

Member of Bid Opening and Evaluation Committee

Signature

Project Director (Lawi HPP)

Director (P&F)

Director (F&A)

Deputy Director (Lawi HPP)

Assistant Director (Lawi HPP)

Project Manager, Management Consultant (ACE)

Contract Specialist, Management Consultant (ACE)

Bidder / Representative of Bidder

[Signature]
21.01.15

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

[Signature]

LAWI HYDROPOWER PROJECT (69 MW)

BIDS SUBMISSION CHECKLIST

Date: 21-01-2015, Time 3:00 pm

Name of Bidder: *ZKB Limak JV*

S. No.	Checklist	Remarks
1	Is Outer Envelope of Bid Properly Sealed?	YES
2	Is Form of Bid Completed and Signed?	YES
3	Expiry Date of Bid	20.10.2015
4	Is documentary Authority for Signing Enclosed?	YES
5	Amount of Bid Security (as Required)	Rs. 200 Mill.
6	Describe any "Substitution", "Withdrawal" or "Modification" Submitted.	NO
7	Describe any Alternative Bid made	NO
8	Additional Comments	NIL
9	Are All Addenda Acknowledged?	YES
10	Name of Bidder or His Representative who attended the Bid Opening	<i>Aliy Ahmed</i>

Member of Bid Opening and Evaluation Committee

Signature

Project Director (Lawi HPP)

Director (P&F)

Director (F&A)

Deputy Director (Lawi HPP)

Assistant Director (Lawi HPP)

Project Manager, Management Consultant (ACE)

Contract Specialist, Management Consultant (ACE)

Bidder / Representative of Bidder

[Signature]
21.01.15

[Signature]

[Signature]

[Signature]

APPENDIX – 3

CONFORMITY OF BID DOCUMENTS

Lawi Hydropower Project

Confirmity of Bid Documents

Dated:
21st January 2015

S/No	Name of Contractors		1. Eligible	2. Reponsive Application		3. Commercially Accepted										4. Result of preliminary Screening
			Applicant is National of an eligible Country	All Letters of Bids duly filled, signed and sealed in accordance with IB 17	Post qualification Application must be substantially complete	Confirmation that applicant is a proper contracting entity			Documents Comprising the Bid							
	JV Name	JV Partners				a) Private Sector Company	b) Independent Public Sector Enterprise	c) Other Public Sector Enterprise	a) Letter of Bid Signed	b) Completed Schedules (A to I)	d) Bid Security valid and in accordance with IB 15	e) Written Confirmation Authorizing the Signatory of the Bid to Commit the Bidder	f) Documentary Evidence in Accordance with IB 13 & 14 establishing the Bidder's Qualification to Perform the Contract	g) Technical Proposal in Accordance with IB 17	h) Conformity to Bid Documents	
1	DESCON - ZOEC JV	DESCON Zhejiang Orient Engineering Co. Ltd (ZOEC)	C	C	C	C	NA	NA	C	C	C	C	C	C	C	C
2	CLIC JV	CLIC HRL	C	C	C	C	NA	NA	C	C	C	C	C	C	C	C
3	Sichuan-Sarwar-Silian-Chongqing Luyang JV	Sichuan Province Geological Engineering Complex Sarwar & Co. (Pvt.) Ltd. Silian Technical Import & Export Co., Ltd, Chongqing Luyang Engineering Design Co. Ltd.	C	C	C	C	NA	NA	C	C	C	C	C	C	C	C
4	ZKB - LIMAK JV	ZKB LIMAK	C	C	C	C	NA	NA	C	C	C	C	C	C	C	C

Total Contractors
Responsive Contractors4
4

C = Conform

NA = Not Applicable

APPENDIX – 4A

GENERAL SCREENING OF TECHNICAL BIDS

Dated: January 21st, 2015

The details for evaluation of technical bid:

DESCON - ZOEC JV

Sr. No.	General Screening of Technical Evaluation of various parameters		Minimum threshold details as per project type	Remarks
i	Experience	General Experience of the firm as per schedule I	Experience under contracts in the role of contractor, subcontractor, or management contractor for at least last Ten (10) years prior to the applications submission deadline.	JV Partner ZOEC has shown 8 years past experience (2005-2013) while as per Schedule I (Past performance and present Commitments) the projects shown outside Pakistan are not certified by concerned country's embassy in Pakistan.
		Particular Experience of the firm as per schedule I	has completed at least one (1) EPC/turnkey Contract with a minimum value of Rs. 13,000 Million (Eq. US \$ 123 M or more) during the last Fifteen (15) years. At least Ten (10) years experience in the field of tunneling and construction of powerhouse.	M/s ZOEC (JV Partner) has shown 1 project (TOROS HPP) on EPC/Turnkey basis with a project cost of USD 130 Million. Sub-contractor Hussain Khan & Co. has shown 4 projects including tunnels construction that fulfills the given criteria (11 Years). However, JV/ MOU with subcontractor is missing.
ii	Competence	Design capacity as per IB 13.4 (a) (ii)	has designed, constructed, supplied and installed at least one similar facility during the last Fifteen (15) years of Rs. 13,000 Million (Eq. US \$ 123 M or more) At least Ten (10) years experience for design of tunnels and powerhouse.	M/s ZOEC (JV Partner) has shown 1 project (TOROS HPP) on EPC/Turnkey basis with a project cost of USD 130 Million. 1 project shown for design of Tunnel while sufficient no. of projects shown for design of powerhouse.
		Construction Schedule / Work methodology / Resource scheduling plan as per schedule B,C and D	Must Meet Requirement	1. Certain key positions including Project Manager already occupied on Ranolia Project. 2. Chinese personnel's CVs doesn't show experience details.
		Available Resources of the firm i.e. Equipment and Manpower as per schedule G	Must Meet Requirement	A no. of Equipments and Tools stated as "will be made available if project awarded"
iii	Performance	Past performance as per schedule I	No negative remarks from any client	
		Current work commitments as per schedule I	No negative remarks from any client	
iv	Financial	Financial soundness as per IB 13.4 (b)	An average annual turnover in the last five years equal to or more than US\$ 50 Million for lead partner while JV partner must meet 25% or above of the above requirement	English translation of Financial Statements for foreign bidders not notarially authenticated.

Note:

- The bidder has provided adequate information regarding its technical and financial capabilities and hence is declared **PASS**.
- Clarifications were asked regarding missing information and the bidder subsequently fulfilled the requirements through its replies.

Dated: January 21st, 2015

The details for evaluation of technical bid:

CLIC JV

Sr. No.	General Screening of Technical Evaluation of various parameters		Minimum threshold details as per project type	Remarks
i	Experience	General Experience of the firm as per schedule I	Experience under contracts in the role of contractor, subcontractor, or management contractor for at least last Ten (10) years prior to the applications submission deadline.	Contractor fulfills the criteria for general experience. However, as per Schedule I (Past performance and present Commitments) the projects shown outside Pakistan are not certified by concerned country's embassy in Pakistan.
		Particular Experience of the firm as per schedule I	has completed at least one (1) EPC/turnkey Contract with a minimum value of Rs. 13,000 Million (Eq. US \$ 123 M or more) during the last Fifteen (15) years. At least Ten (10) years experience in the field of tunneling and construction of powerhouse.	M/s CLIC has shown 1 project (i.e. Lianjiang Tuanpo Hydropower Project) on EPC/Turnkey basis having a project cost of USD 163M. Only 01 project shown with tunnel construction experience.
ii	Competence	Design capacity as per IB 13.4 (a) (ii)	has designed, constructed, supplied and installed at least one similar facility during the last Fifteen (15) years of Rs. 13,000 Million (Eq. US \$ 123 M or more) At least Ten (10) years experience for design of tunnels and powerhouse.	M/s CLIC has shown 1 project (i.e. Lianjiang Tuanpo Hydropower Project) on EPC/Turnkey basis having a project cost of USD 163M. A number of projects shown by M/S Yellow River (Designer)
		Construction Schedule / Work methodology / Resource scheduling plan as per schedule B,C and D	Must Meet Requirement	Double nominations for all Key Positions by both the JV partners.
		Available Resources of the firm i.e. Equipment and Manpower as per schedule G	Must Meet Requirement	
iii	Performance	Past performance as per schedule I	No negative remarks from any client	No detail attached for projects mentioned under schedule I.
		Current work commitments as per schedule I	No negative remarks from any client	No current work commitments shown under schedule I
iv	Financial	Financial soundness as per IB 13.4 (b)	An average annual turnover in the last five years equal to or more than US\$ 50 Million for lead partner while JV partner must meet 25% or above of the above requirement	English translation of Financial Statements for foreign bidders not notarially authenticated.

Note:

1. The bidder has provided adequate information regarding its technical and financial capabilities and hence is declared **PASS**.
2. Clarifications were asked regarding missing information and the bidder subsequently fulfilled the requirements through its replies.

Dated: January 21st, 2015
 Sichuan - Sarwar - Silian -
 Chingqing Luyang JV

The details for evaluation of technical bid:

Sr. No.	General Screening of Technical Evaluation of various parameters		Minimum threshold details as per project type	Remarks
i	Experience	General Experience of the firm as per schedule I	Experience under contracts in the role of contractor, subcontractor, or management contractor for at least last Ten (10) years prior to the applications submission deadline.	Contractor fulfills the criteria for general experience. However, as per Schedule I (Past performance and present Commitments) the projects shown outside Pakistan are not certified by concerned country's embassy in Pakistan..
		Particular Experience of the firm as per schedule I	has completed at least one (1) EPC/ turnkey Contract with a minimum value of Rs. 13,000 Million (Eq. US \$ 123 M or more) during the last Fifteen (15) years. At least Ten (10) years experience in the field of tunneling and construction of powerhouse.	M/s Sichuan Province Geological Engineering Complex (Lead Partner) has mentioned one project (Kazi HPP) on EPC/ Turnkey basis which fulfills the required criteria Two projects mentioned (Kazi HPP & LUYE HPP)
ii	Competence	Design capacity as per IB 13.4 (a) (ii)	has designed, constructed, supplied and installed at least one similar facility during the last Fifteen (15) years of Rs. 13,000 Million (Eq. US \$ 123 M or more) At least Ten (10) years experience for design of tunnels and powerhouse.	M/s Sichuan Province Geological Engineering Complex (Lead Partner) has mentioned one project (Kazi HPP) which fulfills the required criteria Two projects mentioned (Kazi HPP & LUYE HPP)
		Construction Schedule / Work methodology / Resource scheduling plan as per schedule B,C and D	Must Meet Requirement	
		Available Resources of the firm i.e. Equipment and Manpower as per schedule G	Must Meet Requirement	
iii	Performance	Past performance as per schedule I	No negative remarks from any client	Not substantiated with certification from concerned country's embassy
		Current work commitments as per schedule I	No negative remarks from any client	Not substantiated with certification from concerned country's embassy
iv	Financial	Financial soundness as per IB 13.4 (b)	An average annual turnover in the last five years equal to or more than US\$ 50 Million for lead partner while JV partner must meet 25% or above of the above requirement	English translation of Financial Statements for foreign bidders not notarially authenticated.

Note:

1. The bidder has provided adequate information regarding its technical and financial capabilities and hence is declared **PASS**.
2. Clarifications were asked regarding missing information and the bidder subsequently fulfilled the requirements through its replies.

Dated: January 21st, 2015

The details for evaluation of technical bid:

ZKB - LIMAK JV

Sr. No.	General Screening of Technical Evaluation of various parameters		Minimum threshold details as per project type	Remarks
i	Experience	General Experience of the firm as per schedule I	Experience under contracts in the role of contractor, subcontractor, or management contractor for at least last Ten (10) years prior to the applications submission deadline.	Contractor fulfills the criteria for general experience. However, as per Schedule I (Past performance and present Commitments) the projects shown outside Pakistan are not certified by concerned country's embassy in Pakistan.
		Particular Experience of the firm as per schedule I	has completed at least one (1) EPC/ turnkey Contract with a minimum value of Rs. 13,000 Million (Eq. US \$ 123 M or more) during the last Fifteen (15) years. At least Ten (10) years experience in the field of tunneling and construction of powerhouse.	M/s LIMAK has shown 2 projects which fulfills the criteria for specific experience. Three projects shown with experience in tunnel construction.
ii	Competence	Design capacity as per IB 13.4 (a) (ii)	has designed, constructed, supplied and installed at least one similar facility during the last Fifteen (15) years of Rs. 13,000 Million (Eq. US \$ 123 M or more) At least Ten (10) years experience for design of tunnels and powerhouse.	M/s LIMAK has shown 2 projects which fulfills the criteria for design capacity. Three projects shown with experience in tunnel design.
		Construction Schedule / Work methodology / Resource scheduling plan as per schedule B,C and D	Must Meet Requirement	
		Available Resources of the firm i.e. Equipment and Manpower as per schedule G	Must Meet Requirement	
iii	Performance	Past performance as per schedule I	No negative remarks from any client	Not substantiated with certification from concerned country's embassy
		Current work commitments as per schedule I	No negative remarks from any client	Not substantiated with certification from concerned country's embassy
iv	Financial	Financial soundness as per IB 13.4 (b)	An average annual turnover in the last five years equal to or more than US\$ 50 Million for lead partner while JV partner must meet 25% or above of the above requirement	English translation of Financial Statements for foreign bidders not notarially authenticated.

Note:

1. The bidder has provided adequate information regarding its technical and financial capabilities and hence is declared **PASS**.

2. Clarifications were asked regarding missing information and the bidder subsequently fulfilled the requirements through its replies.

APPENDIX – 4B & 4C

FINANCIAL SITUATION

Construction of 69MW Lawi Hydropower Project

Evaluation of Bidding Documents

Financial Situation

Dated: January 21st, 2015									
Applicant Ref.	Applicant Name	Entity / Group	Net Worth (NW)					Pass/Fail	
			Specified Currency	2010-11	2011-12	2012-13	2013-14		Avg NW US \$ M
1	DESCON - ZOEC JV	DESCON	USD Million		142.35	172.61	147.26	154.07	pass
		ZOEC	USD Million	19.61	37.23	52.94		36.59	Pass
2	CLIC JV	CLIC	USD Million	258.90	291.00	316.29		288.73	Pass
		HRL	USD Million	21.83	23.90	23.08		22.93	Pass
3	Sichuan - Sarwar - Sillan - Chongqing Luyang JV	Sichuan Province Geological Engineering Complex	USD Million	2.18	2.44	2.66	2.77	2.51	Pass
		M/s Sarwar & Co. (Pvt.) Ltd.	USD Million	12.37	15.51	15.86		14.58	Pass
		Silian Technical Import & Export Co., Ltd,	USD Million		68.57	70.75	75.51	71.61	Pass
		Chongqing Luyang Engineering Design Co. Ltd.	USD Million	0.73	0.93	1.13	1.28	1.02	Pass
4	ZKB - LIMAK JV	ZKB	USD Million	48.68	49.06	52.62		50.12	Pass
		LIMAK	USD Million	703.50	789.09	694.04		728.88	Pass

Construction of 69MW Lawi Hydropower Project

Evaluation of Bidding Applications

Financial Situation

Dated: January 21st, 2015

Applicant. Ref.	Applicant Name	Entity / Group	Annual Construcion Turn over (US\$ 50 Million)							Present Commitments M US\$	Audit Sheet Attached (Y / N)	Pass/Fail
			Specified Currency	2010-11	2011-12	2012-13	2013-14	Given currency	In M US\$			
1	DESCON - ZOEC JV	DESCON	USD M		478.40	501.22	404.01	461.21	461.21	634.00	Y	Pass
		ZOEC	USD M	18.66	36.78	52.26		35.90	35.90	133.00	Y	Pass
2	CLIC JV	CLIC	USD M	310.80	306.00	288.10		301.63	301.63	168.62	Y	Pass
		HRL	USD M	45.47	55.40	51.47		50.78	50.78	31.59	Y	Pass
3	Sichuan - Sarwar - Silian - Chongqing Luyang JV	Sichuan Province Geological Engineering Complex	USD M	89.21	90.78	93.49	94.82	92.07	92.07	67.85	Y	Pass
		M/s Sarwar & Co. (Pvt.) Ltd.	USD M	19.07	28.53	20.68		22.76	22.76	9.03	Y	Pass
		Silian Technical Import & Export Co., Ltd.	USD M		63.80	114.46	130.70	102.99	102.99	39.50	Y	Pass
		Chongqing Luyang Engineering Design Co. Ltd.	USD M	16.28	17.04	18.25	16.86	17.11	17.11	0.79	Y	Pass
4	ZKB - LIMAK JV	ZKB	USD M		76.99	108.28	115.12	100.13	100.13	37.28	Y	Pass
		LIMAK	USD M		607	590	625	607.52	607.52	558.48	Y	Pass

APPENDIX – 5

PRELIMINARY EXAMINATION OF TECHNICAL BIDS

Table 5: Preliminary Examination of Technical Bids

Dated: January 21st, 2015

Sr. No.	Description	Tender documents Reference page	Bidder's Name: DESCON-ZOEC JV	
			Result	Remarks
1	Bid			
1.1	The Bidders' representatives who are present shall sign in a register evidencing their attendance.	I-21	Y	
1.2	ORIGINAL and four (04) COPIES of the original Technical Bid and Price Bid shall be separately sealed and put in separate envelopes and marked as such.	I-18	Y	
1.3	Letter of Bid (filled & signed)	I-56	Y	
1.4	Bid Security (Amount, format and Validity Period)	I-17	Y	
1.5	Technical Proposal & Schedules to Bid	I-55		
	(A) Specific Works Data	I-58	Y	
	(B) Proposed Organization for the Project	I-59	Y	
	(C) Method of performing Works	I-62	Y	
	(D) Proposed programme of Works	I-64	Y	
	(E) Works to be Performed by Subcontractors	I-65	Y	
	(F-1) Deviations from Technical Provisions	I-66	Y	
	(F-2) Deviations from Contractual Conditions	I-67	Y	
	(G) Specific Operation/Plant and Equipement Detail	I-68	Y	
	(H) Specimen JV Agreement (Notorily Authenticated)	I-73	Y	
	(I) Past Performance and Present Commitments	I-74	Y	
1.6	Appendix B Instructions to Bidders	I-35		
	(B1) Bidder's Information (with attachments)	I-37	Y	
	(B2) JV Information (with attachments)	I-38	Y	
	(B3) Financial Situation (with attachments)	I-39	Y	

Sr. No.	Description	Reference page	Bidder's Name: DESCON-ZOEC JV	
			Result	Remarks
	(B4) Average Annual Turnover	I-40	Y	
	(B5) Specific Experience	I-41	Y	
	(B6) Manufacturing facility Information	I-42	Y	
	(B7) Quality Control Facility	I-43	Y	
	(B8-a) Personnel	I-44	Y	
	(B8-b) Resume of Proposed Personnel	I-46	Y	
	(B9) List of Similar Works Done by the Bidder's Manufacturer(s)	I-47	Y	
	(B10) Projects Contractual Commitments	I-48	Y	
	(B11) Financial Resources	I-49	Y	
	(B12) Health, Safty & Emergency Plan	I-50	Y	
	(B13) Training & Employment Plan	I-51	Y	
	(B14) Litigation or Arbitration	I-52	Y	
2	Propriety of Signature and Completeness			
2.1	Power of Attorney	I-15	Y	
2.2	Form of Bid Security	II-103	Y	
3	Acceptance for Detailed Examination		Yes	

Y = Yes N = No

P = Partial NA = Not Applicable

Table 5: Preliminary Examination of Technical Bids

Dated: January 21st, 2015

Sr. No.	Description	Tender documents Reference page	Bidder's Name: CLIC JV	
			Result	Remarks
1	Bid			
1.1	The Bidders' representatives who are present shall sign in a register evidencing their attendance.	I-21	Y	
1.2	ORIGINAL and four (04) COPIES of the original Technical Bid and Price Bid shall be separately sealed and put in separate envelopes and marked as such.	I-18	Y	
1.3	Letter of Bid (filled & signed)	I-56	Y	
1.4	Bid Security (Amount, format and Validity Period)	I-17	Y	
1.5	Technical Proposal & Schedules to Bid	I-55		
	(A) Specific Works Data	I-58	Y	
	(B) Proposed Organization for the Project	I-59	Y	
	(C) Method of performing Works	I-62	Y	
	(D) Proposed programme of Works	I-64	Y	
	(E) Works to be Performed by Subcontractors	I-65	Y	
	(F-1) Deviations from Technical Provisions	I-66	Y	
	(F-2) Deviations from Contractual Conditions	I-67	Y	
	(G) Specific Operation/Plant and Equipement Detail	I-68	Y	
	(H) Specimen JV Agreement (Notorily Authenticated)	I-73	Y	
	(I) Past Performance and Present Commitments	I-74	Y	
1.6	Appendix B Instructions to Bidders	I-35		
	(B1) Bidder's Information (with attachments)	I-37	Y	
	(B2) JV Information (with attachments)	I-38	Y	
	(B3) Financial Situation (with attachments)	I-39	Y	

Sr. No.	Description	Reference page	Bidder's Name: CLIC JV	
			Result	Remarks
	(B4) Average Annual Turnover	I-40	Y	
	(B5) Specific Experience	I-41	Y	
	(B6) Manufacturing facility Information	I-42	Y	
	(B7) Quality Control Facility	I-43	Y	
	(B8-a) Personnel	I-44	Y	Key persons nominated by both JV partners. Clarification required.
	(B8-b) Resume of Proposed Personnel	I-46	Y	-do-
	(B9) List of Similar Works Done by the Bidder's Manufacturer(s)	I-47	Y	
	(B10) Projects Contractual Commitments	I-48	Y	
	(B11) Financial Resources	I-49	Y	
	(B12) Health, Safety & Emergency Plan	I-50	Y	
	(B13) Training & Employment Plan	I-51	Y	
	(B14) Litigation or Arbitration	I-52	Y	
2	Propriety of Signature and Completeness			
2.1	Power of Attorney	I-15	Y	
2.2	Form of Bid Security	II-103	Y	
3	Acceptance for Detailed Examination		Yes	

Y = Yes N = No

P = Partial NA = Not Applicable

Table 5: Preliminary Examination of Technical Bids

Dated: January 21st, 2015

Sr. No.	Description	Tender documents Reference page	Bidder's Name: Sichuan-Sarwar-Silian-Chongqing Luyong JV	
			Result	Remarks
1	Bid			
1.1	The Bidders' representatives who are present shall sign in a register evidencing their attendance.	I-21	Y	
1.2	ORIGINAL and four (04) COPIES of the original Technical Bid and Price Bid shall be separately sealed and put in separate envelopes and marked as such.	I-18	Y	
1.3	Letter of Bid (filled & signed)	I-56	Y	
1.4	Bid Security (Amount, format and Validity Period)	I-17	Y	
1.5	Technical Proposal & Schedules to Bid	I-55		
	(A) Specific Works Data	I-58	Y	
	(B) Proposed Organization for the Project	I-59	Y	
	(C) Method of performing Works	I-62	Y	
	(D) Proposed programme of Works	I-64	Y	
	(E) Works to be Performed by Subcontractors	I-65	Y	
	(F-1) Deviations from Technical Provisions	I-66	Y	Clarification required for deviation note
	(F-2) Deviations from Contractual Conditions	I-67	Y	
	(G) Specific Operation/Plant and Equipment Detail	I-68	Y	
	(H) Specimen JV Agreement (Notorily Authenticated)	I-73	N	JV Agreement not notorily authenticated.
	(I) Past Performance and Present Commitments	I-74	Y	
1.6	Appendix B Instructions to Bidders	I-35		
	(B1) Bidder's Information (with attachments)	I-37	Y	
	(B2) JV Information (with attachments)	I-38	Y	
	(B3) Financial Situation (with attachments)	I-39	Y	

Sr. No.	Description	Reference page	Bidder's Name: Sichuan-Sarwar-Silian-Chongqing Luyong JV	
			Result	Remarks
	(B4) Average Annual Turnover	I-40	Y	
	(B5) Specific Experience	I-41	Y	
	(B6) Manufacturing facility Information	I-42	Y	
	(B7) Quality Control Facility	I-43	Y	
	(B8-a) Personnel	I-44	Y	
	(B8-b) Resume of Proposed Personnel	I-46	Y	
	(B9) List of Similar Works Done by the Bidder's Manufacturer(s)	I-47	Y	
	(B10) Projects Contractual Commitments	I-48	Y	
	(B11) Financial Resources	I-49	Y	
	(B12) Health, Safty & Emergency Plan	I-50	Y	
	(B13) Training & Employment Plan	I-51	Y	
	(B14) Litigation or Arbitration	I-52	Y	
2	Propriety of Signature and Completeness			
2.1	Power of Attorney	I-15	Y	
2.2	Form of Bid Security	II-103	Y	
3	Acceptance for Detailed Examination		Yes	

Y = Yes N = No

P = Partial NA = Not Applicable

Table 5: Preliminary Examination of Technical Bids

Dated: January 21st, 2015

Sr. No.	Description	Tender documents	Bidder's Name: ZKB-LIMAK JV	
			Result	Remarks
1	Bid			
1.1	The Bidders' representatives who are present shall sign in a register evidencing their attendance.	I-21	Y	
1.2	ORIGINAL and four (04) COPIES of the original Technical Bid and Price Bid shall be separately sealed and put in separate envelopes and marked as such.	I-18	Y	
1.3	Letter of Bid (filled & signed)	I-56	Y	
1.4	Bid Security (Amount, format and Validity Period)	I-17	Y	
1.5	Technical Proposal & Schedules to Bid	I-55		
	(A) Specific Works Data	I-58	Y	
	(B) Proposed Organization for the Project	I-59	Y	
	(C) Method of performing Works	I-62	Y	
	(D) Proposed programme of Works	I-64	Y	
	(E) Works to be Performed by Subcontractors	I-65	Y	Clarification needed regarding given options '1' & '2'. Agreement with Andritz missing
	(F-1) Deviations from Technical Provisions	I-66	Y	
	(F-2) Deviations from Contractual Conditions	I-67	Y	
	(G) Specific Operation/Plant and Equipement Detail	I-68	Y	
	(H) Specimen JV Agreement (Notorily Authenticated)	I-73	Y	
	(I) Past Performance and Present Commitments	I-74	Y	
1.6	Appendix B Instructions to Bidders	I-35		
	(B1) Bidder's Information (with attachments)	I-37	Y	
	(B2) JV Information (with attachments)	I-38	Y	
	(B3) Financial Situation (with attachments)	I-39	Y	

Sr. No.	Description	Reference page	Bidder's Name: ZKB-LIMAK JV	
			Result	Remarks
	(B4) Average Annual Turnover	I-40	Y	
	(B5) Specific Experience	I-41	Y	
	(B6) Manufacturing facility Information	I-42	Y	
	(B7) Quality Control Facility	I-43	Y	
	(B8-a) Personnel	I-44	Y	
	(B8-b) Resume of Proposed Personnel	I-46	Y	
	(B9) List of Similar Works Done by the Bidder's Manufacturer(s)	I-47	Y	
	(B10) Projects Contractual Commitments	I-48	Y	
	(B11) Financial Resources	I-49	Y	
	(B12) Health, Safty & Emergency Plan	I-50	Y	
	(B13) Training & Employment Plan	I-51	Y	
	(B14) Litigation or Arbitration	I-52	Y	
2	Propriety of Signature and Completeness			
2.1	Power of Attorney	I-15	Y	Bid signed by single person against 3 nominated representatives
2.2	Form of Bid Security	II-103	Y	
3	Acceptance for Detailed Examination		Yes	

Y = Yes N = No

P = Partial NA = Not Applicable

APPENDIX – 6A

DETAILED EVALUATION OF TECHNICAL BIDS (CIVIL)

Construction of Lawi Hydropower Project
Evaluation of Technical Requirements (Civil) of Substantively Responsive Bidders

Dated: 21st January 2015

Sr. No.	Section	Scope of Civil Works	BIDDERS			
			DESCON- ZOEJ JV	CLIC JV	Sichuan-Sarwar- Silian- Chongqing Luyong JV	ZKB-LIMAK JV
1	Part I Section3	SPECIFIC WORKS DATA	Y	Y	Y	Y
2	Part I Section3	PROPOSED ORGANIZATION FOR THE PROJECT	Y	Y	Y	Y
3	Part I Section3	PERSONNEL	Y	Y	Y	Y
4	Part I Section3	METHOD OF PERFORMING WORKS	Y	Y	Y	Y
5	Part I Section3	PROPOSED PROGRAMME OF WORKS	Y	Y	Y	Y
6	Part I Section3	WORKS TO BE PERFORMED BY SUBCONTRACTORS	Y	Y	Y	Y
7	Part I Section3	DEVIATIONS	Y	Y	Y	Y
8	Part I Section3	SPECIFIC OPERATION/PLANT AND EQUIPMENT DETAIL	Y	Y	Y	Y
9	Part I Section3	JV AGREEMENT	Y	Y	Y	Y
10	Part I Section3	PAST PERFORMANCE AND PRESENT COMMITMENTS	Y	Y	Y	Y
11	Part I Section2	HEALTH, SAFETY & EMERGENCY PLAN	Y	Y	Y	Y
12	Part I Section2	TRAINING & EMPLOYMENT PLAN	Y	Y	Y	Y
13	Part IIISection 1.2.4.1	WEIR AND DIVERSION WORKS	Y	Y	Y	Y
14	Part IIISection 1.2.4.2	LATERAL INTAKE	Y	Y	Y	Y
15	Part IIISection 1.2.4.3	CONNECTION TUNNEL	Y	Y	Y	Y
16	Part IIISection 1.2.4.4	TRANSITION CHAMBER	Y	Y	Y	Y
17	Part IIISection 1.2.4.5	UNDERGROUND SEDIMENTATION BASIN/ CHAMBER	Y	Y	Y	Y
18	Part IIISection 1.2.4.6	HEADRACE TUNNEL	Y	Y	Y	Y
19	Part IIISection 1.2.4.7	SURGE SHAFT/ CHAMBER	Y	Y	Y	Y
20	Part IIISection 1.2.4.8	CONCRETE LINED PRESSURE TUNNEL	Y	Y	Y	Y
21	Part IIISection 1.2.4.9	STEEL LINED PRESSURE TUNNEL	Y	Y	Y	Y
22	Part IIISection 1.2.4.10	POWERHOUSE	Y	Y	Y	Y
23	Part IIISection 1.2.4.11	TAILRACE	Y	Y	Y	Y
24	Part IIISection 1.2.4.12	132kV SWITCHYARD	Y	Y	Y	Y
25	Part IIISection 1.2.5	HYDRAULIC STEEL WORKS	Y	Y	Y	Y
26	Part IIISection 1.3.1	BID SUBMISSION	Y	Y	Y	Y
		Design Criteria	Y	Y	Y	Y
		Design Parameters and Methodology	Y	Y	Y	Y
		Construction Work Schedule	Y	Y	Y	Y
		Tender Design Report covering basic design of Civil Works	Y	Y	Y	Y
		Hydraulic Design	Y	Y	N	N
		Head Loss Calculations	Y	N	N	N
		Power and Energy Studies	N	N	N	N
		Specifications	Y	N	N	Y
		Tender Drawings for Civil Works	Y	Y	Y	Y
		Outline Training Programme	Y	Y	Y	Y

**Construction of Lawi Hydropower Project
Evaluation of Technical Requirements (Civil) of Substantively Responsive Bidders**

Dated: 21st January 2015

Sr. No.	Section	Scope of Civil Works	BIDDERS			
			DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Linyong JV	ZKB-LIMAK JV
27	Part IIISection 2.1	CODES & STANDARDS FOR CIVIL WORKS	Y	N	Y	Y
28	Part IIISection 2.6	QUALITY ASSURANCE & QUALITY CONTROL	Y	Y	Y	Y
29	Part IIISection 2.8	EMPLOYERS FIELD FACILITIES				
		Main Field Offices	N	N	N	N
		Mosque	N	N	N	N
		Residential Accomodation	N	N	N	N
		Vehicles	N	N	N	N
		Site Communication	N	N	N	N
30	Part IIISection 2.9	UTILITIES				
		Water Supply System	N	N	N	N
		Water Distribution System	N	N	N	N
		Sewerage System	N	N	N	N
31	Part IIISection 2.10	ENVIRONMENTAL PROTECTION & MISCELLANEOUS	Y	Y	Y	Y
32	Part IIISection 2.11	PROJECT SIGNS	N	N	N	N

Note: Client generated clarification letters regarding missing information in the bids as stated above. Bidders provided their replies in his regard which are attached as Appendix 7 ~ 10.

APPENDIX – 6B

DETAILED EVALUATION OF TECHNICAL BIDS (E & M)

Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

Dated: 21st January 2015

Sr. No.	SECTION	DESCRIPTION	DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyong JV	ZKB-LIMAK JV
	Part III Section 1	MECHANICAL EQUIPMENT				
1	1.2.2.2	Turbines	Y	Y	Y	Y
		Type	Y	FC (6 Jet)	Y	FC (6 Jet)
		Turbine rated Out put	Y (23.98)	Y	Y	Y
		Rated Net Head	Y	Y	Y	Y
		Rated Turbine Speed (n)	Y	Y	Y	Y
		Turbine Runaway Speed (nr)	N (853)	Y	Y	Y
		Regulation	N	FC	Y	FC
		Unit Discharge	Y	Y	Y	Y (6.59)
		Efficiency	Y	Y	FC (91.5)	Y
		No. of Units	Y	Y	Y	Y
2	1.2.2.3	Inlet Valve	Y	Y	Y	Y
		Inner Diameter	FC (1.1m)	FC (1.1m)	FC (1.1m)	FC (1.1m)
		Design Head	FC	FC	Y	FC
		Sealing System	FC	Y	Y	Y
3	1.2.2.4	Governor System	Y	Y	Y	Y
		Type	Y	Y	Y	Y
4	1.2.2.5	Powerhouse Crane	Y	Y	Y	Y
a		Bridge Crane	Y	Y	Y	Y
		Capacity	Y	Y	Y	Y
		Span	Y	Y	Y	Y
		Traveling & Hoisting Speed	Y	Y	Y	Y
		auxiliary hoist capacity	Y	Y	Y	Y
b		Mobile Crane	Y	N	Y	Y
		Capacity	Y	Y	Y	Y
		Radius of beam	Y	Y	Y	Y
5	1.2.2.6	Elevator	Y	N	N	N
		Passenger Elevator	Y	N	N	N
		Capacity	Y	N	N	N
6	1.2.2.7	Workshop Equipment & Tools	Y	Y	N	Y
		Electric Shop	Y	Y	N	Y
		Machin Shop	Y	Y	N	Y
		Portable Equipment	Y	Y	N	Y
7	1.2.2.5	Auxiliary Systems	Y	Y	Y	Y
		Cooling Water System	Y	Y	Y	Y

**Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders**

Dated: 21st January 2015

Sr. No.	SECTION	DESCRIPTION	DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyong JV	ZKB-LIMAK JV
		Drainage dewatering system	YES	Y	Y	Y
		Station water services	YES	FC	Y	Y
		Portable and service water system	YES	Y	Y	Y
		Transformer and lubricating oil handling facilities	YES	Y	Y	Y
		Sewage treatment system	YES	FC	Y	Y
		Monitoring Equipment, heating/ ventilating & air conditioning	YES	Y	Y	Y
		Fire fighting protection & detection system	YES	Y	FC	FC
8	1.2.3	ELECTRICAL EQUIPMENT				
	1.2.3.2	Generator	Y	Y	Y	Y
		Nominal Capacity	27.4 MVA (23MW)	Y	Y (27.058MVA)	Y (27.058MVA)
		Nominal Speed	500rpm	Y	Y	Y
		Runaway Speed	900rpm	FC (853)	Y	Y
		Nominal Voltage	11Kv/50Hz	Y	Y	Y
		Generator Efficiency	97%	FC	Y (97.5)	Y (97.5)
		Protection Class	IP44	FC	FC	Y (97.72)
		Insulation Class	F	Y	FC	FC
		Temperature Rise	B	FC	FC	FC
		Cooling	Air/Water	Y	Y	Y
		Power Factor cos Φ	0.85	Y	Y	Y
15	1.2.3.3	Excitation	Y	Y	Y	N
		Type	Static or Rotary	Y	Y	FC
16	1.2.3.4	Main Transformers (3 No.s)	Y	Y	Y	N
		Function	Step up	Y	Y	Y
		Rated Output	30 MVA	Y	Y	Y
		Primary Voltage Secondary Voltage	11 kV 132 kV	Y	Y	Y
		Frequency	50Hz	Y	Y	Y
		Temperature Rise	55o C	Y	FC	FC
		Power Factor	0.8	Y	FC	FC
		Tap changer	On Load	Y	Y	Y
		Vector group	YN d11	Y	Y	Y
		Impedence	9-12 %	Y	Y	FC
		Cooling	ONAN/ONAF/OFWF	Y	Y	Y

Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

Dated: 21st January 2015

Sr. No.	SECTION	DESCRIPTION	DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyong JV	ZKB-LIMAK JV
17		Service station Transformer (1 No.s)	Y	Y	Y	Y
		Function	Step Down	Y	FC	Y
		Rated Output	5MVA	Y	FC	Y
		Primary Voltage	132 kV	Y	FC	Y
		Secondary volatage	11kV	Y	FC	Y
		Frequency	50Hz	Y	FC	Y
		Temperature Rise	55o C	Y	FC	FC
		Power Factor	0.8	Y	FC	FC
		Vector group	Dyn 11	Y	FC	Y
		Impedence	9 - 10 %	Y	FC	Y
		Cooling	ONAN	Y	FC	Y
17		Auxiliary Transformers	Y	Y	Y	Y
		Function	Powerhouse/ intake	Y	Y	Y
		Rated Output	0.2 MVA	Y	Y	Y
		Primary Voltage	11KV	Y	Y	Y
		Secondary volatage	0.4KV	Y	Y	Y
		Frequency	50Hz	Y	Y	Y
		Power Factor	0.8	Y	FC	FC
		Tap changer	Off Load	Y	FC	Y
		Vector group	Dyn 11	Y	Y	Y
		Impedence	5 - 6 %	Y	FC (4%)	FC (4%)
		Cooling	ONAN	Y	Y	Y
1.2.3.5		Switchyard (132 kV)	Y	Y	Y	Y
		Installation of Equipment	outdoor-type	Y	Y	Y
		Highest Voltage for 132 kV Equipment	145kV	Y	Y	Y
		Rated short circuit current (1s)	21kA	Y (31.5)	Y (31.5)	Y (31.5)
		Rated Impulse withstand voltage	650kV (to earth)	Y	Y	Y
18	1.2.3.4	Medium Voltage Installations (11 kV)	Y	Y	Y	Y
		Type	vacuum type	FC	FC	FC
		Max. Voltage	33 KV	FC (15kv)	FC	FC (12kv)
		Short Circuit Current	21 KA	Y (31.5)	FC	FC
19	1.2.3.4	Low Voltage Installations AC Supply (0.4 kV)	Y	Y	Y	Y

Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

Dated: 21st January 2015

Sr. No.	SECTION	DESCRIPTION		DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyong JV	ZKB-LIMAK JV
		Source of Supply	Two 11/0.4kV stepdown transformers (500KVA) plus additional unit auxiliary transformer from 11 KV line and a stand by diesel generating set.				
20	1.2.3.4	Low Voltage DC Supply		Y	Y	Y	Y
		Type	Independent double battery system	Y			
		Function	Supply power to the complete Plant Control System, the Local Control System, and the control voltage for hardwired part of this system and DC equipment for black start purpose.	Y		Y	
		DC Supply voltage	220 V	Y		Y	
		Battery Rating	1200 Ah	Y		Y	
		Battery Voltage for telecommunication & Computer	24 or 48 V	Y		FC	
21	1.2.3.5	Control & Alarm System		Y	Y	Y	Y
		Plant control system PCS	Complete Set				
		Unit control system UCS	Complete Set				
		Data Communication System DCS	Complete Set			Y	
		Communication between PCS & UCS	Fiber Optics (SCADA)				
22	1.2.3.8	Generator Protection		Y	Y	Y	Y
		Relays	Single multifunction, digital modular design				
		Operating Voltage	220 V DC from 20% to + 10%				
23	1.2.3.9	Telecommunication		Y	Y	Y	Y
		Type	Digital	Y	FC	FC	FC
		PABX	As required	Y	FC	FC	FC
		Internet facility	Yes	Y	FC	FC	FC
24	1.2.3.8	External communication		Y	Y	Y	Y
		Link	WAPDA Grid & power House				
		Type	Both Fiber Optics Cable & Radio Communication				
25	1.2.3.9	Lighting and small power		Y	Y	Y	Y
26	1.2.3.11	Emergency Diesel set		Y	Y	Y	Y
			333 KVA				
27	1.2.3.12	Earthing System		N	Y	Y	Y
		Type	Mesh and Independent		Y		Y

**Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders**

Dated: 21st January 2015

Sr. No.	SECTION	DESCRIPTION		DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyong JV	ZKB-LIMAK JV
		Earth resistance	< 0.16 ohm	FC	FC (<1 Ohm)	0.19ohm	FC (<1 Ohm)
29	1.2.3.13	Transmission Line and Interconnection		Y	N	FC	N
		Conductor	ACSR	Y	FC		FC
		Other specification	As per WAPDA system	Y	FC		FC
30	1.2.3.14	Transmission Line (11KV)		Y	Y	FC	Y
30	1.2.3.14	400V Distribution line for Colony	As per WAPDA system	Y	Y		Y
31	1.1.3.1	Mandatory Spare Parts	As per Specifications	Y	Y		Y
32	1.1.3.2	Tool and Appliances	As per Specifications	Y	Y		Y
33	1.2.2.7	Workshop Equipment	As per Specifications	Y	Y		Y

Y = Yes

FC = Further Clarification

N = No.

Note: Client generated clarification letters regarding missing information in the bids as stated above. Bidders provided their replies in his regard which are attached as Appendix 7 ~ 10.

APPENDIX – 7

CLARIFICATION REPLIES (DESCON-ZOEC JV)



Reference No. IP/LAW/205

Dated: February 11, 2015

Project Director
Lawi Hydropower Project
Pakhtunkhwa Energy Development Organization
110 - PEDO House, 38/B2, Phase-V, Hayatabad
Peshawar

Dear Sir,

**SUBJECT - MISSING INFORMATION REGARDING CIVIL / E & M WORKS AS REQUIRED IN THE
BIDDING - LAWI Hydropower Project (69 MW)**

Reference: 1821/PEDO/PD LAWI-HPP, dated February 06, 2015

- 1) This bears on your letter at reference given above whereby at Point # 3 we are required to clarify for the attached three (3) Pages.

In compliance to the above requirement, please find M/S DESCON-ZOEC JV clarifications attached as Annex-1 (4 sheets) of this letter.

- 2) This bears on your letter at reference given above whereby at Point # 4 we are required to conform that M/S DESCON - ZOEC JV will complete the project as per stipulations of the Bid Documents of 69 MW Lawi HPP including addendum # 1, 2 & 3 of the bidding documents. In compliance with the aforesaid, we submit as follows:

"We hereby conform that M/S DESCON - ZOEC JV will complete the project as per the stipulations of the Bid Documents of 69 MW Lawi HPP, including addendum # 1, 2 & 3 of the bidding documents".

With the above submissions, the requisites as contained vide Point # 3 & # 4 of your letter at Reference given above stand fulfilled.

Yours Truly

Khalid Javid Iqbal

Khalid Javid Iqbal
Proposal Manager
DESCON - ZOEC JV



CC.

- 1) Director (P & F) PEDO, Peshawar
- 2) Project Manager / Team Leader, MC for 69MW Lawi HPP
- 3) PS to Chief Executive Officer PEDO, Peshawar

DESCON ENGINEERING LIMITED

Desccon Headquarters, 18-Km. Ferozepur Road, PO Box 1201 Lahore-54760, Pakistan
UAN: 42 (11) 337 266. T: +92 42 3599 0034 F: +92 42 3581 1005 E: desccon@desccon.com W: www.desccon.com

DESCON - ZOEC JV
Construction of Lawi Hydropower Project
Evaluation of Technical Requirements (Civil) of Substantively Responsive Bidders

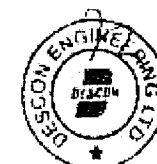
Section		Scope of Civil Works	Bidders' provided data	Bidders' Response
Part III Section 2.8	EMPLOYERS FIELD FACILITIES	Main Field Offices	not specified	DESCON - ZOEC JV confirms the full compliance as per Client's Bid Documents.
		Mosque	not specified	
		Residential Accomodation	not specified	
		Vehicles	not specified	
		Site Communication	not specified	
Part III Section 2.9	UTILITIES			
		Access roads (7m width)	not specified	Although Part III Section 2.9 of Bid Documents does not have any referral of specific width of road i.e 7.0m, yet DESCON - ZOEC JV heraby confirms that Access Roads of 7.0m width in Employer Field Facilities shall be provided.
		Water Supply System	not specified	DESCON - ZOEC JV confirms the full compliance as per Bid Documents.
		Water Distribution System	not specified	
		Sewerage System	not specified	
Part III Section 2.11	PROJECT SIGNS		not specified	

Handwritten signature and date 26/10/14



DESCON - ZOEC JV
Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

SECTION		DESCRIPTION	Bidder's quoted values	Bidder's Response
Part III Section 1	MECHANICAL EQUIPMENT			
1.2.2.2	Turbines			
	Turbine Runaway Speed (nr)	900 RPM	853 RPM	DESCON - ZOEC JV confirms the compliance of Turbine Runaway speed as 900 RPM.
	Regulation	Double Regulated	Not specified	DESCON - ZOEC JV confirms the compliance of Regulation as Double Regulated.
1.2.2.3	Inlet Valve			
	Inner Diameter	950mm	1.1m	The inlet valve is selected based on the turbine spiral distributor diameter. As per Turbine designer, spiral distributor diameter shall be 1100mm at least. Hence, the inlet valve of 1100mm dia is chosen. If 950mm valve is chosen, a reducing pipe is needed between inlet valve and turbine. Normally, the reducing pipe will be one meter long, which will increase the power house size. Further, 1100mm dia of inlet valve instead of 950mm dia, will lower the water velocity in the pipe line, and as a result, the water head loss will be decreased.
	Design Head	535 m WC	Not specified	DESCON - ZOEC JV confirms the compliance of Design Head as 535 m WC.
	Sealing System	Cast Steel	Not specified	DESCON - ZOEC JV confirms the compliance of Sealing System as Cast Steel



1.2.2.5	Auxiliary Systems			
	Station water services	YES	Not specified	DESCON - ZOEC JV confirms the full compliance of Auxiliary Systems of Plant.
	Sewage treatment system	YES	Not specified	
1.2.3	ELECTRICAL EQUIPMENT			
1.2.3.2	Generator			
	Runaway Speed	900rpm	853rpm	DESCON - ZOEC JV confirms the compliance of Runaway Speed as 900 RPM
	Generator Efficiency	97%	Not specified	DESCON - ZOEC JV confirms the compliance of Generator Efficiency as 97%
	Protection Class	IP44	Not specified	DESCON - ZOEC JV confirms the compliance of Protection Class as IP44
	Temperature Rise	A	Not specified	DESCON - ZOEC JV confirms the compliance of Temperature Rise B.

Noted
06/02/18



DESCON - ZOEC JV
Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

SECTION		DESCRIPTION	Bidder's quoted values	Bidder's Response
1.2.3.4	Medium Voltage Installations (11 Kv)			
	Type	vacuum type	Not specified	
	Max. Voltage	33 KV	15KV	The Medium voltage level has been considered 11 Kv, as specified in clause 1.2.3.6 "Medium and Low Voltage Installations" of Employer's Requirement, and as per IEC standard 60038 (Table 3- Series 1), the highest voltage of 12 Kv is proposed for the equipment with nominal voltage level of 11 Kv.
	Short Circuit Current	21 KA	31.5KA	In accordance with the revised voltage level to 11Kv Short Circuit Current shall be increased to 31.5 KA.
1.2.3.12	Earthing System			
	Type	Mesh and Independent	Not specified	DESCON - ZOEC JV confirms the compliance of Type as Mesh and Independent.
	Earth resistance	< 0.16 ohm	Not specified	DESCON - ZOEC JV confirms the compliance of earthing Resistance as < 0.16 ohm

N24
06/02/15





Reference No: IP/LAWI/006

Dated: February 11, 2015

Project Director
Lawi Hydropower Project
Pakhtunkhwa Energy Development Organization
110 – PEDO House, 38/B2, Phase-V, Hayatabad
Peshawar

Dear Sir,

**SUBJECT - CLARIFICATIONS REGARDING AUTHORIZATION FROM SUB-CONTRACTORS - LAWI
Hydropower Project (69 MW)**

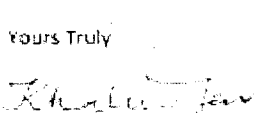
Reference: 1825/PEDO/PID LAWI HPP, dated February 06, 2015

This bears on your letter at reference given above whereby M/S DESCON-ZOEC JV is required to provide Authorization letter or MOU or Agreement with the sub-contractors listed in the Schedule E of the Technical Bid submitted.

In compliance to the above requirement, please find attached Subcontractors' Authorization Letters as Annex-1, 2 & 3 of this letter.

With the above submissions, the requisite as contained in your letter at Reference given above stand fulfilled.

Yours Truly


Khalid Javid Iqbal
Proposal Manager
DESCON - ZOEC JV



CC:

- 1) Director (P & F) PEDO, Peshawar
- 2) Project Manager / Team Leader, MC for 69MW Lawi HPP
- 3) PS to Chief Executive Officer PEDO, Peshawar

Desccon Engineering Limited

Desccon Headquarters: 18 km Ferozpur P.O.Box 1201, Foad, Lahore - 54760, Pakistan

UAN: (T) DESCON (337266) F: (+92) (42) 3581 1135 E: desccon@desccon.com W: www.desccon.com

Annex - 1



Subcontractor's Authorization

Dated: February 9, 2015

Bid Reference: ICB No. LHP-01

To:

The Project Director

89 MW Lawi Hydropower Project

110-PEDO House, 38/B-2, Phase - V, Hayatabad.

Peshawar, GOKP

Tel: +92 91 9217463 & Fax: +92 91 9217464

www.lawihydro.gov.pk

We M/s Hussam Khan & Co., hereby authorize M/s Dascon-ZOEC JV to participate in

Lawi Hydropower Project and give our consent to be their sub-contractors for the

Tunnelling and other underground works of the aforementioned project.

Signed BY:



Hussam Khan

Director





Subcontractor's Authorization

Providing Transmission Line for Lawi Hydropower Project

Date: Feb 05, 2015

Bid Reference: TCB No. LHP-01

To

Project Director
69 MW Lawi Hydropower Project
110-PE-DO House, 38/B-2, Phase-V, Hayatabad
Peshawar, Khyber Pakhtunkhwa, Pakistan
Tel: +92 91 9217463 & Fax: +92 91 9217464,
www.shydo.gov.pk

We M/S Pakistan Power Construction (PPC) official approved, Manufacturer's Agent of [Transmission Line] do hereby authorize DESCON-ZOEC JV (Descor Engineering Limited & Zhejiang Orient Engineering Co., Ltd JV) to submit a bid for providing [Transmission Line] for 69MW Lawi Hydro Power Project, and to subsequently negotiate and sign the contract

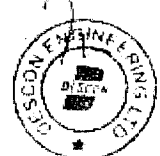
We hereby extend our full guarantee and warranty with respect to the goods offered

Signed,



Name: Atiaz Ahmed Abbasi

Title: Managing Director



Head Office

Plot # 9 & 10, E-1 Road, Satellite Phase 1/1, A-15 Road Rawalpindi, Pakistan
Tel: +92 51 4862102 Fax: +92 51 4862122

Factory

G-1 Road, Sangjani Islamabad Ph: +92 51 2296171 Fax: +92 51 2296172





Subcontractor's Authorization

ARDEN ME
P.O BOX 232099 DUBAI, UAE

Date: February 6th, 2015
Bid Reference: AEA/Q/DESCON/LAW13/2014

To

Project Director
66MW Lawi Hydropower Project
110 PEDD House, 38/B-2 Phase-V, Hayatabad
Peshawar, Khyber Pakhtunkhwa, Pakistan
Tel: +92 91 9217463 & Fax: +92 91 9217464
www.ardenme.com.pk

We, Arden ME, who are authorized by manufacturers of CCTV & TELECOM Equipment, having offices in UAE & Pakistan, authorize DESCON ZOEC JV (Descon Engineering Limited & Zhejiang Orient Engineering Limited Co, Ltd. JV) to submit a bid for providing CCTV & TELECOM SYSTEM for 66 MW LAWI Hydropower Project, and to subsequently negotiate and sign the contract.

We hereby extend our full guarantee and warranty with respect to the goods offered.

Signed

Name: Mr. Adnan Siddiqui

Title: Director Operations



This document is valid for the purpose of the bid only. It is not to be used for any other purpose. The validity of this document is limited to the period of the bid.

APPENDIX – 8

CLARIFICATION REPLIES (CLIC JV)

CLIC JOINT VENTURE

69 MW HYDROPOWER PROJECT

14-A/1, Aibak Block, New Garden Town, Lahore Pakistan
Tel: +92-42-35855080, 35867215, Cell: +92-301-4077898, 03008450212
Fax No: +92-42-35841888, Email: clicpk@gmail.com

1/7

Ref No. CLICJV/69MW/2016/0119-6

Dated: February 11, 2015

To

Project Director
Lawi Hydropower Project
Pakhtunkhwa Energy Development Organization
Government of Khyber Pakhtunkhwa Peshawar
38/B2, Phase-V, Hayatabad, Peshawar
Tel: +92-91-9217304
Fax: +92-91-9217307

**Subject: MISSING INFORMATION REGARDING CIVIL / E&M WORKS AS REQUIRED IN
THE BIDDING - LAWI HYDROPOWER PROJECT (69 MW)**

Dear Sir,

Reference your letter number 1820/PEDO/PD Lawi HPP dated 06.02.2015 regarding the subject

We are pleased to enclose details of clarification as required in the various section of the bid documents, pointed out by the Evaluation Committee, attached as Annexure - A.

Furthermore, we hereby confirm that M/s CLIC Joint Venture shall complete the project as per stipulations of the Bid Documents 69 MW Lawi HPP, including addendum #1, 2 & 3 of the bidding documents

You are requested to proceed our case & oblige

for CLIC Joint Venture


Engr. Wei Jun
JV Authorized Representative



Encl: as above

cc

- Director (P & F) PEDO, Peshawar.
- Project Manager / Team Leader, MC for Lawi HPP
- PS to Chief Executive Officer PEDO, Peshawar

CLIC JOINT VENTURE

69 MW HYDROPOWER PROJECT

14 A/C, Aibek Bakh, New Garden Town, Lahore, Pakistan

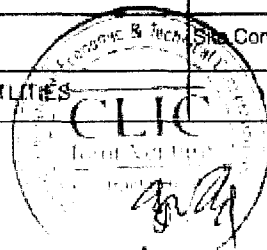
Tel: +92-42-35655080, 35657215, Cell: +92-301-4077163, 33069450712

Fax No: +92-42-35641809, 35762274, Email: clicpk@gmail.com

ANNEXURE - A

Construction of Lawi Hydropower Project Reply of Technical Requirements (Civil)

Section	Scope of Works		Question - Bidders' provided data	Answer - Bidders' Response
Part III Section 1.3.1	BID SUBMISSION			
		Head Loss Calculations	not specified	To agree design as per the requirement of the clause of 1.3.1 of Part III of Tender document
		Power and Energy Studies	not specified	To carry on research during detailed design and to provide research report
		Specifications	not specified	International Standard as per bidding documents/if other standard subject to the approval of the Employer
Part III Section 2.1	CODES & STANDARDS FOR CIVIL WORKS			
Part III Section 2.8	EMPLOYERS FIELD FACILITIES	Main Field Offices	not specified	To agree design as per the requirement of the clause of 2.8 of Part III of Tender document
		Mosque	not specified	100m ²
		Residential Accommodation	not specified	To agree design as per the requirement of the clause of 2.8 of Part III of Tender document
		Vehicles	not specified	Six sets
		Site Communication	not specified	To agree design as per the requirement of the clause of 2.8 of Part III of Tender document
Part III Section 2.9	UTILITIES			



4/2

CLIC JOINT VENTURE

ANNEAURE - A

69 MW HYDROPOWER PROJECT

14-A/1, Abbat Block, New Garden Town, Lahore Pakistan

Tel. +92-42-35655080, 35667215 Cell. +92-301-4077996, 03008450212

Fax No. +92-42-35941888, 35762274 Email: clicpk@gmail.com

Section	Scope of Works		Question - Bidders' provided data	Answer - Bidders' Response
		Access roads (7m width)	not specified	To agree design as per the requirement of the clause of 2.9 of Part III of Tender document
		Water Supply System	not specified	To agree design as per the requirement of the clause of 2.9 of Part III of Tender document
		Water Distribution System	not specified	To agree design as per the requirement of the clause of 2.9 of Part III of Tender document
		Sewerage System	not specified	To agree design as per the requirement of the clause of 2.9 of Part III of Tender document
Part III Section 2.11	PROJECT SIGNS		not specified	To agree design as per the requirement of the clause of 2.8 of Part III of Tender document



6/6/07

CLIC JOINT VENTURE

69 MW HYDROPOWER PROJECT

14 A/1, A Block, New Garden Town, Lahore Pakistan

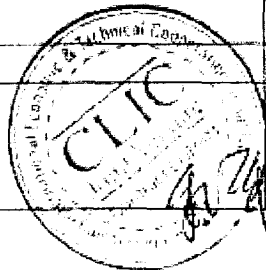
Tel: +92-42-35955089, 35957215, Cell: +92-301-4077998, 03006450212

Fax No: +92-42-35941888, 35762274, Email: clicpk@gmail.com

ANNEXURE A

Construction of Lawi Hydropower Project Reply of Technical Plant Particulars

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's response
Part III Section 1	MECHANICAL EQUIPMENT			
1.2.2.2	Turbines			
	Type	Pelton, Vertical Shaft 4 jet	Pelton, Vertical Shaft 6 jet	To design as per 4 jets during detailed design
	Regulation	Double Regulated	Not specified	Double Regulated
1.2.2.3	Inlet Valve			
	Inner Diameter	950mm	1 m	To select as per outlet diameter of water distribution ring pipe.
	Design Head	535 m WC	Not specified	The maximum water level of reservoir is 1664m. Turbine center elevation is 1251m. The maximum hydrostatic pressure of Inlet valve is 413m. Considering the rising rate of the maximum pressure stated by specification is 25%, the maximum artesian head is 518.3m. So 535m is suggested to adopt.
1.2.2.5	Powerhouse Crane			
	Mobile Crane	ONE No.	Not specified	In detailed design stage, different type of chain block or electric block is equipped as per installation weight.



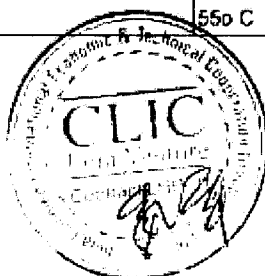
CLIC JOINT VENTURE

ANNEXURE -A

69 MW HYDROPOWER PROJECT

14-A/1, Abok Block, New Garden Town, Lahore Pakistan
Tel: +92-42-35855080, 35887215, Cell: +92-301-4077898, 03008450212
Fax No: +92-42-35841888, 35762274, Email: clicpk@gmail.com

SECTION	DESCRIPTION	Bidder's quoted values	Bidder's response
1.2.2.6	Elevator		
	Passenger Elevator	ONE No	Not specified
	Capacity	1000Kg / 13 persons (Minimum)	Not specified
1.2.2.6	Auxiliary Systems		
	Fire fighting protection & detection system	YES	Not specified
			Detail design on Fire fighting protection & detection system in detailed design stage.
1.2.3	ELECTRICAL EQUIPMENT		
1.2.3.2	Generator		
	Protection Class	IP44	Not specified
	Insulation Class	F	Not specified
	Temperature Rise	B	Not specified
1.2.3.4	Main Transformers (3 Nos.)		
	Temperature Rise	55o C	Not specified



CLIC JOINT VENTURE

60 MW HYDROPOWER PROJECT

14-A/1, Alhaz Brook, New Garden Town, Lahore, Pakistan

Tel: +92-42-3505000, 35057215, Cell: +92-301-4377198, 03004450711

Fax No: +92-42-35541888, 35762274, Email: clicpj@gmail.com

ANNEXURE - A

Construction of Lawi Hydropower Project Reply of Technical Plant Particulars

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's response
	Power Factor	0.8	Not specified	Agree
	Service station Transformer (1 No.)			
	Temperature Rise	55o C	Not specified	Agree
	Power Factor	0.8	Not specified	Agree
	Auxillary Transformers			
	Power Factor	0.8	Not specified	Agree
	Impedence	5 - 6 %	4%	Agree
1.2.3.4	Medium Voltage Installations (11 kV)			
	Type	vacuum type	Not specified	Breaker type in original bidding design technique proposal is vacuum type.
	Max. Voltage	33 KV	Not specified	32kv voltage class is not adopted in this power station.
	Short Circuit Current	21 KA	Not specified	Rated short circuit current in original bidding document is 25ka, is bigger than 21ka and satisfied the requirement.
1.2.3.9	Telecommunication:			
	Type	Digital	Not specified	Agree

(6/9)

⑦/3

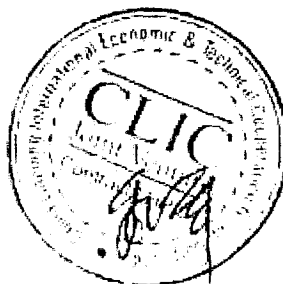
14-A/1, Aibak Block, New Garden Town, Lahore Pakistan

14-A/1, Aibak Block, New Garden Town, Lahore Pakistan

Tel +92-42-35653080, 35653216. Cell +92-301-4077998, 03038450212

Fax No. +92-42-35941888. Email: clips@cpm.com

1. Yellow River Engineering Consulting Co., Ltd, project designer, No. 109, Jinshui Road, Zhengzhou City, Henan Province, P.R.China.
2. Wuhan Atrong Automatic Contro; Technology Co., Ltd, Governor manufacture, Tieji Industry Park #6, Hongshan Wuhan, Hubei, China
3. Pinggao Group Co., Ltd, Circuit Breakers & disconnectors sets No.22 Nanhua Road, Pingdingshan City, P.R.China
4. Shandong Taikai Transformer Co., Ltd, transformers manufacture, Talan High tech Industrial Development Zone, Shandong Province, P.R.China
5. Tianjin Tianfa Heavy Machinery & Hydro Power Equipment ManufactURE Co., Ltd, manufacture for Hydraulic Turbine-Generators, Gaofeng Road, Beichen District, Tianjin, P.R.China
6. Chongqing Water Turbine works Co., Ltd(CWTW), manufacture for Turbine - Generator sets & its auxiliary equipment, Li jia tuo, Chongqing, China
7. Chongqing Water Turbine works Co., Ltd(CWTW), manufacture for small and medium and large sized turbine-generator sets & its auxiliary equipment, Li jia tuo, Chongqing, China
8. Jiangsu DAQIAO Changjiang electric Co., Ltd, manufacture for electric equipment and intelligent engineering electric equipments, switch cubicle and complete electrical equipment of high-low voltage etc, No 66 south Xinzhong road, Xinba Town, yangzhong, Jiangsu China.
9. Far East Cable Co.,Ltd, manufacture for XLPE Insulated with 220KV and aerial wire with 750 KV, having factories at No 8, yuandong Road, Gaochen Town, Yixing City, Jiangsu Province, P.R.China
10. Holley Group Co.,Ltd having address at 181, Wuchang Road, Yuhang Hangzhou City, China manufacture and supply of electrical and mechanical equipment



CLIC JOINT VENTURE

69 MW HYDROPOWER PROJECT


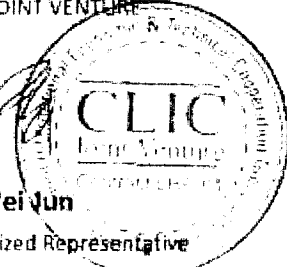
14-A/1 Aibak Block New Garden Town, Lahore Pakistan

Tel: +92-42-35955080, 35927215, Cell: +92-301-4077950, 03005450212

Fax No: +92-42-35941888, Email: clic@cljv.com

- 11 NARI GROUP Corporation, manufacture for Control and Protection system, having factories at Building D-II, Pukou High-Tech Development Zone, Nanjing, China
- 12 Hydrochina Huadong Engineering Corporation, in Zhejiang East China Mechanical & Electrical engineering Co., Ltd, having address at Building I, Jiangdongerlu Road, Linjiang Industrial Park, Xianshan District, Hangzhou, P.R.China
- 13 Technicon enterprises (Pvt.) Ltd, having address at 85 C Industrial State, Peshawar, manufacture, supplier and installer for steel gates/Trash Rack, Embaded Parts, Trcm Machine, etc

For CLIC JOINT VENTURE



Engr. Wei Jun
JV Authorized Representative

APPENDIX – 9

CLARIFICATION REPLIES (SICHAUN-SARWAR-SILIAN- CHONGING LUYONG JV)

四川省地质工程集团公司

SICHUAN PROVINCE GEOLOGICAL ENGINEERING COMPLEX

Ref SSSC/Lawi/BD/001

Date 09 February 2015

Project Director,

Lawi Hydropower Project

PEDO House, 38/B-2, Phase-V, Hayatabad,

Peshawar, Khyber Pakhtunkhwa, Pakistan.

Tel +92 91 9217295 & Fax: +92 91 9217331. Email: zasabri@hotmail.com

www.shydo.gov.pk

Project: DESIGN, PROCUREMENT AND CONSTRUCTION OF 69MW LAWI HYDROPOWER PROJECT IN DISTRICT CHITRAL

Subject: UPDATED PEC'S REGISTRATION CERTIFICATE

Dear Sir

With reference to your letter no. 1826/PEDO/PD Lawi HPP dated 05/02/2015, we enclose herewith the updated PEC registration certificate of M/s Sarwar & Co (JV Partner) which is valid upto 31-12-2015, for your further necessary action please.

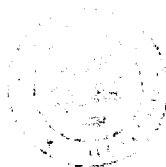
Yours truly



Shareef Bhatti

Authorized Representative

M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV



CC:

Office file



Serial No. 314106
PEC-II

PAKISTAN ENGINEERING COUNCIL

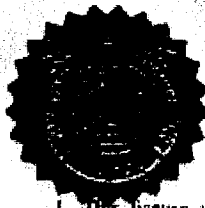
License No: 00031 Category: CA Validity: 31st December, 2015

LICENCE OF PAKISTANI CONSTRUCTOR/OPERATOR (Under the bye-laws of Pakistan Engineering Council 1987)

This is to certify that M/s **SARWAR & CO (PVT) LTD** (Licensee), with its registered office at 195-G/3 JOHAR TOWN LAHORE-53770 has/have been licensed under Construction and Operation of Engineering Works Bye-laws 1987, until the validity date to construct/operate engineering works, the construction/capital cost of which does not exceed Rs. **NO LIMIT** provided the licensee fulfils all the qualification requirements prescribed by Client or Employer for a particular engineering work; and subject to the licensee continuing to fulfill all the requirements of the bye-laws.

Field of Specialization **EC01 - CE01 - CE02 - CE03 - CE04 - CE05 - CE06 - CE09 - CE10 - EE01 - EE02 - EE04 - EE05 - EE06 - ME02 - ME05 - ME06** (Specialized Fabrication & Treatment and Miscellaneous Mechanical Equipment) - **(SEVENTEEN ONLY)**
(Specialization Code Nos. for detail see overleaf)

Date of Issue : January 27, 2015
(Islamabad)



[Signature]

Registrar
Pakistan Engineering Council
Islamabad.

Note:

1. This license is valid upto 31-12-2015 and shall be renewed before 31st March 2016 without late payment surcharge. However, application for 2015 for renewal may be submitted to the Council after 5th November, 2015.
2. The employer must ensure employment of engineers whose names are mentioned on backside of the license. The Consulting Engineer (the Engineer incharge in case the consultant is not appointed) shall monitor the number of engineers employed by the Constructor/Operator and inform the Council accordingly.
3. Owner(s) of the firm shall be held responsible, if any information, document or paper submitted by him/them is found incorrect or forged.

Sr. No	Names of Engineers	Registration No
1	ENGR. MUNIR AHMED ASLAM	CIVIL/03229
2	ENGR. SHAMS UDDIN	CIVIL/15558
3	ENGR. SHAHID AMIN	ELECT/26507
4	ENGR. ASAD IQBAL KHOKAR	MECH/06646
5	ENGR. AFZAL TAJ	MECH/06689
6	ENGR. NAZIR AHMAD AKHTAR	MECH/07656
7	ENGR. QAMMAR UDDIN	MIN/00631
8	ENGR. MUHAMMAD TAHIR JAMIL	MIN/01422

Registration Categories and Specialization of Pakistani Constructors/Operators

CODE	SPECIALIZATION	CODE	SPECIALIZATION
CE 01	Road and Pavements Drainage & Retaining Structures Signcraft Installation	ME 03	Lifts and Escalators Compressor Generators
CE 02	Bridge Structures Piling	ME 04	Building Automation System
CE 03	Marine Structures Dredging Underwater Works	ME 05	Workshop, Mill, Quarry System
CE 04	Dams Water Retaining Structures Irrigation & Flood Control Systems	ME 06	Specialized Fabrication and Treatment Medical Equipment Kitchen and Laundry Equipment Heat Recovery System Pollution Control System Miscellaneous Mechanical Equipment Chiller for Power Generation Specialized Plant
CE 05	Offshore Works	EE 01	Sound System
CE 06	Tunneling and Underpinning	EE 02	Security, Safety Surveillance System
CE 07	Railway Tracks	EE 03	Building Automation System and Energy Generation System
CE 08	Oil and Gas Pipe Lines	EE 04	Low Voltage Installation
CE 09	Sewerage Works Water Supply	EE 05	High Voltage Installation
CE 10	General Civil Engineering Works Concrete Repairs Soil Investigation and Stabilization Landscaping & Horticulture Reclamation Works General Buildings and Maintenance Water Proofing	EE 06	Specialized Lighting System
EC 01	Prefabricated Buildings, Steel Frames in Buildings and Industrial Plants	EE 07	Telecommunication Installation
EC 02	Restoration and Conservation	EE 08	External Telecommunication Works
EC 03	High Rise Buildings	EE 09	IT & Software Engg.
ME 01	Heating, Ventilation, Air Conditioning	EE 10	Miscellaneous Specialized Any other Works
ME 10	Fire Detection and Protection System		

四川省地质工程集团公司

SICHUAN PROVINCE GEOLOGICAL ENGINEERING COMPLEX

Ref: SSSC/Lawi/BD/002

Date: 10 February 2015

Project Director,
Lawi Hydropower Project,
PEDO House, 38/B-2, Phase-V, Hayatabad,
Peshawar, Khyber Pakhtunkhwa, Pakistan
www.shydo.gov.pk

**Project: DESIGN, PROCUREMENT AND CONSTRUCTION OF 69 MW LAWI
HYDROPOWER PROJECT IN DISTRICT CHITRAL**

**Subject: CLARIFICATIONS REGARDING CIVIL/E&M WORKS AS REQUIRED IN THE
TECHNICAL PROPOSAL**

Dear Sir,

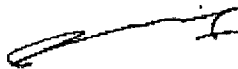
With reference to your letter No. 1822/PEDO/PD Lawi HPP dated 05/02/2015, enclosed please find herewith our para-wise replies to the queries.

Regarding following the Standards and Specifications under clauses 2.1.1 and 2.2.1 of Employer's Requirements, we conform that our JV will follow the above-referred clauses. However, after detail geotechnical investigations and design, if our design team intends to use certain standards/specifications, prior approval of the Employer shall be sorted out.

Furthermore, we (M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV) conform that we will complete the project as per the stipulations of the Bid Documents 69 MW Lawi HPP, including addendum #1, 2 & 3 of the bidding documents.

We shall be pleased to provide you any further clarifications if so required by you.

Yours truly,



Muhammad Shareef Bhatti
Authorized Representative
M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV



End: Replies of Clarifications (17 pages)

CC

- Office file.

地址：四川省成都市青羊区草市街12号时代锦尚大厦4楼 电话：(028) 86950336

传真：(028) 86950337

邮编：610017

Clarifications of Technical Requirements (Civil)

Section	Scope of Civil Works		Bidder's Response	Bidder's clarification
Part III Section 1.3.1	BID SUBMISSION			
		Hydraulic Design	not specified	The design of the runoff in feasibility study is reasonable. the catchment area for the upper weir is 579 km ² , the average runoff for years is 13m ³ /s. During the stage of reviewing the feasibility study, We will gather the relative data from the year 2006 to 2014, and will review the runoff result through the long-term runoff serials
		Head Loss Calculations	not specified	Please find details in attached document Annexure No. 1 for clarification
		Power and Energy Studies	not specified	The generation indicated in the feasibility study basically reasonable. The 303.77GWh generation is calculated by the monthly discharge data through the year 1961-2006. During the stage of reviewing the feasibility study, we will check the average generation based on the new discharge data recorded in the year of 1961-2014. Our JV conform to provide the power and annual energy as per the Bid Documents

Section	Scope of Civil Works		Bidder's Response	Bidder's Clarification
		Specifications	not specified	Employer Requirements Part-III Volume-I will be followed. However, after detail geotechnical investigations and design, if our design team intends to use certain standards/specifications, prior approval of the Employer shall be sorted out
Part III Section 2.8	EMPLOYERS FIELD FACILITIES			
		Main Field Offices	not specified	Employer Requirement Part-III Volume-I will be followed
		Mosque	not specified	
		Residential Accommodation	not specified	
		Vehicles	not specified	
		Site Communication	not specified	
Part III Section 2.9	UTILITIES			
		Access roads(7m width)	not specified	Employer Requirement Part-III Volume-I will be followed.
		Water Supply System	not specified	
		Water Distribution System	not specified	
		Sewerage System	not specified	
Part III Section 2.11	PROJECT SIGNS		not specified	Employer Requirement Part-III Volume-I will be followed



Clarifications of Technical Plant Particulars

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
Part III Section 1	MECHANICAL EQUIPMENT			
1.2.2.2	Turbines			
	Efficiency	92%	91.6%	<p>92% is not practical value. Our quoted value is 91.6%</p> <p>Turbine 91.6% Generator 97.72%</p> <p>Our TG set overall efficiency 89.51%</p> <p>While the Tender document requirement Turbine 92% Generator 97%</p> <p>TG set overall efficiency 89.24%</p> <p>Our overall efficiency is higher than the bidding document. However, our JV shall provide the Power and Annual Energy as per the Bid Documents</p>
1.2.2.3	Inlet Valve			
	Inner Diameter	950mm	1.1m	Please find details in attached document Annexure No. 2 for clarification.
1.2.2.6	Elevator			
	Passenger Elevator	ONE No.	Not specified	The elevator has been included into supply scope and its price has been included into our price schedule submitted. Please find details in attached document Annexure No. 2 for clarification.
	Capacity	1000Kg/13 persons(Minimum)	Not specified	

SECTION	DESCRIPTION	Bidder's quoted values	Bidder's Response
1.2.2.7	Workshop Equipment & Tools		
	Electric Shop	Not specified	The Electric Shop has been included into supply scope and its price has been included into our price schedule submitted Please find details in attached document Annexure No. 2 for clarification
	Machine Shop	Not specified	The Machine Shop has been included into supply scope and its price has been included into our price schedule submitted Please find details in attached document Annexure No. 2 for clarification
	Portable Equipment	Not specified	The Portable Equipment has been included into supply scope and its price has been included into our price schedule submitted Please find details in attached document Annexure No. 2 for clarification
1.2.3	ELECTRICAL EQUIPMENT		
1.2.3.2	Generator		
	Temperature Rise	B Not specified	Temperature rise will be according to class B as per Employer's Requirement

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
1 2.3.4	Main Transformers (3No.s)			
	Temperature Rise	55°C	Not specified	Temperature rise will be 55°C as per Employer's Requirement.
	Power Factor	0.8	Not specified	Power Factor will be 0.8 as per Employer's Requirement
	Impedance	9-12%	Not specified	Impedance will be 9-12% as per Employer's Requirement
	Service station Transformer (1No.s)			
	Function	Step Down	Not specified	Step Down as per Employer's Requirement
	Rated Output	5MVA	Not specified	5MVA as per Employer's Requirement
	Primary Voltage	132kV	Not specified	132kV as per Employer's Requirement
	Secondary Voltage	11kV	Not specified	11kV as per Employer's Requirement
	Frequency	50Hz	Not specified	50Hz as per Employer's Requirement
	Temperature Rise	55°C	Not specified	55°C as per Employer's Requirement
	Power Factor	0.8	Not specified	0.8 as per Employer's Requirement
	Vector group	Dyn 11	Not specified	Dyn 11 as per Employer's Requirement
	Impedance	9-10%	Not specified	9-10% as per Employer's Requirement
	Cooling	ONAN	Not specified	ONAN as per Employer's Requirement
	Auxiliary Transformers			
	Power Factor	0.8	Not specified	0.8 as per Employer's Requirement
	Tap changer	Off Load	Not specified	Off Load as per Employer's Requirement
	Impedance	5-6%	Not specified	5-6% as per Employer's Requirement

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
1.2.3.4	Medium Voltage Installations (11kV)			
	Type	vacuum type	Not specified	vacuum type as per Employer's Requirement.
	Max. Voltage	33kV	12kV	According to IEC 62271, a maximum voltage of 12 KV, 15 KV or 17.5 KV should be used for 11 KV Switch gear systems, there are no such 33KV ratings for 11 KV systems. Also the maximum rated short circuit time withstand current of 31.5 KA mentioned in Schedule A, Technical Data Sheet Page 14, is much better than 21 KA
	Short Circuit Current	21kA	Not specified	21kA as per Employer's Requirement
1.2.3.4	Low Voltage Installation AC Supply (0.4kV)			
	Source of Supply	Two 11/0.4kV stepdown transformers (500KVA) plus additional unit auxiliary transformer from 11kV line and a stand by diesel generating set	Not specified	The Low Voltage Installation AC Supply has been included into supply scope and its price has been included into our price schedule submitted. Please find details in attached document Annexure No. 2 for clarification The diesel generator is 400V, 250KVA

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
1.2.3.4	Low Voltage DC Supply			
	Battery Voltage for telecommunication & Computer	24 or 48 V	Not specified	The Low Voltage DC Supply has been included into supply scope and its price has been included into our price schedule submitted The DC for telecommunication is 48v. The 48V supply is provided by DC/DC converters
1.2.3.9	Telecommunication			
	Type	Digital	Not specified	Digital as per Employer's Requirement
	PABX	As required	Not specified	As required as per Employer's Requirement
	Internet facility	Yes	Not specified	Yes
1.2.3.12	Earthing System			
	Type	Mesh and Independent	Not specified	Mesh and Independent as per Employer's Requirement
	Earth resistance	<0.16ohm	0.19ohm	<0.16ohm as per Employer's Requirement
1.2.3.13	Transmission Line and Interconnection			
	Conductor	ACSR	Not specified	The transmission line and interconnection is not the bidder's scope of supply so there is no specification in bidding document
	Other specification	As per WAPDA system	Not specified	

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
1.2.3.14	Transmission Line (11kV)			
1.2.3.14	400V Distribution line for Colony	As per WAPDA system	Not specified	There is no detail requirement and not mentioned in scope of supply and price schedule. However it shall be carried out as per Employer's Requirement.
1.1.3.1	Mandatory Spare Parts	As per Specifications	Not specified	There is no detailed requirement found in 1.1.3.1 (page III-6, item 1.1.3 describes Security, Health and Safety) of employer's requirement or at any other clause of tender documents. We have submitted recommended spare parts price in our price schedule.
1.1.3.2	Tool and Appliances	As per Specifications	Not specified	Please find details in attached document Annexure No. 2 for clarification.
1.2.2.7	Workshop Equipment	As per Specifications	Not specified	Please find details in attached document Annexure No. 2 for clarification.




Annexure No. 1 for clarification (CIVIL WORK)

- Clarification for Head Loss

Discharge capacity review and head loss calculation at the intake area for Lawi HPP
Lawi HPP diversion system was composed of intake, connecting tunnel, transition chamber, sedimentation basin, headrace tunnel, surge shaft, concrete lined pressure shaft, and steel lined pressure tunnel.

I. Reference Code

Hydraulic Calculation Manual

II. Discharge Capacity Review

1. Intake Area

$$H_s \geq 2D + h_s D_e$$

$$L \leq 10H_e$$

H: water depth before the start of the intake

D: Water depth at the start of the intake

L: The length of the intake

H: Water depth at the end of the intake

Conclusion, short tunnel (no pressure), consider wide crest weir

$$Q = \sigma m B \sqrt{2g} H_e^{3/2}$$

σ submerge coefficient 0.65

m discharge coefficient 0.356

$$B=5m, H_0=3m_e$$

The discharge capacity at the intake area is 26.6m³/s, which meet the design requirement.

2. End of the Sedimentation Basin

The top of the gate gallery is wide crest weir

Width of each weir crest $B=3m$, head of the weir $H_0=1.75m$

$$Q = E \sigma m B \sqrt{2g} H_e^{3/2}$$

The calculated value of $E = 0.85$

σ submerge coefficient 1.0

m discharge coefficient 0.385

The calculated discharge value for one hole wide crest weir is 10.2m³/s, and for two holes is 20.4m³/s.

The discharge capacity meet the requirement

3 Headrace Tunnel

Pressure flow calculation equation:

$$Q = m_3 A \sqrt{2g (H_0 + L - \beta D)}$$

$$m_3 = \frac{1}{\sqrt{1 + \sum \zeta + \frac{2gL}{C^2 R}}}$$

$$\sum \zeta = \zeta_1 + \zeta_2 + \zeta_3 + \zeta_5 + \zeta_6$$

m_3 : discharge coefficient ;

ζ_1 : inlet loss coefficient 0.2 ;

ζ_2 : trash rack loss coefficient 0.3 ;

ζ_3 : gate duct loss coefficient 0.1 ;

ζ_5 : inlet transition section loss coefficient 0.2 ;

ζ_6 : outlet transition section loss coefficient 0.5 ;

β : correction coefficient 0.85 ;

D: Tunnel Diameter , 4.0m.

Tunnel Length =11300m.

The calculated discharge capacity is 22.4m³/s .

The value meets the requirement

III. Head loss calculation

1. from intake to the first section of power tunnel

Intake :The intake is located at the right bank of the reservoir, install 2 gates at the right side of the flushing gate

Intake : Quotative Discharge Q=20m³/s



Discharge Area : $S1=2 \times 3 \times 5=30m^2$,

Velocity : $V1=Q/S1=20/30=0.667m/s$;

Collection Canal : Quotative Discharge $Q=20m^3/s$

Discharge Area : $S2=4 \times 6=24m^2$;

Velocity : $V2=Q/S2=20/24=0.833m/s$.

Calculate the head loss through energy equation $hw1$:

$$H + \frac{\alpha_1 V_1^2}{2g} = h_{p1} + \frac{\alpha_2 V_2^2}{2g} + h_{w1}$$

H —Intake area head ; $H=1665m$

h_{p1} —Head for the end of box channel ; $h_{p1}=1664m$

$hw1$ —head loss

$V1$ — Velocity for intake area

$V2$ —velocity for end of the box channel

$hw1=0.99m$

2 From the first section of the tunnel to surge shaft

The length of Tunnel is 11300m , the section of the tunnel is horse-shoe type , width and height respectively 4m.

Tunnel head loss $hw3$:

$$h_{w2} = \sum \zeta \frac{V^2}{2g} + \lambda \frac{L}{d} \frac{V^2}{2g}$$

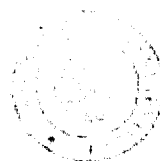
$\sum \zeta$ —total sum of the part head loss coefficient along the tunnel, see the table ;

Inlet ζ	outlet ζ	Corner $\sum \zeta$
0.5	1	0.08

V — Average velocity for cross section of tunnel ; $V=Q/S=20/13.27=1.507m/s$

λ —head loss coefficient along the tunnel , $\lambda = \frac{8g}{C^2}$; C — chezy coefficient ,

L —Tunnel length



d —Tunnel Inner diameter

Calculated head loss: hw2=9.49m

3. From surgh shaft to power house

Concrete lined pressure shaft, vertical aligned, 238m long, diameter 3m, steel lined penstock (bured type), vertical and horizontal alignment combined 100m long vertical aligned, 684m long horizontal aligned, diameter 2.5m. Three manifolds at the end of the penstock shall be connected to powerhouse.

Concrete lined pressure shaft hw3 :

$$h_{w3} = \sum \zeta \frac{V^2}{2g} + \lambda \frac{L}{d} \frac{V^2}{2g}$$

$\sum \zeta$ —total sum of the part head loss coefficient along the shaft, see the table :

Inlet ζ	Outlet reduce ζ
0.5	0.16

V —Average velocity for the cross section of shaft V=2.83m/s

λ —head less coefficient along the shaft , $\lambda = \frac{8g}{C^2}$; C - chezy coefficient ;

L —shaft length

d —inner diameter of the shaft

Calculated head loss: hw3=1.20m

Steel lined penstock hw4 :

$$h_{w4} = \sum \zeta \frac{V^2}{2g} + \lambda \frac{L}{d} \frac{V^2}{2g}$$

$\sum \zeta$ —total sum of the part head loss coefficient along the penstock. see the table :

intet ζ	Sharp Cornor ζ	The manifold cross section reduce ζ
0.25	0.99	3

V —Average velocity for the cross section of penstock ; V=4.08m/s

λ —head less coefficient along the penstock , $\lambda = \frac{8g}{C^2}$; C - chezy coefficient ,

L —length



d —inner diameter

Calculated head loss, $hw_4=6.54m$

Lawi HPP total head loss shall be the total sum of the four parts .

$$hw=hw_1+hw_2+hw_3+hw_4=0.99+9.49+1.20+6.54=18.22m.$$



Annexure No. 2 for clarification (E&M Equipments)

1. Inner Diameter of inlet valve (1.2.2.3)

The inlet pipe of turbine should more than 1.126m, we suggest at least 1.1m If 950mm, it's not reasonable and the velocity rate is big, which will result in efficiency loss and head loss, also reduce the turbine output. So we suggest at least 1.1m valve diameter. Our calculation:

K = discharge velocity coefficient

V_e = discharge velocity

Q_r (rated discharge) = 6.65 m³/s

D = diameter of inlet pipe

H = 398.5m

g = 9.81 m/s²

From the chart, when H (rated head) is 398.5m, the K value is 7.7%

$$V_e \leq K \sqrt{2gH} = 7.7\% \sqrt{2 \times 9.81 \times 398.5} = 6.8$$

$$V_e = 4Q_r / \pi D^2$$

$$D \geq 1.126m$$

水斗直径 $d_1 = 1.05d_0$

喷嘴直径 $d_n = 1.228d_0$

喷嘴最大行程 $S_n = 1.16d_0$

水斗设计尺寸允许在 $d_n = (0.9 \sim 1.02)d_0$ 的范围内通用, 效率作相应修正。

十一、引水管、导水肘管及其曲率半径

如图 4-24 所示, 引水管内流速

$$v_s < K \sqrt{2gH}$$

式中 K —— 流速系数, 可由图 4-25 上查取。

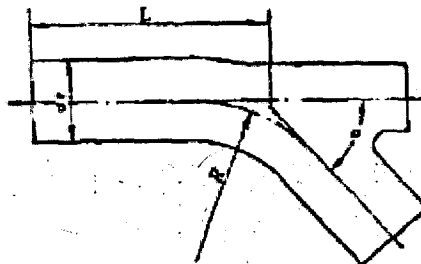


图 4-24 引水管

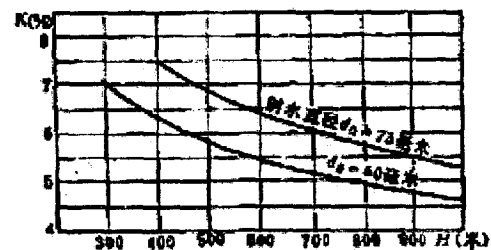


图 4-25 引水管及肘管中水流的流速系数



2. Elevator (1.2.2.6)

No	Name	Parameters	
		Unit	Value
1	Live-weight	Kg	1000
2	Maximum Capacity	person	13
3	Travelling speed	m/s	1.0
4	Opening size	Mm	900*2100
5	Cage size	Mm	1400*1100*2300
6	Power	V	380
7	Frequency	Hz	50
8	Door		opening in the middle with two leaves and stainless sheet facing

2 Workshop Equipment & Tools

A) Electric Shop

No	Name	Parameters	
		Unit	Value
1	Relay protection tester		3 loops for current and 3 loops for voltage , 220V , 50HZ
2	Motor coil winding machine		220V , 50HZ , wire diameter is 0 ~ 100mm
3	Constant temperature welding station		200-480 (), 220V , diameter of the soldering tin is 0.6mm , 0.8mm , 1.0mm , 1.2mm

B) Machine Shop

No	Name	Parameters	
		Unit	Value
1	Lathe machines		2220*1150*1590mm.Width of bed 360mm Max swing diameter over bed 360mm
2	Drilling machine		1235*600*1780mm travel of spindle 120mm Distance spindle to table surface 220~980mm
3	Milling machine		Work area 1250X360mm T slot number is 3 vertical type

4	Storage racks and shelves		1200*400*2000mm, shelf type
5	Work benches		1200*750*800mm, used for bench worker
6	One power hacksaw		220V, 50HZ, 600r/min, Blade Diameter is 185mm
7	One hydraulic press		200kn, oil pressure is 60Mpa
8	Welding plants (SAW, TIG type)		380V, 50HZ,
9	Grinding tools		Can be grinding work piece diameter is 250mm, Grinding speed is 5000r/min, total power is 1KW
10	Jigs and fixtures for material handling		Q235A
11	NDT test equipment		0~110db, 0.2~10MHz, scan range is 2.5~6000mm, Pulse Shift is -20 ~ +3400μs

C) Portable Equipment

No	Name	Parameters	
		Unit	Value
1	Mobile electric welding sets		220V , 45 ~ 65W , 250
2	Mobile air compressor		220V , 0.8Mpa , capacity of tank is 60L
3	Portable grinders		220V, 10500r/min, Blade Diameter is 100mm
4	Toolkits and devices for maintenance		Include wire cutter, nose pliers, adjustable spanner, screwdriver and claw hammer
5	Hacksaws and drilling machines		12', length of saw is 350mm; 220V, 600W, 2600r/min

3. Unit Auxiliary Transformers

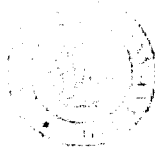
No	Name	Parameters	
		Unit	Value
1	Rated output	kVA	500
2	Rated voltage High voltage windings Low voltage windings	kV	11 0.415

3	Rated frequency	Hz	50
4	Noise	dB	56
5	Vector group		Dyn 11
5	Cooling		ONAN

4 PABX - Communication System

No	Name	Parameters	
		Unit	Value
1	Standards		ITU-T
2	Exchange capacity		≥80
3	Capable of extension		32
4	Interface port		2M
5	Number of subscriber		
	a Analogue		30
	b Digital		1
	c Trunk CO		8
	d Trunk 2Mbps ISDN/ Primary		1

[Handwritten signature]



APPENDIX – 10

CLARIFICATION REPLIES (LIMAK-ZKB JV)



LIMAK-ZKB J/V



Letter No. LIMAK-ZKB JV/LAWI-69MW/2015/251-

Dated: February 11, 2015

To

The Project Director,
Lawi Hydro Power Project,
Pakhtunkhaw Energy Development Organization (PEDO),
Govt. of Khyber Pakhtunkhaw,
Peshawar.

Subject: **CONFIRMATION OF THE BIDDING DOCUMENTS ADDENDUM NO. 2 –
LAWI HYDRO POWER PROJECT (69 MW)**

Dear Sir,

Please refer to your letter No. 1825/PEDO/PD Lawi HPP dated 05 / 02 /2015 on the subject.

We have reviewed your queries in depth, and our reply is as under:

Para No. 1

Quote

"It is to inform you that in the letter of Technical Bid submitted by M/s LIMAK-ZKB JV, you have accepted only the Addendum No.1 along with the issued tenders. In order to consider your bid you have to confirm that you have examined and accepted the Addendum No.2 during preparation of your bidding documents."

Unquote

Reply to Para No. 1

We confirm that we have examined and accepted the Addendum No.2 during preparation of our bidding documents.

Para No. 2

Quote

"You are requested to subject your confirmation of Addendum No.2 on or before 11th February 2015, so as to finalize the Technical Evaluation of the bids at the earliest"

Unquote

Limak Construction Industry and Trade Inc.

Hafta Sokak No: 9 GOP 06700
Ankara - Turkey
Tel: +92 312 446 88 00
Fax: +90 312 446 88 10
URL: www.limak.com.tr
E-mail: limak@limak.com.tr



Zahir Khan & Brothers

House, No. 200, Street # 74,
F-11/1, Islamabad Pakistan.
Tel: +92 - 51-21 11 771-2
Fax: +92 - 51-21 11 770
Email: zkb_isb@yahoo.com




LIMAK-ZKB J/V



Reply to Para No. 2

Our required confirmation of Addendum No. 2 has been stated above, and we are submitting on February 11, 2015, so as to finalize the Technical Evaluation of the bids.

With best regards


Mohabat Khan
Authorized Representative
LIMAK-ZKB JV



Limak Construction Industry and Trade Inc.
Hafta Sokak No: 9 GOP 06700
Ankara - Turkey
Tel: +92 312 446 88 00
Fax: +90 312 446 88 10
URL: www.limak.com.tr
E-mail: limak@limak.com.tr

Zahir Khan & Brothers
House No. 200, Street # 74,
F-11/1, Islamabad Pakistan.
Tel: +92 - 51-21 11 771-2
Fax: +92 - 51-21 11 770
Email: zkb_isb@yahoo.com

Letter No. LIMAK-ZKB JV/LAWI-69MW/2015/252-

Dated: February 11, 2015

To

The Project Director
Lawi Hydro Power Project,
Pakhtunkhaw Energy Development Organization (PEDO),
Govt. of Khyber Pakhtunkhaw,
Peshawar.

Subject: **EVALUATION OF SUB-CONTRACTOR / MANUFACTURER AS PER
SCHEDULE "E" OF THE TECHNICAL BID - LAWI HYDRO POWER
PROJECT (69 MW)**

Dear Sir,

Please refer to your letter No. 1827/PEDO/PD Lawi HPP dated 05 / 02 /2015 on the subject

We have reviewed your queries in depth, and our reply is as under:

Para No. 1**Quote**

It is to inform your that in the Technical Bid submitted by M/S LIMAK-ZKB JV, the authorization from M/S Andritz Hydro is missing and further to this all provided authorization from other manufacturers are in the name of M/S Chongqing Water Turbine Works Co. Ltd. Therefore to evaluate the performance / experience of sub-contractors as per attached Schedule E, we are considering M/S Chongqing Water Turbine Works Co. Ltd only.

Unquote**Reply to Para No. 1**

Please note that in the Original Bid submission we have attached the Authorization letter of M/S Andritz Hydro. If required we will send you the copy of this letter

Please also consider and evaluate M/S Andritz Hydro in addition to M/S Chongqing Water Turbine Works Co. Ltd as our Sub-Contractor. However, we will comply with your decision and evaluation regarding Sub-Contractors

Limak Construction Industry and Trade Inc.

Hafta Sokak No. 9 GOP 06700

Ankara - Turkey

Tel: +92 312 446 88 00

Fax: +90 312 446 88 10

URL: www.limak.com.tr

E-mail: limak@limak.com.tr

**Zahir Khan & Brothers**

House No. 200, Street # 74,

F-11/1, Islamabad Pakistan.

Tel: +92 - 51-21 11 771-2

Fax: +92 - 51-21 11 770

Email: zkb_isb@yahoo.com

Letter No. LIMAK-ZKB JV/LAWI-69MW/2015/250

Dated: February 11, 2015

To,

The Project Director,
Lawi Hydro Power Project,
Pakhtunkhaw Energy Development Organization (PEDO),
Govt. of Khyber Pakhtunkhaw,
Peshawar.

Subject: **MISSING INFORMATION REGARDING CIVIL / E&M WORKS AS
REQUIRED IN THE BIDDING - LAWI HYDRO POWER PROJECT
(69MW).**

Dear Sir,

Please refer to your letter No. 1821/PEDO/PD Lawi HPP dated 05 / 02 /2015 on the subject.

We have reviewed your queries in depth, and our para-wise reply is as under:

Para No. 2**Quote**

"You are requested to submit the required information on or before 11th February 2015 so as to finalize the technical evaluation of the bid at the earliest".

Unquote**Reply to Para No.2**

We are submitting the required information on 11th February, 2015 as directed.

**Para No. 3****Quote**

"It is pertinent to mention here that the Bid Documents clearly demonstrate the requirements for standards and specifications under clause 2.1.1 and 2.2.1 of Employer's Requirements. However, if Contractor uses any standards other than specified in the Bid Documents, these should be verified by some competent authority and also acceptable to the Employer. Please reply for the attached Three (3) Pages."

Unquote**Construction Industry and Trade Inc.**

No. 9 GOP 06700

Tel: +92 446 88 00

Fax: +92 446 88 10

Email: info@limak.com.trWebsite: www.limak.com.tr**Zahir Khan & Brothers**

House No. 200, Street # 74,

F-11/1, Islamabad Pakistan.

Tel: +92 - 51-21 11 771-2

Fax: +92 - 51-21 11 770

Email: zkb_isb@yahoo.com

Para No. 2

Quote

Your confirmation is required in this regard"

Unquote

Reply to Para No. 2

Please refer to our reply of Para No. 1

Para No. 3

Quote

Your Firm may also submit the Authorization from M/S Andritz Hydro"

Unquote

Reply to Para No. 3

Please refer to our reply of Para No. 1

Para No. 4


Quote

Your are requested to confirm/submit the missing information on or before 11th February 2015, so as to finalize the Technical Evaluation of the bids at the earliest"

Unquote

Reply to Para No. 4We are submitting the missing information on 11th February 2015, so as to finalize the Technical Evaluation of the bids.

With best regards


Mohabat Khan
Authorized Representative
LIMAK-ZKB JV

Reply to Para No. 3

We confirm that we have fulfilled the requirement for standard and specifications under clause 2.1.1 and 2.2.1 of Employer's Requirements.

Para No.4Quote

"Furthermore you are required to confirm that M/S CLIC JV will complete the project as per the stipulations of the Bid Documents 69 MW Lawi HPP, including addendum # 1, 2 & 3 of the bidding documents."

UnquoteReply to Para No.4

Please note that the Project Director has clarified that M/S CLIC JV is a typographic error and should be read as LIMAK-ZKB JV.

As required M/S LIMAK-ZKB JV hereby give a written undertaking that they will complete the Project as per the stipulations of the Bid Documents 69 MW Lawi HPP, including addendum # 1, 2 & 3 of the bidding documents.

Bidder's response as required is in Attachment-1 and Attachment-2 is also attached with this letter.

With best regards



Mohabat Khan
Authorized Representative
LIMAK-ZKB JV



Construction Industry and Trade Inc.

Sokak No: 9 GOP 06700

• Turkey

+92 312 446 88 00

+90 312 446 88 10

www.limak.com.tr

limak@limak.com.tr

Zahir Khan & Brothers

House. No. 200, Street # 74,

F-11/1, Islamabad Pakistan.

Tel: +92 - 51-21 11 771-2

Fax: +92 - 51-21 11 770

Email: zkb_isb@yahoo.com



Construction of Lawi Hydropower Project
Evaluation of Technical requirements (Civil) of substantively responsive Bidders

Section	Scope of Civil works	Bidders' Provided Data	Bidders' Response
Part III Section 1.3.1	BID SUBMISSION		
	Hydraulic Design	Not specified	Hydraulic Design has been discussed/given in detail in Schedule C, Design Criteria Section 2. Actual design for each components such as diversion weir, power intake, sand trap, tunnel, penstock, etc will be done at design Level 1 after award of contract and be got approved from Client/Client representative before entering in to Level 2 design.
	Head Loss Calculations	Not specified	Criteria for head loss calculation have been provided in Design Criteria Section 2.5 However, head loss calculation depends upon so many factors (contraction, trash rack, expansion, surface roughness, etc.). These constants can only be applied at Level 1 design and will be submitted to Client before



				entering in to Level 2 design.
		Power and energy Studies	Not specified	Power and Energy Studies is part of design criteria already provided. Fixing of upstream water level and downstream water levels totally depends upon layout studies and topographic survey and downstream rating curve of the Gabral River at location of proposed powerhouse and diversion weir. In absence of topographic survey, actual layout plan, head loss and type/size of turbine, power and energy calculation provision is not possible. Therefore detailed power and energy calculation would be provided at Level 1 design before entering in to Level 2 design. It is the responsibility of the EPC contractor to ensure the power and energy mentioned in the bid document.
Part III Section 2.8	EMPLOYERS FIELD FACILITIES	Main Field Offices	Not specified	The detail of field office has been provided in Schedule C (Method Performing Work) Section 3.3 page 6 of 32
		Mosque	Not specified	Mosque will be constructed as per requirement and approval of Client and Consultants
		Residential Accommodation	Not specified	Residential Accommodation for



Part III Section 2.9	UTILITIES	Vehicles	Not specified	Employer will be constructed as per requirement and approval of Client and Consultants The contractor will provide the six (6) vehicles one Land Cruiser and five Double Cabins along Drivers as mentioned in part III Section 2.8.4
		Site Communication	Not specified	Site Communications will be constructed as per requirement and approval of Client
		Access Roads (7m width)	Not specified	Access Roads has been given in detail in Schedule C, method performing works, Section 8 page 18
		Water Supply System	Not specified	Water Supply, Distribution and sewerage system has been given in detail in Schedule C, method performing works, Section 3.2 page 5
		Water Distribution System	Not specified	
Part III Section 2.11	PROJECT SIGNS	Sewerage System	Not specified	Adequate sign board will be provided at appropriate location with the approval of Client/Consultants



Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
Part III Section 1	MECHANICAL EQUIPMENT			
1.2.2.2	Turbines			
	Type	Pelton, Vertical Shaft 4 jet	Pelton, Vertical Shaft 6 jet	confirmed, the Pelton Turbines are with 4 jets, but attached
	Regulation	Double Regulated	Not specified	Double Regulation
1.2.2.3	Inlet Valve			
	Inner Diameter	950mm	1.1m	confirm according to spec.
	Design Head	535 m WC	Not specified	do
1.2.2.6	Elevator			
	Passenger Elevator	ONE No.	Not specified	confirmed
	Capacity	1000Kg / 13 persons (Minimum)	Not specified	confirmed as per spec.
1.2.2.5	Auxiliary Systems			
	Fire fighting protection & detection system	YES	Not specified	Yes
1.2.3	ELECTRICAL EQUIPMENT			
1.2.3.2	Generator			
	Protection Class	IP44	Not specified	Confirmed according to spec.
	Insulation Class	F	Not specified	do
	Temperature Rise	B	Not specified	do
1.2.3.3	Excitation			
	Type	Static or Rotary	Not specified	Static



Construction of Lawi Hydropower Project
Technical Plant Particulars of Substantively Responsive Bidders

SECTION	DESCRIPTION		Bidder's quoted values	Bidder's Response
1.2.3.4	Main Transformers (3 No.s)			
	Temperature Rise	55o C	Not specified	Confirmed as per spec
	Power Factor	0.8	Not specified	Confirmed as per spec
	Service station Transformer (1 No.s)			
	Temperature Rise	55o C	Not specified	Confirmed as per spec
	Power Factor	0.8	Not specified	Confirmed as per spec
	Auxillary Transformers			
	Power Factor	0.8	Not specified	Confirmed as per spec
	Impedence	5 - 6 %	4%	
1.2.3.4	Medium Voltage Installations (11 kV)			
	Type	vacuum type	Not specified	Confirmed as per spec
	Max Voltage	33 KV	Not specified	- do -
	Short Circuit Current	21 KA	Not specified	- do -
1.2.3.9	Telecommunication			
	Type	Digital	Not specified	- do -
	PABX	As required	Not specified	- do -
	Interret facility	Yes	Not specified	- do -
1.2.3.12	Earthing System			
	Type	Mesh and Independent	Not specified	- do -
	Earth resistance	< 0.16 ohm	<1 Ohm	Confirmed as per spec
1.2.3.13	Transmission Line and Interconnection			
	Conductor	ACSR	Not specified	The clause does not exist in the spec
	Other specification	As per WAPDA system	Not specified	- do -



PRICE BID EVALUATION REPORT
MARCH, 2015

TABLE OF CONTENTS

1.	INTRODUCTION	1
1.1	BACKGROUND	1
1.2	EVALUATION OF TECHNICAL BIDS.....	1
1.3	PRICE BID OPENING	1
1.4	DOCUMENTS COMPRISING THE PRICE BID	2
1.5	PRELIMINARY EXAMINATION AND DETERMINATION OF RESPONSIVENESS OF BIDS	2
1.6	CONFORMITY TO BID DOCUMENTS.....	3
2.	COMPARISON OF PRICE BIDS AND DETERMINATION OF LOWEST EVALUATED BID.....	3
2.1	COMPARISON OF BID PRICES	3
2.2	LOWEST EVALUATED BID.....	3
2.2.1	Analysis of Prices.....	3
2.2.2	Arithmetic Correction (IB 24.2).....	3
2.2.3	Price Adjustment (IB 26.2& IB 26.4)	4
2.2.4	Schedules of Prices	4
2.2.5	Schedules J, K and L.....	5
2.2.6	Payment Procedure (Annex 1 – Attachment to PCC Sub Clause 33.1)	5
3.	RECOMMENDATIONS OF THE BID OPENING & EVALUATION COMMITTEE:	6

Appendix-A Basic Data Sheet.

Appendix-B Record of Bid Opening.

Appendix-C Conformity of Bid Documents.

Annexure-I SBP's Foreign Currency Exchange Rate for December 24, 2014.

Annexure-II Comparison of Schedule of Prices.

Annexure-III Arithmetic Check & Summary of Bid Prices.

Annexure-IV Price Adjustment for Difference in Turbine / Generator
Efficiencies

Annexure-V Estimated Progress Payments.

Annexure-VI Clarification Regarding Financial Bid.

1. INTRODUCTION

1.1 Background

The Pakhtunkhwa Energy Development Organization (PEDO), Government of Khyber Pakhtunkhwa, Pakistan ("the Employer") has allocated funds through its own resources, towards the development of 69 MW LAWI HYDROPOWER PROJECT (LHPP) DISTRICT CHITRAL "the complete Power Plant" on Engineering, Procurement and Construction (EPC) mode. "The Works" include detailed Engineering design, supply, construction, erection/installation, testing and commissioning of all Civil Structures and Electro-Mechanical Equipment of the Power Plant including other infrastructure works. Bidding was open to all eligible bidders. The construction period of the Project is 60 months. The project is located along Shishi River near Drosh, in District Chitral, Khyber Pakhtunkhwa, Pakistan. The key information of the bidding process has been prepared and Basic data sheet is attached as **Appendix-A**.

The bids for Lawi Hydropower Project (2nd time bidding) were annuled by PEDO on June 9, 2014 and were invited for the 3rd time on EPC basis (Technical and Financial) through single stage-two envelop system, from eligible International firms as per the bidding documents requirements for the Works which was advertised in leading local English/Urdu newspapers as well on PEDO website on June 13, 2014.

The Peshawar High Court upon the application of M/s SINOTEC-SIDRI-GRC JV stayed the bidding process on June 19, 2014. The Court dismissed the petition of M/s SINOTEC-SIDRI-GRC JV against the retendering by the Pakhtunkhwa Energy Development Organization (PEDO) on November 20, 2014. Besides ordering the dismissal of petition, the Court also ordered vacation of stay order issued on the bidding process.

1.2 Evaluation of Technical Bids

The Bid Opening & Evaluation Committee evaluated the Technical Bids of the following four (04) bidders

1. M/s DESCON-ZOEC JV.
2. M/s CLIC JV.
3. M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV
4. M/s LIMAK-ZKB JV.

and found all the bids substantially responsive.

1.3 Price Bid Opening

Price Bid opening was held on March 03, 2015 at 1400 hours, in the conference room of PEDO house, Peshawar, by the Bid Opening & Evaluation Committee, the composition of which was as follows:-

- i. Project Director / Director Concerned

Convener

- | | |
|---|--------|
| ii. Director (Finance / Admin.) | Member |
| iii. Deputy Director concerned | Member |
| iv. Assistant Director concerned | Member |
| v. Project Manager / Team Leader of Management Consultant | Member |

The Price Bid envelopes were opened in presence of representatives all four (04) bidders. As no Bidder submitted any "Modification", "Substitution", "Withdrawal" or "Notice of Withdrawal", therefore the Committee examined and signed the documents and announced the Bidder's name and Bid Prices. The record of Bid Opening is attached as **Appendix-B**.

1.4 Documents Comprising the Price Bid

The Price Bids were required to include the following documents:-

- (a) Covering Letter
- (b) Letters of Bids duly filled, signed and sealed, in accordance with Clause IB.17.
- (c) Schedules (J to L) to Bid, duly filled and signed, in accordance with the instructions, contained therein.
- (d) Schedule of Prices completed in accordance with IB.11 and IB.12.
- (e) Documentary evidence, in accordance with Clause IB.14, that the Plant and Ancillary services, to be supplied by the Bidder are eligible Plant and Services and conform to the Bidding Documents.
- (f) Any other documents prescribed in Particular Conditions of Contract and or Technical Provisions to be submitted with the Bid (i.e. Annex-1 to PCC sub-clause 33.1).

1.5 Preliminary Examination and Determination of Responsiveness of Bids

Price Bids were evaluated on the basis of "Preliminary Evaluation and Determination of Responsiveness of Bids", as provided in the clause IB.24 of Instruction to Bidders (Volume 1 of EPC Bidding Documents).

As per the clause IB.24 of Section E of the EPC, Bidding Documents (Volume-I), Preliminary Evaluation and Determination of Responsiveness of bids was determined as follows:-

Prior to detailed evaluation, pursuant to Clause IB.26, the Employer/ Project Manager / Engineer will determine the responsiveness of the Bids by examining the following:-

- (i) the Bid is complete and does not deviate from the scope,
- (ii) any computational errors have been corrected,
- (iii) required sureties have been furnished,
- (iv) the documents have been properly signed,

- (v) the Bid is valid till the required period,
- (vi) the Bid prices are firm during currency of the Contract, if it is a fixed price bid,
- (vii) completion period proposal is within the specified limits,
- (viii) the Bidder/Manufacturer is eligible to Bid and possesses the requisite experience,
- (ix) the Bid does not deviate from the basic technical requirements,
- (x) the Bid is generally in order.

1.6 Conformity to Bid Documents

All the four (04) bidders substantially conformed to the Bid Documents as described in the section 1.5 and 1.6 above. Therefore, no bidder was declared non-responsive on the basis of completeness of bid documents. Examination of Completeness of Bid Documents is attached as **Appendix-C**.

2. COMPARISON OF PRICE BIDS AND DETERMINATION OF LOWEST EVALUATED BID

2.1 Comparison of Bid Prices

Comparison of Bid Prices is made after application of corrections/adjustments to work out the evaluated bid prices as stated in IB.26.2 (e). The applicable exchange rate of December 24, 2014 is attached as **Annexure-I**.

2.2 Lowest Evaluated Bid

2.2.1 Analysis of Prices

On the basis of comparison of Schedule of Price Bids, it is concluded that the Bidders, particularly the lowest Bidder (M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV) fully meets the requirements for the Work and the specifications governing materials and construction processes, and that they were prepared to carry out the Work as specified in the Bidding Documents. A comparison of Schedule of Prices of all bidders is attached as **Annexure-II**.

2.2.2 Arithmetic Correction (IB 24.2)

All bids were checked arithmetically in which M/s DESCON-ZOEC JV, M/s CLIC JV and M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV have loaded their bids with amounts mentioned under the head "Taxes & Duties". However, it was clearly mentioned in the Price Schedules that taxes and Duties shall not be made part of the Bid Price. M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV did not add amount of Provisional sum in summation of total price of Schedule No. 4 and M/s Limak-ZKB JV also needed correction as regard to the Provisional Sum amounts in Schedule no. 4 of schedule of prices. There were some other minor errors in the bids. After applying all these arithmetic corrections, the Corrected Prices for the Bids doesn't change their

position in order of prices quoted for the works. Arithmetic Check Summary of Bid Prices is attached as **Annexure-III**.

2.2.3 Price Adjustment (IB 26.2& IB 26.4)

Pursuant to Sub-Clause 26.2, Para (e)(iii), following price adjustment methods were adopted to evaluate adjusted prices for each bidder:

(a) Price Adjustment for Completeness in Scope of Work

No price adjustment was needed for completeness of scope of work.

(b) Price Adjustment for Technical Compliance

An adjustment in bid price was needed for efficiency of turbines of M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV as shown in **Annexure-IV**.

(c) Price Adjustment for Commercial Compliance

No major deviation was found in the price bids submitted by the bidders in terms of commercial compliance except for the Bidder M/s LIMAK-ZKB JV who has loaded his bid with 21.99% additional cost to its original Bid Price in the Summary of Bid Prices (Schedule No. 5). A price adjustment was needed in this regard to reduce his price with respect to this addition as shown in Annexure-IV.

(d) Price Adjustment for Deviations in Terms of Payment

All the bidders accepted the terms of payments as defined in the Bid Documents.

(e) Price Adjustment for Completion Schedule

M/s LIMAK-ZKB JV in its submitted bid has not quoted prices for the Items no. 3.2 and 3.6 of Price Schedule No. 3. The prices of these items are considered to be included in the total bid price quoted by the bidder. However, for comparison purposes the average of prices of these items quoted by other three bidders are loaded in M/s LIMAK-ZKB Bid.

The Price Adjustment Summary is attached as **Annexure-III**.

2.2.4 Schedules of Prices

Following is the list of Schedule of rates and prices to be provided by the bidders:

Schedule No.1	- E&M Plant and Mandatory Spare Parts Supplied from Abroad
Schedule No.2	- E & M Plant and Mandatory Spare Parts Supplied from within Pakistan
Schedule No. 3	- Design Services, Installations and other services
Schedule No. 4	- Civil Works, Installation and Other Services
Schedule No. 5	- Grand Summary
Schedule No. 6	- Recommended Spare Parts

Schedule No. 7 - Day Work Schedule

All the bidders provided the required schedules on prescribed format which were evaluated for arithmetic errors and compared accordingly. The quoted and corrected bid prices of all bidders are attached as **Annexure - III**.

2.2.5 Schedules J, K and L

M/s DESCON-ZOEC JV has provided Schedule J for his nominated sub-contractors only while Integrity Pact for the JV partners is missing. Also the Schedule L provided by the JV does not serve the purpose. M/s CLIC JV and M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV have provided Schedules J, K and L which fulfill the requirements. M/s LIMAK-ZKB JV has attached Schedules J and K in his bid. However Schedule L was missing. Also Schedule K provided by the JV does not serve the purpose.

Comparison Sheet for Estimated Progress Payments is attached as **Annexure-V**.

2.2.6 Payment Procedure (Annex 1 – Attachment to PCC Sub Clause 33.1)

The Bidders were advised to provide the procedure for payment in terms of progressing works / Construction Schedule in their bids. A format was also provided as Annex 1 – Attachment to PCC Sub Clause 33.1. However, none of the bidders have provided the said payment procedure. A Clarification was sought from M/S Sichuan-Sarwar-Silian-Chongqing Luyang JV vide letter No. 1857/PEDO/PD LAWI HPP dated 11-03-2015 and the Bidder vide letter No. SSSC/Lawi/BD/003 dated 12-03-2015 has undertaken to provide the required information before the Award of the Contract. The Clarification letter to the Bidder and his reply are attached at **Annexure-VI**.

3. RECOMMENDATIONS OF THE BID OPENING & EVALUATION COMMITTEE

The Bid Opening and Evaluation Committee, unanimously recommends that, "since the bidder, M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV, has been qualified technically and stands lowest financially on the grounds that they have undertaken to fully comply with all the specifications of the bidding documents without any change in the bid price" therefore, the Project may be awarded to M/s Sichuan-Sarwar-Silian-Chongqing Luyang JV with all works i.e. Detailed Engineering Design & Drawings, Construction, Supply, Erection, Installation, testing, Commissioning and Joint Operation on full load at cost of Pak Rs. 16,337,654,685/- (Inclusive of Provisional Sum and Exclusive of Taxes, Duties and Priced Day works).

Sr. No.	Member	Signature
1	Director Panning & Facilitation	
2	Director Finance / Administration	
3	Project Director Lawi HPP	
4	Deputy Director Lawi HPP	
5	Assistant Director Lawi HPP	
6	Project Manager MC (ACE)	

APPENDIX-A

Basic Data Sheet

Basic Data Sheet

- | | |
|------------------------|--|
| 1. Project Title | Lawi Hydropower Project |
| 2. Project Funding | Hydel Development Fund (90%) & Annual Development Programme (10%) of Khyber Pakhtunkhwa. |
| 3. Bid Title | Design , Procurement and Construction of Lawi Hydropower Project (69 MW) |
| 4. Mode of Procurement | International Competitive Single Stage, Two Envelope System |

A. TECHNICAL BIDS

- | | |
|---------------------------------|---------------------------------|
| 5. Bid Closing Date & Time | 14:30 Hours on January 21, 2015 |
| 6. Bid Opening date & Time | 14:30 Hours on January 21, 2015 |
| 7. Number of Bids Received | Four (04) |
| 8. Number of Responsive Bidders | Four (04) |

B. PRICE BIDS

- | | |
|---|---|
| 10. Opening Date & Time of Price Bids | 14:00 Hours on March 03, 2015 |
| 11. Bid Validity Period | 180 Days from the Date of Opening of Bids |
| 12. Bid Validity Expires on | July 20, 2015 |
| 13. Bid Security Validity Period | 208 Days from the Date of Opening of Bids |
| 14. Bid Security Validity Expires on | August 17, 2015 |
| 15. Date for Determining Applicable Exchange Rate | December 24, 2014 |
| 16. Exchange Rate for Evaluation | 1 US\$ = 100.6677 PKR |

APPENDIX-B

Record of Bid Opening

ATTENDANCE SHEET

OPENING OF FINANCIAL BIDS
FOR 69 MW LAWI HPP, DISTRICT CHITRAL KP

MARCH 03, 2015

PEDO

Sr. No.	Name	Designation	Signature
1.	WAJID NAWAZ KHAN	Dir (F&E)	Wajid
2.	Mohammad BASHIR	Dir (F/A)	m-bashir
3.	Niamal Khan	PD Lawr	Niamal
4.	Narinder Kumar	Deputy Director	Narinder
5.	JUNAID IRBAL	ASSISTANT DIRECTOR (LAW)	Junaid

MANAGEMENT CONSULTANTS (ACE)

Sr. No.	Name	Designation	Signature
1.	Muhammad Aslam Bhatti	PM/TL	Muhammad Aslam Bhatti
2.	Syed Nabeel Ahmad	PE (contracts)	Syed Nabeel Ahmad
3.	NAWAZISH ALI	SENIOR ENGR	Nawazish Ali

OTHERS


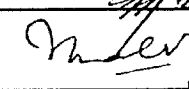
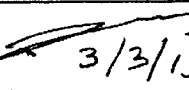
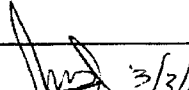
Sr. No.	Name & Department	Designation	Signature
1.			
2.			
3.			

ATTENDANCE SHEET

OPENING OF FINANCIAL BIDS
FOR 69 MW LAWI HPP, DISTRICT CHITRAL KP

MARCH 03, 2015

BIDDERS / AUTHORIZED REPRESENTATIVE

Sr. No.	Name of Bidder	Name of Authorized Representative	Signature
1.	M/s CLIC JV	Muhammad Anwar	
2.	M/s DESCON-ZOEC JV	Khalid Jawaid Iqbal	 3/3/15
3.	M/s SICHUAN-SARWAR- SILIAN-CHONGQING LUYANG JV	Muhammad Sharif Bhatti	 3/3/15
4.	M/s LIMAK-ZKB JV	Mohammed Saeed	 3/3/15


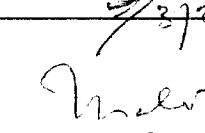
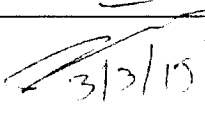
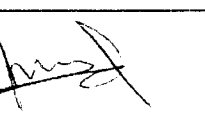
DECLARATION / UNDERTAKING

69 MW LAWI HYDROPOWER PROJECT, DISTRICT CHITRAL

OPENING OF FINANCIAL PROPOSALS

03-03-2015

We, the Authorized Representatives of Bidders / JVs hereby certify that the FINANCIAL PROPOSALS of All the Four Bidders / JVs were found Properly Sealed before Opening of the Financial Bids and further that the Opening of the Financial Bids for the subject Project was conducted in a Fair and Transparent manner and we are satisfied with the proceedings of the Opening of the Financial Bids.

S. No.	Name of Representative	Firm / JV	Signature
1.	Muhammad Anwar	M/S CLIC JV	
2.	Khalid Javed Iqbal	M/S DESCON-ZOEC JV	 3/3/15
3.	Muhammad Sharif Bhatti	M/S Sichuan-Sarwar-Silian-Chongqing Luyang JV	 3/3/15
4.	Atiqur Saeed	M/S LIMAK-ZKB JV	

OPENING OF FINANCIAL BIDS FOR 69 MW LAWI HPP DISTRICT CHITRAL

HELD ON MARCH 03, 2015 AT 1400 HOURS IN THE COMMITTEE ROOM OF PEDO HOUSE, PESHAWAR

Sr. No.	Name of Bidder	Bid Price (Pak Rupees)	Discount (If any) (Pak Rupees)	Net Price (Pak Rupees)	Name of Bidder's Representative	Signature
1.	M/s CLIC JV	Rs 19,542,917,421	- Nil -	Rs 19,542,917,421	Muhammad Anwar	
2.	M/s DESCON-ZOEC JV	Rs. 21,494,936,975	Rs. 2,727,659,410	Rs 18,767,277,565	Khaled Javed	
3.	M/s SICHUAN-SARWAR-SILIAN- CHONGQING LUYANG JV	Rs. 15,466,289,476	- Nil -	Rs 15,466,289,476	M. Shariq Bhatti	
4.	M/s LIMAK- ZKB JV	Rs. 32,233.41 Million	- Nil -	Rs. 32,233.41 Million	M. Waqar Saad	

Bid Opening & Evaluation Committee:

Director Finance & Administration, PEDO

Director Planning & Facilitation, PEDO

Project Director, Lawi HPP

Deputy Director, Lawi HPP

Assistant Director, Lawi HPP

Project Manager MC (ACE)

APPENDIX-C

Conformity of Bid Documents

69MW LAWI HYDROPOWER PROJECT

Confirmity of Bid Documents

Sr. No.	Name of Contractor	Covering Letter/ Letter of Price Bid	All Letters of Bids duly filled, signed and sealed in accordance with IB 17	Schedules to Bid duly filled, signed and sealed			Schedules of Prices in accordance with IB 11 & IB 12							Arithmetic Check	Eligibility for Domestic Preference IB 27	Other Documents Payment Procedure Annex-1 to PCC sub-clause 33.1
				Schedule J	Schedule K	Schedule L	Schedule No. 1	Schedule No. 2	Schedule No. 3	Schedule No. 4	Schedule No. 5	Schedule No. 6	Daywork Schedule			
1	DESCON-ZOEC JV	P	P	RC	P	RC	P	P	P	P	P	P	P		NA	NP
2	CLIC JV	P	P	P	P	P	P	P	P	P	P	P	P		NA	NP
3	Sichuan-Sarwar-Silian-Chongqing Luyang JV	P	P	P	P	P	P	P	P	P	P	P	P		NA	NP
4	LIMAK-ZKB JV	P	P	P	RC	NP	P	P	P	P	P	P	P		NA	NP

P = Provided

NP = Not Provided

A = Applicable

NA = Not applicable

RC = Requires Clarification / Correction

Annexes I-VI

Annexure-I	SBP's Foreign Currency Exchange Rates for 24 December, 2014
Annexure-II	Comparison of Schedule of Prices
Annexure-III	Arithmetic Check & Summary of Bid Prices
Annexure-IV	Price Adjustment for Difference in Turbine / Generator Efficiencies
Annexure-V	Estimated Progress Payments
Annexure-VI	Clarification Regarding Financial Bid.

ANNEXURE-I

SBP's Foreign Currency exchange rate for December 24, 2014



STATE BANK OF PAKISTAN
DOMESTIC MARKETS & MONETARY MANAGEMENT DEPARTMENT

Weighted Average Customer Exchange Rates¹ as on 24-Dec-14

CURRENCY	BUYING	SELLING
AED	27.3565	27.4038
AUD	81.4935	81.6502
CAD	86.4677	86.6286
CHF	101.7430	101.9334
EUR	122.3449	122.5728
GBP	155.9140	156.2007
JPY	0.8349	0.8365
SAR	26.7705	26.8190
USD	100.4814	100.6677

¹ Note: The data is compiled and disseminated for information only. These Exchange Rates are an estimate of the Exchange Rates quoted by various Commercial Banks to their clients. They are compiled from the Exchange Rate sheets issued daily by various Commercial Banks providing their indicative Exchange Rates for commercial transaction with customers.

ANNEXURE-II

Comparison of Schedule of Prices

69MW LAWI HYDROPOWER PROJECT

Schedules of Rates and Prices

Schedule No. 1 - Plant and Mandatory Spare Parts Supplied from Abroad

		DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
Item	Description	Total Price	Total Price	Total Price	Total Price
		Foreign Currency (US\$ Million)	Foreign Currency (US\$ Million)	Foreign Currency (US\$ Million)	Foreign Currency (US\$ Million)
1	2	3	4	5	6
1					
1.1	Pelton Turbines, 4 Jets, double regulated.	1.7890	6.2100	7.9884	7.5791
1.2	Generators & Auxiliaries	2.4195	16.6441	7.7717	10.1748
1.3	Governor Inlet Valves	0.7137	2.0952	2.6190	3.5620
1.4	Powerhouse Overhead Cranes & Equipment	0.6895	0.9418	0.4643	0.7916
1.5	Mobile Crane	0.3795	0.2863	0.4125	0.4288
1.6	Trashracks alongwith Trashrack Cleaning Machine(TRCM) & Gates	1.4515	0.7924	16.1378	2.0109
1.7	Step up Transformers	3.5301	6.1953	1.8769	6.2500
1.8	Medium & High Voltage Busbars	1.8975	4.4762	2.3910	1.5775
1.9	132 KV Switchyard	2.7132	1.3781	0.8106	2.2500
1.10	SCADA System	1.0391	6.1587	1.1250	2.8750
1.11	Telecommunication System	0.2252	0.4155	0.1250	0.7827
1.12	Essential Spare Parts	-	1.2565	1.5000	1.8058
1.13	Fire Protection and HVAC system	-	1.0345	0.1600	1.1061
TOTAL		16.8479	47.8845	43.3822	41.1942

Schedule No. 1 (a) - Country of Origin Declaration Form

Country	Item No.	Item No.	Item No.	Item No.
China	Item no. 1.1 to 1.10 & 1.12	Item no. 1.1 to 1.13	Item no. 1.1 to 1.13	Item no. 1.1 to 1.13
UAE	Item no. 1.11			

69MW LAWI HYDROPOWER PROJECT

Schedule No. 2 - Plant and Mandatory Spare Parts Supplied from within Pakistan

			DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
Item	Description	Qty	Total EXW Price Million PKR	Total EXW Price Million PKR	Total EXW Price Million PKR	Total EXW Price Million PKR
1	2	3	4	5	6	7
2						
2.1	Pelton Turbines, 6 Jets, double regulated.	1				
2.2	Generators & Auxiliaries	1				
2.3	Governor	1				
2.4	Inlet Valves	1				
2.5	Powerhouse Overhead Cranes & Equipment	1	9.4086			
2.6	Mobile Crane	1				
2.7	Trashracks alongwith Trashrack Cleaning Machine(TRCM) & Gates	1				
2.8	Stepup Transformers	1				
2.9	Medium & High Voltage Busbars	1				
2.10	132 KV Switchyard	1	52.3890			
2.11	132 KV Transmission Lines (Including Civil Works)	1				
2.12	SCADA System	1				
2.13	Telecommunication System	1				
2.14	Essential Spare Parts	1	10.0569			
TOTAL			71.8545	-	-	

69MW LAWI HYDROPOWER PROJECT

Schedule No. 3 - Design Services

Item	Description	DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
		Total Price	Total Price	Total Price	Total Price
		Million PKR	Million PKR	Million PKR	Million PKR
1	2	3	4	5	6
3	DESIGN				
3.1	Design of Civil Works	108.4030	274.8786	608.4599	900.0000
3.2	Construction + As built Drawings	65.0418	54.9757		
3.3	Design of E&M Works	113.5500	137.4393	42.2263	100.0000
3.4	Erection Sequence Drawings for E&M Works	68.1300	27.4879	13.8815	400.0000
3.5	Testing and Commissioning on Completion	136.2600	27.4879	376.1250	100.0000
3.6	Design of Infrastructure Works	43.3612	27.4879	50.0000	-
TOTAL		534.7459	549.7571	1,090.6927	1,500.0000

SICHUAN PROVINCE GEOLOGICAL ENGINEERING COMPLEX

Date: 12 March 2015

Office file.



PEDO

PAKHTUNKHWA ENERGY DEVELOPMENT ORGANIZATION
GOVERNMENT OF KHYBER PAKHTUNKHWA PESHAWAR

38/B2, Phase-V, Hayatabad, Peshawar. Tel: 091- 9217304, Fax: 091-9217307



No. 1857/PEDO/PD Lawi HPP
Dated: 11 / 03 / 2015

To

M/S Sichuan-Sarwar-Silian-Chongqing Luyong JV,
195-G/3, Johar Town,
Lahore, Pakistan.

Subject: **MISSING INFORMATION REGARDING ANNEX-1, ATTACHMENT TO PCC
SUB-CLAUSE 33.1 OF THE BIDDING DOCUMENTS**

It is to inform you that in the Financial Bid submitted by M/s Sichuan-Sarwar-Silian-Chongqing Luyong JV, the Annex-1, attachment to PCC sub-clause 33.1 regarding Payment Procedure is missing.

2. You are required to provide the above mentioned document duly filled in within two days positively in order to complete the Evaluation of your Financial Bid in time.

Project Director
Lawi Hydropower Project

Cc:

1. GM (Hydel), PEDO, Peshawar.
2. Director (P&F), PEDO, Peshawar.
- ✓ 3. Project Manager/Team Leader, Management Consultant for Lawi HPP.
4. PS to Chief Executive Officer PEDO, Peshawar.

Project Director
Lawi Hydropower Project

[Signature]
11/3/15

ANNEXURE-VI

Clarification regarding Financial Bid

**69MW LAWI HYDROPOWER PROJECT
ESTIMATED PROGRESS PAYMENTS**

	DESCON-ZOEC JV	CLIC JV	Sichuan-sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
Period	Amounts	Amounts	Amounts	Amounts
	LCC (Rs.)	LCC (Rs.)	LCC (Rs.)	LCC (Rs.)
37th Month	-	14,116,456.00	291,593,269.50	
38th Month	-	1,502,425.00	291,593,269.50	
39th Month	1,152,830,060.00	8,753,793.00	291,593,269.50	
40th Month	-	787,383,147.00	194,395,513.00	
41st Month	-	787,383,147.00	194,395,513.00	
42nd Month	697,104,379.00	5,746,755.00	97,197,756.50	
43rd Month	-	361,892,555.00	97,197,756.50	
44th Month	-	262,676,116.00	-	
45th Month	558,808,544.00	110,508,570.00	-	
46th Month	-	3,152,345.00	-	
47th Month	-	56,128,506.00	232,791,054.30	
48th Month	522,831,933.00	97,916,638.00	718,779,836.80	
49th Month	-	262,436,203.00		
50th Month	-	16,192,753.00		
51st Month	469,874,995.00	33,036,415.00		
52nd Month	-	14,850,021.00		
53rd Month	-	4,513,620.00		
54th Month	395,322,017.00	12,494,083.00		
55th Month	-	97,684,961.00		
56th Month	-	70,578,595.00		
57th Month	134,039,152.00	21,729,156.00		
58th Month	-	97,107,759.00		
59th Month	-	97,107,759.00		
60th Month	760,510,466.00	6,551,054.00		
61st Month	-			
62nd Month	-			
63rd Month	-			
64th Month	-			
65th Month	-			
66th Month	-			
During Defects Liability Period (DLP)	-			
After DLP	-			
Total Bid Price	20,334,936,974.00	19,542,917,423.00	15,466,289,476.00	19,700

69MW LAWI HYDROPOWER PROJECT
ESTIMATED PROGRESS PAYMENTS

	DESCON-ZOEC JV	CLIC JV	Sichuan-sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
Period	Amounts	Amounts	Amounts	Amounts
	LCC (Rs.)	LCC (Rs.)	LCC (Rs.)	LCC (Rs.)
Advance				
1st Month		787,383,147.00	1,546,628,947.60	1,000
2nd Month		7,873,831,473.00	-	900
3rd Month	169,697,500.00	1,574,766,295.00	485,988,782.50	1,100
4th Month		3,936,915,736.00	194,395,513.00	1,200
5th Month		787,383,147.00	194,395,513.00	800
6th Month	944,923,700.00	132,697,418.00	659,977,621.60	1,000
7th Month		32,900,411.00	1,176,018,979.00	1,200
8th Month		175,449,322.00	194,395,513.00	1,300
9th Month	1,361,549,987.00	17,725,596.00	194,395,513.00	1,400
10th Month	-	87,888,760.00	892,768,675.90	1,800
11th Month		38,123,221.00	194,395,513.00	1,500
12th Month	1,177,096,827.00	21,547,698.00	97,197,756.50	1,400
13th Month	-	8,022,692.00	97,197,756.50	1,800
14th Month	-	22,437,577.00	97,197,756.50	1,700
15th Month	1,938,252,585.00	22,437,577.00	1,358,350,784.50	1,600
16th Month	-	29,916,769.00	194,395,513.00	
17th Month	-	39,916,616.00	194,395,513.00	
18th Month	1,590,848,221.00	93,138,770.00	194,395,513.00	
19th Month	-	4,126,873.00	194,395,513.00	
20th Month	-	10,571,327.00	194,395,513.00	
21st Month	2,073,172,585.00	41,343,507.00	1,591,141,838.80	
22nd Month	-	57,357,605.00	194,395,513.00	
23rd Month	-	47,864,765.00	194,395,513.00	
24th Month	1,626,794,958.00	27,615,427.00	194,395,513.00	
25th Month	-	119,463,959.00	194,395,513.00	
26th Month	-	20,695,519.00	194,395,513.00	
27th Month	1,250,117,427.00	18,454,067.00	194,395,513.00	
28th Month	-	24,910,212.00	194,395,513.00	
29th Month	-	43,553,634.00	194,395,513.00	
30th Month	985,599,801.00	20,200,020.00	194,395,513.00	
31st Month	-	12,858,337.00	194,395,513.00	
32nd Month	-	29,877,801.00	194,395,513.00	
33rd Month	1,372,832,182.00	81,379,771.00	194,395,513.00	
34th Month	-	31,907,419.00	194,395,513.00	
35th Month		32,076,255.00	291,593,269.50	
36th Month	1,152,729,655.00	4,735,868.00	291,593,269.50	

ANNEXURE-V

Estimated Progress Payments

Price Adjustment for Difference in Turbine/ Generator Efficiencies

Average Weighted Efficiency for Turbine for Evaluation 92%

Average Weighted Efficiency for Generator for Evaluation 97%

S.No.	Project Components	Bidders	Efficiency as quoted by the Bidder	Difference in Efficiencies	Price Adjustments for Difference in Efficiency (PKR.875,000 for each 0.1% Increase or decrease)
1	Turbines	DESCON-ZOEC JV	92.00%	0.00%	-
		CLIC JV	92.00%	0.00%	-
		Sichuan-Sarwar-Silian-Chongqing Luyang JV	91.60%	0.400%	3,500,000
		LIMAK-ZKB JV	92.00%	0.00%	-
2	Generators	DESCON-ZOEC JV	97.00%	0.00%	-
		CLIC JV	97.00%	0.00%	-
		Sichuan-Sarwar-Silian-Chongqing Luyang JV	97.00%	0.00%	-
		LIMAK-ZKB JV	97.00%	0.00%	-

BidderTotal Price Adjustment

DESCON-ZOEC JV

-

CLIC JV

-

Sichuan-Sarwar-Silian-Chongqing Luyang JV

3,500,000

LIMAK-ZKB JV

-

ANNEXURE-IV

Price Adjustment for Difference in Turbine/Generator Efficiencies

69MW LAWI HYDROPOWER PROJECT
Price Adjustment
Summary of Bid Prices (Comparison Purpose Only)

LIMAK-ZKB JV	Submitted Prices (Million)		Correction		Corrected Bid Prices (Million)		Ranking
	M USD	M PKR	M USD	M PKR	M USD	M PKR	
(a) Price Adjustment for Completeness in Scope of Work	-	-	-	-	-	-	4
(b) Price Adjustment for Technical Compliance	-	-	-	-	-	-	
(c) Price Adjustment for Commercial Compliance	-	27,269.92	-	-	-	-	
(d) Price Adjustment for Deviations in Terms of Payment	-	-	-	-	-	-	
(e) Price Adjustment for Completion Schedule (Missing items No. 3.2 & 3.6 in Schedule No. 3)	-	-	-	135.2193	-	-	
Domestic Preference	Nil		Nil		Nil		
Total Price Adjustment				135.2193			
Corrected Bid Price before Price Adjustment						27,269,924,662.67	
Total Bid Price after Price Adjustment						27,405,143,913.18	

69MW LAWI HYDROPOWER PROJECT
Price Adjustment
Summary of Bid Prices (Comparison Purpose Only)

Sichuan - Sarwar - Sillan - Chongqing Luyang JV	Submitted Prices (Million)		Correction / Addition		Corrected Bid Prices (Million)		Ranking
	M USD	M PKR	M USD	M PKR	M USD	M PKR	
(a) Price Adjustment for Completeness in Scope of Work	-	-	-	-	-	-	1
(b) Price Adjustment for Technical Compliance (Turbine Efficiency)		804.17	-	3.5000	-	807.6739	
(c) Price Adjustment for Commercial Compliance	-	-	-	-	-	-	
(d) Price Adjustment for Deviations in Terms of Payment	-	-	-	-	-	-	
(e) Price Adjustment for Completion Schedule	-	-	-	-	-	-	
Domestic Preference	Nil		Nil		Nil		
Total Price Adjustment				3.5000			
Corrected Bid Price before Price Adjustment						16,337,654,684.94	
Total Bid Price after Price Adjustment						16,341,154,684.94	

69MW LAWI HYDROPOWER PROJECT
Price Adjustment
Summary of Bid Prices (Comparison Purpose Only)

CLIC JV	Submitted Prices (Million)		Adjustment		Adjusted Prices (Million)		Ranking
	M USD	M PKR	M USD	M PKR	M USD	M PKR	
(a) Price Adjustment for Completeness in Scope of Work	-	-	-	-	-	-	3
(b) Price Adjustment for Technical Compliance	-	-	-	-	-	-	
(c) Price Adjustment for Commercial Compliance	-	-	-	-	-	-	
(d) Price Adjustment for Deviations in Terms of Payment	-	-	-	-	-	-	
(e) Price Adjustment for Completion Schedule	-	-	-	-	-	-	
Domestic Preference	Nil		Nil		Nil		
Total Price Adjustment							
Corrected Bid Price before Price Adjustment						19,149,738,679.35	
Total Bid Price after Price Adjustment						19,149,738,679.35	

69MW LAWI HYDROPOWER PROJECT
Price Adjustment
Summary of Bid Prices (Comparison Purpose Only)

DESCON-ZOEC JV	Submitted Prices (Million)		Adjustment		Adjusted Prices (Million)		Ranking
	M USD	M PKR	M USD	M PKR	M USD	M PKR	
(a) Price Adjustment for Completeness in Scope of Work	-	-	-	-	-	-	2
(b) Price Adjustment for Technical Compliance	-	-	-	-	-	-	
(c) Price Adjustment for Commercial Compliance	-	-	-	-	-	-	
(d) Price Adjustment for Deviations in Terms of Payment	-	-	-	-	-	-	
(e) Price Adjustment for Completion Schedule	-	-	-	-	-	-	
Domestic Preference	Nil		Nil		Nil		
Total Price Adjustment				-			
Corrected Bid Price before Price Adjustment						18,186,352,479.78	
Total Bid Price after Price Adjustment						18,186,352,479.78	

69MW LAWI HYDROPOWER PROJECT

Arithmetic Check

Summary of Bid Prices

Bidder	Price Schedules	Submitted Bid-Prices (Million)		Arithmetic Correction		Corrected Bid Prices		Percentage sharing of Local and Foreign Currency		Ranking
		M USD	M PKR	M USD	M PKR	M USD	M PKR	% USD	% PKR	
LIMAK-ZKB JV	Schedule No. 1	41.1942	-	0.00	-	41.1942	-	100.00%	0.00%	4
	Schedule No. 2	-	-	-	-	-	-	0.00%	0.00%	
	Schedule No. 3	-	1,500.0000	-	-	-	1,500.0000	0.00%	100.00%	
	Schedule No. 4	-	20,623.0000	-	1,000.00000000	-	21,623.0000	0.00%	100.00%	
	Schedule No. 5	43.0000	22,123.0000	(1.80580800)	1,000.00000000	41.1942	23,123.0000	15.21%	84.79%	
	* The amounts not to be included in Schedule 5									
	Exchange Rate	1USD=100.00PKR				1USD=100.667PKR				
			Schedule 5 Eq PKR							
	Grand Total of Bid Price in PKR with addition of 21.99 %		32,233,410,001.00		(4,963,485,338.33)		27,269,924,662.67			
	Discounted Total Bid Price in PKR		32,233,410,001.00		(4,963,485,338.33)		27,269,924,662.67			
	Schedule No. 7		19,795,000.00		-		19,795,000.00	0.00%	100.00%	

** The Bidder has added 21.99% amount to his Original Bid Price.

69MW LAWI HYDROPOWER PROJECT

Arithmetic Check
Summary of Bid Prices

Bidder	Price Schedules	Submitted Bid-Prices (Million)		Arithmetic Correction		Corrected Bid Prices		Percentage sharing of Local and Foreign Currency		Ranking
		M USD	M PKR	M USD	M PKR	M USD	M PKR	% USD	% PKR	
Sichuan-Sarwar-Silian-Chongqing Luyan JV	Schedule No. 1	43.3822	304.5864	-	(304.58642620)	43.3822	-	100.00%	0.00%	1
	Schedule No. 2	-	-	-	-	-	-	0.00%	0.00%	
	Schedule No. 3	-	1,090.6927	-	-	-	1,090.6927	0.00%	100.00%	
	Schedule No. 4	-	9,719.7757	-	1,160.00000000	-	10,879.7757	0.00%	100.00%	
	Schedule No. 5	43.3822	11,115.0548	-	855.41357400	43.3822	11,970.4684	26.73%	73.27%	
	* The amounts not to be included in Schedule 5									
	Exchange Rate	1USD=100.3PKR				1USD=100.667PKR				
			Schedule 5 Eq PKR							
	Grand Total of Bid Price in PKR		15,466,289,476.00		871,365,208.94		16,337,654,684.94			
	Discounted Total Bid Price in PKR		15,466,289,476.00		871,365,208.94		16,337,654,684.94			
	Schedule No. 7		48,839,000.00		4,291,500.0000		44,547,500.00	0.00%	100.00%	

69MW LAWI HYDROPOWER PROJECT

Arithmetic Check
Summary of Bid Prices

Bidder	Price Schedules	Submitted Bid-Prices (Million)		Arithmetic Correction		Corrected Bid Prices (Million)		Percentage sharing of Local and Foreign Currency		Ranking
		M USD	M PKR	M USD	M PKR	M USD	M PKR	% USD	% PKR	
CLIC JV	Schedule No. 1	47.8845	337.3034	0.00	(337.30339400)	47.8845	-	100.00%	0.00%	3
	Schedule No. 2	-	-	-	-	-	-	0.00%	0.00%	
	Schedule No. 3	-	549.7571	-	(0.00)	-	549.7571	0.00%	100.00%	
	Schedule No. 4	-	13,837.2370	-	(57.68072700)	-	13,779.5563	0.00%	100.00%	
	Schedule No. 5	47.8845	14,724.2975	0.00	(394.98412200)	47.8845	14,329.3134	25.17%	74.83%	
	* The amounts not to be included in Schedule 5									
	Exchange Rate	1USD=100.63PKR				1USD=100.667PKR				
			Schedule 5 Eq PKR							
	Grand Total of Bid Price in PKR		19,542,917,421.00		(393,178,741.65)		19,149,738,679.35			
	Discounted Total Bid Price in PKR		19,542,917,421.00		(393,178,741.65)		19,149,738,679.35			
	Dayworks Schedule		56,197,058.00		(28.0000)		56,197,030.00	0.00%	100.00%	

69MW LAWI HYDROPOWER PROJECT

Arithmetic Check
Summary of Bid Prices

Bidder	Price Schedules	Submitted Bid-Prices (Million)		Arithmetic Correction		Corrected Bid Prices (Million)		Percentage sharing of Local and Foreign Currency		Ranking
		M USD	M PKR	M USD	M PKR	M USD	M PKR	% USD	% PKR	
DESCON - ZOEC JV	Schedule No. 1	16.847854	526.0002	0.00	(526.00020000)	16.84786	-	100.00%	0.00%	2
	Schedule No. 2	-	81.3497	-	(9.49518000)	-	71.8545	0.00%	100.00%	
	Schedule No. 3		534.7459	-	-	-	534.7459	0.00%	100.00%	
	Schedule No. 4	-	18,657.8426	-	(46.46594900)	-	18,611.3767	0.00%	100.00%	
	Schedule No. 5	16.8479	19,799.9384	0.00	(581.96132900)	16.8479	19,217.9771	8.11%	91.89%	
	* The amounts not to be included in Schedule 5									
	Exchange Rate	1USD=100.606PKR				1USD=100.667PKR				
			Schedule 5 Eq PKR							
	Grand Total of Bid Price in PKR		21,494,936,975.00		(580,925,085.22)		20,914,011,889.78			
	Discounted Total Bid Price in PKR		18,767,277,665.80		(580,925,085.22)		18,186,352,479.78			
	Dayworks Schedule		46,465,950.00		(330,000.0000)		46,135,950.00	0.00%	100.00%	

ANNEXURE-III

Arithmetic Check (Summary of Bid Prices)

Summary of Price Adjustments (Comparison Purpose only)

Item	Description	Unit	Quantity	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Silian-Chongqing Luyang JV		LIMAK-ZKB JV	
				Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)
	Tractor, including bull or angle dozer :				-		-		-		-
DW.348	Up to and including 37KW (drawbar)	Hour	50	5000	250,000	117	5,850	7000	350,000	500	25,000
DW.349	Over 37 KW up to and including 67 KW	Hour	50	5200	260,000	162	8,100	8000	400,000	700	35,000
DW.350	Over 67 KW up to and including 100 KW	Hour	50	8000	400,000	293	14,650	9000	450,000	800	40,000
DW.351	Over 100 KW	Hour	50	9000	450,000	385	19,250	9000	450,000	1000	50,000
	Welding and cutting set :				-		-		-		-
DW.352	Oxy-acetylene	Hour	50	1000	50,000	252	12,600	5000	250,000	500	25,000
DW.353	Electric, 300 Amp	Hour	50	1500	75,000	1833	91,650	5000	250,000	500	25,000
	Vibrator, concrete, immersion type				-		-		-		-
DW.354	Light (40 mm and below)	Hour	100	1000	100,000	126	12,600	1000	100,000	500	50,000
DW.355	Heavy (50 mm and above)	Hour	100	1100	110,000	225	22,500	1200	120,000	700	70,000
	TOTAL (C/F to Summary)				46,135,950		56,197,030		44,547,500		19,795,000

SUMMARY

Ref. No.	Description
A	Day work labour
B	Day work materials
C	Day work Equipment
	Total

DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
Local Currency Portion	Local Currency Portion	Local Currency Portion	Local Currency Portion
5,486,350	7,729,075	2,235,000	1,565,000
22,177,600	18,552,255	17,142,500	11,510,000
18,472,000	29,915,700	25,170,000	6,720,000
46,135,950	56,197,030	44,547,500	19,795,000

Item	Description	Unit	Quantity	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Sillan-Chongqing Luyang JV		LIMAK-ZKB JV	
				Rate	Extension	Rate	Extension	Rate	Extension	Rate	Extension
				(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)
	Excavator; for shovels, skimmers, draglines or back-acters:				-		-		-		-
DW.332	Backhoe Case 580 G or equivalent (0.15 cu.m)	Hour	100	5000	500,000	4146	414,600	5000	500,000	1000	100,000
DW.333	Up to and including 1/2 cu.m	Hour	100	4500	450,000	5923	592,300	6000	600,000	1200	120,000
DW.334	Over 1/2 cu.m and up to and including 1 cu.m	Hour	100	5000	500,000	11853	1,185,300	6500	650,000	1500	150,000
DW.335	Over 1 cu.m and up to and including 2 cu.m	Hour	100	5500	550,000	14213	1,421,300	7000	700,000	2000	200,000
DW.336	Over 2 cu.m and up to and including 5 cu.m	Hour	100	6000	600,000	42213	4,221,300	7500	750,000	2500	250,000
	Generating set :				-		-		-		-
DW.337	Up to including 10KW	Hour	100	2000	200,000	2122	212,200	2000	200,000	500	50,000
DW.338	Over 10 KW up to and including 60 KW	Hour	100	3000	300,000	3213	321,300	3000	300,000	800	80,000
	Pneuma : tyred rollers :				-		-		-		-
DW.339	10 tonnes	Hour	100	3500	350,000	2229	222,900	5000	500,000	1000	100,000
DW.340	20 tonnes	Hour	100	5800	580,000	5793	579,300	7000	700,000	1500	150,000
	Lorry, ordinary :				-		-		-		-
DW.341	Up to and including 3 tonnes	Hour	100	1300	130,000	2117	211,700	4000	400,000	500	50,000
DW.342	Over 3 tonnes up to and including 4 tonnes	Hour	100	2000	200,000	2928	292,800	5000	500,000	700	70,000
DW.343	Over 4 tonnes up to and including 6 tonnes	Hour	100	2500	250,000	3176	317,600	6000	600,000	800	80,000
DW.344	Over 6 tonnes up to and including 10 tonnes	Hour	100	3000	300,000	4720	472,000	7000	700,000	1000	100,000
	Vibrating roller :				-		-		-		-
DW.345	2 tonnes up to and including 5 tonnes static weight	Hour	100	1650	165,000	7201	720,100	7000	700,000	1000	100,000
DW.346	5 tonnes up to and including 10 tonnes static weight	Hour	100	3520	352,000	9477	947,700	8000	800,000	1500	150,000
DW.347	Over 10 tonnes up to and including 15 tonnes static weight	Hour	100	5500	550,000	11707	1,170,700	9000	900,000	2000	200,000

Item	Description	Unit	Quantity	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Silian-Chongqing Luyang JV		LIMAK-ZKB JV	
				Rate	Extension	Rate	Extension	Rate	Extension	Rate	Extension
				(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)
	Lorry, tipper				-		-		-		-
DW.313	Up to and including 3 tonnes	Hour	100	1300	130,000	2858	285,800	3000	300,000	1000	100,000
DW.314	Over 3 tonnes up to and including 6 tonnes	Hour	100	2000	200,000	3159	315,900	4000	400,000	1200	120,000
DW.315	Over 6 tonnes up to and including 10 tonnes	Hour	100	2500	250,000	5790	579,000	6000	600,000	1500	150,000
DW.316	Over 10 tonnes up to and including 15 tonnes	Hour	100	4000	400,000	7740	774,000	7000	700,000	2000	200,000
	Mixer. Concrete:				-		-		-		-
DW.317	3/2	Hour	100	2500	250,000	1673	167,300	2000	200,000	500	50,000
DW.318	7/5	Hour	100	2600	260,000	2484	248,400	3000	300,000	700	70,000
DW.319	10/7	Hour	100	2800	280,000	3815	381,500	3500	350,000	800	80,000
DW.320	14/10	Hour	100	3000	300,000	4630	463,000	4500	450,000	900	90,000
DW.321	21/41	Hour	100	3500	350,000	5575	557,500	7000	700,000	1000	100,000
DW.322	Concrete mixer tank	Hour	100	3200	320,000	13105	1,310,500	7000	700,000	1200	120,000
	Pump, portable, including hoses, strainers, etc:				-		-		-		-
DW.323	50 mm. delivery (2")	Hour	100	1400	140,000	935	93,500	2000	200,000	1000	100,000
DW.324	100 mm. delivery (4")	Hour	100	1600	160,000	1350	135,000	3500	350,000	1200	120,000
DW.325	150 mm. delivery (6")	Hour	100	1800	180,000	1659	165,900	4500	450,000	1500	150,000
DW.326	200 mm. delivery (8")	Hour	100	2800	280,000	2161	216,100	6000	600,000	2000	200,000
DW.327	250 mm. delivery (10")	Hour	100	3500	350,000	3567	356,700	7000	700,000	2500	250,000
DW.328	Portable compactor	Hour	100	3000	300,000	816	81,600	1000	100,000	1000	100,000
DW.329	Rammer, mechanical	Hour	100	3200	320,000	816	81,600	2000	200,000	1000	100,000
	Roller, road:				-		-		-		-
DW.330	Up to and including 5 tonnes	Hour	100	3000	300,000	2000	200,000	3000	300,000	1000	100,000
DW.331	Over 5 tonnes up to and including 10 tonnes	Hour	100	4000	400,000	2229	222,900	4000	400,000	1000	100,000

Item	Description	Unit	Quantity	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Sillan-Chongqing Luyang JV		LIMAK-ZKB JV	
				Rate	Extension	Rate	Extension	Rate	Extension	Rate	Extension
				(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)	(PKR)
	Welding rods (electrodes) :				-						
DW.215	6 gauge	kg	50	600	30,000	179	8,950	300	15,000	1000	50,000
DW.216	8 gauge	kg	50	600	30,000	197	9,850	300	15,000	1000	50,000
DW.217	Timber (soft wood)	cu.m	20	288000	5,760,000	65934	1,318,680	105000	2,100,000	20000	400,000
DW.218	Timber (hard wood)	cu.m	20	108000	2,160,000	63340	1,266,800	10500	210,000	15000	300,000
DW.219	Bitumen	kg	20	130	2,600	101500	2,030,000	70000	1,400,000	80000	1,600,000
	2. PLANT				-						
	Compressor, portable, with breakers, rock drills,				-						
	spades, air lines, lubricators and steel:				-						
DW.301	6 cu.m./min and below	Hour	100	3200	320,000	3037	303,700	3000	300,000	1000	100,000
DW.302	Over 6 cu.m./ min up to and including 9 cu.m./min	Hour	100	3700	370,000	3996	399,600	4000	400,000	1500	150,000
	Cranes. Mobile:				-						
DW.303	3 tonnes	Hour	100	3500	350,000	2325	232,500	3000	300,000	1000	100,000
DW.304	5 tonnes	Hour	100	3800	380,000	2803	280,300	3000	300,000	1000	100,000
DW.305	10 tonnes	Hour	100	4500	450,000	4981	498,100	3500	350,000	1500	150,000
DW.306	15 tonnes	Hour	100	4800	480,000	7008	700,800	4000	400,000	2000	200,000
DW.307	20 tonnes	Hour	100	5200	520,000	7995	799,500	5000	500,000	2500	250,000
	Derrick crane, all electric, up to 80 ft. Jib:				-						
DW.308	20 tonnes	Hour	100	6000	600,000	13516	1,351,600	7000	700,000	3000	300,000
DW.309	40 tonnes	Hour	100	10000	1,000,000	33433	3,343,300	9000	900,000	3500	350,000
	Dumper, petrol or diesel:				-						
DW.310	Up to and including 2 cu.m.	Hour	100	3360	336,000	3159	315,900	3000	300,000	1000	100,000
DW.311	Over 2 cu.m. up to and including 5 cu.m.	Hour	100	3840	384,000	6591	659,100	3500	350,000	1500	150,000
DW.312	Over 5 cu.m. up to and including 8 cu.m.	Hour	100	4400	440,000	9048	904,800	5000	500,000	2000	200,000

Item	Description	Unit	Quantity	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Silian-Chongqing Luyang JV		LIMAK-ZKB JV	
				Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)
DW.122	Fitter's/Mechanic's Assistant	Man day	100	2338	233,800	2902	290,200	1100	110,000	800	80,000
DW.123	"Frog" type mechanical rammer operator	Man day	50	2750	137,500	5125	256,250	1200	60,000	800	40,000
DW.124	Truck/Lorry driver	Man day	50	2750	137,500	5125	256,250	900	45,000	1000	50,000
DW.125	Lorry attendant	Man day	50	1850	82,500	2902	145,100	800	40,000	500	25,000
DW.126	Dumper driver	Man day	50	2750	137,500	5125	256,250	1000	50,000	1000	50,000
DW.127	Crane driver (of all classes)	Man day	25	4400	110,000	5125	128,125	1500	37,500	1000	25,000
DW.128	Crane driver's Assistant /Signaller	Man day	25	3850	96,250	2902	72,550	800	20,000	1000	25,000
DW.129	Heavy plant Driver (of all classes)	Man day	25	4400	110,000	5125	128,125	1000	25,000	1500	37,500
DW.130	Plant operator	Man day	25	5500	137,500	5125	128,125	1500	37,500	1500	37,500
	1. MATERIALS										
DW.201	Bricks	No.	10,000	20	200,000	100	1,000,000	15	150,000	10	100,000
DW.202	Cement, Ordinary Portland	50 kg	100	1000	100,000	974	97,400	600	60,000	500	50,000
DW.203	Cement, Sulphate Resisting Portland	50 kg	50	11000	550,000	1169	58,450	700	35,000	600	30,000
DW.204	Cement, high alumina	50 kg	25	12000	300,000	1169	29,225	700	17,500	600	15,000
	Coarse graded aggregate for concrete :-										
DW.205	38 mm	cu.m	50	3000	150,000	3143	157,150	1800	90,000	1100	55,000
DW.206	19 mm	cu.m	50	3000	150,000	3143	157,150	1800	90,000	1100	55,000
DW.207	Sand for pipe surround	cu.m	50	2000	100,000	3772	188,600	1800	90,000	1000	50,000
DW.208	Fine graded aggregate for concrete	cu.m	50	3000	150,000	3143	157,150	1800	90,000	1000	50,000
DW.209	Granular fill	cu.m	50	2600	130,000	3143	157,150	1600	80,000	1000	50,000
DW.210	Random Rockfill	cu.m	50	2000	100,000	3143	157,150	1200	60,000	900	45,000
DW.211	Crushed stone for road	cu.m	50	2800	140,000	3143	157,150	1600	80,000	1200	60,000
DW.212	Rip-rap Material	cu.m	50	2500	125,000	1258	62,900	1200	60,000	6000	300,000
DW.213	High tensile steel reinforcing bars straight and cut to all length (all sizes)	tonne	50	120000	6,000,000	115385	5,769,250	160000	8,000,000	150000	7,500,000
DW.214	M.S. reinforcing bars, straight and cut to length to (all sizes)	tonne	50	120000	6,000,000	115385	5,769,250	90000	4,500,000	15000	750,000

69MW LAWI HYDROPOWER PROJECT
Schedule No. 7 DAY WORK

Item	Description	Unit	Quantity	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Sillan-Chongqing Luyang JV		LIMAK-ZKB JV	
				Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)	Rate (PKR)	Extension (PKR)
	1. LABOUR										
DW.101	General labourer (male)	Man day	200	1650		1608	321,600	700	140,000	500	100,000
DW.102	Pneumatic Driller	Man day	50	3025	151,250	5125	256,250	1500	75,000	500	25,000
DW.103	Concretor and concrete vibrator operator	Man day	50	2750	137,500	5125	256,250	2000	100,000	800	40,000
DW.104	Concrete screeder	Man day	50	2750	137,500	5125	256,250	1200	60,000	800	40,000
DW.105	Mason	Man day	100	2750	275,000	2902	290,200	1200	120,000	800	80,000
DW.106	Steelbar bender/steel fixer	Man day	50	2750	137,500	5125	256,250	1000	50,000	800	40,000
DW.107	Steel erector	Man day	50	2750	137,500	5125	256,250	900	45,000	800	40,000
DW.108	Pump operator/attendant	Man day	100	4400	440,000	1608	160,800	900	90,000	700	70,000
DW.109	Chainman	Man day	100	2750	275,000	5125	512,500	2000	200,000	500	50,000
DW.110	Ganger (or charge hand)	Man day	100	6600	660,000	5347	534,700	1000	100,000	1000	100,000
DW.111	Compressor/wireman	Man day	100	2750	275,000	5125	512,500	1000	100,000	800	80,000
DW.112	Electrician/wireman	Man day	100	3025	302,500	5125	512,500	1000	100,000	1000	100,000
DW.113	Welder	Man day	50	3850	192,500	5125	256,250	1500	75,000	1200	60,000
DW.114	Welder's assistant	Man day	100	2063	206,300	2902	290,200	1000	100,000	600	60,000
DW.115	Plumber	Man day	50	2750	137,500	5125	256,250	1500	75,000	800	40,000
DW.116	Drainlayer (or joiner)	Man day	50	2750	137,500	2902	145,100	1500	75,000	800	40,000
DW.117	Pipelayer (or joiner)	Man day	50	2750	137,500	1608	80,400	1500	75,000	1000	50,000
DW.118	Bricklayer	Man day	50	2750	137,500	5125	256,250	1200	60,000	800	40,000
DW.119	Carpenter	Man day	50	2750	137,500	5125	256,250	1300	65,000	800	40,000
DW.120	Painter	Man day	50	2750	137,500	2902	145,100	1000	50,000	1000	50,000
DW.121	Fitter/mechanic	Man day	50	3025	151,250	5125	256,250	1100	55,000	1000	50,000

69MW LAWI HYDROPOWER PROJECT
Schedule No. 5 – Grand Summary

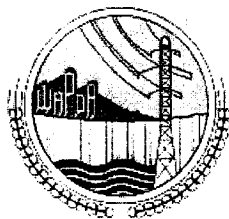
Schedule No.	Title	DESCON-ZOEC JV		CLIC JV		Sichuan-Sarwar-Silian-Chongqing Luyang JV		LIMAK-ZKB JV	
		Total		Total		Total		Total	
		Foreign (US\$ Million)	Local (PKR Million)	Foreign (US\$ Million)	Local (PKR Million)	Foreign (US\$ Million)	Local (PKR Million)	Foreign (US\$ Million)	Local (PKR Million)
1	Plant and Mandatory Spare Parts Supplied from Abroad	16.8479	-	47.8845	-	43.3822	-	41.1942	-
2	Plant and Mandatory Spare Parts Supplied from Within the Employer's Country	-	71.8545	-	-	-	-	-	-
3	Design Services	-	534.7459	-	549.7571	-	1,090.6927	-	1,500.0000
4	Civil Works, Installation and Other Services	-	18,611.3767	-	13,779.5563	-	10,879.7757	-	21,623.0000
SUB TOTAL		16.8479	19,217.9771	47.8845	14,329.3134	43.3822	11,979.4684	41.1942	23,123.0000
Exchange Rate for Foreign Currency US \$		100.6677		100.6677		100.6677		100.6677	
GRAND TOTAL (Without Discount)		Schedule 5 Eq. PKR		Schedule 5 Eq. PKR		Schedule 5 Eq. PKR		Schedule 5 Eq. PKR	
		29,914.9119		19,149.7387		16,337.6547		27,269.9247	
GRAND TOTAL to be carried forward to Letter of Price Bid in Equivalent Pak Rs. (Discounted / Profit Price)		Discount of Rs. 2,727,659,419 on Items 4.7 to 4.13 of schedule 4		Nil		Nil		21.99% Addition to Bid Price (Not Incorporated)	
		18,186,352,479.78		19,149,738,679.35		16,337,654,684.94		27,269,924,662.67	

Item	Description	DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Sillan-Chongqing Luyang JV	LIMAK-ZKB JV
		Total Price Million PKR	Total Price Million PKR	Total Price Million PKR	Total Price Million PKR
1	2	3	4	5	6
4.3	Provisional Sum				
4.3.1	Provisional Sum				
A	(i) Protection of the Environment				
	COC Sub Clause 16.6	30.0000	30.0000	30.0000	30.0000
	(ii) (10%)* on Provisional Sum				
B	(i) Health and Safety				
	COC Sub Clause 14.2	60.0000	60.0000	60.0000	60.0000
	(ii) (10%)* on Provisional Sum				
C	Currency Rate Adjustment under Schedule No. 1 as stated in PCC sub-clause 47.1	1,000.0000	1,000.0000	1,000.0000	1,000.0000
D	(i) Security Arrangements	70.0000	70.0000	70.0000	70.0000
	COC Sub Clause 14.2				
	(ii) (10%)* on Provisional Sum				
	Total Specified Provisional Sum	1,160.0000	1,160.0000	1,160.0000	1,160.0000
4.7.2	Day Works (Provisional Sum)	46.13595	56.19703	44.54750	19.79500
	Total Provisional Sum	1,206.1360	1,216.1970	1,204.5475	1,179.7950
4.7.3	Total Amount of % on Provisional Sum				
	TOTAL	18,611.3767	13,779.5563	10,879.7757	21,623.0000

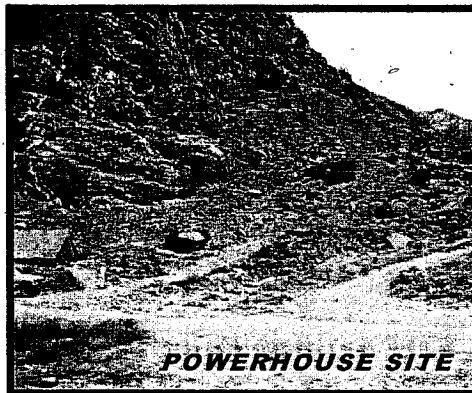
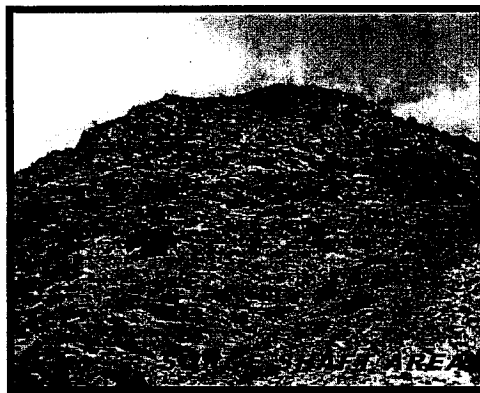
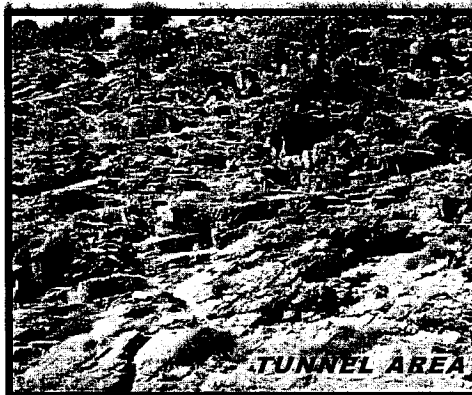
69MW LAWI HYDROPOWER PROJECT
Schedule No. 4 – Civil Works, Installation and Other Services

Item	Description	DESCON-ZOEC JV	CLIC JV	Sichuan-Sarwar-Silian-Chongqing Luyang JV	LIMAK-ZKB JV
		Total Price Million PKR	Total Price Million PKR	Total Price Million PKR	Total Price Million PKR
1	2	3	4	5	6
4.1	Civil Works				
4.1.1	Temporary Works	137.1297	202.2137	252.8713	30.0000
4.1.2	Permanent Works	589.0060	1,427.5941	750.0000	100.0000
4.1.3	Improvement of existing Access Road.	369.1739	298.1259	300.0000	837.0000
4.1.4	Other Access Roads to various structures	180.8626	302.4517	180.0000	500.0000
4.1.5	Diversion Weir	380.0677	511.7524	350.0000	550.0000
4.1.6	Intake Structure	62.6348	21.5656	57.3000	70.0000
4.1.7	Connecting Tunnel	61.6464	28.2506	85.9500	112.0000
4.1.8	Sedimentation Basin	760.3996	910.1417	286.5000	130.0000
4.1.9	Headrace Tunnel	8,725.9799	5,029.3440	4,650.0000	12,655.0000
4.1.10	Adits for main Tunnel Works	476.1711	1,265.5769	334.2500	1,000.0000
4.1.11	Concrete Lined Surge Shaft	1,023.5341	384.3869	242.3000	128.0000
4.1.12	Concrete Lined Pressure Shaft	680.1228	268.0090	334.2500	531.0000
4.1.13	Steel Lined Pressure Tunnel	1,190.0717	396.7612	915.0000	1,094.0000
4.1.14	Power House	753.1295	1,200.0933	534.8000	1,500.0000
4.1.15	Tailrace	85.6213	139.1671	67.3944	171.0000
4.1.16	132 KV Switchyard	109.1296	59.8182	39.1600	5.0000
4.1.17	Miscellaneous items	1,805.5630	-	180.0000	1,000.0000
4.2	Vehicles for Employer	61.1330	174.3041	160.0000	50.0000

PAKISTAN
WATER & POWER DEVELOPMENT AUTHORITY



LAWI HYDROPOWER PROJECT
69 MW



FEASIBILITY STUDY REPORT

VOLUME-I EXECUTIVE SUMMARY

HYDRO PLANNING, WAPDA, SUNNY VIEW, LAHORE

July 2007

LAWI HYDROPOWER PROJECT FEASIBILITY STUDY REPORT

MAIN TABLE OF CONTENTS

VOLUME – I	EXECUTIVE SUMMARY
S-1	INTRODUCTION
S-2	SOCIOECONOMICS AND DEMAND FORECAST
S-3	HYDROLOGY
S-4	SEDIMENT TRANSPORT STUDIES
S-5	SURVEYING AND MAPPING
S-6	ENGINEERING GEOLOGY
S-7	SEISMIC HAZARD EVALUATION
S-8	PROJECT ALTERNATIVES AND OPTIMIZATIONS
S-9	PROJECT PREFERRED LAYOUT
S-10	ENVIRONMENTAL IMPACT ASSESSMENT
S-11	TRANSMISSION LINE
S-12	POWER AND ENERGY ESTIMATION
S-13	QUANTITIES AND COST ESTIMATE
S-14	CONSTRUCTION PLANNING AND SCHEDULING
S-15	ECONOMIC AND FINANCIAL ANALYSIS
S-16	ONGOING AND PROPOSED INVESTIGATIONS

VOLUME – II	MAIN REPORT
--------------------	--------------------

VOLUME – III	DRAWINGS
---------------------	-----------------

VOLUME – IV	APPENDICES (A,B,D,E,F,G,H)
--------------------	-----------------------------------

APPENDIX – A	SOCIOECONOMIC AND DEMAND FORECAST
APPENDIX – B	HYDROLOGY
APPENDIX – D	SEISMIC HAZARD EVALUATION
APPENDIX – E	PROJECT ALTERNATIVES AND OPTIMIZATIONS
APPENDIX – F	PROJECT PREFERRED LAYOUT
APPENDIX – G	ENVIRONMENTAL IMPACT ASSESSMENT
APPENDIX – H	POWER AND ENERGY ESTIMATION

VOLUME – V	APPENDIX C
-------------------	-------------------

APPENDIX – C	ENGINEERING GEOLOGY
--------------	---------------------

TABLE OF CONTENTS

LAWI HYDRO POWER PROJECT
VOLUME-I EXECUTIVE SUMMARY
TABLE OF CONTENTS

SALIENT FEATURES OF THE PROJECT

DESCRIPTION OF THE PROJECT

S-1	INTRODUCTION.....	S-1
S-2	SOCIOECONOMICS AND DEMAND FORECAST.....	S-2
S-3	HYDROLOGY	S-3
S-4	SEDIMENT TRANSPORT STUDIES.....	S-4
S-5	SURVEYING AND MAPPING.....	S-5
S-6	ENGINEERING GEOLOGY	S-5
S-7	SEISMIC HAZARD EVALUATION.....	S-6
S-8	PROJECT ALTERNATIVES AND OPTIMIZATION	S-6
S-9	PROJECT PREFERRED LAYOUT	S-7
S-10	ENVIRONMENTAL IMPACT ASSESSMENT	S-9
S-11	TRANSMISSION LINE	S-10
S-12	POWER AND ENERGY ESTIMATION	S-10
S-13	QUANTITIES AND COST ESTIMATE	S-10
S-14	CONSTRUCTION PLANNING AND SCHEDULING	S-11
S-15	ECONOMIC AND FINANCIAL ANALYSIS.....	S-11
S-16	ONGOING AND PROPOSED INVESTIGATIONS.....	S-12
S-17	CONCLUSION OF THE STUDY	S-12

FIGURES

SUM - 001	GENERAL PROJECT LOCATION AND COMMUNICATION MAP
SUM - 002	PROJECT LOCATION AND LAYOUT PLAN
SUM - 003	IMPLEMENTATION PLAN

TABLES

S - 001	SUMMARY OF COST ESTIMATE
S - 002	ECONOMIC ANALYSIS
S - 003	SENSITIVITY ANALYSIS
S - 004	COST per KWh and kW
S - 005	FINANCIAL ANALYSIS

DRAWINGS

S - 001	PROJECT PREFERRED PLAN AND PROFILE
S - 002	WEIR CROSS SECTIONS
S - 003	POWERHOUSE CROSS SECTIONS

SALIENT FEATURES **OF THE PROJECT**

LAWI HYDROPOWER PROJECT

SALIENT FEATURES OF THE PROJECT

Location		Gross Head	
Pakistan, North Western Frontier Province		Maximum	413 m
(I.WFP), Chitral District, on Shishi River ,		Minimum	377 m
Left tributary of Chitral River.			
Organization		Discharge	
Hydro Planning, Water and Power		Design discharge	20 m ³ /s
Development Authority (WAPDA)			
Hydrology		Powerhouse- Machine Hall	
Catchment area at weir site	394 Km ²	Length	56.0 m
Mean monthly discharge	13 m ³ /s	Width	19.85 m
Design Flood	872 m ³ /s	Height	26.0 m
(return period 500 year)			
Diversion Weir		Tailrace canal	
Weir height above riverbed	5 m	Length	130 m
Length of weir	65 m	Cross-section	5 m x 2 m
Connecting Tunnel		Hydro-Mechanical Equipment	
Tunnel diameter	5 m	Pelton turbines	3 Nos.
Tunnel length	40 m	Speed	500 rpm
Sedimentation Basins (Underground)		Discharge/unit	6.67 m ³ /s
No. of Chambers	2	Electrical Equipment	
Size of Chamber	7.5(W)x7.0(H) m	Generators	3 Nos.
Chamber length	70 m	Speed	500 rpm
Collection Chamber(canal)		Installed Capacity	
No. of Chambers	1	Plant Capacity	69 MW
Size of Chamber	4.0(W)x5.0(H) m	Capacity per unit	23 MW
Chamber length	23 m		
Headrace Tunnel (Low Pressure)		Energy	
Tunnel diameter	4 m	Mean annual energy	303 GWh
Tunnel length	11.30 km	Plant factor annual	51 %
Surge Shaft		Project Cost	
Surge shaft internal diameter	10 m	Total Cost	7931.648 Mill. Rs.
Height	70 m	(with transmission line)	
Concrete Lined Pressure Shaft		Economic and Financial Analysis	
Diameter	3.0 m	B/C Ratio	1.49
Length	332 m	IERR	18.51 %
Steel Lined Pressure Tunnel		IFRR	11.65 %
Diameter	2.5 m	Cost/ kWh Generated	Rs. 2.23 (3.72 US\$)
Length	684 m	Cost/ kW Inst.	114951 Rs. (1916 US\$)
		Construction Time	4.5 Years

DESCRIPTION OF THE PROJECT

EXECUTIVE SUMMARY

DESCRIPTION OF THE PROJECT

S-1 INTRODUCTION

Lawi Hydropower Project is located about 40 km short of Chitral city which is the northern most district of North West Frontier Province of Pakistan. Chitral lies from 35°-15' to 36°-55' North and 71°-12' to 73°-55' East (Fig. SUM 001).

Lawi Hydro Power Project of installed capacity of 69 MW has been planned on Shishi River, a left bank tributary of Chitral River (Fig SUM 002) by utilizing a gross head of 413 m and discharge of 20 m³/s to generate approx. 303 GWh annual energy. A fixed concrete weir is proposed on Shishi river near Lao Nassar village to divert maximum of 20 m³/s discharge of water to a headrace tunnel which will carry it to Lawi village from where pressure shaft and tunnel will bring these flows down to the powerhouse. The releases from the powerhouse will be carried to Chitral River through a concrete lined tailrace canal. The main objective of this Hydro Power Project is the supply of cheaper electricity to the people of Drosh & Chitral valleys to meet their power demand. The unused power will be transmitted to Dir for connection to National Grid.

The Chitral area is sandwiched between Hindu Kush Range in the north and the Hindu Raj Range in the south. Located further east are the Great Himalayas. The entire Chitral valley is mountainous region cut into deep and steep valleys by Chitral River and its numerous tributaries. The mountain elevations generally range from 3500m to 7700 m (Terchmir the highest peak). Development of relief is greatest in the north where it is not uncommon for valley bottoms to be 3000-5000 m below the elevation of the higher peak.

The climate of Chitral is hot in summer ranging from very low lands to warm and up lands to cool at higher elevations. Spring weather is unpredictable with frequent rains and snowfall. Autumn has mild and pleasant temperature recorded in Drosh is 36.8° for the month of July. The extreme minimum temperature recorded at Drosh is -3.8° and -0.9° for the months of January and February respectively. March and April are the months of maximum rainfall while the lowest rainfall occurs in the month of July. The maximum daily precipitation recorded during the historic period is 203 mm in August, 1968. The project area receives precipitation in the form of rain in summer and snow is dominant in winter.

Access to the project area is possible by three routes: two within Pakistan area and one through Afghanistan. The shortest of all and most commonly used is from Peshawar/ Mardan to Dir then crossing over Lowari Pass (10400 ft.) to Chitral which due to extreme weather conditions remain closed for about half a year from December to May. During this period the only access to and from this district is by PIA Air Service that is itself subject to erratic weather. To cross Lowari Pass a rail tunnel is being constructed and scheduled to be completed within next three years that will ensure access to Chitral region throughout the year.

A hydel power station of 300 kW installed capacity exists at Shishi river which supplies power to Drosh area. On Shishi river downstream of the proposed Lawi HPP a hydel project of 1.875 MW is being constructed by SHYDO which is scheduled to be completed by 2008. There are two power stations in Chitral city: one hydel of 1000 kW and other thermal of 960 kW capacity. In Garam Chashma a hydel power station of 100 kW exists. Another hydel power station in Reshun of installed capacity 4.2 MW has been functioning since 1999.

S-2 SOCIO ECONOMICS AND DEMAND FORECAST

Socio Economics & Demand forecast survey and assessment of Chitral, Upper and Lower Dir districts have been carried out. The districts have rich water resources comprising different streams and mineral ores of Iron and Copper. There are different kinds of flora such as Pollen Zira, Banafsha, Gangora, Berg-e-Sumbol, Sarlobal and Antedolt, Zahar Morha found in abundance in the surrounding hills. Besides, roses, bogan valia, Gul-e-Dawdoodi, Gul-e-Kharro and daffodils are also found in the districts. Animals/birds including Chakoor, Mania, duck, leopard and jackal are found in the districts. The climate of Chitral is suitable for fish cold water fisheries. The government has established trout hatcheries at Jaghoor and Bomburet with production capacity of 120,000 and 130,000 fries respectively.

The districts have rich culture, traditions, foods and dresses. Communication, transportation facilities and administrative set up is good. Agriculture is the major source of income. The literacy ratio has increased from 4.5 percent in 1981 to 21.2 percent in 2005. In 2005 the literacy ratio for males is 36.1 percent as against 6.1 percent for females. The ratio is much higher in urban areas when compared with rural areas both for male and female. The economically active population as enumerated in the last census was 17.2 percent of the total population or 27.4 percent of the population 10 years and over i.e. the population exposed to the risk of entering the economically active life at any time. The unemployment rate in the districts was 37.1 percent, which was mainly due to unemployment amongst male representing 37.5 percent while female unemployment rate was just 1.9 percent.

The demand forecast has been made using WAPDA's methodology (Field Survey Method) which gives a detailed forecast of area for various categories of consumers, this method is considered suitable for developing countries where accurate assessment of general trend is not possible and detailed area-wise studies is more important. The demand of the area for the initial year 2006 was calculated, and further projected as per growth rates. These growth rates were adopted on the recommendations of WAPDA's Power Market Survey (PMS) section based on their past experience. Different growth rates used by different departments, i.e. WAPDA Energy Wing, NPP, Historical trend used by HEPO for determining demand forecast are given here under for comparison.

CATEGORY	AVERAGE ANNUAL GROWTH RATES OF PEAK DEMAND		
	NORTH PAKISTAN (%)	HISTORICAL TREND (%)	WAPDA ENERGY WING (%)
DOMESTIC	7.8	9	8.1
COMMERCIAL	7.7	6	6.4
CRAFT	3.7	3	8.2
PUBLIC SERVICE	2.9	3	8.8

The demand forecast covers Chitral-Dir region. The analysis is based on the historical trend evaluation as well as the existing socioeconomic conditions of the people with the prevailing existing infrastructure. It is pointed out that the forecast does not include **"cooking and heating with electricity"**. Present power demand of Chitral-Dir region is 70MW. Power supply available from the hydropower plants including GÖLEN GOL and LAWI Hydro plants will meet the demand of the region during summer season and surplus power will be transmitted to the national grid system.

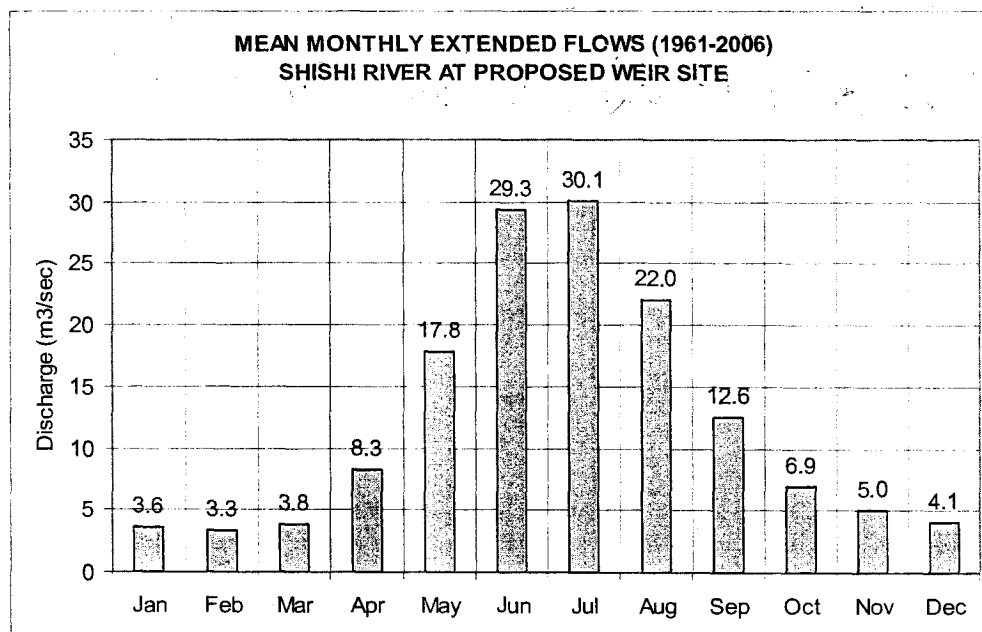
HYDROLOGY

The drainage area of Shishi River upto proposed Weir site is about 394 km². Several streams drain into the Shishi River upstream of proposed site and contribute appreciable amount of water for hydropower. These streams include Domuk Gol, Aski Gol, Tangal Gol, Kalas Gol, Kawash Gol, Tingal Gol, Gawuch Gol, Gurin Gol, etc. The valley of Shishi River descends from an elevation of 5563 meters above mean sea level (masl) at Andawir upto 1661 masl at proposed weir site.

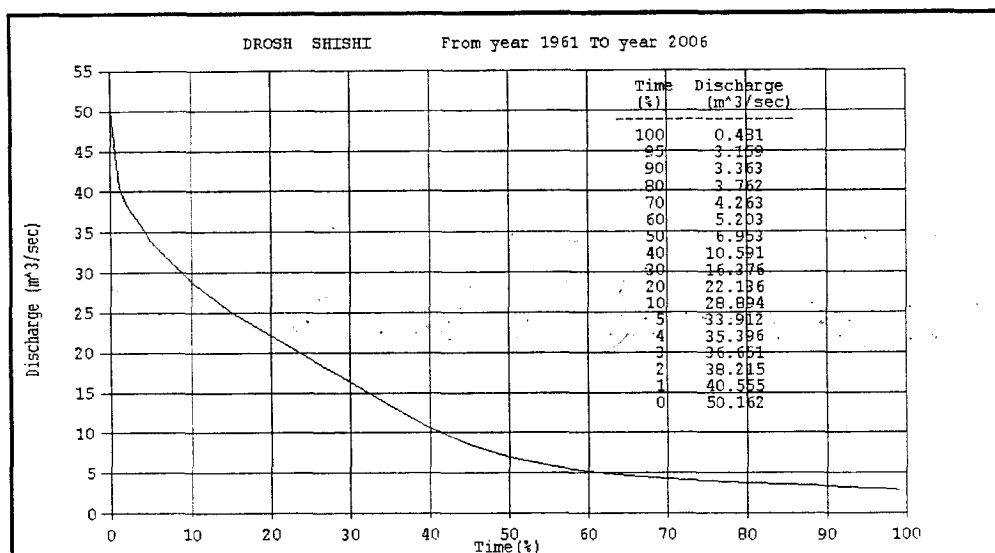
The hydro-meteorological stations in the project area of which the data has been used and processed are Chitral, Babuka, Mastuj Road, Shishi and Kalam.

A stream gauging station was installed on Shishi River at Shishi by SWHP, WAPDA in 1986. The discharge data for the station at Shishi was initially available from January 1986 to July 1987. From August 1987 to June 2005 station was remained closed. The station was re-activated in July 2005 and stream flow measurements have been carried out till to date. The discharge and gauge data of this hydrological station are thus available in small patches. Keeping in view the missing record of flow data of Shishi River the recorded daily flow data of nearby stations has been utilized for extension of flow series at Shishi River for further use in Lawi HPP.

Extension of flows in case of Shishi River has been made with the help of available long term recorded daily flows of nearby rivers having same characteristics. In this regard, nearby gauging station of Chitral river at Chitral & Swat river at Kalam were considered and relationships were developed. Further to the available record at Shishi River flow measuring site, runoff relationships were estimated by using flow data for the corresponding recorded January 1986 to July 1987 for further lengthening the flow series of Shishi River for the final selection of flow pattern for water availability. At proposed weir site mean annual flow is estimated as 12.24 m³/s while the mean monthly flows are graphically shown as under:



In order to check the availability of flows at the proposed weir site, a flow duration analysis was carried out. The flow duration curve of the simulated series been computed and plotted by combining the data of all the years i.e. 1961 to 2006 which is presented below:



Low flow analysis was carried out on the long term extended series (1961-2006). It shows that minimum of the minimum flows occurs in the month of February which is 2.9 m³/s.

Flood estimates at the proposed weir site have been carried out by different methods i.e. Flood Frequency analysis, Gumble, Extreme method, Pearson, Log Normal, Regional method, Slope area method and Flood estimation in relation to peak floods in sub-catchments, etc. Following flood estimates computed by relationship with peak floods in sub-catchments are recommended at proposed weir site:

Return Period (Years)	Flood Discharge m³/sec
10	259
100	705
500	872
1,000	1191

S-4 SEDIMENT TRANSPORT STUDIES

Suspended load measurements were carried out on Shishi river during mean and high flows at the gauging station from Jan 1986 to July 1987 and July 2005 to March 2006. The suspended measurements were carried out in connection with discharge. Bed load measurements were not carried out on the Shishi River in the past because mostly bed load measurement devices developed in the past were designed for low land rivers only.

Data of Chitral and Golen Gol was used to make correlations. The empirical formulas for calculation of sediment transport were used and the followings were concluded:

- Mean annual sediment load (1961-2006) at proposed weir site is of the order of 158,254 tons.
- The mass of bed load is minor as compared to the suspended load. It is estimated to be 83.7 tons. It was recommended to start bed load measurements at site to verify these results.

- The useful capacity of the small reservoir at proposed weir site is sufficient for the accumulation and flushing of sedimentation accumulated in the reservoir. The expected life of reservoir is over 50 years.
- The characteristics of sediment deposition upstream of the weir, as well as adequate countermeasures such as reservoir flushing and sediment routing procedures should be studied in detail during design phase of the project.

S-5 SURVEYING AND MAPPING

Existing topographic information of the area was collected and Survey & Mapping carried out to prepare feasibility study of Lawi Hydro Power Project. Global Positioning (GPS) Survey was conducted to connect the project area in Shishi valley with established Survey of Pakistan bench marks. GPS network for Lawi project was conducted as a part of whole survey. Three latest GPS instruments SR300 manufactured by LEICA of Switzerland were used to establish GPS control points. A computer software "SKI" was used to process the data and to achieve the corresponding results.

The topographic survey of Lawi hydropower project was carried out for weir, powerhouse and adit area with scales at 1:2000 with 5 m contour interval and at 1:500 scale with 2 m contour interval. Longitudinal profile of Shishi river was surveyed along with different X-sections on Shishi and Chitral rivers for weir and powerhouse structures respectively.

S-6 ENGINEERING GEOLOGY

Engineering geology encompasses the regional as well as site geology of the project and its technical implications for the surface and subsurface works. The most important aspect of regional geology in the region is the presence of two mega shear zones, the Main Karakoram Thrust (MKT) and Shishi Fault. These have brought together the rocks of diverse lithology and tectonic significance. Tectonic activity is accountable for the formation of NE – SW trending Main Karakoram Thrust (MKT) and parallel running Shishi fault, both are crossing the proposed tunnel for Lawi HPP on right bank of Shishi river. The weir is located on Kohistan Island Arc and power house is located on Eurasian plate. Rhyolites, shales, schists, granodiorite and dolerite of cretaceous, Jurassic/Devonian age are present in the area.

The basis for planning and executing the geological study is preparation of feasibility report. This study includes geological mapping of the reservoir, weir, intake, sandtrap, inlet portal, outlet portal, surgetank, pressure shaft/tunnel, power house and tailrace areas on scale 1:2000. Sub-surface investigations are performed by drilling bore holes at various components of the project. Rock joint measurements were also taken to analyze the cause of deformation.

Drilling of 12 No. bore holes at weir (3 Nos.), sedimentation basin (1 No.), near surge shaft (1 No.), on penstock alignment (1 No.) and 3 Nos. along tunnel alignment have been completed. This was done to explore sub-surface geological conditions at various structures of the project. Collection of core samples and preservation of core boxes at appropriate location has been done. Petrographic study/analyses of selected core samples was made to establish their lithologic and engineering characteristics of various rock units encountered during drilling and as exposed on surface.

Borrow areas for fine and coarse aggregate in the close vicinity of the project were explored/sampled and got tested to determine strength properties and other parameters for their suitability as construction material.

Geotechnical design and analysis for the tunnel, weir and powerhouse have been done. Rock support design following NATM excavation method is proposed for the different

formations encountered in the alignment of tunnel. Weir foundation design is carried out by using various theories i.e. Khosla, Lane, Bligh and by Limit equilibrium method using computer software SEEPW. Dewatering methods and Cut slopes design are elaborated for the weir and powerhouse structures.

S-7 SEISMIC HAZARD EVALUATION

The seismic hazard evaluation for Lawi Hydropower project was carried out through a study of all the available geological, tectonic and seismicity data of the region in which the project is located and in accordance with the ICOLD guidelines for selecting seismic parameters for large dams.

The project is located in a region which is seismically active due to the proximity of the collisional boundary of the Indian and the Eurasian plates. The seismicity of the area is mainly depicted by small to major earthquake activity. The historical earthquake data shows that intensity up to IX has been felt in the project region.

The main active tectonic features within 100 km of the site, which governs the ground motion at the project site are the Main Karakoram Thrust (MKT), Shishi Fault, Reshun Thrust, Tirich Mir Thrust and the Hindukush Seismic Zone.

Results of Maximum Credible Earthquake for representative faults in the form of Peak Ground Acceleration (PGA) are given in the Table:

Tectonic Feature	Maximum Magnitude (M _w)	Closest Distance to Fault (Km)	Peak Horizontal Acceleration (g)			
			Median			
			Idriss (1991)	Ambroseys et al. (1996)	Boore et al. (1997)	Lungu et al. (1995)
Main Karakoram Thrust (MKT)	7.6	3	0.70	0.85	0.56	
Shishi Fault	7.3	5	0.49	0.55	0.42	
Reshun Fault	7.5	15	0.32	0.26	0.26	
Tirich Mir Fault	7.5	30	0.19	0.14	0.16	
Hindukush Seismic Zone	8.0	80				0.17

For this project, the most critical tectonic feature controlling the MCE is the Main Karakoram Thrust (MKT) which may cause maximum acceleration at the project site. The recommended PGA is 0.30g for OBE which has a probability of exceedance of 10% within 100 years service life of the project (corresponding to 1,000 years return period). On the basis of probabilistic hazard analysis, the PGA of 0.30g associated with Operating Basis Earthquake (OBE) is recommended for the power house and diversion structure. All the project components should remain fully functional under the OBE associated ground motions.

S-8 PROJECT ALTERNATIVES AND OPTIMIZATIONS

Seven Project alternative layouts were identified by map studies, checked in the field and analyzed for the purpose of selecting the best development concept by using mean annual flow as plant discharge. Cost of each alternative was computed by Hydropower Costing Programme (HPC). Based on Cost per kW installed preferred layout was selected with weir at Lao Nisar, 11.3 km tunnel and powerhouse on left bank of Chitral river about 1.25 km, from Shishi river. For preferred layout first its operational status (peak or run-off river) evaluated and its operation as Peak plant recommended. Then different alternatives of the components/structures were studied/analyzed and weir with lateral Intake, underground sedimentation basins, surge shaft, pressure shaft/tunnel, surface powerhouse and open tailrace channel were selected. Optimization studies for design discharge, headrace tunnel

diameter, pressure shaft and steel lined pressure tunnel diameters were finalized as 20 m³/s, 4.0 m, 3.0 m and 2.5 m respectively. Three units of vertical shaft Pelton turbines were selected on the basis of optimization studies.

S-9 PROJECT PREFERRED LAYOUT

The project preferred layout is shown in Drawing no. S-001 and its components are described as hereunder:

CIVIL STRUCTURES

- **Weir with Lateral Intake** is designed to pass flood discharge of 872 m³/s which corresponds to 500 years return period. Lateral Intake has been designed for 20 m³/s. It is 5 m high from river bed and has two parts i.e. Overflow section and Flushing section with lengths as 55 and 10 m respectively (Drawing no. S-002). Two radial gates for flushing section and two sliding gates are proposed for Intake along with stop logs and trash racks.
- **Connecting Tunnel** is 40 m long and 5m dia. connects Intake with transition chamber of the sedimentation basins
- **Transition Chamber** is 27 m long and 7m wide which terminates to the start of sedimentation basins
- **Underground Sedimentation Basins:** Two chambers, the length and width of each chamber is 70 m and 7.5 m respectively with maximum operating level of 1664.75 m.a.s.l. These terminate to Flushing Duct, Gate Gallery and Collection canal.
- **Flushing Duct:** The sediments after settling in sedimentation basin will pass through flushing gates to a 180 m long Flushing Duct of size 2.5 x 5.0 m which will carry sediments back to Shishi River.
- **Gate Gallery:** Gallery for operation of flushing gates. Size is 23 (L) x 3 (W) x 4 (H) m.
- **Collection Chamber/Canal:** Sediments free water is collected here and then taken into headrace tunnel. Size is 23 (L) x 4 (W) x 5 (H) m. The maximum operating level is 1664.0 m.
- **Headrace Tunnel:** A 4 m diameter shotcrete lined Low Pressure tunnel of total length of 11.3 km starts from collection canal and terminates to Surge Shaft.
- **Surge Shaft:** A 70 m high vertical shaft of 10 m diameter for absorption of surges.
- **Pressure Shaft:** A 3 m diameter concrete lined pressure shaft of 238 m height connects surge shaft to steel lined pressure tunnel. The thickness of concrete lining is 0.45 m.
- **Steel lined Pressure Tunnel:** A 2.5 m. diameter steel lined pressure tunnel of length as 784 m. Initially 100 m alignment of tunnel is vertical then 684 m is nearly horizontal
- **Powerhouse:** Surface powerhouse is proposed after carrying out the structural analysis which is shown in Drawing nos. S-001 and S-003. The size is 56 (L) x 19.85 (W) x 26 (H) m. It will house three turbo-generators, transformers. It comprises of Machine hall, Erection and Unloading bays etc. with state of the art facilities of modern powerhouse. The structure is designed for 0.3 g ground acceleration
- **Tailrace Canal:** Tailrace canal of 130 m length of size as 5 m (W) x 2 (D) m is proposed. It will outfall into Chitrai river.

HYDRO- MECHANICAL EQUIPMENTS

Three vertical shaft 4 jet PELTON Turbines are best solution for LAWI HPP. The selection of turbine was based on variation of discharges and transportation limitations.

The hydrological and mechanical considerations including transportation constraints have lead to the conclusion that three Pelton turbines each of nominal power capacity of 23.4 MW at a speed of 500 rpm and three step-up transformers of capacities 30 MVA each will fulfill requirement of the net head, design flow and transportation. .

The salient features of the proposed turbines are:

Type of Turbine	= Vertical Pelton 4 Jet
No. of Units	= 03
Unit Discharge	Qunit = 6.67 m ³ /s
Min Unit Discharge	Qmin = 0.42 m ³ /s
Rated Net Head	Hn = 398.5 m
Rated Turbine Output at shaft	P = 23.728 MW
Rated Turbine speed	n = 500 rpm
Runner Diameter	d = 1.62 m

Each unit is equipped with spherical type inlet valve having design head of 535 m WC and 0.95 m diameter.

Following Auxiliary systems and mechanical equipments for general services are also proposed for the project:

- Water system
- Compressed air system
- Oil handling system
- Dewatering & Drainage system
- Detecting & suppressing Fire system
- Heating & ventilation System
- Handling of various parts
- Workshop facilities etc.

ELECTRICAL EQUIPMENTS

The main electric installation would consist of three vertical shaft Synchronous generators, generator switchgear, medium and high voltage bus bars, three phase step-up transformers, 132 KV out door switchyard. Auxiliary power system and safety installations has also been provided for adequate operational and personal safety.

The main control room will be equipped with station computers and operator's workstations with keyboard and Video Display units (VDUs) for control and supervision of the entire plant.

The main components required for a complete powerhouse installation & transmission line are as under:

- Generator with its excitation equipment.
- Step-up transformer, including its auxiliary equipment
- Medium and low voltage Switchgears.
- Power & Control Cables.
- Transmission Line for dispersal of power.
- Control, protection and instrumentation equipment.
- Miscellaneous equipment.

• Generator Main Parameters

Number	3
Capacity	27.078 MVA
Nominal Voltage	11 KV
Nominal Speed	500 rpm
Power factor	0.85
Excitation	Static
Frequency	50 Hz
Efficiency	97 %

S-10 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Environmental Impact Assessment (EIA) of the project has been carried out being the requirement of the donor agencies for the hydro projects more than 50 MW capacities. EIA studies of Lawi Hydropower Project have been carried out based on World Bank Guidelines. Physical, Socio-Economic and Ecological studies have been performed by surveys and scoping sessions with the affected community of the project. Total land to be acquired is about 68 hectares which is un-populated. Impacts of the project have been assessed and their mitigation measures have been proposed.

The project area of Lawi HPP is ecologically least disturbed. The Shishi valley has area of 58,940 hectares out of which 6-8% is snow bound. Chitral district is mainly a mountainous terrain. Chitral is the most far flung district of NWFP. Socio-economic indicators show that Chitral is backward with inferior quality of life. One of the important features is that it cut off from rest of the country during winter months due to closure of Lowari top due to snow. There is also a route through Afghanistan presently which is not being used due to safety reasons. The only means of communication after the closure of Lowari Pass is by air which is intermittent due to weather conditions. Ethnic diversity is a characteristic feature of Chitral valley. People from different ethnic composition have distinct socio-cultural traditions, language and way of life. Major tribe in the area is Kho and their language is known as Khawar, which is commonly known all over Chitral valley.

Shooting, trapping of wild animals is not allowed except with a special permit. Markhor and bex descend down during winter. Snow leopard is also found in some areas. The cattle in general appearance are under-sized and weak. Various types of diseases, lack of pastures, inadequate veterinary services, poor managed animal husbandry, danger of wild animals and thieves across the border are great obstacles in the development of flocks. Trout fish is found in abundance although it is an exotic species which has been introduced in 1960. Forests are found about 25 % in the Shishi valley, although lower valley receives about 300 mm of rainfall. The work plan of Forest Department envisages management of dry temperate coniferous forests which includes two formations, silver fir forests and deodar forests. The silver fir forests are generally in the form of a belt above Deodar zone, at elevations ranging from 2500 meter to 3500 meter which varies in width considerably occasionally even absent. The Deodar forests occupy about 75 percent of the total area under coniferous species at elevation from 2000 to 3000 meter. Below deodar belt are the oak forests.

Water is the one of the most important natural resource of the project area. Good quality water is available from Shishi river and the quality of water does not deteriorate even during the rainy season. The mean monthly discharge of Shishi river is 12.24 m³/s. The minimum monthly discharge of 3.4 m³/s occurs during February and March and a maximum monthly discharge of 30.10 m³/s during July. To maintain aquatic life of the river a minimum of discharge of 0.2 m³/s will be continuously released downstream of weir.

Agriculture is generally still in a primitive stage, although some modern research e.g., improved seeds, insecticides, pesticides and fertilizers are getting introduced. The total estimated agriculture land in the project area is 1067 ha. Most of the agricultural activities are carried out on the terraces developed in the vicinity of Lawi, Drosh, Birgha Nissar etc. The cultivated lands are concentrated in the alluvial fans. Wheat is sown in winter and maize in summer. Irrigation is essential for cultivation. Water is diverted from Shishi river via open channel flow.

The impact assessment of this project considers the constructional and operational activities. These include the water related impacts, land related impacts, air related impacts and the socio-economic impacts. A mitigation Programme has to be adopted and monitored to minimize adverse impacts and maximize the secondary benefits. In order to

neutralize the impact of pollution during the construction and operation activities, environmental costs are included. These costs include the environmental impact mitigation cost, institutional cost and the monitoring cost.

The owners of land or house will be compensated by providing equivalent or better building units or cash compensation. The costs of these items have been considered in the environmental cost. The environmental cost of the project is estimated as Rs. 200 million.

S-11 TRANSMISSION SYSTEM

The power from Lawi HPP shall be transmitted through 132KV transmission line (D/C) to Dir at acceptable voltage drop & power losses of 10%. Proposed option ensures reliable power dispersal at moderate investment. The route of transmission lines is suggested along Chitral river valley, crossing the Lowari pass to Dir. In the Lowari pass section heavy climatic conditions must be expected. Regions with danger of snow slide and avalanches shall be avoided or shall be crossed in free span.

To fulfill the mechanical and electrical aspects, conductors of types „rail“ and „deer“ are chosen. „Rail“ would be used for the lower sections of the line while „deer“ is foreseen for the elevated ones. Earth wires are foreseen as steel types with cross sections from 95 to 150 mm².

Towers are considered as bolted lattice steel constructions with separate footing and shall follow WAPDA's standard configuration as much as possible. Costs for the complete 50 km. line are estimated as 728 Mill. Rupees.

S-12 POWER AND ENERGY ESTIMATION

The optimized design discharge of plant is 20 m³/s and with 3 turbine units it is 6.67 m³/s per unit. For power calculations if the inflow is equal or greater than design discharge (20 m³/s) then maximum level of 1664 m.a.s.l is taken while in case of inflow less than design discharge then average of maximum (1664) and minimum (1630) which comes out to be 1647 m.a.s.l. is used. Using the flood level of 1247 m.a.s.l. (500 years return period) the Pelton turbine centerline was selected as 1251 m.a.s.l. Loss of head due to friction in the waterway is calculated as 4.50 m at full plant operation (20 m³/s). For single turbine operation (discharge equal or less than 6.67 m³/s) head loss comes out to be 1.65 m. The plant installed capacity is 69 MW while the generated power and energy estimates of the project for 4 hours peaking for different scenarios are presented below:

Period	Peak Energy (GWh)	Off-Peak Energy (GWh)	Total Energy (GWh)	Plant Factor
Average (1961-05)	79.07	223.73	302.80	0.51
Wet Year (1991)	80.09	240.47	320.56	0.54
Dry Year (1982)	76.08	196.44	272.52	0.46

The generated maximum and firm power of the plant will be 67.63 MW and 11 MW respectively.

S-13 QUANTITIES AND COST ESTIMATE

The estimate proposes the local currency component in Rupee, the foreign currency component is US Dollars and the total cost in equivalent Rupees based on exchange rate of 1 US\$ = Rs. 60.00.

The total cost of Infrastructure improvement/development, Environmental Mitigations, Preparatory works and Site Installations, etc. is estimated as Rs. 520.387 Mill.

The total cost of all civil works is estimated as Rs. 2274.289 Million.
The total cost for hydro-mechanical and electrical equipment is Rs. 1576.320 Mill.

The total cost of the project is presented below:

Local costs	5364.691 Mill. Rupees (65.67 %)
Foreign costs	2566.957 Mill. Rupees (34.33 %)
Total Cost	7931.648 Mill. Rupees

The summary of the project cost estimate is given in Table S-001.

S-14 CONSTRUCTION PLANNING, ACCESS AND TRANSPORTATION

This Section of the report describes the construction planning and scheduling of the Project. The net working period has been worked out to be 25 days per month or 10 months per year. The ratio of net working months is therefore 10/12 or 0.83.

Daily two shifts of 10 hrs. have been proposed to obtain the progress. Four hours has been assigned for maintenance of equipments and change over. Following contract packages have been proposed for the construction of the Project at this stage of study:

Package – I	Access Roads to construction site.
Package – II	Permanent Residential Colony
Package – III	Weir and Tunneling
Package – IV	Power House, Tailrace and E & M Equipment
Package – V	Transmission Lines

Overall implementation plan of the Project has been estimated as 78 months (Fig. SUM-003). According to the plan, 24 months period will be required for pre-construction activities of the Project during which pre-qualifications of the contractors would have been completed. After completion of feasibility study, PC-I Performa will be submitted to Govt. of Pakistan for having permission for implementation of the Project. The tendering process from issuance of tenders up to their awards will take about 4 months. During this time preparation of construction drawings by the Consultants will remain continue.

Construction activities will take about 54 months wherein headrace tunnel is the critical activity which will take about 48 months.

S-15 ECONOMIC AND FINANCIAL ANALYSIS

In case of hydropower projects, useful life of the civil engineering work has been assumed to be 60 to 80 years and that of electrical and mechanical equipments for 30 years. Economic and Financial Analysis has therefore been done over a period of 30 years.

Economic benefits have been computed based on the equivalent thermal generation costs that would be avoided if Lawi Hydropower Project is installed. Thus the savings for not installing thermal plant, fuel and their operating costs would be the benefits, attributable to the project.

The economic feasibility of the project that the internal economic rate of return (IERR) of the project is 18.51% with B.C Ratio of 1.49

The financial cost of the project includes interest during construction (IDC) and custom duties. The power projects are exempted from import duties but involves custom duties @ 5% on import of plant and equipment not manufactured locally (Refer hydel policy 2002). The escalation during construction has also been added @ 6% and 2% per annum on local and foreign components respectively. The IDC has been charged at the rate of 10.65% on local and foreign exchange components. The financial rate of return (FIRR) is 11.65%.

Cost of generation and installation per unit has been worked out for the Lawi Hydropower Project as per practice prevailing in WAPDA, Power Planning Wing (Cost recovery in 20 years and levelized over 30 years) which comes out to be 2.23 Rs (3.72 US Cents) per kWh and 98236 Rs(1637 US \$) per kW installed respectively .

The results of the economic and financial analysis of the project are shown in Tables S-002 to S-005.

S-16 ON-GOING AND PROPOSED INVESTIGATIONS

At the gauge sites of Lao Nissar Bridge (Weir site), Shishi Bridge and Chitral river (near powerhouse site) the recording of the gauges and stream flows shall remain continued by Surface Water Hydrology (SWH) of WAPDA to collect more data for the detailed design studies of the project. The sediment sampling (suspended and bed load) at weir site is proposed to be carried out regularly. Laboratory analysis of the sediment samples is also needs to be carried out.

Geological investigations are proposed during detailed design phase as

- Four more holes should be drilled, two in the sand trap area T1-T2 and two in the T2-T3 tunnel area in addition two shallow holes in surge tank shaft area to find out overburden depth.
- Geological mapping covering 200 meters wide strip from the center line of the tunnel towards SE [down stream in the four Nallas] from T2-T3 up to the chamber area with special emphasis on the joint spacing and frequency joint/ surface character should be done.
- Scan line survey along the tunnel central line and along a scan line at 200 m distance parallel to the centerline on the left of T3-T4 and T4-T5 and filling the specified proformas "Rock Mass Description Data Sheet".
- Excavation of three adits with Hydraulic Jack Test and Flat Jack Test.

Installation of Strong Motion Accelerograph (SMA) must be installed in the project area to record the earthquakes for further detailed seismic study.

Seismo-Tectonic studies in the project area are recommended to be carried out during detailed design stage for better understanding of the causative sources which govern the expected ground motion of the project area. Also on the basis of this study the seismic design parameters for the design of hydraulic structures can be reviewed.

Physical Hydraulic Model study of the weir, stilling basin and Intake structures is necessary to be carried out. Also for the study of sediments mathematical modeling is proposed to be carried out in detailed design phase of the project.

Detailed Environmental studies of the project area.

Transmission route survey will be required to be carried out.

S-17 CONCLUSION OF THE STUDY

On the basis of results of investigations / studies / analysis carried out for Lawi Hydropower Project it can be concluded that the project is technically feasible, economically & financially viable and environmentally sustainable.

FIGURES

LAWI HYDROPOWER PROJECT
IMPLEMENTATION PLAN[illegible]

TABLES

TABLE S-001
LAWI HYDROPOWER PROJECT
SUMMARY OF COST ESTIMATE

Sr. No.	Description	Cost in Million Pak. Rupees		
		Local	Foreign	Total
A	INFRASTRUCTURE DEVELOPMENT, MITIGATIONS & PREPARATORY WORKS			
A-1	Infrastructure Development	313.827	0.000	313.827
A.1.1	Enviromental Matigations	197.560	0.000	197.560
A.1.2	Preparatory works & Site Installlations	9.000	0.000	9.000
	Total (A)	520.387	0.000	520.387
B	CIVIL WORKS			
B-1	Diversion during Construction			
B-1.1	Weir and River Diversion	87.547	0.000	87.547
B-1.2	Retaining Walls	17.207	0.000	17.207
B-2	Intake and Connecting Tunnel	10.046	0.449	10.495
B-3	Sandtrap system incl: Flushing tunnel	151.855	1.657	153.512
B-4	Access Tunnel to sandtrap	24.648	0.753	25.402
B-5	Hydraulic steel structures	16.110	1.790	17.900
B-6	Head Race Tunnel	1296.100	92.739	1388.839
B-7	Surge Tank System	82.512	1.891	84.403
B-9	Pressure Shaft	59.751	17.798	77.549
B-10	Pressure Tunnel	144.170	101.220	245.390
B-11	Power Complex including Switchyard (Civil)	136.655	0.000	136.655
B-12	Tailrace including Bridge	29.391	0.000	29.391
	Total (B)	2055.992	218.298	2274.289
C	HYDRO-MECHANICAL EQUIPMENTS			
C-1	Turbines	28.890	548.910	577.800
C-3	HVAC System	2.526	22.734	25.260
C-4	Cranes	7.980	0.420	8.400
C-5	Auxillary Equipments & Misc. items	31.929	131.451	163.380
	Sub total(C)	71.325	703.515	774.840
D	ELECTRICAL EQUIPMENTS			
D-1	Generators and Transformers	1.200	375.300	376.500
D-2	Switchgears and other Misc. Items	56.781	368.199	424.980
	Total (D)	57.981	743.499	801.480
E	Transmission Line	728.000	0.000	728.000
	Total E & M Equipment (C+D)	129.306	1447.014	1576.320
F	Total (A + B + C + D + E)	3433.685	1665.312	5098.996
G	Transportation cost (5% of C & D)	6.465	72.351	78.816
H	Erection Charges (4% of C & D)	5.172	57.881	63.053
I	Contingencies (3% of F)	103.011	49.959	152.970
J	Engg. &Supervision Civil (2% of F)	68.674	33.306	101.980
K	Admn., Aduit & Accts. (2% of B)	41.120	4.366	45.486
L	Miscellaneous costs (1.5% of B)	30.840	3.274	34.114
	Total Base Cost	3688.966	1886.449	5575.415
M	Escalation @ 6% on Local & 2% on FEC	386.191	55.687	441.878
N	Custom Duties (5% of FEC)	72.351	0.000	72.351
O	Interest During Construction (L & F=10.65%)	1217.183	624.821	1842.004
	Total Project Cost	5364.691	2566.957	7931.648

TABLE S-002
LAWI HYDROPOWER PROJECT
ECONOMIC ANALYSIS

YEAR	C O S T S			EQUIVALENT THERMAL BENEFITS				MILL.Rs
	CAPITAL	O & M	TOTAL	CAPITAL	O & M	FUEL	TOTAL	NET BENEFITS
1	984.613		984.613	198.95			198.95	-785.663
2	1554.651		1554.651	298.43			298.43	-1256.221
3	1502.830		1502.830	497.38			497.38	-1005.450
4	829.147		829.147	397.91			397.91	-431.237
5	310.930		310.930	397.91			397.91	86.980
6		55.754	55.754		39.79	1035.74	1075.53	1019.776
7		55.754	55.754		39.79	1035.74	1075.53	1019.776
8		55.754	55.754		39.79	1035.74	1075.53	1019.776
9		55.754	55.754		39.79	1035.74	1075.53	1019.776
10		55.754	55.754		39.79	1035.74	1075.53	1019.776
11		55.754	55.754		39.79	1035.74	1075.53	1019.776
12		55.754	55.754		39.79	1035.74	1075.53	1019.776
13		55.754	55.754		39.79	1035.74	1075.53	1019.776
14		55.754	55.754		39.79	1035.74	1075.53	1019.776
15		55.754	55.754		39.79	1035.74	1075.53	1019.776
16		55.754	55.754		39.79	1035.74	1075.53	1019.776
17		55.754	55.754		39.79	1035.74	1075.53	1019.776
18		55.754	55.754		39.79	1035.74	1075.53	1019.776
19		55.754	55.754		39.79	1035.74	1075.53	1019.776
20		55.754	55.754		39.79	1035.74	1075.53	1019.776
21		55.754	55.754		39.79	1035.74	1075.53	1019.776
22		55.754	55.754		39.79	1035.74	1075.53	1019.776
23		55.754	55.754		39.79	1035.74	1075.53	1019.776
24		55.754	55.754		39.79	1035.74	1075.53	1019.776
25		55.754	55.754		39.79	1035.74	1075.53	1019.776
26		55.754	55.754		39.79	1035.74	1075.53	1019.776
27		55.754	55.754		39.79	1035.74	1075.53	1019.776
28		55.754	55.754		39.79	1035.74	1075.53	1019.776
29		55.754	55.754		39.79	1035.74	1075.53	1019.776
30		55.754	55.754		39.79	1035.74	1075.53	1019.776
31		55.754	55.754		39.79	1035.74	1075.53	1019.776
32		55.754	55.754		39.79	1035.74	1075.53	1019.776
33		55.754	55.754		39.79	1035.74	1075.53	1019.776
34		55.754	55.754		39.79	1035.74	1075.53	1019.776
35	-518.217	55.754	-462.463		39.79	1035.74	1075.53	1537.993
TOTAL	5182.171	1672.625	6336.579	1790.58	1193.70	31072.20	34056.48	27719.901

PW OF BENEFITS @ 12%; MILL.Rs	=	6164.18
PW OF COSTS @ 12%; MILL.Rs	=	4136.55
NET PRESENT WORTH ; MILL.Rs	=	2027.63
BENEFIT COST RATIO	=	1.49
I . E . R . R	=	18.51%

TABLE S-003
LAWI HYDROPOWER PROJECT
SENSITIVITY ANALYSIS

MILL.Rs							
YEAR	TOTAL COST	BENEFITS	10% LESS BENEFITS	NET BENEFITS	20% COST OVER-RUN	NET BENEFITS	COMBINED IMPACT
1	984.613	198.950	179.055	-805.558	1181.535	-982.585	-1002.480
2	1554.651	298.430	268.587	-1286.064	1865.582	-1567.152	-1596.995
3	1502.830	497.380	447.642	-1055.188	1803.396	-1306.016	-1355.754
4	829.147	397.910	358.119	-471.028	994.977	-597.067	-636.858
5	310.930	397.910	358.119	47.189	373.116	24.794	-14.997
6	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
7	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
8	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
9	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
10	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
11	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
12	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
13	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
14	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
15	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
16	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
17	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
18	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
19	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
20	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
21	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
22	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
23	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
24	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
25	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
26	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
27	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
28	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
29	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
30	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
31	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
32	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
33	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
34	55.754	1075.530	967.977	912.223	66.905	1008.625	901.072
35	-462.463	1075.530	967.977	1430.440	-554.956	1630.486	1522.933
TOTAL	6336.579	34056.480	30650.832	24314.253	7603.894	26452.586	23046.938

INTERNAL RATE OF RETURN = 16.56% 15.25% 13.59%

TABLE S-004
LAWI HYDROPOWER PROJECT
COST PER KWh AND KW

	DESCRIPTION	MILLION RS.
1	BASE COST	5575.415
	a) LOCAL	3688.966
	b) F.E.C	1886.449
2	ESCALATION ON :	441.878
	a) LOCAL @ 6%	386.191
	b) FOREIGN @ 2%	55.687
3	CUSTOM DUTIES @ 5%	72.351
4	INTEREST DURING CONSTRUCTION @ 10.65% ON	1842.004
	a) LOCAL	1217.183
	b) F.E.C	624.821
5	FINANCIAL COSTS	7931.648
	* a) LOCAL (1a+2a+3+4)	5989.512
	b) F.E.C (1b+2b)	1942.136
6	AMORTIZATION @ 10.65% FOR 20 YEARS AND LEVELISED OVER 30 YEARS OF :	
	a) LOCAL	489.994
	b) F.E.C	158.884
7	OPER.& MAINT. COST @ 1% OF BASE COST	55.754
8	ANNUAL RECURRING COST	704.632
9	ANNUAL ENERGY (GWh)	315.39
10	COST PER KWh - Rs	2.23
	US Cents	3.72
11	INSTALLED CAPACITY (MW)	69
12	INSTALLED COST PER KW - Rs	114951
	US\$	1916

NOTE :- EXCHANGE RATE : 1 US\$ = Rs 60.00

* Inclusive of total Interest during construction.

TABLE S-005
LAWI HYDROPOWER PROJECT
FINANCIAL ANALYSIS

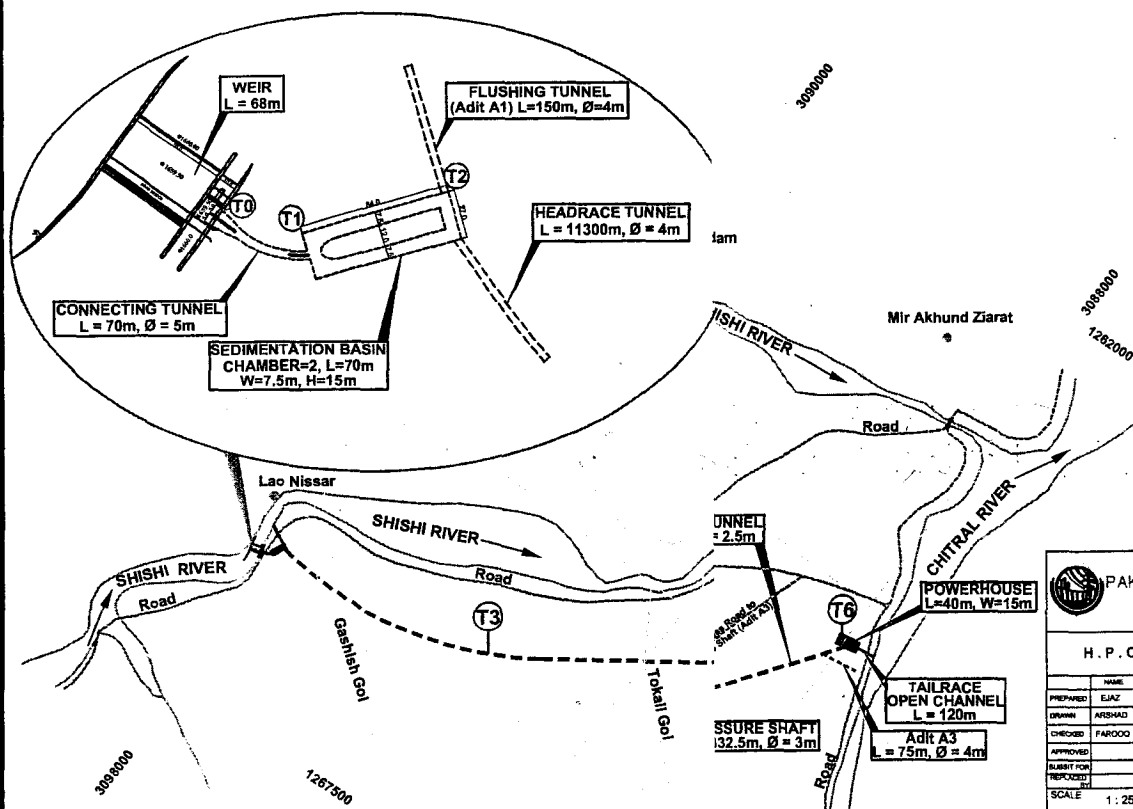
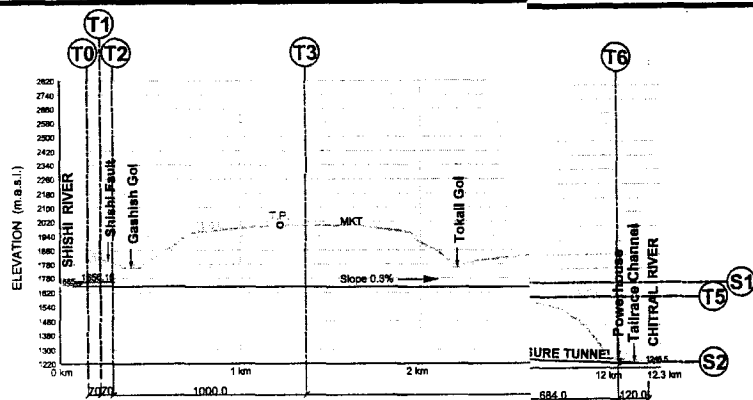
MILL.RS						
YEAR	PROJECT COST	O&M	TOTAL COST	ENERGY GWH	TOTAL BENEFITS	NET BENEFITS
1	1066.334		1066.334			-1066.334
2	1924.243		1924.243			-1924.243
3	2094.793		2094.793			-2094.793
4	1373.345		1373.345			-1373.345
5	530.929		530.929			-530.929
6		55.754	55.754	315.39	1142.610	1086.856
7		55.754	55.754	315.39	1142.610	1086.856
8		55.754	55.754	315.39	1142.610	1086.856
9		55.754	55.754	315.39	1142.610	1086.856
10		55.754	55.754	315.39	1142.610	1086.856
11		55.754	55.754	315.39	1142.610	1086.856
12		55.754	55.754	315.39	1142.610	1086.856
13		55.754	55.754	315.39	1142.610	1086.856
14		55.754	55.754	315.39	1142.610	1086.856
15		55.754	55.754	315.39	1142.610	1086.856
16		55.754	55.754	315.39	1142.610	1086.856
17		55.754	55.754	315.39	1142.610	1086.856
18		55.754	55.754	315.39	1142.610	1086.856
19		55.754	55.754	315.39	1142.610	1086.856
20		55.754	55.754	315.39	1142.610	1086.856
21		55.754	55.754	315.39	1142.610	1086.856
22		55.754	55.754	315.39	1142.610	1086.856
23		55.754	55.754	315.39	1142.610	1086.856
24		55.754	55.754	315.39	1142.610	1086.856
25		55.754	55.754	315.39	1142.610	1086.856
26		55.754	55.754	315.39	1142.610	1086.856
27		55.754	55.754	315.39	1142.610	1086.856
28		55.754	55.754	315.39	1142.610	1086.856
29		55.754	55.754	315.39	1142.610	1086.856
30		55.754	55.754	315.39	1142.610	1086.856
31		55.754	55.754	315.39	1142.610	1086.856
32		55.754	55.754	315.39	1142.610	1086.856
33		55.754	55.754	315.39	1142.610	1086.856
34		55.754	55.754	315.39	1142.610	1086.856
35	-698.964	55.754	-643.210	315.39	1142.610	1785.820
TOTAL	6989.644	1672.625	7963.304	9461.70	34278.300	26314.996

INTERNAL RATE OF RETURN = 11.65%

NOTE:

1. System losses taken as 22%.
2. Revenue attributed to the project @ 75%.
3. Sale price of Rs 6.1929 taken for the year 2014- 2015.

DRAWINGS



PAKISTAN WATER AND POWER DEVELOPMENT CORPORATION HYDRO PLANNING ORGANIZATION		
H. P. O		LAWI HYDROPOWER PROJECT FEASIBILITY STUDY
PREPARED	NAME	DATE
DRAWN	ARSHAD	
CHECKED	FAROOQ	
APPROVED		
SUBMIT FOR		
REPOUNDED		
SCALE	1: 25000	DWG. No. 1-3

L/S

R/S

1670.0

Backfill

ckfill

Rock

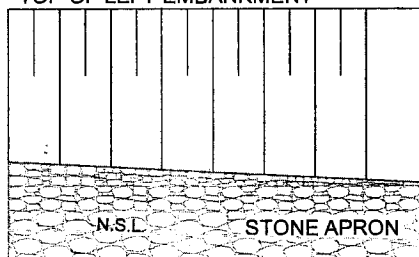
1656.0

ng Gates 4x3m Each

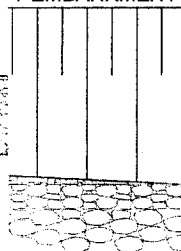
1653.0

1.0

TOP OF LEFT EMBANKMENT



TOP OF RIGHT EMBANKMENT



Concl ALL DIMENSIONS IN METERS.
ELEVATION IN METERS ABOVE SEE LEVEL.



PAKISTAN WATER AND POWER DEVELOP
HYDRO PLANNING ORGANIZATION

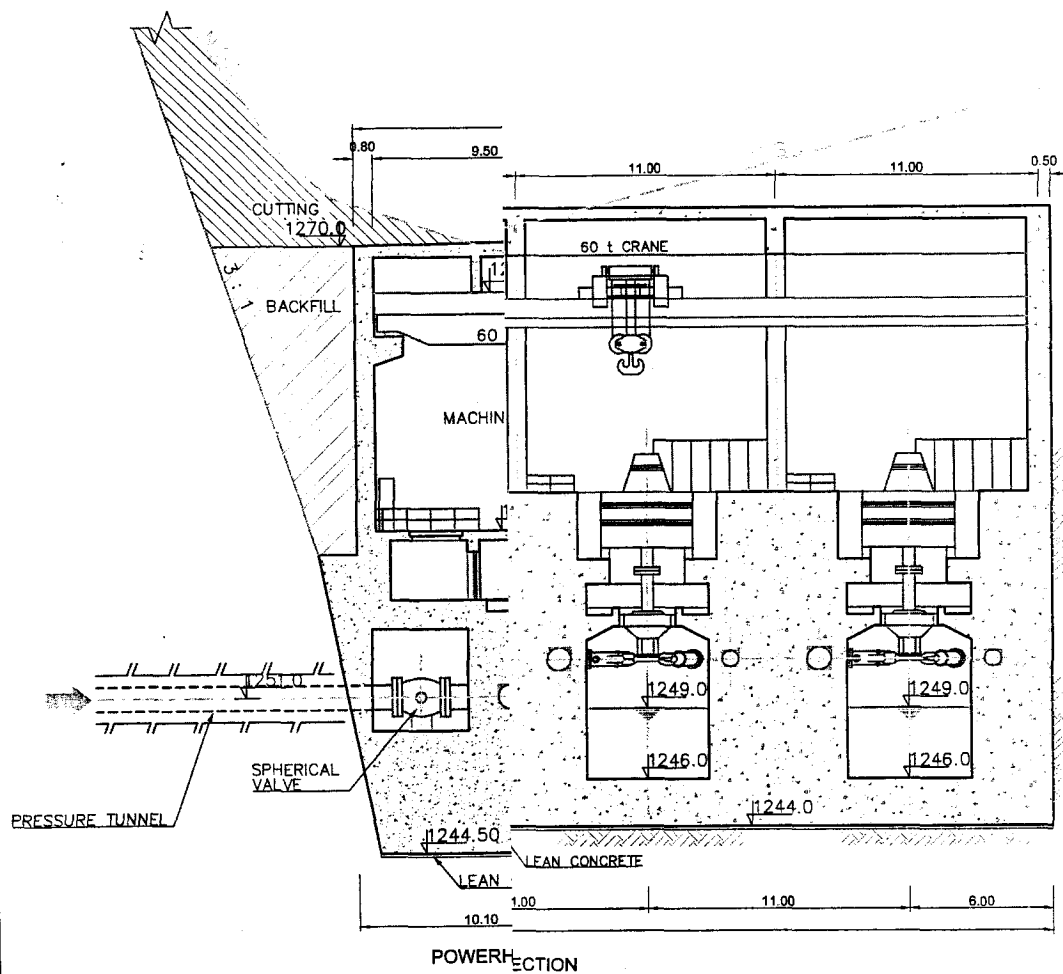
H . P . O

LAWI HYDROPOWER PROJECT
FEASIBILITY STUDY

	NAME	DATE
PREPARED	EJAZ	
DRAWN	ARSHAD	
CHECKED	FAROOQ	
APPROVED		
SUBMIT FOR		
REPLACED BY		
SCALE	1 : 300	

**WEIR
SECTIONS**

DWG: No. S - 002



POWERHOUSE SECTION

- * ALL DIMENSIONS IN METERS.
- * ELEVATION IN METERS ABOVE SEA LEVEL.



PAKISTAN WATER AND POWER DEVELOPMENT CORPORATION
HYDRO PLANNING ORGANIZATION

H. P. O

LAWI HYDROPOWER PROJECT
FEASIBILITY STUDY

	NAME	DATE
PREPARED	EJAZ	
DRAWN	ARSHAD	
CHECKED	FAROOQ	
APPROVED		
SUBSTIT FOR		
REPLACED BY		
SCALE	1:300	

POWERHOUSE
SECTIONS

DWG: No. S - 003