

# ***ALLAI KHWAR HYDROPOWER PROJECT***



PAKISTAN WATER AND POWER DEVELOPMENT AUTHORITY

## PROJECT TEAM (WAPDA)

Chairman	Syed Raghیب Abbas Shah
Member (Water)	Hasnain Afzal
GM Projects (Northern Area)	Brig (R) Muhammad Zareen
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Project Director	Muhammad Tahir Waseem
Consultants:	High-Head Hydropower Consultants (HHC)
Contractors:	
Civil Works:	Dongfang Electric Corporation (DEC), China
E&M Works:	Andritz Hydro GmbH, Austria
Transmission Line:	Northeast China International Electric Power Corporation (NEIE), China Imperial Construction Company (Pvt) Limited (ICC), Lahore



132 kV / 220 kV Allai Switch Yard



General Manager Projects (Northern Areas)  
WAPDA  
[www.wapda.gov.pk](http://www.wapda.gov.pk)

# الائی خواڑ ہائیڈرو پاور پراجیکٹ

## تعارف

ملک میں بجلی کی پیداوار کیلئے زیادہ تر انحصار تھرمل ذرائع پر کیا جا رہا ہے جو کہ نسبتاً تیل کی تیزی سے بڑھتی ہوئی قیمتوں کی وجہ سے خاصا مہنگا ہے۔ اس سلسلے میں واپڈا کا بنیادی مقصد تھرمل پیداوار کی جگہ پن بجلی کا فروغ ہے۔ پن بجلی کی پیداوار بڑھنے کی وجہ سے مہنگے درآمدی تیل پر انحصار کم ہو جائے گا۔ اس مقصد کے حصول کے لیے واپڈا تمام ممکنہ مقامات استعمال میں لا کر پن بجلی کی زیادہ سے زیادہ پیداوار کے لیے کوشاں ہے۔ الائی خواڑ پراجیکٹ وژن 2025 کے تحت تعمیر کیے جانے والے تین منصوبہ میں سے ایک ہے جو صوبہ خیبر پختونخوا کے ضلع بگلرام میں الائی کے نزدیک دریائے سندھ کے معاون دریا الائی خواڑ (الائی نالہ) پر مکمل ہوا ہے جو شاہراہ ریشم پر اسلام آباد سے 245 کلومیٹر جبکہ پشاور سے 330 کلومیٹر کی مسافت پر ہے۔

## منصوبہ

الائی خواڑ ہائیڈرو پراجیکٹ آبی ذخیرے، ڈیم سٹرکچر، پاور اسٹیک سٹرکچر، پریشر ٹنل، سینڈ ٹریپ، چینٹاک، پاور ہاؤس اور سوئچ یارڈ پر مشتمل ہے۔ الائی خواڑ کا پانی (21 کیوبک میٹر فی سیکنڈ) 2366 میٹر لمبی سرنگ کے ذریعے موڑ کر 687 میٹر کی بلندی سے گرا کر جمیٹر کے مقام پر 121 میگا واٹ پن بجلی پیدا کرنے کا منصوبہ ہے جو قومی گرڈ سے 132/220kV ٹرانسمیشن لائن کے ذریعے منسلک ہے۔ یہ منصوبہ جنوری 2005 میں شروع ہوا اور 2005 کے تباہ کن زلزلہ اور مشکل مندوش سیکورٹی حالات اور جولائی 2010 کے تباہ کن سیلاب کے باوجود واپڈا کی بے پناہ کاوشوں کی بدولت 7 سال 10 ماہ میں کم و بیش 13 ارب 84 کروڑ روپے کی لاگت سے مکمل ہوا۔

## منصوبے کے فائدے

- 1- مہنگی تھرمل بجلی کی جگہ سستی پن بجلی کا حصول
- 2- تھرمل پلانٹس کیلئے تیل کی درآمد میں کمی کی وجہ سے غیر ملکی زرمبادلہ کی بچت
- 3- کاربن ڈائی آکسائیڈ اور سلفر ڈائی آکسائیڈ کے نہ ہونے کی وجہ سے یہ منصوبہ خالصتاً ماحول دوست ہے۔
- 4- وادی جمیٹر اکا بڈریج سٹرک منلک سے براہ راست رابطہ

## نمایاں خدو خال

آبی ذخائر میں پانی بھرنے کی مجموعی صلاحیت 915 ایکڑ فٹ

88 میٹر

51 میٹر

ڈیم کی لمبائی

ڈیم کی اونچائی

پریشر ٹنل

لمبائی

اندرونی قطر

2366 میٹر

2.2 میٹر

چینٹاک

پریشر شافٹ سے پاور ہاؤس تک کی لمبائی

37 میٹر

2.2 میٹر

اندرونی قطر

پاور ہاؤس

مشین ہال کی لمبائی

40.00 میٹر

چوڑائی

20.20 میٹر

اونچائی

14 میٹر

ٹیل ریس

ٹیل ریس ٹنل اور آؤٹ لیٹ کی لمبائی

43 میٹر

دو پمپنگن و ہیل (10.5 مکعب میٹر فی سیکنڈ فی ٹربائن)

21 مکعب فی سیکنڈ

ہیڈ

زیادہ سے زیادہ آپریشن کی حد لیول

سطح سمندر سے 1239 ربلند

اوسط آپریشن لیول

سطح سمندر سے 1231 میٹر ربلند

زیادہ سے زیادہ ہیڈ

687 میٹر

کم سے کم ہیڈ

679 میٹر

ہائیڈرو ملکنیکل آلات

ٹربائن

2 (عمودی پمپنگن و ہیل)

رفقار

500 چکر فی منٹ

الیکٹریکل آلات

جزیریز

2 عدد

رفقار

500 چکر فی منٹ

آؤٹ پٹ فی یونٹ

60.5MW/71MVA

توانائی

دو پمپنگن و ہیل کی موجودہ پیداواری صلاحیت

121 میگا واٹ

اوسط سالانہ توانائی کی پیداوار

463 گریگا واٹ ہاور

# ALLAI KHWAR HYDROPOWER PROJECT

## Introduction

The acute shortage of power in the country and high tariff is of great concern to all. Presently power demand is being met through a mix of thermal and hydroelectric plants with thermal percentage increasing in recent years and hence the adverse impact on unit cost of generation higher increasing cost of fuel. WAPDA has endeavored to maximize the country's capacity for Hydropower generation and reduce the dependence upon thermal power generation. In that stride efforts are made to utilize all possible hydropower generation sites. Allai Khwar Hydropower Project is one of Three High Head Projects identified by SHYDO in collaboration with GTZ (a German Firm) under "Vision - 2025" and approved on 17 Jan 2001. (Khan Khwar Hydropower Project has already gone into generation in Nov 2010).

## Location

The Project is located on Allai Khwar (Allai Nullah), a left bank tributary of River Indus in District Battagram of Khyber Pakhtunkhwa Province. It is 245 km from Islamabad and 330 km from Peshawar on famous Silk Route Karakoram Highway (KKH).

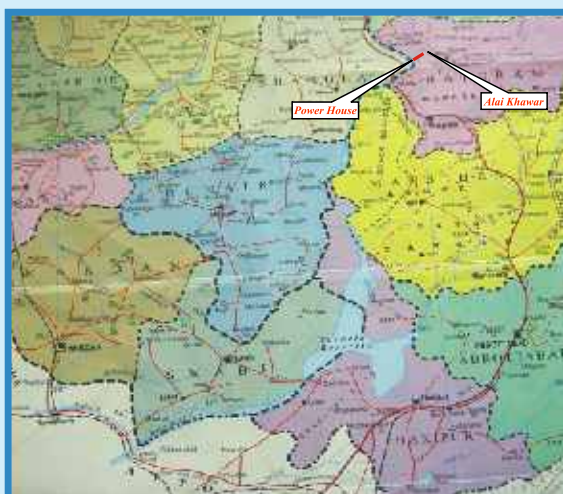
## The Project

The Project is termed High Head Hydro-power Project due to 687 m head and is based on Pelton type turbine the first of its kind in the country. It consists of Reservoir, Dam Structure, Power Intake Structure, Sand Trap, Pressure Tunnel, Penstock, Power House, Tailrace & Switch Yard. It aims at generating 121 MW electricity by drawing 21 m<sup>3</sup>/s water from Allai Khwar through 2366 m long Pressure Tunnel. The Project is connected with the National Grid at Tarnol through 132/220 kV Transmission Line constructed for the High Head Projects and in operation.

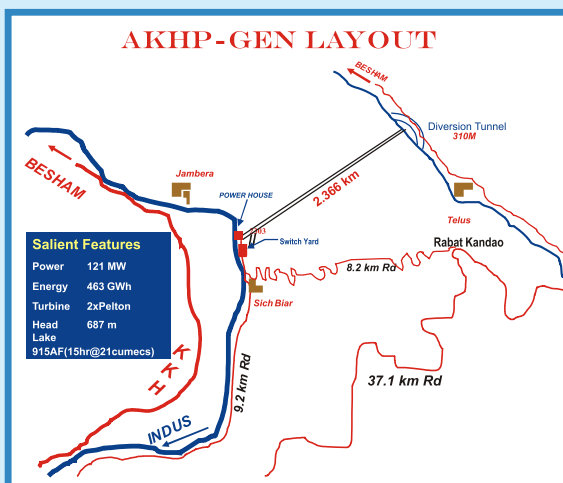
## Objective

As stated above the country generation particularly for the short term, relies heavily on thermal generation, which is rather expensive due to ever rising cost of fuel. The WAPDA power programme thus aims at providing facilities for the cheap hydropower generation so as to address the thermal - hydropower generation matrix in favour of hydro-based generation. Generation capability of Hydel Stations

though does not remain constant throughout the year, yet its generation decreases the dependence on costly imported fuel and hence availability of cheaper power.



Location Map



Project Layout

## Project Impact

- Replacement of expensive thermal by Hydro plants providing cheaper, renewable hydropower to the extent of its capacity generation
- Increasing Hydel share in generation mix
- Saving of foreign exchange by reducing import of fuel that is used in thermal projects
- Environmental friendly especially due to non-production of CO<sub>2</sub> or SO<sub>2</sub>

## Project Cost

Original PC-I amounting to Rs. 8577.824 M including Rs. 3453.540 M Foreign Exchange Component (FEC) was approved by ECNEC during Sep 2002. The world was struck by the phenomenal increase in fuel and construction material cost starting 2007 which was further aggravated by the depreciation of Rupee value. Revised PC-I was thus necessitated which was approved by ECNEC on 29 Jul 2011 for Rs. 13.835 Billion that includes Rs. 6.522 Billion as FEC.

## Financing

Due to non-availability of foreign loan at the start of the Project, the Foreign and Local Costs were met out of PSDP and Cash Foreign Exchange (CFE) upto Dec 2008. A loan amounting to US \$ 38.435 M from Islamic Development Bank (IDB) was effective from Jan 2009 onwards to meet the expenditure on Weir structure and Consultancy Services.

## Project Implementation

The Project implementation suffered so many delays due to natural calamities. No sooner the Project works commenced during Aug 2005, the area was struck by the devastating earthquake on 08 Oct 2005. The construction activities were suspended due to massive land slides blocking the access to Project sites. The work was resumed in Feb 2006. To facilitate the construction of Weir, concrete lined Diversion Tunnel of 7.8 m dia and 310 m in length was completed by Oct 2008. Thereafter work on concrete Weir commenced.



Erection bay of Power House



Stator of Power House No. 1



Transformers bay

The 51 m high Weir site needed extensive support measures for its rather unstable slopes in form of shotcreting and rock bolting which was carried out with due diligence.

The excavation and steel lining / backfill concreting of 2366 m long Pressure Tunnel turned out to be an arduous task because of encountered poor geological conditions and steep slope. The Project execution suffered further setback due to volatile security environments in Swat / Shangla area during Nov 2007 resulting into evacuation of the Contractor from Project sites. After remobilization of Contractor to site in Feb 2008, the Project went through various stages of construction albeit under blockages of access road to Weir site due to land sliding.

The break through of Pressure Tunnel was achieved on 28 Dec 2008. However another calamity hit the Project by way of devastating floods on 28 July 2010, overtopping Coffe Dam and the resultant inundation of Allai Khwar Weir site works. The Indus in exceptional high floods severely damaged / washed away the Batching Plant and allied installations at Power House site. Overcoming the odds while the work on Weir construction resumed in Dec 2010, the steel lining / backfill concreting of Pressure Tunnel was completed by 07 Feb 2011.

In the meantime, massive backslope collapse had occurred at Power House on 31 Oct 2010 and Apr 2011. The backslope stabilization was an additional gigantic task both technically and physically which was substantially completed by Sep 2012 using deep double corrosion protected anchors of 35 m length besides 8 m long bolts.

For power evacuation from 3-HHPs into National Grid, 132 kV Transmission Line (50.5 km) from Duber Khwar to Khan Khwar to Allai Khwar Switch Yard and 220 kV Transmission Line from Allai Khwar Switch Yard to Islamabad Grid at Tarnol (183.1 km) is constructed.



Visage of under construction Weir from upstream



Slope stabilization at Powerhouse back slope



Coupling between Generator and Turbine

The Project is environment friendly with no environmental issue from the construction of Allai Khwar Hydropower Project. About 15 Cusecs water downstream of Allai Khwar Weir as compensation releases during the lean period 15 Nov to 15 Feb (in addition to water available from dependable springs and downstream tributaries) meets the total requirement of water mills, mini hydel generation units, irrigation and human consumption.



2.36 Km Long Headrace Tunnel

## SALIENT FEATURES

Reservoir Capacity		915 AF
Weir Structure	Length Height	88 m 51 m
Pressure Tunnel	Length Internal diameter Gradient	2366 m 2.2 m 38.27 %
Penstock	Length	37 m
Powerhouse (External Type)	Turbine shaft depth below Machine Hall floor Machine Hall - Length Width Height	8.5 m 40.00 m 20.2 m 14.00 m
Tailrace	Tailrace Tunnel & Outlet length	43 m
Design Discharge	2 Vertical Pelton Wheel (10.5 m <sup>3</sup> /s each)	21 m <sup>3</sup> /s
Head	Maximum operation level Minimum operation level Maximum gross head Minimum gross head	1239 m.a.s.l. 1231 m.a.s.l. 687 m 679 m
Hydro-Mech Equipment	Turbine Speed	2 (Vertical Pelton) 500 rpm
Electrical Equipment	Generator Speed Output per unit	2 Numbers 500 rpm 60.5 MW / 71 MVA
Energy Output	Installed capacity (2xPelton) Mean annual energy	121 MW 463 GWh
Executing Agency	Water and Power Development Authority (WAPDA)	