

**B 18 ALEO SMALL HYDROPOWER PROJECT
ALEO, MANALI (H.P.) (2X1500KW)**

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SYNOPSIS

A new breed of Hydropower developers has emerged who think differently than the conventional Hydropower developers. One such company Aleo Manali Hydropower (P) Ltd. (AMHPL) whose Managing Director Er. A.K.Goel with his unconventional approach implemented ALEO SHP in record time of 14 months without disturbing the ecology and environment of fragile Himalayas. In the implementation of ALEO SHP (3000kw) no tree has been removed and only 1.29 hectare land has been acquired for this project. The weir has a unique feature as river flow has not been obstructed. No muck disposal has been done as cutting and filling have been balanced. The natural hill slope has been utilized in developing terraces at different levels, Housing Power House, Control room switch yard etc. Office and staff accommodation have been provided over control room.

Deep excavation has been avoided at all component locations and no blasting has been done, avoiding damage to the environment and ecology of the area. This has yielded good dividend as boulders falling & sliding of hills have not occurred even during heavy rain & snow fall. The features of the scheme as explained in the paper reconfirm that Small Hydropower Projects can be built in a short span without causing any damage to the local environment and community. Aleo Project is a show case project and has set up an example for well designed, well implemented, environment friendly & commercially viable Hydro electric project

Aleo HEP was allotted to Aleo Manali Hydropower P Ltd (AMHPL) by H.P. Energy Development Agency in March 2001. **Aleo HEP is a run of river scheme near Manali town in Kullu district of Himachal Pradesh.** The scheme utilizes 1.33 cumec discharge of Allain Nala by developing a head of 290.4 M for 3000 KW generation, in Aleo village close to Manali. The scheme will generate 28 million KWH yearly during its first four years of operation & 13 Million KWH annually afterwards. The power generated is fed into 33KV H.P.S.E.B. Grid Sub Station at Prini, 1.75 KM from Aleo HEP. Power purchase agreement for 40 years has been signed with H.P.S.E.B. for Sale of power @2.50 per KWH.

Work of detailed Survey, Investigation, Preparation of Detailed Project Report, design construction, & supervision was carried out by M/s Small Hydro Engineer Consultants Pvt. Ltd. (SHC).

MILESTONES:

- MOU with Government of Himachal Pradesh signed in March 2001.
- Detailed Project Report submitted for approval in October 2001.
- Techno-economic clearance accorded by H.P.S.E.B. in January 2002.
- Implementation Agreement signed with H.P. Govt in October 2002.
- Power Purchase Agreement signed with HPSEB in June 2004.
- Construction began in July 2004.
- ALEO HEP synchronized with H.P.S.E.B. grid in August 2005.
- ALEO HEP Commercial Operation Date 14th September 2005.
- First Energy bill submitted in HPSEB in Sept. 8, 2005.
- First Energy bill paid by HPSEB in Oct. 2005.
- Monthly Energy bills are paid by HPSEB regularly well in time.
- Performance testing by AHEC. I.I.T. (Roorkee) carried out in Nov. 2005. The efficiency of the machines are above 82%
- Declared as well designed, well implemented and nicely maintained Small Hydro electric project by AHEC. I.I.T. (Roorkee)
- Subsidy released by Ministry of Non-conventional Energy Sources in Sept. 2006.

- UNFCCC granted CDM status to Aleo project in Sept. 2005. The project have generated more than a 40,000 CERs till the end of May 2007 and thus helped in reduction of more than 40,000 tons of carbon di oxide in the environment.
- The company is certified for ISO 9001:2000 for quality management system standard and ISO 14001:2004 for environment management system standard for generation of electricity.

SURVEY AND INVESTIGATION:

SHC carried out detailed Survey & Investigation on Allain Nala for Aleo project vis-à-vis 192 MW Allain-Duhangan Hydro Power Project proposed upstream on Allain Nala. The waterpower study of the project is based on H.P.S.E.B. long-term discharge data (1979-1999). There is no consumptive use of water between proposed diversion & powerhouse location.

Topological maps of Survey of India in 1:50000 scale (52 H/4 & 52 H/8) were referred for preliminary investigation and reconnaissance. A team of consultants comprising of Sr. Engineers, geologists & Surveyors carried out the reconnaissance of the site & identified best suitable location of the scheme components. After finalization of scheme component locations detailed topographical survey was carried out by experienced surveyors. To maintain accuracy digital survey instrument “Total Station” was used.

PROJECT PARAMETERS:

LOCATION

Aleo HEP is a Run-Of-River Scheme on Allain Nala near Manali town in Kullu District of Himachal Pradesh. Allain Nala is a tributary of Beas River and it meets Beas River form its left bank near village Aloe, about 3km downstream of Manali town at an Elevation of ±1800 m. The Scheme is approachable through motorable road right upto the powerhouse location. Scheme is accessible from State Highway (Manali – Nagar Road) on the left bank of the Beas River and is about 3 Km from Manali and 40 km from Kullu.

Geographical Coordinates

	Weir Site	Power House
Latitude	32 ^o 13’ 35” North	32 ^o 14’ 00” North
Longitude	70 ^o 12’ 47” East	77 ^o 11’ 52” East
Altitude	±2154.8 M above MSL	±1849 M above MSL

HYDROLOGY

Allain Nala originates from an altitude of 6000 meter above MSL and has a catchment area of 144.7 Sq. Km. before its confluence with Beas River. A major Hydro-Electric Project is under construction on Allain Nala (Allain-Dhungan 192 MW), which envisages utilization of Allain Nala discharge by constructing a barrage on Allain Nala at an elevation of ±2747 m. This project is expected to be commissioned in the year 2009. Therefore full discharge (catchment area 142.65) of Allain-Nala shall be available for power generation in Aleo SHP project upto year 2008.

After commissioning of 192 MW Project the available catchments of Aleo SHP at proposed diversion weir site shall be reduced to 13.75 Sq. Km with highest catchment elevation of 3985 m. Aleo SHP is located on right bank of Allain Nala with installed capacity of 3000 KW with 20% overload capacity. After detailed waterpower study 290.4 M net head and 1.33 cumec design discharge (maximum discharge 1.60 cumec) was taken for power generation with diversion weir at El. ±2154.8 M & Power House at ±1849M.

The Allain Nal is perennial source of water for which discharge data (water flow) has been taken by H.P.S.E.B. for last 20 years. The minimum & maximum observed discharges are 2.73 cubic meter per second (cumec) and 104.49 cumecs respectively. The standard projected flood is 479 cumec. Average rainfall at Manali is 1491.18 mm. The minimum & maximum temperatures are -6 degree Celsius & 33 degree Celsius respectively.



Aleo HEP Power House

CIVIL WORKS:

- ❖ **Diversion Structure & Intake:** The water of Allain Nala is being diverted through Trench type weir 10 m long constructed at EL ± 2154.8 m having a design discharge of 2.1 cumec. The water from diversion structure is being regulated from intake gates.
- ❖ **Water Conductor: RD-0 – RD-911.2 m.** Steel pipe of 1000 mm ID acts as the water conductor to carry water from Intake to Penstock. The water conductor consists of very short feeder channel, Desilting basin & Power pipe.
 - Feeder Channel: About 17 m long, 1.35 x 1.5 m RCC feeder channel feeds 1.60 cumec (maximum 2.10 cumec) water from Diversion to Intake which is connected to Desilting Basin.
 - Desilting Basin: 33 m long 5 m wide (RD17 m to RD50 m) RCC Desilting basin removes 90% particles of more than 0.2 mm size from water to prevent damage to water turbines installed in the power house. The desilting basin feeds desilted water discharge of 1.60 cumec (maximum 1.85 cumec) into powerpipe.
 - Power Pipe: The power pipe carries desilted water from desilting basin to forebay (RD50 m to RD911.2 m). It consists of 861.2 m long circular MS pipe of 1012 mm outer dia, 6 mm thick to carry design discharge of 1.33 cumec (maximum 1.60 cumec).
- ❖ **Forebay:** The power pipe discharges water into 7 m dia, 12.25 m high RCC forebay tank located at RD 911.2. The forebay tank feeds water to turbine through penstock pipe. The normal water level at forebay ± 2150 m.
- ❖ **Penstock:** Water discharge 1.33 cumec (maximum 1.60 cumec) from forebay carried through one penstock (800 mm diameter 561.35 m long + 700 mm diameter 162.15 m long), 723.40 m long which bifurcates near power house, each of 500 mm ID, 8 m long & then reduced to 350 mm ID, 1.6 m long each, to feed water into individual turbine.
- ❖ **Power House:** Two Hydraulic turbines (Pelton), Generator & associated equipment are installed in surface power house 25m long, 11 m wide & 9 m high located on the right bank of Allain Nala near Aleo village with a floor level of 1849 m. The power house is equipped with 20T hand operated traveling crane for operation and maintenance of the plant. The control room of size 10 m x 6.5 m is located at an elevation of + 1850.5 m adjacent to the powerhouse.

- ❖ **Tail Race:** After generation of power the water from each turbine is released through individual Tail Race Channel 1.00 M x 1.20 M and combined Tail Race 1.50 m x 1.20 m RCC Box Section with a total length of about 35 m.

HYDROPOWER GENERATING EQUIPMENT:

- ❖ **Turbine(s):** Horizontal pelton turbines (two nos.) with rated output of 1500 kw (+20% continuous overload) each operated at net head of 290.4 m running at 750 RPM are installed and coupled directly to generator. The turbines are provided with Spherical Inlet Valve and electronic governor to regulate & control their operation.
- ❖ **Generator(s):** Two nos. brushless synchronous generators connected to individual turbines generate 1500 KW (+20% continuous overload) each at 3.3 KV & 0.8 power factor. Necessary control & regulating and protection equipments are provided.
- ❖ **Switchyard:** The power generated at 3.3 KV is being stepped up to 33 KV through two transformer 2300 KVA each along with associated equipments like 33 KV SF6 Breakers, CTs, PTs, Isolators, LA etc in the Switchyard adjacent to power house. 100 KVA 33/0.415 KV Step down transformer has been provided for Auxiliary supply.
- ❖ **Transmission Lines:** The power from switchyard busbar is transmitted through 1.75 km long 33 KV single circuit overhead transmission line to H.P.S.E.B. 33 KV substation PRINI.
- ❖ **Metering:** The electricity supplied from Aloe Project is being metered at H.P.S.E.B. 33 KV substation PRINI.



Aleo HEP Generating equipment

POWER PURCHASE ARRANGEMENT:

The power generated from Aleo SHP is being fed into H.P.S.E.B. substation (S/S) Prini. H.P.S.E.B. is purchasing power fed into grid @ Rs. 2.50 per unit. No water royalty will be charged by H.P.S.E.B. for first Fifteen years of the commercial operation of Aleo project. After the expiry of 15 years, 10% energy fed into grid shall be charged as water royalty.

The power purchase agreement has been signed with H.P.S.E.B. for initial period of 40 years, extendable by 20 years on mutual consent. The agreement has provision for paying deemed generation in case of non-availability or partial availability of evacuation system beyond the interconnection point.

BILLING:

As per PPA with H.P.S.E.B., monthly energy bill is submitted by the company on 5th day of next month. The bills have to be paid within 30 days of the receipt of the bill by H.P.S.E.B., who is entitled for a rebate at normal prime landing rate of State Bank of India calculated for each day of payment, if payment is made before 30 days of the receipt of the bill. All bills till Sept 2006 have been paid by H.P.S.E.B. well within due dates.

ENVIRONMENT & ECOLOGY:

Aleo HEP is a run-of-river Hydel scheme, which involves no storage. There is no submergence of forest and cultivated lands due to construction of any components of the scheme. Moreover the project did not involve highly sensitive issues of displacement of people due to construction of the project. The infrastructure facilities for the scheme and its construction and maintenance staff did not cause any adverse effect on the environment. The desilting arrangements, water conductor system and forebay are founded on geologically sound formations.

This project has not any bad effect on the environment and aquatic, wild life or fish as no submergence or stagnation of water has occurred in the project area. **In fact during construction of the project, not a single tree was cut.** Special attention was paid to ensure that no environmental damages are caused. All contractors had stiff penalties built into their contracts and promoters were personally involved in ensuring compliance.

SPECIAL FEATURES:

- **Layout:** The layout of Aleo HEP is very compact minimizing the land use and utilizing the hill slopes with least disturbance. This has reduced the chances of land slide. In fact no land slide has taken place during construction or operation of the project till date. The total land acquired for the project is about 1.3 hectare which is very low by normal standards.
- **Muck disposal:** No muck was generated for disposal. The design and construction has been done to utilize the entire muck generated within the various components of the project i.e. cutting and filling has been equalized. Slope stability of up side & down side hills were not disturbed thereby reducing the impact of construction activities on the general stability of hill slopes and vegetation.
- **Blasting:** Use of Explosives has been avoided to the maximum possible extent. In fact explosives have not been used even in disintegrating the hardest rock. Chiseling has been adopted to minimize the impact of construction on the nearby area.
- **Designs:** The weir, intake and desilting tank have a unique design for catering local conditions. The Transformer track for easy maintenance is another innovation, where the transformer shell is unloaded in the power house by HOT crane provided in P.H. and shell is dredged/pulled in the switchyard on rail track, minimizing the cost and time of erection/maintenance in Anchor blocks. The use of R.C.C. has been reduced by using stone masonry to provide necessary counter weight for Anchor blocks against lifting or sliding.
- **Arrangement for Discharge Measurement:** Permanent arrangement of sharp crested weir has been done in the tail race channel and a chart has been prepared so that discharge in the tail race can be measured. This is required to work out the equipment efficiency. The arrangement has been done as per B.I.S. and has been approved by A.H.E.C. I.I.T. Roorkee during efficiency test in Nov. 2005. The efficiency of the equipment has been found more than 82%.
- **Water supply & irrigation:** The water supply of Aleo village has been provided from Desilting tank which supplies silt free water for drinking purpose. The irrigation channel also gets assured water supply from desilting tank.
- **Air lifting of generators:** The E&M equipment was supplied, installed & commissioned by V.A. Tech. As the delivery period of Generator from Indian companies was too long it was decided to import the Generator from Brazil. To avoid delay in commissioning of the project, both generators each weighing about 14000 kg. were airlifted from Brazil.

SOCIAL ASPECTS:

Since the start of Aleo HEP the company has participated in various development activities **at village, district and state level.**

1. Assured clean and silt free water supply for **drinking and irrigation** purpose to Aleo village.
2. Repair of old and damaged khul (water channel) for uninterrupted supply of water for irrigation purpose to Aleo village.
3. 75 pairs of desk and chairs donated to **primary school** at village Aleo.
4. Street lights, Pucca foot path provided in various parts of Aleo village.
5. Pooja and sports organized in Aleo village.
6. Financial assistance provided for.
 - (i) Summer and winter festivals at Manali.
 - (ii) State level Kabbdi & other sport activities organized in Kullu & other parts of the state.
 - (iii) Kullu Dushera.
7. **Encouraged with the excellent performance of the Aleo project. The company have instituted scholarship for M. Tech student in Alternate Hydro Energy centre I.I.T. Roorkee.**

FINANCING:

The project has been financed on debt equity ratio of 70:30. The lead financier Rural Electrification Corporation has financed 50% of the project cost and Punjab National Bank 20% of the project cost. The project got subsidy from Ministry of non-conventional energy source as per MNES policy.

CONCLUSION:

The implementation of Aleo HEP by Aleo Manali Hydropower Pvt. Ltd. in 14 months time without disturbing the ecology and environment of the fragile Himalayan area has shown that small hydro projects can be built in a short period without causing any collateral damage to the local environment and community.

BIOGRAPHICAL DETAILS OF Mr. A.K.GOEL

Ashwani Kumar Goel Graduated in civil Engineering from I.I.T- Roorkee in 1970 (Formerly University of Roorkee). Sri Goel is presently Managing Director of Aleo Manali Hydropower (P) Ltd. Engaged in hydropower generation. He carries a distinguish carrier as a contractor, Superintending engineer in U.P. Govt. organization. Fellow TERI, Manager Winrock International, Hydropower Consultant and Now as a developer and owner of Hydro Electric project in Himachal Pradesh.

He has 35 years experience in civil and Electrical Engineering field specially for Small Hydropower Projects. This cover technical, financial, technology, managerial and policy related matters. Mr. Goel. Participated and delivered talks in many national & International conferences and have contributed more then 35 papers in Hydropower Sector. He visited many countries such as U.S.A, U.K., Germany, France, China, Netherlands, Switzerland, Hungary, and Nepal. He has to his credit more then 50 Hydro Electric Projects.

He has been instrumental in development and implementation of first Private. Hydro Electric Project in Uttaranchal. He implemented Aleo HEP in Manali (HP) on **BOOT** basis in record time of 14 months. Which is generating power continuously at 115% PLF since last 16 months? **Aleo project is a Shaw case project and have set up an example for well designed, well implemented, environment friendly & commercially viable Hydro electric project**