

## **PROJECT INFORMATION**

### **INTRODUCTION**

Sanjen Jalavidhyut Company Limited (SJCL), a subsidiary of Chilime Hydropower Company Limited (CHPCL), was established as a public limited company in 2010 AD with the objective of development of hydropower in Nepal. Now SJCL has planned to implement two hydroelectric projects in cascade (*Fig. 2 Layout Plan*), which are located in Rasuwa District of Central Development Region.

Upper scheme of the cascade is Sanjen (Upper) Hydroelectric Project (SUHEP) optimized at 14.8 MW installed capacity utilizing 11.07 m<sup>3</sup>/s design flow (Q40) diverted from Sanjen River at Tiloché via 1.4 km long headrace tunnel and 460m long penstock at a gross head of 161.3m. Lower scheme of the cascade is Sanjen Hydroelectric Project (SHEP) optimized at 42.5 MW installed capacity utilizing 11.07 m<sup>3</sup>/s tail water from SUHEP and 0.50 m<sup>3</sup>/s flow diverted from Chhupchhung Khola at Tetanchet via 3.63 km long headrace tunnel and 1010m long penstock at a gross head of 442.0m.

The Sanjen (Upper) and Sanjen Hydroelectric Projects are located in Chilime VDC of Rasuwa District, Bagmati Zone. Tiloché headworks site situated at 2345 amsl is about 161 km road head distance towards north-east of Kathmandu as shown in *Fig.1 Location Map*. Powerhouse of SUHEP and the headworks of SHEP are located in Simbu Village and the Powerhouse of SHEP is located in Chilime village, just upstream of Headworks of existing Chilime Hydropower Plant (22.1 MW).

The projects are accessible via Kathmandu-Trisuli road (72 km), Trisuli-Somdang Highway (Pasang Lhamu Highway 72 km) and 6 km long access road up to existing headworks of Chilime Hydropower Plant i.e. Powerhouse site of SHEP. All working sites of both projects will be accessible after the construction of additional 11 km main access road from existing road up to the headworks site of SUHEP at Tiloché and 8 km long access road to Surge Tank of SHEP.

The projects are basically peaking run-of-river type scheme with average daily peaking facility for 1.2 hours (*Fig. 2 Layout Plan*). The gross annual energy generation of SUHEP is 85.87 GWh and that of SHEP is 251.94 GWh. Generated power from the Sanjen (Upper) Hydroelectric Project will be evacuated through 5 km long 132 kV transmission line and the generated power from the Sanjen Hydroelectric Project will be evacuated through 1.2 km long 132 kV transmission line to the proposed Chilime Hub at Chilime VDC.

Higher Himalaya and the Lesser Himalaya, Central Nepal separated by the Main Central Thrust (MCT) near China border. Winter temperature often falls below 0°C. Maximum temperature reaches up to 32 °C. Afternoons are normally windy in comparison to mornings.

### **HYDROLOGY**

The source river is known as Sanjen Khola, a snow fed river, in the upper catchment, which is then known as Chilime Khola in the lower catchment after having been joined by other tributaries. The Sanjen Khola originates in the upper catchment behind Ganesh Himal Range as high as El. 7422 m. The catchment area of Sanjen Khola behind Ganesh Himal totally lies in Tibet (China) and is about 74 km<sup>2</sup>.

The catchment area at the SUHEP weir site at Tiloche is about 180 km<sup>2</sup> out of which only 4 km<sup>2</sup> lies below El. 3000 m. The catchment area at the SUHEP powerhouse site, Simbu, is about 190 km<sup>2</sup>. Annual precipitation is 1143 mm and monsoon (June – September) precipitation is 958.7 mm. The long term mean monthly flows in the project area at SUHEP weir site reveals a maximum of 42.49 m<sup>3</sup>/s in August and minimum 2.33 m<sup>3</sup>/s in February. 100 years design flood is 194 m<sup>3</sup>/s. The design flow is 11.07 m<sup>3</sup>/s.

The tail water of the upper scheme of cascade development named Sanjen (Upper) Hydroelectric Project SUHEP feeds in to the intake arrangement of lower scheme of cascade development, the SHEP. In addition, SHEP utilizes 0.5 m<sup>3</sup>/s flow from Chhupchung Khola. The catchment area of Chhupchung Khola at SHEP weir site is 24 km<sup>2</sup>. Annual precipitation is 1200 mm and monsoon (June – September) precipitation is 1000 mm. The long term mean monthly flows at Chhupchung weir site reveals a maximum of 6.26 m<sup>3</sup>/s in August and minimum 0.29 m<sup>3</sup>/s in April. 100 years design flood is 71 m<sup>3</sup>/s.

## **GEOLOGY**

The project area is situated in the Higher Himalaya and the Lesser Himalaya, Central Nepal separated by the Main Central Thrust (MCT).

### **Sanjen (Upper) Hydroelectric Project (SUHEP):**

Generally foliation is parallel to sedimentary lamination and bedding. General trend of bedding/foliation is 65° to 120° dipping 30° to 68° due northwest to northeast.

Diversion weir lies on the stable and relatively flat channel of the Sanjen Khola. It is characterized by about 3-4 m thick alluvial deposits consisting of predominately coarse gravel to boulder derived from gneiss, schist and quartzite in sand matrix with large boulders of augen gneiss. Desanding basin, peaking reservoir and forebay lie on a flat alluvial terrace consisting of a thick accumulation of alluvial deposit comprising of grey, sharp-textured, angular to sub-rounded, coarse-grained, well-graded sands, gravelly sands, little or no fines.

Common rock types on the tunnel alignment are feldspathic schist, augen gneiss, quartzite, phyllite, slate and chlorite-garnet-schist. Overburden ranges from 65m to 228m. Generally, rock belongs to fair to good according to RMR and Q values. RMR ranges between 58 and 61 and Q ranges between 4.71 and 26.26.

Surface mapping in the Surge Tank area reveals thin colluvial masses, i.e. less than 1 m thick on hill slope. Vertical overburden from the crown is 51 m. Attitude of joints is FP: 358°/50°, J1: 110°/81° and J2: 210°/52°. RQD, RMR and Q values are 56%, 60 and 4.71 respectively. Value of RMR and Q suggests fair rock. Penstock is partly underground and partly surface. Attitude of foliation is 100°/48° NE and that of joints is J1: 225°/70° and J2: 100°/80°. Powerhouse will be founded on the bed rock.

In-situ deformation modulus obtained along the tunnel ranges between 4.546 and 35.482. Vertical and horizontal stress as well as horizontal to vertical stress ratio along the tunnel ranges 0.123 – 0.958 MPa, 0.233 – 3.231 MPa and 0.880 – 4.090 MPa respectively. Unconfined compressive strength of rock along the tunnel ranges between 27.68 MPa and 136.54 MPa.

**Sanjen Hydroelectric Project (SHEP):**

Chhupchung weir lies in recent alluvial deposits consisting of predominately coarse gravel to boulder derived from gneiss, schist, quartzite and slate in sand matrix with large boulders of augen gneiss. Forebay/Intake of SHEP is in a gently sloping terrain consisting of about 25-30m thick deposits with angular gravel to boulder sized rock fragments of schist, quartzite and slate in loose soil sediments.

Common rocks along the headrace tunnel alignment are Psammitic schist with quartzite, white quartzite, graphitic schist with crenulated phyllite and slate, psammitic schist with crenulated phyllite and quartzite, green-grey quartzite and dolomitic marble. Generally, rock belongs to fair to good according to RMR and Q values. RMR ranges between 47 and 77 and Q ranges between 1.43 and 14.59.

Surface mapping reveals thin colluvial masses i.e. less than 1 m thick on downhill slope in surge tank area and rock cliff on its uphill section. Rock mass is grey, medium- to coarse-grained, unweathered to slightly weathered, thick-banded, medium strong psammitic schist with bands of white to grey, medium- to coarse-grained, medium- to thick-banded, very strong quartzite. Thickness of the quartzite band ranges from 5 to 10 m. Groundwater condition in the area is dry to damp.

Rock mass along the penstock is of mixed lithology consisting of grey, medium- to coarse-grained, unweathered to slightly weathered, medium- to thick-banded, medium strong to strong psammitic schist with quartzite. Bands of white to grey, medium- to coarse-grained, medium- to thick-banded, very strong quartzite with sericite-phyllite or schist partings is also common. Thickness of the quartzite bands range from 5 to 20 m.

The powerhouse site is proposed in a flat alluvial terrace. The switchyard is proposed in terrace deposits characterized by unconsolidated alluvium deposits.

In-situ deformation modulus obtained along the tunnel ranges between 3.88 and 29.10. Vertical and horizontal stress as well as horizontal to vertical stress ratio along the tunnel ranges 0.105–0.755 MPa, 0.045–12.17 MPa and 0.43–16.12 respectively. Unconfined compressive strength of rock along the tunnel ranges between 3.95 MPa and 272.81 MPa. Damage index along the tunnel ranges between 0.001 and 0.367.

**CONSTRUCTION SCHEDULE**

Prequalification of contractors for the construction of main civil works has been completed. List of prequalified contractors and the project/s can be found from the website [www.chilime.com.np](http://www.chilime.com.np). Main civil works of both projects have been planned to start from July 2012. The target completion dates of SUHEP and SHEP have been scheduled on July 2015 and December 2015 respectively.

**SANJEN (UPPER) HYDROELECTRIC PROJECT  
(14.8 MW)**

**SALIENT FEATURES**

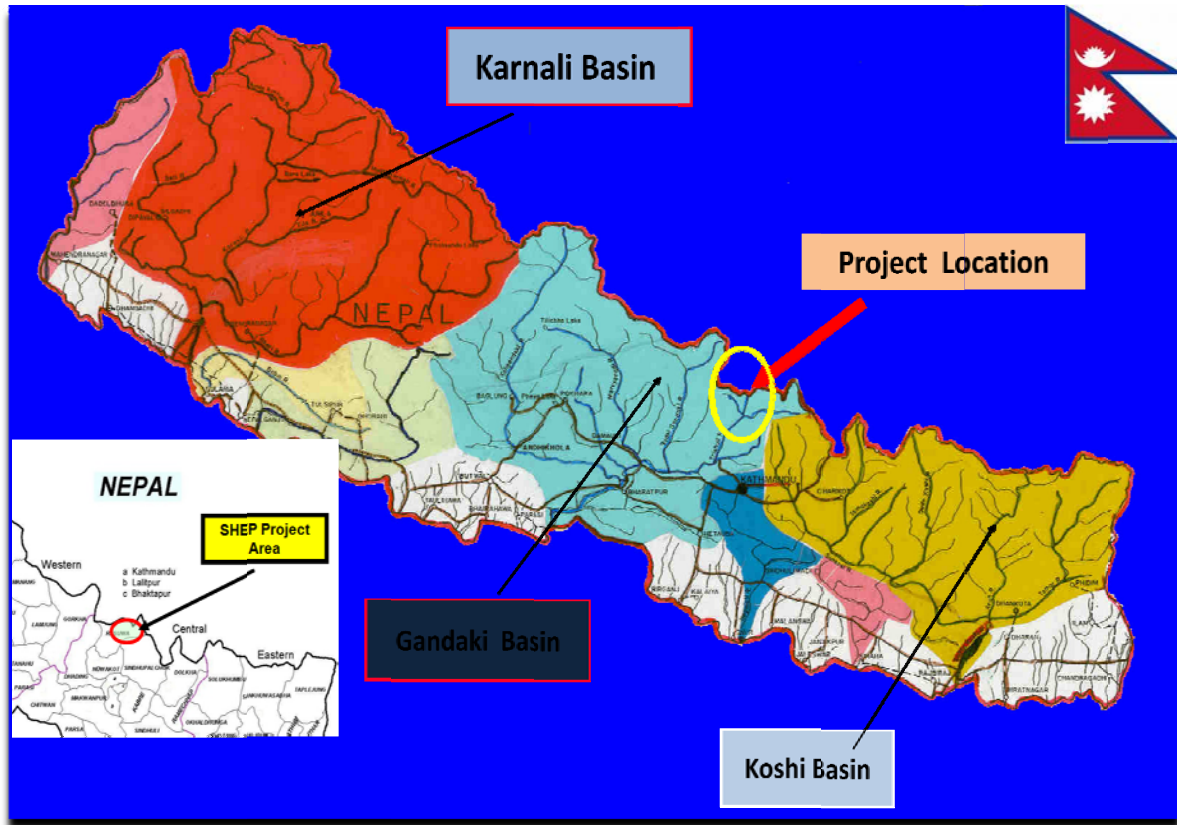
S. N.	Features	Description
1	<b>Location</b>	Chilime VDC of Rasuwa District
2	<b>Type of Project</b>	Peaking Run-Of-River
3	<b>Hydrology</b>	
	Catchment area (Weir axis)	180 km <sup>2</sup>
	90% dependable flow	2.45 m <sup>3</sup> /s
	Design flow (Q <sub>40</sub> )	11.07 m <sup>3</sup> /s
	Design flood (100 years)	194 m <sup>3</sup> /s
4	<b>Geology</b>	Medium Grade Metamorphosed Schist and Quartzite
5	<b>Head</b>	
	Gross	161.30 m
	Net	156.05 m
6	<b>Headworks</b>	
	Weir Type & Size	Overflow, 14.00 m (L) x 3.30 m (H)
	Undersluice Size	Single Bay, 3.00 m x 3.00 m
	Intake Type, Nos. & Size	Side Intake, 3 Nos., 4.70 m (W) x 1.30 m (H)
7	<b>Desanding Basin</b>	
	Type	Surface, Dufour Type, Double Chamber
	Size	75 m (L) x 8.5 m (W) x 5.5 m (H)
8	<b>Peaking Reservoir</b>	
	Live Storage	39746 m <sup>3</sup>
	Dead Storage	4702 m <sup>3</sup>
9	<b>Headrace Tunnel</b>	
	Length	1396.50m
	Size	3.50 m (W) x 3.75 m (H) (Excavation), D-shaped
10	<b>Surge Tank</b>	
	Type	Simple Cylindrical
	Size	40 m (H) x 6 m (Φ)
11	<b>Penstock</b>	
	Type	Mostly Exposed, partly underground
	Size	460 m (L), 1.6 ~ 2.5 m (Φ)
12	<b>Powerhouse</b>	
	Type	Surface
	Size	38 m (L) x 12 m (B) x 20.21 m (H)
13	<b>Tailrace</b>	5 m (L) x 2.5 m (B) x 5 m (H)
14	<b>Turbine</b>	
	Type, Orientation & Number	Francis, Horizontal Axis, 3 Nos.
	Unit Capacity	5.1 MW
15	<b>Generator</b>	
	Type & Number	3 Phase Synchronous AC, 3 Nos.
	Unit Capacity	5.85 MVA
16	<b>Installed Capacity</b>	14.8 MW
17	<b>Annual Energy Generation</b>	85.87 GWh
	Dry Energy	11.02 GWh
	Wet Energy	74.85 GWh
18	<b>Transmission Line</b>	
	Length/Voltage	5 km / 132 kV
19	<b>Main Access Road</b>	11 km

**SANJEN HYDROELECTRIC PROJECT  
(42.5 MW)**

**SALIENT FEATURES**

S. N.	Features	Description
1	<b>Location</b>	Chilime VDC of Rasuwa District
2	<b>Type of Project</b>	Cascade Run-Of-River
3	<b>Hydrology</b>	
	Catchment area (Weir axis)	180 km <sup>2</sup> at SUHEP Intake plus 24 km <sup>2</sup> at Chhupchung Intake
	Design flow (Q <sub>40</sub> )	11.57 m <sup>3</sup> /s
4	<b>Geology</b>	Medium Grade Metamorphosed Schist and Quartzite
5	<b>Head</b>	
	Gross	442.00 m
	Net	436.19 m
6	<b>Headworks</b>	
	Intake Basin (Forebay)	45.00 m (L) x 16.00 m (B) x 7.50 m (D)
	Intake Type	Off-take from Tail water of SUHEP
7	<b>Headrace Tunnel</b>	
	Length	3629 m
	Size	3.50 m (W) x 3.75 m (H) (Excavation), D-shaped
8	<b>Surge Tank</b>	
	Type	Simple Cylindrical
	Size	55 m (H) x 5.5 m (Φ)
	Size of Orifice	1.24 m (Φ)
9	<b>Penstock Shaft</b>	
	Type	Underground
	Size	1010 m (L), 1.8 ~ 2.5 m (Φ)
10	<b>Powerhouse</b>	
	Type	Surface
	Size	50 m (L) x 12 m (B) x 30 m (H)
11	<b>Tailrace</b>	123.8 m (L) x 2.7 m (B) x 2.7 m (H)
12	<b>Turbine</b>	
	Type, Orientation & Number	Pelton, Vertical Axis, 3 Nos.
	Unit Capacity	14.75 MW
13	<b>Generator</b>	
	Type & Number	3 Phase Synchronous AC, 3 Nos.
	Unit Capacity	16.84 MVA
14	<b>Installed Capacity</b>	42.5 MW
15	<b>Annual Energy Generation</b>	251.94 GWh
	Dry Energy	35.71 GWh
	Wet Energy	216.23 GWh
16	<b>Transmission Line</b>	
	Length/Voltage	1.2 km / 132 kV
17	<b>Main Access Road</b>	7 km

### LOCATION MAP



*Fig. 1 – Location Map*

LAYOUT PLAN

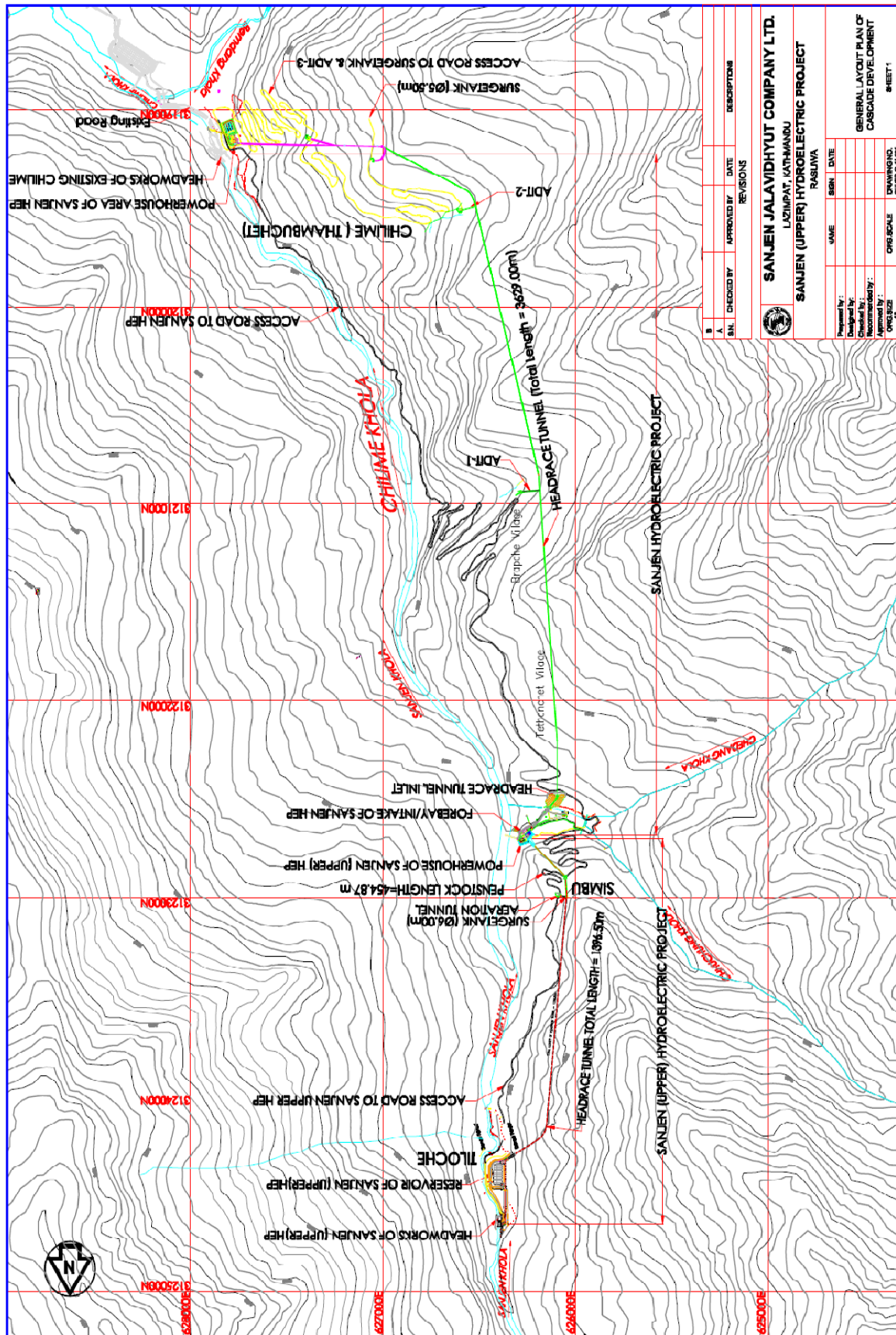


Fig.2 – Cascade Layout Plan