

## **SALIENT FEATURES**

### **OUTLINE OF THE PROJECT**

The Tamakoshi V HEP is located in Dolakha District of Bagmati Province. The project area is situated within Longitude 86°10'30" to 86°14'30" East and Latitude 27°45'00" to 27°49'50" North. The whole project area lies in Bigu and Gaurisankar Rural Municipality. The project is conceptualized to develop as a tandem operation project with Upper Tamakoshi HEP. The intake site / underground interconnection system with Upper Tamakoshi tailrace outlet is located in Gongar whereas the underground powerhouse lies at the right bank of Tamakoshi River just downstream of the Suri River confluence with Tamakoshi River.

In the following, relevant key data of the project have been compiled based on the results derived from the Detailed Project Design.

### **❖ PLANT OPERATING CONDITIONS**

#### **PLANT RATED CONDITIONS**

Rated Gross Head	174.00 m
Rated Net Head	159.10 m
Rated Tailwater Level	984.00 masl
Rated Discharge	66 m <sup>3</sup> /s
Rated Head Loss (d/s waterway)	0.80 m
Rated Capacity	94.80 MW
Installed Capacity	99.80 MW

#### **INSTALLED GENERATING EQUIPMENT**

No. of Units	4
Rated Discharge of Main Units	22m <sup>3</sup> /s
Rated Discharge of Small Hydro Unit	3.3m <sup>3</sup> /s
Total Turbine Capacity	99.8MW
Generator Capacity (Main Units)	38MVA
Generator Capacity (Small Hydro Unit, approx.)	6MVA
Transformer Capacity	2 x 40 / 1 x 44 MVA

### **❖ PROJECT HYDROLOGY**

Catchment Area at intake	2139 km <sup>2</sup>
Catchment area at PH	2460 km <sup>2</sup>

Average Annual Flow	69.51 m <sup>3</sup> /s
Design Flood at Headworks	6,000 m <sup>3</sup> /s
Design Flood at Power Station	6,000 m <sup>3</sup> /s

## ❖ HEADWORKS

### CONNECTING TUNNEL

• length	103.20 m
• width	6.80 m
• maximum depth	3.40m
• invert slope	0.1258 %
• invert elevation at start of horizontal bend	1,155.02 m asl.
• invert elevation at entrance to Headpond	1,154.89 m asl.

### HEADPOND

• length	74.01 m
• width	6.80 ~ 12.77 m
• water level at plant rated condition	1,158.00 m asl.
• maximum depth	14.00 m
• invert elevation at end wall	1,144.00 m asl.

## ❖ SPILLWAY

### SPILLWAY WEIR AND COLLECTING CHANNEL

• type	free overflow concrete
• length	55.50 m
• crest level	1,158.20 m asl.
• freeboard at plant rated condition	0.20 m
• maximum surcharge	0.90 m
• design discharge	103m <sup>3</sup> /s
• weir shape	WES standard

### SPILLWAY TUNNEL

• type	free surface flow
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•	length	311.50	m
•	channel width	4.40	m
•	channel depth	3.55	m
•	invert level at start section	1,153.11	m asl.
•	invert level at exit section	1,150.21	m asl.
•	channel cross section	rectangular	

#### **SPILLWAY TERMINAL STRUCTURE**

•	type	RCC gated box type	
•	length	31.51	m
•	width (box frame)	7.40	m
•	maximum height	11.35	m
•	invert level of apron	1,150.00	m asl.

#### **❖ ACCESS TUNNEL TO CONNECTING TUNNEL (ADIT 1)**

•	length	185.92	m
•	width	4.20	m
•	maximum invert slope	10.72	%
•	invert elevation at start of horizontal bend	1,169.18	m asl.
•	invert elevation at entrance to Headpond	1,154.89	m asl.

#### **❖ CONSTRUCTION ADIT TO SPILLWAY TUNNEL**

•	length	90.34	m
•	width	4.20	m
•	maximum invert slope	13.69	%
•	invert elevation at start of horizontal bend	1,163.25	m asl.
•	invert elevation at entrance to Headpond	1,152.90	m asl.

#### **❖ WATER CONVEYING TUNNELS & SURGE TANK**

##### **HEADRACE TUNNEL**

•	Total length of headace tunnel (HRT)	8098.0	m
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• Length of shotcrete lined section of HRT	1000.0	m
• length of concrete lined section	7,098.0	m
• inner diameter (concrete lining)	5.60	m
• thickness of concrete lining	0.40	m
• length of steel lined section (incl. valve)	41.90	m
• inner diameter (steel lining)	5.6 to 4.20	m
• longitudinal slope	0.4209	%
• center line elevation at start section	1,149.80	m asl.
• center line elevation at end section	1,114.96	m asl.

#### ❖ SURGE TANK

• type	surge tank-	circular
• top of concrete lining	1,180.00	m asl.
• surge tank bottom	1,129.40	m asl.
• highest upsurge	1,179.30	m asl.
• lowest downsurge	1,130.50	m asl.
• inner diameter	15.00	m asl.
• diameter of connecting shaft	2.50	m asl.

#### ❖ U/S VALVE CHAMBER

• length	20.00	m
• width	11.00	m
• height	16.90	m
• invert elevation	1,110.60	m asl.
• span between crane rails	9.60	m

#### ❖ PRESSURE SHAFT

• type	steel lined shaft	
• length including bends	152.72	m
• center line at start section	1,114.96	m asl.
• center line at end section	976.03	m asl.
• Inner diameter (steel lining)	4.20	m
• Steel Thickness	17 to 36	mm

•	excavation diameter	5.00	m
•	bend radii	12.60	m

#### ❖ HIGH PRESSURE TUNNEL & UPSTREAM MANIFOLDS

•	center line elevation at start section	976.03	m asl.
•	diameter at start section (steel lining)	4.20	m
•	center line elevation at end section (U1 - U3)	974.48	m asl.
•	center line elevation at end section (U4)	975.61	m asl.
•	diameter at end section (U1 - U3)	2.425	m
•	diameter at end section (U4)	0.95	m
•	deflection of manifolds	90 deg.	

#### ❖ DOWNSTREAM MANIFOLDS

•	length of manifolds	31.64 ... 36.09	m
•	manifold diameter	3.30 ... 5.60m	
•	longitudinal slope	1.1 %	
•	end section elevation	968.74	m asl.
•	deflection of branches	45 deg.	

#### ❖ TAILRACE TUNNEL

•	length	404.36	m
•	diameter	5.60	m
•	center line elevation at start section	971.90	m asl.
•	center line elevation at end section	976.80	m asl.
•	longitudinal slope	1.13	%
•	deflection of horizontal bend	45 deg.	

#### ❖ OUTLET STRUCTURE

##### GATE & ACCESS SHAFT

•	height above waterway liner	32.46	m
•	outer diameter	8.40	m
•	operation platform level	1,014.00	m asl.

- hoist floor level 1,003.00 m asl.
- rod storage floor level 998.00 m asl.
- shaft cross section circular

#### **OUTLET STRUCTURE TUNNEL**

- length of tunnel 53.00 m
- clear height 5.60 m
- clear width 4.40 ... 5.60m
- centerline elevation 976.80 m asl.
- tunnel cross section rectangular

#### **TAILBAY**

- average length of tailbay 27.28 m
- tailbay floor below tailrace tunnel invert -1.00 m
- slope of tailbay floor towards end sill 1 : 2.35
- end sill elevation 982.80 m asl.
- deflection of side walls 15 deg.

### **❖ POWER STATION**

#### **POWERHOUSE CAVERN**

- Dimension L x W x H 69.m x 18.m x 33.14 m
- Turbines 3 x 31.6 + 1 x 5 MW
- Installed Capacity 99.80 MW
- Over head Crane 80/15 t
- An Elevator serves the Auxiliary Floor, Turbine Floor, Generator Floor and the Machine Hall Floor.
- Two staircases are located diagonally at the opposite ends of the Powerhouse Cavern. The staircase adjacent to the MAT and the Erection Bay reaches down to the Drainage Gallery.
- The Erection Bay and the Main Access Tunnel are arranged at Machine Hall Floor level.
- The MAT passes through the Powerhouse Cavern and extends up to the Transformer Cavern.
- Two Dewatering / Pump Sumps, one between Units 1 and 2 and one between Units 2 and 3.
- A movement joint separates the Units Bay and the Erection Bay.

The floors in the Powerhouse Cavern are (from top to bottom)

- Crane Runway Floor 989.24 m asl.
- Administration Floor 985.64 m asl.
- Machine Hall Floor 982.19 m asl.
- Generator Floor 978.51 m asl.
- Turbine Floor 975.15 m asl.
- Valve Floor 971.25 m asl.
- Drainage Gallery 967.90 m asl.

#### ❖ TRANSFORMER CAVERN

- dimensions L x W x H 47.6 m x 13.0 m x 17.95 m.
- Bridge Crane 10 t bridge crane.
- The upper floor is accessible by two staircases at either end of the Transformer Cavern.

#### BUS DUCT GALLERIES

- 3 nos. provided between Powerhouse & Transformer Caverns
- Dimensions length x width x height 23.79 m x 3.00 x 4.00 m

#### TERMINAL & VENTILATION BUILDING

- Dimensions length x width x height 16.30 m x 15.40 x 15.00 m
- The cable shaft which connects vertically from the Terminal & Ventilation Building extends an additional 32.70 m to either of the two Take-off Yards.
- Three different floor levels were planned in the building.

#### OPERATION BUILDING

- Dimensions length x width x height 44.50 m x 14.00 x 9.6 m (including the Water Treatment Plant)

#### WORKSHOP BUILDING

- Dimensions length x width 28.32 m x 31.35 m
- Building Type RCC
- Crane Capacity 10 t crane

## **TURBINE**

- Type Francis
- Number 4 (3 x 31.6 + 1 x 5.1)
- Turbine Axis Level (Vertical Axis) 974.00 m asl.
- Smaller Unit Axis Level (Horizontal Axis) 976.60 m asl.
- Discharge per unit in big unit 22 m<sup>3</sup>/s
- Discharge Small Unit 3.3 m<sup>3</sup>/s
- Efficiency 94 %

## **GOVERNOR**

- Type PID type designed in accordance with latest IEC standard
- Adjustment for Speed Drop Power will be controlled at an accuracy of not less than 1%

## **GENERATOR**

- Type IM8425/W41
- Number 4 (3 x 38 + 1 x 6) MVA
- Power Factor 0.85
- Generation Voltage 11 KV
- Frequency 50 Hz
- Excitation Type Static Type
- Efficiency 98 %

## **TRANSFORMER**

- Type (outdoor) 3-phase, oil immersed,
- Rated Capacity 2x40MVA; 1x44 MVA
- Voltage Ratio 230/11 KV
- Vector Group YNd11
- Frequency 50 Hz
- Efficiency 99 %



## ❖ SERVICE TUNNELS

For expediency rock support analysis and design of the Service Tunnels were divided into Type A or Type B.

### MAIN ACCESS TUNNEL & ACCESS TUNNEL TO TRANSFORMER CAVERN (TYPE B)

- The Main Access Tunnel Section horseshoe section.
- dimension W xH 6.00 m x 6.00 m
- A concrete invert is foreseen for the MAT

### CABLE & VENTILATION TUNNEL (TYPE A)

- The Cable & Ventilation Tunnel Section horseshoe
- dimension width x height 4.20 m x 5.80 m.
- The entire length (consisting of three legs) 138 m.

### ESCAPE TUNNEL

- Escape Tunnel D-shaped
- section dimension width x height 2.50 m x 3.00 m.
- Total length 30 m.

### ACCESS TUNNEL TO U/S VALVE CHAMBER & ADIT 4 PLUG (ADIT 4 DURING CONSTRUCTION) (TYPE B)

- Dimensions width x height x length 5.00 m x 5.80 x 311 m.
- A gated plug will be installed at the Valve Chamber end.

### VENTILATION TUNNEL TO SURGE TANK (TYPE A)

- Dimensions width x height x length 4.20 m x 5.60 x 72 m.

### ACCESS TUNNEL TO HIGH PRESSURE TUNNEL (TYPE B)

- Dimensions width x height x length as for Main Access Tunnel

## ❖ ADITS TO HEADRACE TUNNEL

- Adit 2 (temporary) 513.43 m
- Adit 3 (temporary) 312.69 m

- Adit 4 (permanent) 311.69 m

#### ❖ TRANSMISSION LINES

- Voltage 220 kV, double circuit
- Total Length of LILO Arrangement 3.4 km
- Conductor Twin BISON

#### ❖ GENERATED ANNUAL ENERGY

##### ROLWALING NOT CONSIDERED

- Annual Energy 495.148 GWh
- Wet Energy 371.658 GWh
- Dry Energy 64.362 GWh
- Additional Energy 59.127 GWh

##### ROLWALING CONSIDERED

- Annual Energy 543.494 GWh
- Wet Energy 370.502 GWh
- Dry Energy 159.454 GWh
- Additional Energy 13.538 GWh

#### ❖ ESTIMATED PROJECT COSTS

Item No.	Description	Foreign USD	Local NPR	Total USD
1	Civil Works	38,041,071.58	3,901,346,236	70,552,290
2	Hydromechanical Equip-ment	2,464,317.92	295,718,150	4,928,636
3	Electro-Mechanical Equip-ment	22,666,077.00	302,214,360	25,184,530
4	Camp Works	-	325,824,703	2,715,206
5	Transmission Line	-	225,984,000	1,883,200
6	Owner's Costs	5,196,762.11	1,810,720,000	20,286,095
<b>Total Base Cost</b>				<b>125,549,957</b>

## ❖ FINANCIAL INDICATORS

### INDICATORS FOR BASE CASE ANALYSIS

• Interest during Construction (IDC)	10.0	%
• Project IRR	16.40	%
• Project NPV	4758.214	mil. NRs
• Benefit/Cost Ratio	1.26	
• Discounted Payback Period	7.46	yrs