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A Field Report
On
Sunkoshi Hydropower Plant

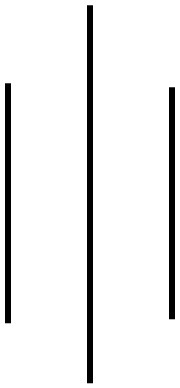

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TABLE OF CONTENTS

Contents	Page No.
Introduction	3
Objective	3
Salient features of Sunkoshi Hydropower Station	3
Components of Sunkoshi Hydropower Station	4
• Dam	4
• Intake	4
• Headrace Canal	4
• Settling Basin	5
• Spillway	5
• Peaking Pond	5
• Fore-bay	5
• Penstock	5
• Powerhouse	5
• Tailrace Canal	5
	6
Present Condition of Sunkoshi Hydropower Project	6
Photo Gallery	6
Conclusion	11

1. Introduction

This report is an outcome of one day field visit to Sunkoshi Hydropower Station located at 81 km East from Kathmandu in Sindhupalchowk district. With the friendly cooperation of Water Conservancy and Electric Power Ministry of the People's Republic of China and the Government of Nepal, the powerhouse was commissioned in 1972 in the month of January. The cost of the project was approximately NRs. 109.4 million including transmission line up to Kathmandu.

2. Objective

The field visit was organized with the following basic objectives:

- To know about the components of ROR hydropower project from intake to the powerhouse.
- To know how the components were laid and their working mechanism.
- To know about the threats to hydropower project.

3. Salient features of Sunkoshi Hydropower Station

Type	Run of River
Location	Sindhupalchowk
Installed capacity	10.05 MW
Design Discharge	39.9 m3/s
Maximum Net head	30.5 m
Length of Canal	2.653 km
Diameter of Penstock	2.54 m, 3 Nos.
Turbine Generator Set	3
Shaft Configuration	Vertical
Turbine	**Type:** Francis (Model: HL123a-LJ-140) **Output:** 3530 kW **Speed:** 300 rpm
Generator	**Type:** Synchronous, 3 phase (Model: TS 325/3620) **Capacity:** 4000 kVA **Rated Voltage:** 6.3 kV **Rated Current**: 361 A **Rated Power Factor:** 0.85
Transmission Line	66 kV, Single Circuit
Project Inception Date	End of 1968
Project Placed in Service	January 1972
Project Financed by	People's Republic of China and Government of Nepal
Project Cost	NRs. 109.37 million (including transmission line)

Source: http://www.nea.org.np/generation/index.php?page=powerhouse&pid=13

4. Components of Sunkoshi Hydropower Station

1. Dam
2. Intake
3. Headrace Canal
4. Settling basin
5. Spillway
6. Peaking pond
7. Fore-bay
8. Penstock
9. Power house
10. Tailrace canal

Dam

A dam can be defined as a barrier built across a stream or a river for the purpose of holding and controlling the flow of water for such uses as drinking water supplies, irrigation, flood control and hydropower generation etc. The dam increases the head, enough to divert the water towards intake.
The dam of Sunkoshi was for Hydropower Generation.
The dam of Sunkoshi consists of six radial gates as outlet gate with hoist for opening and closing of gates when required. Nearly about 10% water are passed towards the downstream of river as an environment flow.

> ***Radial gates*** are considered as the most common and economical type of gate for use.
> **Working:** It is operated by rotating around its hinge about the horizontal axis. Opening and closing of the gate is controlled at the hoist above it.
> When opened, the radial gate occupies less space than that of the vertical gate.
>
> ***Divide wall:*** The divide wall is provided to prevent cross current i.e. for one directional flow.
>
> ***Under sluice:*** Under sluice gates are provided to flush the sediments downstream of river.

Intake

Intake structures is a hydraulic structure constructed to withdraw required amount of discharge from river or reservoir for different engineering purposes.
Four Side intakes in Sunkoshi hydropower station were present. Trash rack has been provided at the entry to prevent the entrance of logs, floating bodies and other dead animals.

Headrace Canal

A canal is provided to convey the water from intake to fore-bay. A side canal has also been provided which comes into use during cleaning of settling basin. The length of canal is 2.653 Km.

Settling basin

The settling basin is one of the most efficient devices for hydropower schemes, constructed on the head race canal for removal of sediment load upto 0.2mm diameter particles from flowing water which cannot be trapped by the gravel trap.

The settling basin at Sunkoshi consists of enlarged section at entrance to reduce the velocity and hence the turbulence so that the bed load gets settled. The provision of baffle walls could be seen which facilitate the reduction of velocity.

> ***Flushing:*** The X-sectional area of the basin decreases when the sediment exceeds which result in the increase of the velocity. This phenomenon leads to decrease in trap efficiency. So flushing need to be done. Three flushing gates were provided with hoist for gate operation.

Spillway

The part of dam which discharges the excess water to the downstream side is known as spillway.

Overflow spillway of ogee shaped has been provided at downstream of settling basin to discharge the excess water. When water flows over the crest of spillway, it must always remain in contact with or slide over the surface of spillway. The spilled water is then mixed with the river through the channel.

Peaking Pond

Since the peaking pond is located just upstream of the fore-bay and is only used during the dry season, the annual sediment deposition rate in the peaking pond is low. The peaking pond of the Sunkoshi Hydropower Plant is utilized during the dry (winter) season when very low sediment concentration exists in the river. During the wet (monsoon) season, the inlet gates of the peaking ponds are closed to stop the access of sediment-loaded water.

Fore-bay

A fore-bay or head pond is a temporary water storage, regulating reservoir provided at downstream end of canal just at upstream of penstocks. When the turbine rejects the load the fore-bay acts as a storage reservoir whereas it supplies water as a sort of regulating reservoir when load increases.

Fore-bay has been provided just upstream of penstock in Sunkoshi Hydropower Station. A spillway has also been provided at side of forebay for the purpose of spilling the excess water. The water spilled is mixed into the river by dissipating its energy at stilling basin. For the purpose of flushing the sediments of fore-bay, flushing gates are also provided.

Penstock:

Penstock is a pipe which carries water under pressure from fore-bays to turbine installed in powerhouse. Three penstock pipes of 2.5m diameter and 76m length supported on saddle has been provided in Sunkoshi Hydropower Station.

Power house

Power house is a multi-storeyed structure consisting of power generating equipment like turbine, generator, switchboard, control room, etc. The net head is of 30.5m.

Three turbine-generator units are provided in Sunkoshi Hydropower Station. Water from 3 penstock pipes hit turbine. Francis turbine are used. Francis turbine is a reaction turbine which is

used for medium head hydropower project. In runner water enters radially and leaves axially so it is also called "*mixed flow turbine*". Major part of available water energy is converted into kinetic energy at the entrance to runner and a considerable remaining part is also utilized as pressure energy. Both kinetic and pressure energy are directly converted into mechanical energy by turbine runner before generating electrical energy. Control room is provided to manually control the power generation.

Tailrace canal
The function of tailrace canal is to discharge the water from powerhouse to river safely.

5. Present condition of Sunkoshi Hydropower Project

After Jure Landslide which occurred on 2nd August, 2014 the radial gates and dam of the Sunkoshi Hydropower Station has been damaged. The fall of tower connecting to the national grid, power generated is only supplied to the local and one out of three turbines have been shut down as the power generated cannot be supplied.

6. Photo Gallery

Fig: Dam showing radial gates with hoist and intake

Fig: Headrace canal and side canal

Fig: Settling basin showing baffle wall

Fig: Spillway

Fig: Fore-bay with spillway

Fig: Three penstock pipes

Fig: Transformers

Fig: Stilling Basin

Fig: Powerhouse

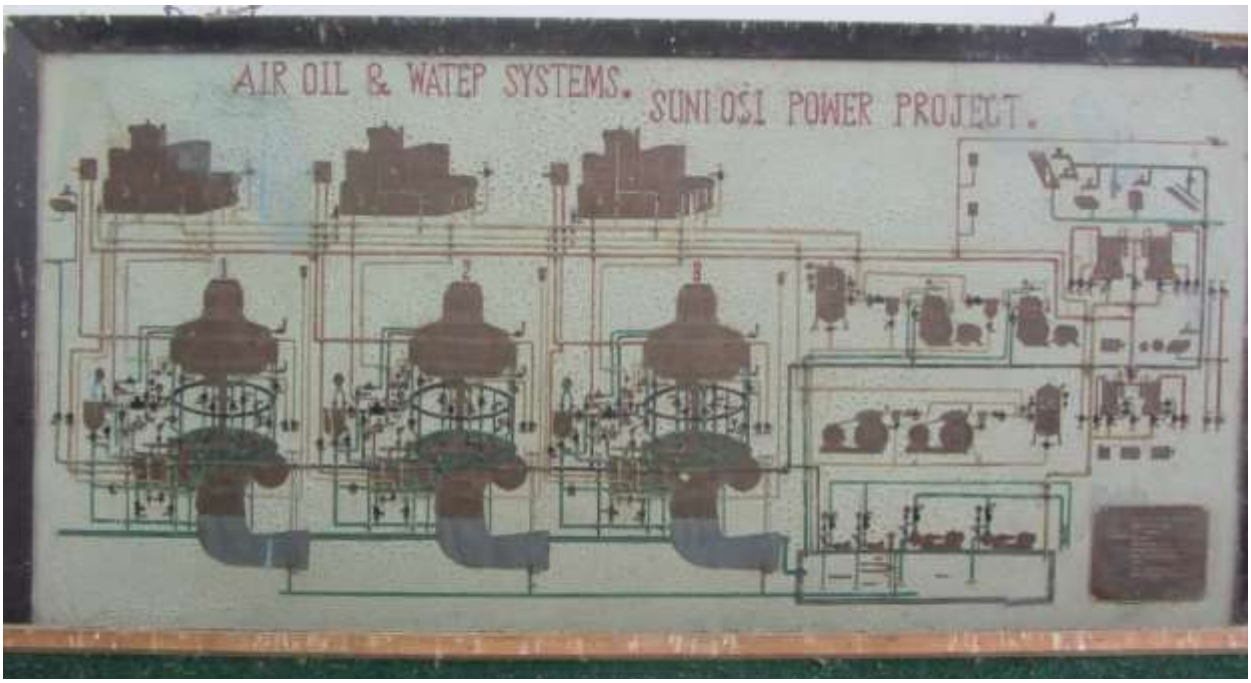

Fig: Air Oil and Water System

Fig: Shaft of Turbine

Conclusion

The one day field visit to Sunkoshi Hydropower Station helped to meet our objective. We knew about the headwork structures of ROR hydropower station, the way the components are placed and their working mechanism. We too observed the effects of Jure Landslide on the dam of Sunkoshi Hydropower. Appropriate land stabilization techniques need to be adopted to mitigate landslides that may occur in the near future. The damaged part of the dam should be repaired.