An Industrial Visit Report

# Ukai Hydropower Plant Visit Report

## 20th September, 2019

# 1. Introduction

The river Tapi is the second largest west flowing river in India. It has its origin at Mulati in Betul District of Madhya Pradesh. The river has a total length of 720 km out of which 208 km lies in the Madhya Pradesh, 323 km in the Maharashtra and 189 km in Gujarat. It ultimately meets the Arabian Sea approximately 19.2 km west of surat in Gujarat.

Ukai Project is the largest Multipurpose Project undertaken by the state and is only next to Narmada Project, so far as benefits are concerned. The Ukai Hydro Power Station is located at Ukai Dam on River Tapi in Tapi district of Surat.

There are four hydro turbine units, each of 75 MW with a total installed capacity of 300 MW. All the above units were made by BHEL. Commissioning dates of units 1 to 4 are: 8 July 1974, 13 December 1974, 22 April 1975 and 4 March 1976.

The Ukai Left Bank Canal (LBC) Hydro Power Station is located at Left Bank Cannel of Ukai Dam on Tapi River in Tapi District. There are two units of hydro turbine each of 2.5 MW with a total installed capacity of 5 MW. All the above units are of BHEL make. Commissioning dates of unit no. 1 and 2 are 08.12.1987 and 19.02.1988 respectively.

***The functions of the project are:***

1. Irrigation
2. Power Generation
3. Flood Protection
4. Fisheries Development

❖ **Facts About UKAI Dam**

I. UKAI Dam is constructed over Tapti River and located at 94 kilometers distance in Surat, Gujarat. This dam was intended with dual services, Irrigation of surrounding area in well manner as well as generation of hydroelectricity. This dam is also known as *Vallabh Sagar*.

II. Flood Control was another reason to construct this dam. Surrounding area of the river Tapi in Surat district had faced severe flood attacks in the past.

# 2. All about Ukai Dam

The **Ukai Dam**, constructed across the Tapi River, is the second largest reservoir in Gujarat after the Sardar Sarovar. It is also known as Vallabh Sagar. Constructed in 1972, the dam is meant for irrigation, power generation and flood control. Having a catchment area of about 62,255 $km^2$ and a water spread of about 52,000 hectares, its capacity is almost same as that of the Bhakra Nangal Dam. The site is located 94 km from Surat.

The storage capacity of Ukai dam is almost 46% of the total capacity of all the other existing dams in Gujarat if put together. Thus it can be concluded that the rest of the dams have as little as 0.1% average storage capacity. During the last 40 years, the actual irrigation potential is attained through all the major and medium water resources projects in the State, which comprises only 14 million hectares.

The dam is an **earth-cum-masonry dam**. Its **embankment** wall is **4,927 m long**. Its **earth dam** is **105.156 meters high**, whereas the **masonry dam** is **68.68 meters high**. The dam's left bank canal feeds water to an area of 1,522 $km^2$ and its right canal provides water to 2,275 $km^2$ of land.

A fort built by the Gaekwad dynasty of Baroda was submerged in the reservoir. It has been spotted when water levels in the reservoir went down.

## 2.1 SALIENT FEATURES

### DAM

| | | |
|---|---|---|
| Construction cost of DAM | 180.74 Cr | |
| Max. Dam Level | 1990-91 | 346.17 Feet |
| Min. Dam Level | 1979-80 | 268.30 Feet |

### MAIN HYDRO

| | | |
|---|---|---|
| Main Hydro Total Cost | 22.87 Cr | |
| Commissioning date of Main Hydro Units | | |
| Unit # 1 (75 MW) | 08-07-1974 | |
| Unit # 2 (75 MW) | 13-12-1974 | |
| Unit # 3 (75 MW) | 22-04-1975 | |
| Unit # 4 (75 MW) | 04-03-1976 | |
| Max. Generation (for Monsoon Year) | 1976-77 | 1261.217 Mus |
| Max. Generation (Monthly) | Sept-2013 | 221.267 Mus |
| Max. Generation (Daily) | 25-09-1998 | 7.689 Mus |

- Ukai hydro power station has been declared 3rd best performing station in India during 2006-2007 year and awarded Bronze shield for the same by Ministry of Power, New Delhi.

- Previous record of generation (210.100 Mus) is break in September 2013 by 221.267 Mus.

# 3. Ukai Hydro Power Station

**There are three basic stages of hydro power station to generate electricity.**

1. Spillway
2. Turbine
3. Generator

## 3.1 Spill Way

Specification of Spill Way is given below

| | | |
|---|---|---|
| 1 | Spill Way Channel | Length = 1524 Meter,<br>Width = 259 Meter<br>Depth = 18.29 Meter |
| 2 | Spill Way Gates | 1) Numbers = 22 nos<br>2) Types = Redial Gates.<br>3) Area = 15.545 m × 14.783 m.<br>4) Weight = 100 Tones Each. |
| 3 | Discharge Capacity | 49490 m3/sec.<br>Maximum=59920 m3/sec |
| 4 | Over all Crest Length | 425.195 m. |

## 3.2 TURBINE

Specification of turbine is given below

| | | |
|---|---|---|
| 1 | Type | Reaction Type, Kaplan, Vertical Shaft, Feathering propeller type. |
| 2 | Make | Bharat Heavy Electricals LTD. |
| 3 | Head | 1) 47.8 m (156.82 ft.) Rated Head.<br>2) 57.2 m (18.66 ft.) Max head.<br>3)34.4 m (112.86 ft.) Min head. |
| 4 | Output power | 1) 1,05,000 Metric HP<br>2) 1,20,750 Metric HP Max |
| 5 | Speed | 150 RPM (clockwise rotation) |
| 6 | Run away Speed | 1) 300 RPM with cam<br>2) 350 RPM Without Cam |

| | | |
|---|---|---|
| 7 | Water Discharge | 6000 cusec (101 m^3/sec) at 75 MW. |
| 8 | Nos. of guide Vanes | 24 nos. |
| 9 | Size of guide vanes | 6660 mm × 19.4 mm |
| 10 | Main shaft dia. | 900 mm |
| 11 | Runner hub dia. | 3160mm |
| 12 | Runner blades | 6 nos. Each having Weight of 5 tones & design to withstand 1700 tones hydraulic. |
| 13 | Spiral inlet dia. | 6500 mm |
| 14 | Largest transport item of turbine | Inner top cover half size 6.1m × 3.5m × 3.0m |
| 15 | Efficiency | 98 % at the full water level. |
| 16 | Weight of turbine with shaft And runner disc | 140 MT |
| 17 | Bearing | Turbine guide bearing 1 no having 8 nos. pads. |

## 3.3 Generator:

Specification of generator is given below

| | | |
|---|---|---|
| 1 | Nos. of Generator | 4 Nos |
| 2 | Sr. no. of Generator | 3000107, 3000108, 3000109, 3000110 respectively |
| 3 | Type | G25 Vertical Umbrella Type Salient Pole<br>Rated 83333 KVA, 0.9 p.f., 11KV (± 5%)<br>3 phase, 4370 AMPS.<br>Rated KVAR 56000 at Zero leading P.F. |
| 4 | Make | Bharat Heavy Electrical Ltd. |
| 5 | Stator Windings: Slots | 384, winding coils 384 |
| Joint 1) Series joint | | 264 |

| | |
|---|---|
| 2) Pole to pole joint | 108 |
| 3) Bus Bar joints | 12 |

- Stator resistance per phase at 200=0.003415 ohm.
- Field resistance at 200 C=0.15 ohm.
- Rotor excitation at no load & 100% voltage= 608 amp.
- Rotor excitation at rated output & voltage = 1052 Amp.
- Excitation voltage = 180 v.

| | | |
|---|---|---|
| 6 | Speed | 150 RPM |
| 7 | Overall dia. | 4127.5 ×2 =8255.0 mm |
| 8 | Heaviest package for shipment | |

- Thrust bearing housing size 04.34m long × 4.12 m width × 2.6 m high having weight 55 tones.

| | | |
|---|---|---|
| 9 | Weight of generator side | 275 MT |
| 10 | Heaviest assembly to be lifted by crane weighting 220 tones. | |
| 11 | Bearing | 1 no – thrust bearing having 12 pads.<br>1 no – Generator guide bearing having 24 pads. |

# 4. Activities

The aim of Ukai Visit was to introduce students with practical approach of plant handling. With this aim, Electrical Engineering Department of Sarvajanik College of Engineering and Technology (SCET), had organized an industrial visit to Ukai Hydropower Plant, Ukai on 20th Sep 2019. In total 48 students from 5th Semester, Electrical Engineering-M Department with 3 faculties visited the plant.

The purpose of this Industrial visit was to provide an excellent opportunity to all the students & faculties, to interact and know more about industrial environment. The intention was to help the students to create a practical perspective on the World of Engineering.

The bus departed for Ukai at 7:30 AM from SCET premises. It arrived at Ukai at around 10:15AM with one stoppage (for breakfast). We took entry in Power Plant at 10:30 AM. In the visit, authorities greeted us on the Gate-Pass section. We all moved to the main site of the plant. After that, we moved to the Control Department of hydro power plant. Then, one of the engineers from the plant explained the working of Hydro power plant with the help of Schematic Diagram of the plant. Also we are thankful to him for assisting us and clearing all the doubts and queries regarding Hydropower Plant.

**Control System Department at Ukai Hydro Power Station, Ukai**

Chief Control Engineer explained all the component of control room. They give brief information regarding monitoring and controlling. All the control of the whole generation system was controlled from the control room containing different control switches and digital panels. Later they discussed about the various activities in plant and in nearby area.

Then we were introduced with Hydro turbine section where we studied the generation of power with the help of turbine, generator and coupling. There are 4 units of hydro turbine each of 75MW with a total installed capacity of 300MW. All the above units were engineered and manufactured by BHEL.

One of the engineers had given overview of the working of the Hydro Turbine, Generator and the other units. The water from the dam was passed from turbines to generate the electricity, which was then generated by the generator. This way, the complete information regarding each and every section of the plant was given by the allotted engineers and they also briefly explained regarding how this power generation was actually taking place.

**Switch Yard & Distribution System at Ukai Hydro Power Station**

We had observed the whole grid system containing generators, transformers, and switch gear. This way we concluded the visit by showing appreciation to all the engineers and the authorities of Ukai Hydropower Plant.

On the way back to college, we praised the scenic beauty of Ukai and captured some photographs. Also we had lunch at “Hotel Ashirwad” before departure.

# 5. Glimpse of Visit

# THE END