S. B. PATIL COLLEGE OF ENGINEERING,

INDAPUR

Visit Report

On

Almatti Hdro Power Plant, Karnataka

(Date of Visit: 21/03/2018)

ACKNOWLEDGEMENT

We all express our sincere thanks to our teacher **Mr. U. S. Gawande, Mr. S. M. Kale, Mr. P. R. Admile** sir and **Miss P. P. Kumbhare** madam for guiding us right from the inception till the successful completion of the **ALMATTI HYDRO POWER PLANT, KARNATAKA** visit. We sincerely acknowledge our faculty for extending their valuable guidance and support during our visit and they provided all moral support to us with all stages at the time of visit.

We would also like to thank our HOD **Prof N. T. Suryawanshi** and Principal, **Dr P. D. Nemade** Sir for giving us permission for the visit.

Last but not least, we are greatly thankful to the management of our SBPCOE, Indapur.

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1. GENERAL

Electric power is the most vital input for industry and agriculture. With the rising trend of oil prices and the need to conserve fossil fuel resources for future use, exploitation of hydro electric energy, which is a renewable and pollution free source of energy, has become increasingly important. Developed countries have all along given top priority to harnessing hydro power. In India, only 15 percent of potential for hydropower has been harnessed so far.

Krishna (Almatti) – Pennar link canal proposes to divert a part of the water that becomes available by way of successive replacement principle for the benefit of drought prone area of Anantapur district of Andhra Pradesh in Upper Pennar sub-basin and Raichur and Bellary districts of Karnataka State in Krishna basin.

2. BRIEF HISTORY

Upper Krishna Project is a major irrigation project in Karnataka, designed to provide irrigation facility to Bijapur, Bagalkot, Gulbarga & Raichur districts. Almatti Dam is the major storage reservoir of this irrigation project. The dam has been completed including erection of crest gates to store water up to 519.60 M by the Krishna Bhagya Jala Nigam Limited. The maximum height of the dam is 48 M and length is 1565 M.

290 MW Almatti Dam Power House has been constructed at the toe of Almatti Dam on the right bank by Karnataka Power Corporation Limited, the fast track power generation specialist company. As against the estimated cost of Rs. 1470 Crores, indicated by an Independent power producer, KPCL had offered to execute the same in Rs. 674 Crores & hence the Government of Karnataka entrusted KPCL to take up the challenge of implementing it in a cost effective manner. KPCL executed this project at 525 Crores with a saving of 149 Lakhs.

ADPH project was flagged off on 15.03.2002. The first Generating unit of 15 MW Capacity was commissioned on 26.03.2004 i.e. in 24 months' time, which is a new bench mark in the country. The project was completed on 10.08.2005, when 6th generating unit was commissioned attaining the installed capacity of 290 MW. Since then, during every year, the generation targets have been exceeded in ADPH. As on March - 2012, the total power generation at ADPH has crossed 4050 MUs since inception.

3. AWARDS:

ADPH bagged gold medal award for early commissioning of Unit- 3 and 6 for the year 2004-05 & 2005 -06 by Government of India

4. BASIC PRINCIPLE

In hydroelectric power plants the potential energy of water due to its high location is converted into electrical energy. The total power generation capacity of the hydroelectric power plants depends on the head of water and volume of water flowing towards the water turbine.

The hydroelectric power plant, also called as Dam or Hydropower plant, is used for generation of electricity from water on large scale basis. The dam is built across the large river that has sufficient quantity of water throughout the river. In certain cases where the river is very large, more than one dam can built across the river at different locations.

The water flowing in the river possesses two type of energy: The Kinetic energy due to flow of water and The Potential energy due to the height of water. In hydroelectric power and potential energy of water is utilized to generate electricity.

The formula for total power that can be generated from water in hydroelectric power plant due to its height is given,

$$P = g \times Q \times h$$

Where, P = Total power that can be produced in Watts.

Q = Flow rate of water measured in Cubic meters per second.

h = It is difference in height between the source of water (from where water is taken) and the water's outflow (where the water is used to generate electricity, it is the place near the turbines).

g = Gravity Constant = 9.81 meter per second sq.

The formula clearly shows that the total power that can be generated from the hydroelectric power plants depends on two major factors, the flow rate of water or volume of flow of water and height or head of water. More the volume of water and more the head of water more is the power produced in the hydroelectric power

plant. To obtain the high head of water the reservoir of water should as high as possible and power generation unit should be as low as possible. The maximum height of reservoir of water is fixed by natural factors like the height of river bed, the amount of water and other environmental factors.

5. POWER GENERATION AT ALMATTI DAM

There will be regulated release of water from Almatti dam to be picked up downstream at Narayanpur dam for diversion into the left bank canal. It has been found feasible to generate hydroelectric power at the foot of Almatti dam by making use of the regulated releases. The Karnataka Power Corporation Limited (KPCL) has proposed to install five generating units of 55 MW each and one unit of 15 MW. The total installed capacity of the Almatti dam powerhouse will be 290 MW. Penstocks have been embedded in the body of the dam and the powerhouse is proposed to be located on the right flank of the dam. To facilitate power generation during monsoon months it has been proposed to maintain the water level at 519.6 m (FRL).

6. EFFECT OF INTER-BASIN WATER TRANSFER ON THE POWER GENERATION AT ALMATTI DAM

The Krishna (Almatti) – Pennar link canal is a component of Mahanadi – Godavari – Krishna – Pennar – Cauvery – Vaigai interlinking proposals. The Almatti project as planned by the Government of Karnataka is an independent scheme envisaging power generation as detailed above. However the interlinking of the river basins as proposed by NWDA envisages transfer of water from Manibhadra on Mahanadi to Dowlaiswaram on Godavari, thereby releasing water upstream of Dowlaiswaram for possible diversion to Krishna and beyond. Major links from Godavari to Krishna are the Inchampalli – Nagarjunasagar, Inchampalli – Pulichintala and Polavaram – Vijayawada (Prakasam 2 Barrage) links. The Nagarjunasagar, Pulichintala and Prakasam Barrage are situated downstream of Almatti dam. The diversion from Almatti dam is considered as in exchange of Godavari waters received down streams from the above links. With the introduction of link canal the reduction in power generation is about 85.5 MU only. This reduction in power generation can be eliminated by further raising the FRL of Almatti reservoir as envisaged in the Upper Krishna Project.

7. INSTALLED CAPACITY

The link canal is proposed to be operated for 6 months i.e., from June to November. The withdrawal pattern of link canal varies from peak demand of 230 cumec during August to lean demand of 30 cumec during June. The Almatti reservoir simulation study reveals that the reservoir level fluctuates from 519.60 m to 514.49 m during June to November. An approach channel of length 700 m and a tunnel of 1.125 km long is proposed to off-take from foreshore of the Almatti reservoir to facilitate crossing the ridge on the rim of reservoir. At the exit of the tunnel a fore bay is proposed with intake arrangement for penstocks for powerhouse and bypass provision for canal operation during emergency periods.

The gross head available at the exit of tunnel varies from 11.23 m to 5.61 m. For design of the tunnel, the economical diameter of tunnel has been worked out based on equivalent discharge and revenue loss in power generation. The equivalent discharge of tunnel was found to be 170 cumec with 9.0 m dia in size.

The average monthly power potential for the period from 1955 to 1983 considering the head losses at tunnel and penstocks with overall plant efficiency of 88% has been worked out and found to be 15.9 MW in August and 2.0 MW in June. The optimum installed capacity of the powerhouse was fixed based on various installed capacities and their power generation. The optimum installed capacity was chosen as the installed capacity at which maximum power is generated and beyond which there is no appreciable increase in power generation due to additional increase in capacity. It was found that 14.0 MW installed capacity as the optimal one and based on this, 3 units of 4.50 MW each have been proposed. Since the powerhouse will operate for 6 months, no standby units are proposed. The power generation with the 13.5 MW installed capacity including 10% overloads due to excess water available is estimated as 42.5 MU.

8. POWER HOUSE

Brief description of the intake structure, machine hall and draft tube is given below:

8.1 Intake Structure

A reinforced concrete intake structure consisting of 6 vents of 2.0 m width and 5.0 m height is provided at the end of the intake fore bay to feed 3 turbines with 2 vents for each turbine. The flow level of intake structure is kept at 504.0 m. A bell mouth is provided at the entry of the intake barrel to obtain a smooth flow into the turbine. Each vent is fitted with gates to control the flow. Three trash racks of 24 m width and 7.85 m height are provided upstream of the bell mouth for each intake barrel to prevent debris entering the turbine. A transition is provided from the

downstream face of the intake gate groove from a rectangular section to a circular section to act as penstock. A RCC slab is provided over the intake structure to serve as a platform.

8.2 Machine Hall

The Machine hall of powerhouse is a reinforced concrete framed structure of 61.20 m long and 20.50 m width and is designed to house 3 units of 4.5 MW each. On the right side, an unloading bay and servicebay are provided to receive the mechanical and electrical equipment for installation in the powerhouse. An overhead EOT crane with facility of its movement in both directions to unload and erect equipment is provided.

Control room is provided adjoining the unloading and service bay to install the control panels required for operation of the generating units. The individual transformer for each turbine is proposed to be kept outside the powerhouse over the draft tube. The gearboxes and generator are erected on floor at 505.0 m elevation.

8.3 Draft Tube Structure and Tail Race Pool

Single pier draft tube structure with individual gate is provided immediately downstream of powerhouse building for each turbine unit. The width and height of the draft tube vent is 5.66 m x 3.78 m. The platform with hoist supporting structure is also provided over the draft tube vents to facilitate operation of draft tube gates. A tail race is provided immediately downstream side of draft tube which consist of a RCC floor with reverse slope of 4 H : 1 V and warped wing walls built in concrete.

8.4 Water Conductor System

It consists of : (i) Approach channel from Almatti reservoir; (ii) Tunnel; and (iii) Fore bay with by pass arrangement.

8.10 Approach Channel

The approach channel off-takes from the fore shore of Almatti dam is 700 m long and 32.0 m wide in bed and trapezoidal in cross sections. The bed level of approach channel is fixed at 505.5 m against the MDDL of reservoir of 506.8 m to facilitate drawl of water up to MDDL level. A transition of 1:3 at the end of approach channel is provided to connect the tunnel. The approach channel is proposed to be lined in cement concrete.

8.11 Tunnel

The tunnel is 1.125 km long and 9.0 m in dia and proposed to be concrete lined. A rectangular passage of 60 m in width and 7.0 m in height with bell mouth at tunnel entry is also proposed. Gate grooves at rectangular passage with erection platform also provided to facilitate the operation of gates at the entry of tunnel. A transition from the downstream face of the groove is provided from rectangular section to circular section. The tunnel is proposed to have a slope of 1: 4400.

8.12 Fore bay

The fore bay is 12.0 m long and 63.0 m wide. A bypass arrangement is provided on left flank to facilitate the release of water in emergency cases and during non-operation of powerhouses. The floor and top of level of the fore bay is fixed at 504.0 m and 521.0 m respectively with provision to raise the height up to 524.256 m level. A transition wing wall of 1:3 is provided to connect the tunnel exit and fore bay.

It is proposed to have on orifice opening, with slide gates and operation platform in bypass, 4 vents with vent size of 2.75 m horizontal and 2.10 m vertical is provided. The elevation of crest at opening is kept at 505.0 m to enable to pass peak discharge. The energy dissipater with chute blocks, basin blocks and dented sill blocks are also provided at the downstream of the by pass channel. The energy dissipater consists of depressed floor up to 500.30 m level for a length of 41.4 m and thereafter at 504.75 m, rose by vertical transition of 3 H and 1 V from the downstream of dented sill. The energy dissipater is connected with main canal just downstream of tailrace pool with smooth transitions. The top of the sidewalls is staggered from 521.0 m to 512.0 m level.

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ALMATTI DAM POWER HOUSE

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AWARDS:

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ALMATTI DAM POWER HOUSE

FINANCIAL DETAILS

A) Estimated Cost :-

1) Total Estimated cost of the Project =	**Rs. 674. 38 crore**

B) Amount Spent as on 31.12.2006 :-

1) Electro Mechanical Works : -	**Rs. 312.58 crore**
2) Civil Works including station Building & Penstocks: -	**Rs. 155.52 crore**
3) a) Hydro Mechanical Works :-	**Rs. 10.00 crore**
b) Extended Draft Tube portion & other works : -	**Rs. 45.22 crore**
C) 1) Estimated Cost per MW	**Rs. 2.325 crore**
2) Actual Cost per MW	**Rs. 1.77 crore**
D) 1) Estimated Tariff of Generation	**Rs. 2.00 per Kwh**
2) Actual Tariff of Generation	**Rs. 1.7983 per Kwh**

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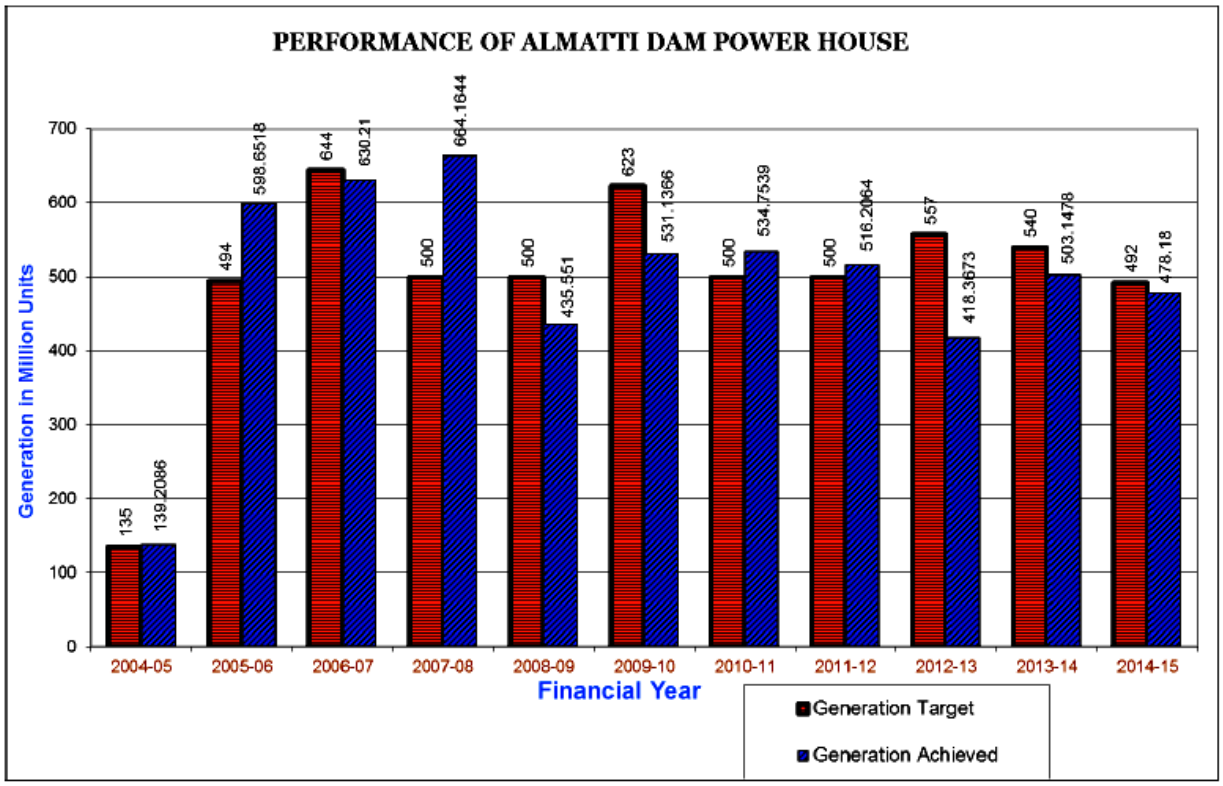
ALMATTI DAM POWER HOUSE

Unit No.	Capacity	Date of Commissioning
1	15 MW	26.03.2004
2	55 MW	04.11.2004
3	55 MW	13.01.2005
4	55 MW	26.03.2005
5	55 MW	06.07.2005
6	55 MW	10.08.2005

PERFORMANCE OF ALMATTI DAM POWER HOUSE



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ALMATTI DAM POWER HOUSE

DETAILS OF ENERGY GENERATION AT ADPH:

Financial Year	Target	Achieved Generation
2003 – 04	Nil	000.4676 MU
2004 – 05	135 MU	139.2086 MU
2005 – 06	494 MU	598.6518 MU
2006 – 07	644 MU	630.2164 MU
2007 – 08	450 MU	664.1644 MU
2008 – 09	500 MU	435.5510 MU
2009 – 10	623 MU	531.1366 MU
2010 – 11	500 MU	534.7539 MU
2011 – 12	500 MU	516.2064 MU
2012 – 13	557 MU	418.3673 MU
2013 – 14	540 MU	503.1478 MU
2014 – 15	492 MU	478.1800 MU

Total Generation since commissioning: 5449.9790 MU

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ALMATTI DAM POWER HOUSE

Salient Features of Almatti Dam Power House

Sl No.	Particulars	Details
1.	Location	Right Bank of Almatti Dam, Sitimani, Bagalkot Dist., Karnataka State
2.	Installed Capacity	290 MW (1 x 15 MW + 5 x 55 MW)

	Turbines		Generators		
Capacity	15 MW Unit	55 MW Unit		15 MW Unit	55 MW Unit
Type	Vertical Kaplan	Vertical Kaplan	Generator MVA (Rated)	16.67	61.11
No. of Units	1	5	Power factor	0.9 lag	0.9 lag
Rated Net Head	24.09 m	26.60 m	Type of Winding	Coil – Lap	Bar - wave
Discharge at rated Capacity in Cumecs.	80.16	252.48	Diameter of Stator bore	5000 mm	7800 mm
Efficiency at rated head at rated output	94.65%	94.85%	Diameter of rotor	4965 mm	7770 mm
Maximum Penstock Diameter	4.48 m	7.80 m	Rotating Mass in MT	107	370
Length of Penstock	86.55 m	86.37 m	Type of Barrel	Steel	Steel
RPM	187.5	115.4			

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ALMATTI DAM POWER HOUSE

Salient Features of Almatti Dam Power House

Outdoor Yard		Other Details		
Arrangement	Double Bus System	Length of Powerhouse	142.00 m (1x 19 m + 5 x 25 m)	
No. of Bays	13 bays (6 units + 2 PT's + 4 Lines+1 BC)	Width of Powerhouse	24 m	
No. of Lines	4 Nos. 220 KV Lines Bagalkot Line – 1 Bagalkot Line – 2 B. Bagewadi Line – 1 B. Bagewadi Line – 2	Length of Repair bay	56 m	
		FRL	EL 519.60 m	
		MDDL	EL 505.97 m (15 MW Unit)	EL 511.16 m (55 MW Unit)
Type of Bus	Rigid for Unit bays Conventional for line bays	Tail Water Level (Min / Max)	EL 489.05 / 492.25 m	

Zero Date	08.03.2002	Date of Completion	10.08.2005
Cost per MW	Rs. 1.77 Crores	Tariff:	Rs. 1.7983 per Kwh w.e.f 01.04.2014

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ALMATTI DAM POWER HOUSE

Salient Features of Hydro Mechanical Works

Penstock Service Gates :-

(i) Penstock Service Gates – 6 Nos.
a) 5 Nos. for Clear vent size :- 6.424 x 10.346 M (for Unit- 2 to 6)
b) 1 No. for Clear Vent size :- 3.653 x 5.861 M (for Unit-1)

Penstock Stop log Gates :-

(I) Two sets of penstock stop log gates
a) One set for Clear vent size :- 6.424 x 17.25 M (for Unit- 2 to 6)
b) One set for Clear vent size :- 3.653 x 10.346 M (for Unit- 1)

Draft Tube Gates :-

a) Draft tube gates (Two nos.) for clear vent size of 4.515 x 3.786 M for Unit -1
b) Draft tube Gates 3 Nos. for each Unit. Total Fifteen Nos. for Unit 2 to 6 with clear vent size of 5.234 x 5.625 M.

Hydraulic Hoist :-

a) 100 T cap. Hydraulic Hoists for operating Penstock service gates of Unit 2 to 6
b) 50 T cap. Hydraulic Hoist for operating Penstock service gates of Unit 1

Trash Rack Panels :-

a) Seven number of trash rack vents have been provided f or Units – 2 to 6 panels/vent. The clear vent size is 3.467 x 3.45 M
b) Five numbers of trash rack vents have been provided for Unit-1 with 4 panels/ vent. The clear vent size is 2.73 x 3.32 M

Gantry Crane :-

a) Gantry crane of 60 T cap. To operate penstock service gate and penstock stop log gates of unit – 1 to 6
b) Gantry Crane of 30 T cap. To operate draft tube gates of unit 1 to 6


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