Case Study

Kabini Mini-Hydel Power Plant

Subhash Kabini Power Corporation Limited

(100% owned by Subhash Projects & Marketing Limited)

SPML

Engineering Life

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Location: The Picturesque' Banks of River Kabini

Once a private hunting spot for the Maharajas of Mysore, Kabini, was a popular shikar hotspot for British Viceroys and Indian royalty. The backwaters of the Kabini River, in Karnataka, 205 km from Bangalore, is considered to be one of the best wildlife sanctuaries in Karnataka, famous for its spectacular wildlife and bird life.

The river Kabini is one of the major tributaries of the River Cauvery, with considerable water potential. A Dam across the river Kabini has been constructed mainly for irrigation. The irrigation scheme consists of a 28.80m high composite dam across the river Kabini, near Bidarahalli and Beechanahalli villages in Heggadevana Kote Taluk, Mysore district, Karnataka State with a gross capacity of 552.7M cum.

Opportunity for Hydro-Power Generation

Current Power Scenario in the country: Only about 40% of the country's households have access to electricity; more than 70,000 villages yet to be electrified; per capita consumption of electricity is one of the lowest; the already huge population base is expected to reach 1.6 Billion by 2050. The current installed capacity in India is 1,50,000 MW; as per the 11th Five year, the plan for enhancement is 2,75,000 MW and for sustaining the nation's energy demand by 2030, the augmentation is expected to be 8,00,000 MW capacity.

In Karnataka, though power availability has increased by over 5,400 MW since 1980, the deficit in peak hour demand and annual energy requirements has been almost continuous. The load forecast for the state till year 2016 indicates that it is a modest increase of about 7% annually. If all the additional peak demand (MW) were to be met by state's own generation, installed capacity of the state has to be doubled.

Therefore, Karnataka, which is blessed with natural water resources in abundance seemed to a perfect location to develop an environmental friendly energy plant. Kabini River, in Karnataka, provided the right opportunity to develop a mini-hydel power plant in close partnership with the Government of Karnataka.

Overview: Kabini Mini-Hydel –Electric project

Project Promoter: Subhash Kabini Power Corporation Limited
Equity stake: SPML Group- 100%
Project Location: Beechanahalli Village, HD Kote Taluk, Mysore District, Karnataka
River: Kabini
The company lead the activity of constructing a Hydro power project on BOOT basis with an installed capacity of 20 MW at the toe of the existing Kabini Dam at HD Kote in the Mysore District of Karnataka State and successfully commissioned the project on 23.6.2003. Since commissioning, the project is generating the power and pumping the same to the national grid.

Project Features:

The Kabini Hydro Electric Project contemplated to utilise the head available at dam site and the surplus water in the river during monsoon after meeting the irrigation requirement at the site for power generation, by constructing a dam site powerhouse at the toe of the Kabini Dam. Surplus water varying from 50 cumecs to 150 cumecs, for the machines through penstock and head varying from a minimum of 13.38 m to a maximum of 21.94 m are available over the year. Power scheme was developed by extending the existing single penstock of 5486 mm dia, constructing a surface power house, a Tail race channel and an outdoor switchyard to generate and transmit the electrical power through the Karnataka State Electricity Board Grid. Two units of 10 MW each were installed. The annual energy generation is 52.8 Gwhrs on 90% dependable year.

The construction activities carried out in the project classified into following six major areas:

- Intake Structure
- Water Conducting System (Penstock)
- Power House
- Tail Race Channel
- Switchyard
- Transmission Line


Turbine Rot Assembly


Control Room


Generator


Intake Gate

Challenges during Project Development:

During the execution stages of the project several unforeseen challenges emerged, however, the resolve and determination of the team ensured that the project went ahead in full pace:

a) Emergence of Hard-rock on the strata:
As per the geological investigations the excavation of hard rock envisaged was at a depth of 17 meters below the surface profile and the quantity was approx., 5000 CUM, however, to the greatest surprise, during execution, the team realized that the hard-rock strata started at just below 7 meters from the surface profile. This necessitated the team to take up planned controlled blasting keeping in mind the proximity to the existing dam and other irrigation structures. Also the quantity of Hard-rock excavation done went up to 18,000 CuM against the envisaged 5,000 CuM, during the Geological investigations.

b) Unprecedented – unpredicted earth collapse:
While the excavation activity for the power house construction was reaching completion, and reinforcement concreting was in progress, owing to the heavy unprecedented rains the entire earth in the project location collapsed, thereby complicating the dewatering process (due to the formation of slush). Overcoming these obstacles, the team had to employ slurry pumps; the dewatering exercise was completed, to enable progress in the project.

c) Position of the intake arrangement for power house:
In an ideal situation the intake arrangement would be located at least 25-30 meters away from the main river course retaining wall of the Dam. However, in the Kabini project scenario it was only 3-4 meters from the retaining wall, posing huge challenge for progress. This meant that the project had to be managed in a sensitive and planned manner to ensure that the engineering balance of the structure was undisturbed.

Further, there was a peculiar site constraint to commence the penstock related works, as there only a uni-directional approach to the work spot – surrounded by unapproachable sides namely dam, retaining wall and the drainage gallery on the 3 sides respectively. Owing to this, the movement was restricted to single path.

d) Monsoon woes – dewatering process:
During the works in the monsoon period, a sudden earth collapse resulted in huge accumulation of water/slush from the river through the weep holes of the dam structure. The dewatering task was humungous, as the work front had to be cleared. Additional pumps were put into use to ensure that the differential was maintained of the inflow and outflow of water.

e) Construction related issues:
A unique situation confronted the project team while designing and erecting the power house roof structure with pre-cast slabs, that of an uni-directional approach to the construction site, with 3 unapproachable sides making it very difficult to reach the roof top to lay the slabs. An innovative engineering practice was the call of the hour – the team engaged the services of a dedicated adjustable long boom “Cole Crane” for the purpose to achieve the task.

Socio-Economic Benefits of the project

The Kabini project was executed in a seamless manner overcoming all the unforeseen challenges and the ripple benefits were unlimited:

- An eco – friendly, non polluting project that taps surplus water which otherwise would not have been utilized
- The 20 MW project was completed in record 20 months time frame
- The plant ensured improved electrical system stability, reduced voltage and uninterrupted power supply to the region

Progress So Far	**Operational Since 2003- Project Capacity – 20 MW, Annual Generation – 65 MU**			
Actual Generated: In MU over the years				
2003-2004	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**
20.30	40.83	54.56	63.20	65.57

ADDITIONAL INFORMATION

Project Details

Installed Capacity	:	2 units of 10MW each
Type of Turbine	:	Vertical Full Kaplan
Runner Diameter	:	3300 mm
Speed	:	200 rpm
Design Discharge	:	77 cumecs
Design Head	:	18 Mtr
Turbine Inlet Valve	:	Butterfly Valve of 4.5 Mtr dia.
Type of Generator	:	Vertical Synchronous
Type of Excitation System	:	Microprocessor based Static Excitation
Type of Governor	:	Electro Hydraulic (G40)
Generation Voltage	:	11 KV
Trashrack	:	24 Nos. panels with each panel having a dimensionof 4.0 Mtr x 3.5 Mtr
Stoplog Gate	:	12.9 Mtr x 5.2 Mtr (in 8 elements)
Intake Gate	:	8.41 Mtr x 5.2 Mtr (in 4 elements)
Draft Tube Gates	:	4.8 Mtr x 3.78 Mtr (4 Nos. Total)
Penstock	:	156 Mtr Long (5.5 Mtr – 80 Mtr, 4.5 Mtr – 76 Mtr) Total Weight : 270 MT
Power Transformers	:	2 Nos. 16 MVA, 11KV/66KV
EOT Crane	:	60/10 MT, Span:21.4 Mtr.
Transmission Line	:	66KV Double Circuit line
Powerhouse dimension	:	51.5 Mtr x 23.5 Mtr
Total excavation quantity	:	115000 cum
Total concrete quantity	:	23000 cum
Total quantity of Steel used	:	1700 MT (approx)
Total quantity of cement used	:	3200 MT (approx)
Generation	:	72.2 MU on 50% availability 60.0 MU on 90% availability

The construction activities carried out in the project classified into following six major areas:

1. Intake Structure
2. Water Conducting System (Penstock)
3. Power House
4. Tail Race Channel
5. Switchyard
6. Transmission Line

Brief note on the work carried out in each of the above major areas are detailed below:

1.	Intake Structure:
	The facilitating works such as embedment for Trash rack panels, Stoplog Gate Groove, Intake Gate Groove have been provided already by the Irrigation Department while constructing the dam.
	In order to asses the healthiness of these structures, an underwater study was carried out on all these areas and measurements taken for all critical dimensions.
	Subsequent to the above underwater study, the trash racks (in 24 panels), stop log gate (in 8 elements) and intake gate were fabricated to suit the existing dimensions of the structures under the water.
	The entire area of trash rack pond, stop log and intake areas cleaned thoroughly and the structures were lowered with the help of divers.
2.	Water Conducting System (Penstock):
	Penstock of 16mm thick and of ID 5486 has been embedded in the dam structure for a length of 30 Mtr. Underwater study was also carried out to measure the ID of the existing penstock, length, healthiness etc.,
	The above penstock has been carried up to the powerhouse and near the power house, the single penstock has been bifurcated into 2 Nos. 4500 mm dia penstocks with the help of Y- Piece, and connected to the inlet pipe of BF Valve.
3.	Power House
	The powerhouse has been constructed at a distance of 105 mtrs from the centerline of the dam. The dimension of the powerhouse is 51.5 mtr x 23.5 mtr. The depth of excavation in the lowest point of powerhouse being 25.0 mtr from the ground level.
	Since the powerhouse is located very near to the existing dam and the river retaining wall, the controlled blasting technique was adopted for excavating the hard rock encountered in the area.
	The powerhouse comprises of 2 Nos. Vertical Full Kaplan Turbines directly coupled to Synchronous Generators. For the purpose of accessibility of various auxiliaries of Turbine Generator, the construction of powerhouse has been planned in 4 floors (viz., BF Valve floor, Turbine Floor, Generator Floor and Service Bay).
	The control, annunciation and protection panels are housed separately inside the control room above the penstock area.
4.	Tail Race Channel:
	Water released out of turbine will be discharged back to the river through the Tail Race Channel measuring to about 100 Mtr long (approx).
5.	Switchyard:
	Outdoor switchyard comprising of Transformers, breakers, CTs and PTs etc., has been constructed in front of the powerhouse.
6.	Transmission line:
	The project involved the construction of 55 Kms Transmission Line from Kabini to Kadakola Substation. In addition to the above, the terminal bay arrangement at Santhesargur has been constructed for catering the power to the local areas.