EXECUTIVE SUMMARY

1. INTRODUCTION

The Government of Karnataka (GOK) has been encouraging private entrepreneurs in mini hydel schemes. M/s. Pusala Power Projects Pvt. Ltd Corporation Limited (PPPPL), a division of M/s. Chanakya Cements Limited, of the M/s. Penna Cement Industries Limited (PCIL) group has set up an office in Hyderabad with the objective of developing mini hydel schemes in Karnataka.

PPPPL has taken up execution of Kenchanguddam Mini Hydro Project (6 MW) across Tungabhadra river in Bellary district, Karnataka. Now, PPPPL envisages to set up a mini hydel project of 24.75 MW (3 x 8.25 MW) capacity across the Krishna River near Tugli Village, Lingsugur Taluk in Raichur District of Karnataka. The project is called Tugli Mini Hydel Project (TMHP).

2. PROPOSED PROJECT

The proposed hydel project envisages utilising the spills/releases from Narayanapur dam and a head of 20 m available in the form of series of rapids present in the riverbed over a length of about 5 km to advantageously generate power. The river water will be diverted by constructing a short diversion structure of 200 m (overflow portion) length across the river, to run 3 turbines of 8.25 MW capacity each. After power generation, the water will be released back into the river through a tailrace canal. The generated power will be observed by the powerhouse Lingsugur Substation of Karnataka Power Transmission Corporation Limited (KPTCL), about 12 km from the proposed project site.

3. ADVANTAGES OF HYDROPOWER

- Most potent source of renewable energy for sustainable development.
- Efficiency is highest among the renewable energy sources.
- Inflation-free production.
- Saves scarce fuel reserves.
- Non-polluting and hence environment-friendly.
- Long life - The first hydro project at Darjeeling completed in 1897 is still in operation. The second project, the Shivasamudram project, which came up in Karnataka in 1902 is still generating power. It has the longest life among other renewable energy sources.
- Cost of generation - O&M is lower than that of other sources of energy.
- Ability to start and stop quickly and instantaneous load acceptance/rejection makes it suitable to meet peak demand and for enhancing system reliability and stability.
- Has higher efficiency (over 90 per cent) compared to thermal (35 per cent) and gas (around 50 per cent).

- Cost of generation is free from inflationary effects after the initial installation.
- Can provide attendant benefits of irrigation, flood control, drinking water supply, recreation, tourism, etc.
- Being located in remote regions leads to development of interior backward areas (education, medical, road communication, telecommunication, etc.).

4. PROPOSED SITE LOCATION

The proposed TMHP is situated on the bank of Krishna River near Tugli village, in Lingsugur taluk of Raichur district in Karnataka State. The Project is about 18 km (by road) from Lingsugur Town and The nearest Highway is the State Highway (SH) at Lingsugur. The Narayanpur dam road is around 12 km from the proposed powerhouse. Lingsugur is around 90 km from Raichur and Bangalore is around 450 km from the proposed site.

The district headquarters, Raichur, is about 110 km to the west of the project site. A 297 MW hydro power station at Almatti & Chayadevi Mini Hydel Project (24 MW) is 75 km & 6 km upstream of the proposed site and Narayanpur Dam is 11 km upstream of the site respectively. Jaldurga Bridge is located around 2 km upstream of the site.

The geographical co-ordinates of the project site are $16^0$14’23” N Latitude and $76^0$28’50” E Longitude.

5. JUSTIFICATION FOR THE PROJECT SITE AND ALTERNATIVE SITES CONSIDERED

A hydel project is a site-specific project for the following reasons:

- There should be sufficient flow of water in the stream to generate power.
- There should be sufficient head difference available for running the turbines.
- The site should be easily accessible.
- Power evacuation facilities should be available within a short distance.

Since the proposed project site near Tugli village satisfies the above criteria and allotted by the Government of Karnataka accordingly, no alternative sites were considered for the project. Moreover, the proposed project site near Tugli village has the following advantages.

a. **Easy approach** – The diversion structure of the proposed project is about 2 km from a pucca road connecting to the Jaldurga village. Also, there is a kutcha road around 1 km from the powerhouse. The project does not need extensive construction of approach road to diversion structure or powerhouse without causing related environmental damages.

b. **Less human habitation in the vicinity** – The diversion is to be set up around 4 km from Jaldurga village. This area has about 74 houses with an approximate population of about 350. Thus, will not have any impact the project implementation on the population and their activities. Also, the powerhouse and the power canal are away from any human habitations.

c. **Easy availability of construction material** – The basic construction material, in particular boulders, will be available from the project excavated material itself, thereby reducing the procurement cost and the environmental impact due to their transportation.

d. **No/minimal impact on surroundings** – The proposed project will have its components next to the River Krishna. Hence, it will have no/minimal impact on the surroundings located in the study area.

e. **No/less waste generation** – It is proposed to utilise most of the project excavated material for the construction of the various components of the project.

In view of the above, the proposed project site near Tugli village is considered appropriate for construction of the mini hydel project.

6. DETAILS OF THE HYDEL SCHEME

The proposed project is a mini hydroelectric power generation facility, which will use the water in Krishna River for generation of electricity. It is proposed to construct a **Diversion Structure** of 330 m length across the river near Tugli village diverts the river flow to the **Power Canal** through **Intake Canal** located at the right bank. The flows from the power canal are conveyed to the powerhouse through a **Forebay** and **Penstock Intake.** Three independent **Penstocks** carry water from the forebay to the powerhouse.

The **Powerhouse** accommodates three **Turbine Generator (TG)** units, of 8.25 MW capacity each. It is proposed to locate the powerhouse on the right bank of the river. After generation of power, water will be released back into the river through a **Tailrace Canal**. The excess water flow over and above the power draft requirement of TG unit will spill over the diversion structure into the river. The diversion structure will also act as a bypass to restore flows in the river during tripping of TG units.

Total installed capacity of the proposed TMHP is **24.75 MW (3 x 8.25 MW)**. The average annual energy for the total installed capacity of 24.75 MW is estimated at **60 Mu,** whereas the net energy available after accounting for 1.0 per cent for station auxiliary consumption and non-availability exigencies of grid at 2.0 per cent is estimated to be **58.2 Mu**.

The generated power will be observed by 110 kV switchyard of Karnataka Power Transmission Corporation Limited (KPTCL) at Lingsugur substation by a double circuit, 12 km long 110 kV transmission line.

7. INFRASTRUCTURE REQUIREMENT

The proposed TMHP will require the following infrastructure for construction, operation, and maintenance of the hydropower station.

7.1 LAND

Total land requirement estimated for the proposed project is given below.

Table 1: Land Requirement for Proposed TMHP

Structure	Area (acres)
Diversion Structure	1.50
Power Canal	14.00
Power House, Pen Stocks and Switch Yard	2.00
Tail Pond and Tail Race Canal	9.00
Approach Roads	0.50
Dump Yard	5.00
Total	**32.00**

7.2 WATER

Water will be used at the facility for construction, power generation and domestic purposes. However, the power generation process does not consume any water. Water requirement during construction phase has been estimated at about 10,000 litres per day for construction and domestic purposes. Water for construction purpose will be drawn from the borewell. Potable water for the TMHP staff will also be obtained from borewell during the construction and operation phases.

7.3 POWER

Power for construction purpose will be tapped from the nearby KPTCL lines. Further, a 200 kVA rating DG set is proposed to be installed to cater to the needs of construction power requirements. This DG set will act as stand-by when KPTCL power is not available. Subsequently, after commissioning of the hydel scheme this DG set is proposed to be used for powerhouse auxiliary requirements whenever KPTCL supply is not available.

7.4 ACCESS ROAD

The powerhouse is proposed to be located on the right bank of the Krishna River, near Tugli village. Approach road to the powerhouse location shall initially be from the road leading towards Guntagola village. A separate service road along the power canal till the diversion structure as well as powerhouse will also be required. A total road length of about 5 km has to be constructed for providing access to the project.

7.5 MANPOWER

Approximately 125 personal are required for the proposed project during its construction phase and whereas about 30 personnel will be employed during the operation phase of the facility. The plant will operate in three shifts.

7.6 SITE OFFICE AND QUARTERS

Residential accommodation for PPPPL staff during construction and subsequently during operation and maintenance phases is necessary. Permanent offices of PPPPL operation staff will be located within the powerhouse building. Residential accommodation for PPPPL staff during construction period and subsequently for O&M of power station can be provided at Tugli village or Lingsugur town. Temporary site offices and store yards during construction can be located at the project site near the

powerhouse on the right bank. Actual allocation of space for Site Offices and Quarters would be finalized only after the process of land acquisition is complete.

8. ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

PPPPL has entrusted the Centre for Symbiosis of Technology, Environment & Management (STEM) to carry out a Rapid Environmental Impact Assessment (REIA) study of their proposed mini hydel project near Tugli village. The objective of the REIA study is to identify, predict and assess the likely environmental impact of the proposed TMHP during its construction and operational stages. The REIA study also aims at developing an appropriate Environment Management Plan (EMP) for mitigating adverse environmental impact of the proposed project, if any.

The study area for assessing the potential environmental impacts of the proposed TMHP, is considered to be the area falling within 10 km radius circle with respect to the proposed project site (diversion structure) as centre. Since the project site is located on the boundary of the Raichur and Gulbarga districts, the study area is spread over the two districts. It comprises villages in the Lingsugur taluk of Raichur district and Shorapur taluk of the Gulbarga district.

8.1 AIR ENVIRONMENT

Micrometeorological data of last five years (1999 to 2003) monitored at the Raichur Observatory of the India Meteorological Department (IMD) has been used as baseline data for this study.

Based on the micrometeorological data of 1999 to 2003 recorded at Raichur, it can be seen that the monthly mean relative humidity recorded at 0830 hrs was in the range of 31 per cent to 77 per cent, whereas that at 1730 hrs was in the range of 18 per cent to 68 per cent. Similarly, the monthly mean temperature recorded varied from a minimum of 15.0°C to a maximum of 42.6°C. The average rainfall is 608.2 mm.

The predominant wind direction is shown from directions between west and south-west from February to September, and from directions between north, east and north-east during winter -October to January.

In order to assess the baseline status of ambient air quality in the study area, ambient air quality monitoring was carried out at the two locations. The results indicate that the concentration of the ambient air quality parameters at all the monitoring locations in the study area are within the applicable National Ambient Air Quality Standards (NAAQS) for sensitive areas.

8.2 NOISE

To establish the baseline noise scenario, noise level monitoring was carried out at the same locations as ambient air quality monitoring. Comparison of the noise monitoring results shows that the average noise levels around the proposed project site are within the applicable Central Pollution Control Board (CPCB) standards.

8.3 WATER

Krishna River is a major surface water body within the study area. The perennial river divides into two branches near Jaldurga. These branches join together again about 20 km downstream near Guntagola.

In order to establish the baseline status of water quality in the study area, water samples were collected from the surface and ground water sources were analysed for their portability. The water quality results show that the river and borewell water needs disinfection before it can be used for potable purposes.

8.4 LAND

54 per cent of the study area comprises “un-irrigated land” and only 11 per cent of the area is being irrigated. The “cultivable waste land” is 2 per cent whereas about 19 per cent of the area falls under “area not available for cultivation”. About 14 per cent of the land in the study area (10 sq km radius) is “forest land”. However, there is no forest land involved in the proposed project area.

8.5 TERRESTRIAL ECOLOGY

8.5.1 Forest

The study area of 10 km radius with respect to the proposed project site partially covers the following Guntagola Reserve Forest.

8.5.2 Flora

The study area is not rich in vegetation. List of trees and plants found in agricultural land and the road side, species in forest and unclassified lands, grasses, agricultural crops, etc. are given in the relevant chapter of the report.

8.5.3 Fauna

The few mammals and reptiles found in the area are listed in the relevant chapter. Since Krishna River a perennial river flows through in the study area both wetland birds and terrestrial birds can be sighted in this area. Some of the birds visit the study area during winter.

8.6 AQUATIC ECOLOGY

There is no significant fishing activity taking place at the project site. Based on the discussion with the authorities of the Fisheries Department, the fish species in the Krishna river are listed in the relevant chapter. The local fishermen confirmed the same during the site visit.

8.7 SOCIO-ECONOMIC ENVIRONMENT

The study area (i.e. area within 10 km radius of the proposed TMHP site) falls in the Lingsugur and Shorapur taluks of Raichur and Gulbarga districts, respectively. Total population of the study area is 48,931, of which 24,748 are male and 24,183 are female. The scheduled castes population of the study area is 26,760 (i.e.26.1 per cent), of which

13,550 are male and 13,210 are female. Average population density in the study area is approximately 109 persons/km^2, which indicates the sparse habitation of the area.

The overall literacy rate in the study area is 30.8 per cent, whereas male and female literacy rates are 41.4 per cent and 20.0 per cent, respectively. Primary education is available in most of the villages. Overall employment in the study area is 49.3 per cent whereas the male and female employment rates are 51.2 per cent and 47.3 per cent, respectively.

Drinking water supply is available in all the villages in the study area - either hand pump or well water. Very few villages have tap water facility while, none of the villages have Over Head Tank water supply as per 1991 census. Similarly, all the villages in the study area are provided with electricity.

The common mode of transportation in the study area is through state and private transport buses. There are no major roads passing through this area. Most of the villages in the study area are connected by kutcha / pucca roads. The state transport (KSRTC) buses are available on internal routes, and in addition to the private small vehicles like jeep and tempo. A 30 year old bridge is the main connecting link to other areas.

There are no Primary Health Centres (PHC) available in the villages. Better medical facilities are available at the taluk headquarters that include well-equipped government and private hospitals, dispensaries, family planning centres, etc.

9. BENEFITS OF THE PROPOSED PROJECT

The benefits and major objectives expected to be achieved by the proposed TMHP are presented as follows.

9.1 INCREASED POWER AVAILABILITY

The proposed power project is designed to generate 24.75 MW of electric power, which will help improve the power availability partially in the region. Also, it is significant for off-grid or on-grid, rural, in far-flung isolated communities having no chances of grid extension or increase in power availability for the years to come.

9.2 LOWER COST FOR POWER GENERATION

The proposed project is a mini hydel project with simple design of turbines, generators and civil works. Therefore, the project takes lesser time for its construction and commissioning, reducing the related costs substantially. Moreover, since a hydel scheme is based on water, which is available free of cost, and does not require any fossil fuels, expenditure towards fuel procurement and transportation are saved. As a result, the levelized cost of generation from small hydro power project would be less than half that of thermal. Auxiliary consumption is much less than that of thermal power production cost. This is an inflation free energy development with minimal operation and maintenance cost.

9.3 MINIMAL ENVIRONMENTAL IMPACTS

Hydro power represents non-consumptive, non-radioactive and non-polluting use of water resources. Hydropower is a free gift of nature – clean, economical, perennial and

inexhaustible, i.e. renewable. The small hydel projects are considered to have minimal impact on the surrounding environment due to negligible area of submergence, no gaseous emissions, or solid waste generation such as fly ash. Moreover, SHPs are simple to operate and easy to maintain.

9.4 SOCIO-ECONOMIC BENEFITS

During the operational phase around 30 workers will be required and during the construction phase, approximately 125 construction workers will be employed for a period of about 18 months, providing direct employment potential to the local villagers. Moreover, indirect employment (secondary support job opportunities) will be generated by the power project, which has the potential to be developed into a picnic spot also.

Table 2: Expected Beneficial Impacts of the Project

a. Increased availability of electric power in the region.
b. Employment to about 125 persons during construction and 30 persons during operation phase as direct services, while there will also be indirect employment for supporting services.
c. The economy of the area improves due to permanent infusion of money through salaries to the employees as well as income to the indirectly employed people.
d. The local economy will also improve, if the project site is developed as a picnic spot. Development of the project site as a picnic spot will further improve aesthetics of the site.
e. Greenbelt development around the project site will improve the flora in the area and also aesthetics of the area.
f. The power generated will be made available over a larger region. The positive impacts of the project will, therefore, not be restricted to the local population alone.
g. Transport, Communication and other community facilities will improve. There will be considerable socio-economic development in the surrounding villages.
h. Will help in development of the interior backward areas.
i. The project can be suitably modified in future to provide attendant benefits of irrigation, flood control, drinking water supply, recreation, tourism, etc.

10. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATIVE MEASURES

The likely impacts of the proposed TMHP, during its operation phase, on the surrounding environment are summarised in **Tables 3** and **4** respectively.

Table 3: Construction Phase: Potential Impacts and Mitigative Measures

Sl. No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
1.	Air quality	Increased SPM concentration in ambient air.	Construction equipment, vehicular traffic, excavation, concreting, *etc.*	Vehicular check; water spraying for dust suppression;		Minor negative but temporary
2.	Noise	Increased noise levels	Construction equipment, various construction activities	Equipment selection & maintenance; usage of ear plugs/muffs by the construction workers		Minor negative impact but temporary
3.	Water	Demand of water supply in addition to extraction from borewells. Local increase in suspended solids	Construction equipment, concrete mixing & curing, cleaning, workers' domestic needs dust suppression etc. Erosion due to excavation activities	Equipment selection, steam curing, high pressure hose for cleaning. Plantation around site before construction. Recharge of borewell		Minor negative impact on surface water
						No impact on ground water
4.	Land	Construction wastes, unstable slopes, soil erosion	Construction waste (excavated material)	Appropriate waste disposal measures; slope stabilization and greenbelt development.		No impact on land use.
						Minor negative on soil quality
5.	Aesthetics	Land clearance, construction waste.	Construction activities and waste	Appropriate waste disposal and greenbelt development. Alternative passages.		Minor negative.

Sl. No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
6.	Terrestrial Ecology	Impact on top soil & existing ecosystem in the vicinity of the site.	Construction activities in a 5km stretch	Low noise generating equipment, soil binding vegetation, greenbelt development. Providing passages.		Minor negative and temporary.
7.	Aquatic Ecology	Change in flow, increase in suspended solids and TDS	Construction activity of diversion canal, power house and tailrace canal	Providing rocky boulders/structures near the powerhouse to restore the original habitat to the extent possible.		Short term Minor negative impact
8.	Socio-economic factors					
(i)	Population	No impact	Construction jobs	Employing local people, Providing proper facilities and community services for the workers		No impact
(ii)	Education	No impact	-	Employing local people		No impact
(iii)	Employment	Increase in direct & indirect employment opportunities	Construction jobs to the local manual laborers and professionals	Employing local people to the extent possible.		Moderate positive
(iv)	Infrastructure facilities & Community services	Disturbance of existing infrastructure & community facilities	Construction activities	Alternative arrangements		Minor negative and temporary
9.	Population displacement and rehabilitation	None	No displacement of population	-		No impact

Table 4: Operation Phase: Potential Impacts and Mitigative Measures

Sl. No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
1.	Air quality	None	Occasional vehicular movement	Green belt development, usage of good quality fuels.		No impact.
2.	Noise	Increased noise levels but below the prescribed standard.	Operation of noise generating equipment like turbines, pumps & compressors	Equipment will be provided with noise reduction measures such as acoustic barriers, vibration pads etc. Maintenance routine for the equipment. Green belt development.		No impact.
3.	Water	None	None	Minimize water usage by water conservation, reuse of treated sewage for greenbelt irrigation. No discharge of untreated wastewater into the river. Mandatory flows shall be maintained.		No impact
4.	Land	None	Project activities	Development of a systematically managed green belt to maintain ecology of the area. Appropriate disposal of solid waste, garbage.		No impact on landuse
						No impact on soil quality
5.	Aesthetics	Better environment	Development of project site as picnic spot	Development of greenery and site as picnic spot		Minor positive impact
6.	Terrestrial Ecology	Minor loss of trees, obstruction to animals to access the river.	Project activities	Greenbelt development. Providing suitable access to river for animals.		No impact

Sl. No.	Environmental Components	Potential Impacts	Source of Impacts	Mitigative Measures		Remarks
7.	Aquatic ecology	Change in flow, passage for fishes.	Diversion of flow	Mesh of appropriate size will be provided at the inlet points of the intake canal to prevent entry of fish along with water into the turbines.		Minor impact and temporary – Water will overflow over the Diversion structure. Also, water will be released back into the river within a dist. (5000 m).
8.	Socio-economic factors					
(i)	Population	*Small increase in population*.	Direct / indirect job opportunities, secondary services	Employment of local people to the extent possible		No impact
(ii)	Education	None	None	Employment of local people to the extent possible		No impact
(iii)	Employment	Better employment opportunities	Operation phase direct & indirect project and social requirements, Development of the site as picnic spot	Employment of local people to the extent possible		Moderate positive
(iv)	Infrastructure facilities & Community services	Improvement in infrastructure facilities & community services	Operation phase project and social requirements	-		Minor positive
9.	Population displacement and rehabilitation	None	No displacement of population	-		No impact