Upper Kolab Pump Storage Project(2X160 MW)

A.INTRODUCTION

A straight masonry gravity dam 54.5 m high is located on the river kolab at village Karange, District Koraput, This dam is under operation and has a live storage capacity of 935 MCM. The existing Upper kolab hydro power plant having a surface power house located at the foothill of the Jeopore Town is equipped with four conventional units of a Francis turbine to generate 4x 80 MW of power.

The Upper Kolab Pumped Storage Project (UKPSP) envisages utilization of the water of the exiting Kolab reservoir as the upper reservoir and a lower reservoir proposed on the left side of the Satiguda pond draining the existing tail race channel flows from the operational stage Upper Kolab H.E Project. The project envisages installation of 2 units of reversible turbines each of 160 MW (total 320 MW) to generate an additional annual energy of 506.60 MU in a 90% dependable year.

B.EARLIER STUDIES BY THDC

THDC India Ltd, final report *dated September 2012* on the prefeasibility study of a pumped storage scheme proposes to reutilize the water of the Upper Kolab Reservoir which is being released from the existing Hydro Electric Power Station and spilled over from the Satiguda pond. This surplus water shall be stored in Satiguda Pond by increasing its capacity. The project with a proposed installation of 320 MW (4x 80MW) would generate an additional energy of 506.6 0 MU in a 90% dependable year.

The existing Satiguda pond at EL.593.20 m has a live storage of 1.519 MCM. Three options available to increase the capacity of the existing pond envisaged by THDC are:

- Increasing height of Satiguda dyke
- Expanding the reservoir towards the d/s of the existing dyke by construction of a new dyke.
- Removal of soil mass from the existing reservoir for creating additional depth.

The report finally concludes that reservoir capacity up to 4.0 MCM at EL.593.50 m of the existing Satiguda reservoir by removal of the excavated material and its disposal at a suitable location, Maximum water levels and the Minimum draw down levels of the Satiguda pond have not been changed in order to avoid the energy loss in the existing plant. THDC proposal envisages utilization of Max. Gross Head of 261.77 m with formation of live storage of 4.00 MCM in the d/s reservoirs at Max. Water level.

OHPC has now entrusted the job for the preparation of a Dependable & Detailed Project Report (DPR) to WAPCOS based on and improvising on the Prefeasibility studies carried out by THDC INDIA Ltd during the year 2012. The DPR shall be prepared after carrying out the necessary Topographical and Geological investigations and other relevant details & data verifications.

C. WAPCOS CONCEPTUAL LAYOUT OF THE SCHEME - MAIN COMPONENTS

Various alternative layouts including the one proposed by THDC in the feasibility report were examined while carrying out the desk top studies. The conceptual layout of the pumped storage scheme as proposed by WAPCOS has been considered based on technical and financial parameters. Since the layout of the existing Upper Kolab H.E project (under operation) lies very close to the proposed scheme, adequate rock taken

into consideration between the two layouts for safety considerations. A minimum clear distance of 100 meters has been maintained from the existing project tunnels layout while aligning the pumped storage scheme. The LAYOUT proposed shall however be verified at site with detailed topographical surveys and geological investigations before the same is adopted in the DPR.

- **UPPER RESERVOIR**

  The Upper Kolab pumped storage project is planned in the vicinity of the existing upper kolab project on the river Kolab. The Upper reservoir is formed by construction of a 54.5 m high straight masonry gravity Dam situated at village Karange, District Koraput, constructed on the River Kolab. The dam is under operation and has a live storage capacity of 935 MCM.

- **LOWER RESERVOIR-WAPCOS PROPOSAL**

The head ranges for the Project as proposed by THDC and WAPCOS are

THDC		WAPCOS	
Turbine mode	**Pumping mode**	**Turbine mode**	**Pumping mode**
Max.head =257.87 m	Max.head =280.30 m	**Max.net head = 253.66 m**	**Max.net head =279.66 m**
Design discharge =152.80 cumec		**Design discharge =148.00 cumec**	

The existing Satiguda pond has been developed for control flow of water for meeting the downstream irrigation requirements .WAPCOS proposes is to create an independent lower reservoir having no interference with the existing system. The proposed reservoir size shall cope with each day turbine volume equal to pumped volume .The THDC proposal to increase the live storage capacity of the lower reservoir at EL.593.50 m by 2.50 MCM has not been favored on account of the following :-

1. The existing capacity of the Satiguda pond is only 1.519 MCM against the requirements of 4.5 MCM
2. Interference with the existing system of power generation as well as the irrigation requirements.
3. The existing homogeneous earthen dam and related structures are already 25 yrs old and shall require huge cost for modifications and its strengthening.
4. Not much appreciable cost difference for creation of a new reservoir.
5. There are no constraints in adopting the Max. & Min. levels of the new reservoir which is now independent of the existing Satiguda reservoir.
6. The safety of the earthen dam could be jeopardized with additional excavations being envisaged for increasing the depth and consequently the capacity of the Satiguda reservoir.
7. There could be temporary loss of power generation and revenue on account of the carrying out the proposed modifications in the lower existing pond.
8. There could be a slight increase in the length of the tail race tunnel on account of the proposed location of the lower reservoir. However, there is already a provision of the tail race surge gallery in the layout of the water conductor system to take care of the back surges.

The location of the new proposed lower reservoir could be at the toe of the existing hill slopes on the left side of the existing Satiguda pond. However the exact location shall be finalised only after carrying out topographical and geological / geotechnical survey.

Proposed lower reservoir data

Top of dam	EL.593.00
FRL	EL.590.00
MDDL	EL.585.00
Live storage capacity	3.0 MCM
Centre line turbine	EL.554.00

The volume of water required for 5 hours of Generation in a day works out 2750400 m^3 (2.75 MCM) .Accordingly, the size of the lower reservoir proposed in order to pond the waters after the generation capacity shall be 800m (L) X 750m (W) X 5m (H) = 3MCM .The depth (H) of the reservoir shall be adjusted as per the requirements of Pumped intake and topography at site. The embankment/dam height may vary between 15 to 25 m.

- **Head race tunnel**

A circular tunnel of 6.75 m dia. and around 4132.42 m length up to the u/s Surge shaft is proposed to carry the design discharge of 148 cumec. In order to increase the rock covers in the alignment of the head race tunnel, a goose neck (45 degree vertical bend) or a vertical drop shaft has been proposed just d/s of the upper power intake thereby lowering the centre line of HRT by around 30 meters. One horizontal bend has also been necessitated in the layout of the head race tunnel in order to have adequate rock covers over the tunnel as well as the existing under operational tunnels.

- **Power house**

The pump storage projects usually have very deep setting of turbines on account of submergence requirements. The disadvantages for a surface power house in this particular location are techno economic considerations, height more than 50 meters, access to hall is cumbersome, requires deeper excavation and intricate support system, additional water tightness, increased length of the pressures shaft steel liner etc .Accordingly, it has been proposed to provide two numbers underground cavities with an adequate rock ledge in between the power house cavity hall and the transformer cavity hall.

D. COST OF PROJECT

Tentative cost of Upper Kolab Pumped Storage Project (320MW) will around 1600 crores Rupees which is based on the per MW cost worked out for upper Indaravati Pumped Storage Project of OHPC limited Odisha.

Bill of Quantities for civil, HM and E&M items shall be worked out based on DPR design & drawings. Labour rates shall be adopted as the State Govt notification on minimum wages/ applicable schedule of rates. Rates of steel, cement, bentonite, ply

wood, drilling accessories, explosive items, diesel etc shall be collected from market or taken as per applicable schedule of rates for cost estimate. Cost of various construction equipments will also be collected from the market to work out the use rate of equipments. Rates of Items of Civil and HM components of the project shall be analyzed. Cost of E&M plant/ equipments will be worked based on the market rates. 12% GST will be taken into consideration in the Project Cost Estimate.

Based on the cost worked out for the Upper Indravati Pumped Storage Project, the cost of an independent lower reservoir of Upper Kolab Pumped Storage shall be around 1610.19 crores.