Purulia Pumped Storage Project – A Success Story

WBSEDCL

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PLANNING & IMPLEMENTATION OF

PURULIA PUMPED STORAGE PROJECTS

For an ideal power generating system conventional Storage Hydro Projects ,

in the Grid with sufficient installed capacity can share the peak load

Base load

can be shared by Thermal Plants

If storage hydro potential is not available then the other alternative is

Pumped Storage Project

or Gas Based Project.

If the Thermal Power Stations are to share both base and peak load then the power system become unstable with frequency excursions

Moreover the Thermal Plants in such conditions have to run at very low load for prolonged period needing fuel oil support,

and thus cost of generation become too high

With wide range of Frequency variation, the industrial units consumer as well as Thermal Power units

run their plants with risk and hazards of damage,

their efficiency and life expectancy reduce drastically

As such the total power system become unstable

with risk of grid collapse

When natural gas is not available in the vicinity

the cost of pipe line to carry gas from a distance place or importing liquid gas become prohibitive.

Pumped Storage Project

then become the only and an ideal solution

Pumped Storage Project

does not require a large Reservoir

Reasonably Small Storage

for 4 to 6 hours

at upstream and downstream

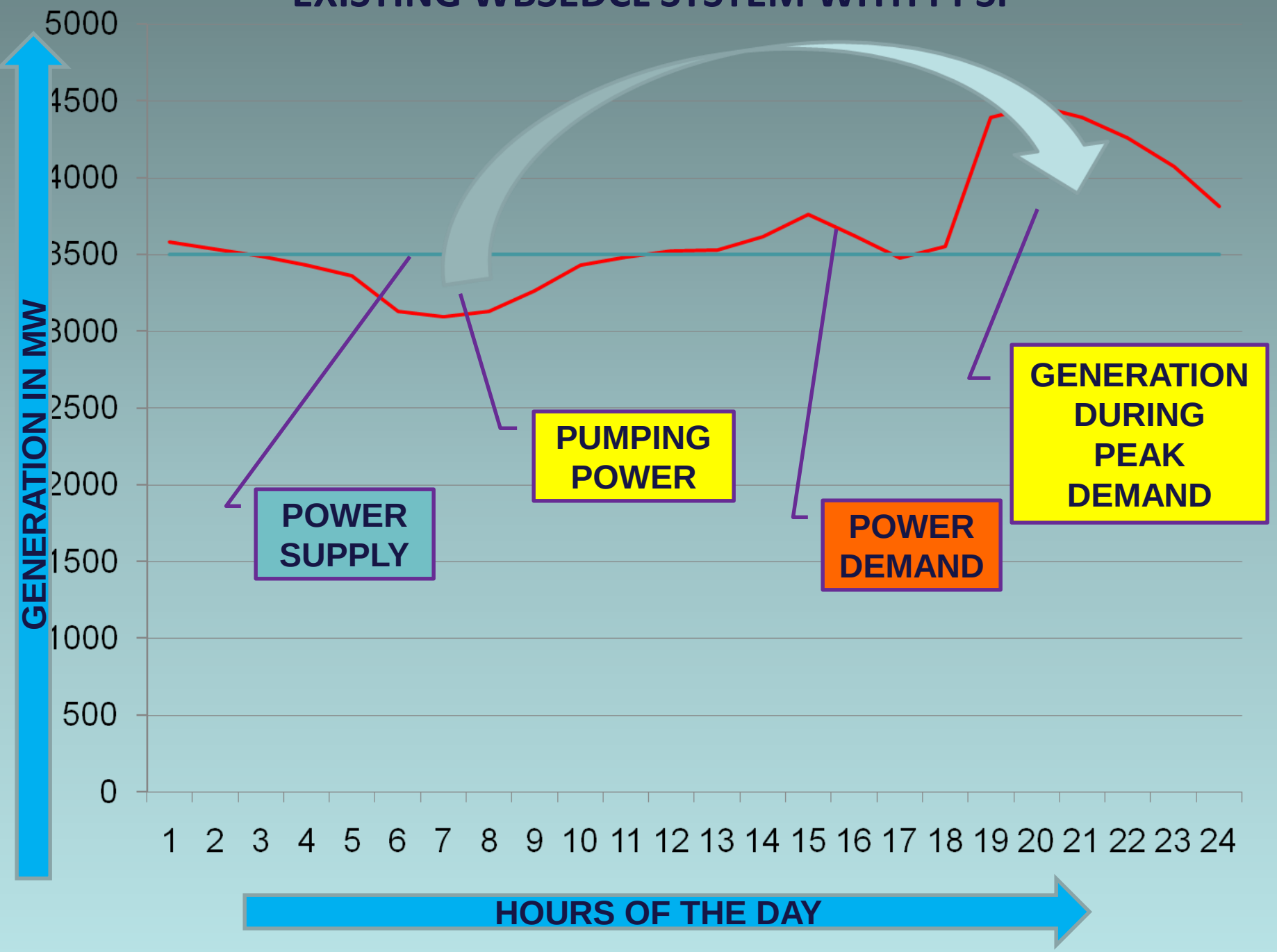
of the Power House

with a short water conductor system can generate large power during peak demand period

It does not require perennial flow

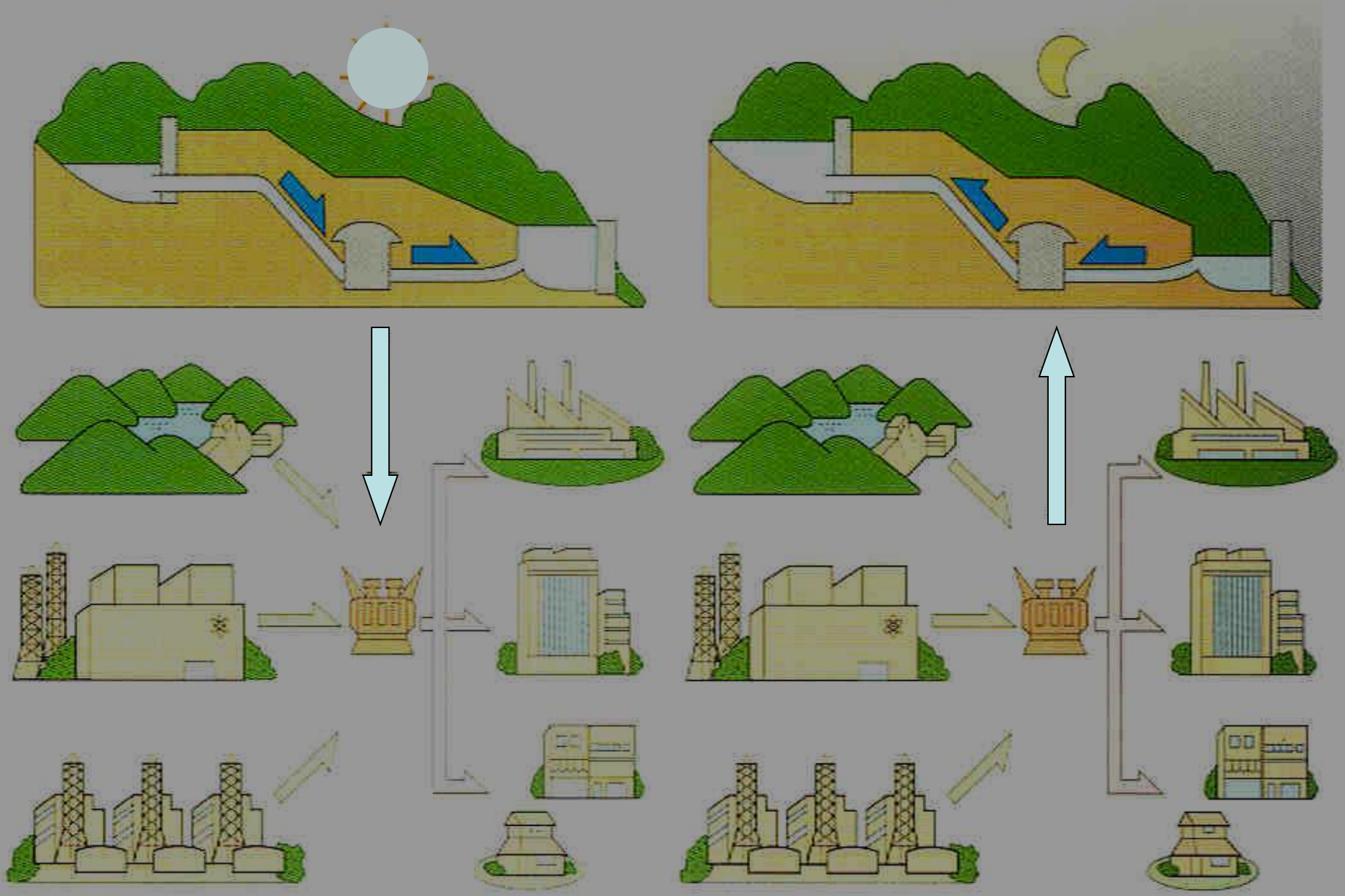
in the river.

EXISTING WBSEDCL SYSTEM WITH PPSP



Evening (Generating Period)

Night (Pumping Period)



PPSP – Necessity in West Bengal Power System

- **The State of West Bengal and the Eastern Region was having predominantly Thermal Power Generation system with an insignificant capacity of Hydro Power**
- **The thermal predominant Power generating region has to cater peak, off peak, fluctuating as well as base load with a serious effect on frequency and voltage**
- **Frequency used to vary widely from 53 Hz to 47 Hz threatening the grid failure. As a result, running of thermal power station at lower load for considerable period reduced the efficiency drastically and caused severe and quicker wear and tear of the plant**

PPSP – Necessity in West Bengal Power System

- **Also due to high variable operating cost, slow in load variation response, thermal facilities were not felt a good means to supply the peak demand**

- **The use of electricity for industries and commercial purposes as well as for domestic consumption had been substantially suppressed due to shortage of peaking power where as there was surplus energy during night**
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- **In order to achieve a better generation mix and more efficient electricity supply in the region, the implementation of Pumped Storage Projects was taken up in Ajodhya hills in Purulia district of West Bengal**

- **Taking advantage of the natural topography of the area Purulia Pumped Storage Project (PPSP) having installed capacity 900 MW (4x225) was taken up first for construction and commissioning**

PPSP – A Success Story

- **PPSP is the first 900MW pumped storage project in India running successfully.**
- **Main Project work started in the year of May 2002 and scheduled completion date was 31.12.2007. Actual Project completed on 17.12.2007 i.e. before scheduled time.**
- **PPSP Project cost also reduced. Expected Project Completion Cost is Rs. 2500 Crore against Revised Project Cost Rs 2952 Crore.**
- **PPSP has overall Cycle Efficiency 77.79% which is higher than Design value 75.5%.**

PPSP- A Success Story

Generation achieved in Million Units in last 3 years:

FY	Generation (MU)	Remarks
2014-15	1416.06	Generation achieved is higher than the CEA target 1200 MU
2015-16	1055.001	One unit was under Overhauling
2016-17 (Up to Dec 2017)	855.268	One unit is under overhauling

PPSP – A Success Story

- **Water from Kistobazar Nalla & accumulated monsoon water impounded in the Upper Dam of 13 million cubic meter of effective capacity with an effective head of 177 m is the source of energy for generation of electricity utilizing 21,200 cusec / 600 cumec (cubic meter per sec) of discharge**
- **The discharged water after passing through reversible Pump-turbine acting as turbine gets stored in the Lower Dam which in turn is pumped up to the Upper Dam by the same reversible pump-turbine acting as pump to replenish the restore water at that conspicuous height for its use in the peak power demand period in the next cycle for generating electricity**

PPSP – A Success Story

- **This project adds power to the system to meet its peak demand, simultaneously it helps the thermal power plants from their running at low load during off peak hours of the regional power system by drawing load for its pumping operation**
- **Thus this can flatten the load curve to some extent and increase the longevity of the turbine blades in the thermal power stations.**

PPSP - A Closed-loop Pumped Storage Utility

- A relatively new approach for developing pumped storage projects is to locate the reservoirs in areas that are physically separated from existing river systems
- These projects are termed ‘closed-loop’ pumped storage, because they present minimal to no impact to existing river systems
- After the initial filling of the reservoirs, the only additional water requirement is minimal operational make-up water required to offset evaporation or seepage losses
- By avoiding existing complex aquatic systems entirely, these types of projects have the potential to greatly reduce the most significant aquatic impacts associated with project development

PPSP - The Spinning Reserve and Non-Spinning Reserve:

- **The spinning reserve is the extra generating capacity that is available by increasing the power output of generators that are already connected to the power system**
- **For most generators, this increase in power output is achieved by increasing the torque applied to the turbine's rotor**

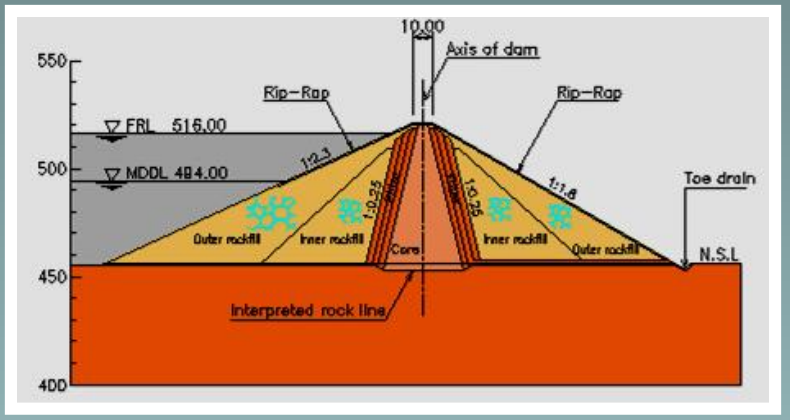
PPSP - The Spinning Reserve and Non-Spinning Reserve:

- **The non-spinning reserve or supplemental reserve is the extra generating capacity that may be off-line and that can be made available within 10 minutes**
- **Unlike spinning reserve capacity, supplemental reserve capacity is not “synchronized” with the grid (frequency)**

- **PPSP is simultaneously being used as spinning and non-spinning reserve**

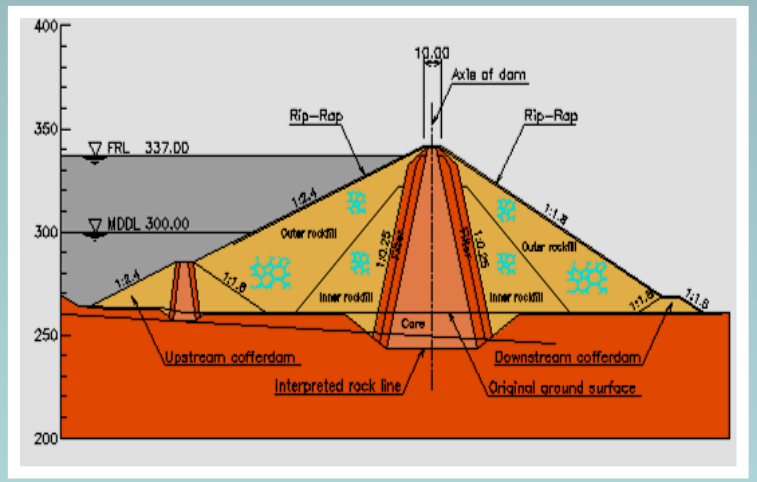
❖ Upper Reservoir

High water level **EL.516.00 m**
Low water level **EL.494.00 m**
Available draw down 22.0 m
Full water capacity **16,404,924 m3**
Available capacity **13,371,025 m3**
(used about 6 hour by 600m3/s)

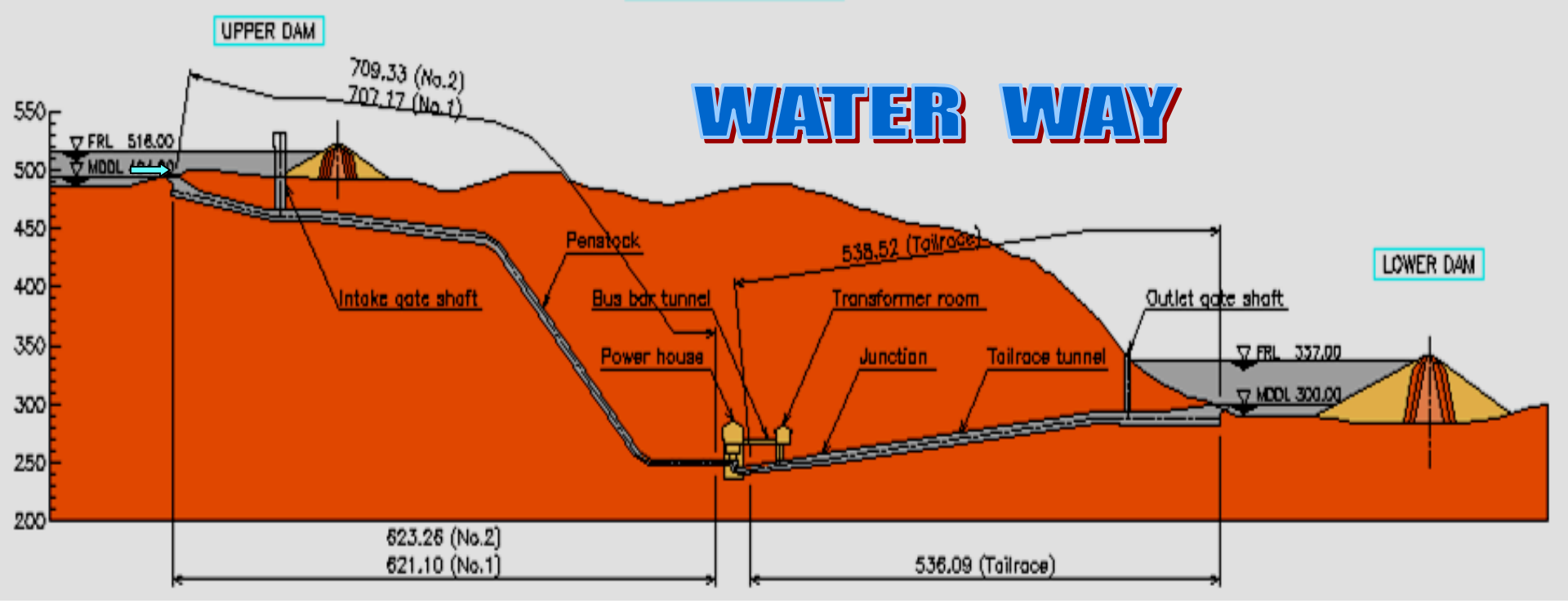


❖ Lower Reservoir

High water level **EL.337.00 m**
Low water level **EL.300.00 m**
Available draw down 37.0 m
Full water capacity **17,253,036 m3**
Available capacity **14,475,571 m3**
(used about 6 hour by 600m3/s)



Headrace Intake Tunnel	**7.70 m dia. x 2 nos.**
Penstock	**7.70 ~ 7.30 m dia. x 2 nos.**
	4.30 m dia. x 4 nos
Tailrace	**8.70 m dia. x 2 nos**
	5.60 m dia. x 4 nos
Sedimentation rate	**9.50 Cum/SqKm./Year**



The world scenario

- **All developed countries had set up pumped storage projects in sufficient capacity in the twentieth century only to cater for the peak load of the day, which varies from country to country & season to season, as meeting up of the peak load by thermal or nuclear would mean subsequent uneconomical, hazardous running of them in low load during off peak**
- **The recent world trend is to set up pumped storage projects in more capacity for using them to store energy of irregular generation from Solar & Wind**

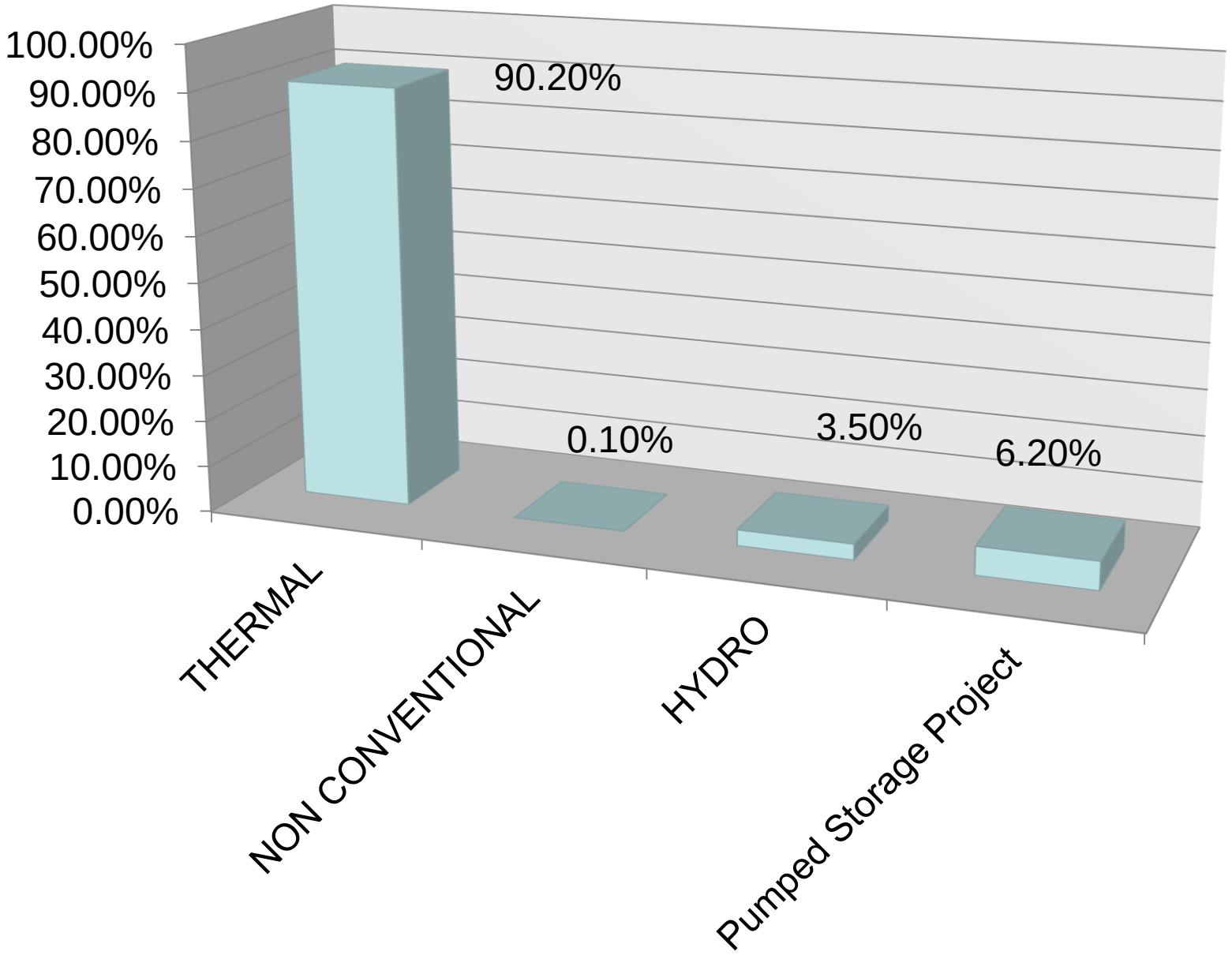
Indian scenario

- **The Indian scenario of pumped storage project is not that bright. There is hardly any pure pumped storage project actually in operation at the present moment (except PPSP)**
- **The Hydro installation of 3,882.12 MW in Eastern Region of India is only 15.17% which is much below the optimum hydro thermal mix of 40:60. Thus there is an urgent need to take up more storage based hydro projects and run of the river hydro-electric projects with an aim to achieve optimum hydro thermal mix in the region**

West Bengal scenario

- **A number of big Thermal Units are going to be set up in and around West Bengal by different Power Utilities, it is imperative to set up more pumped storage projects in the region as WBSEDCL is striving to reach the optimum hydro thermal mix of 40:60 which is now as low as 10:90 considering the presence of PPSP**

STATE GENERATION CAPACITY BASED ON FUEL



Future Planning

- **The West Bengal State Electricity Distribution Co Ltd is now planning another 1,000 MW pumped-storage project on Turga nala in the Purulia District which would help restructure the region's energy portfolio**
- **As almost 90% of the power generated in the state is from thermal power stations, so the strategy is to exploit all possible Hydro sources**
- **Subsequently Bandu Pumped Storage Project (900 MW) will also be taken up**

The Advantage of having Pumped Storage Projects in the Power System

- **The power systems are controlled by the Load Despatch Centres. Their duty is to bridge the gap between the generation utilities and the consumers**
- **There are various difficulties / short comings of the power stations i.e. generation loss due to shortage of coal, sudden outage of generators, sudden outage of load bearing equipments etc. which are required to be managed by Load Despatch Centres**

The Advantage of having Pumped Storage Projects in the Power System

- **Presence of a pumped storage project make this task of grid management very easy and any unit of 225/ 250 MW can start generating within 5 minutes**
- **Imposing of the load shedding may be decreased remarkably due to presence of pumped storage project which can easily balance the short fall of power during peak and the excess of power during off peak**

PPSP has been conceptualized

as peak load power station, which would contribute to system demand as and when required and thereby contribute to increase the stability of grid

Almost every evening,

the plant is run at full load

and in partial/ full load at daytime

Hence, it is of utmost importance

to keep all the four Units (4x225 MW) available at any point of time

In absence of Pumped Storage Project, a Thermal Power Station would require to be setup to meet the evening peak which is needed to reduce its generation during off peak hour (24 – 6 = 18 Hrs) resulting in huge oil firing to keep boiler working beside having high frequency in the system resulting in wastage of power

Requirement of generation is guided by the principle of prediction of next day requirement and also the availability of economic pumping power

PPSP is an embedded system tool and is not a

direct Power selling Utility

and the power is sold from WBSEDCL's pool of Power

THANK YOU