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**Government of India / Bharat Sarkar**  
**Ministry of Power / VidyutMantralay**  
**Shram Shakti Bhawan, Rafi Marg**  
**New Delhi – 110001, Tel: 011-23705841**

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Dated: 15<sup>th</sup> February, 2023

To

1. Chief Secretaries – All the State Governments & Union Territories
2. Principal Secretaries (Energy / Power) - All the State Governments & Union Territories
3. CMDs – PGCIL, NTPC, NHPC, SJVN, THDC, NEEPCO, Grid India,
4. The Chairman – BBMB, DVC
5. All Private Sector Developers of PSPs

विषय: देश में पंप भण्डारण परियोजनाओं के विकास के लिए प्रारूप दिशानिर्देश - टिपणी / सुझाव आमंत्रित।

**Subject: Draft guidelines to promote development of Pump Storage Projects (PSP) in the country – seeking comments - regarding.**

Sir,

Energy Transition entails an increasing presence of variable & intermittent Renewable Energy Sources (VREs) like solar & wind in the energy mix. This presents a grid-level challenge, that would require incentivization of technologies offering storage & ancillary services attributes. Pumped Storage (PSPs) is a MW scale, domestically available, time tested, and internationally accepted technology available for addressing this requirement of storage and ancillary services.

2. The positive aspects of PSPs are not limited to the attributes of storage and ancillary services, rather PSPs are clean, green, safe, and non-explosive. They don't produce any poisonous/ harmful by-products or pose problems of disposal.

3. Keeping in view the immense utility of the PSPs in grid stabilization as well as meeting the peaking power demand, a need for formulating a separate guideline to promote PSPs was felt to set the direction of its development. Accordingly, this Ministry has come up with draft guidelines on PSPs, which seeks to promote the development of PSPs across the country with proactive support of the State Governments. A copy of the draft PSP Guidelines is enclosed herewith.

4. In view of the above, all the State Governments / UTs alongwith other stakeholders are requested to furnish their comments / suggestions within 15 days of the issuance of the draft guidelines, to the email id - hydro2-mop@gov.in.

This issues with the approval of Hon'ble Minister of Power and New & Renewable Energy.

Yours sincerely,



**(Vikrant S. Dhillon)**  
**Deputy Director**

Email: hydro2-mop@gov.in

Tel: 011-23705841

**Copy with similar request to:-**

Secretary, Department of Economic Affairs, Ministry of Finance  
Secretary, Ministry of New & Renewable Energy  
Secretary, Ministry of Environment Forests & Climate Change  
Secretary, Ministry of Mines  
Secretary, Ministry of Coal  
Chairperson, Central Electricity Authority

**Copy also to:**

**In-charge, NIC Cell, MoP:** with request to upload the draft guidelines on the Home Page of the official website of the Ministry and to kindly ensure that it stays on the Home Page for at least 20 days.

**(Vikrant S. Dhillon)**  
**Deputy Director**

## **Guidelines on Pumped Storage Projects**

### **1. Introduction**

Energy Transition entails increasing presence of variable and intermittent Renewable Energy Sources (VREs) like solar & wind in the energy mix. This presents a grid-level challenge for stability and a need for addressing the temporal considerations in power availability. Storage and ancillary services would be the attributes that require incentivization in the power system to ensure appropriate capacity. Comprehensive storage guidelines are required to set the direction of developments in this regard. Amongst the various technologies available for addressing this requirement of storage and ancillary services, Pumped Storage Projects (PSPs) are clean, MW scale, domestically available, time tested, and internationally accepted.

The positive aspects of PSPs are not limited to the attributes of storage and ancillary services. PSPs are clean, green, safe, and non-explosive. They don't produce any poisonous/ harmful by-products or pose problems of disposal. The guidelines to promote PSPs are not only based on their usefulness in maintaining grid stability and facilitating VRE integration but also keeping in view their other positive attributes when compared to other available energy storage systems.

#### **1.1 Perspectives**

Flexible Energy Generation Assets that can supply both Base Load & Peaking Power efficiently and economically are the need of the future and the necessary solution to address the dynamically evolving energy needs of India. At present, Variable Renewable Energy Sources (VRE) such as wind and solar are being connected to the grid at a rapid pace owing to their low cost of installation and the thrust on sustainable & green energy. The energy supply from VREs can't be regulated fully since they are dependent on the time of the day, different seasons, and the vagaries of weather. Hence, there is an ever-increasing demand for Flexible Energy Generation and Storage Assets. PSPs are best suited in the present scenario for addressing this demand. PSPs are also known as 'the Water Battery', which is an ideal complement to modern clean energy systems.

PSPs provide the necessary scale of storage and have a long service life of more than 40-50 years. This is much more than any other energy storage technology presently available. This also results in a low cost of delivered energy over the life of the projects. They are non-polluting and are more environmentally friendly. Pumped Storage Projects account for over 95 percent of installed global energy storage capacity, well ahead of lithium-ion and other battery types. It is estimated that pumped hydro projects worldwide store up to 9,000 gigawatt hours (GWh) of electricity worldwide.

#### **(a) Energy Transition Considerations**

India is on the path towards a clean energy transition, guided by the Nationally Determined Contribution (NDCs) targets, to reduce the emission intensity of its Gross Domestic Product (GDP) by 45% by 2030, get to 50% of installed capacity from non-fossil fuel sources by 2030 and achieve net zero carbon emissions by 2070. Given this thrust, the presence of variable renewable energy in the energy spectrum in the form of solar and wind is bound to increase. Given these ongoing energy transitions in the country, the development of PSPs is of paramount importance for providing greater inertia and balancing power to the grid. With its ability to store a large amount of

energy, frequent starts/stops, and faster ramp-ups/ramp-downs, PSPs are ideally suited to address the dynamic supply and demand in the country. PSPs can also be used for peaking operation and improves the reliability of the power system. While battery storage solutions are still evolving and are required for short duration storage needs in grid management, PSPs are a natural enabler for integrating greater amounts of wind and solar power.

### **(b) Ancillary Services Considerations**

Wind and Solar power, have become one of the lowest-cost sources of renewable energy. However, their inherent variable, uncertain and intermittent nature presents a huge challenge for integrating large quantities of renewables, while maintaining grid stability. The curtailment of wind and solar power is already being witnessed whereas they presently constitute only around 25% of total energy generation. With the increasing presence of VREs, the need for curtailment will be more acute if there is insufficient storage in the grid. PSPs present a viable solution to the integration issues of large RE capacities. They are best equipped for peak load requirements. PSPs can store a large amount of energy during off-peak hours and discharge over longer period. Thus, PSPs would help reduce RE curtailment and improve the plant load factor of VREs.

### **(c) Temporal Considerations**

It is anticipated that with the increasing presence of VRE in the energy mix, the generation of wind and solar energy may be at its peak where the energy demand is the lowest. If the energy from these sources is not stored during off-peak hours in times to come, there will be an increasing need for large operating reserves from thermal power plants (typically high carbon coal and gas) to meet the peak demands of the nation. PSPs provide an economical solution by off taking a large amount of energy from the grid during off-peak hours, increasing the load factor of other systems, and also providing additional capacity to meet the peak loads. Under suitable conditions, pumped hydro storage provides a dynamic response and offers critical backup during periods of excess demand along with maintaining grid stability. Without PSPs, full decarbonization of the electricity sector may not be achievable at reasonable costs. Thus, PSPs provide 'green storage' and make VREs dispatchable by firming up the capacities.

## **1.2 Advantages of Pumped Storage Projects**

### **(a) Ecologically friendly**

PSPs have minimal impact on the environment in their vicinity as they are mainly envisaged on the existing Hydro Electric Projects, reservoirs, or as off-the-river projects. All components of PSPs are connected, operated, and maintained in an environmentally friendly manner. There are no residual environmental impacts in the case of PSPs. The assessment of the storage technologies should be based on life cycle costing including the cost of decommissioning.

### **(b) Atmanirbhar Bharat**

The guidelines for the development of storage systems should be synchronized with the vision of Atmanirbhar Bharat. The PSPs primarily use indigenous technologies and domestically produced materials. Most of the electrical & mechanical parts of PSPs are also made in India. Other alternate solutions to storage such as batteries are heavily import-dependent especially given the current holding of lithium

reserves at the global level. The increasing demand for storage poses a major challenge to the energy security of our country.

### **(c) Tested Technology**

The PSPs operate on time-tested technology thereby infusing confidence in the lending institutions for a longer duration of loans. Additionally, the cost of technologies involved in the construction has reduced rendering PSPs a viable proposition. The technological surety associated with PSPs has opened the possibility for the developers to claim a higher debt-equity ratio in the projects.

### **(d) Local developmental**

The development of PSPs is highly capital intensive and involves the development of local transport infrastructure for the mobilization of men and materials. Local industries such as cement and steel also get impetus and drive job creation in the economy. This in turn can have a salutary effect on local area development. PSPs are an ideal investment for socio-economic and regional development considerations like infrastructure up-gradation and employment generation.

### **(e) Longer and reliable duration of discharge**

PSPs are generally designed for a longer duration of discharge of more than 6 hours to meet the peak demand or for compensating the variability in the grid due to VREs. Currently, Battery Energy Storage Systems are designed for up to 4 hours of discharge generally. The firm capacity of PSPs during peak hours is guaranteed and relatively immune to the grid conditions.

## **1.3 Pumped Storage Potential and Development Status**

As of date, the CEA estimates regarding on-river pumped storage potential is 103 GW in India. Apart from the above, a large number of off-river pumped storage potential is also available which is being estimated. Suitable support is to be extended to the identification and evaluation of such potential.

As of now, 8 projects (4745.60 MW) are presently in operation, 4 projects (2780 MW) are under construction, and 24 projects (26630 MW) have been allotted by States which are under different stages of development.

## **1.4 Long Term Plan for Pumped Storage Hydro Development**

The long-term approach to the development of pumped storage projects will be driven by various factors regarding the requirement of the grid to achieve the energy transition. The draft National Electricity Plan (NEP) published by Central Electricity Authority indicates that 18.8 GW of Pumped Storage Projects and 51.5 GW of BESS (5 hour) are required to integrate the planned RE capacity addition till 2032. However, additional development of PSPs at viable cost would bring down the requirement of BESS. As per the draft NEP published by the Central Electricity Authority, the country would require 18.8 GW of Pumped Storage Projects and 51.5 GW of BESS (5 hour) to integrate the RE capacity envisaged till 2032. The PSP capacity requirement may further increase if the cost of BESS does not come down as expected. The Central Electricity Authority will continue modelling and forecasting the energy demand and energy mix over the long term and providing an indication of the probable requirement of the various forms of storage. This exercise would mean factoring in the aspects of viability and technology change. The Resource Adequacy Plan will consider storage as an element of planning.

## **1.5 Barriers in the development of Pumped Storage Projects**

### **(a) Environmental clearances**

Presently, the environmental clearance and forest clearance process of PSPs is very cumbersome, since these projects are treated at par with the conventional hydro projects for the purpose of grant of EC and FC. The environment impact of PSPs constructed on existing reservoirs on on-the-river sites and on the off-the-river sites is generally less as compared to conventional HEPs. Further, unlike the conventional hydro projects, development of PSPs do not lead to significant displacement of the people and thus, require minimum R&R. Therefore, PSPs constructed on existing reservoirs on on-the-river sites and on off-the-river sites are required to be treated as a separate category for processing of clearances as an of infrastructure project.

### **(b) Free power**

PSPs are fundamentally energy storage projects designed to cater the need of grid stability during the peak hours. Unlike conventional hydro projects, PSPs do not produce electricity. They are net consumers of electricity. Therefore, there is no question of imposing the requirement of free power on PSPs.

### **(c) Cost of pumping power**

The cost of power from PSPs has three components - cost of storage, cost of conversion losses and cost of input power. One of the prerequisites to ensure the commercial viability of a PSP unit is availability of input power at affordable tariff. However, this constraint is likely to be overcome in near future, with the availability of solar power at relatively cheaper rates

### **(d) Value of peak power**

The importance of PSP lies in its capability to offer peaking power. Further, other services offered by PSPs, like spinning reserves, reactive support, black start ability, frequency response ancillary services and faster start-up and shutdown, which are essential for grid stability are not adequately monetized.

### **(e) Taxation**

With the approval of Union Cabinet, PSPs have been declared as renewable sources. However, associate concessions which are available to other renewable sources, are yet to be extended to PSPs. PSP components continue to be taxed at the GST rate of 18%/28%, whereas the GST on renewable sources such as solar and wind has been kept as 12%. This affects the viability of PSPs.

## **2. Measures already taken by Government of India for promotion of PSPs**

### **2.1 Utilization of financial and project execution capabilities of CPSUs**

Government of India vide its order dated 08.12.2022 has indicated identified PSP sites against CPSUs to facilitate their development. A state-wise indication has also been carried out to help the States with work related to PSPs. States are encouraged to allocate the PSPs to CPSUs for early and prompt development aligned with the national interest. The present indication is at **Annexure-I**.

## **2.2 Energy Storage Obligation**

Government of India has, vide its order dated 22.07.2022, notified the trajectory of Energy Storage Obligation for the distribution companies to ensure the capacities regarding storage as a grid element. This would create demand for storage. The present trajectory is at **Annexure-II**.

## **2.3 Waiver of ISTS charges for PSPs**

Given the importance of facilitating RE integration to the grid and in pursuance of National Tariff Policy 2016, waiver of ISTS and other transmission charges have also been made available to Pumped Storage Projects vide Ministry of Power's Order dated 23.09.2021 which is given at **Annexure-III**.

## **2.4 Budgetary Support for Enabling Infrastructure**

The hydro projects and PSPs are often taken up in remote areas which have infrastructure deficits. The infrastructure created for hydropower / PSP enables further development of the area as the same is available for reuse for other purposes. Given the same, the Central Government is providing budgetary support for funding the enabling infrastructure of hydropower projects. This scheme will also cover PSPs. The grant for enabling infrastructure is due to the creation of infrastructure facilities that have alternate developmental value. The present dispensation in this regard is at **Annexure-IV**.

## **3. Guidelines for promotion of PSPs**

The following guidelines are being issued for the promotion of Pumped Storage Projects:

### **3.1 Allotment of project sites**

The State Governments may allot project sites to developers in the following manner:

#### **(i) On nomination basis to CPSUs and State PSUs**

For early development, States may award projects directly to hydro CPSUs or State PSUs on a nomination basis. Due consideration shall be given to the experience and financial strength of the CPSUs/State PSUs. Further the CPSU/State PSU shall ensure that award of contracts for the supply of equipments and construction of the project, either through a turnkey or through well-defined packages, is done based on competitive bidding.

#### **(ii) Allotment through competitive bidding**

PSP project may also be awarded to private developers by following a two stage competitive bidding process. PSUs may also be allowed to participate in the bidding process. The first stage shall be for pre-qualification based on criteria of financial strength, experience of developing infrastructure projects of similar size, past track record of developing projects, turnover and ability to meet performance guarantees. In

the second stage, bids are to be called based on quantifiable parameters such as concession period of the project or any other parameter as specified by the Central/State Government.

In case of allocation through modes 3 (i) & (ii) above, the home state shall have the right of first refusal for 40% of the project capacity and tariff shall be fixed by the Appropriate Commission u/s 62 of the Electricity Act, 2003. The developer would be free to sell the balance storage space under short / medium / long term PPA, or in power markets or through bilateral contract.

### **(iii) Allotment through TBCB**

PSP projects may also be awarded on TBCB basis to developers on the basis of:

- a. Composite tariff (including the cost of input power) in case input power is arranged by the developer; or
- b. Tariff for conversion of power from off-peak to peak if the input power is to be arranged by the procurer of the storage capacity.

The appropriate Commission shall adopt the above tariff u/s 63 of the Electricity Act, 2003

## **3.2 Charges to be paid by the developer**

Developers shall begin construction within a period of 2 years from the date of allotment of the project, failing which, allotment of the project site shall be cancelled by the State. Further, in order to ensure the viability of the Pumped Storage Projects, States shall ensure that no upfront premium is charged for project allocation.

## **3.3 Market reforms**

The comparison of PSPs with other conventional and VRE sources purely based on financial aspects is undervaluing and de-emphasizing the economic benefits extended by these projects. The monetization of Ancillary services provided by Pumped Storage Projects will give a much-needed boost to the sector. For this purpose, the following reforms may be undertaken:

- i. The appropriate Commission shall ensure that services like spinning reserves, reactive support, black start, peaking supply, tertiary and ramping support, faster start-up and shutdown, which help in supporting grid stability are suitably monetized.
- ii. Appropriate Commission shall notify Peak and Off-Peak tariffs for Generation to provide appropriate pricing signal to Peak and Base Load Generating Plants.
- iii. PSPs and other storage projects shall be allowed to participate in the proposed high price segment of the day ahead market (HP-DAM) so that they can take suitable advantage of the price differential between Peak and Off-Peak tariffs.



- iv. In the event of capacity contracted not being fully utilized by the contracting agency, the developer would be free to transfer the usage of the capacity to other interested entities so that resources do not remain idle.

### **3.4 Financial Viability**

The current power scenario indicates an imminent deep penetration of electricity storage in future and PSPs would be required to be operated invariably in two cycles for as long as variable RE infusion keeps on increasing. Thus, PSPs are expected to be utilized or run to their full capacities. This ensures recovery of costs in a minimum period. With high rates during peak hours in the power exchanges, PSP developers have the opportunity to optimize their operations and earn suitable returns.

To ensure that only viable PSPs are taken up for construction under Section 62 of The Electricity Act, 2003 the Central Government may notify a benchmark cost of storage for investment decisions of CPSUs for PSPs considering 6-8 hours of operation. This will be based on the prevailing and anticipated difference between peaking and non-peaking rates. Efforts would be made to ensure that only those PSP projects are taken up for development whose levelized cost of storage is within the benchmark cost of storage.

### **3.5 Taxes and duties**

To reap the long-term benefits and socio-economic development of states due to hydropower projects, State Government shall consider reimbursement of SGST on hydropower project components. States may exempt land to be acquired by off-the-river PSPs from payment towards stamp duty and registration fees. Government land, if available, may be provided at a concessional rate to the developers on annual lease rent basis.

Storage is an intermediary system where energy is stored and released later. In line with the principles of double taxation avoidance, power from PSPs may be suitably considered to avoid double taxation.

### **3.6 Exemption from Free Power obligation**

PSPs are energy storage schemes. They do not produce energy. They are net consumers of energy. Hence, the PSPs would be kept out of the liability of free power.

### **3.7 Local Area Development Fund**

PSPs have a minimal environmental impact and have no R&R issues. Therefore, there will be no requirement of creation of a Local Area Development Fund.

## **4. Measures that concern other Ministries**

### **4.1 Utilization of exhausted mines to develop PSPs**

The discarded mines including coal mines in different parts of the country could be used as Hydro Storage and thereby become natural enablers for development of Hydro Pumped Storage Projects (PSPs). Efforts would be made to identify and

develop exhausted mines / coal mines as prospective PSP sites in consultation with the Ministry of Coal and Ministry of Mines.

#### **4.2 Rationalization of Environmental Clearances for off-river PSPs**

The off-river PSPs, are located away from the river course and have minimum impact on the riverine ecology. Hence they may be treated differently for grant of Environmental Clearance. PSP projects, where both reservoirs are built off-river or where one reservoir is built off-river and the existing on-river reservoir undergoes minor structural modification to connect it with the new reservoir may be treated as B-2 category projects. Such projects may be exempted from Environmental Impact Assessment (EIA) and public hearing and may only require preparation of Environment Management Plan (EMP).

#### **4.3 Green Finance**

Pumped storage projects are essential for the integration of renewable energy sources in the grid and their utilization, thereby avoiding greenhouse gas emissions. Hence, in order to initiate and accelerate the pace of establishment, PSPs may be supported through concessional climate finance. Sovereign green bonds issued for mobilizing resources for green infrastructure as a part of the Government's overall market borrowings may be deployed in the development of PSPs which utilize renewable energy for charging.

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