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भारत सरकार / Government of India
विद्युत मंत्रालय / Ministry of Power
Shram Shakti Bhawan, Rafi Marg
New Delhi - 110001, Tel: 011-23705841

Dated: 10th April, 2023

To

1. The Secretaries of all the Ministries / Departments of Government of India
2. The Chief Secretaries of the State Governments & Union Territories
3. Principal Secretaries (Energy / Power) - All the State Governments & UTs
4. CMDs - PGCIL, NTPC, NHPC, SJVN, THDC, NEEPCO, Grid India, PFC, REC
5. The Chairman - BBMB, DVC

Sub: Guidelines to promote development of Pump Storage Projects (PSP) - reg.

Sir / Madam,

This has reference to Ministry of Power's letter of even number dated 15th February, 2023 vide which the draft PSP Guidelines were circulated for comments / suggestions. Subsequently, a webinar was held on 23rd February 2023 on the topic of "Green Growth", wherein, inter alia, suggestions were also received on the framework for Pumped Storage Projects in the country.

2. Based on the comments / suggestions received from the stakeholders, the Guidelines to promote development of Pump Storage Projects in the country have been finalized. A copy of the PSP guidelines is enclosed herewith for information and necessary action.

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

Yours sincerely,

(Mohd. Afzal)
Joint Secretary

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Copy to:-

1. CEO, NITI Aayog
2. Secretary, CERC / All SERCs
3. Chairperson, CEA
4. Chairperson, CWC

Copy also to:

In-charge, NIC Cell, MoP: with request to upload the Guidelines on the website of the Ministry of Power.

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 and safe. They don't produce any poisonous/ harmful by-products or pose problems of disposal. The advantages of promoting PSPs are not only based on their usefulness in maintaining grid stability and facilitating VRE integration but also 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 necessary 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 since they are dependent on the time of the day, seasons, and the vagaries of weather. Hence, there is an ever-increasing demand for Energy 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. PSPs are also non-polluting and are more environmentally friendly. Pumped Storage Projects account for over 95 percent of installed global energy storage capacity. 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 (NDC) 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 the ongoing energy transitions in the country, the development of PSPs is of paramount importance for providing greater inertia and balancing power to the grid as battery storage solutions are still being scaled up 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. 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. PSPs can also be used for peaking operation and improve the reliability of the power system.

(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. Curtailment of wind and solar power is already being witnessed in some areas although they presently constitute only around 25% of total energy capacity. 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 country. 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. Pumped hydro storage provides a dynamic response and offers critical backup during periods of excess demand along with maintaining grid stability. Without PSPs, full decarbonisation of the electricity sector will 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 would 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 would be connected, operated, and maintained in an environmentally friendly manner. There are no residual environmental impacts in the case of PSPs.

(b) Atmanirbhar Bharat

The guidelines for the development of storage systems synchronize 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.

(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 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 capacity 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 27 projects (29930 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. As per the revised draft NEP published by the Central Electricity Authority, the country would require 26.7 GW of Pumped Storage Projects and 47.2 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 much less than 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 and on off-the-river sites may be treated as a separate category for processing of clearances.

(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 and wind 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.

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 08.08.2022 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 in 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 23.11.2021 which is given at **Annexure-III**.

In order to promote the development of PSPs, the waiver of ISTS charges shall be extended to all those PSPs where construction work is awarded by

30.06.2025. ISTS charges shall be levied on PSPs where construction work is awarded after 30.06.2025 as per the following trajectory:

S. No.	Award of construction work	ISTS charges
1.	01.07.2025 to 30.06.2026	25% of applicable ISTS charges
2.	01.07.2026 to 30.06.2027	50% of applicable ISTS charges
3.	01.07.2027 to 30.06.2028	75% of applicable ISTS charges
4.	From 01.07.2028	100% of applicable ISTS charges

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 also covers PSPs. The grant for enabling infrastructure is for the creation of infrastructure facilities that have alternate developmental value. The present dispensation in this regard is at **Annexure-IV**, and also applies to PSPs.

2.5 Timelines for formulation and concurrence of Detailed Project Reports for Pumped Storage Projects

The Central Electricity Authority has issued revised guidelines for formulation and for examination & concurrence of Detailed Project Reports for Pumped Storage Projects in July 2022 and August 2022 respectively. As per revised guidelines, the timelines for preparation of DPR for PSPs has been reduced from 900 days to 720 days. CEA shall further reduce these timelines for off-stream closed loop PSPs and PSPs on existing Hydro projects (where one reservoir is available).

In addition, since no tariff / financial evaluation is required to be done by CEA for PSP projects allotted through Tariff Based Competitive Bidding or as part of integrated Renewable Energy Project or as captive plants, CEA has reduced the timeline for concurrence of such projects from 150 days to 75 days. For other PSPs, the timelines for concurrence has been reduced from 150 days to 125 days.

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. The projects may also be allotted to Joint Ventures (JVs) between CPSUs and/or State PSUs for development of such PSPs. Further the CPSU/State PSU shall ensure that award of contracts for the supply of equipment 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 upto 80% 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

PSPs may also be awarded on a TBCB basis to developers. For this purpose, the task of carrying out S&I and preparation of DPR may be given to an SPV under a CPSU/State PSU. SPV may be responsible for pre-construction activities such as preparation of project report, land acquisition, environment and forest clearance, etc. Such a dispensation would ensure the possibility of tariff determination based on competitive bidding. The DPR may be subsequently bid out for construction and SPV transferred to the successful bidder 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 storage on a per Megawatt Hour basis 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.

(iv) Self-Identified off-stream Pumped Storage Projects

In addition to the above methods, developers may also self-identify potential off-stream sites where PSPs can be constructed. Since these sites are away from the riverine system and do not utilize the natural resources like river streams, allotment from State Governments would not be required for the development of PSP projects on such sites. Further, all statutory clearances need to be obtained from State and Central agencies before starting construction. It will help in harnessing the off-stream potential in the country at a faster pace. Projects developed in such a manner would be provided all concessions mentioned in these guidelines, subject to the directions issued by the Government from time to time.

3.2 Timelines for Start of Construction work after award of Project

Developers shall start construction work 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. However, relaxation of 1 year may be granted to those projects where delay in start of construction is attributable to pending Environment Clearance (EC) and Forest Clearance (FC), provided that the applications are submitted to concerned authorities within timelines agreed at the time of award of the project.

3.3 No Upfront Premium for Project Allocation

In order to ensure the viability of the Pumped Storage Projects, States shall ensure that no Upfront Premium is charged for project allocation.

3.4 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 all market segments of the power exchange, including the 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. 80% power generated when PSPs operate as conventional hydro power stations during monsoon period (i.e. no pumping energy required for power generation) would be offered to the Home State at the rate of secondary energy fixed by the Central Electricity Regulatory Commission. The developer shall be allowed to sell the remaining energy to cover their Operation & Maintenance costs and other expenses.
- v. 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. The gains made shall be shared with the original beneficiary in the ratio of 50:50.

3.5 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, the Central Government may notify a benchmark tariff of storage for investment decisions of developers considering 6-8 hours of operation of the PSP. 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.

Financial institutions like PFC, REC, and IREDA shall treat PSPs at par with other renewable energy projects while extending long term loans of 20-25 years tenure. The debt equity ratio of PSP projects can be upto 80:20, in consultation with the financial institutions.

3.6 Taxes and duties

To reap the long-term benefits and socio-economic development of states due to PSP projects, State Government shall consider reimbursement of SGST on PSP 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, Electricity Duty (ED) and Cross Subsidy Surcharge (CSS) shall not be applicable on pumping power for charging of PSPs as PSPs are merely facilitating conversion of energy. Electricity is stored during off-peak hours and discharged during peak hours. ED and CSS may only be levied on the final consumption of electricity.

Government of India from time to time has stated that no Water Cess should be levied on Hydro Power Projects since there is no consumptive use of water. Similarly, no water cess shall be levied on PSPs.

3.7 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.

3.8 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. 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, Ministry of Mines and respective State Governments.

5. Rationalization of Environmental Clearances for PSPs

The off-river PSPs, are located away from the river course and have minimum impact on the riverine ecology. Hence they need to be treated differently for grant of Environmental Clearance.

Ministry of Environment Forest & Climate Change (MoEF&CC) has already initiated action in this regard. As per draft notification issued by MoEF&CC on 11.10.2022, PSPs which meet the following criteria would be appraised under B2 category for grant of Environmental Clearance (EC) irrespective of power generation capacity: