सोलर एनर्जी कॉरपोरेशन ऑफ़ इंडिया लिमिटेड
(भारत सरकार का उपक्रम)
Solar Energy Corporation of India Ltd.
(A Government of India Enterprise)
स्वच्छ भारत – स्वच्छ ऊर्जा

Ref: SECI/PS/Green Hydrogen/Grant Prp./55191 Date: 24.04.2023

Sh. Ajay Yadav, IAS
Joint Secretary, Ministry of New and Renewable Energy
Atal Akshay Urja Bhawan, CGO Complex,
Lodhi Road, New Delhi - 110 003

Sub: Proposal for grant of capital subsidy for development of Solar-Wind-BESS-Hydrogen based pilot project

Dear Sir,

With reference to the National Green Hydrogen Mission by the Govt. of India, a financial outlay of 1,466 crores has been allocated for pilot projects. In this regard, SECI proposes to develop a 50 MW Solar-Wind-BESS-Hydrogen based pilot project to demonstrate the capability of green hydrogen as energy storage medium in dispatchable RE solutions in Sri Sathya Sri District of Andhra Pradesh, where SECI is having advance possession of land for development of the Project.

The proposed pilot project demonstrates the potential of utilizing hydrogen as storage medium in case of multi-day to seasonal variations in Solar and Wind with RE generation. In addition to hydrogen, the pilot project will also have BESS for managing sub-hourly and diurnal variations. NDMC, a distribution licensee in the NCR region has provided in-principle consent to off-take power at the levelized cost of energy of ₹ 4.00 per kWh from the project. Considering the scale of this project and nascent stage of green hydrogen generation infrastructure in the country, MNRE is requested to grant a capital subsidy of ₹ 235 crores from the budget allotted for pilot projects under National Green Hydrogen Mission. A copy of the project proposal is enclosed herewith.

Upon, approval of grant, SECI shall undertake the development of the project in EPC mode. The operational experience from the pilot project will be shared in public domain in order to instil confidence to project developers and financers in using green hydrogen as energy storage, thereby assisting in meeting the objectives of the National Green Hydrogen Mission.

Yours Sincerely,

YBK Reddy
AGM, PS

Enc.: 1. Proposal for Grant for development of Solar-Wind-BESS-Hydrogen based Pilot Project

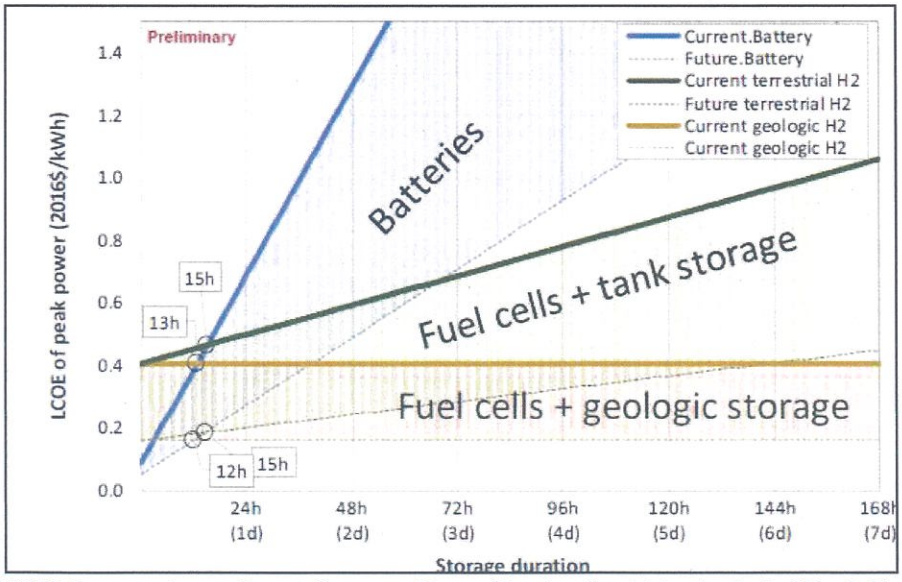
Proposal for grant of capital subsidy for development of Solar-Wind-BESS-Hydrogen based pilot project

Background

Government of India has launched National Green Hydrogen Mission with the objective of producing at least 5 Million Metric Tonne of Green Hydrogen per annum by 2030. Ministry of New and Renewable Energy has been assigned responsibility for overall coordination and implementation of the Mission. The Mission proposes pilot projects in sectors like steel, long-range heavy duty mobility, energy storage and shipping etc. Financial outlay of ₹ 1,466 crores has been allotted for pilot projects under the Mission. The proposal aims to develop Solar-Wind-BESS-Hydrogen based pilot project to demonstrate the capability of green hydrogen as energy storage medium in Load Following RE applications with grant support from the outlay for pilot projects.

Project Rationale

Renewable energy sources such as Solar and Wind exhibit sub-hourly, diurnal and multi-day to seasonal variations in energy generation which makes energy storage indispensable in Load Following RE applications. Sub-hourly and diurnal variations can be managed by Battery Energy Storage System (BESS). Multi-day to seasonal variations require longer storage duration for which hydrogen as a storage medium is cheaper than BESS. The preliminary results of study conducted by National Renewable Energy Laboratory (NREL) show that, with current technology, hydrogen has economic advantage over BESS when storage duration is more than 15 hours.



Ref: NREL Presentation on Energy Storage - Days of Service Sensitivity Analysis, March 19, 2019

The proposed pilot project will demonstrate the cost-effectiveness of hydrogen as storage medium in case of multi-day to seasonal variations in Solar and Wind for Load Following RE

applications. In addition to hydrogen, the pilot project will also have BESS for managing sub-hourly and diurnal variations.

Technology Readiness & International Experience

The generation components of the project – Solar and Wind – are matured technologies with installed capacities of over 64 GW and 42 GW respectively (as on 28th Feb, 2023).

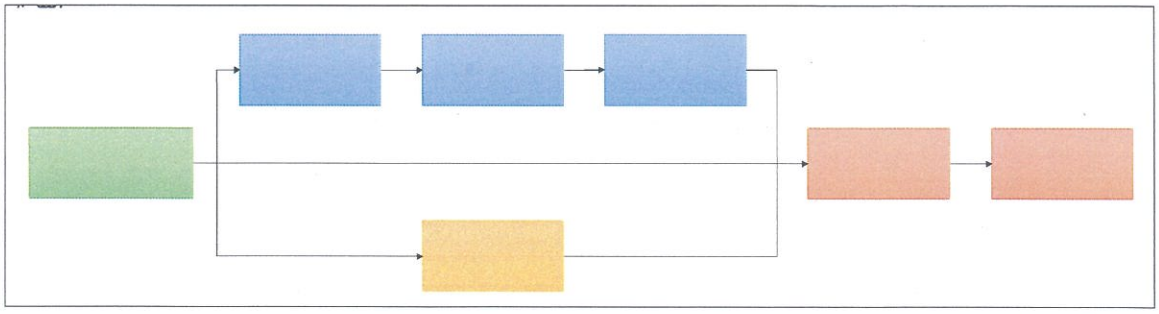
Deployment of large-scale Battery Energy Storage Systems (BESS) is under way in India with award of projects for supply of peak power and Round-the-Clock power. SECI itself is constructing 40 MW/120 MWh BESS project along with 160 MW Solar in Chhattisgarh. SECI also awarded country's first stand-alone BESS project of 500 MW/1000 MWh which will be constructed in Fatehgarh, Rajasthan.

Production of green hydrogen has gathered momentum worldwide with multiple project announcements. A 10 MW electrolyzer project has been constructed in Fukushima Hydrogen Energy Research Field (FH2R), Japan using Asahi Kasei's alkaline based electrolyzer which runs on 20 MW Solar Plant. Air Liquide constructed 20 MW green hydrogen electrolyzer plant in Québec, Canada using four 5 MW HyLYZER 1000-30 electrolyzers of Cummins. Spanish utility Iberdrola has commissioned 100 MW Solar – 5 MW/20 MWh BESS – 20 MW Electrolyzer plant in Puertollano, Spain using Nel Electrolyzer. Multiple MW-scale green hydrogen projects are under construction in various countries.

Power generation through MW-scale hydrogen fuel cell has been showcased in South Korea by Hanwha Energy. The company commissioned 50 MW hydrogen fuel cell power plant at Daesan Industrial Complex in Seosan, South Korea which is the largest industrial hydrogen fuel cell power plant in the world. Fuel cells for the project – 114 nos. of 440 kW each – has been supplied and maintained by Doosan Corporation.

Project Configuration

The proposed pilot project with evacuation capacity of 50 MW (AC) will comprise of 60 MW (AC) / 78 MWp Solar, 60 MW Wind, 10 MW/20 MWh Battery Energy Storage System, 2 MW Electrolyzer and 2 MW Fuel Cell. The project will be installed in Ramagiri Village of Sri Sathya Sai District of Andhra Pradesh. The power generated from the project will be evacuated to the grid through Pavagada CTU Substation at 220 kV level.



Dispatch Philosophy

When the combined Solar-Wind generation is equal to or more than the load plus transmission losses, the generation equal to load plus transmission losses will be dispatched to the grid. Any excess generation will be utilized to charge the BESS and operate the Electrolyzer in the order of priority. BESS will be discharged to manage sudden variations in generation and energy shifting later in the day to meet the load. Hydrogen generated using Electrolysis will be stored in the storage tanks which will be utilized to manage multi-day to seasonal variations by operating the fuel cell to discharge energy.

Sale of Power

SECI approached NDMC for sale of Power from the Project considering that the delivery profile from the Project is suitable for the Demand Profile of the Utility. Based on SECI's proposal, NDMC has intimated consent to purchase power from the Project at Rs. 4/kWh.

Project Cost and Financials

The capital cost of the pilot project is estimated to be ₹ 902.68 crores based on the present trends of Solar, Wind, BESS, Electrolyzer and Fuel Cell. The component breakup of the capital cost is provided in the table below.

S. No.	Component	Cost in ₹ crores
A	Solar	330.19
B	Wind	421.75
C	BESS	48.22
D	Electrolyzer and Fuel Cell	72.00
E	EPC Cost (E = A + B + C + D)	872.16
F	Soft Cost (F = 3.5% of E)	30.52
G	**Capital Cost (G = E + F)**	**902.68**

Operation and Maintenance cost is estimated to be ₹ 12 lakhs per MW per year with 3.84% annual escalation. Considering Debt-Equity ratio of 70:30, interest rate of 9%, Post-tax Return of Equity of 14% and Corporate tax of 25.17%, the levelized tariff is determined to be ₹ 5.08 per kWh for the project life of 25 years. In order to bring down the levelized tariff to ₹ 4.00 per kWh, the grant support required is estimated to be ₹ 235 crores.

It may be noted that solely-hydrogen based Power-to-Power Cycle i.e. without BESS, where the thermal energy is not utilized is a low-efficiency process and results in higher tariff of approx. Rs. 6.50/kWh for similar output profile. In such case, to bring the tariff to Rs. 4.00/kWh, higher Grant Support of approx. 528 Cr. shall be required. BESS component has, therefore, been incorporated in the project design to optimize the tariff. Going forward, as

hydrogen generation infrastructure in the country is developed, project configurations with higher hydrogen-based storage may be considered. ***For the present proposal, MNRE is requested to grant a capital subsidy of ₹ 235 crores from the financial outlay of 1,466 crores allotted for pilot projects under National Green Hydrogen Mission so that levelized tariff can be brought down to ₹ 4.00 per kWh.***

Implementation Modalities

SECI has taken 900 acres of land in advance possession in Ramagiri and Muthavakuntla villages of Sri Sathya Sri District of Andhra Pradesh from New and Renewable Energy Development Corporation of Andhra Pradesh Limited (NREDCAP). SECI has also obtained Stage-I and Stage-II connectivity for 200 MW at CTU Pavagada Substation. As the capital cost of the project is more than 500 crores, the project needs to be appraised by Public Investment Board (PIB) and approved by Minister-in-charge of MNRE and Finance Minister.

While processing for investment approval, bids for Engineering, Procurement and Construction of the Solar-Wind-BESS-Hydrogen pilot project will be invited by SECI. Once investment approval is obtained, EPC contract will be awarded to the successful bidder. The project will be commissioned within 24 months from the date of award of EPC contract. Further, PPA shall be signed with NDMC for 25 year period.

Conclusion

Development of the proposed pilot Solar-Wind-BESS-Hydrogen project for demonstration of Hydrogen as a long-term storage alternative at this scale is first of its kind in the country. The project is envisaged to provide valuable insight into the challenges and opportunities for the country and explore its alternative usage at commercial scale. With the objective of reducing the Levelised Cost of Energy (LCoE) from the project to Rs. 4/kWh, for which NDMC has already intimated consent to off-take power, grant support of Rs. 235 Crores is proposed to be allocated to SECI from the outlay for Pilot Projects under the Green Hydrogen Mission. The operational experience from the pilot project will be shared in public domain in order to instill confidence to project developers and financers in using green hydrogen as energy storage, thereby assisting in meeting the objectives of the National Green Hydrogen Mission.