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Transforming India's Power Landscape

Enabling renewable energy integration in the distribution grid: A pilot on battery energy storage system (BESS) deployment

India's National Tariff Policy mandates that power distribution companies (DISCOMs) purchase renewable energy (RE) to meet their renewable purchase obligation (RPO) targets. Procurement of RE, which is less predictable and variable by nature, requires systems to tackle the variability and intermittency of RE power supply and prevent demand-supply mismatches in the grid. Battery energy storage systems (BESS) are regarded as an effective tool to meet these needs, given the technology's power-balancing capability to store and deliver energy quickly. Many countries across the globe are evaluating BESS as a major option for reliable RE integration. India, too, has been proactively examining technology options to modernize and evolve its power systems in line with the country's clean, green energy goals.

THE IMPERATIVE FOR ENERGY STORAGE SYSTEMS AT DISTRIBUTION UTILITIES

GTG-RISE conducted a pilot to examine and demonstrate the benefits that BESS can bring to distribution system stakeholders. As part of the pilot, GTG-RISE provided technical assistance to a private DISCOM in Delhi — BSES Rajdhani Power Limited (BRPL) — for designing and implementing distribution network level BESS deployment to manage distribution network congestion and reduce peak power purchase requirements.

To meet its RPO targets, BRPL has committed to purchasing 1,199 megawatt (MW) of RE power at a competitive tariff, to be commissioned by 2021–22. The increase in RE procurement means that BRPL's power supply will be more variable and

intermittent. The DISCOM aims to meet the variability with more accurate forecasting techniques and using fast ramping resources. However, the current absence of such measures can put grid stability at risk, and in turn cause the system operator to purchase reserves on a larger scale, which in turn would increase system costs.

BRPL also has a large seasonal and diurnal variation in demand, which means that its system load varies considerably. Given the high growth of solar rooftop photo voltaic (PV) in BRPL's network, this variability will continue to increase in the future. The variability can mean that the system has both huge surpluses and shortages within a single day, which again has significant financial implications. The sale of surplus power during off-peak hours is mandated as a must-sale in the day-ahead market (power exchange) at a price much lower than the purchase price. Selling surplus power in the day-ahead market will lose money for any DISCOMs like BRPL.

USAID's Greening the Grid-Renewable Integration Sustainable Energy (GTG-RISE) program, a joint bilateral initiative with Ministry of Power, Government of India has been testing solutions to enable large-scale RE integration in the national grid. USAID through GTG-RISE has implemented a series of prioritized innovation pilots to bolster national and regional power systems' ability to stay resilient while integrating RE. GTG-RISE is a key initiative under the U.S-India Strategic Clean Energy Partnership (SCEP) and is implemented by Deloitte Consulting LLP.

MAKING THE CASE FOR DISTRIBUTION NETWORK-LEVEL DEPLOYMENT OF BESS

The GTG-RISE team provided technical assistance to BRPL to examine how BESS could help it address the challenges it faced. The team undertook a techno-economic benefits demonstration to assess the multiple benefits BESS could provide; and supported BRPL in evaluating the benefits associated with adding 20 MW BESS to its system. The technical study assessed the optimal locations at which BESS could be deployed on BRPL's network, focusing on RE's impact on ramping requirements in accordance with the Indian Electricity Grid Code deviation limit set by Central Electricity Regulatory Commission (CERC) and Delhi Electricity Regulatory Commission (DERC). The BESS would allow BRPL to store surplus power for use at the time it is needed.

The GTG-RISE team helped BRPL prepare a business case for BESS deployment in the distribution grid. This included a cost-benefit analysis, using D.VAST (Deloitte Value Analyzer for Storage Technologies - Deloitte's proprietary model), to evaluate the economic viability of deploying BESS on BRPL's distribution network. The team estimated BESS's benefits for ramping support, energy arbitrage (peak-shaving), capacity deferral, loss reduction, and outage management. The analysis was undertaken for all sizes of BESS (from 1 MW to 50 MW). Deloitte determined the BESS size that would provide the maximum benefits and recommended the optimum size – 20 MW – to BRPL.

The pilot also supported the design of a BESS Power purchase agreement (PPA) with Service Level Agreement (SLA). Based on the pilot's outcomes, BRPL proposes to install a 20-MW 2-hour BESS project, which will be owned and operated by the Solar Energy Corporation of India (SECI) under the SLA which is to be signed between BRPL and SECI. This will be one of the first large-scale grid-connected BESS deployments in the country. It will demonstrate use cases that bring value to the system and provide benefits to end users. BRPL has submitted the GTG-RISE pilot

A 20 MW / 40 MWh BESS provides annual benefits to the tune of INR 114 million (levelized) and was recommended as the optimum battery size to be deployed in BRPL's network



analysis report to DERC for its approval. If deployed successfully, the study and the model could be replicated by utilities across the country.

SCALING UP

The BRPL pilot study was the first of its kind in India. The study's modeling efforts demonstrated the potential scope and value of BESS applications for distribution. The framework GTG-RISE used to estimate BESS's economic benefits for BRPL can be replicated at other DISCOMs to analyze the viability of BESS for their systems.

Because of its strong potential to save DISCOMs and customers' money, BESS is likely to become integrated into most DISCOMs' operations over the next few years. Recognizing BESS's importance in the transition to a clean energy economy, NITI Aayog, with assistance from The World Bank, undertook an assessment of BESS requirements in four Indian states. The World Bank used the outcome of the GTG-RISE BESS pilot to commission similar BESS value assessments for Gujarat, Madhya Pradesh, West Bengal, and Karnataka, with the goal of designing public-private partnership (PPP) opportunities to deploy battery storage in each state's distribution systems. The International Finance Corporation (IFC), part of the World Bank group, has already initiated multiple studies to identify potential battery storage deployment opportunities across different user groups, including distribution utilities.

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Notably, CERC's recently notified draft Ancillary Service Regulations (2021) aim to provide mechanisms for procuring and deploying ancillary services (AS) in India. The draft AS regulations, if implemented, will pave the way for deployment of large grid-scale energy storage facilities for commercial operations.

The results from the RISE pilot catalysed the World Bank to fund BESS value assessments in the transmission and distribution network of four states



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