



USAID
FROM THE AMERICAN PEOPLE



GOVERNMENT OF INDIA
MINISTRY OF POWER

AGENDA

BATTERY ENERGY STORAGE SYSTEMS FOR GRID APPLICATIONS TRAINING

ORGANIZED BY
UNITED STATES ENERGY ASSOCIATION
FUNDED BY
U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
UNDER THE
GREENING THE GRID/INDIA PROGRAM
A JOINT INITIATIVE OF
USAID AND THE MINISTRY OF POWER

November 28 – 30, 2018
New Delhi, India



GREENING THE GRID/INDIA

USAID's Greening the Grid is a five-year program implemented in partnership with India's Ministry of Power (MOP) under the U.S.-India Partnership to Advance Clean Energy Deployment (PACE-D). This program aims to support the Government of India's (GOI) efforts to manage large-scale integration of Renewable Energy (RE) into the grid. The program combines the following three components:

- Power system planning reforms and targeted analysis for large RE parks and RE integration pilots
- Renewable Integration and Sustainable Energy (RISE) initiative to implement innovation pilots to improve the integration of RE
- Peer-to-Peer exchanges between U.S.-India system operators and regulators

Under the U.S.-India System Operators Partnership, the U.S. Energy Association is implementing a series of activities to support the GTG program targeting system operators from the national, regional and state load dispatch centers and other stakeholders. It will focus on sharing transmission system operation and planning best practices for large-scale variable renewable energy (VRE) integration into the power grid.

TRAINING GOAL & OBJECTIVES

India plans to deploy unprecedented levels of renewable energy (RE) on its power grid – 227 GW installed capacity of renewable energy by 2022. Current estimates stand at approximately 71.33 GW of installed RE capacity.) Further, India's Nationally Determined Contributions (INDC) extends this ambition to 40% non-fossil fuels-based electricity generation capacity by 2030. This will greatly reduce the economy's carbon intensity and strengthen energy security. Compared to conventional power, however, India's key RE options are more variable, less predictable and often further from demand centers. Experience in other systems has shown that when penetration of RE reaches significant levels, the capacity of the power grid to manage it must be addressed to avoid challenges to the reliability and affordability of electricity. Critical to integrating VRE into the power system is rigorous analytical support to identify grid stability issues, options for optimizing dispatch, and sources of potential flexibility.

Training Goal

This purpose of this training is for executives from Power System Operation Corporation Ltd. (POSOCO), the Central Energy Authority (CEA), state load despatch centers (SLDCs), and other relevant stakeholders aims to gain knowledge of battery energy storage system (BESS) for grid applications. Worldwide, BESS technology is being used to support grid operation and facilitate integration of variable renewable energy sources.

Training Objectives

The objectives of this training are to provide participants with updated information on battery energy storage technology, specifically:

- Policy frameworks from international best practices intended to enable R&D and utilization
- Current economic viability of battery technology
- Uses and benefits of BESS for renewable energy integration and efficient grid operation

Venue

NRLDC, POWER SYSTEM OPERATION CORPORATION LIMITED
18-A, Shaheed Jeet Singh Sansalwal Marg, Katwaria Sarai, New Delhi - 110016

SPEAKERS

Gurpreet Chugh, Managing Director – ICF

Gurpreet is Managing Director in India. He joined ICF in 2013 and manages ICF's portfolio of consulting business in the country and region. He has expertise in the energy sector and has close to 17 years of global experience. Prior to joining ICF, Gurpreet was director, Natural Resources at CRISIL Infrastructure Advisory. Gurpreet has worked in India, UK, West Africa and Russia. He has a mix of consulting, industry and investment experience. He has led, evaluated and structured private M&A deals in E&P sector in Asia and Africa. In his professional career as a consultant, he has worked on consulting engagements for International energy majors and provided advisory services on issues across the gas value chain.

Email: gurpreet.chugh@icf.com

Alan Greenshields, Chairman – Innolith AG

Alan has been working in the rechargeable battery space for the last 15 years and was co-founder of fortu, the company which originally developed the core inorganic electrolyte technology used by Innolith. He started his career in high-volume manufacture of computer electronics with IBM, Scotland and later worked for the Instrumentation Division of VDO Adolf Schindling AG, Germany, a world-leader in automotive instrument clusters and now part of Continental, having executive management responsibility for R&D and production of the international business unit. His entrepreneurial career includes a successful start-up Cambridge UK in digital temperature monitoring equipment (now part of Fluke Process Instruments) and the turnaround and sale of Germany's then-largest software localization and multilingual technical translation company (now part of Lionbridge Technologies). Alan holds a double bachelor's degree in Manufacturing Sciences & Engineering with First Class Honours from the University of Strathclyde in Glasgow, Scotland. He was awarded a Knox Fellowship to study Business Economics at the Harvard Graduate School of Arts and Sciences, and later returned to Harvard Business School where he obtained an MBA with High Distinction (Baker Scholar). He is a Chartered Engineer (CEng), Member of the Institution of Engineering and Technology (MIET) and Member of the Institute of Mechanical Engineers (MIMechE). He is engaged in several initiatives relating to renewable energy including the Think Tank on Energy Environment and Business initiated by Harvard Business School in 2010 and has served for many years as a main-jury judge for the Swiss Technology Awards.

Email: alan.greenshields@innolith.com

Vibhu Kaushik, Director of Grid Technology and Modernization – Southern California Edison

Southern California Edison (SCE), the largest subsidiary of Edison International, is the primary electricity supply company for much of Southern California, USA. It provides 15 million people with electricity across a service territory of approximately 50,000 square miles. As the Director of Grid Technology and Modernization at SCE, Vibhu leads SCE's strategic roadmap for grid modernization, and serves as SCE's leader in applied research and grid modernization, leading industry groups and external stakeholders on industry initiatives, research activities, standards and cooperative projects. He also leads SCE's technical efforts in deployment of emerging technologies including key integrated pilot demonstration projects. Previously, Vibhu held several roles within SCE including Principle Manager of Asset Management and Generation Strategy group where he was responsible for driving the major maintenance and capital investment decisions and maximize the returns for the company's hydroelectric, natural gas, energy storage, and solar power plants; Vibhu originated and led SCE's award-winning Hybrid Enhance Gas Turbines project and Energy Storage initiatives. Vibhu earned a bachelor's degree in mechanical engineering from Indian Institute of Technology, Delhi, and a master's degree in mechanical engineering from University of Manitoba, Canada, and a master's degree in business administration from University of California, Los Angeles.

Email: vibhu.kaushik@sce.com

Dia Dean Koujak, Director, Energy – Navigant Research

Dia Dean Koujak, a Director in Navigant's Energy Practice, provides advisory services to utilities, developers, investors and other stakeholders in the electric power industry. Having more than 14 years of industry experience, he has advised on several key decisions in power procurement, large scale renewable development, renewable portfolio standards compliance, transmission infrastructure planning, grid modernization, non-wires solutions, RTO markets (NYISO/PJM/ISO-NE), energy efficiency program implementation, utility contract negotiations, procurement standards and compliance, electric resource planning, M&A and industry litigation. He has managed multiple key utility initiatives throughout all stages of the projects including planning, design, implementation and execution. Over time, he has enabled electric utilities to successfully plan, evaluate, select, and contract over 4,600 MW of electric generating facilities. He has supported and been engaged on competitive power procurement and electric market matters in New York, New Jersey, Texas, Hawaii, California, Ohio, Massachusetts, Ontario, Saskatchewan, Alberta, and North Carolina. Over the course of multiple resource planning and procurement engagements, he led the comparative evaluation of energy storage, renewable and conventional generation resources. Mr. Koujak has a BS degree in Engineering Management from New York Institute of Technology, an MBA in Operations Management from the State University of New York at Stony Brook, and a JD from Hofstra University School of Law.

Email: dkoujak@navigant.com

Kiran Kumaraswamy, Market Applications Director – Fluence

Kiran is a stationary energy storage expert with knowledge on storage policy, operations, early-stage market and customer development and product design. He has experience in evaluating multiple-use cases for energy storage and ability to identify appropriate applications that make commercial sense for customers. Mr. Kumaraswamy has strong experience in energy market design, transmission and distribution planning, and regulatory issues related to distributed energy resources and wholesale power assets, as well as modeling expertise in power transmission systems (power flow modeling), energy production cost modeling.

Email: kiran.kumaraswamy@fluenceenergy.com

Rupam Raja, Market Director, India – Fluence

Rupam leads Fluence's market development activity in India currently focusing on front and behind the meter energy storage applications in transmission, distribution, commercial and industrial sectors. Prior to Fluence he was Partner with an environmental risk advisory with primary responsibility of working with private equity, strategic investors, law firms and investment advisors, working across sectors that have material environmental footprint (i.e. power, chemical, infrastructure). Rupam's past experience includes development of an investment pipeline of clean energy projects in Indonesia and Malaysia with a total generation capacity of over 200MW for a premier energy focused private equity fund and for AES Corporation. He has published research reports and opinion pieces, guest lectured at academic institutions in India and US, addressed industry associations, media and moderated panel discussions on issues at the intersection of environmental policy and business.

Rupam is based in Gurgaon, India.

Email: rupam.raja@fluenceenergy.com

Pramod Kumar Singh, Manager, India Power & Fuels – ICF

Pramod Kumar Singh has around 12 years of experience working on clean energy projects. He has been involved in projects pertaining to the complete energy cycle, including power generation, transmission, distribution, demand side management, and energy efficiency and worked on projects in Australia, Bangladesh, Europe, India, Nepal, Philippines, Singapore, Thailand, and the United States. Relevant to storage, he was involved in a World Bank study on assessment of storage market in India. He has conducted techno-economic feasibility studies for utility scale and commercial scale storage projects. For instance, he was involved in the technical design, engineering, economic assessment, and implementation of a MW scale renewable energy hybrid microgrid (solar, batteries, diesel generator, and biomass) for a project funded by the California Energy Commission. He also assisted a utility district of California to conceptualize a MW scale hybrid renewable energy microgrid (solar, batteries, diesel generator). He is an Electrical Engineer from Indian Institute of Technology, Roorkee and a post graduate in Energy Technology and Policy from California State University, Humboldt.

Email: Pramod.Singh@icf.com

Vinayak Walimbe, Director, Financial Services – Customized Energy Solutions

Vinayak is a Chartered Financial Analyst with extensive experience in the power sector. His work includes providing investment analysis and developing proposed price structures for electric power projects. He leads the development of the CoMETS modelling suite used for economic evaluation of energy storage projects. He has evaluated numerous grid-connected as well behind-the-meter energy storage projects in North America. Vinayak has been involved in valuing and structuring multimillion-dollar deals in the power and aircraft industries. Before joining CES, he was a manager at BTU Ventures, a private equity fund based in Boston where he focused on power project finance and fund raising. Prior to BTU, he worked at RISConsulting, a Boston-based firm, where he was involved in aircraft securitizations and other structured finance products. Previously, he had done research in nonlinear control systems where he worked on problems involving differential geometry and bifurcation theory. Vinayak holds a Master of Science from Georgia Institute of Technology, Atlanta and a Master of Engineering from V.J.T.I. Mumbai. He holds an undergraduate degree in Electrical Engineering from Walch and College of Engineering, Sangli, India.

Email: ywalimbe@ces-ltd.com

CONTACT FOR QUERIES

Ms. Sarah Blanford (USEA GTG Partnership)

Senior Program Coordinator, Energy Utility Partnership Program

U.S. Energy Association

M: +1-202-641-6112

sblanford@usea.org

Ms. Elise Voorhis (USEA training host/organizer)

Program Coordinator, Energy Utility Partnership Program

U.S. Energy Association

M: +1-512-796-2624

sblanford@usea.org

Mr. Satish Kumar Singh (GTG RISE)

USAID/India Greening the Grid (GTG) Program

Renewable Integration and Sustainable Energy (RISE) Initiative

Implemented by Deloitte Consulting LLP

503-504, Fifth Floor, DLF Place Mall Office Block, Saket, New Delhi – 110017

M: +91 9717070868

satishsingh@deloitte.com

SCHEDULE

Day I	Wednesday, November 28
9:00 – 9:30	Registration
9:30 – 10:30	Inaugural session
	9:30 Opening Speaker: Ms. Elise Voorhis – USEA
	9:35 Introductory remarks Speaker: Mr. Michael Satin, Director of Clean Energy and Environment – USAID
	9:50 Welcoming remarks Speaker: Mr. K.V.S. Baba, Chairman & Managing Director – POSOCO
10:10 Introductions of speakers and participants Moderator: Ms. Elise Voorhis – USEA	
10:30 – 11:00	Coffee Break & Group Photo
11:00	Reconvening: Ms. Elise Voorhis – USEA
11:00 – 12:15	Session 1: Battery Energy Storage Systems Overview Presenter: Mr. Shubhranshu Patnaik /or/ Satish Kumar Singh – GTG RISE
	BESS has become an important component for enhancing power system performance and grid reliability. This session will provide a brief overview of the types of BESS, applications/uses, the difference between storage as an energy supply vs. demand resource, and market implications, behind-the-meter storage, storage for generation support vs. distribution support vs. grid-connected storage.
12:15 – 13:30	Session 2: Policy and regulations governing BESS for grid support applications Presenter: Mr. Kiran Kumaraswamy, Market Applications Director – Fluence
	The Indian grid is going through a transformative phase. Understanding the role that BESS can play in this transformation is essential for creation of future policy and regulation. An overview shall be provided for key trends in policies for development, deployment, and commercialization of large scale BESS for grid applications. Success stories from around the world shall provide insights to participants on important policy aspects related to development and scaling up of investments for grid scale BESS.
13:30 – 14:30	Lunch Break
14:30 – 16:30	Session 3: Moderated discussion – Policy examples from international markets and applicability for India
	Presenters will provide brief case studies that tie the issues that face the Indian grid with other markets globally and identify potential policy examples that are relevant for India. The moderator will pose questions to the panel to generate a

	discussion on policy frameworks and roadmaps for implementing BESS grid applications for India
	<p>Opening presentation: Mr. Matthew Ogonowski, Energy Specialist – USAID</p> <p>Moderator: Ms. Monali Zeya-Hazra, Regional Energy Manager and Clean Energy Specialist - Clean Energy and Climate Change – USAID</p> <p>Panelists:</p> <ul style="list-style-type: none"> • Mr. Vibhu Kaushik, Director of Grid Technology and Modernization – Southern California Edison • Mr. Dia Dean Koujak, Director, Energy – Navigant Research • Mr. Vinayak Walimbe, Director, Financial Services – Customized Energy Solutions
16:30	Adjourn

Day 2	Thursday, November 29
9:15 – 9:30	Registration
9:30 – 10:45	<p>Session 4 (Part 1): Economic valuation of BESS for grid support applications</p> <p>Presenter: Mr. Vinayak Walimbe, Director, Financial Services – Customized Energy Solutions</p> <p>A key consideration for application of battery storage for grid support is its economic value, justifying deployment / regulatory approval. This session shall focus on economic valuation principles and models adopted in various jurisdictions for establishing value of BESS at the grid level and in deciding capacity targets for BESS. The speaker shall present principles of storage valuation and roadmaps adopted in US states / RTOs / other countries (e.g. California, Germany, etc.).</p>
10:45 – 11:45	<p>Session 4 (Part 2): Economic valuation of BESS for grid support applications</p> <p>Case study: Framework for Deployment of Hybrid Energy Storage Solutions in India</p> <p>Presenters: Mr. Gurpreet Chugh, Managing Director – ICF & Mr. Pramod Kumar Singh, Manager, India Power & Fuels – ICF</p> <p>Presentation of a case study on a renewable energy hybrid project in India that is financed by World Bank. The case study will cover the technical and economic viability of a grid connected storage solution in India. While several aspects were covered in the study, the case study will focus on the approach for selection of use cases, sizing calculation and economic analysis taking an upcoming solar-wind storage hybrid in Andhra Pradesh as an example.</p>
11:45 – 12:00	Coffee Break
	<p>Session 5 (Part 1): Battery Energy Storage System: Utility Perspective</p> <p>Presenter: Mr. Dia Dean Koujak, Director, Energy– Navigant Research</p>

12:00 – 13:00	The use of battery energy storage has become increasingly important with the large-scale deployment of variable renewable energy resources. Electric power system studies identify system needs and show the potential opportunities for BESS and competing technologies. This session shall be focused on the available BESS technologies, electric power system issues and types of electric power system studies that must be conducted, and other considerations that must be addressed to successfully develop battery energy storage systems. The speaker will present on storage for transmission and distribution applications for the grid, factoring in intended and realized benefits from storage deployment in networks.
13:00 – 14:00	Lunch Break
14:00 – 15:00	Session 5 (Part 2): Battery Energy Storage System: Utility Perspective in California Presenter: Mr. Vibhu Kaushik, Director of Grid Technology and Modernization – Southern California Edison
15:00 – 16:30	Session 6: Grid Applications of BESS Presenter: Mr. Kiran Kumaraswamy, Market Applications Director – Fluence BESS can be used to mitigate the voltage unbalance of the electrical networks, provide frequency control, firm up RE power, provide spinning reserves, shave peak demand, reduce operating costs, etc. BESS represents a remunerative investment for many applications. This session is focused on various application of BESS from a RTO/ISO's perspective through case studies and examples that are potentially applicable to India.
16:30	Adjourn
19:00	Dinner hosted by USEA

Day 3	Friday, November 30
9:15 – 9:30	Registration
9:30 – 11:00	Session 7: Battery Technologies and Pricing Trends Presenter: Mr. Rupam Raja, Market Director, India – Fluence Battery technology usage/application is evolving on a continuous basis and new features are being introduced. Simultaneously, the pricing of the battery systems is decreasing, and it is projected that soon, the costs will justify associated benefits from the battery energy storage systems. This session is focused on sharing the experiences of manufacturers and economists on existing and futuristic battery technologies and cost trends.

11:00 – 11:15	Coffee Break
11:15 – 12:15	<p>Session 8: Case Study – Innolith GridBank for Frequency and Voltage Regulation Services for PJM Presenter: Mr. Alan Greenshields, Chairman – Innolith AG</p> <p>The Hagerstown installation was the world’s first-ever deployment of rechargeable lithium batteries using inorganic electrolyte. The Innolith batteries scored 98.52% in initial tests and thereafter have consistently scored above 95% in this competitive market. In the interim substantial improvements have been made to both the electrochemistry and other system components which are expected to improve system performance even further. In particular, the latest version of the chemistry offers very low capacity fade and is projected to support the PJM RegD signal for 15 years without the need for augmentation. This represents a cycle life in excess of 50,000 0-100% depth of discharge cycles and a total bi-directional throughput energy in excess of 60 GWh per MWh of installed capacity. This in turn reflects key features of inorganic electrolytes – safety, robustness, stability and longevity. Innolith believes that its inorganic electrolyte platform can make a major contribution to improving both the technical performance and economics of BESS by providing levels of durability which are not possible with conventional technologies.</p>
12:15 – 13:00	<p>Working Session - Part I Moderator: Ms. Elise Voorhis – USEA</p> <p>Delegates break into groups to draft a framework for India to use for evaluation of potential BESS projects. The framework should identify economic valuation principles, considering policy, regulation, financing, and technical components for enabling an incremental revenue stream to support the economics of BESS.</p>
13:00 – 14:00	Lunch Break
14:00 – 15:00	<p>Working Session – Part 2</p> <p>Groups present frameworks</p>
15:00 – 15:15	<p>Post-bootcamp evaluation surveys Moderator: Ms. Elise Voorhis – USEA</p>
15:15 – 15:45	<p>Closing Ceremony</p> <p>15:15 Closing remarks Speaker: Mr. K.V.S. Baba, Chairman & Managing Director – POSOCO</p> <p>15:30 Vote of thanks Speaker: Mr. Michael Satin, Director of Clean Energy and Environment – USAID</p>
15:45	Adjourn