Pilot Background and Context Setting

Location: Vidyut Bhawan, Jaipur
Date: September 13, 2017

Renewable Integration & Sustainable Energy Initiative
Greening the Grid (GTG) Program
A Partnership between USAID/India and Government of India
1. Key Strategies and Initiatives for RE Integration

2. Overview of Pilots

- Dynamic Compensation for Large RE Integration
- Automatic Generation Control for Secondary Response (South – Karnataka; hydel, wind and solar)
- Grid Connected Storage Systems
- Coal Based Flexible Generation - GSECL (Partnering NTPC?)
- Real-time monitoring of DERs and enhancing net load forecasting ability of Discoms (BESCOM / TPDDL)
- Regional platform for day-ahead and intra-day coordination in dispatch (Western or Southern)
Key Strategies and Initiatives for RE Integration
Range of Options for RE Integration
Range of actions on RE Integration

- Technical committee constituted by the Ministry of Power (for large scale integration of RE, need for balancing, DSM, and associated issues)

- Task force constituted by MOP (on integration of electricity from RE sources in the grid during the 12th plan and beyond) under the Chairman, CEA

- Technical Committee of Forum of Regulators (FOR) for Implementation of SAMAST framework and to facilitate Grid Integration of Renewables at State level

- CERC:
  - CERC (Ancillary Services Operations) Regulations, August 2015
  - Report of the Committee on Spinning Reserves, September 2015
  - Roadmap to operationalize Reserves in the country, October 2015
Overview of RISE Pilots

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1/3/2019
Dynamic Compensation for Large RE Integration
Introduction

• This pilot is proposed to be implemented in partnership with RVPN and ADB.

• Rajasthan is developing the Bhadla Ultra Mega Solar Park in phases & corresponding lines & s/s are being planned/executed by both State Transco and CTU.

• Significant progress has been made in the country on resource adequacy, production cost modelling and load flow studies at the State and National level. However, stability studies focused on all the various stability aspects are required for ensuring a secure and reliable system operation.

• The proposed pilot envisages load flow (detailed State level network modelling with regional interconnections) and stability studies to evaluate impact of grid integration of large solar park.

• Strategies for dynamic compensation shall be evaluated in Bhadla as part of this Pilot, including changes to inverter specifications and deployment of STATCOMS.
Dynamic Compensation for Large RE Integration

Stage 1: System Studies
- Load flow and Reliability Studies to identify need and location of grid-reactive compensation
- Identification of STATCOM capacity and location

Stage 2: Deployment
- STATCOM deployment on the network
- Enhancement of Inverters to build in 4-quadrant operation

Stage 3: Evaluate STATCOM & Inverter Operations for Reactive Compensation
1. Evaluate STATCOM effectiveness in voltage / VAR control.
2. Analyse harmonics, oscillations and other power quality parameters with STATCOM
3. Evaluate extent of compensation possible through smarter inverters
4. Compare standards and guidelines for Inverters and STATCOMS with other grids

Stage 4: Recommendations and Scale-up
- Recommendations on Inverter standards
- Guidelines for Planning studies including VAR/Voltage Control

ADB Financed
2 months
RISE Grants + PSDF + RVPN
6 months
RISE Technical Assistance Support
6 months
GTG-RISE
6 months
Automatic Generation Control
Automatic Generation Control

- POSOCO is conducting a pilot study on secondary response through automatic generation control in northern India.

- A pilot on evaluating AGC in providing secondary response in Southern Region would supplement adoption of AGC for ancillary markets. The scope of the pilot includes the following
  - Participation of select Generation units (hydro, wind, solar) in an AGC pilot
  - Draw inferences from international experiences on pricing and compensation for generators in operating on an AGC mode
  - Work with OEMs and Generators to devise a suitable compensation mechanism for AGC
  - Assist CERC in specifying regulations for phased implementation of AGC with accompanying compensation mechanisms
Grid Connected Storage System
Introduction

• Storage is expected to play a significant role in the successful integration of RE generation into the electric grid of the future.

• Amongst the challenges that storage can address include (a) accommodating RE generation’s output variability at the local and aggregate levels, (b) temporal mismatch between generation and demand, (c) power quality issues caused by RE.

• A pilot for evaluating storage technologies and its commercial and business applications is being proposed under RISE.

• As a first step in the pilot, a partnership is proposed with PGCIL to implement and test techno-economic use cases in PGCIL’s BESS facility under development at Puducherry with the following design parameters.

<table>
<thead>
<tr>
<th>Battery Type</th>
<th>BESS Design for</th>
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<tbody>
<tr>
<td>Advanced Lead Acid</td>
<td>500kW/30min (250kWh)</td>
</tr>
<tr>
<td>Lithium Ion</td>
<td>500kW/30min (250kWh)</td>
</tr>
<tr>
<td>Flow</td>
<td>250kW/4 hours (1 MWh)</td>
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Grid Connected Storage System Evaluation

Stage 1: Evaluate Battery Technologies
- Response time to follow signals
- Charging/discharging cycles, impact on efficiency and battery life after “n” round trips, other losses, thermal limits, etc.

Stage 2: Evaluate BMS, Comm, C&I & Upgrade
- Evaluation of adequacy of existing BMS
- Outline spec’s & to BMS & BoS (IC/software etc.) to perform use cases on storage system

Stage 3: BESS Applications / Use Cases
1. Frequency Regulation
2. Peak Shaving / Avoiding Cap’ Addn
3. Capacity Firming of VRE
4. Energy time-shift (arbitrage)
5. Voltage Support & Black Start
6. Spinning, Non-spinning & Supplemental Reserves
7. EV Charging (auxiliary support through BESS)
8. Distribution Congestion Relief & Deferment of upgrades

Stage 4: Systemic Value Assessment
- Modelling of performance of storage systems w.r.t other flexibility options
- Systemic Value Assessment of Storage
- Evaluate Latency Vs. Storage

PGCIL - Capex for BESS
3 months

RISE Grants + leverage
3 months

PGCIL + GTG-RISE Technical Assistance Support
6 months

GTG-RISE
6 months
Coal Based Flexible Generation for GSECL
Global Experience in Coal Based Flexible Generation

- CEA prescribes a 3%/min ramp rate but actual achieved by stations in India is much lower. OEMs have suggested much higher values of ramping:
  - For e.g. Mitsubishi Hitachi Power Systems gives a rate of 7%/min from 40% to 100% output for steam generators of new hard coal or lignite fired plants.
  - Babcock Power has also reported 7%/min for a USC in load range of 50%-90% in 550 MW units in Germany
- Experience shows that flexibility can be increased by a combination of:
  - making changes to the firing system (changes in mill operations, indirect firing systems, flame monitoring etc.)
  - making changes to pressure parts (designing thinner metal, modifications in evaporator and economizer design)
  - changes to the plant configuration related to the boiler area (using more than one boiler for a STG), and
  - improving control systems and instrumentation.
Real-time monitoring of DERs and enhancing net load forecasting ability of Discoms
Real-time monitoring of grid-connected DERs & enhancing net-load forecasting ability of Discoms

• **Pilot Activity:** Enablement of real-time monitoring of DERs on a pilot basis and improving net load forecasting ability of Discoms
  
  – Undertake a real-time monitoring pilot through deployment of smart meters
  
  – Work out the synergies of UDAY’s smart meters mandate with net-metering systems – can provide a pathway for enablement of real-time monitoring of DERs
  
  – Assist a state-owned Discom with procurement and implementation of net-load (i.e. net of DER generation) forecasting systems in coordination with REMC/SLDC
  
  – Provide inputs to CEA / FOR towards harmonizing net-metering for DERs/prosumers with smart meters for consumers
Regional platform for day-ahead and intra-day coordination in dispatch (Western or Southern)
Regional platform for day-ahead and intra-day coordination in dispatch (2 or more States)

**Pilot Activity:** Design a mechanism & implement a platform for coordination on day ahead basis with joint dispatch (or similar least cost dispatch mechanism) in intra day timescales. Currently the imbalance on intra-day basis is being largely managed within state control areas resulting in reduced flexibility to accommodate VRE.

Progress so far under USAID – Greening the Grid:
- NREL’s Grid Integration studies established the overall benefits of regional / larger balancing areas in reducing curtailments of VRE
- NARUC’s primer on regulatory mechanisms for forecasting, scheduling and balancing outlined the Western US experience of coordination between a large number of disparate control areas
  - Useful parallels for India in operationalizing Joint Dispatch or EIM
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