Call for Proposals - Energy Management System

The adoption of renewable energy (RE) has been expanding rapidly worldwide. The most popular sectors for growth are utility-scale solar and wind farms, with installed capacities over 1 MW each. Owing to the intermittent nature of solar and wind resources, the grid-tied megawatt-scale RE plants cause considerable variability in the power available to the grid. The renewable power production varies on all time scales, minute-by-minute, hourly, daily, monthly, yearly and multi-yearly scales. RE sources may not be able to supply peak power at peak demand hours, necessitating the use of spinning reserves, which invariably increase the system cost.

Energy Storage Systems (ESSs) can be utilized to overcome some, or all challenges caused by intermittence of RE power. Moreover, ESSs can be used to supplement grid operations by providing flexibility. Electro-chemical battery storage is gaining popularity in utility-scale ESSs due to their fast response times, scalability, modularity and potential for cost reduction. Battery ESSs (BESSs) are modular systems that can be deployed in standard shipping containers.

ReNew Power, being the largest renewable Independent Power Producer (IPP) in India, is exploring commercial usage of utility-scale BESSs. We have recently set up a test-bed for BESS at one of our sites. BESSs and ESSs deploy an intelligent decision making hardware, which provides all functionality, supervisory control and safety control. Renew is looking at an academic partnership to develop such a decision making system, popularly known as Energy Management System (EMS).

Objective: Develop complete Energy Management System (EMS) for Battery based Energy Storage Systems to integrate with renewable energy sources.

Deliverables: Develop application layer, or algorithms on a third party hardware (like PLC/industrial PC along with HMI, cabinet etc.) for employing and EMS with following capabilities:

1. Run a complete Battery Management System (BMS) (to be clear, the EMS does not have to replicate the functionality of the BMS. But it does need to interact with commercially available BMS solutions to perform acquisition and control functionality):
    a. Monitor State of Charge (SoC), Depth of Discharge (DoD) and State of Health (SoH)
    b. Monitor and manage total and cell-level voltage
    c. Monitor and manage thermal stability at cell level
    d. Monitor and manage charge and discharge currents of battery
    e. Monitor and manage thermal stability of battery cells
    f. Perform cell balancing
    g. Be chemistry-agnostic (i.e. work with multiple types of batteries)
2. Communicate with all data-collection and actuation devices on the generation and transmission infrastructure. E.g. PV plant SCADA, GSS SCADA etc. Communicate with ancillary data sources e.g. weather station, demand based pricing server (if applicable), master/peer/slave EMSs etc.
3. Collect data from multiple sources, run an algorithm to decide when and how much to charge batteries, or use the batteries to supply to the grid to achieve the following:
    a. Renewable energy time-shift
    b. Energy cost management

    c. Auxiliary energy use minimisation
    d. Peak shaving
    e. Frequency and voltage regulation
    f. Manage ramp up rate / black start
    g. Curtailment management
    h. Other feasible functionalities
4. Be scalable and modular in hardware as well as software.
5. Succeed in managing operation of BESS in coordination with a renewable energy generation site with high ambient temperatures and unpredictable local grid conditions to ensure reliable BESS operation and minimize BESS degradation.

Engagement model: Faculty / Faculty + students +/ postdocs

Time frame: 1-1.5 years