Paris Session 2022

Stable Power System Operations

C1-PS2 Question 2.1.1

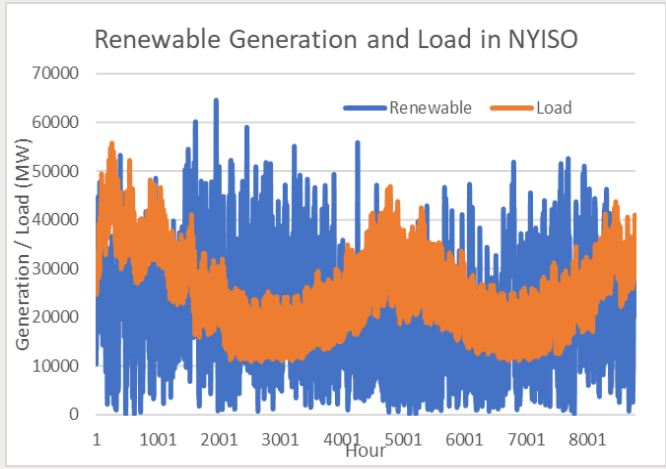
Which criteria can be defined to qualify a stable operation concept in highly decarbonized electrical power systems or subsystems? Are there examples available which define a suitable generation to grid coupling to load ratio?

Jinxiang Zhu, USA

Stable Power System Operations

- Tradition Power System – balance generation and load on a continuous basis
  - Generators are dispatchable to meet time-varying loads
  - Maintain voltage using reactive power sources and transformers as load and flow changes
  - Maintain frequency stable with a given minimum inertia
  - Maintain reserve requirements to face uncertainty of generating resources
- Highly Decarbonized Power System – balance generation and load on a continuous basis
  - Wind and solar are weather sensitive variable resources with uncertainty and variability (not flexible/dispatchable)
  - To meet load continuously, dispatchable resources are needed to fill the gaps
    - Dispatchable generators to meet Load – wind – solar, hydro, PSH, and renewable natural gas dispatchable
    - Demand responses and price induced EV charging strategy
    - Storage units can charge / discharge if renewable is greater / less than load, power to X
  - Synchronized Condensers, FACTS, and STATCOM to provides more stability and quality to decarbonized system
  - Synthetic inertia and primary frequency response from inverter-based resources
  - Grid-forming invertors can set frequency and voltage for the weak grid, microgrid, or island
  - Wind and solar can provide downward reserve; Pre curtailed wind and solar can provide upward reserves

Stable Power System Operations



- New York's Climate Leadership and Community Protection Act (CLCPA) requires
  - 70% Renewable Portfolio Standard (RPS) by 2030,
  - 100% zero-emission electricity by 2040
  - 85% economic-wide GHG Emissions below 1990 levels by 2050
- Grid in Transition CLCPA Case for 2040 – Minimized Transmission upgrades
  - Land-based wind: 23GW, Offshore wind: 25 GW, Solar (BTM): 6GW, Solar (Grid Connected): 32GW, Energy Storage: 14 GW, Renewable Natural Gas Dispatchable: 39,538 MW, and existing
  - installed Capacity: 154GW, NYISO Peak Load: 59GW, Ratio = 2.6