Overview – Clarkson Avenue Medical Complex Microgrid

- Project Background & Design Objectives
- Major Challenges
- Distributed Energy Resources – Existing & Proposed
- Modifying and Utilizing Existing Generation Assets
- Microgrid Electrical Distribution Challenges
- Thermal Distribution Constraints
- Air & Construction Permitting Limitations
Project Background

- NY Prize Community Microgrid - Awarded Stage 1 & Stage 2
- 4 Adjoining Medical Campuses in Heart of Brooklyn ~ 100 acres
  - SUNY Downstate Medical Center
  - Kingsboro Psychiatric Center
  - Kings County Hospital
  - Kingsbrook Jewish Medical Center
- Approx. 1500 beds total
- Serving population of 2.5 million
- 18 MW +/- peak load combined; 8 MW base load
Primary Microgrid Participant Loads

| Monthly Electrical Peak Demand (kW) |
|------------------------------------|---------------------------------|-----------------|
| Kingsboro Psychiatric | Kings County Hospital | SUNY Downstate Medical |
| Jan      | 862                    | 6,406             | 6,178           |
| Feb      | 844                    | 5,074             | 6,292           |
| Mar      | 826                    | 5,074             | 6,119           |
| Apr      | 790                    | 5,976             | 6,658           |
| May      | 1,029                  | 6,772             | 7,231           |
| Jun      | 1,232                  | 7,876             | 7,999           |
| Jul      | 1,311                  | 8,722             | 7,939           |
| Aug      | 1,140                  | 7,916             | 7,546           |
| Sep      | 1,159                  | 8,346             | 7,676           |
| Oct      | 946                    | 7,300             | 6,914           |
| Nov      | 823                    | 6,330             | 6,456           |
| Dec      | 856                    | 5,390             | 6,067           |
| Total    | 1,311                  | 8,722             | 7,999           |
Primary Microgrid Participant Loads

Average Daily Electrical Loads - Building and Cogen Output

- Cogen Electrical Output
- Building Electrical Demand

Average Daily Thermal Loads - Building and Cogen Output

- Cogen Thermal Output
- Building Thermal Demand
Project Design Objectives, Constraints & Challenges

- Maintain full operational continuity during prolonged power grid failure lasting at least two weeks
  - If utilizing liquid fuels, incorporate fuel storage as needed to ensure 14 days of operation

- Maximize value of Microgrid to the local and regional electric grid
  - Participate in NYISO electric markets as possible/feasible to earn revenues to help drive favorable economic performance of the microgrid

- Minimize emissions-related environmental impact
Project Design Objectives, Constraints & Challenges

• Leverage local electrical system infrastructure
• Implement energy efficiency & demand reduction to right size the microgrid
• Incorporate innovative technical & business model solutions that enhance scalability, operation and financial value of microgrids

Kingsboro Psychiatric 1.3 MW peak
Major Challenges

• Con Edison distribution grid in this area is underground and network architecture (vs radial)
  – For technical reasons Con Ed did not allow the microgrid to interconnect their “Clarkson Avenue feeder” that would have greatly simplified the project
  – Routing wires overhead was not feasible and was also discouraged by NYSERDA because of resiliency concerns

• Implementing large cogeneration and a thermal distribution loop serving all sites was not possible due to cost, technical and air permitting constraints

• Solar PV options were limited due to cluttered rooftops, shading & low power density relative to high power consumption density of hospitals
Distributed Energy Resources – Existing & Proposed

• Approximately 17 MW of existing emergency generation distributed throughout the campuses

• Proposed:
  – 8 MW of fuel cells for baseload generation
  – 300 kW of solar PV
  – 100 kW of battery storage
  – 1 MW of demand response
Modifying & Utilizing Existing Emergency Generation

• Convert 8-9 MW of emergency diesel generation units to dual fuel capability

• Enables use of these assets to:
  - perform rapid transition to island operation,
  - load follow during prolonged island operation (minimum of 14 days)

• Minimizes emissions
Centralized cogeneration with thermal distribution to the facilities was not economically feasible due to the high costs posed by tunneling under city streets. This drove the decision to incorporate an array of Bloom Energy fuel cells with electric efficiency of 60%. These units do not have heat recovery. Con Edison is providing incentives for Bloom fuel cells related to offsetting loads at their nearby Brownsville substation.
Electrical Distribution Challenges

• Con Edison, the local distribution utility, determined that it was not feasible to utilize their feeders to connect the facilities and create the microgrid.

• Directional drilling will enable cost-effective installation of dedicated feeders from the base load generation performed:
  - $1/inch/foot
  - 10 inch diameter duct bank = $100/foot
  - Estimated cost = $1 million

Energy Services, F&I
Electrical Schematic of Clarkson Avenue Microgrid
Conclusion & Lessons Learned

- Dense urban settings present unique challenges.
- Creative solutions may enhance feasibility, and/or introduce areas of risk and uncertainty.
- Take what the project gives you, and be clear-eyed about what is and is not possible/feasible.