Reliability Quantification and Visualization for Optimal Asset Dispatch in Electric Microgrids

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FortZED RDSI : A Microgrid in Action

- Renewable and Distributed Systems Integration - a microgrid demonstration project funded by US-DOE and participation from various other government and commercial entities.
- RDSI Asset Distribution

  - Conventional / Diesel: 16%
  - Natural Gas / Biogas: 36%
  - Thermal storage: 15%
  - Load Shed: 3%
  - Solar Photovoltaic: 20%

- Aim: Feeder peak load reduction by 20% of total feeder load
- Total demonstration period capacity: nearly 3 MW
- Peak Load Reduction achieved in range of 6-18%
- Low control deviation was observed during runs

System Control

Asset Dispatch

- RDSI asset dispatch was done through a centralized control system with a specific load scheduling algorithm in a round robin basis for maximum asset participation in test runs.

Reliability Quantification

- Electric power reliability is defined by NERC metrics in North America
- Does not take into consideration the microgrid capacity to meet contingencies
- Metrics calculated as per NERC criterion: Starting Reliability, Average Run Time, Availability Factor, Net Capacity Factor, Net Output Factor, Service Factor, Weighted Availability Factor and Weighted Service Factor.

NERC reliability metrics for all assets at City of Fort Collins

Microgrid Peak Reserve Ratio

\[ MPRR(t) = \frac{RDSI \text{ Capacity}(t) - RDSI \text{ Output}(t)}{RDSI \text{ Capacity}(t)} \]

- MPRR gives the available reserve of the microgrid system
- Minimum MPRR gives the share of underutilized assets
- To avoid stranding of assets any value of MPRR beyond planned reserve may be dispatched either to serve base load or ancillary service based on nature of asset.
- Can be used as a design criterion for capacity assessment of future microgrids

Visualization

- GUI developed in MATLAB for displaying asset and site level metrics
- Variation of metrics in time can be observed to study asset response during the test run period
- Comparison between two test run days or sites can be done easily
- Box plots provides scatter of metric data

Conclusion

- FortZED RDSI project is an insight into future aim of Fort Collins to be a Zero Energy District
- Peak reduction was achieved in the target range over a period of test runs

Future Work

- To develop reliability metrics for microgrids that can model the aggregation of distributed sources in a microgrid
- Develop a reliability based methodology for optimal asset dispatch

Acknowledgements

This material is based upon work supported by the US-Department of Energy (DOE) through FortZED RDSI and Power Systems Engineering Research Center (PSERC)