Active Distribution Systems and Distributed Energy Resources C6

DER Solutions and Experiences for Energy Transition and Decarbonisation PS 1

10238_2022

Utility Energy Use Cases, Health Monitoring, Data Analysis and Learnings (BESS)

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Motivation

- Battery Energy Storage System (BESS) technology provides an important response to increasing complexities in the distribution – ComEd deployed multiple BESS configurations to address these issues
- This study provides use-cases, data analysis, performance study, and software tools developed by ComEd for battery monitoring

Experimental setup & test results

- Data driven analysis of BESS utilizing SCADA with PI Historian, AMI, as well as on-site datalogger, tracking all points provided by BESS manufacturers
- Software tools built around data to contextualize operational scenarios, monitor battery health, and enhance understanding for future utility-owned & customer-owned BESS installations

BESS Installation	Use Case	Rating
BESS 1	Capacity deferral for substation XMFR	2MW/2MWh
BESS 2	Higher penetration of renewables	500kW/2MWh
BESS 3	Capacity deferral for distribution feeder	500kW/750kWh
BESS 4/ CES 1	Outage management and power quality	25 kW/25kWh
BESS 5/ CES 2	Outage management and power quality	25 kW/50kWh

Method /Approach

- 5 BESS were deployed for various use cases: Peak Shaving and Capacity Deferral, Renewable Firming, Community Energy Storage, Outage Management, and Power Quality
- ComEd has collected several years of operational data for these batteries and has performed several data analyses over the years
- Multiple approaches were used for the deployment of the batteries; at first, operational data was examined after event tool place to build methodologies for analyzing these events ; later, tools were built to streamline the analysis with the developed methodologies. This methodology-tool development approach was an iterative process

Discussion

- Results of the deployment included the discussed analysis methologies, tool created, and functioning of the BESS deployments
- Generally, BESS performed as expected for their use cases and tools work for performing analysis and monitoring
- Software tool has helped automate data gathering and reporting compared to manual data pulling and analysis
- With the penetration of emerging technologies in the distribution system, BESS has the potential to foster a smarter and more resilient grid

Objects of investigation

- To put tools and analysis methodologies in place that allow ComEd to accurately assess BESS performance
- Monitor health of BESS throughout its life to perform preventative maintenance

Conclusion

- It is crucial to continuously incorporate and build on learnings from BESS projects to inform future installations across the industry
- Need to continuously monitor and develop metrics for asset health monitoring of these batteries

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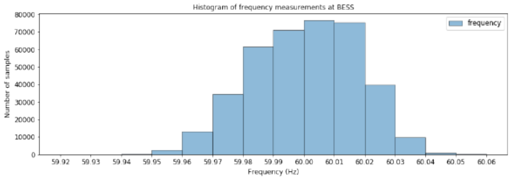
BESS Details

BESS Installation	Use Case	Rating	Operating Setpoint	Year Installed
BESS 1	Capacity deferral for substation XMFR	2MW/2MWh	Substation load > 40.5MW	2019
BESS 2	Higher penetration of renewables	500kW/2MWh	PV output variation	2019
BESS 3	Capacity deferral for distribution feeder	500kW/750kWh	Feeder load > 360A (7.9MW)	2020
BESS 4/ CES 1	Outage management and power quality	25 kW/25kWh	Feeder outages & PQ events	2017
BESS 5/ CES 2	Outage management and power quality	25 kW/50kWh	Feeder outages & PQ events	2018

- BESS installed throughout ComEd to serve various use cases and procured from multiple vendors

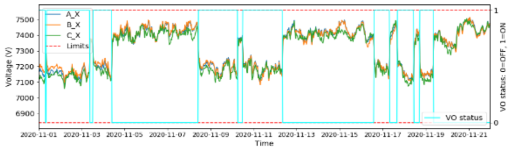
BESS for PV Firming



- ComEd's Bronzeville Community Microgrid includes a BESS equipped with a renewable firming algorithm that responds to a 750 kW Photovoltaic.
- As part of DOE commitment, frequency and voltage of the BESS were monitored with datalogger data reported at 5s interval with a ±0.5 Hz (displaying 11/01/2020 to 11/22/2020 data)

BESS Voltage Monitoring

- BESS voltage on VO schedule – checking ±0.05 pu



- Voltage at recloser point of interconnection with VO status in feeder

Standby Loss Study BESS 1

Operating Mode	Duration (Days)	Delta SoC (%)	Standby Loss (% SoC Loss / Day)
Idle	4	0.78	0.19
Idle	4.8	1.54	0.32
Idle	23.8	7.75	0.33
Peak Shave	10.9	1.91	0.18
Peak Shave	4.9	0.89	0.18
Peak Shave	19.3	3.95	0.21
Peak Shave	24.4	4.88	0.2
Peak Shave	60.4	12.45	0.21

- BESS 1 used for peak shaving and outage management, so it spends most of its time idle
- Collaboration with EPRI to benchmark idle drop in SoC with external battery installation to analyze battery performance throughout life of BESS

Comparison of BESS 1 to External BESS

#	BESS	Approximate Avg. AC Round-Trip Efficiency (RTE)	Approximate Avg. DC RTE	Avg. Self-Discharge (% SOC Loss/Day)
1	External BESS 1 LG Chem Li Ion	No AC data	95.70%	0.7
2	External BESS 2 LG Chem Li Ion	No AC data	97%	0.45-5.4
3	External BESS 3 Avalon Vanadium Flow	54%	57.30%	0.49
4	External BESS 4 Tesla Li Ion	84%	No DC data	0.14
5	ComEd's BESS 1 Tesla Li Ion	Not test cycles	No DC data	0.23

- For #1 and #2, Aux Loads (e.g. thermal management) NOT included in RTE calculation
- For #3, #4, and #5, Aux Loads (e.g. thermal management or electrolyte pumps) are included in RTE calculations

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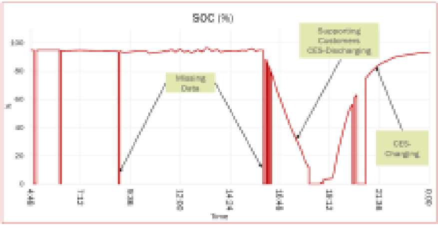
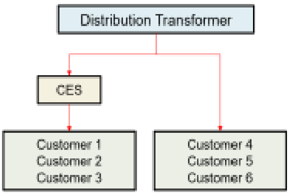
CES SOC During Outage Event

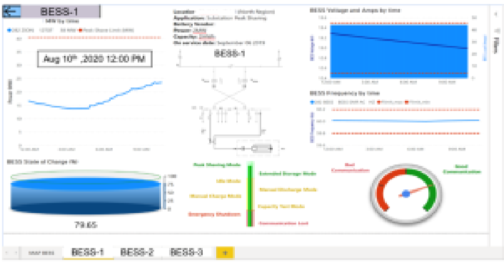


CES Configuration



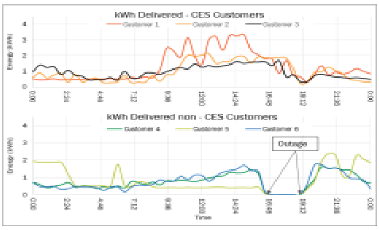
- Identified poor-performing transformer, CES installed on customer side of distribution transformer to provide resiliency during storms
- During an August 2020 Derecho, power was maintained to the CES customers (above)

Software Tools

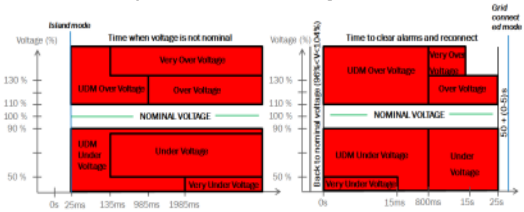


- Python-based Power BI interface to automate analysis and used for real-time monitoring of BESS
- Discussed analysis included in tool as well as, trickle discharge rate, real-time BESS capacity, and communication loss

Maintain Power to CES Customers



CES Operational Settings



- Voltage exceeds 10% from nominal voltage, for over 25ms, CES goes into island mode
- Unit will not return to grid-connected mode until voltage is between 96%-104% of nominal

Conclusion

- It is crucial to continuously incorporate and build on learnings from BESS projects to inform future installations across the industry
- Need to continuously monitor and develop metrics for asset health monitoring of these batteries
- Benchmarking the performance of each BESS and comparing it against other similar installations provides additional insights
- Building tools that provide more alerts can help with preventative maintenance of batteries