SAND2022-8980C

Commissioning Coordination - Lessons Learned

2022 IEEE PES General Meeting
Denver, Co. July 19-21, 2022

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Sandia ESS Projects Activity

Variety of field experience

2021/22 DOE OE-Sponsored Sandia Projects

State or Territory	Partner
Alaska	Cordova Electrical Cooperative (CEC)
Alaska	Alaska Village Electrical Cooperative (AVEC)
Arizona (x3)	Navajo Tribal Utility Authority (NTUA)
Colorado	Poudre Valley Rural Electrical Association (PVREA)
Florida (x4)	Seminole Tribe
Hawaii	Natural Energy Laboratory of HI Authority (NELHA)
Iowa	Alliant Energy
New Mexico	Santa Fe Community College
New Mexico	Albuquerque Public Schools

State or Territory	Partner
New Mexico	Picuris Tribe
North Carolina	NC Electric Membership Corporation (NCEMC)
North Carolina	Ft. Bragg Sandhills Utility Services (SUS)
Puerto Rico	Villalba Municipality
South Dakota	Ellsworth AFB West River Electric Association (WREA)
Tennessee	Electric Power Board of Chattanooga (EPB)
Vermont	Green Mountain Power (GMP)

ESS Acceptance Testing / Commissioning

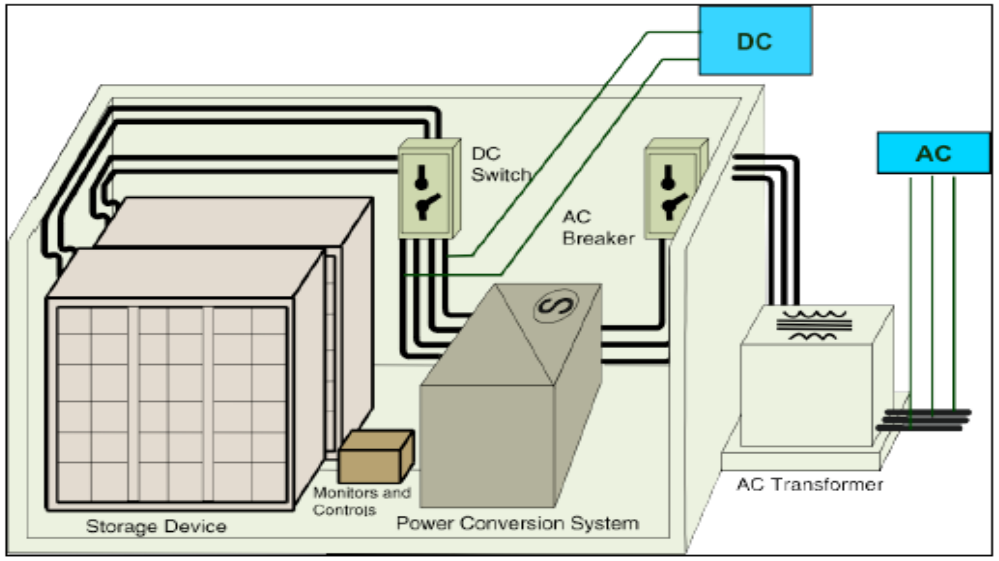
What to Do, Know and Watch Out for

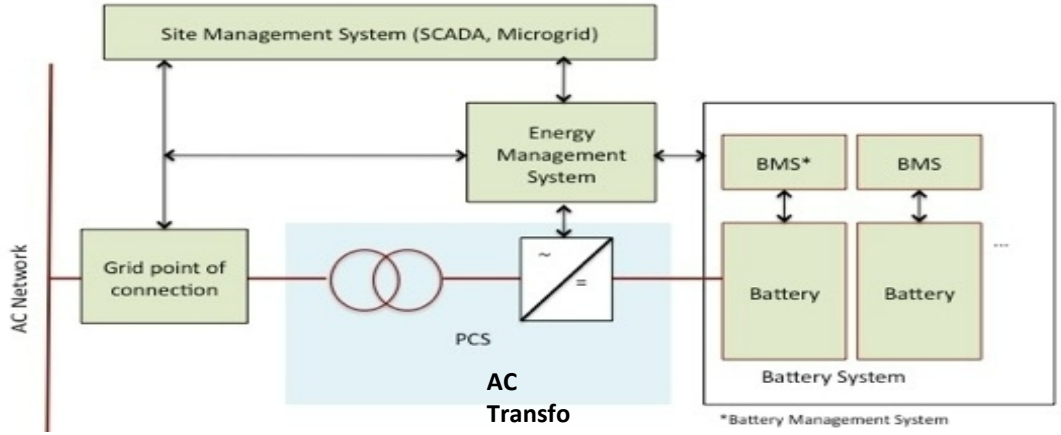
Commissioning begins with RFP

Project Flow

Construction Project Stages	Stage Activities	Commissioning Thoughts (wording?)
Project Initiation	Analysis, Application(s) and sizing	**Applications lead to Sequence of Operation (SOO)**
Project Development & Design	Refine conceptual design with details for RFP , Include load profile and SOO	**Load Profile drives system performance need. SOO will drive commissioning activities, interconnection design and permiting**
Procurement	Develop **RFP with codes, standards, &specifications**	**Proposal to include commissioning plan, code requirements for safety, roles – one ringleader, warranty,**
Construction	site work, system installation, interconnection, Factory testing precedes installation	**Testing at factory nice to have but hard to do:** • **Off shore manufacturing.** • **System components from different vendors and meet at the job site**
Commissioning	Commissioning / checking that system meets **specifications, SOO**	**One owner; Baseline measurements; Safety system checkout**
Operations & Maintenance	Project in-service	**Collect operational data; track performance and capacity fade; Predictive tools; IR scan.**

Energy storage system overview (ES is one Part of Whole)





AC Transformer

The Project Team includes

★ Involved with commissioning

Team Member	Project Responsibility
Owner ★	Programming, Financing, contracting and ownership strategies. Developer or Facility
Design Engineer ★	Design, Load profile, application(s), codes/standards/specifications, Procurement RFP, Construction Inspection,
Site Construction team/installer ★	EHS / Site Safety Plans (SSP) and Safety Meetings, Site prep, permits, system delivery, Construction, all BoP
Vendor ★	Factory Witness Testing, Shop drawings, On-site connections, start-up, troubleshooting, Warranty
AHJ	Code adherence, Design verification
System integrator, or Commissioning Agent ★	OWNS COMMISSIONING. Construction inspection, Operational Acceptance Testing (OAT), Integrated System Startup (S/U), Functional Acceptance Testing (FAT), shakedown, Training, as-builds, Commissioning Closeout
Fire Staff	Design review, Participate in training

Case Study - Decorah

Great project, but…

Commissioning delayed by difficult access to vendors for data…

Decorah Battery System Design

- 2.5 MW, 2.9 MWH system
  - Power (flow rate)
  - Energy (size of tank)

Duration

2.9 MWH ÷ 2.5 MW = 1.16 HRS

- Larger power rating → more flexibility
  - *Voltage managed with reactive power (Vars)*
  - *Power Flows managed with real power (Watts)*
- Samsung / Sungrow Integrated Solution from EnelX
  - Lithium Ion (NMC Chemistry)

Acceptance testing all components and subsystems

Battery/DC Block:

- Rack, module, cell level data
  - DC voltages, currents
  - Temperatures
- Calculated values
  - Aggregations, SOC, SOH

Power Conversion:

- Inverter data (individual & aggregate)
  - DC voltage, current
  - AC voltage, current, frequency, power factor
- Aggregated/calculated values

Testing procedures documentation

Balance of Plant (Environment, Safety Systems):

- Enclosure data:
  - Temperature, humidity
- Local data
  - Outside temperature, humidity
- Fire Protection
  - Water and/or dry chem system status
  - Smoke/heat sensors
- Alarms
  - Faults, e-stops, door open, etc.
- Grid (Point of Interconnection – POI)
  - Voltage, current

Lessons Learned

- Interconnection Request & Approval
  - *It can be a long process – start early, make contact with the Utility, follow through*
- BESS Siting (Location)
  - *Know your installation Standards/Codes consideration*
- Developing a RFP
  - *It is recommend that 'best practice' Codes/Standards are used in the RFP (specifically UL9540 2020 & NFPA 855 2020/IFC 2018 or 2021) no matter what Code year the State has adopted.*
  - *Load Profile and Application identification*
- Bid Analysis: Need to understand who is supplying which component of the BESS
  - *Who does what and who is in charge. In most cases there will be multiple vendors suppling different portions of the energy storage system which can lead to confusion about who is responsible for **acceptance testing** of individual components*
- Communications/Data Acquisition
  - *Collecting **ES data for monitoring** can be complex and scales in complexity with the size of the system, number of data points you have/want, frequency, etc. **Get an IT person on-board the project team**.*
- *Cybersecurity of remote monitoring/data collection is a growing concern.*

Lessons Learned (Continued)

It always takes longer than you think

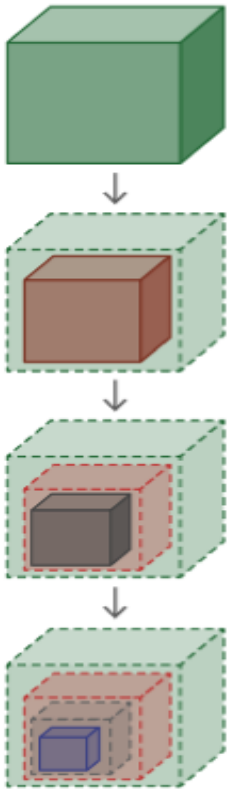
- Personnel scheduling, especially first responders
- Check list – previously prepared
- IT / data collection
- Punch list – for things that don’t work of need modifications
- Rescheduling

Questions that Bother Me So

- Who leads Commissioning and how to identify/request in RFP
- What if Parts are delayed?
- Which State and Federal regulations need to be followed
- What's an interconnection agreement?
- Whats the footprint?
- How long will the battery realistically last?
- Predictive measurements of battery to indicate performance?

Codes and Standards Related to Energy Storage Installations

Standards and Model Codes Hierarchy



BUILT ENVIRONMENT

- iCodes – IFC, IRC, IBC
- IEEE – C2, SCC 21
- NFPA 1, 5000

Complete ESS

- NFPA 855
- UL 9540
- ASME TES-1
- FM GLOBAL 5-33
- DNVGL GRIDSTOR
- NECA 416 & 417

INSTALLATION / APPLICATION

- NFPA 70
- UL 9540 A
- IEEE C2
- IEEE 1635/ASHRAE 21
- IEEE P1578
- IEEE 1547
- IEEE 1679

SYSTEM COMPONENTS

- UL 1973
- UL 1974
- UL 810A
- UL1741
- CSA 22.2 No. 340-201
- IEEE P2686

Thank you

This work is funded by the DOE OE Stationary Energy Storage program, directed by Dr. Imre Gyuk.

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