Eliminating Diesel Generators in Commercial High-Rise Buildings with ESS

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TRADE SHOW EDUCATION

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- Attend 90% of this presentation
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Learning Agenda

- What are some of the most common applications for a Battery Energy Storage System (ESS) today
- An ESS is capable of meeting UL 924
- 30% or more of the total installed cost of the system may be a tax credit per the inflation reduction act (IRA)
- What are the applicable codes to take into consideration when using an ESS for emergency egress power
- What are the best (most cost effective) applications for using an ESS in place of a diesel generator for providing emergency egress power

A Typical High-Rise Will Have a Diesel Generator

- In most **urban** environments, the generator is typically designed into a project to provide code compliant UL 924 emergency egress power for emergency loads consisting of:
  - Lighting (1.5 to 2 hours typical)
  - Fire Pump (2 or 8 hours typical)
  - Elevator
  - Stairwell Pressurization Fan
- It is rarely used other than for its required monthly testing

Diesel Generator Challenges

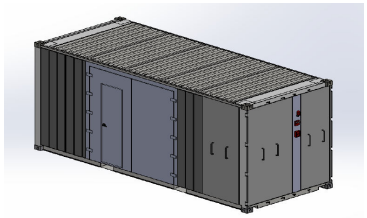
- Vibrate
- Make noise
- Require fuel storage / pumps
- Must be exhausted / ventilated
- Require maintenance
- May require emissions testing
- Might not work because of lack of maintenance

Real World Examples of Diesel Generator Challenges

- NYC power outage of 2019
- Texas Freeze of 2021
- Clark County Schools (⅓ of generators fail when needed)
- Verizon

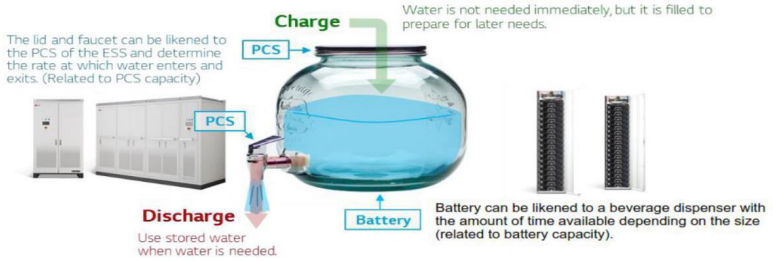
What are Battery Energy Storage Systems?

Battery energy storage systems (BESS), are devices that enable energy from the utility or renewables, like **solar** and **wind**, to be stored and then released when the power is needed.



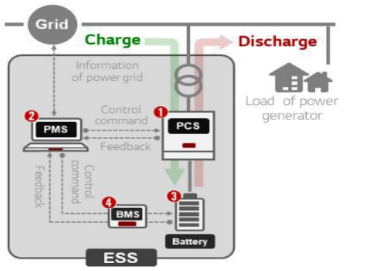
The concept of ESS capacity

- The concept of ESS capacity can be described as a metaphor for a beverage dispenser. The concept is the same as putting and discharging water into the dispenser.
- If you need to store a lot of water, you can increase the size of the container (battery capacity), and if you want to store or release water quickly, you can increase the size of the lid and the faucet of the container (PCS capacity).



Configuration and Function of the ESS

- The main components of the lithium ion battery-based ESS consists of four parts: PCS, PMS, Battery and BMS



❶ PCS
- Invert DC power stored in batteries to AC power with grid voltage and frequency.
- Convert AC power to DC to charge batteries.

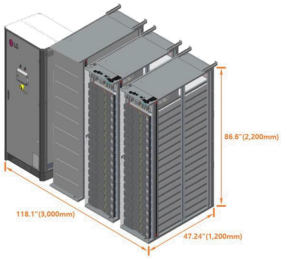
❷ PMS
- Monitor and estimate power consumption.
- Manage system history and versions.
- Remote maintenance for recovery is available in case a fault occurs.

❸ Battery
- Store electrical energy in DC.
- Discharge the electrical energy to the grid via PCS.

❹ BMS
- Monitor battery's current, voltage, temperature, status Information, etc.
- Exchange information and data with PCS.

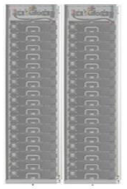
Battery Energy Storage Systems

- May be used to replace a generator for providing UL 924 emergency egress power
- And may also be used for:
  - Providing mission critical power when utility power interruptions are bad for business
  - Storing energy from the utility or on premise solar and providing the energy when needed
  - Demand Response
  - Peak Load Shaving
  - Hedge against utility pricing variation & price increases
  - EV charging stations where transmission services are not sufficient
  - Locations & applications with high peak demand rates
  - Sustainable / Green Clients or striving to be Net Zero
  - And more
- No smells, fossil fuels, always reliable and virtually no maintenance



ESS vs. Genset

- Application 250kW Genset replacement, 2hr run-time:
  - 1.5-2 Hours is typical for code required Lighting, Elevators, Ventilation
  - Fire pump is 2 or 8 hours typically. Can use a 2nd grid connection if available
  - ESS Eliminates Large Cooling Ventilation Air requirement of Genset
  - ESS Eliminates Diesel Fuel storage system, pumps, Fuel Maintenance
  - ESS Reduces standby energy use of Block Heater
  - ESS has few moving parts or critical maintenance items, so has far greater uptime potential than Genset
  - ESS can eliminate crane work for rooftop installation, can use service elevator
  - ESS can be configured for an AC Microgrid, allowing recharge from on-site PV, Genset requires Diesel fuel resupply, which is often interrupted in an emergency.



Battery Racks

PCS

Tax Credits - Benefiting from the Inflation Reduction Act

Project Size	<1 MWac	>1 MWac	>1 MWac
Meets Prevailing Wage & Apprenticeship Requirement	**N/A**	**Yes**	**No**
Base ITC	30%	30%	6%
Domestic Content Bonus	10%	10%	2%
Energy Community Siting Bonus	10%	10%	2%
Low-Income Bonus (only receive one)			
Low-income community or Native American land	10%	10%	10%
Qualified low-income residential building project or economic benefit project	20%	20%	20%
Potential Total ITC	**60% or 70%**	**60% or 70%**	**20% or 30%**

30 to 70% tax credits are available

When does it make sense economically to use an ESS as a diesel generator replacement?

- When the diesel generator is designed in to meet the **code requirement for providing emergency egress power** to get people out of the building
- When the diesel generator will reside inside the building and that location requires pumps for moving fuel and exhausting up the structure which both add cost to the total installed cost of a diesel generator.
- For a typical 100,000 sq ft building, the generator is sized at approximately 250kW
- For a typical 200,000 sq ft building, the generator is sized at approximately 500kW to 750kW

Total Installed Cost Comparison for 100K Sq Ft High-Rise

100K Sq Ft Building with ESS

250kW/500kWh ESS Total = $419,776 (before tax credit - $599,680 - qualifies for the 30% tax credit from the inflation reduction act

100K Sq Ft Building with Indoor Generator

250kW Generator Total - $300,000 Includes generator, pumping infrastructure, exhausting infrastructure, and install plus maintenance and fuel cost

A reliable battery backup power source that can also provide additional functionality and requires virtually no maintenance may be used in a high-rise building

Total Installed Cost Comparison for 200K Sq Ft High-Rise

200K Sq Ft Building with ESS

500kW/1012kWh ESS Total = $669,900 (before tax credit - $957,000 - qualifies for the 30% tax credit from the inflation reduction act)

200K Sq Ft Building with Indoor Generator

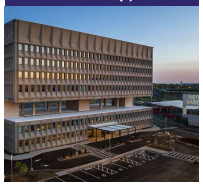
750kW Generator Total - $750,000 Includes generator, pumping infrastructure, exhausting infrastructure, and install plus maintenance and fuel cost

With proper electrical system design optimization, an ESS is more cost effective than a diesel generator and requires virtually no maintenance

ESS Real World Examples

Marriott Autograph Sinclair Hotel

Hilton Tapestry Hotel Marcel (Net Zero; 100% backup)

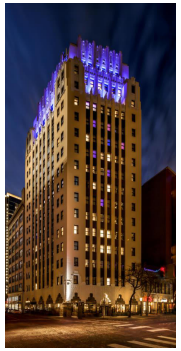


The Bearsley Luxury Hotel (in design; 100% backup)

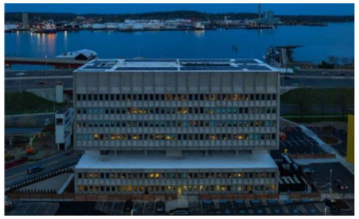
New High School in St Croix (in design; Net Zero)

Sinclair Hotel

Marriott Autograph Hotel / Emergency backup only ESS	
☐ Installation site	Dallas (Texas, USA)
☐ ESS installed capacity	PCS 125kW / Battery 311kWh
☐ Usage Pattern	Emergency power generation
☐ Emergency capacity	90kW (Fire fighting capacity + Emergency load)
☐ Installation of ESS	Completed in April 2019



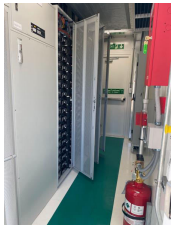
Grid Outage Example at the Hotel Marcel



- Event duration: 2h 36 minutes
- Energy delivered by the microgrid: 516 kWh
- Solar production during the outage: 292 kWh
- Energy delivered by the BESS: 255 kWh
- Carbon based fuel consumed: 0
- Disruptions to the hotel: 0

There were no noticeable disruptions to the morning conference during the grid outage event

Commercial Office Outside Atlanta



Client wanted to backup specific critical loads

Loads were migrated from existing load centers, routed through the ESS & placed on to a new ESS panel

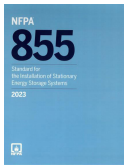
Arthur Richards High School, St Croix

- Will use solar energy to power the building and reduce its dependence on the grid as well as store solar energy for use anytime-at night or during an outage.
- Projected to be Net Zero and will produce more renewable energy from the sun than what is consumed from the utility.
- Will become a **prominent community landmark** that educates students, teachers, faculty & the community with science, technology, engineering and mathematics (**STEM**) skills for use in **information technology careers** and the **renewable energy economy**.
- May be used to provide shelter for the community during extended power outages.

Most Relevant Code Challenges

- NFPA 20 2022 11.4.1.3.1 for generators states that fuel supply tank(s) shall be sized for a minimum of 12 hours of engine run time
  - This code interpretation varies by AHJ when being applied to an ESS.
  - This is why we and/or the electrical design engineer need to meet w/ the AHJ on a project by project basis.

- No more than 600kWh worth of lithium-ion energy storage allowed per area/room/space
  - AHJ may provide an exception (important to explain how the product meets and **exceeds** UL9540A)
  - Additional spaces may be used
  - Location of spaces (above grade, roof, in building varies by city & state)



What Drives Up the Cost of an ESS Deployment

Load Size and Required Duration - kWh or MWh of storage

The larger the load and the longer it needs to run off of battery drives up the cost of an ESS deployment

Example: The requirement is to provide 8 hours of fuel storage to support a 100kW fire pump.

Cities and States where we have already verified that two hours of onsite backup power for the fire pump is approved by the AHJ

Connecticut

Burlington, Vermont

Fort Worth, Texas

Resiliency Delivered

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