



# OFF GRID BATTERY CODE



SOLAR ENERGY INTERNATIONAL

Renewable Energy Education for a Sustainable Future

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# Off Grid Battery Code

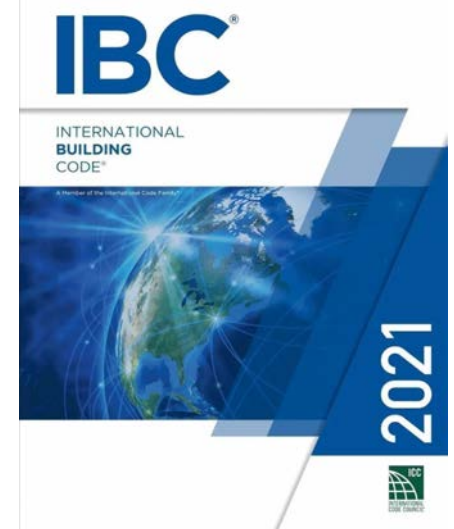
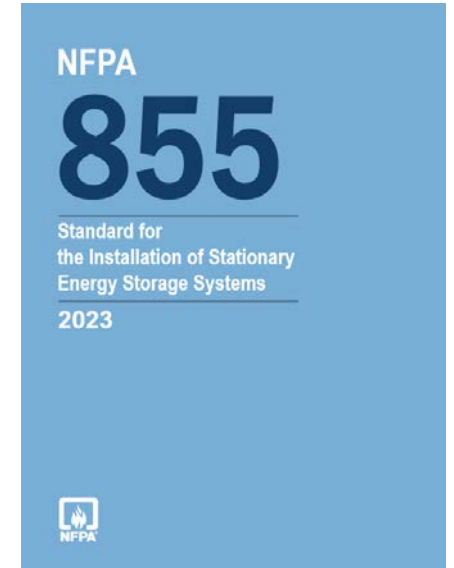
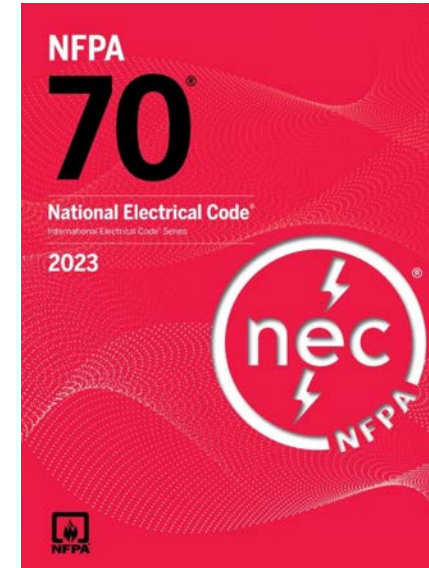


# Wait? Off-grid has to follow code?



# Codes affecting off grid batteries

- ★ 2023 NFPA 70 aka NEC (National Electrical Code)
- ★ NFPA 855 – Standard for Installation of Stationary Energy Storage Systems
- ★ NFPA 855 forms basis of battery regulations in:
  - 2021 IFC (International Fire Code)
  - 2021 NFPA-1 Fire code
  - 2021 IBC (International Building Code) for commercial buildings.
  - 2021 IRC (International Residential Code)



# Listings for Off Grid PV

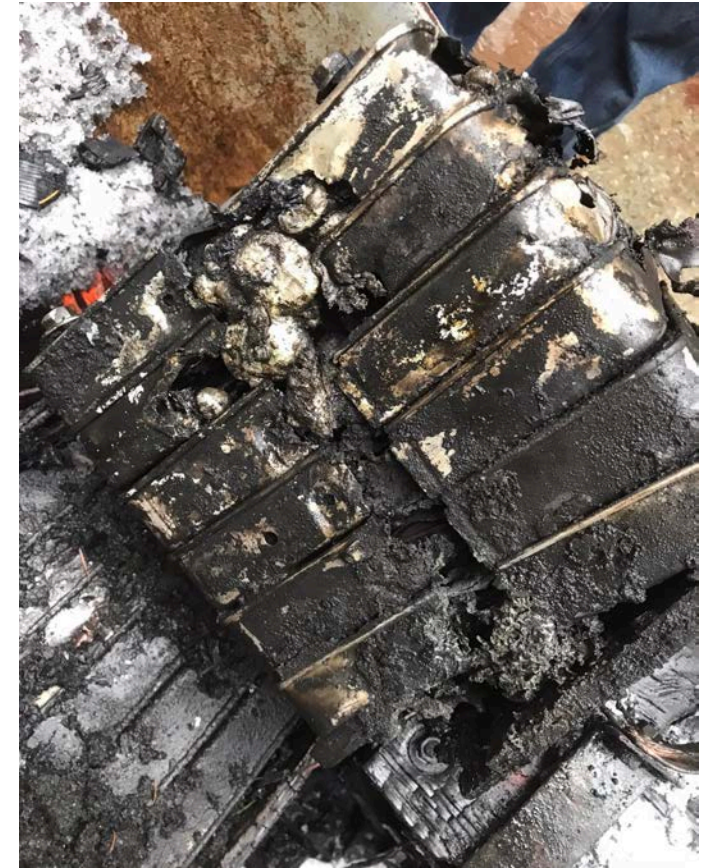
## ★UL listings for batteries and ESS

- UL 9540: First and Second Edition (Second Edition will be required in 2023 IFC)
  - UL 9540 listing may be with or without inverter (AC and DC ESS)
    - Can be without inverter if all battery safety is incorporated into BMS (open loop, or no communications between battery and inverter required)
    - Must be listed with inverter if designed for closed loop communications between battery and inverter for safety of battery
  - Second Edition listing requires UL 9540A testing, metal case required.



# Listings for Off Grid PV

- ❖ UL 9540A thermal runaway/fire test results
  - UL 9540A is not a pass/fail, but an observation of heat/flame results from overheated cell.
  - Can allow closer separation distances than NFPA 855 general requirements.
  - Installation instructions will include allowances for closer separation distances.
  - Should include minimum volume of room to stay under 25% of lower flammability limit during thermal event.
- UL 1741 (inverter and charge controllers)
  - AC ESS may have a battery plus a UL 1741 inverter listed together to UL 9540.



# Listings for Off Grid PV

## ★Other UL listings (that may not apply)

- UL 1973 (battery packs) and UL 1642 (battery cells)
  - Can speed up getting UL9540 listing, but does not replace it.
- UL 2054: consumer battery packs – cordless tools and such. (lithium and nickle)
- UL 1778: self contained UPS units with SLA batteries.
- UL 1989: Standby Batteries?
- UL 458: Mobile Inverters
- UL 1741 listing may be for stand alone or for utility interactive inverters, or for charge controllers.
- UL listed, UL recognized, ETL listed to UL standard
- Fake UL markings



**LISTED**



# Summary of Residential Requirements

- ★As outlined in NFPA 855 section 15 and 2021 IRC section 328
- ★Applies to all systems with >1kWh of storage
- ★UL9540 listing on batteries
  - No lead acid batteries are listed to UL9540
- ★Maximum storage 40kWh indoors, 80kWh in garage or mounted on outside wall. If over maximum, go to commercial rules.
  - Less than 20kWh per ESS, 3' spacing between units (or lower separation per UL9540A test results as outlined in installation instructions)
  - 3' Spacing from windows/doors
  - Fire barrier from garage to occupied space
  - Some jurisdictions allowing max capacity in each location, some max per total.



# Summary of Residential Requirements

- ★ Indoor units require minimum room volume per battery, or explosion detection system and ventilation, per UL 9540A test results.
  - Example: Fortress EvaultMax requires 618 cu-ft for 18.5kWh LFP battery.  
77 sq ft x 8 foot ceiling per battery.
  
- ★ Commissioning and training required for owner

# Summary of Commercial Requirements

- ★ As outlined in NFPA 855 sections 4 to 9 and 2021 IBC section 1207
- ★ For systems >20kWh on commercial buildings, or over residential limit on residential buildings
- ★ UL9540 listing on batteries
  - Not required on lead acid batteries under 60 volts DC if owned by telecom or for power plant control, or in a listed UPS – no exception for off grid PV though.
- ★ Less than 50kWh per unit
- ★ Less than 20kWh per unit for wall mounted units.
- ★ Limited to 600kWh total (unless in dedicated building)

# Summary of Commercial Requirements

- ✦ Fire separation
- ✦ Training
- ✦ Ventilation
- ✦ Plans filed with AHJ and Fire Department
- ✦ Security/access control
- ✦ Fire suppression systems
- ✦ Explosion monitoring/purging
- ✦ Egress requirements
- ✦ Elevation (accessibility without stairs)
- ✦ And More!

# What about separate power sheds?

- ★ Can go over 600kWh

- ★ If using lithium batteries:

- Explosion control (monitor gas, purging)
- Water supply and fire suppression (may be waived by AHJ)
- Don't need spacing between battery packs

- ★ But need to be 100 feet from “buildings, lot lines, public ways, stored combustible materials, hazardous materials, high-piled stock, and other exposure hazards not associated with electrical grid infrastructure”.

- ★ Still not allowed to use lead acid batteries unless a telecom or utility

# NEC 480 vs 706?

★480 for lead acid batteries (but those are not allowed any more for residences...)

★706 for lithium batteries.

OR

★480 for backup power (not normally cycling)

★706 for cycling applications (off grid)

OR

★480 for ones with separate batteries and inverters/charge controllers (most off grid systems)

★706 for all-in-one systems (many grid interactive systems)

★For off grid, we probably need to meet 706 (cycling), and should also make sure to meet 480 just in case.

– Disconnect for ESS on outside of building for either (can be remote control)

# Other NEC sections

- ★690 PV Systems

- ★710 Stand Alone Systems

If connected to the grid

- ★705 Interconnected Electric Power Production Sources

- ★702 Optional Standby Systems

And try to avoid being classified as a:

- ★701 Legally Required Standby Systems

- ★708 Critical Operations Power Systems

# More Training



SEI/Mayfield class

CE538:

NFPA 855 and Fire Code Requirements for Solar-  
Plus- Storage Systems



# Questions?