



62nd Annual Business Meeting

Energy Storage Systems

LOCATIONS, LISTINGS, POWER AND SHUTDOWNS.

Panelists

Pete Jackson, Electrical Specialist, City of Bakersfield

Mike Stone, West Coast Technical Field Representative, NEMA

Mark Baldassari, Director, Codes and Standards, Enphase Energy

Kohl Hetrick, Supervising Fire Marshal, Riverside County

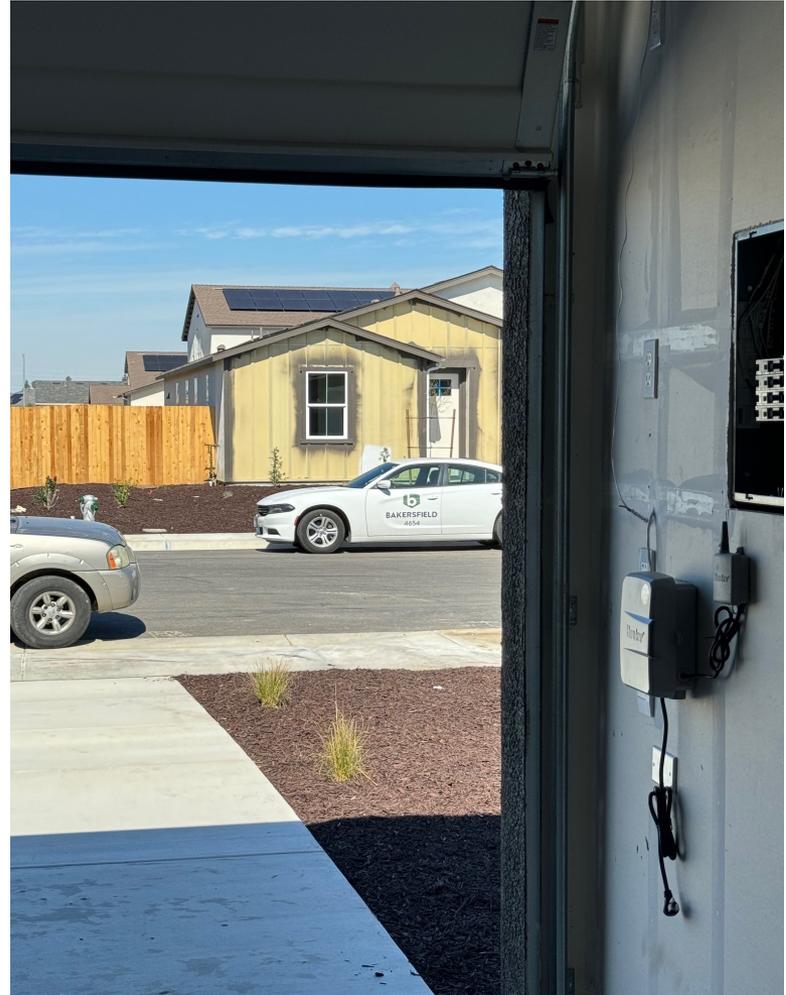
David Myers, Fire Safety Engineer, Riverside County



BESS Protection in Garage



BESS Protection in Garage



CA Residential Code Figure for Reference

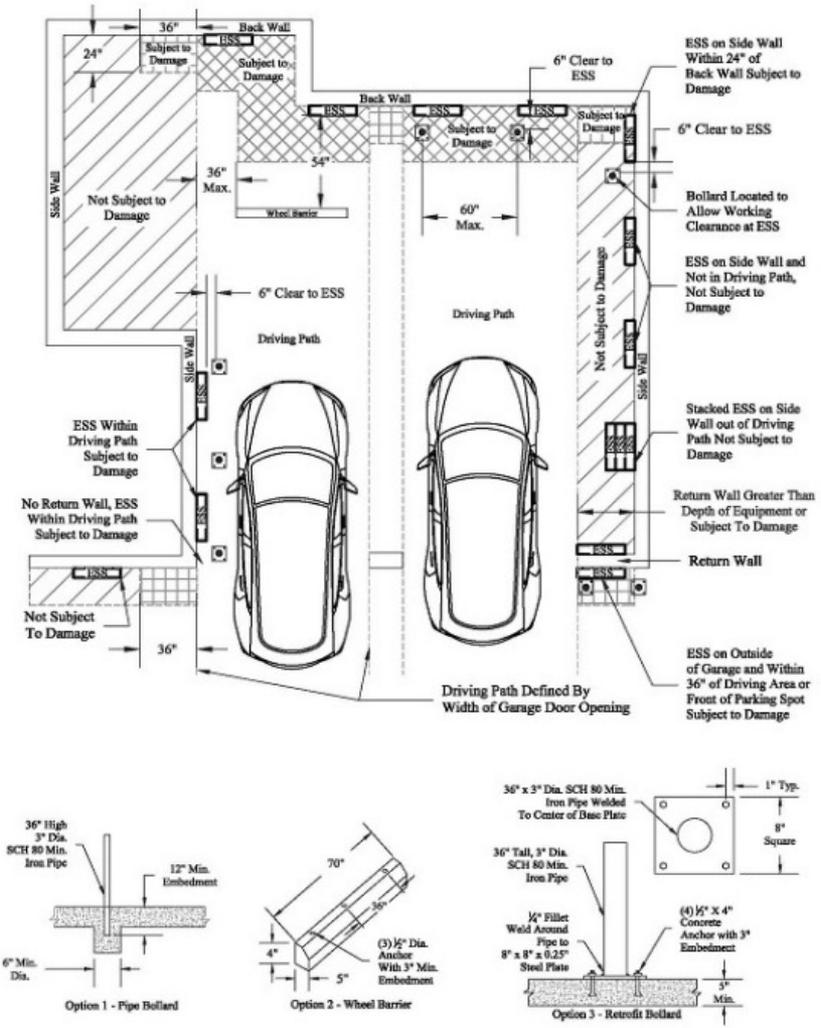


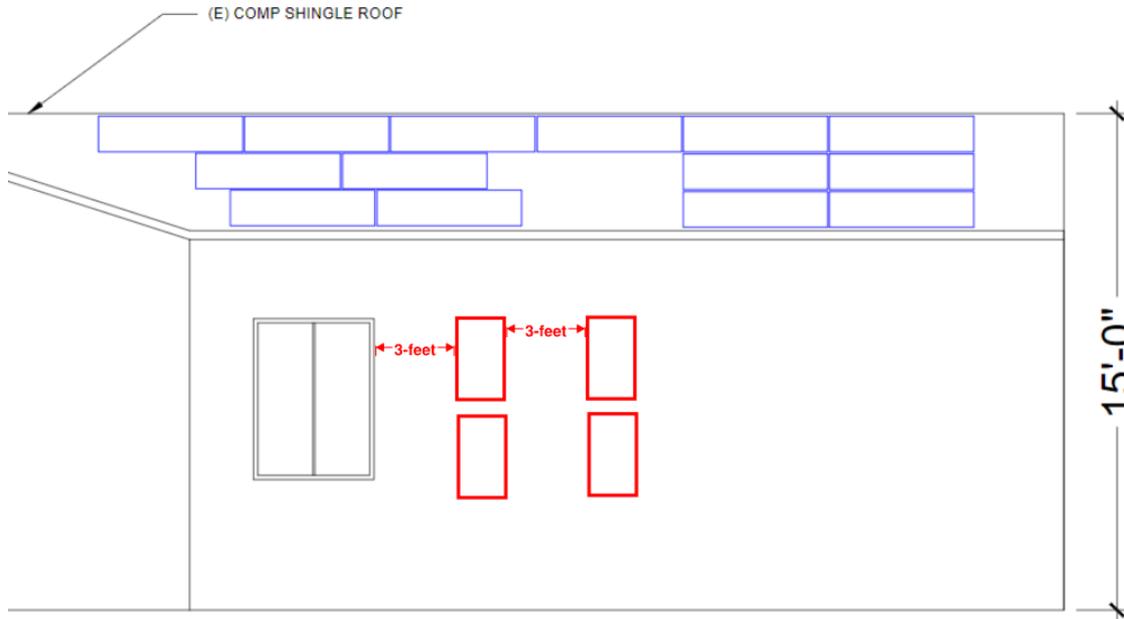
FIGURE R328.8.1 ESS VEHICLE IMPACT PROTECTION

Residential Exterior Installations

CRC R328.4 Locations

ESS shall be installed only in the following locations:

#3 - "Outdoors or on the exterior side of exterior walls located not less than 3-feet from **doors** and **windows** directly entering the dwelling unit.



Listed Smoke Alarms / Or – Heat "Detector"?



R328.7 Fire Detection

Base text references "Heat Detector".

SFM Amendment references "Heat Alarm"

*What options?

CA OSFM Information Bulletin 21-004

CRC R328.5 - July 2024 Supplement

R328.5 Energy ratings.



- > Individual ESS units shall have a *maximum rating of 20 kWh*. The ratings of the ESS *in each location* shall not exceed *the ratings in Table R328.5*. The total aggregate ratings of ESS on the property shall not exceed 600 kWh.

ESS installations exceeding the permitted individual or aggregate ratings shall be installed in accordance with [Section 1207.1 through 1207.9 of the California Fire Code](#).

TABLE R328.5 MAXIMUM AGGREGATE RATINGS OF ESS



LOCATION	MAXIMUM AGGREGATE RATINGS (kWh)	INSTALLATION REQUIREMENTS
<i>Within utility closets, basements, and storage or utility spaces located within dwellings</i>	40	
<i>In attached garages</i>	80	
<i>On or within 3 feet of exterior walls of dwellings and attached garages</i>	100	
<i>On or within 3 feet of exterior walls of dwellings and attached garages</i>	200	<i>Exterior walls and eaves are constructed with noncombustible surfaces^a</i>
<i>In detached garages and detached accessory structures</i>	200	
<i>In detached garages and detached accessory structures</i>	600	<i>Detached garage or detached accessory structure is a minimum 10 feet away from property lines and dwellings</i>
<i>Outdoors on the ground</i>	200	<i>ESS is a minimum 3 feet away from property lines and dwellings</i>
<i>Outdoors on the ground</i>	600	<i>ESS is a minimum 10 feet away from property lines and dwellings</i>

For SI: 1 foot = 304.8 mm.

a. Noncombustible wall surface shall extend in accordance with all the following:

- 1. A minimum of 5 feet horizontally from the edge of the ESS.*
- 2. A minimum of 1 foot vertically below the bottom edge of the ESS.*
- 3. A minimum of 8 feet vertically above the ESS, or to a non-combustible eave, whichever is less.*

The code official is authorized to approve reductions of installation requirements based on large-scale fire testing complying with [Section 1207.1.5 of the California Fire Code](#).

UL 9540 and UL 9540A

WHAT IS THE DIFFERENCE?

UL 9540 and UL 9540A. What is the difference?

UL 9540 – STANDARD FOR SAFETY. Energy Storage Systems and Equipment

1

•Construction

- Enclosures
- Wiring and Electrical Supply Connections
- Insulation Levels, Grounding
- Heating and Cooling

2

•Electrical Tests

- Grounding and Bonding
- Dielectric Voltage Withstand Test, Insulation Resistance
- Electromagnetic Immunity, Electrostatic discharge, Surge

3

•Mechanical

- Crush and impact tests
- Strength test
- Wall Mount Fixture Test

4

•Environmental Tests

- Corrosion prevention due to moisture and salt fog
- Installation in seismic environments
- High and low temperature environments

5

•Manufacturing and Production Tests

- Dielectric voltage
- Grounding and bonding
- Safety control

6

•Markings

- Unit label
- Safety

8

7

•Installation Instructions

Appendix E – Separation distance limits → 914 mm (3 ft.)

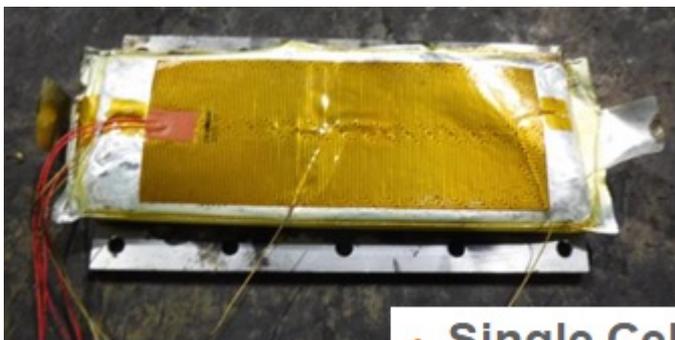
UL 9540 and **UL 9540A**. What is the difference?

- **UL 9540A** – Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
- **A.K.A. – Large Scale Fire Testing**
- **Specified in many Codes**
 - CFC 1207.1.5,
 - CRC R328.3.1
- **Four levels of testing**
 - Cell Level Test
 - Module Level Test
 - Unit Level Test
 - Installation Level Test

UL 9540A – Cell and Module Level Test

- Single Cell or Module test
- Chemistry – LiFePO₄, NMC, other
- Gas Volume
- Burning velocity
- Gas Composition

Gas		Measured %
Carbon Monoxide	CO	6.91
Carbon Dioxide	CO ₂	16.19
Hydrogen	H ₂	63.75
Methane	CH ₄	4.65
Ethylene	C ₂ H ₄	3.20
Ethane	C ₂ H ₆	1.07
Propylene	C ₃ H ₆	2.20
Others, each less than 1%		2.03



• Single Cell Test



• Module Test

UL 9540A – Unit Level Test

•Results of large-scale fire testing

- Give guidance on spacing between installed units
- Appropriate mounting surfaces; combustible vs. non-combustible
- Installation limitations
 - Indoor, outdoor, both
 - Residential, non-residential

•Criteria

- Target wall temperature rise < 97 °C (175 °F)
- Indoor wall mount - No flame beyond outer unit dimensions

•Observations

- Exit of flame, cheesecloth test
- Flying debris
- Re-ignition

•Report

- [UL has published an “AHJ Checklist” to help AHJ’s review UL 9540A results](#)

UL 9540A 4th Edition Unit Level AHJ Checklist



Laboratory Checks:

1. The lab is ISO 17025 accredited.
2. The unit construction details and specifications were provided.
3. The number of cells and location of cells failed at the unit level was the same as what was used at the module level.
4. The thermal runaway method used to initiate propagation was the same as the method used at the cell level and module level test.
5. Mitigation devices that are not part of the module/system construction were not introduced during the test to impact the outcome. (Example: external barriers introduced around the external heater on the cell.)
6. Critical information on any fire mitigation means employed in the system was provided and is consistent with the intended installation.
7. Testing was done at an indoor facility unless the ESS was for outdoor installations only.

Yes No

<input type="checkbox"/>	<input type="checkbox"/>

Test Setup:

8. A summary of the critical data from the cell test is provided (vent temperature, thermal runaway temperature, and gas data is available).
9. A summary of the critical data from the module test is provided (thermal runaway temperature, propagation occurrence, peak heat release rate, convective heat release rate, peak smoke release rate, gas data).
10. Test walls and test rooms were built using 5/8 inch drywall and painted flat black except for outdoor ground mounted residential applications or outdoor wall mounted residential applications which need to be tested with 3/4 plywood.
11. The test layout matched the intended installation layout with regard to separation distances from walls and other units.
12. The system was at maximum operating state of charge, which was checked prior to initiation of the test.

Yes No

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Test Method:

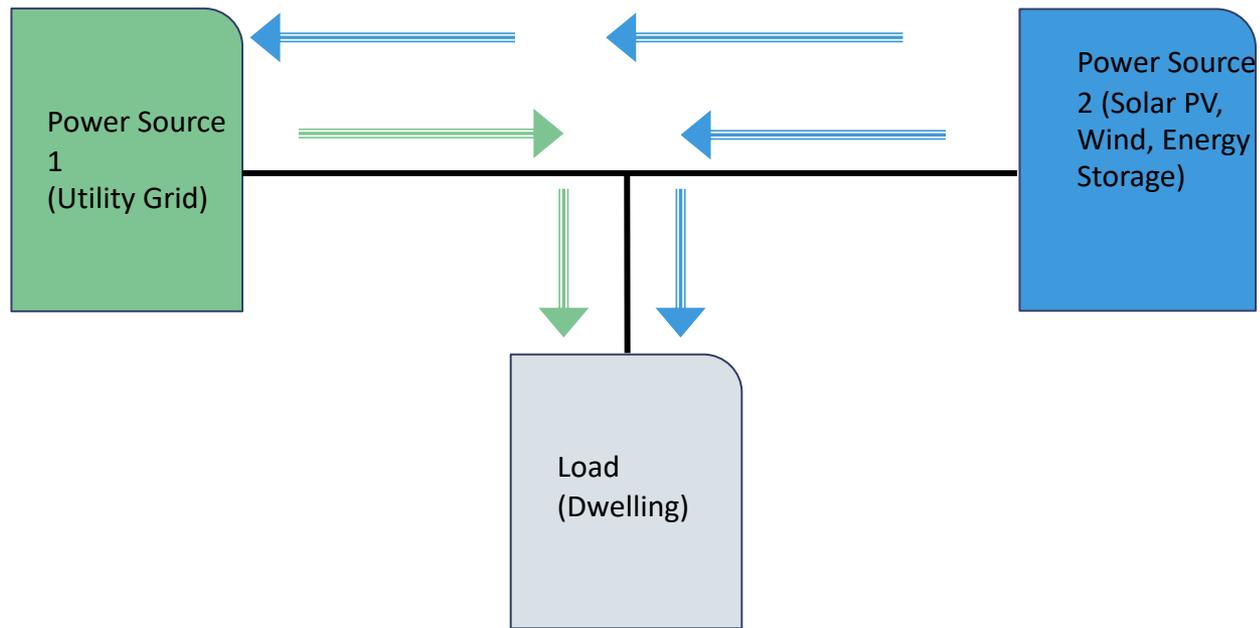
8. Test outcome did not rely upon operation of integral electrical devices such as the BMS, fans or coolant pumps.
9. Temperatures were measured on walls and did not exceed 97°C of temperature rise above ambient unless intended for only noncombustible installations.
10. Temperatures measured on target units did not exceed the onset of cell venting temperature measured during the cell test.
11. Heat flux measured on walls and target units were measured and recorded.

Yes No

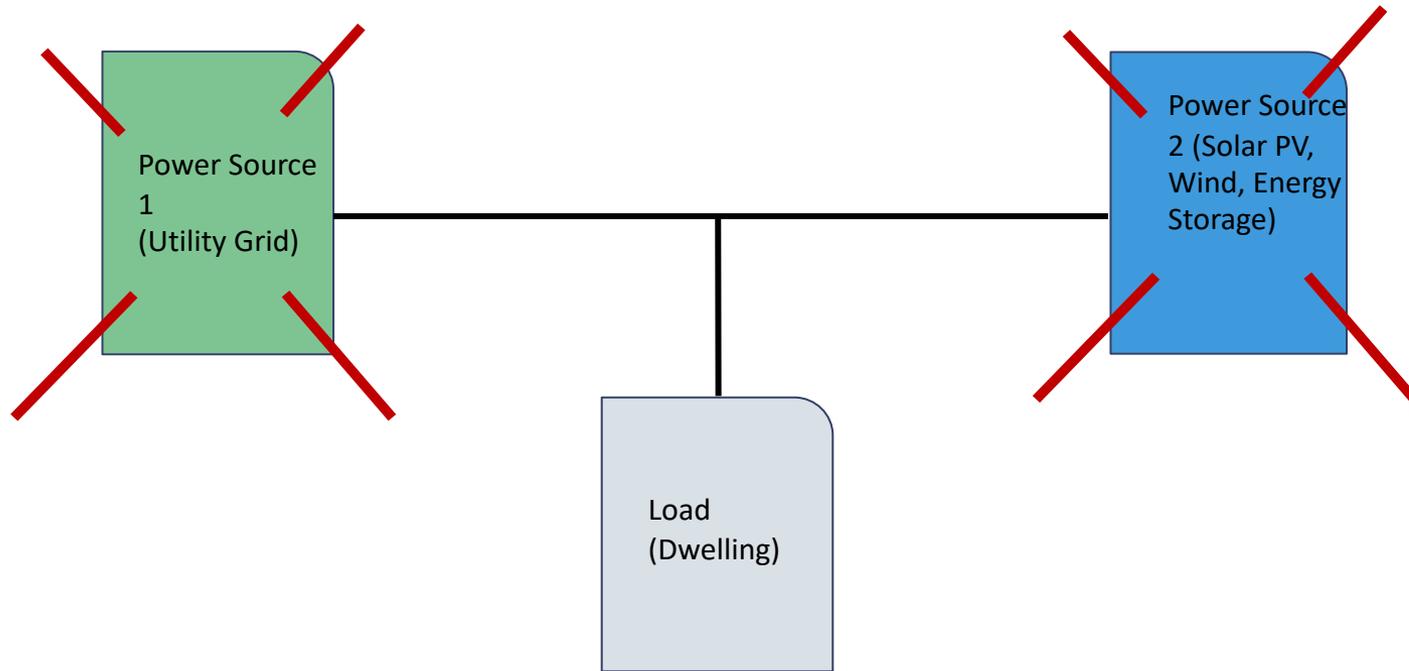
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Parallel vs Standby Power

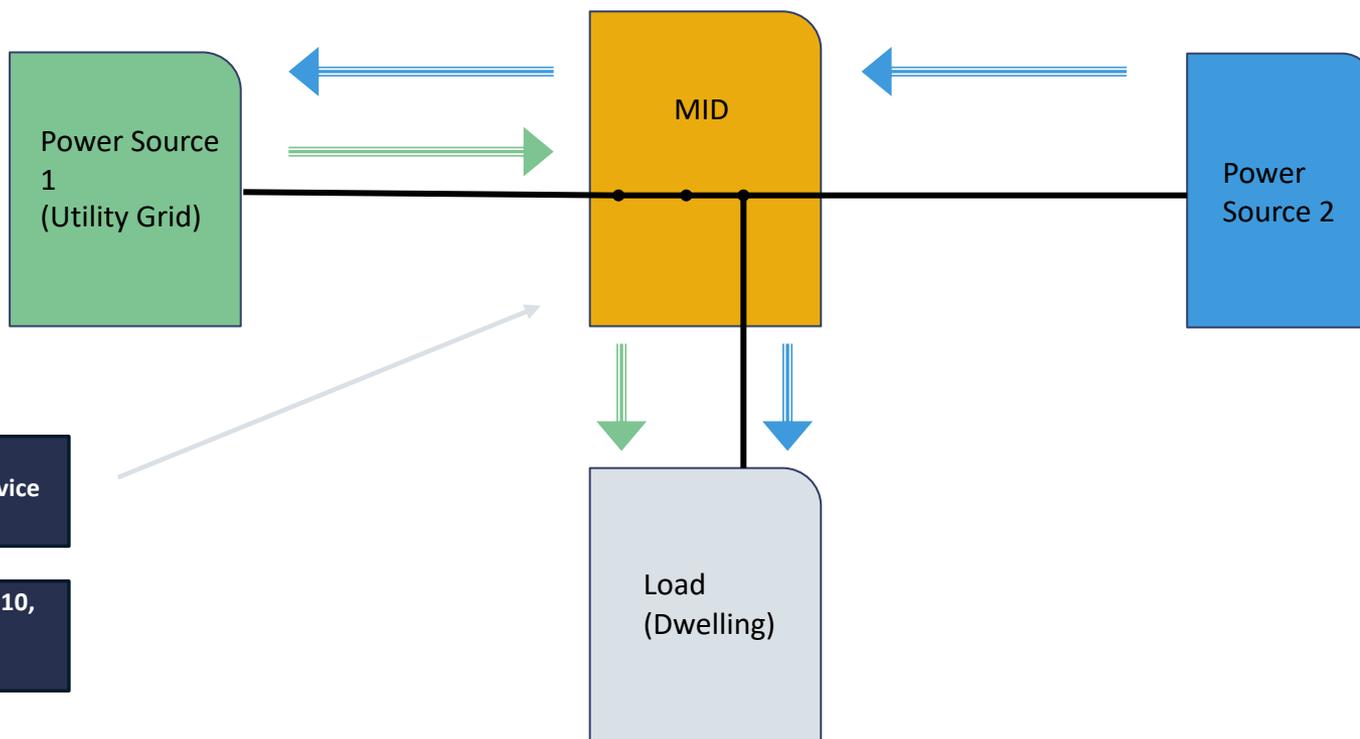
Parallel Utility Interactive System



Parallel Utility Interactive System



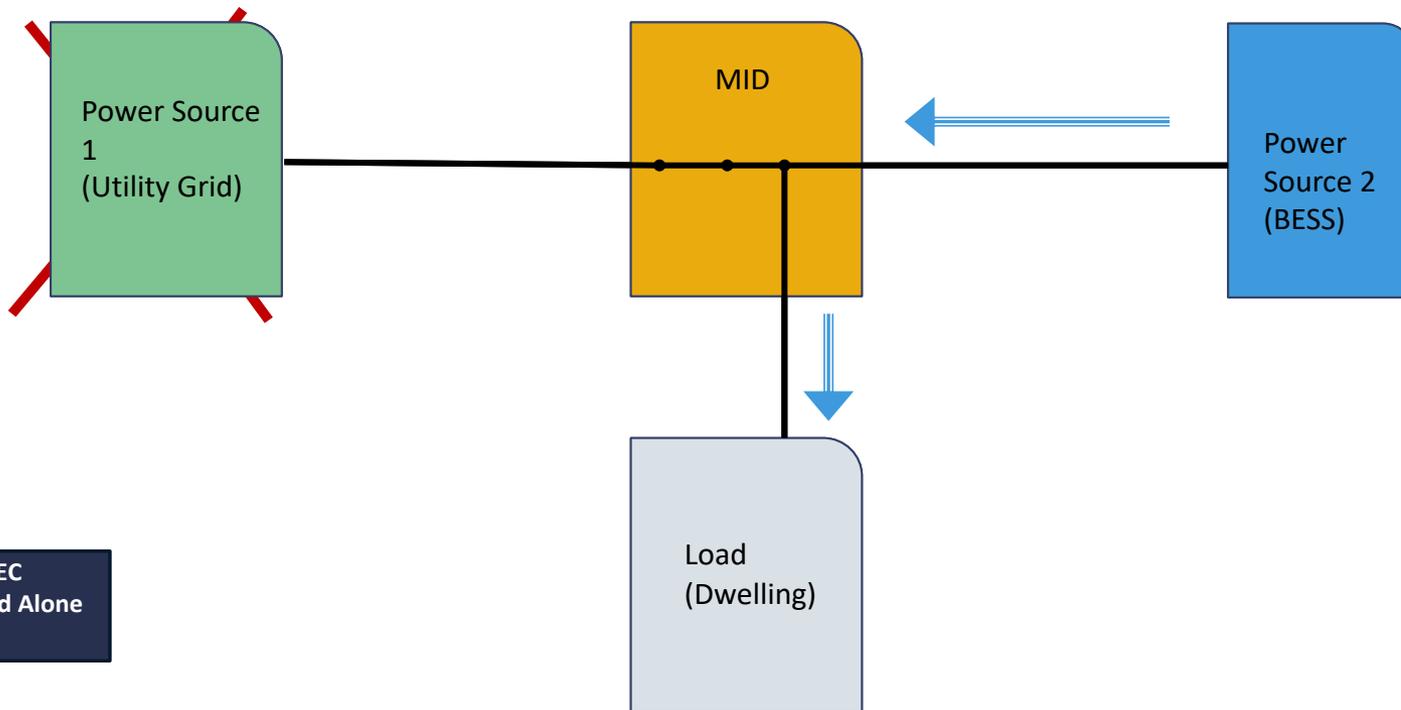
Multimode Parallel and Utility Interactive System



MID= Microgrid Interconnect Device

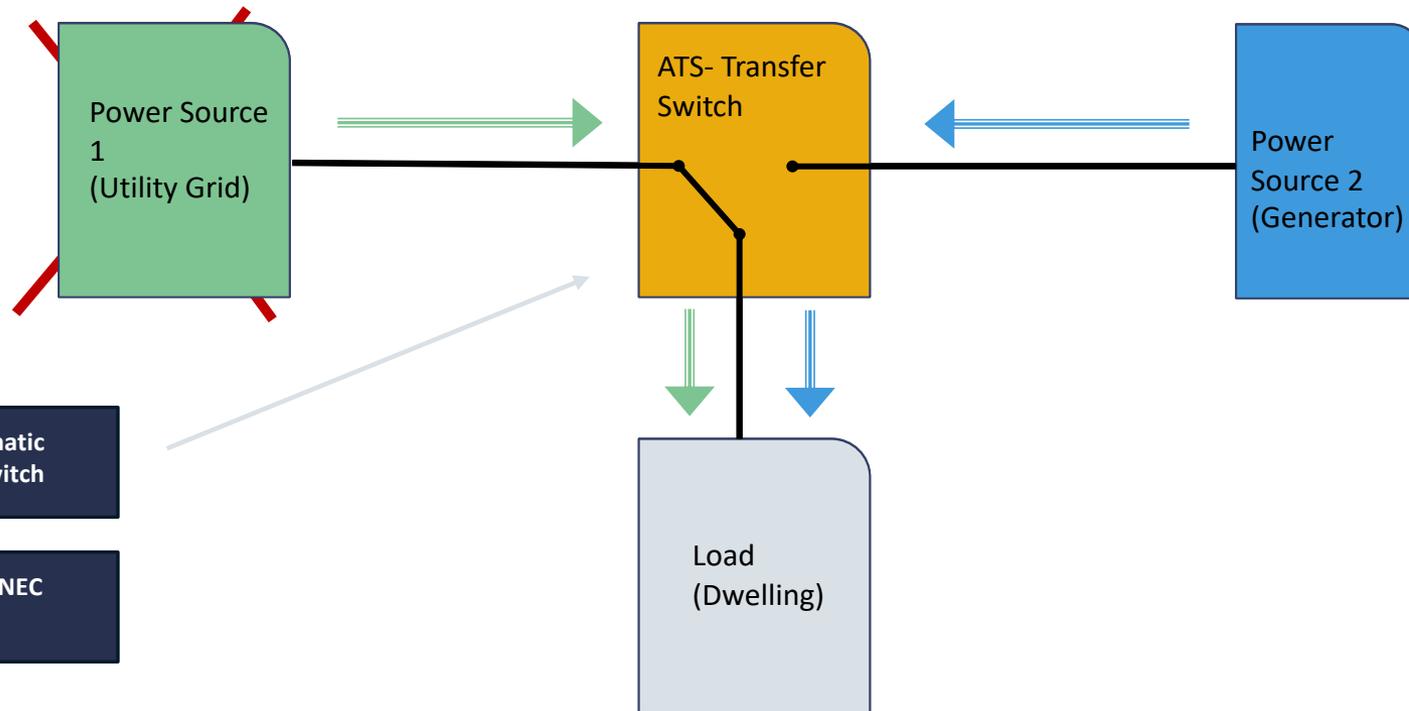
Subject to NEC 710, Stand Alone Systems

Island Mode (Stand Alone) System



Subject to NEC
710.15, Stand Alone
Systems

Standby System (Generator with a transfer switch)



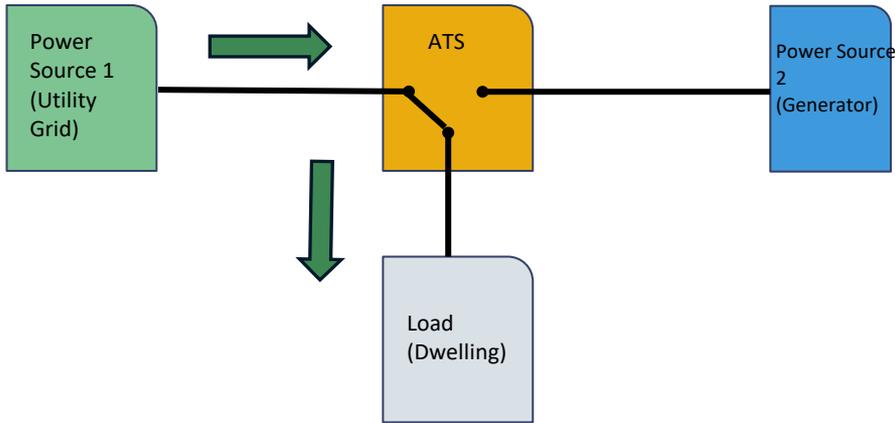
ATS- Automatic Transfer Switch

Subject to NEC 702.5(A)

Parallel Stand Alone vs Transfer Switch Systems

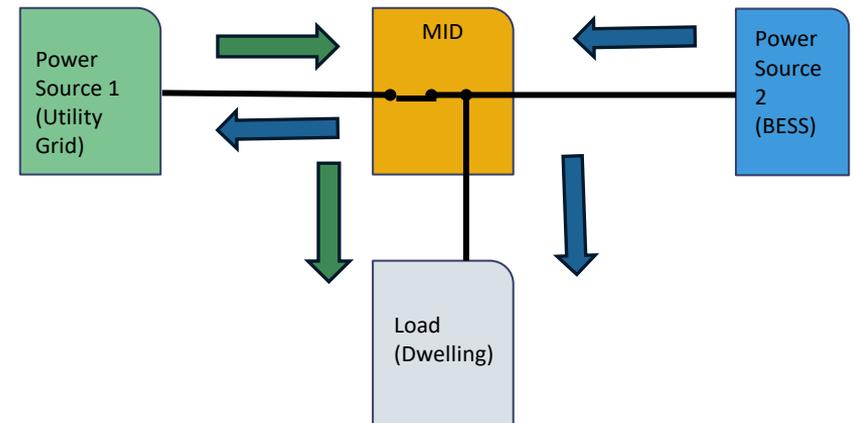
Normal Condition – BESS Connected to Utility & Load

Automatic transfer switch is connected to the generator source



Asynchronous sources are never in parallel

Micro grid interconnect device is connected to the power source 2

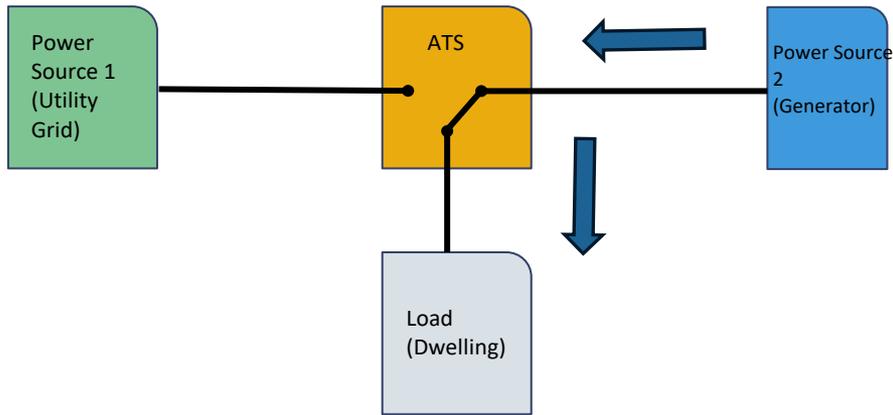


Synchronous sources of power are in parallel or islanded

Parallel Stand Alone vs Transfer Switch Systems

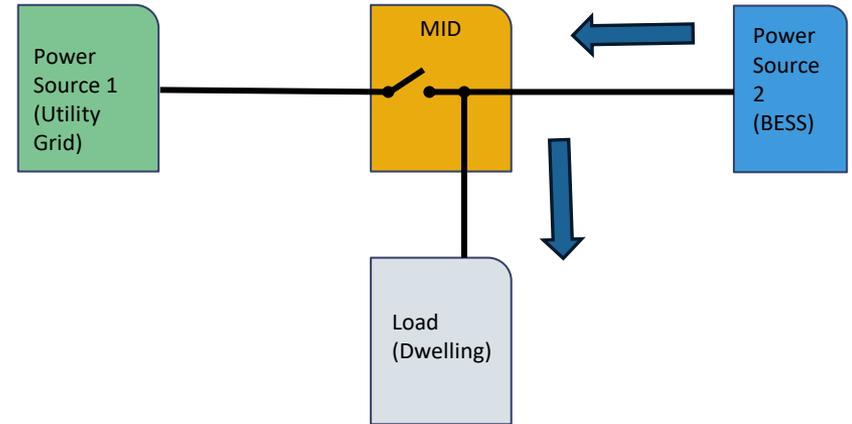
Back Up Condition – Utility Isolated

Automatic transfer switch is connected to the generator source



Asynchronous sources are never in parallel

Micro grid interconnect device is connected to the power source 2



Synchronous sources of power are in parallel or islanded

BESS – Disconnect & Emergency Shutdown

Disconnect Type

System Disconnect

- Isolates power source from premises
- Service disconnect serves this purpose for utility supply
- See CEC 705.20 for interconnected BESS

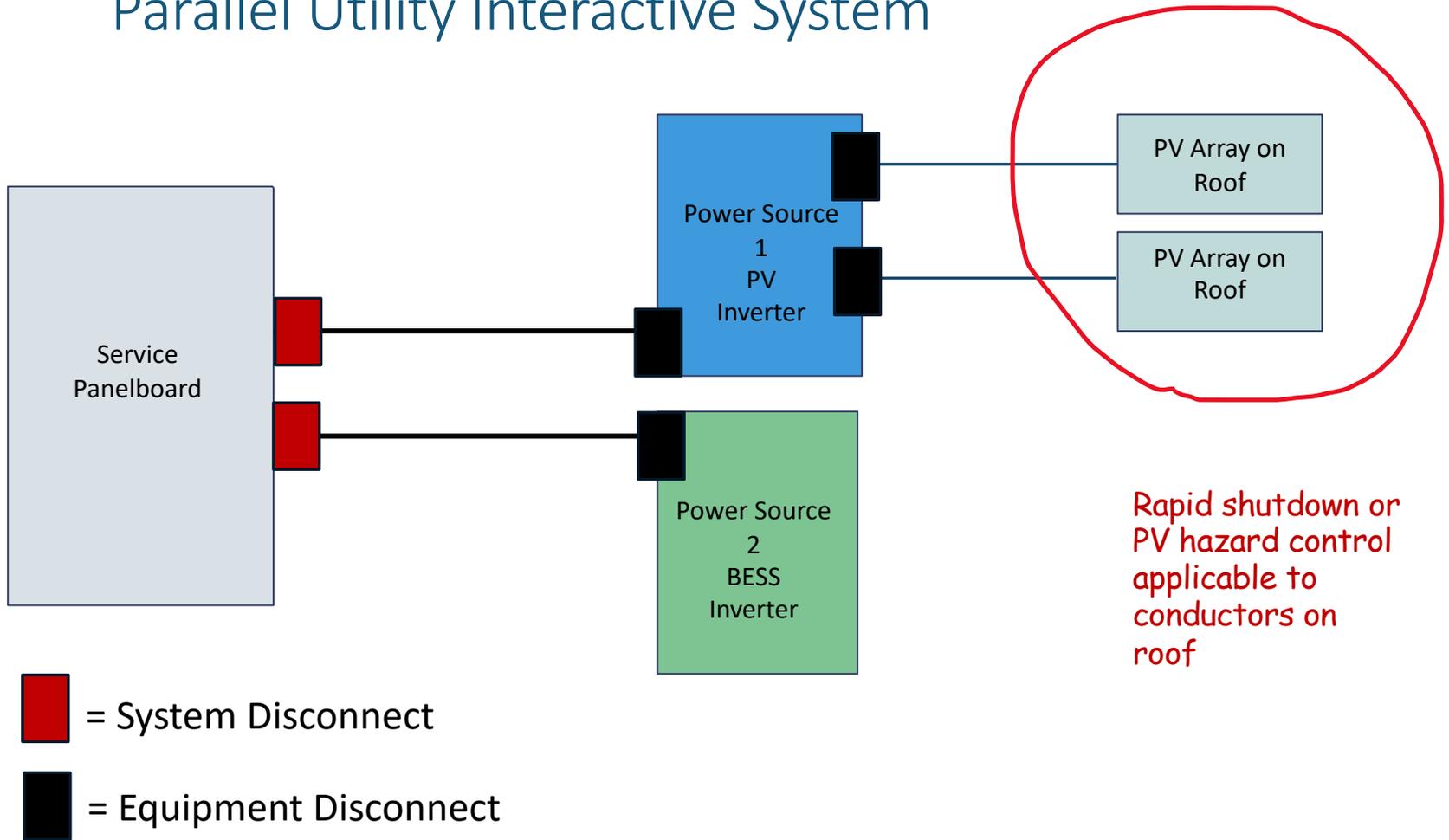
Equipment Disconnect

- Isolates system components for repair or replacement
- HVAC unit disconnect is a common example
- See CEC 706.15 for BESS
- DC or AC coupled BESS?

CEC 706.15

- Readily accessible
- Located within sight of the BESS
- Permitted to be integral to BESS unit(s)
- Lockable open
- Remote activation permitted
- Exterior location required for 1-2 family dwellings

Parallel Utility Interactive System



Remote Activation – 2020 NEC (2022 CEC) Emergency Shutdown – 2023 NEC



Resources

<https://www.ul.com/resources>

<https://www.nfpa.org/>

<https://irecusa.org/>

<https://www.iaei.org/default.aspx>

<https://sustainableenergyaction.org/>

https://code-authorities.ul.com/wp-content/uploads/sites/46/2020/09/UL-9540A-AHJ-Checklist_Rev-2.pdf

Questions?

For questions about this program,
please contact the CALBO Office at
916-457-1103 or info@calbo.org.