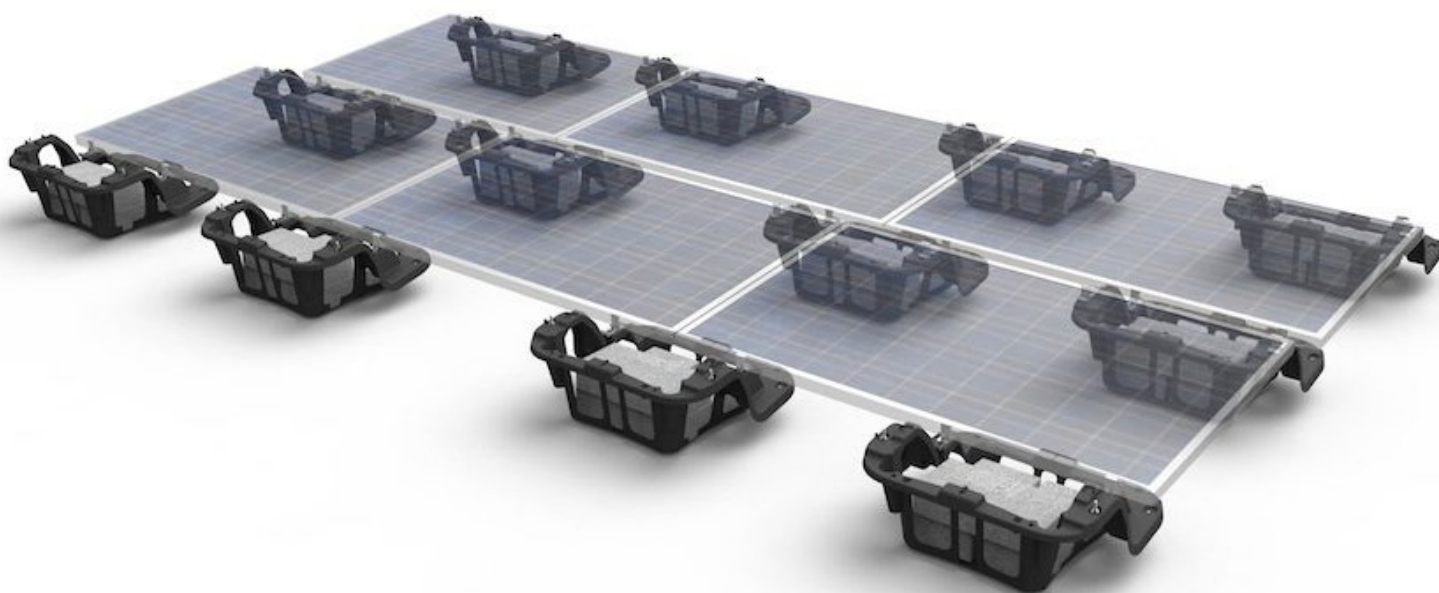


# BX SYSTEM

## UL 3741 PV HAZARD CONTROL INSTALLATION ADDENDUM



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## DISCLAIMER

This manual describes proper installation procedures and provides necessary standards required for product reliability. Warranty details are available at [IronRidge.com](http://IronRidge.com). All installers must thoroughly read this manual and have a clear understanding of the installation procedures prior to installation. Failure to follow these guidelines may result in property damage, bodily injury or even death.

### IT IS THE INSTALLER'S RESPONSIBILITY TO:

- Ensure safe installation of all electrical aspects of the array. All electrical installation and procedures should be conducted by a licensed and bonded electrician or solar contractor. Routine maintenance of a module or panel shall not involve breaking or disturbing the bonding path of the system. All work must comply with national, state and local installation procedures, product and safety standards.
- Comply with all applicable local or national building and fire codes, including any that may supersede this manual.
- Ensure all products are appropriate for the installation, environment, and array under the site's loading conditions.
- Use only IronRidge parts or parts recommended by IronRidge; substituting parts may void any applicable warranty.
- Review the [Design Assistant](#) to confirm design specifications.
- Ensure provided information is accurate. Issues resulting from inaccurate information are the installer's responsibility.
- Ensure bare copper grounding wire does not contact aluminum and zinc-plated steel components, to prevent risk of galvanic corrosion.
- If loose components or loose fasteners are found during periodic inspection, re-tighten immediately. Any components showing signs of corrosion or damage that compromise safety shall be replaced immediately.
- Provide an appropriate method of direct-to-earth grounding according to the latest edition of the National Electrical Code, including NEC 250: Grounding and Bonding, and NEC 690: Solar Photovoltaic Systems.
- Disconnect AC power before servicing or removing modules, AC modules, microinverters and power optimizers.
- Review module manufacturer's documentation for compatibility and compliance with warranty terms and conditions.
- Installers shall refer to the BX installation manual for complete installation instructions
- Ensure that the roof is in good condition prior to installing any IronRidge components.

**CAUTION:** Module removal may disrupt the bonding path and could introduce the risk of electric shock. If during servicing a module is required to be removed, a bonding jumper shall be installed between the adjacent modules from where the module was removed to maintain the bond path.

**WARNING:** To reduce the risk of injury, read all instructions.

## RATINGS

UL 2703 LISTED  
UL 3741 LISTED



#5014158

Intertek

### CONFORMS TO ANSI/CAN/UL STD 3741 STANDARD FOR SAFETY PHOTOVOLTAIC HAZARD CONTROL SYSTEM

- Max PVHCS System Voltage: 1000V

### BX List of approved PV Hazard Control Equipment or Components evaluated at 1000V Max System Voltage:

- All Modules listed in BX Module Compatibility Section with max module area of 30.5ft<sup>2</sup>
- BX Components
  - 5 Deg BX Chassis (BX-5D-P1)
  - 10 Deg BX Chassis (BX-10D-P1)
  - Bottom Clamp (BX-BCL-M1)
  - Top Clamp (BX-TCL-XXMM-M1), where XX is 30 thru 46
- BX Accessories
  - Bonding Jumper (BX-MB8-M1 and BX-RB38-M1)
  - Flat Roof Attachment Kit (BX-MA-FRA-M1)
  - PV Module Grounding Lug (PV-LUG-01-A1)
  - MLPE Mounting Hardware (BX-CMA-MI-M1)
  - BX Inverter Mounting Assembly (BX-CMA-SI-MZ)
  - 3rd Party MLPE Mounts
  - 3rd Party Mechanical Roof Attachments
- PV Connectors (UL 6703 Listed) shall be compatible and approved for the application
- PV Wire (UL 4703 Listed)
- Edge Clip (BX-CT-EC-PZ) and Cable Ties (BX-CT-UV-PZ) (UL 62275 Listed)
- RayTray v2 Solar Wire Management System (UL 870 Listed)
- Listed Conduit
  - Electrical Metallic Tubing (EMT) (UL 797 Listed)
  - Rigid Metal Conduit (RMC) (UL 6 Listed)
  - Intermediate Metal Conduit (IMC) (UL 1242 Listed)
  - Flexible Metal Conduit (UL 1 Listed)
  - Liquid Flexible Metal Conduit (UL 360 Listed)
  - Liquid Tight Flexible Non Metallic Conduit (UL 1660 Listed)
  - Schedule 40/80 Rigid PVC Conduit (UL 651 Listed)
  - Listed Conduit Fittings and Grounding Components

Please see page 3 for list of UL 3741 approved electrical equipment.

## MARKINGS

Product markings are located on the top surface of the BX Chassis.



## Canadian Solar Inverters

- CSI-100K-T480GL03-U
- CSI-90K-T480GL03-U
- CSI-80K-T480GL03-U
- CSI-75K-T480GL03-U
- CSI-100K-T480GL02-U
- CSI-75K-T480GL02-U
- CSI-66K-T480GL01-UB
- CSI-60K-T480GL01-UB
- CSI-50K-T480GL01-UB
- CSI-40K-T480GL01-UB
- CSI-36K-T480GL01-UB
- CSI-30K-T480GL01-UB
- CSI-25K-T480GL01-UB
- CSI-60KTL-GS-B
- CSI-40KTL-GS-FLB
- CSI-40KTL-GS-B
- CSI-30KTL-GS-FLB

## Chint Inverters

- CPS SCA25KTL-DO/US-208
- CPS SCA25KTL-DO-R/US-480
- CPS SCA36KTL-DO/US-480
- CPS SCA50KTL-DO/US-480
- CPS SCA60KTL-DO/US-480

## Fronius Inverters

- Fronius Symo Advanced 10.0-3 208-240/Lite
- Fronius Symo Advanced 12.0-3 208-240/Lite
- Fronius Symo Advanced 15.0-3 480/Lite
- Fronius Symo Advanced 20.0-3 480/Lite
- Fronius Symo Advanced 22.7-3 480/Lite
- Fronius Symo Advanced 24.0-3 480/Lite

## GoodWe

- GW22KLV-SMT-US
- GW28KLV-SMT-US
- GW50K-SMT-US
- GW60K-SMT-US

## NEP Inverters

- Neptune 25K, 30K, 30K-LV , 33K, 36K, 40K, 50K, 60K, 75K and 100K

## SMA Inverters

- STP 33-US-41
- STP 50-US-41
- STP 62-US-41
- STP 20-US-50
- STP 25-US-50
- STP 30-US-50

## Solectria Inverters

- SolectriaRenewablesPVI25TL-208
- SolectriaRenewablesPVI25TL-480-R
- SolectriaRenewablesPVI-36TL-480-V2
- SolectriaRenewablesPVI50TL-480
- SolectriaRenewablesPVI60TL-480

## Solis

- S5-GC60K-LV-US
- S5-GC75K-US
- S5-GC80K-US
- S5-GC90K-US
- S5-GC100K-US
- S5-GC125K-US
- Solis-75K-5G-US
- Solis-80K-5G-US
- Solis-90K-5G-US
- Solis-100K-5G-US
- Solis-25K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-30K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-36K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-40K-US (followed by -US-SW, -US-F-SW or -US-LSW)
- Solis-50K-US (followed by -US-SW, -US-F-SW, -US-F-LSW or -US-LSW)
- Solis-60K-US (followed by -US-F-SW, or -US-F-LSW)
- Solis-66K-US (followed by -US-F-SW, or -US-F-LSW)
- S6-GC25K-US
- S6-GC33K-US
- S6-GC36K-US
- S6-GC40K-US
- S6-GC50K-US
- S6-GC60K-US

## Sungrow Inverters

- SG36CX-US
- SG60CX-US

Note: Requirements for PV arrays addressed in UL 3741 are intended for compliance with the National Electrical Code (NEC), NFPA 70, 2017 and later editions and their requirements for controlling electrical shock hazards inside the array boundary as addressed in NEC section 690.12(B)(2), Rapid Shutdown of PV Systems on Buildings and with the Canadian Electrical Code (CE Code) C22.1. The Inverters shown above within this PVHCS additionally comply with the 30V in 30 seconds requirements outside the PV array as required in 690.12 (B)(1).

## 2020 NEC 690.12(B)(2) Controlling Conductors within the array boundary

The BX Photovoltaic Hazard Control System (PVHCS) is a UL 3741 Listed system that complies with NEC 690.12(B)(2) (1), when installed by qualified persons per the installation procedures outlined in the BX System Installation Manual and this Addendum. Please refer to the following pages of this addendum for various example cases of system designs that comply with 690.12(B)(2).

## 2020 NEC 690.12 Background

NEC 690.12 Rapid Shutdown of PV Systems on Buildings requires that all PV arrays installed on or in buildings shall include rapid shutdown functions to reduce shock hazard for Fire Fighters (FF) in accordance with 690.12(A) through (D):

### (A) Controlled Conductors

- (1) PV system DC circuits
- (2) Inverter output circuits originating from inverters located within array boundary

### (B) Controlled Limits

- (1) Outside Array Boundary:  $\leq 30V$  within 30 seconds
- (2) Inside Array Boundary:
  - (1) Listed PV Hazard Control System (UL 3741)
  - (2)  $\leq 80V$  within 30 seconds after rapid shutdown initiation
  - (3) PV array without exposed wiring methods or conductive parts (NEC 2020 only)

### (C) Initiation devices

- Initiation device(s) shall initiate the rapid shutdown function of the PV system

### (D) NEC 2020 - Equipment

- Equipment that performs the rapid shutdown functions, other than initiation devices such as listed disconnect switches, circuit breakers, or control switches, shall be listed for providing rapid shutdown protection.

### (D) NEC 2023 - Building with Rapid Shutdown

- Buildings with PV systems shall have a permanent label located at each service equipment location to which the PV systems are connected or at an approved readily visible location and shall indicate the location of rapid shutdown initiation devices.

- NEC 690.2 (2020) or Article 100 (2023) defines the array as a mechanically and electrically integrated grouping of modules with support structure, including any attached system components such as inverter(s) or dc-to-dc converter(s) and attached associated wiring.
- NEC 690.12(B) defines the array boundary as 1ft from array in all directions. This indicates that the array boundary can extend 1ft from the edge of the BX racking, inverter or module.
- The inverter is considered within the array boundary if mechanically attached and within 1 foot of the mounting system or module.

## INSTALLATION METHODS PER UL 3741 AND NEC 690.12

The following case studies are provided by Ironridge to show examples of installation configurations that comply with NEC 690.12(B), compliance is not limited to these examples.

Case 1: UL 3741 Listed System – [See page 5](#)

Case 2: UL 3741 Listed System with Contiguous Sub-Array – [See page 6](#)

Case 3: UL 3741 Listed System with Non-Contiguous Sub-Array – [See page 7](#)

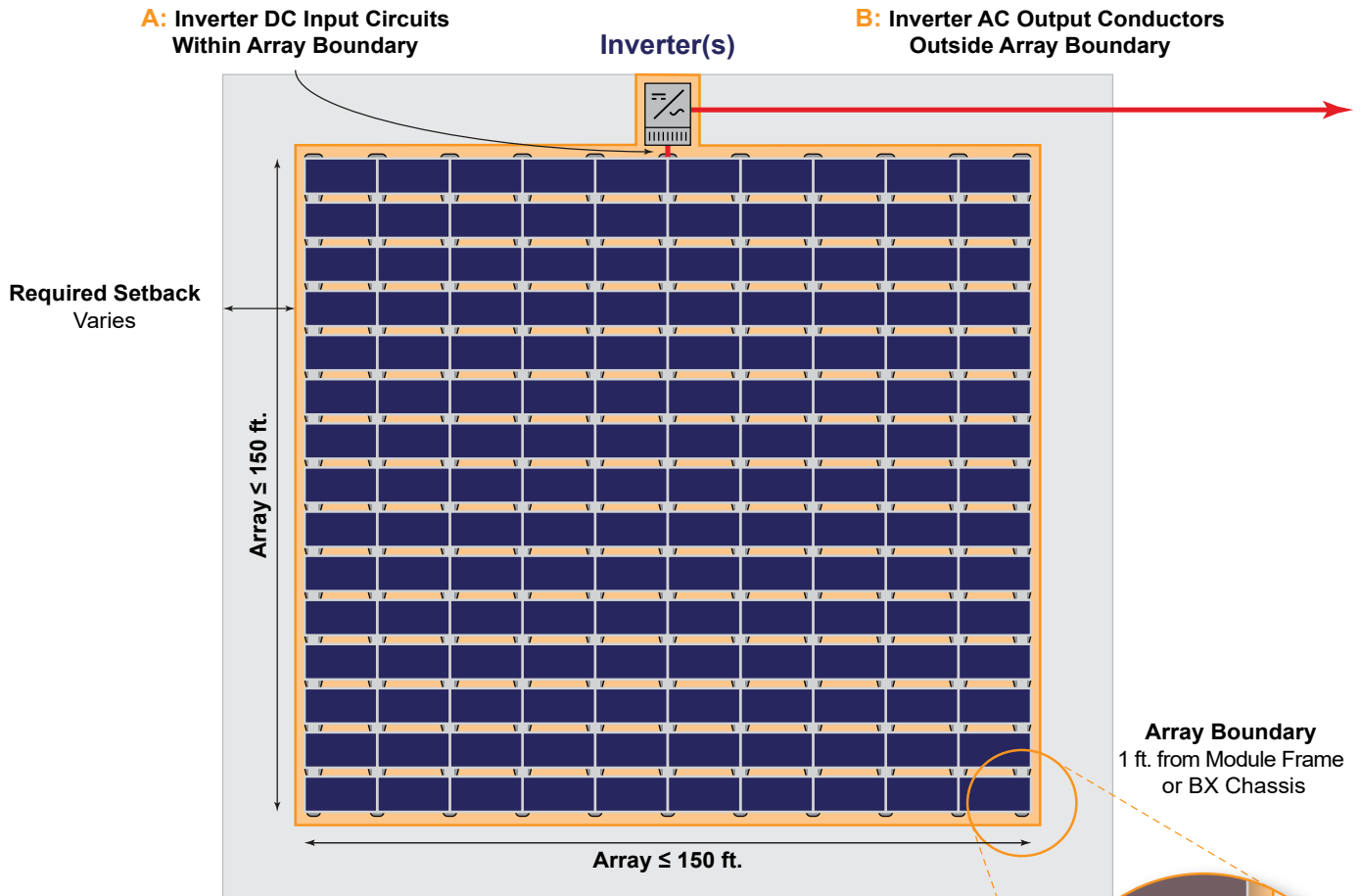
Case 4: UL 3741 Listed System with MLPE Sub-Array – [See page 8](#)

The simplest installation method to comply with NEC690.12(B) is to utilize the BX UL 3741 system with a contiguous array with one or more collocated inverters, as all inverter DC input circuits are within the 1ft array boundary (Case 1). Installations where sub-arrays are required and cannot be included within the 1ft array boundary can comply by using a single or combining one or more of the three options below (Cases 2-4).

Case studies and NEC guidance have not been verified by Intertek.

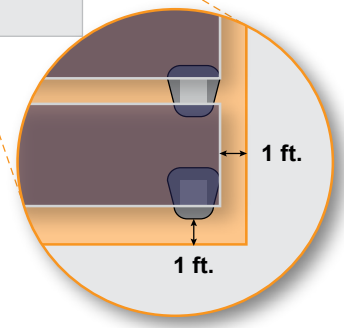
Case 1: Array(s) comply with NEC 690.12(B)(2)(1)

- **Outside Array Boundary:**  $\leq 30V$  within 30 Seconds
- **Inside Array Boundary:**  $\leq 1000V$



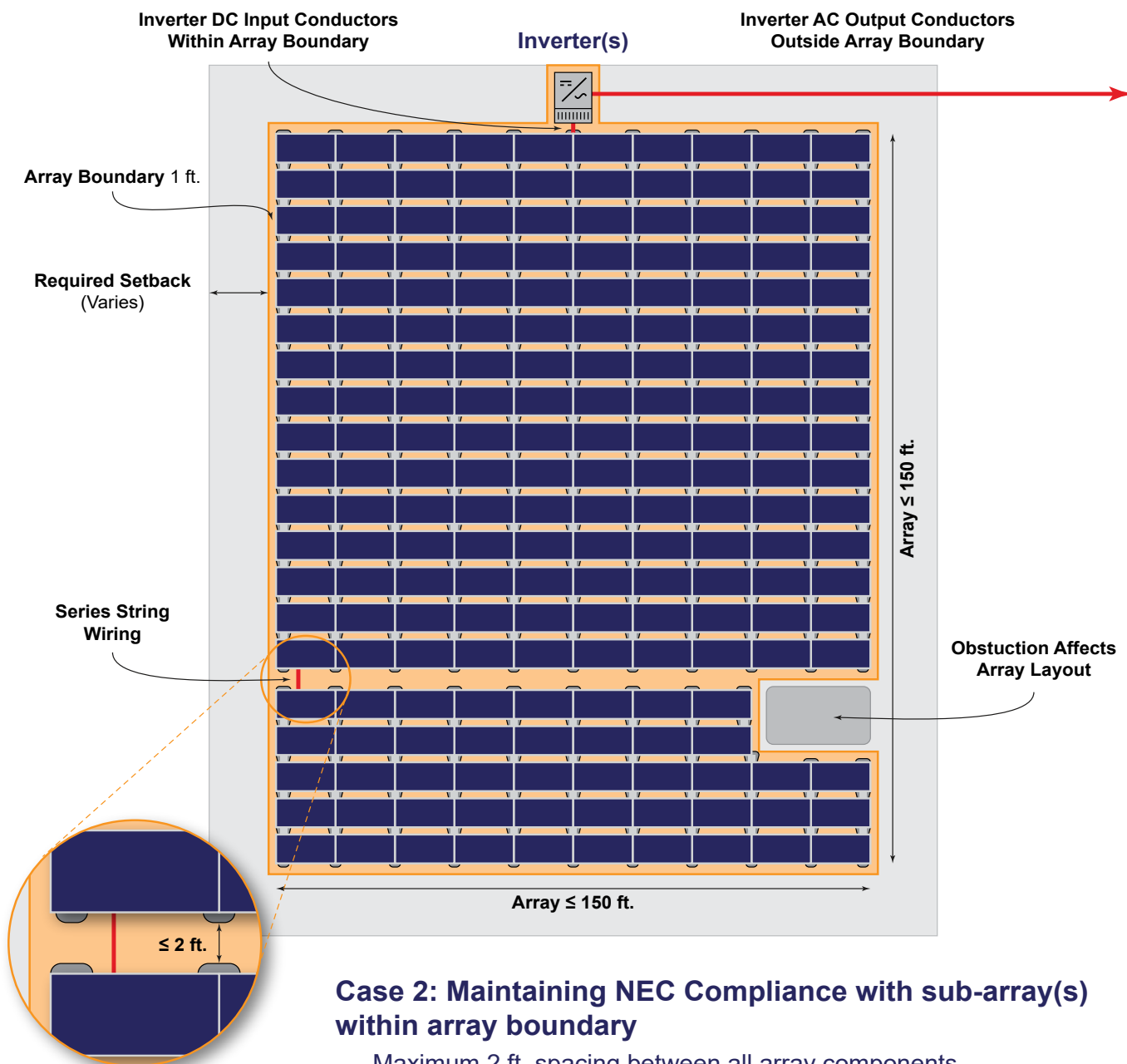
**Case 1: Array(s) complies with 690.12(B) by utilizing a listed UL 3741 PV Hazard Control System**

- A:** All inverter input circuits (DC) are contained within the PV array boundary and do not require additional measures to reduce string voltages per 690.12(B)(2)(1) after initiation (Inverter DC disconnect, AC breaker or AC disconnect).
- B:** Inverter output circuits (AC) are outside of the array boundary and meet the 690.12(B)(1) requirement after initiation (AC breaker or AC disconnect).



Case 2: Sub-Array(s) are within the same Array Boundary and Array(s) comply with NEC 690.12(B)(2)(1)

- **Outside Array Boundary:**  $\leq 30V$  within 30 Seconds
- **Inside Array Boundary:**  $\leq 1000V$



**Case 2: Maintaining NEC Compliance with sub-array(s) within array boundary**

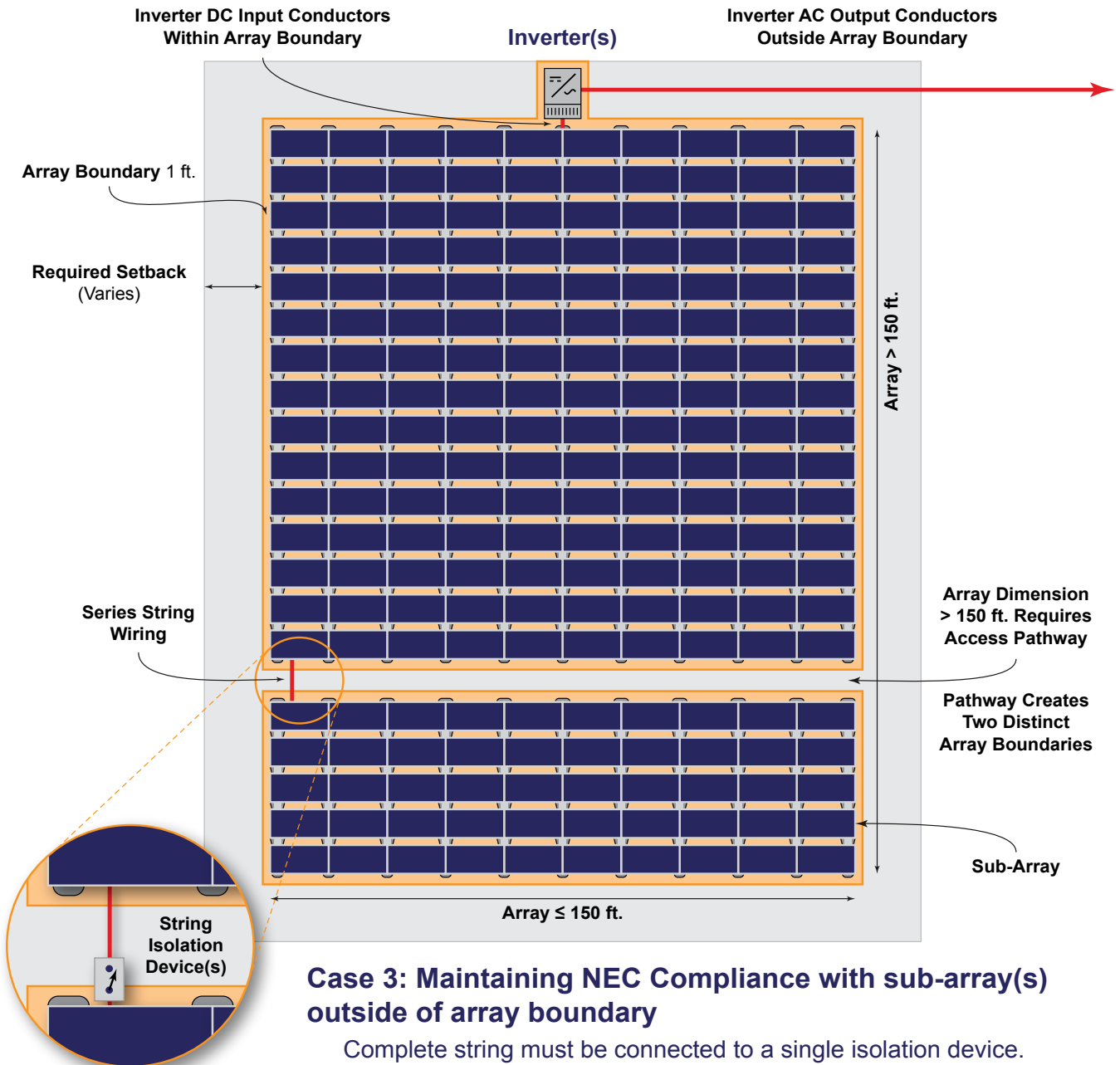
Maximum 2 ft. spacing between all array components resulting in a single array boundary.

**2:** All Modules Within Same Array Boundary



Case 3: Multiple Sub-Arrays with conductors outside of Array Boundary are controlled via String Isolation Device(s)

- **Outside Array Boundary:**  $\leq 30V$  within 30 Seconds
- **Inside Array Boundary:**  $\leq 1000V$



**Case 3: Maintaining NEC Compliance with sub-array(s) outside of array boundary**

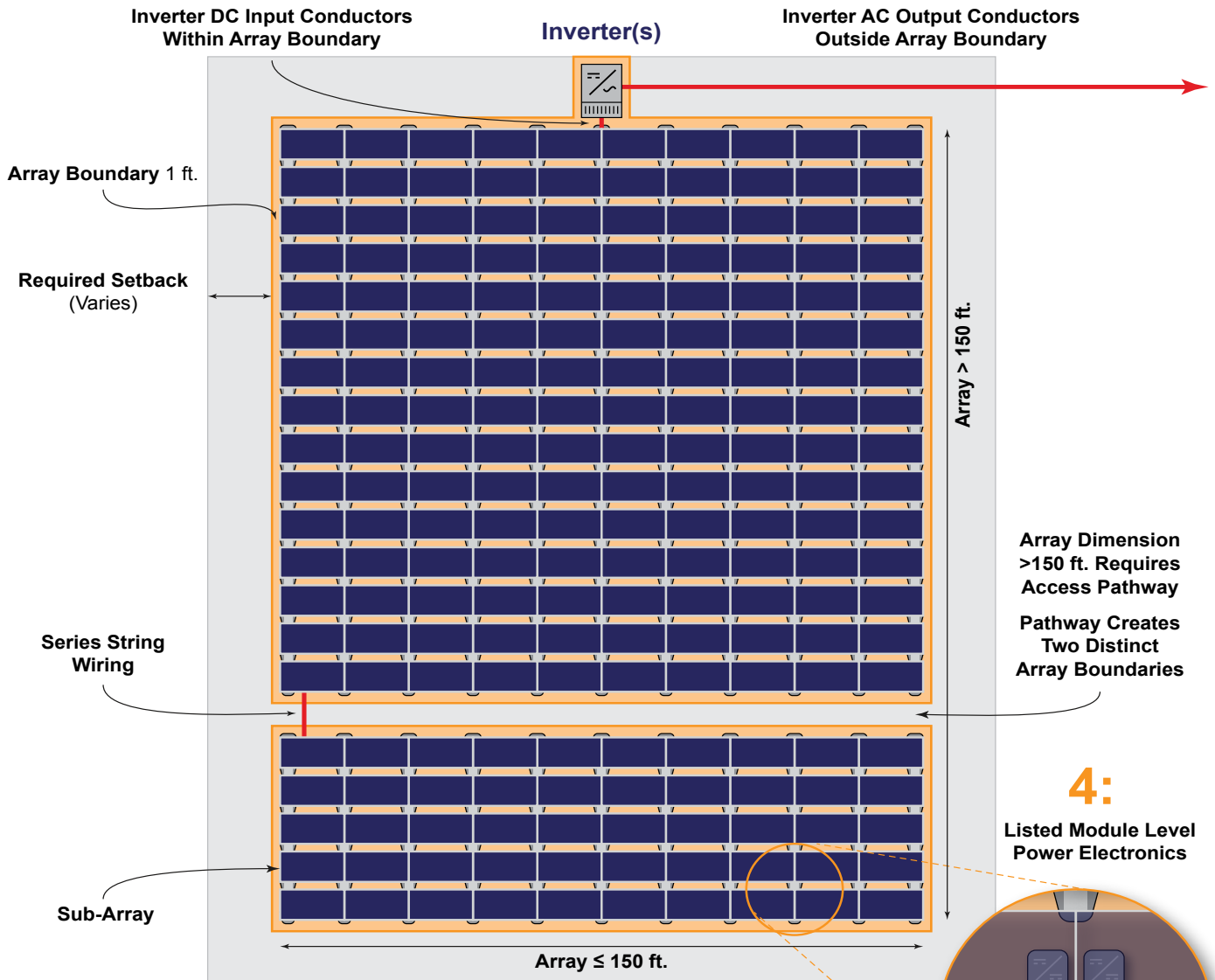
Complete string must be connected to a single isolation device. If used for a partial string, isolation devices required on both sides of the pathway since voltage will be present on both sides.

**3:** String Isolation Device(s) to control conductor outside of array boundary



Case 4: Sub-array(s) using MLPEs to control circuits for 690.12(B)(1) and (B)(2) compliance

- **Outside Array Boundary:**  $\leq 30V$  within 30 Seconds
- **Inside Array Boundary:**  $\leq 1000V$
- **Inside Sub-Array Boundary:**  $\leq 80V$  inside within 30 Seconds



**Case 4: Maintaining NEC Compliance with sub-array(s) outside of array boundary**

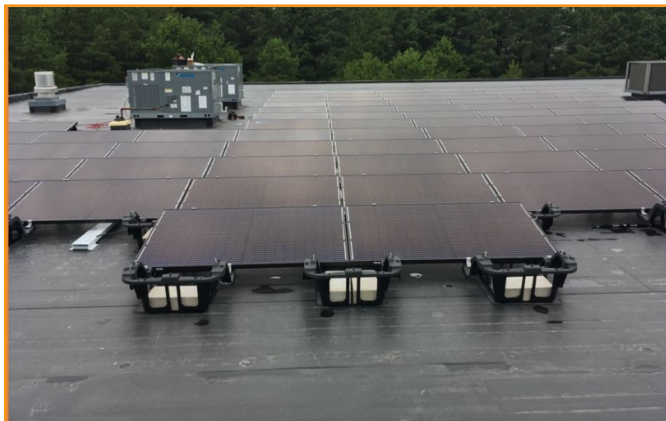
Utilize Module-Level Power Electronics on lower sub-array.  
 All modules on the same inverter input must be connected to an MLPE.  
 Upper array utilizes UL3741 listing without MLPEs for compliance.

NOTE: When using MLPE devices, review installation instructions for both the MLPE device and Inverter to verify that both devices are compatible and comply with UL1741 Rapid Shutdown requirements.

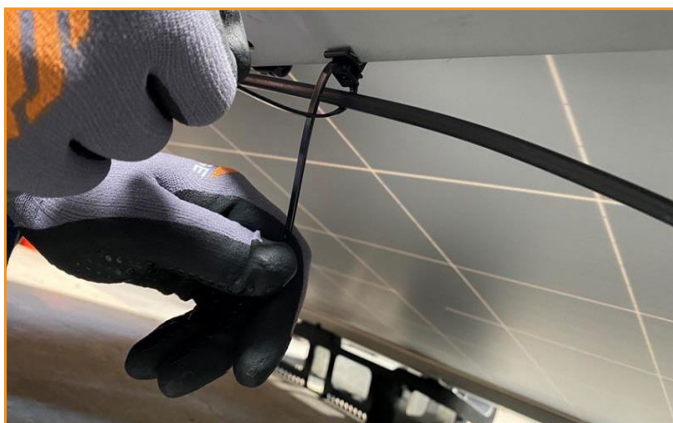
## UL 3741 WIRE MANAGEMENT GUIDELINES

The BX Wire management components noted in the list of approved PVHCS equipment on [page 3](#) were evaluated and approved for providing wire protection against potential FF interactions. Proper wire management is critical for UL 3741 compliance and requires that all wires be routed in a manner that prevents exposure to potential FF interactions. Routing wires under the BX Chassis and under modules, or through approved listed raceway for wires crossing over a pathway, will ensure avoiding exposure to FF interactions.

When using the Edge Clip Cable Tie, wrap the cable tie around the conductor(s) and tighten until wiring is secured in place. Do not overtighten or pinch the conductors. See photos for examples of under module and under chassis wire management.



*All wiring managed under module, BX chassis or in listed raceway.*



*Examples of wire installation under module frame.*



*Examples of wire installation under BX Chassis.*

## UL 3741 WIRE MANAGEMENT GUIDELINES

Manage larger bundles of cables using RayTray or other listed raceway. When entering and exiting the raceway, installers shall ensure PV wires are routed away from exposure to Fire Fighter interactions.



*Examples of wire installation in approved wireways.*