Solar Photovoltaic Power Systems

February 2015

Solar photovoltaic (PV) systems present unique electric shock hazards for firefighters.

During fire suppression activities, firefighters will disconnect the utility alternating current (AC) service to the building. The AC output of the PV system inverter instantly shuts down when utility power is interrupted. However, although the direct current (DC) isn't flowing, the PV system DC voltage remains and can pose electrical hazards to firefighters.

The 2012 Seattle Fire Code Section 605.11 as amended in 2014 has provisions to mitigate these dangers and to provide access pathways on roofs to facilitate firefighting operations. The current Seattle Fire Code section 605.11 can be viewed at: http://clerk.seattle.gov/~archives/Ordinances/Ord_124580.pdf.

Seattle Fire Code Requirements for Solar Photovoltaic Power Systems

Locations of Direct Current Conductors

In addition to installation requirements of the Seattle Electrical Code, the Seattle Fire Code requires:

- Conduit, wiring systems, and raceways for photovoltaic circuits are located as close as possible to the ridge or hip or valley and from the hip or valley as directly as possible to an outside wall.
- Conduit runs between sub arrays and to DC combiner boxes are installed in a manner that minimizes the total amount of conduit on the roof by taking the shortest path from the array to the DC combiner box.
- DC combiner boxes are located such that conduit runs are minimized in the access pathways between arrays.
- DC wiring is installed in metallic conduit or raceways when located within enclosed spaces in a building.

Additional Signage and Marking Requirements

In addition to the provision of the Seattle Electrical Code, the Seattle Fire Code requires marking on interior and exterior DC conduit, enclosures, raceways, cable assemblies, junction boxes, combiner boxes and disconnects as follows:

- The materials used for marking must be reflective, weather resistant and suitable for the environment.
- Marking must have all letters capitalized with a minimum height of 3/8-inch white on red background, and read “PHOTOVOLTAIC POWER SOURCE.”
- Place marking on interior and exterior DC conduit raceways, enclosures and cable assemblies every 10 feet, within 1 foot of turns or bends and within 1 foot above and below penetrations of roof/ceiling assemblies, walls or barriers.
- Provide an identification plate adjacent to the main service disconnect that is clearly visible from the location where the disconnect is operated to provide emergency responders with appropriate warning regarding the solar electric system.

Rapid Shutdown of PV Systems on Buildings

Seattle Fire Code provisions for locations of DC conductors and additional signage and marking may be waived for PV systems that comply with Seattle Electrical Code Section 690.12 Rapid Shutdown of PV Systems on Buildings, as approved by the Department of Planning and Development Electrical Division.

Access and Pathways to Residential PV Systems for One- and Two-Family Dwellings

Seattle Fire Code Section 605.11.3 provisions for roof access and pathways are not required for one-and two-family dwellings where:

- The structure has an approved automatic fire sprinkler system installed; **OR**
- The roofs have slopes of two units vertical in twelve units horizontal (2:12) or less; **OR**
- The total combined area of the solar array does not exceed thirty-three percent (as measured in plan view) of the total roof area of the structure, the solar array will measure 1,000 square feet or less in area, and where a minimum 18-inch wide unobstructed pathway is maintained along each side of any horizontal ridge.
- The structure is a detached, non-inhabitable Group U occupancy such as a storage shed.

For one-and two-family dwellings having PV systems that do not meet the above criteria:

- Roof access points must be located at strong points of building construction, in areas that do not require the placement of ground ladders over openings such as windows or doors, and in locations where the access point does not conflict with overhead obstructions such as tree limbs, wires, or signs.
- Each PV system array must be not greater than 150 feet by 150 feet in either axis.
- Panels/modules must be located **no higher than 18 inches below the ridge** in order to allow for fire department smoke ventilation operations.

Common Residential Roof Types

Single Ridge. Panels/modules installed on one-and two-family dwellings with a single ridge must be located in a manner that provides two, 3-foot-wide unobstructed access pathways from the eave to the ridge on each roof slop where panels/modules are located.

Hip Roof Layouts. Panels/modules installed on one-and two-family dwellings with hip roof layouts must be located in a manner that provides a 3-foot-wide clear access pathway from the eave to the ridge on each roof slope where panels/modules are located. The access pathway must be located at a structurally strong location of the building capable of supporting the live load of fire fighters accessing the roof.

Roof Hips and Valleys. Panels/modules installed on one- and two-family dwellings with roof hips and valleys must be located no closer than 18 inches to a hip or a valley where panels/modules are to be placed on both sides of a hip or valley. Where panels are to be located on only one side of a hip or valley, the panels are permitted to be placed directly adjacent to the hip or valley.

Please refer to Appendix 1 for examples of pathways for residential PV systems for One-and-Two-Family Dwellings.

Access and Pathways to PV Systems for Commercial Buildings

For apartment buildings and other commercial buildings that have a roof configuration similar to that of typical one-or two-family dwellings (gables, hips, valleys, etc.), roof access and pathways may be in accordance with provisions for one-or two-family dwellings.

For all other commercial buildings, the PV system installation must be designed to meet the following:

Where either axis of the building is more than 250 feet, provide a minimum 6-foot-wide clear perimeter around the edges of the roof. Where either axis of the building is 250 feet or less, a minimum 4-foot-wide clear perimeter is required around the edges of the roof.

PV system arrays must be no greater than 150 feet by 150 feet in either axis, with clear access pathways provided between them in order to create opportunities for the Fire Department to conduct smoke ventilation operations. Exemption from some of these requirements may be allowed for buildings equipped with an approved mechanical smoke and heat removal system, or where it can be demonstrated that fire fighter ventilation operations are not practicable due to the roof construction.

Provide centerline axis pathways in both axes of the roof. Where multiple PV system arrays are installed, the access pathways may be run at locations other than the centerline(s) of the roof.

Access pathways between arrays must be in a straight line, and either:

- 8 feet or greater clear width; **OR**

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- 4 feet or greater clear width to 4-feet by 8-feet designated "venting cutouts" proved every 20 feet on alternating sides of the pathway.

In addition, provide 4 feet or greater clear width straight line access pathways from a roof edge or parapet to and around any smoke and heat vents, skylights, roof access hatches, and standpipe hose valves.

Please refer to Appendix 2 for examples of access and pathways to PV systems for Commercial Buildings.

Department of Planning and Development Permit Requirements

In general, the person installing the solar system obtains any required permits. See DPD TIP 420 Solar Energy Systems at http://www.seattle.gov/DPD/Publications/CAM/cam420.pdf .

For specific information, applicants should contact the DPD's Applicant Service Center (ASC) at (206) 684-8850.

Please continue to next page for appendices.

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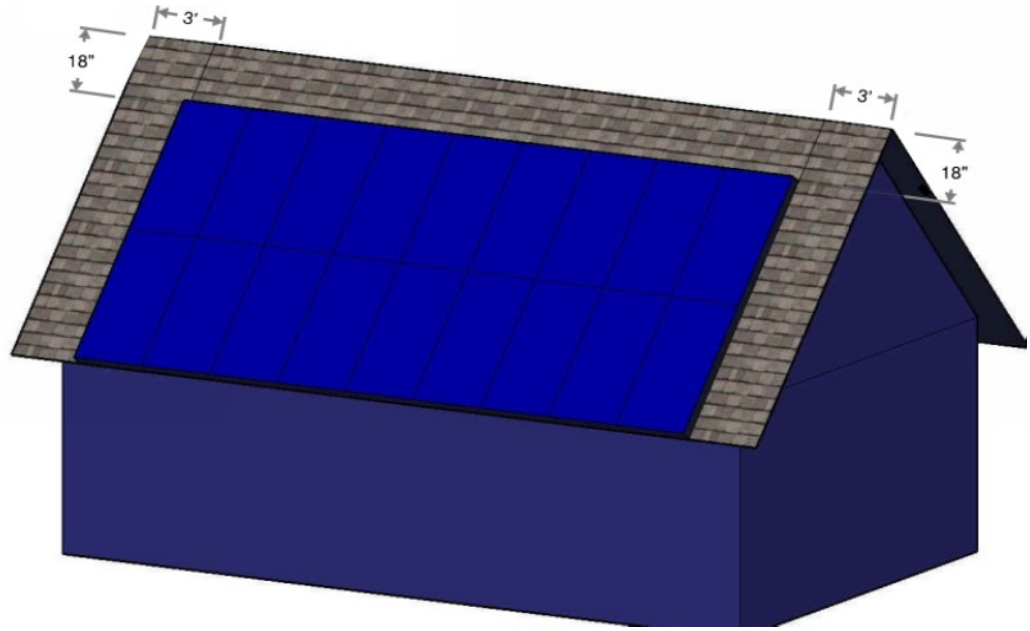
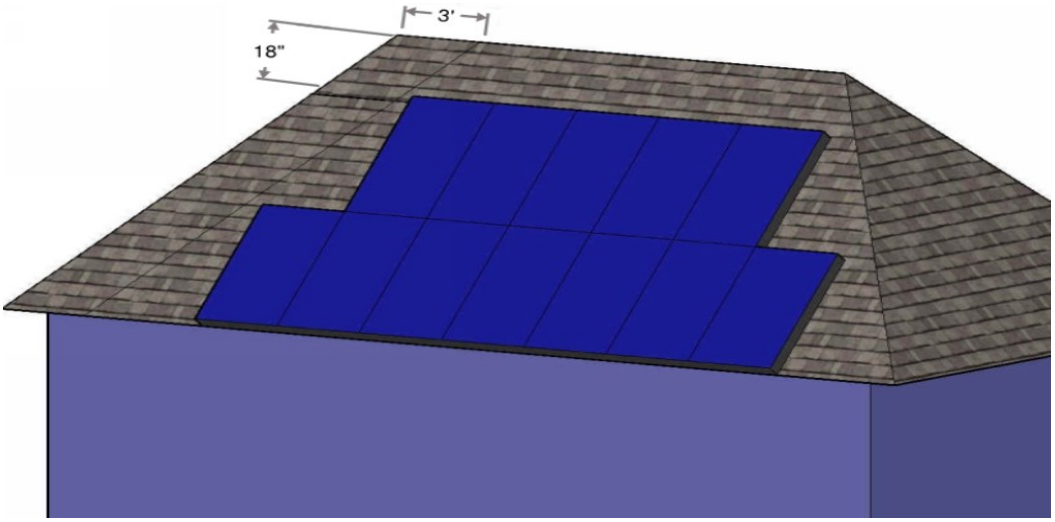
Appendix 1:

Examples of Pathways for Residential PV Systems for One-and Two-Family Dwellings

Single Ridge Full Gable



Single Ridge Full Hip Roof



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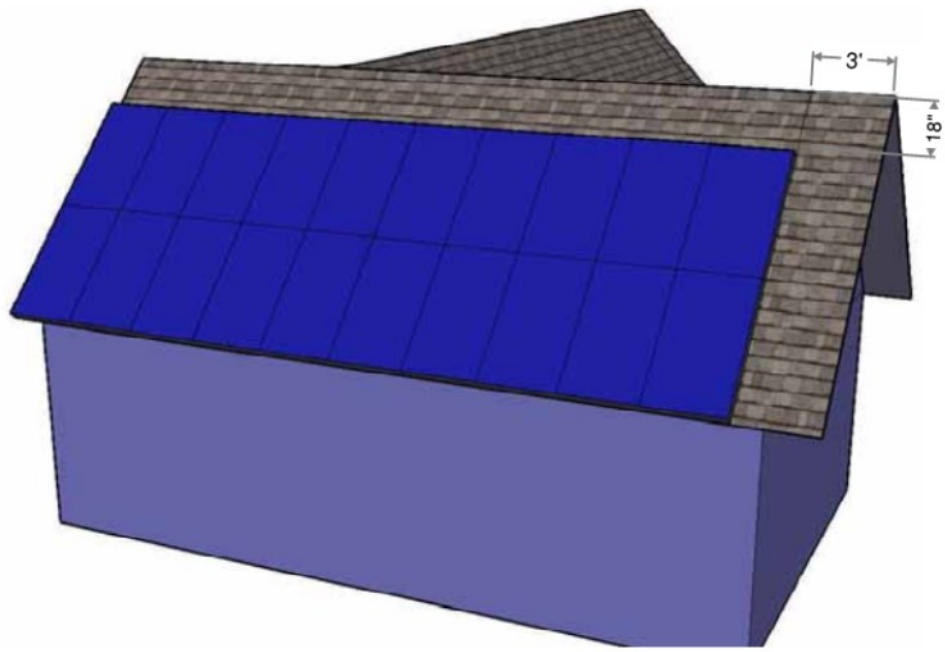
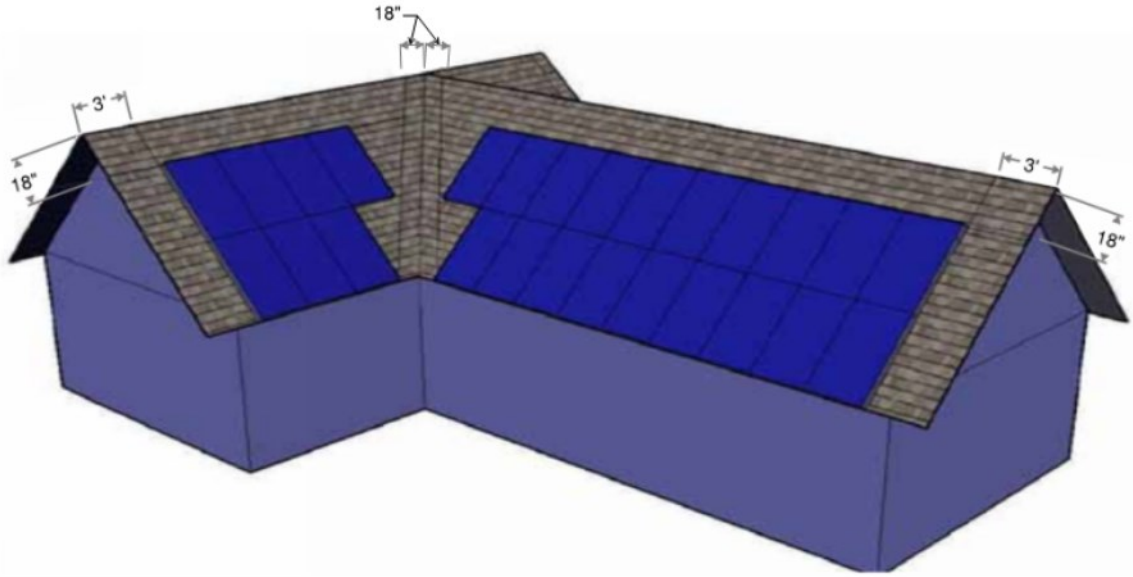
Appendix 1, Cont'd.

Cross Gables with One Valley



Cross Gables with Two Valleys



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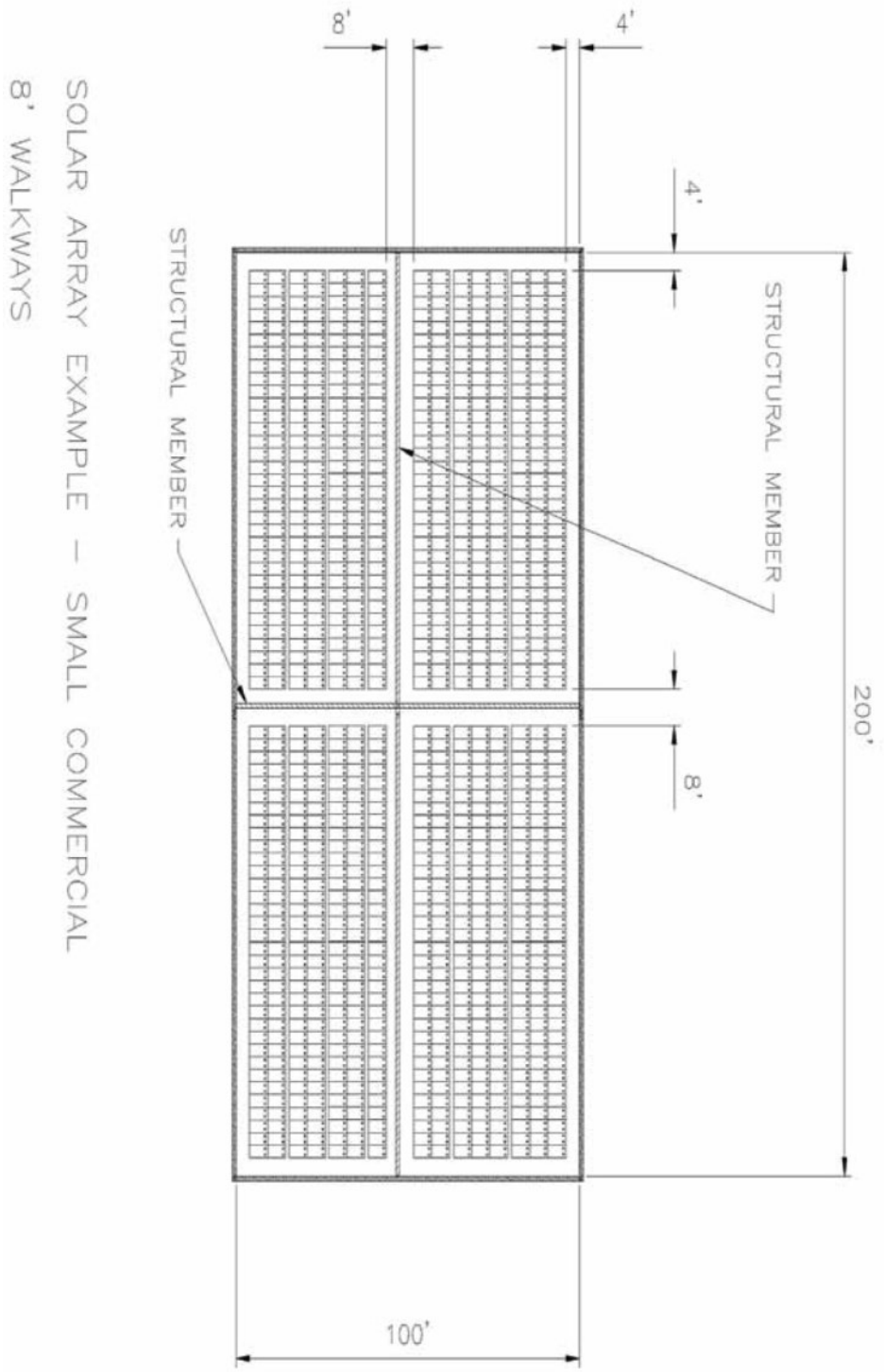
Appendix 2: Examples of Pathways for PV Systems for Commercial Buildings

Image 1: Small Commercial with 8' Wide Pathways



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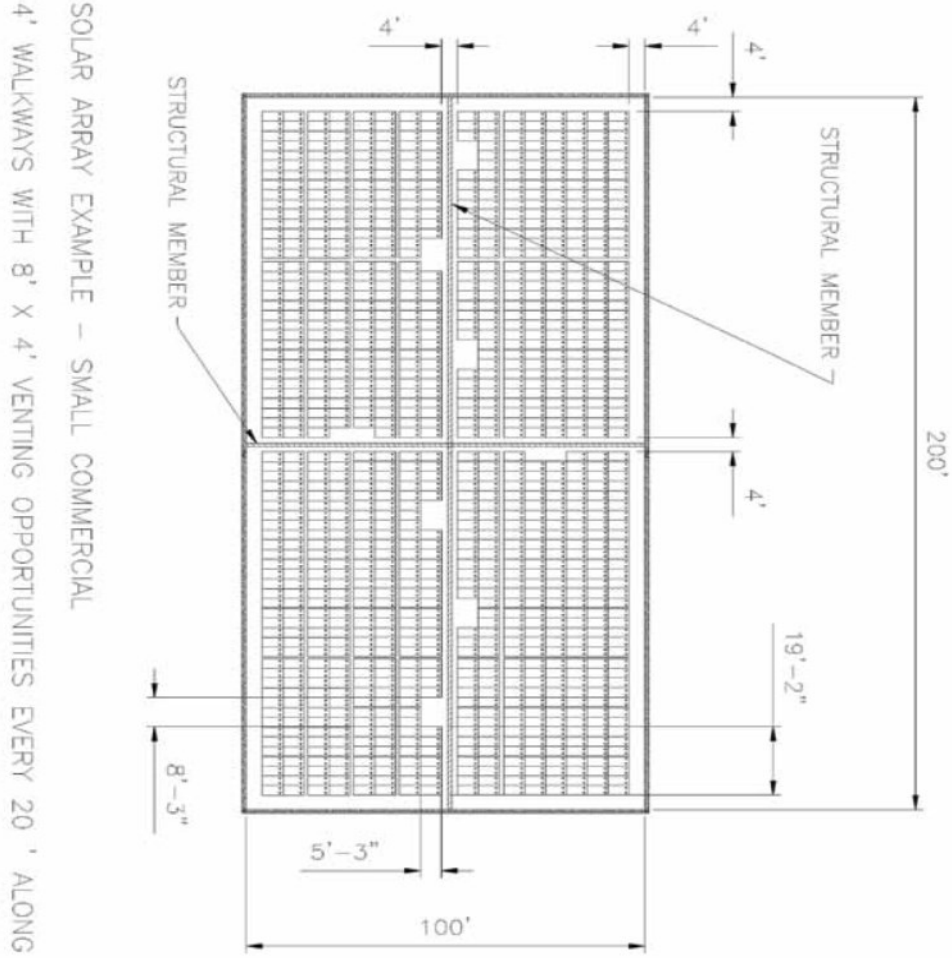
Appendix 2, Cont'd.

Image 2:
Small Commercial with 4' Wide Pathways and 4"x8' Designated Venting Areas Every 20'



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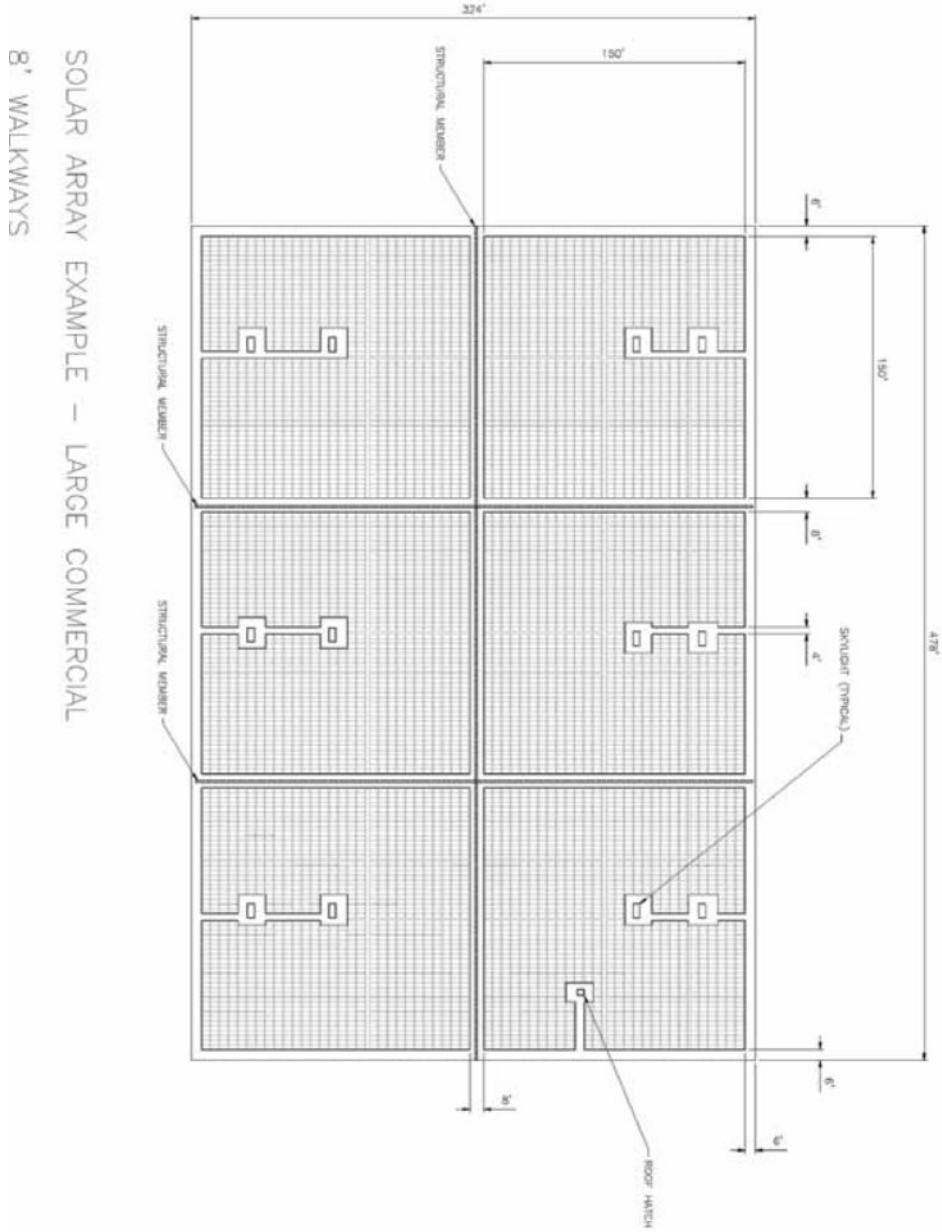
Appendix 2, Cont'd.

Image 3:
Large Commercial with 8-Feet Wide Pathways, Skylights and Roof Hatch



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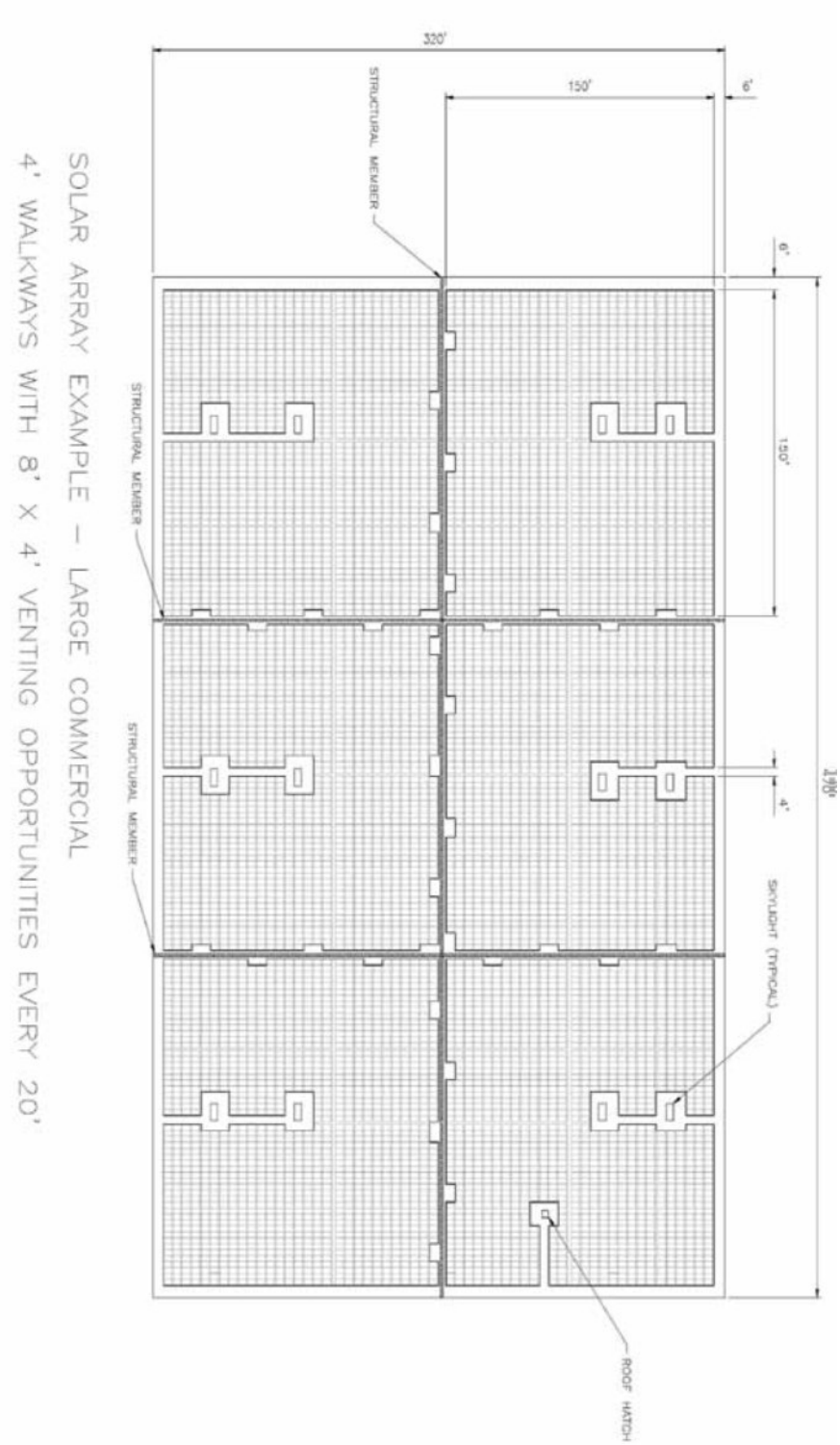
Appendix 2, Cont'd.

Image 4: Large Commercial with 4' Wide Pathways, Skylights and Roof Hatch, and 4" x 8" Designated Venting Areas Every 20'



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