FL Solar Contractor CVC 56734
FL Electrical Contractor 13008657

Serving the Florida Keys since 1989

Date: March 17th, 2021

Prepared by: Caleb Mandile

Description: Historic Architecture Review Commission Application for a Grid-Tied Solar PV System with Seamless Whole-Home Battery Backup for the Holtz Residence, 210 Olivia Street Key West FL 33040.

Preferred Layout: 30x SunPower A410 Solar Panels resulting in 12,300 watts with 2x Tesla Powerwalls resulting in 27,000 Watt-hours of energy storage. This system is designed to offset roughly 100% of the property's electricity consumption and seamlessly power the home during a grid outage. 9x panels are mounted as far from Olivia Street as possible on the SW roof along Hutchinson Lane. 5x and 7x panels are mounted on SE facing roof sections on the back of the house. 9x panels are mounted on a new shade structure. This Preferred Layout is shown below in Image 1. All satellite images in this document have a north orientation.

Image 1: Preferred Layout

HARC Guidelines: SALT Energy believes that the Preferred Layout shown above makes use of the most efficient roof surfaces while also accommodating the guidelines put in place by the Historic Architectural Review Commission to preserve the character of Key West. Each guideline is addressed in detail below.

1. *HARC supports the introduction of new and emerging technology for renewable energy but will seek to achieve this by ensuring equipment is installed without permanent detriment to the historic fabric already established in the district and the least visual impact to buildings and streetscapes HARC's goal is high performance conservation with low public visibility. HARC recommends applicants exhaust all other ways of reducing the carbon footprint before putting forward applications for the installation of solar devices.*
   Mr. and Mrs. Holtz have already exhausted all other ways to reduce their carbon footprint. All appliances in their home are energy star rated and they have a tankless hot water heater. The only have one refrigerator/freezer, which is energy star rated. They do not have a pool heater. They only own one car, an economy compact Ford Fiesta, which they only use for trips off of the island or for grocery runs. For the majority of local errands, they walk or ride their bicycles. Mrs. Holtz works at City Hall most days, and almost always walks to and from work instead of driving. They recently attempted to replace their current central air unit with a new more powerful and more efficient mini-split but were denied by the City because their current central air unit is already very efficient.

2. *Any proposal to install solar energy collectors shall be based on a hierarchy of preferred locations starting with roofing not visible from public streets, then locations within rear gardens or on pergolas and only if none of these are viable because of orientation or overshadowing will HARC consider schemes which involve collectors on roofing areas or other locations visible from public streets.*
   Image 2.1 below is a reference of roof locations and how they will be referred to moving forward. SS is a new shade structure, and SW faces Hutchinson Lane, which dead ends just beyond the bottom of the picture.

Image 2.1 Roof Locations

Image 2.2 Layout 1

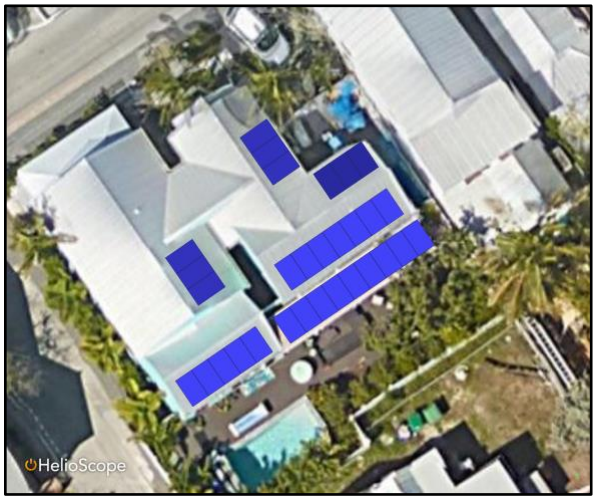

Image 2.3 Layout 2

Image 2.4: **Preferred Layout**, Layout 3

The 3 layouts shown in Images 2.2-2.4 all have 30 solar panels, but the locations of 18 of those panels, or 60% of the system, varies among the layouts. The other 12 panels on all layouts are split into 2 different arrays (5 and 7 panels) and positioned on southeast oriented roof faces not visible from Olivia Street SE and SE2. Below is further explanation of the 3 different orientations for the remaining 18 panels demonstrated in the layouts shown in the above images.

- Layout 1, Image 2.2 is the original design and maximizes efficiency while minimizing disjointed arrays. It includes 18 panels on SW facing Hutchinson Lane, 5 panels on SE and 7 panels on SE2.
- Layout 2, Image 2.3 avoids putting panels on SW, but greatly sacrifices efficiency as a result and is also still visible from Olivia. The 18 panels on SW are moved to four other roof sections, causing disjointed arrays. Three panels are moved to NE, three to NE2, and three to NW. The remaining 9 are moved to SS, a new shade structure that the Holtz residence is having built.
- Layout 3, Image 2.4 is the preferred layout as it maximizes efficiency while keeping the HARC guidelines and the historic scape of Key West in mind. 9 panels are kept on SW but shifted as far away from Olivia as possible to limit visibility. The other 9 are moved to the new shade structure, out of view behind the home.

3. *Any proposals that include collectors and/or related equipment and cabling visible from public streets will be required to show (by way of calculation of energy outputs) that it is not possible to achieve similar performance from equipment located away from public view.*

The preferred layout shown in Image 2.4 was created using a hierarchy of roof surface preference based on maximizing efficiency while still meeting the HARC guidelines. The solar modules' efficiency is important to consider with the 9 panels on SW along Hutchinson Lane versus their alternate locations shown in Layout 2, Image 2.3. A variable known as the Kilowatt-Hour per Kilowatt ratio (kWh/kWp) is used as the basis for the efficiency loss calculations. It tells us the expected yearly kWh energy yield for each kW of solar installed on a particular roof surface. This variable changes depending on the geographic location, tilt, and azimuth of the solar array. An azimuth greater than 90° (East) and less than 270° (West) is ideal for solar. SALT Energy has determined the values in Table 3.1 using Helioscope software which accounts for these parameters.

Roof Surface	SW	NE	NE2	NW
Azimuth	235°	55°	55°	325°
Tilt	30°	30°	30°	30°
kWh/kWp	1,574.1	1313.2	1313.2	1237.3
Energy Loss	N/A	17%	17%	22%

Table 3.1

This means that moving the 9 panels from SW to NE, NE2, and NW will result in a combined energy loss of about 20% for those 9 panels (1267.1

kWh/kW vs 1574.1 kWh/kW). Since those 9 panels are 30% of the system, moving those 9 panels to NE, NE2, and NW would greatly reduce the energy output of the entire system. Therefore, the preferred layout utilizes SW for those 9 panels.

4. *Installations shall not exceed power generation greater than that reasonably needed for the property. All applications must contain calculations of power outputs and on energy retained.*
   210 Olivia utilized 21,043 kWh of electricity between November 7th 2019 and November 6th 2020 according to Keys Energy records shown in Appendix 2. The Preferred layout, layout 3 in Image 2.4 would be expected to produce about 20,910 kWh of electricity per year. This equates to an electricity use offset of about 99%. All excess energy produced by the solar will be stored in the batteries for use in the evening and night. The batteries will see daily charging from solar and discharging during the night to power the home, greatly reducing the home's reliance on the grid.

   As a renewable energy system designed for whole home backup, both the solar and battery are sized with respect to the historical energy usage of the Holtz Residence. This ensures seamless energy availability even during a severe grid outage, like that during Hurricane Irma. Reducing the solar output will greatly hinder the effectiveness of the system during a grid outage as the solar will be unable to fully charge the batteries during the day, resulting in premature battery depletion during the night. This would eliminate the convenience and security the system is designed to provide.

5. *Character defining features of existing buildings (i.e. roofline, chimneys, and dormers) shall not be damaged or obscured when introducing new roof or exterior wall-mounted energy conservation systems.*
   The roofline of 210 Olivia will not be affected by the addition of solar panels according to Layout 3, Image 2.4. All panels will be installed a minimum of 10" from all roof edges to meet wind-load requirements.

6. *All energy collection equipment shall be screened or hidden to the greatest possible while still achieving maximum function and effectiveness.*
   Layout 3 shown in Image 2.4 maximizes the use of low visibility locations to screen or hide the panels while still prioritizing the more efficient surfaces over less efficient surfaces. The panels on SE, SE2, and SS will be hidden from view as they are all rear facing roof sections that are entirely hidden from Olivia. The panels on SW will be mounted as far back from Olivia as possible with the distance from the back edge of the array to the back edge of SW being 10". This leaves over 14 feet of space from the front of SW to the leading edge of the array.

7. *On pitched roofs, solar collector arrays shall run parallel to the original roofline and shall not rise above the peak of the roof. On flat roofs, solar collector arrays*

shall be set back from the parapet edge or wall/ roof conjunction and may be set at a slight pitch if not highly visible from public streets.
All panels will be installed a minimum of 10" from the roof peak and any roof edges to meet wind-load requirements, therefore the panels will not rise above the peak of the roof. All panels will be installed parallel to the original roofline.

8. *All energy collection equipment shall be considered part of the overall design of the structure. Color, shape and proportions of the solar collection array shall match the shape and proportions of the roof. Single installations on single-plane roofs are preferable to disjointed arrays or arrays on multiple roof planes. If more than one array is needed, it shall be limited to one panel section on each side of the structure if the arrays cannot be placed on a rear location. Scattered or disjointed arrays are not appropriate.*
   The proportions and shapes of all arrays are designed to match the shape and proportions of the roof. No arrays will exceed the proportions of the roof they are installed on. All arrays will stay within the "shape" or boundary of the roof surface it is installed on. Layout 3 in Image 2.4 utilizes all available space on the rear locations (SE, SE2, SS) before using any visible roof space. After that the remaining panels can be mounted on either SW or NE, NE2, and NW.
   - For SW, only the back is used with 14' separating the front of SW facing Olivia from the leading edge of the array. This helps with visibility from Olivia Street as shown in images 1 and 2 in Appendix 1. Only the front half of SW is visible from the street thanks to other buildings and trees. SW is visible when viewed directly on Hutchinson Lane as shown in image 3, but it is important to note that Hutchinson Lane is a dead end with only 10 residences. The majority of travel up and down Hutchinson will be the owners of those residences either walking or traveling by car to and from home. From a car traveling on Hutchinson the panels on SW will be hidden from view.
   - For NE, NE2, NW in Layout 2, these surfaces are only considered as an alternative to SW. They are less efficient roof surfaces. Utilizing them also results in disjointed arrays, with 3 arrays instead of 1 for the remaining 9 panels. 2 of those 3 arrays are also visible from Olivia, as demonstrated in image 4 of Appendix 1. **Thus this scenario has no benefit: it is less efficient and is still equally visible, if not more-so than SW in Layout 3**.

9. *All energy collection equipment shall not be mounted to project from walls or other parts of the building.*
   No equipment will be mounted to project excessively from the walls of the building. No wall-mounted equipment will be visible from the street.

Appendix 1: Street Visibility, Image Locations

Image 1

Image 2

Image 3

Image 4

Appendix 2: Keys Energy Records:

1041090	11	Nov 6, 2019 12:00:00 AM	1695		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Dec 6, 2019 12:00:00 AM	1451	21043	1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Jan 8, 2020 12:00:00 AM	1609		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Feb 6, 2020 12:00:00 AM	1422		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Mar 6, 2020 12:00:00 AM	1421		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Apr 9, 2020 12:00:00 AM	1476		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	May 6, 2020 12:00:00 AM	1921		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Jun 8, 2020 12:00:00 AM	1760		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Jul 8, 2020 12:00:00 AM	1976		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Aug 6, 2020 12:00:00 AM	1915		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Sep 9, 2020 12:00:00 AM	2267		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Oct 7, 2020 12:00:00 AM	2023		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST
1041090	11	Nov 6, 2020 12:00:00 AM	1802		1041090	11	RICHARD E HOLTZ JR	210 OLIVIA ST