

April 22, 2019

Mr. Keith Dandridge, EI
Lead Project Engineer
NextEra™ Energy Resources
700 Universe Blvd
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RE: Project No. 19-016
Existing Building Structural Engineering Analysis
New Roof Top Photovoltaic Array II
Becton Dickson Medical
14 Grace Way
Canaan, CT

Girard and Company has completed their structural review of existing Becton Dickson Medical Industrial Building Roof that is to receive proposed Solar Array Roof Top Panel System for Phase II of PV Array addition. Building is located on the company's site, 14 Grace Way, Canaan, CT.

Existing Documents were made available for review study and consists of the following:

- Part Documents - B-D DIVISION CANAAN FACILITY EXPANSION
 - Structural Drawings – Herbert A. Wiener, PE - Structural Engineer
 - S-3 – dated 10-12-00 - Barnhart Johnson Francis and Wild Inc. Consulting Engineers – Roof Framing Plan and Crane Rail Framing Plan Retractable Molding Areas Phase 1 – 3ml Molding Area – Building Roof Area 'N'.
 - C-01 01-024-E – dated 9-19-64 – Werner & Thaler Consulting Engineers - Roof Steel Framing Plan for Building Roof Areas 'M' and 'H'.
 - E2 - dated 2-21-63 – Irvington Steel and Iron Works Steel Erection Drawing for Building Roof Areas 'C', 'E', 'F', and 'G'.
 - S-1 – dated 4-20-81 – Herbert A. Wiener, PE Structural Engineer – Roof Framing Plan (Office Area) – Building Roof Area 'D.'
 - S-1 – dated April 15, 2011 - Girard and Company, LLP Structural Engineers –Roof Framing Plan – Building Roof Areas 'D', 'E' and 'F'.
 - 3 of 5 – dated 2-21-74 – Thomas E. Johnson A.I.A. Architect – Structural Steel Plan – Building Roof Areas 'J' and 'K'
 - E2 – dated 11-2-65 – Proposed Building Expansion – Injection Molding Building - Roof Framing Plan – Part Building Roof Area 'H'.

New Solar Array Information Documentation:

- G100 - 696.15 kw Solar Rooftop System at Becton Dickson – Phase II – Engineered by Pure Power Engineering.
- E300 – Electrical and Panel Information sheets
- Unirac U-Builder Project Report Installation and Design Plan for Array 1/Workspace 1 – Roof 'M' and 'N'
- Unirac U-Builder Project Report Installation and Design Plan for Array 1/Workspace 2 – Roof 'H' and 'C'
- Unirac U-Builder Project Report Engineering Report Array 1/Workspace 1 – Roof 'M' and 'N'

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- Unirac U-Builder Project Report Installation and Design Plan for Array 1/Workspace 2 – Roof 'H' and 'C'
- Eagle HC 72-v 385-405 Watt Module by Jinko Solar.

Description of Existing Building Structures:**Existing Building Structure:**

- There are two different roof elevations being utilized to support the new PV Array system. Both roofs are approximately 7'-0" difference in height between both roofs. The lower roof section which is considered Roof Areas 'C' and part 'H'. The upper roof supporting the PV Array is considered Roof Areas 'M' and 'N'.
- Roofing material consists of reinforced EPDM membrane on 6 ½" maximum thickness tapered insulation that pitch to roof drains. Tapered insulation is set on existing 2" thick Poly ISO insulation that sits on and is attached to existing steel roof.
- The roofing support deck is a 1 ½" deep narrow rib structural steel roof deck supported by Wide Flange Steel Roof Joists.
- The building roof structure consists of 10" deep Wide Flange Steel Joists spaced at approximately 5'-9" on center. Joist cantilever beyond steel girder 3'-4" to support end of adjacent joists of equal spacing. This is Typical for all roof supporting Phase II PV Array system.

- Wide Flange Steel Joists are supported on wide Flange Steel Girders that vary in depth from 18" to 24" deep. Steel Girders cantilever out beyond supported Wide Flange Steel Columns 7'-4" to receive next girder end.
- Wide Flange Steel Girders are supported by 8" deep Wide Flange Steel Columns spaced at approximately 40'-0" on center in the North/South direction and 25'-0" in the East/West direction.
- Foundations consist of 12" thick concrete foundation frost walls on continuous spread footings. Wide flange steel column support bases are supported either on concrete piers and spread footings or directly on concrete spread footings.

Description of Proposed Photovoltaic Array System:

- Pure Power Engineering, Inc. is supplying array module layout as noted earlier.
- New ballasted array layout to be mounted on existing EPDM roof finish.
- Solar Array modules will be Eagle HC 72M G2 390-415 Watt Mono Perc Half Cell Module by Solar Jinko Co., Ltd. approximately 78" x 39" x 1.6" thick panel dimensions. Modules weigh approximately 50.0 lbs.
- Module rack information supplied is a low profile, single tilt, 10 degree tilt ballasted system designed for placement on EPDM Roofs.
- Two different Array locations, Segments 1 and 2, were provided for roof top layout located above existing building areas 'C', 'H', 'M' and 'N'.
- Each Array, differed in configuration and weights with average weights of each system to range from 3.39 psf to 3.76 psf within area of array layouts.
- Tray supported ballast consists of 4" x 8" x 16" solid concrete cap blocks.
- Module frames are constructed of light weight finish aluminum.

Basis of Study Analysis:

- Analysis is based on the current 2018 Connecticut State Building Code, International Building Code, IBC 2015.
- Review for compliance with the 2018 Connecticut Building Code, 2015 International Existing Building Code, IEBC was also made.
- Addition of new Solar Arrays to the existing building structure is considered an Alteration to the existing building and requires to be reviewed for Compliance with the 2015 IEBC Code.
- The Work Area Compliance Method was the selected method as described in IEBC for Level 2 work. Refer to Section 504, Alteration – Level 2, 504.1, "Scope". Level 2 alterations include the reconfiguration of space, the addition of any door or window, the reconfiguration or extension of any system, or ***the installation of any additional equipment.***

Gravity Load Analysis Results:

- Information was received with the assistance of BD Medical's Facilities Department. Request of Carlisle SynTec Incorporated roofing materials used for re-roofing of existing roofs was acquired from Roofing Contractor, Allied Restoration Corporation for work that was performed in 2009.
- Dead Load of existing materials including weight of roofing material, supporting steel roof deck and miscellaneous loads supported below the roof total 10 psf.

- Addition of PV Array system as noted earlier is to be added to this total for review of existing wide flange steel roof framing.
- The design Snow Load for Canaan Connecticut is 40.0 psf with a minimum allowed factored load of 30.0 psf in accordance with the 2018 Connecticut State Building Code which includes the 2015 International Building Code.
- Existing Roof Dead Loads, light ballasted system, were compared with new applied dead loads from the new solar array layout for building roof structures.
- In each building area as described above, Girard and Company analyzed existing framing capacity by design calculations for existing building wide flange steel joists, beams and girders, roof deck, columns, and foundations and found that the original design framing members and foundations have sufficient capacity to support the weight of the new solar array system loading as laid out.

Lateral Load Analysis Results:

- Girard and Company compared the new building roof mass including the addition of solar array system in psf of building roof area and the total mass of entire roof system with that of the original design and found that the mass comparison with newer re-roofing material and additional solar array system is less than the mass in psf of the existing building design requirements, thus the Demand Capacity Ratio of 10% for the building structure has not been exceeded.

Conclusions:

- The existing building roof framing system has the capacity to support the addition of new solar Array Module System equipment and is in compliance with the 2018 Connecticut State Building Code which includes 2015 International Building Code, and 2015 International Existing Building.
- The existing building lateral support meets the Demand Capacity Ratio requirements and is in compliance with the 2018 Connecticut State Building Codes as noted above.

Should you have any questions concerning this report, please feel free to contact this office at any time.



Respectfully submitted,

A handwritten signature in blue ink that reads "Michael J. Vanasse".

Michael J. Vanasse
 Partner
 Girard and Company, LLP