DOCKETED	
Docket Number:	22-BSTD-04
Project Title:	2022 Energy Code Photovoltaic and Battery Storage Cost Effectiveness Determinations
TN #:	251153
Document Title:	Benjamin Project's Reasoning for Increased Costs
Description:	N/A
Filer:	Muhammad Faisal Saeed
Organization:	California Energy Commission
Submitter Role:	Energy Commission
Submission Date:	7/23/2023 11:26:54 PM
Docketed Date:	7/24/2023

The Benjamin Project Response to CEC Questions dated 7/11/2023

Question #1 regarding permitting costs:
"Cal Solar Inc" is the only contractor who provided a cost estimate for the permit cost: "Plan check and permitting fees, allowance up to $36,300 permit fee". An additional $3.552 was added to the overall cost, as an "increase in building department fees". Those two costs add up to $39,852 (or $0.19/W). This number departs significantly from the number added to other bids for permitting: $170,208 (or $0.81/W). Can we get clarification about this difference?

The difference is that on this line item, Lodi building permit fees are added to the LEU interconnection fees.
So: $170,208 – $39,852 = $130,356 is the total project cost for LEU interconnection fees.
Interconnection fees per system are $1,207 x 108 units = $130,356.
Building Dept permit fees per system are $369 x 108 units = $39,852
$130,356 (LEU interconnection fees) + $39,852 (building Dept fees) = $170, 208 for total fees to the City of Lodi
These are not costs that will vary between bidders.

Question #2 regarding roofing penetration seals:
Most newer and larger installations use the ballast mounting method. Why was ballast-type installation not deemed appropriate for this project?

We discussed ballast system design and considerations with Patrick Modesitt, VP of Engineering at our structural engineering firm, PFS Consulting, Inc. (1750 Howe Avenue, Sacramento, CA 95825, 916-978-2875). The takeaway from that conversation is that they would not approve a ballast system on the Benjamin project rooftops. The most optimistic scenario from the Ironridge modeling report is that the average distributed dead load is 8.31psf. For more clarity this involves installing 14,198 pounds of concrete blocks (916) on the roof. They deem this unsafe without a significant review and redesign of the building from the ground up.

Complicating the design of ballast systems are the modern PV wind loading studies that have been completed, codified, and adapted to racking manufacturers modeling programs and their certification guidelines. These standards have significantly impacted PV roof design of all types. The Ironridge model shows the need for 37 mechanical mounting feet for wind and 23 for seismic design. The minimum required would be 37 as the wind anchors also double for the seismic requirements. This contrasts to the 56 required for an aluminum racking system. It is very likely that a more detailed structural study of the breaks in the PV array rows due to roof protrusions and drainage roof swales would necessitate more weight and anchor points.

The roofing TPO manufacturer, Carlisle, will not warranty damage to the roof from the heavy concrete block as they compress the TPO material and create water pooling areas that can lead to premature failure. This then requires even more frequent roof inspections by the roofing subcontractor.

Another issue with ballast system is the low mounting angle of 10-degrees or less versus the 20-degree angle for an aluminum racking system. We can expect increased annual solar production and less module cleaning with a 20-degree mounted PV system.

Finally, no engineering design is complete without considering product lifecycle costs. You can find a commentary on ballast systems for roofing companies from 2014 attached to the email. Without further elaboration, every single concern they brought up then is still very valid today. Perhaps more so with the newer PV wind studies. Contractors of all types, not just solar, like to present competitive bids that can also maximize profits. One easiest way to do this is to ignore total product life cycle costs and build a less resilient system. From our point of view we see no advantage to ballast type systems due to increased building

construction costs, the continued need for roof penetrations and associated costs, increased ongoing maintenance costs and the risk of premature roof seal failures.

Question #3 regarding O&M + Inv Replacement cost:
The NREL single-family cost of $0.78/W specified on Figure 28 page 53 of the study includes some costs that will not apply to larger multifamily projects; for example, the added property insurance and overhead administration O&M costs. The property insurance for the single-family residential building evaluated in the 2022 NREL report does not apply to the multifamily set of buildings. The multifamily systems are mounted on low-sloped roofs, away from any obstructions, and installed on commercial-grade racks with sealing. The administration aspect depends on the time value of any oversight, and a complex building of this size will already have a dedicated property manager, with minimal or no oversight needed.
Could the NREL estimate be revised to remove some of these costs?

The Benjamin Project insurance coverage will increase based on discussions with the insurance company. The estimated increase is $2,500 to $3,000 per year based on a 2023 estimate. It is assumed this would increase over the years.

As far as maintenance and oversight is concerned there are liability and other insurance coverages in play. The property manager is not covered by insurance to go on the roof of these buildings. He or she is also not qualified to inspect the roof or solar infrastructure. This must all be done by qualified, insured subcontractors. In this case the roofer is the key partner because in addition to inspecting the overall TPO roof on a regular basis he must also inspect the solar roof mounts (and if present ballast weights). We've attached a copy of our roofer's maintenance contract estimates, with and without solar mounting feet inspection. The added costs for inspecting and leak testing with PV on the roof is $8,550/year. Bear in mind this is for an aluminum racking system, not a ballast system which has more test areas . It's clear that these costs are substantial and very likely in excess of any NREL considerations.

Question #4 regarding Overhead plus Sales and Marketing:
Our assumption is that sales and marketing costs are embedded in the loaded labor rates for each subcontractor (solar, electrical, and roofing) and there is equipment markup as well. Why have these costs been separately added?

We have tried to follow the NREL categories as you originally requested. If you look at the NREL Q1 2022 Tech report TP-7A40-83586 (https://www.nrel.gov/docs/fy22osti/83586.pdf) on page 21 you'll see they break out Overhead, Sales and Marketing, etc as separate categories distinct from other labor categories.

Summary
We understand that there is a large amount of data to review and absorb in considering our request and we greatly appreciate your questions and attention to detail. If you have any other questions or require further clarification, please let us know.

Best regards,

David Chase
Consultant for the Benjamin Project

YEARLY ROOF MAINTENANCE AGREEMENT / LOW SLOPE SYSTEMS

Client:	RPM Company - The Benjamins All Buildings			**Job No.:**	220221
Contact:	Chris Duke	**Phone:**	209-333-3400	**Fax:**	fax
Project Address:	2525 Century Blvd., Lodi CA				
Billing Address:	1420 S. Mills Ave., Lodi CA 95242 Suite M			**email:**	chrisduke@rpmcompany.com

Roof Maintenance Agreement options include the following:

x Debris Removal:

Debris will be removed from the entire roof system, drains, scuppers, gutters and leaders. Drain flushing is included. Excessive blockage is not included in this agreement. Debris will be disposed of offsite.

x Roof Inspection:

A complete survey of the existing conditions of the roof system, flashings and drainage system will be completed. Pricing for damages caused by abuse, vandalism, new installations by others* and structural defects will be submitted for approval.

x Maintenance Repairs:

Repairs and restoration will be performed as needed to the roof system, surfacing and flashings as required to meet the manufacturer guidelines. All exposed projection sheet metal and baseflashings will be resealed and coated as needed.

x **Repairs to new**

installations*:

All newly installed projections, curbs etc. will be properly stripped in to meet the current manufacturers guidelines and will be covered

under the warranty that is currently in place or approved for extension. * This cost is in addition to the amount shown below.

Special Conditions

Notes: This RMA includes inspection and cleaning of areas around all solar arrays. Cleaning of panels or inspection of solar components

not included.

No
x Warranty

This roof maintenance agreement does not provide a warranty against roof leaks.

Preferred Hourly
x Rate

The hourly rate that will be charged for new installations in addition to any repairs not included in this agreement will be

$120.00 per hour. This rate will be used for a period of one year from the date approved below.

This Maintenance Agreement will be performed every year for __5___ years starting in __2023__ and ending in _2027_____.

Work will be performed between the months of __TBD__ and _TBD__. Either party can cancel this agreement within 90 days of the

next scheduled maintenance.

Total Contract Amount per year: $13,950.00 **Total amount due upon receipt of invoice.**

Surveys and warranties will be submitted upon receipt of final payment. Please review and sign the attached general conditions.

Approved by: Dan Edge **Accepted by:**

Sales Representative **Date** 7-13-2023 **Client** **Date**

YEARLY ROOF MAINTENANCE AGREEMENT / LOW SLOPE SYSTEMS

Client:	RPM Company - The Benjamins All Buildings			**Job No.:**	220221
Contact:	Chris Duke	**Phone:**	209-333-3400	**Fax:**	fax
Project Address:	2525 Century Blvd., Lodi CA				
Billing Address:	1420 S. Mills Ave., Lodi CA 95242 Suite M			**email:**	chrisduke@rpmcompany.com

Roof Maintenance Agreement options include the following:

x Debris Removal:

Debris will be removed from the entire roof system, drains, scuppers, gutters and leaders. Drain flushing is included. Excessive blockage is not included in this agreement. Debris will be disposed of offsite.

x Roof Inspection:

A complete survey of the existing conditions of the roof system, flashings and drainage system will be completed. Pricing for damages caused by abuse, vandalism, new installations by others* and structural defects will be submitted for approval.

x Maintenance Repairs:

Repairs and restoration will be performed as needed to the roof system, surfacing and flashings as required to meet the manufacturer guidelines. All exposed projection sheet metal and baseflashings will be resealed and coated as needed.

x **Repairs to new installations*:**

All newly installed projections, curbs etc. will be properly stripped in to meet the current manufacturers guidelines and will be covered

under the warranty that is currently in place or approved for extension. * This cost is in addition to the amount shown below.

Special Conditions:

x **No Warranty**

This roof maintenance agreement does not provide a warranty against roof leaks.

x **Preferred Hourly Rate**

The hourly rate that will be charged for new installations in addition to any repairs not included in this agreement will be

$120.00 per hour. This rate will be used for a period of one year from the date approved below.

This Maintenance Agreement will be performed every year for __5___ years starting in __2023__ and ending in _2027_____.

Work will be performed between the months of __TBD__ and _TBD__. Either party can cancel this agreement within 90 days of the

next scheduled maintenance.

Total Contract Amount per year: $5,400.00 **Total amount due upon receipt of invoice.**

Surveys and warranties will be submitted upon receipt of final payment. Please review and sign the attached general conditions.

Approved by: Dan Edge **Accepted by:**

Sales Representative **Date** 7-13-2023 **Client** **Date**

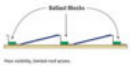
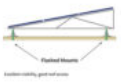
ROOFING CONTRACTOR

Solar Racking: Ballasted or Mechanically Attached?

By Jeff Spies

Mechanically attached racking systems can reduce maintenance costs. Photo courtesy of Fidelity Roof Company.




April 7, 2014

For years the National Roofing Contractors Association (NRCA) and many top solar roofing professionals have discouraged solar contractors from using ballasted racking systems when installing solar arrays on most low-slope roofs. Despite this advice, the vast majority of solar installers continue to use ballasted mounting systems instead of the recommended mechanically attached flashed mounts on low-slope membrane roof systems. So why is this advice from the

roofing industry being ignored by so many solar installers?

The first reason ballasted racking systems dominate in solar low-slope installations is that building owners overwhelmingly dislike poking holes in their roofs to mount a solar racking system. Few solar contractors are willing or able to explain that while ballasted systems minimize holes in the roof at first, they will result in higher maintenance costs over the life of the system. The second reason solar contractors prefer ballasted racking is that it eliminates the need to hire a roofer to flash dozens (or hundreds) of solar standoffs. Hiring a roofing subcontractor transfers labor dollars away from the solar installer, and while the final installed cost of the competing methods is not much different, the solar contractor makes less profit when they have to hire a roofer to install the flashed mounts.

Annual or biannual roof inspection with proactive patching of any suspect areas is key to extending low-slope roof life to more than 20 years. This routine inspection and maintenance is typically mandated for preservation of the roofing warranty. The big knock against ballasted racking systems is they typically cover most of the roof, making inspection and maintenance difficult or impossible without disassembling the major sections of the array.

As a result, minor leaks that would otherwise be easily identified and repaired on a regular roof will often progress to the point of structural water intrusion when hidden under a ballasted array. Once the building owner notices and reports the leak, the solar contractor is then forced to disassemble a large portion of the PV system to allow the roofer to locate and repair the leak. Removing and reinstalling solar modules is an expensive proposition even when the array is young, but as the array ages, PV wire insulation stiffens and cracks more easily, grounding hardware may need to be replaced, racking components can seize and need replacement (also running the risk that the racking components may no longer be available), and PV module damage could result from removal and reinstallation. How many times will systems owners be willing to incur this high cost of leak repair and array removal/reinstallation before they give up on ballasted racking?

The main benefit of a mechanically attached mounting rack is the installer can design sufficient space under the array to allow for inspection and servicing of the roof under the array. An added benefit is mechanically attached racking systems are lighter on the roof than ballasted systems. This reduced roof load is especially beneficial on roofs without significant load capacity to accommodate heavy ballast blocks.

Another common concern with rooftop solar systems is that often arrays are installed on roofs with less than 15 years of remaining life. Solar PV modules have a productive life of 30 years or more, and there are significant benefits to installing solar on new roofs. The cost to remove and re-install a PV system with ballasted systems to replace a roof can be 20-50 percent of the cost of a brand-new system. Some mechanically attached racking systems allow the roof to be replaced without the

need to remove and reinstall the PV system. This is a major cost advantage that provides a better ROI and payback time to the system owner when calculated over the life of the system. Most experienced roofers feel it is acceptable to install solar on a roof that is no more than 3-7 years old, but after that point installing solar on an older roof may not be a wise investment.

Ballasted racking systems do have their place on some low-slope roofs and may be a more advisable choice for existing built-up roofs that are more than a few years old. Waterproofing reliability on large numbers of built-up flashings on existing built-up roofs may be a challenge, and a ballasted racking system might minimize this leak risk. Even with this exception, the majority of solar-experienced roofers believe that mechanically attached racking is preferable on new BUR roofs and new or existing single-ply roofs.

When ballasted racking systems are used, several design strategies will minimize the problems associated with these systems:

Ponding water is a major concern with any roof. Standing water accelerates roof degradation and it is advisable for solar installers to place the ballast trays in locations that will minimize blocking of drainage pathways. Using ballast-mounting pads (insulation cover board works nicely) reduces or eliminates insulation compression. If insulation does compress under the ballast tray, a small amount of water can accumulate at the perimeter of the ballast tray and attract particulate contamination, forming an abrasive slurry that accelerates the wear of the roof under the ballast tray as the system expands and contracts during the daily thermal cycle. For this reason, it is advisable (and often mandated by roofing warranties) to use a sacrificial slip-sheet on single-ply membrane roofs. Many roofing manufacturers require installers to use their thickest membranes with a slip-sheet also made from the same thickest membrane for a ballasted racking system to be warranted.

Another important consideration is anchorage. While ballasted racking systems don't require penetration-based mounts to support the load of the array, they may require mechanically attached penetrating anchors, especially in seismically active areas like California. Mechanically attached anchor points prevent excessive movement of the ballasted array during an earthquake or strong windstorms.

Unanchored PV systems can also creep down a roof as a result of vibrational forces from air handling systems or simply as a result of the difference between the expansion/contraction of the metal racking system over a non-metal roofing structure. These forces can be significant, and failure to use sufficient mechanical anchorage could result in separation of the conduit that houses the high-voltage DC cables. If this happens, there is a significant risk of shock or fire. It is inappropriate and dangerous to allow the high-voltage conduit to be the sole point of anchorage for a ballasted system.

Another use for mechanically attached anchors is reducing the need for ballast on roofs that do not

have the required load capacity to support heavy ballast blocks.

Solar PV systems that produce the fastest payback and highest ROI are the key to long-term solar success, and mechanically attached racking systems ensure lower maintenance costs over the life of the arrays, delivering the lowest-cost electricity. When building owners and solar contractors fully appreciate the higher lifetime cost of maintenance associated with ballasted racking systems, the solar installation industry will likely shift to mechanically attached racking systems. This will result in additional business opportunities for roofers that have a solar installation division or those roofers that partner with solar installers.

The Center's PV Taskforce

The Center for Environmental Innovation in Roofing's PV Taskforce is focused on providing high-level thought guidelines for rooftop PV installations. The Center's PV Racking and Attachment Criteria for Effective Low-Slope Roof System Integration is an easy-to-read discourse about the important criteria rooftop PV designers and installers should consider when installing PV systems on rooftops. External forces, system integration, roof drainage, roof and PV system maintenance, and roof safety are the main principles. Each principle is divided into many specific examples, and each example includes recommended criteria to resolve the issue. This document is applicable to asphaltic-based roof systems, single-ply roof systems and spray polyurethane foam roof systems. For low-slope metal roofs, The Center's PV Racking and Attachment Criteria for Effective Low-Slope Metal Panel Roof System Integration provides an equivalent discussion. The documents are available at www.roofingcenter.org/special/pv.

Additionally, the Center's PV Taskforce is currently developing PV Racking and Attachment Criteria for Effective Asphalt Shingle Roof System Integration. This will be available in July 2014.