

**BEFORE THE  
PENNSYLVANIA PUBLIC UTILITY COMMISSION**

Petition of PPL Electric Utilities Corporation :  
for Approval of Tariff Modifications and :  
Waivers of Regulations Necessary to : Docket No. P-2019-3010128  
Implement its Distributed Energy Resources :  
Management Plan :

**REJOINDER TESTIMONY OF  
MATTHEW WALLACE**

**PPL Electric Statement No. 6-RJ**

**August 26, 2020**

1 **Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.**

2 A. My name is Matthew Wallace, and my business address is 2 North Ninth Street,  
3 WNDOB, Allentown, PA 18101.

4

5 **Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?**

6 A. I am employed by PPL Electric Utilities Corporation (“PPL Electric” or the “Company”)  
7 as Senior Engineer.

8

9 **Q. HAVE YOU PREVIOUSLY SUBMITTED TESTIMONY IN THIS**  
10 **PROCEEDING?**

11 A. Yes. My rebuttal testimony is set forth in PPL Electric Statement No. 6-R.

12

13 **Q. WHAT IS THE PURPOSE OF YOUR REJOINDER TESTIMONY?**

14 A. I will respond to some of the allegations and recommendations made in NRDC Statement  
15 No. 1-SR, the Surrebuttal Testimony of Harry Warren submitted on behalf of the Natural  
16 Resources Defense Council (“NRDC”); OCA Statement No. 1-SR, the Surrebuttal  
17 Testimony of Ron Nelson submitted on behalf of the Office of Consumer Advocate  
18 (“OCA”); SEF Statement No. 1-SR, the Surrebuttal Testimony of John Costlow  
19 submitted on behalf of the Sustainable Energy Fund (“SEF”); and SEF Statement No. 2-  
20 SR, the Surrebuttal Testimony of Ron Celentano submitted on behalf of SEF. In this  
21 rejoinder testimony, I will address the witnesses’ surrebuttal testimony in that order.

22

1 **Q. ARE YOU SPONSORING ANY EXHIBITS WITH YOUR REJOINER**  
2 **TESTIMONY?**

3 A. Yes. Attached to my rejoinder testimony is PPL Electric Exhibit MW-1RJ, which  
4 provides additional detail and support for the Company’s estimates of the installation  
5 costs for Distributed Energy Resources (“DERs”), and PPL Electric Exhibit MW-2RJ,  
6 which is a copy of the UL Certificate proving that the ConnectDER LLC  
7 (“ConnectDER”) DER Management device’s dongle meets UL Standards 60950-1 and  
8 62368.

9  
10 **I. NRDC STATEMENT NO. 1-SR – SURREBUTTAL TESTIMONY OF HARRY**  
11 **WARREN**

12 **Q. IN HIS SURREBUTTAL TESTIMONY, NRDC WITNESS WARREN**  
13 **QUESTIONS THE ACCURACY OF THE COMPANY’S ESTIMATES OF COST**  
14 **SAVINGS FOR CUSTOMERS UNDER ITS PROPOSAL. (NRDC STATEMENT**  
15 **NO. 1-SR, PP. 6-8.) ARE THE COMPANY’S ESTIMATE ACCURATE?**

16 A. Yes. As seen in PPL Electric Exhibit MW-1RJ, I have provided additional detail and  
17 support for the Company’s estimates of the installation costs for DERs, which many  
18 customers would be able to avoid incurring under the Company’s proposal. Indeed, the  
19 Company consulted with additional local DER system installers and Pennsylvania  
20 electricians to confirm and update PPL Electric’s cost estimates, which are shown in PPL  
21 Electric Exhibit MW-1RJ. However, I want to emphasize that the estimated costs are  
22 estimates. In practice, the actual costs, including the costs incurred by PPL Electric to  
23 install the DER Management devices, could be higher or lower and may vary from site to  
24 site.

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**II. OCA STATEMENT NO. 1-SR – SURREBUTTAL TESTIMONY OF RON NELSON**

**Q. OCA WITNESS NELSON QUESTIONS THE ACCURACY OF THE COMPANY’S “TYPICAL INSTALLATION COSTS” FOR DERS THAT WERE PRESENTED BY PPL ELECTRIC IN ITS REBUTTAL TESTIMONY. (OCA STATEMENT NO. 1-SR, P. 8.) DO YOU AGREE WITH MR. NELSON?**

A. No. The “typical installation costs” for DERs that were presented by PPL Electric in its rebuttal testimony are accurate and supported by multiple DER installers in Pennsylvania. PPL Electric has discussed several methods of inverter interconnection and their costs for the work related to installing and interconnecting the customer’s DER system. Through these discussions, PPL Electric reviewed several methods to interconnect DER systems. The first installer installed a total of 230 DER systems over the last year in 7 total states. Of these installations, 79 DER systems were installed in Pennsylvania, some of which were installed in PPL Electric’s service territory. The second installer involved with the review installed 13 DER systems in PPL Electric’s service territory over the past year. The third installer involved with the review installed 125 DER systems over the past year in Pennsylvania, New Jersey, and Maryland. Through the involvement of these certified DER installers, along with their experience currently installing systems, PPL Electric confirmed that its cost estimates are accurate representations of the DER installation costs that customers would experience in the Company’s service territory.

1 **III. SEF STATEMENT NO. 1-SR – SURREBUTTAL TESTIMONY OF JOHN**  
2 **COSTLOW**

3 **Q. SEF WITNESS COSTLOW CLAIMS THAT THE “COMMUNICATION**  
4 **PROTOCOL” CONNECTDER DER MANAGEMENT DEVICE IS STILL IN**  
5 **TESTING. (SEF STATEMENT NO. 1-SR, PP. 9-10.) DO YOU HAVE AN**  
6 **UPDATE ON THE TESTING OF THE CONNECTDER DER MANAGEMENT**  
7 **DEVICE?**

8 A. Yes. The ConnectDER DER Management device has been tested and complies with all  
9 applicable Underwriters Laboratories (“UL”) standards. Both the meter collar and the  
10 dongle hold UL listings and MET Laboratory, Inc. (“MET”) listings. Although the UL  
11 testing of the dongle was delayed due to the ongoing COVID-19 pandemic, the UL  
12 testing was completed on May 7, 2020. Also, attached to my rejoinder testimony and  
13 PPL Electric Exhibit MW-2RJ is a copy of the UL Certificate providing that the  
14 ConnectDER dongle meets UL Standards 60950-1 and 62368. Thus, any concerns about  
15 the UL testing of the ConnectDER DER Management device are now moot.

16  
17 **Q. MR. COSTLOW ALSO RAISES A QUESTION ABOUT THE DISTANCE OF**  
18 **THE CONNECTDER DER MANAGEMENT DEVICE’S WI-FI**  
19 **TRANSMISSIONS. (SEF STATEMENT NO. 1-SR, P. 9.) COULD YOU PLEASE**  
20 **COMMENT?**

21 A. PPL Electric’s DER Management device’s Wi-Fi transmissions have the normal distance  
22 limitations associated with Wi-Fi. The device has been tested to transmit approximately  
23 90 feet. Through input from the three certified inverter installers, roughly 80% of  
24 installations are within 15 feet of the meter base, 15% are between 15 and 50 feet, and the

1 remaining installations beyond 50 feet at less than 5% of the total installations. Only in  
2 extremely rare instances have residential systems' inverters been installed more than 90  
3 feet from the customer's meter base. For installations where system design constraints  
4 dictate that the inverter would be located out of the device's Wi-Fi range, PPL Electric  
5 will install necessary additional equipment to extend the range of connection. For  
6 installations where the inverter is greater than 90 feet from the meter base, the Company  
7 has developed and tested a solution that will extend the range to approximately 300 feet.  
8 This solution is compliant under the existing UL certification and does not require any  
9 additional UL testing, nor is there any change to the installation process. Any additional  
10 costs in these atypical installations will be borne by PPL Electric.

11  
12 **IV. SEF STATEMENT NO. 2-SR – SURREBUTTAL TESTIMONY OF RON**  
13 **CELENTANO**

14 **Q. LIKE SEF WITNESS COSTLOW, SEF WITNESS CELENTANO “QUESTION[S]**  
15 **HOW FAR THE DONGLE CAN EFFECTIVELY COMMUNICATE VIA WI-FI**  
16 **TO THE METER COLLAR.” (SEF STATEMENT NO. 2-SR, P. 7.) COULD YOU**  
17 **PLEASE CLARIFY?**

18 A. As noted previously, the DER Management device can transmit via Wi-Fi for  
19 approximately 90 feet, and, if needed, the Company can implement a solution that  
20 extends this range to approximately 300 feet. Therefore, PPL Electric has answered this  
21 question.

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23 **Q. MR. CELENTANO ALSO STATES THAT “PPL ELECTRIC SHOULD PAY FOR**  
24 **THE ENCLOSURE AND THE LABOR FOR INSTALLING THE DONGLE IF IT**

1 **DOES NOT FIT INSIDE THE INVERTER HOUSING.’’ (SEF STATEMENT NO.**  
2 **2-SR, P. 7.) WOULD YOU PLEASE RESPOND?**

3 A. If the ConnectDER DER Management device’s dongle does not fit inside the smart  
4 inverter’s housing, PPL Electric will pay for the dongle’s enclosure and the labor, as it is  
5 a part of purchasing, installing, owning, and maintaining the DER Management device  
6 under the Company’s updated proposal. Therefore, Mr. Celentano’s concern is  
7 unfounded.

8  
9 **Q. COULD YOU PLEASE RESPOND TO MR. CELENTANO’S ALLEGATION**  
10 **ABOUT THE COST OF INSTALLING A VISIBLE-BREAK ISOLATION**  
11 **DEVICE? (SEF STATEMENT NO. 2-SR, PP. 6-7.)**

12 A. Mr. Celentano’s allegation is confusing. He claims that the labor and materials cost for  
13 installing a visible-break isolation device is \$250 and that the Company’s estimated cost  
14 for installing the device is “grossly overstated.” (SEF Statement No. 2-SR, p. 7.)  
15 However, the Company’s estimated costs for the AC Disconnect Switch were \$185 for  
16 installations under 8 kW and \$235 for installations between 8 kW and 15 kW. (See PPL  
17 Electric Exhibit MW-1R.) The labor costs that the Company presented were for the  
18 entire installation, not only for installing the AC Disconnect Switch. However, assuming  
19 Mr. Celentano is only talking about the installation cost for the AC Disconnect Switch,  
20 then the Company’s estimated costs are very close to his estimate of \$250.

21  
22 **Q. MR. CELENTANO ALSO TAKES ISSUE WITH YOUR DESCRIPTION OF**  
23 **HOW THE CONNECTDER DER MANAGEMENT DEVICE WOULD BE**

1           **INSTALLED IN A TYPICAL SCENARIO. (SEE STATEMENT NO. 2-SR, PP. 7-**  
2           **8.) WOULD YOU PLEASE RESPOND?**

3    A.    I want to clarify that PPL Electric Exhibit MW-1R did not include additional methods  
4           involving wire taps on the outside of the house. Costs associated with the installation  
5           methods using these processes were confirmed to exceed the \$393 low end costs detailed  
6           in the PPL Electric Exhibit MW-1R. External suppliers' cost estimates for these methods  
7           were approximately \$1,000. Even though these methods are not as invasive as what was  
8           noted in Figure 1 in PPL Electric Exhibit MW-1R, it is inaccurate to say that no work is  
9           performed on the cable that enters into the customer's house and connects to the  
10          customer's breaker panel. Through discussions with the installers mentioned above, most  
11          installations using the quoted "line-side connection" methodology still require a  
12          replacement of the cable that enters the customer's home. Considering this option  
13          mentioned in Mr. Celentano's surrebuttal testimony, the cost range for current methods of  
14          DER interconnections result in customer costs greater than \$393. This is true with both  
15          the line-side connection method and the method detailed in PPL Electric Exhibit MW-1R,  
16          Figure 1. Thus, and as explained in response to OCA witness Nelson's surrebuttal  
17          testimony, the "typical installation costs" and methods for DERs that were presented by  
18          PPL Electric in its rebuttal testimony are accurate and supported by multiple DER  
19          installers in Pennsylvania.

20  
21    **Q.    DOES THIS CONCLUDE YOUR REJOINDER TESTIMONY AT THIS TIME?**

22    A.    Yes, although I reserve the right to supplement my rejoinder testimony.



# Common Inverter-Based DER Electrical Connections

## Summary

The following methods of inverter-based DER interconnection are what electricians and solar installers commonly use to connect the AC side of a customer's inverter to the load center and distribution system. This review does not detail the costs associated with the inverter wiring and DC components of a customer's DER, as these costs vary widely and do not impact the inverter-to-load center costs. PPL Electric conducted a review of the most common designs and their average costs by soliciting input from local DER system installers and Pennsylvania electricians. Each of the installers that was contacted has experience installing these DER systems within the Company's service territory and in the Commonwealth of Pennsylvania. The first installer installed a total of 230 DER systems over the last year in 7 total states. Of these installations, 79 DER systems were installed in Pennsylvania, some of which were installed in PPL Electric's service territory. The second installer involved with the review installed 11 DER systems in Pennsylvania over the past year. The third installer involved with the review installed 125 DER systems over the past year in Pennsylvania, New Jersey, and Maryland. In the discussions between PPL Electric and these installers, two common approaches to connecting customers' DER inverters were identified:

- 1. Connection through Customer Panel**
- 2. Connection through Line-Side (source side of breaker) Wire Tap**

As you will see in the sections below, the installers and their electricians identified the average cost of various components for each approach shown below.

- 1. Connection through Customer Panel:** Average cost is between \$393 and \$700 (Additional \$1,000 - \$1600 could be expected for work involving upgrades to the customer meter panel or need of a sub-panel)
- 2. Connection through Line-Side (source side of breaker) Wire Tap:** Average cost is \$1,091

Additional costs could be expected depending on the complexity of the installation. These general estimated costs assume simple installation situations. PPL Electric also notes that, in certain situations, the "Connection through Customer Panel" approach may require the installation of a sub panel (which is required if the existing main panel has no spare breaker spots to accommodate the breakers for the inverter installation) or an upgrade to the customer's existing breaker panel. If the installing electrician determines that either of these is required, an additional \$1,000 - \$1600 of average combined equipment and labor costs would be incurred. These typical installation estimates do not include the DER system installation cost up to the disconnect.

## Connection Diagram for Customer Panel Approach

The following diagram shows the required connections and equipment that are installed by the customer’s electrician. Items highlighted in red represent the standard wire path and equipment that is needed to be installed by the licensed electrician. As stated in the summary above, the electrical connection may require the installation of a sub-panel (highlighted in blue), in certain situations. The costs associated with each item as provided by an experienced, licensed local electrician are documented in the Estimated Cost section.

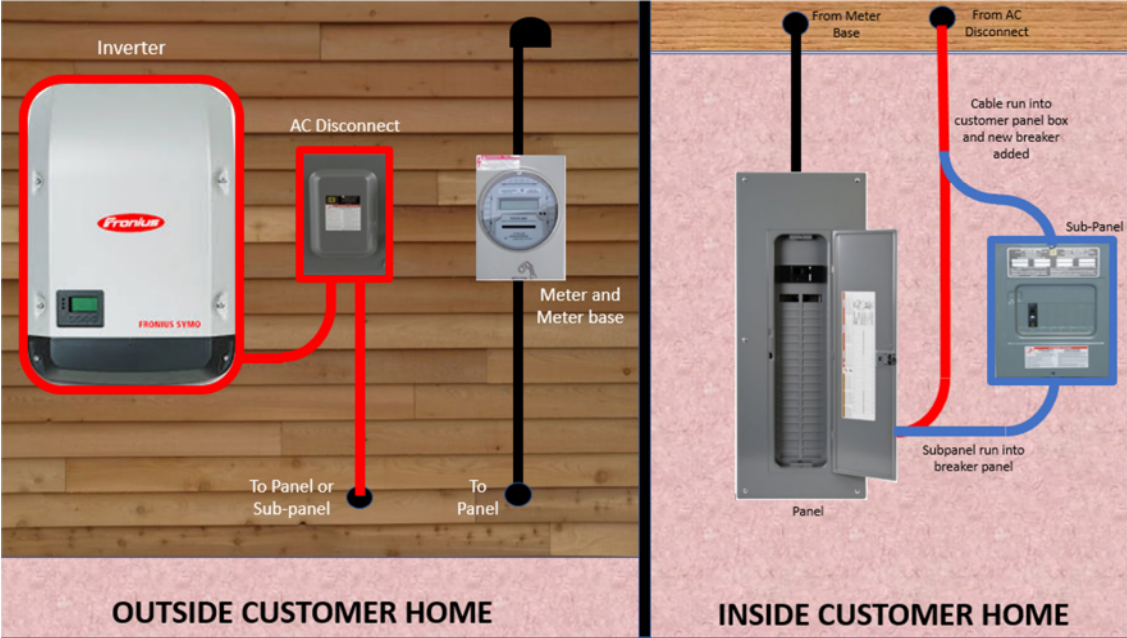


Figure 1: Standard Electrical Interconnection of Inverter-Based DER Systems

## Estimated Cost

### Inverter Systems (< 8kW)

When using the current standard approach for systems ranging from 0-8kW, electrically connecting a customer’s solar inverter system would cost a customer between \$393 and \$618. This range depends a lot on the customer’s residence and existing equipment.

Table 1: Standard Installation Approach, Vinyl/Wood Exterior (Simplest Situation)

Description	Detail	Costs
AC Disconnect Switch	D222NRBCP 60-Amp 240-Volt Two-Pole Outdoor General Duty Fusible Safety Switch with Neutral	\$185
Panel Box Breaker	Eaton Circuit Breaker, 40 Amps, Number of Poles: 2, 240VAC AC	\$13
Labor (\$75/hour)**	Installing cabling between disconnect and internal panel with the need to drill through a vinyl or wood siding.	\$75
Wire Run between Disconnect Switch and Internal House Panel	20 feet wiring running in conduit to get from the disconnect switch to the main service panel inside the house.	\$120
<b>TOTAL</b>		<b>\$393</b>

\*\* Estimated of electrician labor costs ranged between \$50 and \$100. PPL Electric used the average of these numbers (\$75/hr) for estimates shown above.

**Table 2: Standard Installation Approach, Masonry Exterior (Most Complex Situation)**

Description	Detail	Costs
AC Disconnect Switch	D222NRBCP 60-Amp 240-Volt Two-Pole Outdoor General Duty Fusible Safety Switch with Neutral	\$185
Panel Box Breaker	Eaton Circuit Breaker, 40 Amps, Number of Poles: 2, 240VAC AC	\$13
Labor (\$75/hour)**	Installing cabling between disconnect and internal panel with the need to drill through a masonry wall.	\$300
Wire Run between Disconnect and Internal House Panel	20 feet wiring running in conduit to get from the disconnect to the main service panel inside the house.	\$120
<b>TOTAL</b>		<b>\$618</b>

\*\* Estimated of electrician labor costs ranged between \$50 and \$100. PPL Electric used the average of these numbers (\$75/hr) for estimates shown above.

### Inverter Systems (8kW – 15kW)

When using the current standard approach for systems ranging from 8-15kW, electrically connecting a customer’s solar inverter system would cost a customer between \$475 and \$700. This range depends a lot on the customer’s residence and existing equipment.

**Table 3: Standard Installation Approach, Vinyl/Wood Exterior (Simplest Situation)**

Description	Detail	Costs
AC Disconnect Switch	D223NRB SquareD, Safety Switch, Switch Fusible GD240V, 100A, 2P NEMA 3R	\$235
Panel Box Breaker	Eaton Circuit Breaker, 80 Amps, Number of Poles: 2, 240VAC AC	\$45
Labor (\$75/hour)**	Installing cabling between disconnect and internal panel with the need to drill through a Vinyl/Wood wall	\$75
Wire Run between Disconnect and Internal House Panel	20 feet wiring running in conduit to get from the disconnect to the main service panel inside the house.	\$120
<b>TOTAL</b>		<b>\$475</b>

\*\* Estimated of electrician labor costs ranged between \$50 and \$100. PPL Electric used the average of these numbers (\$75/hr) for estimates shown above.

**Table 4: Standard Installation Approach, Masonry Exterior (Most Complex Situation)**

Description	Detail	Costs
AC Disconnect Switch	D223NRB SquareD, Safety Switch, Switch Fusible GD240V, 100A, 2P NEMA 3R	\$235
Panel Box Breaker	Eaton Circuit Breaker, 80 Amps, Number of Poles: 2, 240VAC AC	\$45
Labor (\$75/hour)**	Installing cabling between disconnect and internal panel with the need to drill through a masonry wall.	\$300
Wire Run between Disconnect and Internal House Panel	20 feet of wiring running in conduit to get from the disconnect to the main service panel inside the house.	\$120
<b>TOTAL</b>		<b>\$700</b>

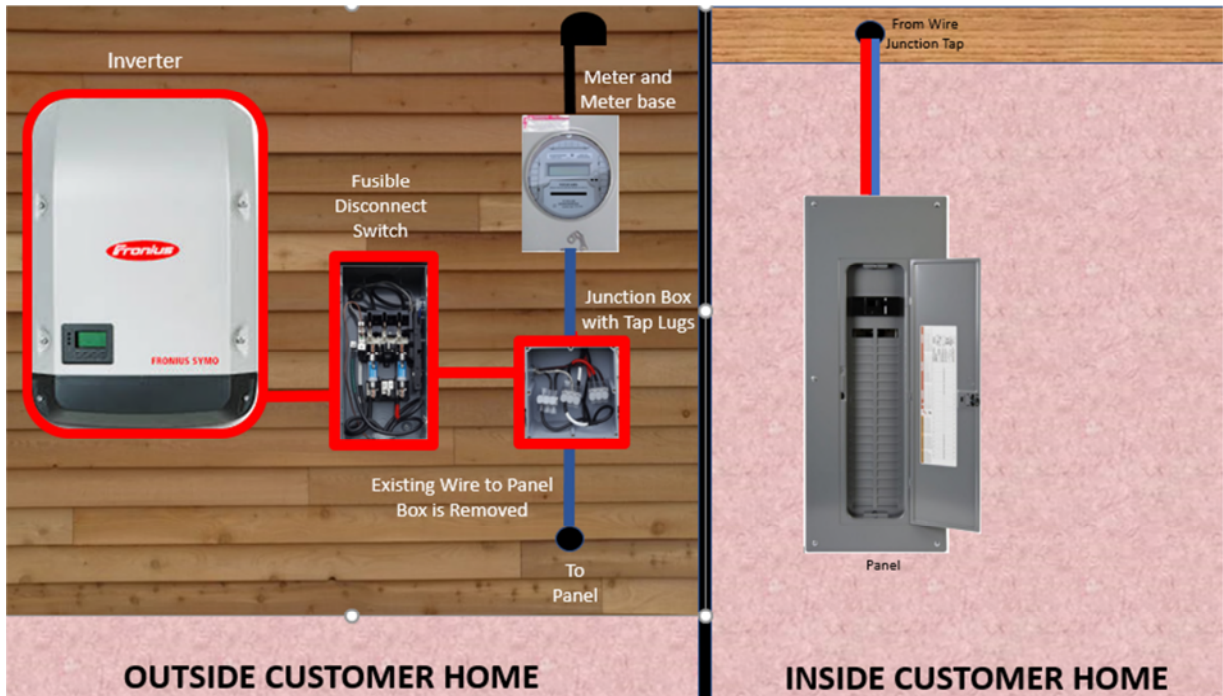
\*\* Estimated of electrician labor costs ranged between \$50 and \$100. PPL Electric used the average of these numbers (\$75/hr) for estimates shown above.

**Estimate for an additional cost associated to a required upgrade to existing breaker panel or installation of a new sub-panel**

In some cases, due to space in a customer's main panel, a customer will be required to have an electrician install a sub-panel (illustrated in blue in the diagram) or upgrade the existing breaker panel. If a sub-panel needs to be installed or the existing breaker panel needs to be upgraded in order for the DER to be installed, an additional \$1,000 - \$1,600 can be expected to be paid by the customer on top of the ranges specified above. For example, if a panel upgrade is required for a 0-8kW system, the cost range would increase from \$393-\$618 to \$1,993-\$2,218 (e.g.,  $\$393 + \$1,600 = \$1,993$ ).

## Connection Diagram for Line Side Wire Tap Approach

The following diagram pictorially demonstrates the required connections and equipment that are installed by the customer’s electrician for a standard inverter-based DER electrical connection using a line side wire-tap approach. Items highlighted in red represent the standard wire path and equipment that the electrician would install. Items highlighted in blue represent items that are typically removed.



**Figure 2:** Electrical Interconnection of Inverter-Based DER Systems through a Wire Tap Approach

## Estimated Cost

If the electrician uses the wire tap (line-side connection) approach for inverter-based systems up to 15kW, electrically connecting a customer’s solar inverter to the distribution system would cost a customer around \$1,091. This range depends a lot on the customer’s residence and distance of associated cabling. The estimate below highlights the estimated costs for non-complex situations.

**Table 5: Standard Installation Approach Using A Line Side Wire Tap**

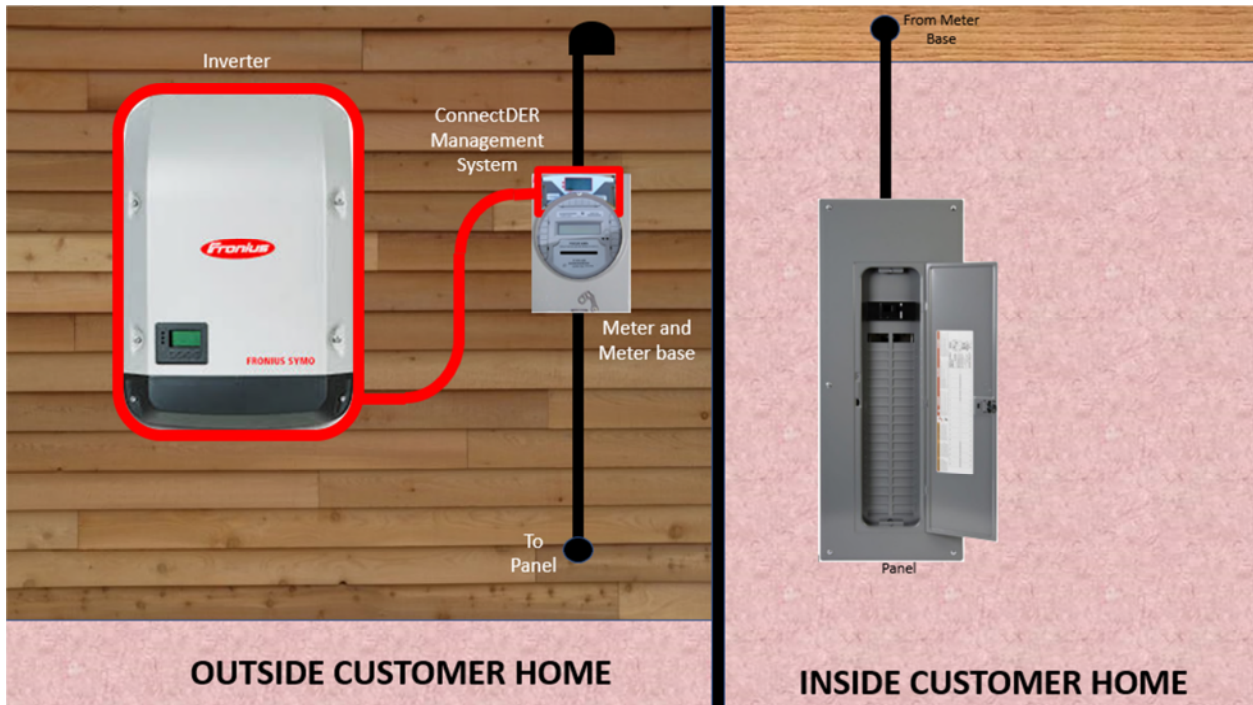
Description	Detail	Costs
Fused Disconnect Switch	Square D D323NRB General Duty Safety Switch	\$260
Junction Box	2'X2' PVC Junction Box (1 unit)	\$30
Polaris Lugs	Polaris Vision Tap 3.41" L3 Port Insulated Multitap Connector, Double Sided Entry Z (3 Units @ \$127)	\$381
Labor (\$75/hour)	Installing cabling, Mounting Equipment, Splicing and rerunning wiring	\$300
Wire Run between disconnect and Internal House Panel	20 feet wiring running in conduit to get from the disconnect to the main service panel inside the house.	\$120
<b>TOTAL</b>		<b>\$1,091</b>

## Proposed PPL DER Management Solution Summary

The following method of inverter interconnection is the method that is being proposed for use pursuant to the Company’s DER Management Plan. Through this method, the customer no longer needs to pay for traditional installation costs for as outlined in the above sections. The standard installation cost for installing ConnectDER DER Management device (including meter collar and dongle) would be approximately \$55. Since the ConnectDER Management device would be provided and installed by PPL Electric, the Company would incur those installation costs, not the customer. Installation and wiring associated with the inverter and the DER system are not included and remain the customer’s responsibility.

### Connection Diagram

The following diagram is provided to illustrate how the inverter can be electrically wired to the ConnectDER Management device. Items highlighted in red represent the standard wire path and equipment installed. The diagram shows what the electrical connection would look like for a system less than 15 KW.



**Figure 3:** PPL Electric’s DER Management Solution of Inverter-Based DER Systems

For systems larger than 15 KW, the ConnectDER DER Management device will be used as a communication medium to the system’s inverter. However, customers will still need to install the AC disconnect switch and run wires through the panel.



NOTICE OF COMPLETION  
AND  
AUTHORIZATION TO APPLY THE UL MARK

5/7/2020

Mr. Jonathan Knauer  
ConnectDER Inc  
2001 Jefferson Davis Hwy, Suite 403  
Arlington, VA, 22202, US

Our Reference: File E513988, Vol X1                      Order: 13233612  
Project: 4789373804

Project Scope: UL/cUL/CB - Dual 60950-1 and 62368 of Wifi Dongle

Dear Mr. Jonathan Knauer:

Congratulations! UL's investigation of your product(s) has been completed under the above Reference Number and the product was determined to comply with the applicable requirements. This letter temporarily supplements the UL Follow-Up Services Procedure and serves as authorization to apply the UL Mark at authorized factories under UL's Follow-Up Service Program. To provide your manufacturer(s) with the intended authorization to use the UL Mark, you must send a copy of this notice to each manufacturing location currently authorized under File E513988, Vol X1.

Records in the Follow-Up Services Procedure covering the product are now being prepared and will be sent in the near future. Until then, this letter authorizes application of the UL Mark for 90 days from the date indicated above.

Additional requirements related to your responsibilities as the Applicant can be found in the document "Applicant responsibilities related to Early Authorizations" that can be found at the following web-site: <http://www.ul.com/EAResponsibilities>

Any information and documentation provided to you involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

We are excited you are now able to apply the UL Mark to your products and appreciate your business. Feel free to contact me or any of our Customer Service representatives if you have any questions.

Very truly yours,

Zachary Wenning  
Engineer Project Associate  
Zachary.Wenning@ul.com

Reviewed by:

Bruce A. Mahrenholz  
CPO Director  
Bruce.A.Mahrenholz@ul.com

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