New Design Concept for Residential Electric Meter Adapter

sdmay20-28

Team Information

Client:
Alliant Energy

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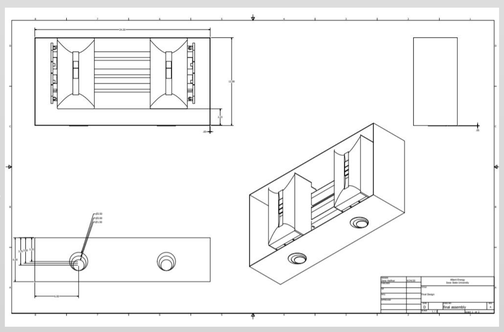
Introduction

Problem Statement:
Our client, Alliant Energy, is in the process of converting all of their overhead line meter connections into underground line connections in effort to reduce the number of power outages due to weather and other environmental challenges. The process involved with this conversion is costly, and if certain constraints are not followed, it may result in legal requirement of the homeowner to bring the entire house up to current electrical code, which will be very expensive in most cases. Our goal is to devise a process or design which will allow this new connection to be made to the customer's home in a cost-effective way that does not require the home to be updated to current electrical code.

Solution:
We approached this problem with three goals in mind: reducing Alliant Energy labor, reducing contractor labor, and reducing material costs. Our solution to this problem is shown in the picture to the right. We have designed an adapter box using stock parts to keep the cost minimized while also allowing for easy and universal installation. By doing this, we have significantly reduced the material costs of this product while also providing a universal solution that can solve the problem at hand.



Intended Users:
The intended users of this product are Alliant Energy customers that own a residence with an overhead power connection who wish to opt in to the upgrade to underground feeds.

Intended Use:
The intended use of this product is to streamline the process of upgrading Alliant Energy customers' power connections from overhead line connection to underground line connection, while reducing costs for both Alliant Energy and the customer.

Design Requirements

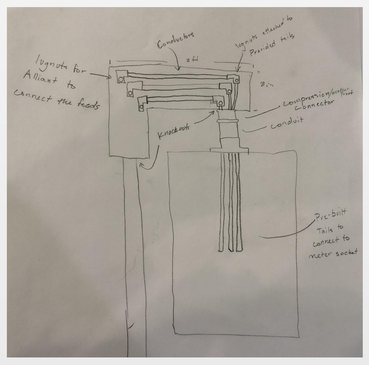
Functional Requirements:
- Product must be able to successfully connect underground electrical lines to the electrical meter without violating current NEC Code.
- Operating standards must be sufficient to maintain electrical service to the residence, and not fail due to inadequate design and construction.
- Product must be fully weatherproof. It will be operating outdoors at all times.
- Must be generally universal to install, able to fit on many different sized homes.

Non-Functional Requirements:
- Product must be as cost-effective as possible.
- Product needs to be relatively low-profile in order to not impact the appearance of the equipped building.

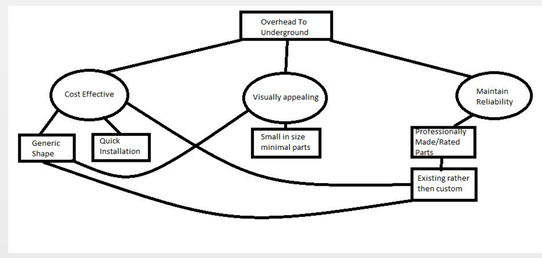
Operating Environment:
This product is designed to operate on the exterior of residential buildings, and will be able to withstand high and low temperatures in the Midwest. It is also designed to operate safely in severe weather ranging from thunderstorms to blizzards.

Design Approach

Concept Sketch:



Block Diagram:



Main Functional Modules:
Adapters: These connect our wire to the busbar, eliminating wire bend.
Busbar: The busbar carries current from one adapter to another
Supports: The supports hold the busbar off the back of the enclosure.
End Cap: The end caps prevent the busbar from shifting left and right
Enclosure: The enclosure provides protection from the elements. A standard enclosure is modified to have a locking door and knockouts on the bottom.

Engineering Standards and Design Practices:
National Electric Code 2017: section 110.28
NFPA (National Fire Protection Association)

We spoke to two different state inspectors and used off the shelf parts to ensure our design is code compliant and follows industry standards.

Technical Details

Functional Module Details:
Adapters: Rittal 9342.300, bottom access, qty. 2
Busbar: Rittal 3524.000, copper, qty. 3, length 19.685”
Supports: Rittal 9341.000, qty 2
End Caps: Rittal 9341.070, qty 2
Enclosure: Hoffman A122406LP 24” l x 12” h x 6” d

Testing

Economic Analysis:
We are able to estimate the manufacturing costs of a first article prototype build at $1000 dollars. Buying in bulk would drive the cost down even more. This is a positive sign as the existing strategies run at $2500 or more. We also spoke to an independent contractor who priced the original work at around $2000 to install, including updating the house to current code requirements. Since a prototype did not get manufactured we did not get a quote for a larger quantity order. Manufacturing a prototype is essential for accurate labor estimates for a larger order. We did not complete tests for labor or contractor costs due to our inability to meet with members of Alliant's labor force due to COVID-19. We were able to achieve this price drop by using standard sizes of enclosures, and parts that were pre-existing. We also designed the adapter in a way that Alliant could do the full installation themselves without the need for an electrician or inspector to appear on site.

Testing Environment and Strategy
The testing we had planned was to make sure the prototype can deliver stable service in various weather conditions and we would also evaluate the cost effectiveness of the solution when we got to test installation time and evaluate the prices of bulk orders. However, due to the COVID-19 outbreak we were unable to complete any of this testing because our manufacturer was not able to complete the process and we were unable to meet with members of Alliant's labor force.

Project Schedule