Feasibility Study for the Production of an Outdoor-Rated Energy Storage System

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Abstract

The objective of this project was to determine the feasibility of introducing an outdoors-rated Energy Storage System (ESS) as a new product offering from a company. The two drivers for determining the feasibility were defining Business Benefits and proving Quality Measurement. Business Benefits were defined by researching previous & current projects and comparing how the installation & commissioning process would get improved. Quality Measurement being maintained was proved by developing a 3D model, which includes the mechanical layout & spacing for wiring / system related components. In conclusion, the major business benefits were a 10 to 15% reduction in savings to customers and bringing system costs down by 4.70%. As far as quality measurement using 3D designing software, it was concluded that all the needed components can be housed in the container being considered.

Introduction

Blue Planet Energy (BPE) is a microgrid integrator company best known for its premier energy storage system (ESS) found in residential and commercial & industrial markets around the world. Current product offerings from BPE are indoor-rated ESS. The objective of this project is to determine if the introduction of an outdoors-rated ESS as a new product offering from the company is feasible.

Microgrids and the ESS

A microgrid "is a local energy system capable of producing, potentially storing and distributing energy to the facilities within the network" [1]. It consists of a group of loads and distributed energy resources (DERs) that act as a single entity with respect to the grid. Microgrids can be built in different ways and using different DERs, typically a solar array, batteries, a storage inverter, fossil fuel generator, the grid and a brain also known as the microgrid controller.

ESS is defined by the company as separating the battery, storage inverter and microgrid controller from all the assets that could be present in the microgrid. The ESS is that part of the microgrid that stores the energy produced by the solar array or generator so at nighttime when there is no solar production the loads can be supplied by the energy stored in the batteries.

Microgrids have many benefits for their users. First, reliability, power outages could not only be a big inconvenience but also a big hazard, microgrids keep the power flowing by islanding from the grid when it fails. Storage inverter technologies have evolved such that these days the user may not even notice the grid has been disconnected due to the seamless transition features. Second, resilience, it is the ability to avoid power outages in the first place or to recover quickly if they do occur. Third, monetary benefits, electricity prices fluctuate throughout the day based on expected and historical demand, an advanced microgrid controller can leverage this fluctuation on its customers behalf with features like peak shaving and demand response. Fourth, microgrids help protect the environment if using green technologies that reduce the emissions of carbon dioxide [2].

Problem

There is a need for having an outdoors rated solution as a product offering. Current solutions offered being indoors-rated only represents an issue for some customers since there is a need to build a concrete electrical room or to procure an electrical outdoors-rated enclosure to house the battery cabinets and other related equipment present in the ESS. In those cases, the problem is that the additional expenses the indoors-rated ESS incurs makes it difficult to compete in the market where there are already outdoors-rated solutions available.

Methodology

The first phase was researching the following topics:

- Items are needed to make the system code compliant. It was established that to make the system code compliant in the US it must contain as minimum the following items: fire suppression system for emergency heat dissipation situations, heating, ventilation, and air conditioning (HVAC) to maintain batteries in the operating temperature range, a emergency stop shut off point accessible without the need of opening enclosure doors. It was defined as relevant the location of the storage inverter, if it was to be in the same enclosure with the batteries that would mean that the ESS will only be code compliant with that same inverter.
- Additional items competitors with outdoor-rated ESS include. Similar outdoor-rated offerings include the minimum requirements, while some also include on the package the microgrid controller and others even include the transformer needed for the storage inverter.
- Determination of the sweet spot price to achieve the biggest saving to the customers. To achieve this the total system price was calculated and compared to other competitors. Ideally the cost must remain under $1000/kWh to remain competitive. Additionally, monetary savings based on the average size of systems sold between 2021 and 2022 were calculated and defined as business benefits.

The second phase was 3D modeling. For this, the following tasks were completed:

- Determining if desired capacity will fit in the enclosure. The company established a desired capacity of 256kWh since it is the most common size sold, thus the model was built based on 256kWh which equals 8 battery cabinets.
- Determining if code required components will fit in the enclosure. The enclosure was designed to also house the fire suppression system, HVAC, and other related components that will make the installation and commissioning of the system easier.
- Define space available to spare for site specific additional items. Some systems require additional items like power meters, protective relays, and load control relays. Such items go connected to the microgrid controller and must be near it, thus why it was considered leaving empty space to install these in the cases where they are present.

Results and Discussion

Business Benefits

There were two relevant business benefits identified as an outcome of the new offering. First, monetary savings for a regular customer were estimated at around 10 – 15%. These savings were identified in steps involved in the construction & installation stages. With an indoors-rated system, the way it goes is that there will be a shipment for battery enclosures, battery modules, storage inverter, DC combiner, fuses & disconnects, microgrid controller, and a separate shipment for any of the balance of system items needed since each component was sources by the installer. With an outdoors rated system, it then means that the ESS enclosure will ship partially assembled, it will already have installed the battery cabinets, DC combiner, fuses & disconnects, microgrid controller and all the wiring in between those items will be pre-done. That then leaves a separate shipping for the storage inverter and battery modules. This then means there are less people from the installer side involved in procuring, managing, installing, and testing each one of the components. The company offers a top-quality battery module in terms of safety and performance, and it means it is typically more expensive than some of its competitors.

Second, when comparing indoor-rated solutions, the company was 6.83% more expensive than the next competitor with a similar offering but when considering outdoor solutions, the company is only 2.13% more expensive than the next competitor. Figure 1 shows a comparison between the company and two other companies with similar offerings.

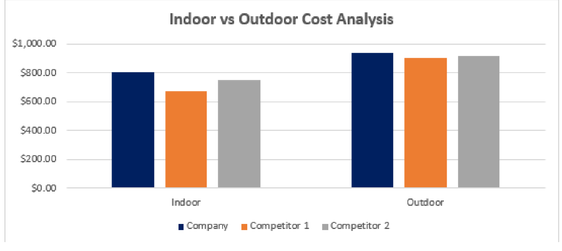

Figure 1
Indoor vs Outdoor Cost Analysis

Quality Measurement

Figure 2 shows the 3D design preview of the system. Through the preliminary 3D design, it was proved that a 20 feet ISO container is enough space to house the batteries and all related equipment needed to make the solution code compliant in the US. It can be observed that the enclosure can house up to 16 cabinets, 512kWh. There will be two HVAC units mounted on the left wall (not shown). On the right end, there is a compartment that is intended to house the microgrid controller, DC combiner, power meter, protective relays, load control relays and even some of the commonly used storage inverters. The company's main product is the battery, thus why it was an important item to remain inverter agnostic. To achieve that it was decided to have the storage inverter in a separate enclosure and not in the same enclosure as the batteries. This also simplifies the certification part, because if the inverter was included in the same enclosure with the batteries a series of additional testing must be performed on the system.

Figure 2
Preliminary 3D Design

Conclusions

The objective was to determine if the introduction of an outdoors-rated ESS as a new product offering from the company is feasible. It was addressed with a technical review of all the details involved behind the design of that new outdoors-rated product. The major advantage found was not only that it is feasible to introduce a new product, but also that it will make the organization more competitive in the industry, given the fact that when comparing indoor-rated solutions, the company was 6.83% more expensive than the next competitor with a similar offering but when considering outdoor solutions, the company is only 2.13% more expensive than the next competitor. Also, implementing an outdoors solution will open the door to new markets in which requests for proposals specify that the systems must be outdoors rated.

Future Work

The next upgrade that is worth considering is the manufacturing of a custom enclosure instead of using a modified ISO container. This should provide more flexibility regarding installing components and should help to drive the manufacturing costs down.

References

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