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Kingspan ESB

Boston Scientific Energy Storage Project

Final Report (PUBLIC) – November 2016

Executive Summary

Kingspan ESB Limited applied for Energy RD&D funding for the 'Boston Scientific Solar PV Energy Storage Project' in April 2016. In July 2016 the project was successful in it's application for approximately 45% of the budgeted capital cost of the project[1]. This grant was for the installation of Ireland's largest co-located solar PV and energy storage system, and will be a critical test bed for embedded energy storage in Ireland. The project was to be an extremely challenging an innovative co-location of Solar PV and battery energy storage.

Due to the tight project timelines the agreement of necessary legal contracts was not possible. These contracts preclude the grantee from progressing the solar PV element of the project, but do not preclude the progression of the battery energy storage element. A scope change was agreed with SEAI in October 2016 and the grant amount reduced as a result of this scope change.

The battery energy storage element, a 190kWh / 100kW Tesla 'Powerpack', will deliver a number of functions during operation, namely:

- Time shifting of demand to take advantage of lower retail electricity prices (arbitrage)
- Delivery of 'system services' within the new DS3 system service ancillary market as part of the ISEM market restructuring

The project will be installed by end of November 2016, with some commissioning and testing continuing through December 2016 and January 2017.

[1] Award letter received from SEAI on 28th July 2016

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Project Activities Since September Progress Report

Since the Progress Report was submitted in September 2016 the following activities have been undertaken by the project team.

1. Battery selection, payment and shipping of Tesla Powerpack battery
2. Site selection and site integration design
3. Installation of concrete foundation for Tesla Powerpack battery at site
4. Installation of Tesla Powerpack battery system, G10 protection panel, electrical and control interfaces.

The following sections outline some of these activities in more detail

Battery Selection and Design

The battery system for the project was specified initially to have a storage capacity of around 100kWh. Kingspan ESB, through ESB Innovation, sent an RFP to four potential battery suppliers;

Three responses were received and evaluated based on the following criteria

- Cost
- Performance
- Delivery schedule (driven by grant timeline)

A number of factors were evident from this RFP responses received

- The market for battery energy storage systems does not readily deliver 100kWh batteries, a larger system would be required
- Delivery time would be a challenge for all suppliers
- There was a wide variation on price

A Tesla 100kW/190kWh system was selected as the preferred battery for this project. The cost of this was higher than the original budgeted cost, but that is due to the capacity being almost double that of the budgeted system.

The selection of Tesla as preferred supplier in June 2016 and they committed at this time to delivering by end September 2016, in line with the project schedule. As a deposit could not be paid until the SEAI grant agreement was received in late

July, Tesla adjusted their expected delivery date to end October 2016. This was outside the original agreed project schedule. This delivery date of the battery to site was achieved within October 2016.

Below is the Tesla PowerPack layout for this project, it's location at the Boston Scientific Site, and a description of the main components

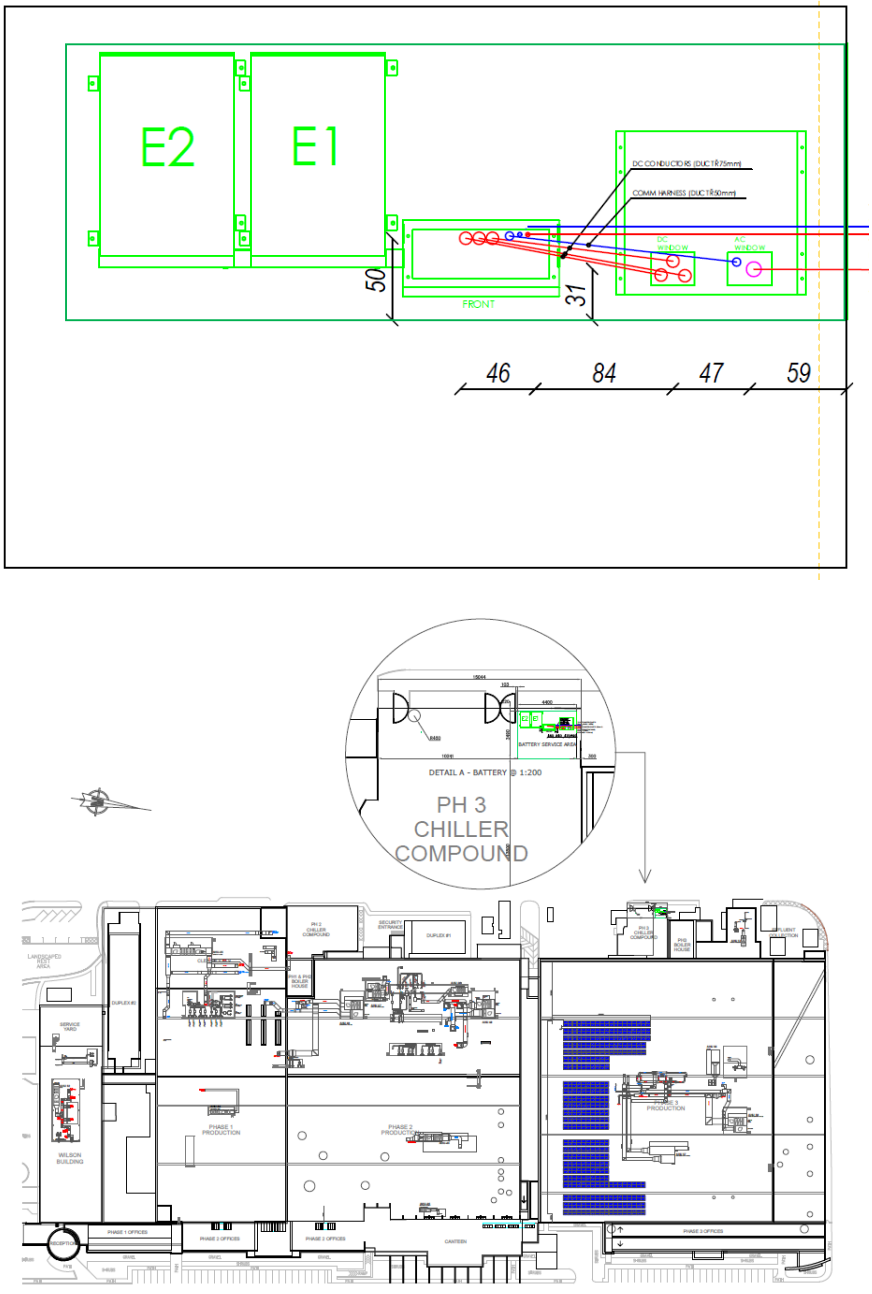

Figure 1: Tesla Battery System configuration at Boston Scientific. 2 x Powerpack battery units, 1 x DC combiner, 1 x PCS (Power Conditioning System)

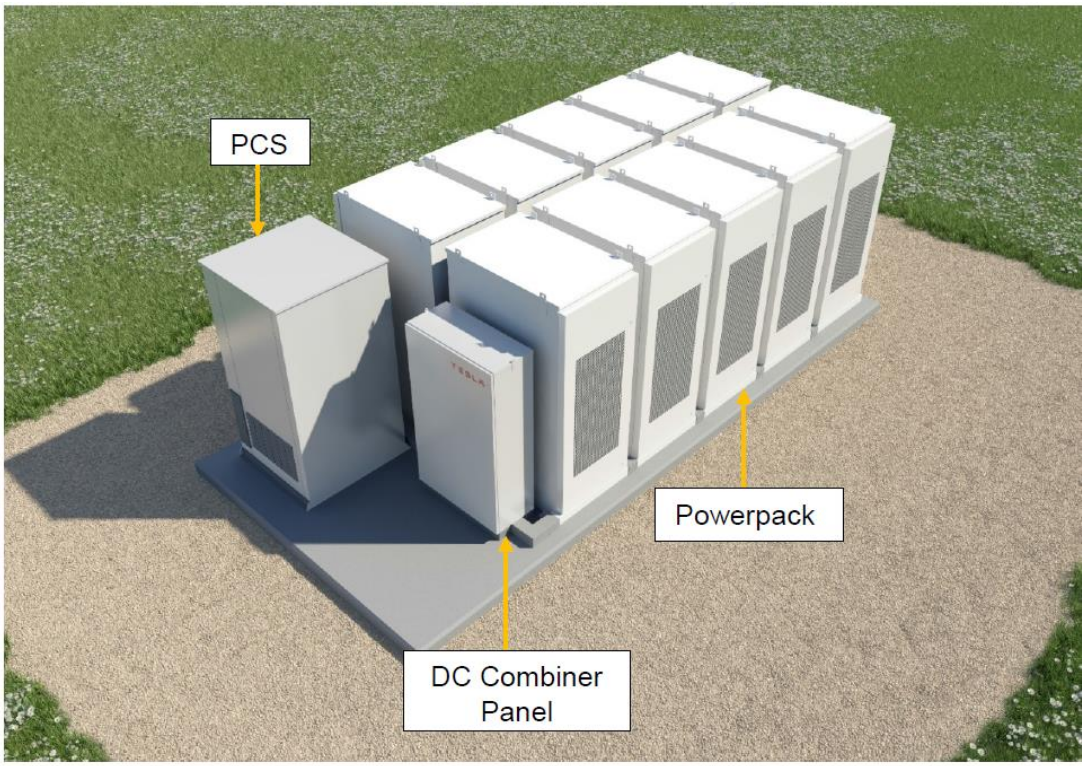

Figure 2: Typical Tesla Powerpack installation showing main components. Note only two Powerpack units installed at Boston Scientific.

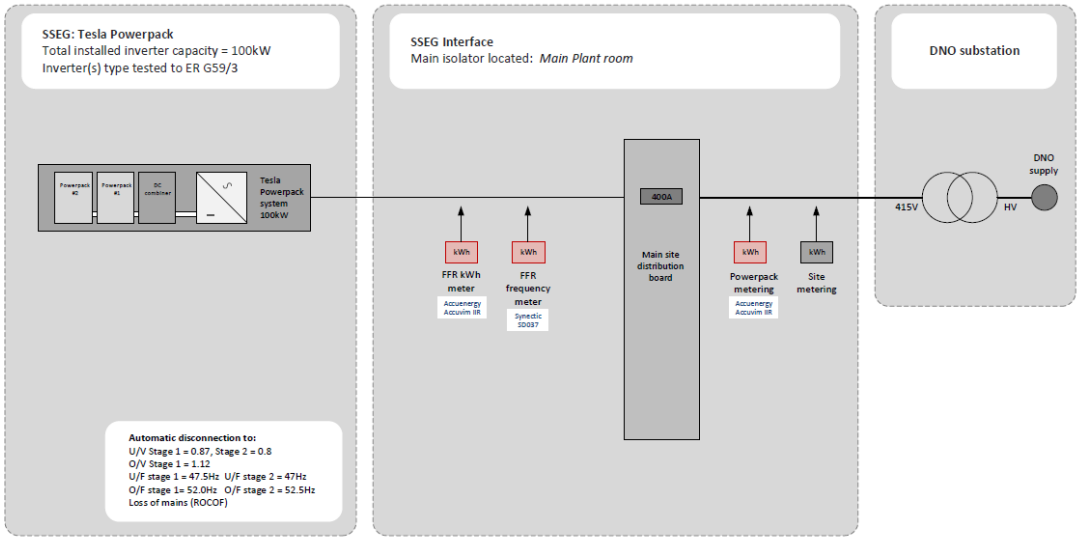

Figure 3: SLD of 100kW/190kWh Tesla battery system for Boston Scientific

Foundation Installation

The final battery system location was agree between Boston Scientific, Kingspan ESB and Tesla. The area selected was within the 'Phase 3 Chiller Compound' at Boston Scientific.

Installation of the concrete foundation was undertaken in early November 2016 in line with Tesla's foundation specification. The foundation includes a service area for battery maintenance.

Figure 4. Foundation pad during installation before concrete pour

Installation of Powerpack, G10 relay

The installation of all major components was undertaken in November 2016. This involved the installation of the below components at site over three days

- 2 x 100kWh/50kW Tesla Powerpack batteries
- 1 x DC Combiner panel
- 1 x Power Conditioning System (nominal power 250kVA)
- 1 x Tesla Master Controller
- 1 x Frequency Meter
- 1 x Battery Meter

- 1 x G10 Protection Panel
- Associate DC, AC and Signal cables

Photos of the installation in progress and final installation are shown below. The battery was installed by 28th November 2016.

Figure 5. Internal components of 100kWh/50kW Powerpack – 2 of these installed at Boston Scientific

Figure 6. Installed major components on concrete foundation

Figure 7. DC Link Box Internals

Figure 8. Completed Tesla Powerpack System

Figure 9. Master Controller and Metering

Figure 10. Completed Tesla Powerpack System

Figure 11. Completed Tesla Powerpack System

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Next Steps

The Tesla Powerpack system is now installed at the Boston Scientific site in Galway. This is the very first Tesla battery storage system in Ireland, and one of the first battery energy storage systems of any type in Ireland.

Through December and January the final phases of commissioning and testing of the system will be undertaken with ESB Networks (Embedded Generation Interface Protection) and Tesla. The battery will be available for service following this test period.

Over the initial year of operation it is expected that the battery system will deliver the following benefits to both Boston Scientific and ESB.

- System arbitrage savings to Boston Scientific from a day/night shifting of energy (i.e. charging the battery at nigh-time rates, and discharging at daytime or peak rates)
- Eirgrid DS3 Qualification Trials (2017) – ESB have entered the battery system into the DS3 Qualification Trial tender for 2017. This will allow the demonstration of the battery providing Primary Operating Reserve (POR) as a system service.
- DS3 Market (2018 on) – ESB expect that when operation is demonstrated the battery will deliver DS3 services through a competitive auction from 2018 onwards.

The Tesla PowerPack system will operate as a R&D test bed to understand the following

- Operation and degradation effects of a Li-Ion battery system providing multiple functions (arbitrage and system services)
- Demonstration of delivery of several DS3 system services including Fast Frequency Response, Primary Operating Reserve Secondary Operating Reserve, and Tertiary Operating Reserve
- Demonstration of an embedded (behind the meter) energy storage system to trade within the DS3 market
- Future addition of renewable energy, such as the originally planned rooftop solar PV system, to develop an understanding of the co-location of battery energy storage and renewable power generation on industrial energy consumer sites
- Provision of real world operating data to universities and IT’s to enable primary research into embedded energy storage operation within the electricity system