



S&C Electric Company/ FIAMM Worldwide Energy

S&C Electric Company Introduction

S&C Electric Company (S&C) is pleased to provide information for the supply of and commissioning of integrated PureWave® Storage Management System (SMS) for the Living Pilot. As a globally recognised technical innovator in the power transmission and distribution industry with over 100 years of power systems experience, S&C has significant in-house engineering capabilities, a diverse suite of applicable products and the regional and global capabilities required to assist with the development and commercialization of next generation energy storage systems.

Not only does S&C manufacture equipment and solutions to meet the needs of many different applications in the energy sector, our Power Systems Solutions group provides full EPC/Turnkey solutions by utilizing our extensive in-house engineering, project management, and construction services. Included in our engineering group is a highly specialized systems studies team that has the capability to perform all of the studies required to integrate a complex Energy Storage System. We are currently involved in many highly technical Energy Storage deployments ranging from simple peak shaving applications to the combination of automated dynamic islanding and advanced distribution automation technologies used to managed a micro-grid which includes the integration of multiple renewable energy generation sources as well as diesel generation and the ability to seamlessly transfer to and from the utility grid. **These solutions are commercially available now for the Living Pilot.**

S&C Electric Company Experience and Benefits

S&C's Power Quality Products group represents the most experienced team providing MW size inverter based products and services available worldwide. Beginning in the early 1990s, S&C identified power electronics as a growing need for the worldwide electrical industry. The first power electronic based multi-MW High Voltage UPS was installed in 1996. Then the first inverter based DSTATCOM was installed in 1997 by employees of what is now the S&C's Power Quality Products. In 2006, the first S&C SMS Energy Storage System went into service. From those first systems, S&C has continued to grow and improve its power electronic offerings to address a wide variety of industry real and reactive power requirements.

- For the utilities industry – S&C has provided inverter based products and services that serve the utility industry starting in 1996. Since then S&C has grown our products for utility substations to include both PureWave® DSTATCOM Distributed Static Compensators and PureWave® Storage Management Systems equipment and services.
- For the renewables industry – S&C has provided numerous power electronic products and services that serve the renewable energy sector starting in 2001. S&C has grown our services in both substation and collector system design, construction and equipment installation, including design and installation of Dynamic VAR compensation and Energy Storage Systems.
- Power Electronics Project Experience – S&C has medium voltage PureWave® UPS Systems, PureWave® DSTATCOMs, PureWave® Storage Management Systems and PureWave® Community Energy Storage serving a variety of critical utility and end user process applications.

Key advantages

- S&C is a proven, profitable supplier to the Electrical Utility Sector who has demonstrated our long term and conservative engineering approach for more than 100 years. Utility sector business accounts for over 80% of S&C's annual turnover.
- Extensive experience in the Energy Storage field. S&C are globally recognized pioneers and technological innovators of large scale battery integrated power electronics with over 85MW of systems in service worldwide.
- Over 40MW / 165MWh of EPC energy storage projects in service featuring:
 - **Complex Multiple Renewables integration and micro-grid control, wind, solar, fuel cells, (and diesels) on the one grid-tied dynamically islanding micro-grid.**
 - **Peak Shaving; Smoothing/Load Following**
 - **Dynamic Islanding (including dynamic load management & load shedding)**
 - **Reactive Voltage Support ; Frequency Regulation; Arbitrage; Black Start**



- The first (and to S&C's knowledge the only) Energy Storage supplier in the world to have developed and successfully demonstrated (through actual field outages testing), multiple energy storage projects including proven, functional automated Dynamic Islanding schemes with intelligent load shedding.
- As a true R&D-focused organization and innovator of technologies associated with the power transmission and distribution industry, S&C has a 100+ year history of assisting Electrical Utilities and research institutions with the development and integration of new technologies.

S&C's in-house system studies group is capable of performing all of the detailed studies required for the successful interconnection of an Energy Storage System, regardless of the size of the grid/micro-grid.

1MW S&C SMS Basic Description

The inverter module has its own local controls which are located in a sealed cabinet on the front of the inverter module and the system master controls are housed in a segregated, sealed, air-conditioned room. AC and DC power cables all enter through the same side of the container and all control cabling enters through a separate gland-plate located in the control room. Exhaust hoods are made from light-weight, corrosion resistant aluminium and all external fixings are stainless steel.

FIAMM Worldwide Energy Introduction

Privately held and in business for over 70 years, the FIAMM Group has factories and offices all over the world. FIAMM is the supplier to the world's leading manufacturers, despite remaining deeply linked to its Italian roots. FIAMM ENERGY STORAGE SOLUTIONS builds both traditional storage systems and ones employing the new FIAMM lead-free sodium nickel SoNick batteries. It is present in sixty countries, with about seventy percent of its sales overseas.

SoNick battery Applications

The SoNick applications cover a wide range of use from kilowatt-hours to several megawatt-hours with a 2 h to several hours of discharge time. The following applications are indicated as 'proven' in several SoNick battery installations.

Load Leveling; Power Quality; Renewable Resource Optimization; Energy storage markets on-grid, off-grid, micro grid; Utility Grid; Ancillary Services; Telecom Backup Power; Black Start

Benefits of the FIAMM Energy Storage System:

- FIAMM Energy Storage System "SoNick" technology has demonstrated long-term safety and reliability with over 10 years of field deployment with over 100MW installed globally & 150M miles deployed on EV
- Energy modules are designed to continue to operate with multiple cell failures & are field replaceable with no impact on system performance.
- System designed for zero maintenance & DOES not need to shut down to replace energy modules (increased uptime, systems remains in operation should field technician be required)
- No additional A/C or generation needed to maintain battery operations (lower Capex)
- Battery can be stored up to 20 years with no loss of performance.
- Energy modules have zero impact on the environment. (100% recyclable)
- System can be monitored remotely. Small footprint required, higher energy density

Technology Overview:

ZEBRA “SoNick” battery technology and its brand originally created for public local transportation fleets and logistic services by a Swiss company MES-DEA, has been solely owned by FIAMM Group since February 2010. The technology has been renamed as SoNick and is now equipped with advanced control system to better-fit system requirements of energy storage applications.

- Safety

By comparison with other electrochemical batteries (PbA, Li-ion, NaS), SoNick batteries offer important advantages, such as high specific energy and energy density, independence of external temperature, no hydrogen emission. With respect to other high temperature batteries such as NaS, SoNick features improved robustness and safety. There are four major safety features in all SoNick batteries.

Safety by: 1) Chemistry; 2) by Cell Design; 3) by Battery Design; 4) by electronic control

- Performance

SoNick battery is a high-energy battery with medium-power capability suitable for a wide range of applications with energy storage capacities from a few kilowatt-hours to several megawatt-hour installations. Energy density of integrated battery module less BMS is 100Wh/kg or 120Wh/l. The battery may be discharged within 2 hours giving highest constant power. Due to the ceramic electrolyte the battery has no electrochemical self-discharge. Dependent on operation conditions, the thermal loss is balanced by the internal electrical loss that is converted to heat so that the overall efficiency is in the range of 80-95%.

Proposed offering for Pilot Program-These are commercial NOW.



FIAMM Spring 1



S&C PureWave® SMS

Solution 1: 2 container 1.5MW scalable solution.

- Spring 1-1.5MW contained in a standard 20 foot shipping container
- S&C 1MW PureWave SMS is housed in a single 20 foot ISO container
- Containers can be easily deployed with minimum EPC, set back or easment requirements.
- Assetts can be repurposed for multiple locations
- Spring 1 can provide multiple services from single assett, anciliary, time shift, load shift etc.
- Standard 10 year life with ability to extend to 20, 30.

Solution 2:

- FIAMM Energy Storage System-Scalable cabinet solution for KW to MW services.
- Capacity on demand. Paired with S&C PCS with additional capacity scalable on demand for additional capacity.
- Scalable cabinet solution containing 4 batteries (100kw each) , Small footprint, flexible, scalable design.
- Cabinets can be deployed as needed for indoor or outdoor use.