SIEMENS

Case Study

Large-scale battery maker taps Siemens Automation for end-to-end solutions and expertise to save huge costs and critical time-to-market

UET

Customer: UniEnergy Technologies, founded in 2012, based north of Seattle

Challenge: Develop a comprehensive and highly scalable automated control system for multi-megawatt energy storage using minimum engineering time and cost to ensure fastest time-to-market

Solution: Integrate key components from the Siemens Totally Integrated Architecture (TIA) portfolio with software engineering via the TIA Portal, along with a Siemens WinCC SCADA software and small Siemens variable frequency drives

Results: Time-to-market cut by 50 percent; site-specific engineering costs reduced substantially; engineering, procurement and support greatly simplified with sole-sourcing, reducing operating risk

As the smart grid quickly evolves into a distribution infrastructure for AC electricity with ever more sensory, interactive and transactional capabilities, a 150-year-old DC technology has re-emerged on the scene. It's the wet-cell battery, but now with extremely advanced chemistry and designed, engineered and built to deliver multi-megawatt capacities and with plenty of smarts inside.

One of the world's top suppliers of such energy-storage solutions is a small but growing company founded in 2012 called UniEnergy Technologies (UET). From its headquarters and manufacturing facility near Seattle, it makes and sells the Uni.System™. This is a highly scalable, next-generation energy-storage solution for utility, commercial and industrial, microgrid and other applications housed in standard 20-foot shipping containers.

Inside the containers are tanks circulating an aqueous vanadium electrolyte, plus electrode stacks, sophisticated controls and electronics. Big and massive as they are – one container full of electrolyte weighs 40 tons – their modular architecture enables UET's customers to add as much capacity as they need with plug-and-play simplicity similar to adding data storage to today's computer systems.

Unlike other battery types, such as lithium-ion lead-acid, and zinc-air, UET's system has no capacity fade and can be fully discharged without losing capacity any number of times over its 20-year lifecycle design. It also has no flammable components and no risk of thermal runaway, making it safer. The Uni.System components are fully reusable or recyclable.

As a buffer between bulk energy generation and sustained energy use, the Uni.System can provide near-instant energy response for different durations. For short periods, just milliseconds to seconds long, its batteries can absorb and inject power into a grid or circuit to help regulate AC voltages and frequencies.

It also can supply power for medium durations from minutes up to an hour, which are typical of solar farms when clouds pass over and drop output to zero almost immediately. Finally, it can help utilities shift bulk energy for periods of two to four hours or longer. This enables them to store energy during a generation peak when grid loads are low, then discharge it during a loads peak.

Challenge: Develop a complete, highly scalable control system for multi-megawatt energy storage using minimum engineering time and cost to ensure fastest time-to-market and profitability

According to UET's Director of Electrical Engineering David Ridley, the company faced numerous challenges in bringing the Uni.System to life. Overall was the need to commercialize the vanadium electrolyte chemistry the company licensed from the U.S. Department of Energy's Pacific Northwest National Laboratory, where UET's CEO Gary Yang headed the energy storage program.

This commercialization involved designing and engineering the electrolyte tanks and pump systems, electrode stacks, instrumentation and controls, all to fit compactly in a 20-foot container. "We needed to create a control architecture that's scalable and extensible just like our product," Ridley explains. "That way, if customers want to add another megawatt of capacity, no problem. Our controls needed to scale easily, so that once we deliver another container and hook it up, we could just increment the counter in our software by one megawatt and the customer is up and running."

Simplicity and reliability were important, too, for both customers and UET. "The last thing our customers want is to add complexity and risk to their operations, so we had to keep everything as simple as possible to ensure availability and serviceability," he says, noting that service contracts enhance UET's business model. "Of course, for our service business to be profitable, we need to minimize service calls by maximizing uptime and, if problems do occur, be able to troubleshoot and fix them remotely as much as we can."

Among the Uni.System's other design goals were low manufacturing costs and physical modularity. Ridley says that's why the company chose the 20-foot shipping containers. "They're available as pre-built commodities, saving materials sourcing and fabrication costs," he says. "They're also stackable and easy to transport via multimodal logistics, whether by truck, rail or ship."

Despite being a well-funded startup with lots of potential customers, UET was mindful of conserving cash on the path to profitability. Ridley's team knew they had to run through the steps of product development – design, engineer, prototype, test and manufacturing validation – as fast as possible but with the highest possible quality.

"Like the launch of any new product, we have to install referenceable deployments as fast as we could, which then helps us sell more," he says. "We didn't have time to evaluate and source the best components individually. Instead we had found the best supplier with the most competitive products, plus expertise and experience in our markets."

Solution: Integrate key components from the Siemens Totally Integrated Architecture (TIA) portfolio, with software engineering via the TIA Portal, along with Siemens WinCC SCADA software and small Siemens variable frequency drives

Ridley and his team considered other major controls suppliers in addition to their evaluation of Siemens. But they chose Siemens for several reasons – one being its Totally Integrated Architecture (TIA) portfolio of highly integrated automation and control components based on global industry standards.

"What really stood out about Siemens is its full-line capability," he says. "It has everything from PLCs to I/O to industrial computers to HMIs, plus a full line of SCADA software. We've done market surveys on all the components that go into our Uni.System and Siemens is very competitive on almost everything.

"Plus it has variable frequency drives, circuit breakers and power supplies, motor starters and other gear. And then there's the fact that its huge energy division is involved with large-scale utility projects all over the world."

Another big attraction was the Siemens TIA Portal, a software engineering framework that's been proven by hundreds of Siemens customers to shave as much as 30 percent off their development and commissioning times – and, in many cases, even more, up to 60 percent.

"The TIA Portal's code libraries handle things like communication protocols, distributed I/O, interfacing with the drive for our pumps, so we don't have to spend precious

time doing so," Ridley says. "You drag and drop the code, and hardware is automatically configured. Assign it an IP address and it's ready for your code.

"With the TIA Portal and the Siemens TIA control platform, we can forget all the protocols, drivers and memory management issues that we'd have to code, then compile, test, debug, recompile and on and on. This lets me keep a small, efficient team that just focuses on battery logic. That's our value-add, not all that other effort."

Specifically, Ridley and his team built the Uni.System's control and electrolyte pumping systems using the following Siemens components, with his selected comments about each:

- **SIMATIC S7-1500 PLC:** "We wanted this PLC because it can feature two isolated ports that are unique to it: one to communicate with the local instrument network; the other to communicate with the higher level SCADA network. We could always add ports later, but it can be quite expensive to do so."
- **SIMATIC ET 200SP distributed I/O:** "By using the same I/O to make all our analog and digital ins and outs from each of the battery containers available on the same bus, we're able to use the same type 20-foot box over and over again, which leverages our manufacturing efficiencies."
- **SIMATIC WinCC Open Architecture SCADA:** "We built our SCADA operations interface using the object-oriented architecture of the WinCC OA product. This lets us build a generic template for our battery data type, then instantiate as many batteries as we want to, dynamically in run-time. Other vendor's products might take an object-oriented approach, but they don't implement it nearly as well."
- **SIMATIC Comfort Panel HMI:** "We use this more as a local interface, geared towards maintenance personnel. The WinCC OA provides the customer-facing, operations interface."

- **SCALANCE X-200 PROFINET industrial Ethernet switches:** "With PROFINET, we don't have to run a lot of analog and digital wires between containers. We just run one Ethernet cable. That saves a lot of deployment time."
- **SINAMICS G120 variable frequency drives:** "We use these to drive our electrolyte pumps, with two in each 20-foot container. With them, we're able to optimize the speed of the electrolyte's flow and therefore its efficiency much better than we could by using, say, a six-speed motor."

UET designed the Uni.System to operate in temperature extremes from -40°F (-40°C) to 122°F (50°C), a wide range in which the Siemens components are designed and engineered to operate without additional ruggedization.

Results: Time-to-market cut by 50 percent; site-specific engineering costs reduced by a substantial amount, procurement and support greatly simplified with sole-sourcing, reducing operating risk

Ridley estimates that choosing Siemens helped UET cut its time-to-market in half, saving months of development time and conserving precious cash. One reason was the Siemens TIA portfolio. This ensured the compatibility and interoperability of the underlying architectural design and engineering of each Siemens component.

"We didn't have to figure out, 'how do I make this PLC from manufacturer X talk to this drive from manufacturer Y?, then test, debug and re-test to ensure the combination's interoperability," he says. "Those tasks can be very arduous and time-consuming, distracting us from our focus on optimizing our battery system's performance."

The second reason was the Siemens TIA Portal, which saved weeks of engineering time by providing libraries of proven software code, so Ridley and his team could focus on optimizing battery logic. "We need to focus on the things that are unique to our company and our core competency as a battery manufacturer," he says. "The Siemens TIA Portal allowed us to build our battery control using a proven platform with all the software blocks that we ever need for generic functions, so we wouldn't have to code them."

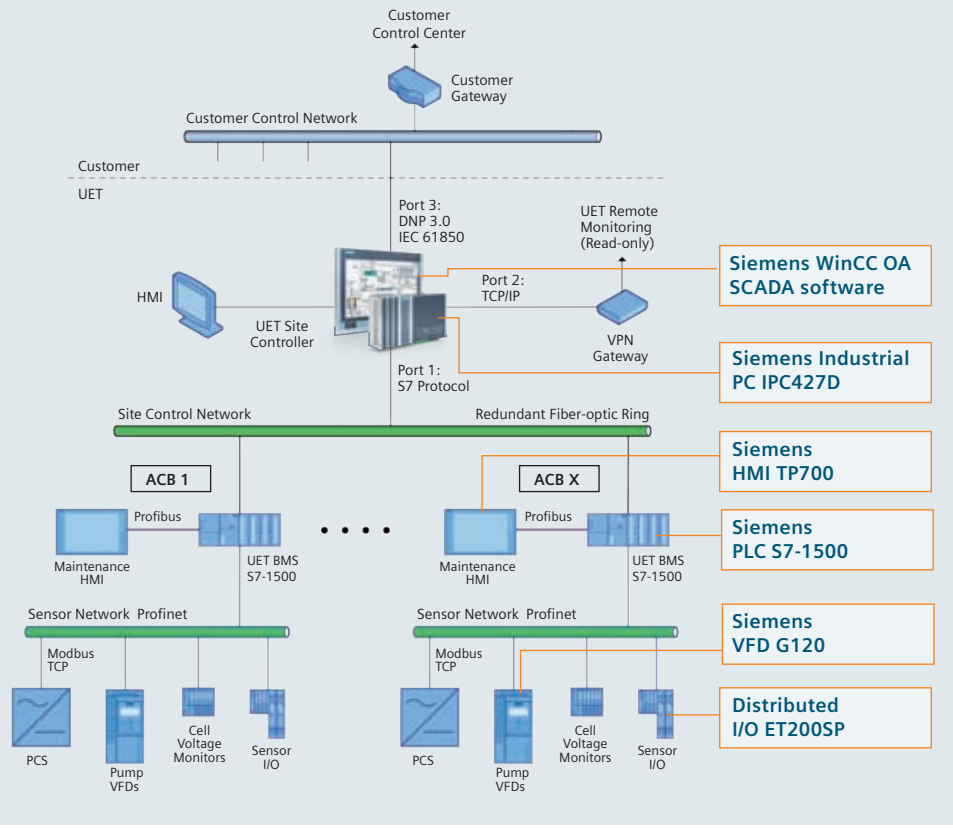
In addition to time-savings in developing UET's Uni.System, Ridley expects that the plug-and-play scalability of the Siemens control system will help reduce site-specific engineering costs to under 10 percent of a customer's project costs – savings that are substantial for a typical project.

"With other large-scale battery systems, onsite engineering can be from 30 to 50 percent of total costs," he says. "But with the Siemens control system, we run just one Ethernet cable between the containers once they're delivered and positioned on a customer's site."

Ridley also found that sole-sourcing with Siemens has greatly simplified procurement and support. UET saves time in ordering components and parts, not to mention time when problems arise. “I don’t have to argue with supplier A and supplier B, pointing their fingers at each other,” he says. “With Siemens, it’s much more collaborative when we have a problem. We just work together to figure it out.”

Another benefit of working with Siemens has been the added credibility and trust UET gains among potential customers, especially those in the utility industry. “We certainly mention we’re using Siemens standardized components that have hundreds of thousands of hours of mean-time-to-failure,” he says. “Siemens is a trusted name across just about every industry and the utility industry, in particular. It sure helps build our credibility and move our sales cycles forward.”

Proven Components: Control System Architecture



Siemens Components

- Each string is controlled by a single Siemens PLC
- String consists of four batteries, the PCS, cooling system, communications
- The PLC is master of the PCS
- The site controller controls up to 100 strings using Siemens new WinCC OA on an industrial PC

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