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FEATURE

Inside construction of the world's largest lithium ion battery storage facility

SDG&E's 120 MWh Escondido storage project will help mitigate a natural gas shortage in southern California

By Gavin Bade • Dec. 6, 2016

The largest battery storage system in the world will also be one of the fastest constructed in history.

In August, San Diego Gas & Electric tapped energy storage company AES to install two energy storage projects totaling 37.5 MW, 150 MWh. When completed, the larger, 120 MWh project is expected to be the single biggest lithium ion battery in service on a utility grid in the world.

Both battery facilities are expected to be online by the end of January 2017 — nothing short of miraculous in an industry where deploying assets, especially newfangled technologies, can take years.

And the companies are not alone. Southern California Edison and Tesla announced a 30 MW, 80 MWh project in September that is expected to be online even sooner, and will be the largest operating battery for a time.

The accelerated deployment comes in response to an unprecedented shortage of natural gas for electricity generation in southern California. Last October, a leak at the Aliso Canyon gas storage facility outside Los Angeles caused it to be shut down, constricting fuel supplies for area plants.

Fearing blackouts, the California Public Utilities Commission quickly mandated a series of mitigation measures, including an expedited procurement for local energy storage resources. The more renewable energy that can be stored during the day, the reasoning went, the less

need to fire up fossil fuel generators as electricity demand increases in the evening.

The CPUC order directed the utilities to identify storage projects that could be sited, constructed and put into operation in only a few months. Though the regulators said storage resources must be "cost-effective" compared to other local capacity products, no pricing details for the projects have been released.

At first, the order only concerned Southern California Edison, whose service territory includes the affected area. But when the procurement was expanded to include SDG&E, storage company officials said the utility was ready to hit the ground running, thanks in part to a previous CPUC order to procure 165 MW of storage in its territory.

"They were already looking at storage and understood the technology," Brian Perusse, vice president for international market development at AES told Utility Dive during a visit to the 120 MWh battery in Escondido. "They were doing things before this ever came on the radar and nothing would have happened at this speed had they not already been doing things."

The expedited deployment is testing the mettle of both utility and developer — pushing them to condense the typically year-long siting and construction process into just a few months. But executives say the gas crisis could help prove that energy storage can serve needs on the bulk power system, potentially becoming a viable replacement for gas peaker plants. And the lessons from the speedy installation could help build confidence in long-duration storage and boost the sector around the world.

The SDG&E project

Initially, the CPUC mitigation plan for Aliso Canyon included the utilities in the greater Los Angeles area. The Department of Water and Power, for instance, was authorized to halt economic dispatch of generation and allowed burn diesel in dual fuel plants when demand spiked during the summer.

But comments in the regulatory docket suggested that SDG&E be allowed to include some of its local capacity resources in the mitigation plan, and regulators assented in May. At that point, the utility was already was already running a Request for Offers for large-scale energy storage to meet its CPUC mandate, according to Randy Nicholson, SDG&E's policy manager for advanced technology.

"We had gone through an evaluation of firm bids from AES and others and that actually started about 10 days before the [Aliso Canyon] resolution came out," Nicholson said, "so we were getting to know each other really well when the resolution hit and that allowed us to move really quickly."

Because of the tight timeline, SDG&E leaned toward firms with ample experience in deploying large-scale storage quickly. That gave AES, the largest battery installer in the world, an advantage.

"We've done this a number of times. We built a 32 MW project in 2011, another 20 MW facility and other projects around the world," Perusse said. "There's a knowledge base and a team built so you know some of the problems before they occur in the process so there's some comfort around that."

"One of the things that made the choice easier with AES was [they] were coming off six successful deployments," Nicholson said. "That helped because we knew for this project meeting the timeline was critical ... and we didn't want to take a chance on someone who didn't do a project this year or hasn't done something in a while."

When Utility Dive visited San Diego in early October, the AES facility was little more than an empty industrial lot next to a substation — a site chosen for its easy access to the bulk power grid. Wooden frames sat on slabs of cement where, eventually, the batteries would be sited:

When Utility Dive visited Escondido in early October, the project site was little more than a vacant lot. *Credit: Gavin Bade*

SDG&E close a site next to a substation for easy access to the bulk power grid *Credit: Gavin Bade*

Battery operation and upkeep

Once in operation, the two AES systems will combine to provide 37.5 MW of power for four hours on a nearly daily basis. Because the batteries count toward the utility's local capacity requirements, that stored energy will replace fossil fuel generation otherwise deployed to meet peak demand in the evening.

"It's going to act like a sponge," said Hanan Eisenman, SDG&E spokesperson. "Let's say the middle of the day you have overproduction of solar, you just soak that up with the battery and then you got the evening peak usage time at 5 p.m. ... we can release it at that time."

Under the Aliso Canyon resolution, storage resources must qualify for any local capacity requirements stipulated by the California ISO, Perusse said. "That's sort of California industry code for being a resource adequacy resource, so you're obligated to bid or schedule into the markets on a daily basis."

"In effect and in administrative form at the ISO, these [batteries] would be peaking resources,' he said. "They will be bid and scheduled and receive market rents and receive the same compensation as a generator."

Using a battery to meet demand peaks means it will likely be fully charged and discharged nearly every day. That puts a lot of strain on lithium batteries, which degrade as they get older and are cycled more often.

Under SDG&E's contract, AES must maintain the batteries' nameplate capacity and performance for 10 years, after which the utility takes responsibility for the project. Typically this is done two ways — by oversizing a battery project upfront or by adding new cells during operation to support capacity.

In some small projects, AES may oversize battery facilities to start, Perusse said. But in large-scale projects, "our philosophy is more to be adding than substituting."

"There's extra racks that you can populate with additional cells, so the number of batteries at the project will be greater at the end than at the

beginning," he said.

For this project, AES will deploy batteries manufactured by Samsung SDI. While the degradation rates of batteries are closely-held trade secrets, Perusse said the cells offered the right combination of performance, cost and a fast delivery schedule.

"[Batteries] each have their own degradation curve, so part of this is really understanding the usage profile and comparing it to the degradation curve," he said, "then part of it is really understanding what percentage they are going to degrade over time and model that out."

Especially in an expedited deployment, more important than making sure the battery is the "perfect fit" for the use case is "having a warranty and knowing what it's going to do," Perusse said.

By mid-November, construction was well underway in Escondido, Eisenman wrote to Utility Dive. Concrete foundations and electrical conduit were being laid in anticipation of battery cells arriving soon.

Concrete foundations were built for each battery container to counteract uneven ground at the construction site. *Credit: SDG&E*

After the foundations, conduit was laid to connect the batteries to the grid. *Credit: SDG&E*

Once the 10-year contract is up, SDG&E will have to decide what to do with the batteries. It could continue to augment the batteries to preserve performance or work to retire the facility and recycle the spent cells.

"The way we're looking at it is the analog is nuclear decommissioning," Nicholson said. "When you built that plant you knew at the end you would have to do something at the end, and when we build the batteries we know at the end we're going to have to do something and we're going to be setting aside money and developing a program ... to manage that."

The future of long-duration storage

Internally, SDG&E has been bullish about storage since well before the Aliso Canyon crisis.

At the 2015 Energy Storage North America conference, the utility's chief development officer Jim Avery captured the attention of the industry by dreaming of a future "where there will be no more gas turbines." While it won't happen overnight, Avery said long-duration storage could eventually obviate the need for natural gas peaker plants that today help integrate variable renewables.

With the deployment of hundreds of megawatt-hours in response to the Aliso Canyon crisis, it would appear Avery's hypothesis is seeing its first

test — how storage will be used to replace natural gas capacity. But the project development team was more cautious in their long-term prognosis for the storage sector as a whole.

"It's a little too early to tell if storage is going to replace all peakers going forward," Nicholson said. "This project in particular is going to help us answer that question, to determine whether going forward if you want to start moving the mix in another direction."

Already, AES says the storage projects in California are attracting attention beyond the state borders. While regulatory mandates are pushing long-duration batteries there, most of the utility-scale batteries elsewhere in the U.S. are used for shorter storage functions, like frequency response. At the end of 2014, 62% of the battery capacity in the U.S. was deployed in the PJM market for that purpose.

As California utilities prove the worth of bigger batteries, Perusse said AES sees an "inflection point."

"With leaders moving in and saying we're willing to sign up for 37 MW and we need it in four or five months, it's already gotten notice with people from South America," he said. "People from Brazil, Mexico and Colombia are saying 'can you tell us a little bit more about that? Can you send us a white paper?"

More than the size of the battery, Perusse said the duration has generated excitement.

"A lot of people have been saying the same thing — this is coming, it's a four to six hour duration product to help serve the peak and improve reliability and it's the first project of its size," Perusse said. "You said four hours is coming? It's here. So that's really changed."

As of Dec. 2, the AES battery containers have arrived at the Escondido site, Eisenman emailed. The cells are being unloaded and placed into the containers in anticipation of operation next month:

Battery cells are shipped in separately from Samsung SDI and installed by AES technicians to their proprietary configuration standards. *Credit: SDG&E*

AES will leave some battery racks empty so it can add cells during operation, preserving the facility's capacity. *Credit: SDG&E*

For SDG&E, the conclusion of this process will likely mean the start of new projects. Nicholson said the utility is expecting the results from the

RFO that spawned the AES projects soon, and that there will be "similar resources," awarded in that process.

Gov. Jerry Brown (D) also recently signed legislation that authorizes the state's IOUs to add 500 MW on top of existing mandates.

"We already have a mandate for 165 MW" of storage through AB 2514, Nicholson said, "and this is another 166 MW on top of that.

"The new legislation is an authorization, so we're authorized to bring that amount of storage on the distribution system, but not mandated," he said. "But we'll certainly be looking to storage that prioritizes public sector customers like the military and the ports, schools, things like that."

Correction: This article has been updated to reflect that the AES project is expected to be the largest lithium ion battery storage facility, though there are larger battery arrays of different types. The Kyushu Electric Power Co., for instance, earlier this year installed a 50 MW, 300 MWh sodium-sulfur battery facility that went into service in March.

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