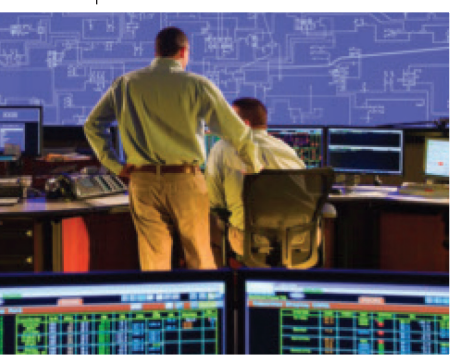
ENERGY STORAGE

Finding the Hidden Megawatts

By Chris Shelton

Opinion

In February 2013, six years after AES began working on advanced battery storage projects and while developing a new project in a large power market in the United States, a member of AES' storage team was presented with a problem. In order to register the planned facility in the market, he had to fill out the "Resource Asset Registration Form" (RARF). This form is required of all resources performing in the market as a way for the grid operator to properly model those resources in the system. It was unclear how one would fill out the form for a storage facility, so he called the grid operations help desk. (See box at right.)



AES

EDISON INTERNATIONAL

As president of AES Energy Storage, LLC, Chris Shelton leads the energy storage efforts of the AES Corporation, a company with over 200 megawatts (MW) of advanced energy storage resources in operation and construction and 2,000 MW of projects in near-term development. He also is a past chairman of the Electricity Storage Association. The views expressed herein are those of the author.

AES:

"Hello, my name is Dauren from AES. I am filling out this registration form for my 40-megawatt battery storage project. I just want to be clear that I should fill out this form as a generator."

Grid Operator:

"Yes. If you are supplying power to the grid you will need to complete the Resource Asset Registration Form or RARF."

AES:

"OK. But what about when I am charging from the grid?"

Grid Operator:

"Will we be controlling your battery while it is charging?"

AES:

"Yes. The system is built specifically to serve the market."

Grid Operator:

"OK, sir. You will need to fill out another form for your controllable load resource, essentially the load RARF."

AES:

"Two forms for one facility? How many megawatts should I put on each form?"

Grid Operator:

"If you can charge and discharge at the 40 megawatts you mentioned, you will need to put 40 megawatts on each form."

AES:

"So that means this is 80 megawatts of resource? Are you sure this is correct?"

Grid Operator:

"That is how we model it in the system—it is two 40-megawatt resources to us—supply and load."

AES

After many years of insightful work and nearly ten storage interconnections in various markets, our storage team at AES had never thought about the facilities we now owned and operated in this way. This experience was a bit humbling and is told here to encourage other stakeholders to examine how little we have considered energy storage in our ecosystem.

From Power Plants to Grid Resources

When an organization wants to connect a facility like a power plant or a large customer site to the grid, it needs to "interconnect" to the grid. This interconnection is rated at a certain size and is often just referred to as a number of megawatts (MW) of power flow. If an independent power producer builds a 500-MW power plant, a 500-MW interconnection to the grid will be required. The same is true on the customer side of the grid. A large data center, for example, may require a 50-MW interconnection in order to withdraw sufficient power for all its servers. The former is injecting power into the grid and the latter is drawing power from the grid.

In the power plant case, that resource is controlled by instructions from the regional grid operator, and in recent years, our industry has begun actively controlling customer loads as well. As more loads have entered the picture, the industry has started generically referring to all of these end-points that serve the grid as "resources." This language is now commonplace for most of the electricity industry stakeholders working on demand-side programs.

For most facilities, the megawatt of interconnection rating and the megawatt of resource rating are nearly always the same number. A 100-MW power plant can supply 100 MW of power and has a 100-MW interconnection over which to do so—the same for both supply resources and load resources. As storage has been added to the grid, this convention has continued unquestioned. I think this convention of interconnection size driving resource designation is erroneous for storage, which we need to explore.

Inception Becomes Conviction

With the remarkable insight that one of the largest power markets in the world was convinced that our planned 40-MW storage facility was actually an 80-MW resource composed of two 40-MW resources, we challenged ourselves to consider whether the whole industry had gotten it wrong. If this RARF insight were comprehensive, then our previously designated 32-MW project at Laurel Mountain in West Virginia should be 64 MW of resource (even though it was located in another market where there is no RARF form). (See the sidebar, "A Unique Combination.")

An engineer on our team made a simple, compelling thought experiment. He said, "Try to do the job our Laurel Mountain battery is doing with a power plant or a load resource. How much would you need? Your answer is our resource equivalence."

A Unique Combination

Located in West Virginia, the AES Laurel Mountain facility is comprised of 98 megawatts (MW) of wind generation and 64 MW of integrated battery-based energy storage resource. The facility supplies emissions-free renewable energy and clean, flexible, regulation service to the PJM Interconnection. AES Laurel Mountain began commercial operation in 2011 as a fully integrated portion of the Laurel Mountain Wind Farm and is among the first wind generation facilities to supply critical grid stability services to help maintain the reliability of the power grid.

I asked the team to develop the concept, and they came back with a mildly technical answer, but one that is abundantly clear.

Since Laurel Mountain provides flexibility to the grid operator, it has the capability to fully discharge, fully charge, or do anything in between at the grid operator's command. That means it can go from plus-32 MW to minus-32 MW. (See Figure 1.) Since power plants cannot "go negative" in order to respond to the same range of signals from the grid operator, the plant would need to be running at a level well above 32 MW to be able to reduce output by 32 MW for the negative dispatch. The plant also would need to be able to increase output by at least 32 MW of head room to take the positive dispatch. Similarly, a large load-side resource like an industrial site would need to be consuming at a rate of at least 32 MW and be able to increase consumption by another 32 MW. Considered together, that is clearly at least 64 MW of resource in each case.

These trends are driving a focus on a grid of the future that is more flexible and fault-tolerant and able to handle rapid changes in load and supply.

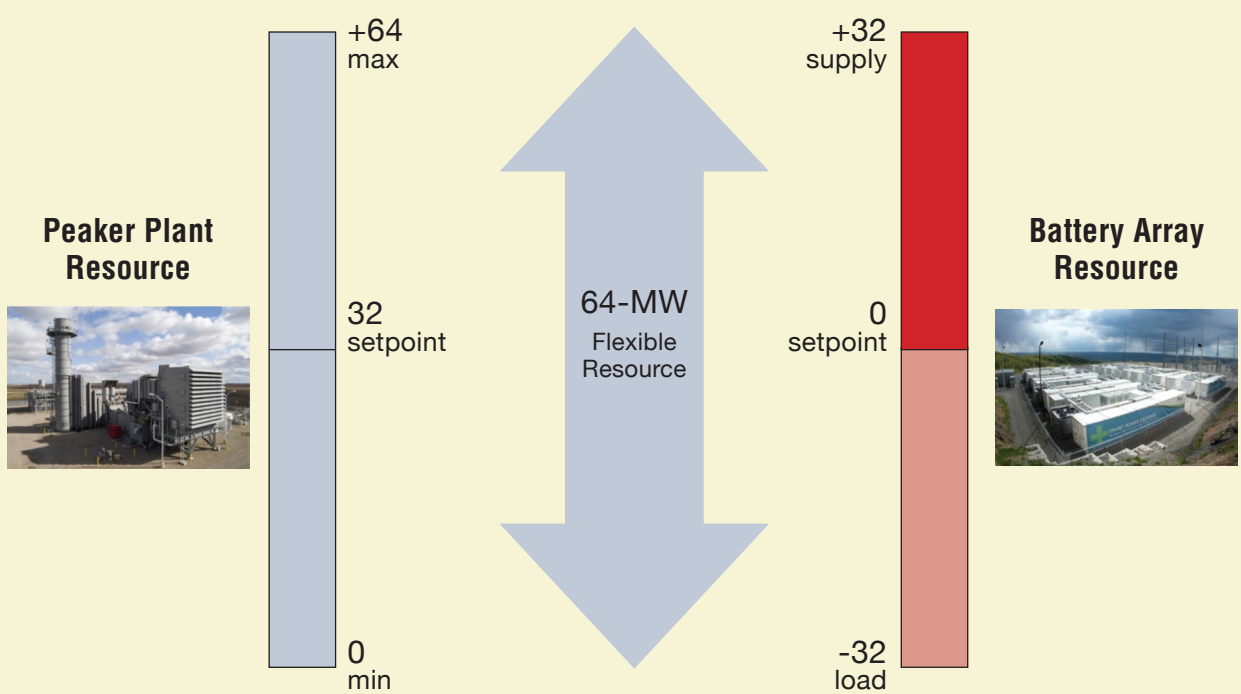
We found that the thought experiment for Laurel Mountain holds broadly for highly controllable advanced storage solutions. Convinced by this insight, we have chosen to move to a new designation for all storage facilities. We now refer to our facilities (and those owned by others) in terms of megawatt of power plant equivalent resource or megawatt of resource in short form. We also maintain the old size with a new designation of megawatt of interconnection. So the Laurel Mountain advanced battery array is a 64-MW resource on a 32-MW interconnection. The same can be said of all similar resources. Based on the growing needs of the industry, this revelation could have a profound impact on future grid resource selections.

Flexible Resource Needs

In the past five years, our industry has seen significant growth in the adoption of variable renewable energy sources like wind and solar. At the same time, we have seen an increasing number of weather-related impacts on the grid and an increased focus on resiliency from a homeland security perspective. These trends are driving a focus on a grid of the future that is more flexible and fault-tolerant and able to handle rapid changes in load and supply. Power plant manufacturers are focused on adding "flex" to their machines, and the demand-side community is highlighting the flexibility of controllable loads like water heaters.

California has launched an entire process to explicitly add the consideration of resource flexibility to their resource adequacy procurement processes. The Energy Information Administration forecasts in its "2013 Annual Energy Outlook" that more than 38,000 MW of combustion turbines will be installed over the next 15 years. Many utilities have said when they

FIGURE 1
TWO 64-MW FLEXIBLE RESOURCES



*For simplicity, minimum load for the power plant is assumed zero, although all conventional power plants have minimum load levels.

plan for and procure peaker plants that many of these plants will be required primarily for flexibility. With this focus on procurement of flexible resources, the evaluated size of energy storage resources becomes very important in the determination of their cost effectiveness.

The utility industry has a clear way of evaluating power resources on a common basis. It uses [dollars of capital investment required to install a facility] divided by [kilowatts (KW) of power of the facility]. This results in $/KW installed. So a 100-MW power plant that costs $90 million to build would be roughly $900/KW.

In the past when storage facilities were compared to power plants, the interconnection megawatt would be used. As discussed, this is inappropriate as it only counts half the power plant equivalent resource of the storage facility and half the flexibility capability available. If a facility like Laurel Mountain costs $32 million to install, and we only count it as 32 MW, the evaluated cost would be $1,000/KW. However, if we use the fair comparison of 64 MW of resource, the facility is only $500/KW.

The Need for Targets

This doubling of the denominator in the procurement calculation will have a profound effect on which resources are chosen in future procurements.

Of particular interest are the procurement targets set out in California for energy storage. Many readers may be aware that the California Public Utilities Commission has defined targets for grid storage in the resource mix that require the three large utilities in the state to procure 1.35 gigawatts of storage resources by 2020. These resources will need to compete with other resources like power plants to meet the state's need for resource adequacy, and the expectation is that the inclusion of storage will help add much needed flexibility to the grid to assist with meeting the state's renewable targets. In the lead-up to the definition of these storage targets, several stakeholders asked me, "If storage is competitive, why does it need targets?"

This story of latent resource value in storage systems that AES had already built years prior indicates that we as an industry can do a better job evaluating how these technologies can serve our grid. Targets that are also held to a competitive process, like those planned in California, are a great way to encourage thorough evaluation of this value. If the procurement process counts the resource appropriately with its full power plant equivalence, storage will have no problem being seen as one of the least costly resources available to meet California's flexible resource needs.

It is surprising how our legacy technologies and processes have created inadvertent barriers for new technologies and solutions. Hopefully, with the nudge of policy and regulatory change, we will be able to fully embrace these amazing technologies and encourage their continued development through more rapid adoption. ◆

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