TECHNOLOGY
INSIGHTS

May 13, 2011

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 11-IEP-1N
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: NGK / TI Comments on CEC Docket Number 11-IEP-1N – "Energy Storage for Renewable Integration" – CEC Committee Workshop held on April 28, 2011

Among the topics addressed at the subject CEC Workshop was the following:

> *". . .what needs to be done to support the implementation of the Assembly Bill 2514 energy storage development, demonstration, and deployment plan and associated activities; . . ." [Item 6, Workshop Notice]*

We, Technology Insights (TI) in collaboration with NGK Insulators LTD, believe our experiences in introducing NGK's sodium-sulfur (NAS) battery to the U.S. market over the past decade will provide important insights to the barriers confronting similar Distributed Energy Storage (DES) technologies. This information is offered in the spirit of facilitating the implementation of AB2514, as well as stimulating changes to the U.S. market structure that will ultimately benefit the emerging energy storage industry. We also offer a few recommendations toward that end.

For context, the sodium-sulfur (NAS) battery is a megawatt-scale DES technology conceived by a utility – Tokyo Electric Power Company (TEPCO) – in the late 1980s for use primarily within metropolitan transmission and distribution (T&D) systems. The NAS system was jointly developed by TEPCO (as the strategic customer) and by NGK (as the supplier) over the past two decades, and is among the more mature of advanced energy storage technologies. By 1996, two 6 MW, 48 MWh NAS systems were operating at substations within Tokyo. By 2002, multiple megawatt-scale pre-commercial demonstrations had been successfully completed, and NAS batteries were commercially available in Japan and were being introduced to global markets. NAS installations cumulatively rated at over 300 MW, 2,000 MWh are now deployed at over 200 locations world-wide. [1]

[1] For additional context, NAS Battery installations are deployed in 1 MW blocks nominally rated at 6 to 7 hours discharge energy, with recent installations typically in the range of 2 to 8 MW. The largest single installation is rated at 34 MW, 245 MWh, and used for wind stabilization in Northern Japan.

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In contrast with rapid deployment in domestic markets and outside the U.S., NAS deployment in the U.S. has been very slow – and expensive, especially in terms of multi-year sales cycles and delayed market introduction. Despite a decade long effort with major U.S. utilities, only 20 MW have been sold, of which NONE are being fully utilized and 6 MW remain stored in a California warehouse after delivery nearly 3 years ago. As a result, efforts to commercialize NAS in the U.S. have been temporarily suspended. We believe the regulatory circumstances that caused this situation would apply to any similar DES technology targeted for use in the T&D grid. Accordingly, we urge the CEC to address the underlying cause(s) of this impasse early in the course of implementing AB2514.

From our perspective, the root cause of stalled deployment is neither NAS technology nor necessarily its cost – we feel that the problem is the rigid U.S. market structure founded on legacy regulations and organizational cultures for conventional generation, transmission and distribution equipment. With regard to cost and value, our experience with U.S. T&D utility hosts (AEP and PG&E) has shown that the value of appropriately located NAS installations to accomplish grid support functions (enhanced reliability, upgrade deferral, etc.,) is 30 to 60% of current installed cost of the system, while projected revenue from market services (e.g., energy arbitrage and ancillary services is a similar amount. The combined value of such grid and market services justifies investment in such DES assets in many locations at or near current prices. However, candidate "T" utility hosts are constrained by FERC prohibition of their participation in energy markets, and no PUC regulatory precedent exists in the U.S. for "D" utility host participation in energy markets. Further, candidate unregulated "Merchant Storage Providers" (MSPs) are deterred by the lack of transparency to high value grid locations, e.g., the location of and constraints on capacity constrained substations. Details of regulatory bottlenecks encountered in NAS deployment have been summarized in our prior submittals to the CPUC, CEC and FERC[2] and are publicly available from those agencies, or upon request.

As previously noted, NONE of the NAS installations deployed in T&D applications in the U.S. are being FULLY utilized. That is, those units are only providing standby reliability functions, or they are only being used 60 to 90 days per year to defer a substation

[2] NGK/TI submittals on NAS deployment in response to CPUC, CEC and FERC requests include the following publicly available information:

1. CPUC Data Request re. Energy Storage Technologies, March 2009
2. CEC IEPR Workshop on Energy Storage to Support RPS Goals, April 2009
3. FERC Request for Comments Regarding. . . Storage Technologies, August 2010

upgrade; and THEY ARE NOT being used to provide market services during the balance of the year. As a result, the lead units in the deployment of NAS batteries in the U.S. market have been prevented from demonstrating their intrinsic commercial value – the market pathway between storage users and the supplier has been blocked by regulatory fiat, or by the discretion of the host utility. Thus, NAS commercialization in the U.S. – and the commercialization of any similar multi-hour DES technology – will remain arrested until such time that enlightened regulations are implemented and precedents have been established.

The implementation of AB2514 has the potential to move grid energy storage from a concept to a practical option. Toward that end, we offer the following recommendations drawn from our efforts to deploy NAS batteries to serve DES applications over the past decade:

1. Pave the way for in-progress projects: Two NAS battery projects (a 4 MW installation near San Jose, and a 2 MW installation near Sacramento) are in-progress at PG&E, both of which will likely to be required to address the issue described above for NAS to be fully utilized. Also, in the April 28th Workshop, the SCE representative stated that their 8 MW ARRA funded lithium ion battery would provide grid benefits, as well as stabilize wind generation. If so, that project will likely have to address the same issue. We recommend that the CEC take steps to ensure that these storage users have regulatory approval and corporate incentives to FULLY utilize their storage assets by providing combined grid and market services. In doing so, the CEC will have paved the way for future projects implemented via AB 2514.

2. Focus on commercially available technologies: AB 2514 states that [underline added for emphasis]:

   > *"For purposes of this chapter, . . . "Energy storage system" means commercially available technology that is capable of absorbing energy, storing it for a period of time, and thereafter dispatching the energy."*

   We interpret the underlined phrase "commercially available technology" to mean those technologies available from industry suppliers under commercial terms and conditions customary in the electric power industry Such terms and conditions include performance warrantees and options for extended service contracts to ensure storage device reliability appropriate for private sector financing. We endorse this provision. In our experience, a thorough program of pre-commercial

field demonstrations is necessary before suppliers can offer such terms. Early implementation of this provision will 1) narrow the field of credible vendors and technologies to a manageable few and 2) improve the likelihood of successful projects. We urge the CEC to promulgate policies supporting this interpretation.

3. Foster cultural change within T&D utilities and regulators: As described above, the dominant issue encountered during NAS deployment – barriers to DES providing combined grid and market services – is rooted in the legacy market structure and corporate cultures of T&D utilities and their regulators. Deployment of DES technologies will require planners and regulators to assess unfamiliar options that involve crossing traditional boundaries between regulated and unregulated entities. A progressive T&D market structure is needed in which DES user entities are incentivized to FULLY utilize assets. Further, the evolution of enlightened regulations should provide for transparent T&D plans for use by "Merchant Storage Providers" (MSPs) to develop high value grid sites, and provide combined grid and market services. We envision a future market structure in which efficient DES user/supplier transactions can proceed, whether the user is a regulated "T" or "D" utility OR an unregulated MSP. Timely CEC leadership in advancing AB2514 policies toward such provisions will be needed.

4. Promote the vision of gigawatt scale DES deployment: We suggest that grid stakeholders be incentivized to deploy DES technologies like NAS at critical substations and customer sites in sufficient number and quantity to demonstrate their integrated benefit within a local grid. Too often, T&D planners are only aware of energy storage in small individual installations serving specific emergency power functions (like conventional UPS systems); and too often, so-called case-by-case demonstrations focus only on a single, small storage unit in isolation. This limited perspective fails to embrace the potential for networked DES, enabled by real-time two-way communications and automated control, i.e., networked storage within a Smart Grid. Demonstrations of dispersed multi-MW units configured in integrated DES networks within metropolitan Smart Grids are needed to confirm the value of properly configured DES as an alternative to remote central energy storage. For example, DES deployed in this manner provides the added benefit of avoided peak demand on T&D assets, as well as improved reliability of service to critical loads, when compared to central storage. Early DES projects, comprised of dispersed multi-MW units on the scale of 50 to 100 MW when integrated, are needed to demonstrate the relevance of DES to

the mission of renewables integration. A precedent for such installations exists. As reported by TEPCO,[3] NAS deployment within their service area has reached about 160 MW, and represents the equivalent of an equal amount of pumped hydro storage capacity.

We urge the CEC to advance policies that will lay the groundwork for the gigawatt-scale deployment of DES. That groundwork should include 1) provisions for enlightened regulations, 2) cultural change within utility planning and regulatory bodies, and 3) aggressive demonstrations of DES within Smart Grids. We caution the CEC not to delay hardware demonstrations until system-wide analytical confirmation has been achieved. Experience has shown that major engineering feats are accomplished by the marriage of empiricism and analysis – not one in isolation of the other. DES advancement will ultimately entail the iterative convergence of field demonstrations with analytical refinements.

Regards,

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[3] The Sodium-Sulfur Battery For Utility-Scale Applications; Cigre 2008, C6-302; K.Tanaka, J.Yoshinaga, N.Kobayashi; Tokyo Electric Power Company, Japan; August 2008.