DOCKETED	
Docket Number:	23-ERDD-08
Project Title:	Request for Information for Long Duration Energy Storage Demonstration Solicitation
TN #:	254527
Document Title:	Black & Veatch Submission for RFI on Long Duration Energy Storage Demonstration Solicitation
Description:	N/A
Filer:	System
Organization:	Black & Veatch Corporation
Submitter Role:	Applicant
Submission Date:	2/16/2024 1:51:53 PM
Docketed Date:	2/16/2024

Comment Received From: Black & Veatch Corporation
Submitted On: 2/16/2024
Docket Number: 23-ERDD-08

Black & Veatch Submission for RFI on Long Duration Energy Storage Demonstration Solicitation, Docket # 23-ERDD-08

Please see the attached pdf file for our RFI submission.

Additional submitted attachment is included below.

Black & Veatch Corporation
4600 South Syracuse Way, Denver, CO 80237

16 February 2024

Subject: **California Energy Commission Request for Information for Long Duration Energy Storage Demonstration Solicitation Docket Number: 23-ERDD-08**

To Whom it may concern:

Black & Veatch Corporation and Cykyl Systems LLC (BV&CS) are pleased to submit this response to the California Energy Commission RFI for Docket Number: 23-ERDD-08: Request for Information for Long Duration Energy Storage Demonstration Solicitation.

Background

The following RFI responses were developed for the California Energy Commission Docket Number 23-ERDD-08, titled: Request for Information for Long Duration Energy Storage Demonstration Solicitation. All responses are based on Amplified Pumped Storage (AMPS) technology by RockRiseES. AMPS is a gravity-based, pumped hydro, long duration energy storage (LDES) technology, developed by Cykyl Systems in collaboration with Black & Veatch.

U.S. mines generate 1.8B tons of waste per year, enough to supply 50,000 MWh of new AMPS energy storage capacity annually. By using mining waste to store energy, mines can offset operational costs with energy savings and revenue generated from selling surplus energy back to the grid and extend site operations for decades as energy storage assets. With low-pressure and high-pressure reservoirs, RockRise's patent-pending hydraulic lifts raise mining wase to efficiently store energy with no deterioration. This technology integrates seamlessly with ongoing mining operations, needing only commercially available equipment.

<u>LDES System Demonstration – questions aimed more for technology developers, but open to all respondents:</u>

1. According to the California legislation that authorized the LDES program, all demonstration projects must have a system capacity of a minimum of 1 MW for at least 8 hours[1]. Given this requirement and the current state of your non-Li LDES, which of the following system sizes could you deliver in the next 18 months to 2 years? Additionally, which system size would help your technology reach the 200-400 MWh system size in the next 3-6 years?

- System size of 8-10 MWh
- System size of 10-20 MWh
- System size of 20-30 MWh

Answer: AMPS by RockRise can accommodate any of the proposed system size options; any option would help enable reaching the specified scale.

2. What would be the range of the estimated project costs in a direct current (DC) configuration for demonstrating each of the three different system sizes listed in question 1 for your non-Li LDES system as a function of the location of deployment? Additionally, what would be the life expectancy of the demonstrated project? Would it be considered pre-commercial or commercial, and have an expected life of 10-20 years or longer? Please explain.

Answer: When commercialized on a large scale AMPS technology is projected to cost \$75/kWh ±100% or \$800/kW ±100% for a 10 hr. / 1 GW system, AC. The AMPS system is not currently planned to produce DC power. The projected cost of smaller scale AMPS installation at the demonstration-scale would be significantly higher / kWh, but is expected to still be lower than comparable size pumped storage plants. Project costs can be significantly impacted by the location and host site characteristics. Notably, longer durations can be achieved at very little incremental cost assuming the same MW capacity.

Installation Size	Generator Size	Storage Duration	Projected Total Cost
10 MWh	1 MW	10 hrs	\$3,000,000 - \$5,850,000
20 MWh	2 MW	10 hrs	\$5,150,000 - \$10,050,000
30 MWh	3 MW	10 hrs	\$7,300,000 - \$14,250,000

As it is similar to pumped storage, AMPS technology is not expected to degrade over time and could be designed for long life. The expected life expectancy of a demonstration installation could be 20 years assuming proper maintenance. Optimistically, AMPS installations may be expected to last 50+ years given what we know about the time tested durability of the materials and technology being used. A demonstration installation would be considered pre-commercial at this point in development. It would be meaningful for other providers to state a projected operational life of their system for a fair comparison of the lifecycle cost of each technology.

3. For the system sizes listed in question 1, what is the maximum amount of match funding that a technology provider and selected end customer can contribute towards one of the proposed future grants - 20%, 30%, 40%, or higher?

Answer: There are several factors that favor requiring the lowest match funding possible for these grants.

First, LDES technologies are generally early in their commercial development, relatively risky, and not fully valued in today's markets. LDES is widely expected to be necessary to balance high penetration renewables in coming decades, but today's market compensation mechanisms do not fully compensate that value today. As such, it can be difficult for investors to justify the economics of a demonstration project against the relatively high risks.

Second, the long-term potential value of a technology generally has little connection to how well funded it is at every point in its development. Greater match percentages raise the likelihood that a temporarily underfunded, but substantially better technology may not make it to market, or that the technologies examined are only sourced from wealthier and more privileged submitters.

Lastly, in many ways it is preferable that the developers of potentially significant new techs push their efforts to the limits of their ability and resources to produce better results sooner. However, having substantial resources available in reserve as would be needed to handle larger match requirements can be difficult. In fact, the match requirement is fundamentally counterproductive to this optimal approach, and only has utility as a safeguard against erroneously directed awards or changes in plans by awardees. There are better mechanisms to ensure each of these, however, which do not produce counterproductive collateral results. These alternatives should be explored as at least an optional alternative to match requirements.

Therefore, we recommend that technology providers and end users advocate for the lowest possible match funding requirement for these grants, while still ensuring that the proposed projects meet the necessary regulatory requirements and achieve the desired GHG reductions.

4. What type of incentives can be leveraged to make a LDES system demonstration more attractive from a financial standpoint? What will be the maximum amount of incentive that a technology provider and selected end user could obtain for the system sizes listed in question 1?

Answer: There are several incentives that can be leveraged to make a LDES system demonstration more attractive from a financial standpoint. Most notable of these is the investment tax credit (ITC) which was recently expanded to stand-alone energy storage systems in the Inflation Reduction Act (2022). On its face, this credit could seemingly be very valuable (up to 50% of eligible cost) for energy storage technologies. However, it should not be assumed that the tax credit is truly available to pre-commercial demonstration technologies. This is because eligibility and benefits can be contingent on meeting specific operational and technical criteria over time. For example, a demonstration technology might fail to generate power, may not meet its intended performance metrics, or it might become uneconomical to continue operating. All are of these are very real possibilities with demonstration technologies, and they could jeopardize the project's eligibility for tax incentives or lead to recapture of credits already claimed.

The tax credit is a very strong incentive for commercially proven technologies. Their ability to leverage the credit creates a competitive advantage over pre-commercial LDES technologies.

Other incentives are typically competitive federal grants with no certainty that they can be obtained.

For these reasons, while there are other incentives, they generally can not be relied on to reduce the costs of demonstration facilities.

5. Considering that California is aggressively planning to procure energy storage and has already approved over 8 GWs of Li-ion systems, when do you anticipate your non-Li system will be able to compete with Li-ion systems in terms of price and performance for a future commercial solicitation if the price range is $350-$450 per kilowatt-hour (kWh) delivered in a DC configuration? Please explain.

Answer: AMPS technology is expected to be competitive with Li-ion systems after it has completed technology development and reaches commercial maturity within 2-4 years. AMPS is expected to have substantial economies of scale related to overall size and duration of storage. AMPS installations ranging from 100 MWh to 10,000 MWh and above are projected to cost half as much as equivalent Li-ion systems even with an uncertainty of ±100%. Additionally, AMPS systems are expected to have 50+

year lifetimes, while Li-ion systems are likely to last less than half as long, which could increase their actual cost by 200 or 300% in comparison to AMPS. DC generation is not applicable to AMPS technology.

6. What demonstration system size would be needed to persuade you to at least partially automate the majority of your LDES system manufacturing capability to deliver a future order in the range of 200-400 MWh in a 12-24-month delivery window?

Answer: Automation is already within our plans for all system sizes.

a. What is the largest system on a kWh basis you have fielded and have been operating to date?

Answer: To date we have deployed a small-scale prototype which was intended to test key subsystems. This prototype did not generate power and was not intended to be continuously operating.

b. What is the largest system on a kWh basis that you have a firm order to deliver in the next 12-18 months?

Answer: We do not have firm orders for systems yet.

<u>Demonstration Sites – questions targeting site hosts and adopters, but open to all respondents:</u>

7. How can funded LDES projects better prioritize benefits for under-resourced (low-income and disadvantaged) communities and Tribes? Should benefits to under-resourced communities and Tribes be strict requirements in the solicitation or incentivized through solicitation scoring criteria bonus points? Should match fund requirements be reduced or potentially eliminated? What are the potential barriers to the funding and development of successful LDES projects in under-resourced and tribal communities? Please explain. Specific examples are welcomed.

Answer: These benefits should be considered, but should not be a strict requirement.

Funded LDES projects can better prioritize benefits for under-resourced communities and Tribes by incorporating community engagement and input into the project development process. This can be done by involving community leaders and representatives in project planning and decision-making to ensure that their needs and concerns are addressed. Regardless of community consultation, LDES technologies are different, and some technologies will inherently provide more benefits (e.g., job creation). Incentives such as scoring criteria bonus points can be offered to encourage technology providers and end users to prioritize benefits to under-resourced communities and Tribes.

However, we do not believe that providing such benefits to these groups should be a strict requirement of a demonstration project. This is because not all LDES technologies would be appropriately sited in such communities, and requiring this may conflict with successful demonstration of the technology. Placing constraints on demonstration technologies will reduce siting options and slow their progress.

Match fund requirements can be reduced or potentially eliminated to make it easier for under-resourced communities and Tribes to access funding for LDES projects. This can help remove financial barriers and ensure that these communities have the same opportunities as others to benefit from LDES projects.

There are several potential barriers to the funding and development of successful LDES projects in under-resourced and tribal communities. These include limited financial resources, lack of technical expertise, and regulatory barriers. Additionally, there may be cultural and social barriers that need to be addressed. For example, in some Tribal communities, there may be concerns about the impact of the project on their land and resources, and these concerns need to be addressed through community engagement and collaboration. Characteristics such as this may impose additional costs that would inhibit technology development & deployment.

One specific example of a successful LDES project that prioritized benefits for under-resourced communities is the Kaua'i Island Utility Cooperative (KIUC) Anahola Solar + Energy Storage Project in Hawaii. This project was developed in collaboration with the local community and provides clean energy to low-income households. The project also helps to reduce the reliance on fossil fuels and supports the local economy by creating jobs.

8. Should demonstration projects be required to be located in Tier 2 or 3 High Fire-Threat District areas (as defined by the CPUC2)? Or should these siting locations be incentivized through solicitation scoring criteria bonus points? Please explain.

Answer: No, this should not be a requirement. Regulations surrounding Tier 2 and 3 HFTD areas are focused on increasing inspection frequency and decreasing fire hazards of electrical and communication infrastructure in affected areas. It could be a good idea to incentivize commercially-ready energy storage tech to be located in Tier 2 or 3 HFTD areas, since surrounding communities would be able to utilize stored energy in the event of a utility disruption caused by a wildfire or risk of wildfire. However, it makes far less sense for demonstration technologies to be located in these HFTD areas because it is more likely that they will require a more controlled environment / lower risk demonstration area. Requiring demonstration projects to be located in these areas would be a deterrent to technology development, and a potential hazard to communities that would be relying on a temporary energy storage installation.

9. Do demonstration projects provide more value in certain service territories (i.e. investor-owned utilities, publicly-owned utilities, community choice aggregators, rural electric cooperatives, and electric service providers)? If so, why?

Answer: For a demonstration project, it's not likely that the project would provide more value in these areas. However, for a full-scale, commercialized technology, yes. Generally, the location of an energy storage system, particularly the service territory, can have a strong impact on its economic value. This can be due to several factors including:

- The rate structure of the utility for behind-the-meter projects. There are major differences in California utility rate structures which can impact economic viability
- The locational market prices on the grid, which might be affected by over-generation of renewables or high local demand
- Transmission and distribution constraints and upgrade deferments

In addition to economic value, some technologies may provide additional indirect value such as job creation, community benefits, water storage, etc. These also vary by location.

10. Is there any preference for behind-the-meter or front-of-the-meter demonstrations for the system size ranges listed in question 1? If so, why?

Answer: No. Our specific LDES technology, AMPS, can be easily configured to provide significant value in either scenario due to the wide range of operational configurations our power generation system is able to accommodate. This flexibility allows the technology to be used in both behind-the-meter and front-of-the-meter applications, providing a range of benefits to end users and utilities alike.

In a behind-the-meter application, AMPS can be configured to provide energy resiliency and cost savings to commercial or industrial customers by offsetting their energy demand and reducing their reliance on the grid. AMPS can also be configured to provide ancillary services such as frequency regulation and voltage support, which can help to stabilize the grid and improve its reliability.

In a front-of-the-meter application, AMPS can be configured to provide grid services such as frequency regulation, voltage support, and peak shaving. This can help to improve the stability and reliability of the grid, as well as to integrate more renewable energy sources into the grid.

Overall, the flexibility of our AMPS technology allows it to be easily configured to provide significant value in either scenario, depending on the specific needs and goals of the end user and the regulatory environment and market conditions in the area where the project is located.

a. For a behind-the-meter installation, does your LDES technology have any advantages to the utility in regard to the utility interconnection agreement?

Answer: Yes, our LDES technology, AMPS, has advantages to the utility in regard to the utility interconnection agreement for a behind-the-meter installation. This is due to the great flexibility of its duration of storage without degradation over time, which allows for a range of operational configurations and benefits to the utility. Specifically, this means the operating characteristics of any given site can be designed to fit within utility interconnection constraints.

The amount of energy that can be stored in AMPS, as well as the length of time it can be discharged, are both greater than other energy storage technologies, such as batteries. This makes AMPS an attractive option for utilities looking to provide LDES to support their grid operations.

b. If you are considering a front-of-the-meter configuration, have you applied for a CAISO reservation? If so, when would that reservation become effective?

Answer: A CAISO reservation has not yet been pursued.

11. Are you considering a project for which the interconnection agreement is already approved?

Answer: No.

<u>California Environmental Quality Act (CEQA):</u>

12. What would be the typical footprint range needed to deploy certain LDES systems for the three system size ranges listed in question 1?

Answer: AMPS is intended to be deployed withing already disturbed/degraded lands and is not expected to result in significant additional land disturbance.

That said, within these lands the specific footprint will depend on project-specific criteria, the following provides general information for the system sizes specified in question 1.

System Size (MWh)	Gen. Capacity (MW)	Storage Duration (hr.)	System Footprint (m^2)
10	1	10	20k – 30k
20	2	10	40k – 50k
30	3	10	60k – 70k

13. When a GFO is posted, proposals are generally due to the CEC within 8 to 12 weeks, and the CEQA process is generally required for the CEC to award grant funding to a project. The CEC has learned from the initial LDES projects that the LDES systems have a greater footprint than systems exempted from CEQA. Therefore, an environmental impact report or negative declaration is normally required for the potential projects, as are other actions required by CEQA. For the system size ranges listed in question 1, how long would it take to complete the CEQA process (and the National Environmental Policy Act (NEPA) if applicable) for your LDES system, and approximately how much would these processes cost?

Answer: The duration and cost of the CEQA process for proposed LDES projects can be further complicated by various factors, including the location, land use, size, potential impacts, and other regulatory requirements. Additionally, the cost and schedule for the CEQA process may be affected by the characteristics of the proposed technology.

For instance, the AMPS technology by RockRiseES is designed for deployment on disturbed lands, which may require amending an existing CEQA process to account for the unique characteristics of the site and the technology. These aspects contribute to the uncertainty in the cost & duration of the CEQA process until a specific site can be evaluated.

14. Is it reasonable to require that all GFO applicants complete discretionary permitting and CEQA through their local public agency before submitting a proposal for a project in the sizes defined in question 1? Please explain.

Answer: No. This largely depends on a wide range of factors, primarily location. While it is important to ensure that projects are environmentally sustainable and socially responsible, requiring GFO applicants to complete discretionary permitting and CEQA before submitting a proposal would create unnecessary risks associated with upfront cost and schedule barriers to applicants. The length of time and risks associated with permitting in California can be a major deterrent to siting emerging technologies in the state.

Instead, it is more reasonable to allow applicants to submit their proposals without this requirement; instead, addressing the environmental and regulatory requirements concurrently with execution of the GFO project tasks. If possible, CEC funding of the CEQA process could be very helpful in reducing permitting risks.

15. If the timeline and costs are not feasible, what preliminary CEQA studies or information would you recommend be completed before proposals are submitted to the CEC? Additionally, how long would it take to complete the preliminary CEQA studies or information for your proposed LDES technology for the system size ranges listed in question 1?

Answer: The specific preliminary CEQA studies or information that should be conducted would depend on the specifics of the project and the regulatory requirements of the local and state government involved. Typical preliminary studies would include species surveys, wetland delineations, hydrological and geological studies, and Phase I/II Environmental Site Assessments. Preliminary discussion can also begin with the regulatory agencies to better understand which permits would be required. Studies can take anywhere from a few weeks to a few months to complete the study and the report. This varies depending on the location, time of year, and size of the project site.

16. What environmental process would be required if your project were not subject to CEQA? Additionally, how long would it take to complete the environmental process for your proposed LDES technology for the system size ranges listed in question 1?

Answer: If our project were not subject to CEQA, other environmental processes may still be required depending on the specific location and regulatory requirements of the project. For example, a project may still be subject to review under the National Environmental Policy Act (NEPA) or other federal, state, or local environmental regulations. Once an initial review of the permitting requirements has been conducted, an estimated timeline for each permit can be estimated. However, generally, the permits would take anywhere from 1-18 months, depending on the regulatory agency.

<u>Greenhouse Gas (GHG) Reductions:</u>

17. As stated in the "Background" section of this RFI, the funds are provided by GGRF, and therefore, CEC is required to track GHG reductions provided by the installed systems.

a. What combination of LDES and renewables is needed to maximize the GHG reductions from a project?

Answer: The specific combination of LDES and renewables needed to maximize GHG reductions from a project will depend on a variety of factors, including the specific location and regulatory requirements of the project, the availability of renewable energy resources, and the demand for energy in the area. Renewable energy sources, such as solar and wind, can help to reduce GHG emissions by providing clean, sustainable energy to the grid. However, the variability of these energy sources can pose challenges to grid stability and reliability. Our LDES technology can help to address these challenges by enabling demand response, energy storage, and other grid management strategies that help to reduce the need for fossil fuel-powered peaker plants. This highlights a major strength of our (RockRise's) energy storage approach: AMPS is fully flexible in terms of capacity, storage duration, grid health support, and power on demand. Typically, each form (and siting) of renewable generation has individual characteristics that would be optimized for GHG reduction in different ways. We can tailor our LDES however needed to best support a renewable generation installation for maximum GHG reduction.

b. Is there a difference in what your technology can provide in GHG reductions if installed in a behind-the-meter or front-of-the-meter configuration?

Answer: Not likely. Any difference in the GHG reductions achieved by our LDES technology installed in a behind-the-meter or front-of-the-meter configuration could be as much due to how GHG reductions are accounted for rather than an actual cut in emissions.

In both behind-the-meter and front-of-the-meter configurations, the LDES system can help to reduce GHG emissions by enabling demand response, energy storage, and other grid management strategies. The specific GHG reductions achieved may vary depending on the specifics of the project and the regulatory requirements of the local and state governments involved.

Others

18. What **lessons have you learned from the LDES projects** you have demonstrated, deployed, or operated to date? What major technical, economic, or policy barriers have affected the demonstration, deployment, or operation of LDES systems in the last two to four years? What are some potential solutions to these barriers? How can future funding from this GFO help solve these barriers?

Answer: There is a mismatch between the future need for LDES and current grid needs and market economics. The need for LDES technologies has largely been established by hypothetical modelling of future grid conditions. For example, as early as 2017, Black & Veatch identified the need for as much as 20,000,000 MWh of storage—about a month's worth of electricity consumption.[1] While the actual number is likely lower, it is still relatively large but relatively far in the future. Many things may change which could dramatically impact the need for this amount of storage and its operating characteristics (e.g., storage duration).

Additionally, technical and economic hurdles significantly impede LDES deployment. High initial costs and scalability concerns limit LDES adoption, despite their potential for grid stabilization and renewable energy integration. In California, the evolving energy market and regulatory landscape pose additional challenges, with current mechanisms insufficient to fully leverage LDES's benefits. This is further complicated by California's high renewable energy targets, which amplify the need for effective storage solutions yet expose the gap in current market structures that fail to adequately compensate for the long-term value LDES offers.

The lack of current market support and high uncertainty about the future reinforces the need for targeted R&D investment such as this GFO. The GFO should specifically prioritize technologies with high levels of flexibility and adaptability that can be successful under a variety of future market conditions. For example, technologies with very low incremental storage costs ($/kWh) can lengthen their storage duration over time as renewable penetration increases.

19. Are there any additional comments or input you want the CEC to consider as they develop this future GFO?

Answer: No additional comments

[1] "Disruptive Technologies and 100 Percent Renewable Energy" https://www.bv.com/perspectives/disruptive-technologies-and-100-percent-renewable-energy/