STATEMENT OF QUALIFICATIONS

Energy Storage

Transforming Our Energy Future



Delivering a better world

Overview

AECOM provides the full complement of services to develop energy storage projects across the globe.

Clients benefit from our broad range of project management services and technical resources, providing them with a single source to thoroughly plan, develop and execute environmental reviews, permitting, engineering/design, procurement, construction and commissioning.

The importance of energy storage can be seen in the wide variety of technologies coming to market.

As the only global planning, engineering and construction management firms also accredited by the National Association of Energy Service Companies (NAESCO), AECOM is vendor and technology neutral. We carefully evaluate both proven and new technologies and make decisions based on what is best for our clients.

Our energy storage project experience includes:

- Battery energy storage systems (BESS)
- Compressed air energy storage (CAES)
- Pumped hydro storage
- Thermal energy storage
- Battery backup systems

Whether paired with traditional or renewable power generation, energy storage is changing the way utilities, project developers and industrial/commercial clients are doing business and their strategic plans for the future.

When working with clients, we use a holistic energy strategy to evaluate storage and generation options, as well as efficiency and conservation methods, to deliver the best overall solution. A close and collaborative working relationship with our clients allows us to deliver creative, sustainable, costeffective and value-added solutions that enhance system infrastructure, improve efficiencies and increase savings.

Benefits of Energy Storage

Energy storage provides greater flexibility for both utility scale and behind the meter applications.



Environmental

Improves effectiveness and use of cleaner and renewable power generation assets

Economical

Maximizes time-of-use rates; ability to participate in demand response markets without impact to on-site energy use or operations





Provides backup and emergency power that contributes to facility resilience and grid stability

Why Choose AECOM

Global Experience, Local Expertise

As a global leader within the energy industry, our fully integrated firm can provide services and solutions to help integrate energy storage solutions. AECOM has extensive experience delivering energy storage projects from concept through to planning and delivery. We provide our clients with integrated solutions, supported by strong technical capabilities.

With 47,000 employees around the world, including nearly 40,000 in North America, AECOM supports such clients as the Long Island Power Authority, Public Service Electric & Gas Company, Noble Wind Farms, Pattern Energy, Hydro-Québec, New York Power Authority, Los Angeles Department of Water and Power, BC Hydro, National Grid, Florida Power and Light (NextEra), SaskPower, Southern Power Company, U.S. Department of Energy, U.S. Army Corps of Engineers, all branches of the U.S. military, and many other similar agencies. firms and municipalities.

Our integrated services framework achieves speed-to-market by bringing together a unique combination of engineers, planners, scientists, project managers, and support staff.

We provide clients with energy analysis and planning, siting and due diligence, environmental permitting and compliance, public outreach, conceptual design, detailed design, engineering, procurement, project management, construction management, and asset management.

In-house planning and environmental teams, engineers, scientists, geographic information system (GIS) and computer-aided design (CAD) staff, planners, regulatory specialists, publications specialists, and community relations staff provide superior technical skills and detailed knowledge of the current regulatory environment.

States/Provinces with

AECOM has supported clean energy projects in almost every U.S. state and Canadian province and territory, including more than 300 projects since 2015.



Our Customized Approach

Understanding each client's unique conditions and project requirements is central to identifying the most appropriate approach for project delivery.

Whether it is overcoming a financing hurdle, guaranteeing cost, reducing risk or finding efficiencies, there are many reasons to look to alternative delivery methods.

Each approach has its own advantages and drawbacks, so we explore all the options to find the methods that best fit an owner's objectives, timelines and constraints.

When it comes to alternative delivery, no one has more experience around the world in more markets than AECOM. From public-private partnerships (P3) and design-build (D-B), to integrated project delivery and construction management-at-risk, AECOM can help find the most suitable approach for your needs.

A customized approach to project delivery, with comprehensive support from idea to operation Idea Generation DENTIF Engineering **Business Case** Procurement Construction Studies and ASSESS Assessments, 📿 @ Compliance, Monitoring **Critical Issues OPERATE** EXECUTE Alternatives Startup Operation & Maintenance Evaluation SELECT DEVELOP Commissioning Compliance, \odot Monitorina Select Best Alternative Due Diligence Approvals. Permitting



Our staff was impressed with the quality of the work and how AECOM has gone beyond what is expected. AECOM performed at a very high level of professionalism, and I'm very impressed with their troubleshooting, communications, organization and planning of all aspects of the project."

U.S. Navy's Space and Navy Warfare Systems Command Systems Center Pacific (NAVWAR), Performance Evaluation

Comprehensive **Project Delivery**

Using integrated project management and technical resources, AECOM plans, develops, and executes environmental review and permitting, engineering design, procurement, construction, and commissioning for energy projects around the world.

ASSESSMENTS AND **FRONT-END STUDIES**

Site selection, siting studies Conceptual design, system sizing Grid interconnections Risk and critical issues analysis Feasibility studies Alternatives evaluations Social impact assessments Financial models Economic benefit assessments

Efficiency improvements

Energy performance

modeling

Project/resource planning Life cycle analysis Risk and hazard assessments Baseline environmental surveys Resource studies and assessments Environmental compliance Public/stakeholder outreach Equipment selection, sizing and specifications Preliminary design

Utility requirements

2

PLANNING AND PERMITTING

PROCUREMENT DETAILED ENGINEERING Civil, electrical, environmental, Commercial terms geotechnical and structural and conditions engineering Construction/as-built drawings Instrumentation, controls, electrical collection and Supervisory Control and Data Acquisition (SCADA) Pre-bid meetings Substation/grid connection 3

5

4

6

Testing procedures Startup planning

On-site inspection



MANAGEMENT AND OPERATIONS

Troubleshooting, optimization, consultation

Site management Safety, health and environmental management

Project reporting and stakeholder management

Contract management Compliance/monitoring

Planning,

permitting

Bid package preparation Contractor pre-qualification Bid solicitation and analysis Purchasing and expediting On-site and source inspections

CONSTRUCTION

Value engineering Constructability review Technical reliability and viability review Construction management D-B services Inspection Commissioning Compliance/monitoring Worker awareness training

COMMISSIONING

O&M support



Recognized Technical and Delivery Excellence

With experience that spans more than 90 years and 150 countries, AECOM has conceived, planned and built energy projects of every type and size.

A single source for multidisciplinary engineering, environmental and management services, AECOM's combination of global experience and technical capabilities allows us to deliver strategic solutions that enhance long-term sustainability and resiliency.

From market analysis, to siting and permitting, through final project development and execution, we develop, design and construct power projects that enhance electrical infrastructure, reduce energy consumption and produce onsite power using traditional and renewable energy sources.

The Engineering News-Record (ENR) – the industry's preeminent trade publication – continues to recognize our capabilities, ranking AECOM #2 in its annual list of the Top 500 Design Firms by revenue (2018), with top rankings across most technical and specialty categories.



A Different Kind of Energy Services Company

AECOM's ability to deliver customized energy services is unmatched. We are the only global planning, engineering and construction management firm accredited by the National Association of Energy Service Companies (NAESCO).

With superior technical and management skills, our engineers, scientists, planners and construction specialists provide clients customized solutions based on:

- TECHNOLOGY NEUTRALITY:

As an unbiased technology integrator, we do not manufacture equipment; instead, using equipment that best-fits our clients needs.

 INNOVATION: Our technical practice network connects subject matter experts from around the world for innovative solutions to today's most challenging issues.

- PROVEN TOOLS AND PROCESSES:

In-house and third-party tools for planning, equipment sizing, design and project management, including safety and quality, deliver efficient and cost-effective project implementation and management.

 DEEP INDUSTRY KNOWLEDGE: Engineers, scientists and technologists are selected for projects based on their in-depth knowledge and expertise in a particular sector and geography to provide excellent service.



Experience and Resources in Energy Storage

AECOM is recognized as an industry leader within the energy industry and continues to expand its offerings to clients all over the world. More recently, AECOM has developed significant experience within the energy storage markets ranging from market analysis (international and domestic), siting and permitting, and project execution. A summary of energy storage initiatives and projects include:

- Compressed Air Energy Storage (CAES)
 - Balance of plant system design, integration of turbomachinery into overall plant design
 - Adiabatic-CAES initiative
- Multiple pumped storage projects serving as member of developer team
- Rocky Point Pumped Storage Project
- Ludington Pumped Storage Project
- Sample of battery storage projects:
- 6 MW/1.5MWh US Government
- 6 MW/1.6MWh Australian Mining Company
- 1 MW/1MWh AusNet Services
- 500 kW/2MWh Goleta, CA
- Energy Storage Study prepared for Australian Renewable Energy Agency (ARENA)

Siting and permitting activities for multiple energy storage projects

Pioneering

Pioneering the integration of innovative energy storage technologies within the utility sector fits within the mission and company experience at AECOM. Legacy AECOM was part of a joint venture to design and engineer the original McIntosh compressed air energy storage (CAES) facility located in McIntosh, Alabama. AECOM has a long history in working with Southern Company including several of the operating entities such as Alabama Electric Cooperative who owns the CAES facility.

During the time of commissioning, the McIntosh CAES facility had a maximum power output rating of 110 MW and utilizes a 19,000,000 cubic foot cavern as the air storage reservoir. Air is stored at a maximum capacity of approximately 1,050 psig and is used to fire natural gas for electricity generation. This project was recognized for several awards and technology achievements including POWER Magazines 1992 Power Plant Award.

AECOM is currently involved in several energy storage initiatives including assessment of Pumped-Hydro Storage projects in California as well as advanced-CAES technologies. AECOM's project experience and design expertise are critical to leveraging new technologies within the power industry.

Engineering, Procurement, and **Construction (EPC) Services**

AECOM has been serving our clients for decades as a leading provider of EPC services in the power, water/wastewater, and oil and gas industries. Across all components of the project cycle-pre-project planning (i.e., FEED) studies, design, build, finance, and operate-we are uniquely positioned to deliver a differentiated service, working globally and delivering locally. As a trusted partner, we draw together teams of engineers, planners, architects, landscape architects, project and program managers, environmental specialists, economists, scientists, cost and schedule specialists, consultants, procurement specialists, and construction specialists-all dedicated to finding the most innovative and appropriate solutions for clients. Whether we serve clients at one phase of the project lifecycle or throughout it, our role is to apply creative vision, technical expertise, interdisciplinary insight, and local experience to address complex challenges in new and better ways.

Engineering

AECOM's engineering services range from master planning, project/program management, subject matter expertise (SME) consulting, front end engineering design (FEED) through detailed design of issued for construction (IFC) packages. AECOM's toolkit for engineering services leverages the latest technologies and engineering analytical capabilities including:

- CFX computational fluid dynamics (CFD) engineering
- Hysys/ASPEN process simulations
- Plant 3D design platforms
- Laser Scan "as-builts" of existing facilities

globe



Delivery and consumption of energy is changing across the

Technology, innovation, regulatory and policy changes, and renewable energy assets continue to transform current energy business models. Energy storage technologies can have immense impact by stabilizing the electricity grid and providing a myriad of services valued by

Consistent with our lean execution approach, AECOM understands the importance of our services being tailored for our clients. Through side-by-side planning and collaborating with our clients, we strive to streamline every project's work products and adapt our framework to seamlessly incorporate client standards, specifications and preferences, avoiding inefficient "one size fits all" approaches.

AECOM is committed to delivering the highest quality product on all its assignments. We are an ISO 9001:2000 certified firm and implement our Quality Management System (QMS) on all projects. The QMS contains detailed documentation on quality procedures in addition to instructions and forms that every project team must use while performing QA/QC reviews.

AECOM has instilled in our staff a philosophy of quality as an ongoing work performance process rather than an isolated activity that occurs only at predetermined intervals. This process includes the following:

- Project Execution Plan (PXP) AECOM prepares a Project Execution Plan customized with information specific to the project and client to align the staff with the project goals and requirements.
- Multi-Step Quality Process AECOM employs a multi-step QA/QC process including discipline detail checks, intradiscipline reviews and independent technical review (ITR) prior to submission to verify the quality and integrity being delivered to our clients.

Procurement

Representative services include:

- Global sourcing
- Purchasing and expediting
- Integrated supply chain management and logistics optimization
- Subcontracting
- Materials management
- Procurement auditing
- Supplier performance evaluations

AECOM offers the full range of in-house procurement services, including supplier/subcontractor pre-qualification; prime agreement review and flow-downs to suppliers and subcontractors; issuance of Request for Quotations; commercial and technical bid reviews and bid tab preparation; purchase order and subcontract preparation and issuance; submittal and invoice tracking; supplier expediting, and vendor surveillance. Our procurement professionals have the work process framework to efficiently serve clients both in the private sector as well as federal services complying with FAR procedures.

Pull Planning

AECOM's success in project delivery results from our focus on aligning the project activities with our client's goals. This alignment happens through extensive pre-project planning activities that begin each of our projects. The primary preplanning activity consists of a "pull planning" session with AECOM and client participation. Through this session, the team develops the overall roadmap for the project, illustrating how the key activities and milestones will fit together to meet the project objectives. The roadmap evolves into a project work plan and schedule, providing a clear vision of the path to project success.

Siting and Permitting Capabilities

AECOM has extensive experience in working with our clients to integrate new technologies and assess impacts to current operations and corporate profitability. AECOM has worked with several energy storage technology suppliers and end-users with design and permitting of energy storage assets. AECOM has worked with a myriad of energy storage technologies ranging from the mature technologies such as pumped hydro and compressed air energy storage to emerging technologies such as grid connected batteries and underwater compressed air energy storage.

AECOM provided permitting services for the world's first underwater compressed air energy storage system located near Toronto Island, Ontario, Canada,

AECOM also provide project design and permitting services for a grid connected Li-ion battery energy storage project in southern California. Considered the first project of its kind in Santa Barbara County California, AECOM is responsible for gathering information to address key issues based on project's urban location as well as impacts to biological and cultural resources. A comprehensive environmental document was prepared to support the application process and address potential safety-related issues related to this energy storage technology.

Project Management

AECOM employs a project management methodology that is highly successful and embodies certain organizational principles, repeatedly used as keystones to achieve a fully integrated effort that meets standards of quality, adheres to cost estimates and schedules, and attains client acceptance. These principles include:

- Establishing clear lines of communication, responsibility, and authority
- Using uniform means of collecting and disseminating information
- Establishing and maintaining realistic baselines, cost estimates, and schedules-against which performance can be measured
- Promoting the use of standardized and disciplined work practices for all project participants and verifying compliance with these practices
- Assigning personnel with proven leadership and experience whose first priority is to the project
- Satisfying the technical, cost, and schedule requirements of the project

Construction and Construction Management

AECOM's construction services experts provide clients with an extensive range of pre-construction and constructionrelated services and solutions for projects of varying scope, budget, schedule, and complexity. As a project progressesor increases in complexity-we customize our services to

fit each client's unique needs and requirements. Our suite of services covers every aspect of a client's project, from design to completion.

Representative Services:

- Constructability reviews
- Value engineering
- Cost estimating - Scheduling
- Sustainability strategizing and implementation
- Procurement
- Document control
 - Bid evaluation
- Field supervision
 - Safety programs
- QA/QC
- Cost control
- Logistics panning
- Field engineering
- Estimating
- Startup and commissioning

- Bid package preparation
- Closeout and warranty procedures
- Building commissioning
- Materials and equipment receiving and reporting

Representative Projects

AECOM truly looked out for the client's best interest, which in my experience is quite rare. The engineering staff was skilled, professional, and completed assigned tasks in a very timely manner."

Matthew Zents Senior Project Manager Southern California Edison

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AECOM served as owner's engineer for installation and commissioning of two hybrid storage systems.

System Hybrid Projects

Cucamonga and Norwalk, California

SCE.

Installed in 2017 at the Grapeland and Center Peaker Plants, each storage system has a capacity of 10 MW. AECOM successfully managed the 5-month installation, delivering both on time and on budget in late 2016. Both projects met all CAISO and California Public Utilities Commission (CPUC) requirements, deadlines, and acceptance criteria.

What sets this project apart is the synergy of combining the battery's ability to immediately respond to the grid's needs with the flexibility of a quick-start, fast-ramping gas turbine (50 MW).

The new system provides value in the existing peaker plants by making the hybrid EGT instantaneously available 24/7, providing grid frequency control and spinning reserves even when the gas turbine is off line.

If greater loads are required, the system's battery will provide power long enough for the gas turbine to start and reach a specific power output, eliminating the need for fuel and water consumption in standby mode.

This configuration allows SCE to reduce operating cost and maintain flexibility in balancing demand and variable production from renewable energy resources.

Gas Turbine and Battery Energy Storage

AECOM served as the owner's representative and provided on-site construction and project management along with commissioning and operations support of hybrid storage systems at two peaker plants for

Energy Savings Performance Contract with Battery Energy Storage System

Colorado Springs, Colorado

AECOM is implementing a comprehensive energy savings performance contract (ESPC) at Fort Carson, a major U.S. Army training base that had already implemented four previous programs. With much of the 'easy' efficiency measures already implemented in the previous ESPCs, finding additional energy savings required careful engineering by AECOM. To do so, we used AECOM's Sustainable Systems Integration Model (SSIM) to develop a comprehensive master plan. This plan included the addition of an 8.5 megawatt hour (MWh) BESS with a discharge rate of 4.2 MW.

This BESS includes a smart energy management control systems (EMCS) that manages electrical demand charges. Savings will be achieved by charging the BESS during off-peak periods for discharge during the installation's peak demand periods.

The BESS can eventually be connected to the installation's solar assets to provide additional demand response, time-of-use shifting, solar-firming, frequency and voltage support and microgrid support.

In addition to impressive cost savings, the BESS provides Fort Carson a new asset to bolster resiliency, with the ability to store more than 8 MWh of energy for emergency use.

The BESS and other energy efficiency improvements, including upgrades to the EMCS, lighting and heating, ventilation and air conditioning (HVAC) systems throughout the installation, are being delivered at no cost to the installation through the ESPC. The improvements are paid for using the excess funds realized by the energy savings measures designed and implemented by AECOM.

This arrangement allows for major improvements to be quickly implemented, with costs covered by a third party. For this ESPC, the improvements will save Fort Carson more than \$530,000 a year.



AECOM is implemented the first battery energy storage system deployed at a federal facility through an energy savings performance contract.



Sentinel Battery Backup

Orangeburg, New York; Somerset, New Jersey

AECOM was the construction manager responsible for both the high voltage and low voltage installations for battery backup systems used for as uninterrupted power supply.

Our Orangeburg scope included four new substations with five, 3.25 MW generators and 13.2 MW of battery backup systems. Our Somerset scope included five new substations with six, 2.5 MW generators and 13.2 MW of battery back-up systems. The battery monitoring systems reported back to the battery analysis software (BAS).

All battery facilities were fitted with dual-demand ventilation based on hydrogen levels within the room, containment dikes, eyewash stations and fiberglass reinforced conduit or diesel locomotive cable.

Design and Permitting for Battery Energy Storage System

Santa Barbara, California

AECOM supported a confidential energy company's efforts to install two modular battery units with an approximate combined capacity of 500 kilowatt (kW) on the site of an existing generating station. The project provides for increased electricity capacity and supports the stability of the local grid. Electricity dispatched from the BESS will supplement the existing peaking capacity available to the CAISO system.

Project components include two modular lithium ion battery units, with power conversion systems, transformers, and other auxiliary electrical equipment connecting the battery storage system to the existing power distribution system.

AECOM was responsible for both project design and permitting. The agency application package included project design details and technical studies to address key issues based on the project's location in an urbanized area (public safety, noise, aesthetics, and existing hazardous conditions), as well as biological resources, cultural resources and other topics.

We prepared a comprehensive environmental document to support the application process, including a detailed discussion of potential safety issues and measures based on current industry practices and evolving design standards.

AECOM's permitting support helped deliver a project that received timely review and approval, fostered community understanding of potential risks and public safety measures, and created minimal noise and aesthetic disruption to the community.



Advanced Compressed Air Energy Storage

Goderich, Ontario, Canada

AECOM is partnered with Hydrostor Inc. to assist with engineering services for a utility-scale A-CAES facility. This first-of-its-kind, adiabatic energy storage facility has a power rating of 2 MW and has an expected discharge duration of approximately 5 hours, which provides approximately 10 MWh to the local grid.

This project utilizes an existing salt cavern to store the compressed air and takes advantage of a fuel-free adiabatic process to provide additional reserves/peaking power along with other ancillary services.

AECOM's support includes a range of engineering services, including site engineering, balance of plant, detailed engineering review for critical processes and corrosion engineering.

We also previously conducted bench-scale laboratory testing to help Hydrostor evaluate options for storing thermal energy as a component of its adiabatic CAES system. AECOM's role included evaluating potential technical approaches, assisting with the design and testing of a laboratory system and design of a full-scale thermal management system

In addition, we are also providing engineering services to Hydrostor related to its new Terra[™] technology. This technology can be deployed in a wide variety of geographies and geologic conditions, eliminating the need for existing underground structures, such as abandoned mines or caverns.

When compared to competing energy storage technologies, Terra has some distinct advantages that help lower lifecycle costs, including:

- Ability to repurpose existing site infrastructure to lower capital costs
- No use of fossil fuels or chemicals
- No emissions
- Less storage volume than pumped hydro or conventional CAES
- Low-pressure, bankable surface equipment
- Small surface footprint







Advantages of advanced compressed air energy storage

- Utility scale
- Long duration (4-12 hours)
- Emission free
- Small mechanical footprint
- Economical

Glyn Rhonwy 99.9 MW Pumped Storage

Llanberis, Wales, United Kingdom

With support from AECOM, the Snowdonia Pumped Hydro gained its development consent order in March 2017 for the Glyn Rhonwy pumped storage project. We performed the environmental impact assessment, managed the permitting process and established stakeholder engagement programs as part of the planning application.

Located just outside the Snowdonia National Park, this is the UK's first onshore hydro project to go through a Planning Act 2008 review process and the first such project in a generation. The project has been approved by the UK Planning Inspectorate, with construction anticipated for 2018-2019.

For this project, two abandoned slate quarries will be dammed with a sluice connecting the two to allow the release of large quantities of water during periods of peak electricity demand. When operational, the project will have a capacity of around 99.9 MW and generate electricity for around 200,000 homes for up to seven hours a day.

AECOM managed and mitigated several key environmental sensitivities, including the impact of the project on local communities, heritage assets and tourism — the area's main income stream. A nearby and rare population of Arctic char also required careful design of the spillways into Llyn Padarn. Additionally, the quarry was used as an ammunition store during World War II, which required an action plan for potential areas of unexploded ordnance.

AECOM supported the United Kingdom's first pumped hydro project in 30 years that will be located near the Snowdonia National Park in Wales.

Pumped Storage Site Screening Study

California, Utah, Arizona, Nevada

AECOM performed a screening study to locate and evaluate sites for potential pumped storage development. Our team identified an initial group of 123 sites and then narrowed the list to the 10 most promising sites for our client. Each of the 10 sites was researched and included in a report with:

- Location and description: general location of project, land ownership, access roads, public use or recreational facilities in the area, location of nearest transmission lines and other relevant information.
- **Project size and layout:** anticipated capacity of the project, elevation profile, and basic description of major features of the project.
- Site geology: assessment of suitability for foundation of project facilities and excavation material needed for construction.
- Water supply: location of nearby aquifers and/or rivers and types of water rights required.
- Environmental considerations: identification of any major impediments to development.
- Project costs: summary of total construction costs, annual escalations rates, interest rates and annual project operating and maintenance costs.
- Benefits and economic analysis: benefit/cost ratio for project.
- Detailed cost estimate: Pricing for all essential project elements.

Gordon Butte Pumped Storage

Martinsdale, Montana

AECOM provided geological and geotechnical assessments, balance-of-plant equipment lists, advanced conceptual designs and drawings (plans, drawings raw and one-lines, etc), and write-ups to support development of a new closed-loop pumped storage hydro facility.

When constructed (estimated 2018-2022), the facility will provide ancillary and balancing capabilities to Montana's renewable energy industry and provide multiple services to facilitate stability, reliability, growth and longevity to existing energy infrastructure and resources in the state and region. These generators will provide an installed capacity of 400 MW, allowing for an estimated annual energy generation of 1,300 gigawatt hours (GWh).

The facility will consist of upper and lower closed-loop reservoirs connected by an underground concrete and steellined hydraulic shaft. Each reservoir will be approximately 4,000 feet long and 1,000 feet wide with depths of 50 to 75 feet. As currently designed, an underground powerhouse with four turbine-generators would be located at the bottom reservoir.

The facility received its preliminary permit from the FERC in 2013, with the Final License Application accepted as complete in November 2015. The Environmental Analysis with a Finding of No Significant Impacts was issued in September 2016.

AECOM supported planning and design of a closed-loop pumped storage facility in Montana with construction estimated for 2018-2022.

Eagle Mountain Pumped Storage

Eagle Mountain, California

AECOM developed the layouts and designs for a 1,300 MW pumped storage project for the purpose of preparing a Federal Energy Regulatory Commission (FERC) license application. The license to construct was issued in June 2014, but a construction start date has not been established following a new development agreement in 2016 between the site's owners and NextEra.

The reservoirs will be developed using two existing pits from earlier mining operations. The head that can be developed will be about 1,400 feet. A 29-foot diameter tunnel and shaft will connect the upper reservoir with an underground powerhouse, from which another 29-foot diameter tunnel will make the connection to the lower reservoir. The powerhouse will contain four 325 MW reversible hydroelectric turbines to provide 1,300 MW of firm, stable and dispatchable power when needed. A 60-mile 500 kV transmission line will transmit the power.

The project will provide electricity during the peak electrical demand periods, unexpected generation outages and help correct and balances in the southwestern grid. Through its ability to store the off-peak energy produced by windmills, solar panels, and baseload nuclear and fossil fuel plants, this single project can accomplish the equivalent of many smaller peak-energy projects.

Cascade Battery Energy Storage System

Stockton, California

Our client is currently developing a 25MW / 100 MWh lithium ion battery energy storage project in Stockton, California on a 2 acre portion of a parcel conveniently located next to Pacific Gas and Electric's (PG&E) Weber substation, with an anticipated commercial operation of 2020. This project executed a power purchase tolling agreement with PG&E.

The project must maintain the energy rating for a 20 year useful life. Interconnection into the grid will be stepped up to 60 kV through the on-site project substation through an overhead line into the PG&E Weber substation located next door.

AECOM is providing all of the preliminary and detailed engineering for the project. The project planning design will be submitted to San Joaquin County in early November. Once the approval is granted, AECOM will proceed with the detailed engineering and construction design.

Client benefits:

- Strategically located next to the PG&E substation in a light agricultural area in the County.
- One of the largest BESS projects in the country with 100 MWh capability
- Commercial operation expected in 2020

Pomerado Battery Energy Storage System

Poway, California

AECOM is providing all of the preliminary and detailed engineering for two 3 MW co-located battery energy storage projects, which is in an ideal commercial location to deliver supplemental power to San Diego.

Enel is currently developing a 6 MW / 24 MWh lithium ion battery energy storage project in Poway, California with an anticipated commercial operation in Q4 2019. The proposed project will be two separate Battery Energy Storage Systems, 3 MW (12 MWh) co-located on one parcel of land. The client holds an option to lease on a privately owned 0.86-acre parcel that is located in a commercial area. This project executed a power purchase tolling agreement with the utility, San Diego Gas and Electric (SDG&E) in March 2017.

The project must maintain the energy rating for a 20-year useful life. Interconnection into the grid will be at the 12 kV line underground on the site with both systems interconnecting into existing SDG&E circuits. SDG&E operates the Pomerado Substation just a block away from the BESS project site.

AECOM is providing all of the preliminary and detailed engineering for the project. The project is currently pending development approval with the City of Poway. Once the approval is granted, AECOM will proceed with the detailed engineering design.

Client benefits:

- Strategically located within one block of the SDG&E substation in a commercial area in the City of Poway
- Only the second BESS project in San Diego
- Commercial operation expected in Q4 of 2019



Pomerado Battery Energy Storage System



Beacon 250 MW Solar Plant and 20 MW BESS Project

Kern County, California

AECOM's coordination with contractors included the development and maintenance of master project schedule, project documentation, budgeting, and coordination of in-house engineering and construction groups, and providing QA/QC of the solar plant construction on behalf of LADWP. The Beacon BESS project was installed adjacent to the Beacon Solar Substation.

LADWP's Power System Engineering Division (PSED), Major Project Section, managed the overall 250 MW Beacon Solar Plant project and coordinated the in-house design engineering and construction activities and delivery of solar power facilities to be designed, constructed, and operated by third-party contracted generating station in California. This project will provide increased electricity capacity and support the stability of the local grid at a strategic location, near the western terminus of the service territory. Electricity dispatched solar developers. This project was a unique blend of in-house infrastructure buildout by LADWP and the individual solar fields designed and constructed by the third-party solar developers.

This project entailed having AECOM senior construction managers on-site during all construction activities. Additionally, AECOM also provided all of the environmental construction compliance monitoring on behalf of LADWP under an on-call environmental contract with LADWP.

The Beacon Solar Plant was a high-priority project, being an essential part of LADWP's 50% Renewable Portfolio Standard (RPS). The professional services delivered through this task order are assisting LADWP in successfully meeting the overall project goals.

20 MW BESS Capacity

The BESS, installed adjacent to the Beacon Solar Substation, provides voltage support and reactive power adjustments at the 230kV transmission line to help mitigate voltage rise and voltage drop occurring due to the wide variability in energy production and load during a typical day. The BESS also maintains and meets North American Electric Reliability Corporation (NERC) and Federal Energy Regulatory Commission (FERC) alternating current frequency specifications within allowable tolerances as a Balancing Authority (BA).



Beacon 250 MW Solar Plant and 20 MW BESS Project Kern County, California





Underwater compressed air energy storage system located in Toronto, Ontario, Canada.

Underwater-Compressed Air Energy Storage Techno-**Economic Analysis**

AECOM has partnered with Hydrostor, Inc. to assist with expanding the world's first underwater compressed air energy storage system located in Toronto, Ontario, Canada. The main objective for this project is to increase system generation capacity and larger air cavity.

Given AECOM's global footprint and technical diversity, AECOM is exploring alternatives to conventional energy storage technologies such as Li-ion batteries, Pumped-Hydro, etc.

AECOM is performing due diligence and technoeconomic analysis of a novel approach to store compressed air in an underwater air cavity which uses the head from water above to store air at pressures greater than >300 psig. Similar to the CAES technology, this technology seeks to provide grid support and time-shifting of renewable energy for locations near coastal areas or islands/microgrids.

AECOM approaches this opportunity armed with a multi-talented resource pool and a creative spirit also exhibited by Southern Company.

McIntosh Compressed Air **Energy Storage**

Pioneering the integration of innovative energy storage technologies within the utility sector fits within the mission and company experience at AECOM. Legacy AECOM was part of a joint venture to design and engineer the original McIntosh compressed air energy storage (CAES) facility located in McIntosh, Alabama. AECOM has a long history in working with Southern Company including several of the operating entities such as Alabama Electric Cooperative who owns the CAES facility.

During the time of commissioning, the McIntosh CAES facility had a maximum power output rating of 110 MW and utilizes a 19,000,000 cubic foot cavern as the air storage reservoir. Air is stored at a maximum capacity of approximately 1,050 psig and is used to fire natural gas for electricity generation. This project was recognized for several awards and technology achievements including POWER Magazines 1992 Power Plant Award.

WDG Battery storage integration to PV Projects

AECOM prepared interconnection applications for three battery-based energy storage projects in Southern California Edison service territory. Each has planned capacity of 2 MW. They are collocated with existing solar energy projects that AECOM helped develop but they are stand alone in terms of interconnection, power off-take and ownership. Preliminary design was based on ABB technology.

SolarWorld PV project in Puerto Rico

provider.

project execution.

AECOM is currently engaged with SolarWorld on a PV project in Puerto Rico that has an energy storage component. We are providing on-call, as-needed, technical services for a 10 MWh PV project that has roughly 5 MW of battery energy storage. The purpose of the battery energy storage system is to smooth power ramps due to the intermittent generation resource as well as provide frequency response to the utility during offnominal frequency events as required by PREPA, the utility

AECOM has developed significant experience within the energy storage markets ranging from market analysis (international and domestic), siting and permitting, and

You have big challenges, we have bigger solutions



For more information, contact: Energy Live@aecom.com



