DOCKETED

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Project Title:	Gem Energy Storage Center
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Document Title:	Section 6_Alternatives_Gem Energy Storage Center
Description:	This section discusses alternatives to the proposed Gem Energy Storage Center (Gem / GESC). These include the "no project" alternative, site alternatives, transmission line route alternatives, technology alternatives, water supply alternatives, and excavated rock recycling or disposal alternatives. This discussion focuses on alternatives that could feasibly accomplish most of the basic objectives of the project and could avoid or substantially lessen one or more of the potential impacts.
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6.0 ALTERNATIVES

This section discusses alternatives to the proposed Gem Energy Storage Center (Gem / GESC). These include the "no project" alternative, site alternatives, transmission line route alternatives, technology alternatives, water supply alternatives, and excavated rock recycling or disposal alternatives.This discussion focuses on alternatives that could feasibly accomplish most of the basic objectives ofthe project and could avoid or substantially lessen one or more of the potential impacts.

The California Environmental Quality Act (CEQA) requires consideration of "a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project and evaluate the comparative merits of the alternatives" (Title 14, California Code of Regulations [CCR] 15126.6[a]).

Thus, the focus of an alternatives analysis should be on alternatives that "could feasibly accomplish most of the basic objectives of the project and could avoid or substantially lessen one or more of the significant effects" (Title 14, CCR 15126.6[c]). The CEQA Guidelines further provide that "among the factors that may be used to eliminate alternatives from detailed consideration in an EIR are: (i) failure to meet most of the basic project objectives, (ii) infeasibility, or (iii) inability to avoid significant environmental impacts."

The Energy Facilities Siting Regulations (Title 20, CCR, Appendix B) guidelines titled Information Requirements for an Application require the following:

> *A discussion of the range of reasonable alternatives to the project, including the no project alternative… which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project, and an evaluation of the comparative merits of the alternatives.*

The data adequacy regulations also require the following:

> *A discussion of the applicant's site selection criteria, any alternative sites considered for the project, and the reasons why the applicant chose the proposed site.*

A range of reasonable alternatives are identified and evaluated in this section, including the "no project"alternative (i.e., not developing a new power generation facility), alternative site locations for constructing and operating the Gem project, alternative project design features (including transmission line routes, water supply sources, and excavated rock recycling/disposal options), and various technology alternatives. This section also describes the site selection criteria used in determining the proposed location of the Gem project.

6.1 Project Objectives

Gem has been designed to deliver up energy and reliability services with no fossil fuel combustion or related air quality impacts. The project will be one of the first commercial applications of Hydrostor's Advanced Compressed Air Energy Storage (A-CAES) technology at this scale. Gem will combine dispatchable, operationally flexible, and efficient energy generation with state-of-the-art A-CAES technology to facilitate the integration of variable renewable energy on the grid and to meet California and regional needs for reliability services.

On July 14, 2021, U.S. Secretary of Energy Jennifer M. Granholm announced the U.S. Department of Energy (DOE)'s new goal to reduce the cost of grid-scale, long-duration energy storage by 90 percent within the decade. The second target within DOE's Energy Earthshot Initiative, "Long Duration Storage Shot" sets bold goals to accelerate breakthroughs that store clean electricity to make it available anytime, anywhere and support more abundant, affordable, and reliable clean energy solutions. "We're going to bring hundreds of gigawatts of clean energy onto the grid over the next few years, and we need to be able to use that energy wherever and whenever it's needed," said Secretary Granholm. "That's why DOE is working aggressively toward cheaper, longer duration energy storage to reach President Biden's goal of 100 percent clean electricity by 2035" (US Department of Energy 2021). According to recent public comments by the California Energy Commission (CEC) Commissioner Douglas at the September 9, 2021 California Coastal Commission Informational Briefing and Public Comment on Offshore Wind: "the State will need to add between 4 – 6 gigawatts per year of renewable energy and storage starting now" to meet the State's ambitious goal of zero carbon emissions by 2045 (California Coastal Commission 2021). On June 24, 2021, the California Public Utilities Commission (CPUC) adopted Decision 21-06-035 recognizing the need for long lead time, long-duration energy storage resources, such as the Gem project. Among other things, the CPUC decision requires "at least 1,000 megawatts (MW) of long-duration storage (able to deliver at maximum capacity for at least eight hours from a single resource)" by June 2026 (CPUC 2021). The Gem project's capabilities are completely aligned with this objective.

Kern County has become a significant renewable energy center for California. There are more than 5,000 wind turbines in the Tehachapi-Mojave wind corridor, producing 1.3 terawatt-hours (1.3 million megawatts) each year. Increases in renewable generation and curtailments of solar and wind have followed an increase in new renewable capacity additions (Kern County 2021). In 2020, the California Independent System Operator (CAISO) curtailed 1.5 million megawatt hours of utility-scale solar or 5 percent of its utility-scale solar production (US Energy Information Administration 2021). Enhanced stability of the electrical grid will allow for less curtailment and further integration of renewable resources, such as the extensive wind and solar development continuing to occur in eastern Kern County. The Gem project is consistent with the CPUC and will provide a wide range of operational capabilities including the crucial flexible capacity to support electrical system stability and reliability during periods of rapidly changing renewable energy output, as well as a local response to other instances of grid instability.

Gem's basic project objectives include the following:

1. Provide 500 MW of quick-starting, flexible, controllable generation with the ability to ramp up and down through a wide range of electrical output to facilitate the integration of the renewable energy into the electrical grid in satisfaction of California's Renewable Portfolio Standard (RPS) and climate objectives, by displacing older and less efficient generation.

2. Interconnect the project to CAISO-controlled Southern California Edison (SCE) Whirlwind Substation, a major substation in or near the Tehachapi Renewable Wind Resource Area, to facilitate the integration of onshore and offshore renewable energy development.

3. Implement a proven sustainable energy storage technology that provides improved technological diversity, non-combustible energy storage, minimal residual hazardous waste at asset retirement, long term commercial lifespan of 30 years or greater and non-degrading energy storage.

4. Use advanced compressed air energy storage (A-CAES) technology to provide dispatchable long-duration storage and energy delivery for a minimum 8 hours, fossil fuel and greenhouse gas emissions-free operation, flexible capacity with minimal response time, peaking energy for local contingencies, voltage support and primary frequency response including synchronous power output to support grid resiliency without the need for fossil fuel, superior transient response attributes including synchronous power output, and superior round trip thermodynamic efficiency.

5. Locate on a site with adequate geologic characteristics for the underground facilities for compressed air storage, including, suitable overburden characteristics (limited thickness, constructable soil type); deep subsurface geological formation of sufficient quality and definition at the required depth for construction of the excavated storage cavern; ultra-low hydraulic conductivity and permeability in deep subsurface geological formation to retain water and air under pressure within the excavated storage cavern; and competent geological structural integrity to sustain an excavated storage cavern at depth intact indefinitely, allowing for repeated compressed air injection and discharge cycles over the life of the project without eroding or collapsing.
6. Site the project in close proximity to an adequate fresh water supply.
7. Site the project on flat land and with adequate access and size for construction of aboveground facilities, at least 60 acres.
8. Identify a site that is available to provide adequate site control, through long-term lease or purchase.
9. Minimize additional supporting infrastructure needs and reduce potential environmental impacts by locating the facility near existing and planned infrastructure, including access to an existing substation with available transmission capacity and avoiding lengthy generation tie lines.
10. Create jobs in Kern County and the State of California through both construction and operation of the facility.
11. Be a good corporate citizen and respected member of the community through the lifecycle of the project.

6.2 The “No Project” Alternative

If the project were not constructed, the Gem basic project objectives would not be met, and the grid reliability, and environmental and policy benefits, as identified above, from this highly dispatchable and flexible project, would not be realized. The Gem project would provide a significant carbon-free contribution to the State’s ambitious renewable energy and storage needs and the no project alternative would deprive the State and the area of this significant contribution. The no project alternative would also not be consistent with California’s environmental policy goals of encouraging development and deployment of long lead time, long-duration energy storage resources, such as the Gem project, as articulated in CPUC Decision 21-06-035.

The no project alternative could result inadequate system reliability (more blackouts), greater fuel consumption, greenhouse gas emissions, air pollution, climate change and other environmental impacts in the state because older, less efficient plants or emergency generation facilities with higher air emissions would continue to supply transitional power instead of being replaced with cleaner, more flexible, and more efficient energy storage such as Gem. The no project alternative would also deprive the area of a significant multi-year construction employment opportunity with associated purchases of local goods and services, as well as permanent jobs associated with the operation of the facility, and ongoing property tax revenue, and other community benefits. Therefore, because the no project alternative would not satisfactorily meet the project objectives specified above, the no project alternative was rejected in favor of the proposed project.

6.3 Power Plant Site Alternatives

The project owner considered multiple sites for the Gem project. Finding available real estate on which to site an A-CAES facility such as Gem, is a significant hurdle in almost any area under consideration. Coupled with the objective of locating the facility in an area with competent deep hard rock geology and proximity to a major point of interconnection near the SCE Whirlwind Substation, quickly reduced site options to four site alternatives (including the project site itself). The project site and three site alternatives are shown in Figure 6-1. The project site and three alternate sites are discussed below followed by an alternative site summary section.

LEGEND

GEM SITE

ALTERNATE

0 2 4 Miles

REFERENCE

COORDINATE SYSTEM: NAD 1983 STATEPLANE CALIFORNIA V FIPS 0405 FEET

CLIENT
HYDROSTOR, INC.

PROJECT
GEM ENERGY STORAGE CENTER

TITLE
GEM ALTERNATIVE SITES MAP

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2021-10-08
PREPARED	MR
DESIGN	MR
REVIEW	DH
APPROVED	DH

PROJECT No.	CONTROL	Rev.	FIGURE
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6.3.1 Proposed Project Site

The Gem project will be located on an approximately 71-acre project site consisting of two adjacent parcels in unincorporated Kern County (County), approximately 1.0-mile northeast of the community of Willow Springs and 7 miles west of Rosamond, California (Figure 1-3). The site is currently undeveloped desert land located in an area that is zoned E-District (Estate 2.5 Acres I, Residential Suburban Combining (RS)). The area to the southeast of the site, including Willow Springs Butte, is public land administered by the U.S. Department of the Interior, Bureau of Land Management (BLM). The area to the north of the site across Sweetser Road is used for irrigated agriculture. The site is not under a Williamson Act Contract. Gem is expected to be a conforming land use as is further discussed in Section 5.6 (Land Use).

The geology underlying the site is expected to consist of hard rock at a depth that is compatible with the design of the A-CAES cavern storage system.

The site has adequate space for all of the aboveground Gem facilities. A long-term lease for the eastern approximate 61-acre parcel has been executed and site control for the adjoining 10-acre parcel is in progress.

Gem will interconnect with SCE’s Whirlwind Substation via a new 10.9-mile-long tie-line, as described in Section 3, Electrical Transmission. The SCE Whirlwind substation is a major point of interconnection for existing and planned renewable energy projects in the Tehachapi Wind Resource Area.

Process water supply will be available in adequate quantity and quality from onsite groundwater wells to be constructed for the project and delivered under negotiated water contracts available from other groundwater users with surplus entitlements.

The proposed Gem site is not expected to result in any environmental effects that cannot be either avoided or mitigated to insignificant levels.

The Gem site, therefore, meets the project objectives.

6.3.2 Alternative 1 – BLM Site

The BLM Site is an approximate 90-acre irregularly shaped parcel owned by the U.S. Government and managed by the Bureau of Land Management (BLM). It is located nearly adjacent to the Gem site, abutting the Willow Springs Butte on the north side, with only about 350 feet separating the southeast corner of the Gem site and the northwest boundary of the BLM site. The site was identified in Hydrostor’s preliminary examination of the geology of the area as another site with apparently suitable deep subsurface geological characteristics (required hardness and lack of permeability at cavern depth), adequate parcel size, a viable process for establishing site control, and a location within a 10-mile radius of the SCE Whirlwind Substation. Hydrostor submitted a SF299 form with BLM to initiate the site control process. However, further examination of the site from a constructability and operability perspective revealed that the vast majority of the site (approximately southern 70 to 80 percent) consists of irregular, complex and steep terrain that would not be conducive to site development. Creating a developable project site of adequate size with the remaining usable portion of the BLM parcel would have required Hydrostor to fill in the developable portion of the BLM site by securing site control over more than 20 separately owned parcels. This was viewed as intractable, time-intensive problem with a low probability of success. As a result, Hydrostor proceeded with development of the nearly adjacent Gem site that did not have these issues.

From an environmental perspective, the BLM site would pose very similar potential impacts compared to the proposed Gem site. The site exhibits the same basic habitat, the length of transmission interconnection would be very similar, the distance to the Ridgeline Quarry (excavated rock beneficial use recycling destination) is nearly the same, the site is in the same groundwater basin with similar water supply expected. Other environmental attributes of the site would be nearly identical. Since BLM is a federal agency and issuance of a land or right-of-way grant is a discretionary federal action, BLM approval to use the site would need to conform to requirements of the National Environmental Policy Act (NEPA). Although this would pose an additional regulatory process for the BLM site, this was not viewed as a major concern.

Alternative 1, the BLM Site, was not selected for the Gem Project for the following reasons:

- Inadequate development area - The site is located on complex, irregular terrain that would render the vast majority of the parcel unusable for development.
- Low probability of gaining site control for adjoining area - Securing control over additional adjoining parcels area to expand the usable portion of the site into a compatible size would be challenging, time consuming, and with a low probability of success.

6.3.3 Alternative 2 – Little Buttes Site

The Litte Buttes Site is near the Little Buttes outcropping in unincorporated Los Angeles County, approximately 8.5 miles east southeast of the SCE Whirlwind Substation. This site was also identified in an initial geological review of the general area as exhibiting high potential for subsurface hard rock, low permeability characteristics compatible with Hydrostor's A-CAES cavern design requirements, although the geology is considered less preferred than the Gem site. The Little Buttes themselves consist of complex terrain that would pose uniquely challenging constructability issues. The area surrounding the site is undeveloped open land with biological features similar to the Gem site that are characteristic of this general area. The area surrounding the site is sparsely populated with the nearest resident approximately 0.75 mile away, at the northern border of the unincorporated community of Antelope Acres.

Land availability and the likelihood of gaining site control over sufficient property to accommodate a 500 MW Hydrostor A-CAES facility was a major hurdle in this area. The area surrounding Little Buttes is checkered with small parcels ranging in size from approximately 2.5 to 10 acres with the majority appearing to be zoned Agriculture. There is no single parcel in the area of adequate size to accommodate the facility and creating a site from multiple parcels was viewed as an extremely challenging exercise with a low probability of success.

From an environmental and land use perspective, the Little Buttes site would pose very similar potential impacts compared to the proposed Gem site. The site exhibits the same basic habitat, the length of transmission interconnection would be very similar, and the site is in the same groundwater basin with similar water supply expected. The haul distance to the Ridgeline Quarry (excavated rock beneficial use recycling destination) is approximately 11 miles, more than double the distance from the Gem site, approximately doubling emissions associated with excavated rock transport. Other environmental attributes of the site would be similar to the Gem site. Since the site is located in Los Angeles County, the permitting associated with the SCE gen-tie interconnection would need to involve both Kern County and Los Angeles County. Although this would pose an additional regulatory process for the Little Buttes site, this was not viewed as a major concern.

Alternative 2, the Little Buttes Site, was not selected for the Gem project for the following reasons:

- Inadequate development area - The Little Buttes site itself consists of complex terrain with extreme slopes that are not realistically suitable for project construction

- Low probability of gaining site control for adequate area - Securing control over an additional 15 to 20 parcels needed to achieve an adequate area for project development would be challenging, time consuming, and with a low probability of success

6.3.4 Alternate Site 3 - Rosamond Hills Site

The Rosamond Hills Site is an approximately 160-acre parcel that was available for lease near the Rosamond Hills outcropping in unincorporated Kern County, approximately 4 miles northeast of the Gem site and approximately 12 miles northeast of the SCE Whirlwind Substation. The site is a combination of complex rugged terrain to the south and more gently sloping or relative flatter terrain to the north. The northern approximately 80 acres were initially considered of adequate size to support development. This site was identified in an initial geological review of the general area as exhibiting possible potential for subsurface hard rock, low permeability characteristics compatible with Hydrostor's A-CAES cavern design requirements. However, more focused geologic assessment revealed the Rosamond Hills site to be the least favorable of the alternate sites as a result of the presence of surface fanglomerate and underlying tuff and/or tuffaceous sandstone. The near-surface fanglomerate at the Rosamond Hills site is problematic because its strength would be highly variable depending on whether the matrix or the larger particle (pebbles or boulders) predominate, as well as on the mineralogy of the pebbles/boulders and the matrix. Also , the underlying tuff and/or tuffaceous sandstone would not be expected to be as strong, durable, and impermeable as the Gem site or the other alternate sites.

The area surrounding the site is undeveloped open land with biological features similar to the Gem site that are characteristic of this general area. The area surrounding the site is generally sparsely populated but there are approximately a dozen residences within 0.25 miles of the northern site boundary. The parcel is zoned Agriculture.

From an environmental and land use perspective, the Rosamond Hills site would pose many similar potential impacts compared to the proposed Gem site. The site exhibits the same basic habitat and is in the same groundwater basin with similar water supply expected. The haul distance to the Ridgeline Quarry (excavated rock beneficial use recycling destination) is slightly shorter than the project site (approximately 1 mile shorter). However, the interconnection gen-tie from the site to the SCE Whirlwind Substation would be approximately 6 miles longer (total interconnection length of approximately 17 miles versus the 10.9-mile interconnection for the proposed site). This would result in more environmental disturbance an interconnection to the Rosamond Hills site than any of the other alternates. Other environmental attributes of the site would be similar to the Gem site.

Alternative 3, the Rosamond Hills Site, was not selected for the Gem project for the following reasons:

- Less desirable surface and subsurface geology – Both the surface geology and subsurface geology at cavern depth at Rosmond Hills are expected to be inferior to the other sites from both a constructability and performance perspective.
- Longer transmission length – A 50 percent longer transmission interconnection would pose additional unwarranted cost and environmental impacts compared to the project site.

6.3.5 Alternative Site Summary

Key conclusions of the alternative site attributes are compared in Table 6-1. Only the Gem site meets all of the project objectives. While the other alternate sites would meet some of the project objectives, all three alternative sites fail to meet several key objectives that are considered fatal flaws.

Table 6-1: Alternative Site Summary

Project Objective[a]	Proposed Gem Site	Alternative 1 – BLM Site	Alternative 2 – Little Buttes Site	Alternative 3 – Rosamond Hills Site
1 – 500 MW of quick-starting, flexible, controllable generation	Yes	Yes	Yes	Yes
2 – Interconnect to SCE Whirlwind Substation	Yes	Yes	Yes	Yes- Lengthy transmission (>15 miles)
3 – Sustainable energy storage technology	Yes	Yes	Yes	Yes
4 – Fossil-fuel and GHG emissions-free long duration (>8 hour) A-CAES technology	Yes	Yes	Yes	Yes
5 – Adequate geological characteristics for A-CAES technology	Yes	Yes	Likely	Unlikely – near surface fanglomerate and underlying tuff and/or tuffaceous sandstone considered problematic
6 – Close, adequate fresh water supply	Yes	Likely – same aquifer	Likely – same aquifer	Likely – same aquifer
7 – Flat land with adequate size (>60 acres) and access	Yes	No – large portion of the site is complex, steep terrain that is not suitable, remaining flat portion is less than 60 acres	No – site itself consists of complex terrain unsuitable for development, no parcels of adequate size in the area	Yes – 160-acre site
8 – Site available for long-term lease or purchase	Yes	Unlikely – site control of >20 separate parcels would be required to create a site of adequate size	Unlikely – site control over numerous parcels would be required to create a site of adequate size	Yes

Project Objective[a]	Proposed Gem Site	Alternative 1 – BLM Site	Alternative 2 – Little Buttes Site	Alternative 3 – Rosamond Hills Site
9 – Minimize additional infrastructure, including avoiding lengthy gen-tie to minimize environmental impacts	Yes – 10.9-mile interconnection	Yes – slightly longer interconnection of ~11.2 miles	Yes – Similar transmission length to Project and Alternative Site 1	No – Lengthy transmission (>15 miles)
10 – Create jobs for Kern County and California	Yes	Yes	Yes	Yes
11 – Good corporate citizenship	Yes	Yes	Yes	Yes

[a] See Section 6.1 for the complete description of each of the numbered project objectives

6.4 Alternative Project Design Features

This subsection addresses alternatives to some of Gem project design features such as the linear facility routing, interconnection location, water supply source, excavated rock recycling, and/or disposal alternatives.

6.4.1 Electrical Transmission Line Route Alternatives

The facility will connect with SCE's Whirlwind substation via an approximately 10.9-mile-long generation tie-line (designated the Preferred Route). This is the most direct interconnection route that maximizes the use of existing improved surface road corridors and minimizes the number of private easements required. The Preferred Route would exit the site heading west along Hamilton Road, turn south along 110th Street W, turn west along Irone Avenue, turn south at 150th Street W, turn west along Stetson Avenue and enter the Whirlwind substation at a location along its northwest border. Alternatives to the Preferred Route interconnecting at Whirlwind substation are shown in Figure 1-4. Also shown in Figure 1-4 are two alternative interconnections to the future Los Angeles Department of Water and Power (LADWP) Rosamond substation. All of the SCE Whirlwind alternative routes are considered potentially viable and nearly equivalent from an environmental impact and land use perspective.

Alternative 1A is a minor reroute of a portion of the Preferred Route that would turn south along 100th Street W, turn west after approximately 1 mile traveling overland to approximately 1 mile join the Preferred Route near the intersection of 110th Street W and Irone Avenue. Alternative 1A would result in the same overall transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route and would require a new site access road on the 1-mile overland portion between 110th Street W and Irone Avenue.

Alternative 1B is a reroute of a portion of the Preferred Route. Rather than turning south at 110th Street W, this alternative would continue another 3 miles west along Hamilton Road, turn south for 1 mile along 140th Street W, and then join the Preferred Route near the interstation of 140th Street W and Irone Avenue. Alternative 1B would result in the same overall transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route and would require a 1-mile extension of Hamilton Road between 110th Street W and 120 Street W.

Alternative 1C is another reroute of a portion of the Preferred Route. Rather than turning south at 110th Street W, this alternative would continue another 3.7 miles west along Hamilton Road, turn southwest for approximately 0.4 miles adjacent to and east of the SCE Tehachapi Renewable Transmission Project (TRTP) 500 kilovolt (kV) corridor, turn south along 150th Street W and then join the Preferred Route near the interstation of 150th Street W and Irone Avenue. Alternative 1C would result in nearly the same overall transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route and would require a 1-mile extension of Hamilton Road between 110th Street W and 120 Street W.

Alternative 1D is a minor reroute of a portion of the Preferred Route that would turn south at the intersection of 140th Street W and Irone Avenue, travel south approximately 0.7 miles along 140th Street W, turn west at Stetson Avenue after approximately 1 mile and rejoin the Preferred Route near the intersection of 150th Street W and Stetson Avenue. Alternative 1A would result in the same transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route.

Alternative 1E is a minor reroute of a portion of the Preferred Route that would continue south along 150th Street W and turn west at Rosamond Boulevard to join the Preferred Route near the border of the Whirlwind Substation. Alternative 1E would result in the same overall transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route.

Alternative 1F is a minor reroute of a portion of the Preferred Route that would turn West along Fisher Avenue (instead of Stetson Avenue), turn southwest for approximately 0.4 miles adjacent to and east of the SCE Tehachapi Renewable Transmission Project (TRTP) 500 kV corridor, then rejoin the Preferred Route near the intersection of the TRTP corridor and Stetson Avenue. Alternative 1F would result in the same overall transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route.

Alternative 1G is a minor reroute of a portion of the Preferred Route that would turn West along Fisher Avenue (instead of Stetson Avenue), turn southwest near the intersection of the TRTP corridor and Stetson Avenue, travel approximately 0.3 miles adjacent to and east of the TRTP corridor, turn west at Rosamond Boulevard and rejoin the Preferred Route near the border of the Whirlwind substation. Alternative 1F would result in the same approximate overall transmission length as the Preferred Route. It would potentially require more property owner easements than the Preferred Route.

In addition to the above, two route alternatives that would interconnect into the future LADWP Rosamond substation were evaluated. Route 2A would parallel the LADWP 230 kV Barren Ridge transmission line for the majority of its approximately 2.5-mile length. Route 2B would follow Tehachapi-Willow Springs Highway approximately 2 miles south and turn west along Rosamond Boulevard for an additional approximately 1.5 miles before reaching the future LADWP Rosamond substation (approximately 3.5-mile total length). Both LADWP options are several miles shorter than the distance to the Whirlwind substation and would result in somewhat reduced environmental impacts for the construction of the transmission interconnection component of the project. The renewable integration and grid reliability benefits of interconnecting at LADWP Rosamond would be similar to those expected for an SCE Whirlwind interconnection and would be consistent with the project’s overall objectives.

6.4.2 Water Supply Source Alternatives

The Gem project proposes to use new groundwater wells installed on site as the primary source of water supply for construction, with the initial filling of the surface compensation reservoir being the primary component of the construction water demand. Gem would lease surplus water rights entitlements from current water users (such as Antelope Valley East Kern Water District (AVEK)) in the Antelope Valley Groundwater Basin with approval from the Antelope Valley Water Master.

6.4.2.1 Ocean Water

The Pacific Ocean is located approximately 80 miles from the project site through mountainous terrain. Routing a pipeline to the ocean would be extremely complex environmentally and cost prohibitive. For these reasons, this alternative was not considered further.

6.4.2.2 Reclaimed Water

The Rosamond Community Sanitation District (RCSD) operates the Rosamond Wastewater Treatment Plant (WWTP) located approximately 9 miles from the project site. Although the facility has sufficient reclaimed water capacity to meet the needs of the project, the Gem site is not within the service boundaries of RCSD. Gem would need to obtain an exemption from the requirement to be within RCSD boundaries to receive reclaimed water from Rosamond WWTP. In addition, reclaimed water service would require siting and constructing a 9-mile pipeline or delivery to the site by a water truck. Both options would involve additional permitting, add to base case development costs, and have greater environmental impacts than the preferred water supply option. For these reasons, reclaimed water from Rosamond WWTP is not a preferred option.

The Lancaster Water Reclamation Plant (LWRP) located approximately 11 miles from the project site is under the jurisdiction of Los Angeles County. Although the facility has sufficient reclaimed water capacity to meet the needs of the project, the Gem site is not within the service boundaries of LWRP. Gem would need to obtain permission from Los Angeles County to receive reclaimed water from LWRP. In addition, reclaimed water service would require siting and constructing an 11-mile pipeline or delivery to the site by a water truck. Both options would involve additional permitting, add to base case development costs, and have greater environmental impacts than the preferred water supply option. For these reasons, reclaimed water from LWRP is not a preferred option.

The Palmdale Water Reclamation Plant (PWRP) located approximately 24 miles from the project site is under the jurisdiction of Los Angeles County. Although the facility has sufficient reclaimed water capacity to meet the needs of the project, the Gem site is not within the service boundaries of PWRP. Gem would need to obtain permission from Los Angeles County to receive reclaimed water from PWRP. In addition, reclaimed water service would require siting and constructing a 24-mile pipeline or delivery to the site by a water truck. Both options would involve additional permitting, add to base case development costs, and have greater environmental impacts than the preferred water supply option. For these reasons, reclaimed water from PWRP is not a preferred option.

6.4.2.3 Water from State Water Project

AVEK receives State Water Project (SWP) water allotments annually that are subject to potential curtailment. AVEK also produces groundwater from the adjudicated basin and accesses banked water that has been injected for basin recharge when there is a surplus water supply. Delivery of SWP surface water from AVEK would require the construction of a 5-mile pipeline or delivery to the site by truck. Both options would involve additional permitting, add to base case development costs, have delivery uncertainty associated with potential curtailment, and have greater environmental impacts than the preferred water supply option. For these reasons, SWP water from AVEK is not a preferred option.

6.4.3 Excavated Rock Recycle or Disposal Alternative

Construction of the Gem project would result in the excavation of approximately 1.1 million cubic yards of waste rock that is expected to be of aggregate quality. As a result, the project will attempt to recycle excavated material for site grading and construction of the earthen berms for the surface compensation reservoir. The preferred alternative is for the remaining portion of excavated material to be hauled offsite to the Ridgeline Materials, LLC quarry located approximately 5 miles north on Tehachapi-Willow Springs Highway where it would be repurposed to the extent possible for beneficial uses. The hauling of excavated material will result in air quality and greenhouse gas emissions as well as traffic impacts that are discussed in Sections 5.1, Air Quality and 5.12, Traffic and Transportation. Although the preference is to reuse excavated material onsite, the traffic analysis assumes the worst-case impacts of hauling 100 percent of the material offsite. Alternatives to this plan for the excavated material are discussed below.

6.4.3.1 Recycle for Additional Onsite Beneficial Use

Instead of hauling the material that is expected to be surplus, Gem could use the excess material to raise the entire site by several feet. Additional testing of site-specific core material would need to be conducted to establish whether the material has appropriate engineering qualities to be used for this purpose. Raising the site would result in the structures being slightly taller and thus slightly more visible from key observation points. However, given the scale of the facility, this additional visual impact would not be expected to be significant. Elevating the facility may also result in slightly greater noise impacts at nearby receptors that would need to be evaluated but mitigation measures would likely be available to reduce these incremental impacts to insignificant levels. With appropriate onsite stormwater management, raising the site by this amount would not be expected to result in a significant change to stormwater management requirements to ensure that offsite drainage patterns remain unimpacted by the project. This alternative would also result in the avoidance of truck traffic and emissions associated with hauling the material offsite.

6.4.3.2 Disposal at Offsite Landfill

Another alternative for the excavated rock would be to dispose of the material at a nearby landfill. This alternative would likely result in truck traffic and emissions impacts like the preferred alternative but without the beneficial reuse. Disposal at a local landfill would also consume valuable landfill capacity and be inconsistent with the State’s objectives to recycle waste material to the extent possible. For these reasons, this alternative is less preferred.

6.5 Technology Alternatives

6.5.1 Conventional and Renewable Generation Technology Alternatives

Conventional generation technologies such as combined cycle or peak load (simple cycle) combustion turbine-based power plants as well as power plants are developed that would generate comparable power output but would not meet basic project objectives of providing long term energy storage or fossil-fuel and greenhouse gas emissions-free operation and therefore were not considered further. Renewable energy generation technologies such as wind or solar are dependent on available wind and sun, have variable power output profiles that would not provide dispatchable long-term energy storage with synchronous generation response capability. Biomass-fired power plant technology also does not meet basic project objectives including dispatchable energy storage and greenhouse gas emissions-free operation. As such, renewable energy technologies do not meet the basic project objectives and were not considered further.

6.5.2 Energy Storage Alternatives

6.5.2.1 Battery Storage Systems

Battery-based energy storage technology offers some similar attributes to Hydrostor's A-CAES technology, including ancillary service provision and fossil-fuel-free generation. Battery energy storage on the other hand is typically much shorter duration (typically ranging from 2-to-4 hours) and lower capacity energy storage. Battery storage systems are more limited in lifespan (typically requiring replacement within 10 years) and exhibit performance degradation starting early in their lifespan and declining nearly linearly thereafter. Additionally, battery-based energy storage technologies present an operation risk due to potential for chemical fire and hazardous waste disposal requirement at the end of life. Performance is also materially impacted by environmental factors like temperature. Batteries, therefore, serve an important distributed, smaller-scale role with excellent frequency response applicability and provide very different grid services, with batteries primarily focused on distributed, behind-the-meter applications and frequency response, whereas A-CAES can deliver grid services like capacity, voltage support, and synchronous inertia much like conventional generating sources.

Recent market reception to Hydrostor's long-term storage capability has indicated the desirability and importance of long duration storage (more than 8-to-10-hour duration) to be able to provide reliable capacity to the grid when it is required. As a mechanical storage technology, A-CAES performance is not significantly impacted by time (minimal performance degradation over project life), amount of cycling, or environmental factors like temperature. It is, therefore, a very reliable long-term, long-duration storage that is highly cost-effective at scale, and able to directly replace synchronous generation with similar operating characteristics. For these reasons, the battery energy storage systems do not meet basic project objectives and were rejected in favor of Hydrostor's A-CAES technology.

6.5.2.2 Pumped Hydro Storage

Pumped hydro storage uses water released by gravity from an upper reservoir through turbine generating equipment into a lower reservoir separated by at least several hundred to more than a thousand feet or more of elevation to generate electricity. Typically, power is generated during peak power demand periods or when needed to address system reliability. During off-peak periods, water from the lower reservoir is pumped back up into the upper reservoir to "recharge" the system. Pumped hydro storage shares many positive characteristics with A-CAES, including a long lifespan (50+ years), long storage durations, and the provision of synchronous generation (including rotational inertia) to the grid (including similar performance characteristics). Pumped hydro storage would require much larger reservoirs and surface elevation differentials than are required for A-CAES technology. The creation of large reservoirs would require inundation of a much larger area than the proposed Gem project and may result in much greater land use, biological and visual resources impacts than the proposed project. Viable sites are not located near the Whirlwind substation. The technology is also much more capital intensive per installed MW than the A-CAES technology. Finally, pumped hydro would not meet a basic project objective of deploying Hydrostor's A-CAES technology. For these reasons, this alternative was rejected as not meeting key project objectives.

6.5.2.3 Traditional Compressed Air Energy Storage

Traditional compressed air energy storage (CAES) is similar to A-CAES in that a compressor is used to convert electrical energy into high pressure compressed air that is stored in this increased energy state, typically by injecting the compressed air into existing, deep salt caverns or depleted gas reservoirs that can store compressed air and retain it in the formation for long periods. When electricity is required, the compressed air is expanded through a turbine generator, converting the stored energy back into electricity. Because the expansion process results in significant cooling of the expanding air stream, heat is added back into the compressed air before to avoid unacceptably low temperatures for continuing operation of the turbine. A key difference between CAES and A-CAES is that the addition of heat to the expansion process generally requires the combustion of significant quantities of fossil fuel with associated emissions including criteria and toxic air contaminants as well as significant emissions of greenhouse gases.

Hydrostor's technology also deploys a heat transfer and storage system that extracts and stores the heat from air compression and uses it to heat the expanding air during the generation portion of the process without the need to burn fuel of any kind. Hydrostor's A-CAES process, therefore, operates no emissions of greenhouse gases or other air pollutants. Because the technology involves emissions of greenhouse gases and other air pollutants, traditional CAES technology is not compatible with key project objectives.

6.6 References

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