Eagle Mountain Pumped Storage Project
Draft License Application

Exhibit A
Project Description

Palm Desert, California

Submitted to: Federal Energy Regulatory Commission
Submitted by: Eagle Crest Energy Company

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Executive Summary

The Eagle Crest Energy Company proposes to develop the Eagle Mountain Pumped Storage Project near the town of Eagle Mountain in Riverside County, California. The proposed project is a hydroelectric pumped storage project that will provide system peaking capacity and system regulating benefits to Southwestern electric utilities.

The Project will use off-peak energy to pump water from the lower reservoir to the upper reservoir during periods of low electrical demand and generate valuable peak energy by passing the water from the upper to the lower reservoir through the generating units during periods of high electrical demand. The low demand periods are expected to be during weekday nights and throughout the weekend, and the high demand periods are expected to be in the daytime during weekdays. The Project will provide an economical supply of peaking capacity, as well as load following, system regulation through spinning reserve, and immediately available standby generating capacity.

The Project will have 1300 MW of generating capacity, using reversible pump-turbine units, with four units of 325 MW each. The project reservoirs will be formed by filling existing mining pits with water. The mining pits are currently empty and have been unused for decades. There is an elevation difference between the reservoirs that will provide an average net head of 1410 feet. The proposed energy storage volume will permit operation of the Project at full capacity for 9 hours each weekday, with 8 hours of pumping each weekday night and additional pumping during the weekend to fully recharge the upper reservoir. The amount of active storage in the upper reservoir will be 17,700 acre-feet, providing 18.5 hours of energy storage at the maximum generating discharge. Water stored in the Upper Reservoir will provide approximately 22,200 megawatt hour (MWh) of on-peak generation. Tunnels will connect the two reservoirs to convey the water, and the generating equipment will be located in an underground powerhouse.

A 500 kV transmission line will convey power to and from the Project through a proposed Southern California Edison substation located west of Blythe, California, called the Colorado River Substation**.** Other transmission connection upgrades may be necessary to service nearby markets. The Project has filed an Interconnection Request with the California ISO, and the formal scoping and study process for transmission interconnection has been initiated. System improvements and accessible power markets will be investigated during upcoming system analysis performed by the California ISO in coordination with Southern California Edison.

The Project will be located entirely off-stream in that neither the upper nor lower reservoirs intercept a surface water course. The reservoirs will receive only incidental runoff from surrounding slopes in a very limited watershed area within the historically mined lands. Water to initially fill the reservoirs and annual make-up water will be pumped from groundwater within the adjacent Chuckwalla Valley. Alternatively, some or all of the Project's water needs may be obtained from surface water purchased from a willing seller and transferred to the site via the Colorado River Aqueduct. Water to replace losses due to seepage and evaporation could be obtained from the same sources. If groundwater is the selected option, the applicant proposes to utilize either existing wells or new wells to be installed within or adjacent to a central collection pipeline corridor.

Site access is currently planned to be provided by Kaiser Road, a public County road, to the entrance to property owned by and leased from Kaiser Ventures Inc.

Plans are currently being developed by Mine Reclamation Corporation (MRC), a division of Kaiser Ventures Inc., to use portions of the inactive mine site for a major landfill serving the Southern California urban areas. The pumped storage project has been formulated with the assumption that the landfill will exist as proposed by the landfill developers. As detailed in Exhibit E of this License Application, the landfill and pumped storage are compatible in that neither would materially interfere with the construction or operation of the other.

The characteristics and description of the major features of the Project are described in this Exhibit A and summarized in Table 1-1. The layout, dimensions, equipment characteristics, and ratings may change during the detailed design phase of the Project. However, any such changes are not expected to have a material impact upon the concept for the Project nor upon the environmental impacts that will result from its construction and operation. The project area also has the capacity for an enlarged operation in future years if there is increasing demand for generation capacity, and adequate supporting systems (primarily transmission and water) are available. As such, the project has the ability to accommodate and enhance the value of a growing portfolio of renewable energy including wind, solar, and hydroelectric energy.

The Eagle Mountain Project, in addition to firming the energy from the growing portfolio of wind energy in the nearby area, has other environmental benefits and low potential for environmental impacts. Thus, it will be contributing to the “green” value of such renewables. Because the system is located on a large mine site with existing pits, those pits will be economical to convert into large upper and lower reservoirs. Typically, such reservoirs might dam a river and affect fisheries and water quality. Such projects also might have much larger terrestrial impacts due to construction of larger dams to store large amounts of water thus creating impacts at the “borrow areas” as well as at the footprint of the project itself. Since the site is already disturbed and “pre-adapted” for two large reservoirs, this will be among the lowest impact projects of its kind. In addition, since the project is quite remote from population centers, there will be little potential for impacts to people or conflicts with other land uses.

1 Physical Composition of the Project

The layout and major dimensions of the features of the Eagle Mountain Pumped Storage Project are described by the drawings included in **Exhibit F and published under separate cover because they are classified as CEII**. These features include the upper dams and reservoir, lower reservoir, inlet/outlet structures, water conveyance tunnels, vertical shaft, surge control facilities, underground powerhouse, access and cable tunnels, switchyard, transmission line, and water supply facilities. A summary of the significant project components is provided in Table 1-1.

Table 1-1. Significant Data for Eagle Mountain Pumped-Storage Project

Project Feature	Feature Data
Hydroelectric Plant	
Total Rated Capacity	1,300 MW
Number of Units	4 (Reversible)
Unit Rated Capacity	325 MW
Maximum Plant Discharge	11,600 cfs
Pump/Turbine and Motor/Generator Unit Data	
Rated Head	1410 ft
Rated Turbine Output	319 MW
Maximum Turbine Flow	2,900 cfs
Operating Speed	333.3 rpm
Generator Rating	347 MVA
Low Pressure Upper Tunnel	
Diameter	29 ft
Length	4,000 ft
Shaft	
Diameter	29 ft
Length	1,390 ft
High Pressure Lower Tunnel	
Diameter	29 ft
Length	1560 ft
Tailrace Tunnel	
Diameter	33 ft
Length	6,835 ft
Powerhouse Cavern	
Height	130 ft
Length	360 ft
Width	72 ft
Upper Reservoir	
Dam Type	Roller-compacted
Volumes	
Total Reservoir Capacity	20,000 ac-ft

Project Feature	Feature Data
Inactive Storage	2,300 ac-ft
Active Storage	17,700 ac-ft
Operating Levels	
Minimum Operating Level	El. 2343
Maximum Operating Level	El. 2485
Water Surface Areas	
Water Surface Area at E1. 2,343 feet	48 acres
Water Surface Area at E1. 2,485 feet	191 acres
Dimensions of Dams	(URD-2 and URD-1)
Structural Heights	60 ft and 120 ft
Top Widths	20 ft (both dams)
Crest Lengths	1100 to 1300 ft
Crest Elevation	El. 2490 (both dams)
Lower Reservoir	
Dam Type	None
Volumes	
Total Reservoir Capacity	21,900 ac-ft
Inactive Storage	4,200 ac-ft
Active Storage	17,700 ac-ft
Operating Levels	
Minimum Operating Level	El. 925
Maximum Operating Level	El. 1092
Water Surface Areas	
Water Surface Area at E1. 925 feet	63 acres
Water Surface Area at E1. 1,092 feet	163 acres

1.1 Upper Reservoir

The Central Pit of the inactive Eagle Mountain Mine will be utilized for the Upper Reservoir. The bottom of the pit is at El. 2,230, and the existing low point of the rim is at El. 2,380. The active portion of the reservoir is planned between El. 2,340 feet and El. 2,485. The volume between these elevations is 17,700 acre-feet, and the respective surface areas are 50 and 188 acres. The existing low points of the pit rim are at El. 2,380 and El. 2,440. To obtain the required volume of storage it will be necessary to construct two dams along the perimeter of the pit. These dams are identified as URD-1 and URD-2.

The dams are planned to be constructed of roller-compacted concrete (RCC) with an upstream membrane liner to control seepage. The crest elevation of the dams will be El. 2,490 and the crest width will be 20 feet. The south embankment (URD-1) will have a height of 120 feet and a crest length of 1,300 feet. The west embankment (URD-2) will have a height of 60 feet and a crest length of 1,100 feet. Dam construction will require preparation of the foundation to remove any waste materials from mining, overburden, and weathered rock to expose firm, un-weathered bedrock prior to placement of dental and leveling concrete and the RCC lifts. For project planning and based on available information, we assumed an average of 10 feet of excavation would be required for the foundation. Normal freeboard was assumed to be 5 feet between the normal high-water level and the dam crest. A spillway will protect the upper reservoir in the event of overtopping during an over-pumping event and to handle surface runoff from the very small surrounding watershed area into the reservoir.

Due to site access constraints, ECE has not been able to perform detailed subsurface explorations at the dam locations. Drilling and testing of the foundation and dam and testing of RCC aggregate sources will be initial design tasks performed when access rights to the site are obtained.

The downstream face of the dam was assumed to be 0.8 (H) to 1 (V), with no chimney section. This section is conservative based on experience and judgment with dam design in southern California. Many concrete gravity dams have steeper downstream faces and chimney sections in areas with greater seismic loads. The configuration of the dam may be modified during final design, with expected savings in the amount of RCC mass. Similar to the recently completed Olivenhain Dam in San Diego County, the upstream face of the dam would be formed with grout-enriched RCC and later covered with a membrane liner to control seepage. Seepage control is in the economic and environmental interest of the project and will also protect the downslope groundwater aquifer. The preliminary design concept envisions a drainage gallery to accept flows from foundation drains provided to control uplift. The foundation would most likely require grouting for seepage control, and we assumed a double row grout curtain with depths equal to the height of the dam along the dam axis. Final design of the RCC will follow criteria established for RCC gravity dam design and comply with all requirements of the FERC and the California Division of Safety of Dams (DSOD).

Control of seepage from the upper reservoir will be important to minimize water losses and to limit the amount of reservoir water that could potentially reach the aquifer and the nearby Colorado River Aqueduct. Existing geologic data suggest sufficient permeability of the fractured rock that underlies the Central Pit, that seepage from the upper reservoir is likely. The final design will include seepage control at the upper reservoir utilizing localized grouting and shotcrete placement and potentially other methods. Once access to the pit can be obtained, geologic mapping will be performed and seepage control methods will be defined with greater certainty. Further discussion of seepage potentials and seepage control measures are provided in the Exhibit F Preliminary Supporting Design Report (PSDR). The Water Resources chapter of Exhibit E also details a seepage mitigation program consisting of monitoring and pump-back recovery wells.

An excavated approach channel to the inlet/outlet (I/O) structure at the east end of the reservoir will have a bottom width of 100 feet and side slopes of 0.5 horizontal to 1.0 vertical. The approach channel will have an invert at El. 2,287 and slope down to the tunnel invert at El. 2,282. The I/O structure will have a trashrack with a gross area that is about 84-feet-wide by 60-feet-high. Three piers within the flared portion of the structure will assist in spreading flow uniformly over the trashrack area in the pumping mode. The Upper Reservoir inlet/outlet structure will be equipped with a fixed-wheel gate for emergency closure and tunnel inspection.

The entire upper reservoir area will be fenced and gated to prevent the entry of unauthorized personnel and the public both during and after construction.

Access to the dams and reservoir will be by improved roads planned as part of the landfill operation and by new 30 feet wide gravel roads constructed from the landfill road to the features.

1.2 Lower Reservoir

The East Pit of the inactive Eagle Mountain Mine will form the lower reservoir for the project. The bottom of the pit is at El 740, and the existing low point of the rim is at El. 1,100. The active portion of the reservoir is planned between El. 925 and El. 1,092. The volume between these elevations is 17,700 acre-feet, and the respective surface areas are 63 and 163 acres. The entire active reservoir volume can be contained within the pit; therefore, construction of dams will not be necessary at the Lower Reservoir.

Seepage potential from the Lower Reservoir is expected to be more significant because the east end of the mine pit is in alluvial material. Studies conducted by Kaiser and MRC (1991) [in EMEC, 1994] indicated that the horizontal permeability of these alluvial deposits is relatively high (EMEC, 1994). Therefore, the eastern end of the pit will be treated with a seepage control blanket. Earlier design concepts envisioned placing a minimum blanket depth of three feet using fine mine tailings. This blanket would need to be placed at stable slopes for expected loading conditions. Most of the fine tailings that may be suitable for the seepage blanket would come from a large pile of tailings on the south bank of the pit, which will have to be moved in any case to accommodate the project. Depending upon the impermeability of this material, it may also be necessary to top it with a layer of the finer tailings from the nearby fine tailings ponds or to mix the tailings with bentonite to further reduce permeability. In addition to this general blanketing at the eastern end of the pit, some localized blanketing may be required at other locations in the lower reservoir. Also, grouting and shotcrete placement may be required. Once access to the pit can be obtained, geologic mapping will be performed and seepage control methods will be defined with greater certainty. In addition, as discussed in the Water Resources chapter of Exhibit E of this License Application, a seepage mitigation program consisting of monitoring and pump-back recovery wells will also be employed to ensure that seepage does not impact downstream waters or the Colorado River Aqueduct.

The I/O structure at the Lower Reservoir will be located near the west end of the reservoir and will be constructed in the sloping bank of the pit. The inlet/outlet structure approach channel will have an invert at El. 862 and slope down to the tunnel invert at El. 857. The structure will have a trashrack with a gross area that is about 84 feet wide by 60 feet high. A fixed-wheel gate will provide for emergency closure and for tailrace tunnel inspection.

The entire lower reservoir area will be fenced and gated to prevent the entry of unauthorized personnel and the public during construction and operation.

Access to the reservoir will be by improved roads planned as part of the landfill operation and by new 30 feet wide gravel roads constructed from the landfill road to the features.

1.3 Spillways

No spillway will be needed for the Lower Reservoir because the reservoir can contain either the entire PMF inflow or the total volume of circulated water and dead storage water down to the invert of the inlet/outlet structure from the other reservoir without overflowing. A spillway will be provided for the Upper Reservoir, probably at URD-2. This spillway will handle any excess water that cannot be stored during the inflow design flood, which will be the probable maximum flood, and will also provide for protection of the dam if over-pumping should occur.

1.4 Water Conductors

A system of water conductor tunnels will convey the water from the Upper Reservoir to the underground powerhouse and from the powerhouse to the lower reservoir in the generating mode. Flow will be reversed in the pumping mode of operation. From the Upper Reservoir I/O structure, an upper (“low head”) pressure tunnel will extend approximately 4,000 feet to a 1,390-foot-deep vertical shaft connecting the upper tunnel to the lower (“high head”) tunnel; the lower pressure tunnel will extend 1,560 feet to a penstock manifold; and four penstocks will extend approximately 500 feet to the turbine inlet valves at the powerhouse. From the powerhouse, the four individual tailrace tunnels will extend approximately 200 feet to a tailrace manifold, and the main tailrace tunnel will extend 6,835 feet from the manifold to the Lower Reservoir I/O structure.

The upper pressure tunnel and the main tailrace tunnel will most likely be excavated by tunnel boring machine (TBM). The finished tunnel diameter for the upper pressure tunnel will be 29 feet. For planning, we have assumed that the upper tunnel will be concrete lined; however, depending on rock quality, the upper tunnel may be not be lined throughout its entire length. A concrete-lined manifold will connect the lower pressure tunnel to the penstocks. The four penstocks will be completed to a finished diameter of 15 feet and will be steel lined. The four tailrace tunnels upstream of the concrete-lined tailrace manifold will be completed to a finished diameter of 17 feet. These tunnels will be concrete lined. The main tailrace tunnel from the manifold to the Lower Reservoir will be completed by TBM or drill and blast methods. This tunnel will be shotcrete lined to a finished diameter of 33 feet.

The penstock lining steel is designed to be ASTM A537, Class 1, with a yield strength of 50,000 psi and a design stress with normal pressure rise of 37,500 psi. The resulting thickness will be

1.625 inches. External pressure on the lining will be controlled with drains extending from a grout curtain at the end of the steel lining farthest from the powerhouse to the powerhouse cavern, with provisions for reaming out deposits in the future. Steel linings will be backfilled with concrete and low pressure grouted.

The penstock and tailrace manifolds will be concrete lined, as will portions of the individual penstocks and tailrace tunnels that are not steel lined. Just downstream of the tailrace manifold there will be a rock trap to collect rock spalls and prevent them from reaching the pump-turbines from downstream direction. Access to the rock traps for cleaning will be through a bulkhead door. The door is in a plugged section of a construction access tunnel and from above for the lower tailrace surge tunnel.

Surge control facilities will be provided upstream and downstream from the powerhouse. The upstream surge chamber will be an enlargement of the vertical pressure shaft to a diameter of 90 feet. The surge chamber portion of the shaft will extend from elevation 2,270 to the ground surface at elevation 2,515 feet. The surge chamber will have a restricted orifice entrance to balance the transient pressure rise. The tailrace surge chamber will consist of two horizontal tunnels, each 550 feet long, connected with a shaft, which continues to a connection with the main tailrace tunnel immediately above a rock trap. The tunnels will be 26 feet wide by 26 feet high and horseshoe shape, and the shaft will be 12 feet in diameter. Both the tunnels and the shaft will be concrete lined. Air admission and release to and from the tailrace surge chamber will be through an air shaft extending to the ground surface outside of the landfill boundary. The tailrace surge chamber will also have a restricted orifice below the lower tunnel.

1.5 Underground Powerhouse

The powerhouse cavern will be located underground approximately 6,300 feet from the upper reservoir and 7,200 feet from the lower reservoir. The pump/turbine centerline will be at elevation 770 feet. The cavern will be sized to accommodate four 325 MW units. The cavern will be approximately 72 feet wide, 150 feet high, and 360 feet long. A separate transformer gallery a short distance downstream from the powerhouse will be approximately 46 feet wide, 40 feet high, and 400 feet long.

The powerhouse substructure and superstructure will be constructed of cast-in-place reinforced concrete. The pump/turbine spiral cases will be permanently embedded in second-stage concrete. Floors will be supported with concrete walls and columns. Walls will also serve to partition areas. Substructure and superstructure configurations will be dictated by final mechanical and electrical equipment arrangements.

Suspended corrugated metal panels supported from steel trusses will extend the length of the machine hall. The false ceiling will protect against possible water seepage and rockfalls. A drain system will be provided around the powerhouse walls to carry collected seepage to the powerhouse drainage sump pit.

An unloading and erection bay will be located at one end of the unit bays, accessed by the main access tunnel. Space for the control room, workshop and office and personnel-related space will be located in the two upper levels at the end of the cavern adjacent to the erection bay.

The major equipment will be handled by two 300-ton bridge cranes that will run on rails the length of the unit and erection bays. Floor hatches will be provided for moving other equipment between floors. The turbine inlet valves will be handled with the main crane. The transformers will be moved into place on transfer rails. The draft tube gates will be installed and maintained using a dedicated under-hung bridge crane.

Personnel movement will be by two elevators and two sets of stairs. Emergency exit from the powerhouse is possible through the elevator shaft as well as the main access tunnel.

The locations of the main and auxiliary equipment in the powerhouse are shown in the drawings in Exhibit F.

1.6 Access Tunnel, Elevator Shaft, and Cable Shaft

Access to the underground powerhouse will be through the main access tunnel. This will be a vehicular tunnel that is 28 feet wide and 28 feet high. The tunnel portal will be south-east of the powerhouse. The invert elevation at the portal will be approximately 1,100 feet, and it will enter the powerhouse at elevation 808 feet. The length will be approximately 6,625 feet and the slope 4.4 percent. The tunnel will be shotcrete lined and will have a concrete roadway on the invert. Rockbolts or other rock support will be used as required where areas of weak or broken rock are encountered. The top portion of the tunnel will carry a ventilation duct.

An elevator shaft will extend vertically about 1250 feet from the erection bay floor at elevation 808 feet to the ground surface elevation of 2060 feet. The shaft will be shotcrete lined with rock anchors, and will accommodate an elevator for emergency exit. The cable shaft will be approximately 9 feet in diameter; shotcrete lined with anchors, and will contain steel ladders, cage, and steel platforms for installation and inspection of the power cables extending to the transfer station. The shaft will also serve for ventilation.

1.7 Other Structures

The transfer station will be located just southwest of the powerhouse, at the ground surface about 1,250 feet above the main floor of the powerhouse. It will be located on a level site at approximate elevation 2,060 feet. It will be about 65 by 170 feet, with a gravel surface. The transfer station area will be surrounded by a security fence. A security and maintenance lighting system will be provided.

The transfer station will be connected to the powerhouse with 500 kV oil-filled cables, which pass from the transformer gallery through the cable shaft to the transfer station. The cables exiting the shaft will terminate in the outdoor transfer station and be connected through protective breakers and associated switches to a 500 kV transmission line. The transfer station will contain all necessary disconnect switches, protective equipment and metering equipment.

A switchyard will be located about 4,500 feet south of the powerhouse, outside the boundaries of the proposed future landfill. It will be located on a level site at approximate elevation 1,430 feet. It will be 500 by 1,100 feet, with a gravel surface. The substation area will be surrounded by a security fence. A security and maintenance lighting system will be provided. It will also be designed to protect against bird electrocution if appropriate.

The switchyard will be connected to the transfer station with 500 kV overhead transmission lines from the transfer station. The overhead transmission lines will terminate in the outdoor switchyard and be connected through protective breakers and associated switches to a 500 kV transmission line. The switchyard will contain all necessary disconnect switches, protective equipment and metering equipment.

A fenced area near the access road to the access tunnel portal will contain a storage warehouse building and an administration building.

Access to Project facilities will be in part by the roads that were developed for the mining operations and which are planned to be improved for servicing the landfill. In addition to these roads, new access roads will be constructed for the Project to reach the dams at the Central Pit, both inlet/outlet structures, the upper surge chamber and the access tunnel portal, and storage/administration area. The road to the access tunnel portal and the storage/administration will be paved with asphaltic concrete; the other roads will be gravel surfaced.

1.8 Water Supply and Conveyance Pipelines

Water to initially fill the reservoirs and annual make-up water may be pumped from groundwater within the Chuckwalla Valley. If this water source option is selected, three wells will be utilized to provide fill during the first two years of the project. Water to replace losses due to seepage and evaporation could be obtained from the same source. In this scenario, the applicant proposes to utilize either existing wells or new wells to be installed within or adjacent to a central collection pipeline corridor.

Depending on costs, availability, and other factors, ECE may negotiate for a water supply that could be obtained through the Metropolitan Water District's (MWD) Colorado River Aqueduct (CRA) as a “one-time” source for initial filling. This would require a purchase of water from a willing seller and “wheeling” the water to obtain a supply at the CRA. In this scenario, ground water could be used to provide the make-up water supplies. The CRA could also be the source of make-up water supplies if a long-term contract for exchange water and for wheeling through existing facilities could be obtained.

1.9 Reverse Osmosis System

Concerns exist that because of evaporative losses, reservoirs will gradually increase in salt concentration, and by seepage become a potential source of groundwater contamination. The project proposes to include a desalination facility that will maintain water quality levels in the reservoirs comparable to the existing groundwater quality.

If groundwater is used for initial fill and/or annual make-up water it will be extracted from wells and in the northwestern Chuckwalla Valley. Water quality data from those wells were used for assumptions about the source water quality. While the total replacement water need is estimated to be 2,360 acre-feet per year evaporation and seepage, only the evaporation component (1,760 acre-feet per year) enters into the estimation of water treatment requirements. The reverse osmosis (RO) treatment would remove water from the upper reservoir at a rate of 2055 GPM and remove sufficient TDS to maintain the in-reservoir TDS at the same average concentration of the source water, approximately 660 parts per million (PPM), based on available data for the Chuckwalla wells. Approximately 2500 tons of salts would be removed from the reservoir each year.

Based on information from existing facilities, brackish water desalination uses approximately 1,300 – 3,250 kWh of energy per acre-foot, dependent largely on the source water quality, plant capacity, and technology used. Assuming that the energy need is at the low end because of the high-quality initial water source, annual energy needs for RO treatment would be about 4.4 GWh assuming water would be pumped through the RO membranes. However, the actual energy consumption for RO at Eagle Mountain will be less because of the available pressure head of 1,500 feet to gravity flow water.

The specific treatment process steps are: 1) energy recovery turbine, 2) dissolved air floatation, 3) automatic strainers, 4) microfiltration, 5) reverse osmosis, and 6) brine concentration. The energy recovery turbine will utilize the available head differential to provide the majority of the energy needed for the desalting equipment. The dissolved air floatation (DAF) unit is a clarification process provided to treat water from the reservoir for turbidity control and suspended solids control. The DAF unit is particularly efficient in removing algae. The automatic backwash screens provide protection for the microfiltration system which removes fine particles. The filtered water is pumped through the RO membrane system.

Reservoir return water will return to the reservoir by gravity. The RO concentration will also flow by gravity to the evaporation ponds. The ponds are estimated to be about 56 acres. Typical pond design includes 4 foot berms with double liners to protect against seepage and monitoring wells to identify any liner failures.

1.10 Landfill Facilities

The points of contact between the proposed landfill and the pumped storage hydroelectric facilities have been resolved and both projects can cohabitate the location. The closest contact of the underground tunnels and powerhouse to the landfill is 200 feet (20 stories) through rock. Storm water and leachate systems for the landfill will be diverted away from the lower reservoir to the evaporation ponds. The only shared facilities during Phases 1-4 of the landfill project will be roads and possibly drinking water supplied from the hydroelectric project.

The landfill is to be constructed in phases over 115 years. However, permits issued for the landfill do not include Phase-5, the final proposed phase, scheduled to be built approximately 85 years into the operation of the landfill. Phase-5 proposes to fill the East Pit (Eagle Mountain Pump Storage lower reservoir) with waste. At that time, a decision would be made as to which Project will continue in operation. Since FERC grants licenses only up to 50 years in length, conflict issues between the two facilities would be debated in the new license proceeding decades in the future. Further analysis of the compatibility between the Eagle Mountain pumped storage project and the landfill is provided in Exhibit E.

1.11 Visitor Facilities

Depending on input from resource agencies and the FERC, a scenic/interpretive overlook facility may be provided.

2 Normal Maximum Water Surface Area

2.1 Upper Reservoir

The existing Central Pit of the inactive mine will serve as the Upper Reservoir. A description of the proposed Upper Reservoir for the Eagle Mountain Pumped Storage project is included in Section 1.1. The principal physical characteristics of this reservoir are summarized in Table 2-1.

Table 2-1. Key Data on Upper Reservoir

Parameter	Upper Reservoir
Minimum Normal Pool	
Water Surface El. (ft, msl)	2,343
Storage (acre-feet)	2,300
Surface Area (acres)	48
Maximum Normal Pool	
Water Surface El. (ft, msl)	2,485
Storage (acre-feet)	20,000
Surface Area (acres)	191

2.2 Lower Reservoir

The existing East Pit of the inactive mine will serve as the Lower Reservoir. A description of the proposed Lower Reservoir for the Eagle Mountain Pumped Storage project is included in Section 1.2. The principal physical characteristics of this reservoir are summarized in Table 2-2.

Table 2-2. Key Data on Lower Reservoir

Parameter	Upper Reservoir
Minimum Normal Pool	
Water Surface El. (ft, msl)	925
Storage (acre-feet)	4,000
Surface Area (acres)	63
Maximum Normal Pool	
Water Surface El. (ft, msl)	1,092
Storage (acre-feet)	21,900
Surface Area (acres)	163

3 Proposed Turbines or Generators

The underground powerhouse will contain four equal-size Francis-type reversible, vertical shaft, pump-turbine units. Preliminary unit sizing has been based on typical performance characteristics obtained from information published by the Corps of Engineers and Bureau of Reclamation as well as experience of engineers working on the Project.

The project size (1,300 MW) was selected based on the previous license application and the preliminary permit. Market studies will establish the final installed capacity. The currently proposed configuration envisions 4 units, each rated at a nominal capacity of 325 MW at maximum head. Unit sizes in the 300 to 350 MW range are fairly common throughout the United States (for example Bath County, Ludington, and Raccoon Mountain). The hydraulic capacity of each turbine will be approximately 2,900 cfs (11,600 cfs total). The operating speed of the turbines will be about 333 rpm, and the rated head for the pump/turbine units will be about 1,410 feet. The principal characteristics of the proposed pump-turbine/motor-generators are summarized in Table 3-1.

In the pumping mode, the units will operate the hydraulically actuated wicket gates in the fixed mode, with maximum pump discharge corresponding to the operating head. Each pump will be directly coupled to a vertical shaft, three phase, 60 Hertz, ac motor/generator. Each motor/generator will have 20 poles and be rated at 347 MVA.

Pump starting will be accomplished with a static frequency converter (SFC). This system will bring each unit up to synchronous speed with the water in the turbine and draft tube depressed with compressed air. When the unit reaches normal speed, the compressed air will be released and the inlet valve will then be opened. Back-to-back starting will also be provided as a backup to the SFC starting.

In the generating mode the units will rotate in the opposite direction and be controlled by an electronic governor that operates the hydraulically actuated adjustable wicket gates. Each generator will have a variable frequency output that is converted electronically to 60 Hz synchronous frequency for transmission at 500 kV. The size of the motor/generators is determined by the pumping power requirements at minimum head. The maximum power output is controlled by the hydraulically actuated adjustable wicket gates. The objective of the variable frequency is to optimize the efficiency.

Table 3-1. Principal Characteristics of the Hydroelectric Plant

Project Feature	Value
Total Plant Capacity	1,300 MW
Number of Units	4
Unit Rated Capacity	325 MW
Maximum Plant Discharge	11,600 cfs
Rated Flow (each unit)	2,900 cfs
Approximate Maximum Gross Head	1,560 feet
Approximate Minimum Gross Head	1,250 feet
Overall Efficiency	86.6%
Efficiency (Pumping/Generating)	92% / 98%
Capacity (Pumping/Generating)	319 MW / 347 MVA
Operating Speed	333 rpm

4 Primary Transmission Lines

Power will be supplied to and delivered from the Project by a single circuit 500 kV transmission line. The line will extend approximately 50.5 miles from the Project switchyard to the proposed Colorado River Substation adjacent to the existing Palo Verde-Devers 500-kV line owned by SCE.

A new substation/switching station at Eagle Mountain will be constructed, requiring an estimated total area of approximately 25 acres. The proposed Colorado River substation facilities, southwest of Blythe, California would be expanded to accommodate the interconnection of the proposed project transmission line.

The typical right-of-way for the transmission line will be about 200 feet. However the right-of-way width could be reduced in specific locations to mitigate potential impacts to resources (e.g., historic trails, adjacent land restrictions, existing roads and highways, and biological and cultural resources). The total right-of-way area is estimated to be approximately 1,188 acres, which does not include construction access roads. A summary of additional proposed transmission line facilities and communication facilities is presented in Table 4-1.

Table 4-1. Summary of Proposed Transmission Line Facilities and Communication Facilities

Transmission Line Facilities (500 kV, single circuit)
• Conductors: One, three-phase AC circuit consisting of three 1.5 to 2-inch ACSR conductors per phase.
• Minimum Conductor Distance from Ground: 35 feet at 60°F and 32 feet at the maximum operating temperature.
• Shield Wires: Two 1/2 to 3/4-inch-diameter wire(s) for steel lattice.
• Transmission Line Tower Types:
  - Steel Lattice Tower along entire route.
  - Structure Heights (approximate): Steel Lattice – 100 to 180 feet.
• Average Distance between Towers: Steel Lattice – 1,200 feet.*
• Total Number of Towers (approximate): 225 – 265.*

Communications Facilities • Systems: Digital Radio System, microwave, VHF/UHF radio, fiber optics. • Functions: Communications for fault detection, line protection, SCADA, two-way voice communication.
*The exact quantity and placement of the structures depends on the final detailed design of the transmission line and route, which is influenced by the terrain, land use, and economics. Alignment options may also slightly increase or decrease quantity of structures.

5 Additional Equipment

The Project will have all appurtenant equipment necessary for the safe and efficient operation of a large pumped storage project. The detailed specification for the appurtenant equipment will be developed during the detailed design phase. The general characteristics of the equipment are listed in Table 5-1.

Table 5-1. General Characteristics of Additional Project Equipment

EQUIPMENT	DESCRIPTION
Upper Reservoir Inlet/Outlet Gate and Hoist	Fixed wheel leaf type gate operated by electric/ hydraulic remote controlled hoist.
Upper Reservoir Inlet/Outlet Trashracks	60 ft x 84 ft of steel bar trashrack
Lower Reservoir Inlet/Outlet Gates and Hoist	Fixed wheel leaf type gate operated by electric/ hydraulic remote controlled hoist.
Lower Reservoir Inlet/Outlet Trashracks	65 ft x 84 ft of steel bar trashrack
Pump/Turbine Inlet Valves	Four 108 inch diameter spherical valves, with full closing capability.
Pump/Turbine Draft Tube Gates	Four 10 ft x 14 ft high presser slide gates operated by electric/hydraulic hoist.
Powerhouse Bridge Crane	2 x 300 ton overhead, top running, electric bridge crane
Draft Tube Gates Crane	30 ton Under-hung electric bridge crane
Auxiliary Powerhouse Cranes and hoist	Electric monorail hoists sized and located for erection and maintenance of equipment in addition to the Powerhouse Bridge Crane.
Cooling Water System	Water intake from and discharge to the tail-race tunnel to provide cooling for pump/turbines, motor/generators, transformers, compressors and Powerhouse HVAC compressors.
Compressed Air Systems	Compressors, pipe, and accessories to provide air for draft tube depression, station service, motor generator brakes and high pressure governor.
Drainage Systems	Plant drains, piping, pumps, sump, and oil separating facilities.
Unit Dewatering and Filling	High capacity pumps, sump, pipe, and accessories connecting the unit draft tubes, pressure tunnel and tailrace tunnel.
Fire Protection Equipment	Detection, alarm, isolation and extinguishing equipment.
Potable Water and Sanitary Services	Extend existing nearby potable water system to plant. Pump sanitary wastes to surface and transfer to existing nearby sewer systems to be treated.

EQUIPMENT	DESCRIPTION
Heating, Ventilation, and Air Conditioning	Central HVAC system for control room, communication rooms, workshop and personnel spaces. Ventilation exhaust system for powerhouse cavern, transformer cavern and electrical equipment areas. Ventilation system for cable/emergency exit tunnel.
Elevator	Two electric personnel elevators.
Diesel Generator	1,000 kW emergency, diesel fueled generator.
Unit Transformers	Transformers to consist of two banks of three 500/18 kV, 167 MVA, single-phase, three winding transformers. One spare will be provided.
Bus	18 kV, isolated phase bus duct.
Generator Circuit Breakers	Metal enclosed, SF6 type.
18 kV Switchgear	Generator/motor circuit breakers and motor start circuit breakers SF6 type, motorized phase reversal switches, motorized disconnect switches.
Outdoor Switchyard	500 kV switchyard, open-air bus type including 500 kV cable terminations, disconnect switches, coupling capacitor voltage transformers, current transformers, power line carrier line traps, surge arrestors and transmission line termination structures.
Station Service Power	480 volt, 3-phase, 60 hertz. Transformers will be 2,000 KVA, cast-resin dry type. Switchgear will consist of draw-out-type air circuit breakers. The system will include major control centers, panel-boards, and associated accessories. DC system for control and monitoring will consist of batteries, chargers, and the distribution system.
Controls	Fully distributed industrial grade control, monitoring, and protection system for complete manual and automatic operation including instrumentation, alarms, hardcopy recording, and limited supervisory control. Fiber and microwave link for real-time connection and control by the CAISO.

6 All U.S. Lands Identified and Tabulated

All lands of the United States, portions of which may be within the project have been tabulated according to legal subdivisions of public lands survey. Table 6-1 presents the lands of the United States within the project boundary. Note that the tabulation presents each plot identified within the project boundary. In actuality, only a 200-foot wide strip within or adjacent to the identified plot may be within the project boundary. The table identifies the acreage of federal lands with two alternatives, if the land exchange between the BLM and Kaiser is effectuated, the other if the land exchange is not effectuated. If the land exchanged is effectuated, the amount of federal land this project will affect is decreased.

Table 6-1. Lands of the United States Affected by the Eagle Mountain Pumped Storage Project

Federal Lands (All BLM)

Facility	Area (acres)		Location		
	With land exchange	Without land exchange	Section	Township	Range
Transmission and Water Pipeline	1157	1188	Section 11, 12, 13	Township 4S	Range 14E
			Section 7, 8, 17,18, 20, 21, 25, 26, 27, 28, 34, 35	Township 4S	Range 15E
			Section 19, 30,	Township 4S	Range 16E
			Section 8, 17, 21, 22, 23, 25	Township 5S	Range 16E
			Section 31, 32	Township 5S	Range 17E
			Section 4, 5, 8, 9, 10, 13, 14, 15, 23, 24	Township 6S	Range 17E
			Section 19, 28, 29, 30, 32, 33, 34, 35	Township 6S	Range 18E
			Section 31, 32, 33	Township 6S	Range 19E
			Section 1,2,3	Township 7S	Range 18E
			Section 1,2,3,4,6	Township 7S	Range 19E
			Section 1,2,3,4,5,6	Township 7S	Range 20E
			Section 6, 7	Township 7S	Range 21E
Access Road	-	22	Section 1	Township 4S	Range 14E
			Section 6, 7	Township 4S	Range 15E
Road to Upper Reservoir	38.7	126.8	Section 27, 33, 34	Township 3S	Range 14E
Upper Tunnel	-	83.2	Section 26, 27, 35	Township 3S	Range 14E
Lower Tunnel	-	3.4	Section 35	Township 3S	Range 14E
Staging Area	-	44.5	Section 31	Township 3S	Range 15E
All Other Facilities	-	55.9	Section 6,7,	Township 4S	Range 15E
TOTAL	1196	1524.5			

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