Southern California Edison
Circle City and Mira Loma-Jefferson PTC A.15-12-007

DATA REQUEST SET A1512007 ED-SCE-18

To: ENERGY DIVISION
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Question 18.04:

Section IV, Part B of the SCE Draft EIR comments state: "SCE's Proposed Project presents a more cost-effective solution for SCE's customers than the battery alternative endorsed by the ESA." We are trying to better understand how these costs vary over time. To support this statement, please
quantify how SCE incorporated relative costs over time with regard to battery replacement vs. the cost of a substation. Please explicitly cover SCE's cost of capital and the present value revenue requirement.

Response to Question 18.04:

Cases Evaluated
In order to respond to this question, SCE has developed and evaluated 7 different cases to quantify the substation costs vs. various battery alternatives. These cases include:

Case 1) traditional substation built for operation in 2023;

Case 2) 10 MW of batteries installed in 2021 with no replacement cycle; Battery Only; Single Installation (DEIR Alternative D1, Option 2A)

Case 3) 15 MW of batteries built in 2021 and 2027 with no replacement cycle; Battery Only; Single Installation (DEIR Alternative D1, Option 2B)

Case 4) 20 MW of batteries built during 2021, 2027 and 2029 with no replacement cycle; Battery Only; Single Installation (DEIR Alternative D1, Option 2C)

Case 5) Case 2 with the batteries replaced every 10 years throughout a 40-year project lifecycle;

Case 6) Case 3 with the batteries replaced every 10 years throughout a 40-year project lifecycle; and,

Case 7) Case 4 with the batteries replaced every 10 years throughout a 40-year project lifecycle.

Rationale for Case Attributes
Case 1 reflects SCE's proposed project. Cases 2, 3 and 4 reflect the battery alternatives presented in the DEIR. Cases 5, 6 and 7 reflect the battery alternatives presented in the DEIR operating over the equivalent life a substation. The 40-year life was chosen since this lines up with the currently authorized approximately 40-year life of a substation. A 10-year replacement cycle for the batteries was selected since this is the replacement cycle SCE presented in its most recent GRC.

Development of the Cash Flows

SCE developed cash flow models for each of the seven cases. Costs were based on SCE's projected cost to construct the substation as well as SCE internal costs (based on SCE proprietary models) to construct battery energy storage systems ("BESS") in the future. Revenue estimates were developed through the use of SCE proprietary models and forecasts of future electricity costs.

Present Value of Revenue Requirement (PVRR)

SCE has performed a PVRR analysis to compare the costs of each of the alternatives. PVRR is a single value that sums the time-discounted cash flows (in terms of revenue requirements) for each year of the project. This converts the ratepayer revenue required to repay an investment over its life into a common basis in current-year dollars (2018 for this case). The PVRR value for each of the alternatives can then be compared to determine which alternative is the most cost effective. Note that recorded costs through 2017 are **not** included in the PVRR analysis but are captured in the Capex column for each alternative analyzed and the estimates provided are only applicable to SCE-owned storage. Use of PVRR analysis also allows SCE to present the impact of battery revenues on the financial benefits of each Case without releasing SCE battery revenue forecasts which are proprietary and confidential.

The results of the developed cash flows and PVRR calculations are listed in Table 1 (below).

Table 1: Total Capital and PVRR

Case #	Description	MVA	Capex	PVRR
1	Substation Only	72	$128.5	$125.1
2	Battery Only; Single Installation (DEIR Alternative D1, Option 2A)	10	$103.9	$99.3
3	Battery Only; Single Installation (DEIR Alternative D1, Option 2B)	15	$118.4	$108.3
4	Battery Only; Single Installation (DEIR Alternative D1, Option 2C)	20	$135.2	$119.2
5	Battery Only; Replacement Cycle	10	$140.5	$101.6
6	Battery Only; Replacement Cycle	15	$178.0	$111.6
7	Battery Only; Replacement Cycle	20	$220.9	$120.3

Notes:

$ in millions

Nominal capital and PVRR for costs incurred in 2018 and later

Use of PVRR Metric

Caution should be exercised in solely using PVRR to evaluate the alternatives. Cases 1, 5, 6, and 7 each have an approximately 40-year project lifecycle, while cases 2, 3 and 4 are much shorter. The substation alternative (Case 1) can operate up to 72 MVA, while the largest battery installation is rated at 20.3 MVA (Cases 4 and 7), so the substation alternative has over 3 times greater capacity. Consequently, if the load continues to grow beyond 20 MVA, the substation alternative will continue to serve the need with no additional cost. For a battery only solution (Cases 2 through 7), another solution will be needed which will add cost beyond what is presented in the cases above. In addition, there are a number of reliability and operational flexibility advantages of the substation over the batteries. These have been presented in SCE's response to Data Request 15 Question 5 and in SCE's comments to Table 5-3 of the Draft EIR and it should be emphasized that the battery alternatives can only be used to serve load when the batteries are charged and available versus that of a substation that would almost always be available to serve load.

Sensitivity Analysis

The analysis compares the PVRR of the proposed project with the PVRR of the battery-only alternatives. The PVRR reflects the revenue requirement of the capital expenditures incurred in 2018 and beyond, including replacing the batteries every 10 years to approximate the equivalent life of a substation. The PVRR also includes the battery market revenues over the life of the batteries, which would offset the capital revenue requirement.

In the analysis, SCE chose to use the values supporting the Low Cost Projection case cited by NREL (National Renewable Energy Laboratory) rather than the Mid Case because it is closer to other recent external forecasts, including those in Bloomberg New Energy Finance's 2018 New Energy Outlook. However, because battery costs over the next 10 to 30 years are highly uncertain, SCE also calculated the PVRR using NREL's Mid Case to test how sensitive the results are to battery costs.

Using NREL's Mid Case, the PVRR increased by $9.6 million, making the net PVRR of the battery-only Alternative C higher than the proposed project's by approximately $5 million.

Assumptions

The assumptions used in this response are listed in Table 2.

Table 2 - Description of Assumptions

Length of Forecast	o To make the lifecycles equal, modeled cash flows required over life of substation o Assumed battery energy storage systems are replaced every 10 years o Revenue requirement extends over life of assets
Cash Flows	o For the purposes of calculating the PVRR, SCE only included capital expenditures incurred during and after 2018. Because the costs prior to 2018 are the same in all cases, this will not affect the differences between each case.
Discount Rate	o The revenue requirements for the capital investments are discounted at 10%, representing SCE's incremental cost of capital o The battery market revenue is also discounted at 10%
Battery Revenue	o Market benefits are based on the 5/22/2018 price forecast from SCE o Energy price used is SP15 (South of Path 15) (not nodal) o Ancillary Service (AS) market performance is based on SCE standard RFO assumptions which are based on historical AS (Ancillary Services)performance

	of flexible hydro resources o Energy storage specifications are based on SCE's estimates based on an installation year of 2020 (Round trip efficiency of 90%, annual energy degradation rate of 2.0%) o Resource adequacy (RA) start date is one year after battery energy storage system's (BESS) online date and assumes the BESS receives its full NQC (Net Qualifying Capacity) through the DGD (Distributed Generation Deliverability) [1] assessment process. SCE assumes that it takes 1 year to get an NQC when going through the DGD process. o RA (Resource Adequacy) capacity degrades as the energy of the system degrades o Analysis does not include idle load cost o The BESS is taken out of the market during the days in which it is needed for substation deferral. o The BESS did not receive RA value in the months of June through September (every year) to be consistent with a strict interpretation of D.18-01-003. [1] Reference: www.caiso.com or https://www.sce.com/wps/portal/home/business/generating-your-own-power/Grid-Interconnections/The-California-Independent-System-Operator--CAISO----Wholesale-Markets/!ut/p/b0/04_Sj9CPykssy0xPLMnMz0vMAfGjzOK9PF0cDd1NjDz9TUONDRzNnDyCfYLCjLz9DfULsh0VAc8CxVs!/#accordionGrp1-1-hash
Battery Price Forecast	o Source: **NREL (National Renewable Energy Laboratory). 2018. 2018 Annual Technology Baseline.** Golden, CO: National Renewable Energy Laboratory. http://www.nrel.gov/analysis/data_tech_baseline.html. o Points in between forecasted years between years forecasted in the NREL study are linearly interpolated and escalated to nominal dollars.
Battery Life Cycle of 10 Years	Consistent with GRC request. Excerpt from SCE's 2018 GRC, SCE-09, Vol. 03: (8) Energy Storage The Commission has required SCE to procure and install 580 MW of energy storage facilities in its service territory by 2020. These facilities represent emerging technology and face significant risk of technological obsolescence in the future. SCE estimates the life of Energy Storage by the design life, cycle times of the proposed facilities, discussion with engineers, reviewing of reputable engineering studies and benchmarking with industry peers. SCE proposes a 10-year average service life for the Energy Storage and this represents a reasonable estimate of the expected life of these facilities when they are deployed.

SCE Cost of Capital

The revenue requirements for the capital investments are discounted at 10%, representing SCE's incremental cost of capital