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 18.01:

The first complete paragraph on page 5 in Section IV, Part B of SCE's comments includes the following statements:

"Unlike a substation where multiple substation sources (i.e., subtransmission lines) provide a constant source of power to the substation allowing it to be available all of the time (increasing reliability and operational flexibility), batteries are unable to alleviate electrical demands outside of the immediate circuits they are connected to, and the existing substation which serves those circuits, nor are they available all of the time. Further, because batteries do not have their own source of constant independent power (e.g., 66 kV source line and 66/12 kV transformers), they are unable to operate and serve load separately from the electrical facilities surrounding them; rather their function would be to supplement existing electrical facilities. These shortcomings will become especially important after 2031, or once it is determined that the battery solution can no longer support the ENA. Accordingly, it is imperative that a substation alternative be included in order to provide the operational flexibility SCE needs to balance electrical loads among multiple substations in the ENA, and enhance the reliability of electrical service to SCE's customers."

Please provide a description of SCE's standard practices for transferring load between distribution substations within a distribution planning area for reliability purposes. In particular, please indicate how much "headroom" (in MW or MVA, depending on how that capacity is measured) in the distribution planning area SCE plans for for load switching from other substations in the same planning area. If these numbers are based on targeted Customer Average Interruption Duration Index (CAIDI), System Average Interruption Duration Index (SAIDI), or System Average Interruption Frequency Index (SAIFI) levels, please include them explicitly. We understand these planning exercises are done based on peak load numbers and do not include consideration of the varying load cycle, yet the comment suggests that the inability of the battery storage facility to provide continuous voltage to the grid reduces its operational flexibility. The response should indicate how the potential storage resource associated with Alternative D1, which would directly reduce the peak load at Chase Substation, would be handled differently for transferring peak load and off-peak load compared to Circle City Substation from a reliability planning perspective.

Response to Question 18.01:

SCE presents the answer and reasoning below as a response to this data request question and to support its rationale behind its position that the Circle City Substation is a superior solution to that of a battery energy storage solution from the position of addressing the capacity, reliability, and operational flexibility needs of the area under a broad-range of reasonably expected system conditions. As SCE has stated before, its proposed Circle City Substation project is the preferred solution; however, SCE can support a solution that would include approval to construct the Circle City Substation as a "backstop" should circumstances occur to demonstrate that the battery storage solution was either insufficient to meet capacity needs (demand exceeds available capacity including the batteries) or proved operationally inadequate.

SCE performs distribution system load transfers for a number of reasons which include transfers to address distribution substation *transformer* capacity needs and also distribution *circuit* capacity needs. This is to say, load transfers may be made to address projected overloads of a substation, of individual circuits, or both.

SCE's standard practices for transferring load between distribution substations within a distribution planning area are implemented on an annual basis as part of SCE's 10-year distribution planning process. When a forecast capacity deficit is identified in an area, an assessment is made evaluating the capabilities of surrounding facilities to accommodate the identified deficit through transferring, or reallocating load from the area with the capacity deficit to a nearby area with available capacity and which would not require significant new construction activities. This is a consistent planning practice SCE employs when reviewing alternatives to solve capacity needs. If the surrounding areas and associated electrical facilities are determined to have insufficient available capacity to address the forecast deficit, a project (or projects) is proposed to increase capacity of existing infrastructure or to install new infrastructure to add capacity.

Within SCE's service territory, the most common distribution voltage is 12 kV. The distribution circuits which operate at this voltage are typically planned to have an average loading value during peak load conditions of approximately 8 MW. The circuits can be operated at higher levels and generally**,** out of any particular substation**,** it is not uncommon that some circuits at peak loading conditions are above and some below 8 MW. By planning for an average of 8 MW per circuit, this affords a reasonable amount of "headroom" or available capacity of circuits to provide assistance during an unplanned outage of a circuit or of a transformer at an adjacent substation. The average circuit loading values that are planned for and the associated "headroom" to address unplanned outages are not directly associated with reliability metrics such as SAIDI, CAIDI, or SAIFI; however, SCE's approach to maintaining some "headroom" on each circuit is an essential planning practice to maintaining a high level of system reliability.

There are a number of circumstances that SCE references where a substation solution would be expected to be superior to a battery energy storage solution. As an example, Circle City Substation upon its initial construction is planned to have 56 MW of nameplate transformer capacity and four 12 kV distribution circuits. Should the four circuits each transfer 8 MW of capacity from existing facilities in the area (totaling approximately 32 MW) and which would most likely come from Chase Substation, Chase Substation would then have been relieved of 32 MW of load that it had previously served. The distribution circuits that previously served that load would also then have significant capacity available for which the circuits could then be used to perform load transfers to Chase Substation from the neighboring Jefferson and Corona Substations using the ties that exist between these three substations through the distribution circuits. Through this practice, load is permanently reallocated in the electrical needs area resulting from the capacity addition afforded by the new Circle City Substation and its distribution circuits. This process systematically reshapes the coverage areas of the existing substations through use of permanent cascading load transfers. Please see the attachment titled "A.15-12-007 ED-SCE-18 Q1.pdf" for an illustration depicting a conceptual "before and after" of the electrical needs area with and without the Circle City Substation at full build-out. The first illustration represents the current areas of coverage of the three existing substations. The second diagram represents what the areas of coverage for each of the four substations (including Circle City) may look like over time following the reallocation of load between them.

The actual practice of performing these load transfers, however, is not trivial. It involves a thorough review of such things that include: substation transformer capacities, individual circuit capacities, voltage support, distributed energy resource (DER) penetration, unique circuit characteristics that may be present,[2] geographical constraints, permitting constraints, etc. To perform desired load transfers of specific discrete amounts, it is not uncommon that this can require that the circuit be segmented in a way that is different from its current configuration. For example, if existing switch locations do not allow for the transfer of the desired load amount, new switches/equipment may have to be installed to allow for that. All of these activities take significant time to plan, model, scope, document,[3] permit, and construct. For these reasons, proposed load transfers are carefully planned and executed and are considered permanent for normal operating conditions. While the distribution grid is always evolving and changing, a considerable amount of effort and resources are involved in making changes to ensure that the resulting configuration is safe, reliable, flexible, and operationally sound.

SCE anticipates that the use of battery energy storage facilities would be able to provide capacity under normal system conditions to reduce loading on the circuits to which they would be attached for a discrete period of time, as well as to Chase Substation from which those circuits emanate. However, this is with the understanding that this load relief would occur only during times of discharge and upon their depletion, they would then become a load on the circuit and substation (while recharging) and when fully charged, would be switched off in preparation for their next discharge cycle. In terms of peak load conditions, this load relief is expected to positively impact the loading out of Chase Substation, but this load relief is temporary, in that it is not available at all times in a manner in which a load transfer would be. After the battery energy would be exhausted, or if the batteries were unavailable for any reason, the circuits would still be responsible for serving all of the load connected to them.

As an example, by connecting 5 MW of battery energy storage to each of the four circuits from Chase Substation and using a planned loading limit of 8 MW for each circuit as described earlier, this implies that there would be 5 MW of additional capacity on each circuit following the connection of the batteries. This would then allow for this capacity to be used to transfer load from adjacent circuits. Most likely, these transfers would offload other circuits emanating from Chase Substation which in turn would then transfer load to Chase Substation from Jefferson or

Corona Substations. Following the battery storage installations and the corresponding capacity increases they provide, load transfers would result in increasing the actual connected peak load to approximately 13 MW (the original 8 MW plus the additional 5 MW).

After the load transfers, if for any reason the batteries on any particular circuit were not available,[4] the actual peak load on that circuit would be higher than intended and be overloaded. As there are the four circuits that primarily serve the area surrounding the proposed Circle City Substation site, the circuit ties that they have are predominantly between each other and they also share common overhead and underground structures for most of their routes from Chase Substation. This results in the risk of events occurring which could cause some of the battery resources to not be available should a likely contingency event occur (which SCE plans for) such as a car-hit pole or an underground duct bank failure. Such a contingency event involving only a single structure, but with multiple circuits, could cause an outage to two or more of the connected battery installations. This could remove from service much of the installed battery storage capacity at both the circuit level and at the Chase Substation level. Circuit overloads, substation overloads, and possible load shedding are potential outcomes. During such an event, it would be typical for the adjacent circuits to be used to assist in restoring electrical service to the circuit(s) which experienced the unplanned outage. This either may not be possible due to high loading values on the adjacent circuits or may result in the inability to operate the all of the battery resources during the abnormal condition.

As an additional example, if an unplanned outage on a battery supplemented circuit occurred due to a car-hit pole, the adjacent circuits (also battery supplemented) would likely be used to assist in restoring electrical service to a portion of the affected circuit while repairs were made. This potentially results in the adjacent circuit serving the section of the affected circuit that had the 5 MW battery storage installation connected to it. This would result in a single distribution circuit with 10 MW of battery storage capacity connected to it. Real-time operational considerations would then have to be made to determine if the combined 10 MW of battery storage resources on one circuit could remain operational or if curtailment of the battery resource would have to occur for the duration of the outage and/or repairs. This determination would depend on many things including circuit loading values, other connected DERs, and the voltage requirements of the circuit. Significant amounts of distributed energy resources on a circuit can result in high voltage conditions for the customers served by the circuit. Should 10 MW on a single circuit result in such conditions, the resource would likely have to be curtailed to ensure SCE could maintain voltage to its customers within the acceptable ranges as required by its Rule 2 filing[5] with the CPUC.

In contrast, a substation with its initial 56 MW of installed transformer capacity and the associated permanent load transfers that would occur within the broader electrical needs area, is not expected to encounter similar issues serving the load during fairly commonplace distribution circuit outages. This is because the capacity resources (substation transformers) are within the substation itself and subject to far less exposure to outages than would distributed resources (battery installations connected to distribution circuits) whose availability are subject to circuit related outages. Additionally, with a substation solution, loading on the distribution circuits would be expected to remain consistent with the 8 MW average value discussed above, thus maintaining the necessary “headroom” to provide assistance and operational flexibility. There are a great number of permutations of circuit configurations that could occur following an unplanned outage and a traditional substation facility and its distribution circuits are well equipped to address these conditions safely and reliably under a variety of conditions that address both normal and abnormal system configurations without adverse impacts to reliability and operational requirements.

Scenarios such as those presented above are representative of some of the uncertainties regarding the battery energy storage facilities and for which SCE has concerns. It is to be expected that with several years of operational experience and performance history with the battery storage facilities being operated in this capacity, SCE would be in a better position to quantify, with empirical data, its concerns should there be any. Because of these uncertainties, and absent a decision approving the substation project initially, SCE strongly supports a solution that would include approval to construct the Circle City Substation as a fail-safe should circumstances occur to demonstrate that the battery storage solution was either insufficient to meet capacity needs (demand exceeds available capacity including the batteries) or proved operationally inadequate.

Alternatively, with the Circle City Substation solution, the reasonably probable scenarios presented in the examples above would not likely occur or, at a minimum, be managed by the operational flexibility and capacity addition of the substation solution. This is because with the type of permanent load transfers that would occur and the corresponding reallocation of load throughout the three existing substations, none of the circuits or substations would be loaded to a level that would be above their planned operating limits under either normal or abnormal (any single facility out-of-service) system conditions. Additionally, Circle City Substation would have a constant power source and the relief it could provide would be available at essentially all times.

[1] For simplicity, unity power factor is assumed and therefore MW=MVA.

[2] May include such things as critical load customers, preferred/emergency switchgear, operational constraints due to design features, etc.

[3] Includes such things as making map changes, outage management system updates, energy management system updates, asset management updates, etc.

[4] Performance issues, maintenance issues, failure to operate, circuitry related outages separating the batteries from the grid, etc.

[5] https://www.sce.com/nr/sc3/tm2/pdf/rule2.pdf