Southern California Edison
Presidential Substation Project A.08-12-023

DATA REQUEST SET Presidential ED-09 Supplemental

To: ENERGY DIVISION
Prepared by: Rosalie Barcinas
Title: Project Manager
Dated: 07/17/2012

Question 01 Supplemental:

Please confirm (or provide corrected information) that existing Potrero Substation transformers are in the process of being replaced and the new units will have transformer ratings of 28 MVA top rating (PLL 36.4 MVA) however, the existing transformer breakers and bank leads will continue to limit the substations capability to the current 128.9 MVA and there are no plans to upgrade the bank leads and breaker.

Response to Question 01 Supplemental:

SCE has amended its original response to remove those portions considered confidential. Please consider the non-confidential response below as a companion or supplemental response to the original response.

The current No. 3 transformer bank (composed of 2 - 22.4 MVA transformers connected in a "back to back" configuration with a top rating of 44.8 MVA) is scheduled to be replaced with a new bank (composed of 2 -28 MVA transformers connected in a "back to back" configuration with a top Rating of 56 MVA) by 12/31/2012. This transformer bank is being replaced due to an existing Infrastructure Replacement (IR) project which does not include replacement of the transformer breakers and bank leads (which can impact the useable capacity of the No. 3 transformer bank). Since the transformer breakers and bank leads are not being replaced as part of the IR project, the full capacity of four 28 MVA transformers may not be achieved. Prior to the No. 3 transformer bank replacement, a new heat run study will be performed to determine the revised total substation transformer bank capability.

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Question 02 Supplemental:

If System Alternative B was revised to include the expansion of the three existing ENA Substations (Potrero, Thousand Oaks, and Royal), discuss the technical feasibility issues/constraints at each substation. Such an alternative would assume that the existing transformer banks would continue to be used but each substation would add a third bank similar in design to existing transformer banks (i.e. two back to back transformers each rated 28 MVA @65C rise OA/FA/FA, PLL rating 36.4MVA). Also assume expansion would be restricted to within existing substation property and would not require all three expansions (if feasible) to occur at the same time. Address changes and work necessary to accommodate third transformer bank, including:

- Necessary expansion of the 16kV switchrack to accommodate up to an additional five16kV circuits.
- Necessary changes/additions to 16kV get away lines and cables.
- 69kV bus and upstream transmission upgrades required.
- Any other physical/electrical issues that may need to be addressed to accomplish the expansion.

Response to Question 02 Supplemental:

SCE has amended its original response to remove those portions considered confidential. Please consider the non-confidential response below as a companion or supplemental response to the original response.

Challenges Related to Adding a Third Bank at Potrero, Royal, and Thousand Oaks Substations

In response to this data request, SCE has performed the conceptual engineering required to evaluate the impact of adding a third bank to Potrero, Royal, and Thousand Oaks substations. SCE's primary concerns with this proposal are related to the revised configuration of the 16 kV and 66 kV switchracks that would be required to accommodate an increased substation nameplate capacity. Other concerns are related to maintaining compliance with SCE's operating

and design standards. SCE's concerns and technical challenges are discussed below.

16 kV Switchrack Configuration

The existing 16 kV switchrack (at Potrero, Royal, and Thousand Oaks substations) is configured in a Double Operating and Transfer bus arrangement, which is SCE's standard design. This configuration is appropriate for the existing two bank substation configuration. However, adding a third bank at each of the three substations would require SCE's standard Double Operating and Transfer bus arrangement to be changed to a non-standard three operating bus arrangement with one long bus and two short buses. This seemly small change results in an extremely complex configuration that would result in exposing SCE's workers to increased safety hazards and would also increase the difficulty in operation of the equipment. Examples of safety hazards inherent in the proposed design include increased short circuit duties that exceed the interrupting ratings of SCE's highest rated distribution circuit breakers, and could result in severe arc flash exposure to SCE field crews if switching errors are made or in the case of equipment failure during operation. SCE's highest rated distribution circuit breakers come equipped with an interruption rating that is significantly lower than the calculated fault current under certain operating conditions with this non-standard configuration. In addition, other operating complexities would limit SCE's ability to balance loads on the transformer banks within the substation, increase the potential of circuit breaker mis-operation due to circulating currents, and increase the potential of restoration delays due to field personnel's lack of familiarity with a non-standard substation configuration. SCE also does not have an alternative design available that would fit in the space available at the existing substations.

While the short circuit duty issue can be resolved by the replacement of all 16kV circuit breakers at the three (3) substations (moving up to a larger circuit breaker interrupting rating), these breakers are not qualified for use on SCE's distribution system. SCE believes that it would take up to 36 months to specify, manufacture, and test a new breaker that meets the new interrupting requirements for these three substation applications. Once this new breaker is developed and tested, SCE would then need to evaluate if this new breaker would physically fit within the existing switchrack. If it is determined that the newly qualified circuit breaker does not fit, then this option would no longer be viable. In addition, as a result of the higher imposed fault duty, SCE would need to develop a new safety grounding system specific to these three substations to protect the field crews who would be responsible for constructing, operating and maintaining the equipment in the switchrack.

66 kV Switchrack Configuration

Increasing the substation ultimate nameplate capacity from 112 MVA to 168 MVA would limit the ability of the substation to maintain service to customers during the loss of a 66 kV operating bus with the current configuration. SCE's "Loss of an Operating Bus" criteria requires the substation to be able to carry the peak substation load on one 66 kV subtransmission supply line when the 66 kV operating bus is out of service for planned or forced outages. The increased substation loads associated with the proposed capacity increases would prevent the substation from meeting this reliability requirement

during summer load conditions. There are essentially two potential options to resolve this criteria violation: (1) increase the size and rating of the subtransmission system supply conductors; or (2) provide a new switchrack design that is configured with a Double Operating Bus. The first option could potentially require replacing many or all of the poles and conductors on at least two of the 66 kV subtransmission lines that supply each of the substations. The second option would require the installation of SCE's standard Double Operating Bus configuration (Breaker and a Half arrangement), which features two operating buses, with 3 breakers installed in series (in each bay) between the two operating buses, allowing the installation of two line positions, or a line and a bank position in each bay. However, this configuration would not fit within the existing property lines of these substation facilities, and is therefore not viable.

While it may be possible to install a non-standard Double Bus, Double Breaker (DBDB) configuration in place of the existing Operating and Transfer Bus configuration at each of the substations to address the 66 kV switchrack concerns, it does not resolve the non-standard design for the 16 kV switchrack configuration as well as the stated safety and operational concerns associated with the 16 kV switchrack. Furthermore, this configuration would be a non-standard design that is not familiar to SCE's field crews, would require additional grounding activities, personnel training, would limit use of "out of town" crews during emergency conditions (thus impacting customer reliability), and would potentially result in a higher total cost of ownership than the more economical Breaker and a Half configuration.

Standards

SCE strives to construct substations in a consistent manner, meaning that the substation layouts, switch rack designs, equipment, and operating requirements at each substation are consistent and familiar to the field personnel that are required to operate and maintain the equipment at multiple substations. These standards are developed and revised as necessary based on experience to ensure we are building safe, reliable and operable substations on a consistent basis. In addition, the consistent design ensures that upgrades to existing substations and / or construction of new substations are constructed in a manner that provides the lowest total cost of ownership. During emergency conditions, the consistent design allows SCE to bring in "out of town" field crews to help restore power to SCE's customers. We obtain this consistent design through the development and use of standards. In addition, SCE's standards provide a base to evaluate the merits of proposed changes which are evaluated to determine impact on safety, reliability, operations, maintenance, construction and cost.

While SCE does not recommend the three bank option proposed in this data request for the reasons identified above, we have (in an effort to provide a complete response to this data request) completed a very conceptual engineering study to identify the facility upgrades that would be required to implement the requested capacity increases at Potrero, Royal, and Thousand Oaks substations. To meet the requirements of this data request (specifically, restricting the work to within the existing property boundaries) a non-standard 66 kV DBDB switchrack configuration and conversion / upgrade of the existing 16 kV Double Operating and

Transfer Bus to a non-standard 3 Bus configuration were evaluated in SCE's conceptual engineering study. However, it should be noted that SCE does not support this option because of the safety, operability, reliability, and standards issues identified above.

The results of SCE's conceptual engineering studies are summarized below.

Royal Substation

Transformer Bank Related Work
Requirement: Increase the nameplate capacity of Royal Substation from 112 MVA to 168 MVA

Scope of Work (may include but is not limited to the following): Install two 3-phase, 28 MVA transformers in a back to back bank configuration (56 MVA) to increase the substation nameplate capacity from 112 MVA to 168 MVA. Installation would require the addition of new transformer foundations, one new transformer dead-end rack, isolating disconnect switches on the primary side (2) and on the secondary side (2) of the new transformer bank, a new primary voltage (overhead) bank lead, and a new secondary voltage (overhead and underground) bank lead.

66 kV Switch Rack Related Work
Requirement: Upgrade the 66 kV switchrack from an operating and transfer bus configuration to a DBDB configuration as required to meet SCE's loss of operating bus criteria and to facilitate installation of the third bank.
Scope of Work (may include but is not limited to the following): Convert the existing seven position operating and transfer bus configuration to an eight position DBDB configuration to accommodate the new 66 kV bank position and a future 66 kV line position (required to support the ultimate capability of the three bank substation when load growth requires the additional capacity). This work entails:

- Remove the existing transfer bus, existing bus tie circuit breaker, disconnect switches and supports, and bus potential transformers;
- Increase the ratings of the existing disconnect switches, circuit breakers, and jumpers on the existing operating bus; Add a new bank position and circuit breaker with the increased ratings;
- Re-conductor existing operating bus (which would become the east operating bus); and
- Install a new 66 kV west operating bus, seven new 66 kV circuit breakers, 14 new disconnect switches, new bank position, a future line position, and new potential transformers on three existing 66 kV subtransmission lines

16 kV Switch Rack Related Work
Requirement: Upgrade the existing 16 kV switchrack to accommodate a third bank position, two new shunt capacitor positions and five new distribution circuit line positions.
Scope of Work (may include but is not limited to the following):

- Replace all of the existing 16 kV circuit breakers and disconnect switches (ten line positions, two bank positions, one bus paralleling position, and one bus tie position) with new circuit breakers and disconnect switches
- Extend the existing 16 kV bus to provide eight new positions;
- Relocate the existing bus paralleling position;
- Construct a new bank position by rebuilding the existing position;
- Install new circuit breaker and disconnect switches in the new bank position
- Equip five new 16 kV line positions with circuit breakers and disconnect switches;
- Add a second bus tie circuit breaker and disconnect switches;
- Add a second bus paralleling circuit breaker and disconnect switches;
- Install new potential transformers (three on each of the three operating bus);
- Install two new 4.8 MVAR capacitor banks (one on the south bus and one on the north bus),
- Install new 16 kV duct bank getaways for five new 16 kV distribution circuits.

Automation (Substation Automated System) / Protection Related Work
Requirement: Replace or modify the existing SAS / protection system as required to support the facility modifications described above.
Scope of Work (may include but is not limited to the following):

- Modify or expand the existing substation automation / protection systems as required to support the facility changes described above (66 kV line protection changes, 66 kV bus configuration change, 66 kV bank position addition, 16 kV bank addition, 16 kV bus reconfiguration and expansion, new 16 kV distribution line positions and new 16 kV capacitor additions).

Miscellaneous Upgrades
Requirement: Ensure that the substation auxiliary power system is adequately sized to support the increased substation load associated with the proposed capacity increase.
Scope of Work (may include but is not limited to the following): Increase the capacity of the existing substation light and power system to support the additional substation load.

Equipment / Structure Relocation Related Work
Requirement: Relocate equipment and structures as required to support the proposed capacity increase.
Scope of Work (may include but is not limited to the following): The following equipment and structures may be required to be relocated to facilitate the equipment additions required to increase the substation nameplate capacity to 168 MVA.

- Relocate two – 16 kV, 4.8 MVAR Capacitor banks to facilitate extension of the south bus.
- Relocate three – 66 kV towers to make room for the new 66 kV west operating bus
- Relocate the existing Moorpark-Royal No. 2 66 kV underground cable to facilitate installation of the new 16 kV north switchrack extension.
- Relocate the 16 kV north duct bank

- Relocate the northeast corner fence to the substation property line.

66 kV Line Modification / Addition Related Work
Requirement: Ensure that the 66 kV subtransmission system has enough capacity to support the proposed substation capacity increase.
Scope of Work (may include but is not limited to the following):

- Re-conductor the underground section of the Moorpark-Royal No. 2 66 kV Subtransmission Line from 1750 Al XLPE cable to 3000 CU XLPE cable in 2016
- Re-conductor the overhead sections of 653 ACSR to 954 SAC in 2021.
- Construct a new third Moorpark-Royal 66 kV subtransmission line (That would likely be composed of both overhead and underground line sections) when additional capacity is required to serve customer load (i.e., Bank capacity would be limited by subtransmission line capacity)

16 kV Distribution Circuit Addition Related Work
Requirement: Expand the existing distribution system as required to accommodate five new distribution circuits
Scope of Work (may include but is not limited to the following): Construct five new distribution circuits (details to be determined).

New Real Estate Requirements
Existing property is adequate for the substation expansion.
Additional property, easements or Right of Way may be required to be obtained to support 66 kV subtransmission line modifications or additions and / or 16 kV distribution circuits.

Potrero Substation

Transformer Bank Related Work
Requirement: Increase the nameplate capacity of Potrero Substation from 112 MVA to 168 MVA.

Scope of Work (may include but is not limited to the following): Install two 3-phase, 28 MVA transformers in a back to back bank configuration (56 MVA) to increase the substation nameplate capacity from 112 MVA to 168 MVA. Installation would require the addition of new transformer foundations, one new transformer dead-end rack, disconnect switches on the primary side and on secondary side of the new transformer bank, and new primary (overhead) and secondary (overhead and underground) bank leads.

66 kV Switch Rack Related Work
Requirement: Modify the 66 kV switchrack from an operating and transfer bus configuration to a DBDB configuration as required to meet SCE's loss of operating bus criteria and to facilitate installation of the third bank.
Scope of Work (may include but is not limited to the following): Convert the existing operating and transfer bus configuration to an eight position DBDB configuration and to accommodate the

new 66 kV bank position. This work entails:

- Remove the existing operating bus, existing bus tie position equipment (circuit breaker, disconnect switches, supports and bus Potential Transformers), eight – 66 kV disconnect switches and two -66 kV disconnect structures and associated foundations;
- Increase the ratings of the existing disconnect switches on the existing transfer bus, add new circuit breakers and disconnect switches as required, and a new bank position;
- Re-conductor existing transfer bus (which would become the south operating bus); and
- Install a new low-profile 66 kV north operating bus, seven new 66 kV circuit breakers, 14 new disconnect switches, new 66 kV bank position, and new potential transformers on the four existing 66 kV subtransmission lines

16 kV Switch Rack Related Work

Requirement: Upgrade the existing 16 kV switchrack to accommodate a third bank position, two new shunt capacitor positions and five new distribution circuit line positions.

Scope of Work (may include but is not limited to the following):

- Replace all of the existing 16 kV circuit breakers and disconnect switches (ten line positions, two bank positions, one bus paralleling position, and one bus tie position) with new circuit breakers and disconnect switches
- Extend the existing 16 kV wrap-around bus to add ten new positions;
- Relocate the existing 16 kV line from the existing position to a new position;;
- Construct a new bank position by rebuilding the existing steel structure and equipping the position with a circuit breaker and disconnect switches;
- Equip five new 16 kV line positions with circuit breakers and disconnect switches;
- Install a second bus tie circuit breaker and disconnect switches
- Install a second bus paralleling circuit breaker and disconnect switches;
- Install a new control cable trench;
- Install new potential transformers (three on each of the three operating bus),
- Install two new 4.8 MVAR capacitor banks (one on the south bus and one on the north bus),
- Install new 16 kV duct bank getaways for five new 16 kV distribution circuits.

Automation (Substation Automated System) / Protection Related Work

Requirement: Replace or modify the existing SAS / protection system as required to support the facility modifications described above.

Scope of Work (may include but is not limited to the following):

- Modify or expand the existing substation automation / protection systems as required to support the facility changes described above (66 kV line protection changes, 66 kV bus configuration change, 66 kV bank position addition, 16 kV bank addition, 16 kV bus reconfiguration and expansion, new 16 kV distribution line positions and new 16 kV capacitor additions).

Miscellaneous Upgrades
Requirement: Ensure that the substation auxiliary power system is adequately sized to support the increased substation load associated with the proposed capacity increase.
Scope of Work (may include but is not limited to the following): Increase the capacity of the existing substation light and power system to support the additional substation load.

Equipment / Structure Relocation Related Work
Requirement: Relocate equipment and structures as required to support the proposed capacity upgrade
Scope of Work (may include but is not limited to the following): The following equipment and structures may be required to be relocated to facilitate the equipment additions required to increase the substation nameplate capacity to 168 MVA.

- Relocate two – 66 kV structures to make room for the new 66 kV north operating bus
- Relocate 150 feet of two – 5" ducts (getaway for two – 16 kV circuits)
- Relocate 66 kV dead end structures

66 kV Line Modification / Addition Related Work
Requirement: Ensure that the 66 kV subtransmission system has enough capacity to support the proposed substation capacity increase.
Scope of Work (may include but is not limited to the following): No new 66 kV subtransmission lines or line upgrades are required.

16 kV Distribution Circuit Addition Related Work
Requirement: Expand the existing distribution system as required to accommodate five new distribution circuits
Scope of Work (may include but is not limited to the following): Construct five new distribution circuits (details to be determined)

New Real Estate Requirements
Existing property is adequate for the substation expansion.
Additional property, easements or Right of Way may be required to be obtained to support 66 kV subtransmission line modifications or additions and / or 16 kV distribution circuits.

Thousand Oaks Substation

Transformer Bank Related Work
Requirement: Increase the nameplate capacity of Thousand Oaks Substation from 112 MVA to 168 MVA.

Scope of Work (may include but is not limited to the following): Install two 3-phase, 28 MVA transformers in a back to back bank configuration (56 MVA) to increase the substation nameplate capacity from 112 MVA to 168 MVA. Installation would require the addition of new transformer foundations, one new transformer dead-end rack, disconnect switches on the primary side and on secondary side of the new transformer bank, and new primary (overhead)

and secondary (overhead and underground) bank leads.

66 kV Switch Rack Related Work

Requirement: Upgrade the 66 kV switchrack from an operating and transfer bus configuration to a DBDB configuration as required to meet SCE's loss of operating bus criteria and to facilitate installation of the third bank.

Scope of Work (may include but is not limited to the following): Convert the existing operating and transfer bus configuration to an eight position DBDB configuration and to accommodate the new 66 kV bank position. This work entails:

- Remove the existing transfer bus, existing bus tie circuit breaker, disconnect switches and supports and bus potential transformers;
- Upgrade the ratings of the existing disconnect switches, circuit breakers, and jumpers;
- Re-conductor the existing operating bus (which would become the south operating bus); and
- Install a new 66 kV North Operating Bus, seven new 66 kV circuit breakers and 14 new disconnect switches, new 66 kV bank position, and new potential transformers on the four existing 66 kV subtransmission lines.

16 kV Switch Rack Related Work

Requirement: Modify the existing 16 kV switchrack to accommodate a third bank position, two new shunt capacitor positions, and five new distribution circuit line positions.

Scope of Work (may include but is not limited to the following):

- Replace all of the existing 16 kV circuit breakers and disconnect switches (ten line positions, two bank positions, one bus paralleling position, and one bus tie position) with new circuit breakers and disconnect switches
- Build out existing 16 kV bus vacant position by adding a new circuit breaker and disconnect switches
- Extend the existing 16 kV bus to provide seven new positions;
- Relocate the existing bus paralleling position;
- Construct a new bank position by rebuilding the existing steel structure and equipping the position with a circuit breaker and disconnect switches;
- Equip five new 16 kV line positions with circuit breakers and disconnect switches;
- Install a second bus paralleling circuit breaker and disconnect switches;
- Install a second bus tie circuit breaker and disconnect switches;
- Install new potential transformers (three potential transformers on each of the three operating buses);
- Install two new 4.8 MVAR capacitor banks (one on the South Bus and one on the North Bus);
- Install new 16 kV duct bank getaways for five new 16 kV distribution circuits.

Automation (Substation Automated System) / Protection Related Work

Requirement: Replace or modify the existing SAS / protection system as required to support the

facility modifications described above.
Scope of Work (may include but is not limited to the following):

- Modify or expand the existing substation automation / protection systems as required to support the facility changes described above (66 kV line protection changes, 66 kV bus configuration change, 66 kV bank position addition, 16 kV bank addition, 16 kV bus reconfiguration and expansion, new 16 kV distribution line positions, and new 16 kV capacitor additions).

Miscellaneous Upgrades
Requirement: Ensure that the substation auxiliary power system is adequately sized to support the increased substation load associated with the proposed capacity increase.
Scope of Work (may include but is not limited to the following):

- Increase the capacity of the existing substation light and power system to support the additional substation load.

Equipment / Structure Relocation Related Work
Requirement: Relocate equipment and structures as required to support the proposed capacity upgrade
Scope of Work may include but is not limited to the following: The following equipment and structures may be required to be relocated to facilitate the equipment additions required to increase the substation nameplate capacity to 168 MVA.

- Relocate four – 16 kV, 4.8 MVAR Capacitor banks to facilitate extension of the South Bus.
- Relocate six – 66 kV towers to make room for the new 66 kV North Operating Bus
- Relocate one – 66 kV underground cable

66 kV Line Upgrade / Addition Related Work
Requirement: Ensure that the 66 kV subtransmission system has enough capacity to support the proposed substation capacity increase.
Scope of Work (may include but is not limited to the following): No new 66 kV subtransmission lines or line upgrades are required.

16 kV Distribution Circuit Addition Related Work
Requirement: Expand the existing distribution system as required to accommodate five new distribution circuits
Scope of Work:

- Getaway Construction. Construction of the getaways would be a challenge given the number of duct banks already in the ground, the minimum space requirement that must be maintained between the getaways to minimize the heat transfer between the getaways, and the limited getaway easements that are available. Other issues may include the availability of space in the street to accommodate the new duct banks and vaults required for the new circuits.
- Construct five new distribution circuits beyond the getaways (details to be determined).

New Real Estate Requirements

Existing property is adequate for the substation expansion. However, additional property, easements or Right of Way (ROW) may be required to be obtained to support 66 kV subtransmission line modifications or additions and / or 16 kV distribution circuits.