

As discussed in my testimony, during the period January 2017 through December 2018, SCE forecasts:

- \$748 million in ISO non-incentive network transmission closings (including \$395 million in ISO Blanket Specifics closings),
- \$312 million in FERC incentive rate qualified CWIP expenditures, and;
- \$68 million of CWIP Expenditures closing to plant

In addition to the numerous but relatively small transmission projects, there are 26 significant transmission projects (each \$5 million or greater in ISO-related costs) that are expected to be placed in service in the period January 2017 through December 2018 – 10 Blanket Specifics (items 1 through 10 below), 14 Specific non-incentive projects (items 11 through 24 below), and 2 Specific incentive projects (items 25 and 26 below). These projects will increase the reliability of the ISO transmission grid, increase access to new generation resources to serve the ISO market, and/or provide congestion relief. The costs associated with these facilities are included in the Formula Rate proposed by SCE in this filing. SCE's proposed Formula Protocols, Section 3(a) specifies that SCE will provide work papers detailing specific information regarding its capital forecast. These proposed Protocols are identical to those in the original Formula Rate.

Table 1
Forecast Direct Capital Expenditures Projected to Go into Rate Base between 2017 and 2018
(Nominal \$Million)

No.	PIN	Project	FERC CWIP	FERC Non-CWIP	Total
1	3362	Critical Infrastructure Spares	0	10.793	10.793
2	3364	Transmission Maintenance Planned	0	12.838	12.838
3	3364	Transmission Deteriorated Pole Repl & Restoration	0	7.194	7.194
4	4211	Bulk Power Circuit Breaker Replacement	0	8.580	8.580
5	4756	Substation Miscellaneous Equipment Additions & Betterment	0	19.910	19.910
6	5089	Bulk Power 500 kV & 220 kV Line Relay Replacement	0	26.370	26.370

7	5210	Substation Transformer Bank Replacement Program (AA- & A-Bank)	0	33.811	33.811
8	6428	Generation Interconnection Remedial Action Scheme (RAS)	0	12.658	12.658
9	7298	Transmission Line Rating Remediation	0	223.340	223.340
10	7392	Seismic Mitigations for Transmission Substation Assets	0	13.563	13.563
11	7451	Bailey Sub 66 kV Switchrack Upgrades	0	13.764	13.764
12	7645	Victor Loop-in	0	10.177	10.177
13	3138	LADWP DC electrode replacement	0	41.612	41.612
14	6824	La Fresa Sub New MEER	0	9.101	9.101
15	7113	El Nido 220 kV Circuit Breakers	0	7.835	7.835
16	7518	Springville 220 kV Circuit Breakers	0	6.784	6.784
17	7666	Colorado River Corridor Remedial Action Scheme (RAS)	0	6.474	6.474
18	7680	Santiago Synchronous Condenser	0	58.864	58.864
19	Various	Substation Maintenance and Test Building Improvements	0	22.808	22.808
20	7120	Chino 220 kV Circuit Breakers	0	28.932	28.932
21	7547	Eldorado-Mohave and Eldorado Moenkopi 500 kV Line Position Swap	0	18.745	18.745
22	7119	Walnut 220 kV Circuit Breakers	0	12.613	12.613
23	7763	Lugo-Victorville 500 kV T/L SPS	0	13.556	13.556
24	7681/ 7820	Substation Physical Security Enhancements	0	83.140	83.140
25	7555	Tehachapi 500 kV Underground	23.616	0	23.616
26	7650/ 7695	Whirlwind Substation Expansion	31.183	0	31.183
27	Various	Less than \$5m each	13.683	44.274	57.957
		Total	68.482	747.736	816.218

1. Critical Infrastructure Spares (PIN: 3362)

Substation equipment controls the flow of electricity to customers. Therefore, when equipment and parts needs to be replaced, delays must be minimized. SCE must maintain an inventory of equipment that requires a long lead-time for ordering, especially as the infrastructure ages faster than it can be replaced. This inventory enables SCE to reduce outage time at the substation and minimize the customer minutes of interruption caused by an unplanned major equipment failure. Examples of the equipment maintained in inventory at substations are transformers, circuit breakers, disconnects, and other similar equipment. Spare

transformers are also used temporarily to address unforeseen increased load requirements at various substations during peak summer months.

Large transformers typically have deliver lead times of over one year. An AA- (500/220 kV) or A- (220/66 kV or 220/115 kV) Bank transformer failure results in a significant reduction of system reliability and rapid replacement of failed transformers is essential to grid safety, efficiency, and reliability. Therefore an adequate number of readily available spare transformers is required.

The estimated ISO-related direct capital expenditures that are projected to go into rate base during this period are \$10.793 million.

2. Transmission Maintenance Planned (PIN: 3364)

Transmission Capital Maintenance includes the costs to remove, replace, and retire assets on a programmatic or reactive basis.

Planned transmission capital maintenance is driven by inspection results or Infrastructure Replacement Program activities. Sometimes, field observations lead to projects to address emergent issues in a particular grid or equipment or structure type. In other instances, projects are identified through SCE's Transmission Infrastructure Replacement program, which programmatically identifies capital maintenance work for items such as conductor and switch replacements using grid and/or engineering analyses. SCE initiated its Transmission Infrastructure Replacement program in 2013 to address issues that were identified but had not yet led to equipment failure. These issues result from aging transmission infrastructure and address safety and/or reliability risk. The criteria for projects identified in this program varies, but includes the replacement of obsolete or deteriorated assets.

Reactive replacements are initiated when equipment fails in-service, equipment failure is imminent, or possible safety issues are identified. Equipment identified as requiring replacement must be replaced in a timely manner because

transmission equipment failures may lead to prolonged outages, unsafe operating conditions, or a more expensive reactive solution.

Depending on the maintenance work, the costs either record to O&M or capital. For example, insulator replacements are treated as O&M expenses and conductor or tower replacements are treated as capital expenditures.

The 2017-2018 forecast for Transmission Capital Maintenance includes planned capital maintenance driven by inspection results or identified through the transmission Infrastructure Replacement program. Planned capital maintenance includes the replacement of obsolete equipment (which prevents operational issues), projects that increase public safety (using steel poles, where possible, for conductor that spans a freeway), the installation of fencing around rights-of-way, and projects for General Order (“GO”) 95 or GO 128 compliance.

The estimated ISO-related direct capital expenditures for this program that are expected to be operational in the period January 2017 through December 2018 are \$12.838 million.

3. Transmission Deteriorated Pole Repl & Restoration (PIN: 3364)

The Deteriorated Pole Replacement Program is an ongoing inspection and maintenance program through which deteriorated wood poles are identified for replacement consistent with CPUC GOs 95 and 165. GO 95 sets forth the “requirements for overhead line design, construction, and maintenance, the application of which will ensure adequate service and secure safety to persons engaged in the construction, maintenance, operation, or use of overhead lines and to the public in general.” GO 165 establishes “requirements for electric distribution and transmission facilities... regarding inspections in order to ensure safe and high-quality electrical service.” The estimated ISO-related direct capital expenditures for this program that are expected to be operational in the period January 2017 through December 2018 are \$7.194 million.

4. Bulk Power Circuit Breaker Replacement (PIN: 4211)

Bulk power circuit breakers interrupt the flow of electricity through a transmission lines, typically at the 500 kV or 220 kV voltage levels. Circuit breakers are essential in preventing equipment damage and public injury when faults occur in their downstream circuits. Bulk power circuit breaker replacement program identifies and replaces bulk power circuit breakers approaching the end of their service lives that contain parts known to be problematic or no longer available, or that can no longer be cost-effectively maintained. The replacement of bulk power circuit breakers is under FERC jurisdiction and is necessary to proactively replace aging 220 kV and 500 kV circuit breakers at substations to enhance transmission system safety and to improve system reliability. This program also increases the reliability of the ISO transmission grid. The estimated ISO-related capital expenditures for this program that are expected to be operational in the period are \$8.580 million.

5. Substation Miscellaneous Equipment Additions & Betterment (PIN: 4756)

Substation Miscellaneous Equipment Additions & Betterment captures the cost to remove, replace, and retire miscellaneous assets on a reactive or programmatic basis. It does not include the costs for preemptive replacement of circuit breakers, substation transformers, substation protection, and control systems. Instead, it is predominantly like-for-like replacement of miscellaneous substation equipment with limited engineering. Equipment that is identified as requiring replacement must be replaced in a timely manner because substation equipment failures may lead to prolonged outages, unsafe operating conditions, or more expensive reactive solutions. Example includes the replacement of obsolete Digital Fault Recorders (“DFRs”) at Mira Loma, Antelope, Colorado River, Devers, Eldorado, and Rancho Vista 500 kV Substations. The estimated ISO-related direct capital

expenditures for this program that are expected to be operational in the period are \$19.910 million.

6. Bulk Power 500 kV & 220 kV Line Relay Replacement (PIN: 5089)

Relays are devices that monitor the currents and voltages for each piece of equipment in substations and actuate circuit breakers should these parameters exceed acceptable limits. Relays in 500 kV and 220 kV substations fall under FERC jurisdiction. Examples include the replacement of bulk relay(s) at Lugo, Vincent, Eldorado 500 kV, and Vista, Ellis, Hinson 220 kV substations. The estimated ISO-related direct capital expenditures for this program that are expected to be operational in the period January 2017 through December 2018 are \$26.370 million.

7. Substation Transformer Bank Replacement Program (PIN: 5210)

AA-Bank transformers are located in major substations where they take electricity at the 500 kV transmission level and transform it down to 220 kV. The Substation Infrastructure Replacement (“SIR”) program identifies and replaces AA-Bank transformers that are approaching the end of their service lives, that contain parts which are known to be seriously problematic or are no longer available, or that can no longer be cost effectively maintained. The costs of AA-Bank transformer replacement are all under FERC jurisdiction.

A-Bank transformers are located in major substations where they take electricity at the 220 kV transmission level and transform it down to a subtransmission voltage, either 115 kV or 66 kV. The SIR program identifies and replaces A-Bank transformers those are approaching the end of their service lives, that contain parts which are known to be seriously problematic or are no longer available, or that can no longer be cost-effectively maintained. The consequences of an in-service failure of an A-Bank transformer are highly undesirable. A-Bank

transformers typically supply power to large portions of SCE's distribution system servicing hundreds of thousands of customers. While redundancy is built into the A-Bank system, an in-service failure would place the system into an "N-1" condition, wherein a second failure or system disturbance could result in a massive blackout affecting significantly large areas. So severe are the consequences of such a blackout that SCE believes that every reasonable precaution must be taken to prevent it. Although infrequent, in-service failures of A-Bank transformers can be violent. These transformers are oil-filled and catastrophic failures and ensuing fires can endanger the safety of SCE employees and the operability of nearby equipment. Inspections are extremely helpful in identifying many incipient failures. However, because of the speed at which failure mechanisms can arise and progress, inspections cannot prevent all failures. Therefore, planned preemptive replacements under controlled conditions of transformers clearly approaching the end of their service lives are a prudent and responsible action to minimize the risk of in-service failures.

In summary, the replacement of AA- and A-Bank transformers is managed by the Substation Infrastructure Replacement program which combines engineering analysis and expert judgment to ensure that the appropriate number of AA- and A-Bank transformers is replaced each year and that those which are replaced are the most risk-significant.

The estimated ISO-related direct capital expenditures for this program that are expected to be operational in the period January 2017 through December 2018 are \$33.811 million.

8. Generation Interconnection Remedial Action Scheme (PIN: 6428)

SCE is implementing a comprehensive Centralized Remedial Action Scheme ("CRAS") to replace the existing localized RAS and accommodate any additional RAS in the future in a phased approach. The Scope of Phase 1 is the deployment

of the full capability of the CRAS Central Controller System (“CCS”) at the Grid Control Center (“GCC”) and Alternate Grid Control Center (“AGCC”), and the conversion and cutover of existing RAS. The estimated ISO-related direct capital expenditures for this program that are expected to be operational in the period January 2017 through December 2018 are \$12.658 million.

9. Transmission Line Rating Remediation (PIN: 7298)

SCE has been conducting a Transmission Line Rating Study to identify transmission lines potentially in violation of CPUC GO 95. As part of the study, SCE has completed its initial survey of all of SCE’s CAISO-controlled transmission lines built before 2005. Based on the results of the survey, SCE prioritized the transmission line discrepancies that will require line clearance remediation. A discrepancy is any condition found in the field requiring remediation to meet GO 95 requirements during peak loading conditions. Discrepancies have been prioritized based on criteria such as line sag when operating at or below 130 degrees Fahrenheit, and potential risk to public safety and system reliability based on location of span, terrain, encroachment type, and extent of deviation from standards. The study prioritized the discrepancies within a span into six levels, with A1 being the highest priority, followed by A2, A3, B1, B2, and B3. Remediation work to address discrepancies includes replacing towers and poles, clearing brush, replacing insulators, removing slack from lines, and other efforts to remediate line clearance issues.

In 2015, SCE finalized work on a plan to remediate all CAISO discrepancies over a ten-year period, 2016 – 2025. This plan requires a significant increase in work and spend over the ten-year period. Through 2015, remediation efforts have focused on the higher priority discrepancies. This remediated 428 discrepancies, cleared 866 discrepancies, and identified 344 discrepancies cleared by other SCE programs or projects. As of the end of 2015, there are

approximately 6,167 CAISO discrepancies to be remediated within the ten-year period. To accomplish this increased level of work, SCE plans to take a more programmatic approach to the remediation work, including the utilization of CPUC licensing projects, major projects exempt from licensing (i.e., re-conductors), and minor projects exempt from licensing (individual tower/pole modifications or replacements). The ten-year plan was developed with North American Electricity Reliability Corporation (“NERC”) and Western Electricity Coordinating Council (“WECC”) input.

Besides the CAISO discrepancies, NERC/WECC requested that SCE perform studies on the non-CAISO controlled lines (radial lines). This study was completed in 2015 and will require additional discrepancies to be remediated by 2030, as agreed to by SCE and NERC/WECC.

Transmission Line Rating Remediation (“TLRR”) efforts include both O&M and capital work. A high percentage of these expenditures are for work on CAISO-controlled transmission, which is under FERC jurisdiction.

The forecast of TLRR capital expenditures is based on a specific, project-based forecast. The forecast includes the costs for remediation activities, engineering and design work, and materials, allocated by year and by priority level. Most projects and associated costs are FERC jurisdictional.

The significant increase in spend is correlated with the change in program strategy to meet the regulatory requirements discussed above. Using the previous strategy, it would have taken SCE well beyond the agreed upon ten-year timeframe to remediate all discrepancies. To shorten the time to achieve compliance, SCE developed a plan that focuses more on bundling many discrepancies by circuit and geographic location, such as utilizing major licensed re-conductor projects which can remediate many discrepancies in the scope of one large project. Since licensing projects take longer to complete, the costs requested in this rate case are for many smaller scale projects that do not require licensing,

though the same bundling approach applies. This will allow SCE to complete the remediation's to meet the regulatory requirements. Forecasts for projects in the preliminary stages of engineering use a cost per remediation method and projects with completed engineering use cost estimates for specific scope.

Total forecast of TLRR direct capital expenditures between 2017 and 2018 is \$256.418 million and estimated ISO-related direct capital expenditures that are projected to go into rate base during this period are \$223.340 million.

10. Seismic Mitigations for Transmission Substation Assets (PIN: 7392)

SCE plans to retrofit and harden components in transmission substation structures built to older standards (pre-1992) and specifications that could lead to a loss of equipment functionality. Capital cost forecast is based on high level unit cost estimates provided by third party consultants and internal estimates based on similar work. SCE anticipates a steady pace of mitigation work from 2018-2020 with costs relatively stable over each year. The work includes: (1) adjusting slack between interconnected equipment, (2) retrofitting anchorage and bracing for electrical equipment, and (3) replacing older equipment or components to comply with current seismic standards. Based on the scope and costs to mitigate ten inspected transmission substations, SCE forecasts ISO-related capital expenditures of \$13.563 million to perform corresponding mitigations for SCE's transmission substations in the period January 2017 through December 2018.

11. Bailey Substation 66 kV Switchrack Upgrades (PIN: 7451)

Project scope is to engineer and construct a new Mechanical Electric Equipment Room ("MEER"), approximately 51-feet by 72-feet. It is also to convert the existing 66 kV switchrack to double-breaker (ultimate breaker-and-a-half) configuration. The proposed operating date is February 2017 with estimated ISO-

related direct capital expenditures of \$13.764 million that are projected to go into rate base by December 2018.

12. Victor Loop-in (PIN: 7645)

This project involves the installation of circuit breakers and disconnect switches in order to loop in the existing Kramer - Lugo #1 and #2 220 kV transmission lines into the existing Victor Substation to create the Kramer-Victor Line #1 and #2, and the Lugo-Victor Line #3 and #4, as well as the installation of necessary protection, control and communications equipment. Looping the two Kramer-Lugo 220 kV lines into Victor Substation eliminates voltage collapse caused by the double outage of the Lugo-Victor 220 kV No. 1 & 2 lines. This project was approved in the 2013-2014 CAISO Transmission Plan. The proposed operating date is June 2017 with estimated ISO-related direct capital expenditures of \$10.177 million.

13. LADWP DC electrode replacement (Ocean segment) (PIN: 3138)

The purpose of this project is to improve the availability and reliability of the newly upgraded Sylmar Converter Station East, the ground return cables need to be replaced and encased in a separate conduit bank along a new circuit route to the ocean electrodes. The project scope includes replacing the existing underground cables with higher-rated, insulated cables that eliminates oil pressure build-up and rupturing of the external lead sheath. The existing cables carry ground return current to ocean electrodes for the Sylmar High Voltage Direct Current (“HVDC”) transmission system and they were installed in 1969 when the Pacific DC Intertie (“PDCI”) was originally energized at +/- 400 kV, 1800 Amps, and 1440 MW. After several upgrades to the PDCI, there have been no upgrades to the electrode and numerous failures have been sustained. Current operations are at a higher rating of +/- 500 kV, 3100 Amps, and 3100 MW. To replace the underground

portion of the PDCI ground return system, project scope includes 7-8 miles of underground line from Kenter Terminal Tower and installation of up to 8 new miles of concrete encased conduit bank and 120,000 feet of new cable. The proposed operating date is November 2017 with estimated ISO-related direct capital expenditures of \$41.612 million, which represents SCE's 50% share of the project. All of the total project cost is projected to go into rate base during this period.

14. La Fresa Substation New MEER (PIN: 6824)

This project involves the installation of a new MEER building in addition to the current MEER building, and cutting over the existing protection. The new MEER is the second phase of a prior addition of a 220/66 kV transformer bank and new 220 kV circuit breakers at La Fresa. The new MEER building is necessary to address the aged control building, house the existing substation controls and protection, as well as to accommodate current standard SCE substation automation. The proposed operating date is December 2017 with estimated ISO-related direct capital expenditures of \$9.101 million.

15. El Nido 220 kV Circuit Breakers (PIN: 7113)

This project involves conversion of the current bank-on-bus configuration to a double breaker configuration for 220/66 kV transformer banks. Equipping the banks in circuit breakers configuration would ensure compliance with present SCE Line and Bus Criteria. The new double breaker configuration provides greater operational flexibility, simplifies future additions, and minimizes the loss of station capacity during planned outages. The proposed operating date is December 2017 with estimated ISO-related direct capital expenditures of \$7.835 million.

16. Springville 220 kV Circuit Breakers (PIN: 7518)

This project involves conversion of the current bank-on-bus configuration to a double breaker configuration for a 220/66 kV transformer bank. Equipping the bank in circuit breakers configuration would ensure compliance with present SCE Line and Bus Criteria. The new double breaker configuration provides greater operational flexibility, simplifies future additions, and minimizes the loss of station capacity during planned outages. The proposed operating date is December 2017 with estimated ISO-related direct capital expenditures of \$6.784 million.

17. Colorado River Corridor Remedial Action Scheme (PIN: 7666)

The Colorado River Corridor CRAS is needed to accommodate existing and future generator interconnections whose output will be delivered to the grid at points of interconnection along the transmission corridor comprised of the Colorado River – Red Bluff No. 1 and No. 2 and Devers – Red Bluff No. 1 and No. 2 500 kV lines. Combined existing and queued generation capacity exceeds the available line capacity on this corridor under various N-1 and N-2 contingency outages. As more generators come on-line, the logic processing capability of “stand-alone” RAS architecture will be insufficient to accommodate the number of participating generators. At that point CRAS will be the required platform for the Colorado River Corridor RAS analytic. This project was approved by the CAISO in an executed Large Generator Interconnection Agreement (“LGIA”). The proposed operating date for the specific project is December 2017 with total ISO related direct capital expenditures of \$6.474 million.

18. Santiago Synchronous Condenser (PIN: 7680)

This project involves installation of one 225 MVAR synchronous condenser at Santiago Substation interconnected to the 220 kV bus. This project was approved by the CAISO in the 2012-2013 CAISO Transmission Plan which included other synchronous condensers located in San Diego Gas & Electric’s (“SDG&E”)

service territory. These other condensers are to be installed by SDG&E. The combined SCE and SDG&E synchronous condensers provide local voltage support in the absence of the San Onofre Nuclear Generating Station which shut down in January 2012. Table 7.1-2 in the 2016-2017 CAISO Transmission Plan lists the Santiago Synchronous Condenser project as previously approved. The CAISO has also confirmed the continued need for the project via a letter dated October 18, 2016. The proposed operating date is December 2017 with estimated ISO-related direct capital expenditures of \$58.864 million.

19. Substation Maintenance and Test Building Improvements (PINs: 7924, 7956, 7957, 7958, & 7959)

SCE operates approximately 900 substations. The T&D crews that perform maintenance and testing are strategically located throughout the service territory, in order to best access these substations. Staff are located in buildings that, initially, were built as a temporary solution, or are in permanent facilities that were not built to adequately support a safe work environment. T&D evaluated all maintenance and test work function locations and identified six substations as priority for improvement. The six in scope for this project were built between 1955 and 1975. Few renovations to these buildings have been made, since they were originally constructed. Test and maintenance operations, at the six identified substations, are performed in separate areas of the site. Sometimes, crew members work at different substation locations, due to the lack of space to accommodate the entire crew. Current storage facilities do not provide secure protection of equipment. In some instances, valuable testing parts and equipment are stored in temporary trailers or are not adequately protected from the environment. Many of the substations do not have adequate shop and storage spaces for the crews to perform their work or store critical equipment. This makes it difficult for work flow continuity and communication between the test and maintenance groups. Co-

locating the test and maintenance functions within one building, at each of these six sites, will improve efficiencies to work flow and communication, reduce downtime, and efficiently bring critical services to the system. Based on preliminary investigation, SCE identified deficient building conditions such as:

- The building areas cannot support productive working conditions (e.g., no break areas, lack of adequate restrooms).
- Given the age and type of construction, some buildings likely have lead or asbestos in the walls, ceilings, or floor tiles.
- The structural integrity of buildings is poor, due to the age of some buildings.
- Buildings are not compliant with modern accessibility or building system regulations (e.g., lighting).

The Substation Maintenance and Test Building Program will address the areas of risk, at the six existing substations, that could have a direct impact on safety and service reliability. Given the: (1) age and condition of existing buildings, (2) productivity issues with crews working in poor building conditions and separate locations, and (3) limited space and storage, it is prudent to build a test and maintenance facility, at each of the six identified substations, which is tailored to its specific site conditions. For this project, SCE will:

- Design and develop an efficient site plan, to include safe vehicular access, circulation, and parking.
- Obtain required studies (e.g., engineering and environmental), permits, and approvals.
- Prepare the site (e.g., excavation and/or grading) for circulation, run-off and water management, and utilities; secure the site for construction.
- Construct a test and maintenance building (approximately 13,000 square feet), at each of the six identified substations, with maintenance shops, test benches, employee work areas, meeting areas, and rest and break rooms.

- Construct covered parking for SCE trucks. Construct employee parking areas.

SCE forecasts total expenditures of \$32.230 million for five of the six identified substations whose capital spend is projected to go into rate base by 2018. Capital spend on the remaining one substation is projected to go into rate base beyond 2018, so it is excluded in this request. The proposed operating date is December 2017 and \$28.808 million out of the total spend amount is ISO related.

20. Chino 220 kV Circuit Breakers (PIN: 7120)

Currently the No. 1A bank at Chino 230/66 kV Substation is connected in bank-on-bus configuration. Equipping the bank in circuit breakers configuration would ensure compliance with current planning criteria and guidelines which would offer higher operation flexibility. The proposed operating date for the specific project is June 2018 with total ISO related direct capital expenditures of \$28.932 million.

21. Eldorado-Mohave and Eldorado-Moenkopi 500 kV Line Position Swap (PIN: 7547)

This project involves the removal and reinstallation of new transmission structures, as well as all necessary equipment at the Eldorado Substation to change these line positions. The majority of the work will occur at the Eldorado 500 kV Substation and approximately 8 miles South of the Eldorado Substation to swap the line positions of these two (2) 500 kV transmission lines to reduce the risk of thermal overloads caused by the loss of the Eldorado-Lugo and Eldorado-Mohave 500 kV transmission lines considered a WECC Category C5 adjacent circuits contingency. This project was approved in the 2012-2013 CAISO Transmission Plan. The proposed operating date is June 2018 with estimated ISO-related direct capital expenditures of \$18.745 million.

22. Walnut 220 kV Circuit Breakers (PIN: 7119)

This project involves conversion of the current bank-on-bus and line-on-bus configuration to a double breaker configuration for 220/66 kV transformer banks and the Mesa 220 kV transmission line. Equipping the banks and line in circuit breakers configuration would ensure compliance with present SCE Line and Bus Criteria. The new double breaker configuration provides greater operational flexibility, simplifies future additions, and minimizes the loss of station capacity during planned outages. The proposed operating date is December 2018 with estimated ISO-related direct capital expenditures of \$12.613 million.

23. Lugo-Victorville 500 kV T/L Special Protection Scheme (“SPS”) (PIN: 7763)

The purpose of this project is to prevent overloads on the jointly-owned Lugo-Victorville 500 kV transmission line. This SPS trips the Transition Cluster (“TC”) generation projects for the N-1 loss of the Eldorado-Lugo 500 kV line and the N-2 loss of the Eldorado-Lugo and Lugo-Mohave 500 kV transmission lines. This project was approved by the CAISO in an executed LGIA. The proposed operating date is December 2018 with estimated ISO-related direct capital expenditures of \$13.556 million.

24. Substation Physical Security Enhancements (PINs: 7681 & 7820)

In 2013, a Pacific Gas and Electric Company (“PG&E”) substation was attacked, resulting in substantial reduction in transmission capability and over \$15 million in damages. This was the first significant attack on a substation in the United States. In 2014, NERC developed physical security regulations to require utilities to protect critical substations from attack that could cause widespread outages in the bulk electrical system. This program was identified as Tier 1-NERC Critical Infrastructure Protection (“CIP”)-014. CIP-014 requires utilities to assess, review,

and identify critical facilities that are vulnerable to physical attack risks, and furthermore, develop and implement a plan to enhance protection for these assets.

After the 2013 attack at the PG&E's Metcalf transmission substation, SCE evaluated its substations to identify areas where the company should bolster its security to prevent a similar occurrence on SCE assets. Because of this, and prior to the development of the NERC CIP-014 program, SCE identified seven substations in 2014 for physical security enhancements. These substations were critical to the reliable operation of our grid. In addition, SCE considered these substations to be probable candidates for future NERC CIP-014 requirements due to their criticality. Therefore, SCE initiated pilot physical security enhancements to four out of the seven substations in 2014, in anticipation of the release of CIP-014. These enhancements included improvements to walls, reinforcement of gates, concealment of key assets, and improvements to technical security to detect threats and improve response, including improved cameras, alarms, and lighting. CIP-014 does not define the specific mitigation tools and methods for identified critical facilities but requires utilities to develop and implement a security risk mitigation plan. To prepare and help inform the development of our security mitigation plan, this pre-CIP-014 pilot program was created not only for SCE to get ahead of the anticipated compliance requirements but also to pilot and test security technology options to determine the best practices to be later incorporated into the remaining CIP-014 qualified sites. Examples of piloting scope include testing long range video or gunshot detection technology to increase situational awareness, building high-security physical perimeter walls, improving security lighting and audible alarms to deter attacks.

In 2015, CIP-014 was released, and the final version of the regulation included criteria that two of the four pilot sites met. Together with the remaining three CIP-014 qualified sites, SCE has seven substations that require physical security enhancements under Tier 1 Physical Security Program.

Both prior recorded and forecast between 2017 and 2018 of Substation Physical Security Enhancements Project direct capital expenditures capture these programs' expenditures in the Transmission Substation portion of the projects. These expenditures are required to fund physical security enhancements such as: AC/DC power feeds to security equipment and lighting, providing ballistic barriers around critical equipment, installing concealment, and replacing or modifying substation fences and gates. SCE will focus on completing the majority of Tier 1 (CIP-14) site enhancements by 2018, with completion of all remaining work in the following year.

The proposed operating date for the specific project is December 2018 with total ISO related direct capital expenditures of \$83.140 million.

25. Tehachapi 500 kV Underground (PIN: 7553)

TRTP 500 kV Underground Project (Segment 8A)'s scope includes placing a 500 kV single-circuit transmission line underground in an approximately 3.5-mile segment of existing right-of-way ("ROW") through Chino Hills. Under project's scope, SCE will also construct two new transition stations, one each on the Eastern and Western boundaries of Chino Hills to transition the overhead 500 kV transmission line to underground cable and vice versa. Project scope also includes construction of voltage control equipment, also referred to as reactive compensation, within the footprint of the Mira Loma Substation as a part of its construction of underground. The 500 kV transmission line was fully energized in the fourth quarter of 2016 and the proposed operating date for remaining portions is June 2017 with estimated ISO-related direct capital expenditures of \$23.616 million.

26. Whirlwind Substation Expansion (PINs: 7650 & 7695)

The transmission facilities that SCE proposed to build as part of the Whirlwind Substation Expansion would provide capacity for an additional 2,000 MW of new generation resources at Whirlwind and include the following: 1) expansion of the Whirlwind 220 kV Switchrack; 2) installation of two additional 500/220 kV AA transformer banks (No.'s 3&4); (3) equipping of 500 kV and 220 kV positions to terminate the two new transformer banks; 4) equipping multiple 220 kV positions to support interconnection of new generation; and 5) use of an SPS. Installation of the second AA-bank and AA Bank N-1 SPS was completed in 2014. The second AA-bank was labelled No.3 AA bank. During the Rate Year, installation of the third AA bank is scheduled to be completed. The third AA bank will be labeled No.4 AA bank. The addition of the third AA bank will trigger the need to modify the Whirlwind AA Bank N-1 SPS. It will also trigger the need to install two General Electric ("GE") N-60 Relays for bank monitoring for the participation in the Whirlwind AA Bank RAS and add the third bank as part of the SPS. The proposed operating date for the third AA bank is June 2017 with estimated ISO-related direct capital expenditures of \$31.183 million.

For further details, please see the following work papers: "WP-Schedule 10-Summary of ISO Capital Expenditures – Incentive Projects", "WP-Schedule 16-Summary of ISO Capital Expenditures - Non-Incentive Projects", and "WP-Schedule 10 & 16."