APPENDIX H: Project Need and Description

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Name	**Garberville Area Reinforcement**
Brief Description	• Reconductor the entire Bridgeville-Garberville 60 kV line to achieve at least 631 Amps of summer normal rating (715 AAC conductor) which is about 36 circuit miles in length. Replacement of wood poles with LDSP will be required. • Install a 20 MVAR STATCOM at Fort Seward 60 kV Substation. • Establish a control point to open line section from Garberville to Kekawaka 60 kV line. • Establish a control point to open line section from Rio Dell Jct. to Carlotta 60 kV line.
Type	Reliability
Objectives	Protect against categories P1, P2, P3 and P6 short-term and long-term overloads and low voltages were identified on the Humboldt 60 kV system.
Project Need Date	Overloads starting 2024
Expected In-service Date	2032 or earlier
Interim Solution	Operating Solution
Project Cost	$102M - $204M (AACE Level 5)
Alternatives Considered but Rejected	***Alternative 1: Status Quo*** This alternative is not recommended because it does not mitigate the P0 and P1 violations. P0 and P1 violations are not allowed per the NERC TPL-001-4 and CAISO Planning standards. ***Alternative 2: Build a new 36 mile Bridgeville-Garberville 115 kV line and install one 115/60 kV transformer at Garberville substation.*** This alternative is not recommended because it is not feasible due to space limitation at Garberville substation. ***Alternative 3: Reconductor about 111 circuit miles of entire Bridgeville-Garberville-Laytonville-Willits 60 kV line*** This alternative addresses the NERC violations, but the cost at $289.5M - $579M (AACE Level 5) is much higher in comparison to the recommended scope. ***Alternative 4: Reconductor about 36 circuit miles of entire Bridgeville-Garberville 60 kV line and install a BESS at Garberville/Fort Seward substation.*** This alternative is not recommended because it is not feasible due to space limitation at Garberville/Fort Seward substation.

Name	**Tulucay-Napa #2 60 kV line Reconductoring project**
Brief Description	Reconductor the Tulucay-Napa #2 60 kV line from Tulucay to Basalt
Type	Reliability
Objectives	Expansion of previously approved project Tulucay-Napa #2 60 kV Line Capacity Increase to include line reconductoring.
Project Need Date	2032
Expected In-service Date	2028
Interim Solution	Operations Solution
Project Cost	$2.3M - $4.6M
Alternatives Considered but Rejected	Original scope to increase capacity with replacing some limiting elements

Name	**Santa Rosa 115 kV lines Reconductoring project**
Brief Description	Reconductoring of the Fulton-Santa Rosa #1 and #2, Santa Rosa-Corona and Corona-Lakeville 115 kV lines
Type	Reliability
Objectives	Reconductoring of multiple lines between Fulton and Lakeville to address overloads under P2-4, P6 & P7 conditions
Project Need Date	2024
Expected In-service Date	2028
Interim Solution	Operation solution
Project Cost	$37M - $74M
Alternatives Considered but Rejected	***Alternative 1: RAS*** Not feasible as the number of required elements (both contingency and overloaded facilities) to be monitored will exceed the maximum per the ISO planning standard ***Alternative 2: Battery storage option*** Not recommended due to concerns from the commercial interest perspective and potential of achieving deliverability on time

Name	**Tesla 115 kV Bus Reconfiguration**
Brief Description	Convert the current Tesla 115 kV DBSB configuration to BAAH configuration with folded bus design to mitigate the voltage collapse issue due to fault on the bus tie breaker at Tesla 115 kV Bus.
Type	Reliability
Objectives	Convert the current Tesla 115 kV DBSB configuration to BAAH configuration
Project Need Date	2030 or Earlier
Expected In-service Date	May 2030
Interim Solution	Operation Solution Generation Redispatch
Project Cost	$27.5M - $55M (AACE Level 5)
Alternatives Considered but Rejected	***Alternative 1: Status Quo*** This alternative is not recommended because it does not mitigate the system collapse issue post P2 contingency. ***Alternative 2: Bus sectionalization*** This alternative is not feasible due to the space limitation within the substation. ***Alternative 3: RAS*** This alternative is not recommended due to loss of large amount of loads (about 300 MW in the 2032 study case), complexity of the RAS design and high requirement on the RAS reaction time.

Name	**Banta 60 kV Bus Voltage Conversion (Central Valley Area)**
Brief Description	- Expand the yard at Banta Substation. Bring 3-115kV lines into the substation. - Install 4-CB 115kV RB (6-CB design) - Install a 115/12kV 60 MVA bank with 12kV switchgear and move Banta 1101, 1102, 1103 feeders to new switchgear. - Remove 60kV line & CB; remove Bk 1 & existing 12kV bus, regulator and CBs
Type	Reliability (NERC Category P1)
Objectives	Due to potential load growth, , there will be overload on the Vierra-Tracy-Kasson 115 kV in long term under P6. The potential mitigation is to move more load from Tracy to the new Banta 115 kV substation.
Project Need Date	2024
Expected In-service Date	2024
Interim Solution	Not applicable
Project Cost	$9M - $17.5M (Transmission Cost)
Alternatives Considered but Rejected	***Reconductoring 4 miles of Vierra-Tracy-Kasson 115 kV Line*** Doesn't facilitate future load interconnection in the area.

Name	**Metcalf 230 / 115 kV Transformers Circuit Breaker Addition**
Brief Description	Add parallel breakers to each of the 230/115 kV banks Nos. 1, 2, and 3 at Metcalf 230 kV Substation so that the three Metcalf 230/115 kV transformer banks can connect to both Metcalf 230 kV Bus1 and Bus 2.
Type	Reliability
Objectives	Mitigate thermal overloads on the Metcalf 230/115 kV banks caused by multiple P2 contingencies.
Project Need Date	NERC Category P2 and P6 starting 2024
Expected In-service Date	2026
Interim Solution	Operating Solution
Project Cost	$7.5M - $15M
Alternatives Considered but Rejected	***Add two sectionalizing breakers at Metcalf 230 kV.*** This alternative is not recommended because it is not feasible due to space limitation at Metcalf substation. ***Convert Metcalf 230 kV to Breaker and Half Configuration*** This alternative addresses the NERC violations, but it is not recommended because the cost is much higher in comparison to the recommended scope.

Name	**South Bay Area Limiting Element Upgrade**
Brief Description	The project scope is to upgrade any limiting elements on the following five lines in the South Bay Area to achieve full conductor rating: 1) Monta Vista –Wolfe 115 kV Line (Estimated Cost: $2.0M - $4.0M) 2) Newark –Jarvis #1 115 kV Line (Estimated Cost: $0.2M - $0.4M) 3) Metcalf-Piercy 115kV Line (Estimated Cost: $1.0M - $2.0M) 4) Metcalf-El Patio#1 115kV Line (Estimated Cost: $0.3M - $0.6M) 5) Los Esteros-Montague 115kV Line (Estimated Cost: $2.0M - $4.0M)
Type	Reliability
Objectives	Increase the load serving capability in the South Bay area 115 kV system by upgrading the limiting elements on five critical lines and enabling the full conductor rating.
Project Need Date	2027
Expected In-service Date	2027
Interim Solution	Not applicable
Project Cost	$5.5 M - $11.0M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to potential criteria violations

Name	Redwood City 115kV System Reinforcement
Brief Description	The scope of this project is to install a new 230/115 kV Transformer at Ravenswood Substation, and reconductor 6.5 circuit miles of the San Mateo - Belmont 115 kV Line and 7.5 circuit miles of the Ravenswood - Bair 115 kV Line #1. The Redwood City Area 115 kV System Reinforcement Project consists of the following scope: • Install a new 230/115 kV Transformer at the Ravenswood Substation using 420 MVA Summer Normal Rating and 460 MVA Summer Emergency Rating which is the largest size as per PG&E standard. • Reconductor 6.5 circuit miles of the San Mateo – Belmont 115 kV Line with single 477 ACSS conductor. • Reconductor 7.5 circuit miles of the Ravenswood – Bair 115 kV Line #1 with single 477 ACSS conductor. • Remove any limiting components as necessary to achieve full conductor capacity.
Type	Reliability
Objectives	Mitigate overloads in the Peninsula transmission system and provide transmission capacity to meet future local demand growth. This project will increase operating flexibility, load serving capability, and customer reliability.
Project Need Date	NERC Category P6 and P7 starting 2024
Expected In-service Date	May 2030 or earlier
Interim Solution	Operating solution
Project Cost	$55.4M - $110.8M (AACE Level 5)
Alternatives Considered but Rejected	***Alternative 1: Status Quo*** This alternative is not recommended because it does not mitigate the P6 and P7 violations in the high density urban load area, for which non-consequential load dropping is not allowed per the California ISO Planning Standards. ***Alternative 2: Reconductor all the three overloaded lines, San Mateo – Belmont 115 kV Line, Ravenswood – Bair 115 kV #1 Line, and the San Mateo – Oracle – San Carlos section of the San Mateo – Bair 60kV Line*** This alternative is not recommended. Although it addresses the overloads with slightly lower cost ($51.9M - $103.8M) compared to the preferred alternative in nearer term, in long term the new transformer at Ravenswood Substation will still be needed. Therefore, the overall long-term cost of this alternative is higher than the preferred alternative.

	Alternative 3: Build a new line from Ravenswood to Bair. Install a new 230/115 kV transformer at Ravenswood Substation. This alternative is not recommended. Introducing a new 115 kV source into Bair have benefits that offloads the existing three 115 kV corridors. However, routing can be challenging as a section of the new line goes through environmental sensitive area. Permitting challenges not only incur potential delays, but may also incur significantly higher cost if the line section has to be underground or submarine according to preliminary engineering review. ***Alternative 4: Build a new line from San Mateo to Bair. Install a new 230/115 kV transformer at Ravenswood Substation.*** This alternative is not recommended. In addition to the new Ravenswood to Bair line in Alternative 3, PG&E has considered other options that will introduce a new 115kV line into Bair from San Mateo. However, in addition to routing challenges associated with environment sensitivity, the cost of such a new line is further inflated due to more substation work and longer distance than the new Ravenswood – Bair line.

Name	**Lone Tree–Cayetano–Newark Corridor Series Compensation**
Brief Description	Add 6 SmartValve units (2 SmartValve 10-1800 units per phase) to the Cayetano – Lone Tree 230 kV line Add 6 SmartValves units (2 SmartValve 10-1800 units per phase) to the Las Positas - Newark 230 kV Line
Type	Reliability
Objectives	Mitigate overloads on the 230 kV lines in Tri Valley area.
Project Need Date	NERC Category P2 and P7 starting 2024
Expected In-service Date	2027
Interim Solution	Operating solution
Project Cost	$15M - $25M
Alternatives Considered but Rejected	Newark 230 kV bus upgrade or reconductor, which are not selected due to high cost.

Name	**Pittsburg 115 kV circuit breakers overstress (PG&E scope addition to previously approved Collinsville 500/230 kV substation policy project)**
Brief Description	Add 18-ohm reactors in parallel between Bus D and E of the Pittsburg 115kV substation
Type	Reliability
Objectives	Mitigate circuit breakers overstress issues caused mainly by addition of Collinsville substation and also portfolio resources.
Project Need Date	2032
Expected In-service Date	2032 or earlier
Interim Solution	Not applicable
Project Cost	$13M - $26M
Alternatives Considered but Rejected	***Status Quo*** Not recommended due to potential impact on future generation interconnection.

Name	**Equipment Upgrade at CCSF Owned Warnerville 230 kV Substation**
Brief Description	Upgrade limiting equipment at Warnerville 230kV - Install new jumpers, switches and new relays at the Warnerville 230kV Sub
Type	Reliability
Objectives	Bellota-Warnerville 230kV reconductoring Project was Approved in the 2012-2013 TPP cycle as a Policy Project. In the 2021-2022 TPP cycle updated information was shared with CAISO that neighboring system equipment upgrades (owned by CCSF) at Warnerville 230kV Substation, are triggered by this CAISO previously approved reconductoring project
Project Need Date	2024
Expected In-service Date	2024
Interim Solution	None, line will be limited due to terminal equipment
Project Cost	$1.6M
Alternatives Considered but Rejected	***Status Quo*** Not recommended due to limiting element preventing the full capacilty utilization of the line

Name	**Los Banos 70 kV Area Reinforcement**
Brief Description	• Install 230 kV partial bay at the new generation driven 230 kV switching station adjacent to Dos Amigos PP 230 kV Substation. • Add a new 70 kV Bus in the new generation driven 230 kV switching station, then it will be converted to a new 230/70 kV substation. • Install one 230/70 kV transformer at the new 230/70 kV substation. • Install a new 70 kV transmission line from new 70 kV Bus to Mercy Springs 70 kV Bus, and the new line is about one mile. • Install one breaker at Mercy Springs 70 kV Switching Station.
Type	Reliability
Objectives	Install a 230/70 kV transformer at the new generation driven 230 kV switching station to be built adjacent to Dos Amigos PP 230 kV Substation to provide an additional source to Los Banos 70 kV area via Mercy Springs 70 kV Switching Station.
Project Need Date	2027
Expected In-service Date	2029
Interim Solution	PGAE will be monitoring load growth interconnections in this area and also the post-contingency overloads of Los Banos bank for loss of the other.
Project Cost	$30M - $60M (AACE Level 5)
Alternatives Considered but Rejected	*Alternative 1: Status Quo* This alternative is not recommended because it does not mitigate the NERC TPL P1violations if the distribution load increase materializes in year 2024. P1 violations are not allowed to trip loads per the NERC TPL-001-4 standard. *Alternative 2: Energy Storage* This alternative is not feasible because the energy storage charging capability is limited by the existing line capacity and will be further limited by the future load growth. *Alternative 3: Reconductor transmission lines and upgrade transformer bank* This alternative is to reconductor both transmission lines feeding this area and upgrade Los Banos Bank #3 without changing the existing system topology. It is not recommended because the cost estimate is higher than the preferred alternative.

Name	**Los Banos 230 kV Circuit Breakers Replacement**
Brief Description	Replace 230 kV circuit breakers 212, 222, 252 and 262 at Los Banos substation.
Type	Reliability
Objectives	Mitigate circuit breakers overstress issues caused by portfolio resources.
Project Need Date	2032
Expected In-service Date	2032 or earlier
Interim Solution	Not applicable
Project Cost	$33M - $66M
Alternatives Considered but Rejected	***Status Quo*** Not recommended due to potential impact on future generation interconnection.

Name	**Panoche 115 kV and 230 kV circuit breakers replacement and bus upgrade (PG&E scope addition to previously approved Manning 500/230 kV substation policy project)**
Brief Description	Replace 115 kV circuit breakers 132, 152, 102 and 162, install a new MPAC building for the 115 kV bus section, convert 230 kV Bus Section D to BAAH and replace overstressed breakers in Bus E to 63 kA at Panoche substation
Type	Reliability
Objectives	Mitigate circuit breakers overstress issues caused mainly by addition of Manning substation and also portfolio resources.
Project Need Date	2032
Expected In-service Date	2032 or earlier
Interim Solution	Not applicable
Project Cost	$92M - $184M
Alternatives Considered but Rejected	***Status Quo*** Not recommended due to potential impact on future generation interconnection.

Name	North East Kern 115 kV Line Reconductoring
Brief Description	• Reconductor ~13.6 circuit miles of Midway – Shafter 115 kV Line with a larger conductor to achieve at least 975 Amps under summer emergency conditions. • Reconductor ~8.3 circuit miles on the Shafter-Rio Bravo 115 kV with a larger conductor to achieve at least 975 Amps under summer emergency conditions. • Reconductor ~3.9 circuit miles on the Midway-Tupman-Rio Bravo-Renfro 115 kV (between Rio Bravo and Renfro Junction From 11/62 To Rio Bravo Sub) with a larger conductor to achieve at least 975 Amps under summer emergency conditions. • Reconductor ~3.5 circuit miles on the Lerdo-Kern Oil-7th Standard 115 kV Line (between Lerdo J and Kern Oil, from 023/005 To Kern Oil Sub) with a larger conductor to achieve at least 975 Amps under summer emergency conditions. • Reconductor ~6.8 circuit miles on the Smyrna-Semitropic-Midway 115 kV Line (between Midway and Ganso from Midway to 081/634 and from 081/634 to Ganso) with a larger conductor to achieve 1517 at least Amps under summer emergency conditions. • Reconductor ~14.1 circuit miles on the Semitropic-Midway #1 115 kV Line (between Midway and Semitropic_E) with a larger conductor to achieve at least 1517 Amps under summer emergency conditions.• Remove any limiting components as necessary to achieve full conductor capacity. • Convert the existing control point to a summer setup to open line section from Wasco to McFarland 70 kV line. • Convert the existing control point to a summer setup to open line section from Famoso to Cawelo C 115 kV line.
Type	Reliability
Objectives	To mitigate new load driven overloads in the North East Kern area
Project Need Date	NERC Category P1, P2, P3, P6, & P7 Starting 2024
Expected In-service Date	2032
Interim Solution	Operating Action Plans
Project Cost	$128M - $256M (AACE Level 5)
Alternatives Considered but Rejected	**Alternative 1: Adding BESS in the Shafter 115 kV pocket** This alternative was not selected for recommendation because it would also not address all the issues identified and there would be a significant cost with upgrading stations in the pocket for interconnection as well as concerns with deliverability of the battery. **Alternative 2 : Connecting Rio Bravo 115 kV to 7TH Standard 115 kV substation by using a portion of an idle line (Rio Bravo to Kern Oil 115 kV) and any necessary substation upgrades required in Rio Bravo and 7TH Standard 115 kV substations; Build new switching station at Shafter 115 kV junction. This alternative would cost $130M - $260M.** This alternative was not selected for recommendation because it does not fully address all the issues identified in this cycle.

Name	Mesa 230/115kV Spare Transformer
Brief Description	Install spare 230/115 kV transformer at Mesa substation.
Type	Reliability
Objectives	To address insufficient maintenance window for the Mesa 230/115 kV transformers.
Project Need Date	2024
Expected In-service Date	May 2029
Interim Solution	Operational Solution
Project Cost	$12M - $24M
Alternatives Considered but Rejected	North of Mesa project – Not selected due to high cost.

Name	Barre 230kV Switchrack Conversion to Breaker-and-a-Half
Brief Description	• Convert Barre 230 kV switchrack to breaker-and-a-half (BAAH) configuration by relocating the south bus and adding a third CB to four bay positions • Add sectionalizing CBs and split Barre 230 kV to lower SCD • Relocate 230 kV lines, towers, and other facilities within substation
Type	Reliability
Objectives	Lower SCD to within allowable limits and enable new generation and transmission interconnections in the area
Project Need Date	2024
Expected In-service Date	6/30/2026
Interim Solution	Operation solution
Project Cost	$45M
Alternatives Considered but Rejected	**Delooping 230 kV lines from Barre 230 kV switchyard** This alternative is not selected because it does not address all of the issues

Name	Mira Loma 500kV CB Upgrade
Brief Description	Replace four (4) 50 kA CBs at Mira Loma 500 kV with new 63 kA rated CBs
Type	Reliability
Objectives	Address the short circuit duty (SCD) concerns on four (4) 500 kV circuit breakers at Mira Loma 500/230 kV substation that are loaded to greater than 95% and even 100% of the rated 50 KA SCD capability in the near term and the long term due to system changes
Project Need Date	2024
Expected In-service Date	12/31/2026
Interim Solution	Limited operation of generation in the area Temporary complex operating procedures to manage overstressed CB
Project Cost	$10M
Alternatives Considered but Rejected	***Status Quo*** Not recommended due to potential reliability and safety concern for new generation interconnection

Name	Serrano 4AA 500/230 kV Transformer Bank Addition
Brief Description	• Install a 4th 500/230 kV 1120/1344 MVA transformer bank at Serrano Substation Rebuild the 230 kV switching facility to 80 kA
Type	Reliability
Objectives	Address the Serrano banks overload for the loss of any two of the three Serrano 500/230 kV banks (P6)
Project Need Date	2025
Expected In-service Date	Q4 2027
Interim Solution	Not applicable
Project Cost	$120M
Alternatives Considered but Rejected	***Battery storage alternative*** Not recommended due to 4-hour energy storage limitation to mitigate the overload during the peak demand. The estimated cost to hypothetically upgrade 4-hour energy storage to 8-hour is as high as $330M
Name	Sylmar Transformer Replace

Brief Description	Replace 230/220 kV transformer bank F at Sylmar substation with 1,290 MVA transformer. LADWP will replace the LADWP-owned bank E at Sylmar substation by June 2025
Type	Reliability
Objectives	Addres the P2 and P4 overload concerns on the SCE and LADWP joint-owned Sylmar bank E and F
Project Need Date	2024
Expected In-service Date	2026
Interim Solution	Operation solution
Project Cost	$23M
Alternatives Considered but Rejected	**Reconfigure the switchyard by adding one-and-half breaker scheme** This alternative was eliminated out due to space limitation in Sylmar substation

Name	**Antelope-Whirlwind 500 kV Line Upgrade Project**
Brief Description	Upgrade Antelope – Whirlwind 500 kV line by increasing the ground clearance for nine (9) towers
Type	Reliability
Objectives	Mitigate thermal overloads on the Antelope-Whirlwind 500 kV line caused by multiple contingencies and reduce renewable generation cultailment
Project Need Date	2024
Expected In-service Date	2025
Interim Solution	Operation solution
Project Cost	$4M - $6M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	Coolwater A 115/230 kV Bank Project
Brief Description	• Install one (1) new No. 1A 230/115 kV transformer bank at Coolwater Substation • Extend the 230 kV Bus • Equip one (1) 230 kV and equip one (1) 115 kV A Bank Position, associated equip, structures • Electrically connects the existing Coolwater 230 kV and Coolwater 115 kV Switchracks and converts the Coolwater-Kramer, Kramer-Sandlot, and Coolwater-Sandlot 220 kV lines to CAISO network lines
Type	Reliability
Objectives	The new 1A Bank Project in Coolwater Substation will eliminate the risk of potential voltage collapse in the North of Lugo area during P6 outages, retire the existing Operating Procedure that radializes the system for a forced or scheduled outage, and will allow the Brightline West High Speed Rail project to energize with minimal delays as this mitigation is also needed for that retail load.
Project Need Date	2026
Expected In-service Date	2026
Interim Solution	SCE Operating Procedure SOB 127 would radialize the system for a forced or scheduled outage
Project Cost	$47M
Alternatives Considered but Rejected	**Add new 115 kV line between Coolwater and Tortilla substations (11.26 miles)** • The estimated cost of this project is $24 Million. • Equip one position with two circuit breakers at both the Coolwater and Tortilla 115 kV Buses. • Does not mitigate the reliability impact of the Brightline West High Speed Rail project.

Name	**Control 115kV Shunt Reactor**
Brief Description	Install a 45 MVAR 115 kV shunt reactor at Control Substation
Type	Reliability
Objectives	The Control 115 kV Shunt Reactor Project will eliminate high voltage issues at the Inyo 230 kV Bus and alleviates the need to coordinate with CAISO on reducing area generation to maintain voltage.
Project Need Date	2026
Expected In-service Date	2026
Interim Solution	SCE Operating Procedure SOB 80 and SOB 17
Project Cost	$4M
Alternatives Considered but Rejected	**Continue to manage high voltages by utilizing the existing system operating bulletins (SOB 80 and SOB17)** Not a long term solution

Name	**Miguel-Sycamore Canyon 230 kV line Loop-in to Suncrest**
Brief Description	• A 16-mile double circuit 230kV transmission line that will loop-in the existing TL23021 Miguel – Sycamore Canyon into Suncrest substation. • Install two new 500/230 kV banks at Suncrest and Miguel substations (one at each substation).
Type	Reliability
Objectives	Mitigate thermal overloads in TL23054 / TL23055 Suncrest – Sycamore Canyon, and Suncrest and Miguel 500/230 kV banks; increase operational flexibility; and reduce the complexity of the TL 23054/TL 23055 RAS and Miguel BK 80/BK 81 RAS.
Project Need Date	2032
Expected In-service Date	2032
Interim Solution	Rely on the existing TL 23054/TL 23055 RAS and Miguel BK 80/BK 81 RAS, 30-minute short-term emergency ratings and operational actions, such as reducing generation output in the greater Imperial Valley area, dispatching conventional gas generation, preferred resources, and energy storage in the San Diego area, and adjusting the Imperial Valley phase shifting transformers.
Project Cost	$275M - $375M
Alternatives Considered but Rejected	***Status Quo*** Not recommended due to the risk that the necessary operational actions could not be implemented under 30 minutes per ISO Planning Standards.

Name	**Borden-Storey 230 kV 1 and 2 Line Reconductoring**
Brief Description	Reconductoring the Borden – Storey section(s) of the Wilson – Storey #1 and #2 230 kV lines
Type	Policy
Objectives	Reconductoring the Borden – Storey section(s) of the Wilson – Storey #1 and #2 230 kV lines
Project Need Date	Base and sensitivity starting 2035
Expected In-service Date	2032
Interim Solution	Operating Action Plans
Project Cost	$25M - $50M
Alternatives Considered but Rejected	RAS was considered as an alternative but was not selected due to not meeting the RAS guiedlines. Series compensation was also considered as an alternative but was not selected due to the size that would be needed to mitigate the overload

Name	**Henrietta 230/115 kV Bank 3 Replacement**
Brief Description	Replace Henrietta 230/115 kV Bank 3
Type	Policy
Objectives	Replace Henrietta 230/115 kV Bank 3
Project Need Date	Base and sensitivity starting 2035
Expected In-service Date	2032
Interim Solution	Operating Action Plans
Project Cost	$12M - $20M
Alternatives Considered but Rejected	RAS was considered as an alternative but was not selected due to not meeting the RAS guidelines.

Name	**Lugo–Victor–Kramer 230 kV Upgrade**
Brief Description	The Lugo–Victor–Kramer 230 kV Upgrade is comprised of the following transmission additions and upgrades: 1. Adding a 3rd 500/230 kV transformer at Lugo Substation 2. Reconductoring the four Lugo–Victor 230 kV lines and 3. Rebuilding the double circuit Kramer–Victor 115 kV lines for 230 kV operation and looping the existing segment of Kramer–Victor 115 kV line into Roadway
Type	Policy (with reliability and economic benefits)
Objectives	The primary objective of the Lugo–Victor–Kramer 230 kV Upgrade is to mitigate constarints in the Lugo–Victor–Kramer corridor that limit deliverability of portfolio resources in the North of Lugo area. The project also has significant reliability benefits and production cost savings.
Project Need Date	1. Lugo 500/230 kV transformer addition – 2028 2. Lugo–Victor 230 kV line upgrades – 2028 1. Conversion of Kramer–Victor 115 kV lines to 230 kV – 2033
Expected In-service Date	2. Lugo 500/230 kV transformer addition – 2028 3. Lugo–Victor 230 kV line upgrades – 2028 4. Conversion of Kramer–Victor 115 kV lines to 230 kV - 2033
Interim Solution	Continuing to expand the North of Lugo Area RAS
Project Cost	1. Lugo 500/230 kV transformer addition – $70 million 2. Lugo–Victor 230 kV line upgrades – $112 million 3. Conversion of Kramer–Victor 115 kV lines to 230 kV - $300 million Total - $482 million
Alternatives Considered but Rejected	Lugo–Kramer 500 kV Development

Name	**Devers-Red Bluff 500 kV 1 and 2 Line Upgrade**
Brief Description	• Increase the rating of the Devers-Red Bluff 500 kV 1 Line from 2598 / 2858 MVA (normal/emergency) to 3291 / 3880 MVA (normal/emergency). • Increase the rating of the Devers-Red Bluff 500 kV 2 Line from 2598 / 2910 MVA (normal/emergency) to 3291 / 3880 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Devers-Red Bluff 500 kV deliverability constraint. First step of transmission upgrades considered to address this constraint, and to maximize the use of existing transmission infrastructure as much as possible.
Project Need Date	2032
Expected In-service Date	2028
Interim Solution	Not applicable
Project Cost	$140M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**Colorado River-Red Bluff 500 kV 1 Line Upgrade**
Brief Description	Increase the line rating from 2338 / 2858 MVA (normal/emergency) to 3421 / 3880 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Coloardo River-Red Bluff 500 kV deliverability constraint
Project Need Date	2032
Expected In-service Date	2028
Interim Solution	Not applicable
Project Cost	$50M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**Devers-Valley 500 kV 1 Line Upgrade**
Brief Description	Increase the line rating from 2598 / 2858 MVA (normal/emergency) to 3421 / 3880 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Serano-Alberhill-Valley 500 kV deliverability constraint
Project Need Date	2032
Expected In-service Date	2028
Interim Solution	Not applicable
Project Cost	$45M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**Serrano-Alberhill-Valley 500 kV 1 Line Upgrade**
Brief Description	Increase the line rating of the Serrano-Alberhill 500 kV 1 Line from 2598 / 4157 MVA (normal/emergency) to 3421 / 4157 MVA (normal/emergency). Increase the line rating of the Alberhill-Valley 500 kV 1 Line from 2598 / 4157 MVA (normal/emergency) to 3421 / 4616 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Serano-Alberhill-Valley 500 kV deliverability constraint
Project Need Date	2032
Expected In-service Date	2028
Interim Solution	Not applicable
Project Cost	$60M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**San Bernardino-Etiwanda 230 kV 1 Line Upgrade**
Brief Description	Increase the line rating of the San Bernardino-Etiwanda 230 kV 1 Line from 988 / 1040 MVA (normal/emergency) to 1287 / 1737 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Serano-Alberhill-Valley 500 kV deliverability constraint
Project Need Date	2032
Expected In-service Date	2031
Interim Solution	Not applicable
Project Cost	$65M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**San Bernardino-Vista 230 kV 1 Line Upgrade**
Brief Description	Increase the line rating of the San Bernardino-Vista 230 kV 1 line from 988 / 1331 MVA (normal/emergency) to 1287 / 1737 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Serano-Alberhill-Valley 500 kV deliverability constraint
Project Need Date	2032
Expected In-service Date	2026
Interim Solution	Not applicable
Project Cost	$18M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**Vista-Etiwanda 230 kV 1 Line Upgrade**
Brief Description	Increase the line rating of the Vista-Etiwanda 230 kV 1 Line from 797 / 876 MVA (normal/emergency) to 988 / 1331 MVA (normal/emergency).
Type	Policy
Objectives	To mitigate the Serano-Alberhill-Valley 500 kV deliverability constraint
Project Need Date	2032
Expected In-service Date	2031
Interim Solution	Not applicable
Project Cost	$13M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**Mira Loma-Mesa 500 kV Underground Third Cable**
Brief Description	Add 3rd set of 5000 kcmil to underground section to increase the rating of the most limiting section of the existing Mira Loma-Mesa 500 kV circuit, the rating will be upgraded from 1992 / 3204 MVA (normal/emergency) to 3421 / 4616 MVA (normal/emergency)
Type	Policy
Objectives	To mitigate the Serano-Alberhill-Valley 500 kV and Mesa-Mira Loma 500 kV Line UG Segment deliverability constraints
Project Need Date	2032
Expected In-service Date	2026
Interim Solution	Not applicable
Project Cost	$35M
Alternatives Considered but Rejected	***Status quo*** Not recommended due to criteria violations

Name	**Imperial Valley–North of SONGS 500 kV Line and Substation**
Brief Description	• New 500/230 kV Substation north of SONGS c/w three (3) 500/230 kV transformers; loop San Onofre–Santiago No. 1 & No. 2 and San Onofre–Viejo 230 kV lines into the new substation • New Imperial Valley–N.SONGS 500 kV line (~145 miles) with 50% series compensation on the first segment
Type	Policy
Objectives	SDG&E area: To mitigate the East of Miguel deliverability constraint SCE Eastern area: To mitigate the Devers-Red Bluff 500 kV deliverability constraint
Project Need Date	2030
Expected In-service Date	2034
Interim Solution	Rely on operational actions and the use of the West of Colorado River CRAS.
Project Cost	$2,228M
Alternatives Considered but Rejected	• Alternative A1: North Gila–Imperial Valley–Inland*–Serrano–Del Amo*–Mesa 500kV AC Development • Alternative B1: North Gila–Imperial Valley AC & Imperial Valley**–Inland**–Del Amo** HVDC 500 kV Development • Alternative B2: North Gila–Imperial Valley–N.SONGS* AC & N.SONGS**–Del Amo** HVDC 500 kV Development • Alternative B3: North Gila–Imperial Valley–Inland* AC & Inland**–Del Amo** HVDC 500 kV Development • Alternative C: North Gila–Imperial Valley–Suncrest, Red Bluff–Devers–Mira Loma and Serrano–Delamo–Mesa 500 kV AC Development

Name	**North of SONGS–Serrano 500 kV line**
Brief Description	New N. SONGS–Serrano 500 kV AC line (30 miles)
Type	Policy
Objectives	SDG&E area: To mitigate the East of Miguel deliverability constraint SCE Eastern area: To mitigate the Devers-Red Bluff 500 kV deliverability constraint
Project Need Date	2033
Expected In-service Date	2034
Interim Solution	Refer to “Imperial Valley–North of SONGS 500 kV Line and Substation” section above
Project Cost	$503M
Alternatives Considered but Rejected	Refer to “Imperial Valley–North of SONGS 500 kV Line and Substation” section above

Name	Serrano–Del Amo–Mesa 500 kV Transmission Reinforcement
Brief Description	The Serrano–Del Amo–Mesa 500 kV Transmission Reinforcement consists of the following developments: • New 500 kV switchyard at Del Amo complete with three (3) 500/230 kV transformers; • Utilize the existing conductor on Mesa-Miraloma 500 kV line and build approximately a 2 mile new section into Mesa and an approximately 13 mile new 500 kV line to Serrano; and • Interconnect the new Mesa-Serrano 500 kV line with 2 new 500 kV lines from Del Amo (approximately 13 miles) to form the Del Amo-Mesa and Del Amo-Serrano 500 kV lines • Loop the Alamitos–Barre No. 1 and No. 2 230 kV lines into Del Amo Substation
Type	Policy (with reliability and local capacity reduction benefits)
Objectives	The primary objective of the Serrano–Del Amo–Mesa 500 kV Transmission Reinforcement is to address the South of Mesa and Serrano–Barre corridor deliverability constraints that were found to limit delivery of portfolio resources in much of southern California to the SCE Metro load center/LA Basin local capacity area. The project is recommended for approval considering: • The 10+ year lead time of the project and the ability to meet the need date assessed based on the 2023-24 TPP portfolios • guidance from the CPUC to take under consideration the 2023-24 TPP base case portfolio that is also based on the 30 MMT GHG target when evaluating transmission needs resulting from the 2022-23 TPP policy driven sensitivity portfolio, • the CPUC request to CAISO pursuant to SB 887 to identify the highest priority transmission facilities that are needed to allow for increased transmission capacity into local capacity areas to deliver renewable energy resources or zero-carbon resources that are expected to be developed by 2035 and consider whether to approve such transmission projects as part of the CAISO's 2022–23 TPP. • Opportunities that are expected to facilitate construction of the project in this densely populated project area as explained in Chapter 3
Project Need Date	2033
Expected In-service Date	2033
Interim Solution	N/A
Project Cost	$1,125M
Alternatives Considered but Rejected	1. Serrano-Mesa–Del Amo 500 kV Development ($1.2 billion) 2. HVDC alternatives involving a 2500 MW converter station at Del Amo identified to address constraints in the SDG&E and Eastern areas (7.0–7.8 billion)

Name	North Gila–Imperial Valley 500 kV line
Brief Description	New North Gila–Imperial Valley 500 kV AC line (97 miles)
Type	Policy
Objectives	SDG&E area: To mitigate the East of Miguel deliverability constraint
Project Need Date	2028
Expected In-service Date	2028
Interim Solution	Refer to “Imperial Valley–North of SONGS 500 kV Line and Substation” section above
Project Cost	$340M
Alternatives Considered but Rejected	Refer to “Imperial Valley–North of SONGS 500 kV Line and Substation” section above

Name	Upgrade series capacitors on HW-NG and HA-NG to 2739 MVA
Brief Description	Upgrade the Hoodoo Wash-North Gila and Hassayampa-North Gila 500 kV lines and series capacitors to 3250 Amps emergency rating
Type	Policy
Objectives	SDG&E area: To mitigate the East of Miguel deliverability constraint
Project Need Date	2032
Expected In-service Date	2032
Interim Solution	Refer to “Imperial Valley–North of SONGS 500 kV Line and Substation” section above
Project Cost	$27M
Alternatives Considered but Rejected	Refer to “Imperial Valley–North of SONGS 500 kV Line and Substation” section above

Name	**Rearrange TL23013 PQ-OT and TL6959 PQ-Mira Sorrento**
Brief Description	Swap TL23013 Penasquitos-Old Town with TL6959 Penasquitos-Mira Sorrento so that TL23013 & TL23071 will not share same Structures (TL23071 sharing structures withTL6959 and TL23013 sharing structures with TL13810). This proposal will require to upgrade 2 miles of 138kV structures for 230kV operation
Type	Policy
Objectives	To mitigate the Friars-Doublet Tap constraint
Project Need Date	2032
Expected In-service Date	2032
Interim Solution	RAS to protect TL13810A/TL13810B/TL13810C Friars - Penasquitos - Doublett Tap 138kV Lines
Project Cost	$21M
Alternatives Considered but Rejected	RAS to protect TL13810A/TL13810B/TL13810C Friars - Penasquitos - Doublett Tap 138kV Lines Reconductor TL680C San Marcos-Melrose Tap

Name	**Reconductor TL680C San Marcos-Melrose Tap**
Brief Description	Reconductor San Marcos-Melrose Tap 69 kV line to 250 MVA
Type	Policy
Objectives	To mitigate the San Marcos-Melrose Tap constraint
Project Need Date	2032
Expected In-service Date	2032
Interim Solution	TL680 OLS
Project Cost	$28M
Alternatives Considered but Rejected	TL680 OLS

Name	**3 ohm series reactor on Sycamore-Penasquitos 230 kV line**
Brief Description	Install 3 ohm series reactor on Sycamore-Penasquitos 230 kV Line
Type	Policy
Objectives	To mitigate the Sycamore Area constraint
Project Need Date	2032
Expected In-service Date	2032
Interim Solution	Not applicable
Project Cost	$8M
Alternatives Considered but Rejected	Not applicable

Name	**Upgrade TL13820 Sycamore-Chicarita 138 kV**
Brief Description	Reconductor Sycamore-Chicarita 138 kV line to 250 MVA
Type	Policy
Objectives	To mitigate the Sycamore Area constraint
Project Need Date	2032
Expected In-service Date	2032
Interim Solution	Not applicable
Project Cost	$60M
Alternatives Considered but Rejected	Not applicable

Name	**Trout Canyon – Lugo 500 kV Line**
Brief Description	• Build a new 500 kV transmission line from Trout Canyon 500 kV substation to Lugo 500 kV substation, approximately 180 miles, with 70% series compensation.
Type	Policy
Objectives	The project would mitigate identified Lugo – Victorville 500 kV area constraints in both base and sensitivity portfolios. It would also improve deliverability of GLW and VEA area portfolio resources and mitigate GLW area constraints.
Project Need Date	2035
Expected In-service Date	2033
Interim Solution	Extending the Lugo – Victorville N-1 RAS
Project Cost	$1,500~2,000 million
Alternatives Considered but Rejected	**Eldorado – Lugo 500 kV No.2 line** This alternative would build a new 500 kV line from Eldorado 500 kV substation to Lugo 500 kV substation, approximately 180 miles. The cost estimate was $2.1 billion. This alternative could also mitigate the Lugo – Victorville 500 kV area constraint. However, it was not considered a potential mitigation because this option would require a second Sloan Canyon – Eldorado 500 kV line with a cost estimate of $14 million to address GLW area constraints, and it would includes an excessive number of line crossings in a very congested area.

Name	**Beatty 230 kV Project**
Brief Description	• Build a new Johnnie Corner 230 kV station and loop into the Pahrump – Innovation 230 kV line. • Expand existing Beatty, Lathrop, Valley Switch and Vista 138 kV substations to 230 kV substations. • Build 32 miles Beatty – Lathrop 230 kV line next to the existing 138 kV line in an adjacent ROW. • Build 30 miles Johnnie Corner – Valley Switch – Lathrop 230 kV DCTL lines next to the existing 138kV line in an adjacent ROW. • Install a second Johnnie Corner – Innovation and Johnnie Corner – Vista – Pahrump 230 kV line on the Innovation – Pahrump double circuit tower approved in 2021/22 TPP
Type	Policy
Objectives	The project would mitigate all identified VEA 138 kV system constraints and provide sufficient transmission deliverability capacity to accommodate geothermal and other renewable resources in VEA 138 kV system in both base and sensitivity portfolios.
Project Need Date	2032
Expected In-service Date	2027
Interim Solution	Not applicable
Project Cost	$155 million
Alternatives Considered but Rejected	N/A