

**2016 Risk Assessment Mitigation Phase  
Investigation 16-10-015  
Workpapers to  
Electric Infrastructure Integrity  
(Chapter SDG&E-12-WP)**

January 2017



2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (O&M)

Line No.	Mitigation	Project/Program	Project/Program Description	Status	Recorded (Directs, 2015 \$000)					Forecast Range (Directs, 2015 \$000)						Forecast Methodology
					2011	2012	2013	2014	2015	2017 Low	2017 High	2018 Low	2018 High	2019 Low	2019 High	
1	Premature Overhead Failure	Post-Construction True-Up Quality Assurance and Quality Control (QA/QC) Program	AKA Pole Risk Mitigation & Engineering (PRIME); new process creation and enhancements aimed to improve data quality, true up as-built designs, and correct field failures based on overloaded pole calculations. Corrective actions may include minor unit additions or rearrangements and major unit replacements (i.e. poles).	P	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 6,055	\$ 7,872	\$ 6,055	\$ 7,872	\$ 6,055	\$ 7,872	Zero-Based
2		Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	1,030	1,339	1,030	1,339	1,030	1,339	Zero-Based
3		Annual Pole Reinforcement	Cyclical program aimed to reinforce pole bases with "C-Truss" devices for added structural support.	B	1,362	1,170	1,142	1,306	1,179	1,232	1,602	1,232	1,602	1,232	1,602	5-Year Average
4	Premature Overhead Failure Subtotal				1,362	1,170	1,142	1,306	1,179	8,317	10,813	8,317	10,813	8,317	10,813	
5	Premature Underground Failure	Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	1,280	1,664	1,280	1,664	1,280	1,664	Zero-Based
6	Premature Underground Failure Subtotal				-	-	-	-	-	1,280	1,664	1,280	1,664	1,280	1,664	
7	Premature Substation Failure	Install Condition Based Maintenance (CBM) on GCBs	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. SF6 is one key unit measured in gas circuit breakers (GCB).	B	-	-	-	-	-	60	78	80	104	100	130	Trend
8		CBM - Distribution	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Distribution transformers (e.g. 69/12 kV) and their associated oil/gas measurements are monitored.	B	-	-	-	-	-	120	156	120	156	120	156	Zero-Based
9		CBM - Transmission	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Transmission transformers (e.g. 500/230 kV) and their associated oil/gas measurements are to be monitored.	P	-	-	-	-	-	30	39	30	39	30	39	Zero-Based

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (O&M)

Line No.	Mitigation	Project/Program	Project/Program Description	Recorded (Directs, 2015 \$000)						Forecast Range (Directs, 2015 \$000)						Forecast Methodology
				Status	2011	2012	2013	2014	2015	2017 Low	2017 High	2018 Low	2018 High	2019 Low	2019 High	
10		CBM - Batteries	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Substation batteries and their associated voltage levels and other asset health data are to be monitored.	P	-	-	-	-	-	8	10	11	14	11	14	Zero-Based
11	Premature Substation Failure Subtotal				-	-	-	-	-	218	283	241	313	261	339	
12	System Modernization	Replace degraded or non-functioning Supervisory Control and Data Acquisition (SCADA) RTUs	Proactively replace SCADA remote terminal units (RTU) with failed communications or bad sensors in order to improve data-informed operations of field switches and other equipment.	B	52	52	52	52	52	52	68	52	68	52	68	Trend
13		Proactively replace bridged cutout switches with SCADA gang operated or disconnect switches	Proactively replace bridged cutout switches in order to improve relay coordination and reliability. Reduce risk of safety hazards in the field while operating bridged cutouts. (This is the O&M component of work orders associated with minor units of property.)	P	-	-	-	-	-	629	818	629	818	629	818	Zero-Based
14	System Modernization Subtotal				52	52	52	52	52	681	886	681	886	681	886	
15	TOTAL				\$ 1,414	\$ 1,222	\$ 1,194	\$ 1,358	\$ 1,231	\$ 10,496	\$ 13,646	\$ 10,519	\$ 13,676	\$ 10,539	\$ 13,702	

Notes:

- Baseline (B) and Proposed (P).
- Numbers in risk chapter tables may differ due to rounding.
- The purpose of Risk Assessment Mitigation Phase (RAMP) is not to request funding. Any funding requests will be made in the General Rate Case (GRC). The forecasts for mitigations are not for funding purposes, but are rather to provide a range for the future GRC filing. This range will be refined with supporting testimony in the GRC.

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (Capital)

Line No.	Mitigation	Project/Program	Project/Program Description	Recorded (Directs, 2015 \$000)						Forecast Range (Directs, 2015 \$000)								
				Status	2011	2012	2013	2014	2015	2017 Low	2017 High	2018 Low	2018 High	2019 Low	2019 High	2017-2019 Low (Sum)	2017-2019 High (Sum)	Forecast Methodology
1	Premature Overhead Failure	4 kV Modernization - Distribution	Proposed program aims to remove 4 kV assets and replace with 12 kV. Scope of work may include complete distribution circuit rebuild or relatively minor replacements of distribution system components such as transformers on a case-by-case basis. Distribution risks are determined by number of actual and projected wire down incidents, among other safety related factors.	P	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 6,000	\$ 7,800	\$ 6,000	\$ 7,800	\$ 6,000	\$ 7,800	\$ 18,000	\$ 23,400	Zero-Based
2		Overhead small wire and connector replacement	A comprehensive wire correction program aimed to enhance distribution system reliability specifically for protection from energized wire down incidents in the non-fire threat zone (non-FTZ). Scope of work includes installing line monitoring, field and substation relay and communication systems, SCADA switches, and replacing conductors or connectors in single phase areas with small conductor.	P	-	-	-	-	-	31,488	40,934	31,488	40,934	31,488	40,934	94,464	122,802	Zero-Based
3		Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	3,638	4,729	3,638	4,729	3,638	4,729	10,914	14,187	Zero-Based
4		Anchor rod maintenance	Based on corrosion data collected, replace high risk anchor rods for distribution poles serving double circuit freeway crossings. Scope may be expanded to capital development if pole upgrades (e.g. wood to steel) are required as mitigation.	P	-	-	-	-	-	125	163	125	163	125	163	375	489	Zero-Based
5		Continued deployment of distribution avian protection systems in at-risk areas	As part of design consideration, proactively deploy avian protection systems on distribution poles and adjacent systems to protect from avian and other wildlife electric contact.	B	-	-	-	1,575	1,575	1,575	2,048	1,575	2,048	1,575	2,048	4,725	6,144	3-Year Average
6		Annual Pole Reinforcement	Cyclical program aimed to reinforce pole bases with "C-Truss" devices for added structural support.	B	44	446	876	565	641	632	822	632	822	632	822	1,896	2,466	5-Year Average
7		Electric Distribution Overhead (ED/OH) – Pole Replacement (Corrective Maintenance Program [CMP] Only)	Upon inspection, replace at-risk poles.	B	11,937	10,561	15,514	13,525	14,012	13,110	17,043	13,110	17,043	13,110	17,043	39,330	51,129	5-Year Average
8		SCADA capacitor deployment	Replace, upgrade, or deploy new distribution SCADA capacitor banks to improve voltage control and reduce risks of older generation capacitor failures (improve field operating safety).	B	-	3,453	4,536	687	(944)	1,933	2,513	1,933	2,513	1,933	2,513	5,799	7,539	4-Year Average
9		Corrective Maintenance Program Improvement of Overhead Service	Upon inspection, replacement of overhead service wires and terminations to prevent customer safety hazards.	B	1,047	717	360	180	756	612	796	612	796	612	796	1,836	2,388	5-Year Average
10	Premature Overhead Failure Subtotal				13,028	15,177	21,286	16,532	16,040	59,113	76,848	59,113	76,848	59,113	76,848	177,339	230,544	

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (Capital)

Line No.	Mitigation	Project/Program	Project/Program Description	Status	Recorded (Directs, 2015 \$000)					Forecast Range (Directs, 2015 \$000)								
					2011	2012	2013	2014	2015	2017 Low	2017 High	2018 Low	2018 High	2019 Low	2019 High	2017-2019 Low (Sum)	2017-2019 High (Sum)	Forecast Methodology
11	Premature Underground Failure	Proactive cable replacement	Proactively replace underground cable of known high failure rates. Example: replace unjacketed older vintage cable with new jacketed cable.	B	18,196	13,639	10,267	8,229	9,896	21,900	28,470	21,900	28,470	21,900	28,470	65,700	85,410	Zero-Based
12		Strategic undergrounding	Associated with the overhead wire correction program, utilize undergrounding as a form of mitigating overhead wire down risks. Scope of work to vary depending on viability of overhead upgrades.	P	-	-	-	-	-	23,258	30,235	23,258	30,235	23,258	30,235	69,774	90,705	Zero-Based
13		Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	4,890	6,357	4,890	6,357	4,890	6,357	14,670	19,071	Zero-Based
14		Proactive at-risk identification and replacement of 600-amp tee connectors	Deploy specialized monitoring and data collection service or system and proactively replace at-risk 600-amp tee connectors with superior products.	P	-	-	-	-	-	396	515	396	515	396	515	1,188	1,545	Zero-Based
15		Replace live front transformers and terminators	Performed concurrently with other maintenance activities, replace live front distribution equipment with dead front to reduce the risk of electric contact by field personnel.	B	857	884	246	32	265	685	891	685	891	685	891	2,055	2,673	Zero-Based
16		Continue "do no operate energized" (DOE) Switch Removal and Replacement Program	Proactively replace DOE underground switches to reduce the risk of field injury or catastrophic failure.	B	5,258	5,423	4,016	5,567	5,635	5,180	6,734	5,180	6,734	5,180	6,734	15,540	20,202	5-Year Average
17		Electric Distribution Underground (ED/UG) – Corrective Maintenance Program Improvement of Underground Service	Upon inspection, replacement of underground service wires and terminations to prevent customer safety hazards.	B	10,208	10,492	8,991	9,750	11,677	10,224	13,291	10,224	13,291	10,224	13,291	30,672	39,873	5-Year Average
18		CMP Switch Replacement & Manhole Repair	Upon inspection, replacement of distribution switches and repair manhole facilities in order to prevent customer safety hazards.	B	5,258	5,423	4,016	5,567	5,634	5,180	6,734	5,180	6,734	5,180	6,734	15,540	20,202	5-Year Average
19	Premature Underground Failure Subtotal				39,777	35,861	27,536	29,145	33,107	71,713	93,227	71,713	93,227	71,713	93,227	215,139	279,681	
20	Premature Substation Failure	Install CBM on GCBs	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. SF6 is one key unit measured in gas circuit breakers (GCB).	B	-	-	16	1,592	2,309	2,700	3,510	2,700	3,510	2,700	3,510	8,100	10,530	Trend
21		CBM - Distribution	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Distribution transformers (e.g. 69/12 kV) and their associated oil/gas measurements are monitored.	B	249	3,435	3,924	1,946	943	500	650	-	-	-	-	500	650	Zero-Based

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (Capital)

Line No.	Mitigation	Project/Program	Project/Program Description	Status	Recorded (Directs, 2015 \$000)					Forecast Range (Directs, 2015 \$000)								
					2011	2012	2013	2014	2015	2017 Low	2017 High	2018 Low	2018 High	2019 Low	2019 High	2017-2019 Low (Sum)	2017-2019 High (Sum)	Forecast Methodology
22		CBM - Transmission	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Transmission transformers (e.g. 500/230 kV) and their associated oil/gas measurements are to be monitored.	P	996	76	1,666	554	433	696	905	-	-	-	-	696	905	Zero-Based
23		CBM - Batteries	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Substation batteries and their associated voltage levels and other asset health data are to be monitored.	P	-	-	-	-	-	13	17	18	23	18	23	49	63	Zero-Based
24		Distribution - Substation Equipment Assessment (SEA) Team-guided design and construction program. Includes obsolete equipment replacement and relay replacements	Rebuild at-risk substations or substation equipment based on comprehensive rankings determined by the SEA team.	B	-	2,975	387	276	504	8,000	10,400	8,000	10,400	8,000	10,400	24,000	31,200	Zero-Based
25		4 kV Modernization - Substation	Proposed program aims to remove 4 kV assets and replace with 12 kV. Scope of work may include complete removal and rebuild of 4 kV substation facilities (including step-down units). At-risk example includes package/unit substations that feature single points of failure and long lead time to replace units, requiring temporary solutions.	P	66	49	5	-	-	1,400	1,820	1,400	1,820	1,400	1,820	4,200	5,460	Zero-Based
26	<b>Premature Substation Failure Subtotal</b>				<b>1,311</b>	<b>6,535</b>	<b>5,998</b>	<b>4,368</b>	<b>4,189</b>	<b>13,309</b>	<b>17,302</b>	<b>12,118</b>	<b>15,753</b>	<b>12,118</b>	<b>15,753</b>	<b>37,545</b>	<b>48,808</b>	
27	System Modernization	Advanced SCADA infrastructure (formerly referred to as the Smart Grid Communication System)	Deploy substation and distribution Advanced SCADA systems to enable phasor measurement unit (PMU) capability and intelligent control (e.g. Falling Conductor Protection).	B	-	3,872	5,041	430	571	2,479	3,223	2,479	3,223	2,479	3,223	7,437	9,669	4-Year Average
28		Advanced SCADA infrastructure: Install or modernize SCADA systems in substations (e.g. EM to MP or MP to MP)	Replace, upgrade, or deploy new advanced relaying systems in substations to accommodate/enable distribution Advanced SCADA systems.	P	-	-	-	-	-	2,000	2,600	2,000	2,600	2,000	2,600	6,000	7,800	Zero-Based
29		Replace degraded or non-functioning SCADA RTUs	Replace degraded or non-functioning SCADA RTUs.	P	-	-	-	-	-	-	-	-	-	-	-	-	-	Trend
30		Proactively replace bridged cutout switches with SCADA gang operated or disconnect switches	Proactively replace bridged cutout switches in order to improve relay coordination and reliability. Reduce risk of safety hazards in the field while operating bridged cutouts. (This is the O&M component of work orders associated with minor units of property.)	P	-	-	-	-	-	4,244	5,517	4,244	5,517	4,244	5,517	12,732	16,551	Zero-Based
31	<b>System Modernization Subtotal</b>				<b>-</b>	<b>3,872</b>	<b>5,041</b>	<b>430</b>	<b>571</b>	<b>8,723</b>	<b>11,340</b>	<b>8,723</b>	<b>11,340</b>	<b>8,723</b>	<b>11,340</b>	<b>26,169</b>	<b>34,020</b>	
32	<b>TOTAL</b>				<b>\$ 54,116</b>	<b>\$ 61,445</b>	<b>\$ 59,861</b>	<b>\$ 50,475</b>	<b>\$ 53,907</b>	<b>\$ 152,858</b>	<b>\$ 198,717</b>	<b>\$ 151,667</b>	<b>\$ 197,168</b>	<b>\$ 151,667</b>	<b>\$ 197,168</b>	<b>\$ 456,192</b>	<b>\$ 593,053</b>	

Notes:

- Baseline (B) and Proposed (P).
- Numbers in risk chapter tables may differ due to rounding.
- The purpose of Risk Assessment Mitigation Phase (RAMP) is not to request funding. Any funding requests will be made in the General Rate Case (GRC). The forecasts for mitigations are not for funding purposes, but are rather to provide a range for the future GRC filing. This range will be refined with supporting testimony in the GRC.

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (GRC Total - O&M)

				Recorded (Directs, 2015 \$000)								Forecast Range (Directs, 2015 \$000)									
Line No.	Mitigation	Project/Program	Project/Program Description	Status	GRC 2011	GRC 2012	GRC 2013	GRC 2014	GRC 2015	Non-GRC 2015	O&M Total 2015	GRC 2017 Low	GRC 2017 High	GRC 2018 Low	GRC 2018 High	GRC 2019 Low	GRC 2019 High	Non-GRC 2019 Low	Non-GRC 2019 High	O&M Total 2019 Low	O&M Total 2019 High
1	Premature Overhead Failure	Post-Construction True-Up Quality Assurance and Quality Control (QA/QC) Program	AKA Pole Risk Mitigation & Engineering (PRIME); new process creation and enhancements aimed to improve data quality, true up as-built designs, and correct field failures based on overloaded pole calculations. Corrective actions may include minor unit additions or rearrangements and major unit replacements (i.e. poles).	P	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 6,055	\$ 7,872	\$ 6,055	\$ 7,872	\$ 6,055	\$ 7,872	\$ -	\$ -	\$ 6,055	\$ 7,872
2		Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	-	-	1,030	1,339	1,030	1,339	1,030	1,339	-	-	1,030	1,339
3		Annual Pole Reinforcement	Cyclical program aimed to reinforce pole bases with "C-Truss" devices for added structural support.	B	1,362	1,170	1,142	1,306	1,179	-	1,179	1,232	1,602	1,232	1,602	1,232	1,602	-	-	1,232	1,602
4	Premature Overhead Failure Subtotal				1,362	1,170	1,142	1,306	1,179	-	1,179	8,317	10,813	8,317	10,813	8,317	10,813	-	-	8,317	10,813
5	Premature Underground Failure	Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	-	-	1,280	1,664	1,280	1,664	1,280	1,664	-	-	1,280	1,664
6	Premature Underground Failure Subtotal				-	-	-	-	-	-	-	1,280	1,664	1,280	1,664	1,280	1,664	-	-	1,280	1,664
7	Premature Substation Failure	Install Condition Based Maintenance (CBM) on GCBs	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. SF6 is one key unit measured in gas circuit breakers (GCB).	B	-	-	-	-	-	-	-	-	-	-	-	-	-	100	130	100	130
8		CBM - Distribution	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Distribution transformers (e.g. 69/12 kV) and their associated oil/gas measurements are monitored.	B	-	-	-	-	-	-	-	120	156	120	156	120	156	-	-	120	156
9		CBM - Transmission	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Transmission transformers (e.g. 500/230 kV) and their associated oil/gas measurements are to be monitored.	P	-	-	-	-	-	-	-	-	-	-	-	-	-	30	39	30	39
10		CBM - Batteries	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Substation batteries and their associated voltage levels and other asset health data are to be monitored.	P	-	-	-	-	-	-	-	-	-	-	-	-	-	11	14	11	14
11	Premature Substation Failure Subtotal				-	-	-	-	-	-	-	120	156	120	156	120	156	141	183	261	339

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (GRC Total - O&M)

				Recorded (Directs, 2015 \$000)								Forecast Range (Directs, 2015 \$000)									
Line No.	Mitigation	Project/Program	Project/Program Description	Status	GRC 2011	GRC 2012	GRC 2013	GRC 2014	GRC 2015	Non-GRC 2015	O&M Total 2015	GRC 2017 Low	GRC 2017 High	GRC 2018 Low	GRC 2018 High	GRC 2019 Low	GRC 2019 High	Non-GRC 2019 Low	Non-GRC 2019 High	O&M Total 2019 Low	O&M Total 2019 High
12	System Modernization	Replace degraded or non-functioning Supervisory Control and Data Acquisition (SCADA) RTUs	Proactively replace SCADA remote terminal units (RTU) with failed communications or bad sensors in order to improve data-informed operations of field switches and other equipment.	B	52	52	52	52	52	-	52	52	68	52	68	52	68	-	-	52	68
13		Proactively replace bridged cutout switches with SCADA gang operated or disconnect switches	Proactively replace bridged cutout switches in order to improve relay coordination and reliability. Reduce risk of safety hazards in the field while operating bridged cutouts. (This is the O&M component of work orders associated with minor units of property.)	P	-	-	-	-	-	-	-	629	818	629	818	629	818	-	-	629	818
14	System Modernization Subtotal				52	52	52	52	52	-	52	681	886	681	886	681	886	-	-	681	886
15	TOTAL				\$ 1,414	\$ 1,222	\$ 1,194	\$ 1,358	\$ 1,231	\$ -	\$ 1,231	\$ 10,398	\$ 13,519	\$ 10,398	\$ 13,519	\$ 10,398	\$ 13,519	\$ 141	\$ 183	\$ 10,539	\$ 13,702

Notes:

- Baseline (B) and Proposed (P).
- Numbers in risk chapter tables may differ due to rounding.
- The purpose of Risk Assessment Mitigation Phase (RAMP) is not to request funding. Any funding requests will be made in the General Rate Case (GRC). The forecasts for mitigations are not for funding purposes, but are rather to provide a range for the future GRC filing. This range will be refined with supporting testimony in the GRC.



2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (GRC Total - Capital)

Line No.	Mitigation	Project/Program	Project/Program Description	Recorded (Directs, 2015 \$000)								Non-GRC 2015	Capital Total 2015	Forecast Range (Directs, 2015 \$000)								Capital Total 2017-2019 Low	Capital Total 2017-2019 High	
				Status	GRC 2011	GRC 2012	GRC 2013	GRC 2014	GRC 2015	GRC 2017 Low	GRC 2017 High			GRC 2018 Low	GRC 2018 High	GRC 2019 Low	GRC 2019 High	GRC 2017-2019 Low (Sum)	GRC 2017-2019 High (Sum)	Non-GRC 2017-2019 Low	Non-GRC 2017-2019 High			
1	Premature Overhead Failure	4 kV Modernization - Distribution	Proposed program aims to remove 4 KV assets and replace with 12 kv. Scope of work may include complete distribution circuit rebuild or relatively minor replacements of distribution system components such as transformers on a case-by-case basis. Distribution risks are determined by number of actual and projected wire down incidents, among other safety related factors.	P	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 6,000	\$ 7,800	\$ 6,000	\$ 7,800	\$ 6,000	\$ 7,800	\$ 18,000	\$ 23,400	\$ -	\$ -	\$ 18,000	\$ 23,400
2		Overhead small wire and connector replacement	A comprehensive wire correction program aimed to enhance distribution system reliability specifically for protection from energized wire down incidents in the non-fire threat zone (non-FTZ). Scope of work includes installing line monitoring, field and substation relay and communication systems, SCADA switches, and replacing conductors or connectors in single phase areas with small conductor.	P	-	-	-	-	-	-	-	-	31,488	40,934	31,488	40,934	31,488	40,934	94,464	122,802	-	-	94,464	122,802
3		Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	-	-	-	3,638	4,729	3,638	4,729	3,638	4,729	10,914	14,187	-	-	10,914	14,187
4		Anchor rod maintenance	Based on corrosion data collected, replace high risk anchor rods for distribution poles serving double circuit freeway crossings. Scope may be expanded to capital development if pole upgrades (e.g. wood to steel) are required as mitigation.	P	-	-	-	-	-	-	-	-	125	163	125	163	125	163	375	489	-	-	375	489
5		Continued deployment of distribution avian protection systems in at-risk areas	As part of design consideration, proactively deploy avian protection systems on distribution poles and adjacent systems to protect from avian and other wildlife electric contact.	B	-	-	-	1,575	1,575	-	-	1,575	1,575	2,048	1,575	2,048	1,575	2,048	4,725	6,144	-	-	4,725	6,144
6		Annual Pole Reinforcement	Cyclical program aimed to reinforce pole bases with "C-Truss" devices for added structural support.	B	44	446	876	565	641	-	-	641	632	822	632	822	632	822	1,896	2,466	-	-	1,896	2,466
7		Electric Distribution Overhead (ED/OH) – Pole Replacement (Corrective Maintenance Program [CMP] Only)	Upon inspection, replace at-risk poles.	B	11,937	10,561	15,514	13,525	14,012	-	-	14,012	13,110	17,043	13,110	17,043	13,110	17,043	39,330	51,129	-	-	39,330	51,129
8		SCADA capacitor deployment	Replace, upgrade, or deploy new distribution SCADA capacitor banks to improve voltage control and reduce risks of older generation capacitor failures (improve field operating safety).	B	-	3,453	4,536	687	(944)	-	-	(944)	1,933	2,513	1,933	2,513	1,933	2,513	5,799	7,539	-	-	5,799	7,539
9		Corrective Maintenance Program Improvement of Overhead Service	Upon inspection, replacement of overhead service wires and terminations to prevent customer safety hazards.	B	-	-	-	-	-	756	756	-	-	-	-	-	-	-	-	-	1,836	2,388	1,836	2,388
10	Premature Overhead Failure Subtotal				11,981	14,460	20,926	16,352	15,284	756	16,040		58,501	76,052	58,501	76,052	58,501	76,052	175,503	228,156	1,836	2,388	177,339	230,544
11	Premature Underground Failure	Proactive cable replacement	Proactively replace underground cable of known high failure rates. Example: replace unjacketed older vintage cable with new jacketed cable.	B	18,196	13,639	10,267	8,229	9,896	-	-	9,896	21,900	28,470	21,900	28,470	21,900	28,470	65,700	85,410	-	-	65,700	85,410
12		Strategic undergrounding	Associated with the overhead wire correction program, utilize undergrounding as a form of mitigating overhead wire down risks. Scope of work to vary depending on viability of overhead upgrades.	P	-	-	-	-	-	-	-	-	23,258	30,235	23,258	30,235	23,258	30,235	69,774	90,705	-	-	69,774	90,705

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (GRC Total - Capital)

Line No.	Mitigation	Project/Program	Project/Program Description	Status	Recorded (Directs, 2015 \$000)					Non-GRC 2015	Capital Total 2015	Forecast Range (Directs, 2015 \$000)										Capital Total 2017-2019 Low	Capital Total 2017-2019 High
					GRC 2011	GRC 2012	GRC 2013	GRC 2014	GRC 2015			GRC 2017 Low	GRC 2017 High	GRC 2018 Low	GRC 2018 High	GRC 2019 Low	GRC 2019 High	GRC 2017-2019 Low (Sum)	GRC 2017-2019 High (Sum)	Non-GRC 2017-2019 Low	Non-GRC 2017-2019 High		
13		Switch Inspection and High-Risk Replacement	Proactively test, repair, or replace switches on the OH and UG systems with notable potential for failure. Program excludes do not operate energized (DOE), sulfur hexafluoride (SF6), and other switches already slated for SCADA upgrades.	P	-	-	-	-	-	-	-	4,890	6,357	4,890	6,357	4,890	6,357	14,670	19,071	-	-	14,670	19,071
14		Proactive at-risk identification and replacement of 600-amp tee connectors	Deploy specialized monitoring and data collection service or system and proactively replace at-risk 600-amp tee connectors with superior products.	P	-	-	-	-	-	-	-	396	515	396	515	396	515	1,188	1,545	-	-	1,188	1,545
15		Replace live front transformers and terminators	Performed concurrently with other maintenance activities, replace live front distribution equipment with dead front to reduce the risk of electric contact by field personnel.	B	857	884	246	32	265	-	265	685	891	685	891	685	891	2,055	2,673	-	-	2,055	2,673
16		Continue "do no operate energized" (DOE) Switch Removal and Replacement Program	Proactively replace DOE underground switches to reduce the risk of field injury or catastrophic failure.	B	5,258	5,423	4,016	5,567	5,635	-	5,635	5,180	6,734	5,180	6,734	5,180	6,734	15,540	20,202	-	-	15,540	20,202
17		Electric Distribution Underground (ED/UG) – Corrective Maintenance Program Improvement of Underground Service	Upon inspection, replacement of underground service wires and terminations to prevent customer safety hazards.	B	10,208	10,492	8,991	9,750	11,677	-	11,677	10,224	13,291	10,224	13,291	10,224	13,291	30,672	39,873	-	-	30,672	39,873
18		CMP Switch Replacement & Manhole Repair	Upon inspection, replacement of distribution switches and repair manhole facilities in order to prevent customer safety hazards.	B	5,258	5,423	4,016	5,567	5,634	-	5,634	5,180	6,734	5,180	6,734	5,180	6,734	15,540	20,202	-	-	15,540	20,202
19	Premature Underground Failure Subtotal				39,777	35,861	27,536	29,145	33,107	-	33,107	71,713	93,227	71,713	93,227	71,713	93,227	215,139	279,681	-	-	215,139	279,681
20	Premature Substation Failure	Install CBM on GCBs	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. SF6 is one key unit measured in gas circuit breakers (GCB).	B	-	-	-	-	-	2,309	2,309	-	-	-	-	-	-	-	-	8,100	10,530	8,100	10,530
21		CBM - Distribution	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Distribution transformers (e.g. 69/12 kV) and their associated oil/gas measurements are monitored.	B	249	3,435	3,924	1,946	943	-	943	500	650	-	-	-	-	500	650	-	-	500	650
22		CBM - Transmission	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Transmission transformers (e.g. 500/230 kV) and their associated oil/gas measurements are to be monitored.	P	-	-	-	-	-	433	433	-	-	-	-	-	-	-	-	696	905	696	905
23		CBM - Batteries	Install specialized monitoring and communication devices on substation equipment in order to create a data-informed maintenance and replacement process for major substation assets. Substation batteries and their associated voltage levels and other asset health data are to be monitored.	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	63	49	63
24		Distribution - Substation Equipment Assessment (SEA) Team-guided design and construction program. Includes obsolete equipment replacement and relay replacements	Rebuild at-risk substations or substation equipment based on comprehensive rankings determined by the SEA team.	B	-	2,975	387	276	504	-	504	8,000	10,400	8,000	10,400	8,000	10,400	24,000	31,200	-	-	24,000	31,200

2016 Risk Assessment Mitigation Phase  
SDGE-12-WP  
Risk: Electric Infrastructure Integrity (GRC Total - Capital)

Line No.	Mitigation	Project/Program	Project/Program Description	Status	Recorded (Directs, 2015 \$000)					Non-GRC 2015	Capital Total 2015	Forecast Range (Directs, 2015 \$000)						GRC 2017-2019 Low (Sum)	GRC 2017-2019 High (Sum)	Non-GRC 2017-2019 Low	Non-GRC 2017-2019 High	Capital Total 2017-2019 Low	Capital Total 2017-2019 High
					GRC 2011	GRC 2012	GRC 2013	GRC 2014	GRC 2015			GRC 2017 Low	GRC 2017 High	GRC 2018 Low	GRC 2018 High	GRC 2019 Low	GRC 2019 High						
25	Premature Substation Failure Subtotal	4 kV Modernization - Substation	Proposed program aims to remove 4 KV assets and replace with 12 kV. Scope of work may include complete removal and rebuild of 4 kV substation facilities (including step-down units). At-risk example includes package/unit substations that feature single points of failure and long lead time to replace units, requiring temporary solutions.	P	66	49	5	-	-	-	-	1,400	1,820	1,400	1,820	1,400	1,820	4,200	5,460	-	-	4,200	5,460
26					315	6,459	4,316	2,222	1,447	2,742	4,189	9,900	12,870	9,400	12,220	9,400	12,220	28,700	37,310	8,845	11,498	37,545	48,808
27	System Modernization	Advanced SCADA infrastructure (formerly referred to as the Smart Grid Communication System)	Deploy substation and distribution Advanced SCADA systems to enable phasor measurement unit (PMU) capability and intelligent control (e.g. Falling Conductor Protection).	B	-	3,872	5,041	430	571	-	571	2,479	3,223	2,479	3,223	2,479	3,223	7,437	9,669	-	-	7,437	9,669
28		Advanced SCADA infrastructure: Install or modernize SCADA systems in substations (e.g. EM to MP or MP to MP)	Replace, upgrade, or deploy new advanced relaying systems in substations to accommodate/enable distribution Advanced SCADA systems.	P	-	-	-	-	-	-	-	2,000	2,600	2,000	2,600	2,000	2,600	6,000	7,800	-	-	6,000	7,800
29		Replace degraded or non-functioning SCADA RTUs	Replace degraded or non-functioning SCADA RTUs.	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30		Proactively replace bridged cutout switches with SCADA gang operated or disconnect switches	Proactively replace bridged cutout switches in order to improve relay coordination and reliability. Reduce risk of safety hazards in the field while operating bridged cutouts. (This is the O&M component of work orders associated with minor units of property.)	P	-	-	-	-	-	-	-	4,244	5,517	4,244	5,517	4,244	5,517	12,732	16,551	-	-	12,732	16,551
31	System Modernization Subtotal				-	3,872	5,041	430	571	-	571	8,723	11,340	8,723	11,340	8,723	11,340	26,169	34,020	-	-	26,169	34,020
32	TOTAL				\$ 52,073	\$ 60,652	\$ 57,819	\$ 48,149	\$ 50,409	\$ 3,498	\$ 53,907	\$ 148,837	\$ 193,489	\$ 148,337	\$ 192,839	\$ 148,337	\$ 192,839	\$ 445,511	\$ 579,167	\$ 10,681	\$ 13,886	\$ 456,192	\$ 593,053

Notes:

- Baseline (B) and Proposed (P).
- Numbers in risk chapter tables may differ due to rounding.
- The purpose of Risk Assessment Mitigation Phase (RAMP) is not to request funding. Any funding requests will be made in the General Rate Case (GRC). The forecasts for mitigations are not for funding purposes, but are rather to provide a range for the future GRC filing. This range will be refined with supporting testimony in the GRC.