



Order Instituting Investigation into the November) Investigation 19-11-011
2019 Submission of San Diego Gas & Electric)
Company's Risk Assessment and Mitigation Phase.)

RISK ASSESSMENT MITIGATION PHASE
WORKPAPERS TO
CHAPTER SDG&E-6
MEDIUM PRESSURE PIPELINE INCIDENT

November 27, 2019

Chapter	SDG&E-6			
Risk	Medium Pressure Gas Pipeline Incident (Excluding Dig-in)			

PHMSA Incident Rate

Number of Incidents_National

Type	Number of Incidents_Excl. 3rd party dig-in			
	Transmission	Distribution_Main	Distribution_Service	Distribution Meters
MAOP <= 60 psig	-	149	136	139

SDG&E

Type	Miles			
	Transmission	Distribution_Main	Distribution_Service	Total
MAOP <= 60 psig	-	7817	8512	16329

National

Type	Miles			Meter
	Transmission	Distribution_Main	Distribution_Service	
MAOP <= 60 psig	-	1212344	924770	66075100

SDG&E

Type	Meters		
	Residential	Industrial	Total
SCG	842792	28561	871353

SDG&E_Excl. 3rd party dig-in

Type	Incident Rate			
	Transmission	Distribution_Main	Distribution_Service	Meters
MAOP <= 60 psig	-	0.26		0.21

Chapter	SDG&E-6
Risk	Medium Pressure Gas Pipeline Incident (Excluding Dig-in)

Single Point

ID	Activity	Project Life In Years	Cost Forecast (O&M, \$M) 2022	Cost Forecast (Capital, \$M)			Pre-Mitigation Single Point		% risk reduction (use if % risk addressed not available) (%)	% Risk Reduction			RSE	Post-Mitigation Single Point	
				2020	2021	2022	LORE	CORE		Safety	Reliability	Financial (\$M)	Single Point	LORE	CORE
				SDG&E-6-M1-T3	Location Verification and Assessment Oil Drip Piping Removal	67	0.00	9.28		9.28	9.28	101	2		2.1%
SDG&E-6-C2	Assessment Buried Piping in Vaults	40	0.00	7.72	7.72	7.72	101	2		0.3%	0.3%	0.3%	0.81	101.33	2.49
SDG&E-6-C1	MP CP program	1	1.59	4.23	4.23	4.23	101	2		30.6%	30.6%	30.6%	4.16	131.89	2.49
SDG&E-6-M1-T2	Early Vintage - T2 - Early Vintage Steel Replacement	68	0.00	5.49	6.44	7.39	101	2		7.6%	7.6%	7.6%	27.53	93.37	2.49
SDG&E-6-M1-T1	Early Vintage - T1 - Early Vintage Threaded Main	68	0.00	7.39	7.39	7.39	101	2		2.0%	2.0%	2.0%	6.51	98.94	2.49
SDG&E-6-M2-T1	Dresser Mechanical Couplings	40	0.00	7.88	7.88	7.88	101	2		0.1%	0.1%	0.1%	0.28	100.88	2.49
SDG&E-6-C4	Plastic Pipe Replacement	68	0.00	57.00	57.00	57.00	101	2		3.1%	3.1%	3.1%	1.28	104.14	2.49
SDG&E-6-A2	ALTERNATIVE: Soil Sampling Collection	1	11.90	0.00	0.00	0.00	101	2		0.2%	0.2%	0.2%	0.03	100.83	2.49
SDG&E-6-A1	ALTERNATIVE: Cathodic Protection – CP10's	68	0.00	0.55	0.55	0.55	101	2		0.1%	0.1%	0.1%	2.75	100.93	2.49
SDG&E-6-M2-T2	Removal of closed valves between HP/MP	52	0.00	3.52	0.00	0.00	101	2		0.1%	0.1%	0.1%	2.45	100.87	2.49

Low Alternative

ID	Activity	Project Life In Years	Cost Forecast (O&M, \$M) 2022	Cost Forecast (Capital, \$M)			Pre-Mitigation Low Alternative		% risk reduction (use if % risk addressed not available) (%)	% Risk Reduction			RSE	Post-Mitigation Low Alternative	
				2020	2021	2022	LORE	CORE		Safety	Reliability	Financial (\$M)	Low Alternative	LORE	CORE
				SDG&E-6-M1-T3	Location Verification and Assessment Oil Drip Piping Removal	67	0.00	9.28		9.28	9.28	101	0		2.1%
SDG&E-6-C2	Assessment Buried Piping in Vaults	40	0.00	7.72	7.72	7.72	101	0		0.3%	0.3%	0.3%	0.15	101.33	0.46
SDG&E-6-C1	MP CP program	1	1.59	4.23	4.23	4.23	101	0		30.6%	30.6%	30.6%	0.77	131.89	0.46
SDG&E-6-M1-T2	Early Vintage - T2 - Early Vintage Steel Replacement	68	0.00	5.49	6.44	7.39	101	0		7.6%	7.6%	7.6%	5.09	93.37	0.46
SDG&E-6-M1-T1	Early Vintage - T1 - Early Vintage Threaded Main	68	0.00	7.39	7.39	7.39	101	0		2.0%	2.0%	2.0%	1.20	98.94	0.46
SDG&E-6-M2-T1	Dresser Mechanical Couplings	40	0.00	7.88	7.88	7.88	101	0		0.1%	0.1%	0.1%	0.05	100.88	0.46
SDG&E-6-C4	Plastic Pipe Replacement	68	0.00	57.00	57.00	57.00	101	0		3.1%	3.1%	3.1%	0.24	104.14	0.46
SDG&E-6-A2	ALTERNATIVE: Soil Sampling Collection	1	11.90	0.00	0.00	0.00	101	0		0.2%	0.2%	0.2%	0.01	100.83	0.46
SDG&E-6-A1	ALTERNATIVE: Cathodic Protection – CP10's	68	0.00	0.55	0.55	0.55	101	0		0.1%	0.1%	0.1%	0.51	100.93	0.46
SDG&E-6-M2-T2	Removal of closed valves between HP/MP	52	0.00	3.52	0.00	0.00	101	0		0.1%	0.1%	0.1%	0.45	100.87	0.46

High Alternative

ID	Activity	Project Life In Years	Cost Forecast (O&M, \$M) 2022	Cost Forecast (Capital, \$M)			Pre-Mitigation High Alternative		% risk reduction (use if % risk addressed not available) (%)	% Risk Reduction			RSE	Post-Mitigation High Alternative	
				2020	2021	2022	LORE	CORE		Safety	Reliability	Financial (\$M)	High Alternative	LORE	CORE
				SDG&E-6-M1-T3	Location Verification and Assessment Oil Drip Piping Removal	67	0.00	9.28		9.28	9.28	101	6		2.1%
SDG&E-6-C2	Assessment Buried Piping in Vaults	40	0.00	7.72	7.72	7.72	101	6		0.3%	0.3%	0.3%	1.91	101.33	5.88
SDG&E-6-C1	MP CP program	1	1.59	4.23	4.23	4.23	101	6		30.6%	30.6%	30.6%	9.81	131.89	5.88
SDG&E-6-M1-T2	Early Vintage - T2 - Early Vintage Steel Replacement	68	0.00	5.49	6.44	7.39	101	6		7.6%	7.6%	7.6%	64.92	93.37	5.88
SDG&E-6-M1-T1	Early Vintage - T1 - Early Vintage Threaded Main	68	0.00	7.39	7.39	7.39	101	6		2.0%	2.0%	2.0%	15.35	98.94	5.88
SDG&E-6-M2-T1	Dresser Mechanical Couplings	40	0.00	7.88	7.88	7.88	101	6		0.1%	0.1%	0.1%	0.65	100.88	5.88
SDG&E-6-C4	Plastic Pipe Replacement	68	0.00	57.00	57.00	57.00	101	6		3.1%	3.1%	3.1%	3.03	104.14	5.88
SDG&E-6-A2	ALTERNATIVE: Soil Sampling Collection	1	11.90	0.00	0.00	0.00	101	6		0.2%	0.2%	0.2%	0.08	100.83	5.88
SDG&E-6-A1	ALTERNATIVE: Cathodic Protection – CP10's	68	0.00	0.55	0.55	0.55	101	6		0.1%	0.1%	0.1%	6.49	100.93	5.88
SDG&E-6-M2-T2	Removal of closed valves between HP/MP	52	0.00	3.52	0.00	0.00	101	6		0.1%	0.1%	0.1%	5.77	100.87	5.88

SDG&E-6-M1-T1: Early Vintage Threaded Main Replacement

Attribute	Risk Reduction		Formula	Basis			Reference	Project Life	
		Total		Scope	Effectiveness	Risk Addressed			
Safety	% Scope	36%	2%	<i>Replaced miles/total miles</i>	SDGE designation of miles	SME Estimate based on low failure rate of replacement pipe	Based on PHMSA data assessment including vintage analysis. Multiple of residual risk based on extrapolation of steel pipe leak rate experience	68	
	% Effectiveness	100%							<i>Very high</i>
	% Risk Addressed	5.7%							<i>Historical information</i>
Reliability	% Scope	36%	2%	<i>Replaced miles/total miles</i>	SDGE designation of miles	SME Estimate based on low failure rate of replacement pipe	Based on PHMSA data assessment including vintage analysis. Multiple of residual risk based on extrapolation of steel pipe leak rate experience		
	% Effectiveness	100%							<i>Very high</i>
	% Risk Addressed	5.7%							<i>Historical information</i>
Financial	% Scope	36%	2%	<i>Replaced miles/total miles</i>	SDGE designation of miles	SME Estimate based on low failure rate of replacement pipe	Based on PHMSA data assessment including vintage analysis. Multiple of residual risk based on extrapolation of steel pipe leak rate experience		
	% Effectiveness	100%							<i>Very high</i>
	% Risk Addressed	5.7%							<i>Historical information</i>

SDG&E-6-M1-T2: Early Vintage Steel Replacements												
Attribute	Risk Reduction			Formula	Basis			Reference	Project Life			
			Total		Scope	Effectiveness	Risk Addressed					
Safety	% Scope	43%	8%	<i>Replaced miles/total miles</i>	SDGE designation of miles	SME Estimate based on low failure rate of replacement pipe	Based on PHMSA data assessment including vintage analysis. Multiple of residual risk based on extrapolation of steel pipe leak rate experience		68			
	% Effectiveness	100%		<i>Very high</i>								
	% Risk Addressed	17.7%		<i>Historical information</i>								
Reliability	% Scope	43%	8%	<i>Replaced miles/total miles</i>								
	% Effectiveness	100%		<i>Very high</i>								
	% Risk Addressed	17.7%		<i>Historical information</i>								
Financial	% Scope	43%	8%	<i>Replaced miles/total miles</i>							PHMSA data	
	% Effectiveness	100%		<i>Very high</i>								
	% Risk Addressed	17.7%		<i>Historical information</i>								

SDG&E-6-M1-T3: Early Vintage Oil Drip Removal

Attribute	Risk Reduction		Formula	Basis			Reference	Project Life	
		Total		Scope	Effectiveness	Risk Addressed			
Safety	% Scope	100%	2%	<i>Locations to be verified and assessed</i>	SDGE designation of locations	SME Estimate	Based on PHMSA data assessment	68	
	% Effectiveness	45%							<i>High</i>
	% Risk Addressed	5%							<i>Internal incidents</i>
Reliability	% Scope	100%	2%	<i>Locations to be verified and assessed</i>	SDGE designation of locations	SME Estimate	Based on PHMSA data assessment		
	% Effectiveness	45%							<i>High</i>
	% Risk Addressed	5%							<i>Internal incidents</i>
Financial	% Scope	100%	2%	<i>Locations to be verified and assessed</i>	SDGE designation of locations	SME Estimate	Based on PHMSA data assessment		
	% Effectiveness	45%							<i>High</i>
	% Risk Addressed	5%							<i>Internal incidents</i>

SDG&E-6-M2-T1: Dresser Mechanical Coupling Removal									
Attribute	Risk Reduction			Formula	Basis			Reference	Project Life
			Total		Scope	Effectiveness	Risk Addressed		
Safety	% Scope	33%	0.12%	Locations to be addressed	SDGE designation of locations	SME Estimate	Based on PHMSA data assessment		40
	% Effectiveness	75%		High					
	% Risk Addressed	0.5%		Dresser mechanical coupling associated events in data sample					
Reliability	% Scope	33%	0.12%	Locations to be addressed					
	% Effectiveness	75%		High					
	% Risk Addressed	0.5%		Dresser mechanical coupling associated events in data sample					
Financial	% Scope	33%	0.12%	Locations to be addressed					
	% Effectiveness	75%		High					
	% Risk Addressed	0.5%		Dresser mechanical coupling associated events in data sample				PHMSA data	

SDG&E-6-M2-T2: High/Medium Valve Separation Removal

Attribute	Risk Reduction			Formula	Basis			Reference	Project Life
			Total		Scope	Effectiveness	Risk Addressed		
Safety	% Scope	100%	0.1%	<i># of interfaces</i>	SDGE designation	SME Estimate	Based on PHMSA data assessment. Assumed only a fraction are associated with the mitigated mode.		52
	% Effectiveness	100%		<i>High</i>					
	% Risk Addressed	0.1%		<i>Valve attributed incidents in sample</i>					
Reliability	% Scope	100%	0.1%	<i># of interfaces</i>					
	% Effectiveness	100%		<i>High</i>					
	% Risk Addressed	0.1%		<i>Valve attributed incidents in sample</i>					
Financial	% Scope	100%	0.1%	<i># of interfaces</i>					
	% Effectiveness	100%		<i>High</i>					
	% Risk Addressed	0.1%		<i>Valve attributed incidents in sample</i>					

SDG&E-6-C1: Cathodic Protection (CP)

Attribute	Risk Reduction		Formula	Basis			Reference	Project Life	
		Total		Scope	Effectiveness	Risk Addressed			
Safety	% Scope	100%	31%	<i>Pipe operating at <=60 psi</i>	SDGE designation	SME Estimate	Based on PHMSA data assessment. Multiple of residual risk based on extrapolation of steel pipe leak rate experience	1	
	% Effectiveness	95%							<i>High</i>
	% Risk Addressed	32.2%							<i>Corrosion-related incidents in sample</i>
Reliability	% Scope	100%	31%	<i>Pipe operating at <=60 psi</i>	SDGE designation	SME Estimate	Based on PHMSA data assessment. Multiple of residual risk based on extrapolation of steel pipe leak rate experience		
	% Effectiveness	95%							<i>High</i>
	% Risk Addressed	32.2%							<i>Corrosion-related incidents in sample</i>
Financial	% Scope	100%	31%	<i>Pipe operating at <=60 psi</i>	SDGE designation	SME Estimate	Based on PHMSA data assessment. Multiple of residual risk based on extrapolation of steel pipe leak rate experience		
	% Effectiveness	95%							<i>High</i>
	% Risk Addressed	32.2%							<i>Corrosion-related incidents in sample</i>

SDG&E-6-C2: Assessment of Buried Piping in Vaults

Attribute	Risk Reduction			Formula	Basis			Reference	Project Life
	% Scope	% Effectiveness	Total		Scope	Effectiveness	Risk Addressed		
Safety	% Scope	74%	0.3%	<i>SDGE vaults to be assessed/repared</i>	SDGE designation of vaults	SME Estimate	Based on PHMSA data assessment		40
	% Effectiveness	95%		<i>High</i>					
	% Risk Addressed	0.5%		<i>Vault associated events in sample</i>					
Reliability	% Scope	74%	0.3%	<i>SDGE vaults to be assessed/repared</i>					
	% Effectiveness	95%		<i>High</i>					
	% Risk Addressed	0.5%		<i>Vault associated events in sample</i>					
Financial	% Scope	74%	0.3%	<i>SDGE vaults to be assessed/repared</i>					
	% Effectiveness	95%		<i>High</i>					
	% Risk Addressed	0.5%		<i>Vault associated events in sample</i>					

SDG&E-6-C4: Plastic Pipe Replacement									
Attribute	Risk Reduction			Formula	Basis			Reference	Project Life
			Total		Scope	Effectiveness	Risk Addressed		
Safety	% Scope	6%	3%	<i>Vintage plastic pipe miles to be replaced/total miles</i>	SDGE designation of miles	SME Estimate	Based on PHMSA data assessment, residual risk multiplier based on comparison of vintage versus modern pipe		68
	% Effectiveness	100%		<i>High</i>					
	% Risk Addressed	53%		<i>Plastic Aldyl-A pipe events in sample</i>					
Reliability	% Scope	6%	3%	<i>Vintage plastic pipe miles to be replaced/total miles</i>					68
	% Effectiveness	100%		<i>High effectiveness due to very low failure rate of modern plastic pipe</i>					
	% Risk Addressed	53%		<i>Plastic Aldyl-A pipe associated events/nationwide significant events</i>					
Financial	% Scope	6%	3%	<i>Vintage plastic pipe miles to be replaced/total miles</i>			PHMSA data		68
	% Effectiveness	100%		<i>High effectiveness due to very low failure rate of modern plastic pipe</i>					
	% Risk Addressed	53%		<i>Plastic Aldyl-A pipe associated events/nationwide significant events</i>					

SDG&E-6-A1: Cathodic Protection (CP10s)									
Attribute	Risk Reduction			Formula	Basis			Reference	Project Life
			Total		Scope	Effectiveness	Risk Addressed		
Safety	% Scope	3%	0.06%	<i>Units to be replaced/total units</i>	SME Estimate	SME Estimate	Based on PHMSA data assessment		68
	% Effectiveness	95%		<i>High effectiveness</i>					
	% Risk Addressed	2%		<i>Historical information reported to PHMSA</i>					
Reliability	% Scope	3%	0.06%	<i>Units to be replaced/total units</i>					
	% Effectiveness	95%		<i>High effectiveness</i>					
	% Risk Addressed	2%		<i>Historical information reported to PHMSA</i>					
Financial	% Scope	3%	0.06%	<i>Units to be replaced/total units</i>			PHMSA data		
	% Effectiveness	95%		<i>High effectiveness</i>					
	% Risk Addressed	2%		<i>Historical information reported to PHMSA</i>					

SDG&E-6-A2: Soil Sampling Program

Attribute	Risk Reduction		Formula	Basis			Reference	Project Life
		Total		Scope	Effectiveness	Risk Addressed		
Safety	% Scope	100%	0.17%	100% of soil to be sampled as a one-time effort	Entire system targeted	SME Estimate	SME Estimate	1
	% Effectiveness	1%		Minimal				
	% Risk Addressed	17%		Same as SCG plastic DREAMS program				
Reliability	% Scope	100%	0.17%	100% of soil to be sampled as a one-time effort	Entire system targeted	SME Estimate	SME Estimate	
	% Effectiveness	1%		Minimal				
	% Risk Addressed	17%		Same as SCG plastic DREAMS program				
Financial	% Scope	100%	0.17%	100% of soil to be sampled as a one-time effort	Entire system targeted	SME Estimate	SME Estimate	
	% Effectiveness	1%		Minimal				
	% Risk Addressed	17%		Same as SCG plastic DREAMS program				