Line 1600 Test or Replacement Plan

September 26, 2018

I. EXECUTIVE SUMMARY

In compliance with California Public Utilities Commission (Commission) Decision (D.) 18-06-028, San Diego Gas & Electric Company (SDG&E) and Southern California Gas Company (SoCalGas) submit this proposed Line 1600 Test or Replacement Plan.[1] SDG&E and SoCalGas evaluated four potential design alternatives for the pressure test or replacement of 49.7 miles of Line 1600 in its present corridor: (1) replacing Line 1600 pipeline in High Consequence Areas (HCAs)[2] and hydrotesting Line 1600 pipeline in non-HCAs (Replace in HCA/Test in Non-HCA alternative); (2) hydrostatic strength testing (hydrotest or test) the entire length of Line 1600 (Full Hydrotest alternative); (3) full replacement of Line 1600, routing in nearby streets in the north (Full Replacement in Nearby Streets alternative); and (4) full replacement of Line 1600, routing along Highway 395 in the north (Full Replacement Along Highway 395 alternative). The alternative designs evaluated by SDG&E and SoCalGas in preparing this Plan are summarized in Table 1 below. Unless otherwise indicated, the estimated costs presented in this Plan are loaded and escalated.

[1] D.18-06-028 at 128, Ordering Paragraph 7. *See also id*. at 90-92.

[2] HCAs are defined in 49 CFR 192.903. Generally, an HCA is defined to include Class 3 and 4 locations, as well as any area in a Class 1 or 2 location where the potential impact radius is greater than 660 feet and the area within the potential impact radius includes 20 or more buildings intended for human occupancy or a site identified as occupied by 20 or more persons on at least 50 days in any twelve-month period.

TABLE 1
Line 1600 Test or Replace Alternative Designs Evaluated

Alternative Design	Loaded and Escalated Cost[3] ($ millions)			Description
	Capital	O&M	Total	
Replace in HCAs/ Test in Non-HCAs[4]	630	47	677	Replace pipeline in 14 replacement sections (*i.e.*, replace 37 miles primarily in HCAs with installation of ~43 miles of new, modern design, thicker 16-inch pipe); retrofit and hydrotest pipeline in 5 hydrotest sections; achieves compliance with Public Utilities Code section 958; enhances safety and extends lifespan of the pipeline by removing all vintage A.O. Smith flash-welded pipe in more populated areas; leaves vintage A.O. Smith flash-welded pipe in service in non-HCAs.
Full Hydrotest[5]	92	233	325	Hydrotest entire pipeline in 22 sections, retrofit line to make fully piggable; achieves compliance with Public Utilities Code section 958 but leaves vintage A.O. Smith flash-welded pipe in service.
Full Replacement in Nearby Streets	778	-	778	Replace all vintage A.O. Smith flash-welded pipe (install ~56 miles of new, modern design, thicker 16-inch pipe); achieves maximum safety, reliability and operational enhancement and extends lifespan of the entire pipeline by abandoning or derating all vintage A.O. Smith flash-welded pipe; achieves compliance with Public Utilities Code section 958.
Full Replacement Along Highway 395	725	-	725	Replace all vintage A.O. Smith flash-welded pipe (install ~55 miles of new, modern design, thicker pipe); achieves maximum safety, reliability and operational enhancement and extends lifespan of entire pipeline by abandoning or derating all vintage A.O. Smith flash-welded pipe; achieves compliance with Public Utilities Code section 958; reduces costs and realizes construction efficiencies by installing replacement pipe in Old Highway 395.

[3] Costs shown are loaded and escalated. Loaded costs are the sum of direct costs and indirect costs. Direct costs are costs for labor, material, services and other expenses incurred to design, engineer, plan, execute and document the Line 1600 testing and replacement work described in this document. This includes project development costs, project management, materials, construction, inspection, environmental and other project execution activities. Indirect costs are for Administrative & General, purchasing, warehousing, pension and benefits, payroll tax, and other costs that are overhead in nature. Allowance for Funds Used During Construction (AFUDC) and property taxes are not included in the costs presented for review in this Plan.

[4] Identified as "Option 2" in D.18-06-028.

[5] Identified as "Option 1" in D.18-06-028.

Each design alternative divides the scope of work into separate sections that can be completed independently to meet statutory and Commission directives to execute SDG&E and SoCalGas' Pipeline Safety Enhancement Plan (PSEP) as soon as practicable and manage potential impacts to customers. SDG&E and SoCalGas evaluated the design alternatives consistent with the requirements set forth in D.18-06-028, SDG&E and SoCalGas' approved PSEP Decision Tree, and the overarching objectives of PSEP to: (1) comply with the Commission's directives [subsequently codified in Public Utilities Code section 958]; (2) enhance public safety; (3) minimize customer impacts; and (4) maximize the cost effectiveness of safety investments.[6] As required by D.18-06-028, SDG&E and SoCalGas coordinated with the Commission's Safety and Enforcement Division (SED) in developing and evaluating this Plan and alternative designs.

After carefully evaluating each alternative design and the Commission's direction in D.18-06-028, SDG&E and SoCalGas propose to replace approximately 37 miles of existing Line 1600 primarily located in HCAs and hydrotest the remaining approximately 13 miles of existing Line 1600 located in non-HCAs through execution of 19 separate project sections (Replace in HCAs/Test in Non-HCAs). A map of the proposed scope of work for the Plan is presented below in Figure 1. As summarized in Table 1 above, the estimated loaded and escalated cost of the proposed Plan, based on preliminary engineering, design and planning is approximately $677 million. Of the total estimated cost, SDG&E and SoCalGas anticipate recording approximately $630 million as a capital expenditure and approximately $47 million as an operating expense.

[6] Rulemaking (R.) 11-02-019, *Amended Testimony of Southern California Gas Company and San Diego Gas & Electric Company in Support of Proposed Natural Gas Pipeline Safety Enhancement Plan* (December 2, 2011) at 10.

Figure 1: Map of Plan to Primarily Replace in HCAs, Hydrotest in Non-HCAs[7]

Detailed planning, engineering, and permitting activities for the proposed Plan are already underway, and SDG&E and SoCalGas anticipate that the first construction and testing

[7] Approximately 2.1 miles of vintage Line 1600 located within a non-HCA area within the Marine Corp Air Station (MCAS) Miramar is planned to be replaced to address airfield security, access and environmental concerns raised by MCAS Miramar.

field work will commence in the first quarter of 2020, with an initial focus on HCAs. Construction and testing activities are anticipated to span approximately four years. SDG&E and SoCalGas intend to present costs incurred for projects completed prior to 2022 for reasonableness review in a General Rate Case application and to include forecasts of testing and replacement costs for years 2022 and beyond in General Rate Case applications, consistent with D.16-08-003.

The Commission requires SDG&E and SoCalGas' Plan to include specific information as outlined in D.18-06-028 (at 90-92). SDG&E and SoCalGas' Plan complies with D.18-06-028 by providing the requisite information organized as follows:

TABLE 2
Plan Requirements Index

Plan Requirement	Location of Required Information in Report
Interim Safety Enhancement Measures	Section VI
Spike Test Best Practices	Section IV
Compliance with Applicable Regulations and Industry/Company Standards	Section IV
Maximum Test Pressure	Section IV
Prioritization List and Test/Replace Section Schedule	Section IV
Completion Timeline	Section IV
Test Section Prioritization Criteria	Section IV
Public Safety and Property/Environment Protection Measures	Section VI
Temporary Service Requirements (including location of temporary lateral pipelines if applicable)	Section IV
Cost Forecast (O&M and Capital) by Section and Year	Section VII
Test vs Replace Rationale for Each Section	Section IV

Plan Requirement	Location of Required Information in Report
Listing and GPS Coordinates of Existing Commercial and Residential Structures that abut the Easement (including potential encroachments)	Section VI
Identification of Potential Reroutes and/or Removal/Moving of Structures	Section IV

Introductory and background information in support of the proposed Plan is provided in Section II below. Throughout the development of this Plan, SDG&E and SoCalGas worked closely with SED, and those activities are described in Section III. In Section IV, SDG&E and SoCalGas describe the proposed Plan in greater detail, describing each individual project section, the prioritization process used to develop a construction schedule for each section, the routing criteria used to evaluate the alternatives considered in preparing the Plan, temporary service requirements to minimize service disruptions to customers during construction, and how implementation of the Plan is designed to meet or exceed current regulatory and industry standards. In Section V, a summary of technical considerations, including the attributes of Line 1600, its installation and assessment history, as well as the operating and maintenance history is provided. In Section VI, additional public safety and environmental protection measures, including interim safety enhancement measures, are described. In Section VII, SDG&E and SoCalGas present preliminary cost estimates for the proposed Plan and describe the methodology used to calculate them. In Section VIII, other alternative designs that were considered are discussed. SDG&E and SoCalGas address potential future Plan modifications in Section IX. Additional maps, illustrative materials, and other supporting information are provided in Section X as an Appendix.

II. BACKGROUND

A. Introduction

SDG&E and SoCalGas own and operate an integrated backbone natural gas transmission system consisting of pipelines, compressor stations, and underground storage facilities (Gas System). With their network of transmission pipelines and four interconnected underground storage facilities, SDG&E and SoCalGas deliver natural gas to a regional population of over 24 million energy consumers.

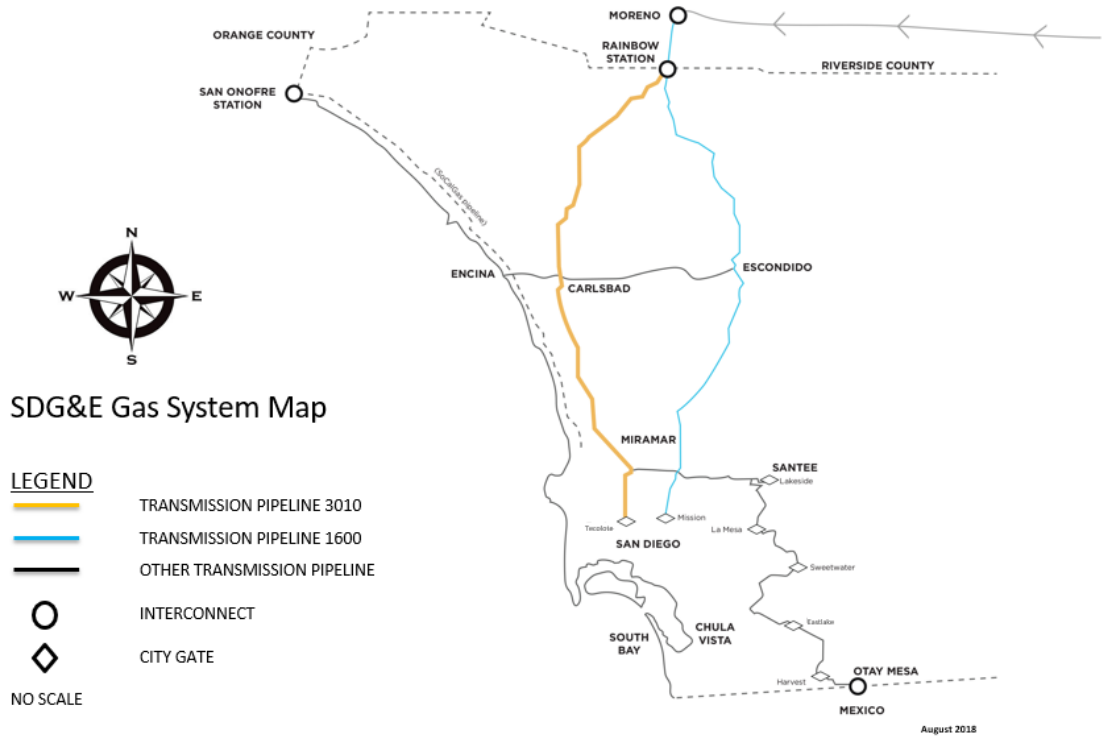
SDG&E's service territory for natural gas is the County of San Diego, which has a growing population of over 3.3 million, a $200 billion economy, and home to the largest concentration of military assets and personnel in the world. Including its electric service territory in southern Orange County, SDG&E safely and reliably provides natural gas and electric service to approximately 3.6 million residential, commercial, and Electric Generation (EG) consumers, including the military, hospitals, universities and schools, through over 870,000 natural gas meters and 1.4 million electric meters.

Continuous enhancement of the safety of the natural gas transmission pipeline system through the execution of programs such as PSEP is an integral part of the safety culture at SDG&E and SoCalGas. As described above, two overarching objectives of PSEP are to enhance public safety and comply with the Commission's directives. This commitment to public and employee safety while complying with Commission orders and Public Utilities Code section 958 has not wavered.

B. The SDG&E Gas System

The SDG&E gas transmission system, which is part of SDG&E and SoCalGas' integrated natural gas system, is illustrated in Figure 2 below. The SDG&E gas transmission system consists primarily of two high-pressure, large-diameter pipelines that originate at Rainbow Station, located at the Riverside and San Diego County border, and extend south terminating within the core of the San Diego metropolitan area. The SDG&E system also has a receipt point at Otay Mesa which has historically only been used intermittently.

Figure 2: SDG&E Gas Transmission System



The SDG&E gas transmission system is designed to flow gas supplies from north to south, starting at the Riverside County line, and south to north, starting at the Mexican border, to meet consumer demand for heating homes on peak winter days, providing gas service to commercial and industrial operations, and to generate electricity to meet cooling demands on the hottest

days of summer. Gas supplies originating in the southwestern United States are transported on the SoCalGas system to San Diego first using a compressor station located in Moreno Valley, California known as the Moreno Compressor Station, and then using the two major transmission pipelines mentioned previously and described in more detail below.

Line 1600 is a 16-inch diameter natural gas transmission pipeline that runs from Rainbow Station in the north to Mission Station in the south. Line 1600's transmission function is important, not only for its contribution to system capacity, but also as a supply source for the portions of the gas distribution system that it directly feeds. Line 1600 also contributes to gas transmission system reliability should other elements of the system be out of service or require pressure reduction. While Line 1600 tends to contribute 65 million cubic feet per day (MMcfd) to the SDG&E system capacity with Line 3010 in service, Line 1600 could supply 115 MMcfd at a Maximum Allowable Operating Pressure (MAOP) of 512 pounds per square inch gauge (psig), 150 MMcfd at an MAOP of 640 psig, or 160 MMcfd at an MAOP of 800 psig, if Line 3010 were out of service.

Line 1600 works in conjunction with another north-to-south running pipeline, Line 3010, a 30-inch diameter transmission pipeline running from the Rainbow Station to the Tecolote Station. Line 3010 was placed into service in 1961 and provides approximately 90 percent of SDG&E's capacity, assuming compression is available. Line 3010 and Line 1600 also interconnect via transmission cross-tie pipelines between Oceanside and Escondido and between Miramar and Santee.

In addition to Lines 3010 and 1600, the third major component of the SDG&E system bringing gas from the north is the Moreno Compressor Station. The Moreno Compressor Station

is located in the SoCalGas service territory approximately 35 miles north of the San Diego County line in Moreno Valley in Riverside County. Essentially, all gas supplies that come into San Diego County from the north pass through the Moreno Compressor Station. This is a critical facility in meeting gas supply requirements for SDG&E.

C. Overview of Line 1600

Line 1600 operates as a transmission pipeline, supplies approximately 10% of the natural gas volumetric demand in San Diego County and serves as the sole or primary supply of natural gas for customers in the inland valley communities of Rainbow, eastern Fallbrook, Valley Center, Escondido, Rancho Bernardo, Rancho Peñasquitos, Poway, Scripps Ranch, Kearny Mesa, and Serra Mesa. These communities represent about 17% (~150,000) of San Diego's customers who depend on Line 1600 for reliable natural gas supply.

Currently, Line 1600 has a Maximum Operating Pressure (MOP) and MAOP of 512 psig along its entire 50-mile length. Line 1600 distributes gas to customers along its length via approximately 60 pipeline interconnections that feed local gas distribution systems or directly feed customers at high pressure meter sets.

The distribution supply line systems (defined as greater than 60 psig) depend on Line 1600 for a steady supply of high pressure natural gas to support the local demands downstream. Each of the distribution supply systems has been designed, sized, and planned to reliably serve customer peak demand based on existing, as well as anticipated, system growth in the areas they serve. As considered in this Plan, the "Line 1600 corridor" constitutes those areas served by the natural gas distribution system along the 50-mile length of Line 1600, where Line 1600

supplies significant amounts of natural gas to those areas. The Line 1600 corridor is generally represented by the area displayed in the map included in Section X, Appendix, Figure 10.

A foremost consideration in conjunction with replacing and testing Line 1600 is that Line 1600 is the primary, and in many cases, the only natural gas supply source for the local gas distribution systems that serve well over 100,000 customers along the Line 1600 corridor. Given that there are no other supply sources, any work identified for Line 1600 requires significant efforts and must be carefully planned to avoid customer service interruptions. The pipeline infrastructure required to be installed to replace Line 1600 must be interconnected to the existing gas distribution system at select locations to ensure that pipeline capacity, and therefore reliability of service to customers, is not compromised. This will require modifications to the gas distribution system to interconnect new supply sources to portions of Line 1600, and these interconnections will require some new distribution pipeline extensions as well as new pressure regulator stations and "tie-overs" that connect the new infrastructure to the remaining existing infrastructure.

III. COORDINATION WITH THE COMMISSION'S SAFETY AND ENFORCEMENT DIVISION

In D.18-06-028, the Commission directs SDG&E and SoCalGas to coordinate with SED on the future treatment of existing Line 1600. Specifically, the Decision requires:

- The Director of the Safety and Enforcement Division, or designee, is delegated the following authority to:
    a) Review all activities of any kind related to the hydrotesting of Line 1600;
    b) Inspect, inquire, review, examine and participate in all activities related to Line 1600;
    c) Order San Diego Gas & Electric and Southern California Gas Company to take any actions necessary to protect public safety. (OP15)

- The Applicants shall work with SED to prepare the Plan. (p. 91)
- Applicants shall work with SED to determine:
    a) The maximum test pressure commensurate with the MAOP deemed safe for Line 1600; and
    b) A prioritization list and schedule for testing of sections. (p. 91)

In compliance with the Decision's directives, SDG&E and SoCalGas coordinated with SED throughout the development of this Plan. Between the Decision date of June 21, 2018 and the Plan submission date of September 26, 2018, SDG&E and SoCalGas met with SED both telephonically and in person more than six times and facilitated an on-site examination by SED staff of the existing Line 1600 easements and several identified locations for replacement sections in nearby streets.

During these coordination meetings, SED emphasized that it is SDG&E and SoCalGas' responsibility, as the system operator, to make determinations about which sections to replace and which to test, considering the best interest of safety related to existing Line 1600, as well as aspects of any re-route of the replacement sections. SED advised SDG&E and SoCalGas to include all issues and factors that influence decisions to replace or test sections of Line 1600 in the Plan.

Throughout the three-month coordination period, SDG&E and SoCalGas frequently shared Plan development objectives, challenges and proposed treatment of section projects with SED, and received ongoing feedback and guidance from SED to inform the development of this final Plan. SDG&E and SoCalGas have incorporated SED's input from the three-month coordination into this proposed Plan.

IV. PROPOSED TEST AND REPLACEMENT PLAN FOR LINE 1600

A. Scope

Through this test and replacement Plan, SDG&E and SoCalGas propose to replace approximately 37 miles of existing Line 1600 located in HCAs and through secured federal lands,[8] and pressure test approximately 13 miles of existing Line 1600 located in non-HCAs. The proposed scope of work is divided into 19 sections, each of which has independent utility and can be constructed separately to enable SDG&E and SoCalGas to minimize customer and community impacts and meet the Commission's directive to execute PSEP as soon as practicable.[9] The initial focus will be on the HCA sections. The following sections provide additional information supporting the proposed Plan.

The proposed Plan is the result of following the PSEP Decision Tree analysis and applying sound judgment and working knowledge of Line 1600 and the San Diego natural gas transmission and distribution systems. It identifies the work required to complete the replacement and testing of Line 1600 while maintaining gas supply to the current customer base. The overarching objectives of this Plan are consistent with the overarching objectives of PSEP: (1) comply with the Commission's directives [subsequently codified in Public Utilities Code section 958]; (2) enhance public safety; (3) minimize customer impacts; and (4) maximize the cost effectiveness of safety investments.[10]

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[8] Approximately 2.1 miles of vintage Line 1600 located within a non-HCA area within MCAS Miramar is also planned to be replaced to address airfield security, access, and environmental concerns raised by MCAS Miramar.

[9] D.11-06-017 at 19.

[10] R.11-02-019, *Amended Testimony of Southern California Gas Company and San Diego Gas & Electric Company in Support of Proposed Natural Gas Pipeline Safety Enhancement Plan* (December 2, 2011) at 10.

B. SDG&E and SoCalGas Considered Testing or Replacement Alternatives Consistent with the Approved PSEP Decision Tree and the Commission's Directives in D.18-06-028.

As indicated above, SDG&E and SoCalGas evaluated four test or replacement alternatives in preparing the proposed Plan. The four alternatives evaluated by SDG&E and SoCalGas are rooted in the approved PSEP Phase 1 Decision Tree process, which guides the determination of whether a pipeline should be tested or replaced. The PSEP Phase 1 Decision Tree was approved by the Commission in D.14-06-007[11] and represents SDG&E and SoCalGas' analytical approach to testing or replacing pipelines to enhance the safety of their integrated natural gas transmission system. SDG&E and SoCalGas use the Decision Tree and its concepts to guide their decision-making process, and ultimately apply professional judgment, as knowledgeable operators of their system, to determine what is prudent, best achieves safety enhancement objectives, and maximizes the cost effectiveness of customers' safety investments. Relevant considerations include costs associated with pressure testing, including managing customer impacts, costs of replacing the existing pipeline, and other engineering factors, depending on the unique conditions and circumstances of each pipeline project.

SDG&E and SoCalGas apply the following guiding principles to complete this PSEP test versus replacement analysis: (1) SDG&E and SoCalGas will not interrupt service to core customers in order to pressure test a pipeline; (2) SDG&E and SoCalGas will work with noncore customers to determine if an extended outage is possible; (3) SDG&E and SoCalGas will, where necessary, temporarily interrupt noncore customers as provided for in their tariffs; (4) SDG&E and SoCalGas will work with noncore customers to plan, where possible, service interruptions

[11] D.14-06-007 at 59, Ordering Paragraph 1.

during scheduled maintenance, down time or off-peak seasons; and (5) SDG&E and SoCalGas will consider cost and engineering factors along with the improvement of the pipeline asset. These principles were explained in SDG&E and SoCalGas' amended PSEP and at hearings in A.11-11-002. It is important to note that no industry-wide standard exists that balances the risk of a pipeline failure with the cost of testing or replacing such pipeline. SDG&E and SoCalGas are in the best position to make this determination on a project-by-project basis, based on the unique characteristics and circumstances of each pipeline, applying their engineering expertise and knowledge of the pipelines they operate.

Applying the Commission-approved Decision Tree and professional judgment, and the limitations imposed by the Commission in D.18-06-023, SDG&E and SoCalGas determined that replacing vintage Line 1600 pipe in current and anticipated HCAs and pressure testing in non-HCAs is reasonable, enhances public safety, and complies with Commission and statutory requirements and benefits customers. Having evaluated the characteristics of Line 1600 and the environment in which it operates, SDG&E and SoCalGas propose to replace sections of Line 1600 in HCAs because this allows the greatest opportunity to significantly improve safety in populated areas by eliminating known flaws associated with the A.O. Smith electric flash welded (EFW) pipe and incorporate new, significant safety features (*e.g.*, modern manufacturing methods, heavier wall thickness, improved grade with better fracture control, and installation of modern safety features, such as warning mesh above the pipeline to alert excavators they are near the pipeline). These safety improvements could not be achieved through hydrotesting alone. Moreover, replacing 1949-vintage pipeline in the HCA sections of Line 1600 avoids the significant costs associated with hydrotesting the entire existing line (including any repairs

identified during hydrotesting), the costs to retrofit Line 1600 to accommodate in-line inspection tools, and additional costs to replace those sections of the nearly 70-year-old Line 1600 in the future. In addition, ongoing operations and maintenance costs for the new sections of pipeline are anticipated to be lower than historical costs.

This Plan assumes that all customers who currently have natural gas service will continue to have the same level of service after Line 1600 is replaced/tested. The enhancements included as part of the Plan are intended to avoid existing customers experiencing a reduction in reliability, capacity, or pressure compared to what they have historically experienced. The final design of improvements will incorporate good engineering judgment related to gas transmission and distribution system reliability and capacity and should allow for reasonable long-term future operating conditions.

Engineering factors associated with the vintage A.O. Smith EFW pipe that influence pipeline safety, especially in populated areas, are the primary driver for the proposed replacement of sections of Line 1600 in HCAs. The approach set forth in this proposed Plan recognizes the additional value of the installation of new pipeline sections in densely populated areas, including enhancement of the overall safety and reliability of the pipeline, because new pipe is manufactured to modern standards and has physical characteristics that enhance safety as compared to the earlier vintage pipelines. This is consistent with PSEP and Commission General Order (GO) 112-F, which requires escalating margins of safety as population density increases.

The scope of work required to replace/test Line 1600 includes new transmission main, some new supply lines and new distribution mains, and new or rebuilt pressure regulating

stations that must be connected to the modified system. Also included in this analysis is the abandonment of existing infrastructure, including pressure regulator stations that would no longer be needed.

Testing work includes the work necessary to perform the test, including a spike test, and keep existing customers in service while this work is performed. Test section preparation work also includes removal of wrinkle bends as well as shorter radius bends and other features which prevent in-line-inspections of the legacy pipeline using commercially available circumferential magnetic flux leakage (CMFL) smart pigging tools.

The proposed Plan is a prudent approach to achieving compliance with the directives of the Commission and Public Utilities Code section 958. Factors such as potential environmental impacts, impacts to private property, potential growth, project costs, and feasibility were considered as part of determining replacement routes for each project section. As SDG&E and SoCalGas transition from high-level planning to detailed design, engineering and planning, additional analysis will be completed, and some refinement and modification of the Plan may be necessary to address engineering, permitting, community, or cost considerations.

C. Descriptions of Each Pressure Test or Replacement Project Section

The proposed test and replacement Plan for Line 1600 is comprised of 19 project sections. The sections have been numbered from north to south as shown on Figure 1 above. To provide additional descriptive reference, each project section has been assigned a name that corresponds to a geographic reference and also describes whether the section is planned to be replaced or hydrotested. These names are also reflected in Figure 1 above. Each of these sections is further described in Table 3 below, which summarizes key factors considered in

planning the scope of work for each section. Unique factors associated with each section can influence hydrotest break points, section boundaries, schedule, and other key project attributes.

TABLE 3
Descriptions of Each Test or Replace Project Section and Estimated In-Service Dates

Section Number	Section Name	HCA	Approx. Mileage	Description	Estimated In-Service Date
1	Rainbow Replacement	Yes	3.7	Section starts at Rainbow Station (beginning of line) and will tie into existing line about 2,000 feet past non-HCA alignment due to easier access to land and more level laydown area for water tanks. The south point also serves as a breaking point due to tap to a power plant which will minimize impact.	Q4 2022
2	Rice Canyon Hydrotest	No	3.2	Section starts after Rainbow Replacement section and ends at Main Line Valve (MLV) 1601 due to valve isolation point and adjacent laydown yard a couple feet from MLV.	Q1 2024
3	Couser Canyon North Hydrotest	No	2.6	Section begins after MLV 1601 and ends at Pala Loma Dr., the midpoint of increasing elevation.	Q2 2024
4	Couser Canyon South Hydrotest	No	2.6	Section starts at Pala Loma Dr. and goes southbound until reaching Keyes Creek Rd. Keyes Creek Road is a little over 2,000 feet north of the start of the HCA section (Lilac Rd. Replacement). Keyes Creek Rd. was selected as the break point because it provides adequate level work space for hydrotest equipment and working area. Utilizing Keyes Creek Rd. location also minimizes environmental impacts.	Q3 2024
5	Lilac Rd Replacement	Yes	5.9	Section starts at Keyes Creek Rd. and ends south of Betsworth Rd., where non-HCA segment starts. Southern break sits on private property, which is planned to be used as a laydown yard.	Q1 2023

Section Number	Section Name	HCA	Approx. Mileage	Description	Estimated In-Service Date
6	Moosa Creek Hydrotest	No	0.9	Section starts at the beginning of non-HCA near Betsworth Rd. and runs south until break point at Mirar De Valle Rd. Mirar De Valle Rd. is used as a breaking point because it is the mid-point of rising elevation with the adjacent hydrotest and has a yard within a couple feet from the line.	Q2 2023
7	Daley Ranch Hydrotest	No	3.5	Section starts at Mirar De Valle Rd. and ends about 1,000 feet north of MLV 1604 where HCA starts.	Q2 2023
8	La Honda & Lincoln Replacement	Yes	1.6	Section starts about 1,000 feet north of MLV 1604 where HCA starts and ends at the crossing of Lincoln Ave. & Midway Dr. due to gas handling purposes.	Q2 2022
9	Midway Dr Replacement	Yes	2.2	Section starts at the crossing of Lincoln Ave. & Midway Dr., runs south of Midway Dr. and ends north of Birch Ave. due to tie in to previously-tested pipe and close to laydown yards.	Q3 2020
10	Bear Valley Pkwy Replacement	Yes	3.7	Section starts north of San Pasqual Valley Rd. where previously replaced pipe ends and HCA starts. Section runs south of Bear Valley Pkwy. and ends at Mule Hill where it meets previously tested pipe. Replacement route resolves narrow 20-foot ROW issues near homes and sensitive habitat by placing pipeline in major roadway.	Q3 2021
11	Pomerado Rd North Replacement	Yes	5.8	Section starts at MLV 1606 near Highland Valley Rd. and runs south along Pomerado Rd., ending at Ted Williams Pkwy. Ted Williams Pkwy. is used as a break point because it is the midpoint of the entire Pomerado Rd. replacement and is close to a laydown yard. Scope of work removes the pipe from close proximity to commercial and residential structures in the Rancho Bernardo, Carmel Mountain Ranch and Rancho Peñasquitos communities.	Q4 2021

Section Number	Section Name	HCA	Approx. Mileage	Description	Estimated In-Service Date
12	Pomerado Rd South Replacement	Yes	3.1	Section starts at Ted Williams Pkwy. and runs south in large four-lane streets using Pomerado Rd. and Scripps Poway Pkwy. Break point was selected due to large available roadways and having a potential laydown yard at the south end of the section. Section routing does not traverse sensitive habitat associated with Peñasquitos Creek and removes the pipe from close proximity to commercial and residential structures in the Carmel Mountain Ranch and Rancho Peñasquitos communities.	Q1 2022
13	Scripps Poway Pkwy Replacement	Yes	3.0	Section starts at the intersection of Pomerado Rd. and Scripps Poway Pkwy. and runs along Scripps Poway Pkwy and remains inside Miramar Ranch North neighborhood until reaching 15 Freeway. The section ends near 15 Freeway due to proximity to a potential laydown yard within Miramar Ranch North neighborhood.	Q1 2022
14	Black Mountain Replacement	Yes	4.5	Section starts near intersection of Scripps Poway Pkwy. and 15 Freeway, runs south on Black Mountain Rd. until reaching Miramar Rd. This route was selected to remain inside the Miramar neighborhood to interconnect feeds to existing distribution system, and to relocate pipe away from close proximity to existing commercial and residential structures.	Q4 2020
15	MCAS North Replacement	Yes	1.3	Section starts at the intersection of Miramar Rd. and Kearny Villa Rd. and runs south on Kearny Villa Rd. until reaching Miramar Way at the location of the tap that feeds MCAS Miramar.	Q3 2023

Section Number	Section Name	HCA	Approx. Mileage	Description	Estimated In-Service Date
16	MCAS Central Replacement	No	1.3	Section starts on MCAS Miramar near Miramar Way and extends southward along Kearny Villa Rd. to the Kearny Pressure Limiting Station. Section ties into existing previously tested pipe that crosses under Highway 163. Although this section is not within HCA, this section is a replacement section due to limitations in the current alignment. The current alignment crosses through MCAS Miramar base and the current easement is set to expire in 2022. Replacement provides a new easement in a public road, is compatible with base operations as it removes Line 1600 from within the high security area, and avoids environmentally-sensitive areas along existing ROW. MCAS Miramar sent a letter to SDG&E stating their concerns with hydrotesting within the secured base perimeter and their preference for replacement in the public Kearny Villa Road.[12]	Q3 2023
17	MCAS South Replacement	No	0.8	Section starts at the Kearny Villa Pressure Limiting station cross tie and continues south in Kearny Villa Rd. to Highway 52, where it ties into previously tested pipe that crosses under Highway 52. Although this section is not within HCA, this section is identified for replacement due to limitations in the current alignment. The current alignment crosses through MCAS Miramar base across environmentally sensitive areas. Installing a replacement section at this location significantly reduces downstream customer service impacts compared to hydrotesting. Because of these factors, along with access issues to the existing ROW, SDG&E and SoCalGas propose to replace the line within the adjacent street ROW.	Q4 2023

[12] MCAS, Miramar letter from Colonel C. B. Dockery, Commanding Officer of MCAS Miramar, dated September 5, 2018.

Section Number	Section Name	HCA	Approx. Mileage	Description	Estimated In-Service Date
18	Kearny Mesa Replacement	Yes	1.4	Section starts south of 52 Freeway near the intersection of Ruffin Rd. and Kearny Villa Rd. New replacement reconnects to previously-tested pipe at Chesapeake Dr. and continues again at the intersection of Overland Ave. and Farnham St., where HCA section starts. Replacement runs south of Overland Ave., Spectrum Center Blvd., and Ruffin Rd., until reaching Ridgehaven Ct. Section is split at this intersection due to the need to maintain service to a large industrial customer.	Q1 2021
19	Serra Mesa Replacement	Yes	4.4	Section begins near the intersection of Ridgehaven Ct. and Ruffin Rd. Alignment runs through Ruffin Rd., Aero Dr., Sandrock Rd., Murray Ridge Rd., and Sandmark Ave., until reaching the terminus of L1600 at Mission Station.	Q1 2021

D. Section Schedule/Prioritization

The proposed Plan is comprised of groupings of 19 independent project sections that can be completed independently to efficiently address safety, operational, community, environmental, constructability, and cost considerations associated with each distinct portion of Line 1600. The scope of work consists of 14 replacement sections and five hydrotests. For the hydrotest work, four of the tests will be grouped into adjacent pairs that will be managed together, resulting in a total of three hydrotest projects. If added together, the total length of new 16-inch diameter pipe to be installed is approximately 42.6 miles. Cumulatively, the total length of existing Line 1600 to be hydrotested is approximately 12.9 miles. Maps showing details of the proposed scope of work are presented in the Appendix.

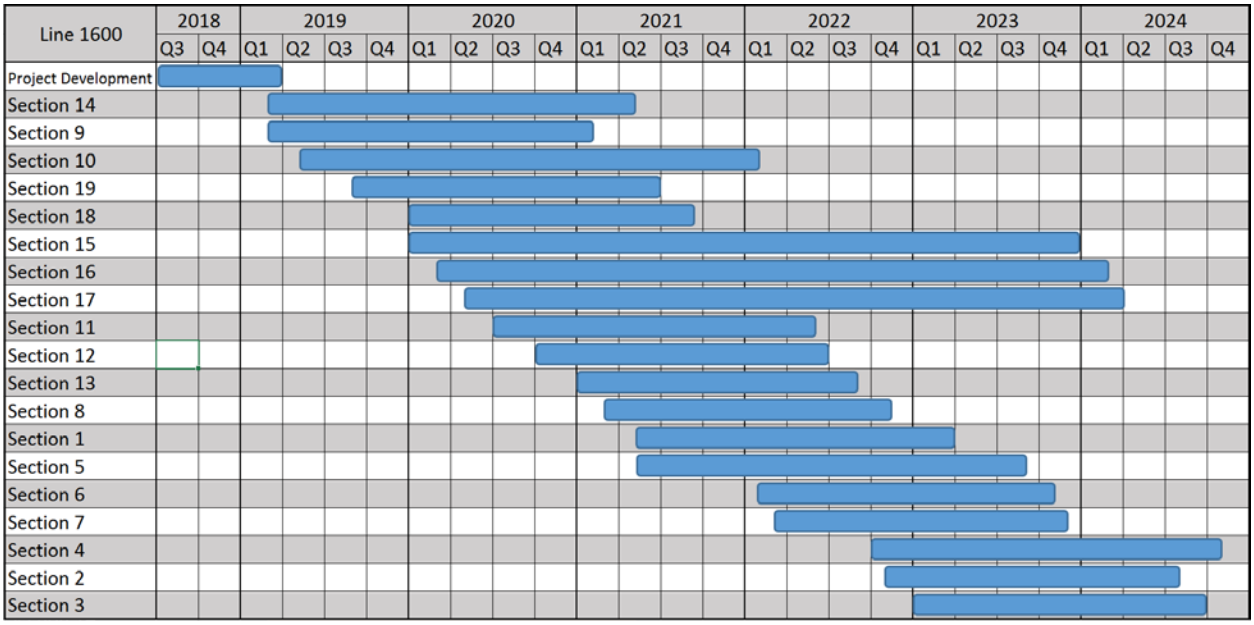
The 19 sections are prioritized and scheduled so as to achieve the greatest safety enhancement benefits and complete the replacement and testing of Line 1600, with an initial

focus on HCAs, as soon as practicable. Many factors were considered while scheduling the projects, including customer impacts, permit lead time, land rights lead time, potential environmental impacts, outreach activities, and operational limitations. Generally, sections from the City of Escondido south to the terminus of Line 1600 at Mission Gate Station are prioritized first as this corridor represents the highest concentration of population immediately adjacent to existing Line 1600 and therefore stands to achieve the biggest relative safety benefit. Additionally, the majority of the route for replacement pipeline sections falls within existing streets, which is anticipated to minimize permitting time. The construction schedule presented in this Plan will enable SDG&E and SoCalGas to bring Line 1600 into compliance with the requirements of Public Utilities Code section 958 "as soon as practicable," and prioritizes project sections to achieve the greatest safety enhancement in areas with the highest concentrations of people and property.

To facilitate isolating Line 1600 for hydrotesting or connecting sections of replacement pipeline during the winter months when core customer gas use is highest, it may be necessary to schedule gas to be delivered at the Otay Mesa receipt point. During summer months, sections of Line 1600 north of where it meets Line 1601 in Escondido cannot be isolated due to high peak loads on peaker plants in the area; supply delivered at the Otay Mesa receipt point cannot mitigate this concern during summer periods due to pipeline capacity limitations. Because the hydrotest sections are located north of Escondido, this is a main driver for scheduling the hydrotest sections. Several project sections are located within jurisdictions that are anticipated to require long-lead permits or land acquisitions. For scheduling purposes, some projects will require effort early on to begin a potential lengthy permit and/or land rights acquisition process

and which will lead the project to be constructed in the latter years of the proposed timeline. For example, there are some potential long-lead land acquisitions needed from local municipality-owned, State-owned and Federal-owned lands. There are also some potentially long-lead time permits that may be required. For example, a project within an environmentally-sensitive area may require an incidental take permit due to the potential for an endangered and/or listed species occuring within the proposed construction work areas. The acquisition of these permits may take one-to-two years of field work, environmental documents preparation and negotiations with agencies before a permit is granted to the utilities. Given the size, scope and complexity of the project, SDG&E and SoCalGas assume extensive community and customer outreach activities will be necessary to achieve the schedule and timeline set forth in this Plan. Figure 3 below shows the preliminary schedule, which may be revised as SDG&E and SoCalGas complete the detailed engineering, design and planning process, for all 19 sections.

Figure 3: Plan Schedule



E. Routing Criteria

As described above, the overarching objectives of PSEP are to: (1) comply with the Commission's directives [subsequently codified in Public Utilities Code section 958]; (2) enhance public safety; (3) minimize customer impacts; and (4) maximize the cost effectiveness of safety investments. Consistent with these overarching objectives and the requirements set forth in D.18-06-028, SDG&E and SoCalGas' Plan considers the following factors to address Line 1600 as soon as practicable, execute the Plan through efficient use of resources, and minimize potential impacts to customers and communities. These factors are incorporated in the proposed routing criteria utilized to evaluate alternatives and ultimately to develop the final Plan.

- Follow generally accepted principles for siting infrastructure.
- Avoid unnecessary impacts to the environment.
- Avoid unnecessary acquisition of private property.
- Allow for safe and efficient construction and testing activities.
- Provide all-weather accessibility for operations, maintenance, and emergency response.
- Allow replacement pipelines to integrate into the existing natural gas pipeline infrastructure serving customers along the existing Line 1600 corridor.
- Avoid impacts to critical operations at MCAS Miramar.
- Meet current and near-term energy needs in a cost-effective and efficient manner.

Of the approximately 43 miles of new pipeline planned for installation as part of the replacement scope of work outlined in this Plan, approximately 41 miles will be routed in nearby streets, minimizing potential impacts to environmentally sensitive areas and private property, consistent with SDG&E and SoCalGas' routing criteria. Where possible, the replacement pipeline will be installed in larger multi-lane streets that are most suitable for larger-scale utility

infrastructure. This allows for safe and efficient construction and future inspections and maintenance of the pipeline to be completed with minimal disruption to the community. Construction in existing roadways typically limits environmental impacts, as the work area is paved over and has been previously disturbed. Placing the pipeline in existing roadways also avoids the need to acquire private property, which can be time-consuming and costly if property owners are not interested in selling and eminent domain is required. Photographs representative of the streets proposed for replacement construction are provided in the Appendix.

In the evaluation of alternative designs, SDG&E and SoCalGas considered the reasonableness of potentially constructing replacement pipe in existing 20-foot-wide Line 1600 easements. SDG&E and SoCalGas concluded it is not feasible, prudent nor reasonable to build a new replacement pipeline entirely within the existing Line 1600 rights-of-way. Accordingly, the Plan calls for the relocation of replacement pipeline sections to nearby public roadways, as appropriate. Adequate space for new construction (40-50 feet to 50-100 feet) does not generally exist along the Line 1600 centerline because the area surrounding the existing 20-foot-wide rights-of-way has been heavily developed in many locations since the line was originally constructed in 1949. Photographs that illustrate the development that has occurred along the existing rights-of-way are presented in the Appendix.

In most locations, constructing in the existing right-of-way would be very difficult and would potentially have a large impact on the community and the environment due to the need to obtain additional right-of-way to perform construction safely. To complete construction in a reasonably safe and efficient manner, as mentioned above, a minimum of 40-to-50 feet, and in

some areas, between 50 and 100 feet, of clear right-of-way is normally required. Construction would be complicated, and there would be additional risk and safety complexity, and extensive heavy equipment operations in close proximity to the existing 16-inch diameter pipeline.

The costs to acquire additional rights-of-way necessary to safely and efficiently complete construction are anticipated to be significant and could require SDG&E and SoCalGas to invoke the eminent domain process. When this concept was studied as part of developing the proposal for SDG&E and SoCalGas' Pipeline Safety & Reliability Project (PSRP) Application (A.15-09-013), it was determined that approximately 500 parcels are located within 35 feet of the existing rights-of-way. Approximately 125 residences, 24 commercial buildings, and seven apartment buildings are anticipated to possibly require acquisition for construction of a new pipeline within the Line 1600 rights-of-way. The effort and cost of expanding the existing rights-of-way for pipeline replacement construction is anticipated to be considerable, as well as disruptive to the property owners and tenants. In addition, by law, the success of an eminent domain action is determined by balancing various factors, including whether the property is necessary for the public project for which it is condemned. Existing roadways would not pose these challenges and costs, as SDG&E has existing franchise rights that permit installation of pipeline in streets and disruption would be limited.

In preparing this Plan, SDG&E and SoCalGas sought input from two reputable gas pipeline contractors with experience working in southern California regarding constructability of different alternatives, including attempting to construct replacement pipeline sections within Line 1600's existing 20-foot rights-of-way. Both contractors noted the challenges of potentially constructing in the existing rights-of-way and the impacts to productivity. Both noted that construction in

nearby roads would be more efficient. Copies of letters provided to SDG&E and SoCalGas from these contractors are provided in the Appendix.

Because of the identified constraints, construction of replacement sections of pipeline entirely within the existing Line 1600 rights-of-way would not be consistent with the routing criteria described in this Plan and would be infeasible from a constructability, environmental, social, economic, and site-suitability perspective. As such, SDG&E and SoCalGas determined the most suitable and preferred location for the majority of the replacement pipe is in existing nearby streets.

F. Temporary Service Requirements

To maintain uninterrupted gas supply to customers during replacement/hydrotest of the pipeline, customers may be temporally fed using compressed natural gas (CNG), liquefied natural gas (LNG) or through construction of a bypass pipeline. The equipment required varies by the volume consumed by each customer. SDG&E's Distribution Region Engineering organization, along with SoCalGas' Gas Control & System Planning organization, evaluated the pipeline and identified the customers that would require isolation and alternate gas supply during replacement/hydrotesting activities. After analyzing the needs of and potential service impacts to customers, SDG&E and SoCalGas identified the equipment required to maintain service during construction. The types of equipment identified include CNG pods, medium and large CNG trucks and bypass installations. Isolation of customers is accomplished using stopples and temporary and permanent bypasses. The estimates presented in this Plan include estimated costs for a hook-up at each site and a temporary alternative gas supply cost, based on the type of equipment required.

G. Compliance with Applicable Regulations and Industry/Company Standards

All testing or replacement projects implemented under this Plan will be subject to robust guidelines and oversight to comply with SDG&E and SoCalGas' internal standards and applicable laws and regulations. These applicable regulations include the Code of Federal Regulations, Title 49, Part 192, (49 CFR 192), which provides requirements for Materials (Subpart B), Pipe Design (Subpart C), Design of Pipeline Components (Subpart D), Welding of Steel in Pipelines (Subpart E), General Construction Requirements for Transmission Lines and Mains (Subpart G), and Test Requirements (Subpart J). In addition to its specific requirements, the Federal Code also "incorporates by reference" the requirements of industry standards such as the American Society for Mechanical Engineers (ASME), American National Standards Institute (ANSI), American Petroleum Institute (API) and American Society for Testing and Materials (ASMT). These industry standards provide methodologies and calculations for more specific and technical requirements addressed in the code. In addition, Commission GO 112-F provides additional requirements with respect to the design, construction, testing, maintenance, and operation of utility gas gathering, transmission and distribution piping systems.

SDG&E and SoCalGas' internal standards have been developed to address applicable laws and regulations and contain references to the regulations that are addressed. These internal standards are reviewed both on a periodic basis and ad-hoc basis as regulations are changed and updated. For each project, internal standards and practices are employed to govern the design analysis, materials purchased, and construction practices.

SDG&E and SoCalGas' Gas Standards are driven by a dual objective: complying with applicable laws and regulations and promoting safety and operational efficiency. The Gas

Standards are the policies and documents that demonstrate compliance with applicable state and federal requirements. The Commission's SED regularly reviews the natural gas transmission and distribution functions for each utility providing natural gas in the state. The Commission compares the functions of transmission and distribution with requirements set forth in GO 112-F as well as federal standards. Through these reviews, SED is able to evaluate and provide input on the sufficiency of the Gas Standards in complying with GO 112-F and the referenced provisions of Title 49 of the Code of Federal Regulations (49 CFR).

Additionally, the Gas Standards are regularly reviewed and updated by SDG&E and SoCalGas personnel and contractors[13] to promote both compliance with laws and regulations and to reflect industry standards and SDG&E and SoCalGas' best practices.[14] These Gas Standards form the foundation for SDG&E and SoCalGas' PSEP standards and practices.

The Plan will, at a minimum, meet applicable federal and state safety regulations, rules, and requirements by complying with applicable SDG&E and SoCalGas Gas Standards, and will, in many cases, exceed these requirements. SDG&E and SoCalGas' Gas Standards comprise the policy and procedures that govern the design, construction, operations, and maintenance of the Transmission and Distribution systems and are based on the relevant regulatory codes and ordinances. Although the Gas Standards themselves may exceed federal and state safety

[13] For example, when PSEP was first initiated, PSEP contractors reviewed policies, procedures, technical specifications and work instructions. This review was done to incorporate, where possible, improvements and content enhancements.

[14] When unique situations require additional Gas Engineering guidance, PSEP seeks out the assigned Gas Standard "owner" for solutions. A gas standard owner is the subject matter expert responsible for updating standards for compliance with applicable codes. For example, when situations require an exception to an applicable Gas Standard, the appropriate Gas Standard owner is consulted and, if the exception is an acceptable accommodation, the Gas Standard owner documents his/her approval.

regulations, rules, and requirements, for this Plan, SDG&E and SoCalGas identify additional areas where they propose to exceed federal and state safety regulations, rules, and requirements. Section D of the Appendix provides a summary of where the execution of the proposed Plan is anticipated to exceed applicable state and federal safety regulations, rules, and requirements, including those set forth in GO 112-F, CFR Parts 191 and 192, and the California Occupational Safety and Health Act (Cal/OSHA).

In addition to the summary provided in Section D of the Appendix, SDG&E and SoCalGas provide the following supplemental explanation regarding the applicable Code[15] requirements the proposed Plan is anticipated to meet or exceed.

1. SDG&E and SoCalGas Design Standards and Practices

SDG&E and SoCalGas' design standards and practices address materials to be used and proper design in accordance with GO 112-F and applicable federal laws and regulations. These design standards and practices enable: (1) development of specific engineering requirements for materials used in strength test or replacement projects; (2) preparation of designs that comply with applicable laws, permits, SDG&E/SoCalGas, and industry standards; (3) utilization of applicable engineering and design standards developed for strength testing or replacement projects; and (4) implementation of consistent design and material requirements for the various engineering design firms contracted to assist with design development. While many industry

[15] As used in this Plan, "Code" refers to 49 CFR Part 192, which governs nearly all aspects of the design, inspection, and testing of a pipeline and its appurtenances.

standards are incorporated by reference in the Gas Standards,[16] the industry standards generally applied when designing facilities are summarized in Table 4 below.

TABLE 4
Summary of Applicable Industry Design Standards

Steel Line Pipe	API 5L
Steel Line Pipe Grade B	ASTM A 106
Valves	API 6D
High Yield Weld Fittings	Manufacturers Standardization Society (MSS) SP 75
Grade B Weld Fittings	ASTM A234
Flanges	ANSI B16.5
Forged Steel Weld Fittings	ASTM A105
Pressure Vessels	ASME VIII
Welding	API 1104
Cathodic Protection	National Association of Corrosion Engineers (NACE) RP-0169
AC Mitigation	NACE RP-0177
National Electric Code	National Fire Protection Association (NFPA) 70

The design specifications, testing requirements and testing results are documented and retained for the life of the asset to demonstrate compliance, and support the operation, maintenance, and design level of each new section of pipeline intended to operate at a pressure greater than 100 psig.

2. Spike Test Best Practices: SDG&E Gas Standards G7361, G7365, G7369

Under existing SDG&E Gas Standards, absent an applicable exception, hydrotests of new and existing pipeline sections require a 5% spike for 30 minutes at the beginning of the test, such

[16] For example, designs are also reviewed for conformance with ANSI B31.8, "Gas Transmission and Distribution Piping Systems." Additionally, each pipeline section may have additional design components. To illustrate, PSEP pipeline facilities also include, as applicable, cathodic protection systems designed to satisfy the requirements of 49 CFR 192, NACE Standard RPO 0169, NACE Standard TM0497, and applicable Gas Standards.

that decreasing the pressure from the spike pressure results in at least a 5% reduction for the entire pipe section. Exceptions to spike testing requirements must be approved by SDG&E/SoCalGas Pipeline Engineering. Spike testing is not recommended when the spike would exceed the actual or likely mill test pressure, and elevation changes require a significant number of additional spike test sections.

3. Maximum Test Pressure

For those portions of existing Line 1600 that are proposed to be hydrotested, SDG&E and SoCalGas plan to test the existing line to at least 1.5 times its desired MAOP of 640 psig. This equates to a minimum test pressure of 960 psig. In order to safely test the existing line, SDG&E and SoCalGas will not exceed 90% of the SMYS of the pipe, by dividing Line 1600 into multiple test sections to address elevation changes that otherwise can significantly increase test pressures at low points. Based on preliminary engineering, SDG&E and SoCalGas anticipate the maximum test pressure that existing sections of Line 1600 will experience will be 1,459 psig, or 89.8% of SMYS, in the Rice Canyon section, which has the highest elevation change. Table 5 below summarizes the characteristics of each of the sections of existing pipe planned for hydrotest, including the maximum test pressure at the lowest elevation.

TABLE 5
Summary of Hydrotest Project Sections

Hydrotest Section	Start Elev (ft)	High Elev (ft)	Low Elev (ft)	Elev Change (ft)	Part 192 Test Range (psi)	Spike Test Range (psi)	Max Spike Press @ Low Elev (psi)	% SMYS @ Low Elev
Rice Canyon	1159	1159	289	870	30	20	1459	89.8%
Couser Canyon North	289	935	283	652	30	20	1360	83.7%
Couser Canyon South	898	1374	722	652	30	20	1360	83.7%
Moosa Creek	713	713	686	27	30	20	1075	66.2%
Daley Ranch	704	731	625	106	30	20	1111	68.4%

The replacement sections of pipeline also will be subject to hydrotest. Newly installed pipeline sections will be tested to satisfy SDG&E and SoCalGas strength test procedures. The new line will be tested to at least 90% SYMS according to SDG&E standard G7369. SDG&E and SoCalGas plan to install 16-inch diameter, 0.375-inch wall thickness, grade X52 pipe for new installations. The minimum test pressure for this pipe at 90% of SMYS equates to 2194 psig. Should some installations result in a combination of new pipe being interconnected with sections of existing modern 0.250-inch wall, grade X52 pipe (non-A.O. Smith EFW pipe), minimum test pressures will be adjusted accordingly to fall within a range of 1200 psig to 1463 psig, as determined by SDG&E and SoCalGas' Gas Engineering department. This test pressure range equates to 1.5 times the original MAOP rating of 800 psig, at the lower end, to 90% of SMYS for the 0.250-inch wall pipe at the upper end.

4. Materials Standards and Practices

Once a testing or replacement project has been scoped, designed, and approved, materials are ordered that comply with SDG&E and SoCalGas' Materials Specifications for Gas

Operations. Unless otherwise specified, API 5L pipe, with the specific approved grades and wall thicknesses, are used. These wall thicknesses and grades for each diameter pipe are as specified in applicable standards and Materials Specifications for Gas Operations. The required wall thicknesses for the various class locations are determined and verified using design data. Table 6 below summarizes the generally applicable Materials Specifications for Gas Operations.

TABLE 6
Generally Applicable Materials Specifications for Gas Operations

Pipe	MSP 41.06.1	Pipe - Steel, Grades A25 Through X70
	MSP 52.83	Fittings - Forged Steel
Fittings	MSP 52.96	Fittings – Butt-Weld Steel
	MSP 58-15.1	Valves - Ball, Small (High Pressure)
Valves	MSP 58-15.2	Valves; Ball, Steel Floating
	MSP 58-20	Valves - Check
	MSP 58-82	Valves; Ball, Steel, Trunnion Mounted
Coatings	MSP 44-50	Fusion Bonded Epoxy External Line Pipe Coating
	MSP 44-50.1	Fusion Bonded Epoxy External Fitting Coating
	MSP 44-50.4	Powder Coating for External Protection of Prefabricated Gas Components

Materials Specifications for Gas Operations are used for each purchase and outline the instructions and expectations for shop inspections and quality assurance. To validate adherence to these standards, SDG&E and SoCalGas may inspect and test materials to help verify the accuracy of the manufacturer's certification and testing, to promote compliance with company requirements and, if applicable, the Materials Specifications for Gas Operations Quality Control Inspection Instructions. Documentation of compliance and certification is retained.

5. Construction Standards and Practices

Construction is subject to extensive standards, practices, and guidelines. First, SDG&E and SoCalGas enforce guidelines on how contractors are qualified to work on the system.[17] Contractors are not permitted to commence working on the SDG&E/SoCalGas system until they have demonstrated compliance with applicable requirements and Gas Standards and demonstrated appropriate financial and insurance capabilities.

In addition to these threshold requirements to begin work, SDG&E and SoCalGas implement comprehensive standards that address, among other areas, excavation, coating application and inspection, welding, welding inspection, trenching, cover, and pressure testing. Prior to starting work, as a part of the agreement with the contractor, contractors are provided an index of standards, practices, guidelines, and requirements; as applicable, contractors are provided updates when issued. SDG&E and SoCalGas monitor and document compliance with applicable standards, laws, and requirements.

Direct management of the project construction activities is the responsibility of SDG&E and SoCalGas' Construction Management organization. The organization is structured to provide oversight and monitor whether construction is meeting quality standards in a safe construction

[17] Contractors are thoroughly vetted and must, among other requirements: have a record of job and safety performance; demonstrate approved production and technical equipment and facilities; demonstrate approved Operator Qualification program, as required by 49 CFR 192.801 through 192.809; demonstrate an adequate quality assurance and safety program; have a Department of Transportation (DOT)-and Company-approved Alcohol & Drug Testing Program in accordance with the DOT CFR, Title 49, Part 40 and Part 199 regulated by the Pipeline & Hazardous Materials Safety Administration (PHMSA) or Part 382 if contractor's employees perform commercial motor vehicle driver functions regulated under the DOT Federal Motor Carrier Safety Administration's (FMCSA) Part 382; demonstrate the contractor is meeting State and Federal requirements for the installation and construction of natural gas pipelines (49 CFR 190, 191, 192) Cal Occupational Safety and Health Administration (OSHA) or any other state requirements; and maintain a California Contractors State License.

environment at an economical total cost. The organization also provides extensive oversight with respect to safety, environmental protection, site security, construction contract management and administration, planning, scheduling, progress control, cost control, inspection, job site material and logistics management and job site customer interface management. For example, during construction, inspection reports are generated to detail the work, photograph aspects of the work, and document the standards applicable to the work performed during the day (as well as compliance with those standards). Company employees, as well as third party inspection service providers, verify compliance with standards.

In addition, an assigned Project Manager and other key members of the Project Management Team assist the Construction Management team and provide management and project support, particularly with respect to engineering, constructability, procurement follow-up, inspection/expediting of purchased equipment and materials, and other specialized services as may be required to support construction. While each construction activity is subject to extensive guidelines, standards, and requirements, welding in particular is discussed in greater detail below.

6. Welding and Welding Inspection

SDG&E and SoCalGas adhere to applicable laws, regulations, and Gas Standards for welder qualification and re-qualification. As such, SDG&E and SoCalGas qualify and re-qualify company and contractor welders in accordance with Title 49 of the Code of Federal Regulations.[18]

[18] 49 CFR Parts 192.227 Qualification of welders, and 192.229 Limitations of welders.

SDG&E and SoCalGas prepare a Welder Qualification Test Report when a welder is qualified, maintain a list of qualified personnel, and conduct destructive testing on steel weld samples submitted by welders in accordance with 49 CFR 192 and API 1104 (revision incorporated by reference in 49 CFR Part 192). Subsequently, welders must regularly be requalified. Qualification compliance is monitored by requiring welders to carry proof of certification and verifying their qualifications when performing welding or joining operations.

To provide further oversight, welding inspections are performed by qualified welding inspectors and each weld undergoes non-destructive examination (NDE).[19] Inspection of a weld takes multiple forms. First, the welding inspector performs quality checks prior to and during the welding process. Second, the welding inspector performs a visual inspection of the weld. Finally, an NDE technician inspector performs non-destructive testing, such as radiographic or ultrasonic inspection. Company and contract personnel performing non-destructive testing are certified according to API-1104 and ASNT-SNT-TC-1A and provide, upon request, a current certification record demonstrating qualification for Task 1.25-0601 – Radiography Examination – 49 CFR 192.243 Nondestructive Examination.

[19] Qualified inspectors must demonstrate knowledge and understanding of high pressure steel pipeline materials and components; be CWI (Certified Welding Inspector), CPWI (Certified Pipeline Welding Inspector) or an equivalent certification or training deemed acceptable; demonstrated experience and knowledge in API Standard 1104; have NDT (non-destructive testing) experience and or certification preferred for RT (radiographic) and PT (penetrant) inspections; passing required PSEP operator qualification (OQ) Covered Common Tasks (CCTs); be qualified to perform visual weld inspection in accordance with the recommendation of ASNT or any recognized certification program that is acceptable to the Company; and qualified under task 0811 to perform Visual Inspection of Welding and Welds.

7. Steel Pipeline Materials (49 CFR 192.55)

SDG&E and SoCalGas utilize greater pipe base metal and pipe toughness than required by API5L. API5L requires the steel pipe to have a minimum average (from a set of three specimens) absorbed energy for each heat based on full-size transverse specimens to 20 ft-lbs. SDG&E and SoCalGas exceed this requirement by applying a Charpy energy equation which calculates a value greater than 29 ft-lbs. By exceeding the API5L requirements, the proposed Plan is designed to provide greater resistance to propagating cracks and increases the pipe's resistance to third party damage.

8. Steel Pipe Design Factors (49 CFR 192.111)

The design factor of a pipe section establishes the safety margin against pipe yielding from its internal pressure.[20] For example, a pipeline in a Class 3 location is required to have a design factor of 0.5 or lower. This limits the maximum pressure in a pipe section to half of its yield pressure, which is equivalent to having a safety factor of 2, based on yield. Table 7 below summarizes the code requirements for design factors based on the class location of a pipe section.

[20] For clarity, the term "yielding" does not mean the pipe ruptures but rather refers to permanent deformation. Pipe has additional strength beyond its yield point.

TABLE 7
Summary of Minimum Design Factors Required Under Federal Regulations

Class Location	Description of Class Location	Design Factor
1	10 or fewer buildings intended for human occupancy.	0.72
2	More than 10 but fewer than 46 buildings intended for human occupancy.	0.60
3	46 or more buildings intended for human occupancy, or an area where the pipeline lies within 100 yards of either a building or a small, well-defined outside area (such as a playground, recreation area, outdoor theater, or other place of public assembly) that is occupied by 20 or more persons on at least 5 days a week for 10 weeks in any 12-month period.	0.50
4	Where buildings with four or more stories above ground are prevalent	0.40

Population densities along the proposed Plan vary by location from a mixture of Class 1, Class 2 and Class 3 in the northern reaches of the pipeline to predominately Class 3 and Class 4 in the high density urban areas in the south. SDG&E and SoCalGas plan to design the northern section of the pipeline between Rainbow and Escondido to meet Class 3 requirements. The southern section from Escondido to Mission Station is planned to be designed to meet Class 4 requirements. This will satisfy design code requirements and provide an additional safety margin to accommodate future growth and development should the class location change.

9. Transmission Line Valves (49 CFR 192.179)

The proposed Plan is designed to enable detection of a significant change in pipeline pressure within two minutes in designated Class 3 and/or HCA sections and for full depressurization of the segment within 30 minutes should a failure occur. This design criteria will meet or exceed PSEP objectives for isolation and depressurization of sections of a pipeline, which

already exceed Code requirements.[21] All new Main Line Valves (MLVs) installed pursuant to this Plan will have capabilities for remote operation by SDG&E and SoCalGas' Gas Control Center and/or automatic closure without operator intervention in the event of a significant failure. Further, valves on selected taps, crossovers and bridle assemblies will be equipped with remote control capabilities to support operation of the pipeline and prevention of back-flow of gas into any main pipeline section isolated to control an unplanned gas release. MLVs will have actuators that reside above ground or will be installed below grade within a concrete vault. The actuator will operate using gas pressure provided from the pipeline, supported by pneumatic and electronic controls. The MLVs will be 16-inch, full-opening, to allow for the passage of internal inspection devices. Each MLV location will have a blow down valve installed on each side of the MLV to allow for depressurization of either of the adjoining pipe sections. The Plan calls for a maximum spacing between MLVs of five miles unless other constraints require spacing more than 5 miles apart. In all locations, five-mile spacing meets or exceeds Code requirements, which specify maximum valve spacing of 20, 15, 8 and 5 miles for Class 1, Class 2, Class 3 and Class 4 locations, respectively. The reduced valve spacing will enable a faster blow down time for all pipe sections than would be achieved if the less-stringent valve spacing requirements of the Code were followed.

10. Inspection and Testing of Pipeline Welds (49 CFR 192.241)

The Federal Code requires non-destructive testing for pipelines constructed in Class 1 and

[21] A.11-11-002, Amended Testimony of Southern California Gas Company and San Diego Gas & Electric Company in Support of Proposed Natural Gas Pipeline Safety Enhancement Plan, Chapter V, Proposed Valve Enhancement Plan, dated December 2, 2011, http://www.socalgas.com/regulatory/documents/r-11- 02-019/Amended%20Testimony-12.2.11.pdf.

Class 2 locations that are not in highway or railroad rights-of-way on 10% and 15% of welds, respectively. SDG&E and SoCalGas plan to exceed the requirement by performing non-destructive testing of 100% of the welds and non-destructive examination by dye penetrant of branch connections for pipelines in these areas.

11. Protection from Hazards (49 CFR 192.317)

The pipeline route in this proposed Plan does not cross any active seismic faults. Based on a preliminary assessment, the pipeline also does not traverse any potential landslide areas. Typical mitigation for potential landslides is to slightly reroute the pipeline away from potential landslide areas or to install the pipe at a depth below the slide plane of the landslide. Should any landslides be discovered during detailed design, further site-specific geological investigation will be performed to select the appropriate mitigation method.

12. Strength Test Requirements (49 CFR 192.505)

The proposed Plan will traverse Class 1, Class 2, Class 3 and Class 4 locations. The pipe material (16-inch diameter by 0.375-inch wall, Grade X52) to be used in replacement projects provides enhanced safety benefits as it satisfies the more rigorous requirements for Class 4 locations. As a result, the pipeline will have greater strength and safety margins than is required by the Code in Class 1, Class 2, and Class 3 areas.

Another safety factor anticipated to be incorporated into the final design of each replacement project section is at the pressure testing phase. Where practical, the new installed pipe is planned to be tested to more than 2.5 times the MAOP, which provides an additional 66% safety factor beyond even the more rigorous testing requirements for Class 3 and Class 4 locations. The pressure testing will also include a short duration pressure spike to provide an

additional factor of safety.

13. Odorization of Natural Gas (49 CFR 192.625)

All natural gas flowed through Line 1600 will be odorized. Odorized gas enhances the ability to detect leaks.

14. Patrolling of Line 1600 (49 CFR 192.705)

Consistent with SDG&E and SoCalGas standards, where feasible, new 16-inch pipeline installed as part of the Plan will be equipped throughout its routing with an advanced right-of-way intrusion detection/monitoring fiber optics system to provide early warning when digging, drilling, boring, cutting, compacting, or unplanned heavy vehicle operations by third parties pose a threat to pipeline integrity. The system will also continuously monitor for ground movement and temperature gradients associated with an unplanned release of gas from the pipeline. This fiber optics monitoring program is consistent with the company standard requiring new and replacement pipelines to be outfitted with fiber monitoring technology. This requirement applies to pipelines that are being installed that are one mile or greater in length, 12 inches or greater in diameter, and operate above 20% SMYS. Fiber optic cable will be installed during construction and will be coupled to a computer-based monitoring station for detection and alerting purposes. The system of sensors is intended to allow for preemptive identification and mitigation of pipeline threats and enhance SDG&E and SoCalGas' ability to manage pipeline risk.

V. TECHNICAL CONSIDERATIONS

In evaluating the four alternatives considered during the preparation of this Plan, SDG&E and SoCalGas carefully considered the technical attributes and installation history of Line 1600,

along with the integrity assessment and operational and maintenance history of the line. A summary of these technical considerations is provided in this section.

A. Pipeline Attributes and Installation History

Line 1600 was placed in service in 1949 and is primarily comprised of 16-inch diameter, 0.250-inch wall, grade X52 pipe. It is approximately 50 miles long, with 46.5 miles (approximately 93%) of the pipe comprised of 1949-vintage electric flash welded (EFW) pipeline sections, with a small percentage of electric resistance welded (ERW) pipe. Additionally, approximately 33 miles (approximately 66% of the total length) of Line 1600 is located in HCAs, with significant residential and commercial development along the pipeline's existing route. Line 1600 contains the largest mileage of flash welded pipeline within HCA in the combined SDG&E/SoCalGas Gas System.

SDG&E and SoCalGas do not have documentation to demonstrate that Line 1600 was pressure tested when it was originally placed into service in 1949, and Line 1600 was grandfathered under federal pressure testing regulations adopted in 1970.[22]

B. Line 1600 Vintage Pipe Material and Manufacturing Related Anomalies

Line 1600 was originally constructed in 1949 with predominantly EFW pipe, and a small percentage of ERW pipe. In February 2017, Kiefner and Associates, Inc. published a technical report (2017 Kiefner Report) which reviewed and analyzed risk factors to evaluate whether Line

[22] *See* D.11-06-017 at 5, n.3.

1600 may prudently be pressure tested and restored to full operating pressure.[23] Some of the salient findings presented in the report are summarized below.

The 2017 Kiefner Report explains that electric flash welding of long seams is an obsolete form of pipe manufacturing where the longitudinal edges of heat softened pipe are forced together to form a welded bond. Excess extruded material is then trimmed away, forming the classic "box-like" appearance of a flash welded seam. This process was only utilized by a single pipe manufacturer—A.O. Smith Corporation—and pipe production using flash welded seams was discontinued by 1969. Process control, material chemistry, and manufacturing-related factors all contribute to EFW seam weld quality issues and related anomalies in such pipe.

The A.O. Smith EFW pipe is associated with a number of well-documented integrity concerns including hook cracking, cold welds, non-metallic inclusions, susceptibility to selective seam corrosion, and a variety of other related issues.[24] Among the types of anomalies listed above, hook cracks associated with the EFW seam welds have been observed on Line 1600.

Hook cracks (also known as upturned fiber imperfections) take their name from the distinctive "J-shaped" flaw that results when metal separations in the steel skelp[25] that are originally oriented parallel to the skelp surfaces are forced together, resulting in flow of the

[23] Rosenfeld, M.J., "Review of Risk Factors for Line 1600," Kiefner Final Report to SDG&E, February 20, 2017. *See also* A.15-09-013, Supplemental Testimony of SDG&E and SoCalGas at Attachment C (2017 Kiefner Report).

[24] J.F. Kiefner and E.B. Clark, *History of Line Pipe Manufacturing in North America* (1996 Kiefner Report), American Society of Mechanical Engineers (ASME) CRTD-Vol. 43 (1996).

[25] Skelp is a strip of metal (such as wrought iron, steel) for making a hollow cylindrical piece or tube by bending it round longitudinally or helically and welding.

material toward either the inner or outer surface of the resultant weld.[26] Additionally, selective seam corrosion - preferential metal loss that occurs at a weld bond line region or heat affected zone (HAZ) – remains a threat to the integrity of Line 1600. This phenomenon is promoted by localized galvanic differences in the weld and surrounding material and, when exposed to a corrosive environment, results in the preferential attack of the weld area at an accelerated rate relative to the surrounding pipe material.[27,28]

The 2017 Kiefner Report further explains that the vintage A.O. Smith flash welded pipe is known to have both hook cracks and low fracture control. The objective of "fracture control" is to prevent leaks and ruptures caused by crack propagation initiated by an event, such as third-party damage. Fracture control has traditionally been categorized as "initiation control" and "propagation control." "Toughness" may be broadly defined as the ability of a material to absorb energy during fracture. Sufficient toughness is an essential component of fracture control, as it increases the likelihood that a failure will be progressive, and not catastrophic.

The 2017 Kiefner Report further states that A.O. Smith pipe installed in 1949 was not manufactured with fracture control in mind because the concept was not known at the time. While the pipe has good mechanical strength, its propagating fracture control properties do not meet modern criteria for gas transmission pipelines. The implication of these inherent properties of Line 1600 is that at its current operating pressure, in the event of a failure on the sections of vintage pipeline that remain in service, particularly in the seam but potentially even

[26] J.F. Kiefner with the assistance of the Interstate Natural Gas Association of America (INGAA), *Evaluating the Stability of Manufacturing and Construction Defects in Natural Gas Pipelines, Department of Transportation Final Report 05-12R*) (2007 Kiefner Report), Table A-1 (Apr. 26, 2007).
[27] *Id.* at Table 3.
[28] 1996 Kiefner Report, at 5-4.

in the pipe body, a failure could result in a rupture and propagating brittle fracture rather than a leak. Although the inherent properties of Line 1600 vintage pipe do not render the line unsafe at current operating pressures, they do increase the vulnerability to certain integrity threats or increase the difficulty of defending against those threats. Consequently, it is accurate to state that a vintage pipeline poses a higher risk to the public than a new pipeline, even when the vintage pipeline appears to be in a safe condition.

The modern 16-inch diameter, 0.375-inch wall thickness Grade X52 pipe proposed as Line 1600 replacement material will provide superior fracture control properties compared to the vintage A.O. Smith pipe material. In addition, SDG&E and SoCalGas' proposed wall thickness (0.375-inch) for the 16-inch replacement pipe will provide greatly improved resistance to mechanical excavation damage compared to the vintage pipe material (0.250-inch wall thickness), further enhancing the long-term safety of the pipeline.

C. Integrity Monitoring and Operations & Maintenance Repair History of Line 1600

Continual and active integrity monitoring is a key component of pipeline safety and will continue to be an important part of SDG&E and SoCalGas' continued safe operation of Line 1600. Integrity monitoring of Line 1600 includes (but is not limited to) monitoring conditions such as selective seam corrosion, corrosion coincident with hook cracks, or other forms of interaction between threats such as third-party damage at otherwise stable defect locations.

Since installation in 1949, a combined total of approximately two dozen repairs associated with routine operations and maintenance (O&M) activities have taken place on Line 1600. These repairs are representative of typical maintenance for a pipeline of this size and vintage, and do not significantly impact the integrity condition of the pipeline. A review of the

repair and maintenance history is incorporated into the assessments conducted as part of SDG&E and SoCalGas' Transmission Integrity Management Program (TIMP).

D. Line 1600 Integrity Assessment History

In accordance with 49 Code of Federal Regulations (CFR) sections 192.921(a)(3) and 192.937(c)(1), three TIMP-related assessments have been conducted on Line 1600: (1) an External Corrosion Direct Assessment (ECDA) in 2007; (2) a series of in-line inspections (also known as "smart pigging") conducted from 2012-2015; and (3) a subsequent in-line inspection in 2016.

E. External Corrosion Direct Assessment

The baseline ECDA of pipe sections within HCAs on Line 1600 was completed on February 23, 2007. Inspections were performed over approximately 20.7 miles, resulting in eleven examinations to investigate the likelihood of active external corrosion. External corrosion and third-party damage were not observed during examinations of the excavated pipe and no repairs were required.

F. In-Line Inspection Phases

A TIMP assessment of Line 1600 was conducted utilizing a series of in-line inspections from December 2012 through December 2015. All pipe sections between the launcher and receiver (*i.e.*, both HCA and non-HCA sections) were inspected using axial magnetic flux leakage (AMFL), circumferential magnetic flux leakage (CMFL, also known as transverse field inspection or TFI), and geometry smart pigs. AMFL technology is sensitive to volumetric flaws, such as metal loss caused by corrosion or third-party damage; CMFL technology is sensitive to some

types of long seam flaws, such as selective seam corrosion and hook cracking; and geometry tools detect areas of deformation.

During the inspection work completed from 2012-2015, the inspection of Line 1600 was performed in three separate phases, primarily due to the break in geometric continuity created by the reduction in pipeline diameter from 16-inch down to 14-inch diameter (near the middle of the pipeline at Lake Hodges), and back up again to 16-inch diameter for the remainder of the pipeline. The phases are numbered from 1 to 3 in the chronological order of inspection. The inspection lengths, in-line inspection tools utilized, and dates for each inspection phase are summarized in Table 8 below.

TABLE 8
In-line Inspections of Line 1600 by Phase (2012-2015)

Phase	Inspection Length (miles)	Inspection Extent	ILI tools	Assessment Date
1	29.1	Rainbow Metering Station to Lake Hodges	• Axial MFL • Geometry	12/5/2012
			• Circumferential MFL	2/6/2013
2	20.1	Lake Hodges to Mission Base	• Axial MFL • Geometry	12/19/2013
			• Circumferential MFL	3/20/2014
3	0.5	Lake Hodges	• Axial MFL • Geometry	12/10/2015

G. Findings from 2012-2015 In-line Inspections

The final reports for each of the in-line inspection phases for Line 1600 identified anomalies:[29] in Phase 1, 1,471 anomalies were identified; in Phase 2, 1,226 anomalies were identified; and in Phase 3, 85 anomalies were found. Reported anomaly types and quantities for

[29] Anomalies refer to unexamined pipe features that are classified as potential deviations from sound pipe material, welds, or coatings. All engineering materials contain anomalies that may or may not be detrimental to material performance.

each phase are listed in Table 9 below. Due to differences in tool sensitivities, the quantity of anomalies listed for the CMFL tool for Phases 1 and 2 contain anomalies that were detected by the AMFL and geometry tools (*i.e.*, anomalies may have been counted twice). Discounting the repairs that have been completed on Line 1600, the AMFL in-line-inspection work completed in 2016 resulted in similar findings as those identified through the 2012-2015 assessments summarized in Table 9 below.

TABLE 9
In-line Inspection Reported Anomalies (2012-2015)

	Phase 1		Phase 2		Phase 3
Reported Anomaly Type	AMFL and Geometry	CMFL	AMFL and Geometry	CMFL	AMFL and Laser Deform.
Crack-like	0	3	0	14	0
Deformation	47	116	28	33	0
Long Seam	123	265	100	198	0
Manufacturing	18	20	134	40	6
Metal loss	343	536	148	531	79
TOTAL	**531**	**940**	**410**	**816**	**85**

H. Inspection Based Repairs Related to 2012-2015 In-Line Inspections

Validation of smart pig data by direct examination is necessary to correlate the smart pig data against actual findings confirmed in the field by unearthing the pipe. Though smart pigs provide much valuable and accurate data, they are not without limitations. Smart pigs detect many anomalies, but are not infallible, and cannot detect *all* anomalies in a pipeline during an in-line inspection. For Phases 1 and 2, a total of 62 direct examinations (*i.e.*, excavations) of Line 1600 were conducted to validate the anomalies reported by the smart pigs. Nineteen examinations either directly confirmed the presence of hook cracking or were determined to likely be hook crack-related. Six examinations were performed at locations where crack-like

anomalies were reported, and hook cracking was confirmed in all six locations. Thirteen examinations were performed at locations where manufacturing-related metal loss was detected at the longitudinal seam: hook cracking was confirmed at four locations, and hook cracking was determined to be likely at the remaining nine locations. Where appropriate, anomalies associated with the pipe long seam and base metal flaw, as well as mechanical damage, were remediated through a combination of replacing sections of pipe, installing repair bands, or grinding out smaller base metal or workmanship flaws. Findings from the direct examinations resulted in the following remediation activities:

- Ten cylindrical replacements (totaling approximately 290 feet) to remediate[30] a mechanical damage defect and mitigate[31] 140 flaws (approximately 77% were longitudinal seam weld and base metal flaws from the pipe manufacturing process),
- 39 repair bands to remediate 17 defects due to both mechanical/third-party damage and 68 nearby flaws (approximately 87% were longitudinal seam weld and base metal flaws from the pipe manufacturing process), and
- 84 repairs to mitigate workmanship and base metal flaws from the construction and manufacturing process.

I. Existing State of Line 1600

During 2016, SDG&E and SoCalGas completed an additional AMFL in-line inspection of Line 1600. An inspection using CMFL technology was also initially planned, but in-line inspection vendors raised the concern that available CMFL tools were unlikely to successfully navigate Line 1600 due to the presence of shorter radius elbows throughout the pipeline. SDG&E and SoCalGas attempted to obtain the same CMFL tool that previously successfully inspected Line

[30] Remediate means an operation or procedure that transforms an unacceptable condition to an acceptable condition by eliminating the causal factors of a defect.

[31] Mitigate means the limitation or reduction of the probability of occurrence or expected consequence for a particular event.

1600; however, that tool had been decommissioned and permanently retired. SDG&E and SoCalGas worked with the CMFL in-line inspection vendors and selected the tool thought to have the highest chance of successfully negotiating the geometry of Line 1600. In November 2016, an attempt to run the selected tool was initiated but resulted in failure when the tool became lodged in the pipeline. This resulted in a shutdown of a section of the line so the tool could be extracted. To date, the inability to perform in-line inspections of Line 1600 using CMFL technology remains an outstanding concern. Consistent with the Commission's directives in D.11-06-017 and the statutory requirements of Public Utilities Code section 958, the scope of work identified in this Plan includes the work necessary to retrofit or replace shorter radius elbows and other legacy features in Line 1600 that prevent SDG&E and SoCalGas from using CMFL technology to complete in-line inspections of Line 1600.[32]

Assessment data from both in-line inspection technologies demonstrate that for the remaining anomalies in Line 1600, adequate safety margins exist for operation at both its current MAOP of 512 psig and at its previous MAOP of 640 psig. Under 49 CFR section 192.939(a), operators are required to establish a reassessment interval for each covered section and prescribes methods for determining an interval based upon the safety margins calculated for remaining flaws. The maximum reassessment interval allowed under TIMP for any covered section is seven years, although findings may yield longer duration intervals as prescribed in 49 CFR sections 192.939(1) through 192.939(3). A covered section is assigned a maximum

[32] *See* D.11-06-017 at 32, Ordering Paragraph 8 ("The Implementation Plan must consider retrofitting pipeline to allow for in-line inspection tools. . . .") and Cal. Pub. Util. Code § 958 ("At the completion of the implementation period, all California natural gas intrastate transmission line segments shall . . . [w]here warranted, be capable of accommodating in-line inspection devices.").

reassessment interval when the remaining flaws are not expected to exceed acceptable safety limits prior to the next assessment. Each integrity assessment of Line 1600 has resulted in a maximum reassessment interval of seven years.

While Line 1600 is safe for service as it is being operated today, to continue operating the pipeline at a transmission service level, it must be pressure tested or replaced as part of PSEP. As the 2017 Kiefner Report concludes, "While there is no evidence that Line 1600 is unsafe, there is much that is unknowable about the line, including the ability of girth welds to withstand loadings from natural events, and features in the longitudinal seams. Risk is proportional to what is unknown, at least in part."[33] Though the study specifically referred to the 36-inch diameter replacement pipeline proposed in A.15-09-013, the identified concerns pertaining to the operation of vintage pipe sections remain the same. All new sections of modern pipe installed to replace legacy pipe sections will eliminate gaps in integrity data that contribute to risk. As discussed in greater detail in this Plan, although replacement of the entirety of Line 1600 may be a more cost effective investment in the long term, replacing portions of Line 1600 in HCAs and pressure testing portions of Line 1600 in non-HCAs is a reasonable approach to bringing Line 1600 into compliance with the Commission's directives in D.11-06-017, D.14-06-007, D.18-06-028, and Public Utilities Code section 958 as soon as practicable.

[33] 2017 Kiefner Report at 2 and 31.

VI. ADDITIONAL PUBLIC SAFETY AND PROPERTY/ENVIRONMENTAL PROTECTION MEASURES

A. Interim Safety Enhancement Measures

SDG&E and SoCalGas have implemented several safety enhancement measures with respect to Line 1600 to increase the margin of safety and validate the integrity of the line pending completion of pressure testing or replacement activities under PSEP. These interim safety measures include pressure reductions, in-line inspection assessments, and conducting instrumented leak surveys at greater frequencies.

The historic MAOP of Line 1600 was 800 psig. SDG&E and SoCalGas reduced the MAOP to 640 psig in 2011 and then again to 512 psig in July 2016.[34] Lowering the MAOP of Line 1600 to 31.5% of its specified minimum yield strength (SMYS) increases the margin of safety for Line 1600, partially mitigating the integrity risks associated with the pipeline.

In addition to the second pressure reduction noted above, in Resolution SED-1 dated August 18, 2016 (Resolution), the Commission directed SDG&E and SoCalGas to perform several interim safety measures on Line 1600. In compliance with the Resolution, the following actions were or are being taken to enhance the safety of Line 1600 until implementation of the Plan is complete:

- During July 2016, the operating pressure was reduced with maximum limits set not to exceed 512 psig.

[34] In July 2011, the Utilities voluntarily reduced the MAOP of Line 1600 to 640 psig in response to the safety recommendations issued by the National Transportation Safety Board on January 3, 2011. *See* R.11-02-019 *Report of Southern California Gas Company (U 904 G) and San Diego Gas & Electric Company (U 902 G) on Actions Taken in Response to the National Transportation Safety Board Safety Recommendations* (April 15, 2011). On July 8, 2016, the Commission's Executive Director ordered the Utilities to reduce the MAOP of Line 1600 further to 512 psig. This was ratified in Commission Resolution SED-1.

- An additional in-line inspection was performed in 2016 using an axial magnetic flux leakage tool, with the exception of the Lake Hodges crossing, which had just recently been inspected in 2015.
- Replaced the section at Engineering Section 17-31.
- Performing bi-monthly instrumented leak surveys.

In summary, in-line inspection-related repairs coupled with the reduced operating pressure on Line 1600 have already created a significant safety margin to allow the line to continue to operate at its current capacity until replacement and pressure testing can be completed in association with the Plan outlined in this document.

B. List of Structures Abutting or Within Existing Line 1600 Easement

As part of developing the Plan, and in conformance with D.18-06-028, SDG&E and SoCalGas performed an analysis to identify structures that abut or encroach within the existing rights-of-way (ROW) for Line 1600. In D.18-06-028 (at 92), the Commission orders SDG&E and SoCalGas to:

> [P]rovide a detailed summary of existing physical commercial and residential structures that directly abut the edge of the easement (and any possible encroachments that lie within the easement) on Line 1600, including GPS coordinates. Based on this analysis, Applicants shall also identify proposed rerouting of the line in specific sections and/or removal or moving of specific physical structures, known at this time, due to safety compliance reasons.

SDG&E and SoCalGas continuously monitor the rights-of-way of transmission pipelines, including Line 1600, to identify surface conditions on or adjacent to pipeline ROWs, construction activity, encroachments and other factors that could impact the safety and operation of transmission pipelines. Commission GO 112-F, section 143.5, Encroachments, establishes the following requirements for natural gas pipeline operators in California:

> With the exception of gas pipeline facilities related to installations in gas meter rooms or other specially designed indoor locations where an outdoor meter installation is not possible or practical, a utility transporting LNG, natural gas or other gas shall not construct any part of a LNG, natural gas or other gas pipeline system under a building. In addition, the utility shall not allow a building or other encroachments to be constructed on to its pipeline right-of-way that would hinder maintenance activities on the pipeline or cause a lengthy delay in accessing its pipeline facilities during an emergency. If the utility finds a building or other encroachment built over a pipeline facility after the effective date of this section, then the utility may require the party causing the encroachment to remove the building or other encroachment from over the pipeline facility or to reimburse the utility for its costs associated with relocating the pipeline system.[35]

In preparing this Plan, SDG&E and SoCalGas conducted a detailed assessment of the Line 1600 ROWs and adjacent structures to compile the information required to be included in the Plan under D.18-06-028. This assessment confirms there are no known encroachments on Line 1600 that would hinder maintenance activities on the pipeline or cause a lengthy delay in accessing Line 1600 during an emergency.

While the width of the existing Line 1600 varies in some locations, the existing Line 1600 ROW is predominantly 20 feet wide, with the pipeline generally located along the center of the easement. For the purposes of preparing the analysis required under D.18-06-028, SDG&E and SoCalGas identify all structures located within fifteen feet of the pipeline. As described in greater detail below, SDG&E and SoCalGas completed this assessment by analyzing geospatial data and conducting confirmatory field investigations to physically locate the pipeline relative to adjacent structures at identified locations.

[35] Consistent with the requirements of GO 112-F, the majority of the easements for Line 1600 contain a provision that precludes landowners from constructing "any building or other structure within 15 feet of any pipe, or plant any trees over said pipe, or drill or dig any well in a location which would jeopardize the safe use and operation of said pipe lines."

The first step in SDG&E and SoCalGas' process was to analyze available information to identify commercial and residential structures near the pipeline. SDG&E and SoCalGas used the centerline geometry of Line 1600, which is based upon finalized construction completion drawings dimensioned from property boundaries and other land reference points and validated with inertial measurement unit (IMU) results obtained during inline inspection of the pipeline. The source data related to the location of nearby structures is based upon structure geometry that has been digitized as a polygon from orthorectified aerial imagery that is obtained annually through custom flight(s). During this first step, to screen for structures near the pipeline, a conservative buffer of 30 feet was created from the mapped centerline of the pipeline. This screening process identified 250 mapped locations of interest potentially falling within the 30-foot screening buffer.

Next, these locations were further investigated in the field by SDG&E Pipeline Locators who reviewed the sites and marked out and measured the pipeline location relative to the identified sites. Of the 250 identified locations, 216 were confirmed to be located more than 15 feet from the pipeline or of permissible use, such as open space, softball fields, etc. As such, those 216 locations were cleared as not warranting further investigation. SDG&E and SoCalGas identified 34 remaining locations where structures reside within 15 feet from the pipeline. Of these, SDG&E and SoCalGas identified no structures built over the pipeline or in a location that would hinder maintenance activities on the pipeline or cause a lengthy delay in accessing Line 1600 during an emergency.

A summary of these 34 locations is presented in Table 10 below along with GPS points, as required in D.18-06-028. Under the proposed Plan outlined in this document, at any locations

where a structure resides within ten feet of the pipeline, the existing Line 1600 pipeline will be relocated to a new location sufficiently far away from the identified structure.

Table 10
Structures Identified Within or Abutting Line 1600 Easements

ADDRESS/ DESCRIPTION	GPS COORDINATES
[redacted]	

ADDRESS/ DESCRIPTION	GPS COORDINATES
[redacted]	

C. Environmental Protection Measures

During the planning stages of a project, environmental subject matter experts (SMEs) complete a Detailed Environmental Review (DER). A DER provides the project execution team with a summary of the potential environmental constraints and/or conditions required to be addressed prior to clearing the project for construction. It also identifies potential environmental permits that may be required to complete a project. If a project requires a permit from an environmental agency, environmental subject matter experts prepare and submit the required documents and work with the applicable agency to secure the permit.

Prior to construction the environmental experts may deliver an Environmental Clearance to the PSEP Project Manager and construction team. The Environmental Clearance outlines environmental restrictions or allowances (for example, where vegetation clearing may or may not be permitted). The environmental experts may also provide Worker's Environmental Awareness Procedure (WEAP) training materials for use in informing/educating individuals working on the project. If required for a project, the environmental experts may also contract environmental monitors who work with the construction team to ensure compliance with permit conditions and/or local, state or federal regulations.

VII. PROPOSED PLAN PRELIMINARY COST FORECAST AND ESTIMATING METHODOLOGY

SDG&E and SoCalGas prepared preliminary estimates for each of the design alternatives considered in the preparation of this Plan, in accordance with the Commission's directive in D.18-06-028 to "include best available expense and capital cost projections for each prioritized segment and each test year."[36] The preliminary cost estimates presented in this Plan were prepared by a dedicated PSEP cost estimating team[37] using the methodology refined by the team over time to estimate in-service pipeline pressure test and replacement projects. Since first implementing PSEP over six years ago, SDG&E and SoCalGas have continued to enhance estimate accuracy by incorporating actual costs and activity timelines encountered. These continuous improvement enhancements have resulted in a more robust estimating tool and process that incorporates the input of subject matter experts. These subject matter experts apply their respective expertise and professional experience to provide estimate assumptions for their respective areas, which then form the basis of each estimate.

SDG&E and SoCalGas assessed the project parameters, conducted site visits to determine feasibility of construction within existing rights-of-way and relocation routes, developed preliminary designs and reviewed maps, and analyzed environmental restrictions and workspaces. The project cost estimates consider project execution, engineering design, and construction considerations, as further described below. As described in greater detail below, the cost estimates for the alternatives presented in this Plan utilized subject matter expertise and professional experience to develop the assumptions that form the basis of each

[36] D.18-06-028 at 91.

[37] In 2015, SDG&E and SoCalGas formed a dedicated estimating department to increase focus on the quality and accuracy of estimates.

estimate. As also described in further detail below, estimates are based on the best information available at this engineering, design and planning stage and, as such, SDG&E and SoCalGas expect both foreseeable and unforeseeable conditions to be encountered during construction that will result in actual expenditures that vary from these initial preliminary estimates.

A. Proposed Plan Preliminary Cost Forecast

Tables 11a and 11b below summarizes the direct and fully loaded and escalated preliminary cost forecast for SDG&E and SoCalGas' proposed Line 1600 Test and Replacement Plan. Cost estimates are based on the preliminary scoping of the work, validated by field visits to the proposed construction and testing sites. Given that the scope of work described in the Plan is conceptual at this time, and detailed engineering and project planning will not be completed until after the Plan is submitted, the available information only enables development of a Class 4 level estimate. Annual spending forecasts are based on a combination of project estimates and the anticipated work schedule.

Table 11a
Direct ($2018) Proposed Plan Preliminary Cost Forecast
(*in Millions*)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 24	$ 34	$ 124	$ 155	$ 106	$ 56	$ 6	$ 506
O&M	$ 2	-	-	-	$ 6	$ 18	$ 13	$ 39
Total	**$ 26**	**$ 34**	**$ 124**	**$ 155**	**$ 112**	**$ 74**	**$ 19**	**$ 545**

Table 11b
Loaded and Escalated Proposed Plan Preliminary Cost Forecast
(*in Millions*)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 30	$ 41	$ 152	$ 193	$ 134	$ 72	$ 8	$ 630
O&M	$ 2	-	-	-	$ 7	$ 22	$ 16	$ 47
Total	**$ 33**	**$ 41**	**$ 152**	**$ 193**	**$ 141**	**$ 94**	**$ 24**	**$ 677**

In addition to reflecting a more refined cost estimating methodology that better reflects actual costs and timelines incurred on prior PSEP projects, this preliminary estimate reflects the overall escalation of pipeline construction costs that has occurred since similar estimates were prepared for A.15-09-013 more than three years ago. Some costs, such as for steel, have significantly increased over the last three years beyond standard escalation rates. Additionally, to accommodate assessment of 1949-vintage portions of Line 1600 using advanced in-line inspection technology, a greater number of pipeline features must be cut out of the pipe and replaced prior to pressure testing than initially contemplated when estimates were prepared for A.15-09-013.

Notwithstanding improvements in and level of rigor of the estimating methodology implemented by SDG&E and SoCalGas, estimates remain estimates. As such, SDG&E and SoCalGas expect conditions to be encountered that will result in actual expenditures varying from estimates. This forecast is therefore subject to adjustment once detailed engineering, project planning and permitting information becomes available as the Plan moves beyond the high-level preliminary scoping phase. Additional detail regarding the estimating methodology employed by SDG&E and SoCalGas to develop the Plan forecast is described below.

B. Planning and Engineering Design

For the purpose of developing the pressure test estimates in this Plan, SDG&E and SoCalGas undertook the following work:

- Assessment and confirmation of project parameters;
- Site visits;
- Review of feature studies;
- Coordination with SoCalGas/SDG&E Gas Engineering and Pipeline Integrity groups to identify repairs/cut-outs for anomalies and in-line inspection compatibility;
- Development of a pipeline profile using ground elevation data for hydrotest planning purposes;
- Determination of maximum and minimum allowable test pressures, and corresponding sectioning of the pipeline into test sections;
- Development of a high-level preliminary routing and design for each section;
- Desktop environmental review of routing options to identify potential environmental constraints and permits;
- Analysis of seasonal restrictions; and
- Determination of additional valve locations, as required.

C. Development of the Project Cost Estimate

As part of the scope definition process described above, subject matter experts representing key areas of the project planning process have contributed to the estimate development.

In alignment with the Association for the Advancement of Cost Engineering (AACE) Recommended Practice 17R-97, the cost estimate for the various options in this Plan were developed under a Class 4 estimate classification. Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. They are

typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Typically, engineering is from 1% to 15% complete, and would comprise at a minimum the following: plant capacity, block schematics, indicated layout, process flow diagrams (PFDs) for main process systems, and preliminary engineered process and utility equipment lists. In the case of this estimate, the preliminary layout was provided in order to develop quantities and assumptions for construction with support for the project team and construction SMEs.

Class 4 estimates generally use factored estimating methods such as gross unit costs/ratios and other parametric and modeling techniques. In the case of this estimate, a combination of gross unit costs and parametric estimating methods were utilized. Based upon the scope and quantities presented, the estimating department developed construction costs for each key quantity unit. For each option, the quantities were updated to account for high level items with very limited knowledge of the geotechnical conditions, detailed/specific routing, permit or traffic restrictions.

Typical accuracy ranges for Class 4 estimates are -15% to -30% on the low side, and +20% to +50% on the high side, depending on the technological complexity of the project, appropriate reference information, and other risks (after inclusion of an appropriate contingency determination, consistent with industry standard). Ranges could exceed those shown if there are unusual risks.

D. Project Execution

Project Execution subject matter experts provide the following in support of estimate development:

- For replacement projects, analysis of alternatives to replacement (*e.g.*, abandonment, de-rating the line, and non-destructive examination for short sections);
- Validation of appropriate replacement diameter;
- Identification of taps and laterals within pressure test or replacement sections;
- Assessment of potential system and customer impacts and development of mitigation strategies;
- Identification of pipeline features to be cut out prior to a pressure test (*e.g.*, pipeline anomalies, non-piggable features, and obsolete appurtenances);
- Identification of potential valve additions;
- Review and approval of scope of work; and
- Review and approval of project-specific pressure test procedures, when applicable.

E. Engineering Design

Engineering Design consists of performing the planning and engineering design work necessary to provide a scope of work with sufficient detail to develop more robust project cost estimates. The scope of work is intended to facilitate the proximation of all identifiable cost components up to, and including, the completion of construction and close-out. The typical planning and engineering design scope includes the following considerations:

- Assessment and validation of project extent/parameters;
- Physical visit to job site to gain familiarity with the area;
- Development of preliminary design for each work site;
- Development of pipeline profile;
- Identification of pressure test sections based on the minimum and maximum allowable test pressures in order to achieve required test pressures; and
- Identification of any special pipeline crossings for replacement projects (*e.g.*, waterways, railroads, freeways, etc.).

F. Environmental

Environmental subject matter experts conduct a desktop review of the route options, identify potential environmental permits and provide estimated costs for the following items in support of estimate development:

- Environmental Services (consultant support for planning, permitting, field surveys, construction and closeout);
- Abatement of potential asbestos containing material and lead paint, as applicable;
- Water treatment, waste management and disposal costs, as applicable;
- Potential permit fees; and
- Potential mitigation fees.

G. Construction

The forecast of construction costs incorporates input from SDG&E and SoCalGas subject matter experts and impacted organizations including the following elements:

- Input from contractors with construction expertise;
- Field walk with all parties to capitalize on combined expertise for assessment of constructability issues; and
- Review of engineering design package to determine construction assumptions.

H. Land Services

Land Services provides the following in support of estimate development:

- Determination of applicable municipal permit requirements and associated costs;
- Identification of potential laydown/staging yards required for individual projects, and subsequent communication with land owners as required to determine availability; and
- Development of cost estimates associated with laydown yards, temporary construction easements, grants of easement, appraisals, title reports, etc.

I. Compressed Natural Gas/Liquefied Natural Gas (CNG/LNG) Team

The CNG/LNG Team provides the following in support of estimate development:

- Provision of analyses on impacted customer natural gas loads to determine optimal process for keeping customers online; and
- Development of cost estimates for the provision of CNG/LNG.

J. Supply Management

To assist in developing cost estimates, Supply Management provides material and logistics-related cost estimates based on a preliminary bill of material developed by the Project Team.

K. Estimating

Upon receipt of input from the above subject matter experts, a comprehensive estimate is developed incorporating the various teams' analyses. The estimating team works with the subject matter experts to identify potential risks and their potential for occurrence. The results are factored into the project cost estimate.

VIII. ALTERNATIVE DESIGNS

A. Overview

As part of developing the Line 1600 Test or Replacement Plan, SDG&E and SoCalGas considered four alternative designs. The alternative designs were evaluated consistent with the requirements set forth in D.18-06-028 and the overarching objectives of SDG&E and SoCalGas' PSEP to: (1) comply with the Commission's directives; (2) enhance public safety; (3) minimize customer impacts; and (4) maximize the cost effectiveness of safety investments. Engineering factors associated with the unique characteristics of existing Line 1600 were also central to the evaluation. The alternative designs that were considered but not selected include:

- Full hydrostatic strength testing (hydrotesting) of the entire length of Line 1600. Referenced as Line 1600 Full Hydrotest Alternative, or "Full Hydrotest."

- Full replacement of all vintage sections of Line 1600 in existing streets near Line 1600, with a derate of existing Line 1600 in the north. Includes a pressure reduction of existing Line 1600 in the north to distribution pressure. Referenced as Line 1600 Full Replacement Alternative A – Nearby Streets, or "Full Replacement Nearby Streets."

- Full replacement of all vintage sections of Line 1600 using Old Highway 395 in the north and nearby streets in the south. Includes a pressure reduction of existing Line 1600 in the north to distribution pressure. Referenced as Line 1600 Full Replacement Alternative B – Hwy 395 North, Nearby Streets South, or "Full Replacement Hwy 395."

Information regarding these three alternative designs is presented below.

B. Full Hydrotest Alternative

As required under D.18-06-028, SDG&E and SoCalGas considered performing a full hydrostatic test of the entire approximately 50-mile length of Line 1600 as one design alternative. A map of the scope of work associated with the Full Hydrotest alternative design is presented below in Figure 4. In evaluating this alternative, SDG&E and SoCalGas considered the technical aspects of how the entirety of Line 1600 could be hydrotested. The evaluation also considered gas supply to local distribution customers during testing of individual pipeline segments of Line 1600 that is necessary to minimize customer impacts.

The preliminary loaded and escalated cost estimate of the Full Hydrotest alternative based on high level scoping of this work is approximately $325 million. Of the total estimated loaded and escalated cost, SDG&E and SoCalGas anticipate recording approximately $92 million as a capital expense and approximately $233 million as an operating expense. SDG&E and SoCalGas developed a project schedule that factors in time for detailed planning, engineering, and permitting activities, as well as time for construction and testing. This conceptual schedule

is presented below in Figure 5. A corresponding annual spending forecast is presented in Tables 12a and 12b.

Figure 4: Full Hydrotest Alternative

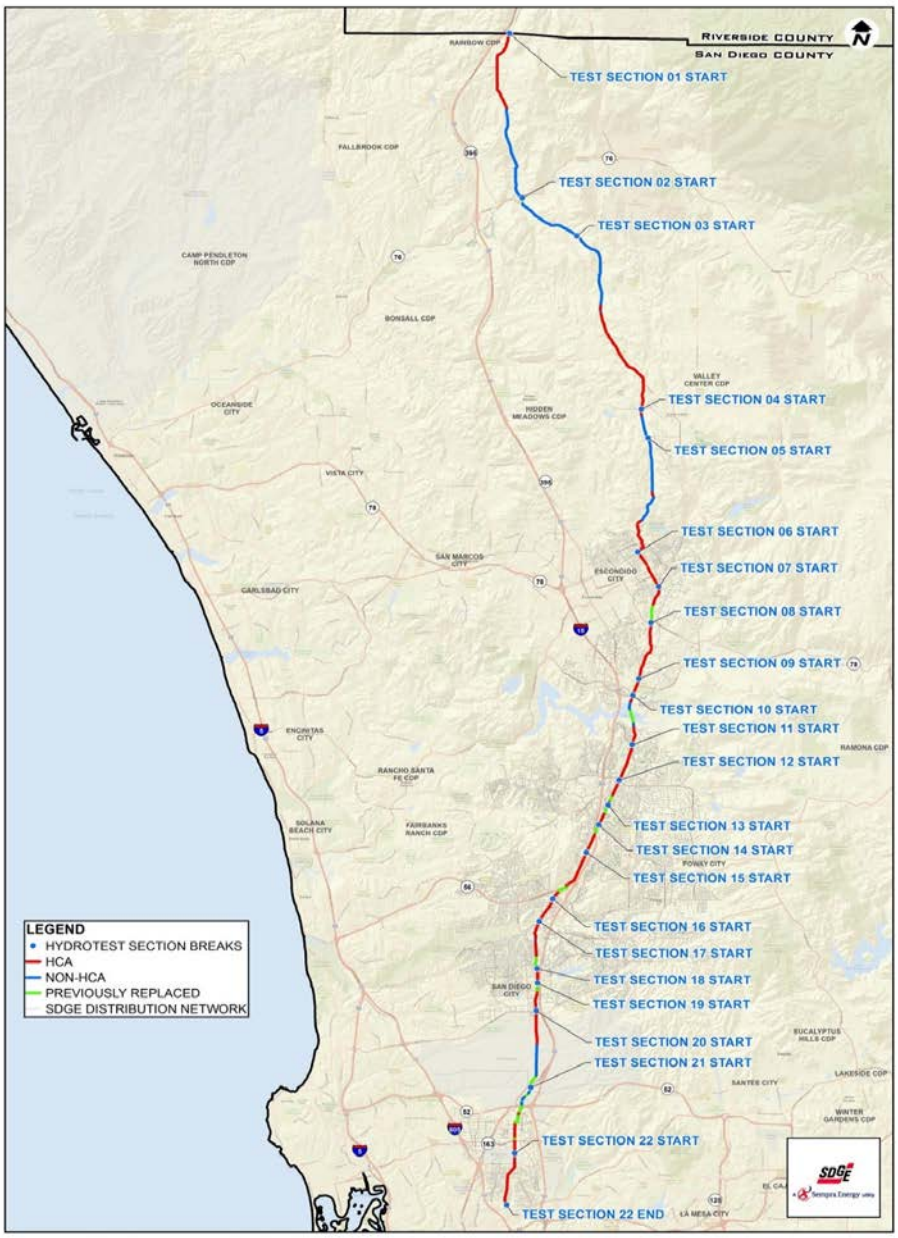
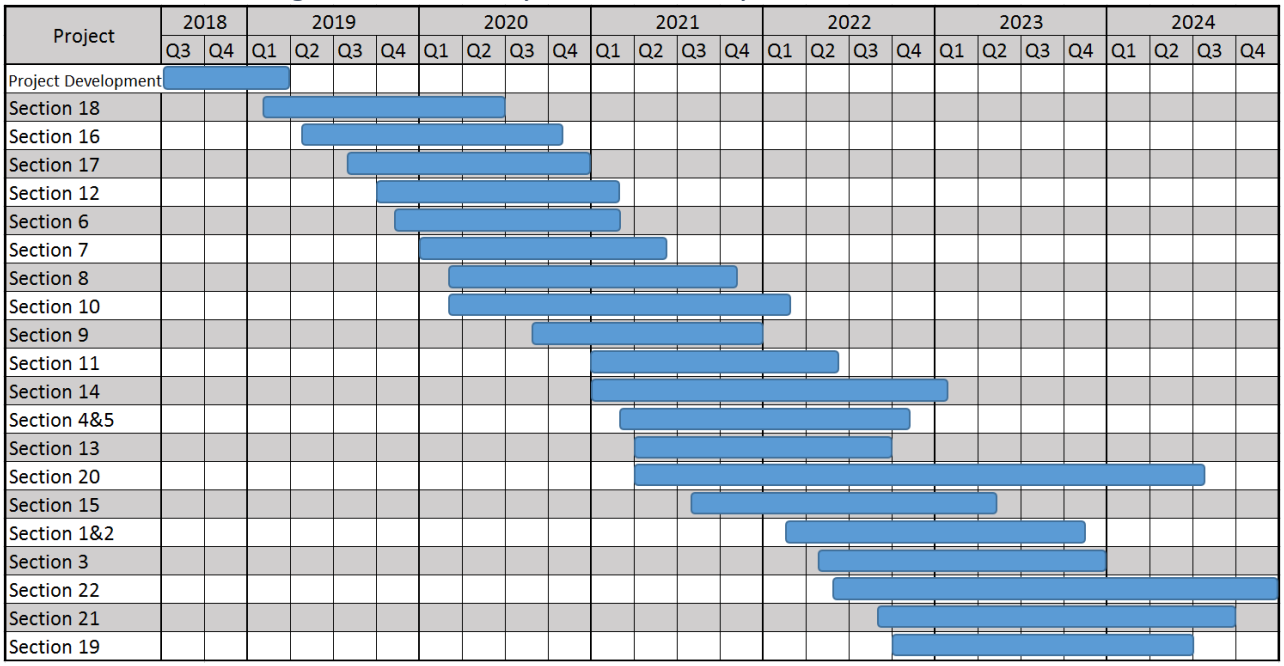


Figure 5: Preliminary Schedule Full Hydrotest Alternative



Hydrotesting the entirety of Line 1600 presents numerous challenges. Line 1600 supplies gas to approximately 150,000 gas meters, many of which have no alternative supply source if Line 1600 is out of service. There are 62 connections on the line that currently provide service to major communities as well as individual customers, including the military, electric generation, and large industrial customers.

To hydrotest Line 1600, 22 separate tests would need to be performed. The 22 test sections are needed to account for elevation changes and to minimize interruption of service to customers. In addition, the scope and schedule needed to account for the high natural gas demands experienced during the summer months due to electric generation prohibit testing of the northern section during that time period. In order to maintain natural gas service during hydrotesting, a combination of various activities will be needed and include back feeding Line 1600, providing temporary supplies via CNG trailers or NG bottles, LNG supplies, or building bypass pipelines. Adequate work space must be secured for test equipment including test

heads, pumps and water storage tanks. As part of the commitment to make Line 1600 fully piggable, preparation of a test section includes the removal of wrinkle bends, shorter radius bends and elbows, pressure control fittings, and other features that prevent the performance of in-line-inspections to assess the integrity of the legacy pipeline using commercially available CMFL (long seam) smart pigging tools.

Test segments were designed according to elevation restrictions, valve sites, large taps, and accessibility/workspace. The tests range from approximately 2,800 feet to 7.5 miles in length, with the average being approximately two miles. The pipeline would be sectionalized at each large tap or valve using either stopples or the main line block valve and installing temporary bypass lines to serve the large customers or major distribution feeder lines.

Since testing requires a flow path from either the north or the south, only one test can be conducted at a time. It is assumed all test water would be filtered and properly disposed of at the end of each test. Each test segment would take approximately four to six weeks to conduct and assumes a separate construction crew would install bypasses concurrently with the hydrotesting effort. Some segments may take longer depending on the specific scope of work on that particular section and permit conditions. If a section of pipe fails the hydrotest, the leak will need to be located, repairs made, and a new test initiated. This could extend the schedule and result in additional costs.

This alternative design contemplates strength-testing by hydrotest with a minimum test pressure of 960 psig, which is 1.5 times the most recent historical MAOP of 640 psig. This minimum test pressure of 960 psi would be held continuously for at least eight hours. A spike test is also included with each test, raising the pressure approximately 5% for one-half hour at

the beginning of the test. The maximum test pressure would be higher in some cases to accommodate elevation differences and is based on an objective to not exceed 90% SMYS or 1462 psig.

Tables 12a and 12b below summarizes the direct and fully loaded and escalated preliminary cost forecast for the Full Hydrotest alternative.

Table 12a
Direct ($2018) Full Hydrotest Alternative Preliminary Cost Forecast
(in Millions)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 7	$ 4	$ 12	$ 11	$ 15	$ 14	$ 6	$ 70
O&M	$ 18	$ 11	$ 32	$ 30	$ 41	$ 38	$ 16	$ 186
Total	**$ 26**	**$ 15**	**$ 44**	**$ 41**	**$ 56**	**$ 52**	**$ 22**	**$ 256**

Table 12b
Loaded and Escalated Full Hydrotest Alternative Preliminary Cost Forecast
(in Millions)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 9	$ 5	$ 15	$ 15	$ 20	$ 19	$ 8	$ 92
O&M	$ 23	$ 13	$ 39	$ 37	$ 51	$ 49	$ 21	$ 233
Total	**$ 33**	**$ 18**	**$ 54**	**$ 52**	**$ 71**	**$ 68**	**$ 29**	**$ 325**

Following PSEP project evaluation criteria and considering the engineering factors associated with the unique characteristics of the vintage A.O. Smith electric flash welded pipe, SDG&E and SoCalGas determined the Full Hydrotest alternative design is not the best design to pursue. While it is the least expensive, in terms of minimally achieving compliance with Public Utilities Code section 958, it does not resolve long term safety considerations associated with the legacy pipe in populated areas. As discussed earlier in this Plan, these safety considerations, which include lack of fracture control and hook crack anomalies, would remain even if the line

passes the hydrotest. Pressure testing the existing Line 1600 pipeline does not reduce the rupture risk from future mechanical damage, remove sub-critical flaws that may grow or interact with other threats, improve the pipe material's resistance to rupture, or ensure that Line 1600 will remain in transmission service in the future. As such, SDG&E and SoCalGas concluded that the most prudent choice with respect to providing long term safety, reliability and operational benefits is to replace the HCA portions of this legacy pipe. Therefore, the Full Hydrotest alternative design is not proposed by SDG&E and SoCalGas.

C. Full Replacement in Nearby Streets Alternative

SDG&E and SoCalGas also considered performing a full replacement of Line 1600 re-routed in roads and streets near the existing Line 1600. A map of the scope of work associated with the Full Replacement in Nearby Streets alternative design is presented below in Figure 6. The scope of work South of Escondido is identical under the Replace in HCA/Test in Non-HCA, Full Replacement in Nearby Streets and Full Replacement Along Highway 395 alternatives. Because the scope of work South of Escondido is already described above as part of the proposed Plan, this discussion focuses on the scope of work north of Escondido, specifically, the installation of new pipe north of the intersection of Line 1600 and Line 1601, [redacted]. This alternative offers the advantage that all 1949-vintage A.O. Smith pipe would be removed from transmission service in both HCAs and non-HCAs, thereby increasing the margin of safety and long-term reliability of the entire pipeline for the benefit of customers. This also provides the opportunity to restore the MAOP of Line 1600 to 800 psig, which matches that of the other transmission pipelines it will interconnect with and would allow Line 1600 to provide greater benefit in the event of an outage or pressure reduction on Line 3010. SDG&E and

SoCalGas' plan would be to operate so as not to exceed the capacity requirement of the Commission Decision, even though the line would be constructed and tested to allow for the potential to operate at an MAOP of 800 psig.

This alternative includes a pressure reduction and conversion of the old Line 1600 to 60 psig distribution pressure from Rainbow Station in the north to the intersection with Line 1601 in [redacted], thereby eliminating the need for installation of long runs of smaller diameter pipe between the new Line 1600 and the existing old Line 1600.

The Full Replacement in Nearby Streets route requires approximately 56 miles of 16-inch pipeline, as follows:

- Install 25 miles of 16-inch diameter pipe from Rainbow Station to Line 1601.
- Install 31 miles of 16-inch diameter pipe from Line 1601 to Mission Station.

The route involves installation along several narrow, winding, and rocky San Diego County roads, including Rainbow, Rice Canyon, Couser Canyon, Lilac, and Valley Center Roads. The southern terminus of this route is within the jurisdiction of the City of Escondido, with pipe installation in relatively high-traffic volume city streets. A minimum of three (3) jack-and-bore[38] installations and two (2) horizontal directional drill installations[39] would be required. Due to the narrow county roads with widespread potential for rock in the trench line, construction experts anticipate some of the lowest rates of production along these roads, which is expected to

[38] Jack-and-bore is a form of installation that enables construction crews to drill a horizontal hole underground between two points without disturbing the surface between the sending and receiving excavation pits. This method of drilling is costlier than a standard open trench method, and may be necessary to address anticipated site conditions, such as adjacent facilities, and/or permitting requirements.

[39] Horizontal Directional Drilling is a trenchless method of construction. Like jack-and-bore, this construction method is costlier than a standard open trench method, but may be necessary to address anticipated site conditions, such as adjacent facilities, and/or permitting requirements.

increase overall construction costs. For this reason, the Full Replacement in Nearby Streets alternative route is estimated to be the costliest of the full replacement alternatives, at a capital cost of $778 million (loaded and escalated). SDG&E and SoCalGas developed a preliminary schedule that factors in time for detailed planning, engineering, and permitting activities, as well as time for construction and post-construction testing. This preliminary schedule is presented below in Figure 7. A corresponding annual spending forecast is presented in Table 13.

Figure 6: Full Replacement in Nearby Streets Alternative

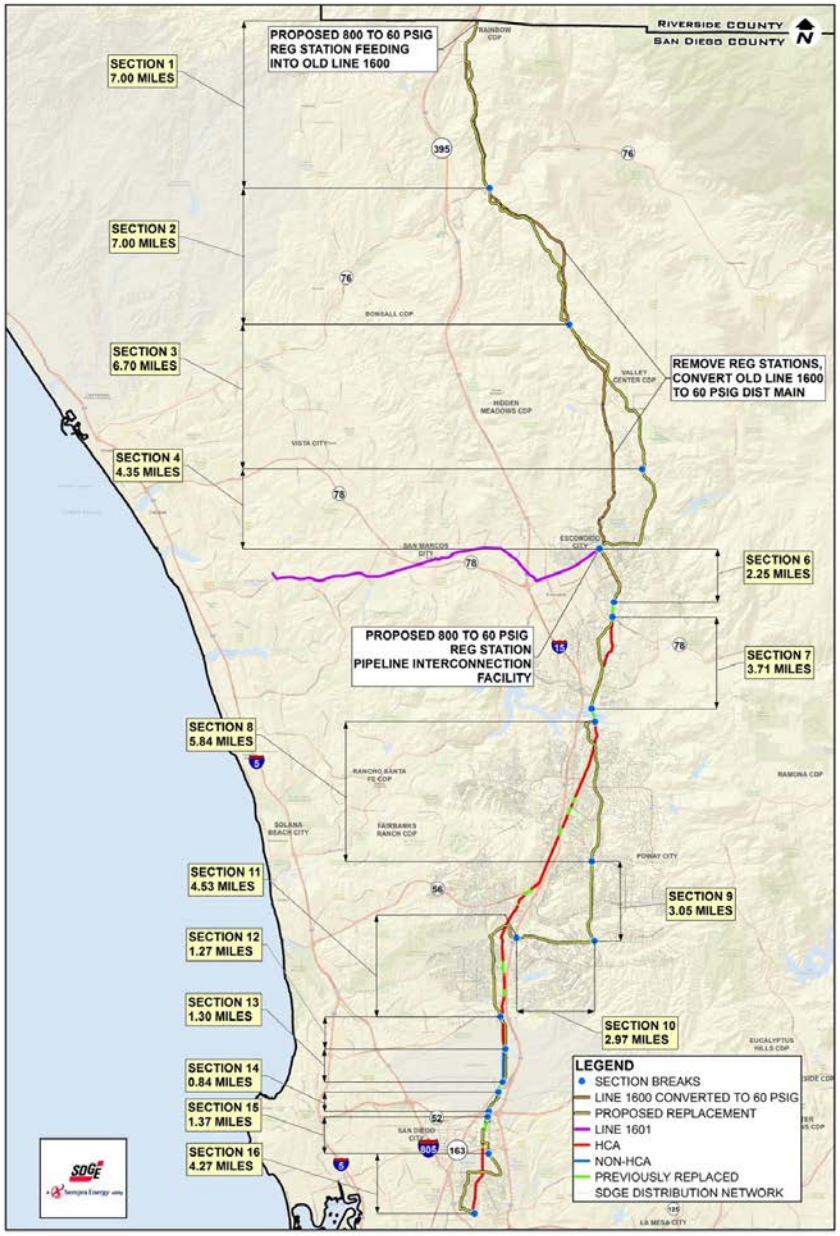
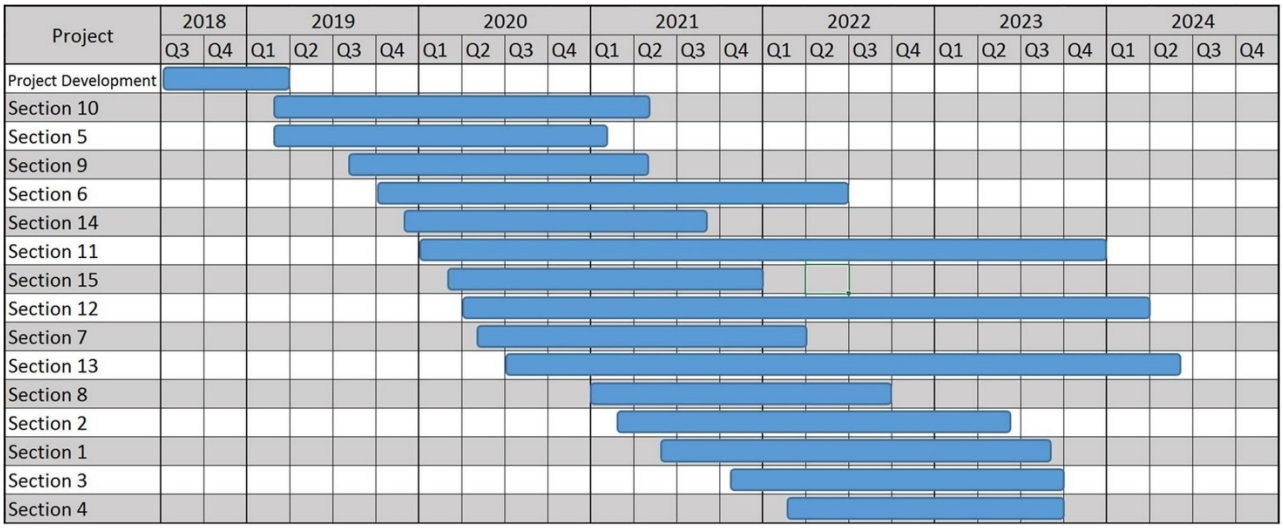


Figure 7: Preliminary Schedule for Full Replacement in Nearby Streets Alternative



The Full Replacement in Nearby Streets alternative is considered a viable and beneficial design alternative in that full replacement of the existing 1949 vintage A.O. Smith pipe enhances safety, improves reliability, and eliminates certain operations and maintenance difficulties. Benefits are summarized below:

- Replacement of 1949 A.O. Smith pipe in non-HCA areas enhances the safety margin in such areas. Although such areas do not fall within the High Consequence Area definition under federal regulations, failure of a natural gas pipeline in non-HCAs still poses risks to people, society and the environment.

- Full replacement of 1949 A.O. Smith pipe in Line 1600 ensures that Line 1600 will remain capable of transmission service in the foreseeable future. The SDG&E natural gas transmission system relies on Line 3010 and Line 1600 to provide reliable service. Line 1600's capacity allows planned maintenance outages or pressure reductions on Line 3010. In the event of an unplanned outage or pressure reduction on Line 3010, Line 1600 provides capacity to maintain gas service to some or all customers, depending upon gas demand at the time.

- Full replacement of 1949 A.O. Smith pipe in Line 1600 would allow the restoration of an 800 psig MAOP on Line 1600, thus enhancing reliability of service to customers.

- Replacement of 1949 A.O. Smith pipe in non-HCAs eliminates the need to cut out pipeline components that are not piggable with CMFL (long seam) inline inspection tools (*e.g.*, shorter radius elbows and certain bend geometries), thereby enhancing

the ability of SDG&E and SoCalGas to assess and maintain the integrity of the pipeline. Many of these cutouts are in environmentally sensitive areas that require long-lead permitting.

- Elimination of hydrotests of 1949 vintage pipe in non-HCAs reduces the risk of environmental damage due to a hydrotest failure in environmentally sensitive areas of north San Diego county, as compared to the Full Hydrotest and Replace in HCA/Test in Non-HCAs alternatives. Hydrotest options, by necessity, require testing of a pipeline at a pressure much higher than the operating pressure.

As depicted in Tables 13a and 13b below, the Full Replacement in Nearby Streets alternative is the most costly alternative considered.

Table 13a
Direct ($2018) Full Replacement in Nearby Streets Preliminary Cost Forecast
(*in Millions*)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 26	$ 30	$ 113	$ 184	$ 188	$ 81	$ 2	$ 623
O&M	-	-	-	-	-	-	-	-
Total	**$ 26**	**$ 30**	**$ 113**	**$ 184**	**$ 188**	**$ 81**	**$ 2**	**$ 623**

Table 13b
Loaded and Escalated Full Replacement in Nearby Streets Preliminary Cost Forecast
(in Millions)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 33	$ 35	$ 138	$ 228	$ 237	$ 105	$ 2	$ 778
O&M	-	-	-	-	-	-	-	-
Total	**$ 33**	**$ 35**	**$ 138**	**$ 228**	**$ 237**	**$ 105**	**$ 2**	**$ 778**

Consistent with the overarching PSEP objective to maximize the cost effectiveness of safety enhancement investments for the benefit of customers, SDG&E and SoCalGas do not propose the Full Replacement in Nearby Streets alternative due to the higher costs of construction, and lack of discernible safety enhancement advantage above the Full Replacement in Highway 395 alternative described below.

D. Full Replacement Along Highway 395 Alternative

Lastly, SDG&E and SoCalGas considered performing a full replacement of Line 1600 in franchise roads and streets predominantly using old Highway 395 from Rainbow Station to the intersection of Line 1601 in Escondido at [redacted]. A map of the scope of work associated with the Full Replacement Along Highway 395 alternative design is presented below in Figure 8. As this design alternative is identical to the proposed Plan south of Escondido, the focus of this explanation is the pipe installation north of Escondido, specifically north of the intersection of [redacted] at Line 1601.

Like the Full Replacement in Nearby Streets alternative, the Full Replacement Along Highway 395 alternative offers the advantage that all vintage 1949 A.O. Smith pipeline would be removed from transmission service in both HCAs and non-HCAs, thereby increasing the margin of safety and long-term reliability of the entire pipeline for the benefit of customers. This also provides the opportunity to restore the MAOP of Line 1600 to 800 psig, which matches that of the other transmission pipelines with which it will interconnect.

This alternative includes a pressure reduction of the existing Line 1600 to distribution pressure from Rainbow Station in the north to the intersection with Line 1601 in Escondido at [redacted], eliminating the need for installation of long runs of smaller-diameter pipe between the new Line 1600 and the existing old Line 1600.

Installation along the Highway 395 Route requires approximately 57 miles of new large diameter pipeline, as follows:

- Install 24 miles of 16-inch pipe from Rainbow Station to Line 1601.
- Install 31 miles of 16-inch pipe from Line 1601 to Mission Station.

- Install two (2) miles of 10-inch from I-15 tie-in to Rice Canyon tie-in to the existing 10-inch diameter transmission level pressure pipeline that feeds the [redacted] electric generating station along Highway 76.
- Tie-in to and utilize two (2) miles of existing 16-inch Line 1601 from [redacted]. No hydrotest required.

The route requires installation across a small number of agricultural and undeveloped parcels within the jurisdiction of San Diego County. The southern terminus of this northern route section is within the jurisdiction of the City of Escondido, with pipe installation located down relatively high-volume city streets. A minimum of six (6) jack-and-bore installations are required, and one (1) horizontal directional drill installation is required. However, the majority of the replacement is within relatively open, wide, and low-traffic density roadways in the North County. Therefore, construction experts anticipate achieving some of the highest rates of production in these sections, which translates into improved cost efficiency overall for this option. For this reason, the Highway 395 Route is estimated to be the lowest cost of the full replacement design alternatives, at a capital cost of $725 million (loaded and escalated). SDG&E and SoCalGas developed a preliminary schedule that factors in time for detailed planning, engineering, and permitting activities, as well as time for construction and post-construction testing. This conceptual schedule is presented below in Figure 9. A corresponding annual spending direct and fully loaded and escalated forecast is presented in Table 14a and 14b below.

Figure 8: Full Replacement Along Highway 395 Alternative

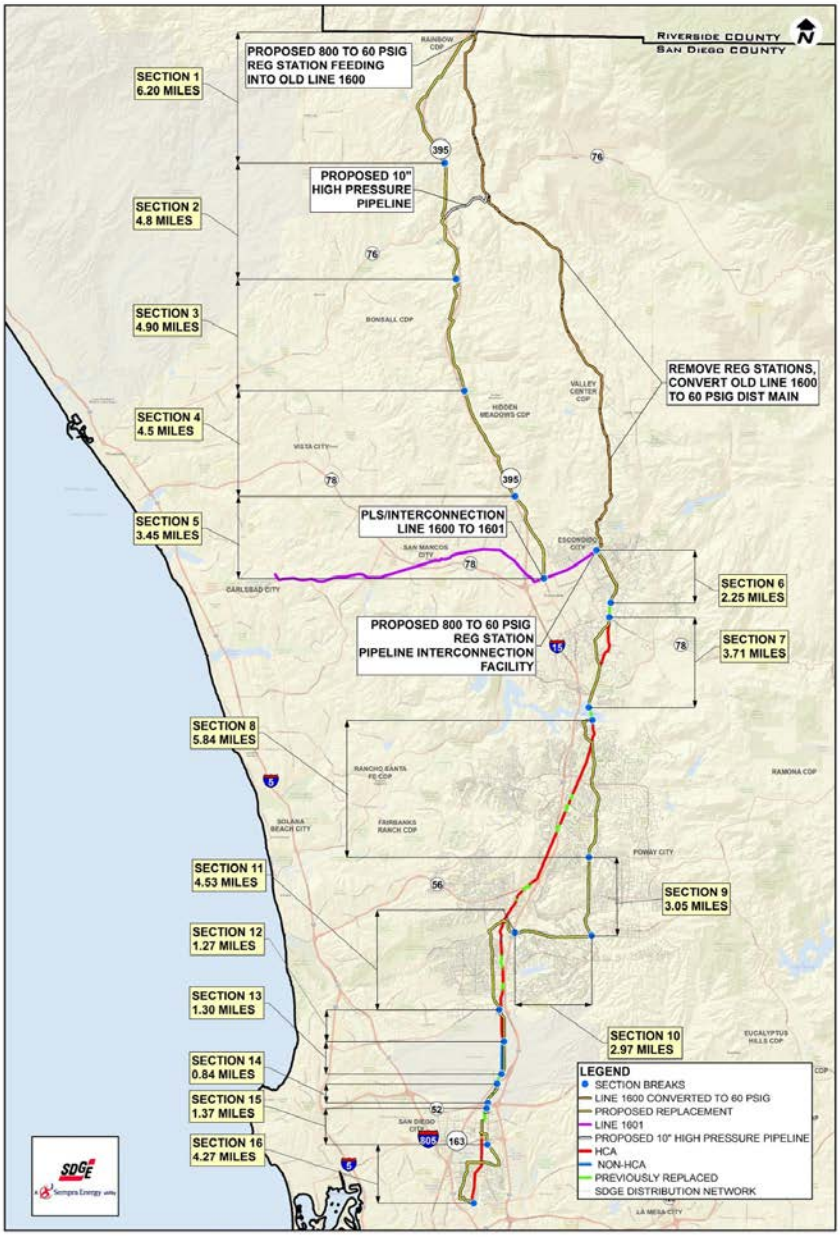
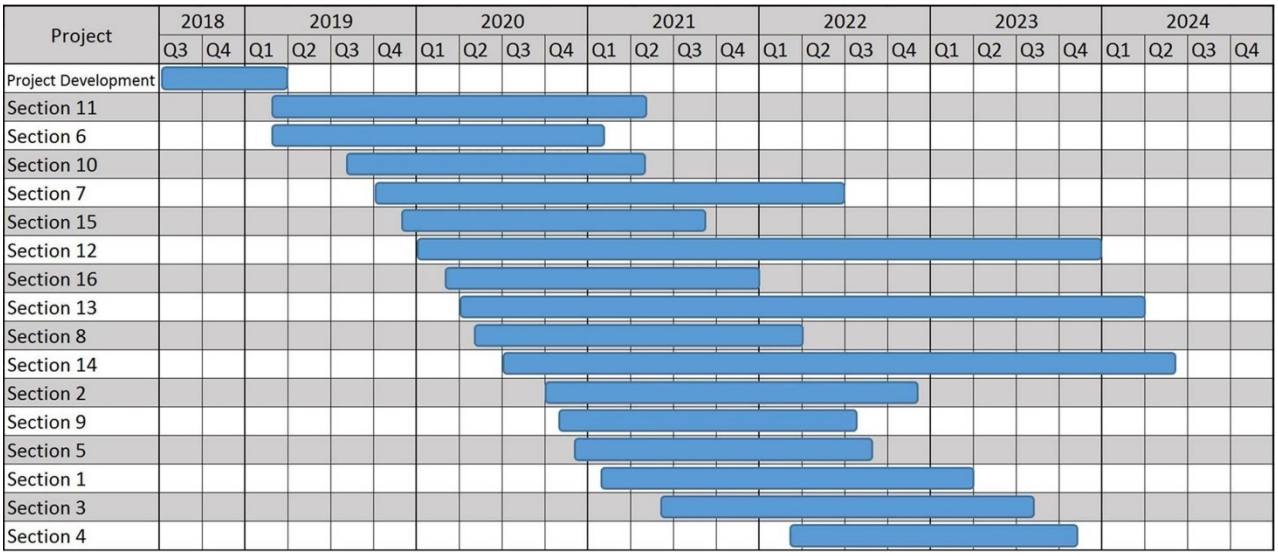


Figure 9: Preliminary Schedule Full Replacement Along Highway 395 Alternative



The Full Replacement Along Highway 395 alternative is considered a viable and beneficial design alternative in that full replacement of the existing 1949 vintage A.O. Smith pipe enhances safety, improves reliability, and eliminates certain operations and maintenance difficulties. These benefits are summarized as follows:

- Replacement of 1949 A.O. Smith pipe in non-HCAs enhances the margin of safety in those areas.

- Full replacement of all Line 1600 1949 A.O. Smith pipe enables Line 1600 to continue to provide reliable transmission service in the foreseeable future. The SDG&E natural gas transmission system relies on Line 3010 and Line 1600 to provide reliable service. Line 1600's capacity allows planned maintenance outages or pressure reductions on Line 3010. In the event of an unplanned outage or pressure reduction on Line 3010, Line 1600 provides capacity to maintain gas service to some or all customers, depending upon gas demand at the time. Full replacement of 1949 A.O. Smith pipe in Line 1600 would allow SDG&E and SoCalGas to potentially restore an 800 psig MAOP on Line 1600, with Commission approval, thus returning the full operational capability to serve customers.

- Replacement of 1949 A.O. Smith pipe in non-HCAs eliminates the need to cut out pipeline components that are not piggable with CMFL (long seam) in-line inspection tools (*e.g.*, shorter radius elbows and certain bend geometries), thereby enhancing the ability of SDG&E and SoCalGas to assess and maintain the integrity of the pipeline.

Many of these cutouts are in environmentally sensitive areas that may require long-lead permitting.

- Elimination of hydrotests of 1949 vintage pipe in non-HCAs reduces the risk of environmental damage due to a hydrotest failure in environmentally sensitive areas of north San Diego county, as compared to the Full Hydrotest and Replace in HCA/Test in Non-HCA alternative. Compliant hydrotests, by nature, require testing of a pipeline at a pressure much higher than the operating pressure.

- Installation along Highway 395, which parallels much of Interstate 15, enhances accessibility to the pipeline for maintenance or in the event of an emergency.

- Highway 395 is a wider road than the roads associated with the northern sections of the Full Replacement in Nearby Streets alternative and thus provides more working space during construction and maintenance, which results in less disruption to the community. Local communities are anticipated to be less affected by the Highway 395 route due to more effective traffic flow, thus causing only moderate traffic delays.

- Relatively wide, open roadways are expected to increase rates of production for this route, resulting in reduced installation cost.

SDG&E and SoCalGas recognize the value of full replacement along the Highway 395

Route, which include:

1) Increased safety margins in non-HCAs;

2) Enhanced reliability of the SDG&E natural gas transmission system;

3) Elimination of the challenges of acquiring specialized integrity assessment equipment to complete in-line inspections of Line 1600;

4) Reduced risk of hydrotest failures in non-HCAs;

5) Enhanced access to the pipeline for operations and maintenance of the new pipeline, thereby increasing safety and reducing future operations and maintenance costs;

6) Reduced construction burden on nearby communities compared to the Full Replacement in Nearby Streets alternative; and

7) Full and safe restoration of Line 1600's transmission function using modern materials, construction methods and safety features.

Table 14a
Direct ($2018) Full Replacement Along Highway 395 Preliminary Cost Forecast
(in Millions)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 26	$ 31	$ 134	$ 195	$ 131	$ 61	$ 2	$ 580
O&M	-	-	-	-	-	-	-	-
Total	**$ 26**	**$ 31**	**$ 134**	**$ 195**	**$ 131**	**$ 61**	**$ 2**	**$ 580**

Table 14b
Loaded and Escalated Full Replacement Along Highway 395 Preliminary Cost Forecast
(in Millions)

	Cost to Date	2019	2020	2021	2022	2023	2024	Total
Cap	$ 33	$ 38	$ 164	$ 243	$ 167	$ 79	$ 2	$ 725
O&M	-	-	-	-	-	-	-	-
Total	**$ 33**	**$ 38**	**$ 164**	**$ 243**	**$ 167**	**$ 79**	**$ 2**	**$ 725**

Compared to the cost of the Replace in HCA/Test in Non-HCA alternative proposed, the loaded and escalated incremental cost to replace all the vintage A.O. Smith pipe is anticipated to be approximately $48 million. Although this design alternative offers the greatest safety enhancement benefits for a modest 7% increase in cost, SDG&E and SoCalGas do not propose this alternative.

IX. POTENTIAL PLAN MODIFICATIONS

As explained above, SDG&E and SoCalGas anticipate that the scope and schedule for each testing and replacement project section in this Plan will be refined over time as SDG&E and SoCalGas complete the detailed engineering, design and planning work necessary to safely complete the testing and replacement projects as soon as practicable. As with all Phase 1 PSEP projects, changes in scope that impact the schedule of a Line 1600 test or replacement project

will be reflected in the PSEP status reports submitted to SED and Energy Division on a monthly basis under D.12-04-021.

In the event that additional information or conditions are identified during implementation of this Plan which lead SDG&E and SoCalGas to conclude that it would be more prudent to replace a project section currently identified for pressure testing, SDG&E and SoCalGas propose to submit a revised Replacement plan for that section to SED for review and concurrence with the change in scope. Circumstances that could lead to such changes in scope may include: (1) receipt of new information regarding the condition or integrity of a pipeline section currently identified for pressure testing that indicates replacement would be a more prudent safety enhancement investment for customers; (2) changes in non-HCA status, land use regulations, or development within a pressure-test segment; and (3) identification of customer impacts that cannot be cost-effectively mitigated through the means described above in Section IV.F.

X. APPENDIX

A. Maps of Replace in HCA/Test in Non-HCA Alternative

Figure 10
Replace in HCA/Test in Non-HCA Overview Map

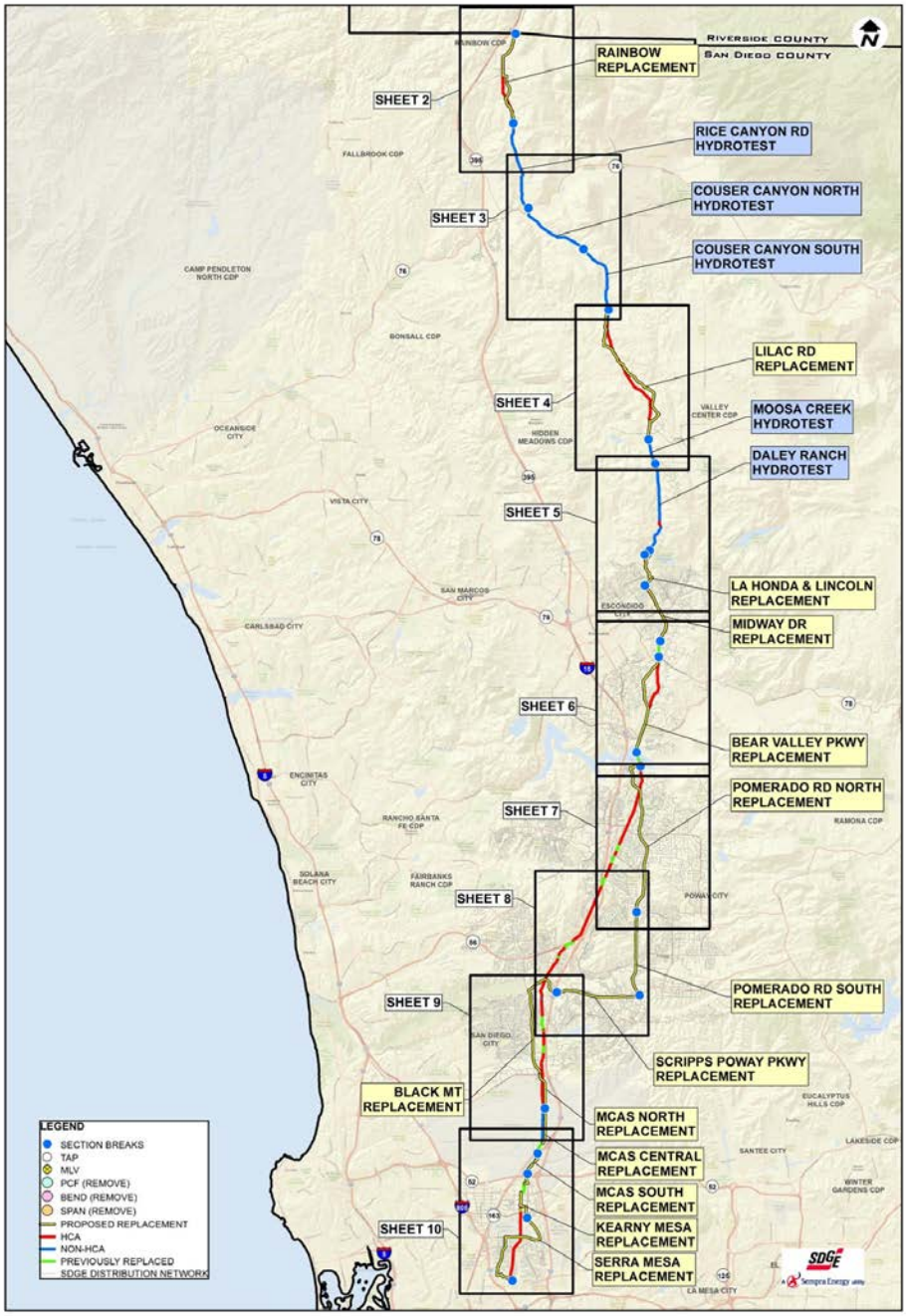


Figure 11
Replace in HCA/Test in Non-HCA Detail Map

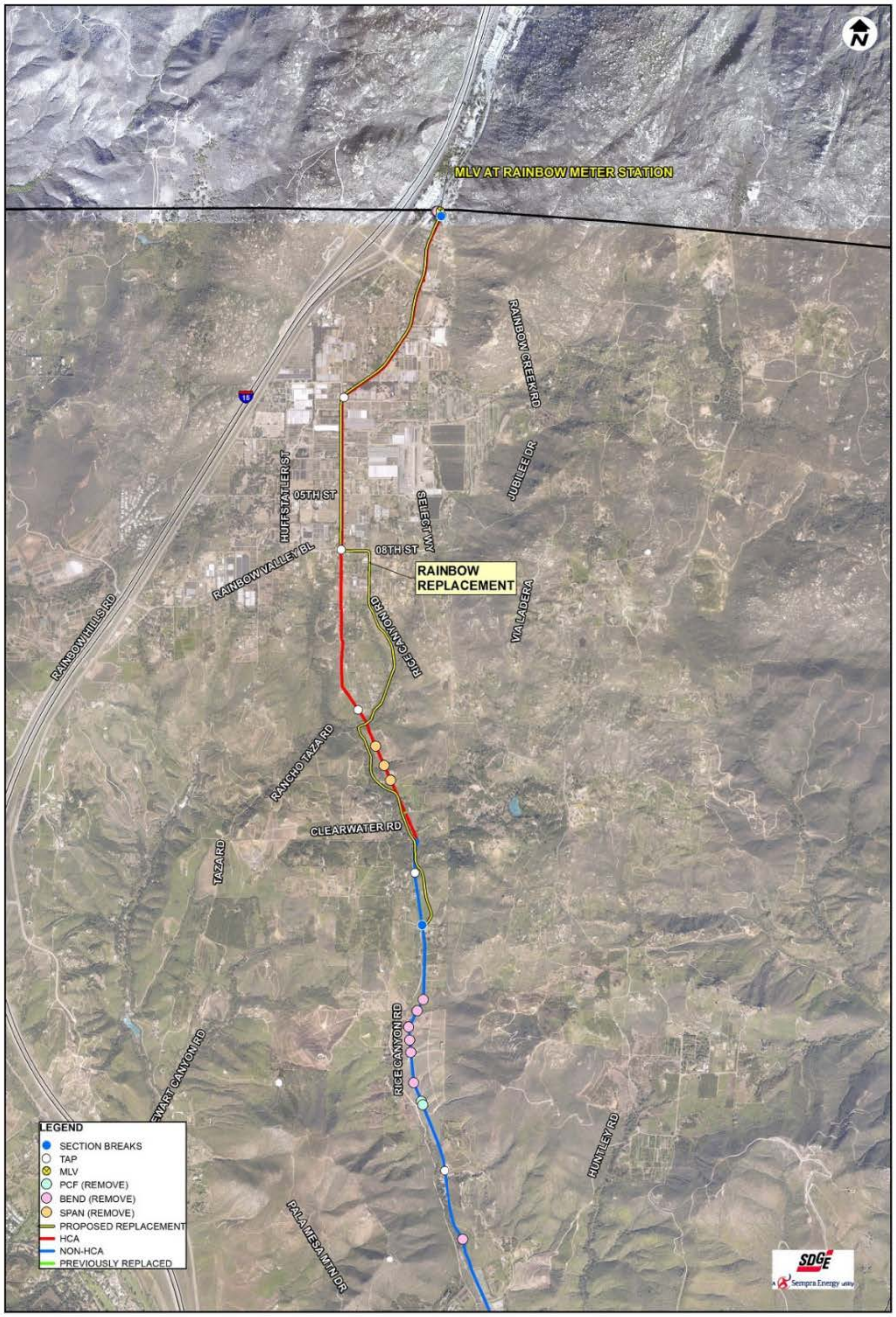


Figure 12
Replace in HCA/Test in Non-HCA Detail Map

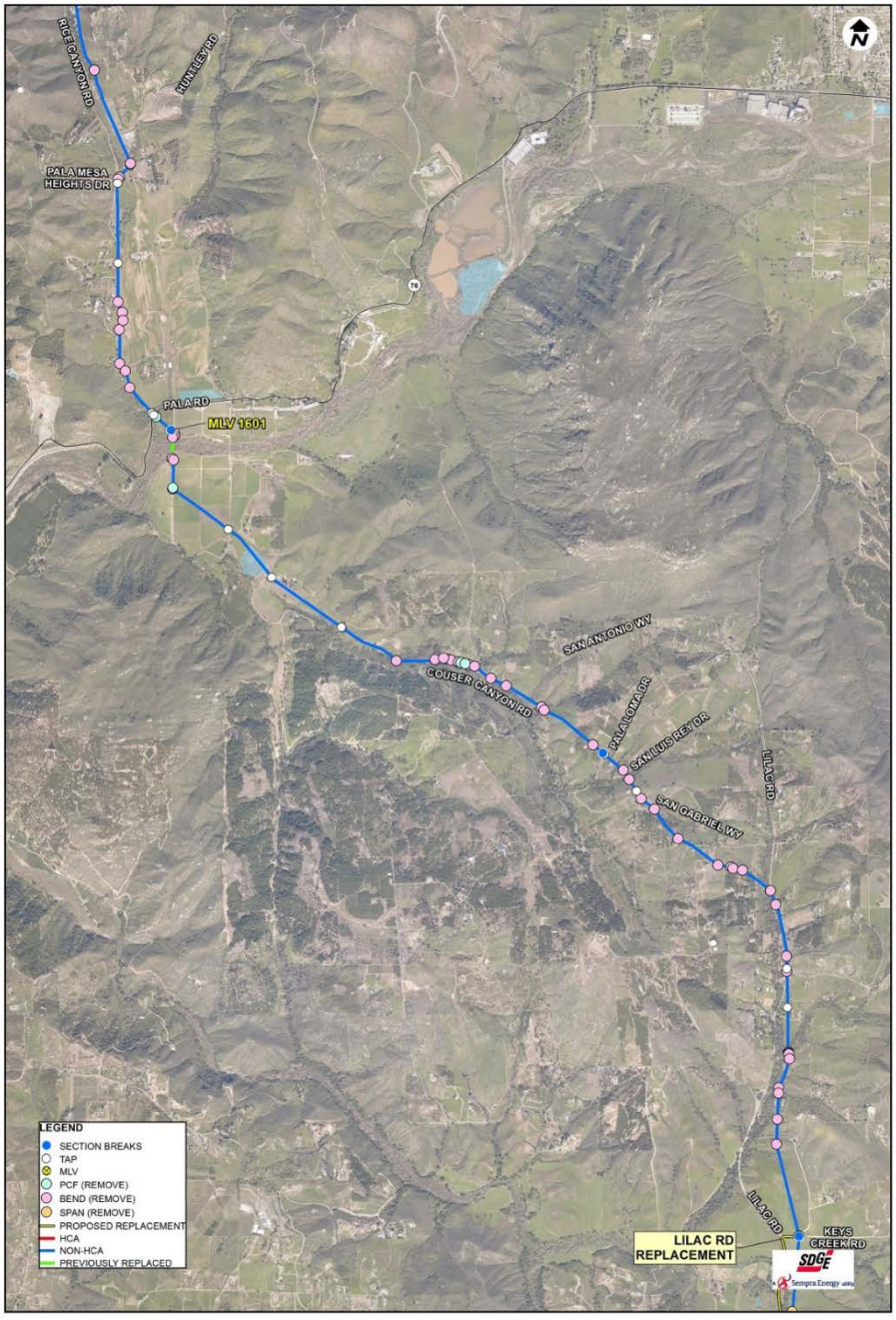


Figure 13
Replace in HCA/Test in Non-HCA Detail Map

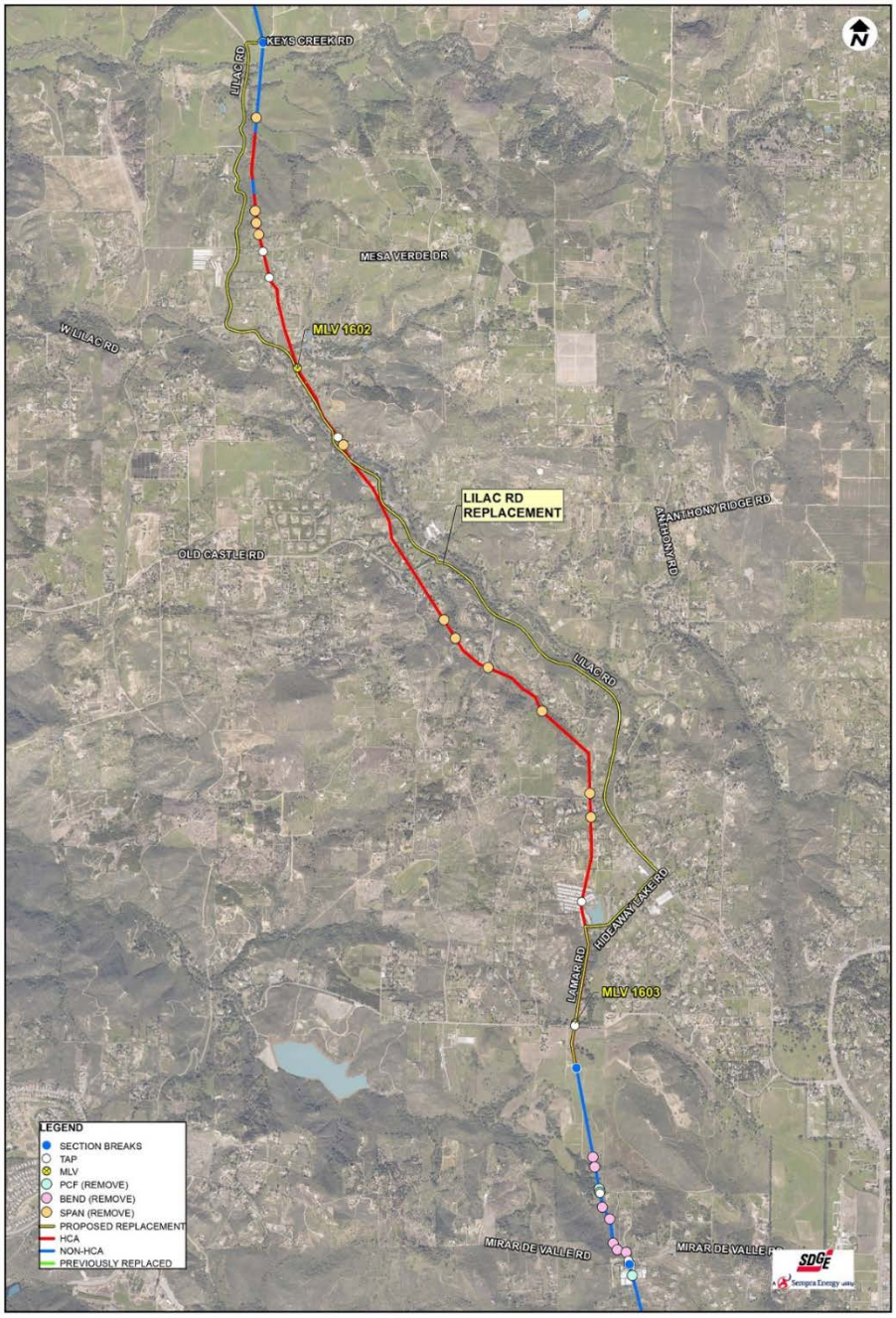


Figure 14
Replace in HCA/Test in Non-HCA Detail Map

Figure 15
Replace in HCA/Test in Non-HCA Detail Map

Figure 16
Replace in HCA/Test in Non-HCA Detail Map

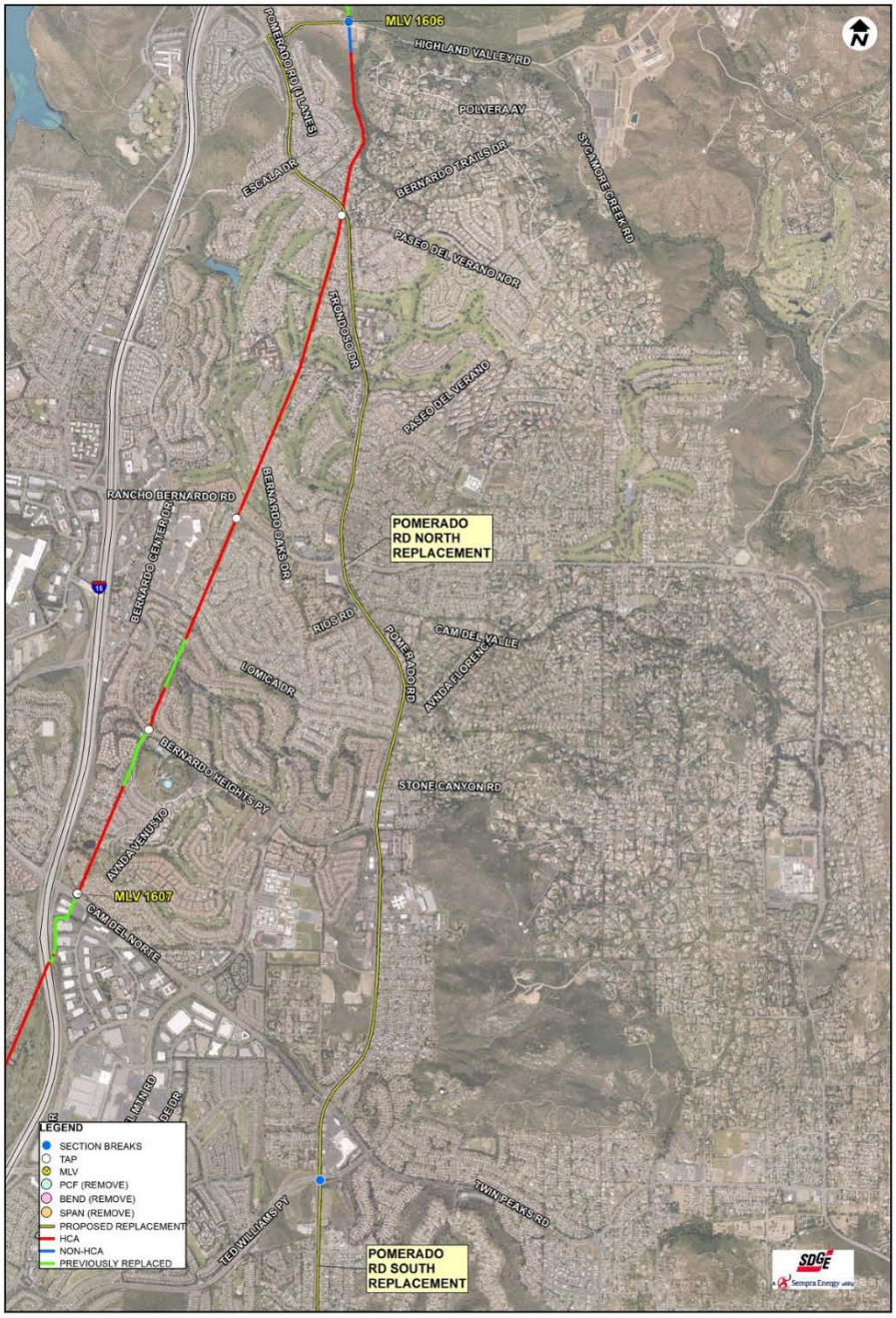


Figure 17
Replace in HCA/Test in Non-HCA Detail Map

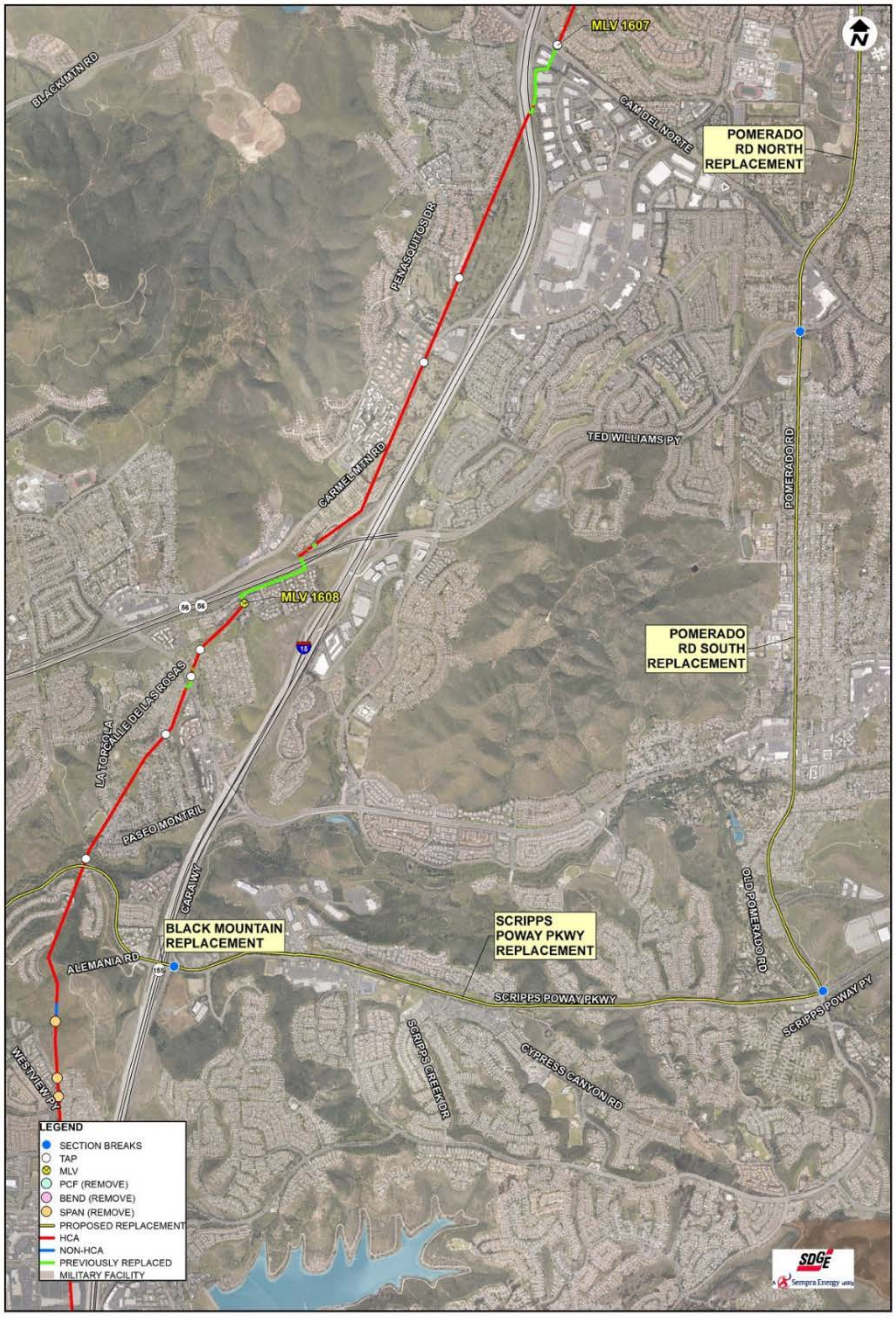


Figure 18
Replace in HCA/Test in Non-HCA Detail Map

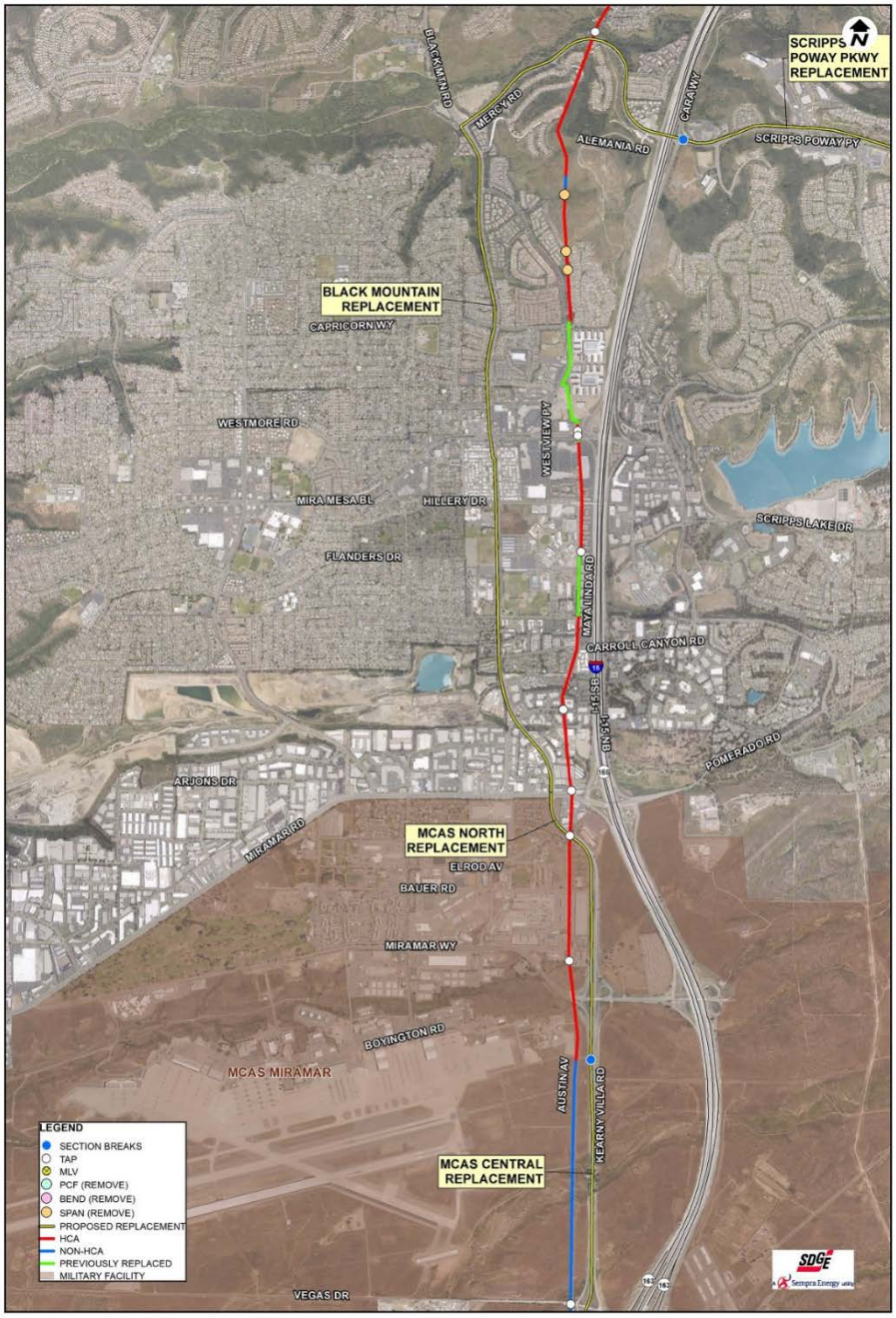
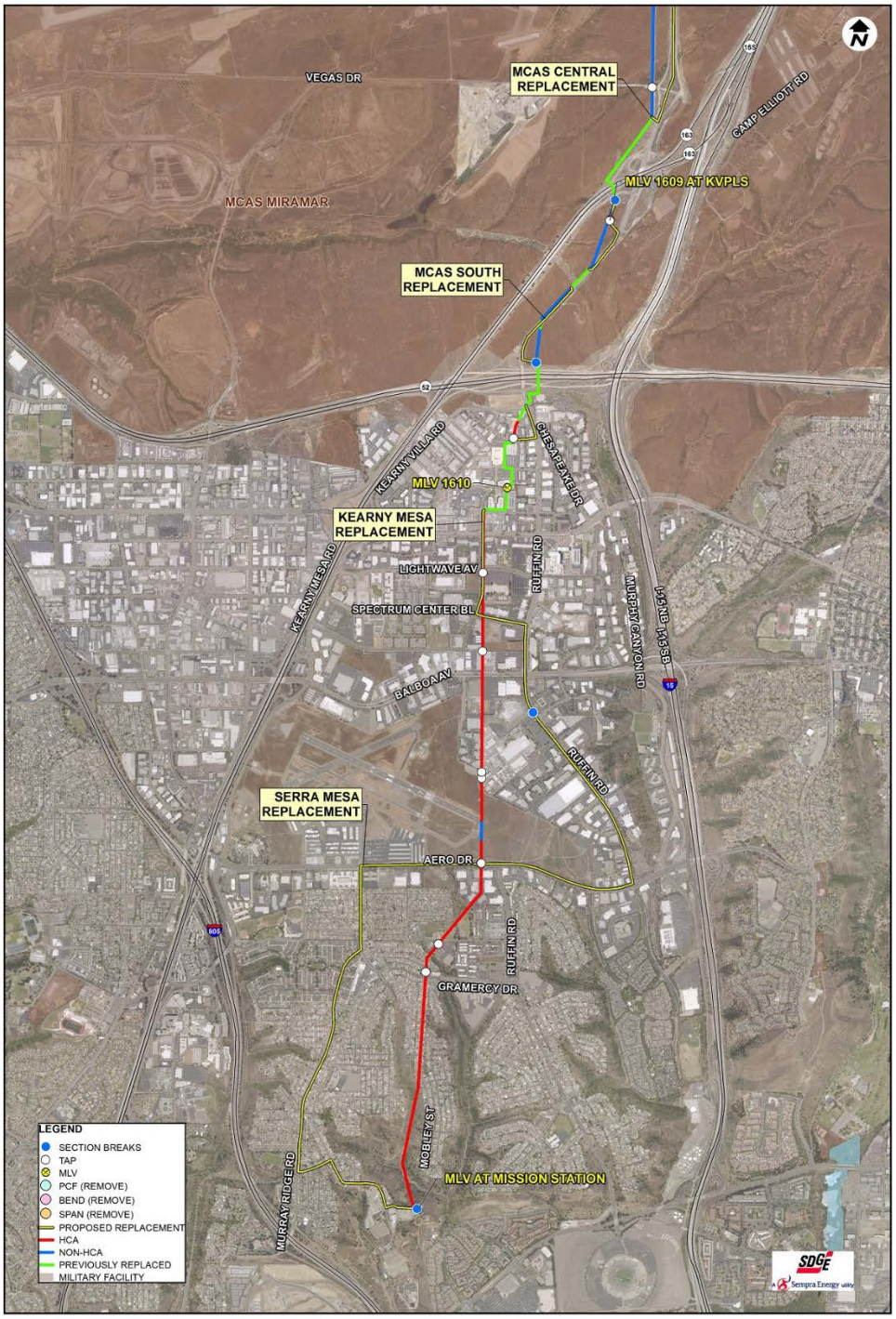


Figure 19
Replace in HCA/Test in Non-HCA Detail Map



B. Illustrative Photographs of Nearby Street Route for Replacement Pipe

Figure 20

[redacted]

(Rainbow Replacement Section)

Figure 21

[redacted]

(Rainbow Replacement Section)

Figure 22

[redacted]

(Lilac Road Replacement Section)

Figure 23

[redacted]

(Midway Drive Replacement Section)

Figure 24

[redacted]

(Bear Valley Replacement Section)

Figure 25

[redacted]

(Pomerado Road North Replacement Section)

Figure 26

[redacted]

(Scripps Poway Parkway Replacement Section)

Figure 27

[redacted]

(Black Mountain Replacement Section)

Figure 28

[redacted]

(Black Mountain Replacement Section)

Figure 29

[redacted]

(MCAS Central Replacement Section)

Figure 30

[redacted]

(MCAS South Replacement Section)

Figure 31

[redacted]

(Kearny Mesa Replacement Section)

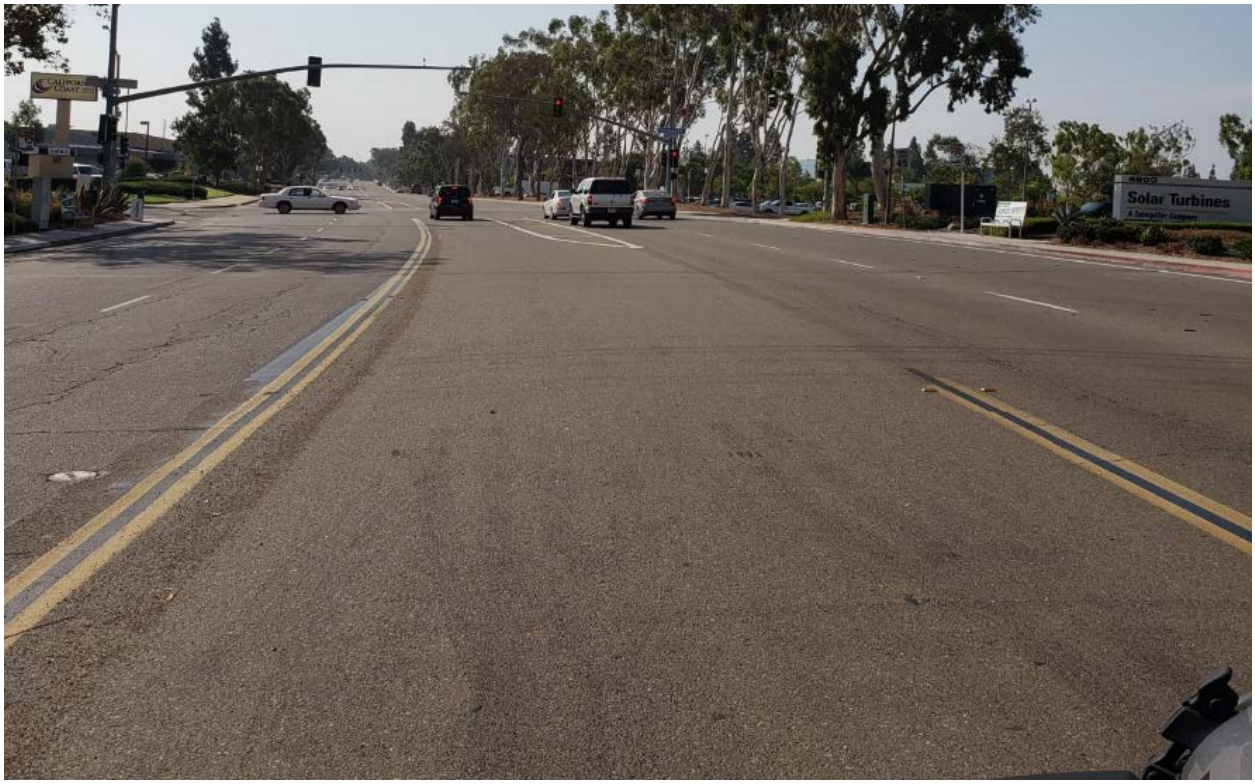


Figure 32

[redacted]

(Sera Mesa Replacement Section)

Figure 33

[redacted]

(Sera Mesa Replacement Section)

C. Illustrative Photographs of Existing Line 1600 Right-of-Way

Figure 34

Approximately [redacted]

Figure 35

[redacted]

Figure 36

[redacted]

Figure 37

Existing Line Near [redacted]

Figure 38

[redacted]

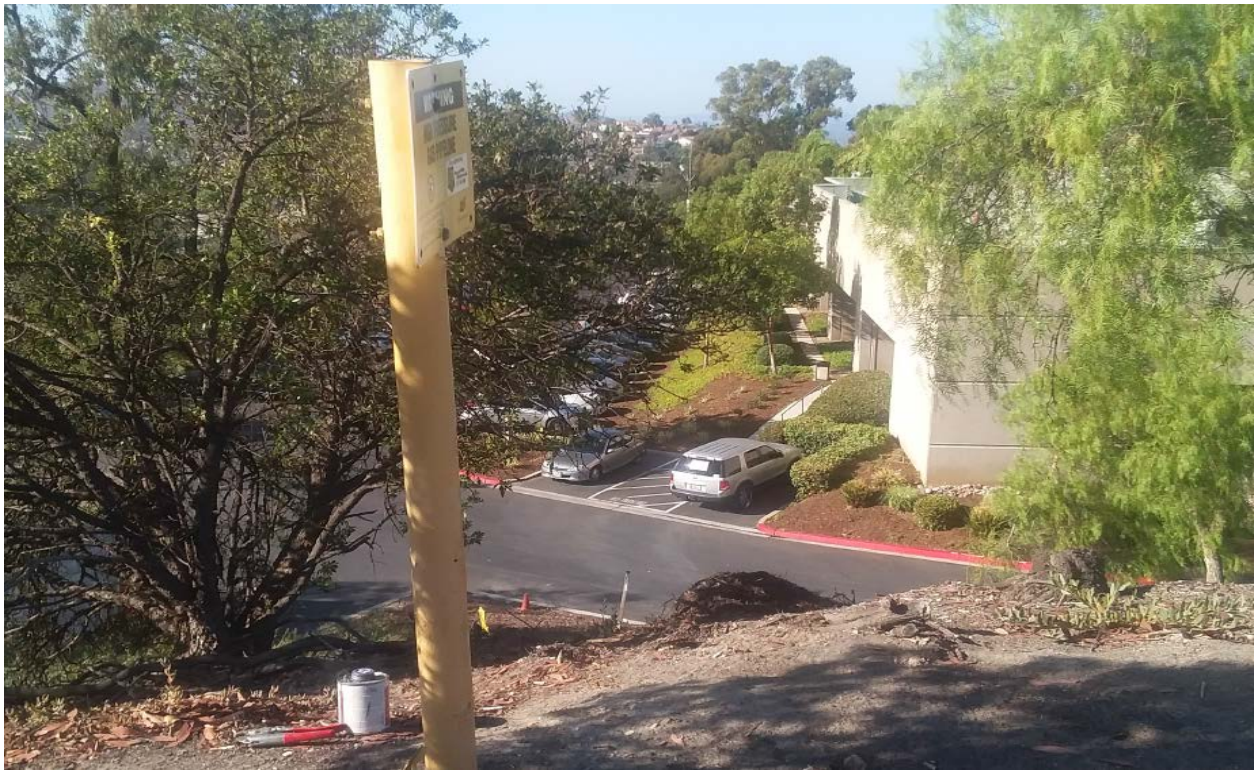


Figure 39

Near [redacted]

Figure 40

Near [redacted]

Figure 41

[redacted]

Figure 42

[redacted]

Figure 43

[redacted]

D. SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations

Table 15

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
CPUC General Order 112-F					
Subpart B-REPORTS	122	Gas Incident Reports		Meet	
Subpart B-REPORTS	123	Annual Reports		Meet	
Subpart B-REPORTS	124	Reporting Safety – Related Conditions		Meet	
Subpart B-REPORTS	125	Proposed Installation Report		Meet	
49 Code of Federal Regulations Part 191					
Reports	§191.5	Immediate notice of certain incidents		Meet	
Reports	§191.7	Report submission requirements		Meet	
Reports	§191.15	Transmission systems; gathering systems; and liquefied natural gas facilities: Incident report		Meet	
Reports	§191.17	Transmission systems; gathering systems; and liquefied natural gas facilities: Annual report		Meet	
Reports	§191.23	Reporting safety-related conditions		Meet	
Reports	§191.25	Filing safety- related condition reports		Meet	
49 Code of Federal Regulations Part 192					
Subpart A - GENERAL	192	General		Meet	
Subpart B – MATERIALS	§192.53	General		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart B – MATERIALS	§192.55	Steel pipe	Comply with American Petroleum Institute's (API) 5L "Specification for Line Pipe." The required minimum average absorbed energy for each full size specimens is 20 ft- lbs.	Exceed	SDG&E and SoCalGas will exceed API5L by requiring pipe impact toughness greater than 29 ft- lbs. for 16" diameter pipe and a more stringent chemical composition to comply with qualified welding procedures.
Subpart B – MATERIALS	§192.65	Transportation of pipe	Comply with API5L recommended practice RP5L1 and RP5LW	Exceed	SDG&E and SoCalGas also require compliance with API recommended practice RP5LT for Truck Transportation of Line Pipe
Subpart C –PIPE DESIGN	§192.103	General		Meet	
Subpart C –PIPE DESIGN	§192.105	Design formula for steel pipe		Meet	
Subpart C –PIPE DESIGN	§192.109	Nominal wall thickness (t) for steel pipe		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart C –PIPE DESIGN	§192.111	Design factor (F) for steel pipe	Classes 1, 2, 3 and 4 locations require 0.72, 0.6 0.5, 0.4 Design Factors, respectively.	Exceed	A 0.4 Design Factor, which is only required in Class 4 locations, will be used for all locations where new pipe is installed, resulting in significantly higher safety factors than required in Class 1,2, and 3 locations.
Subpart C –PIPE DESIGN	§192.115	Temperature De-rating Factor (T) for Design of Steel Pipe		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.143	General requirements		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.144	Qualifying metallic components		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.145	Valves		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.147	Flanges and flange accessories		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.150	Passage of internal inspection devices		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.153	Components fabricated by welding		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.155	Welded branch connections		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.159	Flexibility		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.161	Supports and anchors		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.163	Compressor stations: Design and construction		N/A	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.165	Compressor stations: Liquid removal		N/A	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.167	Compressor stations: Emergency shutdown		N/A	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.169	Compressor stations: Pressure limiting devices		N/A	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.171	Compressor stations: Additional safety equipment		N/A	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.173	Compressor stations: Ventilation		N/A	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.179	Transmission line valves	The required Spacing between Main Line Valves is 20 miles in Class 1, 15 miles for Class 2, and 8 miles for Class 3 locations. Each section of a transmission line must have a blow down valve with enough capacity to blow down a line as rapidly as practicable	Exceed	The pipeline is designed to have 5-mile Main Line Valve spacing between the city of Escondido and the southern terminus of line 1600, which is shorter valve spacing than is required by Code for most locations in this section.
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.183	Vaults: Structural design requirements		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.185	Vaults: Accessibility		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.187	Vaults: Sealing, venting, and ventilation		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.189	Vaults: Drainage and waterproofing		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.195	Protection against accidental over pressuring	Each pipeline that is connected to a gas source so that the maximum allowable operating pressure could be exceeded as the result of pressure control failure or of some other type of failure, must have pressure relieving or pressure limiting devices that meet the requirements of §§192.199 and 192.201	Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.199	Requirements for design of pressure relief and limiting devices		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.201	Required capacity of pressure relieving and limiting stations		Meet	
Subpart D - DESIGN OF PIPELINE COMPONENTS	§192.203	Instrument, control, and sampling pipe and components		Meet	
Subpart E – WELDING OF STEEL IN PIPELINES	§192.225	Welding procedures		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart E – WELDING OF STEEL IN PIPELINES	§192.227	Qualification of welders	API 1104, "Welding of Pipelines and Related Facilities"	Exceed	SDG&E and SoCalGas require welders to perform an additional overhead weld for qualification that is not required by API 1104.
Subpart E – WELDING OF STEEL IN PIPELINES	§192.229	Limitations on welders		Meet	
Subpart E – WELDING OF STEEL IN PIPELINES	§192.231	Protection from weather		Meet	
Subpart E – WELDING OF STEEL IN PIPELINES	§192.235	Preparation for welding	API 1104, "Welding of Pipelines and Related Facilities" allows misalignment of 1/8"	Exceed	SDG&E and SoCalGas require more precise alignment by limiting misalignment to 3/32".
Subpart E – WELDING OF STEEL IN PIPELINES	§192.241	Inspection and test of welds		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart E – WELDING OF STEEL IN PIPELINES	§192.243	Nondestructive testing	Code requires 10% and 15% of welds in Class 1 and 2 locations respectively, that are not in highway or railroad right-of-ways to be non-destructively tested.	Exceed	100% of welds in Class 1 and 2 locations not in highway or railroad rights-of-way will be non-destructively tested.
Subpart E – WELDING OF STEEL IN PIPELINES	§192.245	Repair or removal of defects	API 1104, "Welding of Pipelines and Related Facilities" allows repair of rejected first time repair	Exceed	SDG&E and SoCalGas do not allow subsequent repair of a rejected first-time repair.
Subpart G— GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.305	Inspection: General		Meet	
Subpart G— GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.307	Inspection of materials		Meet	
Subpart G— GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.309	Repair of steel pipe		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart G—GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.313	Bends and elbows		Meet	
Subpart G—GENERAL CONSTRUCTION	§192.317	Protection from hazards		Meet	
REQUIREMENTS FOR TRANSMISSION LINES AND MAINS					
Subpart G—GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.319	Installation of pipe in a ditch		Meet	
Subpart G—GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.323	Casing	Code does not require coating or cathodic protection of casing pipe.	Exceed	All casing pipe will be coated and cathodically protected regardless of outside agency requirements.
Subpart G—GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.325	Underground clearance		Meet	We typically exceed 12" clearance unless impracticable.
Subpart G—GENERAL CONSTRUCTION REQUIREMENTS FOR TRANSMISSION LINES AND MAINS	§192.327	Cover		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.453	General		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL FOR CORROSION CONTROL	§192.455	External corrosion control: Buried or submerged pipelines installed after July 31, 1971		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.459	External corrosion control: Examination of buried pipeline when exposed		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.461	External corrosion control: Protective coating		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.463	External corrosion control: Cathodic protection		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.465	External corrosion control: monitoring		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.467	External corrosion control: Electrical isolation		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.469	External corrosion control: Test stations		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.471	External corrosion control: Test leads		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.473	External corrosion control: Interference currents		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.475	Internal corrosion control: General requirements		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.476	Internal corrosion control: Design and construction of transmission line.		Meet	
Subpart I—REQUIREMENTS FOR CORROSION CONTROL	§192.479	Atmospheric corrosion control: General requirements		Meet	
Subpart J—TEST REQUIREMENTS	§192.503	General requirements		Meet	
Subpart J—TEST REQUIREMENTS	§192.505	Strength test requirements for steel pipeline to operate at a hoop stress of 30 percent or more of SMYS	Tests in Class 1 require a test to a pressure of 1.1 x Maximum Allowable Operating Pressure (MAOP); For Class 2 - 1.25 x MAOP; and Class 3 and 4 - 1.5x MAOP.	Exceed	Where possible the pipeline will be tested to 90% of its Yield Pressure (YP), including at least a 5% pressure spike. This will result in a test that is more than 2.5x MAOP, which exceeds the testing requirement for all locations.
Subpart J—TEST REQUIREMENTS	§192.515	Environmental protection and safety requirements		Meet	
Subpart J—TEST REQUIREMENTS	§192.517	Test Documentation		Meet	
Subpart L - OPERATIONS	§192.605	Procedural Manual for operations, maintenance, and emergencies		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart L - OPERATIONS	§192.613	Continuing surveillance		Meet	
Subpart L - OPERATIONS	§192.614	Damage prevention program	Each operator of a buried pipeline must carry out, in accordance with this section, a written program to prevent damage to that pipeline from excavation activities.	Exceed	Additional pipeline cover is provided to aid in damage prevention. See 192.327 for "cover" details and 192.705 additional monitoring. Warning Mesh will be installed above the pipeline to identify the pipeline below. Fiber optic cabling with real-time monitoring for ground movement and inferential leak detection will be installed along the pipeline route.
Subpart L - OPERATIONS	§192.615	Emergency plans		Meet	
Subpart L - OPERATIONS	§192.616	Public awareness		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart L - OPERATIONS	§192.619	Maximum allowable operating pressure (MAOP): Steel pipeline	The MAOP is the lowest of the following: 1. Design Pressure of the weakest component; or 2. Pressure obtained by dividing the test pressure by a factor based on Class Location.	Exceed	The pipeline will be operating at a lower pressure than the Code requires in Class 1, 2 and 3 locations due to designing the entire pipeline for a Class 4 location and testing to a higher pressure than required by Code (see sections 192.505 and 192.619).
Subpart L - OPERATIONS	§192.625	Odorization of gas	Odorizing is required for Class 3 and 4 locations.	Exceed	SDG&E and SoCalGas transmission pipelines are odorized regardless of location.
Subpart L - OPERATIONS	§192.629	Purging of pipelines		Meet	
Subpart M— MAINTENANCE	§192.705	Transmission lines: Patrolling	The requirement for the frequency of patrolling varies from 2 - 4 times per year depending on the location.	Exceed	Fiber-optic right-of-way continuous intrusion monitoring is planned to be installed on new pipeline sections where practical to provide early threat warning, consistent with the technology enhancements discussed in SDG&E and SoCalGas' PSEP.

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart M—MAINTENANCE	§192.706	Transmission lines: Leakage surveys	Leakage surveys must be conducted at intervals of 7.5 - 15 months depending on Class Location.	Exceed	Real-time above ground methane sensors will be installed on select sections of the pipeline identified by risk analysis consistent with the technology enhancements discussed in SDG&E and SoCalGas' PSEP for right-of-way leak monitoring. The fiber optic cable monitoring system referenced under 192.705 and 192.614 will also allow for pipeline leak detection in near-real time.
Subpart M—MAINTENANCE	§192.707	Line Markers		Exceed	In addition to the requirement to install above ground pipeline markers, SDG&E and SoCalGas will install Warning Mesh above the pipeline to indicate that there is a pipeline below the mesh.
Subpart M—MAINTENANCE	§192.731	Compressor stations: Inspection and testing of relief devices		N/A	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart M—MAINTENANCE	§192.735	Compressor Station Storage of Combustible materials		N/A	
Subpart M—MAINTENANCE	§192.736	Compressor Station: Gas Detection		N/A	
Subpart M—MAINTENANCE	§192.743	Pressure Limiting and regulating stations; Capacity of relief devices		Meet	
Subpart M—MAINTENANCE	§192.751	Compressor stations: Prevention of accidental ignition		N/A	
Subpart N—QUALIFICATION OF PIPELINE PERSONNEL	§192.801	Scope		Meet	
Subpart N—QUALIFICATION OF PIPELINE PERSONNEL	§192.803	Definitions		Meet	
Subpart N—QUALIFICATION OF PIPELINE PERSONNEL	§192.805	Qualification program		Meet	
Subpart N—QUALIFICATION OF PIPELINE PERSONNEL	§192.807	Recordkeeping		Meet	
Subpart N—QUALIFICATION OF PIPELINE PERSONNEL	§192.809	General		Meet	

SDG&E and SoCalGas Compliance with Applicable State and Federal Regulations					
Code	**Section**	**Title**	**Requirement**	**Meet or Exceed**	**If exceeding, how?**
Subpart O—GAS TRANSMISSION PIPELINE INTEGRITY MANAGEMENT	§192.939	What are the required reassessment intervals	Operators are required to only perform a lesser confirmatory reassessment every 7 years if a longer reassessment period has been obtained.	Exceed	SDG&E and SoCalGas will be performing full integrity reassessments of the pipeline with internal inspection devices called smart pigs at a maximum interval of 7 years.

E. Construction Contractor Assessments and Recommendations

[redacted]

August 1, 2018
Attention: [redacted]
San Diego Gas and Electric

Subject: L-1600 Constructability Review

[redacted]

Pursuant to your request, [redacted] has performed a constructability review of the sixteen inch gas pipeline through an existing right-of-way (ROW). The current ROW occurs at various locations between Rainbow and Mission Stations.

Based on our site observations along the L-1600 easement and based on our review of the documents prepared by SDG&E through various emails, we offer the following comments and opinions.

- The existing route consists primarily of the following site conditions:
  - Two lane rural roads
  - Two and four lane city streets
  - Several golf courses
  - Commercial areas including parking lots
  - Earth ROW
- For all pipe installation activities occurring in two lane roads and city streets [redacted] does not foresee any issues which could result in production inefficiencies beyond those typically observed (i.e. pedestrian and vehicle traffic). The installation process would be considered standard city street pipeline construction. In areas where traffic control is needed [redacted] assumes sufficient working room for all construction activities. As a result,

[redacted]

[redacted]

reasonable productions and costs are to be expected.

- Outside the standard two lane roads and city street work areas, the remaining ROW will occur within a 20' wide easement. Consisting primarily of earth landscape, the 20' easement occurs through rolling hills, some brush covered, with trees (which will be removed and/or trimmed), and some deep canyons. Other segments of the ROW are situated between houses in residential areas where landscapes and hardscapes will be affected. Additionally, segments within the ROW are in commercial areas near buildings and in paved parking lots. The ROW also lays in a mobile home park and crosses several golf courses. While reviewing these differing site conditions, many problems/inefficiencies became apparent as described below.
    - In all likelihood, the existing 1949 sixteen inch pipeline is at an insufficient depth for large equipment to operate. Will require mats or additional cover for construction of a parallel pipeline. From our experience, there is an inherent risk associated with excavating next to and under the in service 69 year old, 16" gas line.
    - The 20' wide easement does not provide a sufficient work space area to install a 16" pipeline. Industry standard is 40 to 60 feet.
    - In our experience, installing a second pipeline in this type of ROW adds an additional 30-50% to installation costs.
    - Due to 20' wide ROW, all excavated material will need to be hauled off the work area in order to facilitate pipe stringing, bending, and laying.

[redacted]

- Increased risk of fire hazard while grinding/welding on current ROW.
- Environmental issues through the entire ROW, especially in the deep ravines during the wet seasons.
- Construction through deep ravines would be extremely difficult without additional work space.
- The 20' wide ROW and the limited access creates what is referred to as the "tunnel effect". The tunnel effect occurs when equipment, such as dump trucks, are required to enter and exit the ROW from the same point of access. For instance, during excavation activities, dump trucks will be required to enter the ROW in front of the excavation crew. Once the truck has been fully loaded with soils, it must exit the ROW from the same path it used to enter the section. Similar pathing is required for slurry and/or dump trucks during shade and backfill operations from one access point behind the backfill crew. All other activities are stuck in the middle.
- In some cases, due to site conditions or conflict with existing 16" pipeline, dump trucks are unable to park adjacent to the excavator while occupying the same ROW. As a result, the dump trucks will be required to park behind the excavator, requiring a one joint at a time type construction, which yields low production.
- While in the mobile home Park, difficulties arise due to the narrow streets and close proximity of homes adjacent to the ROW. With the existing 16" line, as well as other utilities in the narrow streets, low production installation should be

[redacted]

expected.

- The golf courses present the same limited access and narrow ROW problems as previously described. Installation will also interrupt play in addition to the difficulties/expenses associated with restoration of sod, sprinklers and electrical.
- In some residential areas the ROW runs between homes and/or accesses private property, in which case, landscape and/or hardscape will be affected. During the restoration process, issues may arise while trying to match or replace existing landscape/hardscape. There will, without doubt, be many disgruntled property owners if current route is selected.
- In the areas where the ROW traverses commercial parking lots, limited accessibility and reduced parking availability will be factors to consider during construction. Commercial parking lot paving is not typically constructed to support heavy trucks and equipment. Therefore, replacement could be extensive, well outside the limits of the trench and bell-holes.

In conclusion, it is our opinion that the new 16" pipeline should not be installed in the existing easement, except for areas which include paved roads & streets routes, as shown to [redacted]on the July 26, 2018.

[redacted]

[redacted]

Thank you for the opportunity to present this constructability review letter. If you have any questions, or require additional information, please do not hesitate to contact me at [redacted]

Regards,

[redacted]

[redacted]

[redacted]

August 7, 2018

SUBJECT: Line 1600 Route Recommendation

[redacted]ecently drove the Right of Way (ROW) for the proposed relocation of SDG&E's Line 1600 with representatives from the Public Utilities Commission (PUC) and SDG&E. We were asked to provide our opinion with regards to the feasibility of replacing the line within the existing ROW and potential alternatives. Below is a constructability comparison with regards both options.

Current ROW:

- The existing ROW is 20' wide and travels through steep and rocky mountainous terrain and close proximity to several residents (through yards and driveways).
- The ROW will need to be cleared and all work will need to be contained within the 20' area.
- There will be limited access to the ROW (one way in, one way out). This will limit production due to the accessibility of dump trucks and methods of excavation. It will also limit pipe and materials are brought to the ROW. Production will be held to 40-80 feet per day.
- The existing pipeline alignment will have constant heavy equipment traveling over it at any given time exposing it to risk for potential integrity issues.
- This pipeline was installed in the 1940's. Over time many oak trees have populated the area of the ROW. Our experience has been that we cannot dig within the "drip line" of the oak trees. This creates the need to find alternative installation methods such as boring to avoid environmental concerns.
- Following the installation in the ROW it has been our experience that hydro-seed is required per SWPPP measures. This also requires silt fence installation and water maintenance for several months beyond the project's completion.

Alternative Alignment:

- Installation in paved roads would greatly improve the installation environment for this project.
- Production rates would be as much as three to four times the rate than within the existing ROW
    - With the exception of Rice Canyon which would be approximately 60-80 feet per day production
        - Hwy 395 would be an additional route that would have higher production rates
    - There is plenty of access to the site due to the proximity of major highways
- There will be less direct impact to the public because we would be within the roadways and not near homes
- Environmental issues are limited (i.e. nesting birds and other inhabitants found in rural areas)
- The overall project duration would be greatly decreased

Our recommendation is that an alternative route be chosen. By installing this pipeline within the roadway we lessen the public and environmental impact along with the overall cost of the project. Please feel free to contact me if you have further questions.

Thank you,

[redacted]