Application: A.22-09-006
Witness: B. Waymire
Chapter: 2

PREPARED DIRECT TESTIMONY OF

BLAINE WAYMIRE

ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

(SOCALGAS'S HYDROGEN BLENDING DEMONSTRATION - OPEN SYSTEM PROJECT)

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

March 1, 2024

TABLE OF CONTENTS

CHAPTER 2

PREPARED DIRECT TESTIMONY OF BLAINE WAYMIRE

(SOCALGAS'S HYDROGEN BLENDING DEMONSTRATION - OPEN SYSTEM PROJECT)

I. PURPOSE

The purpose of this prepared direct testimony on behalf of Southern California Gas Company (SoCalGas) is to provide the technical objectives, need, project implementation detail, and costs for a second proposed SoCalGas hydrogen blending demonstration project, which will be held in an open portion of the natural gas distribution system (Open System Project). This testimony will focus on a description of the Open System Project and how it will help inform a future hydrogen injection standard and support SoCalGas's, San Diego Gas & Electric Company's (SDG&E), Pacific Gas and Electric Corporation's (PG&E), and Southwest Gas Corporation's (Southwest Gas) (collectively, the Applicants) focus on safety, system integrity, and reliability, as well as adhering to the project requirements set out by California Public Utilities Commission (Commission) Decision (D.) D.22-12-057 and guidance under D.21-07-005. This testimony will address the Open System Project's purpose, how the live blending data collected will provide key technical, operational, and safety information to support a future hydrogen injection standard, how SoCalGas will collaborate with the City of Orange Cove, California, the other investor-owned utilities (IOUs), and other relevant stakeholders to integrate data collected from the demonstration projects and prevent duplicative efforts, and provide project cost estimates.

The purpose of this Open System Project is to demonstrate operational, live blending and collect system performance data for blending from 0.1% to 5% hydrogen gas by volume[1] in an open portion of a medium pressure[2] plastic and steel distribution pipeline system. Project data will inform the feasibility of developing a hydrogen injection standard for distribution systems that serve existing natural gas-powered appliances found in residential and commercial facilities.[3]

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[1] In this testimony, all blend percentages mentioned are by volume.

[2] Medium pressure is defined as 60 pounds per square inch gauge or lower.

[3] The City of Orange Cove makes up approximately 2,000 residential meters and approximately 100 commercial meters on SoCalGas's system.

Testing on an open portion of a distribution system in SoCalGas's territory is necessary because it will emulate behavior of what occurs when hydrogen is blended into a broader pipeline distribution network and served to a vast number of customers. This is important because it will give a closer snapshot of what hydrogen blending across the larger distribution system might look like and provide meaningful data on widespread hydrogen blending. Additionally, the City of Orange Cove hosts various mixed material gas pipeline and vintages with steel, polyethylene (PE), and Aldyl-A pipeline materials. The Open System Project will showcase blending in various pipeline materials at lower concentrations of hydrogen and complements the projects proposed by SDG&E and Southwest Gas, which occur in an isolated portion of the distribution system, and by PG&E, which occurs in an isolated transmission test loop.[4] Demonstrating behavior of hydrogen blends in live operation across an open branch of the greater distribution system provides a unique opportunity to prove the use case of hydrogen blending at a greater scale.

SoCalGas is pleased to work with the City of Orange Cove, an agriculture community located along the eastern foothills of the Sierra Nevada Mountains and home to approximately 10,000 residents and various local businesses.[5] The City of Orange Cove's Mayor Pro Tem expressed excitement for the potential of a hydrogen blending demonstration project in his city, stating, "I'm excited about that; that they want to do something here in our city."[6] The city enjoys a year around growing season for hundreds of acres of orange and lemon citrus fruit, with major packing house operations surrounding the community.[7] In addition to the strong collaboration with the City of Orange Cove, the community was identified as an ideal candidate to receive the hydrogen blend from a technical feasibility standpoint due to the variety of pipeline materials it contains as indicated above. The community also has one natural gas feed coming into it, which would allow for ample control of the hydrogen blend that it receives because there will be only one point of interconnection to the pipeline system.

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4 *See* Direct Testimonies of Pooyan Kabir (Chapter 3), Kevin Lang (Chapter 4), and Danielle Mark (Chapter 5).

5 City of Orange Cove, *About Orange Cove, available at*: https://cityoforangecove.com/about-orange-cove/.

6 Mid Vally Times, *SoCalGas presents hydrogen blending to Orange Cove* (November 13, 2023), *available at*: https://midvalleytimes.com/article/news/2023/11/13/socalgas-presents-hydrogen-blending-to-orange-cove/.

7 *Id*.

The Open System Project will provide validation on a local system of a strong base of previous analysis, testing, and field demonstrations including comparable field testing performed by ATCO for their hydrogen blending demonstration in Fort Saskatchewan, Canada.[8] The Open System Project will blend into an entire community just downstream of a SoCalGas regulator station so that the entire area served by a regulator station receives the hydrogen and natural gas blend in order to simulate blending into an "open portion" of the distribution system. The project will begin with an initial hydrogen blend level of 0.10% and gradually ramp up to 5% based on safety and technical feasibility validated with testing throughout the project duration. This demonstration will provide valuable operational data that will support the development of a hydrogen injection standard for gas distribution systems. Meanwhile, the projects hosted by SDG&E, Southwest Gas, and PG&E will aim to inform and support the development of a hydrogen injection standard for higher blends of hydrogen in distribution and transmission systems.

II. PROJECT DESCRIPTION

In this section, SoCalGas outlines the details of the proposed Open System Project focused on blending hydrogen into an open portion of a mixed material natural gas distribution system. To demonstrate blending into an open system, or an open portion of the distribution system, blending will occur just downstream of a regulator station that feeds an entire community.

SoCalGas intends to blend from 0.1% to 5% hydrogen by volume into the City of Orange Cove's gas infrastructure. The project will demonstrate hydrogen blending under live operational conditions in plastic and steel pipeline infrastructure across an open portion of the distribution system, and also provide useful data on impacts to end use equipment in various customer types.

The pipeline system supplying the City of Orange Cove will be unaltered, with the exception of a new pipeline that will be installed directly downstream of the regulator station. This pipeline will divert the gas coming out of the regulator station to the blending skid, where it will be blended with hydrogen to the designated blend percentage and reintroduced into the associated pipeline system. The hydrogen blend will be used for residential natural gas

[8] ATCO, *Fort Saskatchewan Hydrogen Blending Project, available at:* https://gas.atco.com/en-ca/community/projects/fort-saskatchewan-hydrogen-blending-project.html.

equipment in homes across the City of Orange Cove and commercial gas equipment in the businesses of the City of Orange Cove. Equipment examples consist of, but are not limited to, water heaters, furnaces, common cooking appliances, and commercial space and water heating. To blend up to 5% hydrogen by volume to the entire community, SoCalGas utilized historical consumption of natural gas for the community based on the years 2021-2023 to size equipment capable of meeting the demand for the designated hydrogen blend. The Open System Project is proposed to be implemented over 18 months during which SoCalGas to collect data and evaluate for seasonal demand conditions. The hydrogen blend volume will be gradually increased over the course of the demonstration through frequent testing of gas quality, leakage, end-use equipment, pipelines, and pipeline components.

The Open System Project will be divided into four chronological phases with defined budgets for each phase. The Phases are briefly summarized in Table 1 and defined in detail in subsequent testimony.

Table 1: Summary of the Open System Project Phases

Phase & Activity	Description	Estimated Duration
0. Pre-development	All efforts supporting this Amended Application submittal are considered "Pre-development." Upon Commission approval, the project will move on to subsequent phases	Pre-application submittal
1. Design, Construction, and Commissioning	Hydrogen production and blending equipment is designed; detailed safety and feasibility analyses are performed. Stakeholder engagement will be conducted throughout the project's lifespan. Following design and feasibility, equipment is procured, constructed, and commissioned; pre-demo equipment and pipeline system inspections and any necessary remediation are conducted	18 months
2. Demonstration and Data Collection	Hydrogen is blended in system on a data analysis schedule; data is collected; periodic inspection of equipment and pipelines; test pipelines and components pre-, during, and post-hydrogen blend exposure	24 months (18 months live blending and 6 months asset inspection and validation)
3. Decommissioning, Equipment Removal, and System Restoration	Potential removal of hydrogen equipment	6 months

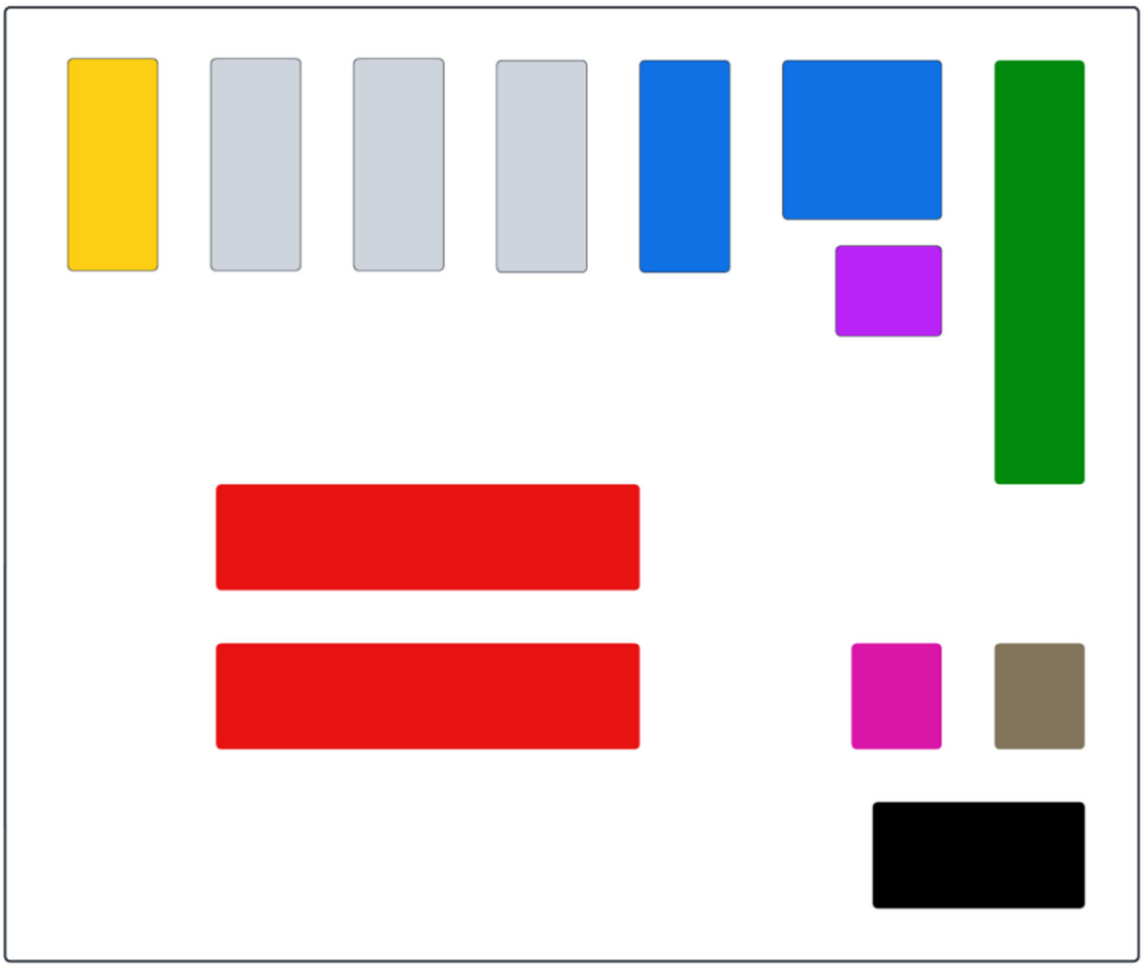
Phase & Activity	Description	Estimated Duration
4. Data Analysis and Dissemination	Data from pilot is analyzed and a public report will be released	9 months

Figures 1 to 3 show the potential project site layout, plot plan in the City of Orange Cove, and the pipeline schematic to introduce the hydrogen blends. The proposed site is at the southwest corner of Jacobs Avenue and South Avenue, situated diagonally across the intersection from SoCalGas's regulator station. The project site and layouts shown in Figures 1 to 3 provide the technical, spatial, and construction feasibility in order to serve blends to the community served by SoCalGas's regulator station.

Figure 1: Proposed Site Layout

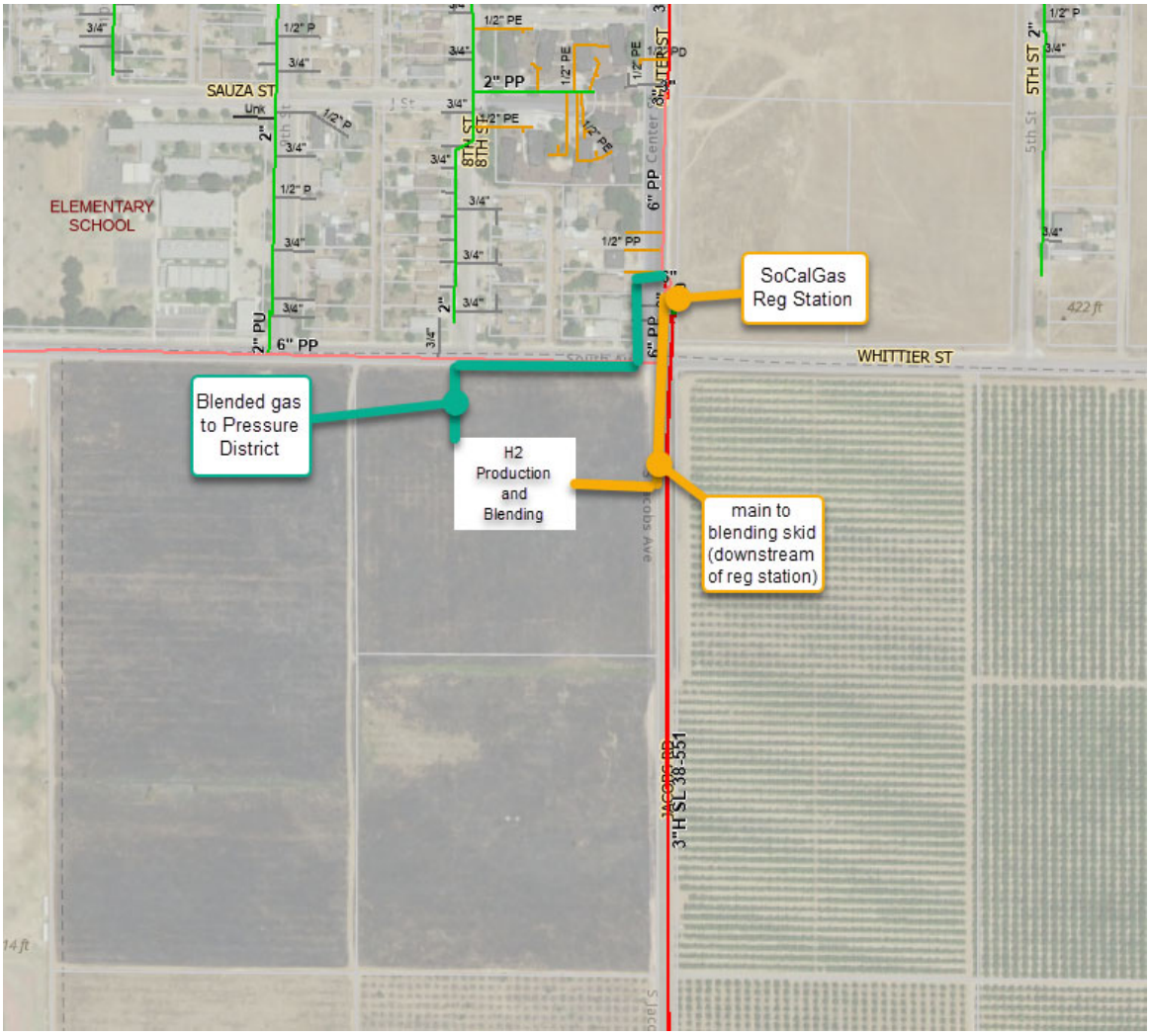
The equipment layout and separation distances are planned to occupy an area of 107 feet by 90 feet. This area may decrease as the design specifications mature. The figure illustrates the proposed site layout with the safe distances, as well as equipment sizes. The proposed site would be 100 feet from intersection and 50 feet from the road on each side. The grey shading in Figure 2 represents a proposed solar array on the plot.

Figure 2: Preliminary Project Plot Plan



Equipment Type	Color
Water Storage and Purification Systems	Blue
Electrolyzer	Green
SCADA Building	Yellow
Bulk Hydrogen Storage	Red
Hydrogen Compressor	Pink
Chiller Unit	Purple
Gas Composition Analyzer	Brown
Blending Skid	Black
Battery Energy Storage	Grey

Figure 3: Routing of Pipelines



The proposed Open System Project aligns with recommendations from the University of California, Riverside's (UC Riverside) Hydrogen Blending Impacts Study (UC Riverside Study),[9] the requirements set out in D.22-12-057, and guidance in D.21-07-005. One of the key directives from D.22-12-057 is that the proposed project should evaluate "… hydrogen injection at blends between 0.1% and 5%."[10] The Commission's Energy Division later clarified that the lower-level blends should be performed in an open portion of the distribution system.[11] The project will follow the Commission's recommendation and collect operational data on an open

[9] UC Riverside, *Hydrogen Blending Impacts Study* (July 2022); *available at* https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

[10] D.22-12-057 at 69 (OP 7.d).

[11] In a virtual meeting held in January 2023, the Commission's Energy Division clarified its expectation that lower blend percentages would be evaluated in an open portion of the distribution system.

pipeline system that feeds residential and light commercial gas equipment typically found in California.

A. Phase 0: Pre-Development

All efforts supporting this Amended Application filing are considered "Pre-development." Upon Commission approval, the Open System Project will proceed to subsequent phases.

To develop this Amended Application, SoCalGas collaborated with personnel from the City of Orange Cove to identify a preferred preliminary site and scope. The proposed site selection was made with input from city personnel and considered the following factors:

- Pipe properties and operational history
- Proximity to SoCalGas regulator station
- End-users and equipment
- Constructability (adequate space)
- Safety
- Summer load and yearly load (sufficient flow to blend)
- Time to survey pipeline system and load (pre-, during, and post-demonstration)
- City personnel support

B. Phase 1: Design, Construction, and Commissioning

Detailed engineering design and an independent safety review will be undertaken to verify the feasibility of the proposed scope and location. The preliminary project design will be finalized with a third-party expert as required. This third-party expert will be involved in every step of the process to provide input on testing protocols and project design.

During the construction period, the site will be prepared and equipment installed. Construction will be coordinated with city personnel. The Open System Project will include the following major equipment:

- **Electrolyzer**: Hydrogen used in this demonstration will be produced onsite via a dedicated electrolyzer. The electrolyzer will produce hydrogen using water and electricity and will be sized to blend up to 5% hydrogen into the city of Orange Cove based on historical usage for the community. The electrolyzer will use electricity from installed solar and locally sourced water to create and store

hydrogen onsite. Wherever possible, the water used will come from a non-potable water source so that there is minimal impact to water use from the electrolyzer.

- **Hydrogen Blending Skid**: A blending skid will be required to inject hydrogen into the pipeline system. SoCalGas will collaborate with a blending skid vendor to design a blending skid suitable for the project. Commissioning blending skids for the demonstration projects will be key to learn about sizing and operation of these units that will likely be utilized for injection throughout the California system when a final hydrogen injection standard is established.
- **Hydrogen Storage Vessel**: A hydrogen pressure vessel will be installed to meet sufficient hydrogen supply so that hydrogen blending levels are consistent and allow for efficient operation of the electrolyzer equipment.
- **Solar Array**: Approximately 6.5 acres of solar array will be installed over the majority of the plot provided where the equipment is sited to produce the electricity required for operation of the electrolyzer and associated equipment needed for hydrogen production. Six-and-a-half (6.5) acres translates to approximately 1.1 MW of power, which will be coupled with onsite energy storage to create a microgrid.[12] The microgrid will serve as the primary power source for the hydrogen production and blending equipment and can provide approximately 5 days of independent power operation, dependent on solar operating conditions. The solar array is sized to operate the full facility with supplemental power from the electric grid.
- **Battery Storage:** Approximately 9 MWh of battery energy storage will be installed to supplement the solar energy for the hydrogen production and auxiliary equipment. The battery storage can provide approximately 1.5 days of energy

[12] Calculations performed using NREL's Land Use Requirements for Solar Plants in the United States. Ong, S., Campbell, C., Denholm, P., Margolis, R., and Heath, Gavin, *Land-Use Requirements for Solar Powered Plants in the United States* (June 2013), *available at*: https://www.nrel.gov/docs/fy13osti/56290.pdf.

supply, in the event the solar is completely unavailable and the local electric utility is unable to supply back up power.

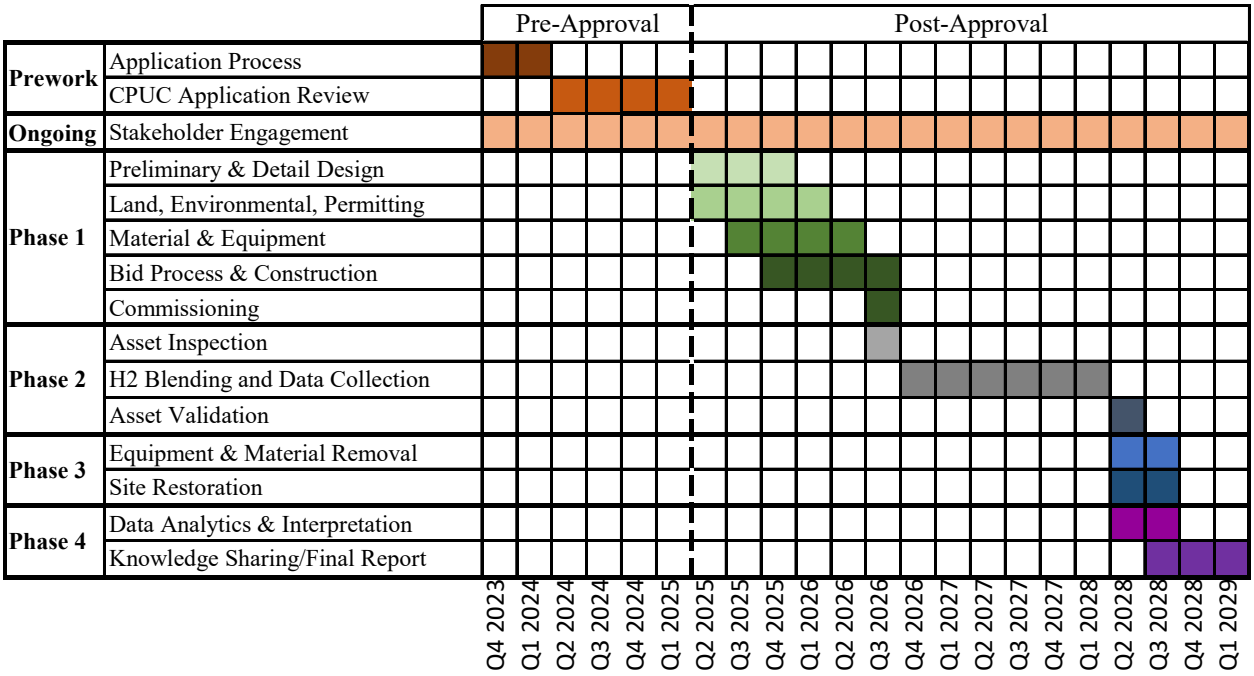
- **Water Storage and Cleanup:** Water will be sourced from sustainable sources whenever possible, and stored onsite using water storage and purification systems so that there is sufficient water available for hydrogen production.

Additional equipment and instrumentation that will be utilized are Supervisory Control and Data Acquisition (SCADA) RTU, chiller, compressor, de-ionizer (DI), gas analyzers, gas detectors, fire detectors, pressure transmitters, and temperature transmitters. A minimal amount of additional plastic pipe will be installed to route the gas downstream of the regulator station to the blending skid and back to the injection point across the intersection as shown in Figure 3 above.

1. Project Schedule

Table 2 provides an estimated project timeline; however actual timeline and schedule will vary depending on the regulatory process approval. Additionally, lead time for materials and other items may have unforeseeable impacts to project schedule.

Table 2: Estimated Project Schedule



C. Phase 2: Testing and Demonstration

1. Asset Inspection

Prior to the introduction of hydrogen, SoCalGas will conduct an asset review and inspection, and will baseline the demonstration area with regular natural gas. All customer appliances involved in the demonstration in the City of Orange Cove will be offered courtesy inspections to confirm the appliances are in safe working order. Leak surveys will also be performed throughout the community prior to the demonstration to confirm the system is leak tight. Any material repair or replacement needed on SoCalGas's distribution system will be completed prior to injecting hydrogen. Leak surveys will be conducted periodically throughout the demonstration as outlined in Section II.C.2 below.

2. Live Hydrogen Blending and Data Collection

The Open System Project will follow the American Petroleum Institute's Recommended Practice 1173 (API RP 1173) Pipeline Safety Management System (PSMS) Plan-Do-Check-Act approach and (1) translate laboratory research and literature review into actual system operations and cover as many aspects of the technical considerations as possible, (2) confirm understanding of material response, end-use/appliance response, load balancing and blend consistency, and (3) establish protocol for leak detection of the new gas composition (should it occur).[13] The selected project site will allow for these objectives to be achieved physically and operationally. More detail on the PSMS model can be found in the Project Guidance Section (Section III.A) below.

Operational needs include training, additional leak surveying, gas handling, customer service, routine service operations and customer interactions, and emergency response plans. Monitoring during demonstrations will include both system monitoring as well as collecting feedback from customers.

The PSMS "Check: Analysis of Data" step will analyze quantitative and qualitative data and will include an analysis of knowledge gained from any operational changes. Such analysis will inform SoCalGas's recommendations for a statewide hydrogen injection standard. Many of the items below have been assessed through literature review, laboratory testing, and/or vendor

[13] API, *Pipeline Safety Management Systems* (July 2015), *available at*: https://flipflashpages.uniflip.com/3/94156/1106646/pub/html5.html.

surveying. The project will allow for operational review and confirmation of the following within the limitations of the proposed project site:

- Odorant compatibility
- Leak detection equipment compatibility
- Material compatibility
- Component (*e.g.*, fittings, valves) compatibility
- Blend consistency (hydrogen blending injection skid)
- End-use customer appliance compatibility
- Review of Gas Standards for the construction, maintenance and operations of hydrogen blended natural gas system
- Effects on metering
- Impact on emissions of end-use equipment

Table 3 provides an overview of the type of data that SoCalGas will collect with the project. Each data element serves to validate past hydrogen blending research. Data will be collected prior to, during, and after the project. The data will be analyzed to provide insights to confirm hydrogen blending compatibility of the gas system and end-use equipment. More detailed information on SoCalGas's preliminary data collection plan can be found in Exhibit 2A: Preliminary Data Collection Plan.

Table 3: Preliminary Data Collection Plan

Area	Objective	Frequency	Pre-Demo	During Demo	Post-Demo
Odorant sampling	Confirm hydrogen does not affect efficacy of current natural gas odorant	Monthly	✓	✓	
Leak surveys	Safety checks; repair any leaks prior to starting demo; determine if hydrogen blends affect leakage from fittings, valves, etc.	Quarterly; And as needed for customer service calls	✓	✓	✓

Area	Objective	Frequency	Pre-Demo	During Demo	Post-Demo
Leak survey equipment	Evaluate performance of new leak survey equipment	Quarterly; And as needed for customer service calls		✓	
Heating value measurement	Monitor and Analyze changes to heating value of gas supplied	Monthly	✓	✓	
Customer meters	Analyze and validate select meter performance	Quarterly		✓	✓
Customer equipment evaluation	Confirm equipment is working properly; validate gas interchangeability	As needed for customer service calls	✓	✓	✓
Customer equipment checks for emissions, including NOx	Perform measurement on emissions from various end-uses in community	To be determined based on comprehensive customer survey	✓	✓	

Table 4 below summarizes the incremental hydrogen blending level schedule. Please note that the actual blend percentage will depend on available hydrogen production and usage demand. This blending schedule aligns with recommendations from UC Riverside Study. Per the study, "[I]t is critical to conduct real world demonstration of hydrogen blending under safe and controlled conditions; and…[a] three year timeline is proposed to complete these activities and the adopt a hydrogen blending standard."[14] Prior to introduction of hydrogen, the demonstration area will be baselined with regular natural gas. Data collection will start with a target blend level of 0.1% and gradually go up to 5%. Six months of data will be collected up to 3% and 12 months of data will be collected for the blends from 4-5%.

[14] UCR, *Hydrogen Blending Impacts Study* (July 2022) at 4; *available at* https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

Table 4: Estimated Blending Intervals by Increments

% Blending Level	Timeframe
Baselining at 0%	3 months prior to demo
Up to 1%	Months 1 to 3
Up to 3%	Months 4 to 6
Up to 4%	Months 7 to 12
Up to 5%	Months 13 to 18

3. Billing Impacts

Since the introduction of hydrogen will have the potential to change the heating value of the gas supplied to the City of Orange Cove, SoCalGas plans to apply retroactive volumetric adjustments to applicable customer bills to accurately charge residents and businesses based on therm usage. SoCalGas intends to address this directly with residents during project implementation.

4. Asset Validation

At the end of the data collection period and hydrogen blending has concluded, leak surveys will be performed to verify no additional leaks have developed. SoCalGas will also confirm with city personnel that there have been no reports of equipment malfunction. SoCalGas and the other IOUs will then work with an independent third-party to gather data collected and disseminate results accordingly.

D. Phase 3: Decommissioning, Equipment Removal, and System Restoration

At the end of Phase 2, and with input from the Commission and the City of Orange Cove, SoCalGas will evaluate whether decommissioning of the equipment is appropriate or if the system should remain in place. After completion of the demonstration, the equipment could be utilized as an injection point for clean renewable hydrogen into the distribution system. Because the project will be designed to produce hydrogen via a microgrid and inject into a portion of the distribution system, the grounds for a hydrogen injection point into the localized gas distribution system are already established and set up. That way, if a hydrogen injection standard is established, there will already be infrastructure in place to begin injecting hydrogen, and a source for producing clean renewable hydrogen. The project is designed with an automatic bypass, so

while the hydrogen injection standard is still being determined, the hydrogen blending system can be bypassed and continue to supply natural gas to the community.

In the event that decommissioning shall occur, SoCalGas can remove the hydrogen blending and production equipment and donate the solar array and associated battery energy storage equipment to the city for its own use to provide community benefits as well as save decommissioning costs to ratepayers. SoCalGas would restore the site where the hydrogen equipment was temporarily located as per terms and conditions to be developed with the City of Orange Cove.

Lastly, if none of the assets shall remain in place, SoCalGas can decommission the entirety of the site that was installed during Phase 1 and restore the area to its pre-demonstration condition. Phase 3 cost estimates reflect this conservative scenario in which full decommissioning might occur.

E. Phase 4: Data Analysis and Dissemination

After the demonstration's completion, all of the data collected will be analyzed to guide any operations and maintenance updates needed for hydrogen blending and to support a future hydrogen injection standard in the California gas system. Additionally, any impacts observed will be documented via data collection protocols proposed above and in Exhibit 2A. The Applicants will work accordingly with any selected independent research organizations to provide necessary data and coordinate results that can published for independent evaluation. A report will be published and made available to the general public. A public workshop will be held to share the project's findings.

III. PROJECT GUIDANCE

A. API RP 1173 Pipeline Safety Management System

Safety is at the core of this Amended Application, of paramount importance at SoCalGas, and at the forefront of the Open System Project. The Open System Project utilizes the API RP 1173 PSMS Plan-Do-Check-Act model[15] and is currently in the "Plan" stage. SoCalGas will move into the "Do" stage by initiating the controlled blending demonstration that has been informed by the "Plan" stage. In advance of this Amended Application filing, SoCalGas has

[15] API, *Pipeline Safety Management Systems* (July 2015), *available at:* https://flipflashpages.uniflip.com/3/94156/1106646/pub/html5.html.

continually engaged various stakeholders to garner feedback on the technical details of the proposed demonstration. This way, stakeholder feedback can be accurately incorporated into any operational, safety, or data collection plans. Leading up to and during the "Do" stage, SoCalGas will be establishing operational controls, training to operate with hydrogen blends, documenting and recording data from the demonstration, and continuing to engage with stakeholders, including the communities and end-users. Following this stage, the project leads into the "Check" stage where SoCalGas will learn from the data collected, including utilizing the data for an integrity/risk management analysis. Finally, during the "Act" stage, SoCalGas will be reviewing and updating a potential hydrogen injection standard to allow for blended hydrogen in the distribution system more broadly. SoCalGas will translate the knowledge gained from the project to safety policies and mitigations for the rest of our natural gas distribution system and customer installed equipment. The Plan-Do-Check-Act model is a continuous loop and SoCalGas intends to expand risk modeling, revise standards, policies, and procedures to safely blend hydrogen, and consider future larger scale demonstrations.

B. Overarching Safety Case

Throughout the course of this demonstration, SoCalGas will implement safety protocols in accordance with existing safety codes and standards. SoCalGas's safety efforts to be taken before, during, and after the Open System Project include, but are not limited to:

- Hydrogen safety education for personnel
- Safety assessment for hydrogen storage and hydrogen components
- Offer surveys of end-use customer equipment to confirm behind-the-meter equipment present is free of leakage and is operational
- Conduct pre-, during, and post-implementation leak surveys
- Mitigation measures to prevent hydrogen or hydrogen blends from reaching natural gas storage areas and electrical switching equipment
- Create hydrogen blending specific customer protocols and emergency response plans
- Continuous remote monitoring of hydrogen production, storage, and blending areas

- Automatic and remote shutdown capabilities for the hydrogen production and blending facility in the case an alarm is triggered or a leak is detected
- Offer gas system operational tests and equipment tests (*e.g.*, customer appliance leak, customer appliance flame-out, or pilot light failure), and other operational activities that occur in a natural gas distribution system
- Test existing and new leak survey equipment

C. ATCO's Fort Saskatchewan Hydrogen Blending Project

A separate hydrogen blending demonstration currently underway is ATCO's Fort Saskatchewan Hydrogen Blending Project (ATCO Project) in Fort Saskatchewan, Canada, which is currently demonstrating successful blending up to 5% hydrogen by volume into a subsection of the Fort Saskatchewan natural gas distribution system.[16] According to the ATCO Project website, "About 2,100 customers became the first in the province to use hydrogen-blended natural gas to safely and reliably fuel their homes and businesses."[17] ATCO plans to increase the hydrogen blend in the natural gas system from 5% to 20% to some customers in the project zone in the near future, however, timing for the increased blend is uncertain at this time. As noted by ATCO, this increase will remain safe and reliable.[18]

Building on the success of the ATCO Project and the knowledge gained, SoCalGas proposes to conduct a similar demonstration where hydrogen blends are introduced into a larger subsection of the distribution system. It is important to emphasize that although SoCalGas and other stakeholders can learn from the ATCO Project, there is still a need to conduct a California-specific hydrogen blending demonstration due to potential different designs in pipeline systems and end-use equipment. The operational data that will be collected and analyzed for the gas system and end-use equipment will validate past hydrogen blending research and facilitate future hydrogen blending in the wider gas distribution system in California.

D. Stakeholder Engagement Plan

SoCalGas recognizes that education, outreach, and engagement are important components of the Open System Project, as a broad range of stakeholder groups will be touched

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[16] ATCO, *Fort Saskatchewan Hydrogen Blending Project, available at:* https://gas.atco.com/en-ca/community/projects/fort-saskatchewan-hydrogen-blending-project.html.

[17] *Id*.

[18] *Id*.

by the proposed hydrogen blending demonstration project. Additionally, in accordance with D.22-12-057, Applicants are required to take into consideration the parties' comments and stakeholder input regarding the project.[19]

As such, SoCalGas has worked closely with the City of Orange Cove and various other parties to discuss hydrogen blending and the proposed projects. In order to meet the requirements in D.22-12-057, Ordering Paragraph (OP) 7(h), on June 13, 2023, Applicants hosted a public stakeholder workshop to solicit feedback from interested parties. Applicants collectively followed up with any outstanding questions that were not addressed during the workshop so that all feedback was taken into account. To solicit best practices from industry experts and technical stakeholders, on November 6, 2023, Applicants held a technical focused workshop to solicit feedback on their proposed data collection and test plans. Follow-up questions submitted by stakeholders were addressed by the Applicants in a timely manner. Through these various engagement techniques, SoCalGas was able to gather information and inform additional details about the project implementation.

SoCalGas has been specifically proactive in its stakeholder engagement throughout the Orange Cove community. Below is a list of additional activities that SoCalGas has taken to engage stakeholders and solicit feedback:

- Facilitated tours with community leaders, including city officials, first responders and business organizations of SoCalGas's H2 Innovation Experience, providing a real-world example of an existing hydrogen blending facility. The tours enabled SoCalGas to further solicit feedback on the proposed project.
- Completed project briefings with elected officials and presented to the Orange Cove City Council.
- Hosted a community engagement meeting in Spanish and English to provide residents with information about the proposed project, solicit feedback from the community, and share valuable information about the bill-assistance programs available to them.[20]

[19] D.22-12-057 at 69 (OP 7.h).

[20] Mid Valley Times, *SoCalGas presents hydrogen blending to Orange Cove* (November 13, 2023), *available at*: https://midvalleytimes.com/article/news/2023/11/13/socalgas-presents-hydrogen-blending-to-orange-cove/.

SoCalGas intends to continue working with the City of Orange Cove, which can use this demonstration project in its community as a showcase for advancements in clean energy. SoCalGas will continue performing stakeholder outreach with city staff, residents, businesses, and interested parties after filing of the Amended Application so that the community continues to stay engaged throughout the demonstration period. SoCalGas will keep community members abreast of project updates as additional details become available and project planning unfolds.

SoCalGas will work with the local community to identify relevant community-based organizations (CBO) for project engagement and will hold stakeholder meetings for participation of relevant CBOs. CBO collaborations will be formalized through Memorandum of Understandings (MOU). SoCalGas will provide compensation for CBOs based at $150/hour.[21] SoCalGas proposes CBO engagement meetings not to exceed four (4) per year during Phase 1 and an additional three meetings, one at the conclusion of each additional project phase, to share updates, conclusions, and findings. SoCalGas will work with identified CBOs to determine appropriate workshop frequency.

Lastly, SoCalGas will develop a dedicated means of communicating with stakeholders that provides easy accessibility for stakeholders to get in touch about the project.

IV. ORDERING PARAGRAPH 7 COMPLIANCE

D.22-12-057 outlined several requirements for the implementation of hydrogen blending demonstration projects and the Applicants engaged the Commission's Energy Division throughout the development of this Amended Application to address any interpretation issues. Below is a detailed discussion of how SoCalGas's proposed Open System Project complies with OP 7 of D.22-12-057.

A. OP 7a

Ensures the long-term safety of the California pipeline, the prevention of hydrogen leakage, the inclusion of hydrogen monitoring, the consideration of the dilution rate, and the monitoring and reporting of all mechanical characteristics of hydrogen blends in the natural gas pipeline stream

Within the Open System Project, SoCalGas intends to take various steps to maximize safety, prevent hydrogen leakage, monitor hydrogen production and storage facilities, measure

[21] This hourly rate is consistent with CBO compensation outlined in SoCalGas Advice No. 6146G; *available at:* https://tariff.socalgas.com/regulatory/tariffs/tm2/pdf/submittals/GAS_6146.pdf.

the hydrogen blends in the demonstration program, and monitor all mechanical characteristics. As such, SoCalGas will perform enhanced leak detection protocols to verify that the introduction of hydrogen is not compromising the safety of the gas system and associated end-use equipment throughout the duration of the demonstration. As outlined in Section II.C.2, SoCalGas will increase leak testing to a quarterly basis compared to the standard annual frequency. SoCalGas will deploy robust monitoring surrounding the hydrogen production, storage, and blending facilities to detect leakage or issues with the hydrogen equipment. Remote and continuous monitoring on these systems will notify SoCalGas of leakage to the hydrogen facilities and prompt SoCalGas to respond to address any issues as necessary. If an alarm is triggered or leakage is detected in the hydrogen production and storage area, the hydrogen system will go into a shutdown mode, isolating equipment, stopping hydrogen production, and returning the pipeline system to 100% natural gas. A gas measurement analyzer will be installed at the outlet of the blending skid so that the blend percentage introduced into the system is accurate. Additionally, gas sampling will be implemented by taking measurements downstream of the introduction point to monitor the hydrogen blends at select points in the system. SoCalGas will continually monitor the operation of the hydrogen blending, storage, production, and associated electrical and water aspects of the project. SoCalGas intends to perform upfront inspections as well as continuous inspections on various points of this demonstration. Exhibit 2A outlines detailed data collection plans.

B. OP 7b

Prevents hydrogen from reaching natural gas storage areas and electrical switching equipment directly or through leakage

There will be no modifications to the pipeline system, other than the piping installed to divert gas downstream of the regulator station to the associated blending equipment. However, there are no natural gas storage facilities in the area. SoCalGas will install backflow prevention so that no hydrogen blends flow backward into the system upstream of the regulator station. Hydrogen storage, production, and blending equipment will be sited in a plot of land across from SoCalGas's regulator station, and there is no known electrical switching equipment within proximity. The site will be designed in a matter that if any electrical equipment switching equipment were to be present, it will be located in unclassified areas or will be protected by classified enclosures per applicable industry codes and standards. Lastly, independent risk

analyses will be performed prior to project implementation and will inform if any unforeseen risks are present regarding a potential for hydrogen to reach natural gas storage or electrical switching equipment. If anything is found during the risk assessment stages, design will be implemented for mitigation.

C. OP 7c

Avoids end user appliance malfunctions

SoCalGas will work with the community, including the business customers, to analyze the various end-uses and make sure there are no known processes that would be impacted by hydrogen blends, even at low percentages. SoCalGas will offer equipment inspections prior to introduction of hydrogen to verify the appliances are in working order and will provide contact information for customers to use should they experience difficulties with their appliances. SoCalGas will work with City staff to ensure that once blending commences, any reports of appliance malfunction are documented and, if necessary, SoCalGas will provide operational support.

Additionally, research shows that common appliances can operate safely with blends above 20% hydrogen. A study from GTI, which tested various partially premixed combustion equipment with no adjustments, has shown that heating equipment "…was successfully operated up to 30% hydrogen-blended fuels."[22] This demonstration is designed to further validate previous research findings.

D. OP 7d

Evaluates hydrogen injection at blends between 0.1 and five percent and five to twenty percent; such evaluations must adhere to approved monitoring, reporting, and long-term impact study in accordance with the approval of the pilot project application, and must include validation programs to confirm performance

The Open System Project will evaluate blends from 0.10 to 5% in an open system. In doing so, it will adhere to approved monitoring and reporting that are in alignment with the UC Riverside Study. Please refer to Section II.C.2 and Exhibit 2A for complete details of a

[22] Glanville, P., Fridlyand, A., Sutherland, B., Liszka, M., Zhao, Y., Bingham, L., and Jorgensen, K., Impact of Hydrogen/Natural Gas Blends on Partially Premixed Combustion Equipment: NOx Emission and Operational Performance (February 24, 2022), available at: https://www.mdpi.com/1996-1073/15/5/1706.

preliminary data collection plan. SoCalGas's proposed Closed System Project, SDG&E's Project, Southwest Gas's Project, and PG&E's project, outlined in Chapters 1, 3, 4, and 5, respectively, will evaluate hydrogen blends between 5% and 20% in closed systems.

E. OP 7e

Specifies the amounts of funding necessary to complete all aspects of the proposal and proposes testing durations adequate to draw meaningful conclusions

A level 5 cost estimate was performed to calculate the funding necessary for all four phases of the Open System Project. Section V summarizes the project cost and WP-2 provides a breakdown of the project cost.

Regarding the demonstration's duration, SoCalGas's Open System Project is in line with other notable hydrogen blending studies and would allow sufficient time to show changes in seasonal gas flows. Testing duration is in line with previous successful demonstrations, such as the HyDeploy Trial Phase I and Phase 2 demonstrations discussed in Chapter 1, that were performed for 18 months[23] and 10 months,[24] respectively. As of February 2022, ATCO's demonstration blending 5% hydrogen into the gas system has been in service for 16 months with plans to increase to 20% hydrogen blends in the near future. The Open System Project will test at a minimum of three (3) months for lower levels and six (6) months for greater hydrogen concentrations. This also aligns with the three-year timeline to adopt a hydrogen blending standard proposed by the UC Riverside Study.[25]

F. OP 7f

Is consistent with all directed courses of action specified in this decision relevant to leakage, reporting, heating value, system safety, environmental considerations, end-use emissions, and all other elements enumerated in this decision

The Open System Project is consistent with all directed courses of action specified in decision D.22-12-057. Details of how SoCalGas's proposed Open System Project addresses all courses of actions has been discussed throughout this prepared testimony and summarized in Table 5 below.

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[23] *See* HyDeploy Phase 1, *available at:* https://hydeploy.co.uk/project-phases/.
[24] *See* Hydeploy Phase 2, *available at:* https://hydeploy.co.uk/project-phases/.
[25] UCR, *Hydrogen Blending Impacts Study* (July 2022), at 4; *available at* https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M493/K760/493760600.PDF.

Table 5: Directed Courses of Action in D.22-12-057

Topic	Recap of SoCalGas's Action	Reference
Leakage	The project will be designed to minimize and monitor leakage for hydrogen, methane, and a hydrogen/methane blend with sensors, remote alerts, and other detection systems.	Section II. C.2, IV.A and Exhibit 2A
Reporting	The project's testing program explained will collect and analyze data, and will report the findings of the project. SoCalGas will work with a selected third-party and the Joint Utilities to report on findings.	Section II
Heating value	Gas composition will be monitored after blending skid and at various points downstream of the injection point. Additionally, SoCalGas is evaluating gas chromatographs capable of detecting and measuring hydrogen up to 20 vol%.	Section II.C.2, IV.A and Exhibit 2A
System Safety	Various safety and alert systems are in place so that the project adheres to safety requirements, including a remote monitoring and alarm system. All relevant codes and standards will be applied.	Section III.B and IV.A
Environmental Considerations	The project will produce important information about the potential for carbon reductions using different blend percentages. Other emissions will be measured. Additionally, solar energy is being procured for production of clean renewable hydrogen throughout the duration of the project. Lastly, non-potable water sources will be utilized where possible.	Section II, II.C.2
End-use Emissions	NOx, CO_2, CO, and Oxygen will be measured from select end-use equipment to monitor the emission performance.	Section II.C.2, Exhibit 2A

Topic	Recap of SoCalGas's Action	Reference
Blending Limitations	The project will evaluate hydrogen blending between 0.10% to 5% by volume in an open system as directed in D.22-12-057 and clarified by Energy Division. The open system is a real-world gas distribution network using components of gas distribution pipeline. The project is focused on ensuring the long-term safety of the California pipeline.	Section I, II, IV.D
Additional Consideration	Section IV address how the project is in compliance with the directives of D.22.-12-057.	Section IV

G. OP 7g

Proposes rigorous testing protocols consistent with the UC Riverside Study

The Open System Project is consistent with all directed courses of action specified in the UC Riverside Study as well as actions specified in decision D.22-12-057. Additionally, on November 6, 2023, Applicants sought feedback on their data collection plans from stakeholders, the public, and industry experts in their technical stakeholder workshop. Applicants incorporated feedback from stakeholders into their respective data collection plans.

Rigorous testing protocols proposed and will be further developed to address leakage rates, impacts on end-use appliances, impacts to the existing natural gas pipeline system, impacts on fittings, and other components. Exhibit 2A demonstrates the test plan developed for different aspects of the project.

This filing represents pre-development of the Open System Project. Upon application approval, the Applicants will contract an independent party as directed to finalize a research plan for assessment, measurements, monitoring, and reporting. This plan will consider feedback from the technical workshop held on November 6, 2023, as well as the UC Riverside Study.

H. OP 7h

Takes into account parties' comments and further stakeholder input and includes the opportunity for compensation for parties and for community-based organizations

SoCalGas has and will continue to consider parties' comments and stakeholder input. Refer to Section III.D for more details on SoCalGas's stakeholder engagement activities to date, plans for engagement post-Amended Application filing, and CBO compensation.

Applicants utilized public stakeholder workshops to gather feedback from the public. SoCalGas also worked closely with impacted stakeholders within the City of Orange Cove to take into account feedback from the community. SoCalGas hosted a community engagement event to discuss hydrogen blending demonstrations and field questions from residents. The project will provide educational materials and information sessions to disseminate knowledge on the technology, safety measures, and progress on the project.

I. OP 7i

Proposes a methodology for performing a Hydrogen Blending System Impact Analysis that can ensure that any hydrogen blend will not pose a risk to the common carrier pipeline system

This System Impact Analysis would be a checklist for Joint Utilities and potential third parties connecting to the gas system to use to confirm the common carrier pipeline system will remain safe should a hydrogen injection standard be established.

The Joint Utilities propose developing a methodology for performing the Hydrogen Blending System Impact Analysis upon completion of the projects. The proposed methodology will provide a framework so that hydrogen blends do not compromise gas system integrity, safety, or impact end-use equipment.

The methodology will benefit from using the data collected from the demonstration projects. The proposed methodology for hydrogen blending will follow a similar framework as a biomethane interconnection agreement. The framework will include, but will not be limited to:

- Identification of downstream systems.
- Potential materials.
- Operating pressures.
- Equipment (*e.g.*, valves, meters, etc.).
- Review of pipeline history and end-use equipment.
- Any further analysis that is deemed necessary by the interconnecting utility.

J. OP 7j

Includes new or revised heating values and discusses whether heating values would be modified through the use of propane or other means and whether such modifications to heating value can be done safely

Propane or other means will not be used to supplement heating values during the demonstration. The composition of the blended gas will be measured at the outlet of the blending skid and also downstream of the point of injection. This will inform any impacts to heating value at the point of injection and also downstream at strategically selected customer meter set assemblies. Specific information is detailed in Section II.C.2 and impacts to bills are discussed in Section III.C.3.

K. OP 7k

Demonstrates the ability to reliably detect leakage of any hydrogen, methane, or hydrogen/methane blends and describes rigorous hydrogen leak testing protocols that are consistent with leak testing and reporting elements identified in the University of California at Riverside's 2022 Hydrogen Blending Impacts Study, identifies and addresses the comments presented by parties in this proceeding regarding leak issues, and identifies and addresses the comments presented by workshop stakeholders in this proceeding regarding leak issues

The Open System Project will include procedures to monitor, identify, and quickly repair leaks to minimize safety risks, including appropriate methods for prompt and reliable leak detection, such as the use of odorant. First, the project will utilize the appropriate design and construction standards, as well as operating gas standards within the designed parameters to minimize the risk of hydrogen leakage. In addition, continuous monitoring of the hydrogen storage and production facilities will be deployed to detect leakage. Also, more frequent leak detection will be utilized through the duration of the project for the blended gas lines and customer equipment. Instrumentation systems will be utilized to measure performance of the system, including temperature, pressure, and gas quality. More information can be found in Section II.C.2, IV.A and Exhibit 2A.

L. OP 7l

Contains an independent research plan for assessment, measurement, monitoring, and reporting through an independent party, which must be engaged in such activities during the development, construction, operational life, and decommissioning of the pilot project

Upon approval of this Amended Application, Applicants will issue a request for proposals (RFP) to solicit competitive bids from an independent party or parties to complete the independent research plan. Given the differences in demonstration projects, different entities might be contracted for development of the research plan. The application phase of the project is pre-development, and therefore the cost of the independent party involvement will be assessed and recovered after the Commission's decision on the Amended Application through a subaccount.

V. COST ESTIMATES

An unloaded direct cost estimate is provided in Table 6 below. The unloaded direct cost includes all anticipated expenses, with contingency, for the entirety of the Open System Project. The costs are based on a level 5 estimate and shown in 2023 dollars. Please see WP-2 for the detailed breakdown of cost estimates by project phase. Details on revenue requirements are described in the Direct Testimony of Nasim Ahmed and Marjorie Schmidt-Pines (Chapter 6).

Table 6: Unloaded Direct Cost Estimate

2025	2026	2027	2028	Total
$34,366,986	$11,709,582	$966,419	$1,371,045	$48,411,032

VI. CONCLUSION

A live hydrogen blending demonstration is the next critical step to develop a hydrogen injection standard for California. SoCalGas's proposed Open System Project will provide the necessary operational and material data to support such a standard for using the larger distribution gas system to transport natural gas and hydrogen blends. SoCalGas and the City of Orange Cove are looking forward to taking this next step to help California achieve its decarbonization goals.

This concludes my prepared direct testimony.

VII. QUALIFICATIONS

My name is Blaine Waymire. I am employed at SoCalGas as a Project Manager in the Gas Engineering and System Integrity organization. Currently, I lead the Hydrogen Blending Strategy Team's planning for live hydrogen blending demonstrations and regulatory applications. Prior to this, I have held positions within SoCalGas including Sr. Distributed Energy Resources Advisor and Sr. Account Executive, with various engineering analysis and regulatory responsibilities. I have been employed at SoCalGas since May 2012. I hold a Bachelor of Science degree in Mechanical Engineering from California State University, Long Beach. I am a licensed Professional Engineer in the State of California.

Exhibit 2A: Preliminary Data Collection Plan

Joint IOU Hydrogen Blending Demonstration Application

Prepared by: Southern California Gas Company

Contents

Goals

The purpose of this document is to create a data collection and test plan for the two proposed SoCalGas Hydrogen Blending Demonstration Projects in the medium pressure distribution system. For the purposes of these demonstrations, the medium pressure distribution system is defined as pipelines and components with operating pressures of 60 pounds per square inch gauge (psig) or less.

The first proposed SoCalGas Hydrogen Blending Demonstration Project (closed system) will be held in an isolated portion of the natural gas distribution system located at UC Irvine campus for blending hydrogen from 5 vol% to 20 vol%. The second SoCalGas Hydrogen Blending Demonstration Project (open system) will be held in an open portion of the natural gas distribution system located in the City of Orange Cove for blending hydrogen from 0.1 vol% to 5 vol%

This document presents our strategy for gathering data on four distinct topics aimed at validating knowledge derived from research studies. This will provide the essential data and operational insights required to facilitate the future expansion of hydrogen blending. The four topics encompass: leakage, material testing, heating value measurement, and end-use emissions. Every part of the demonstration will have its own respective test plan and data collection schedule to support the necessary data analysis.

Leakage

Odorization

For both open and closed system demonstration projects, hydrogen-natural gas blends will be odorized per Company Odorization Gas Standard. Odorant levels will be monitored upstream of the hydrogen injection point as base case and multiple locations downstream of the hydrogen injection point to verify odorant intensity throughout the pipelines. Four consecutive weekly odor intensity tests will be conducted, followed by monthly tests, which will confirm hydrogen compatibility and efficacy of the odorant.

Leak Survey

Leak survey will be conducted at frequencies listed in Table 1. Only Company Field Employees qualified through Gas Operations Training may perform the leak survey. Pipe joints, valves and meters will be leak surveyed. Downstream of the meter, pipe connections to the end use appliances will be leak surveyed as well to confirm safety, integrity, and reliability. SoCalGas will explore various leak survey technologies available on the market.

Table 1. Leak Survey Technologies and Frequency

Demo Project	Examples of Leak Survey Technologies to Explore	Leak Survey Frequency
Closed System	• Portable gas detectors • Fiber optic technology • Ground vehicle • Mass balance method	• Pipeline: monthly • Pipe connections to appliances: monthly or by customer call
Open System	• Portable gas detectors • Ground vehicle • Aerial detectors	• Pipeline: quarterly

		• Pipe connections to appliances: by customer call

Materials Testing

For both closed and open system demonstration projects, the effect of hydrogen on materials will be continuously monitored through leak surveys at various points within the system. If any leaks are detected during leak surveys, the affected section of the pipeline or specific components may be isolated for further material testing to assess any potential impact of hydrogen on the material's integrity. If an opportunity arises to remove specific sections of the pipeline or components at the conclusion of the demonstration, further material testing may be conducted.

Heating Value Measurement

The current gas chromatographs used for heating value measurement have a limitation to detect hydrogen. To ensure accurate gas composition measurement for customer billing purposes, it is essential to implement and incorporate compatible gas chromatographs.

For the closed system project, SoCalGas will monitor the caloric value of the blend both at the blending injection skid and at the meter set assembly of the Anteater Recreation Center (ARC).

For the open system project, SoCalGas will monitor the calorific value of the blend at the blending injection skid and at strategically selected customer meter set assembly.

End Use Emissions

For both closed and open system projects, SoCalGas will perform emissions testing (CO_2, NO_x, CO, and O_2) per South Coast Air Quality Management District (SCAQMD) and San Joaquin Valley Air Pollution Control District (APCD) test methods to determine the appliance performance and combustion efficiency. SoCalGas also plans to visually inspect the change in flame appearance, flame ignition, and start-up and steady operation between 5 vol% to 20 vol% hydrogen blends. Table 2 summarizes End-Use equipment proposed testing. It should be noted that for the open system project, the frequency of testing will be determined following a comprehensive customer survey.

Table 2. End- Use Equipment Proposed Testing

Demo Project	End Use Equipment	Emissions Testing		Visual Testing	Frequency
		Monitored Parameters	Applicable Test Methods		
Closed system	Boilers, Water heaters, pool heaters, and food services	NOx, CO2, CO, O2	SCAQMD Rules	The change in flame color, longer cooking duration, the delayed ignition	Beginning and end of each phase or per Customer call
Open System	Common residential appliances, general commercial HVAC, and water heating	NOx, CO2, CO, O2	San Joaquin Valley APCD Rules	To be determined	To be determined