Application: A.22-09-XXX
Witness: K. Woo
Chapter: 2

PREPARED DIRECT TESTIMONY OF

KEVIN WOO

ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

(SOCALGAS' HYDROGEN BLENDING DEMONSTRATION PROJECT)

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

September 8, 2022

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CHAPTER 2

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I. PURPOSE

The purpose of my prepared direct testimony on behalf of Southern California Gas Company (SoCalGas) is to provide the technical objectives, need, project implementation detail, and costs for the proposed SoCalGas Hydrogen Blending Demonstration Project (Project). My testimony will focus on a description of the Project and how it will help inform a future hydrogen injection standard and support SoCalGas', San Diego Gas & Electric Company's (SDG&E), and Southwest Gas Corporation's (Southwest Gas) (collectively, the Applicants) focus on safety, system integrity, and reliability. My testimony will discuss the 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 University of California (UC) Irvine, or UCI, 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 Project is to provide operational, live blending and system performance data for blending up to 20% hydrogen gas by volume[1] in an isolated portion of a medium pressure[2] steel and plastic distribution pipeline system. Project data will inform the feasibility of developing a hydrogen injection standard for older steel and plastic distribution systems that serve existing natural gas-powered appliances found in residences and smaller commercial facilities. [3]

Testing on the steel pipeline system in SoCalGas' territory is necessary because steel is the more common material used for pipeline mains in the SoCalGas medium pressure pipeline system. At the end of 2021, SoCalGas managed 25,965 miles of steel distribution mains, which makes up approximately 50.3% of pipeline mains. The other distribution pipeline mains are

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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] UCI's pipeline system was originally installed in the 1970s.

made of polyethylene (PE) plastic.[4] SDG&E's proposed Project will address hydrogen blending in a medium pressure PE plastic pipeline system.[5]

SoCalGas is pleased to work with UCI, a leading research university in the sustainable energy and environmental space and home to the renowned Advanced Power and Energy Program (APEP), to conduct a hydrogen blending demonstration project on the UCI campus.[6] A Director's Message from APEP states, "The campus and surrounding area act as a living laboratory where APEP practices the development and deployment of efficient, environmentally sensitive, and sustainable power generation and energy conversion."[7]

The Project will provide validation on a local system of a strong base of previous analysis, testing, and field demonstrations including comparable field testing performed in the United Kingdom.[8] The Project will be located on UCI's campus and will begin with an initial hydrogen blend level of 5% and up to 20% over time. The blend volume will be gradually increased 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 older gas distribution systems and potentially for transmission systems.

II. BACKGROUND

In November 2020, the Joint Utilities filed Application (A.) 20-11-004 where they proposed a Hydrogen Blending Demonstration Program to be conducted by SoCalGas and SDG&E, consisting of three hydrogen blending projects on gas distribution and transmission pipeline systems. In July 2021, the Application was dismissed without prejudice due to the California Public Utilities Commission's (Commission or CPUC) concerns about, inter alia,

[4] Pipeline and Hazardous Materials Safety Administration*, Gas Distribution, Gas Gathering, Gas Transmission, Hazardous Liquids, Liquefied Natural Gas (LNG), and Underground Natural Gas Storage (UNGS) Annual Report Data, available at:* https://www.phmsa.dot.gov/data-and-statistics/pipeline/gas-distribution-gas-gathering-gas-transmission-hazardous-liquids.
[5] *See* Direct Testimony of Melanie Davidson and Pooyan Kabir (Chapter 3).
[6] Refer to Exhibit A for Memorandum of Understanding with UCI.
[7] Advanced Power and Energy Program, *Director's Message, available at:* https://www.apep.uci.edu/Directors_Message.html.
[8] Pipeline Research Council International, *PR-720-20603-R01 Emerging Fuels - Hydrogen SOTA Gap Analysis and Future Project Roadmap, available at:* https://www.prci.org/Research/Measurement/MEASProjects/MEAS-15-02/178529/202786.aspx.

duplicative efforts undertaken by the California Energy Commission's (CEC) funding solicitations and a blending study by UC Riverside (UCR).

With this Application refiling, SoCalGas proposes to conduct a "real world" demonstration project which will (1) implement demonstration recommendations set forth in the recently-published UCR study[9], (2) model the United Kingdom's successful hydrogen blending trial at Keele University[10], (3) demonstrate the integrity, durability, and safety of blending hydrogen into a mixed material distribution gas system in support of a hydrogen injection standard, and (4) guide the design of experiment for a potential transmission system demonstration.

A. UCR Hydrogen Blending Impacts Study

In July 2022, the CPUC published a study it sponsored titled "Hydrogen Blending Impacts Study"[11] that UCR prepared in collaboration with GTI Energy. The goal of the study was to determine the viability of blending hydrogen with natural gas in California's existing natural gas infrastructure based on existing information and targeted experimental and modeling work. Specific areas of investigation were maximum hydrogen blending percentage at which no or minor modification are required to existing natural gas infrastructure and end-use systems, potential modifications required at higher blending percentages, impact and safety aspects related to end-use appliances, degradation and durability of the existing pipeline system components (e.g., valves, fittings), leakage rates, natural gas storage, and cathodically protected pipelines. As an outcome of their findings, UCR recognized that a single, systemwide injection would have to consider the most susceptible conditions observed through all infrastructure components as well as end-uses, appliances, and industrial processes. The study further highlights "as there are knowledge gaps in several areas, including those that cannot be addressed through modeling or laboratory scale experimental work, it is critical to conduct real world demonstration of hydrogen blending under safe and controlled conditions."[12] UCR also recommended that the utilities:

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[9] Miroslav Penchev, Taehoon Lim, Michael Todd, Oren Lever, Ernest Lever, Suveen Mathaudhu, Alfredo Martinez-Morales, and Arun S.K. Raju*. 2022. Hydrogen Blending Impacts Study Final Report. Agreement Number: 19NS1662.

[10] HyDeploy, *First UK trial of hydrogen blended gas hailed a success* (September 8, 2021), *available at*: https://hydeploy.co.uk/about/news/first-uk-trial-of-hydrogen-blended-gas-hailed-a-success/.

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

[12] *Id*. at 4.

> Conduct demonstration of hydrogen blending in a section of the infrastructure that is isolated or is custom-built to include the commonly present materials, vintages, facilities, and equipment of the generic California natural gas infrastructure with appropriate maintenance, monitoring and safety protocols over extended periods. The recommended hydrogen percentages for this demonstration are 5 to 20%. Such demonstration projects will allow critical knowledge gaps to be filled, including the effect of parameters such as weather induced temperature changes, pressure cycling, length of exposure, effect of natural gas components and contaminants, and potential mitigation techniques.[13]

Additionally, these demonstration projects support the development of necessary policies and procedures towards adoption of a hydrogen injection standard.

Per these recommendations, the proposed Project will demonstrate hydrogen blends in the 5-20% range considering this is the range at which no major modifications are required to end-use equipment and will not impact the safety and operation of end-use appliances. Furthermore, the Project will monitor system operations, conduct safety and leak surveys, and assess hydrogen tolerance levels and impact through sampling and laboratory analysis.

The UC Riverside study also recommends the following key activities in parallel:

- R&D (R&D Organizations Lead): address knowledge gaps and assess higher hydrogen percentages blending, mitigation strategies, support demonstration activity
- Planning (State Agencies Lead): develop inventories, update and develop specifications, safety/maintenance protocols, workforce development
- Engagement (State Agencies/Community Organizations Lead): understand priorities and concerns, outreach and consensus building

The Projects proposed by the Applicants will inform stakeholders of the critical technical and operational data that will support these parallel efforts. The Applicants also intend to collaborate with stakeholders on these recommended parallel efforts given the opportunity.

B. United Kingdom's HyDeploy University Hydrogen Blending Trial

A similar study has proven successful in the United Kingdom with the HyDeploy Keele University project that trialed blending up to 20% hydrogen in a private distribution gas system and fed 100 homes and 30 university buildings for 18 months. The live demonstration was completed in March 2021. The project demonstrated that hydrogen blends of up to 20% can be

[13] *Id*. at 5.

safely delivered to and used by customers without changes to the gas system or end-use equipment. The United Kingdom is planning a phase 2 that will blend hydrogen into a public distribution gas system.

Building on the success of the United Kingdom's HyDeploy hydrogen blending strategy and the knowledge gained, SoCalGas proposes to conduct a similar pilot where hydrogen blends are first introduced to a university distribution gas system. It is important to emphasize that although SoCalGas can learn from the successful HyDeploy Keele University project, there is still a need to conduct a California-specific hydrogen blending pilot due to potential different designs in pipeline systems and end-use equipment.[14] 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 distribution gas system and potentially the transmission gas system. SoCalGas potentially anticipates a second demonstration phase to study the transmission gas system, leveraging lessons learned during this distribution system trial.

III. PROJECT DESCRIPTION

Hydrogen will be injected into a medium pressure steel pipeline where the blend will then be delivered to end-users via additional steel and plastic pipelines. The UCI campus will be isolated such that only certain university buildings will receive the 5 to 20% hydrogen blend. The buildings include Mesa Arts Building, Mesa Court Housing (29 halls and 3 towers), Mesa Office Building, Alumni Center, art studios, and a food court. The hydrogen blend will be used for residential and light commercial equipment, such as ovens, furnaces, water heaters, dryers, and boilers. The total connected load is 26,816 MBTUH. The Project will take place over 18 months and allow for 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 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.

[14] For example, in the United Kingdom, gas appliances manufactured after 1996 have been designed to operate with hydrogen blends up to 23%. In North America, natural gas appliance manufacturers are not required to conduct hydrogen testing and certification for their equipment.

Table 1: Summary of Project Phases*

Phase & Activity	**Description**	**Estimated Duration**
1. Planning, Design, Construction, and Commissioning	Hydrogen production and blending equipment is procured; system is designed, constructed, and commissioned on campus; pre-demo equipment and pipeline system inspections and any necessary remediation are conducted; stakeholder engagement; temporary pressure regulating stations installed and campus isolated	18 months
2. Testing and Demonstration	Hydrogen is blended in system on a testing schedule; data is collected; periodic inspection of equipment and pipelines; test samples of pipelines and components pre- 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	Hydrogen equipment is removed from campus; temporary pressure regulator stations removed and campus restored	5 months
4. Knowledge Sharing	Data from pilot is analyzed and a public report will be released	9 months

*Project Phases have some overlap. See Estimated Project Schedule for details.

Figures 1 to 3 show the potential Project site layout, plot plan on the UCI campus, and the temporary pressure regulating stations and isolation points. Note that two additional sites along West Peltason Drive are also being evaluated for feasibility. The project site and layouts shown in Figures 1 to 3 provide the most conservative estimate of the three potential sites.

Figure 1: Proposed Site Layout on UCI campus

Figure 2: Preliminary Project Plot Plan

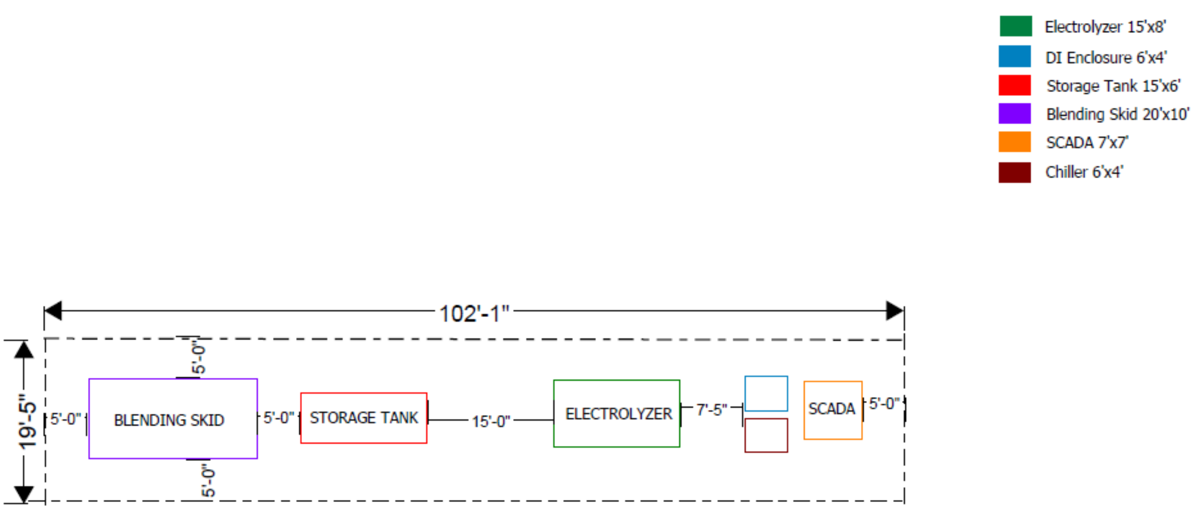
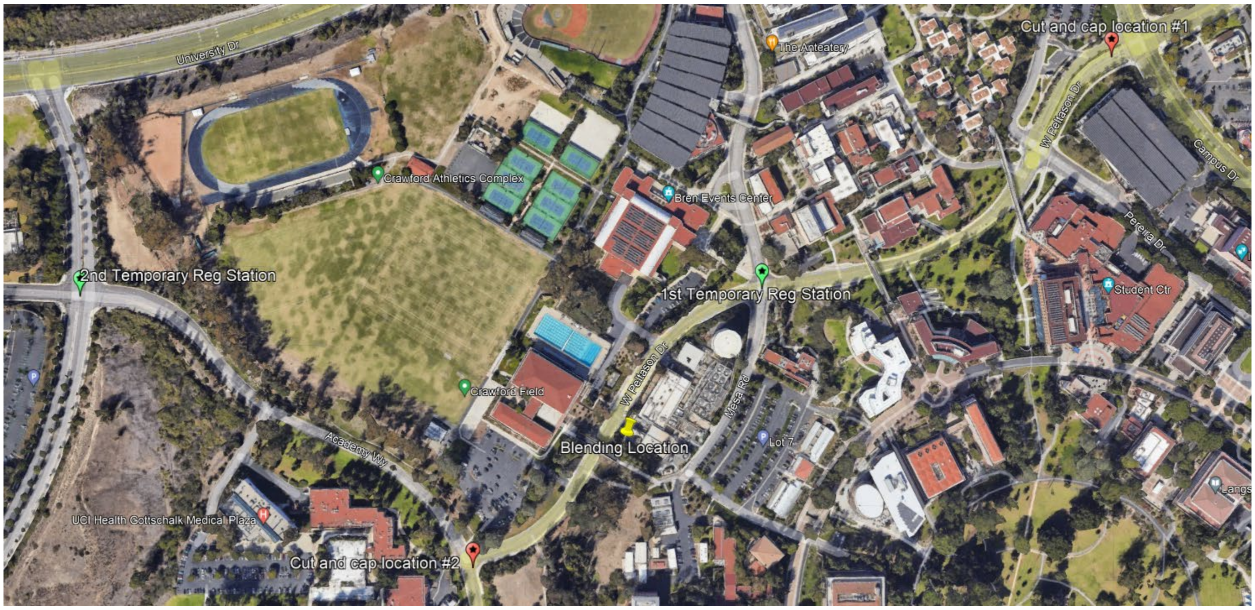


Figure 3: Location of Temporary Pressure Regulating Stations and Isolation Locations Relative to Proposed Project Site



Refer to Exhibit B for additional Project details and visuals.

The Project aligns with recommendations from UCR's Hydrogen Blending Impacts Study. One of the key recommendations from the study is to "[conduct a demonstration] in a section of the infrastructure that is isolated or is custom-built to include the commonly present materials, vintages, facilities, and equipment of the generic California natural gas infrastructure with appropriate maintenance, monitoring and safety protocols over extended periods." The Project will follow UCR's recommendation and collect operational data on a mixed material pipeline system that feeds typical residential and light commercial gas equipment found in California.

A. PHASE 1: Planning, Design, Construction, and Commissioning

1. Planning

Site selection was made with input from UCI personnel and considered the following:

- Pipe properties and operational history
- End-users and equipment
- Constructability (adequate space)
- Summer load and yearly load (sufficient flow to blend)
- Time to survey pipeline system and load (pre-, during, and post-demonstration)

- Local customer support
- Safety

A blending exception report under SoCalGas Rule No. 45[15] will accompany the Project. The report will follow the "Utility Evaluations" steps in the Renewable Gas Interconnection Tariff[16] and document the evaluation of the feasibility of blending and the safety assessment supporting blending percentages. The report will incorporate the following considerations:

- Flow rates and directional consistency of receiving pipeline(s), including daily and seasonal variations.
- Historical gas composition and gas quality specification at the chosen demonstration system and area of influence for purposes of determining impact on a British Thermal Unit (BTU) district.
- Current and expected future composition of natural gas in the pipeline system for the purpose of determining interchangeability on customers' end-use equipment and the pipeline system's future capability to accommodate supplies.
- Current and future customers in receiving pipeline flow rate, distance to these customers, time to first receiving customer, and anticipated downstream gas demand growth.
- Maximum time and distance required for complete mixing to occur under all pipeline flow conditions.
- The design, operation, and overall condition of the receiving pipeline(s), including any sensitivities to gas constituents.
- Additional monitoring, control, and/or mixing equipment that may be required to verify and ensure that adequate blending has occurred in the receiving pipeline system.

2. Design, Construction, and Commissioning

This Project will include the following major equipment:

- **Electrolyzer**: hydrogen used in this demonstration will be produced on-site via a dedicated, grid-connected electrolyzer. The electrolyzer will produce hydrogen

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[15] SoCalGas, *Rule No. 45 – Standard Renewable Gas Interconnection* (September 28, 2020), *available at:* https://tariff.socalgas.com/regulatory/tariffs/tm2/pdf/45.pdf.

[16] *Id.* at Section L (Pipeline Blending Study (Blending Study)).

using water and electricity and will be sized to blend up to 20% hydrogen in the isolated system. Estimated daily power and water requirements are 4,192.5 kWh and 170.4 gallons, respectively.

- **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 created.
- **Storage Tank**: a hydrogen pressure vessel will be on-site to minimize target hydrogen blend level fluctuations over the duration of the demonstration.
- **Temporary Pressure Regulating Stations**: two temporary stations will need to be installed to continue providing gas to end-users while the gas system is isolated for the purposes of the Project.

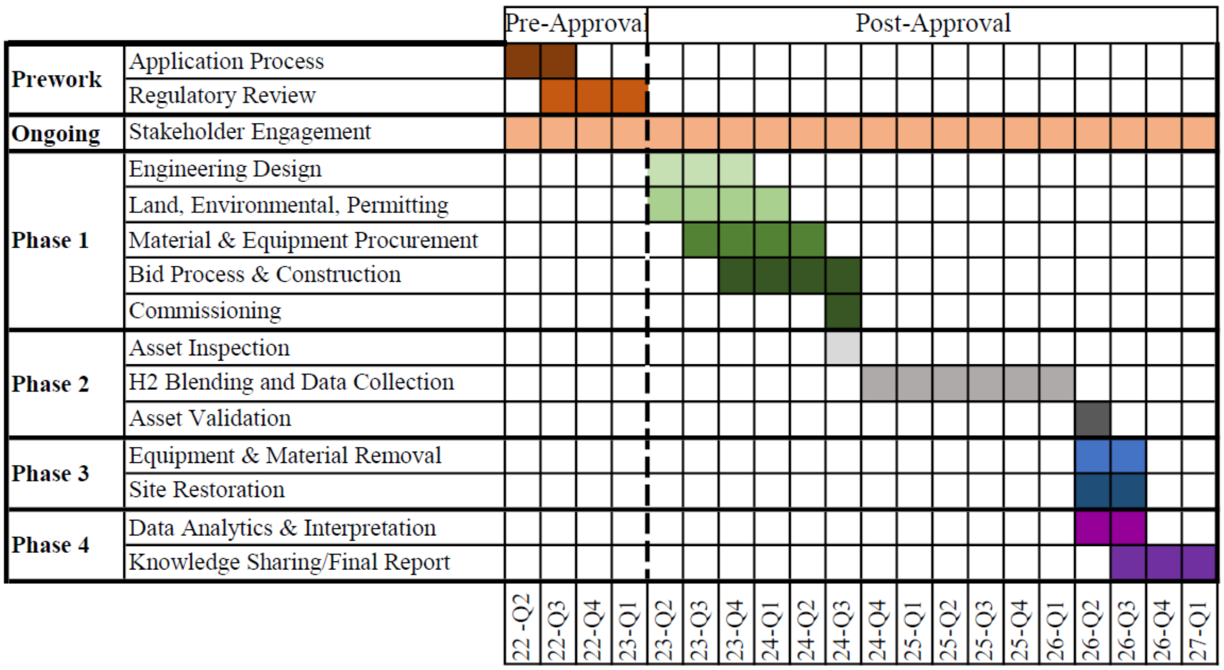
Additional equipment and instrumentation that will be utilized are Supervisory Control and Data Acquisition (SCADA), chiller, de-ionizer (DI), gas analyzers, gas detectors, fire detectors, pressure transmitters, and temperature transmitters.

In order to deliver hydrogen blends to specific UCI end-users, a portion of the campus will need to be isolated from the rest of the distribution system through two cut and capped pipeline locations and installation of two temporary pressure regulating stations to continue feeding the isolated portion. The first temporary pressure regulating station will provide gas to five meters on UCI's campus, and the second temporary pressure regulating station will provide gas to meters that feed UCI and non-UCI customers to the west of the hydrogen injection point. Note that these meters will not receive hydrogen blends and that the purpose of the second temporary pressure regulating station is to continue providing gas to these customers. The installation of the second temporary pressure regulating station involves installation of approximately 700 feet of pipe to provide the medium pressure system with a feed from a high-pressure pipeline.

3. Project Schedule

An estimated project timeline is included here in Figure 4 for discussion purposes. The actual timeline and schedule will vary depending upon the Application's regulatory process and approval.

Figure 4: Potential Project Schedule



B. PHASE 2: Testing and Demonstration

1. Asset Inspection

SoCalGas will conduct an asset inspection, which includes a tabletop review of all materials in the selected systems followed by a detailed validation in the field. All customer appliances in the demonstration area will be offered and encouraged to participate in courtesy inspections to confirm no appliance modifications are needed and the appliances are in safe working order. In the unlikely event that modifications are required to customer appliances, these will be completed prior to injecting hydrogen. Asset inspections will also include detailed surveys of the pipelines and appurtenances. Any material repair or replacement needed will be completed prior to injecting hydrogen. Leak surveys will also be performed prior to the demonstration and continued throughout the Project.

2. Live Hydrogen Blending, Data Collection, and Analysis

The 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). The 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 of this Chapter.

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' recommendations for a statewide hydrogen injection standard. Many of the items below have been assessed through literature review, laboratory testing, and/or vendor 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 (or determine need for material replacement)
- Component (e.g., fittings, valves) compatibility (or determine need for component replacement)
- Long-term integrity modeling
- Blend consistency (hydrogen blending injection skid)
- End-use customer feedback
- End-use customer appliance compatibility
- Development of new Gas Standards for the construction, maintenance and operations of hydrogen blended natural gas system

- Effects on metering, and the effect on customers' energy use and billing (note: SoCalGas does not intend to bill customers for blended hydrogen for the Project)
- Impact on emissions of end-use equipment, including NOx

Error! Reference source not found. 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.

Table 2: Project 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.	Monthly; And as needed for customer service calls	✓	✓	✓
Leak survey equipment	Validate performance of new leak survey equipment	Monthly; And as needed for customer service calls		✓	
Samples of pipe/pipeline components (Material Compatibility)	Verify if there are any material impacts (steel and polyethylene piping, elastomers, rubbers, gaskets, valves, fittings, regulators) after exposure to hydrogen blends	Prior to demo and post-demo	✓		✓
Blending skid operation	Validate design, load balancing, and blend consistency	Continuous		✓	
Customer feedback	Validate customer equipment operation/response	Monthly		✓	✓

Gas usage	Monitor and analyze demand changes to forecast potential future supply needs	Monthly		✓	
Customer meters	Compare data from customer meters and blending skid data to confirm accuracy and performance of meters	Monthly		✓	✓
Customer equipment evaluation	Ensure equipment is working properly; validate gas interchangeability calculations and lab testing that has been done	Monthly; And as needed for customer service calls	✓	✓	✓
Customer equipment checks for emissions, including NOx	Perform measurement on emissions from hot water and space heaters	To be determined	✓	✓	

Table 5 summarizes the incremental hydrogen blending level increase schedule. Please note that the actual blend percentage will depend on available hydrogen production and usage demand (i.e., if there is increased gas usage due to abnormally cold weather, the actual blend percentage may be lower than the target). This blending schedule aligns with recommendations from UCR's Hydrogen Blending Impacts Study. Per the study, "it is critical to conduct real world demonstration of hydrogen blending under safe and controlled conditions. The recommended hydrogen percentages for this demonstration are 5 to 20%." Data collection will start with a target blend level of 5% and gradually go up to 20%. 6 months of data will be collected for the lower blends (up to 10%), and 12 months of data will be collected for the higher blends (10 to 20%).

Table 3: Estimated Blending Intervals by Increments

% Blending Level	Timeframe
Up to 5%	Months 1 to 3
Up to 10%	Months 4 to 6
Up to 15%	Months 7 to 12
Up to 20%	Months 13 to 18

3. Asset Validation

Asset validation includes the following post-hydrogen blending activities:

- Leak surveys of the pipeline system to verify no additional leaks have developed
- Gathering of pipe and component samples to test and compare with pre-demo samples to evaluate if there are any material changes after exposure to hydrogen blends
- Customer equipment checks to ensure equipment continues to work properly
- Two meters will be removed for mechanical integrity testing

4. Billing Impacts

Since hydrogen will lower the heating value of the gas supplied to UCI, SoCalGas plans to apply retroactive volumetric adjustments to UCI's bill to accurately charge UCI based on therm usage. SoCalGas intends to address this directly with UCI during project implementation.

5. Project Updates

While the demonstration is in progress, SoCalGas will provide periodic status updates on the project. Depending on the data available, potentially enough information will be collected to support an interim preliminary hydrogen blending standard for the SoCalGas distribution system. SoCalGas will share project information with the CPUC as it becomes available.

C. PHASE 3: Decommissioning, Equipment Removal, and System Restoration

Given that the Project is a temporary installation, all hydrogen blending equipment will be removed from the campus upon completion of the 18-month demonstration. The decommissioning of the project will remove the two temporary pressure regulating stations, electrolyzer, hydrogen storage vessel, DI enclosure, blending skid, chiller, and SCADA unit. The water line connection will be capped. The piping for run-off water from electrolyzer to the city sewer system will be removed and disposed. The hydrogen blending skid will be removed from the site and repurposed for another project. The pipelines used for the demonstration will be reconnected to the medium pressure line on the main line. The water line between the city water line and the electrolyzer will be removed and disposed of.

The site of the project will need to be restored to its original state. The power line needs to be disconnected and conduit needs to be removed for the electrical work. The foundation for the equipment needs to be demolished and debris will be removed and disposed of according to the city codes. Construction and demolition debris needs to be removed from the site and either recycled or disposed of according to UCI Facilities Management.

D. PHASE 4: Knowledge Sharing

After the completion of the demonstration, all 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. A report will be published and made available to the general public. This report will be published in collaboration with the Applicants to integrate data collected from the demonstration projects to inform a future California hydrogen injection standard. A public workshop will be held to share project knowledge.

It is anticipated that the lessons learned from the Project will guide the development and execution of a potential transmission hydrogen blending demonstration project. Given that this is SoCalGas' first distribution hydrogen blending demonstration project, the operational experience gained, and processes established will facilitate the planning of a potential subsequent transmission system demonstration project and potentially expedite the project schedule.

IV. PROJECT GUIDANCE

A. API RP 1173 Pipeline Safety Management System

Safety is at the core of this overall Application, of paramount importance at SoCalGas, and at the forefront of the Project. The Project utilizes the API RP 1173 PSMS Plan-Do-Check-Act model.[17] SoCalGas is currently in the "Plan" Stage. The Project will move into the "Do" Stage by initiating the controlled blending project that has been informed by the Plan Stage.

[17] https://flipflashpages.uniflip.com/3/94156/1106646/pub/html5.html#page/1

Leading up to and during this stage, SoCalGas will be establishing operational controls, training to operate with hydrogen blends, documenting and recording data from the demonstration, and engaging with stakeholders, including the communities and end-users. The Project leads into the "Check" Phase where SoCalGas will learn from the data collected, including utilizing the data for an integrity/risk management analysis. The "Act" Phase will be updating the 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. Plan-Do-Check-Act 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

SoCalGas' safety efforts to be taken before, during, and after the Project include, but are not limited to:

- Hydrogen Safety Training for personnel
- Safety Assessment for hydrogen storage
- Survey end-use customer equipment to confirm behind-the-meter equipment present (SoCalGas successfully tested residential end-use equipment for hydrogen compatibility up to 20%)
- Conduct pre-, during, and post-implementation leak surveys
- Create hydrogen blending specific customer protocols and emergency response plans
- Conduct 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. Stakeholder Engagement & Reporting

Education and outreach are important components of the Project because it will affect a range of stakeholder groups from various internal SoCalGas organizations to external organizations, including UCI staff and students, City of Irvine, Orange County, state regulatory agencies, and legislators. Hydrogen has the potential to play an important role in California's efforts to achieve carbon neutrality and stakeholders, from utility personnel to customers to policymakers, need to understand how blended hydrogen can be utilized safely and reliably.

As such, SoCalGas intends to work with UCI, who can conduct publishable research to develop best practices for survey design and public outreach to understand how to best affect behavioral and attitudinal outcomes to changing energy technologies. Education, outreach, and survey materials will be coordinated in partnership with the university to ensure communications are timely, meaningful, and address concerns.

SoCalGas and SDG&E can partner on development of key educational resources to inform on the purpose and details of the blending project. Materials can include, for example, co-development materials featuring previous hydrogen blending research and demonstration to date, such as SoCalGas' H2 Hydrogen Home[18] and H2 ProQual[19] projects. Resources to be developed may include public webinars, public forums, short videos, and literature for communities affected by the pilot.

As part of the ongoing Project, periodic reports with status updates will be provided to the Commission.

V. COST ESTIMATES

The table below summarizes the direct and indirect cost estimates for the four phases of the Project. Please see WP-1 for the detailed breakdown of Project direct cost estimates by phase. Details on rates and bill impact are described in Chapter 5.

Indirect costs include Overhead allocations which are added to project costs, consistent with those costs' classification as company labor, contract labor, or purchased services and materials. Overhead loaders used to develop the revenue requirement for the project are for illustrative purposes and subject to change. The overhead allocations in this application adhere to

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[18] *See* https://www.socalgas.com/sustainability/h2home.

[19] *See* https://newsroom.socalgas.com/press-release/socalgas-among-first-in-the-nation-to-test-hydrogen-blending-in-real-world.

the methodology established by the Federal Energy Regulatory Commission (FERC)[20] and were derived using the same methodology used in SoCalGas' 2019 GRC filing.[21] Escalation is applied to direct costs to properly account for inflation. SoCalGas applied the indices published in IHS Global Insight's 1st Quarter 2022 Utility Cost Forecast for this application.

Table 6: Total O&M Cost *(In Millions)*

	2023	2024	2025	2026	2027	Total
O&M	2.88	7.38	0.60	1.84	0.15	12.86
Overheads & Escalation	0.26	0.68	0.34	0.56	0.13	1.96
Total	3.14	8.06	0.94	2.40	0.29	14.82

VI. CONCLUSION

A live hydrogen blending demonstration is the next critical step to develop a hydrogen injection standard for California. This Project will provide the necessary operational and material data to support such a standard for using older steel and plastic distribution gas systems to transport hydrogen blends. SoCalGas and UCI are looking forward to taking this next step to help California achieve its decarbonization goals.

This concludes my prepared direct testimony.

[20] FERC guidelines reference the Statement of Federal Financial Accounting Standards 4: Managerial Cost Accounting Standards and Concepts.

[21] Application (A.) 17-10-007/008 (cons.), Second Revised SoCalGas/SDG&E Direct Testimony of James Vanderhye (Shared Services & Shared Assets Billing, Segmentation & Capital Reassignments), Ex. SCG-34-2R/SDG&E-32-2R (April 6, 2018).

VII. QUALIFICATIONS

My name is Kevin Woo. I am employed at SoCalGas as a Team Leader in the Gas Engineering and System Integrity organization. Currently I lead the Hydrogen Blending Strategy's Research team and have held this position since April 2021. Prior to this I have held positions within SoCalGas including Pipeline Integrity Management, Distribution Planning and Engineering, and various engineering and team leader roles at the Engineering Analysis Center. I have been employed at SoCalGas since October 2006. I hold a Bachelor of Science degree in Aerospace Engineering from University of California Los Angeles.