Application: A.22-09-006
Witness: B. Waymire
Chapter: 1

# PREPARED DIRECT TESTIMONY OF

# BLAINE WAYMIRE

# ON BEHALF OF SOUTHERN CALIFORNIA GAS COMPANY

# (SOCALGAS'S HYDROGEN BLENDING DEMONSTRATION – CLOSED SYSTEM PROJECT)

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

March 1, 2024

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# CHAPTER 1

# PREPARED DIRECT TESTIMONY OF BLAINE WAYMIRE

# (SOCALGAS'S HYDROGEN BLENDING DEMONSTRATION – CLOSED 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 the proposed SoCalGas hydrogen blending demonstration project, which will be held in an isolated portion of the natural gas distribution system (Closed System Project). This testimony will focus on a description of the Closed 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 or Joint Utilities) focus on safety, system integrity, and reliability, as well as adhering to the requirements set out by Decision (D.) 22-12-057 and guidance under D.21-07-005. This testimony will address the Closed 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 University of California, Irvine (UC Irvine), 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 Closed System Project discussed is contingent upon the California Public Utilities Commission's (Commission) approval and will require further collaboration with UC Irvine to refine project details through detailed engineering design and analyses.

The purpose of this Closed System Project is to demonstrate operational, live blending and collect system performance data for blending from 5% 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 steel and plastic

[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.

distribution systems that serve existing natural gas-powered appliances found in commercial facilities.[3]

Testing on the steel pipeline system in SoCalGas's territory is necessary because steel is a common material used for pipeline mains in SoCalGas's distribution pipeline system. At the end of 2022, SoCalGas managed 25,913 miles of steel distribution mains, which makes up approximately 49.9% of distribution pipeline mains. The other distribution pipeline mains are made of plastic.[4] While SoCalGas's Closed System Project will also showcase polyethylene (PE) pipeline, SDG&E and Southwest Gas's proposed projects will address hydrogen blending solely in a distribution-level PE plastic pipeline system, and at different climates.[5] Further, the project hosted by PG&E will aim to inform and support the development of a hydrogen injection standard for transmission systems.[6]

SoCalGas is pleased to work with UC Irvine, 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 UC Irvine campus. Refer to Exhibit 1B for the Memorandum of Understanding (MOU) with UC Irvine. 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 Closed 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 in the United Kingdom[8] and on the UC Irvine campus.[9] The Closed System Project will begin

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[3] End-uses selected on UC Irvine's campus consist of water heating equipment and commercial kitchen appliances.

[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 Testimonies of Pooyan Kabir (Chapter 3) and Kevin Lang (Chapter 4).

[6] *See* Direct Testimony of Danielle Mark (Chapter 5).

[7] Advanced Power and Energy Program, *Director's Message, available at:* https://www.apep.uci.edu/Directors_Message.html.

[8] 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/.

[9] UCI News, *In a national first, UCI injects renewable hydrogen into campus power supply* (December 6, 2016), *available at:* https://news.uci.edu/2016/12/06/in-a-national-first-uci-injects-renewable-hydrogen-into-campus-power-supply/.

with an initial hydrogen blend level of 5% and will increase up to 20% over time. The gradual increase of the blend volume will be 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. With the inclusion of both transmission-level and distribution-level hydrogen blending projects at various climates, and in both open and closed systems, the proposed projects will complement each other in providing meaningful data to inform a statewide hydrogen injection standard.

## II. PROJECT DESCRIPTION

In this section, SoCalGas outlines the details of the proposed Closed System Project focused on blending hydrogen into an isolated mixed material natural gas distribution system.

SoCalGas intends to blend 5% to 20% hydrogen by volume with natural gas into the nearby natural gas distribution system that will serve an isolated portion of the UC Irvine campus. After collaborating with campus personnel, UC Irvine's Anteater Recreation Center (ARC) was identified as a well-suited location to isolate and receive the blended fuel. The ARC is a large gymnasium and recreation complex on UC Irvine's campus. The project will demonstrate hydrogen blending under live operational conditions in both steel and plastic pipeline infrastructure and also provide useful data on impacts to heating and cooking equipment located in the selected buildings.

If approved, UC Irvine's campus will be isolated such that only select university buildings (in this case, the ARC) will receive the 5% to 20% hydrogen blend. The hydrogen blend will be used for light commercial equipment, such as boilers, water heaters, and cooking equipment. To blend up to 20% hydrogen, SoCalGas utilized the historical natural gas usage for the select buildings on UC Irvine campus based on the years 2021-2023 to size equipment capable of meeting and blending the hydrogen/natural gas blends. The Closed System Project is proposed to be implemented over 18 months during which SoCalGas will 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.

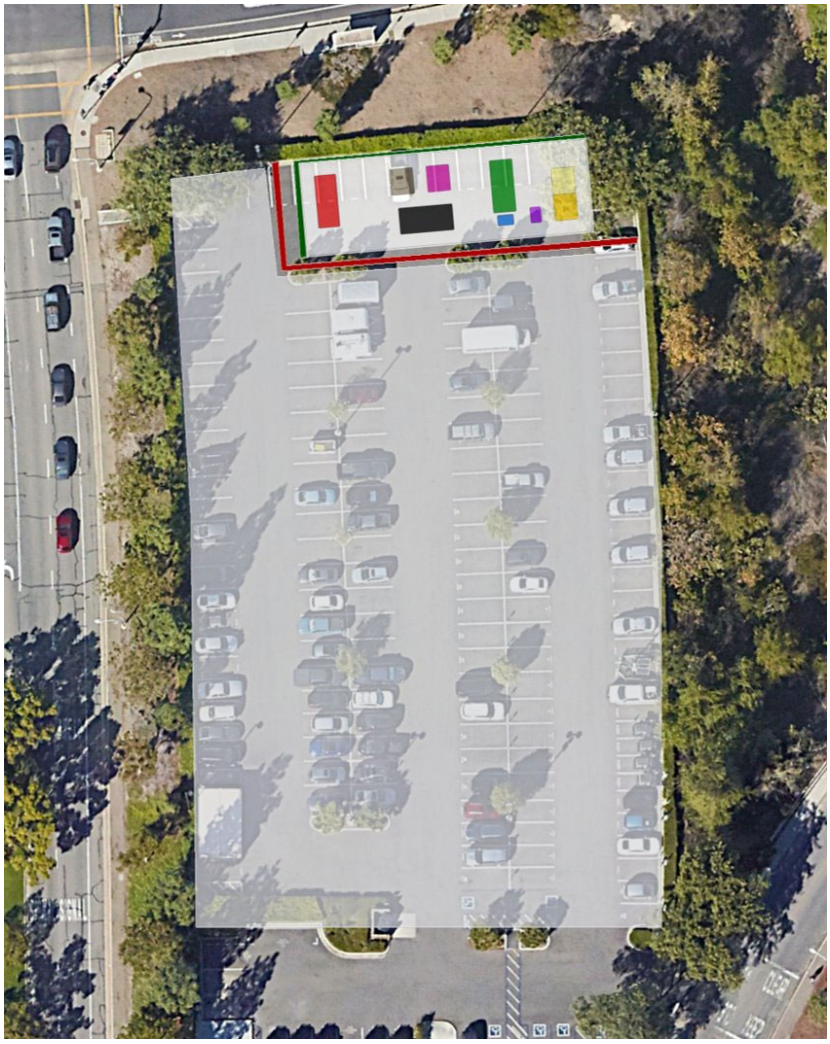
The proposed Closed System Project will be divided into four chronological phases with defined budgets for each phase. The phases are briefly summarized in Table 1 and defined in detail in subsequent testimony.

**Table 1: Summary of the Closed 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 on campus; 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 | Hydrogen equipment is removed from campus, unless otherwise agreed upon with UC Irvine | 6 months |
| 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 on the UC Irvine campus, and the location of pipelines involved in the demonstration. The project site and layouts shown in Figures 1 to 3 provide the most technical, spatial, and construction feasibility in order to serve blends to the predetermined isolated buildings on UC Irvine campus.

**Figure 1: Proposed Site Layout on UC Irvine's Campus**

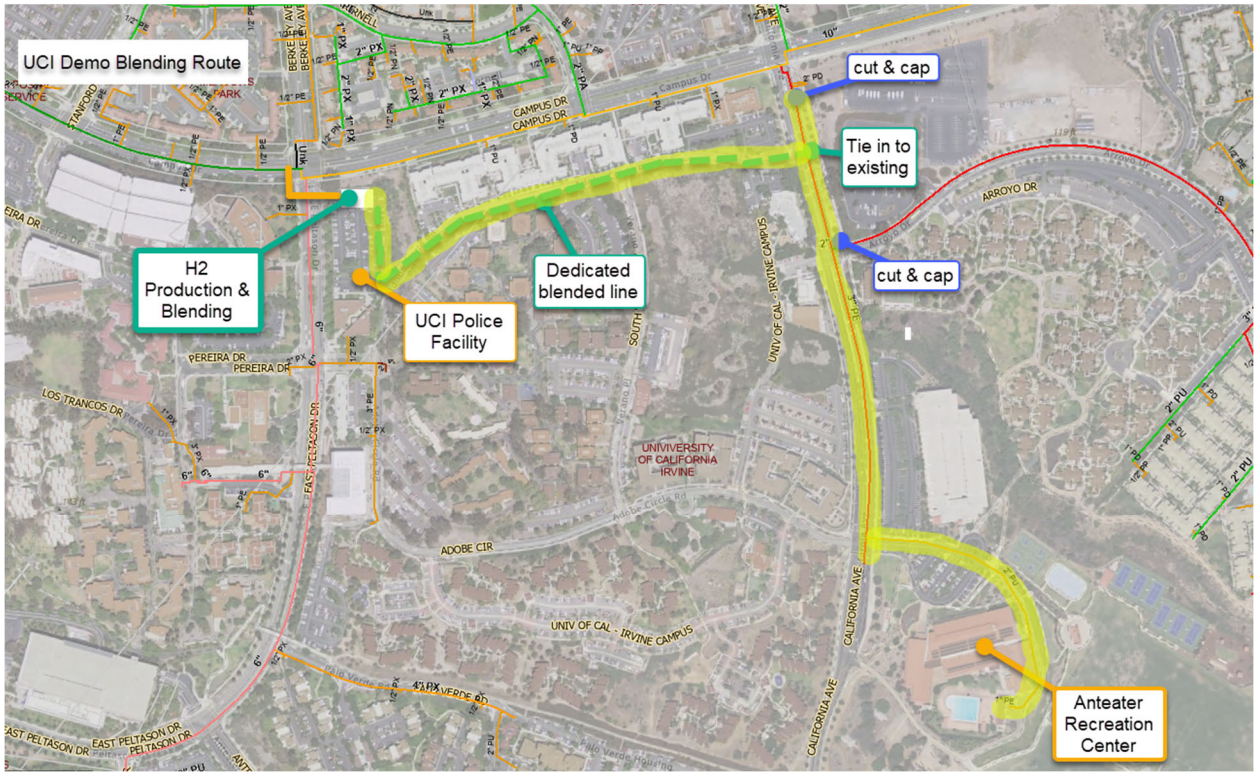


The equipment layout and separation distances with fencing as initially proposed will occupy an estimated space of 108 feet by 35 feet. Figure 1 illustrates the proposed site layout with the safety distances, as well as equipment sizes. The proposed site would estimate 85 feet from the intersection and 50 feet from the road. Parking bollards would likely be required on the south and west sides of the equipment layout, while a protective block wall would likely be required on the north and west sides. A fence would likely be utilized to contain the equipment on all sides. Initial plans include solar panels that can be installed in the remaining parking lot space to offset the site's electrical loads.

**Figure 2: Preliminary Project Plot Plan**

| Equipment Type | Color |
|---|---|
| Electrolyzer | Green |
| SCADA Building | Orange |
| Storage Shed | Yellow |
| Hydrogen Storage | Red |
| Chiller Unit | Purple |
| Gas Composition Analyzer | Brown |
| Blending Skid | Black |
| Hydrogen Compressor | Pink |

**Figure 3: Location of Pipelines Performing the Demonstration**




The proposed Closed System Project aligns with recommendations from UC Riverside's Hydrogen Blending Impacts Study (UC Riverside Study),[10] the requirements set out in D.22-12-057, and guidance in D.21-07-005. One of the key recommendations from the UC Riverside 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."[11] The Closed System Project will follow the UC Riverside Study's recommendation and collect operational data on a mixed material pipeline system that feeds typical light commercial gas equipment found in California.

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

[11] *Id*. at 5.

### A. Phase 0: Pre-Development

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

To develop this Amended Application, SoCalGas collaborated with UC Irvine personnel to identify a preferred preliminary site and scope. SoCalGas worked closely with various stakeholders at UC Irvine when determining (i) a site that was suitable to host the hydrogen blending equipment and (ii) an end-use that would provide meaningful load data. When determining site locations, the following factors were considered:

- Pipe properties and operational history
- 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)
- UC Irvine Facilities 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 initially 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 UC Irvine personnel. The Closed 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 20% hydrogen in the isolated system. The electrolyzer will use electricity from solar installed at the site along with UC Irvine's campus microgrid and local municipal water to create hydrogen and store it onsite.

- **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.
- **Hydrogen Storage Vessels**: Hydrogen pressure vessels 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**: Initial design includes approximately 1.1 acres of solar array which can be installed over the majority of the parking lot where the equipment is sited in order to produce the majority of the electricity required for operation of the electrolyzer, associated equipment, and hydrogen production. One-point-one (1.1) acres translates to approximately 150 kW of power, which can be interconnected to UC Irvine's campus microgrid.[12] The campus microgrid will serve as an alternative power source to supply the hydrogen production and blending equipment power when solar power is not available.
- **New Steel Pipe**: Approximately 2,000 feet of steel pipe will be installed from the outlet of the blending skid to the interconnection point of the PE pipeline located on California Avenue. Because there is no steel infrastructure in this portion of campus, SoCalGas will be installing new steel pipe to emulate a mixed material demonstration.

Additional equipment and instrumentation that will be utilized are Supervisory Control and Data Acquisition (SCADA) RTU, chiller, de-ionizer (DI), gas analyzers, gas detectors, gas compressors, fire detectors, pressure transmitters, and temperature transmitters. Much of the listed equipment and instrumentation is for safety of the hydrogen production, storage, and blending components. However, safety practices are discussed further in Section III.B below.

[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.

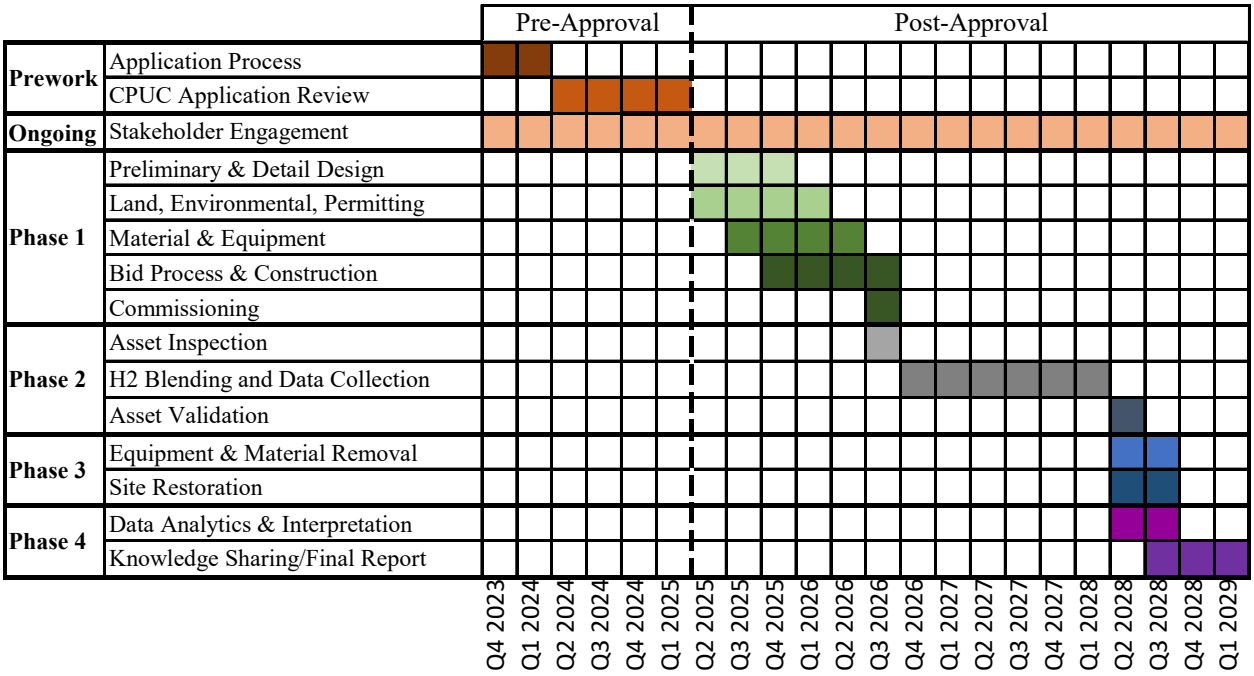
In order to deliver hydrogen blends to the specified UC Irvine end-user, in this case the ARC, a portion of the campus will need to be isolated from the rest of the distribution system through two cut and capped pipeline locations. The first temporary cut and cap location is the 3" main at California Avenue and Campus Drive. The second cut and cap will occur at the existing 3" main at Arroyo Drive and California Avenue to isolate the customers to the east of California Avenue from receiving the blended gas. These means of isolating the pipeline infrastructure in this manner is designed so that only the ARC will receive the blended gas.

In order to serve the blended gas to the isolated campus buildings via the existing 3" plastic main in California Avenue, approximately 2,000 feet of 3" steel main will be run from the outlet of the blending skid and east through Adobe Circle. The 3" steel line will then be tied into the 3" plastic line at the intersection of Arroyo Circle and California Avenue. Please reference Figure 3 above.

### 1. Project Schedule

Table 2 below 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 the project schedule.

**Table 2: Estimated Project Schedule**



### C. Phase 2: Testing and Demonstration

#### 1. Asset Inspection

SoCalGas will conduct an asset review and inspection prior to the introduction of hydrogen into the system. Prior to the introduction of hydrogen, the demonstration area will be baselined with regular natural gas. All customer appliances involved in the demonstration on UC Irvine's campus will be offered courtesy inspections to confirm the appliances are in safe working order. Leak surveys will also be performed 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 Closed 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 the best opportunity 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 education, additional leak surveying, gas handling, customer service, routine customer interactions, and emergency response plans. Monitoring during demonstrations will include both system monitoring as well as collecting feedback from UC Irvine.

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 Closed System 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 below provides an overview of the type of data that SoCalGas will collect with the Closed System 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 1A: 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. | Monthly; And as needed for customer service calls | ✓ | ✓ | ✓ |

| | | | | | |
|---|---|---|---|---|---|
| Leak survey equipment | Evaluate performance of new leak survey equipment | Monthly; And as needed for customer service calls | | ✓ | |
| Heating value measurement | Monitor and Analyze changes to heating value of gas supplied | Monthly | ✓ | ✓ | |
| Customer meters | Compare data from customer meters and blending skid data to evaluate accuracy | Monthly | | ✓ | ✓ |
| Customer equipment evaluation | Confirm equipment is working properly; validate gas interchangeability | Monthly; And as needed for customer service calls | ✓ | ✓ | ✓ |
| Customer equipment checks for emissions | Perform measurement on emissions from heating and cooking equipment | Monthly | ✓ | ✓ | |

Table 4 below summarizes the incremental hydrogen blending level increase schedule. Please note that the actual blend percentage will depend on available hydrogen production and usage demand. This blending schedule aligns with recommendations from the 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 the introduction of hydrogen, the demonstration area will be baselined with regular natural gas. Data collection will start with a target blend level of 5% and gradually increase up to 20%. Six 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%).

[14] UC Riverside, *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 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. Billing Impacts

Since introduction of hydrogen will have the potential to change the heating value of the gas supplied to UC Irvine, SoCalGas plans to apply retroactive volumetric adjustments to UC Irvine's bill to accurately charge based on therm usage. SoCalGas intends to address this directly with UC Irvine 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 UC Irvine that end-use equipment is still in proper working order. 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

Phase 3 of the Closed System Project will commence at the conclusion of the Testing and Demonstration period. Given that the project is a demonstration, the hydrogen blending equipment is planned to be removed from the campus upon completion of the 18-month demonstration, except for the installed solar array. However, should UC Irvine want to keep the hydrogen blending equipment in place for further testing or demonstration purposes, SoCalGas can work with the campus to explore options for keeping it onsite, rather than moving forward with the planned decommissioning.

Should decommissioning take place, equipment will be removed upon completion of the 18-month demonstration and SoCalGas will restore the site where the hydrogen equipment was temporarily located as per terms and conditions to be developed with UC Irvine. Relevant equipment will be warehoused and efforts will be made to redeploy or reutilize the assets. The

solar system supplying the electricity for the electrolysis process will be donated to the UC Irvine campus to save decommissioning costs.

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 1A. 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 Closed System Project. The Closed System Project follows 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 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

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

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 demonstration 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 Closed System Project include, but are not limited to:

- Hydrogen safety education for personnel
- Safety assessment for hydrogen storage and hydrogen components
- Survey end-use customer equipment to confirm behind-the-meter equipment present is free of leakage and is operational
- Install appropriate gas detection alarm systems where indoor equipment is housed
- 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
- 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. United Kingdom's HyDeploy Hydrogen Blending Trial

Another hydrogen blending demonstration has proven successful in the United Kingdom with Phase 1 of the HyDeploy hydrogen blending trial (HyDeploy Trial) at Keele University, which blended up to 20% hydrogen in a private distribution gas system and fed 100 homes and 30 university buildings for 18 months, concluding in March 2021.[16] The project demonstrated that hydrogen blends of up to 20% can be safely delivered to and used by customers without changes to the gas system or end-use equipment. Phase 2 of the HyDeploy Trial took place in Winlaton, England, for 10 months and successfully served a 20% hydrogen blend to more than 650 homes and several small businesses.[17]

Building on the success of the HyDeploy Trial and the knowledge gained, SoCalGas proposes to conduct a similar demonstration where hydrogen blends are first introduced to a university distribution gas system. It is important to emphasize that although SoCalGas and other stakeholders can learn from the successful HyDeploy Trial, there is still a need to conduct a California-specific hydrogen blending demonstration due to potentially different designs in pipeline systems and end-use equipment.[18] 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

Stakeholder engagement is a vital component of the Closed System Project and SoCalGas has taken a proactive approach in its outreach at UC Irvine and throughout Orange County. SoCalGas aims to provide an educational platform in collaboration with UC Irvine to inform stakeholders about the role hydrogen can play in a clean energy future and to obtain feedback as it pertains to this project.

Since 2022, SoCalGas has conducted a series of community outreach efforts with various stakeholders including UC Irvine staff, faculty, students, city and county officials, state regulatory agencies, and legislators. Working in partnership with these stakeholder groups has

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[16] HyDeploy, *Project Phases, available at:* https://hydeploy.co.uk/project-phases/.

[17] *Id.*

[18] 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.

presented meaningful opportunities for deepening stakeholder collaboration and participation. Outreach activities have included educational presentations, townhalls, project briefings, and facilitating tours of SoCalGas's H2 Innovation Experience [H2IE], North America's first-ever clean hydrogen-powered home, including a microgrid and home which provides a real-world example of an existing hydrogen blending facility. SoCalGas will continue with these types of outreach activities including utilizing media and digital/virtual platforms to provide relevant updates to stakeholders and the community throughout the project duration.

Pursuant to 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 so that Applicants could address questions submitted by stakeholders. Following the workshop, Applicants collectively responded to outstanding questions submitted by attendees so all answers would be recorded. In addition, to solicit best practices from industry experts and technical stakeholders, on November 6, 2023, Applicants held a technical-focused workshop to receive feedback on 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 will continue performing stakeholder outreach in collaboration with UC Irvine after the Amended Application is filed so that the campus and community stays informed and engaged throughout the demonstration period.

Also, the relationship between SoCalGas and UC Irvine creates an opportunity to collaborate on research projects related to hydrogen blending and associated equipment, which will provide a robust ample learning environment for students, faculty, and community at large. Because the Closed System Project will take place on campus, this will also compliment UC Irvine's APEP and its National Fuel Cell Research Center (NFCRC) because these departments have been internationally recognized for their leadership in energy and are national pioneers in researching, educating, evaluating, and deploying clean energy technologies and systems. SoCalGas first partnered with UC Irvine's NFCRC in 2016 for the first successful green hydrogen blending project in the United States. Since then, hydrogen blending has been ongoing at the UC Irvine campus and has successfully demonstrated that hydrogen could be safely blended with natural gas.

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 MOUs. SoCalGas will provide compensation for CBOs based at $150/hour.[19] 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 Closed 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 Closed System Project, SoCalGas intends to take various steps to maximize safety, prevent hydrogen leakage, monitor hydrogen production and storage facilities, measure 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 monthly 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

[19] 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.

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 the customer meter. 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 1A outlines detailed data collection plans.

### B. OP 7b

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

The pipeline system will be isolated in a manner that no hydrogen or hydrogen blends will reach any natural gas storage or electrical switching equipment. As mentioned in Section II.B, SoCalGas will perform cut and caps on various pipelines in the area so that no blended gas is reaching any customers other than UC Irvine's ARC, or any natural gas storage fields. Hydrogen storage, production, and blending equipment will be sited in UC Irvine's police parking lot 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*

When blending has commenced, SoCalGas will work closely with UC Irvine staff to confirm that the appliances and equipment are in proper working order. Further, equipment will be monitored for continued proper operation and SoCalGas will provide operational support if needed. SoCalGas will establish a means of communication for UC Irvine Facilities to use should they experience difficulties with their end-use equipment.

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."[20] 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 Closed System Project will evaluate blends from 5% to 20% in an isolated 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 1A for complete details of a preliminary data collection plan. SoCalGas's proposed Open System Project outlined in Chapter 2 will evaluate hydrogen blends between 0.1 and 5%.

[20] 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.

### 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 Closed System Project detailed in this testimony. Section V summarizes the project cost and WP-1 provides a breakdown of the project cost.

Regarding the demonstration's duration, SoCalGas's Closed 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, that were performed for 18 months[21] and 10 months,[22] respectively. The Closed 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.

### 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 Closed System Project is consistent with the directed courses of action specified in D.22-12-057. Details of how SoCalGas's proposed Closed System Project addresses all courses of action have been discussed throughout this prepared testimony and are summarized in Table 5 below.

**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. Hydrogen production and storage will have 24/7 continuous monitoring. | Section II. C.2, IV.A and Exhibit 1A |

[21] HyDeploy, *Project Phases – Phase 1, available at*: https://hydeploy.co.uk/project-phases/.
[22] *Id*. at Phase 2.

| | | |
|---|---|---|
| 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 1A |
| 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. | Section II, II.C.2 |
| End-use Emissions | NOx, $CO_2$, CO, and Oxygen will be measured from the end-use equipment to monitor the emission performance. | Section II.C.2, Exhibit 1A |
| Blending Limitations | The project will evaluate hydrogen blending between 5% to 20% by volume in a closed system as directed in D.22-12-057 and recommended through the UC Riverside Study. The closed system is a real-world system 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 addresses 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 Closed System Project is consistent with all directed courses of action specified in the UC Riverside Study as well as actions specified in 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 will be developed to address leakage rates, impacts on end-use appliances, impacts to the existing natural gas pipeline system, impacts on fittings, and other components. In addition, inputs from industry experts will be utilized to measure, test, and report the most relevant data for the Closed System Project. Exhibit 1A demonstrates the data collection and testing plan developed for different aspects of the project.

This filing represents pre-development of the Closed 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 general public. SoCalGas also worked closely with the impacted stakeholders, such as UC Irvine, to take into account feedback from the campus community. 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 the customer's meter. Specific information is detailed in Section II.C.2 and impacts to bills are discussed in Section II.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 Closed 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, gas lines downstream of the customer meter, 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 1A.

### 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 the 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. This 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 Closed System

Project. The costs are based on a level 5 estimate and shown in 2023 dollars. Please see WP-1 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 |
|---|---|---|---|---|
| $16,357,612 | $5,660,911 | $ 949,936 | $1,451,947 | $24,420,406 |

## VI. CONCLUSION

A live hydrogen blending demonstration is the next critical step to develop a hydrogen injection standard for California. SoCalGas's proposed Closed System Project will provide the necessary operational and material data to support such a standard for using steel and plastic distribution gas systems to transport natural gas and hydrogen blends. SoCalGas and UC Irvine 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 1A: 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<br>• Fiber optic technology<br>• Ground vehicle<br>• Mass balance method | • Pipeline: monthly<br>• Pipe connections to appliances: monthly or by customer call |
| **Open System** | • Portable gas detectors<br>• Ground vehicle<br>• 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 |

# Exhibit 1B: Memorandum of Understanding (MOU) with UC Irvine

## Joint IOU Hydrogen Blending Demonstration Application

Prepared by: Southern California Gas Company

# MEMORANDUM OF UNDERSTANDING

**By and Between**

**THE REGENTS OF THE UNIVERSITY OF CALIFORNIA, ON BEHALF OF THE ADVANCED POWER AND ENERGY PROGRAM AT ITS IRVINE CAMPUS ("UCI")**
**and**
**SOUTHERN CALIFORNIA GAS COMPANY ("SoCalGas")**

## RECITALS

WHEREAS UCI is an internationally recognized leading public research university;

WHEREAS UCI is a "living laboratory," incubating numerous clean energy initiatives and technologies that contribute to future decarbonized energy systems;

WHEREAS the parties to this MOU agree that clean hydrogen is a promising carbon-free fuel that may be critical to supporting California's clean energy transition on the electric and natural gas systems;

WHEREAS the California Public Utilities Commission ("CPUC") has asked investor-owned gas utilities, including SoCalGas, to inform on a safe hydrogen injection and blending standard for California's natural gas pipeline system;

WHEREAS the CPUC has asked investor- owned gas utilities, including SoCalGas, to propose live hydrogen demonstration projects;

***NOW, THEREFORE,*** UCI and SoCalGas enter into this non-binding memorandum of understanding ("MOU") effective as of the 29th of February, 2024.

## I. PURPOSE

UCI and SoCalGas enter into this non-binding memorandum of understanding ("MOU") to collaborate on a proposed multi-year pilot demonstration program to inject and blend hydrogen in a portion of the natural gas distribution system on UCI's campus as further described in Exhibit A attached hereto (the "Project"). This non-binding MOU summarizes principal terms of a proposed collaboration to be set forth in a future, definitive joint demonstration agreement (the "Future Agreement").

This proposed Project is part of a joint investor-owned gas utility ("IOU") CPUC application to study the impacts of hydrogen on California's natural gas infrastructure. Research is to be developed between the IOUs and University of California (UC)

system campuses, including UCI, UC San Diego, and potentially others. The Project requires and is dependent upon approval by the CPUC.

## II. GENERAL CONSIDERATIONS:

1. This MOU does not supersede other existing agreements and/or memorandums of understanding between either of the parties.
2. Each party will retain its primary responsibility for meeting all legal and regulatory requirements pertaining to it and its property.
3. Participation in any phase of the MOU is voluntary. Nothing contained in this MOU shall obligate any party to continue participating in any phase of the MOU and any party may terminate its participation in any phase of the MOU at any time for any reason or for no reason.
4. This MOU is not a contract, but merely a memorandum of the understanding of the parties to coordinate their efforts with respect to establishing the basis for the proposed Project. Neither party shall be bound with respect to any of the matters set forth in this MOU. Nothing in this Agreement shall create, or be construed to be, a joint venture, association, partnership, franchise, or other form of business or contractual relationship. At no time will the employees, agents, or assigns of one party be considered the employees of the other party for any purpose, including, but not limited to, workers' compensation purposes. Neither party shall be authorized to act on behalf of the other party, or to make representations or commitments of any kind on behalf of the other party.
5. Amendments to this MOU may be made by notification of the proposed changes to the other party and will become effective upon written execution by both parties, which may occur in counterparts.
6. This MOU may be terminated by delivering written notice to the other party, effective thirty (30) calendar days following the date of delivery of such written notification.
7. This MOU shall be included as an Exhibit in SoCalGas' testimony to the CPUC.
8. Neither party will use the name, abbreviation of the name, logo, seal, or other mark of the other party (including in any advertisement, press release, or publicity related to this MOU) without that other party's prior written approval. To seek approval, a party will submit a request to the other party's institutional contact, who will assist with obtaining any internal authorization required by their institution.

## III. BOTH PARTIES SHALL WORK TOGETHER ON THE FOLLOWING TASKS:

1. Collaborate to establish Project plan and terms and conditions, including construction, siting, deployment, and removal of associated equipment and utilities and reasonable timelines. For clarity, execution of the Project will be subject to execution of the Future Agreement.
2. Collaborate to determine communications, education, safety, and fire safety protocols with campus staff and residents who may be affected by the Project.

3. Seek to find research collaboration areas to support student and faculty research.
4. To the extent that the implementation of any agreed-upon activity related to the Project requires a commitment of personnel, facilities, funding, intellectual property, or other institutional resources, the parties will negotiate and enter into Future Agreement signed by each party's authorized representative. Future Agreement will specify each party's commitment of resources and terms related to funding, equal opportunity, intellectual property, confidentiality, export control, indemnity, liability and other matters relevant to the Project.
5. Working with and providing relevant information to all UCI administrative committees established to support the Project.

## IV. SUBJECT TO TERMS AND CONDITIONS IN FUTURE AGREEMENT, SOCALGAS SHALL INVESTIGATE:

1. A cut and cap of two pipeline locations to isolate UCI's gas system and to continue providing gas to UCI and non-UCI customers in the area;
2. Managing the design, permitting, construction, procurement and temporary siting on campus of related hydrogen equipment, including fencing, an electrolyzer and blending skid;
3. Testing hydrogen injection and blending on the system in increments from 5% to 20% by volume over the course of the Project;
4. Performing inspections and maintenance of the hydrogen blending facility over the course of the Project;
5. Following the end of the Project, reconnecting the demonstration pipeline system to the main distribution system and removing hydrogen blending equipment;
6. Providing facilitation services to support the UCI community throughout the duration of the Project;
7. Seeking full rate recovery for the Project from the CPUC; and
8. Obtaining all required licenses and/or easements from UCI prior to performing any such work, which licenses and/or easements shall be subject to Future Agreement.

## V. SUBJECT TO TERMS AND CONDITIONS IN FUTURE AGREEMENT, UCI SHALL INVESTIGATE:

1. Providing easements (and/or temporary license) and site access sufficient to install, operate, maintain and remove the Project equipment;
2. Providing facility access to test end use equipment as necessary; and
3. Providing faculty and student engagement to further the achievement of Project goals, for example in the areas of environmental engineering, behavioral sciences, and environmental education, among others.
4. Providing our faculty, students and our broader research community the opportunity to contribute data, information and knowledge on the use of natural gas pipelines for hydrogen transport. The outcomes are expected to contribute significantly to the development of California's hydrogen blending regulations

and support the state's climate and energy goals.

## VI. MISCELLANEOUS:

This non-binding MOU is not a contract, nor an agreement for a contract, but an expression of the intention of the parties to negotiate toward a binding and definitive Future Agreement and such other transaction documents as necessary based on the understandings contained herein and such additional or different terms as may be mutually acceptable to the parties. Neither party shall have any obligation to commence or continue negotiations for Future Agreement and may terminate negotiations for Future Agreement at any time for any reason or no reason whatsoever. Neither of the parties shall be bound with respect to any of the matters set forth in this MOU, except to the extent such matters are contained in binding and definitive transaction documents executed by both parties. Any such definitive transaction documents will contain usual and customary provisions for transactions of the types contemplated therein with due regard for applicable tax, financial, indemnity, liability, and regulatory requirements.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding as of the last date written below:

| UNIVERSITY OF CALIFORNIA IRVINE | SOUTHERN CALIFORNIA GAS COMPANY |
|---|---|
| By: Errol Arkilic, Chief Innovation Officer<br>Full Name and Title | By: Neil Navin, Chief Clean Fuels Officer<br>Full Name and Title |
| DocuSigned by:<br>020736A0F70A409...<br>Signature | DocuSigned by:<br>NEIL NAVIN<br>291B695DE71C478...<br>Signature |
| Date: 2/29/2024 | Date: 2/29/2024 |

Reviewed by: DS AC
Andrew Cheung, Sr. Counsel

**EXHIBIT A**

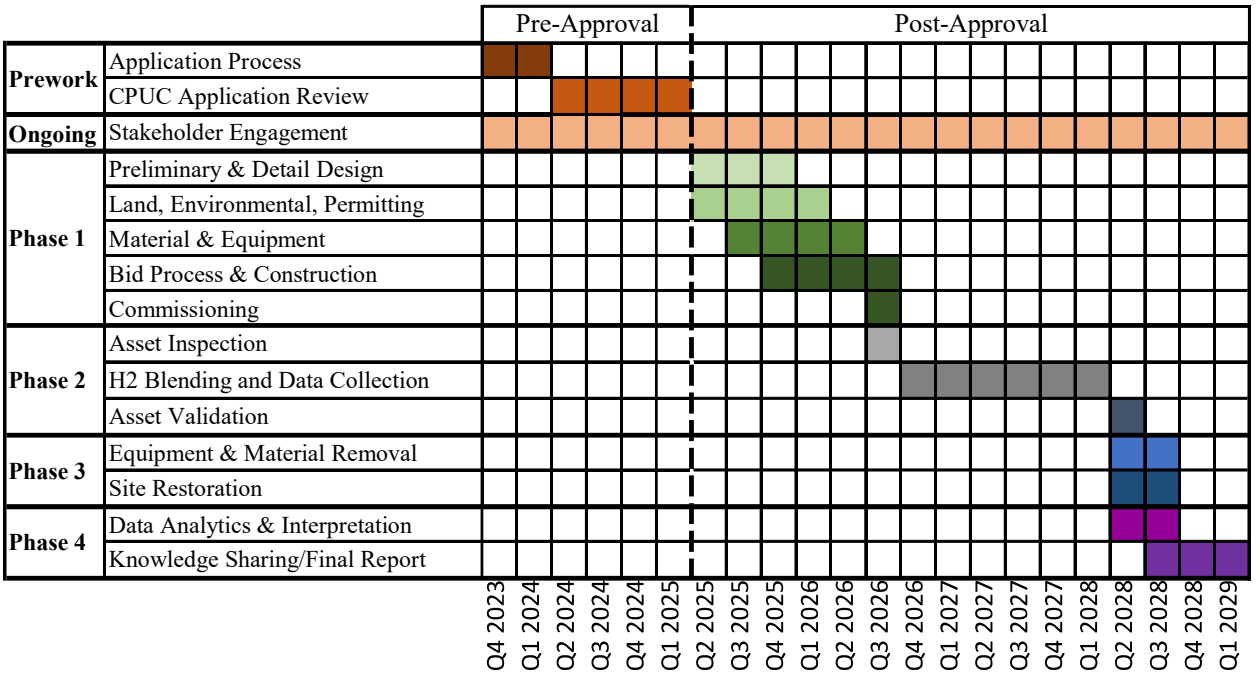
The purpose of the Project on the UCI campus is to specifically provide operational, live blending data for blending from 5% up to 20% hydrogen by volume in an isolated portion of a medium pressure steel and plastic distribution natural gas system. The Project will inform the feasibility of developing a state-wide hydrogen blending standard for steel and plastic pipe gas distribution systems that serve existing customers and equipment in the State of California.

The hydrogen production, storage, and blending equipment will be located in the parking lot of UCI's campus police department on the corner of Campus Dr and E Peltason Dr. The Project will ultimately serve blended fuel to UCI's Anteater Recreation Center (ARC). The Project goal is to safely blend hydrogen into an isolated section of the medium pressure natural gas distribution pipeline system. The Project will begin by observing 100% natural gas in the pipeline system. Once that baseline is established, SoCalGas plans to blend and inject hydrogen into the system, starting at 5% hydrogen by volume and up to 20% hydrogen by volume over time. The blend volume will be gradually increased based on safety and technical feasibility validated with testing throughout the project duration, including evaluating key impacts on safety, odorant, pipes, valves, meters, and unmodified common appliances that will receive the blended gas.

The Project will be divided into four chronological phases ("Phases"). The Phases are briefly summarized in the table below; timing and duration of the Phases are estimated and subject to change. Phases have some overlap. See Estimated Project Schedule for details.

| 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 on campus; 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 | 24 months (18 months live blending and 6 months asset |

| | | |
|---|---|---|
| | post-hydrogen blend exposure | inspection and validation) |
| 3. Decommissioning, Equipment Removal, and System Restoration | Hydrogen equipment is removed from campus, unless otherwise agreed upon with UC Irvine | 6 months |
| 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 on the UCI campus.

**Figure 1: Potential SoCalGas Hydrogen Blending Demonstration Site Layout on UCI campus**

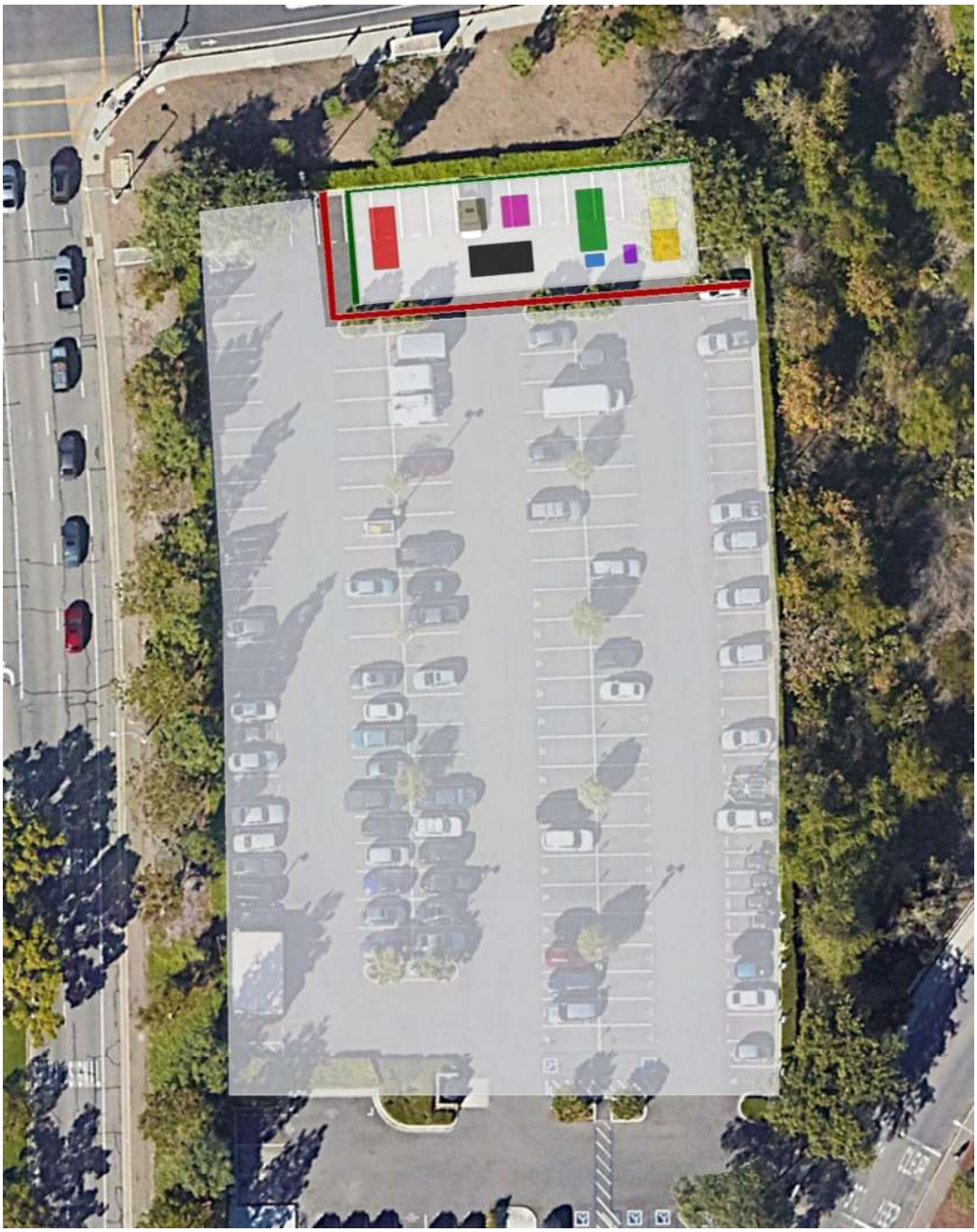


**Figure 2: Preliminary Project Plot Plan**

| Equipment Type | Color |
|---|---|
| Electrolyzer | Green |
| SCADA Building | Orange |
| Storage Shed | Yellow |
| Hydrogen Storage | Red |
| Chiller Unit | Purple |
| Gas Composition Analyzer | Brown |
| Blending Skid | Black |
| Hydrogen Compressor | Pink |

**Figure 3: *Location of Pipelines Performing the Demonstration***


The first cut and cap location is Campus Drive and California Ave to isolate the line on Campus Ave. The second cut and cap location is Arroyo Dr and California Ave to isolate the end users to the east of the campus from receiving the hydrogen blend.