Application: A.22-09-006
Witness: K. Lang
Chapter: 4

PREPARED DIRECT TESTIMONY OF

KEVIN M. LANG

ON BEHALF OF SOUTHWEST GAS CORPORATION

(SOUTHWEST GAS' HYDROGEN DEMONSTRATION PROJECT)

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

March 1, 2024

TABLE OF CONTENTS

CHAPTER 4
PREPARED DIRECT TESTIMONY OF KEVIN M. LANG
(SOUTHWEST GAS' HYDROGEN BLENDING DEMONSTRATION PROJECT)

I. PURPOSE

The purpose of this testimony is to provide a description of and support for Southwest Gas Corporation's (Southwest Gas) proposed hydrogen blending demonstration project in Truckee, California (Project). The Project will help inform a future hydrogen injection standard and support Southwest Gas', Southern California Gas Company's (SoCalGas), San Diego Gas & Electric Company's (SDG&E) and Pacific Gas & Electric Company's (PG&E) (collectively, the Joint Utilities) focus on safety, system integrity, and reliability. Southwest Gas' Project is submitted in compliance with Decision (D.) 21-07-005 and D.22-12-057. issued in Rulemaking (R.) 13-02-008.

Southwest Gas' Project aims to establish critical knowledge complimentary to the other gas utilities' demonstration projects while uniquely targeting hydrogen blending in extremely cold weather conditions in Northern California, which will help determine the threshold for blending hydrogen into Southwest Gas' system and identify the necessary adjustments in training activities, operating policies, and procedures that are imperative for upholding the safety, integrity, and reliability of the system.

The following describes why demonstration projects play a crucial role in discovering critical information necessary to develop a hydrogen injection standard for California:

1. **Real-world Validation**: Demonstration projects provide a real-world testing ground for the proposed hydrogen injection technology. They allow operators, regulators, and stakeholders to validate the performance and safety of hydrogen injection systems in practical applications. This validation is critical for ensuring that hydrogen injection is a viable option for the state of California.
2. **Data Collection**: These projects collect data on the performance and safety of hydrogen-blended systems. This data is essential for operators to make informed decisions and establish standards. The data also helps identify any potential issues or challenges that need to be addressed before widespread adoption.
3. **Environmental Impact Assessment**: California has ambitious environmental goals, and hydrogen injection is seen as a potential pathway to reduce greenhouse gas emissions.

Demonstration projects can provide data on the environmental impact of hydrogen injection.

4. **Safety Evaluation**: Hydrogen is a highly flammable gas, and its safe injection into existing infrastructure is a primary concern. Demonstration projects help assess the safety measures required, such as leak detection, emergency shutdown procedures, and risk mitigation strategies. This information is vital for the utilities in developing operational codes & standards for hydrogen blending.
5. **Cost-Benefit Analysis**: Demonstration projects also aid in conducting cost-benefit analyses. They provide insights into the economic feasibility of hydrogen injection, including the upfront costs, maintenance expenses, and potential cost savings over time. This information is crucial for stakeholders and policymakers to evaluate the economic viability of hydrogen injection right now.
6. **Public Awareness and Acceptance**: By showcasing the technology in real-world scenarios, demonstration projects can raise public awareness and acceptance. When people see the benefits of hydrogen injection firsthand, they are more likely to support its adoption. This support can be crucial for policy implementation.
7. **Stakeholder Engagement**: These projects provide a platform for engaging various stakeholders, including industry experts, environmental organizations, community representatives, and policymakers. This collaboration assists in fine-tuning the policies, procedures, and regulations to ensure they are practical and effective.
8. **Scaling Up**: Demonstration projects can also help identify the challenges and potential roadblocks to scaling up hydrogen injection across the state. This information is valuable for creating a roadmap for a gradual, systematic transition to hydrogen injection technology.
9. **Policy Development**: The data and insights gained from demonstration projects will directly inform the development of policies and standards. This information assists policymakers in the establishment of specific targets, regulations, and incentives for the adoption of hydrogen injection technology.

Demonstration projects serve as a critical phase in the process of developing a hydrogen injection standard for California. They provide the necessary data, validation, and insights to

ensure that the technology can be safely and effectively integrated into the state's energy infrastructure, while also aligning with its environmental and economic goals.

II. PROJECT DESCRIPTION

i. Background

Through the collaboration of third-party experts in the field of hydrogen and data collection, Southwest Gas' Project aims to rigorously examine and document the hydrogen blending process in a high-altitude, cold weather climate. The scope of Southwest Gas' proposed Project is unique as it contemplates testing the emerging technology in one of the coldest regions in California and on commercial customers with different natural gas appliances including a back-up natural gas generator, a range, gas lights, radiant heaters, furnaces, boilers, and water heaters. To demonstrate confidence in the blending demonstration testing, Southwest Gas is implementing the technology within its own operations building in Truckee, California, serving as the inaugural recipient of the hydrogen blended gas.

Gaseous hydrogen has different properties from natural gas, including higher flammability and lower energy content per volume. As a result, determining the optimal percentage blend in extremely cold areas, which dictates higher heating demand, is further affected by the physical properties of hydrogen in cold temperatures. Understanding how much hydrogen can be blended in these areas will serve as a threshold to discover the optimal percentage blend in this extreme end of the weather spectrum in California. Truckee, California is an ideal location to gain understanding of how hydrogen blending affects the existing natural gas system on the extremities of cold weather conditions in the State. Truckee is a mountain community located in the northern Sierra Nevada Mountain Range at an elevation of 5,817 feet. For eight months of the year, the average low temperature is below freezing. The average high and low temperatures of Truckee are provided in the table below.

Table 1: Average Temperatures (Fahrenheit) in Truckee, CA

Average Temperatures (Fahrenheit) in Truckee, CA						
	Jan	Feb	Mar	Apr	May	Jun
Average high in °F	41°F	44°F	49°F	55°F	64°F	74°F
Average low in °F	14°F	16°F	21°F	24°F	31°F	36°F
Avg snowfall in inches	41”	44”	34”	16”	4”	1”

	Jul	Aug	Sep	Oct	Nov	Dec
Average high in °F	83°F	82°F	75°F	64°F	49°F	40°F
Average low in °F	41°F	40°F	34°F	27°F	20°F	15°F
Avg snowfall in inches	0”	0”	1”	4”	19”	38”
Source: usclimatedata.com						

ii. Objectives

The objectives of Southwest Gas' Project are designed to complement the projects proposed by SoCalGas (Chapters 1 and 2), SDG&E (Chapter 3) and PG&E (Chapter 5) and aims to achieve the following:

1. **Optimal Hydrogen Blending Percentages:**
    - Conduct a comprehensive assessment to recommend optimal hydrogen blending percentages. This evaluation will take into account critical system considerations, including but not limited to, the sensitivity of system materials, safety and operational equipment, end-user applications, and variations in supply-demand dynamics resulting from seasonally cold weather.
2. **Operational and Emergency Response Manual Enhancements:**
    - Propose recommendations for modifications to Southwest Gas' operations, emergency response manuals, and associated policies. This includes the refinement of operational and training procedures to seamlessly incorporate and accommodate the nuances of hydrogen blending within the natural gas system.

iii. Scope

The active portion of Southwest Gas' Project will take place over an 18-month period, and will include the generation of electrolytic hydrogen, the seamless flow of hydrogen-blended gas through diverse infrastructure, a phased increase in hydrogen blending levels for injection into an isolated system serving Southwest Gas' Truckee Operations Office, a new commercial development and the California Highway Patrol. The Project will serve approximately 1,425-feet of 4-inch, 2,300-feet of 2-inch, and 150-feet of 1-inch high-density polyethene pipe. Pipeline facilities to be served by the project were installed in 2003, 2005, 2017, 2018, and 2022. All pipeline facilities have a Maximum Allowable Operating Pressure (MAOP) of 60 PSIG. Related materials that will also be served by the Project include tapping tees, excess flow valves,

couplings, inline tees, end caps, risers, and meter set assemblies. Existing delivery pressure for the meter set assemblies are set to 2 PSIG with expected delivery pressures for the new commercial development ranging from 7-inches water column (0.25 PSIG) to 2 PSIG.

1. **Generation of Hydrogen:**
    - The Project will utilize an electrolyzer to split local municipal water to create and capture electrolytic hydrogen for subsequent blending or storage for future use. The only byproduct, oxygen, will be released into the atmosphere. The Project will use Truckee's electricity grid which currently uses up to 60% renewable energy with the end goal of reaching 100% renewable electricity by 2030.[1]
2. **Comprehensive Flow of Hydrogen-Blended Gas:**
    - The Project will flow hydrogen-blended gas at medium and low pressures[2] through various components, including plastic pipelines, steel or copper house lines, and diverse end-user equipment, maintaining this flow throughout the entire 18-month project duration. This approach ensures a thorough examination of the compatibility of hydrogen blending with diverse infrastructure elements.
3. **Progressive Hydrogen Blending Levels:**
    - The Project will implement a systematic increase in hydrogen blending levels, progressing from 5% up to 20% by volume, thereby assessing the performance and feasibility of incremental changes in hydrogen concentration. This phased approach over the 18-month project duration will provide valuable insights into the technology's adaptability and operational efficiency at scale. The higher the percentage blend of hydrogen, the greater displacement of methane (CH4) in the pipeline and reduction in the total amount of carbon dioxide (CO2) generated from combustion at the end-use appliances.
4. **Commercial End Use:**
    - Integrate the project scope with commercial accounts characterized by a peak hour load of approximately 17 MCFH. This load is derived from the usage patterns of two established customers, Southwest Gas' Truckee Operations Center

[1] *See* https://public.nzero.com/truckee/#:~:text=Truckee%20Donner%20PUD%20consistently%20provides,its%20way%20to%20reaching%20100%25.

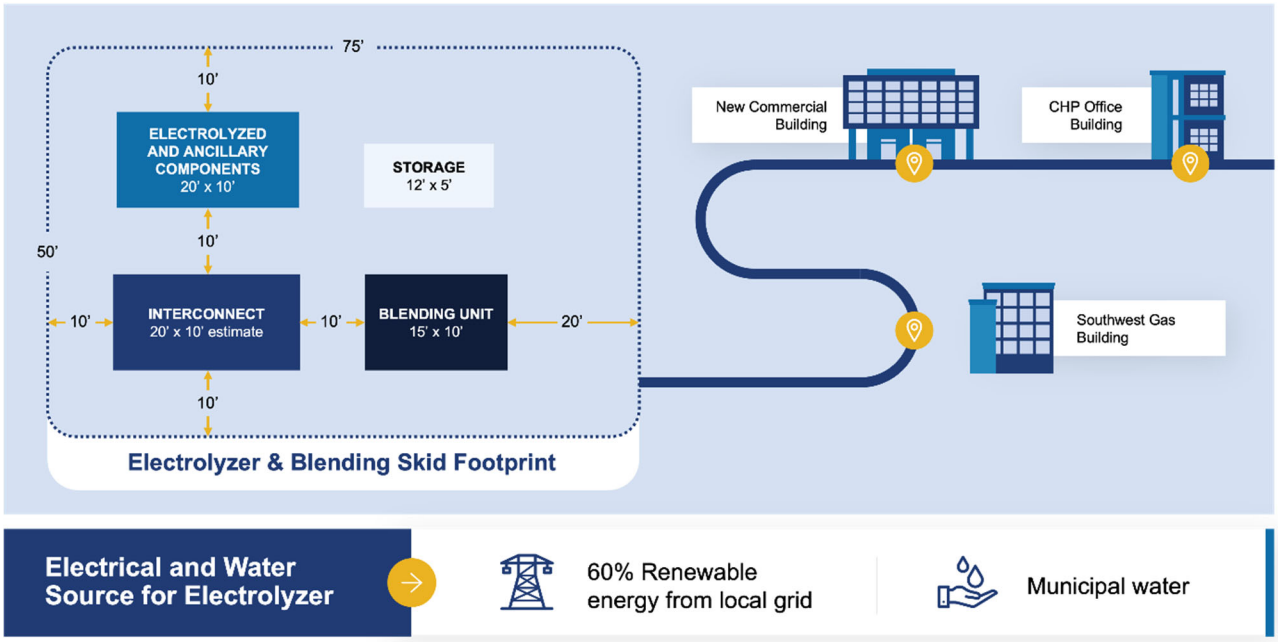
[2] Main pipeline pressure is 60 PSIG, while the end-use pressure is ~0.25 PSIG up to 2 PSIG.

and the California Highway Patrol office, (illustrated in Figure 1), and the anticipated requirements of a forthcoming commercial development, slated for construction in 2024, consisting of up to 16 new customers. This expansion of commercial accounts adds towards a holistic evaluation across diverse operational scenarios.

The Project will gather a comprehensive understanding of the technology's performance, reliability, and scalability across various operational contexts and scenarios.

Figure 1: Proposed Blending Demonstration Site

Figure 2: Proposed Electrolyzer Set-up and Connecting Customers



iv. Project Timing

PHASE & ACTIVITY	DESCRIPTION	ESTIMATED DURATION
1. Planning, Design, Construction and Commissioning	Hydrogen equipment is procured; system is designed, constructed, permitted, and commissioned on campus; pipeline system replacement and inspections and any necessary remediation are conducted; stakeholder engagement commences.	21 months
2. Testing and Demonstration	Hydrogen is blended in system on a testing schedule; data is collected; periodic inspection of equipment and pipelines; samples of pipelines and components are collected	21 months (18 months live blending, + 3 months asset inspection & validation)
3. Decommissioning & Equipment Removal, and System Restoration	Hydrogen equipment is removed from campus and campus restored;	5 months
4. Knowledge Sharing	Data from pilot is interpreted and disseminated; a public report will be released	9 months

A. PHASE 0: Pre-Development

The initial stages of planning and developing this project fall under the category of "Pre-development." Stakeholder and community engagement has been initiated as part of Phase 0 of the Project and will continue through the duration of the Project up until dissemination of the final report. More detailed information on our stakeholder engagement plan can be found in

Section III.E of this testimony. Following the approval of this application, Southwest Gas will engage with one or more third-party experts to outline the subsequent phases. This includes the creation of a comprehensive testing plan that details the activities to be monitored and reported during the course of the Project. An illustrative data collection plan is provided in Table 2.

Table 2: Illustrative Data Collection Plan

Area	Objective	Frequency	Pre-Demo	During Demo	Post-Demo
Odorant sampling	Confirm that hydrogen does not affect the efficacy of the current natural gas odorant.	Monthly	✓	✓	
Leak surveys	Perform safety checks; repair any leaks before starting the demo; determine if hydrogen blends affect leakage from fittings, valves, etc.	Monthly and as needed for customer service calls	✓	✓	✓
Leak survey equipment	Validate the 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 (polyethylene piping, elastomers, rubbers, valves, fittings) after exposure to hydrogen blends.	Before demo and post-demo	✓		✓
Customer meters	Compare data from meters and blending skid data to confirm the accuracy of meters.	Monthly		✓	✓
End-use equipment evaluation	Ensure equipment is working correctly; validate gas interchangeability calculations and lab testing that has been done.	Monthly and as needed for end-use equipment	✓	✓	✓
End-use equipment checks for emissions, including NO_x	Measure emissions from the fuel cell.	To be determined	✓	✓	

It is important to note that any efforts undertaken prior to the Commission's approval of this Project are collectively termed as "Pre-development."

B. PHASE 1: Design, Construction, and Commissioning

Upon approval of the Application, Southwest Gas will proceed with designing, engineering, and constructing a short segment of pipeline to supply natural gas to the blending skid at its Truckee Operations facility, serving the building and both the connected commercial buildings downstream of the isolated distribution system. Southwest Gas will collaborate with an Engineering Procurement Construction (EPC) firm to oversee the engineering, procurement, construction, and commissioning of the hydrogen production facility, along with storage and blending skid at the Truckee Operations facility.

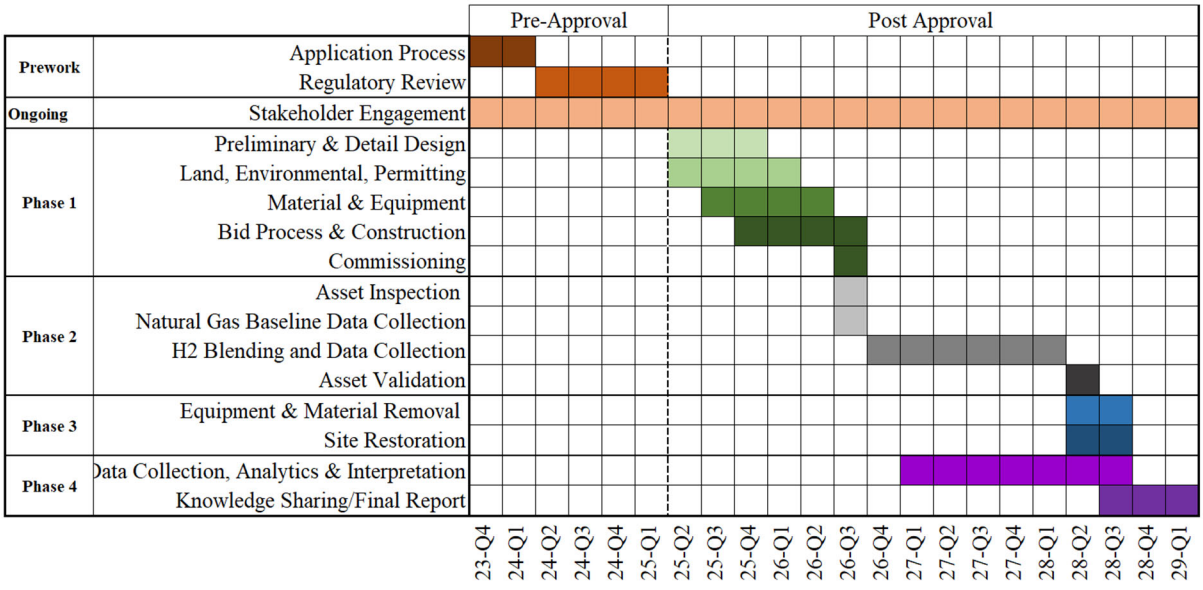
Project Schedule

Figure 3 below provides an estimated project timeline. The schedule is contingent upon Commission approval. Based on discussions with equipment suppliers surrounding the blending skid, electrolyzer, controls equipment, and contract labor, the following are time estimates associated with acquiring equipment from time of purchase.

Electrolyzer Procurement:	6 – 12 months
Blending Skid & Storage:	12 – 18 months
Construction:	12 months

This project schedule assumes normal material procurement times.

Figure 3: Proposed Project Schedule



C. PHASE 2: Testing and Demonstration

To ensure a systematic and thorough evaluation of the Project, Southwest Gas is committed to a collaborative effort with a third-party expert. This collaboration will entail conducting a scientific and comprehensive baseline assessment of asset and operational equipment inspections, all under normal 100% natural gas operating conditions.

As Southwest Gas progressively integrates higher percentages of hydrogen into its system, following the testing schedule outlined in *Table 2*, data collection will occur quarterly along with concurrent periodic inspections of equipment and pipelines to ensure ongoing safety and performance. Additionally, annual project status updates will be submitted to the Commission, as well as regular updates to the surrounding community about major milestones of the Project consistent with the Commission's stakeholder engagement.

Table 2: Incremental hydrogen blending percentage schedule

% 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

Recognizing the critical importance of a well-designed test plan and continuous analysis, Southwest Gas will actively engage with one or more independent third-party expert(s) to conduct rigorous scientific testing and analysis. This collaboration encompasses the entire process, from test plan development through asset inspection, ongoing analysis, and the comprehensive reporting of findings. This multi-faceted approach ensures a cohesive and comprehensive evaluation of Project, aligning with Southwest Gas' commitment to transparency and the highest standards of operational integrity.

Live Hydrogen Blending, Data Collection

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

- Odorant compatibility
- Leak detection equipment compatibility
- Material compatibility

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

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

The hydrogen equipment, encompassing elements such as the electrolyzer and blending skid, will be systematically decommissioned, and removed from the site. Following this process, Southwest Gas will restore the site to its pre-Project condition. Additionally, the three buildings associated with this initiative will seamlessly transition back to 100% natural gas service. This transition will be executed without any planned service interruptions to customers or disruptions to the surrounding community.

E. PHASE 4: Data Analysis and Dissemination

Following a thorough analysis of the demonstration data, Southwest Gas will compile and release a comprehensive public final report. The report will present the Project findings and also provide recommendations for optimal hydrogen percentage blends, particularly in the context of extremely cold weather conditions. Moreover, the report will offer valuable guidance on how these findings will contribute to the development of the preliminary hydrogen injection standard for the state of California.

III. PROJECT GUIDANCE

A. API RP 1173 Pipeline Safety Management System

Southwest Gas' Project will adhere to the American Petroleum Institute's (API) Recommended Practice 1173: Pipeline Safety Management System and will integrate the Plan-Do-Check-Act (PDCA) model into the Project. The PDCA model, as a continuous improvement cycle, will play a pivotal role in the Project management approach. The PDCA is a four-step loop that involves planning, implementing, reviewing, and taking corrective actions based on safety checks and efficiency evaluations. This dynamic process is instrumental in addressing challenges, managing unexpected issues, and ensuring adaptability throughout the Project

lifecycle. By embracing the PDCA model, Southwest Gas aims to enhance the efficiency and effectiveness of the Project, wherein the Project plan is regularly reviewed, adjustments are made as necessary, and changes are seamlessly integrated to enhance overall project performance and safety standards.

Overarching Safety Case

The Project represents a significant step towards advancing sustainable energy solutions while ensuring the highest safety standards throughout the Project's lifecycle. Southwest Gas' primary objective is to seamlessly demonstrate and collect data for the safe integration of hydrogen into its natural gas infrastructure while safeguarding the well-being of the customers and community it serves, its employees, and property.

Risk Assessment: A comprehensive risk assessment has been conducted, considering potential hazards associated with hydrogen blending. This evaluation encompasses factors such as material compatibility, equipment integrity, leak detection, and emergency response protocols. By identifying and understanding these risks, Southwest Gas can proactively implement measures to mitigate and manage them effectively.

Third-Party Expert Involvement: To ensure an objective and thorough safety evaluation, a reputable and scientific third-party expert in hydrogen safety will be engaged. This expert will provide expertise in assessing potential risks, validating safety measures, and confirming the compatibility of the system with hydrogen blends. The expert third-party involvement adds an additional layer of assurance to Southwest Gas safety protocols.

Compliance with Regulatory Standards: Southwest Gas' Project is designed to adhere strictly to all relevant regulatory guidelines as directed in D.22-12-057. This includes compliance with approved monitoring, reporting, and a long-term impact study, as directed by the Commission.

Emergency Response Preparedness: A robust emergency response plan will be developed, outlining procedures for addressing potential incidents promptly and effectively. Southwest Gas employees will undergo hydrogen emergency response training to ensure they are well-prepared to respond to any unforeseen circumstances. Drills and simulations will be conducted to reinforce emergency response protocols.

Community Engagement and Transparency: Southwest Gas recognizes the importance of engaging with the community and fostering transparency throughout the Project. Regular communication channels will be established to disseminate information, address concerns, and gather feedback. Community involvement is integral to our commitment to accountability and responsible project management.

Continuous Monitoring and Improvement: The safety of the Project is an ongoing priority. Continuous monitoring of system performance, environmental impacts, and safety metrics will be conducted. Any lessons learned or areas for improvement that are identified during the project will be promptly addressed to enhance safety protocols.

B. Enbridge Gas Inc.'s (Enbridge Gas) Hydrogen Blending Demonstration Project in Canada

Enbridge Gas' Hydrogen Demonstration Project showcased a commitment to innovation and sustainability, setting a commendable precedent in the successful implementation of hydrogen blending projects similar to Southwest Gas' pilot project scope of work (i.e., blending in a colder climate). By referencing their demonstration project, Southwest Gas aims to leverage the invaluable lessons learned, best practices observed, and industry-leading insights gained, laying a solid foundation for the strategic direction and successful execution of our own initiatives.

Enbridge Gas achieved groundbreaking success with North America's first hydrogen blending initiative in Markham, Ontario. Their project aimed to reduce the carbon footprint of natural gas delivery by integrating clean hydrogen into the distribution network. The project, fully operational and serving approximately 3,600 customers, utilized Enbridge's existing Markham Power-to-Gas facility, and involved blending hydrogen into Enbridge Gas' natural gas framework, resulting in lower-carbon natural gas delivery to consumers. Notably, the project had the capacity to abate up to 117 tons of carbon dioxide annually.[3] The success of the project was underscored by regulatory support, government recognition, and collaboration with key partners. The Minister of Natural Resources in Canada, Jonathan Wilkinson, commended the effective use of hydrogen as part of the government's plan to reduce emissions. The Enbridge Gas project not only showcased technological innovation, but also demonstrated a scalable and replicable model

[3] Clean hydrogen enters the Markham energy mix. (2022, January 13). *www.enbridge.com*. https://www.enbridge.com/stories/2022/january/hydrogen-blending-project-enbridge-gas-cummins-operational-markham-ontario

for similar initiatives. The pilot's success positioned Enbridge Gas to pursue larger-scale hydrogen-blending activities in Canada, validating their commitment to a clean energy future and contributing to the reduction of greenhouse gas emissions. Drawing inspiration from the success of Enbridge Gas' project, the Joint Utilities can leverage this exemplary model to develop the first hydrogen injection standard in the United States.

C. Risk Identification and Assessment

With the introduction of hydrogen into Southwest Gas' natural gas system, careful consideration of potential adjustments to safety protocols and operational procedures will be performed. Safely conducting hydrogen blending demonstrations has been proven, as mentioned in the above Enbridge Gas example in Canada, and the UK's HyDeploy project, as discussed in SoCalGas' Chapter 1. Adequate resources are crucial to support the enhancement and implementation of policies, procedures, and training to effectively manage potential risks. Additional aspects that require assessment and potential adjustments to Southwest Gas Policies and Procedures that will be addressed by this Project include:

- Purging & Ventilation
- Leak Detection
- Damage Prevention
- Corrosion Control
- Integrity Management
- Electronic Instruments
- Emergency Response
- Facilities Protection
- Gas Control
- Gas Quality
- Metering
- Main & Service Pipeline Design
- Pressure/Temperature Recorders
- Odorization
- Pipe & Component Testing & Design
- Pipe Joining
- Pigging Design
- Pressure Control Design
- Process Transmitters Inspections and Calibration Procedure
- Repairs
- Supervisory control and data acquisition (SCADA)
- Selection of Materials
- Welding
- Tools & Equipment

D. Environmental Impact Testing Methods

Southwest Gas' Project site is unique in that it is located in an area of environmental attainment, which means it meets or exceeds the environmental goals set locally or by the Environmental Protection Agency. To mitigate and monitor potential environmental impacts from the Project, Southwest Gas will select and apply a set of air quality testing protocols, i.e., South Coast Air Quality Management District Rule 1146, for example. The final determination of which air quality protocols or rules Southwest Gas will apply will be determined based on potential impacts, stakeholder feedback, environmental expertise, and third-party experts. By implementing an air quality standard Southwest Gas will require additional resources, careful planning, and ongoing monitoring yet it is committed to incorporating an appropriate set of rules for monitoring air quality as an integral part of our project's testing methodologies. By implementing air quality standards, Southwest Gas will meet project objectives and understand the environmental impacts of hydrogen blending.

E. Stakeholder Engagement Plan

Stakeholder engagement is a critical component of Southwest Gas' Project implementation. Southwest Gas' Stakeholder Engagement Plan aims to inform and educate the public of this regarding its Project in Truckee, California. Open and transparent communication with stakeholders will foster a sense of ownership, build trust, and enhance the project's overall success.

Stakeholder Engagement Plan Objectives

1. **Inform:** Ensure the community is well-informed and educated about the Project, its goals, potential benefits, and impacts.
2. **Engage:** Actively involve stakeholders, seeking their input and addressing concerns regarding the Project.
3. **Build Trust:** Establish and maintain trust with the community by being transparent and responsive.
4. **Foster Collaboration:** Encourage collaboration between the Project team, community members, and relevant authorities.
5. **Mitigate Concerns:** Address and mitigate any concerns or issues raised by stakeholders.

Stakeholder Identification

Some examples of stakeholders in this Project may include:

1. **Customers:** The customers who will be directly affected by the Project.
2. **Local Businesses:** Business owners and employees in the community.
3. **Local Government:** Municipal authorities, local councils, and relevant government agencies.
4. **Environmental Groups:** Organizations and individuals concerned with environmental impacts.
5. **Media:** Local newspapers, TV stations, and online news outlets.
6. **Project Team:** The internal project team responsible for planning and execution.
7. **Regulatory Agencies:** Authorities responsible for project approvals and compliance.

Communication Channels

To effectively reach and engage with the identified stakeholders, Southwest Gas may utilize a variety of communication channels, which may include:

1. **Community Meetings:** Regular in-person and virtual meetings to provide Project updates and gather input.
2. **Project Webpage:** A dedicated website with Project information, updates, and a feedback mechanism.
3. **Social Media:** Utilize platforms such as Facebook, X (formerly Twitter), and Instagram for announcements and engagement.
4. **Local Media:** Press releases and interviews with local media outlets.
5. **Direct Mail:** Postcards and letters distributed to nearby residents and businesses.
6. **Email:** A dedicated email to address questions and concerns.
7. **Community Surveys:** Anonymous surveys to collect feedback and concerns.
8. **Public Hearings:** Official public hearings to present the Project and receive input.

Engagement Timeline

- **Pre-Design Start:** Initial public meeting to introduce the Project and gather preliminary feedback.
- **Throughout the Project:** Regular updates, meetings, and newsletters to keep stakeholders informed.

- **Milestone Announcements:** Significant Project milestones communicated to the public.
- **Post-Project:** A final meeting to summarize Project outcomes and impacts.

Community-Based Organizations

Southwest Gas proactively identified various relevant community-based organizations (CBOs) within Truckee and surrounding communities. Southwest Gas has initially communicated with the identified CBOs to gauge interest and future participation in update meetings as further described in response to OP 7h in Section IV. Southwest Gas plans to either hold stakeholder meetings for participation or provide written communication of Project status during each Phase. Southwest Gas will provide compensation to CBOs at a rate of $100 per hour for their participation at stakeholder engagement meetings when held either virtually or in person. Southwest Gas 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.

Feedback and Response Mechanism

A dedicated team will be responsible for monitoring the feedback received from stakeholders through the various channels outlined above. Concerns, questions, and suggestions will be documented and addressed in a timely manner. Responses will be provided through the chosen communication channel or during community meetings.

Evaluation and Continuous Improvement

The stakeholder engagement process will be regularly evaluated to assess its effectiveness in meeting the communication objectives. Feedback from stakeholders and lessons learned will inform continuous improvements to the plan.

F. Reporting

Southwest Gas is committed to ensuring a rigorous scientific evaluation of hazards, risk analysis, and system compatibility throughout the Project. To maintain an objective and thorough assessment, one or more third-party expert(s) will be engaged. These experts will conduct a comprehensive baseline and periodic analysis of the materials, components, and equipment within the isolated system slated for hydrogen introduction. This evaluation encompasses critical elements such as materials, corrosion, electronic instruments, SCADA, metering equipment, leak detection tools, house lines, and end-user equipment.

The assessment protocol includes a meticulous baseline and periodic examination, analyzing existing materials and components to report on all factors, whether affected or unaffected, that relate to the integrity of the system. Simultaneously, existing policies and procedures will be reviewed to identify recommended changes aimed at enhancing safety protocols.

Furthermore, Southwest Gas will submit of annual progress reports on the Project to the Commission. These reports will detail the current status of the Project and relevant findings. At the culmination of the demonstration program, a comprehensive final report will be made publicly available. This report will not only summarize the annual progress but will also present a recommended optimal percentage blend based on the specific conditions encountered during the Project's duration.

IV. ORDERING PARAGRAPH 7 COMPLIANCE

Ordering paragraphs from D.22-12-057 outlined several requirements for the implementation of hydrogen blending demonstration projects. The Joint Utilities engaged with the Commission's Energy Division throughout the development of this Amended Application to ensure that orders were carefully understood and followed. Below is a detailed discussion of how Southwest Gas' proposed Project is in compliance with OP 7 in 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;*

The long-term safety of Southwest Gas' pipeline system is of utmost importance. Through protocol development with hydrogen safety experts and its own expertise in leak detection, Southwest Gas will comply with existing safety standards while considering the unique challenges introducing hydrogen may present. In addition, Southwest Gas will seek guidance from the staff that conducted the University of California Riverside Hydrogen Impact study and leverage existing connections with scientific experts through our existing research consortium partnerships, to ensure applicable testing methodologies are consistent and complimentary to the findings in the UCR Report.

Hydrogen leakage: Southwest Gas will implement a hydrogen leakage detection plan to assess and quantify if hydrogen leakage is occurring within its gas system. This Project will

likely use an array of instruments and methods, such as hydrogen detectors for indoors and outdoors, natural gas detectors, and hydrogen-compatible carbon monoxide detectors. A third-party expert in hydrogen leakage will be consulted to help develop a leakage plan that (1) meets or exceeds the minimum interval and distance requirements of our natural gas leak detection policies and (2) in a way that hydrogen leakage can be quantified if or when detected.

Over the past few years, Southwest Gas has and continues to invest in research & development (R&D) related to hydrogen leakage detection advancements achieved by respected industry R&D consortiums, such as Gas Technology Institute (GTI) and NYSEARCH. Given that the development of hydrogen detection equipment in natural gas systems is an ongoing and developing field, the final selection of equipment for the hydrogen leakage detection activity will likely be the most current technology available and utilized during Phase 1 of the Project.

Hydrogen monitoring: Southwest Gas will utilize a gas chromatograph for monitoring hydrogen gas at the beginning of an injection skid to measure hydrogen concentrations. The equipment, technique, and frequency will be determined the assistance of third-party experts in hydrogen safety and data collection.

Consideration of dilution rate: Dilution is not anticipated to impact the gas quality based on research studies available on this topic. Through the use of third-party experts, Southwest Gas will assess dilution rates during the planning phase of the testing and data collection for this Project. This will include sample testing near the customer end use equipment to validate that there are no significant impacts related to the dilution of hydrogen downstream of the natural gas pipeline.

Monitoring and reporting of mechanical characteristics of hydrogen blends in the natural gas pipeline stream: Southwest Gas will employ a third-party research company to assist in developing the monitoring techniques and reporting mechanisms necessary to evaluate the mechanical characteristics of hydrogen blending impacts on pipeline materials.

B. OP 7b

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

Southwest Gas' Project is not adjacent to any natural gas storage areas, as such there is no potential for hydrogen to reach these facilities. Additionally, the Project will adhere to the

relevant National Fire Protection Association codes, ensuring that all electrical equipment is situated at a secure distance from potential hydrogen leakage sources. In the initial phase of the Project, a comprehensive hydrogen leak detection plan will be developed as outlined above.

C. OP 7c

Avoids end user appliance malfunctions;

According to the UC Riverside study, it is suggested that there may be no modifications necessary to end-use equipment for hydrogen blends up to 5%. Additional studies[4] indicate that typical natural gas appliances can take up to 20% hydrogen blending without failure or modifications. Southwest Gas has conducted a preliminary assessment of the appliances through the manufacturer to assess the suitability and compatibility for this Pilot.

If an appliance is assessed and determined to be incompatible for the Project, such as any natural gas equipment containing a combustion chamber (i.e., natural gas generator), then the equipment will be assessed for modification or bypass. Hydrogen separation technologies are in research and development stage for commercialization in the future. If those technologies are commercially available by Phase 1 of this Project, then that equipment would be considered for use to avoid a bypass on sensitive equipment.

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;

Southwest Gas' has structured its Project approach in alignment with the regulatory mandate outlined in OP 7d, which specifies the evaluation of hydrogen injection at blends ranging from 0.1 to five percent and five to twenty percent. Referencing *Table 2: Incremental hydrogen blending percentage schedule* above, Southwest Gas' evaluations precisely correspond to the blending percentages in this OP.

To ensure the thoroughness and precision of our assessments, Southwest Gas will collaborate with a reputable and scientifically proficient third-party expert. This strategic partnership is

[4] Northwest Energy Efficiency Alliance. (2023). Hydrogen-Ready Appliances Assessment Report. In *NEEA.org* (p. IV). 2024 Northwest Energy Efficiency Alliance. https://neea.org/resources/hydrogen-ready-appliances-assessment-report

integral to overseeing and validating Southwest Gas compliance with the mandated evaluation parameters and the gathering and analysis of viable Project data to confirm the performance of the various hydrogen blends throughout the evaluation process.

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;

The Project cost estimates and testing durations are outlined in Sections V and II.iv., respectively, of this testimony. Southwest Gas developed its Project testing duration of 18 months consistent with other notable hydrogen blending studies, such as HyDeploy Trial Phase 1 and Phase 2 demonstrations, and that allow sufficient testing during seasonal gas flows.

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;

Topic	**Recap of Southwest Gas' Response**	Reference
Leakage	The Project will be designed to minimize and monitor leakage. As well as evaluate various leak detection technologies at different hydrogen blends.	Section IV.A
Reporting	The Project's testing program explained will collect, analyze data, and will report the findings of the Project. Southwest Gas will work with a selected third party and the Joint Utilities to report on findings.	Section III.F
Heating value	We are planning to enlist the expertise of a third-party consultancy specializing in energy systems and gas composition analysis. These professionals will conduct comprehensive assessments, examining the system's BTU performance under varying hydrogen concentrations. Their insights will be invaluable in identifying potential challenges related to lowered BTU levels and providing recommendations to optimize system efficiency and ensure accurate billing as the joint utilities work towards the development of a hydrogen injection standard through these demonstrations.	Section IV.J

System Safety	Our overarching safety case underscores our commitment to ensuring the safety and success of the proposed hydrogen blending project. Through thorough risk assessments, third-party expert involvement, regulatory compliance, emergency response preparedness, community engagement, and continuous monitoring, we are confident in our ability to execute this project with the highest safety standards, contributing to the advancement of sustainable and responsible energy solutions.	Section III.A.1
Environmental Considerations	The Project will use Truckee's electricity grid which touts up to 60% renewable energy with a goal of reaching 100% by 2030. The Project will use local municipal water to create electrolytic hydrogen.	Section II.iii.1 & Section III.C-D
End-use emissions	To address potential environmental impacts, the company will implement air quality testing protocols, such as SCAQMD Rule 1146, with the specific protocols chosen based on impact assessments, stakeholder input, environmental expertise, and third-party guidance.	Section III.D
Blending limitations	The Project will evaluate hydrogen blending between 5% and 20% by volume in an isolated system feeding up to 18 commercial customers.	Section II.iii
Additional considerations	Section IV addresses how the Project is complying with the directives of decision D.22.-12-057.	

G. OP 7g

Proposes rigorous testing protocols consistent with the UC Riverside Study

Southwest Gas testing protocols will be developed using the help of an independent research party. The scope of work for a contracted third party will include requirements to develop testing protocols to ensure the Southwest Gas Project will be consistent with rigorous protocols used to validate the data collected, analyzed, and reported on consistent with the UC Riverside Hydrogen Impact Study. Furthermore, Southwest Gas intends to collaborate closely with the UC Riverside Hydrogen Impacts Study team, fostering alignment and continuity throughout the testing and data collection phases of the project.

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;

Despite the limited presence of CBOs in the immediate Truckee district area, Southwest Gas proactively engaged with all identified CBOs within Truckee and surrounding areas. Extending outreach efforts beyond Truckee, Southwest Gas identified and contacted 18 community-based organizations and 8 governmental CBOs serving Truckee, along with an additional 17 CBOs supporting the regional area.

An email outreach initiative launched on November 14, 2023, aimed to gauge initial interest and involvement from these CBOs. The initial response yielded 10 organizations actively expressing questions and interest in staying updated about the project. Southwest Gas is attentively reviewing these questions to tailor our outreach, ensuring that the information provided aligns with the community's specific concerns and interests.

As outlined in section III.E of this testimony, Southwest Gas remains steadfast in its pledge to continue comprehensive outreach efforts throughout all phases of the project. This iterative and responsive engagement strategy ensures that stakeholder input is not only valued but actively shapes the trajectory of the project in alignment with community needs and expectations.

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 ensure the standard carrier pipeline system remains 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 to ensure hydrogen blends do not compromise gas system integrity and 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 framework similar to that of 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 the 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;

Southwest Gas adheres to its California Gas Tariff *Rule No. 2 – Description of Service*, which notes a heating value range of 970 to 1,150 BTU/scf. Additionally, Southwest Gas has a minimum Wobbe Number limit of 1280. Preliminary calculations show that with the addition of hydrogen, the heating value may drop below the current tariff limit to approximately 880 BTU/scf at percentage blends of 20% hydrogen. However, given that hydrogen has more energy density, there will likely be negligible impact on heating values when blended into natural gas.

Recognizing the need to assess potential impacts on the system's heating value and its subsequent implications for billing, Southwest Gas will enlist a third-party consultant specializing in energy systems and gas composition analysis. Southwest Gas will require the third-party to conduct comprehensive assessments, examining the system's BTU performance under varying hydrogen concentrations, which will provide valuable insights on identifying potential challenges related to lowered BTU levels and recommendations to optimize system efficiency and ensure accurate customer billing. This proactive approach helps the joint utilities navigate the complexities of adapting to new energy sources while maintaining reliability and cost-effectiveness in our operations. During the 18-month demonstration period, the Company has decided against using propane or alternative methods to maintain heating values. Instead, our

focus is on studying the effects of hydrogen integration, contributing valuable insights to inform the development of a hydrogen injection standard.

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

Southwest Gas, drawing upon its extensive experience in leak detection and protocol development for safely and reliably detecting natural gas leaks, is well-positioned to demonstrate its ability to reliably detect leakage of hydrogen, methane, or hydrogen/methane blends. Leveraging its established knowledge and expertise in natural gas leak detection, Southwest Gas plans to extend its capabilities to hydrogen safety by collaborating with hydrogen safety experts. In Phase 1 of this project, Southwest Gas commits to developing leak detection protocols for hydrogen and hydrogen/methane blends. These protocols will be crafted in collaboration with hydrogen safety experts, ensuring a comprehensive and thorough approach to address the unique characteristics of hydrogen. To further enhance the reliability of the developed protocols, Southwest Gas will consider comments presented by parties in this proceeding and from stakeholder engagement concerning leak issues. Furthermore, Southwest Gas will be aligning its hydrogen leak testing protocols with the leak testing and reporting elements identified in the University of California at Riverside's 2022 Hydrogen Blending Impacts Study. By adopting a framework consistent with the findings and recommendations of this Commission-sponsored study, Southwest Gas ensures that its leak testing protocols are not only precise but also aligned with best practices and scientific insights. Throughout the development of these protocols, Southwest Gas remains responsive to the comments and concerns raised by parties in this proceeding and workshop stakeholders specifically related to leak issues. The commitment to addressing these comments ensures a collaborative and inclusive approach, enriching the effectiveness of the leak testing protocols.

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

The primary objective of the following independent research plan is to establish a robust framework for the continuous assessment, measurement, monitoring, and reporting of the Southwest Gas Project. Engaging an independent party throughout the project's lifecycle—from development and construction to operational life and decommissioning—ensures impartial and thorough evaluation, fostering transparency and accountability.

Key Components to the Independent Research Plan:

Selection of Independent Party: Conduct a thorough and transparent selection process to identify a reputable and independent research entity with expertise in hydrogen projects and a track record of impartiality. Ensure the selected party adheres to industry standards and possesses the necessary credentials to perform comprehensive assessments.

Development Phase: Engage the independent party in the early stages of project development. Assess environmental impact, safety protocols, and adherence to regulatory requirements. Measure the proposed methodologies against industry best practices.

Construction Phase: Monitor construction activities to ensure compliance with approved plans and safety standards.

Operational Life: Implement continuous measurement and monitoring of hydrogen blending processes. Assess the effectiveness of safety protocols and emergency response plans. Monitor air quality and emissions.

Decommissioning: Engage the independent party in the decommissioning process to evaluate the safe removal of hydrogen equipment. Assess the restoration of the site to its original conditions. Measure any potential residual environmental impacts.

Data Collection and Analysis: Establish a systematic approach for data collection and analysis with the independent third party experts. Utilize advanced monitoring technologies to ensure accuracy and reliability of collected data. Regularly review and analyze data to identify trends, deviations, or potential issues.

Reporting: Develop comprehensive and annual reports detailing findings, assessments, and measurements. Present reports to regulatory bodies, stakeholders, and the public in a

transparent and accessible manner. Include recommendations for improvements or modifications based on research findings.

Stakeholder Engagement: Seek input from local communities, environmental groups, and regulatory bodies. Address any concerns raised by stakeholders through the research findings and subsequent actions.

Continuous Improvement: Establish mechanisms for continuous improvement based on research outcomes. Adapt protocols and procedures based on evolving industry standards and emerging best practices. Foster a culture of learning and responsiveness to ensure the project remains aligned with the highest safety standards, environmental responsibility, and operational excellence.

This independent research plan ensures a comprehensive and unbiased evaluation of our project at every stage, promoting transparency, accountability, and the highest safety standards and environmental stewardship.

V. COST ESTIMATES

Activity	Cost
Design & installation of new infrastructure required to support hydrogen blended pipeline (Design, Equipment, Installation)	$350,000*
Design & build hydrogen generator and blending skid, labor, and equipment	$8.13 million**
Baseline readings and data collection	$1.67 million
Periodic analysis and to report concerns and unexpected changes in the system and end-user equipment	
Final Reports	
Decommissioning of Equipment	$62,500
Total Costs:	**$10.21 million**
* ***Cost breakdown Below***	

*Cost estimates associated with installation of utility infrastructure for this project are as follows:

Natural gas (Southwest Gas, Material and Labor): $282,000

Electric and water (Tahoe Donner PUD, Material and Labor): $68,000

Estimated costs of utility infrastructure:	$350,000

**Cost estimates associated with installation of an appropriately sized electrolyzer for this project are as follows:

Electrolyzer (Materials Only):	$805,000
Blending Skid (Material and Labor):	$968,750
Storage	$97,500
Southwest Gas Metering Equipment (Material and Labor):	$12,500
Hydrogen Compound Construction (Labor):	$6,250,000
Estimated costs of electrolyzer build:	$8,133,750

Exceptions to Cost Estimates:

- Cost estimates were not officially bid to subcontractors. Costs are based on rough estimation from subcontractors that Southwest Gas has executed Non-Disclosure Agreements with.
- Southwest Gas has engaged in discussions with multiple companies, including both EPC firms and equipment suppliers, who have demonstrated interest in participating in this project. Upon approval of the Amended Application, Southwest Gas intends to solicit bids from various subcontractors to facilitate the successful execution of the Project.
- These costs represent a preliminary analysis of the Project from our subcontractors. As the Project progresses, we will be able to more accurately determine the costs associated with the Project.
- All costs shown include a 25% contingency above the estimated value.

VI. CONCLUSION

Southwest Gas' proposed Project in Truckee, California, not only addresses the challenges of cold climates but also plays a pivotal role in establishing a comprehensive preliminary hydrogen injection standard for the state of California. Emphasizing safety and scientific rigor, this initiative leverages the distinct characteristics of the Truckee region, providing nuanced insights crucial for the development of a hydrogen injection standard adaptable to diverse geographical and climatic conditions across the state. The project's safety-focused approach aligns with California's commitment to innovation, sustainability, and resilience in energy infrastructure, laying the groundwork for a responsible hydrogen blending framework applicable statewide.

This concludes my prepared direct testimony.

VII. QUALIFICATIONS

My name is Kevin M. Lang and I am the Director/Engineering Services for Southwest Gas. I direct and coordinate engineering and technical support to five operating divisions for pipeline safety code compliance; right-of-way and land rights acquisition, material specifications and approval; proper energy measurement; pipeline cathodic protection; technical support of the SCADA system; project design review; hydraulic modeling support; and the training and qualification of technical services personnel. I previously oversaw the Company's Distribution Integrity Management Program (DIMP) and laboratory services under the same capacity.

I joined Southwest Gas in 2003 as an engineer in Victorville, California. I was subsequently promoted to distribution engineer in 2005, supervisor/Engineering in 2006 and manager/Engineering in 2007. During this period, I oversaw the design of transmission and distribution facilities for new business, franchise and system reinforcements; PVC pipeline replacements; pipeline safety code compliance; MAOP studies and requalification programs; and preparation of short and long-term capital budgets.

I was promoted to Director/Gas Operation Support Staff in 2011 where I directed Southwest Gas' technical skills training, Operator Qualification (OQ) training and testing, tool and equipment evaluations, operations-related procedures manuals, Incident Command System training and operation of Southwest Gas' Emergency Response Training Facilities. I was subsequently promoted to director/Engineering Services in November of 2012.

I hold a Bachelor of Science degree in Mining Engineering from Virginia Tech and am a registered Professional Engineering in the state of Arizona and Nevada with a proficiency in Civil Engineering. I currently serve on the American Gas Association's Operations Safety Regulatory Action Committee.