Proposal to the Legislature for Establishing a State Framework and Standards for Intrastate Pipelines Transporting Carbon Dioxide

Prepared pursuant to Senate Bill 905 (Caballero, Chapter 359, 2022)

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CALIFORNIA NATURAL RESOURCES AGENCY

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EXECUTIVE SUMMARY

This report to the Legislature on a proposal for establishing a state framework and standards for intrastate pipelines transporting carbon dioxide (Proposal) is submitted to satisfy a requirement of Senate Bill (SB) 905 (Caballero, Chapter 359, 2022). SB 905 requires the California Natural Resources Agency (CNRA), in consultation with the California Public Utilities Commission (CPUC), to "provide a proposal to the Legislature to establish a state framework and standards for the design, operation, siting, and maintenance of intrastate pipelines carrying carbon dioxide fluids (CO2) of varying composition and phase to minimize the risk posed to public and environmental health and safety."

This Proposal was developed by the CNRA, Office of the State Fire Marshal – Pipeline Safety Division, CPUC, and California State Lands Commission, collectively referred to as the "Agencies". During the development of this Proposal, the Agencies met with interested stakeholders and held two public listening sessions. The comments provided to the Agencies were considered during the development of this Proposal. This Proposal is not provided to the Legislature as regulations or draft regulations. Instead, it is intended to inform the development of state safety policies for intrastate pipelines carrying CO2 and provides recommendations on next steps.

INTRODUCTION

California has a goal of reaching carbon neutrality by 2045. In a letter sent July 22, 2022, to the California Air Resources Board (CARB) Chair Liane Randolph, Governor Gavin Newsom directed CARB to "set a 20 MMT carbon removal target for 2030 and 100 MMT carbon removal target for 2045".[1] CARB's 2022 Scoping Plan[2] reflects those carbon removal targets and identifies carbon capture and removal as key actions for achieving carbon neutrality.

Carbon capture, utilization, and storage (CCUS) and carbon removal are relatively new technologies in California that involves capturing or removing, compressing, transporting, and sequestering or storing large amounts of carbon dioxide (CO2) from specific emitting sources or removing atmospheric concentrations of CO2. There are currently at least half a dozen of these projects in various stages of development in California.[3]

Transportation is a key component of CCUS and carbon removal projects because the location at which CO2 is captured may be some distance from the point at which it will be geologically sequestered. Transportation of CO2 can occur by marine tankers, rail, trucks, or pipeline. Pipelines are considered the most efficient way to transport CO2, as well as the safest way for the volume of CO2 they move. In some cases, pipelines are also the most cost-effective way to move CO2.

Current Regulation of CO2 Pipelines

CO2 is an odorless, colorless, non-flammable gas. It is denser than air and an asphyxiant. CO2 can be transported in three forms: as a gas, liquid, or in supercritical form. At standard temperature and pressure, CO2 behaves as a gas. When it is cooled and highly compressed, CO2 becomes a liquid. When both the temperature and pressure are increased above the standard temperature and pressure, CO2 exists in a supercritical state. In its supercritical state, CO2 has some properties of a gas and some properties of a liquid.

The Pipeline and Hazardous Materials Safety Administration (PHMSA) is a federal agency within the United States Department of Transportation. PHMSA develops and enforces

[1] 07.22.2022-Governors-Letter-to-CARB.pdf
[2] https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf
[3] UIC Permits in EPA's Pacific Southwest (Region 9) | US EPA

regulations to ensure the safe, reliable, and environmentally sound operation of the nation's pipeline transportation system. PHMSA maintains regulatory jurisdiction over interstate pipelines, which encompasses pipelines that travel between states and in federal waters.

In the area of CCUS and carbon removal projects, PHMSA has no regulatory jurisdiction over interstate or intrastate pipelines transporting CO2 as a liquid. Federal statute provides PHMSA with regulatory authority over interstate and intrastate pipelines transporting CO2 as a gas or in supercritical state.[4] However, PHMSA has not adopted regulations covering CO2 gas pipelines to date. PHMSA has only adopted regulations regarding transport of CO2 in a supercritical state with a concentration of more than 90% CO2. This creates a regulatory gap in ensuring pipeline safety when CO2 is transported in less concentrated forms or as a liquid or gas.

PHMSA's focus on transport of CO2 in a supercritical state and with a concentration of 90% or more CO2 is likely due to the following considerations:

- Transporting CO2 in supercritical state avoids the volatility that may occur as CO2 transitions between the different phases during gas transport. Gas could turn into a combination of gas and liquid which is not stable and increases the risk of pipeline issues.
- Transported CO2 composed of at least 90% CO2 molecules is less likely to contain contaminants that could increase the risk of pipeline failures.
- Due to the properties of a gas, when an impurity occurs in CO2 gas, it has a higher potential for pipeline corrosivity when compared to that same impurity occurring in CO2 in a supercritical state, and therefore increases the risk of pipeline failures.
- More is known about CO2 in supercritical state which lends itself to a better understanding of engineering and safety related concerns over CO2 gas.
- Shipping CO2 in gas form is less efficient when compared to shipping CO2 in a supercritical state due to the volume capacity and cost.
- Shipping CO2 in a supercritical state limits the issues surrounding temperature, strength of pipe, and fracture mechanics.

PHMSA is in the midst of a rulemaking to update their safety standards for inter- and intrastate CO2 pipelines.[5] That rulemaking is estimated to be completed by the end of 2024. PHMSA has indicated that the standards will strengthen CO2 pipeline safety and include requirements related to emergency preparedness and response, but no draft

[4] Title 49 of the United States Code 60102(i) for CO2 in a gas and/or liquid state; Title 49 of the United States Code 60102 and Title 49 of the Code of Federal Regulations, Part 195.1 for CO2 in a supercritical state.
[5] https://www.reginfo.gov/public/do/eAgendaViewRule?pubId=202204&RIN=2137-AF60

language has been shared to date. As California is considered an outside party, California is limited to only receiving information that is communicated publicly.

The Office of the State Fire Marshal – Pipeline Safety Division (OSFM) is part of the Department of Forestry and Fire Protection (CAL FIRE), within the California Natural Resources Agency (CNRA). OSFM maintains regulatory jurisdiction over hazardous liquid intrastate pipelines which transport petroleum, petroleum products, CO2, highly volatile liquids, anhydrous ammonia, and ethanol or other non-petroleum fuel including biofuel, which is flammable, toxic, or would be harmful to the environment if released in significant quantities.[6] The OSFM regulates the safety of approximately 5,850 miles of intrastate hazardous liquid transportation pipelines through a PHMSA certified compliance and enforcement program. With this certification, OSFM assumes inspection and enforcement responsibility with respect to intrastate facilities over which it has jurisdiction under State law. In relation to federal standards, OSFM may adopt additional safety standards for intrastate pipeline facilities provided such standards are compatible with federal regulation. Those safety standards may be more restrictive or stringent than federal regulation. The OSFM has been a certified State agent for the federal government since 1984.

The California Public Utilities Commission (CPUC) regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. As part of their jurisdiction, the CPUC ensures that intrastate natural gas and liquid petroleum gas pipeline systems are designed, constructed, operated, and maintained according to safety standards set by the CPUC and PHMSA. CPUC's existing authority does not extend to intrastate CO2 gas pipelines.

Currently, no intrastate CO2 pipelines exist in California. When such pipelines are developed, OSFM will exercise jurisdiction over intrastate CO2 pipelines through the existing federal pipeline safety state program agreement.[7] This agreement delegates authority for the OSFM to regulate intrastate pipelines that carry CO2 compressed to a supercritical state and composed of at least 90% CO2. Pipelines transporting less than 90% CO2, including CO2 in a liquid or gas form, would likely fall outside the scope of existing regulation, leaving regulation of pipelines transporting CO2 composed of less than 90% CO2 or in a liquid or gas form to local jurisdictions and those states who choose

[6] See 49 CFR 195.2 definitions. The OSFM imports federal definitions for hazardous liquids through its certification with PHMSA. Note, carbon dioxide "means a fluid consisting of more than 90 percent carbon dioxide molecules compressed to a supercritical state." See also 49 USC 60101 definitions.

[7] The OSFM is a certified state pipeline safety division under PHMSA's state program requirements consistent with Title 49 of the United States Code 60105 and has maintained certification since program inception in 1983.

to adopt related regulations.

At this time, significant regulatory uncertainty exists regarding the design, operation, siting, and maintenance of intrastate CO2 pipelines, regardless of the state that CO2 is transported: liquid, gas, or supercritical. The OSFM is currently limited to applying only federal safety standards to CO2 pipelines: transport of supercritical CO2 that is composed of at least 90% CO2. Establishing separate standards in California that are in addition to federal regulation is only possible if changes are made in State law.

Senate Bill 905

In 2022, Senate Bill (SB) 905 (Caballero, Chapter 359, 2022) was enacted. Among other things, SB 905 prohibits the use of intrastate pipelines to transport CO2 until PHMSA completes its rulemaking. However, "in-facility piping" or pipelines for projects where the CO2 is captured and stored within the same property can be utilized. SB 905 requires the CNRA, in consultation with the CPUC, to "provide a proposal to the Legislature to establish a state framework and standards for the design, operation, siting, and maintenance of intrastate pipelines carrying carbon dioxide fluids of varying composition and phase to minimize the risk posed to public and environmental health and safety".

This report responds to Legislative direction by proposing a state framework and standards for the design, operation, siting, and maintenance of intrastate CO2 pipelines that can inform discussion of possible statutory changes in this area (Proposal). It intends to improve understanding of how intrastate CO2 pipelines may be developed and implemented in California, and how any risk posed to public health, safety, and the environment by these pipelines can be minimized. The report does not propose specific requirements for future intrastate CO2 pipelines; such requirements would be developed through an established statutory and regulatory process called for in state law.

Outreach and Engagement

Agencies solicited input from a variety of interested stakeholders, including community groups and project developers, to help inform this report and Proposal to the Legislature. Additionally, OSFM communicated with colleagues at PHMSA to discuss PHMSA's CO2 pipeline rulemaking and pipeline issues. OSFM also engaged with the Pipeline Safety Trust, a nonprofit public charity that promotes pipeline safety, including attending the Trust's December 2022 Pipeline Safety Conference.

In January 2023, the CNRA convened two public listening sessions: one session convened online and one hybrid session in Bakersfield that allowed in-person and online

participation. Each listening session included public comment. Comments received focused on public safety and the timing of any regulations.

- Community groups and members of the public voiced concerns about the risks that CO2 pipelines could pose to public health and safety, particularly from pipeline leaks. Many of these comments requested that until the public health and safety risks related to CO2 pipelines are fully understood, the State should delay allowing any CO2 pipelines to be built in California. Others requested that the State wait until PHMSA completes its regulations prior to allowing any CO2 pipelines to be built in California.
- CCUS and carbon removal project developers expressed concerns about the length of time to develop regulations governing intrastate pipelines transporting CO2. SB 905 states that "[p]ipelines shall only be utilized to transport carbon dioxide to or from a carbon dioxide capture, removal, or sequestration project once the federal Pipeline and Hazardous Materials Safety Administration has concluded the rulemaking (RIN 2137-AF60) regarding minimum federal safety standards for transportation of carbon dioxide by pipeline…" PHMSA began this rulemaking in 2022 and has indicated it plans to complete the rulemaking in two years. However, developers commented that the federal rulemaking is likely to take longer and given the State's reliance on the establishment of new federal regulations, may discourage developers from building projects in California.
- A utility raised the need to specify the state agencies regulating and overseeing CO2 pipelines and requested clarification this infrastructure is within the scope of public utility service.
- Other comments referred to the economic benefits that CCUS and carbon removal projects would bring to California and voiced concern that any delay in implementing a responsible regulatory framework overseeing the development and operations of CCUS and carbon removal projects and associated infrastructure in California could result in missed opportunities for federal funding.

All comments provided to the Agencies were considered in the development of this Proposal. The Proposal provided in this document is intended to inform legislative discussions and the development of regulations for intrastate pipelines that transport CO2. This Proposal is not provided to the Legislature as regulations or draft regulations. Additional outreach and engagement will benefit any legislative consideration of this topic and any subsequent regulatory proceeding in this area.

RECOMMENDATIONS

Uncertain timing for the completion of PHMSA regulations on pipeline transport of CO2, whether in liquid, gas, or supercritical state, generates uncertainty for current, planned and future CCUS and carbon removal projects in California. Under current law, until PHMSA completes its rulemaking, no regulatory approvals can take place for intrastate CO2 pipelines, nor can OSFM establish regulations for intrastate CO2 pipelines, and, as a result, CCUS and carbon removal projects will have difficulty proceeding in California. This could impact California's ability to achieve its statutory carbon neutrality targets, as the State's recent Scoping Plan indicates that CCUS and carbon removal are needed to help achieve those carbon neutrality goals and that in addition to carbon removal through use of natural and working lands, mechanical carbon removal is needed as well.[8] In addition, it is not yet clear how PHMSA's updated regulations will protect public health, safety, and the environment and whether California policy makers should pursue additional standards to protect public health, safety, and the environment.

If the California Legislature moves forward to authorize and direct appropriate agencies to establish additional regulations governing intrastate CO2 pipelines,[9] these regulations should work to minimize any risks to public health, safety, and the environment. The recommendations provided in this Proposal are aimed at informing additional legislation that would be necessary to create a robust regulatory framework governing CO2 pipelines so as to protect public, health, safety, and the environment. These recommendations are made with the recognition that CCUS and carbon removal projects, and CO2 transport, represent a new set of technologies and infrastructure and accordingly, poses new risks and potentially adverse impacts to human health, safety, and the environment should a pipeline failure occur.

Recommendation #1: Provide OSFM with clear regulatory authority over pipeline transportation of CO2 in liquid, gas, and supercritical state to protect public safety.

Currently, no state agency has explicit authority to regulate intrastate pipelines to transport CO2. Providing OSFM with clear authority to draft safety-related regulations governing intrastate CO2 pipelines will avoid ambiguity about which state agency is charged with regulating liquid, gas, and supercritical CO2 pipelines. It will also ensure a well-defined and understood regulatory process that includes robust public process and allows time to incorporate emerging information from new research and development

[8] https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp_1.pdf

[9] When PHMSA completes their updated CO2 pipeline regulations, those regulations will be automatically adopted under existing California law under California Government Code § 51011.

studies.

Recommendation #2: Specify that State regulations should only allow transport of CO2 through intrastate pipelines when CO2 is in a supercritical state and composed of at least 90% CO2.

As discussed earlier, pipelines transporting CO2 in a gas or liquid state, or less than 90% concentrated CO2 currently fall outside the scope of federal regulations. This creates a regulatory gap in ensuring pipeline safety when CO2 is transported in less concentrated forms and other chemical compositions. Ensuring that State regulations require that CO2 only be transported in a supercritical state with greater than 90% concentration would establish uniformity across intrastate pipeline transport. It would also help eliminate the possibility of corrosion, failure, and other unknown impacts from other chemical compositions of CO2. This requirement would make State regulatory standards more stringent than existing federal standards and could be adopted in the future by PHMSA.

Recommendation #3: Provide OSFM with clear administrative and enforcement authority to order intrastate CO2 pipeline shutdown immediately when safety regulations are violated.

To ensure the safety of pipelines transporting CO2, it is critically important that OSFM have the authority to require an intrastate CO2 pipeline to cease operations immediately if safety standard violations have been identified.

Recommendation #4: Clarify that intrastate pipelines may be used to transport CO2 once PHMSA or California has adopted regulations on this topic.

Given the scope and complexity of CO2 pipelines, it is unclear the amount of time that will be needed to complete the current PHMSA rulemaking. It is possible that it will take several years to complete this rulemaking, which could stall CCUS and carbon removal projects that are critical to meet the State's statutory 2045 carbon neutrality target.

In order to provide regulatory clarity, the Legislature may wish to consider statutory changes to Public Resources Code Section 71465 to allow for intrastate pipelines transporting CO2 to proceed in California once *either* PHMSA *or* California has adopted

safety regulations of these pipelines. This enables projects to move forward once safety-oriented regulations are established on either the federal or State level. It would not preclude the potential of California adopting State standards in addition to federal regulations.

Recommendation #5: Direct that state regulations establish standards regarding how pipelines are designed, sited, operated, and maintained.

To minimize any risks to public health, safety, and the environment from transport of CO2 through intrastate pipelines, state agencies should evaluate, consider and ultimately adopt via regulations clear, understandable standards for pipelines. These standards should guide how CO2 pipelines can be designed, sited, operated, and maintained. Each of these categories of standards is discussed below.

Design

Physical design, layout and materials used in pipelines are critical to maintain pipeline safety. Key aspects of design that require standard setting are listed below:

Fracture Propagation
Fracture propagation occurs when a crack develops in a pipeline, resulting in the release of the material from the pipeline. In the case of CO2 transport, super cooled CO2 escaping a pipeline can chill pipe material (most likely steel) furthering a pipeline failure and exacerbating a release. Often, fracture propagation occurs so rapidly (within a matter of minutes) that it cannot be addressed before failure. CO2 pipelines must be designed and engineered to resist fracture propagation.

Pipe Materials
The material that a pipe is made from plays an important role in safely transporting any product. Variations in pipe material and composition can impact corrosion, operating pressures, and a myriad of other factors. The type and material of piping used for a CO2 pipeline is extremely important and standards must establish appropriate and safe materials for pipes transporting CO2.

Valve Materials
Valves are a key component of pipes, both to maintain safe operations and to enable emergency shutoff. Similar to pipes, the material used for valves impact its function and physical integrity. Careful evaluation of valve spacing and design and a regular inspection of the integrity of the valves must be undertaken for each individual pipeline.

This should be applied to new and repurposed pipelines.

Potential Conversion of Existing Pipelines
Some developers have proposed converting existing natural gas or oil pipelines into pipelines that transport CO2. However, the pressures required to operate a CO2 pipeline may exceed the design specifications for a traditionally designed pipeline used for hazardous liquids. Additional evaluation is needed to ensure no failures occur with the pipeline and may require additional regulations beyond those for new pipelines.

Siting

The location of a pipeline has implications for pipeline safety. Appropriate siting or routing of CO2 pipelines is important to protect public health, safety, and the environment. Key considerations that should be considered during standard setting are:

Determining potential impact areas in a CO2 release depending on transport as a liquid, gas, or supercritical state and composition of CO2 percentage.
Potential impact areas in a release are affected by the state the product is being transported (liquid, gas, or supercritical) and the composition of the product being shipped. Location of a CO2 pipeline will determine the potential impacts of a release. As with all hazardous and highly volatile liquid pipelines, each release poses unique consequences. In the case of CO2, the potential for loss of life is possible given that CO2 is heavier than air and will displace air in a release, leading to the possible suffocation of anyone within the immediate impact area. Siting of pipelines is currently outside of OSFM jurisdiction, which is largely left to local and State entities to review and approve but cannot be overlooked due to the potential threat to human health and the environment. Modeling will be required to demonstrate potential impact areas from a release.

Land Movement
Land movement due to naturally occurring events such as seismic activity, landslides, and subsidence, can cause additional stressors on pipelines that may lead to pipe failure.

Operation

CO2 is a colorless, odorless gas in a natural state. Proper operation is critical for maintaining pipeline integrity. Key considerations of design and operation that require standard setting are listed below:

Odorant Requirements

Odorants can be added to CO2 so that in the event of a leak, CO2 can be smelled. However, as described above under fracture propagation, a failure in a CO2 pipeline resulting in a CO2 release can occur so quickly, that by the time an odor is smelled it may be too late to prevent a release. Similar to the odorant requirements for natural gas pipelines, California should review the ability to use odorants for CO2 pipelines.

Leak Detection
Because a failure in a CO2 pipeline can occur so quickly, leak detection is important for ensuring public health and safety. Existing hazardous liquid pipelines are equipped to detect leaks; however, additional research is needed to determine if those technologies can be applied to CO2 effectively.

Emergency Response Requirements
Emergency response training for first responders and communities in close proximity to CO2 pipelines will be needed prior to operation of those pipelines. In the event of a CO2 leak, CO2 will displace oxygen in the surrounding areas. First responders responding to a situation or communities trying to evacuate an area will not be able to operate traditional gas-powered vehicles, as the CO2 displacement will starve the internal combustion engines of oxygen preventing it from operating. Similarly, first responders not equipped with oxygen sensors will likely be unaware of the harm posed CO2 until they feel the effects. Emergency response plans and training should be considered during the design and operation of an intrastate CO2 pipeline. Additionally, emergency response times, options, and strategies should be considered in the design and siting of an intrastate CO2 pipeline.

CO2 Contaminants
The composition of CO2 being transported is important to consider when planning for the operation and maintenance of a pipeline. CO2 pipelines often transport products where the product is composed of less than 100% CO2. Under the existing federally applied definition of CO2 pipeline, the composition of the transported product must consist of at least 90% CO2. An operator could fall outside of State and federal regulation by transporting CO2 composed of less than 90% CO2. The composition of the products transported by CO2 pipelines is important for understanding potential corrosion and operational issues. For example, if water is present in a CO2 pipeline the mixture can create carbonic acid which corrodes steel and can lead to a release if not carefully inspected, surveyed, and monitored.

Maintenance

Effective pipeline maintenance is important for ensuring pipeline integrity. When

developed in California, pipelines for supercritical CO2 with a concentration of 90% or more will be subject to existing testing and inspection requirements for traditional hazardous liquid pipelines. Standard setting should consider what additional standards should be applied to all CO2 pipelines. This could include increased testing and required inspection cycles.

CONCLUSION

To address the impacts of climate change, California must not only reduce greenhouse gas emissions, but also remove CO2 from the atmosphere. CCUS and carbon removal technologies are essential to achieving California's carbon removal goals of 20 million metric tons CO2 equivalent by 2030 and 100 million metric tons CO2 equivalent by 2045 and offer an opportunity to expand the green economy in California.

However, these projects must be developed in a thoughtful way that consider impacts to the surrounding communities and the environment. The design, siting, operation, and maintenance of a CO2 pipeline have implications for public and environmental health and safety. Pipeline regulations are needed to ensure that any impacts are avoided or minimized to the extent possible. While PHMSA is working to update their pipeline regulations, it is unclear how stringent their regulations will be. California must consider proactively setting pipeline regulations to ensure that developers are aware of the state's expectations and requirements as they design their projects, however, establishing separate standards in California that are in addition to federal regulation is only possible if changes are made in State law.