ATTACHMENT A

Underground Gas Storage Regulations
Standardized Regulatory Impact Assessment

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A. INTRODUCTION

All state agencies that propose major regulations must complete a Standardized Regulatory Impact Assessment (SRIA) as described in Government Code section 11346.36 and California Code of Regulations title 1, sections 2000 through 2004. For the purposes of the SRIA, a major regulation is one that will result in either total costs or benefits of more than $50 million in any given year of the proposed regulation's implementation.

This SRIA, prepared by the California Department of Conservation (Department), analyzes the potential economic impact of a proposed regulatory framework for the oversight of Underground Gas Storage Projects in the State of California. The potential economic impact of this regulation meets the criteria to be considered a major regulation because the estimated costs exceed the $50 million total annual impact threshold.

The analysis uses cost estimates provided directly from gas storage well operators, but when necessary, makes assumptions to ensure that economic costs and benefits are captured to the maximum extent possible. In order to avoid underestimating potential economic impacts, a conservative cost estimate approach was taken. Where there was any question as to whether or not costs incurred by operators could be attributed to the proposed regulations, for the purposes of this assessment, the Department opted to attribute them to the regulations.

B. SUMMARY

The proposed permanent regulations for Underground Gas Storage Projects expand upon existing underground injection control regulations, emergency regulations adopted by the Department in February 2016, and the requirements found in Senate Bill 887 (Pavley, Chapter 673 statutes of 2016) (SB 887). The proposed regulations address a more complete regulatory scheme tailored specifically to underground gas storage wells, and actions already undertaken by operators (voluntarily and by order of the Oil and Gas Supervisor) in response to leaks and maintenance issues at their facilities. In essence, the proposed regulations include new or revised requirements pertaining to underground gas storage (UGS) well construction standards such as rigorous testing and monitoring, well construction standards that ensure gas storage wells maintain integrity over time and risk management plans (RMPs). Elements reviewed in this assessment include a discussion stating the need for the proposed regulations; the proposed regulations presented in detail; a description of the baseline used to analyze

the financial impacts; and a breakdown of the benefits, costs and subsequent economic impacts to industry, the environment, and the public.

This SRIA discusses the potential benefits to California citizens, the environment, and industry by avoiding harm that might occur without the new regulations. It shows that by implementing these proposed regulations, there will be substantial reduction in risks, costs, and potential adverse impacts of future major leak events from gas storage facilities in California. Finally, an analysis of alternatives to the regulations is included, along with estimates of potential direct and indirect costs.

1. STATEMENT OF NEED

The Division of Oil, Gas, and Geothermal Resources (Division), within the Department of Conservation, supervises the drilling, operation, maintenance, and plugging and abandonment of onshore and offshore oil, gas, and geothermal wells. The Division carries out its regulatory authority to encourage the wise development of oil and gas resources while preventing damage to life, health, property, and natural resources.

The Division regulates the injection of natural gas into large underground reservoirs for storage before the gas is later withdrawn for sale to residential, commercial, and industrial customers and natural gas power plants. The Division oversees natural gas facilities to ensure that the original reserves are not lost, that drilling of new wells is conducted safely, and to minimize the risk of damage to public health and the environment.

Prior to the emergency regulations with their specific UGS emphasis, the Underground Injection Control (UIC) program broadly covered UGS wells. However, the UIC program and UGS have differing and distinct concerns and practices that should be considered separately. Gas storage wells present unique engineering challenges and warrant differing construction standards, testing, monitoring, and inspections. The operation of gas storage wells is cyclical throughout the year, subjecting the wells to a wider range of pressures than other types of injection operations associated with oil and gas production. The wells are generally used to store larger quantities of gas during off-peak months, while during peak summer and winter months the gas volume is lower when subject to higher demand. The proposed regulations address the distinct risks and challenges associated with UGS wells.

As indicated in the Division’s Renewal Plan released October 8, 2015, the Division’s existing regulations were not sufficient to ensure well integrity and adequately mitigate risks associated with UGS. This was made starkly evident by the catastrophic leak at the Aliso Canyon Natural Gas Storage Facility on October 23, 2015. Consistent with the requirements of SB 887, the proposed regulations will address these deficiencies by adding risk mitigation requirements, add specificity to the statutorily mandated testing requirements, and building upon the emergency regulations and Division orders promulgated in response to the leak. These proposed regulations represent a

precautionary, rigorous, risk-based approach to the operation of gas well storage activities in California.

2. BACKGROUND

On October 23, 2015, a natural gas leak was discovered from an injection and production well in the Aliso Canyon Natural Gas Storage Facility in Los Angeles County. The leak represented a significant threat to the public peace, health, safety and general welfare. It resulted in the relocation of thousands of people from the areas proximal to the facility and, according to the California Air Resources Board, released 109,000 metric tons of methane. On February 11, 2016, SoCalGas temporarily controlled the leak by injecting mud from a relief well intersecting the bottom of the leaking well. A permanent seal of the well was announced by the Division on February 18, 2016.

As a result of the leak at Aliso Canyon, the Division issued Order 1106 to SoCalGas on December 10, 2015, requiring the operator to not inject gas into the reservoir until injection is authorized by the Division. On March 4, 2016, the Division issued Order 1109, mandating that the operator conduct a detailed Safety Review with rigorous testing of 114 wells associated with the gas storage facility. These 114 wells represent roughly one-fourth of all UGS wells in California. Order 1109 required a series of mechanical integrity tests that exceed the requirements of the well testing required under the proposed regulations. The Order also required that all wells employed at the facility must be equipped with tubing and packer to isolate the tubing-casing annulus and have real-time pressure monitors.

In addition to the orders, the Division promulgated emergency regulations on February 5, 2016, imposing requirements on all UGS facilities in the state. The emergency regulations require at least a daily inspection of gas storage well heads using gas leak detection technology such as infrared imaging, ongoing verification of the mechanical integrity of all gas storage wells, ongoing measurement of annular gas pressure or annular gas flow within wells, regular testing of all safety valves used in wells, establishment of minimum and maximum pressure limits for each gas storage facility in the state, and development of a comprehensive Risk Management Plan (RMP) that evaluates and prepares for risks at each facility.

Under the Division's emergency regulations, the operators' RMPs were submitted in August 2016 and are currently being evaluated. The Division, in consultation with the California Air Resources Board, is also working with UGS operators on finalizing and implementing the leak detection protocols required under the emergency regulations. This means that a majority of the wells in the State will likely be in compliance with significant portions of the proposed permanent regulations before they go into effect.

Effective January 1, 2017, SB 887 establishes a number of significant new statutory requirements for UGS facilities. The bill mandates that the Division's regulations require that no single point of failure poses an immediate threat of loss of control of fluids, and it provides detailed specifications for ensuring well construction integrity. It requires

operators to commence a stringent mechanical integrity testing regime on all gas storage wells by January 1, 2018, and it includes extensive requirements for providing risk management planning and project data to the Division. Annual assessment fee calculations are specified based on the field capacity and number of wells for each operator. The bill also requires that operators develop and maintain employee gas storage well training and mentoring programs. The proposed regulations provide necessary clarifications and specificity to the statutory requirements.

This SRIA includes broad consideration of economic impacts generally associated with the requirements in the proposed regulations. The table in Appendix A, shows all of the direct costs that could result from compliance with the requirements in SB 887 and the regulations. While some of the requirements pertaining to well construction standards and testing stem directly from statutory mandates in SB 887, this assessment attributes all costs associated with regulatory compliance to the proposed regulations because some discretion was exercised in terms of how the statutory requirements would be implemented by the regulations.

Aside from the work being undertaken at all of the wells at the Aliso Canyon Facility, SoCal Gas and PGC&E have voluntarily agreed to undergo the same testing regime that is imposed on Aliso Canyon by Senate Bill 380 (Pavley, Chapter 14 Statutes of 2016) and order of the Supervisor[1] at two other facilities they operate. This will result in at least an additional 127 gas storage wells undergoing a testing regime that exceeds the requirements of the proposed regulations. Nonetheless, because these are voluntary agreements and not enforceable orders or regulations, the Department opted not to exclude the wells covered by these voluntary commitments when calculating the economic impacts.

PUBLIC OUTREACH AND INPUT

From February 17, 2016 through March 18, 2016 the Division of Oil, Gas and Geothermal Resources (Division) held an informal public comment period to outline the Division's immediate regulatory goals regarding underground gas storage, and to solicit specific input on how best to accomplish these goals.

This was accomplished by sending a series of four regulatory goals and associated questions to a list of stakeholders that included oil and gas operators, industry representatives, environmental groups, and members of the general public that expressed interest in previous regulatory efforts involving the Division's Underground Injection Control (UIC) Program. The Department requested any and all stakeholder input, but stressed that suggestions about a specific regulatory approach are most useful if they are supported by discussion of the costs and benefits associated with the approach. During the course of the public comment period, the Department received 30

[1] http://www.conservation.ca.gov/dog/Documents/Aliso/Steps_to_Determine_Injection_at_Aliso_Canyon.pdf

letters, emails, and faxes which were considered during the drafting of the proposed regulations.

On July 8, 2016, DOGGR publicly released pre-rulemaking draft regulations (a discussion draft) for the purpose of receiving public input on the development of updates to the regulations governing underground gas storage. The Division also conducted two workshops to receive verbal and oral input from interested parties, in Sacramento (August 9, 2016) and Woodland Hills (August 11, 2016). The public comment period ended on August 22, 2016 wherein the comments were reviewed and considered by the Division during the regulation updating. The Division also surveyed and engaged with operators to develop the cost estimates.

UNDERGROUND GAS STORAGE IN CALIFORNIA

In 1942, the U.S. government initiated underground natural gas storage as part of the war effort to ensure that a dependable source of energy was available.[2] Many of the wells used for storage were depleted or converted oil production wells. Today, there are over 450 gas storage wells in California. Approximately 88 percent of the western U.S. region's working gas capacity is located in California's 14 underground natural gas storage sites, seven of which are owned by the two principal gas distributors in the state, the Southern California Gas Company (SoCalGas) and Pacific Gas and Electric Company (PG&E). In addition, there are five independently operated storage facilities. These independently operated storage sites are connected to and deliver their withdrawals for consumer and wholesale use.[3]

The natural gas distribution business is seasonal. Natural gas is typically injected into storage during the off months (usually April through October) for withdrawal during the winter months (usually November through March). Natural gas storage is critical for ensuring service reliability during peak demand periods, including heating needs in the winter, as well as peak electric generation needs in the summer.

Northern California

Northern California has approximately two hundred gas storage wells (including active, observation and idle wells) with five operators (four independent, one utility) and a combined total field storage capacity of 237.2 Bcf (billion cubic feet). PG&E is the largest operator with long-standing fields at McDonald Island, Pleasant Creek, and Los Medanos. Independent storage providers include Wild Goose Storage, Inc., Lodi Gas Storage, LLC, Gill Ranch Gas and Central Valley Storage, LLC. The gas energy demand and fluctuating market requires a continual ebb and flow of facility expansion

[2] https://www.socalgas.com/documents/safety/pdr_storage.pdf
[3] https://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/undrgrnd_storage.html

and contraction. Increased storage withdrawals allow pipeline supplies to meet seasonal demand outside of California.[4]

PG&E is a Fortune 200 energy corporation based in San Francisco. In 2014, it supplied natural gas to 4.4 million customers with operating revenues at $3.4 billion. After gas costs, a net balance of $2.4 billion (not including capital expenditures and operating costs) was recorded for 2014.

Southern California

SoCalGas is the principal distributor in the southern region with five UGS fields (Aliso Canyon, Honor Rancho, La Goleta Gas, Playa del Rey, and Montebello). There are a combined 226 wells with a working gas capacity of 134.1 Bcf. The storage fields are located in heavily populated areas within the Los Angeles and Santa Barbara areas. Gill Ranch Storage and PG&E own undivided interests in an additional gas storage project in Southern California.

SoCalGas provides gas for electric generation and household use to 21.6 million customers in more than 500 California communities.[5] Its four wholesale utility customers in Southern California include San Diego Gas & Electric Company (SDG&E), Southwest Gas Corporation, the City of Long Beach Municipal Oil and Gas Department, and the City of Vernon.[6]

Sempra Energy (Sempra) is SoCalGas's parent company. Sempra is a San Diego-based Fortune 500 energy services holding company with 2015 revenues of more than $10 billion. Sempra develops energy infrastructure, operates utilities and provides energy-related services to customers around the world.[7]

C. POTENTIAL AREAS OF ECONOMIC IMPACT

The Division drafted the proposed regulations after careful consideration of industry best practices. To identify industry best practices, the Division examined industry standards recommended by the American Petroleum Institute (API), solicited input from the regulated community, professional experts, scientists at National Laboratories, environmental advocates, and other interested members of the public. With this input, Division staff identified where revisions to existing requirements would be most beneficial. The proposed regulations build upon the emergency regulations and the statutory requirements established by SB 887. In some instances, the direct costs to industry will be lessened because the proposed regulations impose standards that have already been implemented to some degree by operators. The Division has identified the following requirements of the proposed regulations that will likely result in economic impact on California businesses, employment and consumers:

[4] https://www.socalgas.com/regulatory/documents/cgr/2014-cgr.pdf, p. 43
[5] http://www.sempra.com/pdf/financial-reports/2015_statistical_report.pdf
[6] http://www.cpuc.ca.gov/General.aspx?id=4802
[7] http://www.sempra.com/pdf/financial-reports/2015_statistical_report.pdf

1. **Well Construction Standards**
2. **Required Materials**
3. **Mechanical Integrity Testing**
4. **Monitoring**
5. **Inspections**
6. **Direct regulatory fees**

A description of each of the UGS requirements in the permanent regulations follows, along with an estimated cost and categorization.

1. Well Construction Standards

SB 887 requires the Division to consider enhanced design, construction, and maintenance measures to ensure mechanical integrity of gas storage wells and mandates a performance standard for gas storage wells that must ensure that a single point of failure does not pose an immediate threat of loss of control of fluids, as determined by the Supervisor. Consequently, under the proposed regulations, operators would be required to ensure this standard is met for anticipated operating conditions for all UGS projects. As required under Public Resources Code (PRC) section 3180, subdivision (d), the overarching performance standard for gas storage well integrity requires operators to employ multiple methods to ensure that a single point of failure does not pose an immediate threat. The proposed regulations provide operators with detailed specifications for meeting this performance standard, but the proposed regulations also provide operators with the option of developing alternative means of meeting the standard upon approval by the Division. If an operator can demonstrate to the Division's satisfaction that alternative mechanisms or well construction design will ensure that a single point of failure does not pose an immediate threat or loss of fluids, the operator may employ those methods. The Division will determine on a case-by-case basis whether the operator conforms to the required performance standard either by implementing the requirements outlined in the regulation or by other acceptable means. By providing operators the flexibility to find alternate ways to meet this performance standard, the proposed regulations meet the requirements of SB 887 in the most cost-effective way. However, because this flexibility will be granted on a case-by-case basis and would be difficult to forecast exactly how specific operators may meet the performance standard, this assessment assumes that operators will construct or remediate their wells as specified in the technical model laid out in the regulations.

The technical model in the proposed regulations for meeting the "single point of failure" statutory requirement requires that, at a minimum, the primary mechanical barrier shall be comprised of production casing to the surface with the required integrity to contain reservoir pressure; tubing and packer; and a production tree with the required integrity to contain reservoir pressure. Additionally, the model in the proposed regulations would require that wells have surface controlled subsurface safety valves (SCSSV) or a production valve with the required integrity to contain reservoir pressure that halts flow through the well. The technical model in the proposed regulations for meeting the

statutory performance standard requires that a secondary mechanical barrier, at a minimum, shall be comprised of casing cement that overlaps between two concentric casings with good quality cement bond; a wellhead with annular valves and seals and required integrity to contain reservoir pressure; casing with hanger and seal assembly; tubing hanger with seals, and a Christmas tree master valve. The technical model includes other specifications, such as that casing is to be designed to project conditions and cemented so as to maintain the integrity of the storage zone(s) by providing isolation of the reservoir from communication with other sources of permeability or porosity through the wellbore, and verified by cement bond logs or other methods approved by the Division.

Meeting the new well construction standard as specified in the technical model will require upgrades and reworking of many gas storage wells, including installation of tubing and packer, surface controlled safety valves, or other mechanisms proposed by the operator and approved by the Division. How each operator achieves full compliance with the statutorily mandated well construction performance standard, and the workplan for accomplishing it, will be described in their RMPs and subject to approval by the Division. Based on cost estimates developed by the Division with input from gas storage operators, the well construction standard established by SB 887 is the most costly part of meeting the requirements of the proposed regulations. As mentioned above, these cost estimates assume that operators will achieve compliance using the elements of the technical model to meet the standard set forth in PRC section 3180, subdivision (d)(2). The proposed regulations provide a clear path as to how to achieve the statutory standard, as well as the flexibility to develop alternative, equally effective methods subject to the approval of the Supervisor.

In addition to the performance standard compliance flexibility, the proposed regulations provide flexibility in terms of the timeframe to meet the standards. Facility operators who do not meet the well construction standards must submit, as part of the RMP, a detailed work plan including a schedule for bringing their wells up to standards and subject to approval by the Division. This analysis assumes that operators will take five years to bring all of the wells up to the well construction standard requirements of SB 887. This assumption takes into consideration the necessity of acquiring equipment such as rigs, professional staffing to perform the tasks, adherence to safe practices, required testing and reporting, and sufficient time to complete the construction standards and/or retrofits while maintaining operation of gas input and delivery operations. By performing the necessary work over a five-year period, the operators will be able to amortize their costs for meeting the stringent well construction standard and testing requirements.

2. Required Materials

a. Geology and Engineering Studies

The proposed regulations require an engineering and geologic study that demonstrates a thorough understanding of the geology near and around the area of gas injection and

withdrawal. This understanding shall be demonstrated by data provided to the Division including a comprehensive geologic characterization of the gas storage project indicating lithology of the storage zone or zones and sealing mechanisms; at least two geologic cross sections through at least four gas storage wells in the project area and areas immediately adjacent; a description of all formations encountered from the surface to the deepest well in the project; and detailed maps, including those showing underground disposal areas, mining and other subsurface industrial activities, isopach maps, and area of review maps and structure contour maps. Data should include reservoir characteristics of each injection zone such as porosity, permeability, average thickness, areal extent, fracture gradient, original and present temperature and pressure, and original and residual oil, gas and water saturations.

Additionally, the oil and gas reserves and the storage capacity of all proposed storage zones and the storage capacity shall be identified and characterized. Reservoir fluid data for each gas storage zone should be provided along with the proposed waste water disposal methods. Data, analysis and interpretation of the findings must be submitted and demonstrate to the Division's satisfaction that injected gas will not migrate out of the proposed zone or zones. Operators shall provide an electronic log to the depth below the deepest producing zone including geologic units, oil or gas zones, and gas storage reservoirs.

The data must include descriptions of surface and subsurface devices, tests, and precautions to be taken. Maximum and minimum reservoir pressure data and calculations must be provided supporting the basis for the pressure limits with requirements outlined in the regulations.

The data in the engineering study must also include casing diagrams for all of the wells in the area of the project demonstrating that the wells will not be potential conduits for gas to migrate outside of the storage reservoir or otherwise have an adverse effect on the project. In some cases, where identified wells may have containment issues, integrity testing or well logging shall be required to meet the integrity demonstration. Additionally, the Division may select plugged and abandoned wells to be re-entered, examined, re-plugged and abandoned, or monitored to manage identified containment assurance issues prior to approval of gas storage operations. The proposed regulations include specifications for drafting casing diagrams, including specification that the diagrams must indicate such things as depths of shoes, stubs, liner tops, perforation intervals, drill bit size and diameter, and cement plug information.

Although the proposed regulations add new elements and specifications, many of these project data requirements are already found in existing UIC regulations and will have been addressed, at least in part, by the time the permanent regulations are in effect.[8] Most, if not all, of the operators have shown and will have shown they have a good understanding of the geology and engineering requirements, have submitted the

[8] Existing project data requirements are found in California Code of Regulations, title 14, section 1724.7.

required data, and may subsequently forgo some of these requirements. However, operators may need to provide supplemental data as determined by the Supervisor on a case-by-case basis.

b. Risk Management Plans

Pursuant to PRC section 3181, as added by SB 887, RMPs are required for the operation of each gas storage facility, and the proposed regulations will add additional specifications and framework as needed to ensure operators have detailed safe strategies in place.

The RMP shall identify potential threats and hazards to well and reservoir integrity, as well as to life, health, property, and natural resources; assess risks based on potential severity and estimated likelihood of occurrence of each threat; identify the preventive and monitoring processes employed to mitigate each identified risk as well as overall and integrated risks; and specify a process for periodic review and reassessment of the risk assessment and prevention protocols. Risk assessment and prevention protocols shall be consistent with and additional to any other existing requirement in statute or regulation. The RMP shall also state what method and guidance was followed in preparing the risk assessment.

The RMP shall be comprehensive in scope and include well construction and design standards; consideration of employment of surface and/or subsurface automatic or remote-actuated safety valves; ongoing verification and demonstration of well mechanical integrity; corrosion monitoring and evaluation; ongoing evaluation of gas storage wells including monitoring of casing pressure changes at the wellhead, ongoing verification of reservoir integrity, evaluation of natural disasters and threats posed by sabotage, and other specifications outlined in PRC section 3181 and the proposed regulations.

If observation wells are employed, identification and documentation of baseline conditions as specified shall be included. The RMP should include consideration of groundwater quality impact resulting from operations of a gas storage well and a prioritization of risk mitigation efforts based on potential severity and estimated likelihood of occurrence of each threat. A detailed emergency response plan that accounts for threats and hazards identified in the RMP is also a requirement.

The RMP must clearly and concisely consider all gas storage well risk assessment and prevention protocols outlined in the new regulations. The RMP specific to gas storage wells may draw from existing required contingency planning and risk assessment reports to help defray duplication of efforts and to partially defray costs, but all data and assessments must be provided as outlined.

SB 887 requires that RMPs include site-specific information; a leak prevention and response program that will identify protocols for notifying the public to any potentially impacted community in the event of a large, uncontrollable leak; identification of materials and personnel necessary to respond to leaks; and identification of personnel responsible for notifying regulatory authorities over the range of leaks possible.

All gas storage operators were required to submit RMPs by August 5, 2016, under the emergency regulations (within six months of its effective date). Although there may be changes to those RMPs requested by the Supervisor, industry should have already absorbed the cost of RMP preparation. At this time, RMPs are currently under review. In future years, this requirement may impose additional costs associated with updating or modifying risk management plans as conditions at a gas storage facility change.

3. Mechanical Integrity Testing

Consistent with SB 887, the proposed regulations would require an operator to conduct periodic mechanical integrity tests on each gas storage well. The testing regime in the proposed regulations is in accordance with the requirements of SB 887 and was developed by Division engineers in consultation with experts from the Sandia, Lawrence Livermore, and Lawrence Berkeley National Laboratories.

SB 887 listed three basic types of testing (leak, corrosion, and pressure tests); the proposed regulations specify a minimum schedule for those tests. Under the proposed regulations, operators shall, at a minimum, conduct an annual temperature and noise log to detect leaks. Every two years, or as specified by the Division based on the observed rate of corrosion, each well shall undergo a casing wall thickness inspection. Pressure testing of the production casing shall be conducted at least every two years. If any of these mechanical integrity tests indicate a problem with a well, then the well shall not be used for injection or withdrawal without subsequent approval from the Division.

A newly constructed gas storage well, or a reworked gas storage well that has had an existing production casing modified from its previous condition during rework activities, shall be tested per the specified rules. Additionally, the Division may require further testing as needed to demonstrate well integrity.

While the specific types of tests were named in SB 887 and substantial testing is already underway as a result of orders by the Supervisor or voluntary action agreed to by operators at the largest facilities in the state, for purposes of this assessment, the costs associated with the testing requirements are attributed to the proposed regulations.

4. Monitoring

The proposed regulations require the operator to monitor and evaluate annular gas by measuring and recording annular pressure at least once a day. This requirement may

be met by employment of a real-time data gathering system, such as Supervisory Control and Data Acquisition (SCADA), and operators will be required to have such a system in place by January 1, 2020. All facilities will have a SCADA or similar system installed by the time these proposed regulations take effect.

The proposed regulations also require operators to develop and implement an inspection and leak detection protocol, and operators have already submitted such protocols to the Division under the emergency regulations. The California Air Resources Board (CARB) is in the process of developing more stringent requirements for inspections and leak detection at underground gas storage facilities, which are anticipated to be fully implemented in September 2018. The proposed regulations provide that once CARB assumes responsibility for the inspection and leak detection protocols, the Division's requirements on this point will cease to apply.

Activities associated with this requirement and suggested in many of the submitted operators' Leak Detection Protocols are to monitor daily using infrared hand held devices (e.g., Multi-Gas detectors). The primary cost drivers would be sensing equipment and the labor costs associated with daily monitoring.

Additional monitoring requirements such as material balancing and reservoir pressure versus inventory monitoring to measure anomalies, are already being performed by operators and are standard industry practice.

While not currently specifically anticipated at any facility, possible additional costs may be incurred by operators to construct new strategically located observation wells in the vicinity of potential spill points, within an aquifer, and above the caprock in potential collector formations to detect the presence or movement of gas.

5. Inspections, Testing and Maintenance of Wellheads and Valves

The proposed regulations require testing of the surface and subsurface safety valves, where installed, every six months. The master valve must be tested for leaks and operation every year. Inspection of isolation valves and all ports, wellhead assembly and blind flanges should also occur as specified in the regulations. In addition, the operator shall equip all ports on the wellhead assembly above the casing bowl of gas storage wells with valves, blind flanges, or similar equipment.

6. Direct Regulatory Fees

PRC section 3403.5 requires the State Oil and Gas Supervisor to assess a fee on gas storage operators in order to defray the state's costs overseeing natural gas storage operations. As discussed in the "Direct Costs" section below, implementation of the emergency regulations and proposed permanent regulations require significantly increased workload for the Division. As a result, the legislature increased fees as part of the 2015-2016 budget to cover the cost of the new regulatory effort.

D. BENEFITS

Benefits to the California Public

These proposed regulations will benefit the public, protect public health and promote environmental safety by focusing on leak prevention and risk mitigation at UGS facilities. Gas storage wells are subject to immense pressure stresses, corrosion, and metal fatigue. By establishing safety and reliability requirements tailored to UGS facilities, rather than treating these facilities as a subset of the Division's Underground Injection Control (UIC) program, the proposed regulations will reduce risk to the public's health and to the environment.

Well failures and other potential incidents at a gas storage field can become a health and safety hazard. Methane is a volatile organic compound (VOC) and a greenhouse gas and inhalation of the mercaptans added to natural gas pose health risks such as short-term neurological, gastrointestinal, and respiratory symptoms[9]. Regular mechanical integrity tests, the possible increased use of SCSSVs, and daily leak detection will substantially reduce the risk of leaks and ensure earlier discovery of leaks. The resulting reduction of natural gas leakage will decrease the release of greenhouse gases, volatile organic compounds (VOCs), mercaptans and other contaminants into the atmosphere. In addition to reducing the risk of major uncontrolled leaks, the regulations will also provide a system for early detection of smaller leaks that might otherwise go undetected under a less rigorous regulatory regime.

The proposed regulations will benefit those communities situated in close proximity to UGS facilities by reducing the risk of negative health effects potentially associated with exposure to natural gas.

Benefits to California Businesses and Consumers

Underground gas storage facilities are a critical piece of California's energy infrastructure. Statewide businesses and consumers depend upon gas supplied from these facilities either in the form of direct use of natural gas or in the form of electricity generated by natural gas power plants.

The proposed regulations will benefit both consumers and businesses by better ensuring UGS facilities across the state are operated safely, with less risk of disruption in energy supply due to leaks or other infrastructure problems. The proposed regulations may also create some long term cost savings for regulated operators of UGS facilities by reducing the likelihood and severity of a major uncontrolled leak incident. Although rare, such incidents can be extremely expensive, costing operators hundreds of millions of dollars. Direct costs for the operator of the Aliso Canyon Natural

[9] *Ensuring Safe and Reliable Underground Natural Gas Storage,* Final Report of the Interagency Task Force on Natural Gas Storage Safety, October 26, p.27; http://energy.gov/sites/prod/files/2016/10/f33/Ensuring%20Safe%20and%20Reliable%20Underground%20Natural%20Gas%20Storage%20-%20Final%20Report.pdf

Gas Storage Facility attributable to the major leak incident at well SS-25 totaled approximately $717 million as of August 2016.[10]

Additional benefits to California businesses can be realized by avoiding costly litigation. Potential legal liabilities related to the Aliso Canyon event for SoCalGas are substantial and growing. In September, 2016, the operator agreed to pay $4 million to settle criminal charges brought by the Los Angeles district attorney's office over the massive gas leak.[11] Additional lawsuits brought by the California attorney general and thousands more filed by Porter Ranch residents are also seeking financial penalties.

In addition to reducing the risks of major leaks, the potential to disrupt energy supply, and the substantial costs to industry and the public, the preventative testing requirements created by these regulations will also increase the likelihood that smaller leaks and infrastructure degradation are discovered and addressed long before serious risks to health, safety, and the environment arise. Reducing the occurrence of both major and smaller leaks benefits industry operators, consumers, and the environment because it reduces the loss of stored natural gas resources to the atmosphere.

E. BASELINE

The baseline used for this analysis assumes that the operators, without the enactment of the proposed regulation or emergency regulations, would, at a minimum, comply with the statutory requirements imposed by SB 887, comply with the orders issued by the Division prior to the enactment of the proposed regulations or the emergency regulations, and carry out the testing and remediation efforts they have already committed to independent of the proposed regulations or emergency regulations.

F. METHODOLOGY FOR DETERMINING ECONOMIC IMPACTS

The cost of compliance with the proposed regulations will vary depending on the specific design characteristics and conditions of the 452 natural gas storage wells in the state. The cost estimates take into consideration well age, the original purpose of many of the wells in the state, Division records, field information, and institutional knowledge and experience. For example, there are approximately 226 older wells that were not originally drilled for gas storage purposes, 117 wells that have a lower level of risk but may require substantial upgrades and 109 relatively new wells that are specifically designed to withstand the stresses associated with gas storage injection and withdrawal. While specific details regarding the condition of each gas storage well will not be fully known until required testing is complete, there was a deliberate attempt to account for what the Division anticipates will be substantial variation in costs associated with bringing gas storage wells throughout the state up to the proposed standards.

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[10] *Sempra Energy Announces Second-Quarter 2016 Earnings*, Aug. 4, 2016. (http://investor.shareholder.com/sre/releasedetail.cfm?ReleaseID=982958)

[11] Walton, *Southern California Gas to pay $4-million settlement over massive Porter Ranch Gas leak,* Los Angeles Times (September 13, 2016). http://www.latimes.com/local/lanow/la-me-porter-ranch-settlement-20160913-snap-story.html

In order to estimate the economic impacts associated with the regulations, the Division created a list of likely remediation, tests, and monitoring activities that would be necessary to comply with both the statutory changes associated with SB 887 and the regulations. To develop the cost estimates, the Division considered cost estimates provided by one operator as part of their comments on the discussion draft regulations and surveyed all other operators in the state to get their estimated costs for each of the potentially mandated activities. The costs estimated by the operators were reviewed and considered by the Division. An average of estimated costs was used for the purposes of these calculations. To ensure a conservative estimate that captured a larger range of possible costs, this analysis presumes that operators attempt to meet the performance standard using the criteria set forth in the proposed regulations. However, as previously mentioned, it is important to note that the well construction requirements are only one avenue that an operator may take to meet the performance standard laid out by SB 887 in PRC section 3180, subdivision (a)(2).

Compliance costs will be heavily impacted by how operators propose to meet the required well construction standards, testing, and schedule work in their approved RMPs. This analysis assumes existing wells will be brought into compliance within a five year time frame. During actual implementation this could be shorter or longer at the discretion of the Supervisor based on the risk posed by the circumstances at the facility.

The cost estimates for the proposed regulations were calculated by multiplying the direct costs for regulatory requirements by the percentage of anticipated wells affected in hypothetical work plans for each category of wells. The analysis does not attempt to predict how many wells will be removed from service or how many new wells will be drilled as a result of the new statutory and regulatory requirements. Several factors will determine changes to the number of wells in the state. For example, it may be less expensive to plug and abandon some wells and drill new ones rather than upgrade old or damaged wells or it may be that new wells will be necessary at some facilities to compensate for reduced well capacity associated with meeting the new SB 887 performance standard. The analysis assumes that the number of wells is static and does not account for the substantial testing and remediation work already underway on the 114 wells at the Aliso Canyon facility pursuant to Division order and Senate Bill 380[12]. It also does not account for the 127 additional wells located at other facilities that PG&E and SoCal gas have voluntarily committed to put through the same testing regime that is occurring at Aliso Canyon facility. These commitments are voluntary and, while the operators would likely have incurred the testing costs and associated remediation costs absent the regulations, the voluntarily tested wells will still be subject to the regulation. As such they were included in the cost estimates for the regulations. It is likely that this results in an overestimation of the total cost of the regulations.

[12] Requirements from SB 380 can be found here: http://www.conservation.ca.gov/dog/Documents/Aliso/Steps_to_Determine_Injection_at_Aliso_Canyon.pdf

Following calculation of the direct costs, indirect costs and economic impacts were estimated using a computational general equilibrium model of the California economy provided by the U.S. Bureau of Economic Analysis (BEA) and known as Regional Input-Output Modeling System II (RIMS II, 2007/2013)[13]. The RIMS II model generates year-by-year estimates of the total regional effects of a policy or set of policies. The model is designed to be regionally specific and produces a set of multipliers representing output that occurs in affected industries delivered to final demand. RIMS II Type I multipliers were used in the analysis and assessment[14]. Identified industries that would be affected by the gas storage regulations with their corresponding North American Industry Classification System (NAICS) numbers are shown below:

Table 1: Primary and Secondary Industry NAICS Codes[15]

Regulatory Function	NAICS #	NAICS Industry
All testing (including noise & temp)	213111	Support activities for oil and gas extraction
Tubing & packer	420000	Machinery, Equipment, & Supplies Wholesalers
Safety valves	420000	Machinery, Equipment, & Supplies Wholesalers
Maintenance	486000	Pipeline Transportation
New well construction	213111	Support activities for oil and gas extraction
Plug & abandonment	213111	Mining, quarrying, and oil and gas extraction; support activities for mining
Cement casing	213111	Mining, quarrying, and oil and gas extraction; support activities for mining
Leak detection equipment	420000	Business to business electronic markets, durable goods, wholesale trade
Leak monitoring staff	486000	Pipeline Transportation NAICS
New observation wells	213111	Support activities for oil and gas extraction
Records management	518200	Data processing, hosting, and related services
Monitoring	486000	Pipeline Transportation
Risk Management Plans	5416A0	Environmental and other technical consulting services.
Regulatory assessment	S00A00[1][16]	Other government enterprises

[13] The Bureau of Economic Analysis does not endorse any resulting estimates and/or conclusions about the economic impact of a proposed change on an area.

[14] Multipliers that account for only the interindustry effects (direct and indirect) of a final-demand change. BEA RIMS II Guidelines, p. G-3.

[15] Regional Input-Output Modeling System (RIMS II), Regional Product Division, Bureau of Economic Analysis (the Bureau of Economic Analysis does not endorse any resulting estimates and/or conclusions about the economic impact of a proposed change in an area)

[16] This is a RIMS code, subset of Federal, State, and Local Government Enterprises and not classified as industry.

The RIMS II multipliers are industry-specific and include businesses located outside California. The estimated economic impact is likely affected by the geographic area used to develop the multipliers and California specific multipliers may result in higher or lower numbers.

G. INPUTS INTO THE ASSESSMENT

1. DIRECT COSTS

Direct Costs to California Businesses

The following discussion of direct costs includes both a discussion of estimates of the costs imposed by recent statutory changes as well as those that are directly attributable to the proposed regulations. The table in Appendix A shows the total direct costs for SB 887 related changes and the proposed regulatory changes implementing those requirements.

Total costs for implementing the proposed regulations over the next five years are shown in Table 2. The assumptions and calculations are explained in detail below.

Table 2. Direct Costs Imposed by Both SB 887 and the Proposed Regulations

Year 1	Year 2	Year 3	Year 4	Year 5
$243,017,200	$236,388,200	$234,082,200	$233,335,200	$231,199,200

As indicated earlier, the potential direct costs to California Businesses can be divided into six general categories:

- **a. Well Construction Standards**
  - **i. Tubing and Packer**
  - **ii. New Well Construction**
  - **iii. Surface Controlled Subsurface Safety Valves**
  - **iv. Production Casing to Surface**
- **b. Required Materials**
  - **i. Geology and Engineering Studies**
  - **ii. Risk Management Plans**
  - **iii. Emergency Response Plans**
  - **iv. Record Management**
- **c. Mechanical Integrity Testing**
- **d. Monitoring**
  - **i. Supervisory Control and Data Acquisition**

ii. **Observation Wells**
iii. **Leak Detection Protocols**

e. **Inspections**
f. **Direct regulatory fees**

a. Well Construction Standards

Meeting the performance standard established in SB 887, in many cases, will require operators to make significant investments in their gas storage wells. As described above, the proposed regulations provide a technical model for how to meet the rigorous "single point of failure" requirement, but also provide operators with the opportunity to propose alternative means of meeting the standard. The estimates for direct costs in this assessment assume that operators opt to use the approach articulated in the proposed regulations' technical model.

Many of the well construction recommendations proposed in §1726.5 to meet the SB 887 "single point of failure" performance standard are consistent with existing practices already undertaken by prudent operators. As mentioned above, the cost estimates listed below are based on the average cost estimate provided by UGS facility operators. The costs will vary substantially depending on the specific physical and risk characteristics of each facility. In some instances these cost estimates will be higher than actual costs, and in other instances they will be lower than actual costs. For example, operations that require workover rigs include the costs associated with transporting rigs to the site. It is probable that each rig will be used for multiple operations and transportation costs will be spread out over multiple wells. Nonetheless, this analysis includes rig costs for each test. The division has identified the following well construction related activities that go beyond typical well construction designs that may not already be completed by otherwise prudent operators:

- The installation of tubing and packer
- New well construction
- Plugging and abandonment
- The installation of surface controlled subsurface safety valves (if required to adequately mitigate identified risks in RMP)
- Well construction with production casing to surface (five percent of operators do not have this)

i. Tubing and Packer

This analysis assumes that operators that have not already met the standard in PRC section 3180, subdivision (d)(2), will install tubing and packer as suggested in the technical model in §1726.5 of the regulations. Based on a range of estimates provided by operators, the calculations use an estimate of $406,000 for each of the 452 wells in the state and assume that the Division will allow operators a five year period to come into compliance with the performance standard as part of their RMP. This is shown in the table in Appendix A. Tubing and packer can serve as an additional barrier to ensure

that a single point of failure will not result in an uncontrolled release of fluid. This results in an estimated direct cost of $40.95 million per year for the first three years (91 wells/year), $40.5 million in the 4th year (90 wells), and $40.05 million in the 5th year (89 wells).

ii. New Well Construction

For a variety of reasons the Division estimates that operators will have to construct new wells during the period of time that the proposed regulations are being implemented. For example, utilizing tubing and packer within a well as the additional safety barrier effectively reduces the functional diameter of the wellbore. A reduction in wellbore diameter restricts the amount of gas that can be injected or withdrawn from a well. To keep up with the ongoing demand for natural gas users in the State, it is likely that operators will need additional storage wells to counterbalance the reduced capacity for injection and withdrawal of gas in wells operating with tubing and packer as a barrier. Additionally, the 114 wells at Aliso Canyon and the 127 combined wells at SoCal's Playa del Rey and PG&E's McDonald Island will have commenced the battery of tests that exceeds those explicitly required by the proposed regulations by the time they are in effect. This will likely result in some mechanical integrity issues that will require remediation being discovered. Operators may decide that it is more cost-effective to plug and abandon some existing wells rather than repair them. Finally, many wells in the state are over 40 years old, and are no longer economical to maintain. This analysis assumes that operators will decide to construct about 30 new wells over the five years included in this analysis. As shown in Appendix A, direct costs attributable to new well construction at an estimated average cost of $4 million per well will result in an annual cost of $24 million incurred by operators annually.

iii. Plug and Abandonment of Wells

In evaluating aging or damaged wells in the context of the SB 887 performance standard, the Division anticipates that operators will decide that it is more cost-effective to plug and abandon about 5% of the wells in the State rather than repair them over the next five years. As shown in the table in Appendix A, this cost will likely be greater in the first two years as operators work to get their facilities into compliance. This calculation assumes 8 wells in year 1, 6 in year 2, 4 in year 3, 2 in year 4, and 1 in the 5th year at a cost of $389,000 per well.

iv. Surface Controlled Subsurface Safety Valves

Existing regulations only require "critical wells", as defined, to have SCSSVs and PRC section 3180, subdivision (d)(3)(D), requires the Division to consider requiring SCSSVs when developing the proposed regulations.[17] The proposed regulations potentially require the installation of SCSSVs in order to mitigate risk associated with proximity to populations, proximity to critical infrastructure, geologic hazards, or other safety reasons

[17] Existing requirements for critical wells are found in California Code of Regulations, title 14, section 1724.3.

identified in approved RMPs. This will be dependent on a case-by-case analysis that has yet to be performed. The remainder of the wells will be required to have Christmas tree valves, however Christmas tree valves do not impose an additional cost because they are composed of standard equipment such as tubing master valves and annular valves, devices already present on all gas storage wells.

Based on a survey of all gas storage operators and input from the Division's engineers, the cost to install an SCSSV would be approximately $250,000 and would result in increased annual maintenance costs of about $4,000 per well. The installation of SCSSVs will likely be required by the Division where risks have been identified in the RMPs and cannot be otherwise mitigated. For the purposes of this analysis, the Division assumes 25% of wells will be required to be equipped with SCSSVs. This is a deliberately conservative estimate to ensure that this document includes a large range of potential costs and does not reflect an estimate based specifically identified risks. As shown in the Direct Cost tables in Appendix A, the costs of SCSSVs is estimated to be $6.25 million/year for an assumed five year time schedule in an approved RMP. Additionally, an estimated annual maintenance cost of $4,000 per well results in escalating costs as more SCSSVs are installed starting at $100,000 and climbing to $468,000 annually.

v. Production Casing to Surface

The proposed regulations require all wells have production casing to the surface or find some other alternative means of mitigating risks associated with not having a cemented production casing all the way to the surface. This is necessary to meet the performance standard established by SB 887 in PRC section 3180, subdivision (d)(2). Based on Division records, over 95% of wells already meet this requirement. The operators who own these wells will need to remediate the wells such that they meet the performance standard without having production casing to surface. This will require pulling tubing, resetting the tubing and packer, and squeezing cement behind the production casing. As shown in the table in Appendix A, this calculation assumes a cost of $500,000 per well for remedial work to meet the standard and spreads it across an assumed five year compliance schedule (final year has 3 wells).

b. <u>Required Materials</u>

i. Geology and Engineering Studies

As described earlier, the proposed regulations require an engineering and geologic study that demonstrates a thorough understanding of the geology near and around the area of gas injection and withdrawal. Although the proposed regulations add new elements and specifications, existing UIC regulations already require substantial geologic and engineering information for UGS facilities, and those existing requirements would be specifically tailored for gas storage facilities by the proposed regulations. Therefore, prudent gas storage operators are already in compliance with the new

requirements and no new additional costs are attributable to the proposed regulations for these studies.

ii. Risk Management Plans

In addition to stringent well construction and design standards, SB 887 and the proposed implementing regulations require gas storage operators to incorporate a risk-based management approach. The operation of gas storage wells requires management of engineering challenges distinct from those presented by other types of wells associated with oil and gas operations. According to PRC section 3181, added by SB 887, risk management plans are required "to identify and plan for mitigation of all threats and hazards and potential threats and hazards associated with gas storage well operation in order to ensure internal and external mechanical integrity of a well, including site-specific information. The risk management plan shall provide for regular review and revision, as needed, to ensure the plan appropriately reflects current conditions." All evaluations shall be supported by science, engineering and risk assessments outlined in RMPs. By emphasizing specific and definitive terms and recognized best practices for risk management particular to this subset of industry, the proposed regulations will implement the requirements of SB 887 and ensure that public health, public safety and the environment are benefiting from this approach.

Additionally, existing regulations, applicable to all oil and gas facilities, require gas storage operators to develop spill contingency plans.[18] These plans include several elements that overlap with requirements of RMPs in the proposed regulations. All compliant operators will already have those elements of their RMPs complete.

As shown in the table in Appendix A, the Division estimates that operators may have to spend $270,000 to develop an RMP. This would include hiring consultants and staff time to develop the plan that is acceptable to the Division.

iii. Emergency Response Plans

SB 887, in PRC section 3181, subdivision (a)(2)(A), requires operators to develop a natural gas leak prevention and response program. Additionally, existing regulations already require operators to complete spill contingency plans that require much of the same information as that outlined in the proposed regulations' emergency response plans. As such, the Emergency Response Plans required under the proposed regulations do not pose any additional costs to operators. Additionally, an emergency response plan should already be prepared and in effect for gas storage operations under permitting and pre-construction requirements with the California Public Utility Commission.[19]

iv. Records Management

[18] California Code of Regulations, title 14, sections 1722, subdivision (b), and 1722.9

[19] Public Utilities Code section 768.6

The proposed regulation requires operators to establish a records management program that meets specified requirements. The Division believes that most, if not all, operators have records management systems in place that meet proposed regulatory requirements. However, in case an unforeseen issue arises, the calculation shown in the Direct Cost tables in the appendices assume that two operators will have to invest one-time costs of $120,000 in information technology software and services for a total of $240,000.

c. Mechanical Integrity Testing

SB 887 requires that all operators commence a regular well testing regime by January 1, 2018. Specifically, PRC section 3180, subdivision (b), requires that operators conduct regular leak testing, a casing wall thickness inspection, a pressure test of the production casing, and any additional testing deemed necessary by the division to demonstrate the integrity of the well. The proposed regulations implement these statutory requirements by specifying annual noise and temperature logs to test for leaks on each well, requiring casing thickness tests via magnetic flux and ultrasonic technologies every two years or as needed based on test results, and a casing pressure test every two years. The Division developed the proposed testing regime with independent experts including scientists from the National Labs system and determined that they would be the appropriate frequency to ensure safety. The per well cost of each test is in Table 4. The total cost of each of these tests is shown in Appendix A. These costs include the costs of transporting rigs to the site and contracting for rigs, which would likely be spread over multiple tests on multiple wells. As such, these cost estimates are likely an overestimate because of the operational efficiencies that operators would take advantage of by combining one rig charge for multiple tests.

Table 4. Mechanical Integrity Testing Costs

Mechanical Integrity Test	Cost/Well
Noise and Temperature Log	$11,600
Casing pressure test	$247,000
Electromagnetic test (casing thickness test)	$408,000

Orders issued by the State Oil and Gas Supervisor as well as voluntary actions that operators have agreed to undertake have resulted or will result in over 200 of GS wells in the state undergoing a battery of tests that exceed the regime laid out in the proposed regulations[20]. Therefore, cost estimates for testing procedures in this assessment are likely overestimated.

[20] SoCal Gas are required to complete the battery of tests outlined in the comprehensive safety review of all 114 wells at the Aliso Canyon Gas Storage Facility. A description of the safety review can be found here: http://www.conservation.ca.gov/index/Documents/Comprehensive%20Safety%20Review%20Aliso%20Canyon.pdf

The table in Appendix A shows the entire cost of all testing (452 wells for noise and temp and 226 wells for electromagnetic testing and pressure testing every year). It is likely that the regulations will result in substantially less frequent testing because the proposed regulations provide that an actual casing thickness test schedule will be determined by the observed rate of corrosion and that the Division may approve a less frequent pressure testing schedule for a well if the operator demonstrates to the Division's satisfaction that other measures to ensure the integrity of the well warrant less frequent pressure testing.

d. Monitoring

The proposed regulations include various monitoring requirements that are actually standard, recognized best practices. For example, monitoring material balance behavior in the reservoir, monitoring average reservoir pressure versus inventory, monitoring offset hydrocarbon production or disposal operations, and conducting subsurface correlation and gas identification logs are all activities undertaken by operators as part of their normal operations. The proposed regulations also include leak reporting requirements and fingerprinting of gas. Leak reporting is already required pursuant to PRC section 3183, subdivision (b), and fingerprinting is already standard industry practice. As such these elements of the proposed regulations do not impose any additional costs on operators. Other aspects of this section warrant more explanation.

i. Supervisory Control and Data Acquisition

As previously discussed, the proposed regulations require operators to monitor and evaluate annular gas by measuring and recording annular pressure at least once a day. This requirement may be met by employment of a real-time data gathering system, such as Supervisory Control and Data Acquisition (SCADA), and operators will be required to have such a system in place by January 1, 2020. The Division initially anticipated that this would impose an additional cost on operators, however, since the Aliso Canyon leak took place all operators in California have now installed SCADA systems that would meet the requirements of the proposed regulations. As a result, this requirement no longer imposes an additional cost.

ii. Observation Wells

The proposed regulations require monitoring of reservoir and well integrity and one of the options for doing this involves the use of observation wells. All facilities currently have observation wells, however, in order to ensure that regulatory costs are adequately captured, the Direct Cost tables in Appendix A show that this analysis

. SoCal has also agreed to conduct the same battery of tests at their Playa del Rey Facility. PG&E will voluntarily be conducting a similar review at their McDonald Island facility.

assumes the Division may require an additional 5 observation wells to be constructed state wide over the next five years at a cost of $2 million each. There are multiple options for meeting this requirement and not all of them require observation wells, but it is conceivable that a circumstance could arise where the Division may order the construction of these additional observation wells. Like the estimate for SCSSVs above, this estimate is not based on a specific, identified need, but rather is simply included based on the possibility that additional observation wells could, at some point in the next five years, be required by the Supervisor.

iii. Leak Detection Protocols

The emergency regulations and the proposed regulations require operators to develop and implement an inspection and leak detection protocol. All costs associated with monitoring and leak detection are a result of the emergency and proposed regulations. To comply with the leak detection requirements, it is likely that operators will monitor their facilities for leaks daily using infrared hand held devices or OGI, at approximately $95,000 per unit. The Division estimates that operators will purchase at least one and up to three units per field for this monitoring activity for a total of $4 million at all 14 facilities.

Operators will also need to hire staff to conduct the monitoring. As shown in Appendix A, the Division estimates that, on average, each facility will have to hire one to three staff at $80/hr. for approximately 40 hours per week to conduct daily monitoring until the CARB air monitoring regulations take effect. This analysis assumes that operators will have to be compliant with CARB regulations by September of 2018. The cost for equipment and labor in the first year is estimated to be $6.15 million in the first year with labor costing $1.62 million in 2018. While SB 887 adds Health and Safety Code section 42710, which requires the CARB to develop a continuous monitoring program, the Division is not required to do so. The costs associated with monitoring in the proposed regulations are reflected in Appendix A..

CARB may have substantially different cost estimates for leak detection monitoring. CARB requirements include additional elements such as continuous ambient air monitoring. Although both regulations require leak detection protocols, DOGGR and CARB proposals are different in significant enough ways to result in different economic assumptions and resulting cost estimates. For example, CARB's proposed regulation includes different requirements for radius of measurement around the wellhead, alarms, and defective equipment requirements. In addition, CARB noted at their Board Hearing that there will be changes to the proposed regulations which are expected to be released soon. These changes may impact the cost assumptions as well.

e. Testing and Maintenance of Wellheads and Valves

The proposed regulations require testing and maintenance that is consistent with best practices as identified by the American Petroleum Institute and all prudent operators

already conduct the required testing and maintenance described in this section. The Division does not anticipate more than de minimis costs associated with complying with this section.

f. Direct Regulatory Fees

For fiscal year 2016-17, the Legislature approved an appropriation of $4,172,000 and 20 new positions to support the increased regulatory activities at UGS facilities. The funds included in this proposal will support 20 Division staff to:

- Develop a comprehensive risk management plan structure for operators, and ensure compliance;
- Conduct regular risk assessment review;
- Witness and evaluate mechanical integrity tests;
- Conduct annual project reviews;
- Verify and monitor injection and production rates and pressures.

Based on the legislative authorization, beginning June 15th, 2016, the Division increased the annual per well fee required for operators of underground natural gas storage facilities to expedite the increased regulation and oversight. As a result of SB 887, operators will be charged a proportionate share of the total regulatory costs for each fiscal year based on the field capacity and number of wells. The total fees are projected to be roughly $4.17 million for 2017 to $3.26 million for the years 2018 through 2021. See Table C for detailed regulatory fees. While the fee authorization is authorized by statute, if the Division does not hire staff and conduct the regulatory work envisioned by the legislature by implementing permanent regulations, they will assess lower fees on natural gas storage operators.

2. DIRECT COSTS TO INDIVIDUALS

It is conceivable that the proposed regulations would contribute to a very minor increase in the price of natural gas and electricity for individual consumers. However, due to the CPUC's role in regulating prices for utility services as a matter of state policy, forecasting relatively minor anticipated impacts such as those costs imposed by the proposed regulations is of limited value. Quantitative estimates would be largely speculative. As a result, this analysis assumes that electricity and gas rates will be static and does not include them in the direct cost estimates or in the estimates that incorporate RIMS II multipliers.

a. Methodology: Assumptions and Limitations

Assumptions of the total economic impacts of changes to California businesses, gross state product, employment, personal income and other economic variables are limited by the Bureau of Economic Analysis' RIMS II data. The RIMS II multipliers are industry specific and include businesses located outside California. The estimated impact is an approximate estimate that may include non-regional nature of the multipliers. If the

multipliers were more regionally focused, this analysis may have produced higher or lower numbers.

In addition, the economic impact is difficult to model through RIMS II because it is not a straightforward change in final demand. Final demand (final use) is defined as purchases by customers outside the region; investment in new buildings, equipment, and software, purchases by government, and purchases by households. To use RIMS II, the expenses must be treated as investment spending due to a regulatory burden. RIMS II cannot measure the impact of a regulatory burden that changes the cost structure of the affected industry because RIMS II is a static model.[21]

The benefits associated with the indirect economic impacts are measured by avoidance of risk to related harmful outcomes.

b. Gas Storage: Assumptions and Limitations

In the context of the California economy as a whole, the economic impacts of gas storage regulations on the California economy are small. While specific details regarding the condition of gas storage wells will not fully be known until the required testing is complete, for the purposes of determining estimated costs to industry the Division incorporated assumptions based on cost estimates from operators, Division staff knowledge, and experience to estimate the types of probable corrective actions that will be required and the costs of those actions.

3. INDIRECT COSTS

Indirect costs reflecting the total economic impact on output assessments per RIMS II data are shown in the table in Appendix B (Economic Input to Output). These impacts are measurements of RIMS II data modeling that evaluate the economic impacts of the proposed regulations to the current gas storage regulatory scenario without the newer robust risk-based controls.

A full accounting of regulatory cost is difficult and requires assumptions.[22] However, an analysis with the understanding of the complexity of estimating indirect costs appears below that encapsulates anticipated economic impacts within California. The expenditures that gas storage operators will have to undertake as a result of the proposed regulations will increase economic output in California. The regional output multipliers from RIMS II are constructed incorporating information about inter-industry relationships and estimate the diminishing rounds of new spending within the region stemming from the economic activity. The proposed regulations will result in the payment of direct regulatory fees, operators paying for a set schedule of mechanical integrity testing, the installation of tubing and packer, and the installation of SCSSVs,

[21] Stanislaw Rzeznik, Economist, email 08/05/2016, RIMS II Branch, Regional Product Division, U.S. Bureau of Economics, U.S. Department of Commerce

[22] Steven C. Hackett, Environmental and Natural Resources Economics (New York: M.E.Sharpe) p.151

among other things that will result in economic transactions rippling throughout the regional economy.

H. ECONOMIC IMPACTS

1. Employment by Economic Sector

It is anticipated that the proposed UGS regulations will result in additional jobs in employment sectors such as construction, testing, monitoring with specialized equipment needs, and manufacturing of essential products required for implementation of these regulations. Equipment operators for oil rigs and other specialized skilled workers will be in higher demand to conduct the required testing. Thus, the economic sectors most affected would be within the oil and gas industry. As mandated work associated with remediation and drilling of new wells has been completed, the additional jobs will likely decrease over time. However, additional employment as outlined in the requirements for continuous maintenance and testing sectors will likely remain permanent. The table in Appendix C shows the number of jobs created as a result of the expenditures mandated by the regulations.

2. Exports and Imports

The proposed regulations will likely have a de minimis impact on the export and import of natural gas going forward. Because the regulations provide flexibility in compliance, operators will have time to plan when they take their wells out of service in order to meet testing and remediation requirements and avoid disruption to injection and withdrawal schedules.

In the aftermath of the Aliso Canyon incident, injection was suspended at that facility until completion of a comprehensive safety review. However, this was a unique situation that is not likely to be repeated in the future. Once safety measures are confirmed after passing a full battery of tests at Aliso, projected energy usage trends indicate reliance on gas storage is likely to continue, if not grow, in the near term. Northern California is projected to require an additional 6% of gas supply to meet demand for a high gas-demand scenario; whereas southern California's anticipated usage will require an additional 3.5% of supply.[23]

The benefits to implementing these regulations would enhance the safety of UGS facilities for exported and imported gas and ensure their reliability for future market needs. This would minimize future deliverability disruptions that could occur without permanent regulations.

3. Gross State Product (GSP)

The proposed regulations will have a relatively minor impact on the gross state product. Table 5 below shows the respective annual impacts in millions of dollars on the State's

[23] https://www.socalgas.com/regulatory/documents/cgr/2014-cgr.pdf, p. 5

estimated $2.45 trillion GDP.[24] Underground gas storage wells constitute a very small percentage of the total inventory of oil and gas wells in the State.[25] Additionally, the costs of the proposed regulations may be frontloaded due to one-time initial implementation of improvements for existing gas storage wells.

Ongoing costs after the initial implementation has been completed will be much less and will decrease incrementally over time. Table 5 details the estimated direct costs and gross domestic product impacts calculated using RIMS II multipliers over a five-year period, from 2017-2021. Immediately below is a capsule summary of the data from Table 5, showing the estimated per-year total reduction in gross state product attributable to the proposed regulations.

Table 5: Change to Gross State Product from Proposed Regulations

2017	2018	2019	2020	2021
$196,768,633	$191,513,153	$189,560,377	$188,897,944	$187,083,879

4. Creation or Elimination of Jobs

The Underground Gas Storage regulations will have a modest positive impact on the creation of jobs in California over the long term. It is anticipated that the proposed regulations will spur the creation an average of 1,812 jobs in the first year and roughly 1,700 jobs in subsequent years to facilitate compliance with new regulatory requirements. The following table shows the total increase in employment growth estimated using the identified NAICS codes. The table in Appendix C shows the number of jobs resulting from each regulatory requirement.

Table 6: Employment Growth from Proposed Regulations

2017	2018	2019	2020	2021
1,812.5	1,760.3	1,742.7	1,739.0	1,728.9

A limitation to the amount of jobs specified is that the RIMS II data does not specify whether these are full-time or part-time positions. Regardless, the oil and gas industry employment sector is expected to see an initial increase in overall employment with implementation of these proposed regulations.

5. Creation and Elimination of Typical Business

[24] CALIFORNIA STATE GROSS DOMESTIC PRODUCT (GDP), 1963 TO 2015, http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/

[25] Currently, California has approximately 88,500 oil, gas and geothermal wells in use of which only 452 are gas storage wells (DOGGR). This includes plugged and abandoned wells.

The proposed regulations are not anticipated to impact the creation or elimination of businesses in California. Oil and Gas service contracting businesses likely will see an increase in demand for their services as a result of the proposed regulations, the technology-intensive, specialized, niche market for testing services, well remediation, and installation of SCSSVs likely creates barriers to entry that outweigh any incentives to entry created by additional demand attributed to the proposed regulations. The expenditures will likely be absorbed by the directly regulated companies.

6. Competitive Advantage or Disadvantage

Based on the economic modeling, it is unlikely that the proposed UGS regulations will either cause an advantage or disadvantage for industry in California. All gas, whether imported from outside of California or produced in state and stored underground is uniformly subject to these UGS regulations. It is therefore not anticipated that the regulation will have an adverse effect on the competitiveness of California businesses.

The businesses that support gas storage operations are comprised of independent operators and two large utilities, SoCal Gas and PG&E. While the investor owned utilities will likely be able to recoup the majority, if not all, the costs of implementation through the Public Utility Commission process, the independent operators may not require as much remedial work on their facilities.

Independent operators may also experience increased operating costs initially. However, these operators generally have newer equipment and facilities that were designed specifically for UGS. In some cases the requirements in these proposed regulations are already in place, diminishing the need for further capital expenditure by these operators.

7. Increase or Decrease of Investment in State

The proposed regulations will likely have a negligible impact on overall investment in equipment, infrastructure, and real estate within California. The regulations will require operators to undertake additional investment in machinery, equipment and supplies at their natural gas storage wells and related facilities. This will likely be through leasing services and equipment or by investing in manufacturing and similar services for implementation of the regulations. However, this impact of the proposed regulations will be relatively insubstantial compared to California's roughly $2.3 trillion annual economy[26]. Indirect impacts of the proposed regulations are difficult to quantify, but likely will be broadly diffused across regional and statewide populations and unlikely to produce any discernible impact on investment activity.

[26] $2.3 trillion in 2014, California Department of Finance.
http://www.dof.ca.gov/Forecasting/Economics/Indicators/Gross_State_Product/

8. Impacts to Incentives for Innovation

The leak at Aliso Canyon has already spurred evaluation and innovation within the UGS industry, which will likely prompt development and use of improved tools and equipment.[27] The proposed regulations may encourage innovation of more cost-effective solutions for meeting safety requirements. The guided performance and risk management approach to safety requirements adopted by the proposed regulations will incentivize operators to periodically reevaluate new and alternative solutions for reducing or eliminating gas leakage and other potential UGS hazards.

I. AVOIDANCE OF PREVENTABLE HARM

The 2015 Aliso Canyon incident provided a dramatic example of direct and indirect damages and costs to the public and the environmental health in California. Although it is unlikely that an incident like that will occur again, the associated costs magnified the urgency and necessity of risk mitigation efforts and additional UGS regulations. This incident confirmed that the benefits of avoided harm by implementation of enhanced gas storage regulations would save California residents and industry hundreds of millions of dollars. With the safety requirements in the emergency regulations and orders already issued by the Division, the probability of another leak of Aliso Canyon's magnitude is extremely unlikely. The probability will continue to decrease as the proposed regulations are implemented.

Natural gas storage facilities periodically experience an occasional, generally relatively minor leak. These leaks can be related to valves, pipelines, well related issues, accidents, damage incurred during maintenance, and a variety of other factors. However, serious incidents that involve casualties or extended evacuations are rare. The United States Department of Energy looking at 137 incidents throughout the history of the over 400 underground gas storage facilities in the United States estimated the frequency of an incident at a UGS facility to range between 8.4×10^{-4} and 6.0×10^{-3} per site-year, or once every 167 to 1,190 years of UGS site operation. [28] This means that for the 400 UGS facilities currently in the United States, an incident could occur every 4 months to 3 years although not all of them with the severity of the leak at well SS-25. The U.S. Department of Energy included all types of underground gas storage facilities. Another study commissioned by Britain's Health Safety Executive evaluating risks associated from Underground Gas Storage Facilities located in depleted oil and gas

[27] Underground Natural Gas Storage Safety, *Integrity & Safe Operations*, p. 11. API, AGA, INGAA, 7/6/2016. www.energyinfrastructure.org/energy-101/natural-gas-storage.

[28] Ensuring Safe and Reliable Underground Natural Gas Storage: Final Report of the Interagency Task Force on Natural Gas Safety, U.S. Department of Energy, October 2016 (http://www.energy.gov/sites/prod/files/2016/10/f33/Ensuring%20Safe%20and%20Reliable%20Underground%20Natural%20Gas%20Storage%20-%20Final%20Report.pdf)

fields (like Aliso Canyon) using worldwide data, estimated that the rate of failure ranged from 5.8 x 10^{-6} to 8.3 x 10^{-6} per well year.[29]

While the probability of a leak the magnitude of Aliso Canyon is very low, the costs and disruption associated with such a leak can be substantial. Although the final financial costs associated with the leak at the Aliso Canyon Natural Gas Storage Facility have yet to be determined and are still mounting, as of August 2016 the operator's estimated direct costs amounted to over $700 million dollars.[30] In addition, the California Department of Finance estimates that State agencies have spent approximately 25,000 man hours on Aliso Canyon-related tasks, or 37.5 full-time PYs over the four months required to plug the leak. This number does not include time and resources spent by local or Federal agencies nor health issues, environmental and health costs experienced by the public or post-leak oversight by the Division and other agencies.

The avoidance of preventable harm is the backbone of SB 887 and the proposed UGS well regulations. With the implementation of the SB 887 performance standard and the proposed regulations, the risk of this event occurring again is extremely unlikely. A recent report produced by the American Petroleum Institute and two natural gas associations examined the causes of 61 leak incidents that occurred from 1990 to 2013.[31] According to the report, implementation of the American Petroleum Institute's Recommended Practice 1171 would reduce the likelihood of further events like those examined from occurring.[32] Most specifically, based on available data, the report determined that wells with two or more passive physical barriers (such as a casing string and a full cement sheath) have failure rates at least one order of magnitude less than wells with only a single physical barrier system.[33]

Consistent with SB 887 and taking into consideration the costs of another potentially catastrophic event occurring in the state again, the proposed regulations, in addition to a new testing and monitoring regime, require that wells be constructed and maintained such that "a single point of failure does not pose an immediate threat of loss of control of fluids and make certain that integrity concerns with a gas storage well are identified before they can become a threat to life, health, property or natural resources." To that end, SB 887 and the proposed regulations impose a performance standard for gas storage well construction which will require either isolation of gas by two or more

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[29] Failure Rates for Underground Gas Storage: Significance for Land Use Planning assessments, prepared by the Health Safety Laboratory in 2008. (http://www.hse.gov.uk/research/rrpdf/rr671.pdf)

[30] *Sempra Energy Announces Second-Quarter 2016 Earnings*, Aug. 4, 2016 (http://investor.shareholder.com/sre/releasedetail.cfm?ReleaseID=982958)

[31] Underground Natural Gas Storage: Integrity and Safe Operations, July 6, 2016 (http://www.energyinfrastructure.org/~/media/energyinfrastructure/images/ng-storage/underground-natural-gas-20160706t141636.pdf)

[32] API Recommended Practice 1171: Functional Integrity of Natural Gas Storage In Depleted Hydrocarbon Reservoirs and Aquifer Reservoirs, September 2015 (http://www.api.org/~/media/files/publications/whats%20new/1171_e1%20pa.pdf)

[33] See Underground Natural Gas Storage: Integrity and Safe Operations, July 6, 2016, at p. 40

physical barriers within each well, or a demonstration that any alternative well construction methods employed provide at least an equivalent level of safety assurance. Additionally, the proposed regulations contain other safety precautions significantly more rigorous than those proposed by API 1171. Consequently, the best available data suggest that the proposed regulations may reduce the already low probability of a significant leak event occurring at natural gas storage facilities in California by an order of magnitude or more.

J. ALTERNATIVES

To further illustrate the effects of regulatory changes on California industry and residents, a discussion of alternatives will highlight the associated benefits and potential fiscal disadvantages where applicable. While this alternative discussion uses a baseline of "business as usual" or rather, a baseline where there are no new regulations, a comparison of the alternatives to the proposed regulation is included. Based on Division staff expertise, historical information and stakeholder comments, the alternatives discussed below relate to mandatory surface controlled subsurface safety valves on all gas storage wells, and a less strenuous testing regime.

Alternative 1: More Strenuous

Alternative 1 requires all gas storage wells to be fitted with functioning SCSSVs within five years. SCSSVs would protect against uncontrolled flow or leakage from UGS wells in cases of catastrophic damage to wellhead equipment and some stakeholders have advocated for mandatory installation of SCSSVs at all wells.

Benefits
In general, the goal of subsurface safety valves is to provide protection against uncontrolled leaks from gas storage wells in case of catastrophic damage to wellhead equipment. In general, sub-surface safety valves are employed for high risk wells. High risk wells could include a gas storage well that crosses an active fault or a well located near a road where passing cars could damage the wellhead. Many surface controlled subsurface safety valves are placed at shallow depths to allow for well shut-in should the wellhead be damaged. Others are designed to isolate the well from pipelines in the event of pipeline failure. Surface controlled subsurface safety valves can include warning systems, automatic shut-off systems, remote operational controls, and other features that provide maximum opportunity to stop a leak.

Costs to Industry
By increasing the number of wells that are required to have SCSSVs, Alternative 1 would substantially increase operator direct costs over what is required in the proposed regulations. This would also increase the cost of maintenance associated with installation of the SCSSVs. The existing direct costs include anticipated costs and schedules requiring annual regulatory assessments, testing requirements, tubing and packer, new well construction, and plugging and abandonment. In the proposed regulations as in the tables in the appendices, these costs are anticipated to be spread

out over a five-year period after review and schedules are determined by Division-approved operator RMPs.

Alternative 1, however, would require **all** 452 gas storage wells to be equipped with SCSSVs installed and completed within five years of regulation implementation and would result in much higher compliance costs to industry. Estimated additional annual costs over the five year period would stem from operators installing approximately 90 new SCSSVs (instead of 25; at $250k each) and having a larger number of SCSSVs to maintain each year (90 additional wells each year at $4,000 each). Table 7 shows these estimated cost increases.

Table 7: Increased Costs from Alternative 1

	Year 1	Year 2	Year 3	Year 4	Year 5
Alternative 1	$22,860,000	$22,860,000	$22,860,000	$22,860,000	$22,860,000
Proposed Regulations with SCSSVs	$6,350,000	$6,350,000	$6,350,000	$6,350,000	$6,350,000
Increased Costs under Alternative 1	$16,510,000	$16,510,000	$16,510,000	$16,510,000	$16,510,000

Reason for Rejection

Alternative 1 would not address wells based on remediation needs on a case-by-case risk analysis and may result in duplicative and unwarranted expenditures. Each well not only has unique characteristics that should be evaluated, but some wells have already installed SCSSVs either by order, emergency regulation, or voluntarily. By requiring industry to install SCSSVs on all UGS wells, unnecessary expense, duplicative work, and poor planning would result. SCSSVs have drawbacks including reduction in well reliability associated with malfunctioning valves, risk to facility employees and contractors due to increased need to enter the well for maintenance purposes, and other potential risks that would have to be evaluated carefully.[34] Requiring SCSSVs across the board without consideration to the specific circumstances of a well and facility could actually be counterproductive from a risk-based perspective.

The proposed regulations allow measured planning based on sound analysis of the well needs on a case-by-case basis. The regulations take into account the flexibility needed when addressing requirements to ensure the integrity of UGS wells and the time needed to allow for amortization of expenses and conduct the required work.

[34] http://www.energyinfrastructure.org/~/media/energyinfrastructure/images/ng-storage/underground-natural-gas-20160706t141636.pdf

Alternative 2: Less Strenuous Testing Regime

Alternative 2 focuses on a less strenuous mechanical integrity testing regime. Alternative 2 requires operators to conduct corrosion pressure and electromagnetic casing tests once every five years instead of once every two years as recommended in the proposed regulations. In this Alternative 2 scenario, testing of all 452 gas storage wells would require corrosion and electromagnetic testing in Year 1 (2017) and Year 5 (2021).

Costs to Industry
Alternative 2 would have lower costs compared to those of the proposed regulations and costs outlined in Alternative 1. Estimated cost for casing pressure and electromagnetic tests for the Year 1 and Year 5 of implementation are:

Testing costs once every five years:

Year	Year 1 (2017)	Year 5 (2021)	Total Years 1 & 5
Total costs	$296m	$296m	**$592m**

Testing costs that would not be required:

Year	Year 2 (2018)	Year 3 (2019)	Year 4 (2020)	Total Years 2, 3, 4
Total costs	$296m	$296m	$296m	**$**888m

Benefits
Compared to the proposed regulations, the primary benefit of Alternative 2 is that decreased testing would be less costly and burdensome to the operator. It would provide adequate testing of the existing gas storage wells and create a baseline of testing data results.

Reason for rejection

Inherent to proper gas storage operation is the need to test and verify that wells have mechanical integrity and that the risks of leaks are low. This includes a series of tests to verify the condition of the well casing and tubular integrity and to control flow within the well or between the well and attached pipelines. Additional casing thickness and casing pressure tests would verify the integrity of gas storage wells and meet the standard articulated in the proposed regulations' technical model. The testing regime in the proposed regulations were developed by the Division in consultation with independent experts including scientists from the National Labs system who determined that they

would be the appropriate frequency to ensure safety. A testing regime of only once every five years, in many cases, would not be adequate to ensure well integrity.

Operating condition is natural gas storage fields can result in relatively high stress and corrosion rates for wells. As a result, they must be monitored more closely and frequently than other types of underground injection wells. Additionally, leaks may result in larger than normal volumes of escaped gas. The regulations already provide for flexibility based on the test results. It is safer to set minimum testing intervals and then, based on the results, allow for flexibility, as opposed to just allowing greater time intervals between testing across the board. For example, the Supervisor might allow for a casing thickness test every five years or even longer if the rate of corrosion observed in the test results is low. However, testing only once every five years, without any initial period of more frequent testing, would be less effective in providing sufficient data to estimate corrosion rates and anticipate well integrity problems that would be included in the testing schedule contained in the proposed regulations. It is expected that once the wells have accurate and timely testing with subsequent informed evaluations, a more thorough, cost effective, and risk-based approach can be taken on a case-by-case, well specific basis.

K. FISCAL IMPACTS

A. Local Government

Underground gas storage wells are governed by state and federal laws. The regulations would decrease the risk of emergency response and other services provided by local government. Therefore, the proposed regulations will not affect local governments.

B. Department of Conservation

In addition to the yearly testing requirements, each active gas storage well is subject to a well assessment fee necessary for the Division to regulate gas storage operations. In years past, this assessment has been insufficient. Recently, the Division requested through a Budget Change Proposal, the addition of 20 positions necessary for the current and future regulation of underground gas storage.

C. Other State Agencies

State government incurred significant expense when responding to the Aliso Canyon leakage event. Seven state agencies collaborated in response to the leak over the course of 8 weeks. Many of these agencies maintained personnel on-site daily with a great outlay of staff and economic resources. Today, many agencies continue to monitor and coordinate efforts:

The Division of Oil, Gas, and Geothermal Resources was the lead agency on efforts to stop the leak, and provided technical oversight over well-kill efforts. The Division has primary jurisdiction over the wells, and is focusing its investigation on the mechanical and operational conditions of the well to determine the cause of the well failure.

The Governor's Office of Emergency Services coordinated local, state, and federal actions to promote information sharing and ensure government actions were efficient and transparent.

The Division of Occupational Safety and Health Administration monitored the well breach site to ensure worker safety and compliance with workplace safety laws.

The California Public Utilities Commission provided industry expertise, particularly on maximizing gas withdrawal rates.

The Office of Environmental Health Hazard Assessment reviewed air quality data and evaluated public health concerns.

The California Air Resources Board, working in conjunction with the South Coast Air Quality Management District, is collecting measurements near the ground at the well site, and from towers, airplanes, and satellites, to measure total methane emitted and assess the methane release rate. These offices are continuously making ground level measurements around the sealed well to evaluate residual methane in the soil.

In their recent Spring Finance Letter, the Board requested $2.3 million and four new positions to support neighborhood air quality monitoring. This funding would cover short-term (3-4 months per site) community monitoring near oil and gas activities to identify potential risk, and allow the Board to quickly deploy short-term monitoring to respond to emergency leaks.

The California Energy Commission worked with SoCalGas to withdraw as much gas as possible from the facility, while monitoring energy supplies for homes and businesses statewide.

Clearly, state agencies played a significant role by providing time, resources and expertise to expedite the safe remediation of the Aliso Canyon gas leak. By implementing these new UGS regulations, the need for these staff resources will be lessened significantly.

L. CONCLUSION

The average yearly economic impact for the first five years of implementation of these proposed regulations is $236 million for direct costs and the total economic impact to output average is roughly $337 million. The economic impact for employment is estimated to be an additional 1,700 jobs per year, and the gross state product average is approximately $190 million per year during the first five years of implementation.

As described above, this economic analysis took a conservative approach and economic impact estimates should be viewed in the context of the assumptions used to develop the estimates. Some key assumptions that influenced the size of the economic impact estimates include: assuming that operators will meet the new performance standard by adhering to the proposed technical model in the regulations, that the testing

frequency will occur as written in the regulation rather than having case-by-case flexibility granted by the Division based on the condition of the well, rig contracting and transportation costs are included in every test cost rather than being spread across multiple tests, that 25% of wells will be required to have SCSSVs, and others mentioned throughout this document. While these types of assumptions certainly effect the estimates they were necessary in order to complete this type of analysis and ensure a full consideration of possible costs.

The Division has determined that, if enacted as proposed, these regulations:

- May affect the creation or elimination of jobs within the State of California.
- Will not likely affect the creation of new businesses or the elimination of existing businesses with the State of California.
- Will likely result in additional work for oil and gas service businesses that provide well testing and remediation services currently doing business in the State of California.
- Will most likely not affect the ability of businesses within California to compete with businesses in other states.

Appendix A: Direct Costs Associated with SB 887 and the Proposed Regulations

Cost Driver	2017 Cost	2018 Cost	2019 Cost	2020 Cost	2021 Cost
Noise and Temperature Logs (Leak tests)	$5,243,200	$5,243,200	$5,243,200	$5,243,200	$5,243,200
Casing Pressure test	$55,822,000	$55,822,000	$55,822,000	$55,822,000	$55,822,000
Electromagnetic Test (well casing thickness test)	$92,208,000	$92,208,000	$92,208,000	$92,208,000	$92,208,000
Tubing and Packer	$40,950,000	$40,950,000	$40,950,000	$40,500,000	$40,050,000
Subsurface safety Valves	$6,250,000	$6,250,000	$6,250,000	$6,250,000	$6,250,000
Maintenance	$100,000	$192,000	$284,000	$376,000	$468,000
New Well Construction	$24,000,000	$24,000,000	$24,000,000	$24,000,000	$24,000,000
Plug and Abandonment	$3,112,000	$2,334,000	$1,556,000	$1,167,000	$389,000
Production casing to surface equivalence/remediation	$2,500,000	$2,500,000	$2,500,000	$2,500,000	$1,500,000
Leak detection equipment costs	$3,990,000	$0	$0	$0	$0
Ambient Air monitoring Staff costs	$2,160,000	$1,620,000	$0	$0	$0
Additional Observation wells	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
Records management	$240,000	$0	$0	$0	$0
Risk Management Plan	$270,000	$0	$0	$0	$0
Assessment Fees	$ 4,172,000	$ 3,269,000	$ 3,269,000	$ 3,269,000	$3,269,000
	$243,017,200	**$236,388,200**	**$234,082,200**	**$233,335,200**	**$231,199,200**

Appendix B: Economic Impact to Output

Cost Driver	2017 Cost	2018 Cost	2019 Cost	2020 Cost	2021 Cost
Noise and Temperature Logs (Leak tests)	$7,678,142	$7,678,142	$7,678,142	$7,678,142	$7,678,142
Casing Pressure test	$81,745,737	$81,745,737	$81,745,737	$81,745,737	$81,745,737
Electromagnetic Test (well casing thickness test)	$135,029,395	$135,029,395	$135,029,395	$135,029,395	$135,029,395
Tubing and Packer	$56,789,460	$56,789,460	$56,789,460	$56,165,400	$55,541,340
Subsurface safety Valves	$8,667,500	$8,667,500	$8,667,500	$8,667,500	$8,667,500
Maintenance	$141,480	$271,642	$401,803	$531,965	$662,126
New Well Construction	$31,396,800	$31,396,800	$31,396,800	$31,396,800	$31,396,800
Plug and Abandonment	$4,071,118	$3,053,339	$2,035,559	$1,526,669	$508,890
Production casing to surface equivalence/remediation	$3,270,500	$3,270,500	$3,270,500	$3,270,500	$1,962,300
Leak detection equipment costs	$5,842,956	$0	$0	$0	$0
Ambient Air monitoring Staff costs	$3,316,464	$2,487,348	$0	$0	$0
Additional Observation wells	$2,616,400	$2,616,400	$2,616,400	$2,616,400	$2,616,400
Records management	$330,672	$0	$0	$0	$0
Risk Management Plan	$400,734	$0	$0	$0	$0
Assessment Fees	$6,907,163	$5,412,156	$5,412,156	$5,412,156	$5,412,156
	$348,204,522	**$338,418,419**	**$335,043,453**	**$334,040,665**	**$331,220,787**

*Entry represents the total change in output that occurs in all industries for each additional dollar of output delivered to final demand by the industry corresponding to the entry (BEA).

Appendix C: Employment Impact

Cost Driver	2017 Jobs	2018 Cost	2019 Cost	2020 Cost	2021 Cost
Noise and Temperature Logs (Leak tests)	41.8	41.8	41.8	41.8	41.8
Casing Pressure test	445.1	445.1	445.1	445.1	445.1
Electromagnetic Test (well casing thickness test)	735.2	735.2	735.2	735.2	735.2
Tubing and Packer	291.5	291.5	291.5	288.3	285.1
Subsurface safety Valves	44.5	44.5	44.5	44.5	44.5
Maintenance	0.5	1.0	1.4	1.9	2.4
New Well Construction	129.3	129.3	129.3	129.3	129.3
Plug and Abandonment	7.9	5.9	3.9	3.0	1.0
Production casing to surface equivalence/remediation	13.5	13.5	13.5	13.5	8.1
Leak detection equipment costs	31.8	0.0	0.0	0.0	0.0
Ambient Air monitoring Staff costs	21.4	16.1	0.0	0.0	0.0
Additional Observation wells	10.8	10.8	10.8	10.8	10.8
Records management	2.4	0.0	0.0	0.0	0.0
Risk Management Plan	4.0	0.0	0.0	0.0	0.0
Assessment Fees	32.7	25.6	25.6	25.6	25.6
	1,812.5	**1,760.3**	**1,742.7**	**1,739.0**	**1,728.9**

* Each entry represents the total number in change of jobs (either part-time or full-time) that occurs in all identified industries for each additional 1 million dollar of output delivered to final demand by the industry NAIC identifier. Because the employment multipliers are based on 2013 data, the output delivered to final demand should be in 2013 dollars (BEA).

Appendix D: Value Added

Cost Driver	2017 Cost	2018 Cost	2019 Cost	2020 Cost	2021 Cost
Noise and Temperature Logs (Leak tests)	$4,062,956	$4,062,956	$4,062,956	$4,062,956	$4,062,956
Casing Pressure test	$43,256,468	$43,256,468	$43,256,468	$43,256,468	$43,256,468
Electromagnetic Test (well casing thickness test)	$71,451,979	$71,451,979	$71,451,979	$71,451,979	$71,451,979
Tubing and Packer	$37,244,025	$37,244,025	$37,244,025	$36,834,750	$36,425,475
Subsurface safety Valves	$5,684,375	$5,684,375	$5,684,375	$5,684,375	$5,684,375
Maintenance	$74,970	$143,942	$212,915	$281,887	$350,860
New Well Construction	$19,874,400	$19,874,400	$19,874,400	$19,874,400	$19,874,400
Plug and Abandonment	$2,577,047	$1,932,785	$1,288,524	$966,393	$322,131
Production casing to surface equivalence/remediation	$2,073,750	$2,073,750	$2,073,750	$2,073,750	$1,244,250
Leak detection equipment costs	$2,991,303	$0	$0	$0	$0
Ambient Air monitoring Staff costs	$1,836,648	$1,377,486	$0	$0	$0
Additional Observation wells	$1,656,200	$1,656,200	$1,656,200	$1,656,200	$1,656,200
Records management	$226,416	$0	$0	$0	$0
Risk Management Plan	$242,352	$0	$0	$0	$0
Assessment Fees	$3,515,744	$2,754,786	$2,754,786	$2,754,786	$2,754,786
	$196,768,633	**$191,513,153**	**$189,560,377**	**$188,897,944**	**$187,083,879**