

**OCCUPATIONAL SAFETY
AND HEALTH STANDARDS BOARD**

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**INITIAL STATEMENT OF REASONS**

CALIFORNIA CODE OF REGULATIONS

TITLE 8: New Section 5189.1 of the General Industry Safety Orders

Process Safety Management for Petroleum Refineries**Background and Summary**

Labor Code (LC) Section 142.3 establishes the Board as the only agency in the state authorized to adopt occupational safety and health standards that are at least as effective as federal occupational safety and health standards. Labor Code Section 7856 mandates the adoption of process safety management standards for refineries. The proposed regulations implement, interpret, and make specific Labor Code Section 7856.

The federal Clean Air Act Amendments of 1990 [42 U.S.C. Section 7412(r)] directed the federal Occupational Safety and Health Administration (OSHA) and the United States Environmental Protection Agency (EPA) to develop regulations to prevent accidental chemical releases. These became known as the Process Safety Management (PSM) and Risk Management Plan (RMP) regulations, respectively. On February 24, 1992, OSHA published a Final Rule for *Process Safety Management of Highly Hazardous Chemicals* (57, Fed. Reg., 6356, February 24, 1992), codified as 29 CFR Section 1910.119.

The Department of Industrial Relations (DIR) subsequently adopted a PSM standard (California Code of Regulations (CCR) Title 8, Section 5189). Section 5189 is substantially the same as the federal counterpart, in that it addresses the prevention of catastrophic releases of toxic, reactive, flammable, and explosive chemicals and applies to employers who use a process involving a particular chemical (or chemicals) at or above certain threshold quantities (listed in Appendix A) or a flammable liquid or gas as defined in subsection (c) of the regulation.

Since 1992, California's PSM standard has covered approximately 1,500 facilities in the state that handle or process certain hazardous chemicals including its 12 oil refineries, which process approximately two million barrels of crude oil per day into gasoline, diesel fuel, jet fuel, and chemical feedstocks.

Following a chemical release and fire at the Chevron refinery in Richmond, CA, on August 6, 2012, the Governor's Interagency Working Group on Refinery Safety prepared a report raising concerns and recommendations about the safety of California's oil refineries. The report recommended the establishment of an Interagency Refinery Task Force to: (1) coordinate revisions to the state's PSM regulations and California Accidental Release Program (Cal/ARP) regulations; (2) strengthen regulatory enforcement; and (3) improve emergency preparedness and response procedures.

In accordance with the recommendations of the report, the Division of Occupational Safety and Health (known as Cal/OSHA), a division of DIR, is promulgating a new PSM regulatory proposal for oil refineries, GISO Section 5189.1. The proposal implements the recommendations of the report and other PSM elements that safety experts have learned over the past two decades are essential to the safe operation of a refinery and include: applying a *hierarchy of controls* to implement first and second-order inherent safety measures; conducting *damage mechanism reviews*; applying rigorous *safeguard protection analyses*; integrating *human factors* and *safety culture assessments* into safety planning; *involving front-line employees* in decision-making; conducting *root-cause analysis* following significant incidents; and performing comprehensive *process hazard analyses*.

SPECIFIC PURPOSE AND FACTUAL BASIS OF PROPOSED ACTION

Subsection (a) Scope and Purpose.

Specific Purpose

The purpose of this subsection is to specify the objectives of the proposal. The intention is to establish a performance-based approach to reduce the risk of major incidents and protect employee safety and health. Employers are required to mitigate risks to employees by eliminating or minimizing process safety hazards. The proposed section outlines the requirements for implementing this approach.

Necessity

This subsection is necessary to establish the objectives of the proposal. Eliminating or minimizing hazards to eliminate or minimize risk promotes the protection of employee safety and health.

The proposal enhances the existing process safety performance standard for California petroleum refineries, requiring employers to: (1) improve the mechanical and structural integrity of the state's refineries; (2) eliminate or minimize risks to employees; and (3) reduce the risk of a major incident. This approach is consistent with the report of the Governor's Interagency Working Group on Refinery Safety.

Subsection (b) Application.

Specific Purpose

The purpose of this subsection is to establish the regulatory jurisdiction of the proposal, specified as processes within petroleum refineries. The U.S. Census Bureau provides the following definition for petroleum refineries under North American Industry Classification System (NAICS) Code 324110:¹

This industry comprises establishments **primarily engaged** in refining crude petroleum into refined petroleum. Petroleum refining involves one or more of the following activities: (1) fractionation; (2) straight distillation of crude oil; and (3) cracking.

For petroleum refineries, this regulation supersedes CCR Title 8 Section 5189.

¹ United States Census Bureau (2012), *Industry Statistics Portal: Business Data from the U.S. Census Bureau*, 2012 NAICS: 324110, Petroleum Refineries, available at <http://www.census.gov/econ/isp/sampler.php?naicscode=324110&naicslevel=6#/>, accessed May 16, 2016.

Necessity

This subsection is necessary to clarify the jurisdiction of the proposal. An area or activity of a refinery must be related to or able to affect a process to be subject to the requirements of the proposal. The proposal enhances the existing process safety performance standard for California petroleum refineries, requiring employers to: (1) improve the mechanical and structural integrity of the state's refineries; (2) eliminate or minimize risks to employees; and (3) reduce the risk of a major incident. This approach is consistent with the report of the Governor's Interagency Working Group on Refinery Safety.

Subsection (c) Definitions.

Specific Purpose

The purpose of this subsection is to define terms related to process safety that are used throughout the proposal. These definitions provide the specific meaning of terms that appear in the proposal.

Necessity

Change

This definition describes any alteration (such as in process chemicals, technology, procedures, process equipment, facilities, or organization) that could affect a process, with the exception of "replacements-in-kind."

For example, an alteration in process chemistry that increases acidification could trigger the need for changes in safe operating limits, operating procedures, damage mechanism reviews (DMRs), or mechanical integrity assessments.

This definition is necessary because specific changes in a process can introduce process safety hazards that these regulations aim to minimize or eliminate.

Damage Mechanism

This definition identifies mechanisms that can cause degradation of equipment or material used in a process. Types of mechanisms include erosion, corrosion, and physical damage. The definition is relevant to the DMR subsection, which requires the employer to ensure that all damage mechanisms are identified and mitigated before they have the potential to affect the safety of a process.

This definition is necessary because equipment or material degradation, if uncorrected, can affect the integrity of a process, possibly leading to a major incident.

Employee Representative

This definition lists the individuals who could be designated to serve as a representative of the employees. The term is interpreted broadly to include union and non-union facilities. Employee representatives in unionized facilities may include the local union, the international union, or a refinery or contract employee designated by these parties. This definition is necessary because employee representatives may participate throughout the PSM program and because refineries have both represented and unrepresented workers.

Facility

This definition specifies all locations within a refinery that contain or include a process. For example, when conducting a Process Hazard Analysis (PHA), the team must analyze the seismic data for a control room located within a unit to ensure the process is not adversely affected. This definition is necessary to clarify that a facility encompasses the infrastructure and other entities that support, contain, or in some other way include a process.

Feasible

This definition establishes the standard for the development and implementation of process safety recommendations. This definition is necessary to clarify the requirements for assessing and addressing process safety hazards and the factors that may be considered.

Flammable Gas

The term “flammable gas” is included in the definition of “highly hazardous material” below. This definition references Appendix B of CCR Title 8, Section 5194, which further references Appendix B of the federal OSHA Hazard Communication Standard (Title 29 CFR Section 1910.1200). This definition includes Category 1 and Category 2 flammable gases. Category 1 flammable gases are defined as those that are ignitable at 13% or less by volume in air or have a flammable range of at least 12 percentage points, regardless of the lower explosive limit. All flammable gases in Category 1 have a flammable range with air at 20°C (68°F) and a standard pressure of 101.3 kPa (14.7 psi). All other flammable gases are assigned to Category 2. This is necessary to specify the thresholds of combustible gases covered by these regulations.

Flammable Liquid

The term “flammable liquid” is included in the definition of “highly hazardous material” below. This definition references Appendix B of CCR Title 8, Section 5194, which further references Appendix B of the federal OSHA Hazard Communication Standard (Title 29 CFR Section 1910.1200). This is necessary to establish that the flash point of flammable liquids covered by the proposed section is 93°C (199.4°F) or lower.

Highly Hazardous Material

This definition lists substances that are subject to the requirements of the proposal. The terms listed in this definition reference the Appendices of CCR Title 8, Section 5194, which further reference the Appendices of the federal OSHA Hazard Communication Standard (Title 29 CFR Section 1910.1200).

This is necessary to specify the threshold quantities of materials covered by these regulations.

Hot Work

This definition lists the types of activities that constitute hot work at a refinery. This definition is necessary because hot work has the potential to create an ignition source for flammable vapors, which can lead to a major incident and to injuries and fatalities among employees.

Human Factors

Human Factors influence how well the demands of the work environment match human capabilities, limitations, and needs. The goal of an effective Human Factors analysis is to fit the task and work environment to the person, rather than forcing the person to adapt in order to perform the work. Designing the work environment with consideration of Human Factors reduces the potential for human error, which can cause or contribute to process safety hazards or process incidents.

This definition is necessary because the regulations require Human Factors to be incorporated into training, communication, supervision, scheduling, staffing, and operations to ensure the safe operation and maintenance of a refinery.

Independent Protection Layers

This definition describes the attributes of independence that are necessary for certain safeguards to reduce the likelihood or consequences of a major incident through the application of devices, systems, or actions. This is necessary to ensure that an initiating cause does not affect the function of an Independent Protection Layer and that failure in any one layer does not affect the function of any other layer.

Inherent Safety

This definition describes a risk-reduction strategy that focuses on eliminating or reducing the hazards associated with a process.

If the employer substitutes a corrosive chemical with a noncorrosive chemical, for example, the risk of a corrosive burn injury is eliminated. The process of identifying and implementing inherent safety in a specific context is known as inherently safer design. Employers often apply the inherent safety strategies of substitution, minimization, moderation, and simplification to eliminate or reduce a process safety hazard.

This definition is necessary because the proposed section applies a hazard-based approach by prioritizing inherent safety measures over passive, active, and procedural safeguards. The definition clarifies the meaning of inherent safety and first- and second-order inherent safety measures.

Initiating Cause

This definition pertains to events that can trigger an incident sequence and lead to a transition from a normal to abnormal situation. This is necessary to identify the triggering event that may lead to process safety incidents.

Isolate

This definition describes actions that can be taken to remove a piece of equipment from service and separate it completely from all sources of energy or material. Removing a section of pipe, for example, prevents any material that might enter the pipe from passing beyond the opened section. This is necessary to protect worker safety and health, particularly during maintenance and emergency response operations.

Major Change

This definition lists three specific conditions that constitute a major change and can present an opportunity to improve the safety of a process. A major change triggers a requirement in the proposal for the employer to conduct a Human Factors analysis. Where a damage mechanism exists, a major change triggers a DMR. A Human Factors analysis is required in the design phase of major changes.

This definition is necessary to clarify the triggers specific to major changes within a process. These are important to specify because major changes can introduce new process safety hazards that these regulations aim to minimize or eliminate.

Major Incident

This definition describes a major incident as an event that causes a fire, explosion, or release of a highly hazardous material and has the potential to cause death or serious physical harm. For example, an uncontrolled fire could seriously burn an employee and would be considered a major incident. This is necessary to clarify circumstances that would trigger specific requirements for PHA, Hierarchy of Hazard Controls Analysis (HCA), and Incident Investigation.

Petroleum Refinery

This definition identifies petroleum refineries as facilities engaged in activities that fall under the NAICS Code 324110.

Only petroleum refineries engaged in activities that fall under this NAICS Code are subject to the requirements of the proposal. The U.S. Census Bureau provides the following definition for petroleum refineries under NAICS Code 324110:

This industry comprises establishments primarily engaged in refining crude petroleum into refined petroleum. Petroleum refining involves one or more of the following activities: (1) fractionation; (2) straight distillation of crude oil; and (3) cracking.²

Process

This definition describes the refinery activities and systems that are subject to the requirements of this proposal. A process is defined as one that involves a highly hazardous material.

The concept of “interconnectedness” as described in this definition allows the proposal to cover refinery equipment if it is interconnected in some way to a process. The proposal would cover a cooling tower, for example, if a failure in the cooling tower or its equipment could affect the process to which the cooling tower is connected.

Similarly, the concept of “separate vessels” covers refinery equipment if an equipment failure could affect a process that is located near the vessel. A vessel includes tanks, piping, and other containers of highly hazardous materials. The proposal would cover a tank, for example, if a fire, explosion, or loss of containment in the tank (or its equipment) could affect a process.

² United States Census Bureau (2012), *Industry Statistics Portal: Business Data from the U.S. Census Bureau*, 2012 NAICS: 324110, Petroleum Refineries available at <http://www.census.gov/econ/isp/sampler.php?naicscode=324110&naicslevel=6#/>, accessed May 16, 2016.

This includes utilities and process equipment if their failure could affect a process by potentially contributing to a major incident. For example, this includes electrical utilities if a failure in electrical power could potentially cause an upset or other dangerous condition in the process.

This is necessary to clarify the extent and circumstances of interconnectedness and proximity of processes covered by this proposal.

Process Equipment

This definition describes categories of items related to a process that are covered by this proposal. For example, an operator's radio that fails to function in certain areas of the plant could prevent the operator from communicating critical information to the control room. Because a radio is an appurtenance of a process, it is subject to the requirements of the proposal. This is necessary to clarify which process equipment is covered by the regulations.

Process Safety Culture

This definition describes the combination of group values and behaviors that reflect whether leaders and individuals share a collective commitment to emphasize safety. This is necessary to ensure the protection of employees and to promote the prioritization of safety over competing goals.

Process Safety Hazard

This definition refers to hazards of a process that have the potential to cause a major incident or death or serious physical harm. Under this definition, a poorly designed chemical sampling station on a process unit that has the potential to seriously injure an employee would be considered a process safety hazard. This is necessary to define the types of hazards covered by the proposal.

Process Safety Management

This definition refers to a set of interrelated approaches to eliminate or minimize hazards associated with a process and is intended to prevent or reduce the frequency and severity of refinery incidents. This is necessary to ensure the safety of the refinery's employees, processes, and process equipment.

Process Safety Performance Indicators

This term refers to metrics that refineries and regulators use to assess and track process safety performance. Process safety indicators are divided into "leading," "lagging," and "near-miss" metrics. Leading indicators are forward-looking metrics that provide early information regarding deterioration of a process safety element, which enables the employer to take action well before an incident occurs. Lagging indicators are retrospective metrics focused on actual incidents, such as failures of safeguards and orders given to evacuate or shelter in place.

Near-miss indicators are events that did not develop into an incident but that, under slightly different circumstances, could have resulted in harm to people, loss of containment, or damage to property or equipment. This definition is necessary because the employer is required to develop, implement, and maintain an effective program to track and document process safety indicators.

Qualified Operator

This term establishes whether an individual has demonstrated the requisite ability to safely perform all assigned duties pursuant to the training program defined in subsection (g). This is necessary to specify the requirements to perform duties of a qualified operator.

Reactive Substance

This term references Appendix B of CCR Title 8, Section 5194, which further refers to Appendix B of the federal OSHA Hazard Communication Standard (Title 29 CFR Section 1910.1200). This definition is necessary to provide reference to the specific thresholds of reactive substances covered by these regulations.

Recognized and Generally Accepted Good Engineering Practices (RAGAGEP)

RAGAGEP represents an engineering, operation, or maintenance activity that has been accepted and established in a code, standard, technical report, or recommended practice and is published by a recognized and generally accepted organization. RAGAGEP is recognized by subject matter experts as the best way to perform certain engineering, inspection, or mechanical integrity activities, such as fabricating, inspecting, or maintaining a vessel.

This is necessary to establish a safety performance standard for processes and process equipment. Compliance with RAGAGEP ensures that processes and process equipment are designed, constructed, installed, maintained, inspected, tested, and operating in a safe manner.

Replacement-in-kind

This term describes a change in a process in which one piece of equipment is exchanged for another piece of equipment that has equivalent design and technical specifications. A process change that meets the definition of “replacement-in-kind” is equally safe before and after the change, by definition, and is therefore not subject to the Management of Change (MOC) requirements of the proposal. This is necessary to clarify the circumstances when the employer is exempt from conducting the MOC procedure.

Safeguard

This term encompasses three categories of safeguards (passive, active, and procedural) that an employer can implement to mitigate the potential impact(s) of an incident or to interrupt a chain of events that could occur following an initiating cause.

For example, to prevent overpressuring in a tank, the employer could put in place a passive safeguard by increasing the thickness of the tank wall to withstand the highest possible pressure attainable in the system. Alternatively, the employer could implement active safeguards by installing pressure relief devices or procedural safeguards by directing employees to reduce pressure in the system in response to an alarm. The employer could implement these approaches independently or in combination. This is necessary to define the categories of safeguards available to the employer to promote safe operations and protect employees.

Safety Instrumented Systems

This term refers to a specific type of active safeguard that is designed to detect an unsafe condition in a process and, through automatic action, return the process to a safer state. For example, in the case of a

vessel that is at risk of overpressuring, a safety instrumented system might function in the following sequence: (1) high pressure in the vessel triggers a pressure-sensing device; (2) the device is detected by an instrument, which automatically opens one or more pressure relief valve(s); (3) the reduction in pressure inside the vessel returns the system to a safer state.

For scenarios identified in the PHA, the team may conduct hazard and operability (HAZOP) studies and recommend risk mitigation measures using safety instrumented systems. These systems must be independent of other safeguards that control the same equipment. For some scenarios, redundancy in safety instrumented systems may also be recommended to protect against the failure of one system, resulting in a major incident. This is necessary to define a specific type of active safeguard designed to achieve or maintain safe operation of a process.

Serious Physical Harm

This term references California Labor Code Section 6432(e), as follows:

(e) "Serious physical harm," as used in this part, means any injury or illness, specific or cumulative, occurring in the place of employment or in connection with any employment, that results in any of the following: (1) Inpatient hospitalization for purposes other than medical observation. (2) The loss of any member of the body. (3) Any serious degree of permanent disfigurement. (4) Impairment sufficient to cause a part of the body or the function of an organ to become permanently and significantly reduced in efficiency on or off the job, including, but not limited to, depending on the severity, second-degree or worse burns, crushing injuries including internal injuries even though skin surface may be intact, respiratory illnesses, or broken bones.

This is necessary to clarify the term and specify its application in this proposal.

Temporary Pipe Repair

This refers to a repair of an active or potential leak caused by a damage mechanism or pipe metallurgy and includes flanges and packing leaks that have the potential to cause a major incident. For example, to fix a leak on a flange, injection is considered a temporary pipe repair. This is necessary to specify types of temporary repairs to be tracked as Process Safety Performance Indicators and addressed by provisions of the MOC procedure.

Toxic Substance

This term references Appendix A of CCR Title 8, Section 5194, which further refers to Appendix A of the federal OSHA Hazard Communication Standard (Title 29 CFR Section 1910.1200). If an employee inhales or comes into contact with a substance in the form of a liquid, vapor, gas, fume, mist, aerosol (< 1 µm), dust or fine particulate (< 10 µm) for a period of four hours or less, and the employee subsequently develops an adverse health effect, that substance would meet the definition of acute toxicity. This is necessary to specify the thresholds of acutely toxic substances covered by these regulations.

Turnaround

This term describes an event in refinery operations during which hydrocarbons are not moving through the process, and the process is shut down—partially or completely—in order to perform maintenance, repairs, inspections, tests, and replacement of materials and equipment. Turnaround does not include unplanned shutdowns that occur due to emergencies or other unexpected maintenance matters in a process unit or plant. Turnaround also does not include routine maintenance, in which routine

maintenance consists of regular, periodic maintenance on one or more pieces of equipment at a refinery process unit or plant that may require the shutdown of such equipment.

Utility

This term comprises the energy and related services that are essential to the safe operation of a process. Utilities include water and steam and asphyxiants, such as nitrogen and carbon dioxide, when used as part of a process.

Including asphyxiants in the definition of utilities is necessary because they are especially hazardous in confined spaces, such as tanks, pipes, and vaults, where refinery employees may be required to perform work. Nitrogen is a common simple asphyxiant used in refineries to purge flammable vapors from tanks, piping systems, and other process equipment. Workers in the refinery industry have been injured or killed after entering oxygen-deficient spaces that have been purged using nitrogen. All asphyxiants that are used in any aspect of a process are subject to the requirements of the proposal. Utilities can directly affect process safety. Utilities are covered by the definition of process when their failure could adversely affect the process and potentially contribute to a major incident. It is necessary to clarify which utilities are covered by this proposal and their relation to process safety.

Subsection (d) Process Safety Information

Specific Purpose

The employer is required to develop and maintain comprehensive Process Safety Information (PSI) pertaining to refinery processes. For each process, the employer is required to compile information on the hazards of highly hazardous materials used in or produced by the process; the technology of the process; process equipment used in the process; and results of previous DMRs. This information is required in advance of conducting a PHA, HCA, Safeguard Protection Analysis (SPA), or DMR for the process.

The employer is required to provide for employee participation in the PSI and to make the information available to all employees and employees of contractors.

Necessity

This is necessary to ensure that the employer develops and maintains information to support safe operations.

Subsection (d)(1)

The employer is required to develop and maintain a compilation of written PSI before conducting a PHA, HCA, SPA, or DMR. This is necessary to ensure that the PSI is complete, current, and accurate, and included in the analyses required in a DMR, PHA, HCA, or SPA.

This is necessary to enable the employer and employees involved in operating or maintaining a process to identify and understand the hazards posed by the process.

Subsection (d)(2)

The employer is required to develop and maintain information on hazards of highly hazardous materials used in or produced by the process, the technology and equipment used in the process, and results of

previous DMRs. This is necessary to ensure relevant information is compiled and maintained to support safe operations.

Subsection (d)(3)

The employer is required to provide for employee participation in the development and maintenance of the PSI. Involving employees in the PSI helps ensure that the information is current and relevant to a refinery's processes.

The employer is required to make the PSI available to employees and employees of contractors to ensure that employees are informed of hazards that might be encountered on a particular process.

Subsection (d)(4)

The employer is required to include the following information pertaining to hazards of highly hazardous materials used in, present in, or produced by the process: toxicity; permissible exposure limits; data on physical, corrosion, thermal, chemical stability, and reactivity; and the potential hazardous effects of incompatible mixtures. This is necessary to ensure safe practices to protect the integrity of process operations and equipment that could directly affect employee safety. Safety Data Sheets meeting the requirements of CCR Title 8, Section 5194(g) are functionally equivalent to this requirement and may be used to comply with this requirement to the extent that they sufficiently meet the information provisions.

Subsection (d)(5)

The employer is required to include information on the technology of the process, including process schematics, process chemistry, maximum intended inventory, safe process variable limits, and the consequences of deviations. This is necessary to promote safe process operations that could directly affect employee safety.

Subsection (d)(6)

The employer is required to include information on process equipment, including materials of construction, piping and instrumentation diagrams, electrical classification, relief system design, ventilation system design, design codes and standards, material and energy balances, safety instrumented systems, and electrical supply and distributions systems. This is necessary to ensure the maintenance and safe operation of process equipment that could directly affect employee safety.

Subsections (d)(7), (d)(8), and (d)(9)

The employer is required to document that its existing process equipment complies with RAGAGEP or with other equally or more protective standards that ensure safe operation. This is necessary to give the employer flexibility to apply either RAGAGEP or an internal standard to ensure safe operation. If the employer installs new process equipment for which no RAGAGEP exists, or if existing process equipment was designed and constructed in accordance with codes, standards, or practices that are no longer in general use, the employer is required to document that this equipment is designed, constructed, installed, maintained, inspected, tested, and operating in a safe manner.

This documentation is necessary to provide transparency and accountability in the employer's programs to ensure the quality, integrity, and appropriateness of all process equipment and procedures for

maintaining, inspecting, and testing the equipment. The requirements are necessary to ensure that the employer's internal standards are equally or more protective than those in RAGAGEP.

Subsection (e) Process Hazard Analysis

Specific Purpose

The employer is required to systematically identify, evaluate, and control hazards associated with each process, an analysis called the PHA. This establishes a consistent performance standard for the industry.

The PHA team is required to assess scenarios and analyze potential causes and consequences of potential incidents. The team assesses the safeguards that are in place to prevent or mitigate the different accident scenarios to determine if additional safeguards are needed. The PHA team communicates its findings and recommendations to the refinery management, which uses this information to implement corrective actions to ensure the safety and integrity of the process.

Necessity

The proposed PHA subsection requires the employer to develop a comprehensive approach to conducting PHAs. This is necessary to ensure the consistency and effectiveness of PHAs.

Subsection (e)(1)

Within three years, the employer must conduct a PHA for all processes not previously covered by the existing PSM standard (Section 5189). The proposal allows a PHA that was previously conducted for a process in accordance with the requirements of Section 5189 to satisfy the initial PHA requirement. The proposal requires the PHA to cover all modes of operation of a process. This is necessary to ensure that process hazards are identified and analyses are completed in a timely manner.

Subsection (e)(2)

The employer is required to prioritize PHAs based on the extent of the hazard, the number of potentially affected employees, and the process operating history. This is necessary to ensure that PHAs for the most serious process hazards and risks are conducted earlier in the PHA schedule.

The employer is required to select at least one PHA methodology from the following: what-if, checklist, what-if/checklist, HAZOP, Failure Mode and Effects Analysis, Fault-Tree Analysis, or another PHA method recognized by engineering organizations or government agencies. This ensures the quality and appropriateness of the methodology selected for the hazards in the process.

Subsection (e)(3)

The employer is required to address the following in the PHA:

1. Hazards of the process and their potential consequences
2. Previous major incidents in the petroleum refinery and petrochemical industry sectors that are relevant to the process
3. Applicable DMR, HCA, MOC, incident investigations, and Human Factors report
4. Potential effects of external events
5. Facility siting intended to protect employees from process safety hazards
6. Qualitative evaluation of potential incidents that could result from process or equipment failure.

This ensures the accuracy and integrity of the information used in the PHA. Access to this salient information is necessary to address the hazards and potential consequences using the best information available. This promotes safe operation and minimizes or eliminates process safety hazards. Outcomes of previous incidents and external events provide a historical record to inform current and future safety practices.

Subsection (e)(4)

The employer is required to form a PHA team with expertise in engineering and process operations, and it requires the team, as necessary, to consult with experts in damage mechanisms, process chemistry, and control systems. The team must include at least one refinery operating employee who has experience and knowledge specific to the process being evaluated, and the employer must provide employee participation on the PHA teams. These requirements are necessary to ensure the PHA is conducted by individuals with the requisite expertise, including at least one member who routinely works on the process and who understands the current operating conditions. This is also necessary to promote employee participation and transparency.

Subsection (e)(5)

The employer is required to perform a comprehensive SPA for each scenario in a PHA that identifies the potential for a major incident. The purpose of the SPA is to determine the overall and combined effectiveness of the safeguards for each of the failure scenarios that have the potential for a major incident. This is necessary to ensure that the employer applies a quantitative or semi-quantitative safety analysis for process safety hazards identified in a PHA.

The proposal requires that all protection layers in an SPA be independent of one another and of initiating causes. This is necessary to isolate safeguards and prevent sequential failure. The employer is required to use a quantitative or semi-quantitative SPA method to identify the most protective safeguards.

The employer is required to use site-specific or industry-wide failure rate data to estimate the obtainable risk reduction. This is necessary for objective analysis and to ensure the effectiveness of safeguards.

The SPA may be conducted as part of the PHA or as a stand-alone analysis. The employer is required to ensure the SPA is conducted by individuals with adequate expertise in the specific SPA methodology used and to allow for employee participation. This is necessary for transparency and accountability and to ensure that SPAs are conducted by individuals with the requisite expertise. The stand-alone analysis option allows the employer flexibility in scheduling and analyzing the effectiveness of safeguards.

The employer is required to document the likelihood and severity of all potential initiating events as well as the risk reduction achieved by each safeguard in the SPA. Potential initiating events include, but are not limited to external events, equipment failures, human errors, loss of flow control, loss of pressure control, loss of temperature control, loss of level control, excess reaction or other conditions that may lead to a loss of containment. This is necessary to ensure accountability and transparency of the analysis and selection of effective safeguards.

The employer is required to complete all SPAs within six months of completion of the PHA. This is necessary to ensure appropriate safeguards are installed in a timely manner.

Subsection (e)(6)

The employer is required to conduct an HCA for all recommendations made by a PHA team for each scenario that identifies the potential for a major incident. This is necessary to ensure that, when a PHA team identifies the potential for a major incident, the employer implements protections prioritized by the highest order of inherent safety.

Subsections (e)(7), (e)(8), (e)(9)

The employer is required to prepare a PHA report containing the methodologies, analyses, and factors considered, as well as the findings and recommendations by the PHA team. The employer is required to make the report available to operating and maintenance employees and other persons who may be affected by the findings and recommendations.

This is necessary to ensure transparency and accountability. Standardized PHA reporting requirements allow for comparisons between current and previous experience with the process. Standardized reporting enables regulatory oversight and demonstrates PHA compliance.

Subsection (e)(10)

The employer is required to implement all PHA recommendations in accordance with subsection (x). This is necessary to ensure that the employer takes corrective action to implement PHA recommendations in a timely manner.

Subsection (e)(11)

The employer is required to update and revalidate all PHAs every five years. This is necessary to ensure the accuracy of all PHAs and the review of any changes or new information for potential hazards. This also promotes the safe operation of processes at the refinery.

Subsection (e)(12)

The refinery is required to retain all PHAs, SPAs, updates, and revalidations for each process for the life of the process, including documented resolutions of all recommendations. Record retention is necessary to enable future reference for PHAs and other teams' analyses.

Subsection (f) Operating Procedures

Specific Purpose

The employer is required to develop operating procedures for the purpose of ensuring safety during all operating phases and modes of operation for each process, managing deviations in process operating limits, protecting employees from process safety hazards, ensuring the proper function of safety systems, and safely responding to upset or emergency conditions on a process. The employer is required to ensure that information in the Operating Procedures is accurate and consistent with the PSI. The employer is required to review and update the Operating Procedures as often as necessary to ensure that they reflect current, safe operating practices, as well as annually certify that they are accurate. Operating Procedures include any changes that result from alterations in process chemicals, technology,

personnel, process equipment, or other changes to the facility. Changes to Operating Procedures must be managed under the MOC requirements.

The proposal requires the employer to develop, implement, and maintain specific safe work practices to prevent or control hazards during certain operations, such as opening process equipment or piping; tasks requiring lock-out/tag-out procedures; confined space entry; handling, controlling, and stopping leaks, spills, releases and discharges; and controlling entry into hazardous work areas by maintenance, contractor, laboratory, or other support personnel. These practices apply to employees of the refinery as well as to employees of contractors.

The proposal requires the employer to ensure that the operating procedures are readily accessible to any employee who works in or near the process area or who maintains a process.

Necessity

Comprehensive operating procedures are necessary to ensure the safe operation and maintenance of refinery processes and equipment under all operating conditions.

Subsection (f)(1)

The employer is required to ensure that Operating Procedures are consistent with the PSI. Additionally, the employer is required to develop operating procedures for the following activities:

(A) Each operating phase or mode of operation. Operating procedures are required for start-up; normal operations; temporary operations; emergency shutdown; normal shutdown; and start-up following turnarounds, planned or unplanned shutdowns, and emergency shutdowns. It is necessary to specify each of these types of operations to ensure that operating procedures address all process-related events, protect the safety of employees, and reduce the risk of an incident.

(B) Operating limits. Operating Procedures must include information on operating limits for each process, including consequences of deviations in operating limits and the steps required to avoid or correct deviations. This requirement is necessary to ensure that operators are aware of the safe operating range of the process and are able to identify and respond to deviations that could place the process outside this range.

(C) Safety and health considerations. Operating Procedures must include information on the chemical hazards of a process and the actions employees can take to prevent, or respond to, chemical exposures. The procedures must include instructions for safely opening process equipment. These requirements are necessary to ensure that each employee is informed of the chemical hazards associated with a process and the steps that should be taken to avoid exposure. In the event an exposure occurs, the requirements are necessary to ensure that employees are aware of protective actions they can take to reduce harm. The employer is required to verify the composition and properties of raw materials and control of hazardous chemical inventory levels, as well as any special or unique hazards, to ensure safe operation.

(D) Safety instrumented systems and their functions. Operating Procedures must include information on the function of safety instrumented systems. This requirement is necessary to ensure that employees understand the proper function of and can safely operate these systems.

Subsection (f)(2)

The employer is required to make Operating Procedures readily accessible to employees and other persons who work in or near the process or who maintain a process. This is necessary to enable employees to understand and properly follow the procedures associated with each process. This ensures safe operation of refinery processes.

Subsections (f)(3), and (f)(4)

The employer is required to certify annually that the employer has reviewed and updated Operating Procedures as often as necessary to ensure that the Operating Procedures reflect current, safe operating practices.

The employer is required to conduct an MOC for changes to Operating Procedures that result from alterations in process chemicals, technology, personnel, process equipment, or other changes to the facility.

Accurate and current Operating Procedures are necessary to ensure safe operation of the refinery.

Subsection (f)(5)

The employer is required to develop procedures for each process that give authority to qualified operators to initiate emergency procedures. Before allowing any employee in the vicinity of a leak, release, or discharge, the subsection requires the employer, at a minimum, to isolate or shut down the operation or, alternatively, to establish operational conditions that will protect employees at a level that is functionally equivalent to, or safer than, shutting down or isolating the process. This is necessary to protect employee safety during a leak, release, or discharge of a highly hazardous material.

Subsection (f)(6)

The employer is required to develop, implement, and maintain safe work practices to prevent or control hazards during specific activities. Requiring the employer to develop safe work practices for these activities is necessary to protect the safety of employees and contractor employees who perform these tasks.

Subsection (g) Training

Specific Purpose

The purpose of this proposed subsection is to set forth requirements to ensure that refinery operating and maintenance employees are effectively trained to perform their jobs safely. Effective training requires a comprehensive approach to identifying hazardous conditions and training employees to take actions to mitigate those conditions in ways that protect employee safety and the integrity of the process.

The proposal requires initial, refresher, and supplemental training; consultation with employees on the frequency and content of refresher training; involvement of employees in developing and implementing the training program; and certification that employees have received, understood, and successfully completed training. By requiring refinery employers to develop and implement an effective training program, the proposal ensures the competence of employees who operate and maintain the refinery

processes and who are essential to identifying process safety hazards and taking action to mitigate them.

Necessity

The proposed subsection requirements are necessary to (1) ensure that refinery employers develop and implement effective training programs; (2) involve employees in developing and implementing these programs; and (3) ensure the competency and qualifications of refinery employees.

Subsection (g)(1)

The proposal requires the refinery employer to train operating and maintenance employees (including those working in new assignments) in an overview of the process, operating procedures, safety and health hazards of the process, safe work practices, and emergency operations and shutdown.

This provision is necessary to ensure that each operating and maintenance employee receives a baseline level of training before being assigned to a process and that the training emphasizes process hazards that could affect the safety or health of the employee. By requiring specific training in emergency operations and shutdown, the proposal ensures that emergency operations are carried out by employees who are properly trained.

Subsection (g)(2)

The proposal requires the refinery employer to provide effective refresher and supplemental training to each operating and maintenance employee at least every three years. This provision is necessary to ensure that each operating and maintenance employee is trained in the current operating and maintenance procedures of a process. Operating procedures are often revised based on new information, and the operating and maintenance conditions of the process can change. Refresher and supplemental training ensures that all employees are working with the same understanding of the process conditions and procedures. The proposal requires the employer to consult with employees in determining the frequency and content of refresher training.

Subsection (g)(3)

The proposal requires the refinery employer to document that employees have received, understood, and successfully completed their initial or refresher training. The employer is required to do this by developing a certification record of employee training events, which must include the methods used to verify that the employee understood the training. This provision is necessary to ensure the effectiveness of the initial, refresher, and supplemental training programs required for refinery employees.

Subsection (g)(4)

The proposal requires the refinery employer to develop and implement written requirements that an employee must meet in order to be designated as qualified to serve in a particular position. It also requires that the employer develop testing procedures to ensure competency in work practices that the employee is required to follow to protect safety and health.

This provision is necessary to ensure that employees are qualified to perform the tasks specific to the position(s) they are assigned, including the health and safety aspects of the position. This provision helps prevent employees from being assigned to positions for which they are not qualified. A written

qualification process ensures standardized testing procedures for verifying understanding and competency in job skill levels and work practices.

Subsection (g)(5)

The proposal requires the employer within 24 months to develop and implement a training program to ensure that all affected employees and employee representatives are trained in all PSM elements. This provision is necessary because the proposed regulations contain seven new PSM elements that have a direct impact on employee safety and health and require the employer to effectively involve employees.

Employees and employee representatives who participate on a PHA, DMR, HCA, incident investigation, or Process Safety Culture Assessment (PSCA) team must be trained in the PSM elements relevant to the team.

This provision is necessary because employee participation adds practical experience and perspective to the teams that identify, prioritize, and develop solutions for process safety problems.

Subsection (g)(6)

The proposal requires the employer to involve employees in developing and implementing the training program.

This is necessary because employee participation requirements ensure accountability between the employer and employees regarding training requirements, promote safe practices using the most current and relevant information, and contribute to a strong safety culture.

Subsection (h) Contractors

Specific Purpose

The purpose of this proposed subsection is to set forth requirements that ensure the competency of contractors who perform work in a refinery, particularly regarding their understanding of process safety hazards, their adherence to refinery safety procedures, and the effectiveness of their employee safety training programs.

The proposal requires the refinery employer to evaluate the competency of contractors to ensure the safety and health of their own employees. These requirements improve accountability by both refinery employers and contractors.

The proposal requires the refinery employer to evaluate the safety record of contractors before hiring them, evaluate and document the safety performance of the contractor, implement procedures that the contractor must follow while in the plant, and require that contractors have informed and trained their employees in the hazards associated with their work in the refinery.

Contractors are required to train their employees in the hazards associated with their work. Employees of contractors are required to advise the refinery employer of specific hazards presented or identified while performing work for the refinery.

By requiring the refinery employer to actively participate in the selection, oversight, and evaluation of contractors, the proposal improves accountability and transparency in the safety performance of contractors.

Necessity

The proposed subsection requirements are necessary to (1) ensure that refineries select contractors with effective safety and health programs, (2) protect the safety and health of contractor employees and refinery employees, and (3) ensure the safety and integrity of refinery processes.

Subsection (h)(1)

The proposed requirements apply to contractors performing maintenance or repair work, supply services, turnaround, major renovation, or specialty work on or adjacent to a process. The requirements do not apply to contractors providing incidental services that do not affect process safety, such as janitorial work, food and drink services, laundry, delivery, or other supply services. This is necessary to provide clarification of who is and is not considered a contractor covered by this subsection.

Subsections (h)(2) and (h)(2)(A)

The proposal contains refinery employer responsibilities and requires that during the selection of contractors, the refinery employer must evaluate the contractor's safety performance, including programs to prevent injuries and illnesses.

This provision is necessary to require refinery employers to select contractors who effectively demonstrate that their employees understand and implement safe work practices.

Subsection (h)(2)(B)

The proposal requires the refinery employer to inform the contractor—and requires that the contractor has informed their employees—of potential process safety hazards associated with the contractors' work, applicable refinery safety rules, and applicable provisions of the proposal, including the Emergency Action Plan.

This requirement is necessary to ensure that the refinery employer is accountable for the safety of contractors and contractor employees. The provision ensures that contractors and contractor employees are informed of the process safety hazards in the refinery and applicable safety procedures, including what actions to take in the event of an emergency.

This requirement is necessary to ensure the accountability of the refinery employer for the safety performance of contractors and for the protection of contractor employees, throughout the time when the contractor is performing work at the refinery.

Subsection (h)(2)(C)

The proposal requires the refinery employer to develop and implement effective written procedures to ensure the safe entry, presence and exit of contractors and their employees in the process areas.

This requirement is necessary to ensure the security of the facility, including control of access and work in the process area. This is necessary to protect the health and safety of workers who enter and exit the process area.

Subsections (h)(2)(D) and (h)(2)(E)

The proposal requires the refinery employer to periodically evaluate, document, and ensure the contractor's performance in fulfilling the obligations stipulated in this subsection.

Performance evaluation is necessary to demonstrate that the contractor is effectively protecting the safety and health of its employees.

At the request of the Division of Occupational Safety and Health (Division), the employer is required to obtain the contractor's injury and illness log for work performed at the refinery.

This holds the refinery employer accountable for requiring the contractor to comply with health and safety regulations and maintain safe work practices for their employees.

Subsection (h)(3)(A)

This proposal requires contractors to meet the training requirements set forth in Health & Safety Code 25536.7, which specifically requires that contractors must first complete 20 hours of advanced refinery safety training prior to being allowed to work in a refinery. The curriculum for this training must be approved by the Division of Apprenticeship Standards, and this training must be completed once every three years.

This requirement is necessary to ensure the consistency of employee training. Process conditions can change over time, necessitating refresher training every three years. Requiring confirmation of attendance and of employee competency in the topics covered in the training is essential to ensuring the quality and effectiveness of the training.

Subsection (h)(3)(B)

The proposal requires contractors to instruct their employees in the potential process safety hazards related to their jobs, as well as in all applicable refinery safety rules and the provisions of this proposal.

This requirement is necessary because work in a refinery is inherently hazardous. For example, because of the potential presence of flammable vapors, welding near a refinery process is inherently more hazardous than welding at a commercial construction site. Likewise, performing welding at one refinery is likely to be different from performing the same job at another refinery, where process conditions can vary. To perform work safely, and to protect the integrity of the process, contractor employees must receive training specific to the hazards of the refinery job site and specific petroleum process unit.

Subsection (h)(3)(C)

The proposal requires contractors to document the effectiveness of all employee training. This requirement is necessary to ensure that the training of contractor employees actually occurs and that contractors make a concerted effort to ensure that the training is effective—that is, it successfully advances the knowledge of each participant in ways that improve understanding of safety hazards in the refinery and positively affect work practices.

Subsection (h)(3)(D)

The proposal requires the contractor to ensure that its employees understand and follow the safety and health procedures of both the refinery and the contractor. This requirement establishes the accountability of the contractor in ensuring that each employee is fully informed of safety and health procedures and is able to apply those procedures on the job competently.

Subsection (h)(3)(E)

The proposal requires the contractor to advise the refinery employer of hazards presented by the contractor's work, as well as any other hazard identified by the contractor while performing work in the refinery. This requirement is necessary to ensure that the refinery employer is informed of the hazards that the contractor's work could introduce and allows the refinery employer to take protective actions and to advise the contractor of any restrictions that might apply to the contractor's work. This process identifies possible hazards and promotes efforts to eliminate or minimize process safety hazards, as well as hazards associated with confined spaces, lock-out/tag-out procedures, hazardous chemical emissions, hot surfaces, fall protection, and others. Contractors have expertise in the hazards associated with their work. This provision provides a vehicle for improving communication between contractors and refinery employers, thereby improving process safety and the safety of contractor and refinery employees.

Subsection (i) Pre Start-Up Safety Review

Specific Purpose

The employer is required to conduct a Pre Start-Up Safety Review (PSSR) for new processes and for modified processes if the modification necessitates a change in PSI, such as the start-up following a turnaround.

Necessity

The employer is required to conduct a PSSR prior to the start-up of a process and for modified processes. This is necessary to provide relevant information to operators and to ensure the operators are trained on the changes prior to start-up, which ensures safe start-up of the unit.

Subsection (i)(1)

The employer must perform a PSSR for new processes and for modified processes if the modification necessitates a change in PSI. For example, if a modification causes a change in the safe upper operating limits, the employer must amend its PSI, which would trigger the requirement to conduct a PSSR prior to restarting the process. The employer is also required to conduct a PSSR for all turnaround work performed on a process, as defined.

This is necessary to ensure that the employer carefully assesses the function, performance, and integrity of new or modified processes before starting them. Failure of a single piece of equipment can cause or contribute to a major incident. Requiring a comprehensive PSSR is necessary to ensure safety during the start-up process.

Subsections (i)(2) and (i)(2)(A)

The employer is required to confirm that all construction, maintenance, and repair work has been performed in accordance with design specifications. This is necessary to ensure proper oversight and

accountability regarding the quality of work performed on a process (including by contractors) before the process starts.

Subsection (i)(2)(B)

The employer is required to ensure that all process equipment has been maintained and is operable in accordance with design specifications. This is necessary to ensure the safety of process equipment.

Subsection (i)(2)(C)

The employer is required to ensure that effective safety, operating, maintenance, and emergency procedures are in place prior to starting a new or modified process. This is necessary to ensure the safe operation of the process during start-up operations. Emergency procedures enable employees to respond effectively in the event an upset or emergency condition occurs during start-up. This is necessary to ensure the safety of the process and of employees who respond to an incident.

Subsection (i)(2)(D)

The employer is required to perform a PHA, HCA, DMR, and SPA for new processes. Prior to starting a process, the employer is required to implement or otherwise resolve the recommendations made by any of the teams performing these analyses. This requirement is necessary to ensure all damage mechanisms that could affect the integrity of a process are considered; all potential process safety hazards are identified, prioritized, and mitigated; and inherent safety measure and safeguards are effectively applied.

For new or modified processes, the employer is required to implement all changes in accordance with the requirements of the MOC procedures. This is necessary to ensure proper oversight of process safety before, during, and after implementation of a change.

Subsection (i)(2)(E)

The employer is required to ensure that each operating employee and maintenance employee has completed training pertaining to the start-up procedure. This is necessary to ensure that employees are properly trained and qualified to implement the start-up procedures. This promotes safe operations in the refinery.

Subsection (i)(3)

The employer is required to involve operating or maintenance employees who have expertise and experience in the operations and engineering of the process being started. This requirement is necessary to ensure that at least one employee who routinely works on the process and understands the operating conditions participates in the PSSR. The information and experience provided by employees contributes to the safe start-up of a new or modified process and promotes safe operations in the refinery.

Subsection (j) Mechanical Integrity

Specific Purpose

The employer is required to ensure the mechanical integrity of all process equipment.

The purpose is to ensure the safe operation of all processes, prevent process incidents, and ensure the reliability of safety and utility systems that prevent process incidents.

Necessity

The proposed requirements are necessary to ensure the mechanical integrity and safety of process equipment. The failure of a single piece of equipment can cause or contribute to a major incident. For example, a pressure relief valve that fails to open due to poor inspection and maintenance can result in dangerous overpressuring in a process.

Subsections (j)(1)(A) and (B)

The employer is required to develop, implement, and maintain effective written procedures to ensure the ongoing integrity of process equipment, including providing clear instructions for safely conducting maintenance activities on process equipment, consistent with the PSI.

This requirement is necessary to document the employer's efforts to develop and maintain an effective mechanical integrity program. This ensures the integrity of process safety equipment and safe operations in a refinery.

Subsection (j)(1)(C)

The employer is required to make mechanical integrity procedures and inspection documents readily accessible to employees and employee representatives. This is necessary to ensure the accountability and transparency of information, which promote employee safety. Providing information to employees and representatives helps ensure the effectiveness of the program.

Subsections (j)(2)(A–C)

The employer is required to perform inspections and tests on process equipment using procedures that meet or exceed RAGAGEP. The employer is required to conduct inspections and tests with a frequency consistent with the manufacturer's recommendations, with RAGAGEP, or with other equally or more protective internal standards. The employer is required to increase the frequency of inspections and tests if necessary, based on the operating experience with the equipment. This is necessary to provide transparency and accountability in the employer's programs. This ensures the quality, integrity, and appropriateness of all process equipment and procedures for maintaining, inspecting, and testing the equipment. The requirements are necessary to ensure that issues related to the performance of process equipment are identified through testing and inspections to prevent malfunction. The requirements are also necessary to ensure that the employer's internal standards are equally or more protective compared to RAGAGEP.

The employer is required to retain a certification record to document that process equipment testing and inspections meet the requirements of this proposal. The record must identify the date of the inspection, the name of the person who performed the inspection or test, a description of the inspection or test performed, the results of the inspection or test, and the serial number or other identifier of the process equipment. This is necessary to establish a consistent performance standard for testing and inspections related to process equipment.

Subsection (j)(3)(A)

The employer is required to correct deficiencies in process equipment in a manner consistent with RAGAGEP or other equally or more protective internal standards, in order to ensure safe operation. This is necessary to ensure that equipment deficiencies are corrected properly, using standards that are equally or more protective compared to RAGAGEP.

Subsection (j)(4)

The employer is required to ensure that all process equipment complies with the PSI and that the equipment is suitable for its intended use, fabricated from the proper materials of construction, and compliant with design specifications and all applicable codes and standards. The employer is required to ensure that new or existing equipment for which no RAGAGEP exists is designed, constructed, installed, maintained, inspected, tested, and operating in a safe manner. The employer is required to inspect to ensure all maintenance materials, spare parts, and equipment meet design specifications and applicable codes. The employer is required to establish a process for evaluating new or updated codes and standards and implementing changes as appropriate to ensure safe operation.

These requirements are necessary to ensure the safety and integrity of all process equipment, from design and construction to installation and operation. This is necessary to ensure that employers meet or exceed recognized standards and implement changes in response to new or updated codes and standards that may be amended in response to process incidents in the industry. This is necessary to promote safe operation and ensure that process equipment complies with current standards. This protects the safety of employees and the integrity of refinery processes.

Subsection (k) Damage Mechanism Review

Specific Purpose

The employer is required to conduct a Damage Mechanism Review (DMR) on mechanisms that may affect or damage process equipment and lead to a major incident. Examples of damage mechanisms include corrosion by acidic fluids, cracking due to excessive stress, erosion by continued wear in the same location, fatigue due to high temperatures, and mechanical failures caused by excessive loads. The physical damage to pipes, valves, and other process equipment caused by these mechanisms has been identified as a cause of serious process failures in refineries.

Gaps in damage mechanism procedures have been identified as important contributors to incidents in the refinery sector, including at Chevron's El Paso, Texas, refinery (1988), Chevron's Pascagoula, Mississippi, refinery (1988 and 1993), Chevron's Salt Lake City, Utah, refinery (2002), Chevron's Richmond, California, refinery (2007 and 2012), the Silver Eagle refinery in Woods Cross, Utah (2009), Tesoro's Anacortes, Washington, refinery (2010), the Regina, Saskatchewan, refinery (2011), and the BP Cherry Point, Washington, refinery (2012).³

Refineries currently operating in California have a procedure to conduct a DMR. Under the proposed subsection, the employer is required to establish a team with specific expertise to identify damage mechanisms and develop recommendations to mitigate them. The recommendations of the DMR team

³ U.S. Chemical Safety and Hazard Investigation Board (CSB), (April 2013), *Interim Investigation Report on the Chevron Richmond Refinery Fire*, pp. 24-30.

are to be documented in a written report, revalidated every five years, and communicated to the PHA team, which incorporates the recommendations into the PHA evaluation. The PHA team communicates its own findings and recommendations to the refinery management, which uses this information to prioritize and develop corrective actions.

Necessity

A DMR is necessary to identify deficiencies in and degradation of the mechanical and structural integrity of processes. A DMR assists in determining the appropriate selection of construction materials and inspection frequency. This is necessary to help prevent process failures that could cause employee injuries or incidents.

The subsection introduces a DMR performance standard that requires refineries to design and implement a uniform, timely, and comprehensive DMR program.

Subsections (k)(1), (k)(2), (k)(3), (k)(4), and (k)(5)

Within five years, the employer must conduct a DMR for each process in which a damage mechanism exists. Half of these DMRs must be conducted within three years. The employer is required to prioritize DMRs based on the process history, the PHA schedule, and inspection records. All DMRs must be revalidated every five years. The imposed time limits are necessary to ensure that damage mechanisms are identified and prioritized in a timely manner. The proposal integrates the DMR schedule with the PHA schedule, which gives the employer flexibility in aligning priorities for implementation. By aligning with the PHA schedule, the proposed DMR schedule improves the integration of DMR findings into PHAs for each process. By requiring a prioritization process, the proposal ensures that DMRs for the most serious hazards—those with the greatest potential for a major incident—are conducted earlier, rather than later. For processes that do not have a damage mechanism, a DMR is not required but the employer is required to document the rationale. This is necessary to ensure accountability and transparency.

The employer is required to conduct DMRs for new processes and as part of a major change. In addition, where a damage mechanism is identified as a contributing factor in an incident investigation, the employer shall review the most recent DMRs that are relevant to the investigation. If a DMR has not been performed on the processes that are relevant to the investigation, the incident investigation team shall recommend that a DMR be conducted and completed within a specified timeframe. This is necessary to ensure damage mechanisms are evaluated for all processes. This ensures the integrity of the process and prevents newly introduced or unknown hazards from causing unintended safety consequences.

For example, high-temperature sulfidation, as a damage mechanism, can cause general thinning and degradation in piping. If a refinery seeks to replace existing carbon steel piping with chrome piping, which is more resilient to sulfidation, a DMR is performed to determine the appropriate material of construction, which may be 5 or 9 chrome or stainless steel that is resilient to high-temperature sulfidation. Further, when a damage mechanism is identified as a contributing factor in an incident, such as ruptured carbon steel piping caused by high-temperature sulfidation, an incident investigation team may recommend a DMR be conducted on all piping where high-temperature sulfidation could occur. This is necessary to ensure the integrity of all related process equipment that may be affected by the same damage mechanism.

Subsections (k)(6) and (k)(7)

DMRs must be performed by a team with specific types of expertise. This is necessary because damage mechanisms are complex and require specialized knowledge, including DMR methodology. The employer is required to establish DMR teams with relevant expertise and ensure the findings and recommendations are made available to the PHA team. The employer is required to provide for employee participation on DMR teams to ensure transparency and accountability. These requirements ensure the quality and effectiveness of the DMRs performed by a refinery.

Subsection (k)(8)

The employer must include five types of analyses in a DMR, including assessment of process flow diagrams, potential damage mechanisms, materials of construction, methods of prevention, and operating parameters. This is necessary to ensure the comprehensiveness of the DMRs performed and establish a consistent performance standard.

Subsection (k)(9)

Examples of damage mechanisms include corrosion by acidic fluids, cracking due to excessive stress, erosion by continued wear in the same location, fatigue due to high temperatures, and mechanical failures caused by excessive loads. The physical damage to pipes, valves, and other process equipment caused by these damage mechanisms has been identified as a cause of serious process failures in refineries.

This subsection is intended to provide examples of damage mechanisms found in refineries.

Subsection (k)(10)

The employer is required to assess the inspection history and previous damage mechanism data for the process. The employer is required to review the industry-wide experience with the process, as well as all applicable standards, codes, and practices. This is necessary to ensure that the DMRs performed by the employer are complete and that refineries learn from their own experience with the process. Requiring a review of the industry-wide experience with damage mechanisms for a specific process is necessary to ensure that all refineries benefit from the experience of others.

Subsections (k)(11), (k)(12), and (k)(14)

The employer must prepare a DMR report that includes a description of all damage mechanisms analyzed for a process. The report must also include recommendations for temporarily mitigating the damage that was identified, as well as recommendations for preventing the damage from recurring.

The DMR report must be provided to and, upon request, reviewed with employees whose work assignments are within the process unit described by the DMR. The employer is required to retain DMR reports for the life of the process unit.

Documentation is necessary to ensure that the required DMR information is recorded by each refinery and retained over time, ensuring transparency and accountability of damage mechanism identification, control, and mitigation. This risk-based assessment enables the employer to anticipate problems and budget time and materials necessary to proactively mitigate potential problems and ensure the integrity

of the process. Standardized DMR reporting requirements are necessary for monitoring and evaluation over time and across the industry.

Subsection (k)(13)

The employer must implement all recommendations made by a DMR team in accordance with subsection (x). This requirement is necessary to ensure accountability and transparency and ensure that the employer takes appropriate and timely corrective actions to implement DMR recommendations.

Subsection (l) Hierarchy of Hazard Controls Analysis (HCA)

Specific Purpose

The employer is required to ensure the safety and integrity of refinery processes by applying inherent safety measures and safeguards in a specific sequence and priority order. The HCA includes:

First-Order Inherent Safety Measure. This is a measure that eliminates a hazard. Changes in the chemistry of a process that eliminate the hazards of a chemical are usually considered first-order inherent safety measures—for example, by substituting a toxic chemical with an alternative chemical that can serve the same function but is nontoxic.

Second-Order Inherent Safety Measure. This is a measure that effectively reduces a risk by reducing the severity of a hazard or the likelihood of a release, without the use of add-on safety devices. Changes in process variables to minimize, moderate, or simplify a process are usually considered second-order inherent safety measures—for example, by redesigning a high-pressure, high-temperature system to operate at ambient temperatures and pressures.

Passive Safeguard. This is a process or equipment design feature that minimizes a hazard by reducing either its frequency or its consequence, without the active functioning of any device—for example, a diked wall around a storage tank of flammable liquids designed to contain a potential release.

Active Safeguard. This is a control, alarm, safety instrumented system or other mitigation system that is used to detect and respond to deviations from normal process operations—for example, a pump that is shut off using a high-level switch.

Procedural Safeguard. This is a policy, operating procedure, training program, administrative check, emergency response, or other management approach that is used to prevent incidents or minimize the effects of an incident. Examples include hot work procedures and emergency response procedures.

The HCA subsection requires that first- and second-order inherent safety measures be prioritized over passive or active safeguards, which must be prioritized over procedural safeguards.

Necessity

This subsection establishes a consistent performance standard. This is necessary to ensure that refineries evaluate and implement the most effective approaches to preventing or mitigating process safety hazards. These requirements are intended to improve the safety of refinery processes.

For example, to address pipe corrosion caused by high temperatures and sulfidation, the following sequence and priority order represent possible corrective actions: (1) replace the highly hazardous material with a nonhazardous material to eliminate the corrosive effects on the pipe—a first-order inherent safety measure; (2) change the process conditions to reduce the corrosive effects so they are less intense or less likely to occur—a second-order inherent safety measure; (3) apply welded patches over thinning sections of pipe to prevent a leak from occurring—a passive safeguard; (4) install automated corrosion probes that continuously monitor thresholds of safe operation—an active safeguard; (5) conduct routine inspections of the thickness of the pipe—a procedural action; or (6) take various combinations of these actions.

Subsection (l)(1)

Within five years, the employer must conduct an initial HCA as a standalone analysis for all existing processes; 50% of these HCAs must be conducted within three years of the effective date of this section. All HCAs must be revalidated every five years. The proposal integrates the HCA schedule with the PHA schedule, which gives the employer flexibility to align schedules. The proposed HCA schedule, established through stakeholder input, is necessary to ensure that HCAs are conducted in a timely manner.

Subsection (l)(2)

The employer must conduct an HCA in the following cases: (1) for all recommendations made by a PHA team for each scenario that identifies the potential for a major incident; (2) for all recommendations that result from the investigation of a major incident; (3) as part of an MOC review, whenever a major change is proposed; and (4) during the design and review of new processes, process units, and facilities, and their related process equipment. An HCA is necessary in each of these cases to ensure the most effective solutions and inherently safer strategies are identified. Each of these analyses represents an opportunity to reevaluate process safety problems and consider new approaches to solving them.

Subsection (l)(3)

The proposal requires that HCAs be documented, performed, updated, and revalidated by a team with specific types of expertise. The team must include one member with expertise in the HCA method being used and one operating employee who currently works on the process and has experience and knowledge specific to the process being evaluated. The proposal requires the employer to provide for employee participation on HCA teams. The inclusion of an operating employee is necessary to ensure that the team has at least one member who routinely works on the process. Employers are required to consult individuals with expertise in damage mechanisms, process chemistry and control systems as needed. This is necessary to ensure adequate expertise and employee participation when performing the HCA.

Subsection (l)(4)

The HCA team is required to: (1) compile or develop all risk-relevant data for each process or recommendation; (2) identify, characterize, and prioritize risks posed by each process safety hazard; and (3) identify, analyze, and document all inherent safety measures and safeguards for each process safety hazard in a prescribed sequence and priority order. This is necessary to ensure the HCA is comprehensive.

The employer is required to develop a protocol to ensure that the HCA team analyzes and documents publicly available information on inherent safety measures and safeguards that have been (1) achieved in practice by the petroleum refining industry and related industrial sectors and (2) have been required or recommended for the petroleum refining industry and related industrial sectors, by a federal or state agency or a local California agency, in a regulation or report. This is necessary to ensure that the HCA teams have sufficient information to develop recommendations that are effective, feasible, and consistent with best practices.

For each process safety hazard that the HCA team has identified, the team is required to develop written recommendations in the following sequence and priority order: first-order inherent safety measures, second-order inherent safety measures, passive safeguards, active safeguards, and procedural safeguards. The HCA team shall develop recommendations to eliminate hazards to the greatest extent feasible using first-order inherent safety measures. The team shall reduce any remaining hazards to the greatest extent feasible using second-order inherent safety measures. Safeguards must each effectively reduce any remaining risks. This is necessary to ensure inherently safer strategies are prioritized and identified to eliminate and reduce risk.

Subsections (l)(5)

The HCA team is required to prepare a report within 90 days of developing the recommendations that describes the makeup of the team and the HCA methodology used by the team; the hazards analyzed by the team; and a description of, and rationale for, the inherent safety measures and safeguards recommended by the team for each hazard. These requirements are necessary to ensure transparency and accountability in the HCA process and to assess the extent to which refinery employers accept, alter, or reject recommendations made by HCA teams.

Subsection (l)(6)

The employer is required to implement all HCA team recommendations in accordance with subsection (x). This requirement is necessary to ensure that the employer takes corrective action to implement HCA team recommendations in a timely manner.

Subsections (l)(7)

The employer is required to retain HCA reports for the life of each process. Report retention is necessary to enable monitoring and evaluation over time.

Subsection (m) Hot Work Permit

Specific Purpose

The employer is required to develop, implement, and maintain written procedures for the issuance of permits to contractors and others who perform hot work on the refinery property. Hot work refers to electric or gas welding, cutting, brazing, or any similar heat-, flame-, or spark-producing procedure or operation.

Necessity

This is necessary to ensure safe operations and protect workers.

Subsection (m)(1)

The employer is required to develop, implement, and maintain a written procedure for the issuance of hot work permits. This is necessary to ensure that the employer controls hot work operations in a consistent manner, using standard procedures to ensure that all potential hazards have been identified and mitigated prior to starting hot work, during the work process, and at the conclusion of the work.

Subsection (m)(2)

The employer is required to certify in its hot work permit: (1) that the applicable requirements of General Industry Safety Orders (GISO) Section 4848, *Fire Prevention and Suppression Procedures*, and Petroleum Safety Orders (PSO) Section 6777, *Hot Work Procedures and Permits* have been implemented prior to initiation of hot work; (2) the dates and times during which hot work is to be performed; (3) the equipment or process on which the hot work is to be performed; and (4) the name and employer of the party performing the hot work.

GISO Section 4848 requires a refinery to establish a fire prevention and suppression procedure whenever any of the operations and processes covered by Sections 4794(a) and 4850(a) are conducted on its property. Section 4794(a) pertains to gas welding and cutting systems when used with gases and oxygen for welding, flame cutting, heating, and heat treating operations, including brazing and soldering. Section 4850(a) pertains to electrical equipment when used to perform electric welding, cutting, heating, and other operations and processes pertaining to electric welding, including resistance brazing and resistance soldering.

PSO Section 6755 defines the term “source of ignition.” Section 6777 establishes the requirements of hot work procedures and the contents of hot work permits. Before initiating hot work, Section 6777 requires a refinery employer to: (1) ensure that suitable fire-extinguishing equipment is readily available; (2) post the hot work permit in the work area or provide the employee with it performing the work; and (3) revoke a hot work permit under certain conditions.

This is necessary to ensure that the fire prevention requirements of existing regulations explicitly cover hot work performed in a refinery, which promotes safe operations.

Subsection (m)(3)

The employer is required to retain hot work permits on file for a period of one year. This is necessary to ensure transparency and accountability.

Subsection (n) Management of Change (MOC)

Specific Purpose

The purpose of this section is to require refinery employers to develop, implement, and maintain effective written MOC procedures in order to manage changes in process chemicals, technology, procedures, process equipment, or facilities. MOC procedures provide a rigorous review process to ensure that a proposed change—including a temporary change—does not introduce a new hazard or increase the risk of an existing hazard.

An MOC is required for temporary repairs, including temporary pipe repairs. A systematic and comprehensive approach to managing change is necessary to ensure process safety.

The MOC procedures do not apply to “replacements-in-kind.” An example is a corroded gate valve that needs to be replaced. A new gate valve produced by a different manufacturer may be installed without an MOC, provided the design specifications are the same.

Prior to implementing a change, the MOC subsection requires the employer to thoroughly understand and document: (1) the technical basis for the proposed change, (2) the time required for the change; (3) modifications to operating procedures, and (4) necessary authorizations. With this information, the employer is required to proactively address the technical basis for any potential process safety hazards or risks that could result from the change. Effective MOC procedures require the employer to mitigate any process safety impacts of the change.

The MOC subsection also requires the employer to perform an HCA prior to implementing a major change. The employer is required to use qualified personnel and appropriate methods for all MOCs, based upon the hazard, complexity, and type of change. The employer is required to provide for employee participation in the MOC process. MOC information and effective training must be provided to employees and employees of contractors. Where MOCs result in changes to PSI or Operating Procedures, the employer is required to amend and update the information and procedures accordingly.

Necessity

Effective MOC procedures are necessary because the risk of a process safety incident may increase if a modification is made without adequate review. MOC procedures help ensure that changes in process chemicals, technology, procedures, process equipment, or facilities are performed safely.

Section (n)(1)

The employer is required to develop, implement, and maintain effective written MOC procedures to manage changes in process chemicals, technology, procedures, process equipment or facilities, as well as temporary repairs, including temporary pipe repairs. This is necessary to ensure that the employer applies the MOC procedures to a broad range of potential process changes.

The employer is also required to apply the MOC procedures to manage temporary repairs, including temporary pipe repairs. This is necessary because temporary repairs should not be considered permanent repairs, and the expiration dates are documented in the MOC.

The requirement to perform MOC analyses is not new. Refineries are currently required to perform MOC analyses under PSM. Although MOC requirements exist in the current regulations, the new requirements are needed to ensure that refineries are effectively completing the MOC process for physical changes to the refinery and its components and chemicals. Specifically, the existing MOC requirements will be enhanced by provisions requiring the use of qualified personnel and appropriate methods, employee participation, and, for major changes, a hierarchy of control analysis. If a proposed change is made to the hazardous processes that are found at petroleum refineries without appropriate review and without managing the predicted results of the change, the risk of an accident could increase significantly.

The requirements in this subsection are necessary to ensure that the employer’s MOC procedures are up to date, comprehensive, and continually maintained and improved.

Subsection (n)(2)

Prior to implementing any change, the employer is required to address and document: (1) the technical basis for the proposed change, which is necessary for assessing risk(s) associated with the change; (2) potential process safety impacts of the change, which are necessary to evaluate for effects on the health and safety of employees; (3) modifications in the Operating Procedures, which are necessary to ensure the safe operation of the facility; (4) the time required for the change, which is necessary to safely complete the change or determine relevant expiration dates of temporary repairs; and (5) authorizations required for the change, in order to ensure accountability.

These requirements are necessary to ensure that the employer's MOC procedures are effective.

Section (n)(3)

The employer is required to perform an HCA and review or conduct a DMR prior to implementing a major change. This is necessary because a major change can introduce new or worsen existing process safety hazards. In some cases, major changes also provide the employer with an opportunity to make improvements in process safety sooner than during a turnaround.

For example, if a proposed change introduces a more acidic chemical substance to a process, by conducting an HCA prior to implementing this change, the employer can identify inherently safer strategies to ensure safe operation of the process.

Section (n)(4)

The employer is required to use qualified personnel and appropriate methods for all MOCs, based upon hazard, complexity, and type of change. This requires that individuals with the appropriate level of expertise are used to review a change and that the assessment method is appropriate for the scale and nature of the proposed change. In addition, the MOC procedures must be performed by qualified individuals in a meaningful, effective manner.

Section (n)(5)

The employer is required to provide for employee and employee representative participation in MOCs. This requirement is necessary to ensure that the MOC procedures incorporate the experience and expertise of employees and employee representatives to effectively manage change and promote safety.

Section (n)(6)

The employer is required to inform and effectively train employees in a timely manner, prior to implementing the change. This requirement applies to employees who are involved in the process and maintenance workers whose job tasks will be affected by a change.

This requirement is necessary to ensure that employees who are affected by a change are aware of and can safely perform their job tasks once the change is implemented.

Sections (n)(7) and (n)(8)

The employer is required to update the PSI and Operating Procedures in a timely manner in response to an MOC. This requirement is necessary to ensure that the PSI and Operating Procedures reflect the most current conditions in the refinery.

Subsection (o) Incident Investigation—Root-Cause Analysis

Specific Purpose

Refinery employers are required to perform effective investigations of incidents that result in, or could reasonably have resulted in, a major incident. The requirements of this subsection would therefore be triggered for any event within or affecting a process that causes—or could reasonably have caused—a fire, explosion, or release of a highly hazardous material, which has the potential to result in death or serious physical harm.

Investigation is the first step in the process of evaluating, reporting, tracking, communicating, and learning from an incident. Root-Cause Analysis (RCA) is a key element of an effective incident investigation. According to the Center for Chemical Process Safety, an RCA “attempts to identify and address the management system failures that led to an incident.”⁴ Without an RCA, an incident investigation could be limited to focusing strictly on the most direct causes of an incident, rather than on the underlying causal factors that led up to the incident.

For example, an investigation of a pipe failure that resulted in a loss of containment might simply conclude that high-temperature sulfidation corrosion was to blame for the incident. An effective RCA, however, would identify *why* corrosion inside the pipe continued to progress to the point of failure, why the weakened section of pipe was not replaced in a timely manner, and what kinds of systematic changes might be needed to prevent similar incidents in the future.

All California refineries are currently required to perform Incident Investigations for major incidents. The Governor’s Interagency Working Group report recommended statewide regulatory changes to codify the requirement to also conduct an RCA.

The proposed subsection requires a uniform performance standard for conducting systematic, comprehensive incident investigations that include a thorough RCA. This will ensure that employers develop meaningful findings from these incidents, which will provide a foundation for continual improvement in risk reduction in the state’s refineries.

Necessity

Incidents caused by process failures can and should be prevented. Process incidents can place employees at increased risk of harm and are Process Safety Performance Indicators. The proposed subsection is necessary to ensure that refinery employers thoroughly investigate the incidents that occur at their facilities, that they learn from these investigations, and that they identify corrective actions to prevent a recurrence of the incident on the process and on related processes throughout the plant.

⁴ Center for Chemical Process Safety (2007), *Guidelines for Risk Based Process Safety*, American Institute of Chemical Engineers (AIChE), Wiley & Sons, Hoboken, NJ, p. xlv.

Subsection (o)(1)

These proposed subsections require the employer to develop, implement, and maintain effective written procedures for promptly investigating and reporting any incident that results in, or could reasonably have resulted in, a major incident.

In the proposed PSM standard for refineries, the definition of a “major incident” requires that a fire, explosion, or loss of containment presents the *potential* for an employee fatality or serious physical harm. This approach is necessary to ensure that the employer conducts effective investigations for a broad range of incidents to address underlying causes of process failures.

Subsection (o)(2)

The proposed subsections require that the procedures include an effective method for conducting a thorough RCA. This is necessary because RCA provides the most accurate and useful information regarding the underlying causes of an incident. RCA is a well-established investigation technique used in many industries, including petroleum refining, which improves the quality of an incident investigation. There are different methodologies for conducting RCAs. The proposal does not specify a particular method, which allows flexibility in applying the method that is most effective for the employer’s operation.

Subsection (o)(3)

The employer is required to initiate an incident investigation promptly, within 48 hours of an incident. This is necessary to ensure that the details of the incident are accurately recorded and to identify the root causes. Prompt investigation provides the employer with timely information for taking immediate corrective actions.

Subsection (o)(4)

This proposed subsection specifies the composition of the incident investigation team. The members of the team must have expertise and experience in the process involved and in the employer’s RCA method. The team must also include expertise in overseeing an incident investigation and conducting the analysis. The employer is required to provide for employee participation.

The requirements ensure that the team consists of individuals with the expertise necessary to perform an effective investigation, including an RCA. This also ensures that the experience and expertise of employees and contractor employees are effectively represented and integrated into the investigation.

Subsection (o)(5)

The incident investigation team is required to conduct an RCA, using written procedures to determine the underlying causes of the incident, including system failures, such as underlying management system deficiencies. This requirement is necessary to clarify that the RCA is intended to identify any management system failures that may have contributed to the incident. In most cases, these kinds of failures require a thorough and systematic analysis of the events and conditions that cause an incident.

Subsection (o)(6)

The incident investigation team is required to develop recommendations that address the findings of the RCA. The team’s recommendations must also include interim measures that will prevent a

recurrence or similar incident until the employer is able to implement final corrective actions. This requirement is necessary because effectively reducing the risk of a similar incident may require the employer to take short-term, interim actions, such as providing additional safeguards, specialized training, revisions to operating procedures, changes to inspection procedures, revalidation of DMR, or other actions that could be implemented in the near term. This requires the employer to mitigate process safety hazards while simultaneously developing a longer-term prevention plan.

Subsections (o)(7) and (o)(8)

The incident investigation team is required to prepare a report within 90 calendar days of the incident, with additional time provided as needed, up to a maximum of five months. This is necessary to allow Cal/OSHA time to review the report in advance of the six-month statute of limitations imposed by Labor Code section 6317. The following eight elements are required in the report:

- (1) The date and time of the incident. The date is necessary to document when the incident occurred. The time of the incident is necessary because the conditions and staffing at a refinery can differ across a 24-hour period, and the exact timing is relevant to the investigation.
- (2) The date and time the investigation began. This is necessary to document that the investigation is initiated promptly within 48 hours of the time of the incident.
- (3) A detailed description of the incident. This is necessary to ensure that the team's description of the incident contains information that is accurate for developing effective recommendations.
- (4) The factors that caused or contributed to the incident, including direct causes, indirect causes, and root causes, determined through the RCA. This is necessary to ensure that the team evaluates these three types of causes and includes them in the report. Each type of cause is important in the investigation and ensures an accurate and complete analysis.
- (5) A list of DMRs, PHAs, SPAs, and HCAs that were reviewed as part of the investigation. This is necessary to ensure that the team reviews the information from each of these analyses, each of which could provide important information relevant to the incident.
- (6) Documentation of relevant findings from the review of PHAs, SPAs, HCAs, and DMRs. This is necessary to ensure that the team identifies and documents information from any of these analyses that are relevant to the incident. For example, if pipe corrosion was a potential factor in an incident, the investigation team would be required to review the DMR analysis and document whether the DMR findings showed that the pipe was subject to corrosion and whether the employer properly implemented the DMR report's recommendations.
- (7) The incident investigation team's recommendations. This is necessary to ensure the team's recommendations are documented and reflect the team's analysis.
- (8) Interim measures implemented by the employer. This is necessary to ensure that the report includes any interim measures taken by the employer to prevent a recurrence or similar incident in the near term, until the employer is able to implement final corrective actions.

Subsection (o)(9)

The employer is required to implement the team's recommendations in accordance with the requirements of subsection (x), which requires that each corrective action from an incident investigation be completed within eighteen months after completion of the investigation or, if a process shutdown is required, during the next regularly scheduled turnaround. This is necessary to ensure that the causes of the incident, as identified in the report, are corrected in a timely manner. Because stakeholders

proposed a range of one to two years for implementation, Cal/OSHA adopted the time frame of 18 months.

Subsection (o)(10)

The employer is required to conduct an HCA in a timely manner for all recommendations that result from the investigation of a major incident. It is necessary to ensure that the employer identifies, evaluates, and implements the most effective strategies to address the causes of the incident, prioritized by order of inherent safety.

Subsection (o)(11)

The employer is required to provide the report to employees whose job tasks are affected by the incident and review it with them on request. The employer is required to make the report available to all operating, maintenance, and other personnel, including employees of contractors and their representatives whose work assignments are at the facility where the incident occurred or whose job tasks are relevant to the incident.

These requirements are necessary to ensure that all affected employees and their representatives are afforded complete access to the information contained in the report. Requiring the employer to review the report findings and recommendations with employees whose job tasks are affected by the incident is necessary to provide these employees with an opportunity to discuss the incident and the report with the employer. These requirements provide transparency of important safety information contained in the incident report.

Subsection (o)(12)

The employer is required to retain incident investigation reports for the life of the process unit. This requirement is necessary to build a historical record of incidents that occur on a process and to enable future technical reference of the recommendations. This requirement contributes to continual improvement in process safety and helps identify patterns that may be repeated over long periods. This requirement is also necessary to preserve institutional knowledge of process units in refineries in order to inform future recommendations and corrective actions.

Subsection (p) Emergency Planning and Response

Specific Purpose

The employer is required to develop, implement, and maintain an effective written emergency action plan, pursuant to the requirements of CCR, Title 8, Section 3220. Section 3220 requires that the employer's emergency action plan be in writing and that it cover actions that must be taken to ensure employee safety from fire and other emergencies.

Necessity

This subsection is necessary to ensure that the employer plans effectively for a range of possible emergency conditions. Failing to plan for emergencies endangers employee safety and health and can jeopardize the safety of the process itself. Effective emergency planning, as required by Title 8, Section 3220, requires the employer to develop and maintain an emergency action plan.

The employer is required to develop and implement the following elements in the emergency action plan: (1) emergency escape procedures, (2) procedures for employees who remain to operate critical plant operations prior to evacuating, (3) procedures to account for all employees following evacuation, (4) rescue and medical duties for employees who are to perform them, (5) a means for employees to report emergencies, and (6) contact information for key personnel. These elements are necessary because they constitute the minimum components of an effective emergency action plan.

The employer is required to establish an effective employee alarm system that includes audibility, alarm recognition, installation and restoration, maintenance and testing, and manual operation. This requirement is necessary to ensure the effectiveness of the employer's alarm system in protecting life and property during an emergency.

The employer is required to determine the types of evacuations that will be used in emergency circumstances and to designate and train a sufficient number of employees to assist employees in conducting a safe and orderly emergency evacuation. This requirement is necessary because evacuation pre-planning requires consideration of operational factors, construction of evacuation corridors, installation of emergency signage and lighting, and other infrastructure improvements. Providing training for key personnel to oversee emergency evacuation is essential to preventing disorder and confusion in the event of an actual evacuation.

The employer is required to inform employees of their responsibilities under the emergency action plan. This ensures that protective action is taken in the event of an emergency. The written plan must be made available to employees. These requirements are necessary to ensure that employees are aware of the most recent and relevant aspects of the plan given their actual duty assignment at the refinery.

Subsection (q) Employee Participation

Specific Purpose

The employer is required to provide for effective employee participation throughout the PSM program. The subsection requires the employer to consult with employees and employee representatives in developing, implementing, and maintaining a written plan to meet this objective.

The proposed subsection requires effective participation of employees (and employees of contractors, where appropriate) in the design, development, implementation, and continuous improvement of all PSM elements.

Authorized collective bargaining agents may select their own representatives to participate in the development and implementation of the PSM program and the PSM teams. The employer is required to establish effective procedures to select employee representatives to participate when employees are not represented by an authorized collective bargaining agent. The employer may require employees or employee representatives to enter into confidentiality agreements to prohibit disclosure of trade secret information.

The employer is required to implement procedures for employees and employees of contractors to refuse to perform dangerous work, to recommend the partial or complete shutdown of a process, and to anonymously report all hazards encountered. The employer is required to document all Stop Work

activity and respond in writing to all hazard reports within 30 days, prioritizing hazards that present the potential for death or serious physical harm. Qualified operators in charge of a unit are provided the authority to partially or completely shut down an operation or process, based on a process safety hazard.

Necessity

The Governor's Interagency Working Group report recommended that a "labor-management committee should . . . identify stronger methods to prevent retaliation against workers who report unsafe conditions to either management or government agencies, or who exercise their rights under company safety programs to shut down unsafe operations. Meaningful worker and community representation would include participation early in any decision-making process, and should continue throughout the process." The proposed regulations address this recommendation by providing employees with protections to stop unsafe work, shut down a process, and report hazards. The requirements do not relieve the employer of the responsibility for preventing or mitigating process safety hazards, but the requirements effectively expand the number of people at a refinery who have an active role in promoting and maintaining safety.

Effective employee participation is necessary to ensure process safety in all refinery operations because employees are often the first to become aware of process safety hazards. Employees have direct experience with the routine operation or maintenance of a process. In some cases, operators and maintenance personnel may be the sole source of information obtained through their work experiences, and are therefore a valuable source of information. Effectively integrating employee expertise into the refinery's PSM program is critical to ensure—and continually improve—process safety.

Subsection (q)(1)

The proposed subsection requires the employer to consult with employees and employee representatives in developing, implementing, and maintaining a written plan to effectively provide for employee participation in all PSM elements. This is necessary to ensure meaningful participation in decision-making by employees, and to ensure the quality of the work product from any one of the analyses or other activities. Effective participation at the earliest possible point is necessary to ensure the employer allows timely employee participation in the development, training, implementation, and maintenance of the PSM elements. It is necessary for employees and representatives to have access to all documents and information developed by the employer, including trade secrets (examples may include design specifications of a unit, metallurgy reports, incident investigation reports, and near-miss reports), to enable them to operate safely.

Subsections (q)(2) and (q)(3)

Authorized collective bargaining agents have the authority to select their own representatives to participate in PSM program development and implementation planning, including the PSM teams and other activities. This requirement is necessary to ensure fair employee representation in the PSM program. For employees who are not represented by an authorized collective bargaining agent, the employer is required to establish effective procedures for the selection of employee representatives. This is necessary to ensure transparent and meaningful employee participation at refineries that are not represented by an authorized collective bargaining agent.

Subsection (q)(4)

The proposed subsection includes confidentiality provisions regarding trade secret information to protect the employer and prohibit disclosure.

Subsection (q)(5)

The employer is required to develop, with employee input, a system to implement effective Stop Work and hazard reporting procedures within 90 days of the effective date of this proposal. This is necessary to develop timely procedures that incorporate employee perspectives and experiences. This ensures safe operations and protects the safety and health of employees. The time frame was established through stakeholder input.

Subsection (q)(5)(A)

The employer is required to consult with employees and employee representatives in developing a system for implementing procedures that enable employees to refuse to perform a task where doing so could reasonably result in death or serious physical harm. This is necessary to ensure that employees are able to refuse unsafe work. This authority extends to work that may or may not be related to a process. Requiring effective stop work procedures for unsafe work is necessary to protect employee safety and health.

Employees and employees of contractors may recommend to the operator in charge of a unit that a process be partially or completely shut down, based on a process safety hazard. This requirement is necessary to ensure safety by enabling employees to take action to address process safety hazards within a unit.

Qualified operators in charge of a unit have authority to partially or completely shut down an operation or process, based on a process safety hazard. This is necessary to ensure safety by enabling operators to take action to address process safety hazards within a unit.

Subsection (q)(5)(B)

The employer is required to develop effective procedures that enable all employees, including employees of contractors, to report hazards anonymously. This reporting authority covers all hazards encountered by an employee, not only those associated with a process, and it allows anonymous reporting by employee representatives, contractors, employees of contractors, and contractor employee representatives, in addition to refinery employees. This requirement is necessary to provide procedures for employees and other individuals to take action in response to hazards without fear of retaliation. This also allows employee representatives to raise health and safety concerns with the employer on behalf of an employee if the employee chooses to remain anonymous.

The subsection also requires the employer to respond to written reports of hazards within 30 calendar days. This requirement is necessary to ensure that hazards reported by employees are addressed in a timely manner. Establishing a record of employee concerns over process safety hazards and other hazards, and documenting the effectiveness and timeliness of the employer's response, are both useful indicators of the effectiveness of the employer's PSM program and the safety culture at a facility.

Subsection (q)(6)

The employer is required to document all Stop Work activity as well as written reports of hazards and the employer's response to reports of hazards. This is necessary to monitor reports of hazards, track process safety indicators, and evaluate the efficacy of Stop Work procedures and overall safety culture.

Subsection (r) Process Safety Culture Assessment

Specific Purpose

The employer is required to develop, implement, and maintain an effective Process Safety Culture Assessment (PSCA) program, which provides critical information necessary for identifying and correcting safety culture problems.

Process safety culture is a combination of group values and behaviors that indicate whether there is a collective commitment by leaders and individuals to emphasize safety over competing goals, in order to ensure protection of people and the environment.

The purpose of a PSCA is to assess key elements of a refinery's safety culture, identify strengths and weaknesses, implement corrective actions, and reassess progress. The proposed requirements establish a uniform PSCA performance standard for meeting this objective. The resulting information will form the basis for a refinery to improve its safety culture over time.

The U.S. Chemical Safety and Hazard Investigation Board (CSB) final report on the August 2012 fire at the Chevron, Richmond refinery identified several major concerns with the safety culture at that facility and recommended greater attention to improving safety culture at refineries. In particular, the CSB report recommended a requirement for "a process safety culture continuous improvement program including a written procedure for periodic process safety culture surveys across the work force" [CSB Report No. 2012-03-I-CA, January 2015, p. 116].

Necessity

PSCA is necessary for gauging the degree to which a refinery prioritizes safety alongside other production pressures, such as cost, efficiency, and competitiveness.

Subsection (r)(1)

The employer is required to develop, implement, and maintain an effective PSCA program. This information is necessary for employers and employees to identify safety culture improvements and evaluate safety culture in the refinery.

This aligns with the Governor's Interagency Working Group report recommendation to require refineries to perform periodic safety culture assessments, which evaluate the refinery's focus on safety and provide an opportunity to address deficient practices.

Subsection (r)(2)

The proposed subsection requires a refinery to conduct an effective PSCA and produce a written report within 18 months of the effective date of this regulation and update the PSCA every five years. This requirement is necessary to ensure that the process safety culture of a refinery is evaluated on an

ongoing basis, in order to identify areas for improvement and allow course corrections to the program. The time limits were established through stakeholder input.

Subsection (r)(3)

The employer is required to form a PSCA team that includes at least one member who is knowledgeable in refinery operations and at least one employee representative. This requirement is necessary to ensure participation, accountability, and transparency. The team is required to consult with at least one employee or another individual with expertise in assessing process safety culture in the petroleum refining industry. This requirement is necessary to ensure the analysis is comprehensive and adequately addresses the regulatory requirements.

Subsection (r)(4)

The employer is required to evaluate the effectiveness of four elements of process safety leadership in each PSCA:

(1) The employer's hazard-reporting program. This is necessary to assess the effectiveness of the employer's hazard-reporting system, which allows employees to report hazards anonymously.

(2) The employer's response to reports of hazards. This is necessary to assess the effectiveness of the employer's hazard-reporting system in responding in writing (within 30 calendar days) to written hazard reports. This promotes a prompt response to process safety hazards.

(3) The employer's procedures to ensure that incentive programs do not discourage reporting of hazards. This is necessary to ensure the employer's incentive programs do not discourage hazard reporting.

(4) The employer's procedures to ensure that process safety is prioritized during upset or emergency conditions. This is necessary to ensure safety is prioritized in all instances, particularly during upset or emergency conditions.

Subsection (r)(5)

The PSCA team is required to develop a written report within 90 days of completion of the PSCA. The report must include the PSCA methods used, the findings and conclusions of the PSCA, and the team's recommendations to address the findings of the PSCA. These requirements are necessary to ensure transparency and accountability.

Subsection (r)(6)

The employer is required to consult with the PSCA team to identify and prioritize corrective actions that will be implemented within 24 months. This is necessary to ensure that the employer implements high-priority safety culture recommendations in a timely manner. The time limit was established through stakeholder input.

Subsection (r)(7)

The employer is required to conduct a written interim assessment of the implementation and effectiveness of each PSCA recommendation within three years of the completion of a PSCA report. If a corrective action is found to be ineffective, the employer is required to implement changes to ensure

effectiveness. This is necessary to ensure that employers make course corrections when areas requiring improvement are identified.

Subsection (r)(8)

The subsection requires the refinery manager or designee to sign all PSCA reports, corrective action plans, and interim assessments. This ensures accountability and transparency.

Subsection (r)(9)

Within 30 days of completion, the employer is required to communicate corrective action plans and make PSCA reports and interim assessments available to employees and employee representatives, as well as to contractors who participated in the PSCA. This is necessary to ensure transparency and accountability.

Subsection (r)(10)

Contractors are required to provide all PSCA reports, corrective action plans, and interim assessments to their employees and employee representatives within 14 days of receipt. This is necessary to ensure transparency and accountability for contractors and their employees.

Subsection (s) Human Factors

Specific Purpose

The federal OSHA National Emphasis Program for Refineries included Human Factors as one of the 12 core elements of an effective PSM program. The proposed requirements ensure that Human Factors are assessed with other process safety risks.

The US Chemical Safety and Hazard Investigation Board (CSB) identified Human Factor deficiencies as major contributors to the explosion and fatalities at the BP Texas City Refinery in March 2005. The Human Factor deficiencies included worker fatigue, poor human-system-interface design, poor radio and telephone communication, out-of-date and inaccurate operating procedures, and poor communication between workers across shifts.

Necessity

This subsection is necessary to ensure that the employer integrates Human Factors analysis into the PSM program.

Subsection (s)(1)

The employer is required to integrate a Human Factors analysis into the refinery's PSM program and develop, implement and maintain an effective written Human Factors program within eighteen months. Human Factors analysis provides an understanding of human capabilities, limitations and needs in relation to refinery operations and incident prevention, and prioritizes safety in the design of machines, operations, and work environments.

Subsection (s)(2)

A written Human Factors analysis is required during major changes. This is necessary because a major change presents an opportunity to make substantial improvements in a refinery process. Major changes that include an effective Human Factors analysis promote employee safety and the safety of a process.

Human Factors are important to analyze in the design phase of a major change because there are opportunities to alter system design to accommodate Human Factors at this early stage. Installing an automatic shut-off valve instead of a manual valve is an example of incorporating Human Factors in a major change.

A written Human Factors analysis is required as part of all relevant incident investigations, PHA, Management of Organizational Change (MOOC), and HCA. This is necessary because examining Human Factors, including those that could lead to human error, can directly affect the processes analyzed in these PSM elements.

Efforts to make a process inherently safer can inadvertently introduce new worker safety hazards in a maintenance procedure. An effective Human Factors analysis can identify and avoid these kinds of unintended consequences. An example is the substitution of sulfuric acid for hydrofluoric acid in an alkylation unit. Sulfuric acid may be preferred over hydrofluoric acid, but it requires a Human Factors analysis to establish safeguards, procedures, and protective equipment to ensure the health and safety of employees who may be exposed to this highly hazardous substance.

Requiring a Human Factors analysis throughout the MOOC process is necessary to ensure that the employer effectively identifies and addresses organizational changes that have the potential to worsen various pressures on employees, such as fatigue, time pressure, inadequate training levels, mandatory overtime, and the understandability and effectiveness of operating and maintenance procedures.

Human Factors analysis is relevant in an HCA, for example, when a procedural control is considered or recommended, in the design and maintenance of active and passive safeguards, and in situations where advantages and disadvantages of various approaches are considered.

Subsection (s)(3)

A written Human Factors analysis is required for existing operating and maintenance procedures. This requirement is necessary because Human Factors were not required to be analyzed for the existing operating and maintenance procedures when they were developed for the state's refineries. The employer shall complete fifty (50) percent of assessments and revisions within three (3) years following the effective date of this section and one hundred (100) percent within five (5) years. This is necessary to provide the employer with flexibility in completing the required analysis.

Subsection (s)(4)

A written Human Factors analysis is required during evaluations of staffing, task complexity, training, human-machine interface, fatigue, communication systems, and other aspects of plant operations. Requiring a Human Factors analysis for this list of elements is necessary to ensure that the employer applies a standardized, thorough approach to assessing Human Factors in each of these areas of PSM.

Each of the elements in this list affects both the employee and the process; each element therefore can be improved through an effective Human Factors analysis. The analysis might reveal, for example, that reduced staffing can lead to excessive overtime, which can lead to fatigue and stress, which can reduce employee alertness and effectiveness, particularly if the employee is required to respond to an upset or emergency condition on the process. Likewise, communications systems must be designed to function effectively under the actual conditions that employees experience in the work environment. A Human

Factors analysis would reveal whether a communication system is understandable in the noisy conditions of a refinery or the operation of portable radios is overly cumbersome, which could make them difficult to manipulate in an emergency.

Subsections (s)(5)(A), (B), and (C)

A written Human Factors analysis is required in the analysis of process controls. This requirement is necessary to ensure that well-recognized safety systems are included in the Human Factors analysis of process controls.

A poorly designed automatic alert that is intended to signal an upset condition on a process—but that is difficult for employees to visualize or interpret—will markedly reduce the effectiveness of the alert. Similarly, error-proof mechanisms are engineered to allow an action only when the system is in a safe condition. These mechanisms prevent employees from taking inappropriate actions, which can occur if an employee is fatigued, poorly trained, operating outside his or her area of expertise, or under time pressure. An effective Human Factors analysis will identify process control scenarios where error-proof mechanisms may be needed.

Subsection (s)(6)

The employer is required to include an assessment of Human Factors in new operating and maintenance procedures. This requirement is necessary to ensure that the employer integrates a Human Factors analysis into all new operating procedures. As noted above, a Human Factors analysis is necessary to ensure that operating procedures are understandable and effective. Effective procedures are essential for both employee and process safety.

Subsection (s)(7)

The employer is required to train employees in the Human Factors program. This requirement is necessary to ensure that employees understand how Human Factors affect workplace safety and health and the safety of the process. Operating and maintenance employees represent a majority of employees involved in refinery processes and contribute to this analysis as part of team requirements.

Subsection (s)(8)

The employer is required to allow employee participation in the development, maintenance, and implementation of the Human Factors program. Involving employees in the Human Factors program is necessary to ensure that the analyses conducted under the program are current and relevant to a refinery's current process conditions. This expertise is best provided by employees who work on a process on a regular basis and who understand its operating and maintenance conditions.

Subsection (s)(9)

The employer is required to make available and provide on request a copy of the written Human Factors program to employees and their representatives, and to affected contractors, employees of contractors, and contractor employee representatives. This requirement is necessary to ensure that employees are aware and understand the Human Factors aspects of their work. This requirement is necessary to facilitate employee involvement in continually improving and updating the program. This is necessary to ensure the effectiveness of the Human Factors program.

Subsection (t) Management of Organizational Change

Specific Purpose

The employer is required to effectively manage organizational changes in the refinery. The employer is required to develop, implement, and maintain effective written procedures for changes that could affect operations, engineering, maintenance, health and safety, or emergency response, and are anticipated to exceed 90 days in duration.

The employer is required to designate a Management of Organizational Change (MOOC) team to conduct an analysis of potential effects of a change prior to reducing staffing levels, reducing the classification levels of employees, or changing shift duration or employee responsibilities. The purpose is to ensure that a proposed change in one of these areas will not adversely affect process safety. A reduction in staffing, for example, might not appear to affect the day-to-day operation of the process, but it could potentially affect the refinery's ability to respond effectively to an upset or emergency condition on the process.

The Governor's Interagency Working Group report recommended that MOC processes should include organizational and personnel changes. The MOOC team is responsible for assessing the potential impacts of changes and providing recommendations to the employer.

The refinery manager or designee is required to certify that the MOOC assessment is accurate and that the proposed organizational change meets the requirements of the subsection.

A Human Factors analysis is required for all MOOC analyses. The employer is required to assess the potential impacts of organizational change on Human Factors. Prior to implementing a change, the proposed subsection requires the employer to inform all affected employees of the potential impacts of the change.

Necessity

This subsection is necessary because organizational changes can adversely affect process safety. A comprehensive, systematic, and rigorous procedure is required if the changes are expected to exceed 90 days in duration and affect operations, engineering, maintenance, health and safety, or emergency response. This provision emphasizes the importance of organizational changes and their relationship to process safety.

Subsection (t)(1)

The employer is required to develop, implement, and maintain effective written procedures to manage organizational changes. The employer is required to periodically monitor the performance of the MOOC procedures and take action as needed to improve them.

The requirements of this subsection are necessary to ensure that the employer's MOOC procedures are current and comprehensive.

Subsection (t)(2)

The employer is required to designate a team to conduct a MOOC assessment before reducing staffing levels, reducing classification levels of employees, or changing shift duration or employee responsibilities. Employee participation in the MOOC team is required.

This requirement is necessary to ensure that organizational changes are reviewed by those with direct experience in process operations or maintenance. In many cases, operators may be the sole source of unique knowledge that they have gained through their experiences. This information can complement the other factors the employer must take into account when considering making organizational changes.

Effectively integrating employee expertise into the MOOC process is necessary to ensure that a proposed change will not introduce a new process safety hazard or worsen an existing hazard.

Subsection (t)(3)

The employer is required to develop a written MOOC assessment that includes a description of the change being proposed, the makeup of the team responsible for assessing the proposed change, the factors evaluated by the team, and the team's recommendations. This requirement is necessary to ensure transparency and accountability in the MOOC assessment. A written document is necessary for appropriate certification by the refinery manager or designee.

Subsection (t)(4)

This subsection requires the employer—prior to conducting the MOOC assessment—to ensure that the job function descriptions are current and accurate for all positions potentially affected by the change. This is necessary to ensure accurate assessment of how a proposed organizational change will affect job functions. A change in employee responsibilities for a particular job, for example, can be assessed only if the job description for that position is current and accurate.

Subsection (t)(5)

The refinery manager or designee is required to certify that the MOOC assessment is accurate and that the proposed organizational change meets the requirements of this subsection. In practice, the refinery manager would evaluate the MOOC procedure that the employer followed and would assess the written findings and recommendations of the MOOC team. This requirement is necessary to ensure accountability and transparency.

Subsection (t)(6)

The employer is required to conduct a Human Factors analysis as part of the MOOC analyses. This requirement is necessary to promote better understanding of behaviors and other human elements in refinery operations and incident prevention, which promotes safe operations.

Subsection (t)(7)

The employer is required to inform all employees who are potentially affected by an organizational change, prior to implementing the change. This requirement is necessary to ensure accountability and provide transparency of information to affected employees prior to implementation of the change.

Subsection (u) Compliance Audits

Specific Purpose

Employers are required to evaluate the performance of their PSM program in meeting the requirements of the proposed section. In conducting this evaluation, employers must verify that the procedures and practices they have developed under the section are effective and being followed.

An effective compliance audit is a comprehensive evaluation of the past and present conditions of the PSM program at the employers' facilities, in order to develop recommendations for improvement. Internal audits conducted by employers can be very effective at identifying safety issues that might not otherwise be apparent to them. The proposed subsection is intended to require audits as part of the PSM program within the state's refineries.

A comprehensive compliance audit requires a meaningful evaluation of actual practices. For example, in conducting an audit of the employer's training program, an audit team may assess: (1) the relevance of the training content to the employees' responsibilities and work environment, (2) the extent to which employees participated in developing the content, (3) the teaching methods used to communicate the content, (4) the frequency of training, and (5) the extent to which employees understood and retained the content. Through employee interviews, the audit team would assess the employees' application of the training content on the job in order to evaluate the effectiveness of the training in meeting its objectives. During the field inspection, the team would observe actual employee practices relevant to the training content, such as proper implementation of operating procedures and safety practices. This systematic, comprehensive approach to conducting the audit is necessary for the team to understand and document the strengths and weaknesses of the training program and prioritize areas where improvements are needed. Over time, this approach allows for continual improvement in the training program.

The findings of the audit will provide employers with a baseline standard against which they can measure future performance.

Necessity

Compliance audits are necessary to ensure that refinery employers conduct internal PSM assessments that are comprehensive, timely, and rigorous. This is necessary to establish a performance standard across the state's refinery sector, which provides a baseline performance indicator for each refinery, against which future assessments can be measured.

Compliance audits are necessary to promote continual improvement in safety performance and PSM compliance by the state's refineries.

Subsection (u)(1)

Requiring that the compliance audit be conducted every three years is necessary for the audit to serve as a vehicle for continual improvement in PSM performance. Three years between compliance audits is sufficient time for the employer to make meaningful changes, and it is frequent enough to provide timely feedback in areas requiring improvement.

Documenting the findings and recommendations of compliance audits in a report is necessary to ensure that audits are transparent and record improvements and corrective actions over time.

Subsection (u)(2)

The proposal requires the employer to conduct the audit for each PSM subsection using individuals who have expertise specific to that subsection. This is necessary because conducting an effective audit requires subject matter expertise. For example, in conducting an audit of subsection (k), Damage Mechanism Reviews, the employer is required to consult an expert in damage mechanisms to determine whether the employer has developed and maintained an effective DMR program.

To ensure that the employer uses individuals with the requisite expertise, the proposal requires that the identity and qualification of the persons performing the compliance audit be included in the report.

The employer is required to consult with operators who have expertise and experience in each process that is audited, and document the findings and recommendations. This is necessary to ensure that the audit includes the line-level knowledge of operations in the practical application of running a unit.

Subsection (u)(3)

The employer is required to make the Compliance Audit report available to employees and employee representatives. This is necessary to ensure transparency of the results and access to information.

The proposal also requires the employer to respond within 60 days to written comments submitted by an employee or employee representative. This is necessary to provide an avenue for employees to communicate concerns or suggestions regarding the content of the Compliance Audit to the employer.

Subsection (u)(4)

The employer is required to implement all recommendations in the Compliance Audit report in accordance with subsection (x)(11). This is necessary to ensure that recommendations are implemented in a timely manner.

Subsection (u)(5)

The employer is required to retain the three most recent audit reports. This is necessary because the Compliance Audit reports need to be available for future reference to compare report recommendations over time and assess improvement between audits.

Subsection (u)(6)

The Compliance Audit satisfies the provision on inspection requirements of CCR Title 8, Section 3203, for process safety. The employer is still required to comply with all other provisions of Section 3203, including inspections for other safety and health hazards in the refinery. This is necessary to clarify the role of the Compliance Audit regarding the inspection requirements of Section 3203.

Subsection (v) Process Safety Management (PSM) Program

Specific Purpose

The employer is required to develop and implement an effective written PSM program. The purpose of the PSM program is to oversee and coordinate the refinery's compliance with all elements of the

proposed PSM section, in order to ensure compliance and continual improvement in all PSM elements. This clarifies that the refinery manager is responsible for all aspects of PSM program compliance, which ensures transparency and accountability.

As part of this subsection, the refinery is required to track certain performance indicators. An essential element of any management improvement program is the measurement of existing performance. A system for measuring or monitoring performance affords the ability to improve quality, efficiency, reliability, performance, safety, and a variety of other items of interest.

Necessity

Subsection (v)(1)

The refinery manager is responsible for compliance with the proposal. This is necessary to ensure accountability for all PSM elements.

Subsection (v)(2)

The employer is required to develop and implement an effective written program that must be reviewed and updated at least every three years. This is necessary to ensure accountability and transparency of the program, as well as ensure the program information is current and accurate. This also documents compliance and promotes continual improvement of process safety performance.

Subsection (v)(3)

The employer is required to develop and maintain an organizational chart of management personnel responsible for implementing individual PSM program elements. This is necessary to ensure accountability and transparency.

Subsection (v)(4)

The employer is required to develop, implement, and maintain an effective program to track and document Process Safety Performance Indicators.

The Governor's Interagency Working Group report concluded: "Indicators are a standard method of measuring and evaluating performance over time, and they can help identify actions to improve performance and reduce hazards. Indicators can also provide insight into a factor that is more difficult to measure directly, such as safety. Designing and reporting on strong 'leading' and 'lagging' indicators can potentially drive continuous process improvement at refineries."⁵

Requiring the employer to track and document Process Safety Performance Indicators is necessary for monitoring and evaluation, which promotes ongoing process safety improvements. Collecting and analyzing Process Safety Performance Indicators is necessary for continuous improvement in process safety at the refinery.

⁵ Edmund G. Brown Jr., Governor (February 2014), *Improving Public and Worker Safety at Oil Refineries*, Report of the Interagency Working Group on Refinery Safety, p. 30.

Subsection (w) Division Access to Documents and Information

Specific Purpose

The employer is required to provide all documents and information developed or collected pursuant to the proposed PSM section to the Division upon request. Access to information is essential to the Division's enforcement mandate.

Necessity

This subsection is necessary to improve efficiency for both a refinery and the Division by allowing for access to information upon request, without the need to open a formal inspection. This enables the Division to identify potential Process Safety Performance Indicators in a timely manner. This requirement provides the Division with a useful tool to efficiently obtain information for evaluating and regulating the effectiveness of a refinery's process safety program.

Subsection (x) Implementation

Specific Purpose

The purpose of this subsection is to establish standardized procedures and timelines for refinery employers to prioritize process safety recommendations and implement corrective actions. This provision also ensures that there is a process for tracking all recommendations, criteria for rejecting recommendations, and requirements to document completion of corrective actions.

This proposed subsection applies to recommendations arising from the following subsections: PHA, SPA, DMR, HCA, Incident Investigation, and Compliance Audit. The proposed subsection sets requirements by which the employer may change or reject a recommendation, and it establishes timelines for implementing corrective actions.

The proposed subsection enables the employer to reject in writing a PSM team's recommendations, under certain conditions:

- (1) *The analysis upon which the recommendation is based contains material factual errors.* A material factual error is a mistake of fact that substantively alters the foundation or essential meaning of a recommendation. If a DMR team, for example, based its recommendations on inaccurate metallurgy data or out-of-date operating conditions, the employer might conclude that the team's recommendations contain a material factual error.
- (2) *The recommendation is not relevant to process safety.* This applies to recommendations that fall outside the purview of process safety. For example, if a PHA team recommends that a central air-conditioning unit be installed in the place of an evaporative cooler in a control room to reduce the room temperature, the employer might conclude that the recommendation is not relevant to process safety.
- (3) *The recommendation is infeasible; however, a determination of infeasibility shall not be based solely on cost.* PSM teams must assess a range of issues by taking into account health, safety, economic, environmental, legal, social, and technological factors. The cost alone of implementing a recommendation is not a sufficient basis for the employer to reject a recommendation as infeasible.

In addition to rejecting a team's recommendation, the proposed subsection allows the employer to change a recommendation if the employer can demonstrate in writing that an alternative measure would provide an equivalent or higher level of inherent safety. The purpose of these requirements is to ensure that the recommendations of a team are afforded systematic and comprehensive attention by the employer and that employers implement corrective actions in a timely manner. Requiring transparency and accountability in the process will ensure the effectiveness of a refinery's audits, investigations, and required reports.

The subsection requires timelines for the employer to implement corrective actions, including when the corrective action requires a process shutdown. The employer is given the flexibility to extend a timeline if necessary, but the employer is required to document the decision and rationale and implement the corrective action as soon as possible. If the employer is unable to meet a target date, the employer must: (i) conduct an MOC for the date change in order to assess the level of risk that could be affected by the delay; (ii) set a new target date; (iii) inform employees of the rationale for the delay; and (iv) implement the corrective action as soon as possible.

Necessity

This subsection is necessary to enable the employer to effectively address team recommendations and implement corrective actions. It does this by requiring a transparent and accountable decision-making procedure.

The subsection enables the employer to change or reject a team's recommendations, under limited conditions, and provides deadlines for completion of corrective actions. These requirements are necessary to ensure that the employer takes appropriate and timely corrective actions to improve process safety.

Subsection (x)(1)

The employer is required to develop and maintain an effective written corrective action program to prioritize and implement the recommendations of a PHA, SPA, DMR, HCA, incident investigation, Human Factors program, and Compliance Audit. This is necessary to ensure that recommendations are prioritized and implemented in a timely and consistent manner throughout the PSM program.

Subsection (x)(2)

Each PSM team is required to provide its findings and recommendations to the employer in a timely manner. This is necessary to ensure that the employer is made aware of process safety hazards and remedial recommendations as soon as possible.

Subsections (x)(3), (x)(4), and (x)(5)

Subsection (x)(3) provides conditions under which the employer is permitted to reject a team recommendation. This is necessary to provide a framework of accountability for decision-making by the employer regarding team recommendations.

If the employer elects to change a team recommendation, subsection (x)(4) requires the employer to demonstrate in writing that an alternative measure would provide an equivalent or higher level of inherent safety. This is necessary to ensure that solutions that offer less protection are not used in place of more protective measures.

Subsection (x)(5) requires the employer to document and retain a record of all instances in which a team recommendation is rejected or changed. This is necessary to ensure transparency and accountability in the implementation of team recommendations.

Subsection (x)(6)

The employer is required to make any changes to or rejections of recommendations available to the applicable team for comment. All comments received from team members and the employer's final decision for each recommendation must be documented by the employer and made available to team members. This requirement is necessary to ensure that each member of a PSM team is aware of, and able to comment on, any recommendation that the employer has elected to change or reject. This ensures transparency and accountability in addressing team recommendations.

Subsection (x)(7)

Subsection (x)(7) requires the employer to develop and document corrective actions that implement each accepted recommendation, and to assign a date and person responsible for completing the corrective action. This is necessary to ensure transparency and the employer's accountability for the health and safety of employees.

Subsection (x)(8)

Subsection (x)(8) requires the employer to conduct revalidations of any PHA, SPA, HCA, or DMR that may be required as part of a corrective action, and to do so under the documentation and timeline requirements of this subsection. This is necessary to ensure that these analyses are current and are used to improve process safety.

Subsection (x)(9)

Subsection (x)(9) is necessary to ensure that the employer promptly implements corrective actions. The employer is required to conduct an MOC for any proposed change to a completion date, which is necessary to ensure that the date change does not introduce or worsen a process safety hazard. The employer is required to make all completion dates available, on request, to affected employees and representatives. This is necessary to ensure information transparency and the employer's accountability for the health and safety of employees.

Subsection (x)(10)

Subsection (x)(10) requires that each corrective action not requiring a process shutdown be completed within 30 months of completion of the analysis or review (except as noted below). This is necessary to establish a reasonable timeframe for implementing recommendations, based on input from stakeholders and technical experts.

Subsection (x)(11)

Subsection (x)(11) requires that corrective actions be completed within 18 months for Compliance Audit or incident investigation recommendations, because these recommendations result from specific incidents or from deficiencies that warrant more immediate action.

Subsection (x)(12)

Subsection (x)(12) requires that corrective actions requiring a process shutdown be completed during the first regularly scheduled turnaround of the affected process. This is necessary to ensure that applicable corrective actions are completed as soon as possible with the refinery's turnaround schedule.

Except for recommendations that result from incident investigations, subsections (x)(10), (x)(11), and (x)(12) allow the employer limited flexibility to demonstrate in writing the circumstances and rationale that make it infeasible to meet the prescribed time limits. For example, if a particular material is not obtainable prior to the turnaround period when the employer had planned to install the material as part of a corrective action, the employer could demonstrate in writing the factual justification and rationale for its anticipated failure to meet the specified time limit.

Subsection (x)(13)

Subsection (x)(13) requires the employer to prioritize and promptly address process safety hazards either through permanent corrective actions or interim safeguards. This is necessary to establish the prioritization of process safety hazards because the risks posed by these hazards could result in a major incident or employee injury.

Subsection (x)(14)

When an employer cannot implement a corrective action within the specified time limits, the employer is required to ensure that interim safeguards are sufficient to ensure employee safety and health, pending permanent corrections. The employer is required to document the rationale for deferring the corrective action, and document all MOC requirements. The employer is required to document a revised timeline describing when the corrective action will be implemented and develop an effective plan to make the rationale and revised timeline available to all affected employees and their representatives.

These requirements are necessary because failing to implement a corrective action in a timely manner could adversely affect process safety. Some permanent corrective actions require time to complete. Interim measures are necessary to have in place until permanent corrections are completed to ensure the health and safety of employees. The requirements allow the employer to demonstrate in writing the rationale for failing to meet the specified time limits, while ensuring that the employer implements the permanent correction in accordance with the revised timeline.

Subsection (x)(15)

The employer is required to track and document the completion of each corrective action and append the documentation to the applicable PSM element. This is necessary to track the employer's performance in meeting the required implementation timelines. This ensures information transparency and the employer's accountability for the health and safety of employees.

Benefits

Benefits from the proposal include, setting comprehensive safety performance standards for refinery employers that prioritize implementation of inherently safer systems to reduce the risk of incidents and eliminate or minimize process safety hazards to which employees may be exposed. Because the number of refinery incidents is anticipated to be reduced, the proposed regulation provides safety and health benefits to workers and the public in nearby communities as well as other economic benefits for

businesses. The proposal ensures that rigorous safety standards are met through improvements in transparency, accountability, worker participation, and enforcement.

**TECHNICAL, THEORETICAL, OR EMPIRICAL STUDIES, REPORTS, OR
DOCUMENTS RELIED ON BY THE STANDARDS BOARD**

1. Center for Chemical Process Safety (2007), *Guidelines for Risk Based Process Safety*, American Institute of Chemical Engineers (AIChE), Wiley & Sons, Inc., Hoboken, NJ.
2. Center for Chemical Process Safety (2009), *Inherently Safer Chemical Processes: A Life Cycle Approach*, American Institute of Chemical Engineers (AIChE), Wiley & Sons, Inc., Hoboken, NJ.
3. Edmund G. Brown Jr., Governor (February 2014), *Improving Public and Worker Safety at Oil Refineries*, Report of the Interagency Working Group on Refinery Safety.
4. Mendeloff, John. *Refinery Process Safety Performance and Models of Government-Industry Relations*. Santa Monica, CA: RAND Corporation, 2013.
<http://www.rand.org/pubs/testimonies/CT392.html>.
5. U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, *Energy Assurance Daily*, available at <http://www.oe.netl.doe.gov/docs/eads/ead120914.pdf> (accessed December 9, 2014). (Note: For weekly summaries, go to "Download EADs" and scroll to "Petroleum.").
6. United States Census Bureau (2012), *Industry Statistics Portal: Business Data from the U.S. Census Bureau*, 2012 NAICS: 324110, Petroleum Refineries, available at <http://www.census.gov/econ/isp/sampler.php?naicscode=324110&naicslevel=6#/>, accessed May 16, 2016.
7. U.S. Chemical Safety and Hazard Investigation Board (CSB), (April 2013), *Interim Investigation Report on the Chevron Richmond Refinery Fire*
http://www.csb.gov/assets/1/19/Draft_Report_for_Public_Comment.pdf
8. U.S. Chemical Safety and Hazard Investigation Board (CSB), (January 2015), *Final Investigation Report January 2015 Chevron Richmond Refinery Pipe Rupture And Fire* CSB Report No. 2012-03-I-CA. http://www.csb.gov/assets/1/19/Chevron_Final_Investigation_Report_2015-01-28.pdf
9. Advisory Committee Meetings and Information from: September 16, 2014; September 17, 2014; November 6, 2014; and June 22, 2015.

PETITION

This proposal was not the result of a petition.

ADVISORY COMMITTEE

The proposal was developed with the assistance of an advisory committee. (A list of advisory committee members and attendance sheets are included as Documents Relied Upon.)

FIRE PREVENTION STATEMENT

This proposal includes fire prevention or protection standards. Therefore, approval of the State Fire Marshal pursuant to Government Code Section 11359 and/or Health and Safety Code Section 18930(a)(9) is required.

SPECIFIC TECHNOLOGIES OR EQUIPMENT

This regulatory proposal does not mandate the use of specific technologies or equipment.

Standardized Regulatory Impact Assessment (SRIA)

The State of California has proposed revised Process Safety Management (PSM) and California Accidental Release Prevention Program (Cal/ARP) regulations for oil and gas refineries that operate in California. The proposed regulations are more stringent than current federal regulations and are intended to improve refinery worker and public safety, and reduce air pollution.

The RAND Corporation assessed the costs and benefits of the proposed PSM and Cal/ARP regulations. RAND estimated these costs and benefits in four categories: the costs to industry (to implement the regulation), the costs to society (pass through of certain industry costs), benefits to industry, and benefits to society. The results of the analysis are detailed below, respective to the SRIA requirements.

Background

The federal Clean Air Act Amendments of 1990 [42 U.S.C. Section 7412(r)] directed the federal Occupational Safety and Health Administration (OSHA) and the United States Environmental Protection Agency (EPA) to develop regulations to prevent accidental chemical releases. These became known as the PSM and Risk Management Plan (RMP) regulations, respectively. On February 24, 1992, OSHA published a Final Rule for *Process Safety Management of Highly Hazardous Chemicals* (57, Fed. Reg., 6356, February 24, 1992), codified as 29 CFR Section 1910.119.

The Department of Industrial Relations (DIR) subsequently adopted a PSM standard (CCR Title 8, Section 5189) pursuant to its mandate to adopt standards that are at least as effective as federal standards. Section 5189 is substantially the same as the federal counterpart, in that it addresses the prevention of catastrophic releases of toxic, reactive, flammable, and explosive chemicals and applies to employers who use a process involving a particular chemical (or chemicals) at or above certain threshold quantities (listed in Appendix A) or a flammable liquid or gas as defined in subsection (c) of the regulation.

Since 1992, California's PSM standard has covered approximately 1,500 facilities in the state that handle or process certain hazardous chemicals including its 15 active oil refineries, which process approximately two million barrels of crude oil per day into gasoline, diesel fuel, jet fuel, and chemical feedstocks.

Following a chemical release and fire at the Chevron refinery in Richmond, California, on August 6, 2012, the Governor's Interagency Working Group on Refinery Safety prepared a report raising concerns and recommendations about the safety of California's oil refineries. The report recommended the establishment of an Interagency Refinery Task Force to: (1) coordinate revisions to the state's PSM regulations and Cal/ARP regulations; (2) strengthen regulatory enforcement; and (3) improve emergency preparedness and response procedures.

In accordance with the recommendations of the report, Cal/OSHA, a division of DIR, is promulgating a new PSM regulatory proposal for oil refineries, GISO Section 5189.1. Cal/ARP, within the California EPA, is also promulgating proposed Cal/ARP regulations that are in alignment. The regulatory proposal is consistent and compatible with existing state regulations. The proposal implements the recommendations of the report and other elements that safety experts have learned over the past two decades are essential to the safe operation of a refinery and include: applying a *hierarchy of controls* to implement first- and second-order inherent safety measures; conducting *damage mechanism reviews*; applying rigorous *safeguard protection analyses*; integrating *human factors* and *safety culture assessments* into safety planning; *involving front-line employees* in decision-making; conducting *root-cause analysis* following significant incidents; and performing comprehensive *process hazard analyses*.

The refineries operating in California have adopted many of these practices over the past decade, with significant improvements in safety performance; however, the industry continues to experience significant upset events.⁶

The regulatory proposal sets safety performance standards for refinery employers and ensures that those standards are met through improvements in transparency, accountability, worker participation, and enforcement.

The creation or elimination of jobs in the state.

The proposed PSM and CalARP regulations will create an estimated 158 jobs in the state's petroleum refining sector (between 57 and 325 jobs), based on an estimated total compensation (generated by macroeconomic analysis software) in the California refinery sector of \$334,000 per employee and a total increase in labor costs of \$58 million.

The creation of new businesses or the elimination of existing businesses in the state.

There is no anticipated creation or elimination of businesses in California.

The competitive advantages or disadvantages for businesses currently doing business in the state.

Based on the economic modeling, refiners in California complying with the proposed PSM regulations will experience the advantage of cost avoidance due to the reduced likelihood and severity of a major refinery incident, such as the ExxonMobil incident in Torrance in 2015. This will reduce the cost

⁶ U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability, *Energy Assurance Daily*, available at <http://www.oe.netl.doe.gov/docs/eads/ead120914.pdf> (accessed December 9, 2014). (Note: For weekly summaries, go to "Download EADs" and scroll to "Petroleum.")

associated with lost output, which in the ExxonMobil incident had an estimated value of \$323 million (not including the additional equipment repair costs, which could not be estimated).

The increase or decrease of investment in the state.

Multiple stakeholder and advisory meetings with labor, industry, advocacy groups, and other agencies have contributed to the development of the proposed regulations. All input has been considered, and the current proposed regulations reflect a balanced, enforceable, and prevention-focused approach to reducing risks in this industry. There is no indication that the regulations will affect investment in California.

Given the expected annual loss of \$800 million to the California economy due to a costly major refinery incident, the proposed regulations will have to reduce the risk of a costly major incident by 7.3% to be economically justified. Additional sensitivity analysis was conducted to assess how varying expected amounts of annual loss affect the critical risk reduction values.

The incentives for innovation in products, materials, or processes.

The proposed regulations require the establishment of several programs that drive refiners to analyze and implement processes and select materials that offer the highest levels of risk reduction. The inherent safety requirements promote an approach to safety that focuses on eliminating or reducing the hazards associated with certain conditions. A process is inherently safer if it eliminates or reduces the hazards associated with materials or operations used in the process, and this elimination or reduction is permanent and inseparable from the material or operation. A process with eliminated or reduced hazards is described as inherently safer than a process with only passive, active, or procedural safeguards. The process of identifying and implementing inherent safety in a specific context is known as “inherently safer design.” Examples of how innovation is incentivized are described in the prioritized approaches to safety:

- **First-Order Inherent Safety Measure**—a measure that eliminates a hazard. Changes in the chemistry of a process that eliminate the hazards of a chemical are usually considered first-order inherent safety measures—for example, by substituting a toxic chemical with an alternative chemical that can serve the same function but is nontoxic.
- **Second-Order Inherent Safety Measure**—a measure that effectively reduces risk by reducing the severity of a hazard or the likelihood of a release, without the use of additional safety devices. Changes in process variables to minimize, moderate, and simplify a process are usually considered second-order inherent safety measures—for example, by redesigning a high-pressure, high-temperature system to operate at ambient temperatures and levels of pressure.

BENEFITS OF THE PROPOSED ACTION

The benefits of the regulations, including, but not limited to, benefits to the health, safety, and welfare of California residents, worker safety, environment and quality of life, and any other benefits identified by the agency.

The proposed regulations will improve safety at California refineries, which will in turn result in fewer major process incidents and fewer releases of hazardous materials from refineries. Because the number of major refinery incidents may be reduced under the proposed regulation, it could provide safety and health benefits to workers and the public in nearby communities as well as other economic benefits for businesses. The proposed regulations will also increase the openness and transparency of business and government.

Methodologies

Assessing and determining the benefits and costs of the proposed regulation, expressed in monetary terms to the extent feasible and appropriate.

Costs to Industry

The total implementation costs were estimated for all the refineries in California by aggregating estimates. The quality of data reported for one-time, upfront costs was much lower than that reported for ongoing costs. The majority of refiners indicated upfront costs that were relatively minor compared to ongoing costs—about 20% to 80% of a single year's cost. One refiner reported anticipating extremely significant start-up costs in a single PSM category—this estimate is discussed separately. Because ongoing costs made up the bulk of the reported costs and were reported more consistently by refiners, the following analysis focuses on these ongoing costs.

Types of Costs Considered for Implementation of the Proposed Regulations

The additional costs that would be incurred by industry to comply with the proposed regulations were also considered and calculated. Costs were calculated in ten major areas covered by the regulations: Safety Training, Damage Mechanism Review, Root Cause Analysis, Hierarchy of Hazard Controls Analysis, Process Safety Culture Assessment, Program Management, Performance Indicators, Human Factors, Safeguard Protection Analysis/Layers of Protection Analysis (LOPA), Process Hazard Analysis, and Other Costs (or undifferentiated costs). Refiners' estimates were taken essentially at face value as good-faith estimates of cost from those in the best position to understand them.

Only costs attributed to the proposed regulations were aggregated. In some cases, refiners reported the total cost of programs that are already in place and that the new regulations might make more expensive. In these cases, only the additional expense was included in the aggregate expense. Similarly, safety-related initiatives already underway that are not directly mandated by the regulations were excluded from the tabulation of costs of the proposed regulations.

Methods Used to Obtain Average, High, and Low-Cost Estimates

Variation between these estimates was used as the basis for estimating the range of actual costs—assuming that some refiners might miss the mark at either the low or high end. To produce the range of possible costs, each refiner's cost was first normalized by the size of the refinery, measured in barrels per day (BPD) of capacity. Refiners were then ranked in terms of cost by their cost per unit of capacity. The 10th and 90th percentiles of cost were estimated—corresponding to the second-lowest and second-highest cost estimates—and applied to all refiners according to their capacity measured in BPD.

Refiner-reported cost estimates were between \$9 and \$37 per unit of production capacity. Two refiners produced higher estimates, one at \$90 per unit and one at \$187 per unit. All reported estimates were assumed to be good-faith estimates of refiner cost. Although some refiners might face different costs because they have to make a greater or lesser effort in order to meet the proposed requirements, a close reading of the survey responses indicates that this is not the major source of variation in estimates. Rather, it appears that much of the variation stems from different understandings of how the regulations should be interpreted and enforced; some refiners anticipate comparatively minor changes relative to current industry practice, while others anticipate major changes.

The variation in refiner estimates is thus treated as a measure of the uncertainty of this final refiner cost. From this perspective, the estimates reported by the refiners can be thought of as a “best” or average cost estimate. We take the 10th percentile (second lowest) and 90th percentile (second highest) estimates as the likely lower and upper bounds of this cost. Most estimates cluster at the lower end of this range, with much of the probability falling near the best estimate, from \$20 to \$35 per unit.

Results

Summing costs from all refiners produces a best estimate of \$58 million per year (M/y) for refiners to maintain compliance with the proposed regulations, from a low of \$20 M/y to a high of \$183 M/y.

The largest cost categories are Hierarchy of Controls Analysis at \$12.7 M/y, Damage Mechanism Review at \$12.3 M/y, and Root Cause Analysis at \$9.2 M/y. Safeguard Protection Analysis/LOPA at \$6.7 M/y, Safety Training at \$3.2 M/y, Process Safety Culture Assessment at \$2.9 M/y, and Human Factors at \$2.9 M/y make up a second tier of cost in the range of \$3 M/y to \$7 M/y. Process Hazard Analysis at \$1 M/y, Program Management at \$845,000 per year, and Performance Indicators at \$400,000 per year comprise a third tier of cost at or below \$1 M/y industry-wide. The Other cost category (\$5.3 M/y) reflects primarily data that were reported in an aggregated form and cannot be broken into the stated categories without making unwarranted inferences, rather than actual costs that do not fall into the above-stated categories.

Estimates of Start-up Costs

Although the estimates of most refiners were reasonably consistent with one another, several refiners anticipated costs that were much higher in certain categories. In some cases, it was possible to determine that the anomalous numbers were the result of a misunderstanding of the question being asked—for instance, a report of the total cost of a program, rather than the increase in that program’s cost that could be attributed to the regulations. Problems of this sort were minimal, however, because of the extensive meetings to clarify the intent of the questions that were conducted before the refiners prepared their responses. In other cases, these answers, though anomalous, were within the bounds of the study: they did not seem to represent any kind of misunderstanding of the question; instead, they seem to represent either a legitimate difference in the costs faced by certain refiners or a legitimate difference in judgment with regard to how the regulations will be implemented and how much it might cost to comply with them. All answers regarding the ongoing cost of compliance have been incorporated into the estimates presented here. Differences in opinion along these lines have been taken as a healthy part of the estimation process to estimate a range of possible implementation costs.

Most refiners did not view start-up costs as a major component of the costs of the proposed regulations, with most of the cost being the ongoing costs of operating facilities as required by the new regulations. Under most refiners' estimates, the first one to five years may cost more than subsequent years by a factor of 1.2 to 2 (with estimates tending to fall at the lower end of that range).

The SRIA process surfaced many instances of confusion regarding the intent of the regulations and their related requirements. Subsequent revision of the proposed regulations helped refine the intent, which was viewed as a very productive and useful benefit of the SRIA process.

Costs to Society

Assuming that additional regulatory costs will be passed on to consumers through higher gasoline prices and that the demand for gasoline is perfectly inelastic, the price impact of the proposed regulations can be estimated. In recent years, gasoline consumption in California has averaged about 14.5 billion gallons per year.

California requires a unique reformulated gasoline blend to meet the state's pollution control requirements. Gasoline made in other states to meet other state and federal pollution requirements does not meet California standards. Consequently, all gasoline consumed in California is typically refined in the state. Therefore, California refiners' cost of implementing the proposed regulations can be distributed over the cost to consumers of purchasing 14.5 billion gallons of California gasoline.

Spreading the \$58 million estimated cost of the regulations across this volume of sales indicates an increase in price of about \$0.004, or slightly less than half a cent per gallon. The lower estimate of \$20 million reduces this impact to \$0.0014 or about 1/7 of a cent, while the upper estimate of \$183 million increases the impact to \$0.013, or 1.3 cents per gallon. Aggregating this to calculate the impact on the average adult Californian yields an estimated cost per person of about \$2 per year, with a low estimate of \$0.68 and a high estimate of \$6.20 per person per year.

The larger economic impacts of this cost on the California economy are mixed. After applying these costs to a standard input-output model for the state, we observe that this cost is more than offset by the additional refiner spending on labor that drives the higher costs. The net stimulatory effect of the additional spending by refiners would be slightly greater than the inhibiting effect of higher gas prices.

Benefits to Industry: Safety Improvements

Safety improvements may result from implementing the proposed regulation. These safety improvements could reduce the number of major refinery incidents at California refineries. The Contra Costa County Industrial Safety Ordinance (ISO) was used as a proxy for the purpose of estimating the proposed regulations (although the proposed regulations go further than the current ISO in terms of risk reduction requirements, rendering this a very conservative estimate). It is not unreasonable to assume that California refinery incident rates under the proposed regulation will be similar to or lower than those of ISO refineries. When analyzed, the incident rate for major incidents was significantly less (about three times lower) for ISO refineries when compared to the incident rate for non-ISO refineries operating in the state of California.

The analysis of the proposed regulations indicated no reduction in the long-term operating costs of California refineries.

Benefits to Industry: Costs Avoided

Safety improvements may result from implementing the proposed regulation. These safety improvements could reduce the number of major incidents at California refineries. Thus the proposed regulation benefits industry by reducing the costs of major incidents in the future. At least three refinery incidents with macroeconomic impact of greater than \$1.5 billion on the California economy have occurred since 1999. The average cost of such an incident to the refiner that suffers the incident is at least \$220 million. Using ExxonMobil incident in 2015 as an example, the cost to ExxonMobil for a six-month period is estimated at \$323 million, not including other likely costs, such as equipment repair or damage to its reputation.

Benefits to Society: Costs Avoided

In quantitative terms, the largest potential benefit of the proposed regulations is the avoided cost of supply disruption related to a future major refinery incident. Gasoline prices in California, because of the ExxonMobil 2015 incident, cost California drivers nearly \$2.4 billion, in the form of a prolonged \$0.40 increase per gallon at the pump. Macroeconomic analysis indicated that lost supply associated with this one incident cost the California economy \$6.9 billion. If the ExxonMobil event continues beyond six months, such as up to the predicted 12 months, the costs could double in the absence of the availability of alternate reserves in California.

Assessing the value of nonmonetary benefits, such as the protection of public health and safety, worker safety, or the environment, the prevention of discrimination, the promotion of fairness or social equity, an increase in the openness and transparency of business and government and other nonmonetary benefits is consistent with the statutory policy or other provisions of law.

The nonmonetary benefits from these regulations and their ability to reduce the risk of refinery incidents include the protection of health and safety for workers and the public, as well as the environment. Non-economic benefits for residents would also accrue, as they are less likely to be injured or die in refinery incidents. The same is true for the injury and illness rates, as well as fatalities, of the refinery workers. Analysis suggests that the proposed regulations could lead to a refinery worker death rate over three times lower, assuming that the ISO rate is a conservative proxy for the proposed regulations. Several other anticipated costs are avoided for industry that could not be reliably estimated, such as refinery equipment repair and damage to the company's reputation, which can be considerable depending on the incident. Costs avoided also include those from overseas production of reformulated California gasoline, as well as related transportation costs to make these reserves available. Californians would benefit by avoiding costs incurred by residents who live near refineries affected by incidents, such as emergency services, health care, reduction in property values, and reduction in tax revenue to local governments.

Comparing the proposed regulatory alternatives with an established baseline so that agencies can make analytical decisions regarding the adoption, amendment, or repeal of regulations necessary to

determine that the proposed action is the most effective, or equally effective and less burdensome, alternative in carrying out the purpose for which the action is proposed, or the most cost-effective alternative to the economy and to affected private persons that would be equally effective in implementing the statutory policy or other provision of law.

Although data limitations precluded estimation of an established baseline, a breakeven analysis was conducted to compare the costs and benefits. The estimated breakeven point for effectiveness was 7.3%. This indicates that if the regulations reduced the risk of a costly major incident by 7.3% (noting the expected annual loss of \$800 million to the California economy due to a costly major refinery incident), the proposed regulations would be economically justified.

An alternative to the proposed regulations, known as the Safety Case Model, was considered. This approach emerged first in Europe, triggered by disasters in the North Sea and at Seveso. The former led the United Kingdom and Norway to develop a “safety case” model to regulating offshore oil platforms in the 1990s, an approach that later expanded to other high-hazard industries. The European Union’s Seveso Directives ordered similar measures for all member states.

California’s existing model of work safety regulation in process safety management emphasizes investigating serious accidents that have occurred. As examined by the RAND Center for Health and Safety in the Workplace, over the past 25 years, a perspective has developed that argues that the models currently used—nationwide and in California—are inadequate for ensuring safety at very complex facilities, especially those characterized by risks that have low frequency but very high disaster potential.

The “safety case” model involves considerably more resources in terms of time and agency inspectors. The Hazardous Facilities Unit, which oversees the UK safety cases, typically conducts several audits each year at refineries to assess their safety case activities. The safety case model calls on facilities to explain what they will do to ensure their safety. The regulatory authority is charged with determining whether a facilities’ explanation or effort is acceptable or effective. Most regulatory scrutiny goes to auditing the facility to see whether it has been carrying out the activities called for in the safety case document. Some have argued that the safety case process often leads to initial gains in hazard recognition and abatement. However, it must remain “a living document” in order to fulfill its objectives.

A concern with the safety case model is that describing and documenting how a refinery will manage risks is not the same as actually managing risks. Further, augmenting oversight from the existing regulations to a level prescribed by the safety case approach is largely infeasible given the related requisite resource demands for regulatory authorities. For these reasons, the safety case model is not considered the optimal solution for California at this time.

Determining the impact of a regulatory proposal on the state economy, businesses, and the public welfare, as described in subdivision (c) of Section 11346.3.

The IMPLAN model was used to assess the secondary, macroeconomic impacts on the California economy of both the cost of the proposed regulations and the cost (to be avoided) of a major refinery incident. These estimated costs of the proposed regulations, while substantial in absolute terms, are small relative to the size of the industry (\$131 billion per year and the fourth-largest industry by output

in the state). The best estimate of \$58 million is only four-tenths of 1 percent of industry revenue not devoted to inputs and about one-twentieth of 1 percent of industry revenue overall. IMPLAN estimates total compensation in the California refinery sector at about \$334,000 per employee. The best estimate of \$58 million in additional labor costs therefore implies the creation of about 158 jobs in the petroleum refining sector if the major source of costs is additional labor.

Assessing the effects of a regulatory proposal on the General Fund and special funds of the state and affected local government agencies attributable to the proposed regulation.

The PSM regulations are user funded based on a formula that considers barrels of crude oil in terms of inputs and partially processed receipts as a percentage of the state's total. This new assessment on California's oil refineries was implemented by Governor Brown in 2013 and is independent of the state's General Fund.

The proposed regulations and their effect of reducing refinery incidents would confer benefits on local residents and communities in the form of cost avoidance associated with incidents, such as a reduction in property values and a reduction in tax revenue to local governments.

Determining the cost to the agency and affected business enterprises and individuals of enforcement and compliance.

DIR Cal/OSHA PSM Unit will enforce the proposed regulations and has contemplated the associated cost of enforcement. The California Legislature approved a budget that added new inspector positions to this unit, which are user funded through Cal/OSHA's fee authority.

The cost of compliance for industry, as detailed previously, is estimated at \$58 million per year. This estimate was arrived at using refinery-provided data, and a range reflecting the 10th and 90th percentiles produced the likely lower (\$20 million) and upper (\$183 million) bounds for annual compliance costs. Assuming that these costs will be passed on to consumers, the cost of compliance is estimated at \$2 per year per Californian adult.

Making the estimation described in Government Code Section 11342.548.

In broad terms, the cost of major incidents at refineries is widely known as a result of the 2012 Chevron and 2015 ExxonMobil incidents. Because of these immense costs, the ability to avoid such incidents would have immense benefits, well above the \$50 million threshold for conducting an SRIA.

EVIDENCE SUPPORTING FINDING OF NO SIGNIFICANT STATEWIDE ADVERSE ECONOMIC IMPACT DIRECTLY AFFECTING BUSINESSES

DIR makes an initial determination that the action will not have a significant, statewide adverse economic impact directly affecting business, including the ability of California businesses to compete with businesses in other states. The estimated costs of the proposed regulations are relatively small compared to the size of the industry (\$131 billion per year and the fourth-largest industry by output in the state).

Based on the economic modeling, refiners in California complying with the proposed PSM regulations will experience the advantage of cost avoidance due to the reduced likelihood and severity of a major refinery incident, such as the ExxonMobil incident in Torrance in 2015. This will reduce the cost associated with lost output, which in the ExxonMobil incident had an estimated value of \$323 million (not including the additional equipment repair costs, which could not be estimated).

REASONABLE ALTERNATIVES TO THE PROPOSED REGULATIONS **AND REASONS FOR REJECTING THOSE ALTERNATIVES**

Alternative 1: Maintain status quo

One alternative considered was continued enforcement of petroleum refineries under the existing PSM regulation without revising the requirements. In the past four years, there have been two major incidents (Chevron in 2012 and Exxon in 2015). Per the Governor's Task Force Report, existing law, regulation, and level of staffing were unable to forestall the Chevron incident and it was determined that more needed to be done to prevent future incidents of similar or worse consequences. Since 2012, Cal/OSHA has increased enforcement staffing to 10 safety inspectors dedicated to refineries. The additional level of safety achieved through the increased enforcement efforts will be maintained under the current PSM requirements. The costs associated with the continued enforcement or status quo under the existing regulation reflect an unknown but anticipated number of incidents that may occur in the absence of more stringent requirements and tools mandated under the proposed new PSM regulation. These consequences are largely untenable, given the impacts of incidents experienced in recent years. Based on the foregoing, maintaining the regulatory status quo is insufficient in addressing risks and preventing future incidents.

Alternative 2: Safety Case Model

California's existing model of work safety regulation in process safety management emphasizes investigating serious accidents that have previously occurred. As examined by the RAND Center for Health and Safety in the Workplace, over the last 25 years, a perspective has developed that argues that the models currently used—nationwide and in California—are inadequate to ensure safety at very complex facilities, including those characterized by risks that have low frequency but very high disaster potential. This perspective emerged first in Europe, triggered by disasters in the North Sea and at Seveso (RAND 2013). The United Kingdom and Norway developed a "safety case" approach to regulating off-shore oil platforms in the 1990s, an approach that later expanded to other high-hazard process industries.

The "safety case" model involves considerably more resources in terms of time and agency inspectors. The Hazardous Facilities Unit, which oversees the United Kingdom with safety cases, typically conducts several audits each year at refineries to assess their safety case activities. The safety case model requires facilities to explain what they will do in order to try to ensure their safety. The regulatory authority is charged with determining whether a facilities' explanation or effort is acceptable or effective. Most regulatory scrutiny goes to auditing the facility to determine whether it has been carrying out the activities called for in the safety case document. Although some contend that the safety case process leads to initial gains in hazard recognition and abatement, however, it must remain "a living document" in order to fulfill its objectives.

A concern with the safety case model is that describing and documenting how a refinery will manage risks is not equivalent with actually managing risks. Further, augmenting oversight from the existing regulations to a level prescribed by the “safety case” model would be largely infeasible given the related requisite resource demands for regulatory authorities. This approach is estimated to require a fourteen fold increase in staff for Cal/OSHA – from 10 inspectors statewide to 10 inspectors for each of California’s 14 refineries. Additional costs for refineries would also be anticipated, given the significant changes this model would necessitate in California. For these reasons, the “safety case” model is not considered a reasonable alternative to the proposal.