Initial Statement of Reasons

Division 2. Governor's Office of Emergency Services

Chapter 4.5 California Accidental Release Prevention (CalARP) Program

Article 6.5. Program 4 Prevention Programs

GENERAL PROBLEM STATEMENT

Public awareness of the potential danger from accidental releases of hazardous chemicals continues to increase as accidents have occurred around the world. In response to public concern, and recognizing that chemical hazards exist, the United States Environmental Protection Agency (U.S. EPA) initiated a Chemical Emergency Preparedness Program (CEPP) in 1985, as part of U.S. EPA's Air Toxics Strategy. In 1986, Congress adopted many of the elements of CEPP in the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA). EPCRA dealt with incident reporting and chemical inventories and did not directly address accident prevention. Consequently, in 1986, U.S. EPA established a chemical accident prevention program to collect information on chemical accidents, work with other groups to increase knowledge of prevention practices, and encourage industry to improve the safety of chemical facilities. This program resulted in the enactment of a federal law for the prevention of chemical accidents (ref. 58 FR 5102).

Section 112(r) of the amended Clean Air Act (CAA), signed into law on November 15, 1990, mandated the new federal program focusing on the prevention of chemical accidents. The objective of section 112(r) is to prevent serious chemical accidents that have the potential to affect public health and the

environment. Under the CAA 112(r), U.S. EPA promulgated a final rule for the prevention of accidental releases of hazardous substances in Title 40 of the Code of Federal Regulations, Part 68, on June 20, 1996. The rule includes a list of regulated substances that, in the event of an accidental release, could cause death, injury, or serious adverse effects to human health and the environment. The rule requires owners or operators of facilities with more than a threshold quantity of a regulated substance in a process to develop and implement an accident prevention program. The program must include a hazard assessment, prevention program, and an emergency response program. Each regulated business is required to develop and submit a risk management plan (RMP), which is a reflection of the accident prevention program, to the agency implementing the program.

The California State Legislature, recognizing the need for a chemical accident prevention program for California, enacted a new Article 2 for Chapter 6.95 of the Health and Safety Code (HSC) in 1986. HSC section 25531(e) states, "the Legislature finds and declares that the goals of reducing regulated substance accident risks and eliminating duplication of regulatory programs can best be accomplished by implementing the federal risk management program in the state, with certain amendments specific to the state." HSC section 25533 specifies, "[t]he program for prevention of accidental releases of regulated substances adopted by the Environmental Protection Agency pursuant to subsection (r) of section 112 of the Clean Air Act (42 U.S.C. Section 7412(r)), with the additional provisions specified in this article, is the accidental release prevention program for the state." This program is referred to as the California Accidental Release Prevention, or CalARP, program. The CalARP program reflects the requirements of the federal section 112(r) program and includes additional more stringent, state-specific RMP requirements.

The CalARP program is part of the State's Unified Program for Hazardous Materials Management, known as the Unified Program, which is overseen by the California Environmental Protection Agency (CalEPA). CalEPA certifies local agencies to implement the Unified Program as Unified Program Agencies (UPAs). HSC section 25534.05 mandates that the California Governor's Office of Emergency Services (Cal OES) adopt regulations for the CalARP program, in consultation with UPAs, industry, the public, and other interested parties. Cal OES must amend these regulations to address activities specific to the CalARP program.

Following the August 2012 pipe rupture, chemical release and fire at the Chevron, Richmond oil refinery (2012 Chevron Richmond Refinery fire), Governor Brown formed an Interagency Working Group on Refinery Safety (Interagency Working Group) to examine ways to improve public and worker safety through enhanced oversight of refineries, and to strengthen emergency preparedness in anticipation of any future incident. The Interagency Working Group released a final report titled "Improving Public and Worker Safety at Oil Refineries" in February of 2014 (Interagency Working Group Report).

Refineries are subject to the CalARP Risk Management Program (RMP) and the California Department of Industrial Relations, Division of Occupational Safety and Health (Cal/OSHA) Process Safety Management (PSM) regulations, as well as an Industrial Safety Ordinance (ISO) in Contra Costa County, where four refineries are located, and an ISO in the City of Richmond. However, the Interagency Working Group

found gaps in the regulatory schemes, noting that the regulations did not cover all aspects of process safety.

The report recommended that existing CalARP regulations be strengthened to ensure that more data and information are provided to agencies, workers, and the public. The report also recommended development of regulations to require refineries to: "(1) implement inherently safer systems to the greatest extent feasible; (2) perform periodic safety culture assessments; (3) adequately incorporate damage mechanism hazard reviews into process hazard analyses; (4) complete root cause analyses after significant accidents or releases; (5) explicitly account for human factors and organizational changes; and (6) use structured methods such as layer of protection analysis to ensure adequate safeguards in process hazard analysis." (Interagency Working Group Report, pp. 2-3.)

The current proposed regulations are designed to implement the recommendations of the Interagency Working Group, and were developed with extensive pre-regulatory input from refinery workers, labor unions, refineries, non-governmental organizations, academic experts, federal, state, and local agencies, and the public. Two prior drafts of the regulations were previously released for public comment in May 2015 and September 2015, and public meetings to discuss the proposed regulation were held in Martinez, Richmond, Torrance, Carson, Wilmington, Bakersfield, and San Luis Obispo. Numerous changes were made to the text of the draft to reflect the input received. The proposed CalARP regulations will function in parallel with changes to the PSM program that are proposed by Cal/OSHA. (Department of Industrial Relations, Proposed General Industry Safety Order (GISO) § 5189.1.)

As recommended in the Interagency Working Group Report, the proposed regulations would enhance CalARP risk management plan requirements for refineries to protect the public from uncontrolled releases of hazardous materials. The proposed requirements 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.

Non-Substantive Changes: Sections 2735.1, 2735.4, 2735.5, 2735.7, 2740.1, 2745.1, 2745.2, 2745.6, 2745.7, 2745.10, 2745.11, 2750.3, 2750.4, 2755.2, 2755.6, 2755.7, 2760.2, 2760.8, 2760.9, 2775.2, 2775.3, 2775.5, 2775.6, 2780.1, 2780.2, 2780.3, 2780.5, 2780.6, 2785.1.

Specific Purpose

The purpose of the changes in these sections is to ensure that language used in the regulations is consistent with the language used in the Health and Safety Code and throughout the regulations.

Necessity

The proposed amendments to these sections are necessary to change all instances of California Emergency Management Agency to California Governor's Office of Emergency Services, Cal EMA to Cal

OES, Administering Agency to Unified Program Agency, and AA to UPA. These amendments will also correct minor grammar and punctuation errors.

Organization of Program 4: Sections 2735.3, 2735.4, 2735.5, 2735.6, 2745.1, 2745.2, 2745.4, 2745.8, 2745.10.5, 2750.1, 2750.3, 2750.4, 2765.1.

Specific Purpose

The purpose of these sections is to add Program 4 to the current hierarchy and define its structure in relation to the existing Programs 1 through 3. In addition, these sections add cross-references to the new Program 4 regulations.

Necessity

The amendments to these sections are necessary to create Program 4, define the scope and applicability of Program 4, and move refineries, currently covered under Program 3 in Article 6, to Program 4 in Article 6.5. In addition, the amendments to section 2735.3 add new definitions and clarify existing definitions.

Section 2745.7.5 RMP Program 4 Component

Specific Purpose

The purpose of this section is to provide a comprehensive list of the requirements for each Program 4 stationary source process.

Necessity

The proposed section is necessary to provide a comprehensive list of the required information for each process under Program 4. Subsections (b) and (d) through (p) are the same as were previously required under Program 3 in section 2745.7. Subsection (c) requires the name of the highly hazardous material(s) rather than the substance. The new definition of “highly hazardous material” (Section 2735.3 (x)) is discussed below under section 2760.0.2 (Purpose). New information requirements are listed in subsections (q) through (v) and include dates of the most recent Hierarchy of Hazard Control Analysis, Process Safety Culture Assessment, evaluation of the Accidental Release Prevention Program Management policies and procedures, evaluation of the Human Factors Program, Safeguard Protection Analysis, and Damage Mechanism Review or update. These program elements are discussed below.

Section 2760.0.1 Applicability

Specific Purpose

The purpose of this subsection is to establish the regulatory reach of the new Article 6.5, also referred to as "Program 4" in this ISOR. Program 4 applies to "processes within petroleum refineries." "Petroleum refinery" is defined in section 2735.3 (uu) as: "a stationary source engaged in activities set forth in North American Industry Classification System (NAICS) code 324110." The U.S. Census Bureau[1] 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.

"Process" is defined differently in Article 6.5 than in the rest of Chapter 4.5. In section 2735.3 (xx) process for purposes of Article 6.5 means: "petroleum refining activities involving a highly hazardous material, including use, storage, manufacturing, handling, piping, or on-site movement. For the purposes of this definition, any group of vessels that are interconnected, or separate vessels that are located such that an incident in one vessel could affect any other vessel, shall be considered a single process. Utilities and safety related devices shall be considered part of the process if, in the event of an unmitigated failure or malfunction, they could potentially contribute to a major incident." Additionally, a new definition of "utility" has been added: "'Utility' for purposes of Article 6.5, means a system that provides energy or other process-related services to enable the safe operation of a petroleum refinery process. This definition includes electrical power, fire water systems, steam, instrument power, instrument air, nitrogen, and carbon dioxide." (Section 2735.3 (yyy).)

Activities occurring within laboratories are specifically excluded from jurisdiction in this section (Section 2762.0.1 (b)); however, other areas in the refinery are included to the extent that they are part of a process. Many parts of a refinery that were not included under Article 6 would be included under Article 6.5. For example, a storage tank would be considered part of a process if an explosion or fire at the tank could affect a process or if an incident in a process could affect the tank.

For petroleum refineries, this regulation supersedes California Code of Regulations (CCR) Title 19 Article 6.

Necessity

The proposed section is necessary to clarify the jurisdiction of the proposal. The broader jurisdiction described in this section is necessary because refineries contain many interconnections, such that failure in one piece of equipment could cause additional hazards to communities. In their report on the February 18, 2015 explosion at the Exxon-Mobil Refinery in Torrance, CA, the U.S. Chemical Safety and Hazard Investigation Board (CSB) concluded that:

> [L]arge pieces of debris from the explosion were thrown into other units of the refinery directly surrounding the ESP. One of these pieces of debris hit scaffolding in the refinery's alkylation

[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 September 15, 2015.

> unit, narrowly missing a tank containing tens of thousands of pounds of modified hydrofluoric acid, or HF. The CSB determined that had the debris struck the tank, a rupture could have been possible, resulting in a potentially catastrophic release of extremely toxic modified HF into the neighboring community.

(http://www.csb.gov/us-chemical-safety-board-finds-multiple-safety-deficiencies-led-to-february-2015-explosion-and-serious-near-miss-at-the-exxon-mobil-refinery-in-torrance-california/.)

The potential for cascading incidents such as the one that was apparently narrowly avoided in 2015 is why this regulation must apply broadly to any part of a refinery that could affect process safety.

Section 2760.0.2 Purpose

Specific Purpose

The purpose of this section is to specify the objectives of the proposal. The section states that the purpose is to "prevent major incidents at petroleum refineries in order to protect the health and safety of communities and the environment."

"Major Incident" is defined in section 2735.3 (hh) as "an event within or affecting a process that causes a fire, explosion or release of a highly hazardous material, and which has the potential to result in death or serious physical harm (as defined in Labor Code section 6432(e)), or which results in an officially declared public shelter-in-place, or evacuation order."

To understand this definition, it is important to cross reference several other definitions, including the definition of "serious physical harm", and the definition of "highly hazardous material".

"Serious physical harm," as defined in Labor Code section 6432(e)), means:

> [A]ny 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.

Note that in order to be considered a major incident, the incident must only have the *potential* to cause death or serious physical harm, so there is no requirement to have actual harm. As an example, the Chevron Richmond Refinery fire did not result in any deaths or anything that meets the Labor Code

definition above. Yet there was significant potential for death or serious burns of the refinery workers present in the area, and there was potential for significant respiratory illnesses in the many people who visited local emergency departments during and after the fire.

The definition also would have included the Chevron Richmond Refinery fire because of the language incorporating fires, explosions, or releases that result in an officially declared public shelter-in-place or evacuation order. However, this definition would not include an incident in which there is only an on-site shelter-in-place for workers, or one in which the refinery issues a precautionary shelter-in-place but no such declaration is made by a public agency.

“Highly hazardous material” is defined in section 2735.3 (x) to mean “a flammable liquid, flammable gas, toxic or reactive substance as those terms are defined in: (1) flammable gas, as defined in CCR Title 8, §5194, Appendix B, (2) flammable liquid, as defined in CCR Title 9, §5194, Appendix B, (3) toxic substances as acute toxicity is defined in CCR Title 8, §5194, Appendix A, and (4) reactive substance as self-reactive chemical, as defined in CCR Title 8, §5194, Appendix B. Highly hazardous material includes all regulated substances listed in Tables 1, 2, and 3 of this Chapter.”

The referenced definitions are well-established definitions of flammable, toxic, and reactive substances. The inclusion of all regulated substances (as listed in section 2770.5 of this chapter), assures that this definition is broader, not narrower, than the existing list of regulated substances.

The overall purpose of the CalARP Program as set forth in section 2735.1 is to “prevent the accidental releases of regulated substances.” The purpose statement in Article 6.5 is intentionally much broader, and is designed to go beyond a list of regulated substances to the goal of protecting public health.

Necessity

This section is necessary to establish the objectives of the regulations. Eliminating or minimizing hazards in order to eliminate or minimize the likelihood of a major incident promotes the protection of employee and public safety and health.

The proposal enhances the existing CalARP Program for petroleum refineries, requiring owners or operators to: (1) improve the mechanical and structural integrity of the state's refineries; (2) reduce the likelihood of a major incident; and (3) protect health and safety of local communities. This approach is consistent with the objectives articulated in the Interagency Working Group Report.

Section 2762.1 Process Safety Information

Specific Purpose

This section requires the owner or operator to develop and maintain comprehensive Process Safety Information (PSI) pertaining to refinery processes. For each process, the owner or operator 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 Damage Mechanism Reviews (DMRs). This information is required in advance of conducting a Process Hazard Analysis (PHA), Hierarchy of Hazard Control Analysis (HCA), Safeguard Protection Analysis (SPA), or DMR for the process.

Article 6, section 2760.1 requires compilation of PSI prior to conduct of a PHA under existing regulations for Program 3 facilities. Therefore, the requirement to collect and document PSI is not new for refineries in California. This section, however, has been updated to be consistent with other aspects of the new requirements in Article 6.5, and it does require collection of slightly more toxicity information on regulated substances than was previously required, and requires that the information be communicated to affected employees, as detailed below.

Necessity

Accurate and comprehensive information about the process and about the hazards posed to the process is foundational to performing an analysis of process safety issues. If the team performing a PHA, HCA, SPA, or DMR, as required in other sections of Article 6.5, has incorrect or incomplete information about the process, that team could generate findings and recommendations that are fundamentally flawed. A flawed PHA could fail to identify important hazards and therefore fail to generate recommendations to correct those hazards. For these reasons, PSI is the first and fundamental step in a strong refinery safety program.

Written compilation of process safety information

Subsection (a) requires the owner or operator to develop and maintain a compilation of written PSI. The general requirements in this subsection are largely the same as existing regulations, with five exceptions: (1) Instead of just requiring that PSI be compiled prior to any PHA, the new provision requires that PSI be compiled prior to any PHA, HCA, SPA or DMR to ensure that all of these analyses (some of which may be done prior to or in parallel with the PHA) are informed by accurate and complete PSI. (2) The written process safety information "shall be *sufficient* to enable the owner or operator and the employees involved in operating or maintaining a process to identify and understand the hazards posed by the process." The word "sufficient" is new in this regulation, and it is intended to clarify that PSI collection is not a 'check the box' exercise; instead, the owner or operator should consider what information the teams conducting the analyses required under this Article will actually need in order to do an informed analysis. Because each process at each refinery is somewhat different, there may be additional information needed to ensure sufficiency. The PSI listed in the regulation, therefore, is intended to serve as a floor, with a mandate on the owner or operator to compile additional information if it is needed for the purpose of identifying and understanding the hazards posed by the process. (3) The term 'regulated substance' is changed to 'highly hazardous material' as defined in this Article, in order to clarify that hazard information must be collected for a wider range of chemicals beyond those on the regulated substances list. (4) Results of previous DMRs must also be compiled in the PSI, in order to ensure that prior DMRs

inform future PHAs, HCAs, SPAs, and DMRs done on that process in the future. (5) Subsection (a) now requires that PSI be made available to all refinery and contractor employees, and that information pertaining to the hazards of the process shall be effectively communicated to all affected employees. This provision ensures that all interested employees will have access to the information, and that the owner or operator will actively communicate hazard-related information to the subset of employees who work on or near the process. This change is necessary in order to ensure that employees are well-informed about process hazards so they can better protect themselves.

Paragraph (a)(1)(C) contains new language that significantly expands the information that must be collected on hazards of substances used in, present in or produced by the process. This paragraph requires that the owner or operator compile not only the California Permissible Exposure Limit (PEL) as under current regulations, but also additional benchmarks relevant to chemical hazards: the American Conference of Governmental Industrial Hygienists (ACGIH) Emergency Response Planning Guideline values, US EPA Acute Exposure Guideline Levels (AEGLs), and the California Office of Environmental Health Hazard Assessment (OEHHA) acute and eight-hour Reference Exposure Levels (RELs). It is important to note that this additional information is not required for all "highly hazardous materials," but instead is limited to the list of "regulated substances." The provision was narrowed to regulated substances in response to pre-regulatory input from stakeholders who raised concerns that collection of this information for all highly hazardous materials would be excessively onerous. The provision is necessary because the intent of this Chapter is not just to protect workers in the workplace, but also to protect nearby communities. Emergency guideline values are necessary because they will be critical benchmarks in the event of a chemical release. California RELs are necessary because they are designed specifically to be health protective for children, the elderly, and those with underlying health conditions who may be exposed in the event of a chemical release into a nearby community. These additional benchmarks are easily obtained on the ACGIH, U.S. EPA, and OEHHA websites, and are available for download, so it will not be onerous to compile this information for all regulated substances.

Subsection (b) is almost identical to existing regulations. (b)(4) is slightly expanded to also require that "levels" be included among the safe upper and lower limits for process variables. This is necessary because incidents have occurred at California refineries due to over-filling of tanks, so an understanding of safe levels within process equipment is necessary in order to address this potential hazard in the PHA and other analyses. (b)(5) is also slightly expanded to specify that the consequences of deviations should include "chemical mixing or reactions that may affect the safety and health of employees or the public." This addition is viewed as a clarifying change because it specifies what must be included in the information on the consequences of deviations. It is likely that refineries are already collecting information on chemical mixing or reactions.

Subsection (c) is almost identical to existing regulations, with only minor clarifying changes. (c)(6) specifies that inclusion of "design conditions and operating limits" in the information on design

codes, which was not explicit in the existing language. (c)(7) adds a conforming provision requiring inclusion of material and energy balances for processes that were not covered under Article 6 as of the effective date of this Article, since it is unnecessary to require refineries to compile this information retroactively to June 21, 1999 for newly-covered processes. (c)(9) requiring information on electrical supply and distribution systems is new in this revision. It is necessary because power failures at refineries have the potential to trigger a process upset that could cause a hazardous condition, so the power supply for each process should be well-understood and considered in the PHA.

Compliance with standards and practices

Subsection (d) substantially expands and clarifies the provision on recognized and generally accepted good engineering practices (RAGAGEP). This provision has been the source of some confusion in existing regulations. RAGAGEP is defined in section 2735.3 (iii) as "engineering, operation, or maintenance activities based on codes, standards, technical reports or recommended practices published by the American National Standards Institute (ANSI), American Petroleum Institute (API), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), American Society of Mechanical Engineers (ASME), American Society of Testing and Materials (ASTM), National Fire Protection Association (NFPA), Instrument Society of America (ISA), or other standard-setting organizations. RAGAGEP does not include standards or guidelines developed for internal use by the owner or operator." The listed organizations in the definition are widely recognized standard-setting bodies whose work is considered to set a standard of practice in their respective industry sector. The definition is intended to make it clear that "recognized and generally accepted" means that it must be based on more than just an individual company, or an individual owner or operator's usual practice. The new language in subsection (d) is designed to clarify that where RAGAGEP exists, then the owner or operator must comply with those standards or requirements. The new language also offers flexibility by allowing the owner or operator to establish and use their own internal standards instead of RAGAGEP, if they can show that those internal standards are "equally or more protective" and that they "ensure safe operation." Subsection (d) also recognizes that, especially in the case of new equipment, there may not yet be any established RAGAGEP. If that is the case, then the owner or operator "must document that the equipment is designed, constructed, installed, maintained, inspected, tested and operated in a safe manner."

Subsection (e) addresses existing process equipment that may have complied with the most current codes, standards, or practices when it was initially installed, but may no longer comply with current RAGAGEP. Rather than requiring that the owner or operator rebuild all such processes, which would likely not be feasible, this subsection would allow the owner or operator to document that the equipment is "designed, installed, maintained, inspected, tested, and operating in a safe manner for its intended purpose." This subsection is very similar to current regulations, with the addition of the word "installed," and the clarification that the owner or operator's determination of safety must be

tailored to the current "intended purpose" of the equipment. This provision is necessary in order to allow continued operation of older process equipment, while ensuring that the equipment is safe to operate.

Section 2762.2 Process Hazard Analysis (PHA)

Specific Purpose

The purpose of the Process Hazard Analysis (PHA) is to ensure that the owner or operator systematically identifies, evaluates, and controls hazards associated with each process. PHA is an analysis to evaluate the different processes, the hazards and risks associated with the processes, the safeguards that are in place to either prevent an incident from occurring or mitigate an incident if it were to occur. The team will then determine if additional safeguards are required to reduce risk. This establishes a consistent performance standard for the industry.

This section is very similar to the existing requirements for stationary sources under Article 6 section 2760.2 (Program 3). Therefore, the requirements for refineries will not change significantly. The minor wording changes throughout this section are mainly intended to clarify the requirements and maintain consistency with the rest of Program 4. The substantive changes include the requirement to ensure that the results of DMRs are available to the PHA team; the requirement to perform a HCA in developing recommendations that the PHA team determine are necessary; and the requirement that a SPA is performed where there is a scenario that has the potential for a major incident, to determine the effectiveness of the safeguards that are in place to prevent a major incident.

Necessity

PHAs have been performed on chemical processes since an incident in 1974 at a chemical facility in Flixborough, UK where 28 people lost their lives. PHAs were designed to give industries a better understanding of the risks in their processes, and what safeguards are needed to prevent or mitigate incidents. The new requirements are to enhance the understanding of the risks, the effectiveness of safeguards, and to promote the highest level of risk reduction. The main changes in this section are conforming changes to incorporate DMR (Section 2762.5(f)) and SPA into PHAs. The changes in this section are largely conforming changes to allow these components to feed into the PHA process.

CSB recommended: "[Damage Mechanism Review] shall be an integral part of the Process Hazard Analysis cycle and shall be conducted on all PSM-covered process piping circuits and process equipment." The board also recommended that the regulations "Require that Process Hazard Analyses . . . include documentation of the recognized methodologies, rationale and conclusions used to claim that safeguards intended to control hazards will be effective. This process shall use established qualitative, quantitative, and/or semi-quantitative methods such as Layers of Protection Analysis (LOPA)." (CSB Interim Investigation Report, Chevron Richmond Refinery Fire, April 2013, recommendation 2012-03-I-CA-R1, p.53)

The Interagency Working Group Report recommended:

> [T]he results of the damage mechanism hazard reviews, as well as other Mechanical Integrity reviews currently required, should be explicitly incorporated in the information provided to process hazard analysis teams at refineries . . . . Process hazard analysis must use and document the use of layer of protection analysis or a professionally recognized and approved quantitative, qualitative or semi-quantitative method to determine the effectiveness of any existing safeguards and proposed safeguards recommended in the process hazard analysis to reduce the probability and/or severity of a catastrophic release.

(Interagency Working Group Report, pp. 29-30.)

Updated Existing Requirements

Subsection (a)

As required under existing regulations, the owner or operator is required to perform PHAs. These PHAs are no longer restricted to "covered" processes as under Program 3, because all processes at refineries will be covered. The owner or operator is required to complete PHAs for the processes that were not covered in Program 3 within three years of the effective date of this Article. The owner or operator will prioritize the new PHAs based on the process hazards, the number of potentially affected people, the age of the process and the process operating history. The proposed regulations also include a definition of "Process Safety Hazard": "a characteristic of a process that, if unmitigated, has the potential to cause a fire, explosion, or release of a highly hazardous material which could result in death or serious physical harm or a major incident." (Section 2735.3(zz).)

Subsection (b) lists the types of PHA methods that are acceptable and has not changed from Program 3 requirements except that this subsection allows other PHA methods recognized by engineering organizations or governmental agencies to be used, thereby giving refineries additional flexibility to use other methods.

Subsection (d) requires that the PHA be performed by a team, which is also required under Program 3. This subsection states the team, when necessary, must consult with individuals with expertise in damage mechanisms, process chemistry, and control systems. This will provide the necessary expertise and knowledge to appropriately determine the risks that may exist and determine the safeguards to prevent or mitigate incidents. The owner or operator is also required to provide for employee participation pursuant to section 2762.10. This will ensure that employees concerns are heard.

Subsection (j) requires that the PHAs for each of the processes are to be updated and revalidated, as in Program 3.

Subsection (k)

PHAs and PHA updates and revalidations are required to be retained for the life of the process. This is an existing requirement under Program 3. The requirement to include the resolution of recommendations

as an appendix to the PHA report is new; this is necessary to close-out the documentation, showing the findings, recommendations, and resolutions of the PHA.

New requirements

Subsection (c)

The owner or operator is required to address a number of items in the PHA, of which some are existing requirements under Program 3 (subsections (c)) (1) and (c)(11)) and some are new.

Existing requirements that have been slightly changed in Subsection (c) include:

(c)(2) Previous major incidents in the petroleum refinery and petrochemical industry sectors that are relevant to the PHA. This requirement now is more specific in that the PHA shall address where previous major incidents have occurred in petroleum refineries and petrochemical facilities only where those incidents are relevant to the PHA that is being performed.

(c)(7) Facility siting is already required under Program 3. This requirement is more specific in specifying placement of processes, equipment, buildings, employee occupancies and work stations. The 15 worker deaths in the BP Texas City refinery explosion (2005) were largely attributed to facility siting. Most of those people were located in construction trailers. If those trailers have been sited safely, most, if not all, of the people would have survived. The amended language here is necessary to prevent similar fatalities or injuries in the future.

(c)(8) Addressing human factors in the PHA exists in Program 3. This subsection, however, requires that the PHA team address human factors under section 2762.15. This section gives more specifics on how human factors are to be addressed.

(c)(9) The existing regulations in Program 3 require the PHA to address a qualitative evaluation of a range of the possible safety and health effects of failure of controls. The change in this subsection is to require the owner or operator to perform a qualitative evaluation of the types, severity, and likelihood of possible incidents that could result from a failure of a process or process equipment. This change broadens the analysis by including the types and the likelihood of possible incidents.

(c)(10) The potential effects of external events, including seismic events, if applicable. External events also include floods, extreme weather, tsunami, landslides, etc.

Entirely new requirements in subsection (c) include:

(c)(3) DMR reports that have been performed pursuant to subsection 2762.5(e) that are applicable to the process unit where the PHA is being performed is to be provided to the PHA team. This information is necessary so that the PHA team will understand what conditions may exist from the different damage mechanisms.

(c)(4) HCA reports that have been performed pursuant to section 2762.13 for the process where the PHA is being performed shall be available to the PHA team. This information is necessary to the PHA

team so they are aware of any inherently safer measures that have been reviewed and the different safeguards that have been assessed. This will give the team a better understanding of the safeguards that are important to the process.

(c)(5) Reviewing any Management of Change (MOC) documentation completed since the last PHA that applies to the process unit. This gives the PHA team a clear understanding of what has changed since the last PHA. In practice, this is being done now as part of the revalidation process. This change will make it clear that this must be done.

(c)(6) Potential consequences of failures of process equipment, where the existing Program 3 only requires the consequences of failure of engineering and administrative controls. The PHA team needs to know what could occur if a failure does happen so the safeguards are appropriate to address the process risks. This ensures the accuracy and integrity of the information that feeds into the PHA. Access to this salient information is necessary to address the hazards and potential consequences using the best information available to promote safe operation and minimize or eliminate process safety hazards.

Subsection (e)

The owner or operator is required to perform a comprehensive SPA for each scenario in a PHA that identifies the potential for a major incident pursuant to section 2762.2.1. This requirement is discussed below under section 2762.2.1.

Subsection (f)

For all recommendations made by a PHA team, the owner or operator is required to conduct an HCA pursuant to section 2762.13 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 owner or operator implements protections prioritized by the highest order of inherent safety or risk reduction.

Subsections (g) and (h)

The PHA team is required to prepare a PHA report containing the method, analyses, and factors considered, as well as the findings and recommendations by the PHA team. The report is required to be available for review by any person working in the area of the PHA team.

This is necessary to document the lessons learned from the PHA, including the findings and recommendations. This will provide a record of what was learned.

Subsection (i)

The owner or operator is required to implement all PHA recommendations in accordance with subsections 2762.16 (d) and (e), except for the recommendations that require an HCA to be performed under subsection (f). This is necessary to ensure that the owner or operator takes corrective action to implement PHA recommendations in a timely manner.

Section 2762.2.1 Safeguard Protection Analysis (SPA)

Specific Purpose

The purpose of the SPA is to determine the overall effectiveness of the safeguards for each of the failure scenarios that have the potential for a major incident and determine the combined effectiveness of the safeguards for each scenario for the portion of the process that the PHA is performed. The SPA will determine if there are any additional safeguards that may be needed to prevent a major incident, the effectiveness of each individual safeguard, and the combined effectiveness of all safeguards for the portion of the process that the PHA is being performed (subsection (a)).

Necessity

Subsection (b) requires that all protection layers in an SPA be independent of one another and of initiating causes. (See Section 2735.3(cc) [definition of initiating cause].) This is necessary to isolate safeguards and prevent sequential failure. (See Section 2735.3(ff) [definition of isolate].) 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. Subsection (c) requires the owner or operator to use a quantitative or semi-quantitative SPA method to identify the most protective safeguards. Layer of Protection Analysis (LOPA) is the most frequently used method for performing a SPA. LOPA incorporates established frequencies of when a safeguard may fail. Using this frequency rate will assist in determining if the risk of a major incident has been reduced to an acceptable level. Many refineries have already incorporated the LOPA process into the PHA in determining the appropriate number of independent protection layers that it will take to lower the risk of a major incident to an acceptable level. (See section 2735.3(aa) [definition of independent protection layers].)

Subsection (c), (d), (e) and (g) require the owner or operator 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. A number of sources of failure rate data are available for assigning consistent values to the initiating event frequency. These include industry data, company experience, and vendor data. The process for identifying failure rate is described in the Center for Chemical Process Safety, Layer of Protection Analysis Simplified Process Risk Assessment, American Institute of Chemical Engineers, New York, New York, 2001. The SPA may be conducted as part of the PHA or as a stand-alone analysis. If it conducted as a separate analysis, it must be completed within six months of the PHA and the SPA report must be appended to the PHA report. The owner or operator is required to ensure the SPA is conducted by a team of individuals with adequate expertise in the specific SPA method used and allow employee participation. This is necessary to ensure transparency and accountability and that SPAs are conducted by individuals with the requisite expertise. The stand-alone analysis option allows the owner or operator flexibility in scheduling and analyzing the effectiveness of safeguards. Subsections (f), (h) and (i) require the owner or operator to document the likelihood and severity of all potential initiating events as well as the risk reduction achieved by each safeguard in the SPA, retain this documentation for the life of the process, and follow the corrective action work process in subsections

2762.16 (d) and (e). This is necessary to ensure accountability and transparency of the analysis and selection of effective safeguards.

Section 2762.3 Operating Procedures

Specific Purpose

This section requires the owner or operator to develop written procedures for the purpose of ensuring that managers and employees know what to do and thereby to improve safety during all operating phases and modes of operation for each process; for managing deviations in process operating limits; for protecting employees from process safety hazards; for ensuring the proper function of safety systems; and for safely responding to upset or emergency conditions in a process.

This section is very similar to the existing requirements for stationary sources under Article 6 section 2760.3. The changes throughout this section are mainly intended to clarify the requirements and maintain consistency with the rest of Program 4. The most significant change is in the requirements regarding emergency operations, where Subsection (b) includes additional specificity as described below.

Necessity

Comprehensive operating procedures have long been recognized as necessary to ensure the safe operation of processes and equipment at stationary sources. For this reason, written operating procedures are required at refineries under existing regulations. Additional requirements for emergency operations are necessary because investigation of recent incidents at refineries, including the 2012 Chevron Richmond Refinery fire, revealed deficiencies in emergency operations and specifically identified failure to shut down a process in a timely manner during an emergency.

<u>Conforming Changes to Existing Requirements</u>

Subsection (a)

As required under existing regulations, the owner or operator is required to develop written operating procedures. These operating procedures are no longer restricted to “covered” processes as under Program 3, because all processes at refineries will be covered. Operating procedures are required for each operating phase or mode of operation: Startup; normal operations; temporary operations; emergency shutdown; normal shutdown; and startup following turnarounds, planned or unplanned shutdowns, and emergency shutdowns. Emergency operations have been removed from this list because these are addressed separately in more detail in the new subsection (b). The only other change is this subsection is the addition of language requiring that operating procedures include: “provisions granting the authority of the qualified operator to shut down the operation or process.” This language mirrors the requirement in section 2762.16 (f)(1)(C) on Stop Work Authority and requires that the

procedures developed under that section be documented in the operating procedures. Additionally, a new definition of "turnaround" has been added to apply only to refineries:

> "Turnaround' for purposes of Article 6.5 means planned total or partial shutdown of a petroleum refinery process unit or plant to perform maintenance, overhaul or repair of a process and process equipment, and to inspect, test and replace process 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, where routine maintenance consists of regular, periodic maintenance on one or more pieces of equipment at a refinery process unit or plant that may require shutdown of such equipment.

(Section 2735.3(vvv).) This definition mirrors the definition in the proposed Cal/OSHA PSM regulation for refineries (GISO § 5189.1) and will ensure that the compliance obligations for refineries under the new PSM requirements and the new CalARP regulations are consistent.

As in current regulations, operating procedures must include information on operating limits for each process, as well as information on safety and health considerations. These requirements are identical to existing regulations, with the exception of wording changes to replace "engineering controls, administrative controls, and personal protective equipment" with language that is used elsewhere in Program 4 and is consistent with the Hierarchy of Hazard Control (Section 2762.13): "passive, active and procedural safeguards; and personal protective equipment". An additional minor change in (a)(3)(E) changes the words "Quality control for raw materials" to: "Verification of the composition and properties of raw materials." This is not intended to represent a change in the requirements, but rather a clarification of the intent of the existing requirements.

Subsection (c) slightly expands the existing requirement to make operating procedures accessible to employees by also making them accessible to "any other person who works in or near the process area or who maintains a process." This expansion is intended to give contractors access to operating procedures if those contractors meet the criteria in this subsection.

Subsections (d) and (e) are the same as existing requirements except that (d) now requires that changes to operating procedures shall be managed in accordance with the MOC requirements in section 2762.6. This creates a formal process for changing operating procedures and creates consistency throughout the new regulations.

<u>New requirements</u>

Subsection (b) significantly expands the existing requirement to include emergency operations in operating procedures. This subsection now requires substantial additional detail in the operating procedures for different types of emergencies, including "any response to the over-pressurizing or overheating of equipment or piping, and the handling of leaks, spills, releases and discharges." The operating procedures will now also be required to specify that only qualified operators may initiate these operations and that prior to allowing employees in the vicinity of a leak, release or discharge, the

owner or operator shall take one of three actions: "(1) Shutdown and depressurize all process operations where a leak, release or discharge is occurring; or (2) Isolate any vessel, piping, and equipment where a leak, spill or discharge is occurring; or (3) Follow established criteria for handling leaks, spills, or discharges that are designed to provide a level of protection that is functionally equivalent to, or safer than, shutting down or isolating the process." To clarify these requirements, a definition of "Qualified Operator" is added in section 2735.3(fff): "'Qualified Operator' means a person designated by the owner or operator, who by fulfilling the requirements of the training program defined in section 2762.4, has demonstrated the ability to safely perform all assigned duties."

The intent of this subsection is to create a clear default to protect workers and the community in an emergency situation by either shutting down the process or isolating the section of the process. In pre-regulatory discussions, refinery managers pointed out, and workers agreed, that there are also risks associated with shutting down a process and that in some cases the safest action is to keep a process running while addressing a leak, spill or discharge. In recognition of that fact, this subsection allows the refinery to establish other criteria in their operating procedures for addressing leaks, spills, or discharges provided that those other criteria are functionally equivalent to, or safer than, shutting down or isolating the process. This provision is designed to give some flexibility to the owner or operator while also requiring them to identify scenarios for which alternative procedures are warranted, and specify what those alternative procedures should be.

Section 2762.4 Training

Specific Purpose

This section requires that operators and maintenance employees prior to working in a newly assigned process are trained on an overview of the process, and that operators must also be trained on the relevant operating procedures and maintenance employees on the relevant maintenance procedures. Refresher and supplemental training is required at least every three years for operating and maintenance employees. The owner or operator is required to document the training with specified information. These requirements already exist for operators in Program 3. Maintenance employees are required to be trained as part of the Mechanical Integrity Program 3 prevention element. The requirement for the maintenance employees to be trained to this level is new for Program 4, and the requirement has been moved into this section from the Mechanical Integrity section.

The new requirements under this section provide that the owner or operator must have an effective written program on what is required for an employee to be designated as qualified, and testing requirements to ensure competency in job skill levels and work practices. The owner or operator is also required to develop and implement a broad training program for all affected employees so they are aware and understand all Program 4 prevention elements described in this Article. All affected employees are to be trained on the requirements of this Article within 24 months following the effective date of this section.

Necessity

Effective training is essential to ensure that operators understand the hazards of the processes that they are operating, the operating procedures, the safe operating limits of the processes, and the consequence of deviating from the operating procedures. This is an existing requirement under Program 3. The training requirement for maintenance employees in this section is new and more specific. This is necessary to ensure that maintenance personnel are trained appropriately in their job skills and the hazards of the process units in order to reduce the risk that an insufficiently trained worker could cause or contribute to an incident.

Updated Existing Requirements

Subsections (a)(1) and (2) and (b)(1)

As required under existing regulations, the owner or operator is required to provide initial, refresher, and supplemental training to operators. Operators are required to be trained prior to working in a newly assigned process and are to be trained in an overview of the process and on the operating procedures. The training is to include information on the safety and health hazards applicable to the operator's job tasks, and procedures applicable to the operator's job tasks, including emergency operations, shutdown, and safe work practices.

The frequency of refresher and supplemental training may be determined by the owner or operator in consultation with the employees operating the process, but must be provided at least once every three years for each employee.

Subsection (c)

As required under existing regulations, the owner or operator is required to assure that each employee involved in operating a process has received, understood, and successfully completed training as specified by this section. The owner or operator must document the training taken by the employees, the date(s) of training, the means to verify that the employee understood the training, and the person(s) administering the training.

New requirements

Subsections (a) and (b)(2)

Existing Program 3 regulations (Section 2760.5, Mechanical Integrity) require that the owner or operator train each employee involved in maintaining the on-going integrity of process equipment in an overview of that process and its hazards and in the procedures applicable to the employee's job tasks to assure that the employee can perform the job tasks in a safe manner. That requirement has been moved to this section in Program 4. New requirements provide that maintenance employees be trained on an overview of the processes they may work on and the relevant maintenance procedures, and that they receive refresher and supplemental training at least every three years to ensure that they understand and adhere to current maintenance procedures. This is necessary to ensure the maintenance employees

understand any changes to procedures, changes on how to perform a job, or new safety concerns in order to perform their jobs safely and prevent incidents.

Subsection (d) requires that the owner or operator develop and implement a written program that identifies the requirements that an employee must meet in order to be designated as qualified. This is needed because other portions of this Article require that tasks be performed by a qualified operator, and this allows refineries, in consultation with their employees, to determine what it means to be qualified.

This subsection also requires that the owner or operator develop testing procedures to verify understanding and to ensure competency in job skill levels and work practices that will protect employees and public safety and health. This requirement is needed to ensure that the employees are competent in their job skills and work practices. This competency will help prevent incidents from occurring.

Subsection (e)

The owner or operator is required to develop and implement a training program for all affected employees to ensure that they are aware of and understand all Program 4 prevention elements. Affected employees include maintenance, operating, and engineering employees and supervisors and managers that are involved with operating and maintaining the refinery. This training is to be completed within twenty-four months of the effective date of this Article. This training is necessary for understanding the different ways to prevent incidents from occurring at a refinery. Employees need to be aware of what is required and how these requirements will assist in preventing incidents.

This subsection also requires that employees and employee representatives that participate in specialized teams pursuant to this Article receive training in the Program elements relevant to that team. This means that employee representatives participating in any of the reviews or analyses described in other sections of Article 6.5, such as DMRs (Section 2762.5(e)) or HCAs (Section 2762.13), must be trained in the requirements of the relevant sections and in the refineries procedures for conducting those reviews or analyses.

Subsection (f) requires the owner or operator to provide for employee participation in developing and implementing the training program, pursuant to section 2762.10. This is necessary to provide for the most effective and complete training program, and an appropriate frequency of refresher training for employees.

Section 2762.5 Mechanical Integrity

Specific Purpose

Section 2762.5 expands and clarifies existing Program 3 requirements to ensure the mechanical integrity of process equipment. Under Program 3, mechanical integrity requirements cover the following categories of process equipment: pressure vessels and storage tanks; piping systems; relief and vent systems and devices; emergency shutdown systems; controls; and pumps, compressors and their drivers. This section expands the mechanical integrity requirements to all process equipment.

This section also expands and strengthens the current mechanical integrity requirements, which are intended to ensure the safe operation of all processes, prevent process incidents, and ensure the reliability of safety and utility systems that prevent process incidents. One particularly significant expansion of requirements is the addition of a requirement to conduct DMRs as a part of the process of ensuring mechanical integrity of process equipment. *The specific purpose and necessity of DMRs are discussed in detail in subsection (f) below.*

Necessity

The proposed requirements are necessary to expand mechanical integrity requirements. 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 over-pressurization of equipment or piping in a process; a defect in the mechanical integrity of a single pipe caused the 2012 Chevron Richmond Refinery fire.

CSB's Interim Investigation Report on the 2012 Chevron Richmond Refinery fire identified a critical need to improve mechanical integrity programs at refineries and discussed the process for a 100-percent component inspection of carbon steel piping, which might have identified the extent of the high-temperature sulfidation corrosion in the pipe that failed. CSB recommended that California adopt regulations to improve mechanical integrity programs. (U.S. Chemical Safety and Hazard Investigation Board, Interim Investigation Report, Chevron Richmond Refinery Fire, April 2013, p. 55 & 57 (CSB Interim Chevron Report).) This section addresses CSB's recommendation.

<u>Develop written procedures</u>

Subsection (a)(1)

Under Program 3, the owner or operator is required to establish and implement written procedures to ensure the ongoing integrity of process equipment. The current Program 3 definition of "mechanical integrity" in section 2735.3 (iii) also is not changed in the proposed regulations. It means "the process of ensuring that process equipment is fabricated from the proper materials of construction and is properly installed, maintained, and replaced to prevent failures and accidental releases." In the proposed regulations, however, a new definition of "process equipment" has been added in section 2735.3(yy) for Program 4: "'Process Equipment' for purposes of Article 6.5, means any equipment, instrumentation, control, safeguard, except procedural safeguards, or appurtenance related to a process."

The proposal clarifies that the written procedures must be effective to maintain process equipment integrity and must include instructions that are consistent with the refinery's PSI. This requirement is necessary to provide additional specificity, which will facilitate compliance and enforcement.

Ensure employee access

Subsection (a)(2)

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

Inspections and testing

In **Subsection (b)**, existing inspection and testing requirements are modified to incorporate the concept of RAGAGEP as newly defined.

Existing Program 3 regulations require refineries to perform inspections and tests on process equipment according to RAGAGEP. The proposed regulations include a new definition of RAGAGEP in section 2735.3(iii) as "engineering, operation, or maintenance activities based on codes, standards, technical reports or recommended practices published by the American National Standards Institute (ANSI), American Petroleum Institute (API), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), American Society of Mechanical Engineers (ASME), American Society of Testing and Materials (ASTM), National Fire Protection Association (NFPA), Instrument Society of America (ISA), or other standard-setting organizations. RAGAGEP does not include standards or guidelines developed for internal use by the owner or operator."

The new proposal thus limits RAGAGEP to standards established by standard-setting organizations rather than by individual refineries. It also, however, allows refineries to develop their own internal standards that are as stringent or more stringent as RAGAGEP in order to provide for flexibility when alternative internal standards are better suited to the unique needs of an individual refinery. The new provisions are necessary to achieve this balance, allowing refiners some flexibility in inspections and tests to follow either RAGAGEP or their own standards, provided they can demonstrate that the latter are equally or more protective.

Likewise, the frequency of testing must be completed according to manufacturer's recommendations (the current requirement), RAGAGEP, or equally or more protective internal standards. Finally, a reference to a "certification record" is added to existing provisions regarding documentation of inspections and testing to clarify that a record needs to be maintained.

Correct deficiencies

Subsection (c)

The owner or operator 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.

In contrast, existing requirements refer to correction of deficiencies in equipment that are outside of acceptable limits, which allows acceptable limits to be exceeded prior to correction. The new requirement is intended to ensure, insofar as possible, that acceptable limits are not exceeded. The proposed requirement, by referring to RAGAGEP or other standards, creates clearer objective benchmarks for performance in comparison to the "safe and timely manner" language in existing regulation. The requirement to comply with RAGAGEP or other equally or more protective internal standards would also encourage continuous improvement according to advancements in codes and standards. This subsection is necessary to ensure that equipment deficiencies are corrected properly and quickly.

Quality assurance

Subsection (d)

Existing requirements ensure that a standard of quality assurance is met for process equipment. Similar to subsections (b) and (c), subsection (d) enhances and clarifies existing requirements by incorporating the concept of codes and standards. While existing requirements ensure that process equipment is suitable for its intended use, fabricated from the proper materials of construction, and in compliance with design specifications and all applicable codes and standards, subsection (d)(1) cross-references new language in subsection 2762.1(d) (Process Safety Information), which requires consistency with RAGAGEP. This provision ensures internal consistency in the new requirements. It also changes the standard for process equipment from one that relies on suitability for use to one that ensures consistency with established codes and standards. This change strengthens the safety standard because it is more stringent and precise and easier to measure and enforce.

The new provisions also address circumstances where no RAGAGEP exists for a particular type of equipment. For this equipment, the proposal holds refineries to a standard of safe operation. For maintenance materials, spare parts, and equipment the proposal changes the standard from one that requires suitability for the process application to a standard based on design specifications and applicable codes, which also encourages continuous improvement in all aspects of process equipment.

Subsection 2762.5(e) Damage Mechanism Reviews (DMRs)

Specific Purpose

This subsection requires the owner or operator to conduct structured DMRs to identify mechanisms that may weaken or damage the mechanical integrity of process equipment and thereby lead to a major incident. "Damage mechanism" is defined by section 2735.3(r) as "the mechanical, chemical, physical, or other process that results in equipment or material degradation." Examples of damage mechanisms include corrosion by acidic fluids, cracking due to excessive stress, erosion by continued wear in the same location, metal fatigue due to high temperature cycling, 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 numerous serious process failures in refineries, 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). CSB specifically pointed to the need for DMRs in its Interim Investigation Report on the Chevron Richmond Refinery fire (Recommendation 2012-03-I-CA-R1, p. 53; see also U.S. Chemical Safety and Hazard Investigation Board, Final Investigation Report, Chevron Richmond Refinery Pipe Rupture and Fire, Report No. 2012-03-I-CA, January 2015, (CSB Final Chevron Report), p. 2.)

This subsection will require refineries to have a procedure to conduct structured DMRs. The owner or operator 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 are to be documented in a written report, revalidated every five years, and communicated to the PHA team, which incorporates the findings 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

DMRs are necessary to determine the right materials of construction, appropriate inspection frequency, and potential deficiencies in and degradation of the mechanical and structural integrity of equipment and piping. This review is necessary to help prevent process failures that could cause employee injuries or process incidents. The Interagency Working Group Report includes the following recommendation:

> c. Require Refineries to Conduct Damage Mechanism Hazard Reviews
>
> Current PSM and CalARP programs require facilities to include a Mechanical Integrity Process Safety element. The Mechanical Integrity element requires facilities to ensure the mechanical integrity of processes through purchasing of new or replacement equipment, performing inspections, and other actions. But current regulation does not require that an important type of analysis, known as damage mechanism hazard review, be conducted at refineries. This review analyzes risks presented by all known process failure mechanisms at refineries, including corrosion, stress cracking, damage from high temperatures, and mechanical or metallurgical assisted degradation, and should be included as part of the Mechanical Integrity element.

(Interagency Working Group Report, p.28.)

Currently, there is no statewide requirement for DMRs at refineries. Some California refineries are conducting DMRs voluntarily. It is not clear, however, that all refineries have embraced this practice, or that they are all conducting DMRs in a thorough and appropriate manner.

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

<u>Conduct DMRs for all processes</u>

Paragraphs (e)(1) – (4)

Within five years, the owner or operator must conduct a DMR for each process for which a damage mechanism exists. Half these DMRs must be conducted within three years, and 100 percent must be conducted within five years. The owner or operator 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 in a timely manner, but there is flexibility to allow the owner or operator to prioritize their own work process within the three criteria listed above. 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 known damage mechanism, a DMR is not required but the owner or operator must document the rationale for concluding that no damage mechanism exists. This is necessary to ensure accountability and transparency.

In an incident investigation, the most recent DMR that is relevant to the investigation must be reviewed. If a DMR has not been performed for the relevant processes, a new DMR must be conducted. This is necessary to fully understand the causes of any individual incident and to inform recommendations to prevent future incidents. For example, in the investigation of an incident involving ruptured carbon steel pipe caused by high-temperature sulfidation corrosion, the incident investigation team must review any relevant existing DMR that evaluates high-temperature sulfidation corrosion in carbon steel piping, even if that DMR was done in a different process unit. If a DMR has not been performed on piping in all relevant processes, then one or more new DMRs must be conducted, to ensure that this damage mechanism has been evaluated in all relevant processes within the refinery. This is necessary to ensure that all related process equipment that may be affected by the same damage mechanism is identified and addressed.

The proposal integrates the DMR schedule with the PHA schedule, and requires that the DMR for a process unit be made available to the team performing a PHA for that process unit. This implements recommendations from CSB and the Interagency Working Group that underscored the importance of making damage mechanism information available during the PHA process.

<u>DMRs require expert input</u>

Paragraph (e)(5)

DMRs must be performed by a team with specific types of expertise. This is necessary because damage mechanisms are complex and require specialized knowledge. The owner or operator is required to establish DMR teams with relevant expertise and 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.

<u>Perform specific analyses</u>

Paragraph (e)(6)

The owner or operator must include six types of information in a DMR: Assessment of process flow diagrams; identification of potential damage mechanisms; appropriateness of materials of construction; conditions that cause the damage and how fast the damage may progress; methods of prevention; and operating parameters that could either accelerate or minimize/eliminate the damage. This is necessary to ensure the comprehensiveness of the DMRs performed and establish a consistent performance standard. Information on the speed of progression is not intended to require quantitative analysis or detailed temporal predictions; instead, the intent is to require a qualitative discussion of how rapidly the particular mechanism tends to develop in the conditions present in the process under review.

Examples

Paragraph (e)(7)

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 temperature cycling, 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 paragraph is intended to assure that refineries will examine, at a minimum, the important damage mechanisms identified here.

Evaluate specific damage mechanisms

Paragraph (e)(8)

The owner or operator is required to assess the inspection history and previous damage mechanism data for the process, as well as industry-wide experience with the process and all applicable standards, codes, and practices. This is necessary to ensure the completeness of the DMRs performed by the owner or operator 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. It is obviously not possible for refineries to know about all possible issues with the process at all refineries globally, but refineries are expected to be aware of high-profile issues, such as those that have been presented at major industry conferences; written in relevant publications; received significant media or regulatory attention by entities such as Cal/OSHA, Federal OSHA or CSB; or occurred at other facilities within their own company. Applicable standards, codes, and practices would include not just California regulatory standards, but also entities recognized as authoritative for industry practices, such as those listed in section 2735.3 (iii): American National Standards Institute (ANSI), American Petroleum Institute (API), National Association of Corrosion Engineers (NACE), American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), American Society of Mechanical Engineers (ASME), American Society of Testing and Materials (ASTM), National Fire Protection Association (NFPA), and Instrument Society of America (ISA), and other standard-setting organizations.

Documentation

Paragraphs (e)(9), (e)(10), and (e)(12)

The owner or operator must prepare a DMR report that includes a description of all damage mechanisms analyzed for a process, as well as the methods the refinery used in conducting the analyses. The report must include recommendations, including temporary mitigation of the potential for damage, and prevention, such as the correct material of construction for the conditions under which the process is being operated.

Paragraph (10) requires that the reports generated under this section be actively provided to all operating, maintenance, and other personnel whose work assignments are within the process unit covered in the DMR. The paragraph further requires that these reports be reviewed with these groups of people if they request it, rather than simply being posted or requiring employees to seek out the reports. The owner or operator 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 assessment enables the owner or operator 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.

Implementation

Paragraph (e)(11) is identical to those in other sections of the regulation. It ensures that there is a clear and consistent process for taking recommendations from the DMR and from other reports generated under this Article and moving the recommendations forward into corrective actions that are addressed according to specified timelines. This provision also ensures that there is a process for tracking all recommendations, criteria for rejecting recommendations, and requirements to document closeout of corrective actions. These provisions are discussed in more detail in the section of the ISOR describing subsections 2762.16 (d) and (e). This provision is included because the investigation into the 2012 Chevron Richmond Refinery fire revealed that critically important recommendations relevant to process safety had never been acted upon or tracked to completion.

Section 2762.6 Management of Change (MOC)

Specific Purpose

The purpose of this section is to ensure that petroleum refineries adequately analyze and manage changes in refinery processes in order to anticipate and account for any impact on safety resulting from the change. The requirement to perform MOC analyses is not new. Stationary sources subject to Program 3 requirements are required to perform MOC analyses under section 2760.6. Therefore, all stationary sources that will be subject to Program 4 have already been subject to many of the requirements of this section. The main added elements in this section are the requirements: (1) to

perform a HCA prior to implementing a major change, (2) to follow the employee participation requirements in subsection 2762.10, and (3) to conduct Management of Organizational Change (MOOC) analyses to manage changes in personnel or organizational issues.

The purpose of subsections (b)-(i) is to specify procedures that are needed so that the Unified Program Agency (UPA) can effectively enforce and administer requirements related to any change in process chemicals, technology, procedures, process equipment, or facilities. The purpose of subsection (j) is to specify procedures that are needed so that the UPA can enforce and administer requirements related to any organizational change.

The requirements in this section apply to any "change," which is defined in section 2735.3, subsection (m): "any alteration in process chemicals, technology, procedures, equipment, facilities or organization that could affect a process. A change does not include replacement-in-kind."

Necessity

Although MOC requirements exist in the current CalARP 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 Program 3 MOC requirements will be enhanced by provisions requiring the use of qualified personnel and appropriate methods (subsection 2762.6(d)), employee participation (subsection 2762.6(e)), and, for major changes, a HCA (subsection 2762.6(c)). 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 MOC analysis must be done when something changes at the refinery; replacement-in-kind, which is a replacement of a part without a change, does not need to be covered because it is not considered to present the same risks.

MOC is a process for "evaluating and controlling modifications to facility design, operation, organization, or activities – prior to implementation – to make certain that no new hazards are introduced and that the risk of existing hazards to employees, the public, or the environment is not unknowingly increased." (Center for Chemical Process Safety, Guidelines for Management of Change for Process Safety, American Institute of Chemical Engineers, New York, New York, 2007, page 1).

In API Rule 570 "Piping Inspection Code: In-service Inspection, Rating, Repair, and Alteration of Piping Systems," the API emphasizes the importance of MOC analyses for piping:

> The owner/user is . . . responsible for implementing an effective MOC process that will review and control changes to the process and to the hardware. An effective MOC process is vital to the success of any piping integrity management program in order that the inspection group will be able to anticipate changes in corrosion or other deterioration variables and alter the inspection plan to account for those changes.

(API Rule 570. Piping Inspection Code: In-service Inspection, Rating, Repair, and Alteration of Piping Systems. 3rd ed., Section 4.3.1.2, November 2009.)

CSB's Final Chevron Report identified failures in MOC procedures as contributing to the 2012 Chevron Richmond Refinery fire and recommended enhancements of regulatory requirements to improve the usefulness of MOC information. The CSB report recommended a requirement for "inherently safer systems analysis to be automatically triggered for all management of change (MOC) . . . reviews." (CSB Final Chevron Report, October 2014, recommendation 2012-03-I-CA-R21, p. 96.) CSB also identified deficiencies in MOC analysis as contributing to the explosion and fire at the BP Texas City refinery on March 23, 2005. (CSB Final Report, p. 32.)

MOC requirements ensure that refineries have procedures to manage changes to process chemicals, technology, equipment and procedures. Through more effective implementation of the MOC procedures, refineries will evaluate the technical basis for the change, the impact on safety, and any required training for employees.

In addition to the enhanced MOC requirements, the proposed amendments add new provisions requiring refineries to conduct assessments of organizational changes.

MOOC measures the impact on safety due to changes in level of staffing or reorganization. Some changes in job responsibilities, the loss of experienced personnel, or even changes in shift hours have the potential to lead to major incidents. MOOC assessments ensure that changes to organization or responsibilities do not introduce new unforeseen hazards or increase risk of existing hazards. Subsection (j) is necessary to ensure that refineries evaluate and manage organizational changes, such as staffing levels, changing experience levels of employees, changing shift duration, or changing employee responsibilities, which could adversely affect process safety.

The Contra Costa County ISO and the City of Richmond ISO currently require refineries to conduct a MOOC prior to changes in permanent staffing levels or reorganization in operations, maintenance, health and safety, or emergency response. (Contra Costa County ISO, Chapter 450-8 as amended by Ordinance 2006-22 and 2014-7, § 450-8.016(b)(1)(F); Richmond Ordinance, Ordinance 13-14, Chapter 6.43, § 6.43.090(b)(1)(F) (2013).) Pursuant to these requirements, management of organizational change programs exist in at least four California refineries.

The CSB has recommended that federal OSHA include a MOOC requirement in its PSM standard to address risks associated with organizational changes such as mergers and acquisitions that may impact process safety. (CSB Final Chevron Report, p. 93, fn. 446.) For these reasons, the MOOC process in subsection (j), will be required for all Program 4 stationary sources in California in order to prevent accidental releases.

Paragraphs (j)(1)-(5), are necessary to specify procedures that are needed so that the UPA can efficiently and effectively enforce and administer requirements related to the MOOC assessments required under subsections (i) and (j).

Subsection (a) states what changes require an MOC and that the refinery must develop and maintain effective written MOC procedures to address these changes. The MOC is to manage changes to process chemistry, technology, procedures, process equipment, facilities, organizational changes and temporary

piping or equipment repairs. A new definition of "temporary piping or equipment repair" is added in section 2735.3(rrr): "a repair of an active or potential leak to hydrocarbon, chemical, or high energy utility pipe or equipment due to a damage mechanism or manufacturing flaw of the pressure boundary. This includes flange or valve packing leaks that could result in a major incident." An MOC is not required for replacement in kind.

Subsection (b) lists the elements of the MOC report required under this section. This report is the main product of an MOC process and must identify the change and its risks to ensure that risk controls appropriate to the proposed change are implemented. This requirement reflects the existing provisions applicable to Program 3 facilities with minor language changes to clarify the requirements.

Hierarchy of Hazard Control Analysis (HCA) for Major Changes

Subsection (c) requires preparation of a DMR and an HCA as part of the MOC process for a major change. It ensures that refineries evaluate safer alternatives and select the safest feasible alternatives. This requirement is necessary to ensure that changes do not result in less safe conditions and to use the MOC process to require risk reduction. This subsection only applies to major changes, which are defined in section 2735.3, subsection (gg), as any of the following: "(1) introduction of a new process, or (2) new process equipment, or new regulated substance that results in a change in safe operating limits; or (3) any alteration in a process, process equipment, or process chemistry that introduces a new hazard or increases an existing hazard."

The City of Richmond ISO and the Contra Costa County ISO currently require consideration of inherently safer systems as part of an MOC analysis. (City of Richmond, Ordinance section (6)(B) ["The [MOC] procedures shall also require identification and analysis of inherently safer systems as required by subsection (i) of this section."]; Contra Costa County ISO, § 450-8.016 (6)(B).) A HCA is very similar to an analysis of inherently safer systems.

The Center for Chemical Process Safety (CCPS) explains "by including inherent safety guidewords in a management of change program, the MOC protocol recognizes inherent safety as both a driving force for – and an opportunity during – implementation." (CCPS, Inherently Safer Chemical Processes – A Life Cycle Approach. 2nd ed., American Institute of Chemical Engineers, New York, New York, 2009, page 21.) For example, a facility in Contra Costa County was modifying an existing process and recognized that the existing ammonia storage tank was much larger than necessary and posed an unnecessary risk to the workers in the immediate area and the surrounding community. A smaller and more appropriately sized tank was installed achieving a fifteen times volume reduction. In another example, when many facilities needed to reduce emissions of nitrogen oxides (NOx) to comply with air emission rules, some of the facilities selected a low NOx burner design rather than a selective catalyst reduction design that involves hazardous chemical usage.

The CSB specifically recommended that California's process safety management standard should include an inherently safer systems analysis as part of the MOC process. (CSB Interim Chevron Report, p.56 & 57.) Additionally, the CSB noted that the "safety case regulatory regime," which is used in the United Kingdom, includes "the adoption of inherently safer designs as an essential consideration for

determining whether a duty holder has reduced risks to ALARP [as low as reasonably practicable]." (CSB Final Chevron Report, p. 80.)

This subsection will apply a similar standard to California refineries, ensuring that risks are avoided or reduced according to the hierarchy of hazard control analysis in section 2762.13. Through the hierarchy of hazard control analysis, this subsection requires refineries to consider both inherently safer systems and safeguards to reduce risk prior to making major changes. (See ISOR section discussing section 2762.13.) This subsection thus has the effect of implementing the CSB recommendation, extending the Contra Costa County and City of Richmond inherently safer systems requirements statewide for major changes with an expanded scope to include safeguards for risk reduction when inherently safer options are not available or feasible.

The limitation of the application of the hierarchy of hazard control analysis requirement to major changes will ensure that the MOC requirements are triggered only for those changes that are significant enough to warrant enhanced review. Without the limitation to major changes, refineries would be forced to allocate significant time and resources to conduct analyses on numerous minor changes where the risk reduction achieved by the exercise would be minimal. The proposed provision will be equally effective in preventing incidents and less burdensome than a provision that requires a hierarchy of hazard control analysis for every change, regardless of risk.

Damage Mechanism Review (DMR) for Major Changes

Subsection (c) also requires that a DMR be conducted for a major change.

Whenever there is a major change, the refinery is to review the DMR that was done for the process where the major change is occurring. The review is to ensure that the change is consistent with the DMR. A DMR pursuant to subsection 2762.5(e) is to be performed as part of the MOC process if one does not already exist for the process.

This subsection is necessary to ensure that the right materials of construction are being used in the major change that is being performed. If the MOC review does not review the DMR for the process where the change is occurring, inappropriate materials of construction may be used and corrosion or another type of damage mechanism may occur. High-temperature sulfidation was one of the direct causes of the 2012 Chevron Richmond Refinery fire. If a DMR had been performed, and appropriate inspections conducted, then that piece of pipe would most likely have been replaced before the incident occurred.

Subsection (d) requires refineries to use qualified personnel and appropriate methods for MOCs based upon hazard, complexity, and type of change. This section is necessary to ensure that MOCs are conducted adequately. The requirement for qualified personnel and appropriate methods will help to ensure that MOCs identify and address hazards. As API Rule 570 explains, "[t]he MOC process shall include the appropriate materials/corrosion experience and expertise in order to effectively forecast what changes might affect piping integrity. The inspection group shall be involved in the approval process for changes that may affect piping integrity." The CSB identified inadequate MOCs as

contributing to the 2012 Chevron Richmond Refinery fire. (E.g., CSB Final Chevron Report, pp. 71-72; 79-80.)

Subsection (e) requires refineries to provide for employee participation pursuant to section 2762.10. Existing regulations do not require refineries to involve employees in the analysis of the change and its potential safety impacts. Subsection (e) adds a requirement to involve employees in the management of change process from start to finish. This section refers to section 2762.10, which ensures that there is a clear and consistent process for including employees and employee representatives in all major components of process safety. The intent of this provision is to ensure that employees and employee representatives are involved in doing the analysis, interpreting the results, developing the recommendations, and writing the management of change report. The provisions on employee involvement are discussed in more detail in the section of the ISOR describing section 2762.10.

Subsection (f) requires refineries to inform employees involved in the process as well as maintenance workers and employees of contractors whose job tasks will be affected by a change, to be informed of, and effectively trained in, the change prior to its start-up.

This requirement is an existing requirement in Program 3. Subsection (f) is necessary to add this requirement to Program 4 to ensure that refineries inform affected employees of any change and provide training prior to implementation of the change.

Subsection (g) requires refineries to update the PSI required by section 2762.1, if necessary following an MOC.

This requirement is included in current CalARP regulations for Program 3. Subsection (g), is necessary to add this requirement to Program 4 so that refineries incorporate the results of a management of change analysis in the information required by section 2762.1 to ensure that (1) refineries understand the hazards of a change prior to conducting a PHA, Safeguard Analysis, HCA or DMR and (2) changes to process equipment are evaluated in comparison to RAGAGEP or equally protective standards.

Because the Process Safety Information required by section 2762.1 is the starting point for the other listed analyses, as required under the proposed regulations, it is important that this information be kept current. This subsection requires refineries to review the Process Safety Information after completing an MOC and determine whether it should be updated following an MOC.

The CSB Final Chevron Report recognizes the need to apply RAGAGEP to MOCs. With the proposed amendments to section 2762.1 for PSI, refineries will be required to document that process equipment complies with RAGAGEP or other equally protective standards. The new requirement clarifies that the update shall be done as soon as possible to prevent delay of necessary updates.

Subsection (h) requires refineries to update the Operating or Maintenance Procedures or practices required by sections 2762.3 and 2762.5 if necessary following an MOC. The procedures and practices must be updated prior to the start-up of the process. This section is included in current CalARP regulations for Program 3 and for Operating Procedures. Subsection (h) is necessary to add this

requirement to Program 4 to ensure that refineries incorporate the results of a management of change analysis in their the operating procedures required by section 2762.3 and maintenance procedures required by section 2762.5, to ensure that operators and maintenance personnel are able to manage processes safely based on the most current information regarding changes that affect processes. The new requirement clarifies that the update shall be done prior to start-up of the process so the operators and maintenance personnel are performing their jobs with the correct procedures.

Management of Organizational Change (MOOC)

Subsections (i) and (j) require refineries to develop a process to ensure that the MOC process applies to changes in the refinery's internal organization and to implement the process. Subsection (j) sets forth the requirements for the MOOC assessments. Although other sections of the regulation require adequate training for refinery employees, this section requires refineries to consider whether staffing or other organizational changes require additional training or other precautions to reduce safety risks.

Subsection (j) requires a team to conduct MOOC assessments for changes lasting longer than 90 days, and defines the required elements of the assessments. These requirements will require an analysis prior to changes in staffing and management at refineries. They apply, however, only when changes affect operations, engineering, maintenance, health and safety, or emergency response. They also apply where contractors are used in permanent positions.

Paragraph (j)(1) requires the MOOC process to include a written assessment, which must describe the proposed change and provide details regarding the process. The subsection also includes required elements in order to document, not just the team's conclusions, but also how the conclusions were developed and the reasons for them. These requirements are necessary to provide the refinery with necessary information to ensure that decisions take safety risk into account and to provide the regulator with information to review for accountability purposes. The documentation requirements ensure that refinery management will consider the team's findings and implement any measures needed to manage the change in a way that will not increase safety risks.

Paragraph (j)(2) requires the refinery to review and update job function descriptions for affected employees so that the assessments are based on accurate information.

Paragraph (j)(3) is identical other sections of the regulation. It ensures that there is a clear and consistent process for including employees and employee representatives in all major components of process safety. The intent of this provision is to ensure that employees and employee representatives are involved preparing and implementing the assessment. The provisions on employee involvement are discussed in more detail in the section of the ISOR describing section 2762.10.

Paragraph (j)(4) requires assessments to include an analysis of human factors as required by section 2762.15. MOOC assessments are done to consider the impacts of staffing changes or other human-related issues, so these should also incorporate consideration of human factors. Automatic process

controls, specifically error proof mechanisms, automatic alerts and automatic system shutdowns, are all proven ways to reduce the potential for human error, so these strategies should be explicitly considered as potential solutions with consideration given for alarm overload in the human factor analysis. The MOOC assessment requirements in subsection (j)(1) should include these types of solutions as needed to reduce the likelihood of a major incident as a result of the change.

Paragraph (j)(5) requires the refinery manager, or his/her designee, to certify that the assessment is accurate and that the change will not increase the likelihood of a major incident. This requirement ensures that the report is personally reviewed by the refinery manager and that this person is aware of the change, its potential impacts, and measures necessary to reduce the likelihood of impacts. This provision is intended to focus the attention of top management on the importance of organizational changes and their relationship to process safety. This focus is necessary to provide assurance that the managers who are responsible for making organizational changes are the same people who understand the impacts of the change.

Subsection (k) requires the refinery to communicate the change to employees who are potentially affected by the change. The subsection is necessary to ensure that refineries are actively communicating MOOC assessments to the groups of people who will be affected, rather than simply posting them or otherwise requiring employees to seek them out.

Section 2762.7 Pre-Startup Safety Review (PSSR)

Specific Purpose

A Pre-Startup Safety Review (PSSR) is a safety verification performed on process equipment prior to use. Refineries currently perform these reviews to ensure all processes will function safely when they are in operation, and Program 3 regulations require a PSSR for new stationary sources and for certain modifications. The proposal clarifies that the PSSR must be performed for any modification that triggers a change in the PSI and prior to starting up after a turnaround. It also includes minor amendments to clarify the standards to be met in PSSRs, to maintain consistency with the rest of Program 4, and to add an employee participation requirement.

Necessity

The proposed amendments to current PSSR requirements are necessary to clarify when PSSRs are required, to ensure that refineries verify that work, maintenance and the process equipment itself are consistent with design guidelines, and to facilitate enforcement. The proposal also adds a provision requiring refineries to assign an experienced operating employee who works in the unit to participate in the review. This requirement is necessary to ensure that the individuals conducting the review have relevant expertise and practical knowledge. Refineries will be motivated to assign

qualified personnel for this task because, if done well, it will identify deficiencies in time to fix them before they cause an incident.

Conduct a PSSR under certain conditions

Subsection (a) is amended to clarify that refineries must perform a PSSR 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 owner or operator must amend the PSI, which would trigger the requirement to conduct a PSSR prior to restarting the process. The proposal also specifically states that refinery owners or operators are required to conduct a PSSR after turnaround work has been performed on a process.

These provisions make explicit long-standing refinery practices used to ensure safe startup. The amendments are necessary to ensure statewide uniformity in these practices and to provide UPAs with clear enforcement tools. 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 startup process.

Quality assurance

Subsection (b)(1)-(5)

Subsection (b)(1)-(3) Existing requirements outline standards for pre-startup safety reviews. Minor revisions to these standards in the proposed regulations clarify that the refinery must verify that design specifications have been met for any work and maintenance that has been done on process equipment and for the equipment itself.

Subsection (b)(4) Existing regulations require a PHA as part of the pre-startup review for new stationary sources and an MOC for modifications. These requirements are retained in the proposal, and the need for an MOC prior to startup of a new process is made explicit. The proposed regulations amend this section to require refineries to perform a hierarchy of hazard controls, DMR, and SPA for new process units. Prior to starting a process, the owner or operator 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 measures and safeguards are effectively applied prior to operation of the new unit.

Subsection (b)(5) Existing requirements ensure that each operating employee and maintenance employee has completed training pertaining to the startup procedure. These requirements are retained in the proposed regulations.

Employee participation

Subsection (c)

Section 2762.10(a)(1) of the proposed regulations requires effective employee participation in the pre-startup safety review at the earliest possible point in the process. The proposed subsection (c) for pre-startup safety review requires the employee selected for this participation to be an experienced operator in the unit with specific expertise in the process to be 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 startup of a new or modified process and promotes safe operations in the refinery.

Section 2762.8 Compliance Audits

Specific Purpose

A Compliance Audit is a certification process performed by the refinery to certify compliance with the new Program 4 requirements. Refineries currently perform these audits every three years to ensure the refinery is meeting all process safety requirements under the current regulations. The proposed regulations clarify the contents of the written compliance audit report, requires consultation with operators that have relevant expertise, and requires recommendations from the audit to go through the corrective action work process in section 2762.16. It also includes amendments to require retention of audit reports for three years instead of two and adds an employee participation requirement.

Necessity

The proposed regulations to current compliance audit requirements are necessary to ensure that refineries verify that the policies and procedures are actually in compliance with Program 4 requirements, rather than simply certifying that they are adequate. The proposed regulations also add a provision clarifying the required contents of the audit report and requiring refineries to assign an experienced operating employee who works in the unit to consult with the audit team. These requirements will ensure that the compliance audits performed by refineries meet the higher standard of full compliance rather than adequacy and provide sufficient information to identify deficiencies and impose enforceable requirements to address those deficiencies.

<u>Conducting the Compliance Audits</u>

Subsections (a) and (b) is amended to clarify that each refinery must perform a compliance audit and certify that the procedures and practices they have developed pursuant to Program 4 requirements are in compliance with these requirements. The audit process must be effective, meaning that it is designed to enable the refinery to determine whether the procedures or policies are in fact in compliance with Program 4 requirements. The requirement to conduct the audit every

three years is an existing requirement for Program 3 facilities. Similarly, the requirement in subsection (b) that the audit be performed by at least one person with relevant expertise is an existing requirement. Amendments to subsection (b) clarify that the expertise must be in the specific Article 6.5 section under review rather than the process.

These provisions clarify long-standing refinery audit practices. The amendments are necessary to improve the audit function and to provide unified program agencies with clear enforcement tools.

Quality assurance

Subsection (c) includes minor amendments to clarify the content of the audit report and add a requirement for employee review of the report. The additional requirement for content of the report specifies that the questions asked for the audit and answers to the questions must be included in the report. This clarification ensures that refineries will adequately document details regarding the audit process, which will improve the refinery's internal compliance assurance programs and facilitate review by UPAs.

The employee review provisions require that the report be made available to employees as outlined in section 2762.10, and that the refinery respond to employee input within 60 days. These requirements will ensure that employee participation is standardized statewide, providing employees with a way to participate in audits that includes two-way communications with management on audit findings.

Audit Recommendations and Retention of Reports

Subsection (d) requires the refinery to follow the corrective action work process. (See discussion of section 2762.16 below.)

Subsection (e) changes the existing requirement for retention of audit reports from two years to requiring the owner or operator to retain the three most recent reports. This minor amendment is necessary to align the retention schedule with the audit performance schedule to ensure that the report from the prior audit is available for reference when performing each subsequent audit.

Subsections (f) adds a requirement that the refinery consult with experienced operators and document input from these operators. This requirement is necessary to ensure that at least one employee who routinely works on the process and understands the operating conditions is consulted in the audit. The information and experience provided by employees increases the quality of the audit and promotes safe operations in the refinery.

Section 2762.9 Incident Investigation.

Specific Purpose

The purpose of this section is for refineries to perform incident investigations. The requirement to perform incident investigations is not new. Stationary sources subject to Program 3 requirements are required to perform incident investigations under section 2760.9, therefore all petroleum refineries that will be subject to Program 4 have already been subject to many of the requirements of this section. The essential purpose of an incident investigation is to learn from incidents and from incidents that could reasonably have resulted in a major incident ("near-misses") and to translate that learning into measures that will more effectively prevent future incidents that could harm employees and communities. The main added element in this section is the requirement to conduct a root cause analysis. A root cause analysis is specifically directed at identifying management system failures that contributed to the incident. This addition requires Program 4 sources to go beyond identifying employee error, or other 'mistakes', to investigating what management system deficiencies existed to allow the error or mistake to occur.

This section requires that refineries develop a process for conducting a systematic investigation, including a root cause analysis, of any incident that results in or could reasonably have resulted in a major incident. The purposes of the section are to promote a culture of learning from incidents and near-misses, and to create a more uniform, timely, and comprehensive approach to investigating incidents in order to prevent future incidents at refineries.

Necessity

Incident investigations with root cause analysis are important because they can provide information about management system failures that, if addressed, can reduce the risk of future incidents at the same facility and at similar facilities. Incident investigation reports can also provide important information to UPAs that will allow them to focus their compliance efforts in ways that are optimal for reducing future incidents. After any incident that affects workers or the community, the public is frequently interested in a full understanding of what happened. For these reasons, performing a thorough incident investigation is a necessary component of ensuring process safety. For major incidents with the potential for public attention and concern, the incident investigation report should be made publicly available.

The Contra Costa County ISO and City of Richmond ISO require stationary sources to perform root cause analysis on major incidents. Four refineries in California are therefore already required to conduct root cause analyses for major incidents. The Interagency Working Group Report recommended state-wide regulatory changes "directing refineries to…complete root cause analyses after significant accidents or releases" [Executive Summary, p. 2].

The regulation addresses the need for improved incident investigations by requiring: (1) systematic criteria and procedures for investigating incidents, including investigating "near-misses"; (2) root cause analysis to uncover underlying problems; (3) effective employee participation; (4) consideration of damage mechanisms in incident investigations; (5) recommendations for both interim and permanent safety improvements; and (6) detailed reporting requirements. Finally, if the UPA elects to perform an

independent incident investigation or other analysis pursuant to section 2775.2.5, the refinery must assist that effort and cover associated costs. The specific subsections are described in more detail below.

Systematic criteria and procedures for investigating incidents, including "near-misses"

Subsection (a) requires the owner or operator to develop, implement, and maintain written procedures for promptly investigating and reporting any incident that results in or could reasonably have resulted in a major incident. This provision differs from existing requirements in two major ways: (1) it requires written procedures for incident investigations and reports in order to assure that the investigations are performed in a consistent manner regardless of who within the refinery is leading the investigation; and (2) it triggers incident investigations with the term "major incident" rather than "catastrophic release." "Major incident" is defined in section 2735.3 (hh) as "an event within or affecting a process that causes a fire, explosion or release of a highly hazardous material, and which has the potential to result in death or serious physical harm (as defined in Labor Code section 6432(e)), or which results in an officially declared shelter-in-place, or an evacuation order."

Major incident includes a broader set of incidents and is also more specific than catastrophic release because it explicitly includes any incident that results in an officially declared shelter-in-place order or an evacuation order, and it also includes any incident involving a fire, explosion, or release that has the potential to cause serious physical harm, regardless of whether actual harm occurred. The broadening of incident investigations is necessary to capture not only actual serious incidents, but also "near miss" incidents that could have caused serious harm. Near miss reporting has been shown to be an effective accident prevention tool in numerous industries, including aviation, firefighting, and health care.

Root cause analysis to uncover underlying problems

Subsection (b) requires a root cause analysis as part of any incident investigation. This subsection is necessary because it requires the owner or operator to dig deeper into the fundamental reasons why an incident occurred, rather than simply identify a proximate cause, thereby increasing the likelihood of preventing future incidents. Root cause analysis is a well-established incident investigation technique used in numerous industries, including petroleum refining, and it is shown to result in improved incident investigations. There are different methodologies for conducting root cause analyses, and this regulation does not specify any particular method, thereby giving stationary sources the flexibility to continue to use any method that they may already be using, or to adopt their preferred method.

Subsection (c) leaves unchanged the requirement to initiate the incident investigation as promptly as possible, but no later than 48 hours following an incident.

Effective employee participation

Subsection (d) specifies the make-up of the incident investigation team. The requirements are similar to existing language, but contain two substantive changes: The team now must include a person with expertise in the owner or operator's root cause analysis method; and employees must be provided the opportunity to participate in the investigation team. The former provision is needed because root cause

analysis is a new requirement in incident investigations, and the latter requirement is identical to those in other sections of the regulation, insuring that there is a clear and consistent process for including employees and employee representatives in all major components of process safety. This provision is necessary to ensure that employees and employee representatives, and employees of contractors, if applicable to the incident, are involved in all phases of the incident investigation, as well as in the determination of causes, and development of recommendations. The provisions on employee involvement are discussed in more detail in the section of the ISOR describing section 2762.10.

Consideration of damage mechanisms in incident investigations

Subsections (e) and (f) require the incident investigation team to conduct a root cause analysis, using the written procedure developed under subsection (a), to determine the underlying causes of the incident, including identification of management system causes and organizational and safety culture causes. In addition, the team is required to review the appropriate DMRs that were performed pursuant to section 2762.5(e) and incorporate the findings from these DMRs into the incident investigation. This is necessary because findings from DMRs are often relevant to incidents; many incidents are related to corrosion or other damage, so this provision requires that the team explicitly consider damage mechanisms as they develop their investigation report and recommendations. The appropriate DMRs would include relevant DMRs performed on the specific unit that was involved in the incident, as well as DMRs performed on the type of equipment involved in the incident. For example, if the incident involved a leak in a pipe, then DMRs examining that type of piping under similar process conditions would be appropriate for review, regardless of whether they were focused on the specific unit or process involved in the incident.

Recommendations for both interim and permanent safety improvements

Subsection (g) specifies that recommendations resulting from the incident investigation include both interim actions and final actions. Some final actions, according to the corrective action work process in subsections 2762.16 (d) and (e), may take three years or longer to implement. To effectively reduce the risk of a similar incident, interim actions are necessary in most cases. Interim actions could include additional training, revisions to operating procedures, changes to inspection procedures or frequency, revalidation of DMRs, or other changes that could be implemented in the relatively near-term. This subsection is necessary to encourage the owner or operator to take rapid action to address some issues, and to simultaneously develop a long-term prevention plan.

This subsection also requires a HCA to be performed on recommendations that result from the investigation of a major incident, pursuant to section 2762.13. This particular requirement does not apply to incidents that could reasonably have resulted in a major incident (e.g., “near misses”), as such, a requirement is considered to be overly onerous, given the amount of effort expected to perform an HCA. The purpose of an HCA on recommendations stemming from an actual major incident is to assure that there is full consideration of any potential inherently safer solutions that would have the greatest potential of preventing a future incident. This recommendation is intended to reduce the likelihood that

a stationary source would simply apply a low-level safeguard in response to a major incident, and might thereby inadequately prevent a recurrence.

Detailed reporting requirements

Subsection (h) requires the owner or operator to submit a written report for major incidents to the UPA within 90 calendar days of the incident. This requirement only applies to situations where a major incident actually occurs. For incidents that could reasonably have resulted in a major incident ("near misses"), this subsection does not apply and the owner or operator need only provide the report to the UPA upon request as required under section 2762.17. This is because the UPA need not review every incident investigation report, but when an incident occurs that affects the community, UPA review will be important. The 90-calendar day deadline ensures that the investigation is done promptly, but the regulation is written with the flexibility to allow extensions for complex investigations. In such cases the owner or operator must provide status reports to the UPA, starting 90 days after the incident, on an every 30-day basis until the final report is complete, which must be no later than five months after the incident.

Subsection (i) leaves in place with minimal changes most of the elements of the written report that was previously required in this subsection, including (1), (2), (3), (6) and (7). The other two report elements, however, are new: (i)(4) requires the report to "include the factors that caused or contributed to the incident, including direct causes, indirect causes and root causes, determined through the root cause analysis." This requirement is needed to ensure that the findings of the root cause analyses are fully documented in the report. Under (5) the report must also list any DMR, PHA, HCA, and SPA that was reviewed during the investigation. This is necessary to document that the team considered the relevant information in their investigation. For example, if pipe corrosion were a potential factor in an incident, the incident investigation team would need to document that they reviewed the DMR report for any relevant process to determine if corrosion was considered and if the DMR report recommendations were appropriately followed.

Subsection (j) requires the UPA to make reports from investigation of major incidents available to the public by posting the final report on the UPA's website. While Subsection (a) requires investigation of "any incident that results in or could reasonably have resulted in a major incident," the posting requirement in this subsection applies only to those incidents that actually result in a major incident. In other words, stationary sources must investigate both major incidents and near misses, but UPAs will only post incident investigation reports, not near-miss investigation reports. Cal OES views near misses as important opportunities for learning and prevention, but recognizes that these types of events may occur with some frequency and they do not normally rise to public attention, so the value of making such reports public is offset by the need for speed, confidentiality, and encouragement of honest and full reporting. In the event, however, of an actual major incident that affects the community, the public will have a strong desire to know what happened and what recommendations resulted from the investigation. Public review of reports from investigation of major incidents is necessary for the purpose of demonstrating to the local community that a full investigation occurred, and that changes were made to prevent future incidents. The Contra Costa County and City of Richmond ISOs already require the four

refineries in that region to submit their root cause analysis for Major Chemical and Accidental Release incidents to the UPA, which the UPA posts on its website.

Subsection (k) requires that the reports generated under this section be provided to all operating, maintenance, and other personnel, including employees of contractors where applicable, whose work assignments are within the facility where the incident occurred or whose job tasks are relevant to the incident findings. This is necessary so that employees are aware of what happened, and of the report recommendations, so they can participate effectively in any follow up activities for prevention of future incidents. Upon request from the employees or contractor employees, the owner or operator must review the report with the employees to explain the findings and recommendations.

Subsection (l) is identical to those in other sections of the regulation. It ensures that there is a clear and consistent process for taking recommendations from the incident investigation report and from other reports generated under this Article and moving the recommendations forward into corrective actions that are addressed according to specified timelines. This provision also ensures that there is a process for tracking all recommendations, criteria for rejecting recommendations, and requirements to document closeout of corrective actions. These provisions are discussed in more detail in the section of the ISOR describing subsections 2762.16 (d) and (e). This provision is included because the investigation into the 2012 Chevron Richmond Refinery fire revealed that critically important recommendations relevant to process safety had never been acted upon or tracked to completion.

In contrast to other sections of the Article, this subsection specifically requires that the corrective action plan shall require review, and where necessary, revalidation of the appropriate portions of all relevant PHAs and DMRs. This provision is included because incidents may reveal previously unrecognized or underappreciated process hazards and damage mechanisms.

Subsection (m)

Previously, incident investigation reports were required to be retained for five years. This subsection extends that requirement to the full life of the process unit. This provision is necessary because older incident investigation reports may prove to be important in the event that another incident occurs that is relevant to that process in the future.

<u>Assistance to the UPA for independent reviews.</u>

Subsection (n) requires that, if the UPA chooses to perform an independent Process Safety Culture Assessment (PSCA), Incident Investigation, evaluation of the Accidental Release Prevention (ARP) Program management system or Human Factors Analysis after a major incident pursuant to section 2775.2.5, the owner or operator must cooperate with the UPA in conducting the independent analysis. The owner or operator must also pay the costs of the independent analysis. This provision is necessary because after a major incident, there is frequently significant interest from the local community, the media, and elected officials in knowing exactly what went wrong. At such a time, there may also be a high level of public mistrust of the responsible entity, and concern that an internal investigation may not be fair and impartial. This provision allows an impartial third-party review to be performed under such

circumstances. Such a review may be done by the UPA or under contract by an independent outside contractor. The Contra Costa County ISO contains a provision allowing the UPA to conduct such investigations, and this provision has been used several times, including after the 2012 Chevron Richmond Refinery fire.

Section 2762.10 Employee Participation

Specific Purpose

This section explains the requirements for Employee Participation. The subsections explain how to develop and implement a written plan to effectively provide for employee participation. The subsections outline the requirements for employee participation on teams, access by employees to documents, and for confidentiality agreements.

Necessity

The proposed requirements are necessary to ensure that the recommendations of employees and employee representatives are afforded systematic and comprehensive attention by a refinery, and that refineries provide employees and employee representatives access to documents and information necessary for the employees to participate meaningfully in the safe operation of the refinery. “Employee Representative” is defined by section 2735.3(t) to mean “a union representative, where a union exists, or an employee designated represented in the absence of a union. The term is to be construed broadly, and may include the local union, the international union, or an individual designated by these parties, such as the safety and health committee representative at the site.”

Employees are often in the best position to understand the details of day-to-day operation, and to know how procedures are actually carried-out in practice; for these reasons, active employee participation in Program 4 will help to assure that findings and recommendations developed on paper are aligned with actual practice. Employee involvement will also help assure that recommendations that require action by employees are actually carried out effectively. All of these aspects of employee participation will help to enhance safe operations.

Subsection (a) requires the refinery to develop and implement a written action plan for employee participation. It parallels existing language from Program 3. The subsections outline in more detail the provisions that must be included in the employee participation plan.

Paragraph (a)(1) requires the plan to provide for effective participation in performing PHAs, DMRs, HCAs, MOCs, MOOCs, PSCAs, Incident Investigations, SPAs and PSSRs. This parallels existing language in Program 3, but adds the additional program elements that will be required under Program 4. This paragraph also requires that the participation begin “at the earliest possible point” in performing the above analyses. This requirement is designed to assure that the analysis is not developed and conducted without employee participation and then presented to employees for review near the end of the process. The language is designed to allow some limited flexibility in determining when to engage

employees in the process, and the intent is that employee involvement should begin at the point when the owner or operator determines that a PHA, DMR, HCA, MOC, MOOC, PSCA, Incident Investigation, SPA, or PSSR will be conducted.

Paragraph (a)(2) requires provisions for employee participation in the development, training, implementation, and maintenance of the Accidental Release Prevention (ARP) elements of Article 6.5. As in paragraph (a)(1) above, employee participation is required to begin "at the earliest possible point", both for initial establishment of these programs, and for evaluation and updates to the programs.

Paragraph (a)(3) requires the owner or operator to ensure access by employees and employee representatives to all documents or information developed or collected under Program 4, including information that might be subject to protection as a trade secret. Existing language already requires employees be given access to all information developed under the Chapter. Protection of trade secrets is addressed in Subsection (d) below.

Subsection (b) requires the plan to provide for the selection of representatives by authorized collective bargaining agents, in accordance with collective bargaining agreements. This provision includes the teams and procedures described in both Subsections (a)(1) and (a)(2) above.

Subsection (c) requires the owner or operator, in consultation with employees, to establish procedures for the selection of employee representatives in situations where there is no collective bargaining agreement. This provision includes the teams and procedures described in both paragraphs (1) and (2) above.

Subsection (d) allows the owner or operator to require an employee or employee representative to enter into a confidentiality agreement to protect trade secrets.

2762.11 Hot Work Permit

Specific Purpose

Petroleum refineries handle flammable gases and liquids. One way of preventing a fire is to eliminate ignition sources near where flammable gases and liquids are handled. The purpose of this section is to require a permit for any hot work operations that may be conducted at the refinery. "Hot work" as previously defined means "work involving electric or gas welding, cutting, brazing, or similar heat, flame or spark-producing operations." (Section 2735.3(y)) This section requires that fire prevention and protection requirements in CCR Title 8, Section 5189 are implemented and that a permit documents that this regulation is being followed.

Refineries are already required to follow the requirements of this section since the language is unchanged from section 2760.11 of the existing regulations for Program 3 covered stationary sources.

Necessity

Hot Work Permits requirements are necessary to ensure that if an ignition source is introduced it is done such that the possibility of igniting flammable gases is eliminated or reduced to an acceptable level of protection. There are no new requirements added by this change in regulations.

Section 2762.12 Contractors

Specific Purpose

The purpose of this section 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. By requiring the refinery owner or operator to actively participate in the selection, oversight, and evaluation of contractors, the regulation ensures accountability and transparency in the safety performance of contractors.

This section is almost identical to Article 6, section 2760.12, so the actual requirements for refineries will not change in a substantive way. Some minor changes have been made as described below.

Necessity

Maintaining requirements regarding contractors is 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 (a) of this section, which describes the applicability, is unchanged from prior requirements.

Subsection (b) describes the responsibilities of the stationary source owner or operator. This subsection contains only minor changes from prior requirements. Specifically, (b)(2) now includes a more comprehensive list of hazards for which the stationary source owner or operator must inform the contract owner or operator. These include fires, explosions, loss of containment, highly hazardous materials and high temperatures and pressures. Prior language included only fire, explosion, or toxic release hazards. It is important for contractors to also be aware of the hazards associated with loss of containment, high temperatures and pressures because all of these can result in a major incident. Consistent with the other requirements in Program 4, this section uses the term “highly hazardous materials” as defined in section 2735.3 (x). Paragraph (b)(5) no longer requires documentation of the performance of the contract owner or operator because that requirement has been pulled out into a new provision (b)(6). The new provision is designed to ensure documentation of all the requirements in subsection (b) rather than just (b)(5). It is necessary for the owner or operator to document that the contract owner or operator has been evaluated and informed, in order to ensure accountability and compliance.

Subsection (c) describes the responsibilities of the contract owner or operator. This subsection is almost identical with existing requirements. Paragraph (c)(2) mirrors the more complete list of hazards from

(b)(2) above, to ensure that the contract owner or operator passes all information along to their employees. For flow reasons, the requirement regarding training in the applicable provisions of the emergency action plan was moved from (c)(2) to (c)(1), but the requirements have not substantively changed as a result of the rearrangement.

Section 2762.13 Hierarchy of Hazard Control Analysis (HCA)

Specific Purpose

The owner or operator is required to assemble a team to do an analysis of a process or of recommendations from a PHA, in which the team applies inherent safety measures and safeguards in a structured sequence and priority order in order to identify the safest feasible alternative for a specific purpose.

Inherent safety is defined in section 2735.3 (bb) as "an approach to safety that focuses on eliminating or reducing the hazards associated with a set of conditions. A process is inherently safer if it reduces or eliminates the hazards associated with materials or operations used in the process, and this reduction or elimination is permanent and inseparable from the material or operation. A process with reduced hazards is described as inherently safer compared to a process with only passive, active, and procedural safeguards. The process of identifying and implementing inherent safety in a specific context is known as inherently safer design."

The proposed regulations also include a definition of "Safety Instrumented Systems," a type of active safeguard: "Safety Instrumented Systems,' mean systems designed to achieve or maintain safe operation of a process in response to an unsafe process condition." (Section 2735.3(ppp).)

Industrial safety concepts that underlie this section include the distinction between hazard and risk. Hazard is an intrinsic property of a chemical or process, such as toxicity or flammability, whereas risk is a concept that incorporates both hazard and other issues such as exposure and probability. Although risk reduction is desirable, hazard reduction is much more desirable because low-frequency/high-consequence incidents can result in significant harm to workers and communities. In facilities such as refineries, it is not feasible to eliminate all hazards, so a combination of hazard and risk reduction is necessary to protect health and safety.

The HCA is a well-established structured approach to industrial safety that has been used in numerous industrial sectors, mostly for the purpose of worker protection, but also in the area of general safety and incident prevention. The HCA framework incorporates both hazard reduction and risk reduction in five prioritized tiers that are defined in section 2735.3 (bb)(1) and (2) and section 2735.3 (ooo)(1), (2), and (3) as:

> "First Order Inherent Safety measure" is a measure that eliminates a hazard. Changes in the chemistry of a process that eliminate the hazard(s) of the chemicals used or produced are usually considered First Order Inherent Safety measures; for example, by substituting a

flammable chemical with an alternative chemical that can serve the same function but with lower vapor pressure and narrower flammable range.

"Second Order Inherent Safety measure" is a measure that reduces 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 and simplify a process are usually considered Second Order Inherent Safety measures; for example, redesigning a high-pressure, high-volume, and high-temperature system to operate at lower temperatures, volumes, and pressures.

"Passive Safeguards" means minimizing the hazard through process and equipment design features that reduce either the frequency or consequence of the hazard without the active functioning of any device; for example, by providing a diked wall around a storage tank of flammable liquids.

"Active Safeguards" means using controls, alarms, safety instrumented systems, and mitigation systems to detect and respond to deviations from normal process operations; for example, by using a pump that is shut off by a high-level switch in the downstream tank when the tank is 90% full.

"Procedural Safeguards" means using policies, operating procedures, training, emergency response and other administrative approaches to prevent incidents or to minimize the effects of an incident. Examples include hot work procedures and permits and emergency response procedures implemented by employees.

For each process safety hazard that the HCA team identifies, the team is required to develop written recommendations in the above sequence and priority order. To the greatest extent feasible, the team must recommend first order inherent safety measures to eliminate the hazard. If the hazard cannot be eliminated, the team must develop recommendations to reduce the hazard to the greatest extent feasible using second-order inherent safety measures. Only if both of these are infeasible does the team need to continue their analysis to recommend safeguards that can reduce risk. For example, to address pipe corrosion caused by high-temperature sulfidation, the following are possible corrective actions: (1) eliminate the sulfur that exists in the hydrocarbons as early in the refinery process as possible to eliminate the corrosive effects on the pipe downstream of the sulfur elimination—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) upgrade the piping material for sections of pipe —a passive safeguard; (4) install instrumentation that monitors the thickness of the pipe—an active safeguard; (5) routine inspections of the thickness of the pipe—a procedural action; or (6) take various combinations of these actions.

Necessity

HCA is necessary to ensure that refineries evaluate and implement the most effective approaches to eliminating or mitigating process safety hazards. The Interagency Working Group Report stated that: "The intent of inherently safer system requirements is to ensure that refineries incorporate the greatest

degree of hazard reduction, to the maximum extent feasible, in order to avoid major accidents or releases. The focus is on adopting measures that are permanent and inseparable from the production process, as opposed to adding on equipment or installing external layers of protection." (Recommendation 3.1a, p. 28). This section also addresses a recommendation by the Chemical Safety and Hazard Investigation Board to: "Require the documented use of inherently safer systems analysis and the hierarchy of controls to the greatest extent feasible in establishing safeguards for identified process hazards." (CSB Interim Investigation Report, Chevron Richmond Refinery Fire, April 2013, recommendation 2012-03-I-CA-R13, p. 57).

The HCA is necessary to reduce the likelihood that refineries will adopt only active or procedural safeguards in order to reduce the risk of incidents. Failures of such safeguards have been responsible for numerous major incidents at refineries, either because of malfunction of an active safeguard device, or because of failure of a procedure to work as intended. For example, the 2012 Chevron Richmond Refinery fire was caused, in part, by reliance on periodic pipe inspections to detect dangerous corrosion. Requirements to consider – and adopt when feasible – measures that will reduce a hazard will significantly enhance refinery safety.

Conduct an HCA for each process

Subsection (a)

Within five years, the owner or operator must conduct an initial HCA as a standalone analysis for all existing processes; 50% of these HCAs must be conducted within three years. The proposal integrates the HCA schedule with the PHA schedule, which gives the owner or operator flexibility to align schedules. The proposed HCA schedule is necessary to ensure that HCAs are conducted in a timely manner and the schedule was established with stakeholder input.

Conduct an HCA for specific cases

Subsection (b)

The owner or operator 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) as part of an MOC review, whenever a major change is proposed; (3) for all recommendations that result from the investigation of a major incident; and (4) during the design and review of new processes, new process units, and new 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. It is important to note that Subsections (b)(1), (2), and (3) are limited to apply only to the potential for a "major incident" as defined in section 2735.3 (hh) or a "major change" as defined in section 2735.3 (gg); accordingly, an HCA is not required for every recommendation stemming from a PHA, nor for every MOC review, nor for every incident investigation. These limitations were included in response to input from refinery stakeholders and are intended to focus the HCA analyses on the more important safety issues.

The owner or operator is required to submit HCA reports for new processes, new process units and new facilities to the UPA. The UPA is required to post these reports on the UPA's website within 30 days. This provides information to the public on the hazards that are present when a major modification is being proposed and assures the public that the principles of inherent safety were fully evaluated in the design of these new facilities and incorporated to the greatest extent feasible. This process provides transparency on how the refinery is preventing a major incident from occurring. Cal OES recognizes that HCAs may contain confidential business information; for this reason, and to reduce workload, the proposal is not requiring all HCAs to be made publicly available despite the requests from some stakeholders. However, when a new process, unit, or facility is being designed, the public has a right to review this document, in conjunction with related documents prepared pursuant to the California Environmental Quality Act, to assure that alternatives have been fully assessed. In addition, refinery process safety engineers have told us that it is at the initial design phase when opportunities for inherently safer solutions are most feasible, and for that reason, these analyses will be particularly valuable.

HCA Update and Revalidations

Subsection (c)

All HCA's shall be updated and reviewed at least every five years. The revalidations are to be performed in conjunction with the PHA schedule. This provides opportunities for continuous improvement and the ability to incorporate new knowledge to the analysis.

HCA team

Subsection (d) requires that HCAs be performed, updated, revalidated, and documented 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 owner or operator to allow 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. Owners and operators are required to consult individuals with expertise in damage mechanisms, process chemistry and control systems as needed. This team is necessary to ensure adequate expertise and employee participation when performing the HCA.

Requirements

Subsections (e) and (f)

The HCA team is required to: (1) compile or develop all risk-relevant data for each process or recommendation, including incident investigation reports; (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 and in an iterative manner. This is necessary to ensure the HCA is comprehensive.

The owner or operator 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 (A) achieved in practice by the petroleum refining industry and related industrial sectors or (B) 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 provision does not require refinery owner or operators to do exhaustive searches for all measures and safeguards adopted worldwide, but it does require some diligence to be aware – at a minimum - of activities at other refineries in their own company, at other refineries in California, and advances in process safety that have been presented at major industry meetings or in industry publications. It also requires refinery owner or operators to be aware of requirements and recommendations from entities such as the CSB, USEPA, Federal OSHA, Cal/OSHA, and UPAs. This is necessary to ensure that the HCA teams have sufficient information to perform effective HCAs and 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. To the greatest extent feasible, the team must recommend first order inherent safety measures to eliminate the hazard. If the hazard cannot be completely eliminated, the team must develop recommendations to reduce the hazard to the greatest extent feasible using second-order inherent safety measures. Safeguards must each effectively reduce any remaining risks. The term "feasible" "means capable of being accomplished in a successful manner within a reasonable period of time taking into account health, safety, economic, environmental, legal, social, and technological factors." (Section 2735.3 (v)). Thus, refineries are allowed to weigh a variety of factors as they consider feasibility, but to the greatest extent feasible they should strive to incorporate measures in the priority order laid out in the regulation. The expectation of this section is that the owner or operator will explain why each rejected option is not feasible. This is necessary to ensure inherently safer strategies are prioritized and identified to eliminate or reduce risk.

<u>HCA report</u>

Subsections (g) and (i)

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 method used by the team; the process safety hazards analyzed by the team; and a description of, and rationale for the inherent safety measures and safeguards recommended by the team for each process safety hazard. The owner or operator is required to retain HCA reports for the life of each process. These requirements are necessary to ensure transparency and accountability in the HCA process and to have a clearer understanding of the hazards that are present in the refinery processes. Report retention is necessary to provide a history of what has been analyzed, including the hazards, inherent safety measures and safeguards that were considered and reasons for their selection or rejection.

Implement recommendations

Subsection (h) is identical to requirements in other sections of the regulation. It ensures that there is a clear and consistent process for taking recommendations from the HCA report and from other reports generated under this Article and moving the recommendations forward into corrective actions that are addressed according to specified timelines. This provision also ensures that there is a process for tracking all recommendations, criteria for rejecting recommendations, and requirements to document closeout of corrective actions. These provisions are discussed in more detail in the section of the ISOR describing subsections 2762.16 (d) and (e). This provision is included because the investigation into the 2012 Chevron Richmond Refinery fire revealed that critically important recommendations relevant to process safety had never been acted upon or tracked to completion.

Section 2762.14 Process Safety Culture Assessment (PSCA)

Specific Purpose

This section describes the requirements of periodic Process Safety Culture Assessments (PSCA) conducted by the refinery. “Process safety culture” is defined in section 2735.3(aaa) as “a combination of group values and behaviors that reflect 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.” A group's culture reflects the things that the group values. If the group places a high value on safety, the group is said to have a "strong safety culture." Evaluating a refinery's safety culture (and the ways in which it changes over time) is an important way of gauging the degree to which managers are implementing new safety requirements and prioritizing safety above other pressures, such as efficiency, costs, and competitiveness.

PSCAs are tools that are used to determine whether and to what extent managers are implementing genuine safety improvements at a stationary source, and whether and to what extent they are encouraging a culture that values safety. PSCA is based on the tenet that the management of an organization can influence employees to embrace positive shared safety values with consistent policies and practices and by leading through example.

Necessity

The CSB Final Chevron Report 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 Final Chevron Report, January 2015, recommendations 2012-03-I-CA-R36; R37p. 116). For these reasons, safety culture assessment will be required for all Program 4 stationary sources in California in order to prevent accidental releases.

PSCAs are already required in the Contra Costa County ISO [Chapter 450-8 as amended by Ordinance 2006-22 and 2014-7, section 450-8016 (h)] and the City of Richmond ISO [Ordinance 13-14, Chapter 6.43, section 6.43.090 (h)], and programs already exist at least at four California refineries. This requirement does not currently exist at other refineries in California. The proposal addresses these gaps by requiring the following actions: (1) Development of a program; (2) Specified components of a PSCA; (3) Employee representation and communication; and (4) Recommendations, corrective actions and interim reviews.

Development of a program

Subsection (a) requires the refinery to develop, implement, and maintain an effective program for conducting periodic PSCAs.

Specified components of a PSCA

Subsection (b) requires all refineries to conduct an effective PSCA and produce a written report and action plan within eighteen months of the effective date of this Article, and every five years thereafter. Guidelines for how to conduct an effective PSCA have previously been published by Contra Costa County. (Industrial Safety Ordinance Guidance Document, Section F: Safety Culture Assessments, http://cchealth.org/hazmat/pdf/iso/section_f.pdf.) The Contra Costa County guidelines recommend that depending on the size of the facility, the following work groups should be assessed: management, supervisors, operators, maintenance, engineering, health and safety personnel, and contractors. (Industrial Safety Ordinance Guidance Document, Section F: Safety Culture Assessments, p. F-3.) To better understand potential differences in behavior and develop improvement strategies, facilities should consider also creating sub-work groups for soliciting assessments from different processing areas, shifts, crews, maintenance crafts, or levels of management.

Process safety culture can be assessed using any of a number of methods, including surveys, individual interviews, focus groups, and observational studies. This regulation does not require any specific approach to conducting the PSCA because there are numerous equally valid methodologies, and different assessment methods may be used at different facilities. This subsection does, however, specify five process safety culture areas in which refineries must assess their progress: (1) The employee's hazard reporting program; (2) The refinery's response to reports of hazards; (3) Ensuring incentive programs do not discourage reporting hazards; (4) the refinery procedures to ensure that process safety is prioritized during an upset or emergency condition; and (5) management's commitment and leadership. California refineries with an effective PSCA program already in place that assesses progress in these five issue areas would already meet the requirements of this section.

Employee Representation and Communication

Subsection (c) requires the formation of a team to conduct or oversee the PSCA. PSCAs may be performed by contractors, but an onsite team meeting the requirements of this subsection must oversee the process from inception through completion. This subsection specifies that employee representation in the team is required. This ensures that there is a clear and consistent process for

including employees and employee representatives in all major components of process safety. The intent of this provision is to ensure that employees and employee representatives are involved in selecting a contractor (if applicable) to perform the PSCA, choosing a methodology for the PSCA, tailoring the questions to the circumstances in the individual facility, interpreting the results, developing the recommendations, and writing the PSCA report. The provisions on employee involvement are discussed in more detail in the section of the ISOR describing section 2762.10.

Subsection (h) requires that the reports generated under this section be made available to employees, employee representatives and participating contractors within 30 days of completion. The subsection further requires that these reports be actively communicated to these groups of people, rather than simply being posted or requiring employees to seek them out. Process safety culture is relevant to the entire workforce of the refinery and it is something that should be actively communicated to all groups. This provision responds to a recommendation in the CSB Final Chevron Report saying that: "The periodic process safety culture report shall be made available to the plant workforce." (CSB Final Report, p. 116, Recommendations 2012-03-I-CA-R36; R37.) This provision is necessary to ensure that employees will quickly learn about the results, the recommendations, and the plan to address any identified issues.

Recommendations, corrective actions and interim reviews

Subsection (d) requires the refinery to produce a report and recommendations within a specified time (90 days) of the completion of the assessment, and lists the required components of the report. Labor union representatives at some refineries that currently conduct PSCAs provided information suggesting that unfavorable PSCA results have sometimes not been released in a timely manner. This provision is therefore necessary to ensure that refineries finalize a report and make the results available to regulators in a timely manner, regardless of whether the results are favorable or unfavorable. This provision ensures that an unfavorable PSCA leads promptly to recommendations and to corrective action.

Subsection (e) requires the owner or operator working with the PSCA team to develop corrective actions to address the recommendations of the team. The corrective actions are to be complete within 24 months of the completion of the report. This provision is different from other requirements of this Article because the type of recommendations that will come from a PSCA and the corrective actions that will be put in place will be different from the types of recommendations and corrective actions emerging from other sections of this Article. The PSCA will tend to generate recommendations and actions focused on training, communication, and decision-making rather than on engineering solutions. For this reason, the formal corrective action work process in section 2762.16(d) and (e) does not apply to recommendations emerging from the PSCA, but timelines for implementation do still apply. This provision is included because the investigation into the 2012 Chevron Richmond Refinery fire revealed that critically important recommendations relevant to process safety had never been acted upon or tracked to completion.

Subsection (f) requires the refinery to conduct and document an interim assessment (within three years after the completion of the PSCA report) in between each formal PSCA. This ensures that there is a

focused review of interim progress more frequently than every five years. This provision is also intended to allow flexibility in implementation, and to be less onerous than the option of conducting a full PSCA every three years. Issue areas that are not the focus of recommendations in the PSCA are not required to be included in the interim assessment. The purpose of the interim assessment is to evaluate the adequacy of the corrective actions. If a corrective action is not resulting in any measurable improvement to the safety culture indicator in question, then a revised or new corrective action would need to be developed and implemented in order to ensure progress prior to the next full PSCA.

Subsection (g) requires the refinery manager, or his/her designee, to sign the PSCA. This requirement ensures that the report is personally reviewed by the refinery manager and that this person is aware of any areas that are in need of improvement. Research on safety culture has consistently demonstrated that top-level management must demonstrate a strong commitment to safety in order to achieve a strong safety culture. This provision is intended to focus the attention of top management on the importance of process safety and to thereby create the conditions for a strong safety culture to thrive throughout all levels of the workforce at the facility.

Section 2762.16 Human Factors Program

Specific Purpose

The purpose of this section is to set forth requirements for integrating Human Factors into the refinery's Accidental Release Program. “Human Factor” is defined in section 2735.3 (z) as “a discipline concerned with designing machines, operations, and work environments so that they match human capabilities, limitations, and needs. Human factors include environmental, organizational, and job factors, and human and individual characteristics, such as fatigue, that can affect job performance, process safety, and health and safety.”

Human Factors describe the human element of process safety. They include staffing levels, training and competency levels, fatigue and other effects of shift work, communication systems, the human-machine interface, and the general physical challenges of the work environment. Human Factors affect many refinery programs and are especially relevant to procedural safeguards.

The purpose of an effective Human Factors program is to ensure safe operation of a refinery by making sure the process equipment, operating procedures, and all procedural safeguards are designed in a manner that minimizes the potential for human error. This will improve the overarching safety of all refinery processes, which is fundamental to preventing process failures, including those that could lead to a major incident.

Necessity

CSB identified human factor deficiencies as major contributors to the explosion and fatalities at the BP Texas City Refinery in March 2005 (CSB Investigation Report No. 2005-04-I-TX, March 2007, p. 72). 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. The CSB cited similar issues in numerous other major refinery incidents and has repeatedly recommended that industry and regulatory agencies to pay more attention to human factors. The Federal OSHA National Emphasis Program for Refineries included human factors as a component of its national review of oil refineries. (See William Bridges & Revonda Tew, Revonda, Human Factors Elements Missing from Process Safety Management (PSM), Process Improvement Institute, Inc. (PII), http://www.process-improvement-institute.com/_downloads/Human_Factors_Elements_Missing_from_PSM.pdf, page 3.)

The Contra Costa County ISO and the City of Richmond ISO both require written Human Factors Programs (Chapter 450-8 as amended by Ordinance 2006-22 and 2014-7, section450-8.016(b); Ordinance 13-14, Chapter 6.43, section 6.43.090(b)). Four refineries in California are therefore already required to maintain these programs. There is currently no statewide requirement for refineries to conduct human factors analyses or to create a human factors program. If other refineries do have such programs, they are not held to any uniform standard, and they are not reviewed for compliance with any established criteria. Refineries are not currently required to take any actions based on human factors concerns. The regulation would address these gaps by requiring: (1) an effective Human Factors program; (2) evaluation of a specific list of topics within the program; (3) inclusion of a Human Factors analysis in certain situations; and (4) employee training and involvement in the Human Factors program. Each of these requirements is described below.

<u>An effective Human Factors program</u>

Subsection (a) requires that the owner or operator develop, implement, and maintain an effective written Human Factors Program within 18 months of the effective date of the Article. <u>Evaluation of a specific list of topics within the program</u>

Subsection (c)

The written Human Factors Program must include evaluation of a specified list of topics: staffing levels, the complexity of tasks, the length of time needed to complete tasks, the level of training, experience and expertise of employees, the human-machine and human-system interface, the physical challenges of the work environment in which the task is performed, employee fatigue and other effects of shiftwork and overtime, communication systems, and the understandability and clarity of operating and maintenance procedures. In the case of process controls there are additional specific areas that must be addressed to ensure that these are designed with human factors in mind, including: (1) Error proof mechanisms; (2) Automatic alerts; and (3) Automatic system shutdowns. These three issues are particularly important because they reduce the potential for human error by removing the human element in certain emergency situations. This list of Human Factors is derived from the existing ISOs in California and is consistent with recommendations from experts including the CSB. Each of these items is necessary in order to effectively evaluate the likelihood that human factors could contribute to a process safety incident.

<u>Inclusion of a Human Factors analysis in certain situations</u>

Subsection (b) requires the owner or operator to maintain a description of the owner or operator's selected human factors methodologies and criteria for their use, but it does not prescribe what methodology or methodologies the owner or operator must use. This provides maximum flexibility for the refinery to design and implement its own program, as long as that program is effective.

In **subsection (b)**, the stationary source is required to analyze human factors in five situations: during the design phase of a major change; in all incident investigations; in all PHAs; in all management of organizational change analyses (MOOCs); and in all HCAs. 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. For example, installing an automatic shut-off valve instead of a manual valve, or making sure a manual valve is easy to see and to reach would be examples of incorporating human factors in a major change. Human factors have been found among the root causes of most historical major incidents, so these should be routinely considered in all incident investigations. The PHA must incorporate consideration of human factors in developing scenarios and in shaping recommendations because human factors can lead to, exacerbate, or ameliorate process hazards of all types. MOOCs are done to consider the impacts of staffing changes or other human-related issues, so these should also incorporate consideration of human factors. Because the HCA includes not only first- and second-order inherent safety measures, but also safeguards, it is important to include human factors, as relevant, in HCAs. Relevant times to include a human factor analysis in an HCA would be every time 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 and some approaches include human factors considerations.

Subsection (d) requires an assessment of human factors in new operating and maintenance procedures because the human-machine interface and other human factors can lead to errors and process safety risks that could be reduced or prevented by clear procedures. Existing operating and maintenance procedures must be revised according to a timeline specified in this subsection. Operating procedure revisions are a higher priority for safety; these must be completed in three years, whereas maintenance procedures can take up to five years to update. This schedule was considered to be feasible by most refinery representatives consulted.

<u>Employee training and involvement in the Human Factors program</u>

Subsection (f) requires that the stationary source train their employees on the Human Factors Program. This is necessary in order to ensure that all employees are familiar with the important role of human factors in process safety, and are familiar with any procedures in place to reduce the risk of an incident due to human factors.

Subsection (g) is identical to those in other sections of the regulation. It ensures that there is a clear and consistent process for including employees and employee representatives in all major components of process safety. The intent of this provision is to ensure that employees and employee representatives are involved in developing the scope of the human factors program, writing the program itself, training employees in the human factors program, and implementing the program in the various required

contexts. The provisions on employee involvement are discussed in more detail in the section of the ISOR describing section 2762.10.

Subsection (h) requires that the written human factors program produced under this section be provided directly to all employees, employee representatives and participating contractors, contractor employees, and their representatives. Widespread dissemination of the Human Factors Program is warranted in this case because this program is relevant to the entire workforce at the refinery and it is something that should be actively communicated to all groups rather than only to certain groups within the refinery.

Section 2762.16 ***Accidental Release Prevention (ARP) Program Management System***

Specific Purpose

This Chapter requires stationary sources to have a management system to implement the prevention elements for Program 2 and 3 stationary source covered processes. This section includes the requirements for an effective management system to overseeing the development and implementation of the Program 4 prevention elements applicable to refineries. This section also establishes a corrective action work process with timelines to complete corrective actions, provisions to require anonymous reporting of safety concerns, and process safety performance indicators to measure safety performance.

The Center for Chemical Process Safety defines management systems as: "A formally established and document set of activities designed to produce specific results in a consistent manner on a sustainable basis." (CCPS, Guidelines for Risk Based Process Safety, American Institute of Chemical Engineers, New York, New York, 2007, page 10.) This section explains how to develop and implement a written ARP Management System, including creating policies and procedures. The subsections dealing with corrective action work processes outline the procedures for developing and documenting corrective actions that implement recommendations from PHA, DMR, HCA, Incident Investigations, PSCA, compliance audits, and SPAs. These subsections outline specific processes for accepting or rejecting recommendations and timelines for completing all corrective actions.

Necessity

Over the past 20 years, government mandates for formal process safety management systems in Europe, the U.S., and elsewhere have prompted widespread implementation of a management systems approach to process safety. However, after an initial surge of activity, process safety management activities appear to have stagnated within many organizations. Incident investigations continue to identify inadequate management system performance as a key contributor to the incident. Moreover, audits reveal a history of repeat findings indicating chronic problems the symptoms of which are fixed again and again without effectively addressing the technical and cultural root causes. (CCPS, Guidelines for Risk Based Process Safety, 2007, page 1.) These changes are necessary to these regulations in order to maximize refinery safety with the most recent and up to date analysis.

Establish a written management system

Subsection (a) requires the stationary source to develop and implement a written ARP Management System and review and revise the plan every three years. It also requires the development of annual safety goals to achieve continuous improvement. These safety goals may be the same as the individual performance indicators required in subsection (h)(2) below.

Subsection (b)

As part of the ARP Management System, the refinery is required to develop and maintain written ARP policies and procedures. These must include job descriptions, an organizational chart, communication procedures across shifts and personnel, written procedures to ensure communication of recommendations and corrective actions to employees and employee representatives, and policies for employee participation.

Subsection (c) requires the owner or operator to track and document all changes to program elements under Article 6.5.

Follow a corrective action work process

Subsection (d) requires the stationary source to develop and document a corrective action work process to address findings and recommendations resulting from program elements (i.e. PHA, DMR, HCA, Incident Investigation, PSCA, compliance audit, and SPA) as part of the ARP Management System.

Subsection (e)(1) requires that teams transmit PHA, DMR, HCA, Incident Investigation, Compliance Audit, and SPA findings and recommendations to the owner or operator within 14 days after completion. Subsection (e)(2) allows the owner or operator to reject a recommendation only under specific circumstances: when there are factual errors; when the recommendation is not relevant to process safety; or when the recommendation is infeasible. Subsection (e)(3) also allows the owner or operator to change a recommendation only when it is possible to demonstrate that an alternative measure is equally safe or safer. The ability to change a recommendation, however, does not allow the owner or operator to replace a measure recommended by a team with a different measure that is lower on the hierarchy of hazard controls (see Section 2762.13). Subsections (e)(4), (5), and (6), require the owner or operator to document all decisions and communicate them back to the original team members, who are afforded the opportunity to comment.

Subsection (e)(7) requires the owner or operator to develop and document corrective actions tailored to each accepted recommendation. Each corrective action must have a scheduled completion date not to exceed the maximum timelines specified in subsections (e)(10)-(13), and assigned supervisory personnel responsible for ensuring completion. Corrective actions that do not require a process shutdown must be completed within two and a half years (subsection (e)(11)). Corrective actions from compliance audits must be completed within one and a half years (subsection (e)(12)). Corrective actions from incident investigations must be completed within one and a half years of the investigation (subsection (e)(12)).

All corrective actions requiring a process shutdown must be completed during the first regularly scheduled turnaround (subsection (e)(13)).

Subsection (e)(9) requires any change to a completion date must be evaluated under the Management of Change process. The scheduled completion dates are available to the employees upon request. Subsection (e)(14) further requires that the owner or operator to have sufficient interim safeguards in place to ensure that accidents do not occur while permanent corrections are being completed. The owner or operator must track each corrective action to completion and then append the applicable review or analysis report with the completion date (subsection (e)(15)).

Stop work procedures and anonymous reporting

Subsection (f) requires that the owner or operator develop a system within 90 days of the effective date of this Article to implement: (1) Effective Stop Work procedures; and (2) Effective procedures to ensure the right of all employees, including employees of contractors, to anonymously report hazards.

The Stop Work procedures must specifically include three components: (A) The authority of all employees, including employees of contractors, to refuse to perform a task where doing so could reasonably result in death or serious physical harm; (B) The authority of all employees, including employees of contractors, to recommend to the operator in charge of a unit that an operation or process be partially or completely shut-down, based on a process safety hazard; and, (C) The authority of the qualified operator in charge of a unit to partially or completely shut-down an operation or process, based on a process safety hazard.

This subsection further requires the owner or operator to respond in writing within 30 calendar days to written hazard reports submitted by employees, employee representatives, contractors, employees of contractors and contractor employee representatives. The owner or operator must prioritize and promptly respond to reports of hazards that present the potential for death or serious physical harm.

Subsection (g) requires that the owner or operator must have a system in place within ninety (90) days of the effective date of this section to document and enable employees to report information pursuant to subsections (f)(1) and (f)(2).

Subsections (f) and (g) are necessary because encouraging front-line employees to take responsibility for safety, empowering them to take independent action – where necessary – to ensure safety, and having systems in place to encourage reporting of safety concerns without fear of retaliation, are all important contributors to incident prevention.

Establish and report Process Safety Performance Indicators

Subsection (h)

Specific Purpose

The purpose of this subsection is to establish requirements for refineries to develop and track process safety performance indicators. Process safety performance indicators are defined in section 2735.3 (bbb) as: “measurements of the facility’s activities and events that are used to evaluate the performance of process safety systems.” 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, safety, and a variety of other items of interest.

Process Safety Performance Indicators are a new requirement for some refineries in California, however process safety performance indicators are already required in Contra Costa County ISO [Chapter 450-8 as amended by Ordinance 2000-20, 2006-22, and 2014-7 subsection 450-8016(a)(13)(D)] and the City of Richmond ISO [Ordinance 13-14, Chapter 6.43 subsection 6.43.090(a)(13)(D)] and therefore are already required for at least four California refineries.

This subsection establishes the requirement to develop process safety performance indicators that are common to all Program 4 stationary sources and the requirement for the stationary sources to also establish process safety performance indicators specific to their site.

Necessity

CCPS states “Monitoring and analyzing such performance enables organizations to identify and track not only current performance but also trends, both improvements and degradations, so that corrective actions are taken as needed. An organization that expects and maintains performance within operating specifications and that monitors activities or behaviors critical to overall safety operations (e.g., training, management of change) is more likely to avoid major failures, including catastrophic events.” (CCPS, Guidelines for Process Safety Metrics, American Institute of Chemical Engineers, New York, New York, 2010, page 3.)

The United Kingdom Health and Safety Executive (HSE) has published a guidance document to help chemical and major hazard industries develop process safety indicators. HSE states that “Most systems and procedures deteriorate over time, and system failures discovered following a major incident frequently surprise senior managers, who sincerely believed that the controls were functioning as designed. Used effectively, process safety indicators can provide an early warning, before catastrophic failure, that critical controls have deteriorated to an unacceptable level.” (Health and Safety Executive, Developing Process Safety Indicators a Step-by-Step Guide for Chemical and Major Hazard Industries, HSE Guidance Series/HSG Series, HSG254, 2006, Page 4.)

The CSB Interim Chevron Report recommends to the California State Legislature and to the Governor of California the following: “For all California oil refineries, identify and require the reporting of leading and lagging process safety indicators, such as the action item completion status of recommendations from damage mechanism hazard reviews, to state and local regulatory agencies that have chemical release prevention authority. These indicators shall be used to ensure that requirements described in 2012-03-I-CA-R9 are effective at improving mechanical integrity and process hazard analysis performance at all California oil refineries and preventing major chemical incidents.” (April 2013, recommendation 2012-

03-I-CA-R10, p. 56.) For these reasons, process safety performance indicators are necessary for all Program 4 stationary sources in California in order to prevent major incidents.

Common Process Safety Performance Indicators

Paragraph (1) requires the owner or operator to annually report to Cal OES and the UUPAs specified activities and other events to be measured in order to evaluate the performance of process safety systems. These documented measurements are named common process safety performance indicators. These indicators are referred to as "common" because all refineries in California will be required to report them, as distinct from "individual" process safety performance indicators required by paragraph (2) discussed below that are specific to each refinery. This requirement begins one year after the effective date of Program 4 requirements. Refineries are required to submit the common process performance indicators by June 30 for the previous calendar year. Cal OES will make these indicators public by posting them on its website. Having common process safety performance indicators that will be made public will provide a transparent means to assess the commitment to process safety by the different Program 4 stationary sources.

The public can play an important role in monitoring process safety at the refineries. CCPS promotes the sharing of process safety indicators with the public: "Sharing performance metrics and results broadly can engage the public as a partner in holding the organization accountable for process safety performance. Making metrics and performance public can be an especially powerful way of maintaining upper management commitment since it will likely be the CEO or other senior managers who will be called to account by the public if goals are not met or performance declines. Communicating process safety successes also demonstrates to employees and the public that positive change can be, and are being, made within an organization." (CCPS, Guidelines for Process Safety Metrics, American Institute of Chemical Engineers, New York, New York, 2010, page 109.)

Paragraph (1)(A)

Five common process safety indicators are specified. The first common process safety performance indicator is past due inspections for piping and pressure vessels. The stationary source is already required to maintain the mechanical integrity of the equipment, piping, and instruments (see Section 2762.5). To determine the integrity of the existing equipment, piping, and instruments a thorough inspection program is required (see Section 2762.5(b)). This common process safety performance indicator will monitor the stationary source's commitment to maintaining a thorough inspections program.

Paragraph (1)(B)

The second common process safety performance indicator is past due process hazard analyses and seismic analysis corrective actions. Stationary sources are required to perform process hazard analyses (PHA) (Section 2762.2). A PHA is a means to determine the hazards that exist at a stationary source and what safeguards exist to prevent a major incident and to develop recommendations and corrective actions that may be needed to prevent a major incident. Seismic analyses are means to determine what

the impact of a seismic event may be on a stationary source and the ability of the stationary source to withstand the impact of the seismic event. The timely implementation of the corrective actions that result from these analyses is an indication of the stationary source's commitment to process safety.

Paragraph (1)(C)

The third common process safety performance indicator is past due corrective actions from incident investigations. Program 4 stationary sources are required to investigate any incident that results in or could reasonably have resulted in a major incident (Section 2762.9). Program 4 stationary sources are required to determine the causes, including the root causes of the incident. Recommendations and corrective actions are created to address the causes of the incident. The timely implementation of the corrective actions that result from incident investigations is an indication of the stationary source's commitment to process safety.

Paragraph (1)(D)

The fourth common process safety performance indicator is the number of major incidents for the previous calendar year. Incidents are normally called a "lagging indicator," since they are adverse events that have already occurred. The purpose of this Article is to prevent major incidents from refineries. This indicator is an objective measurement of how often the refinery is not successful in meeting the overall purpose of this Article.

Paragraph (1)(E)

The fifth common process safety performance indicator is the number of temporary piping and equipment repairs installed on hydrocarbon and high energy utility systems that are past the replacement date for a permanent repair. Whenever a Program 4 stationary source installs a temporary piping or equipment repair, the stationary source is required to go through a management of change process (see Section 2762.6). Temporary repairs are required to have a specified timeline for implementing a permanent repair (see Section 2762.6(b)(4)). The number of times that the permanent repair has not been installed by the established replacement date, as a fraction of the total number of temporary repairs done that year at the facility, is an indication of the effectiveness of the MOC process at a Program 4 stationary source.

Paragraph (1)(F) specifies the format for reporting the indicators to Cal OES and the UPA. This ensures a consistent means for reporting the common process safety performance indicators to assist in determining any change in process safety performance at a facility over time.

Paragraph (2) requires that, in addition to the five common indicators listed above, the owner or operator must develop a list of site-specific indicators, consisting of activities and other events that it will measure. The owner or operator is required to prepare an annual written report by June 30 for the previous calendar year containing information on all of these site-specific process safety performance indicators. The refinery manager or designee is required to certify annually that the report is current and accurate.

Development of site-specific process safety performance indicators allows the Program 4 stationary sources to tailor process safety performance indicators that will work best at their facility to measure their own progress on process safety. According to the CCPS, "Properly selected metrics (indicators) that fit with the detailed objectives of an organization will identify the successes and point out the weaknesses of the system." (CCPS, Guidelines for Process Safety Metrics, American Institute of Chemical Engineers, New York, New York, 2010, page 10.) The purpose of this requirement is to encourage a process of continuous improvement at California refineries, in which each refinery must develop its own benchmarks for success and strive to meet them. It is important to note that although the common process safety indicators are publicly reported, the site-specific individual indicators are not required to be reported to the UPA or to the public. The owner or operator must, however, provide information on these individual indicators to the UPA upon request. (Section 2762.17.)

2762.17 Access to Documents and Information

Specific Purpose

The purpose of this section is to ensure that the UPA inspectors will have access to all documents and information developed pursuant to Article 6.5 to assist the UPA inspector in determining if the refinery is in compliance with the Article. This includes, but not limited to, the policies, procedures, training documentation, reports, assessments, investigations documentation, process safety information, standards and recommended practices, and inspection records.

Necessity

To determine if a refinery is complying with the requirements of Article 6.5 it is imperative that the UPA have full access to the documentation and information that is required under Article 6.5. Without this requirement, an UPA would be unable to determine if the refinery is in compliance with the requirements of Program 4.

2775.25 Independent Assessments of Program 4 Facilities

Specific Purpose

The purpose of this section is to allow for an independent assessment in the case of a major incident to determine whether the refinery is in compliance with requirements of Article 6.5 and to provide for an additional layer of transparency. This section gives the UPA the authority to provide an independent assessment by performing a PSCA, Incident Investigation, evaluation of the required management system, or a Human Factors Analysis after a major incident. If the UPA has the needed expertise, the UPA may perform one or a combination of these analyses itself, or it may hire a contractor with the applicable expertise to perform these functions. The refinery is required pursuant to subsection 2762.9(n) to assist the UPA and to pay the costs of this independent analysis or analyses.

Necessity

Whenever there is a major incident, the public frequently wants to know what happened and whether the refinery is safe to operate. At such times, the public may have little confidence in any investigations performed by the refinery itself, and often the public demands an independent evaluation. The Contra Costa County ISO gives the Contra Costa County Hazardous Materials Program the ability to perform an independent safety culture assessment, a safety inspection, and/or an incident investigation, including a root cause analysis after a major chemical accident or release. (Contra Costa County ISO, Chapter 450-8 as amended by Ordinance 2006-22 and 2014-7, § 450-8.016(c)(2), 450-8.016(h), and 450-8.018(f).) Three safety evaluations and one root cause analysis has been performed pursuant to the Contra Costa County ISO and the City of Richmond ISO. The three safety evaluations were performed by a third-party overseen by the County Hazardous Materials Program staff with a public interface, and the root cause analysis was performed by the County Hazardous Materials Program staff. This ability to perform an independent evaluation and analysis has provided additional public transparency and an improved ability to determine compliance with the requirements of the ordinances.

2775.7 Unified Program Agency Training

Purpose

The purpose of this section is to ensure that UPA inspectors meet minimum educational and professional experience qualifications and that they continue to learn through ongoing and refresher training.

Necessity

This requirement will ensure that the UPA inspectors performing the audits and inspections of CalARP Program stationary sources have the appropriate knowledge to determine compliance with the requirements of this Chapter.

Subsection (a) requires that UPA inspectors have the needed educational qualifications and professional experience to effectively perform CalARP Program inspections. This subsection also requires Cal OES to develop three levels of training, including a certification process for UPA inspectors. The three levels of training will certify that inspectors are qualified to perform inspections of the following stationary sources:

- Program 1 or Program 2 stationary sources,
- Programs 1, Program 2, or Program 3 stationary sources, and
- Programs 1, Program 2, Program 3, and Program 4 stationary sources.

Subsection (b) requires that UPA inspectors performing CalARP Program inspections have 24 hours of refresher training at least every two years. The refresher training curriculum will be developed by Cal OES.

FIRE PREVENTION STATEMENT

The State Fire Marshal approved these proposed regulations. Because this regulation is not a building standard, Health and Safety Code Section 18930(a)(9) does not apply.

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.

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 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.

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 cost effective.

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.

Summary of the statewide costs and benefits for this regulation and each alternative considered:

Scenario	Benefit	Cost
Proposed Regulations	$800 million	$58 million
Maintain status quo	$0	$800 million
Safety Case approach	$800 million	$122 million

For the proposed regulations, the quantifiable benefits are expressed in terms of costs avoided due to safety improvements that reduce the number of costly major refinery incidents. As discussed above under Alternative 1, the proposed regulations are expected to prevent costly major refinery incidents, with $800 million in costs avoided. As detailed above, the costs associated with compliance with the proposed regulations are estimated at $58 million. This is a net benefit to the state.

Maintaining the status quo generates $0 additional benefit to the state. The opportunity cost of doing nothing to strengthen the existing standards is $800 million in expected annual loss to the California economy.

TECHNICAL, THEORETICAL, OR EMPIRICAL STUDIES, REPORTS, OR DOCUMENTS RELIED UPON BY CALOES

1. CCPS, Guidelines for Process Safety Metrics
2. CCPS, Guidelines for Risk Based Process Safety
3. CCPS, Guidelines for the Management of Change for Process Safety
4. CCPS, Inherently Safety Chemical Processes
5. City of Richmond Industrial Safety Ordinance
6. Contra Costa County Industrial Safety Ordinance
7. Contra Costa County ISO Guidance Document
8. CSB Chevron Final Investigation Report
9. CSB Chevron Interim Investigation Report
10. Human Factors Elements Missing from PSM
11. Interagency Working Group Report
12. UK Health and Safety Executive, Developing Process Safety Indicators a Step-by-Step Guide for Chemical and Major Hazard Industries
13. US Chemical Safety Board Exxon-Mobil Report

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
AEGLs	Acute Exposure Guideline Levels
API	American Petroleum Institute
ARP	Accidental Release Prevention
CAA	Clean Air Act
Cal OES	California Governor's Office of Emergency Services
CalARP	California Accidental Release Prevention
CCPS	Center for Chemical Process Safety
CCR	California Code of Regulations
CEPP	Chemical Emergency Preparedness Program
CSB	Chemical Safety and Hazard Investigation Board
DMR	Damage Mechanism Review
EPCRA	Emergency Planning and Community Right-to-Know Act
HCA	Hierarchy of Hazard Controls Analysis
HSC	Health and Safety Code
ISO	Industrial Safety Ordinance
LOPA	Layer of Protection Analysis
MOC	Management of Change
MOOC	Management of Organizational Change
NAICS	North American Industry Classification System
OEHHA	California Office of Environmental Health Hazard Assessment
PEL	Permissible Exposure Limit
PHA	Process Hazard Analysis
PSCA	Process Safety Culture Assessment
PSI	Process Safety Information
PSM	Process Safety Management
PSSR	Pre-Startup Safety Review
RAGAGEP	Recognized and Generally Accepted Good Engineering Practices

RELs	Reference Exposure Levels
RMP	Risk Management Plan
SPA	Safeguard Protection Analysis
U.S. EPA	United States Environmental Protection Agency
UPA	Unified Program Agency