February 2014

# Improving Public and Worker Safety at Oil Refineries

## *Report of the Interagency Working Group on Refinery Safety*

**Edmund G. Brown Jr.**
**Governor**

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# Executive Summary

In the aftermath of a serious chemical release and fire at Chevron's Richmond oil refinery in August 2012, Governor Brown formed an 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 Working Group consists of participants from 13 agencies and departments, as well as the Governor's Office. Over an eight-month period, the Working Group met internally and with industry, labor, community, environmental, academic, local emergency response and other stakeholders. The Working Group issued a draft report in July 2013 and received comment on the draft from local governments, industry stakeholders, nongovernmental and labor representatives, and members of the public. The report was revised and finalized in response to these comments. The Working Group's findings and recommendations include:

## Findings

***Oversight and Coordination:***
Multiple regulatory agencies have responsibility for oversight of aspects of refineries, sometimes with overlapping jurisdiction. Agency actions and efforts to ensure information sharing, joint prioritization of enforcement or regulation, or other coordinated efforts to avoid potential duplicative action, are insufficient.

***Emergency Response and Preparedness:***
Regulations need to define more precisely a refinery's requirements for reporting leaks or releases of a hazardous material to local and state agencies. Response protocols and incident command authorities between public agencies and refineries need to be clarified and strengthened. Hazardous Materials Area Plans developed at the local level are written as general response guidance and not specifically to address the unique hazards a refinery poses. The current air monitoring network also does not provide real-time air pollution tracking in many geographic regions.

***Safety and Prevention of Hazardous Events:***
Refineries are subject to the California Accidental Release Program (CalARP) Risk Management Program (RMP), and the California Division of Occupational Safety and Health (Cal/OSHA) Process Safety Management (PSM) regulation, as well as an Industrial Safety Ordinance (ISO) in Contra Costa County, where four refineries are located. However, gaps in the regulatory schemes exist, including limitations on their ability to cover all aspects of process safety and the extent to which they are enforceable. Regulatory agencies face multiple issues relating to inspection and enforcement capabilities including: difficulty in hiring, retaining, and training inspectors; lack of mechanisms for information sharing and coordination; deficiencies in data and transparency; and insufficient penalties to create meaningful deterrence.

***Community Education and Alerts:***
There are shortcomings in existing emergency alert systems, public education and timely dissemination of health and safety information related to refinery emissions. These difficulties include challenges in communicating with surrounding communities regarding exposures and potential acute and chronic health risks as well as appropriate health-protective actions the public can take. Public involvement has not been well integrated into discussions to improve air monitoring during both routine refinery operations and upset events.

### Glossary of Terms

**Damage mechanism hazard review** - an assessment of potential damage mechanisms that can affect refinery processes, including corrosion, stress cracking, and mechanical degradation of metals.

**Human factors** - a scientific discipline concerned with understanding the interaction of individuals with each other, with facilities and equipment, and with management systems.

**Inherently safer systems** - requirements to ensure that refineries incorporate the highest level of reliable hazard reduction to the maximum extent feasible.

**Layer of protection analysis** - a semi-quantitative approach for assessment of the adequacy of the existing or proposed layers of protection against an accident scenario.

**Leading and lagging indicators** - predictive and retrospective metrics used to identify potential weaknesses and recurring problems, and also identify potential corrective action.

**Process hazard analysis** - an assessment of potential hazards associated with an industrial process. It is used to make risk management decisions to prevent accidental releases of hazardous chemicals.

**Root cause analysis** - an analysis that addresses the fundamental underlying problems after an incident.

**Safety case** - an alternative regulatory approach focused less on prescriptive regulation and more on comprehensive safety plans developed by facilities.

**Safety culture** - a commitment to safety as an overriding priority at all management levels of a facility.

## Recommendations

***Oversight and Coordination:***
An Interagency Refinery Task Force has been created within the California Environmental Protection Agency (CalEPA), to coordinate agencies' activities and carry out the recommendations in this report. The Task Force will be staffed by a new Refinery Information Officer at CalEPA, who will be a central point of contact for coordination of refinery-related matters for local, state, and federal agencies, and for industry and the public.

***Emergency Response and Preparedness:***
The Governor's Office of Emergency Services (Cal OES), formerly the California Emergency Management Agency, will coordinate improved emergency response by clarifying reporting thresholds during hazardous materials release or threatened release, and work with local Certified Unified Program Agencies (CUPAs) to create refinery-specific elements in Hazardous Materials Area Plans. The Working Group has identified at least four elements that must be included in the Area Plans: (1) alignment of radio communications between response officials; (2) clear criteria for the establishment of a Unified Incident Command and Joint Operation Center; (3) plans and protocols for communicating information to other entities, such as hospitals, schools, transit agencies, and other entities outside the refineries; and (4) requirements for joint drills and exercises. The California Air Resources Board (ARB), in collaboration with the California Air Pollution Control Officers Association (CAPCOA), is working on a parallel effort focused on toxic air contaminant monitoring to improve knowledge and information sharing of real-time air monitoring data.

***Safety and Prevention of Hazardous Events:***
Existing regulations and practices must be strengthened to ensure that more data and information are provided to agencies, workers, and the public. In addition, agency enforcement capabilities need to be enhanced. Additional regulatory changes to improve refinery safety procedures include six prevention strategies that should be required as soon as possible, directing 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. The Working Group additionally identified three areas for further study that include reporting of leading and lagging indicators, increasing worker and community involvement, and exploring the safety case approach.

***Community Education and Alerts:***
State agencies will evaluate improvements to public input during the emergency planning process, create enhanced public information and outreach protocols for use during a toxic chemicals release or fire, and improve alerts and public access to information during emergency events. Agencies are also working to enhance public availability of air monitoring and other relevant information.

The Governor's Office has directed the relevant agencies to respond immediately to the regulatory changes recommended in this report. Where changes require legislative authority, it is expected that agencies will consult with the Legislature, as appropriate.

# A. Introduction

On August 6, 2012, the Chevron refinery in Richmond, California, experienced a catastrophic pipe failure, releasing high-temperature flammable fluid that partially vaporized into a large cloud. The vapor cloud engulfed 19 employees, including one Chevron firefighter who escaped through the ensuing fire. All 19 employees narrowly avoided serious injury or death. The ignition and combustion of the vaporized fluid created a large smoke plume that spread well beyond the refinery confines, causing approximately 15,000 people in the surrounding communities to seek medical attention during and immediately following the incident.

Multiple agencies opened investigations in response to the incident. Cal/OSHA, the U.S. Chemical Safety and Hazard Investigation Board (CSB), and the U.S. Environmental Protection Agency (U.S. EPA) have issued public investigation reports. Chevron also completed its own internal investigation. All four investigations identified serious concerns about process safety management procedures at the refinery and expressed the need for stronger preventative safeguards.

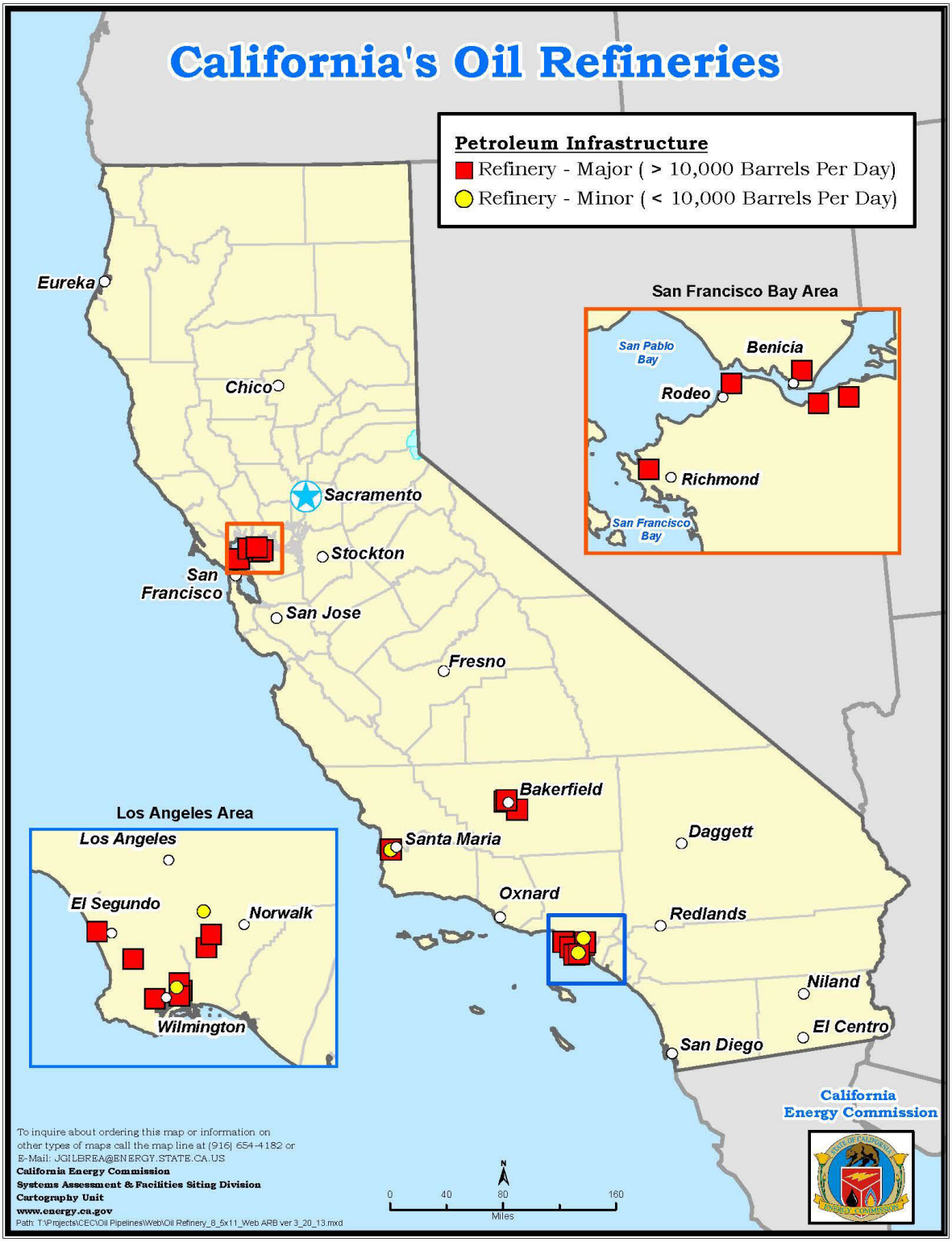
The incident at Chevron also provided an opportunity to take a more comprehensive look at industry performance, as well as agency oversight. While refineries in California are subject to regulation by multiple agencies and some have developed extensive health and safety programs, additional measures and alternative approaches offer the potential for enhanced prevention and risk reduction, without imposing significant new regulatory burdens.

In October 2012, Gov. Brown formed an Interagency Working Group on Refinery Safety to identify means of improving refinery and agency performance. These agencies met regularly over the course of eight months and analyzed their respective roles and responsibilities to identify regulatory gaps, areas of overlap and areas in need of improved coordination.[1]

The Working Group examined the following areas:

- **Oversight and Coordination** – How to coordinate actions of multiple agencies and oversee implementation of recommendations.
- **Emergency Response and Preparedness** – How to strengthen emergency preparedness and response in the event of an incident, through planning, coordination and communication among agencies at all levels.
- **Safety and Prevention of Hazardous Events** – How to prevent refinery incidents that threaten the health and safety of workers, communities and the environment, and promote a culture of safety and prevention of hazards in the industry.
- **Improved Communication and Interaction with the Public and Surrounding Communities** – How to better communicate with the public about refinery safety and health risks, as well as preventive measures, emergency procedures, and the responsibilities of agencies related to refinery safety.

1 The group consisted of the following agencies and departments: California Office of Emergency Services (Cal OES); California Energy Commission (CEC); California Environmental Protection Agency (CalEPA); CalEPA – Air Resources Board (ARB); CalEPA – Department of Toxic Substances Control (DTSC); CalEPA –State Water Resources Control Board (SWRCB); California Technology Agency (CTA); Department of Finance (DOF); Department of Public Health (DPH); Labor and Workforce Development Agency (LWDA); LWDA - Department of Industrial Relations (DIR); DIR - Division of Occupational Safety and Health (Cal/OSHA); and Office of the State Fire Marshal.


California's Oil Refineries
Petroleum Infrastructure
Refinery - Major ( > 10,000 Barrels Per Day)
Refinery - Minor ( < 10,000 Barrels Per Day)
Eureka
Chico
Sacramento
Stockton
San Francisco
San Jose
Fresno
Bakerfield
Santa Maria
Daggett
Oxnard
Redlands
Niland
El Centro
San Diego
San Francisco Bay Area
San Pablo Bay
Benicia
Rodeo
Richmond
San Francisco Bay
Los Angeles Area
Los Angeles
El Segundo
Norwalk
Wilmington
California Energy Commission
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160
Miles

The Working Group grounded its recommendations in the experience and insight of refinery workers, community residents, oil industry executives, governmental enforcement agency staff, and fire officials from city and county fire departments. The Group conducted a series of meetings with key stakeholders in northern and southern California. Technical consultants from the RAND Corporation and the University of California, Berkeley assisted in planning and conducting the meetings and analyzing the results. Additionally, as part of this interagency effort, ARB began collaborating with CAPCOA to examine state and local air monitoring practices in response to refinery incidents, recommend improvements, and encourage statewide best practices.

The Working Group issued a draft report in July 2013 and received comments from numerous interested parties. Since the publication of the draft report, there have been developments in several areas related to refinery safety. Specifically:

1. The Legislature approved a budget that adds new inspector positions to the Cal/OSHA PSM unit, which will increase Cal/OSHA's capacity to conduct inspections and provide technical assistance to refineries and other large facilities in California. These positions will be funded by Cal/OSHA's fee authority.
2. Legislation (SB 54, Hancock) was signed into law by Governor Brown on October 13, 2013. The legislation requires that certain facilities, including refineries, shall use contractors and subcontractors who employ a trained workforce within apprenticeable occupations in the building and construction trades when contracting for the performance of construction, alteration, demolition, installation, repair, or maintenance work. This legislation addresses concerns raised by some stakeholders that the training of contract workers is often insufficient, which can contribute to unsafe conditions.
3. On August 5, 2013, the California Attorney General and the District Attorney for Contra Costa County filed a criminal action against Chevron U.S.A., Inc. stemming from the August 6 incident. Pursuant to a plea agreement, Chevron agreed to pay $2 million in fines and restitution and pleaded no contest to six misdemeanor counts. The $2 million consists of $1.28 million in fines, $575,000 for reimbursement of costs to Cal/OSHA, the Bay Area Air Quality Management District and the Attorney General's Office, and $145,000 to Richmond BUILD, a local public-private partnership to support worker training in renewable energy and construction fields. Cal/OSHA is overseeing the terms of Chevron's three-and-a-half year probation at the Richmond refinery, which requires abatement of all deficiencies identified in Cal/OSHA's citations, and (1) an inspection of all carbon steel piping systems susceptible to sulfidation corrosion, (2) revised procedures for Chevron's damage mechanism reviews, (3) additional requirements for and oversight of fixed equipment recommendations for turnaround events, and (4) enhanced training of refinery personnel.
4. The Refinery Task Force was convened, is holding regular meetings, and has formed workgroups on Emergency Response and on Safety and Prevention to move forward the recommendations in this report.

This final revised report contains the Working Group's conclusions and recommendations, but it is not intended to be exhaustive. Some recommendations are already being implemented; other recommendations will require sustained effort and collaboration among agencies and others to implement; still others will need further evaluation and development before a decision can be made about whether to put them in place. This final report provides the initial blueprint for a multi-year process of continual improvement of refinery safety in California.

**Table 1: California Refineries: Local Regulatory Jurisdictions**

| Refinery and Location | Unified Program Agency (CUPA) | Air District | Cal/OSHA |
|---|---|---|---|
| Chevron Richmond | Contra Costa County Hazardous Materials Programs | Bay Area Air Quality Management District | Northern California PSM Unit |
| Phillips 66 Rodeo | | | |
| Tesoro Rodeo | | | |
| Shell Martinez | | | |
| Valero Benicia | Solano County Environmental Health | | |
| Chevron El Segundo | City of El Segundo Fire | South Coast Air Quality Management District | Southern California PSM Unit |
| Phillips 66 Wilmington | City of Los Angeles Fire | | |
| Tesoro Wilmington | | | |
| Valero-Ultramar Wilmington | | | |
| Valero Wilmington Asphalt | | | |
| ExxonMobil Torrance | LA County Fire / Torrance Fire | | |
| Paramount Oil Paramount | Los Angeles County Fire, Health Hazardous Materials Division | | |
| Tesoro Carson | | | |
| Phillips 66 Carson | | | |
| Lunday-Thagard South Gate | | | |
| Edgington Oil Long Beach | Long Beach CUPA | | |
| ALON Bakersfield | Kern County Environmental Health | San Joaquin Valley Air Pollution Control District | Southern California PSM Unit |
| Kern Oil Bakersfield | | | |
| San Joaquin Oil Bakersfield | | | |
| Phillips 66 Santa Maria | San Luis Obispo County Environmental Health | San Luis Obispo County Air Pollution Control District | Southern California PSM Unit |
| Greka Energy Santa Maria | | | |

# B. Stakeholder Perspectives

Over a six-month period, the Working Group held meetings and engaged in discussions with labor, community, industry, enforcement agencies and emergency response stakeholders. Major themes discussed are summarized below.

## 1. Labor

Workers involved in facility operations, represented by the United Steelworkers, reported that refinery structures are old and outdated, corrosion is pervasive, process safety management staffing has been reduced, and preventive maintenance is often not conducted before failure occurs. Workers also expressed concern that those who exercise their authority to shut down unsafe operations may experience retaliation by management, that relying on shut-down actions by workers shifts responsibility away from management's obligation to ensure mechanical integrity through preventive maintenance, and that maintenance and safety problems identified by refinery workers are not always corrected in a timely fashion. Several workers additionally reported that, in their view, management does not take seriously the monitoring of employee exposures to hydrogen sulfide, which can be immediately fatal.

The refinery workers recommended that the PSM requirements enforced by Cal/OSHA be enhanced based on an assessment of the strengths and weaknesses of an ISO adopted by Contra Costa County. In addition, workers urged that refineries should be required to share useful leading indicators, or early warning signs of safety and health risks with workers, the public, and enforcement agencies. Criminal sanctions to deter unsafe practices were also recommended.

Workers involved in maintenance, represented by building and construction trades unions, reported that training of most maintenance workers is inadequate. They reported that refineries use mostly contract workers, including out-of-state workers, to conduct maintenance during planned shutdowns of a refinery process (also referred to as turnarounds), and that contract workers have less training and experience and are therefore less capable of performing work safely.

The construction trades workers recommended that refineries be required to train maintenance workers through state-approved apprenticeship programs and pay them the prevailing wage. This has now become new law with the passage of SB 54 (Hancock). The same workers also echoed the recommendation of large civil and criminal penalties for unsafe practices.

## 2. Community

Meetings with community members were held in northern and southern California. Northern California participants included members of an ongoing Refinery Action Collaborative consisting of labor, community groups and environmental organizations.

Participants in both locations called for more information about long-term exposures and health effects from refinery emissions. Residents in southern California expressed concerns about visible flaring of gases from refineries. Participants in the northern California meetings reported that immediately after the Chevron fire, emergency communication from local agencies – via sirens and telephone – was inconsistent and unclear. They recommended state-of-the-art, real-time monitoring of air contaminants in the vicinity of refinery property lines (fence lines),

as well as air quality monitoring to help predict exposure levels. They also recommended the establishment of clear criteria to trigger notification to local residents of an incident, as well as clear information and instructions for local residents.

Community members expressed concern that refineries have not been communicating critical information, such as information on corrosion damage, to the state. Some members pointed out that there is insufficient publicly available information to allow independent assessments of refinery performance and safety, and they requested public release of annual information on leading and lagging indicators, air emissions from the refineries, and the annual average composition of the incoming petroleum feedstocks, known as the crude slate. The Refinery Action Collaborative pointed out that the sulfur content of crude oil imports has increased in recent years, which could increase both corrosion rates and emissions of toxic air contaminants, and that refineries are a significant source of greenhouse gas emissions. The Collaborative recommended that refineries be required to report information on the sulfur content of their crude oil, reduce grid energy use, and implement newer technologies to reduce emissions of greenhouse gases and toxic air contaminants.

### 3. Industry

Oil industry executives with expertise in refinery operations attended a day-long workshop facilitated by the RAND Corporation. Participants discussed the number of agencies involved in refinery oversight and the need for better coordination. The group also acknowledged the aging of refinery facilities and the changing workforce. The group discussed best practices for ensuring that refineries operate safely, including resource prioritization, mentorship, knowledge sharing, a strong safety culture with an emphasis on management of change, mechanical integrity assurance through high-quality maintenance, employee engagement in the risk management decision process, and support for employees who raise safety issues.

The group also recommended simplifying agency involvement and establishing one point of contact in government for refineries. They further recommended a focus on safety problem prevention rather than traditional enforcement and issuance of penalties. The Contra Costa County ISO was cited as a successful model of regulation due to its focus on human factors and safety culture. The safety case approach — an alternative regulatory approach under which there is less prescriptive regulation and more focus on comprehensive safety plans developed by facilities — was also cited as a potential model for consideration. This is discussed in greater detail further in the report.

A smaller group organized by the Western States Petroleum Association (WSPA) met to further discuss recommendations based on Contra Costa County's ISO model. The group recommended that Cal/OSHA inspectors work collaboratively with local inspectors from the CUPAs. CUPAs are local agency enforcement programs that regulate hazardous materials through Area Plans for Hazardous Materials Emergency Response (Area Plans) and facility-specific Hazardous Materials Business Plans, which are intended to prevent or minimize releases of hazardous materials. In some geographic locations, steps would need to be taken to ensure that CUPA staff are sufficiently qualified to enforce regulations related to prevention. Overall, WSPA expressed opposition to inflexible regulatory mandates, while expressing the opinion that California's current PSM approach offers a superior level of safety than alternative approaches such as the safety case used in some other countries. In general, the industry encouraged regulatory oversight that emphasizes prevention and evaluation as providing a higher level of safety and responsiveness than oversight more heavily focused on enforcement.

## 4. State and Local Agencies

Enforcement agency staff, including Cal/OSHA and CUPA staff, recommended that interagency coordination be increased through written standardized protocols and regular cross-training and drills. They recommended stronger safety incentives and penalties for multiple and repeat violations. Finally, staff recommended further study of the safety case approach and expressed concern about the numbers and expertise of regulatory staff needed to implement such an approach.

City, county and state fire officials noted a need to improve access to a refinery during an emergency; improve radio communications between their departments and the firefighting staff of refineries during an emergency; and clarify certain decision-making authorities when public agencies share incident command with refinery fire departments. Local officials suggested that cost recovery mechanisms for specialized training and response should be explored, particularly for those departments that provide mutual aid to a major refinery incident outside their municipality. They echoed recommendations to strengthen and possibly expand the Contra Costa County ISO model throughout California.

## 5. RAND Corporation Findings

The RAND Corporation prepared a memo, Refinery Process Safety Performance and Models of Government-Industry Relations, discussing some of the issues involved in considering new models of industry regulation. The memo noted that evidence is mixed as to whether refinery safety in the U.S. has improved over the past 30 years, but that the safety record of U.S. refineries is not as strong as in other countries. It argued that Cal/OSHA's current enforcement program is not achieving significant prevention gains, both because the agency has limited resources to devote to inspections, and because its inspections in recent years have not detected many violations or hazards. RAND suggested that Cal/OSHA could move in the direction of the safety case approach, but noted that evidence to date on whether the safety case has improved performance is mixed, and that implementing this approach would require significantly greater division resources than currently employed. The memo suggests that Cal/OSHA adopt an incremental approach for transitioning to the safety case, perhaps by expanding the Contra Costa County ISO. The memo also discussed the desirability of developing lagging and leading indicators of refinery performance and suggested that this be done through a collaborative industry-labor process.

A copy of the RAND Corporation memo can be found in the Appendix.

## 6. U.C. Berkeley Labor Occupational Health Program Findings

The Labor Occupational Health Program at UC Berkeley's School of Public Health helped facilitate stakeholder meetings of labor, community and emergency response stakeholders and published its findings in a report, Refinery Safety in California: Labor, Community and Fire Agency Views on June 4, 2013. The report summarized a series of 10 meetings and conference calls with labor and community stakeholders in northern and southern California and grouped its findings and recommendations into three areas: (1) Preparedness, Monitoring and Emergency Response, (2) Prevention, and (3) Sustainability. In the area of Emergency Response, the report calls for better coordination between on-site fire brigades and public agencies, clarification of public agency authorities under the unified command structure, improved monitoring and public disclosure of air pollutant releases during incidents and routine refinery operations, cost recovery by fire departments for training and major incidents, and improvements in notification systems for hospitals, transit agencies, area residents, and others. The Prevention section emphasized the need for (i) more attention to inherent safety in regulatory requirements, (ii) enhanced regulatory authorities for agencies, (iii) proactive transmission of leading indicator data and other information by refineries to state agencies, workers and the public, (iv) a comprehensive corrosion audit, and (v) greater opportunities for worker and public engagement. The report

noted the benefits of the Contra Costa County ISO and recommended that it be modernized and strengthened. Under Sustainability, the report called attention to the increasing sulfur content of oil feed stocks, the energy footprint of the refinery sector, and emissions of toxic air contaminants from refineries.

A copy of the Labor Occupational Health Program report can be found in the Appendix.

# C. Investigative Findings to Date

On January 30, 2013, Cal/OSHA issued 25 citations to Chevron, including 11 "Willful Serious" citations, and almost $1 million in civil penalties after a six-month investigation of the Richmond refinery fire. On April 12, 2013, Chevron released its own internal incident report. CSB made specific recommendations to Chevron and federal, state and local government agencies and authorities in a report, issued in April and December 2013. The U.S. EPA also issued its Findings of Violation in December 2013. These findings are summarized here as part of the informational context reviewed by the Governor's Working Group.

## 1. Cal/OSHA, U.S. EPA and CSB Findings

Cal/OSHA, U.S. EPA, and CSB documented deficiencies at the Chevron refinery occurring before, during and after the August 6, 2012, incident. The agencies' reported findings include:

***Before the incident:***

- Chevron failed to follow repeated recommendations of its own pipe inspectors and metallurgical scientists, dating back to 2002, to replace the 36-year-old corroded pipe that ultimately ruptured and caused the fire;
- Chevron metallurgists, materials engineers, and piping inspectors had expertise regarding sulfidation corrosion but had limited practical influence and did not participate in the relevant process hazard analysis,[2] resulting in the failure by Chevron to identify corrosion as a significant problem in the 2009 crude unit process hazard analysis.;
- Chevron failed to test pipe thicknesses throughout the plant in areas that were susceptible to sulfidation corrosion, including areas of piping under high temperature and pressure.; and,
- Chevron failed to conduct an effective process hazard analysis of the operations of the No. 4 Crude Unit.

***During the incident:***

- Chevron failed to implement its own emergency procedures to shut down the No. 4 Crude Unit when the initial leak occurred;
- Chevron failed to recognize the potential for a catastrophic release of ignitable gas-oil leaking from the pipe; ordered its own employees to strip insulation from the leaking pipe with metal tools and a high-pressure water stream; and ordered contract employees to erect a scaffold below the leaking pipe;
- Chevron failed to conduct air monitoring for hazardous chemicals where employees were working during the uncontrolled leak; and,
- Chevron failed to limit the number of workers who entered the incident zone and ensure that all workers exposed to hazards were provided with and were using the necessary personal protective equipment.

2 Process hazard analysis is an assessment of potential hazards associated with an industrial process. It is used to make risk management decisions to prevent accidental releases of hazardous chemicals.

***After the incident:***

- Chevron allowed workers to enter the demarcated danger zone after the fire was extinguished, despite the known hazards posed by metal structures, vessels and piping that were determined by Chevron's certified civil engineer to be structurally unsound;
- Chevron failed to conduct an adequate evaluation of the new pipe materials before selecting them as part of the rebuild of the fire-damaged unit; and,
- A second Cal/OSHA inspection investigating Chevron's leak repair procedures found that clamps and fittings used as temporary repairs on the outside of leaking piping systems throughout the refinery were not removed and replaced permanently at the next scheduled turn-around period as required by Chevron's own procedures and the industry association's recommended practice.[3]

Copies of the Cal/OSHA citations, the U.S. EPA Findings of Violation, the CSB Interim Report and the CSB draft Regulatory Report, and the full details of these investigations' findings, are included in the Appendix.

## 2. Chevron's Internal Investigation Findings

Chevron's internal report found that the incident was caused by incomplete and inadequate hazard recognition, insufficient responses to identified hazards, and that the refinery's emergency response was also deficient. Specific findings in this report include:

- The process hazard analysis for the No. 4 Crude Unit did not consider the potential for corrosion due to the high sulfur content (and high temperature and pressure) of crude oil entering the Unit, combined with the low silicon content of the Unit's carbon steel piping. (Piping with higher silicon content better resists corrosion caused by sulfur in crude oil);
- The pipe wall thickness threshold for inspection and repair of piping did not incorporate safety factors in Chevron's existing guidelines or the American Petroleum Institute (API) Recommended Practice 574;[4]
- The 2002 wall thickness testing information was not captured by Chevron's data system; therefore it was not acted upon by managers;
- The 2009 review of the piping circuit "did not include a 100% component-by-component inspection;"
- The 2011 turn-around period did not include inspection and replacement, when applicable, of every component in the carbon steel piping connecting the No. 4 Crude Unit to the atmospheric distillation tower, known as the 4-sidecut piping circuit;
- The June 2012 pipe inspection results were not entered into the database and no re-inspection occurred;
- Inspection guidelines of piping "were not fully implemented and action items were not tracked until completion;"
- Piping circuit inspections should have included "appropriate damage mechanisms using a standardized methodology and documentation system;" and,
- The emergency response and assessment after the discovery of the leak "did not fully recognize the risk of piping rupture and the possibility of auto-ignition."

A copy of the Chevron internal incident report is included in the Appendix.

Copies of CSB investigation reports of previous oil industry incidents and the testimony of U.S. OSHA officials are also included in the Appendix.

3 This practice is known as American Petroleum Institute Recommended Practice 570, Piping Inspection Code: Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems.

4 American Petroleum Institute Recommended Practice 574: Inspection Practices for Piping Components.

# D. Chemical Safety Board and Chevron Investigators' Recommendations

The CSB's Interim Report (April 19, 2013) contained 20 recommendations directed toward Chevron U.S.A., local officials in the City of Richmond and Contra Costa County, the Governor, Legislature, state agencies of California, and the U.S. EPA. The CSB's draft Regulatory Report in December 2013 focused on a much narrower set of recommendations related to the safety case.[5] The recommendations in the two CSB reports include:

- Establishment of a multi-agency process safety regulatory program for all California oil refineries to improve public accountability, transparency and performance of chemical accident prevention and mechanical integrity programs, as well as greater sharing of data and coordination of enforcement activities among all affected government agencies;
- Revision of the ISO currently in effect in Contra Costa County to require facilities to determine the effectiveness of the safeguards documented in the process hazard analysis; to incorporate stronger requirements for the use of inherently safer systems and materials; and, to consider establishment of similar ISOs in other California counties where oil refining occurs;
- Revision of Cal/OSHA's regulation on PSM of Acutely Hazardous Materials to require improvements to mechanical integrity and process hazard analysis programs for all California refineries, and require the incorporation of applicable industry best practices and inherently safer systems and materials to the greatest extent feasible;
- Revision of Cal/OSHA's PSM regulation to 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 should use established qualitative, quantitative, and/or semi-quantitative methods, such as layer of protection analysis;
- Public reporting and use of "leading" and "lagging" process safety indicators – which provide early and later warning signs – to monitor and evaluate refinery performance;
- Establishment of a safety management regulatory framework for refineries based on the safety case framework, with a requirement that refineries systematically analyze and document all major hazards and identify effective control methods to reduce those risks as low as reasonably practicable; and,
- Greater dissemination to the general public and between collaborating government agencies of the results of hazard analyses and performance evaluations conducted by the refineries themselves and by government agencies.

Chevron's internal incident investigation also contained a series of recommendations for the corporation going forward. Several of these recommendations mirror those of the CSB and the abatement requirements arising from the Cal/OSHA citations. These include:

- Piping circuit inspections that include "appropriate damage mechanisms using a standardized methodology and documentation system;"[6]
- Changes in inspector training and competency and improved oversight of mechanical integrity, inspection plans and escalation procedures; and

5 Recommendations from CSB are advisory in nature and are not legally binding on any party.
6 Damage hazard mechanisms are further discussed in Section F.3.c.

- Revised policies and checklists so that process safety and inspection information is "considered when evaluating leaks and addressing the issue of whether to shut down or continue operation of equipment."

### Table 2: Regulations and Agencies Addressed in Findings and Recommendations

| Regulation/Activity | Agency/Department | Purpose |
|---|---|---|
| **Safety and Prevention** | | |
| Process Safety Management (PSM) | Labor/DIR/Cal/OSHA | To prevent releases of hazardous chemicals that could expose employees and others to serious hazards. |
| California Accidental Release Prevention Program (CalARP) Risk Management Plan (RMP) | CalEPA (oversight/CUPA certification)<br>Cal OES (state regulatory agency)<br>CUPAs (implementation/ enforcement) | To prevent accidental releases of substances that can cause serious harm to the public and the environment, to minimize the damage if releases occur, and to satisfy community right-to-know law. |
| Industrial Safety Ordinance (ISO) | Contra Costa County & City of Richmond | To prevent accidental release of hazardous chemicals and minimize the damage if releases occur. To add additional requirements to supplement the PSM and RMP. |
| Air Permit | Air Pollution Control Districts | To write and enforce rules on air emissions, including from tanks, pipes, vents, and flares. To require ambient air monitoring and accidental release prevention plans. |
| **Emergency Response** | | |
| Area Plans | CalEPA/Cal OES /CUPAs | Local government blueprints for response to a hazardous materials release or threatened release. Must include requirements for multi-agency notification and coordination, impact minimization and emergency response. |
| Hazardous Materials Business Plans | CalEPA/Cal OES /CUPAs | Submitted annually by facilities that handle hazardous materials. Must identify hazardous materials at the facility, prepare a site map, develop an emergency response plan, and implement an employee training program. |
| State Emergency Response Commission (SERC); Local Emergency Planning Committees (LEPCs) | Cal OES (lead state agency) | Serve as a forum for stakeholders and agencies to work together on training and other hazardous materials emergency planning activities. |

# E. Findings of the Governor's Working Group

## 1. Oversight and Coordination

Regulatory agencies with responsibility for refinery oversight have some areas of overlapping jurisdiction, and no single state or local regulatory entity has a complete picture of the compliance status of a refinery.[7] Multiple agencies with varying authority engage in relatively limited information sharing about regulatory compliance requirements. Overall coordination among the various agencies that regulate refineries is also limited. Improved coordination, communication and oversight are essential and will result in smarter, more targeted enforcement, while avoiding the potential for inconsistent and unnecessary regulatory requirements. Improved coordination will also increase opportunities for exploring innovative approaches to improve refinery safety and performance (see Recommendation F.1).

## 2. Emergency Response and Preparedness

The Chevron incident revealed shortcomings in the corporation's emergency response protocol, difficulties in coordination among emergency responders, and challenges in communicating with surrounding communities regarding health risks and appropriate actions. Emergency response by refineries and state and local agencies will be improved through better coordination and other changes in emergency planning and preparedness programs.

***Regulatory Background***

The lead agency responsible for emergency response coordination at the state level is the Governor's Office of Emergency Services. Cal OES develops the State Emergency Plan, which includes various emergency functions that address specific emergency planning topics. CalEPA is the lead agency for the Emergency Function for Hazardous Materials and Oil (EF-10), an Annex to the State Emergency Plan. CalEPA also oversees the 83 local Certified Unified Program Agencies (CUPAs), which have the responsibility (the Unified Program) to produce Area Plans for Hazardous Materials Emergency Response and to oversee facility-specific Hazardous Materials Business Plans to prevent or minimize releases of hazardous materials. Area Plans and Business Plans are part of the six Unified Hazardous Waste and Hazardous Materials Management programs which fall under CUPA responsibility. In addition to these responsibilities, CUPAs have other duties as determined by their local government, which include participating on local hazardous materials (HazMat) teams to varying degrees.

The Area Plan is the local government blueprint for response to a hazardous materials release or threatened release. Area Plans must include requirements for multi-agency notification and coordination, impact minimization and emergency response. Agencies covered by Area Plan provisions include law enforcement, fire services, medical and public health services, poison control centers, and care and shelter services. State law and regulations establish minimum standards for these plans.

In preparing and amending Area Plans, CUPAs incorporate information collected from the Hazardous Materials Business Plans submitted annually by refineries and other facilities that handle hazardous materials. Because the Business Plans identify hazardous materials at the facilities, they are useful to determine the appropriate level of emergency planning necessary

7 The regulatory agencies addressed in the findings and recommendations in this report are listed in Table 2.

to respond to a release. The Business Plan regulations also require businesses to prepare a site map, develop an emergency response plan, and implement a training program for employees.

California emergency response agencies at the local and state level use the Incident Command System to assure command and control at major incidents. A Unified Incident Command is established when multiple agencies are involved in an incident, in which case a Joint Operations Center and Joint Information Center are usually established to coordinate operations and communication with the public. Refineries and other facilities are obligated to immediately report a significant release of hazardous materials to local emergency responders, CUPAs and the State Warning Center.

The federal Emergency Planning and Community Right-to-Know Act also requires facility owners to submit inventories of hazardous materials and report certain accidental releases. In California, these requirements are met through compliance with the Unified Program requirements discussed above. Additionally, the Right-to-Know Act requires a State Emergency Response Commission and Local Emergency Planning Committees. Cal OES provides staff support to the State Emergency Response Commission and six Local Emergency Response Commissions in California. The Local Committees are intended to serve as a forum for discussion and public input and for stakeholders and agencies to work together on training and other hazardous materials emergency planning activities at the local level.

***Findings***
The Working Group made the following specific findings about emergency response protocols.

### 2.1 Area Plans

Hazardous Materials Area Plans do not have a specific element for refineries but are instead written as general response guidance. Refineries are uniquely dangerous and capable of generating significant fires, toxic smoke, chemicals and vapors in communities. Refinery-specific elements in Area Plans could help improve overall community preparedness in the event of an emergency such as the Chevron incident. Specific deficiencies identified include the following:

***a. Alignment of Radio Communications Between Response Agencies***
The refinery and the responding public fire agencies could not communicate with one another on the same radio frequency during the Chevron incident. When on-site fire brigades and public fire agencies operate on different radio frequencies during a disaster, they cannot communicate and coordinate their efforts (see Recommendation F.2.1.a).

***b. Establishment of a Unified Incident Command and Joint Operation Center.***
The refinery and the local agencies did not establish a Unified Incident Command and a Joint Operation Center and Joint Information Center during the Chevron incident. This hampered the ability of the response agencies to rapidly assess the public health risks associated with the fire and translate that into actionable information for other entities, including local health care facilities, transit agencies, and others (see Recommendation F.2.1.b).

***c. Plans and Protocols to Protect Persons Outside of a Refinery***
Area Plans generally do not address procedures for alerting public transit systems during a major incident. For example, during the Chevron incident, the Bay Area Rapid Transit (BART) system and Amtrak had no guidance from responding agencies about what actions to take. Gaps also exist for alerting and directing businesses and public agencies, such as utilities and public works agencies, potentially putting workers in danger. In addition, there are generally no protocols for protecting public spaces, such as schools, parks, and shopping malls where people congregate. These issues could be better managed at the time of an incident with a Unified Incident Command, and Area Plans could specify how to address these issues (see Recommendation F.2.1.c).

***d. Drills and Exercises***
Local emergency response professionals throughout California underscored the importance of regular practice exercises and drills with refinery and public emergency response teams. In practice, the frequency of drills varies significantly. Contra Costa County engages in drills at least annually with each of their four refineries, whereas drills are less frequent in other areas. It can be financially difficult for local agencies to provide response resources and cover the cost of emergency exercises and drills (see Recommendation F.2.1.d).

***e. Preparation for Airborne Releases***
Area Plans often do not include any design, technical review, or advisory role for the local air districts or ARB, even though worst-case scenarios often involve serious toxic air contaminant releases. Review of Area Plans by local air districts and the ARB, especially in communities with refineries and other large facilities that could release toxic air contaminants, could help ensure that the plans incorporate appropriate information and responses (see Recommendation F.2.1.e).

### 2.2 Assessment Plan for Monitoring of Toxic Air Contaminants

The Chevron incident highlighted the need to evaluate emergency air monitoring protocols and capabilities. Local air districts play a crucial role in providing air monitoring information to the public during an industrial incident. While a statewide air monitoring network exists, it is primarily designed to track compliance with long-term state and federal air quality standards. The technical capability to monitor, evaluate and report local releases of toxic air contaminants on a real-time basis following an industrial incident or other unplanned release varies among local air pollution control districts. Air districts would benefit from information on preparedness and response practices and on technologies that would enable them to measure and report real-time exposures to airborne emissions during local emergencies (see Recommendation F.2.2).

### 2.3 Early Notification of Release or Threatened Release of a Hazardous Material

Reporting requirements in the event of a release of a hazardous substance are not well defined, making them challenging to comply with and enforce. Under California Health & Safety Code Section 25504 (b), the Business Plans for refineries must contain emergency response plans and procedures to govern their activities “in the event of a reportable release or threatened release of a hazardous material.” These plans must require “immediate notification to the administering agency and to the appropriate local emergency rescue personnel,” as well as notification to the State Warning Center. The term “immediate” is not defined, nor is the size or nature of the release that triggers the requirement. As a result, refineries do not always notify local agencies promptly when there is a leak or possibility of fire. During the Chevron incident, for example, the company failed to immediately notify local agencies after the leak, and finally made the initial call eight minutes after the fire broke out (see Recommendation F.2.3).

## 3. Safety and Prevention of Hazardous Events

The investigations of the Chevron incident raise significant concerns about ongoing refinery practices and prevention of future accidents. Each of the investigation reports identified incomplete or inadequate policies and procedures at the Richmond refinery; incomplete or ineffective implementation of existing policies and procedures; a failure to evaluate the pipe safety problem during the process hazard analysis; and a failure to act on internal reports about hazards.

While the investigation reports focused on the Chevron Richmond refinery, the findings raise significant issues relevant to the state’s 14 other oil refineries. Following the Richmond incident, for example, Cal/OSHA found a similarly corroded pipe in a crude unit at Chevron’s El Segundo refinery. More general trends in refinery safety also give rise to concern. According to the CSB, as well as the RAND report noted above, the U.S. oil industry’s safety record is inferior to its

global counterparts. A 2006 report by the insurer Swiss Re found accident-related losses three times higher at U.S. refineries compared to refineries in other parts of the world. In a 2012 briefing to the CSB, Swiss Re officials reported that the safety gap between U.S. refineries and those in other parts of the world had widened since the original Swiss Re report.

In recent Congressional testimony, U.S. OSHA officials stated that the same causal factors leading to the Richmond refinery incident in August 2012 could be found throughout the country's oil refineries. U.S. OSHA found that refinery managers failed to take steps to prevent catastrophic accidents even after serious accidents have occurred. As a result, U.S. OSHA implemented a National Emphasis Program in 2007 to comprehensively inspect the process safety management programs of most of the nation's refineries. Unfortunately, that program ended in 2010 due to resource constraints.

The Working Group concluded that refinery safety in California can and must be improved. But prevention of dangerous events at California refineries is complicated by the fact that refineries are highly complex environments requiring specialized expertise and information to detect potential hazards. Other challenges identified at the stakeholder meetings include: California refineries are aging; they are processing higher sulfur crude which increases corrosion; maintenance is often deferred; contractor training may not always be adequate; and regulatory agencies often do not have ready access to information they may need to assess safety. Ultimately, the goal is to incorporate principles of inherent safety more fully into the operations of California refineries; the Working Group recognized that this may be accomplished in various ways, and is an ongoing process.

***Regulatory Background***

The federal Clean Air Act Amendments of 1990 (42 U.S.C. § 7412(r)) required the U.S. EPA to promulgate rules to prevent accidental releases of regulated substances and reduce the severity of releases that do occur. Congress required that the U.S. EPA program be coordinated with a comparable U.S. OSHA program.

In response to the Congressional directive, U.S. OSHA adopted the federal PSM standard in 1992, and DIR adopted the state's PSM standard (Cal. Code Regs., tit. 8, § 5189) pursuant to its mandate to adopt standards that are at least as effective as U.S. OSHA standards. DIR, through Cal/OSHA, administers and enforces this standard. The purpose of the PSM standard is to prevent releases of hazardous chemicals that could expose employees and others to serious hazards. After the 1999 fire at the Tosco Refinery in Martinez, California, which killed four workers, the state established a dedicated Process Safety Management Unit. Cal/OSHA's PSM Unit is the only such program in the nation.

U.S. EPA adopted the federal Chemical Accident Prevention Provisions, also known as the Risk Management Plan Rule, in 1996. These regulations require facilities to submit risk management plans if they have more than a threshold quantity of a regulated substance in a process. The risk management plans must include a hazard assessment of the facility, an accidental release prevention program, and an emergency response program (40 C.F.R. Part 68). California had previously adopted its own accidental release prevention program, which was superseded and incorporated into this program in 1997, creating the current California Accidental Release Prevention Program (Cal. Health & Saf. Code, § 25531 et seq.). The CalARP program operates in parallel to the federal Chemical Accident Prevention Provisions with certain additional state-specific requirements. Cal OES administers CalARP as part of the state's Unified Hazardous Waste and Hazardous Materials Management Program, and the CUPAs implement the program at the local level. The purpose of the CalARP program is to prevent accidental releases of substances that can cause serious harm to the public and the environment, to minimize the damage if releases occur, and to satisfy community right-to-know laws.

The requirements of the Cal/OSHA PSM program and the CalARP program are very similar because the same industrial processes affecting workers may also affect public health and the environment. Both programs include requirements related to process safety information, process hazard analyses, mechanical integrity, and management of change. The difference is in focus; Cal/OSHA's PSM program focuses on potential on-site chemical releases and processes that affect the health and safety of workers, while the CalARP RMP focuses on chemical releases with the potential for off-site impacts needing emergency response.

In 1998, Contra Costa County adopted County Ordinance Chapter 450-8, the ISO. The ISO expands on the CalARP program for refineries and chemical plants that are already required to submit an RMP. Although the Contra Costa County ISO only includes facilities in unincorporated portions of the county, the City of Richmond adopted an ISO in 2000 (Municipal Code Chapter 6.43, RISO) that was generally similar to that of the County. The Chevron refinery located in the City of Richmond is subject to this ordinance. The Richmond ISO was amended in February 2013 to more closely align it with the county ISO. The purpose of the ISO is to prevent accidental release of hazardous chemicals; improve accident prevention by soliciting participation from industry and the community; and conduct periodic audits of the plans and inspections of the industrial plants.

The CalARP program, as well as the ISO, requires refineries to submit and regularly update safety plans. The safety plans must describe a number of elements of a safety program, including a hazard review, written operating procedures, worker training requirements, maintenance requirements, compliance audits, and incident investigation procedures.

***Evaluation of Existing Programs***

The Working Group studied the Cal/OSHA PSM program, the CalARP program, and the Contra Costa County ISO to identify areas for improvement. Overall, the Working Group concluded that the ISO contains the most far-reaching provisions and holds the most promise for improving safety. Specifically, the ISO expands significantly on the PSM and the CalARP program by requiring:

- A safety plan that is a public document, and which must be submitted to the local CUPA (in the case of Chevron, to Contra Costa Health Services);
- A root cause analysis, performed by the facility, as part of their incident investigations for major chemical accidents or releases, and submission of the root cause analysis report to the CUPA (see Recommendation F.3.1.d);
- A human factors program for certain elements, including the process hazard analysis, operating and maintenance procedures, incident investigation, training, and managing change to the staffing levels in maintenance, health and safety, emergency response and operations organizations (see Recommendation F.3.1.e);
- An independent incident investigation, including a root cause analysis, by the county or an independent auditor at the county's discretion;
- Consideration and evaluation of inherently safer technologies and materials by the refineries in some decisions (see Recommendation F.3.1.a); and
- Public meetings after safety plan reviews and preliminary audits by the County.

The Working Group also identified areas for improvement based on specific gaps in the ISO, the CalARP program and the Cal/OSHA PSM regulation:

- Most cities and counties that contain refineries do not have an ISO. There is no statewide consistency;
- Both the Contra Costa County and City of Richmond ISO contain permissive or discretionary compliance language, which limits enforceability of some provisions of the ordinance. As a result, although the County is authorized to issue enforcement

actions, in practice, the inspectors issue action items that list deficiencies and recommend improvements, and have rarely issued citations or fines;

- Under the ISO, refineries are only required to implement inherently safer systems to the extent feasible. Although documentation is required when a refinery rejects an inherently safer system as infeasible, the ordinance does not require the refinery to provide supporting documentation to show that the selected system is inherently safer, or to evaluate the safeguards and controls, making it difficult or impossible for agencies to verify the claim (see Recommendation F.3.1.a);
- The CalARP program only requires the refinery to conduct a compliance audit every three years and to maintain a copy of the audit on-site, a schedule not frequent enough to ensure compliance with regulatory requirements (see Recommendation F.3.2);
- The CUPA is required to evaluate the CalARP RMP at a refinery "periodically" and conduct inspections for compliance only once every three years (see Recommendation F.3.2);
- The Cal/OSHA PSM regulation and the CalARP program describe procedures that refineries must follow to prevent catastrophic releases of toxic, or flammable chemicals, but do not specify exactly how the employer will carry out those procedures. This can leave regulators without clear interim benchmarks or authorization to use all available methods of evaluating the safety performance of refineries (see Recommendation F.1.1);
- The PSM regulation and the CalARP RMP do not require companies conducting process hazard analysis or management of change to actually control hazards using the hierarchy of controls, or to document the effectiveness of safeguards for effectively reducing risks using a structured approach, such as a Layer of Protection Analysis;
- The PSM regulation and the CalARP program do not explicitly authorize Cal/OSHA or the CUPAs to evaluate and enforce the following aspects of process safety: inherently safer systems; use of indicators to evaluate performance; the impact of human factors on safe operations; management of change when applied to organizational changes; damage mechanism hazard review as part of the standard process hazard analysis; and an assessment of the safety culture at the facility (see Recommendation F.3.1).

In addition to the above limitations in the three existing safety structures, the Working Group identified pervasive issues relating to enforcement capacity, including serious limitations in staffing of regulatory agencies; difficulty hiring, retaining, and training inspectors with the necessary skill set; and lack of mechanisms for information sharing and coordination among agencies with overlapping or complementary jurisdictions. Additionally, the Working Group noted that current statutory penalty amounts are unlikely to provide a meaningful deterrent to noncompliance. For example, in response to Cal/OSHA's findings of 25 violations at Chevron, the maximum penalty Cal/OSHA was statutorily authorized to assess was $963,200. Air districts for their part are limited to penalties no greater than $10,000 for releases of toxic air contaminants that constitute an air toxics nuisance. In comparison, average revenue at California refineries exceeds $185 million per day.[8]

In addition to the deficiencies in staffing and penalties, there is a significant data and transparency deficiency. Refineries are not required to provide regulatory agencies with critical information that could help agencies assess safety and plan for effective oversight and prevention, including self-inspection reports, certain testing reports, and relevant information about turnaround work plans and schedules.[9] (see Recommendation F.3.3).

8 SeeCalifornia Energy Commission analysis of weekly refinery data and Oil Price Information Service pricing information.

9 A turnaround is a planned, periodic shut down of a refinery process unit or plant to perform inspection, maintenance and repair work.

## 4. Community Education and Alerts

The investigative reports and stakeholder meetings highlighted shortcomings in communication of emergency alerts and other relevant information to the public. These include:

### 4.1 Emergency Alerts and Public Education

During the Chevron incident, nearby residents saw the rapidly forming black cloud from the refinery but had little sense of the severity of the situation or what individual actions they should take in response, including what to do when the siren alert sounded. Furthermore, the auditory alarms were not widely heard. The reverse 911 phone system used to communicate a warning and shelter in place to the surrounding communities did not work as expected during the incident, and calls were delayed to some people for hours.

At the local and state level, the Incident Command System is used to organize resources and decision-making at major incidents. When more than one agency is involved in a major incident, Unified Incident Command is often established, along with a Joint Operation Center and Joint Information Center to coordinate additional resources and public communication. During the Chevron incident, the Richmond Fire Department established Unified Incident Command with the Chevron Fire Department, but did not establish a Joint Operation Center or Joint Incident Command. As a result, communication with the public and area hospitals was not well-coordinated. This resulted in conflicting statements from Chevron and from responding agencies, which produced confusion among members of the public and local health care providers. Local hospitals that received patients during and immediately following the incident, for example, would have benefited from better information regarding the nature of emissions from the incident and their potential health effects; this could have facilitated patient care and decision-making regarding the need for personal protective equipment for front-line health care providers.

Moreover, relatively few people in Richmond had registered in the local Community Warning System for cell phone alerts during emergencies, and there were no other mechanisms at the time of the incident for alerting people via email, text, website, or other electronic means. Overall, information was poorly disseminated to the public and to the media.

More generally, the Working Group found that members of local communities and the public do not have consistent, accessible, adequate and timely information about refinery safety risks, preventive measures, emergency procedures, and different agencies' roles and responsibilities relating to these areas (see Recommendation F.4.1).

### 4.2 Public Involvement in Emergency Planning

Currently, the main mechanism for public involvement in local emergency response specific to chemical hazards is through the Local Emergency Planning Committees, established pursuant to the federal Emergency Planning and Community Right-to-Know Act. As required by the Act, local committees must be comprised of representatives of the public, industry and government; worker representatives are not currently required to be included, and in practice are rarely included. The six Local Emergency Planning Committee regions in California cover very large geographic areas, making the involvement of community members difficult because of travel time and expense of attending meetings. The large geographic areas also contribute to the loss of a sense of community. Duties and functions depend on voluntary efforts by individuals. Many of the Local Committees in California are fairly inactive and several have not updated their emergency plans on a regular basis, as required. Since California law directs the CUPAs to collect and make available to the public chemical information from facilities, Local Committees which are not aligned geographically or functionally with the CUPAs, have become disconnected from community right-to-know efforts in California (see Recommendation F.4.2).

### 4.3 Public Access to Data and Information

ARB and local air districts currently make hourly ambient air monitoring data from the existing network for particulate matter and ozone readily accessible on the Internet. But people living near refineries generally have limited or no access to immediate data on toxic air contaminant levels in the community or information on associated health risks. More comprehensive and timely information on the latter should be gathered and made available on the Internet. In general, more data relevant to refinery safety should be made publicly available, to allow the public to independently review information pertinent to health and safety. There is a need for a process to identify relevant information that could be made publicly available and to create mechanisms for collecting that information, protecting certain information (such as confidential business information and enforcement confidential information), and making the rest available to the public (see Recommendation F.4.3).

### 4.4 California Air Response Planning Alliance

The California Air Response Planning Alliance (CARPA) is a statewide organization that consists of representatives from Cal OES, CalEPA, ARB, the Office of Environmental Health Hazard Assessment , California Department of Public Health (CDPH), U.S. EPA, local air districts, health officers, and other first responders. CARPA was formed to help develop standard procedures and statewide capabilities to monitor sudden air releases following a disaster and to provide technical expertise to evaluate the risk of exposure to the public. CARPA may be a resource that can be used by incident commanders as well as in planning, preparedness, training, and exercise efforts to enhance community-based monitoring of unexpected airborne releases from refineries (see Recommendation F.4.4).

# F. Recommendations

The Working Group recommendations fall into four broad categories: (1) improved agency coordination through the establishment of an Interagency Refinery Task Force; (2) emergency management and response; (3) safety and prevention; and (4) education and outreach to the public.

## 1. Interagency Refinery Task Force

An Interagency Refinery Task Force has been created to carry out the recommendations contained in this report and to promote more coordinated agency oversight of refineries. This Task Force should continue as a permanent task force housed at CalEPA to provide an on-going forum for interagency collaboration and to facilitate implementation of regulatory efforts.

The Task Force will work with state, federal and local agencies to facilitate and monitor the implementation of recommendations in this report. While the process has identified a number of initial recommendations, other concepts will require additional study, experience and discussion to ensure they meet California's needs.

The Task Force will be located within the CalEPA building based on the agency's experience overseeing 83 local CUPAs, coordinating the implementation of the Unified Hazardous Material Program, and developing and managing the California Environmental Reporting System, a statewide electronic reporting database. In managing the Task Force, CalEPA will work in partnership with DIR, drawing on DIR's expertise and authority in the area of refinery PSM and occupational safety and health.

Participating agencies include: Cal OES, CalEPA, ARB, DTSC, SWRCB, DIR, Cal/OSHA, CDPH, the California Emergency Medical Services Authority (EMSA), Office of the State Fire Marshal, U.S. EPA, CUPAs, and local air pollution control districts in locations where refineries operate.

The Interagency Refinery Task Force is not a substitute for state and local agency activities. Rather, its role is to better coordinate each agency's individual functions and to facilitate information sharing, with the goal of ensuring that refineries comply with all regulatory requirements, move toward inherently safer systems, and continue to improve and enhance protections for workers, communities and the environment. One of the benefits and challenges of the Task Force will be to bridge the gap between agencies with distinctly different mandates.

Specifically, the Interagency Refinery Task Force will complete the following tasks:

### 1.1. Enhance coordination of oversight and enforcement activities by regulatory agencies, including the following:

- Facilitate coordination of enforcement activities, including cross-referrals, cross-training, and joint or coordinated inspections and auditing, as appropriate.
- Communicate to workers and communities information about how to report potential violations to the state, and create a system to ensure that agencies share information about refinery-related calls from all systems, including web-based complaint systems and call lines.
- Determine if additional regulatory authority is needed, and encourage the adoption of industry best practices at refineries.

- Identify what additional information is needed from refineries to enable regulatory agencies to provide more effective oversight; determine mechanisms for collecting that information and making it publicly available while respecting confidential business information; and analyze the information to assess refineries' worker safety and environmental performance.
- Facilitate the development of an electronic information and data sharing system among state, local and federal agencies to include information about inspections, compliance, and enforcement activity as well as the means to collect information identified in reports, a process for timely flow of information and a process for public dissemination.

### 1.2 Designate a Refinery Information Officer

Designate a Refinery Information Officer to provide a state-level, single point of contact for the public regarding the regulation and safety of refineries in California. The Refinery Information Officer will be a catalyst for improved public participation, education and outreach about refinery emissions and releases, safety metrics, regulatory compliance status, emergency planning and response, and the roles of various agencies. The Refinery Information Officer will be a member of the Interagency Refinery Task Force and will work with local, state and federal regulatory agencies to coordinate public participation efforts by the various regulatory programs, including regularly scheduled public updates to communities surrounding refineries.

### 1.3 Establish Forums in Northern, Central, and Southern California

Establish forums in northern, central, and southern California for ongoing dialogue among industry, labor, community, environmental groups and regulators. These Refinery Safety Forums should focus, among other things, on joint learning, sharing of good process safety practices among California refineries, examination of performance metrics, root cause analysis of incidents, and other issues proposed in this report for further evaluation.

Within four months after its formation, the Task Force will develop a work plan for addressing each of the recommendations of this report and will set timelines and identify lead agencies for completing each task. These work plans and timelines will be made publicly available. The participating agencies will estimate the costs to implement the Task Force program and identify mechanisms for covering these costs. Costs should be funded through fees on refineries operating in California.

## 2. Emergency Response and Preparedness

The Working Group recognizes that the central goal of the state's effort on refinery safety is to prevent the conditions that give rise to an emergency by increasing inherent safety and continuous improvement in health, safety and environmental performance at refineries. Increasing inherent safety is addressed in Section 3 below. At the same time, there is broad-based consensus for strengthening existing protocols for refinery-specific emergency response systems, particularly the need for increased communication and coordination.

Emergency preparedness and response activities should continue to be led by Cal OES, with delegation of emergency functions related to hazardous materials and oil spills on land to CalEPA. These agencies will work together, with the CUPAs and other state and local agencies, to implement the recommendations noted below.

**Recommendations on Emergency Response and Preparedness: An Overview**

Better coordinated and more effective emergency response will require Cal OES to:

1. Work with CUPAs to create refinery-specific elements in Hazardous Material Area Plans
2. Clarify reporting thresholds during hazardous materials release or threatened release

Additionally, the Air Resources Board and California Air Pollution Control Officers Association are conducting an assessment and developing recommendations to improve toxic air contaminant monitoring.

Cal OES and the CUPAs will estimate the costs to implement the recommended enhancements to emergency response functions and identify mechanisms for covering these costs. Costs should be funded through fees on refineries operating in California.

The Working Group recommends the following measures:

### 2.1 Improved Area Plans

Cal OES should require counties with refineries to develop a specific element in their Hazardous Materials Area Plan for refinery response. These refinery- specific elements must, at a minimum, include the elements described below:

***a. Alignment of Radio Communications between Response Officials***
Federal Communications Commission Rule 90.523 allows a nongovernmental fire department to operate on the same radio frequency band as a governmental fire agency when they are supporting each other.

Cal OES will ensure that local Area Plans require that refineries, and other facilities that could be subject to fire or explosion, obtain approval for joint operations with local fire departments on each other's communication systems. In addition, Area Plans should include protocols for those joint operations and communication.

In the interim, or in the absence of such approval, responders should leverage existing communications systems that provide interoperability in the area (e.g. East Bay Regional 700 MHz P25 Trunked Radio Communications System). Such systems should be incorporated into Area Plans as a back-up communications system for all responders.

In addition, Cal OES should require the CUPAs to establish operational protocols and procedures for refinery incident response with fire agency communications centers, including periodic testing of these communications systems.

***b. Establishment of a Unified Incident Command and Joint Operation Center***
Jurisdictional Emergency Plans must include clearer criteria for the scale and scope of an incident that requires establishment of Unified Incident Command. In general, any incident that requires significant communication with the public, the media, and health care facilities should trigger establishment of Unified Incident Command and a Joint Operation Center. The Joint Operation Center should be responsible for supporting the Unified Incident Command by addressing off-site consequences and recovery. Where appropriate, it should include county, city, regional, and state representatives. A Joint Information Center, controlled by a public agency, should be located in the Joint Operation Center to ensure that communications with the public — including health care facilities, transit agencies, and others — are accurate and timely. A health officer should oversee the interpretation and release of health-related information.

***c. Plans and Protocols to Protect Persons Outside of a Refinery***
Area Plans must be enhanced to include provisions for how to evaluate, manage, and communicate with entities that may need to act to protect groups of people. Specific consideration should be directed toward plans for working with health care facilities, schools, daycare centers, public transit agencies, railroads, utilities, employers who may have workers in the field, and locations (such as shopping malls) where people congregate.

***d. Drills and Exercises***
Area Plans must include training and exercise schedules that address refineries. The Area Plan should describe existing public agency and refinery fire brigade training exercises and establish procedures for annual training exercises to assure that all systems work, and that the participants know how to use those systems and how to work with one another to implement the response

plan. In those areas where refineries do not staff an on-site fire brigade, exercises should include plant technical personnel and mutual aid agencies.

***e. Preparation for Airborne Releases***

The CUPA shall involve the California ARB and the applicable Air Quality Management District(s) in the technical review of Area Plans and in ongoing partnerships with CUPA programs, especially in areas where there are refineries or other potential major sources of toxic air releases. The partnership should also include Area Plan design, cross-training, preparedness exercises, coordination and communication.

### 2.2 Assessment Plan for Monitoring of Toxic Air Contaminants

ARB, in collaboration with CAPCOA, has prepared a project plan to identify, evaluate and recommend improvements to state and local air monitoring practices and define statewide best practices in the event of a refinery accident involving the release of toxic air contaminants.[10] The project includes expert and public involvement and will examine opportunities to use atmospheric modeling and monitoring programs for two purposes: (1) to provide the public with information about potential exposures in the event of an unplanned release; and (2) to provide local agencies with exposure estimates to help alert the public during an incident. This effort is scheduled for completion by October 1, 2014.

### 2.3 Early Notification of Release or Threatened Release of a Hazardous Material

The Business Plan requirements applicable to refineries currently require "immediate" reporting of a hazardous materials release or threatened release. Cal OES should consider regulations to clarify key terminology in Health and Safety Code section 25504, subdivision (a), specifying criteria for reporting thresholds and a clearer definition of the terms "immediate" and "threatened release." A significant vapor cloud release, such as in the Chevron incident, would certainly be defined as a release of hazardous material, as would any leak that requires the refinery fire department to respond, or a leak that occurs on specific high risk units.

## 3. Safety and Prevention of Hazardous Events

In light of input from stakeholders and the analysis of existing programs, the Working Group identified a set of immediate actions that should be taken and several longer-term issues for investigation that will improve safety and prevention of hazardous events. Ultimately, some approaches, such as the safety case model, may hold promise but require careful evaluation to ensure success in California. In the near-term, the Working Group evaluated ways to improve existing requirements to reduce risks and improve safety at refineries. These actions could be implemented through regulation or statute. For example, enforceable requirements for inherently safer systems could be incorporated into the CalARP and PSM programs, or they could be required in new legislation that would adopt and strengthen major components of the Contra Costa County ISO into California law.

### Prevention Strategies for Statewide Programs

Existing State prevention programs should be strengthened to require refineries to:

1. Implement inherently safer systems
2. Perform periodic safety culture assessments
3. Conduct damage mechanism hazard reviews
4. Conduct a root cause analysis after significant accidents or releases
5. Explicitly account for human factors
6. Require structured methods to ensure effectiveness of safeguards

10 The plan was released in July 2013 and is available at www.arb.ca.gov/fuels/carefinery/crseam/finalrpp.pdf

## Immediate Actions

### 3.1 Strengthen CalARP and PSM Programs

Six state-of-the art prevention strategies must be incorporated into the CalARP and Cal/OSHA PSM programs and made enforceable statewide. These strategies include: (1) the adoption of inherently safer systems, (2) use of safety culture assessments, (3) incorporation of damage mechanism hazard reviews, (4) root cause analyses requirements, (5) required consideration of human factors, and (6) required use of structured methods to ensure effective safeguards in process hazard analysis. The Working Group further identified specific changes to the CalARP and PSM programs, noted below.

The Working Group concluded that changes are needed to strengthen agency enforcement authorities and provide agencies and the public with additional information to improve oversight. These actions are described in more detail below.

***a. Require Refineries to Implement Inherently Safer Systems***
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. For example, had a more comprehensive inherently safer system approach been in place at its Richmond refinery, Chevron would have been forced to demonstrate why continuing to use low-silicon metal susceptible to corrosion was a viable process safety solution, given other inherently safer options.

In general, inherent risk reduction is the process of eliminating the hazard through the use of non-hazardous materials or processes; it represents a "passive" form of risk reduction in that it reduces the frequency or consequence of a hazard without the need to take action or activate any protective system or device. Under the requirements of this program, refineries would be required to use a Hierarchy of Controls to select inherently safer options (see Figure 2), and to report the methodologies, documented findings, rationale, and conclusions used to select particular systems and materials during PHAs as well as during rebuilds, repairs, corrective actions, and incident investigations. This can be done by strengthening current Cal/OSHA PSM requirements and CalARP RMP requirements through either rulemaking or legislation.

***b. Require Refineries to Perform Periodic Safety Culture Assessments***
An organization's safety culture is reflected in the way risk is perceived by workers and managers, as well as in the way that specific incidents and situations are addressed and priorities are adjusted during day-to-day decision making. Safety culture for any organization is difficult to assess. Nonetheless, assessments of safety culture that involve front line workers in meaningful ways can help increase safety orientation and decrease incidents. Safety culture assessments can also help regulators evaluate whether the refinery's focus on safety remains at a high level over time, and provide facility operators the opportunity to address deficient practices. Refineries should be required to conduct safety culture assessments at least every three years based on independent evaluations and findings submitted by both management and labor. Such a requirement can be done by strengthening current Cal/OSHA PSM requirements and CalARP RMP requirements through either rulemaking or legislation.

***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.

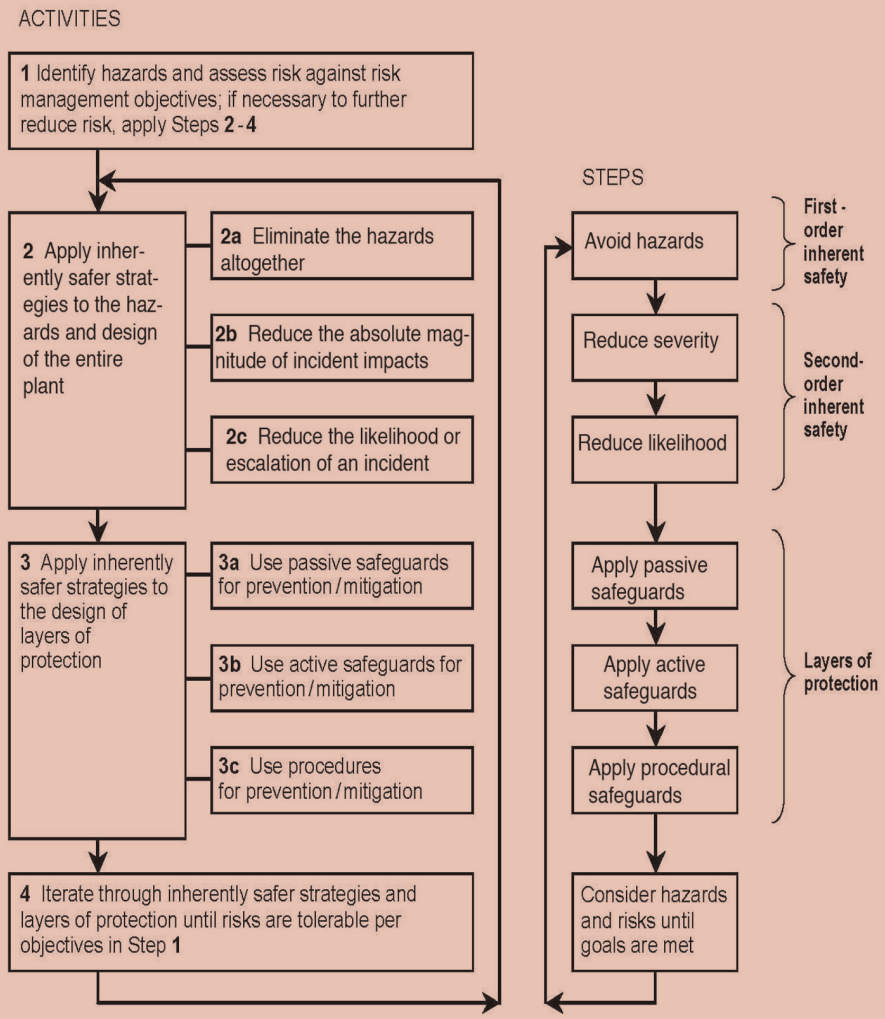
In addition, the results of the damage mechanism hazard reviews, as well as other Mechanical Integrity reviews currently required, should be explicitly incorporated in the information provided to process hazard analysis teams at refineries, and to agencies overseeing refinery safety. Current regulation (both the Contra Costa County ISO and Title 8 PSM regulations) requires that these results be used by process hazard analysis teams at refineries, and these teams should be required to include a corrosion engineer or other professional with the expertise to understand this information.

***d. Require Root Cause Analysis after Significant Accidents or Releases***

When accidents occur, it is necessary to know why they happened so that similar accidents may be prevented in the future. Incident investigation procedure under current state and federal law require facilities to document findings and recommendations, and identify contributing causes. However, understanding root causes, or "why" an incident occurred, is recognized by industry safety experts as necessary to address the fundamental underlying problems and prevent recurrences.

Facilities that fall under Contra Costa County's ISO are required to perform a root cause analysis as part of their incident investigations for major chemical accidents or releases, and to submit the root cause analysis report to Contra Costa Health Services. The root cause analysis reports are made available to the public. These requirements are broader than those currently existing at the federal or state level and should be established statewide. The CalARP and PSM Incident Investigation procedures must be strengthened to require a root cause analysis for significant chemical accidents or releases. This should be done by amending current PSM and CalARP programs through either rulemaking or legislation.

**Figure 2: Application of a Hierarchy of Controls to Process Safety**




Source: Amyotte, P.R. et al, Incorporation of Inherent Safety Principles in Process Safety Management, in Proceedings of the 21st Annual CCPS International Conference, p. 178. Copyright 2006 AIChE and used with permission

***e. Require Refineries to Explicitly Account for Human Factors***
Human limitations and needs must be considered to manage and reduce error. The outcome of a certain activity or task can be strongly affected by the operational procedure followed, the performance level or skill required, and existing safeguards. Two approaches can help address this issue: (1) management of change processes should include organizational and personnel change, such as how a new operator within a unit, or altered shift schedules for inspectors, may affect emergency response, and (2) human factors analysis should provide a better understanding of the human element in facility operations and incident prevention. Federal and state regulations require human factors to be considered during process hazard analysis. However, these factors are not a required consideration in any other processes under the PSM or the CalARP programs.

The Contra Costa County ISO requires that management of change procedures encompass staffing changes, including reorganization in operations, maintenance, health and safety, or emergency response, but it does not require consideration of the experience level of personnel. The ISO also requires a human factors program to be conducted for all covered facilities. California's PSM and CalARP regulation should be amended so that its requirements for human factors and management of change are equivalent to or exceed those of the Contra Costa County ISO by including staffing levels and experience level. This should be done by amending current PSM and CalARP regulations through either rulemaking or legislation.

***f. Require Structured Methods to Ensure Safeguards in Process Hazard Analysis***
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. For all process hazard analyses performed, including damage mechanism reviews, refineries should be required to provide to the appropriate public agency a list of any recommendations rejected, including justifications; those recommended changes that will not be completed as part of the next scheduled turnaround or sooner should also include a justification.

### 3.2 Strengthen the CalARP Program

The CalARP program must be strengthened in the following additional ways: (1) refineries should conduct an annual compliance audit and CUPAs should evaluate the compliance audit to ensure that all deadlines, actions, and projects are completed annually or as scheduled, and (2) CUPAs should increase the frequency of refinery inspections, such as by requiring a schedule that would include focused inspections at refineries at least annually, and a more comprehensive inspection/audit at least every three years. Additionally, the CalARP program should require a triennial evaluation of each refinery's risk management plan for performance and compliance with current applicable industrial, engineering and regulatory standards to provide the highest level of protection of workers and the public. The evaluation should be performed by a qualified third-party or agency engineer. The evaluation report should be provided to the facility, Cal/OSHA, the local Air Pollution Control District, and the CUPA. Refineries should reimburse the CUPAs for the cost of these evaluations. Within 12 months of receiving the report the CUPA should coordinate with Cal/OSHA and the Air Pollution Control District to issue a determination and directive to the refinery that incorporates comments from each agency.

### 3.3 Strengthen Enforcement Capacity and Reporting

There are several actions that should be taken to strengthen the enforcement capabilities of regulatory agencies: (1) increase the maximum penalty amounts for violations of health, safety and environmental requirements so they provide a stronger incentive for compliance; (2) provide agencies with sufficient resources to carry out effective regulatory oversight of refineries; (3) require refineries to provide regulatory agencies with timely information about

operations critical to effective oversight and monitoring, including inspection reports, certain testing reports, and turnaround work plans and schedules, with appropriate safeguards to ensure confidentiality; and (4) require refineries to provide the appropriate regulating authorities, starting six months prior to each scheduled unit turnaround or planned shutdown, a list of recommendations and work order requests from workers, operators, maintenance personnel and inspection personnel that were rejected by refinery management, accompanied by an explanation supporting the management's decision to reject the recommended work. Refineries should provide an updated list of planned work each successive month leading up to the turnaround or planned shutdown.

## 4. Community Education and Alerts

Members of local communities and the public should have consistent, accessible, adequate and timely information about refinery emissions and safety risks, preventive measures, and emergency procedures. There should be an easy mechanism for community participation in emergency planning and preparedness.

The following steps should be taken:

### 4.1 Improve Emergency Alerts and Public Education

Cal OES will work with other state and local agencies to ensure that systems to alert residents during an emergency are timely and operational. For example, the Federal Emergency Management Agency (FEMA) has the capability to broadcast tailored text messages cell phone users; this could be incorporated into Area Plans and deployed in major incidents. Cal OES will also work with FEMA to focus the area targeted by these warnings, so that only the affected community receives a warning. Land-line telephone calls are not reliable in emergencies, but remain valuable because some people (such as elderly residents) may not have cell phones. Counties should identify a reliable provider and back-up provider and test the system to assure it works rapidly and effectively. Additional alert mechanisms include email, Twitter, social media, websites, and local Community Warning System alerts. The latter exist in many California communities and could benefit from additional outreach to increase the percentage of participating residents. Finally, emergency outreach and warning systems should be designed to alert people and provide information in all major languages spoken in a community. Provisions requiring multilingual emergency communications to the public should be added to all Area Plans.

**Recommendation on Community Education and Alerts: An Overview**

**Improving the current system of public involvement, information-sharing, and understanding of emergencies can be accomplished if agencies:**

1. Improve existing alert systems and create a more comprehensive system to notify local residents
2. Increase public involvement in emergency planning processes
3. Increase public involvement in air monitoring

Cal OES should work with other state and local agencies to improve outreach in communities near refineries, with the goal of improving public awareness of health and safety risks and of appropriate self-protective actions that can be taken in the event of a chemical release or fire.

### 4.2 Increase Public Involvement in Emergency Planning

Cal OES, with other state and local agencies, will evaluate ways to improve the use of the State Emergency Response Commission and Local Emergency Response Committees to include members of the public and worker representatives in the emergency planning process. Cal OES will also ensure that California's emergency management systems are more closely aligned with federal Emergency Planning and Community Right to Know Act requirements for emergency response planning. One option is to align the geographic scope of the local committees with the CUPAs or the counties. The more compact, local scale of the 83 CUPAs or the 58 counties make

them more appropriate for community participation, as compared to the large geographic scale of the current six local committees. The Local Emergency Response Committees could provide a forum for community and worker participation, unified with the CUPAs current preparedness and community right-to-know functions.

### 4.3 Improve Public Involvement in Air Monitoring

ARB and CAPCOA should consider the following elements in their project plan[11] to improve state and local air monitoring practices as possible program improvements: increase the availability and quality of air monitoring data on local and state websites during both routine refinery operations and upset events; develop user applications and other electronic tools to make data more accessible; and convene local town hall meetings for community input and outreach.

### 4.4 Review of the California Air Response Planning Alliance (CARPA)

CalEPA and ARB will work with CARPA to determine its capabilities and the ways in which it could support the state's emergency preparedness and response activities.

## Recommendations for Further Study

The Working Group recommends that the Interagency Refinery Task Force review the following areas for future action.

### Process Safety Leading and Lagging Indicators

Indicators are a standard method of measuring and evaluating performance over time, and they can help identify actions to improve performance and reduce hazards. Indicators can also provide insight into a factor that is more difficult to measure directly, such as safety. Designing and reporting on strong "leading" and "lagging" indicators can potentially drive continuous process improvement at refineries. Leading indicators are predictive and are used to identify potential weaknesses in safety systems with enough advance warning to allow corrective action (e.g., whether various activities have been completed on schedule, number of open incident investigations, deviations from standard operating limits, etc.), while lagging indicators are retrospective and may indicate the potential for recurring problems (e.g., number of PSM incidents that have occurred, number of spills or releases). The Task Force will review literature and guidance on leading and lagging indicators currently existing internationally and in the U.S., and in consultation with the Refinery Safety Forums, develop recommendations for appropriate indicators and how they should be used. The intent is to make this information publicly available, insofar as possible.

### Worker and Community Involvement

The Task Force will convene a labor-management committee to identify methods to involve workers in investigating hazards, recommending corrective actions, and providing input in the risk management decision making process, while considering current employee participation requirements under the CalARP regulation. One approach to consider is the Triangle of Prevention strategy developed by the United Steelworkers to report and investigate incidents and near misses, analyze root causes, recommend and track solutions based on a hierarchy of controls, and learn and share lessons. The committee should also identify stronger methods to prevent retaliation against workers who report unsafe conditions to either management or government agencies, or who exercise their rights under company safety programs to shut down unsafe operations. Meaningful worker and community representation would include participation early in any decision-making process, and should continue throughout the process.

11 See Recommendation 2.2

### Safety Case Approach

Several countries have adopted the safety case model to reduce risks in complex industrial processes such as refineries. Under this model, government agencies evaluate, license and permit the operation of a facility based on the facility's successful development and implementation of a comprehensive safety plan (the employer's "safety case") covering all aspects of the operation. The safety case model relies on industry expertise in self-policing, but it may also allow workers to participate more fully in safety decisions. The experience of the countries where the safety case model has been established indicates several regulatory prerequisites for success, including:

- A designated governmental unit dedicated to enforcement at complex facilities and a large number of inspectors to conduct the initial licensing evaluation and periodic audits;
- A specialized skill set and a high competence level among inspectors, including chemical and mechanical engineers, process plant operators and social science experts, who are able to evaluate technical refinery operations as well as human factors, training effectiveness, safety culture, and other factors;
- Salaries and benefits that typically are higher than other regulatory compliance officers in order to hire and retain highly qualified inspectors;
- A dedicated funding source (general fee, licensing or certification fees, fees for service) paid by the industry; and,
- A substantial change in the regulatory framework to allow regulators to require refinery operators to adopt policies and practices beyond those that are required under existing law.

Because the safety case approach represents a paradigm shift from the traditional deterrence-based enforcement approach, and because of the significant resources and changes to the regulatory framework it entails, consideration of adopting this approach will take time. In other countries, the safety case approach typically has been developed in a multi-year, three-part effort involving government agencies, industry, and workers and their unions. In California, community involvement would also be an important component of this process. In consultation with the Refinery Safety Forums, the Task Force will study the safety case approach, including review of relevant literature and the experience of other jurisdictions, evaluation of its benefits and costs in California, and the steps that would be necessary for its adoption here.

# G. Conclusion

Improving refinery safety is a goal strongly shared by government, industry, workers, and communities. As this report details, refinery safety in California can and must be improved. Government agencies and industry can work together to develop and implement a culture that fosters inherent safety, including stronger accident prevention and hazard reduction measures. Government agencies can improve interagency coordination, emergency response procedures, and communication and outreach to the public. Over the long term, more fundamental changes in the current regulatory framework may be needed. The Interagency Refinery Task Force, established as a result of the report, will guide the efforts of government, industry, labor, community and environmental stakeholders to help achieve the highest possible level of safety and prevention in the California refinery sector.

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