

SUMMARY REPORT

Refinery Safety in California: Labor, Community and Fire Agency Views

*March 27, 2013
Revised June 4, 2013*

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University of California, Berkeley
June 3, 2013*

**Prepared for:
Office of Governor Jerry Brown
Interagency Task Force on Refinery Safety**



**CENTER FOR OCCUPATIONAL AND ENVIRONMENTAL HEALTH (COEH)
LABOR OCCUPATIONAL HEALTH PROGRAM**

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About the Labor Occupational Health Program (LOHP)

The Labor Occupational Health Program (LOHP) operates under the aegis of the Center for Occupational and Environmental Health (COEH) at the University of California, Berkeley, School of Public Health. LOHP is one of the nation's preeminent public university outreach programs for advancing community, worker and environmental health. In addition to its educational programs, LOHP organizes strategic partnerships, conducts participatory research, provides technical assistance, consults on occupational health standards and policies, and serves as a link between the University and workers, employers, government, and communities.

The California Legislature established LOHP's parent organization, COEH, in 1978 (AB 3414) to support the University of California in conducting research, teaching and public service for the purpose of solving the state's occupational and environmental health problems. COEH commissions policy-relevant research, provides technical assistance to policymakers and the public, and disseminates research findings and recommendations through peer-reviewed publications and special briefings. The Northern California COEH consists of researchers and practitioners at the UC campuses of Berkeley, San Francisco, and Davis.

About the Summary Report

This report responds to a January 2013 request for technical assistance by the Governor's Interagency Taskforce on Refinery Safety. The report was first released by LOHP on March 27, 2013. This revision, released June 4, 2013, includes the views of the California Building and Construction Trades, as well as new information on the interim findings of the U.S. Chemical Safety and Hazardous Investigation Board (CSB) and updated information provided by labor unions, community groups, and fire agency officials that originally appeared in the 1st report.

This revision addresses the matter of construction, repair, and maintenance work performed during refinery turnaround periods. It is clearly in California's interest to ensure that turnaround work (i) is performed by highly trained and skilled California workers; (ii) is of the highest possible quality; and (iii) is completed using the best safety, health and environmental practices.

The report notes that in the experience of the State Building and Construction Trades, during turnaround periods, refineries often hire unrepresented contractors—sometimes from out-of-state—whose workers are paid a lower hourly wage and are generally less trained, less skilled, and less able to speak up about safety and health hazards compared to permanent refinery workers and represented building trades journeypersons. The report makes initial recommendations on implementing a prevailing wage standard for refinery turnaround work and on improving the quality and safety of work performed by involving the State-approved building and construction trades apprenticeship programs.

The views and recommendations expressed in the report were gathered by the author from labor, community and fire agency leaders through conference calls, face-to-face meetings, participation in large public meetings, and in meetings convened for leaders of the Governor's Interagency Task Force. During this same period, the author participated in an ongoing Refinery Safety Collaborative consisting of the United Steel Workers (USW) Local 5 and USW International, Communities for a Better Environment, the Asian Pacific Environmental Network, the Natural Resources Defense Council, and the California and national offices of the BlueGreen Alliance.

The author has taken great care to accurately reflect the views of labor, community and fire agency leaders in this report; however, the report is not a consensus document, and final responsibility for its content resides with the author. The views presented here do not necessarily represent those of the Regents of the University of California or the University of California, Berkeley.

The California Department of Industrial Relations provided funding for this report.

About the Author

Dr. Michael Wilson is Director of LOHP. He holds a PhD and Master of Public Health (MPH) in Environmental Health Sciences from the University of California, Berkeley, and a BA in Biology from the University of California, Santa Cruz. He holds diplomas from the Stanford Program in Pre-Hospital Care and the Harvard Trade Union Program. He serves in the National Response System with FEMA Task Force 4, hosted by the Oakland Fire Department.

Acknowledgments

The author extends his appreciation to all meeting participants who freely offered their experience and knowledge regarding safety, health and environmental practices in the refinery industry.

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MEETINGS

The author convened, participated in, and/or facilitated meetings in 2012-2013 as noted below. The official meetings of the Governor’s Interagency Task Force occurred in 2013 as follows:

- February 15 Public fire agencies
- March 13 Southern California labor and community groups
- March 15 Northern California labor and community groups
- March 18 Refinery managers and trade groups
- April 30 Building and construction trades

All other meetings noted below were organized for the purpose of gathering and clarifying information but were not expressly convened by LOHP on behalf of the Task Force.

Date and location	Method	Participants
November 6, 2012 University of California Berkeley	Conference call	United Steelworkers (USW) International USW District 12 USW Local 5
November 15, 2012 University of California Berkeley	In-person meeting	Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National Communities for a Better Environment Labor Occupational Health Program Natural Resources Defense Council USW District 12 USW International USW Local 5
December 6, 2012 University of California Berkeley	Conference call	Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National Communities for a Better Environment Labor Occupational Health Program, UC Berkeley Natural Resources Defense Council USW District 12 USW Local 5
January 2, 2013 University of California Berkeley	In-person meeting	Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National Cal/OSHA California EPA Communities for a Better Environment California Department of Industrial Relations Governor’s Office Labor Occupational Health Program, UC Berkeley Natural Resources Defense Council USW District 12 USW Local 5

January 14, 2013 University of California Berkeley	In-person meeting	Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National Communities for a Better Environment Labor Occupational Health Program, UC Berkeley Natural Resources Defense Council USW District 12 USW Local 5
January 23, 2013 USW Local 5 Martinez, CA	In-person meeting	Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National California Department of Industrial Relations Cal/OSHA California EPA Communities for a Better Environment Governor's Office Labor Occupational Health Program, UC Berkeley Natural Resources Defense Council U.S. Chemical Safety Board Chairman and Senior Staff USW District 12 USW Local 5
February 13, 2013 University of California Berkeley	Conference call	BlueGreen Alliance, California Communities for a Better Environment, N. CA Communities for a Better Environment, S. CA Labor Occupational Health Program, UC Berkeley Labor Occupational Safety and Health Program, UCLA USW 675
February 15, 2013 California State Building Oakland, CA	In-person meeting [Task Force mtg]	Alameda County Fire Department California Department of Industrial Relations California Emergency Management Agency California Air Resources Board Emergency Response Contra Costa County Fire Department Contra Costa County Health Services Agency El Cerrito Fire Department El Segundo Fire Department Fremont Fire Department Labor Occupational Health Program, UC Berkeley Los Angeles County Fire Department Moraga-Orinda Fire Department Office of the State Fire Marshall Richmond Fire Department
February 27, 2013 St. Mark's Catholic Church Richmond, CA	In-person meeting	124 members of the Richmond community Asian Pacific Environmental Network Communities for a Better Environment Labor Occupational Health Program, UC Berkeley Natural Resources Defense Council USW District 12 USW Local 5

March 13, 2013 USW Local 675 Carson, CA	In-person meeting [Task Force mtg]	BlueGreen Alliance California BlueGreen Alliance National California Department of Industrial Relations Communities for a Better Environment CSU Dominguez Hill Labor Studies Natural Resources Defense Council RAND Workplace Health and Safety Labor Occupational Health Program, UC Berkeley Labor Occupational Safety and Health Program, UCLA USW District 12 USW Local 5 USW Local 675 USW Local 675 retired Wilmington neighborhood leaders
March 15, 2013 Richmond Progressive Alliance Richmond, CA	In-person meeting [Task Force mtg]	Alliance of Californians for Community Empowerment Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National California Department of Industrial Relations Communities for a Better Environment Contra Costa Labor Council Crockett-Rodeo Fenceline Committee Global Community Monitor IBEW Local 302 Labor Occupational Health Program, UC Berkeley RAND Workplace Health and Safety Richmond Progressive Alliance USW Local 5 West County Toxics Coalition Worksafe
March 18, 2013 RAND Corporation Santa Monica, CA	In-person meeting [Task Force mtg]	Management representatives of California refineries and representatives of California and U.S. refinery trade associations.
April 12, 2013 Richmond Progressive Alliance Richmond, CA	In-person meeting	Asian Pacific Environmental Network BlueGreen Alliance California Communities for a Better Environment, N. CA Communities for a Better Environment, S. CA Labor Occupational Health Program, UC Berkeley Labor Occupational Safety and Health Program, UCLA Richmond Progressive Alliance USW Local 5 USW Local 675
April 30, 2013 State Building and Construction Trades Council Sacramento, CA	In-person meeting [Task Force mtg]	Cal/OSHA California Department of Industrial Relations California EPA Contra Costa Building and Construction Trades Council Internat'l Brotherhood of Electrical Workers Local 302 International Brotherhood of Boilermakers

Labor Occupational Health Program, UC Berkeley
Union of Operating Engineers Local 3
State Building and Construction Trades Council
United Association of Plumbers and Fitters Local 342

The author and LOHP staff prepared detailed notes from each of these meetings as the basis for the findings in the report. These notes are available on request. To facilitate interaction, the meetings were not recorded and a written transcript was not produced. The report's findings are not intended to represent an exhaustive treatment of the issues.

INTRODUCTION

By 2050, California's population is expected to grow by about 50%, from 36 to 55 million residents. This expansion will be accompanied by a growing set of social, economic, and environmental problems whose *magnitude* will be determined in large part by the policy decisions California makes now and in coming years. In charting a course to a sustainable future, government will need to guide industrial development in such a way that it fully integrates matters of environmental quality and human health. In practice, if California is to create a future characterized by improving social, environmental, and economic conditions, industrial development will need to *solve*, not exacerbate, the public and environmental health problems facing the state today.

To move California in this direction, government can benefit from the support of solution-oriented research and outreach efforts that organize the concerns and recommendations of stakeholders in areas of importance to California's future. This report takes the first steps in serving that purpose in the area of refinery safety.

The report summarizes issues raised and recommendations made by labor, community and environmental leaders and fire agency officials regarding refinery safety and environmental performance. Many of the issues raised are not necessarily unique to the state's 15 refineries and could be applied to the 1,680 hazardous Process Safety Management-designated facilities in California.

The report consists of three Sections: (I) preparedness, monitoring and emergency response; (II) prevention; and (III) sustainability. In each Section, the report presents a set problem statements, followed by examples, implications, and recommended action steps.

BACKGROUND

Refining oil—transforming crude petroleum into gasoline and other fuels—is an inherently dangerous process that requires continued attention to, and investment in, mechanical integrity and in the systems that are intended to protect health, safety and the environment. While the August 6, 2012 fire at Chevron, Richmond was catastrophic, the evidence from the Chemical Safety and Hazard Investigation Board described below indicates that it could have been prevented had Chevron followed the repeated maintenance and inspection recommendations of its own technical personnel.

Between August 6, 2012 and January 14, 2013, the California refinery industry reported 30 to 35 upset events to the U.S. Department of Energy, including small fires, hydrogen sulfide releases, unexpected flare events, mechanical break-downs and others.⁽¹⁾

With some exceptions, other countries that refine oil have experienced a decline in major refinery incidents over the last decade, whereas the U.S. appears to be following the opposite trajectory. According to a report by Swiss Re, the world's second-largest reinsurer, the loss burden per refinery per 1000 barrels per day (U.S. \$24,800) processed in the U.S. cluster of countries is about 3 times that of the EU cluster of countries (U.S. \$8,500).^(2, 3) Swiss Re

¹ U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability. *Energy Assurance Daily*. Available: <http://www.oe.netl.doe.gov/ead.aspx> (Accessed May 30, 2013). (Note: For weekly summaries, go to Download EADs and scroll to Petroleum.)

² Zirngast, Ernst. (January 28, 2006). Oil and Petrochemical Industry Regional Differences. *Different Loss Burden According to Cluster of Countries*. Chemical Safety Board presentation, Washington D.C. Risk Engineering Services, SwissRe. p. 34. (Note: "U.S. cluster" is USA, Canada, UK and Australia. "EU cluster" is Europe,

concluded that the higher losses experienced in the U.S. result in part from the complexity of the refinery industry here and to problems related to the following:

- A pushing, or daring, mode of operation;
- A compliance-driven focus on safety;
- Fluctuating and low levels of staffing;
- The extensive use of outside contractors;
- Conducting certain repairs, upgrades and changes while the refinery is actively operating;
- Allowing extensive time to pass (up to 6 years) between turnarounds, when major repair and upgrade work occurs;
- A low level of attention to ongoing maintenance;
- A “detached” workforce resulting from continued changes;
- Workforce training that is limited to specific jobs, rather than whole systems;
- Vessel and pipe inspection processes that are largely self-regulated by individual companies.⁽⁴⁾

In a 2012 briefing to the U.S. Chemical Safety and Hazard Investigation Board (CSB), Swiss Re officials reported that the incident gap between U.S. refineries and those in other parts of the world had widened since their 2006 report.⁽⁵⁾

Singapore, S. Korea, Japan, Saudi Arabia, Gulf States and Egypt).

³ Zimkast, Erst. (June 6, 2006). *Selective U/W in Oil-Petro Segment: Loss Burden in Different Regions, USA vs. Rest of the World, History of Selective U/W, Cause of Losses*. Technical report-DRAFT-EXTRACT. Risk Engineering Services, Swiss Re.

⁴ Zimkast, Erst. op cit. pp. 24-29.

⁵ Holmstrom, Don. (January 23, 2013). Western Regional Manager, U.S. Chemical Safety and Hazard Investigation Board, presentation at the United Steelworkers (USW) Local 5, Martinez, California.

In its April 2013 *Interim Investigation Report on the Chevron Richmond Refinery Fire*, the CSB documented a striking lack of attention on the part of the Richmond Chevron refinery to maintenance and metallurgy upgrades, which—if implemented—would likely have prevented the catastrophic piping failure and subsequent fire on August 6, 2012, which enveloped 19 workers in a hydrocarbon vapor cloud and ultimately caused some 15,000 areas residents to seek medical attention for symptoms related to exposure to products of combustion. The CSB found that Chevron had ignored at least six recommendations over a period of ten years (2002, 2006, 2007, 2009, 2011, 2012) by Chevron technical personnel to upgrade the metallurgy and/or increase pipe inspections, including at the 4-sidecut piping where the failure occurred.⁽⁶⁾

These recommendations by Chevron personnel were made during a period when catastrophic failures due to sulfidation corrosion were occurring on a fairly regular basis in the refinery industry, including at Chevron’s El Paso, Texas refinery (1988), Chevron’s Pascagoula, Mississippi refinery (1988 and 1993), Chevron’s Salt Lake City, Utah refinery (2002), Chevron’s Richmond, California refinery (2007), the Silver Eagle refinery in Woods Cross, Utah (2009), the Regina, Saskatchewan, Canada refinery (2011), and the BP Cherry Point, Washington refinery (2012).⁽⁷⁾

The CSB reports shows that in 2010, Chevron technical personnel reiterated the need for a 100% component inspection protocol, stating:

⁶ U.S. Chemical Safety and Hazard Investigation Board (CSB). (April 2013). *Interim Investigation Report on the Chevron Richmond Refinery Fire*. Available: http://www.csb.gov/assets/1/19/Chevron_Interim_Report_Final_2013-04-17.pdf (Accessed May 28, 2013) pp. 36-39.

⁷ CSB. 2013. *op cit.* pp. 24-30.

“Sulfidation corrosion failures...are of great concern because of the comparatively high likelihood of “blowout” or catastrophic failure. This typically happens because corrosion occurs at a relatively uniform rate over a broad area, so a pipe can get progressively thinner until it actually bursts rather than leaking at a pit or local thin area. In addition, the process fluid is often above its autoignition temperature. The combination of these factors means that sulfidation corrosion failures frequently result in large fires. Chevron and the industry have experienced numerous failures from this mechanism and recent incidents have reinforced the need for revised inspection strategies and a robust PMI (Positive Materials Identification) program.”⁽⁸⁾

The CSB found that the recommended component inspection program for high-risk piping “was not implemented at Richmond; therefore, the thin-walled low silicon 4-sidecut piping component remained in service until it catastrophically failed on August 6, 2012.” CSB concluded that Chevron’s reliance on over 100 temporary “clamps” on hydrocarbon and other process piping components “raised serious questions about its mechanical integrity program.”⁽⁹⁾

CSB’s recommendations R9 to R14 are intended for the Governor of California and the California Legislature and are aligned with many of the recommendations made in this report.⁽¹⁰⁾

Clearly, improvements in safety, health and environmental performance continue to be urgently needed in the refinery industry in California as well as nationally. California has an opportunity to provide national leadership in this arena by taking steps to improve transparency, accountability, and regulatory oversight in the State’s refineries. The Swiss Re findings suggest that in other nations and regions, these kinds of regulatory actions—such as embodied in the Safety Case approach—have greatly reduced upset events that endanger worker, public and environmental health, and

they have done so without compromising the refinery industry’s efficiency or competitiveness.

⁸ CSB, *op cit.* p. 25

⁹ CSB, *op cit.* pp. 62-63

¹⁰ CSB, *op cit.* pp. 56-57

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SECTION I. PREPAREDNESS, MONITORING, AND EMERGENCY RESPONSE

[New material in subsections B, C, D, F, G, H, I]

Background

Many oil refineries train certain employees to function as members of on-site fire brigades, in addition to their primary, day-to-day responsibilities. Fire brigades may respond to fires, spills, rescues and other incidents that occur inside the plant boundaries. They will also respond to neighboring industrial facilities, if pre-arranged and requested to do so. Some large refineries, including the Chevron refinery in Richmond, California, also employ full-time firefighters, who serve as first responders and are supported by on-site fire brigades.

Fire brigades and on-site fire departments provide three benefits to the public: (1) a rapid response to a refinery incident; (2) increased staffing to supplement public fire agencies during a refinery incident; and (3) a source of technical expertise for public fire agencies during an incident.

A) On-site fire brigades, refinery fire departments, and public fire agencies operate on different radio frequencies and are not able to communicate with each other.

- *Example:* At the August 6, 2012 refinery fire in Richmond, fire brigades were unable to communicate by radio to on-site refinery firefighters, who were unable to communicate to public fire agencies.
- *Implications:* Communication failures impair the effectiveness of the response, make personnel accountability at an incident difficult, and endanger the health and safety of responders and the public.

- *Action needed:* California should require that fire brigades and refinery fire departments operate with radios and frequencies that allow regular communication with public fire agencies.

B) Sometimes public fire agencies are not allowed immediate access to a refinery when they arrive at the plant gate to investigate an incident. Some fire agencies have difficulty accessing refineries to conduct training and pre-planning exercises. In most jurisdictions, there is a lack of regular communication between the refinery and the fire agency on matters of public safety.

- *Example:* A refinery is a high hazard site that warrants continued communication, training and pre-planning between the refinery and public fire agencies, not only in preparation for major incidents but for smaller incidents that occur on site, including medical emergencies, hazardous materials incidents, and technical rescues, such as confined space rescue. In some jurisdictions, there is a lack of clarity between public fire agencies and refinery personnel over the importance of ongoing communication, training, access for pre-planning purposes, and access to investigate incidents reported by the public. In some cases, when a member of the public reports an incident at a refinery, the arrival of fire equipment at the plant gate comes as a surprise to plant personnel.
- *Implications:* A lack of regular communication and training between the refinery and public fire agencies can result in confusion and delays during an incident, which undermines the effectiveness of the response and potentially endangers firefighters and the public.

- *Action needed:* California should put in place a mechanism to ensure timely access to the refineries by public fire agencies for training, incident pre-planning and during a reported incident. This should include provisions that require refineries to submit a quarterly report to the public fire agency on all incidents that occurred on-site but were handled by plant personnel alone. This information is an indicator of potential problem areas in the plant and is essential for fire agency pre-planning. This information should also be made publicly available in a format that is easy-to-access and evaluate. The refineries should provide financial support for public fire agencies, including for training purposes, as noted below.

C) A unified command approach is appropriate for most major incidents; however, in the case of large refinery incidents, there is an inherent conflict between refinery personnel, who are accountable to the corporation, and public fire officials, who are accountable to the public.

- *Example:* This inherent conflict can potentially influence the nature of communications with the public and decisions about the need for additional fire resources. Refinery personnel may tend to “downplay” the severity of an incident in both requesting additional emergency resources and in communicating to the public. At the August 6, 2012 Richmond Chevron fire, important public fire agency resources were not requested; a joint information center was never established; media communications to the public were controlled mostly by the refinery; and communications from the incident to health care providers regarding the potential health implications of

hazardous materials emitted during the fire did not occur.

- *Implications:* Members of the public and health care providers are left without adequate information regarding (i) the severity of an incident, (ii) the potential health effects of toxic materials released, particularly for sensitive subpopulations, and (iii) recommended courses of action. This prevents the public from taking protective actions, and it creates uncertainty among health care providers regarding health effects and the need for decontamination of patients prior to treatment.
- *Actions needed:* California should clarify that at a refinery incident, the responsibility for requesting additional resources and communicating with the public rests solely with the senior public fire officer on scene. “Trigger points” should be investigated as a mechanism for automatically deploying additional public agency resources to a major refinery incident; technical experts in air monitoring, exposure assessment, and toxicology should be incorporated into the incident command system to provide timely and accurate information to the public; these experts should be drawn from public agencies, not from refinery personnel.

D) In responding to a major refinery incident, public fire agencies carry financial burdens, draw on neighboring agencies for mutual aid coverage, and leave their own jurisdictions with fewer available resources.

- *Example:* A significant number of public fire agencies responded to the August 6 Chevron refinery fire, which produced wear-and-tear on equipment and reduced fire resources available to the public.

- *Implications:* The public bears the cost of a refinery incident in both fire department expenses and in heightened risks associated with fewer fire and emergency medical services (EMS) resources available to the 911 system during the course of the incident.
- *Actions needed:* California should evaluate strategies for refineries to “pre-pay” public fire agencies for emergency response and equipment costs, including payments for overtime to back-fill positions for the duration of an incident, if necessary. When a refinery does not staff its own on-site fire department, the refinery should support the full costs of public fire agency staffing, training, and specialized equipment necessary for responding effectively to refinery incidents, including fires; hazardous materials releases to air, water, or soil; and technical rescues from confined spaces and other difficult-to-access sites at the refinery.

E) Insurers, employers, taxpayers, and residents carry the responsibility of paying for medical services rendered to individuals who seek medical attention as a consequence of a fire, hazardous materials leak, or other incident occurring at a refinery. There is also no system presently in place for tracking and documenting the health of these individuals in the wake of an incident.

- *Example:* Following the August 6, 2012 Richmond Chevron fire, the cost of medical services for the approximately 15,000 individuals seeking medical attention for respiratory distress, eye irritation, anxiety and other symptoms exceeded \$10 million, as reported by Chevron, which elected to pay these

bills.⁽¹¹⁾ The subsequent health status of these individuals has not been documented or tracked.

- *Implications:* Payment of medical bills typically falls to insurers, employers, taxpayers or residents. The true social and financial costs of these incidents are unknown because these financial data are not captured and the health status of affected individuals is not tracked over time.
- *Actions needed:* California should ensure that procedures are in place to facilitate payment by refineries of costs incurred for both immediate and long-term medical services related to a refinery incident. To do this, a system is needed to track and document both the short and longer-term health status of affected individuals, beginning with those who seek medical attention during—and in the immediate aftermath of—a refinery incident.

F) During a refinery incident, regional air districts do not have sufficient capacity to monitor atmospheric conditions, plume travel, and real-time emissions, nor are they able to communicate this information effectively to the public.

- *Example:* On August 6, 2012, the Bay Area Air Quality Management District (BAAQMD) collected a small number of samples and communicated to some members of the public that the air was free of toxic air contaminants. A large number of people, however, continued to visit health care facilities with

¹¹ Van Derbeken, Jaxon. Chevron’s Fire Bill: \$10 Million and Counting. *The San Francisco Chronicle*. January 28, 2013. Available: <http://www.sfgate.com/default/article/Chevron-s-fire-bill-10M-and-counting-4230414.php>. (Accessed May 30, 2013).

complaints of respiratory distress, burning of the eyes, and other symptoms.

- *Implications:* If the districts are not able to adequately assess the nature of refinery emissions during upset events and report that information to the public in a timely manner, it is not possible for residents, health care professionals and others to determine what protective actions are most appropriate. The public loses trust in the ability of government to protect public health and safety during a refinery incident.
- *Actions needed:* California should ensure that air districts, in cooperation with refinery managers, the state Air Resources Board and public fire agencies, have the capacity to effectively monitor air contaminants during unusual refinery events and communicate this information to the public through the full range of potential media. The districts should also establish systems to communicate this information to health care providers, emergency responders and others. The refineries should carry the costs for the purchase and maintenance of state-of-the-art, real-time air monitoring equipment and communications systems.

G) During routine refinery operations, regional air districts do not have sufficient capacity to monitor toxic air contaminants, particulate matter, and other air pollutants emitted by the refineries on a daily basis, nor are they able to effectively communicate information of this nature to the public.

- *Example:* The BAAQMD operates a small number of ambient air monitoring stations situated at various locations around the East Bay. These devices are

not able to adequately capture routine refinery emissions.

- *Implications:* Without ongoing and comprehensive hazard and exposure information on refinery emissions, it is not possible to adequately assess the health and environmental effects of these emissions or their true costs to the public. The public loses trust in the ability of government to protect public and environmental health from refinery emissions.
- *Actions needed:* California should ensure that air districts, in cooperation with the state Air Resources Board, have the capacity to conduct air monitoring for toxic air contaminants, particulate matter, and other air pollutants on a routine basis and that they post that information online in an easily accessible and understandable format. The districts should establish systems to proactively communicate this information to the public, while also acknowledging areas of uncertainty. Health warning levels for both acute and chronic effects should be those established by the California EPA Office of Environmental Health Hazard Assessment (OEHHA) and should be calibrated for the actual mixed exposures that occur in the population, not simply for individual chemical substances. Warning levels should be calibrated for mixed exposures to children and other susceptible groups. The refineries should carry the costs for the purchase and maintenance of state-of-the-art, real-time air monitoring equipment and communications systems.

H) The Bay Area Air Quality Management District (BAAQMD) does not report the constituent chemical substances in vent gasses released by refineries and reported under

Regulation 12, Rules 11 and 12, Flare Monitoring at Petroleum Refineries.⁽¹²⁾

- *Example:* The BAAQMD website reports aggregate “vent gas” and “non-methane hydrocarbons” but does not report the chemical substances that make up these emissions. Individual chemical constituents, such as acrolein, can be highly toxic and/or irritating; if present in high concentrations, individual chemical constituents can increase health risks associated with flaring and other upset events.
- *Implications:* Without information on chemical constituents, it is not possible for government agencies or the public to adequately assess the health risks or social costs associated with flare emissions and other upset events.
- *Actions needed:* California should require direct monitoring at emission points and reporting by all refineries. Air districts should post all flare and other upset events on a publicly accessible and useable website.⁽¹³⁾ The information provided should include the total release quantities of individual chemical constituents, as defined under (i) the federal Toxics Release Inventory and (ii) California’s Toxic Air Contaminant list, maintained by the

¹² Bay Area Air Quality Management District. Emissions and Volume Trends. *Flare Emissions and Flaring Frequency and Magnitude Trends at Bay Area Refineries*. Available: <http://www.baaqmd.gov/Divisions/Compliance-and-Enforcement/Refinery-Flare-Monitoring/Emissions.aspx> (Accessed May 31, 2013).

¹³ Joshua O, Jarrell M. Upset Over Air Pollution: Analyzing Upset Event Emissions at Petroleum Refineries. 2011. *Review of Policy Research*, 28(4) 365-381.

Cal/EPA Air Resources Board.⁽¹⁴⁾ This information should also include releases of fine and ultra-fine particulate matter.

1) The emergency public warning system largely failed to function during the August 6 Chevron refinery fire, and there was no public agency providing regular updates to the public.

- *Example:* The automated phone system malfunctioned, and auditory alarms were not activated broadly or were simply not heard. There was no public agency website dedicated to providing essential information to the public, including incident updates, air quality status, sheltering instructions, special protections for those with asthma and other respiratory conditions, and steps to protect children.
- *Implications:* Residents in Richmond and neighboring areas could see a large black cloud of smoke coming from the refinery, but they did not know what actions they should take, where they could get information, or how serious their situation could become. They were therefore unable to make informed decisions and take appropriate actions.
- *Actions needed:* California should ensure that refineries fund the development of effective, audible warning sirens and a dedicated website that is accessible by hand-held devices and can be regularly updated by a public agency. These systems should be coupled with other outreach strategies

¹⁴ California EPA, Air Resources Board. Toxic Air Contaminant List (July 18, 2011). Pursuant to Title 17, CCR, §93000. Substances Identified as Toxic Air Contaminants. Available: <http://www.arb.ca.gov/toxics/id/taclist.htm> (Accessed May 31, 2013).

to the public, including pre-arranged agreements with radio and television stations. Funding to support ongoing training of neighborhood-based, community emergency response teams (CERTs) would improve the ability of residents to respond to—and recover from—a major industrial incident.

J) Public transit lines were shut down during the August 6 Chevron refinery fire.

- *Example:* Without having developed an alternative plan, the Bay Area Rapid Transit (BART) train system stopped carrying passengers into Richmond, stranding passengers in outlying stations.
- *Implications:* BART's shut-down made it very difficult for many residents to return to Richmond to take care of children and meet other needs during the incident.
- *Action needed:* California should ensure that local transit districts have developed strategies to respond effectively in the event of an industrial emergency. Shutting down transit lines might be appropriate in some cases; these decisions, however, should be made using pre-planned protocols and with information provided by emergency services personnel; they should not be made *ad hoc* or left to the individual judgment of bus and train operators.

SECTION II. PREVENTION

[New material in subsections C, D, G, H]

Background

The U.S. Chemical Safety and Hazard Investigation Board, the Federal and California OSHA programs, the United Steelworkers union, the U.S. EPA, the American Institute of Chemical Engineers, and the Contra Costa County Health Services Agency have all created recommendations for improving refinery safety, most of which focus on prevention strategies.

While many of these strategies have been adopted in California, improvements continue to be urgently needed, primarily because these efforts have not been able to correct an underlying lack of transparency and public accountability in the industry. In large part, the industry remains self-regulated: it operates in a regulatory environment that lacks robust performance requirements, substantive penalties, and other incentives. It is not required to identify and implement inherently safer systems.

As described by the CSB, above, the industry has responded to this weak regulatory environment by largely neglecting its investments in mechanical integrity, safety and environmental performance; the evidence indicates that these aspects of refinery operations have become tangential to the primary mission of the refinery industry.

A) The refineries have not proactively communicated information on corrosion damage to state, Federal or local government regulatory agencies, nor have they communicated this information to workers or the public.

- *Example:* After a corroded pipe burst in the August 6 Chevron incident,

evidence of serious corrosion damage and deferred maintenance was uncovered throughout the Richmond refinery.

- *Implications:* Unless corrosion information is gathered and communicated proactively by the refineries, it is not possible for government, workers, or the public to understand the nature of this hazard and take steps to ensure that it is corrected.
- *Actions needed:* California should require the refinery industry to conduct a comprehensive audit of corrosion damage, and the results should be reported publicly. A useful initial measure for providing information on corrosion damage is through reporting on the use of clamps and Management of Change (MOC) actions taken for each clamp. Ongoing auditing and public reporting of clamp usage, and its scheduled replacement time, should be required of the refineries to ensure that corrosion risks are identified, prioritized, and repaired.

B) While workers have the authority to shut-down unsafe operations, the power to do so is continually undermined by plant managers; relying on shut-down actions taken by workers also shifts responsibility away from management's obligation to ensure mechanical integrity through preventive maintenance.

- *Example:* Although workers raised concerns over corrosion at the Richmond Chevron refinery, corrosion problems were not prioritized and corrected by plant managers, and a hole subsequently opened in the crude unit side-cut piping on August 6. Chevron continued to operate the unit

under pressure while workers attempted to assess and repair the leak.

- *Implications:* The resulting catastrophic fire nearly killed 19 workers and ultimately caused some 15,000 residents of Richmond and surrounding communities to seek medical attention from area health care facilities.
- *Actions needed:* California should require the implementation of a transparent and robust preventive maintenance program at all refineries, including elements noted below. California should put in place procedures for workers to report unsafe operational conditions to a regulatory agency, in addition to reporting to plant managers.

C) Maintenance and safety problems identified by refinery workers are often not corrected for months or years.

- *Example:* Since 2002, Chevron repeatedly postponed replacing the corroded section of pipe that finally burst on August 6, 2012, despite repeated warnings by USW members and Chevron's own technical personnel and of the potential for catastrophic failure resulting from corrosion damage at this and other sites at the refinery.
- *Implications:* Refineries run an increasing risk of catastrophic failures due to loss of containment, which are accompanied by explosions, large fires and releases of combustion products and toxic air contaminants into surrounding communities.
- *Actions needed:* California should require refineries to disclose to government, employee representatives, and to a publicly accessible database normalized information on (i)

maintenance and safety requests made, (ii) corrective actions taken or not taken, (iii) outcomes, (iv) root causes of the maintenance or safety problem, and (v) the management individual accountable. An accessible record of this type will highlight best practices among leading refineries and will allow government, the public, and workers to track refinery performance. Regulatory actions should be triggered based on the number of maintenance and safety requests left open and uncompleted over a defined period of time.

D) Ensuring that turnaround work is performed by the most skilled and trained workforce is a matter of significant state and public interest. In the experience of the State Building and Construction Trades, some refineries hire unrepresented contract workers during turnarounds whose workers perform work that has significant implications for worker, public and environmental safety, yet these workers are often poorly paid, less trained and skilled, and less able to speak up about safety and health hazards compared to permanent refinery workers and represented building trades journeypersons.

- *Example:* During a typical turn-around period, thousands of workers are employed by outside contractors to perform construction, maintenance and repair tasks in a refinery. A varying number of these workers are unrepresented; some are itinerant workers from outside California.
- *Implications:* The extensive use of unrepresented contract workers undermines refinery safety. If USW-represented refinery workers are augmented during turn-around periods by locally hired, skilled building trades workers who are paid the prevailing wage, local economies would benefit and California would help ensure that

turnaround work is of the highest quality and is performed using well-recognized standards for worker and community health and safety.

- *Action needed:* California should require refineries to report the number of contract workers hired each year who perform construction, maintenance and repair work inside the refinery, including those from outside the state; their duration of employment; their level of training; and the positions these workers fill. California should consider a requirement that contractors hired by refineries pay at least the prevailing wage for skilled labor and employ a certain percentage of workers who are either (i) graduates of a State-approved construction apprenticeship program, or (ii) are registered in a State-approved construction apprenticeship program. State-approved construction apprenticeship programs operating in the geographic area of refineries that do not already do so should include training in occupational safety and health, environmental protection, and basic emergency response practices relevant to the refinery industry.

E) There is a need for much greater worker involvement in management decisions regarding health, safety and environmental performance.

- *Example:* While represented workers at refineries can provide input into safety issues, they do not share decision-making authority with plant managers, whose economic interests are not consistently aligned with safety.
- *Implications:* Safety is continually marginalized in favor of production during both routine operations and turnovers.

- *Action needed:* California should require that refineries operate with a tripartite labor-management-government structure for decisions pertaining to health, safety and environmental performance. This structure would provide the authority for full-time workers and government to engage in tracking of leading and lagging indicators, near-miss reporting and investigation, and sharing of lessons for continuous improvement. The United Steelworkers (USW) *Triangle of Prevention* framework provides an analytical model for decision-making in this context.

F) It is unknown whether and to what extent refineries are tracking and acting on leading, lagging, and near-miss performance indicators.

- *Example:* Even under its Industrial Safety Ordinance, Contra Costa County is unable to identify, track and compare performance indicators among refineries; had it been able to do so, the County might have been made aware of extensive corrosion problems at the Richmond Chevron plant.
- *Implications:* A refinery that documents, tracks, publicly reports, and takes action based on performance indicators is more likely to identify problems early and operate more safely and efficiently, compared to refineries that pay less attention to performance indicators. It is currently not possible to identify the best and worst performing refineries in the state, which makes it difficult to take appropriately scaled regulatory and other actions.
- *Action needed:* California should require refineries to disclose to government and to a publicly accessible database normalized information on (i) leading, lagging, and near-miss

performance metrics, including both planned and unplanned flaring events; (ii) corrective actions taken or not taken; (iii) outcomes; (iv) root cause of deviations in the performance metric; and (v) the management individual accountable. Regulatory actions should be triggered based on continuing failures in certain performance indicators, based on a to-be-determined set of metrics.

***G) The Process Safety Management (PSM) unit of the California Division of Occupational Safety and Health (Cal/OSHA) lacks both the staffing and the expertise in some areas necessary for overseeing the state's 15 refineries and 1,680 other industrial facilities that handle large quantities of toxic, flammable, and explosive materials.*⁽¹⁵⁾**

- Example: The PSM unit is currently authorized to fill eight (8) field inspector positions. This small number of inspectors cannot effectively oversee the large number of hazardous process industries in the state, including the refineries. While this group has extensive experience in refinery operations and safety, it lacks personnel with advanced degrees in chemical engineering, process safety, environmental health sciences, mechanical engineering, and other relevant fields.
- Implications: The PSM unit is unable to adequately oversee the safety of California's process industries; this places the safety of both workers and the public at risk.

¹⁵ California Division of Occupational Safety and Health (Cal/OSHA). Process Safety Management. (Revised 05/19/2007). Available: <http://www.dir.ca.gov/doshpol/p&pc-17.htm> (Accessed May 31, 2013).

- Actions needed: California should take steps to increase the effectiveness of the PSM unit by considering collaborations with sister agencies and by assessing PSM staffing levels and technical training. California should also enhance Cal/OSHA's existing refinery permitting and inspection requirements, including those implemented by the PSM unit.

H) California's refineries are able to operate without having to demonstrate competence in health, safety and environmental performance to a regulatory agency or to the public.

- Example: Unlike other nations that have implemented a Safety Case approach to manage hazardous process industries, there is no requirement in California that refineries proactively generate and disclose a broad set of information to government on their health, safety and environmental performance, nor is there an agency authorized to (i) receive and assess such information, (ii) grant or deny permission to a refinery to operate, or (iii) take other regulatory actions on the basis of that information.^(16, 17)
- Implications: California has placed its trust for worker and public safety and

¹⁶ Testimony of Don Holmstrom and Dan Tillema, U.S. Chemical Safety and Hazard Investigation Board, before the California East Bay Legislators' Public Inquiry into Chevron Refinery Fire of August 2012. April 19, 2013. Richmond, California. Available: http://www.csb.gov/assets/1/16/CA_Field_Hearing_Speech_4-5-13_Final.pdf (Accessed June 2, 2013).

¹⁷ U.S. Chemical Safety and Hazard Investigation Board (CSB). (April 2013). *Interim Investigation Report on the Chevron Richmond Refinery Fire*. Available: http://www.csb.gov/assets/1/19/Chevron_Interim_Report_Final_2013-04-17.pdf (Accessed May 28, 2013) p. 60.

environmental protection largely in the hands of refinery operators, who are accountable not to the public but to the corporation.

- Action needed: California should (i) establish an interagency regulatory entity with broad authority to oversee the safety and environmental performance of the state's refineries and other hazardous process industries; (ii) switch the 'burden of proof' to the process industries by requiring a demonstration of competence in health, safety and environmental performance as a condition of operation, similar to the Safety Case approach adopted by the European Union and elsewhere, and (iii) provide a mechanism for funding a new interagency process safety regulatory program through fees or other financial mechanisms paid by the state's refineries and other hazardous process industries.

1) The Contra Costa County Industrial Safety Ordinance (ISO) is a nationally recognized regulatory program that has produced a marked decline in refinery incidents and could serve as a statewide model; there are also areas where it should be modernized and strengthened.⁽¹⁸⁾

- *Example:* Incorporating inherent safety through choices in the types of materials, technology, feedstocks, and equipment used at a plant eliminates (or reduces) hazards at the source and is therefore the preferred method for reducing health, safety and environmental risks. Inherent safety is

recommended in the ISO but is not required.

- *Implications:* The potential benefits of inherent safety in the refinery industry in Contra Costa County have not been fully realized.
- *Action needed:* Evaluate the ISO for areas that are in need of modernization and strengthening, and then evaluate its efficacy as a statewide model.

¹⁸ Contra Costa County Health Services. (February 26, 2013). Industrial Safety Ordinance. *Annual Performance Review and Evaluation Report*. Available: <http://cchealth.org/hazmat/pdf/iso/iso-report.pdf> (Accessed May 31, 2013).

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SECTION III. SUSTAINABILITY

[New material in subsections B, C]

A) The sulfur content of crude oil imports into California refineries has increased steadily since 1985 and is expected to continue to do so.

Example: The U.S. Energy Information Administration reports that the weighted average sulfur content of crude oil inputs for West Coast refineries increased from 1.05% in January 1985 to 1.35% in July 2012 (Figure 1).⁽¹⁹⁾

Implications: When the total sulfur content in the crude oil used by refineries is greater than about 1.0%, the oil is classified as "sour" and is less expensive but more difficult to process. Sulfur impurities need to be removed prior to processing, which increases energy demands. Higher sulfur-content crude oil also produces toxic air contaminants (hydrogen sulfide and sulfur dioxide) and greenhouse gases (GHGs), and it increases the rate of corrosion throughout a refinery's piping and mechanical systems.

Action needed: California should require air districts to promulgate rules prohibiting increases in routine and episodic air emissions from refineries that result from the use of higher sulfur-content oil inputs. California should consider rules that would bar or limit the importation of refined oil products into the state.

¹⁹ U.S. Energy Information Administration. Petroleum and Other Liquids. *West Coast (PADD 5) Sulfur Content (Weighted Average) of Crude Oil Inputs to Refineries*. Available: <http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRS1P52&f=M> (Accessed May 28, 2013).

B) Refineries are the largest energy-using industry in California and the most energy intensive industry in the U.S.⁽²⁰⁾ The state's refineries have added energy intensive equipment, such as hydrogen plants and hydrotreaters, to process high sulfur-content crude oil inputs.

Example: The California Air Resources Board reports that the state's 15 refineries are the largest industrial emitters of GHGs in the state, accounting for about 31 of 86 million total tons (CO₂ equivalents) of GHGs released by industry in 2010, or about 36%. This is about 1 ton lower than the 32 tons released by the refineries in 2000. In 2010, refinery GHGs accounted for about 7% of the state's total GHGs of 452 million tons.⁽²¹⁾

Implications: GHG emissions are occurring as a result of direct plant emissions and from the increased energy required to process higher sulfur-content crude oil.

Actions needed: California should require the refineries to (i) conduct a comprehensive energy audit; (ii) produce an annual, detailed, online report on the results; and (iii) meet an energy reduction schedule. The audit should include energy uses by, for example, hydrogen plants, hydrotreaters, hydrocrackers, fluid catalytic crackers, cokers, sulfur recovery units, boilers and heaters. Beginning immediately, California should require the refineries to (i)

²⁰ Worrell, Ernst and Galitsky, Christina (March 2004). *Profile of the Petroleum Refining Industry in California*. California Industries of the Future Program. Lawrence Berkeley National Laboratory. Available: http://www1.eere.energy.gov/manufacturing/resource/s/petroleum_refining/pdfs/cpi_profile.pdf (Accessed May 28, 2013). p. iii.

²¹ California EPA, Air Resources Board. California Greenhouse Gas Inventory for 2000-2010. Available: http://www.arb.ca.gov/cc/inventory/data/tables/ghg_inventory_scopingplan_00-10_2013-02-19.pdf (Accessed May 28, 2013).

replace old boilers, heaters, and other inefficient equipment, some of which were built over 50 years ago, and (ii) evaluate and implement U.S. EPA recommendations on available and emerging technologies for reducing greenhouse gas emissions in the refining industry.⁽²²⁾ California should consider requiring refineries to replace a portion of grid energy used each year with alternative energy sources.

C) Refineries are among the largest industrial emitters of toxic air contaminants in California.

Example: The U.S. EPA Toxics Release Inventory (TRI) shows that refineries are the largest source of emissions of hazardous “1995 New Chemicals” in California, with reported releases of 2.8 million pounds in 2011.⁽²³⁾

Implications: Air contaminants are dispersed regionally, causing population-wide health effects and reducing quality of life; residents of communities that host a refinery—who are disproportionately minority and lower income—are exposed to toxic air contaminants at high levels and suffer higher rates of asthma, cancer and other diseases, relative to rates in California as a whole.

Actions needed: California should require refineries to rapidly and continually reduce emissions through the use of Best Available Control Technologies (BACT) or Best Available Retrofit Control Technologies (BARCT), as

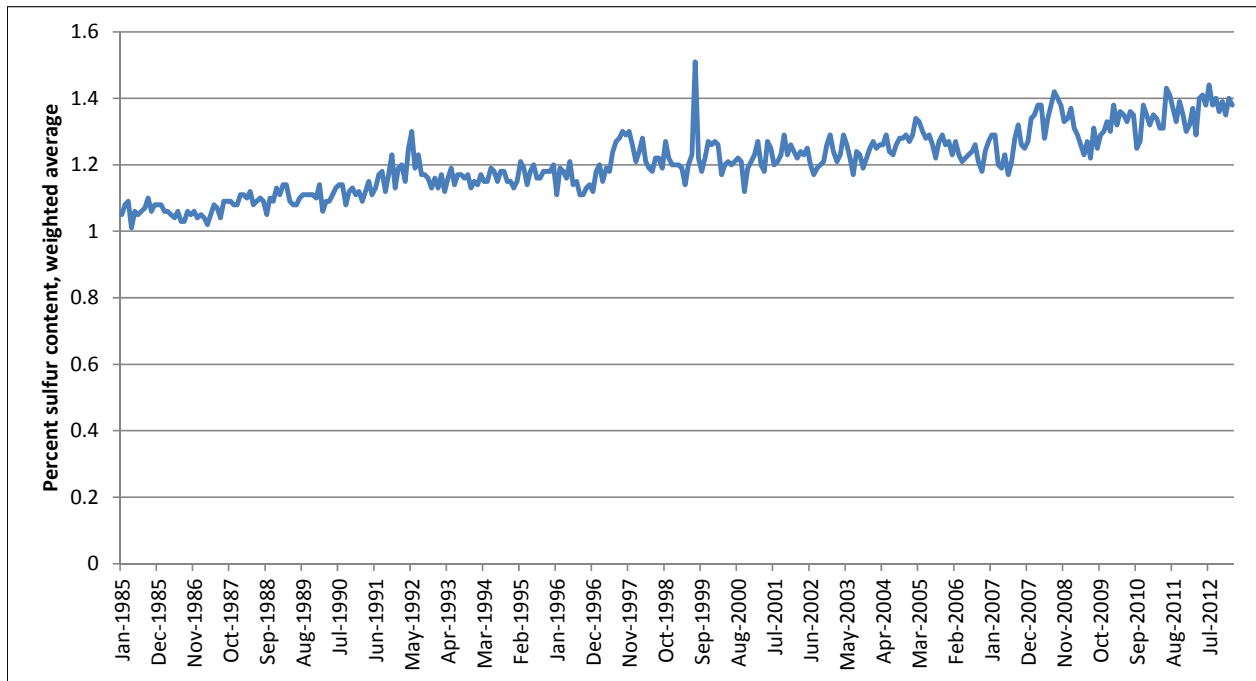
defined under the Federal Clean Air Act and elsewhere.

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²² U.S. EPA. (October 2010). Office of Air and Radiation. *Available and Emerging Technologies for Reducing Greenhouse Gas Emissions from the Petroleum Refining Industry*. Available: <http://www.epa.gov/nsr/ghgdocs/refineries.pdf>. (Accessed May 28, 2013).

²³ U.S. EPA Toxics Release Inventory. TRI Explorer, Release Reports, 2011. All Industries, 1995 New Chemicals. Available: http://iaspub.epa.gov/triexplorer/tri_release.industry (Accessed May 28, 2013).

Figure 1. U.S. EIA trend data on West Coast sulfur content of crude oil to refineries (weighted average), 1985—2012.⁽²⁴⁾



²⁴ U.S. Energy Information Administration (2013). *op cit*.

