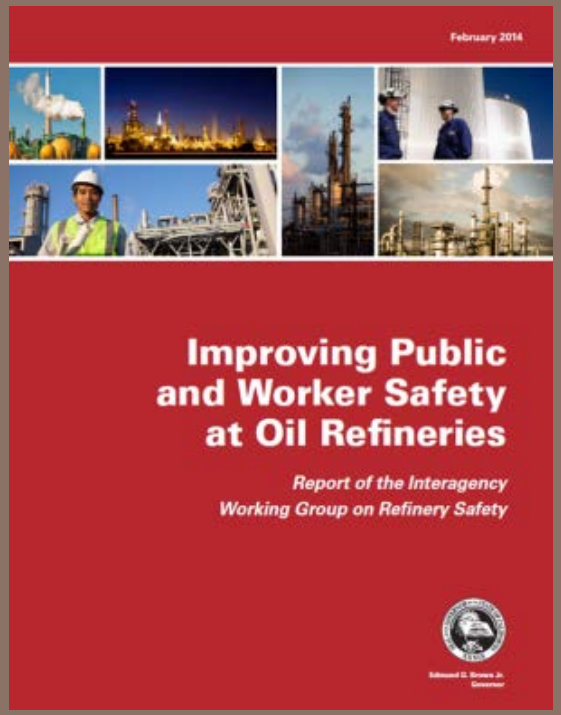


CALIFORNIA INTERAGENCY REFINERY TASK FORCE UPDATE MARCH, 2017

Contra Costa County CAER

Items of Interest

- Refinery **Safety and Prevention** Amendments to Process Safety Management (PSM) by the California Department of Industrial Relations (DIR, CalOSHA) and Risk Management Prevention/ California Accidental Release Prevention program (RMP, CalARP) by Governor's Office of Emergency Services (CalOES)
- Refinery **Emergency Preparedness and Response** Amendments to CalARP and Area Plans by CalOES

Items of Interest (cont.)

- ARB/CAPCOA Refinery Emergency Air Monitoring Project
  - Inventory, Evaluate, Guidance, Improvements
- OEHHA Emergency Refinery Air Monitoring Project: Analysis of Refinery Chemical Emissions and Health Effects

Why Should I Care?

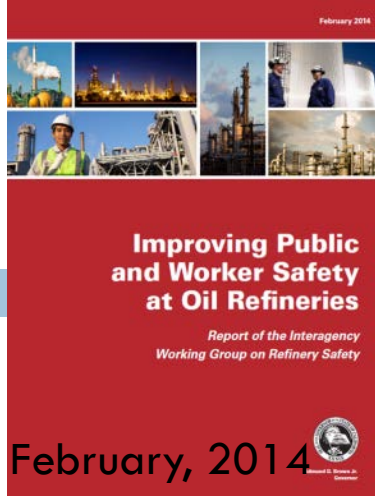
- If you are a refinery, this applies to you
- If you are not a refinery
  - These regulations and tools can be a way to implement best practices to protect your workers, community, and environment
  - We are one major event or legislative initiative from these proposed regulations being applied to other industries
  - Implementing these programs can maximize the long term sustainability of business and thus ensure ongoing profits

The Real Reason You Should Care

- https://www.youtube.com/watch?v=hcKM4xWywLE

Safety and Prevention

Governor's Report on Refinery Safety Recommendations:



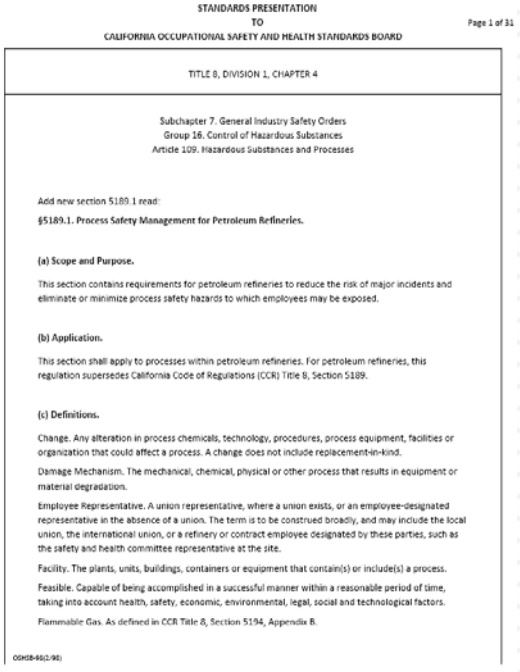
Strengthen PSM and Cal ARP Programs:

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 analysis 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.

Additional areas: Reporting of leading and lagging indicators, increasing worker and community involvement, and exploring the safety case approach.

Formal Rulemaking- California Regulatory Notice Register on July 15, 2016

http://calepa.ca.gov/Refinery/



STANDARDS PRESENTATION
TO
CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH STANDARDS BOARD

Page 1 of 31

TITLE 8, DIVISION 1, CHAPTER 4

Subchapter 7. General Industry Safety Orders
Group 16. Control of Hazardous Substances
Article 109. Hazardous Substances and Processes

Add new section 5189.1 read:

§5189.1. Process Safety Management for Petroleum Refineries.

(a) Scope and Purpose.

This section contains requirements for petroleum refineries to reduce the risk of major incidents and eliminate or minimize process safety hazards to which employees may be exposed.

(b) Application.

This section shall apply to processes within petroleum refineries. For petroleum refineries, this regulation supersedes California Code of Regulations (CCR) Title 8, Section 5189.

(c) Definitions.

Change. Any alteration in process chemicals, technology, procedures, process equipment, facilities or organization that could affect a process. A change does not include replacement-in-kind.

Damage Mechanism. The mechanical, chemical, physical or other process that results in equipment or material degradation.

Employee Representative. A union representative, where a union exists, or an employee-designated representative in the absence of a union. The term is to be construed broadly, and may include the local union, the international union, or a refinery or contract employee designated by these parties, such as the safety and health committee representative at the site.

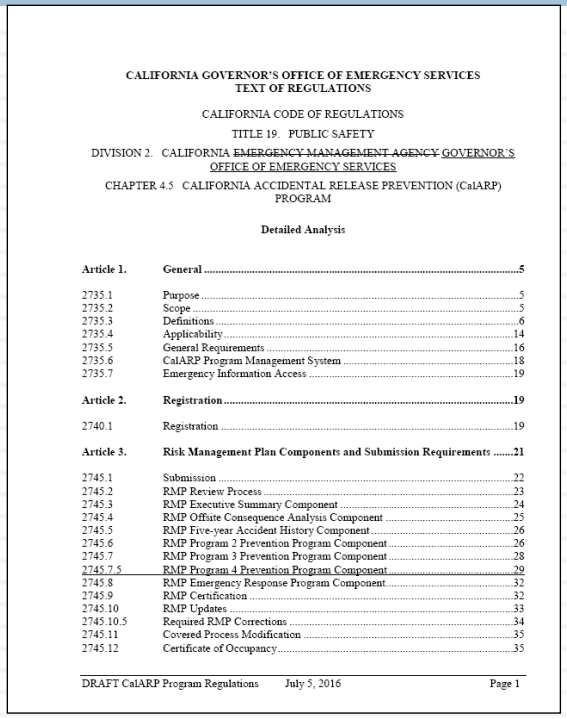
Facility. The plants, units, buildings, containers or equipment that contain(s) or include(s) a process.

Feasible. Capable of being accomplished in a successful manner within a reasonable period of time, taking into account health, safety, economic, environmental, legal, social and technological factors.

Flammable Gas. As defined in CCR Title 8, Section 5194, Appendix B.

OSHSB-66(2/98)

http://www.dir.ca.gov/OSHSB/Process-Safety-Management-for-Petroleum-Refineries.html



CALIFORNIA GOVERNOR'S OFFICE OF EMERGENCY SERVICES
TEXT OF REGULATIONS

CALIFORNIA CODE OF REGULATIONS

TITLE 19. PUBLIC SAFETY

DIVISION 2. CALIFORNIA ~~EMERGENCY MANAGEMENT AGENCY~~ GOVERNOR'S OFFICE OF EMERGENCY SERVICES

CHAPTER 4.5 CALIFORNIA ACCIDENTAL RELEASE PREVENTION (CalARP) PROGRAM

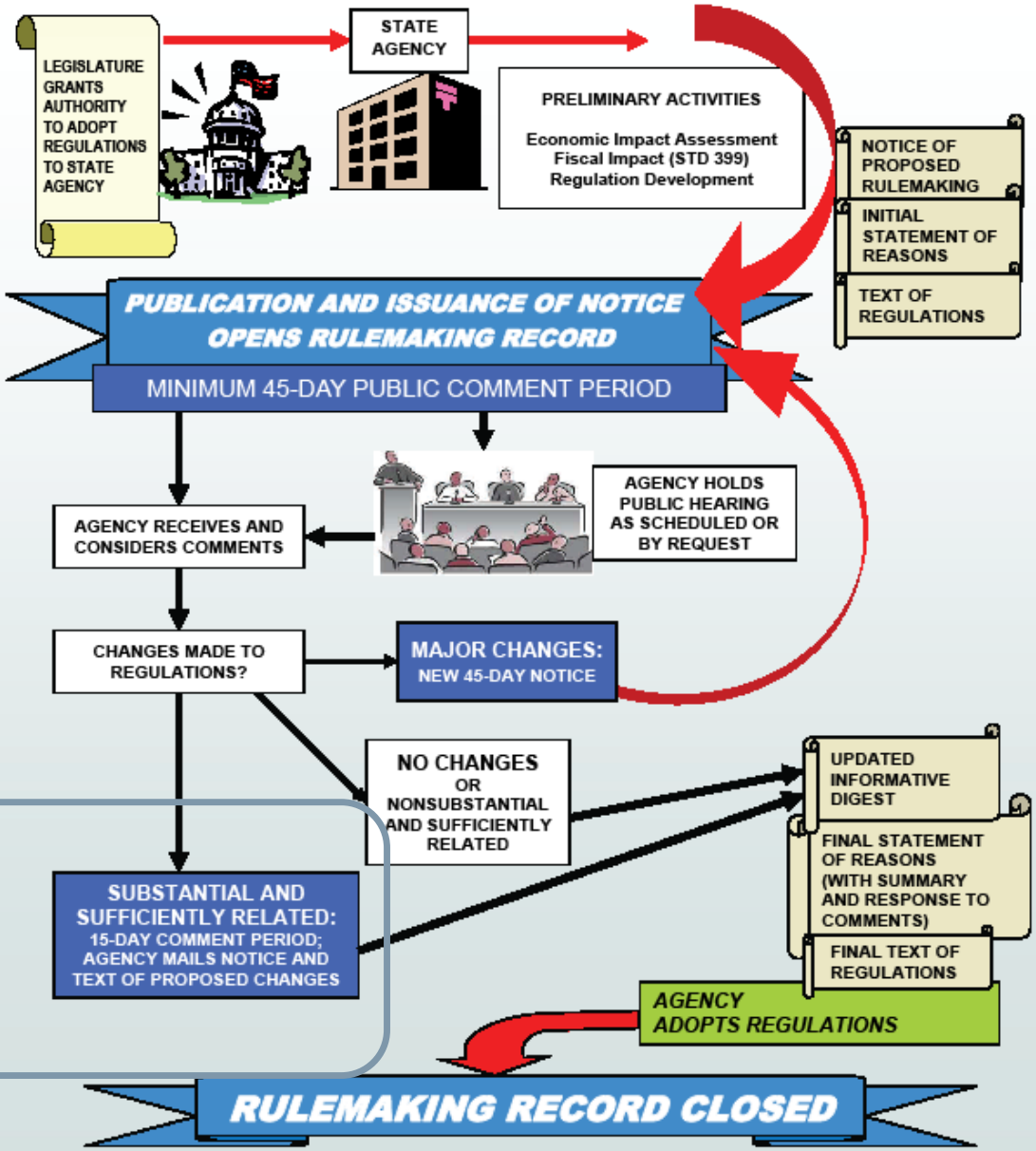
Detailed Analysis

http://www.caloes.ca.gov/cal-oes-divisions/fire-rescue/hazardous-materials/california-accidental-release-prevention

Safety and Prevention

July 15, 2016

REGULAR RULEMAKING



We are here (Comment period ended March 3)

Cal ARP Article 6.5: Program 4 Prevention Program GISO Section 5189.1 Process Safety Management for Petroleum Refineries

Applicability: Petroleum Refineries (NAICS Code 324110)

Strengthen and Align

Purpose

- Cal ARP: The purpose of Program 4 is to prevent major incidents at petroleum refineries to protect the health and safety of communities and the environment.

- PSM: This Section contains requirements for petroleum refineries to prevent major incidents and minimize the process safety risks to which employees may be exposed.

Selected General Definitions

Excerpts

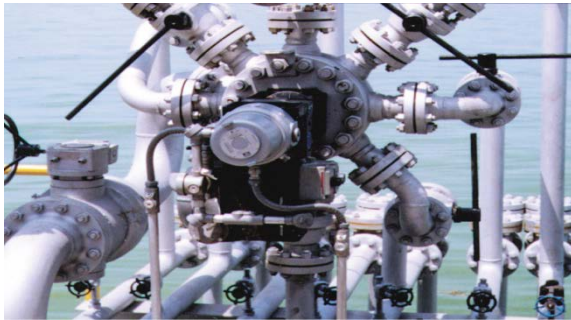
"Major Incident" means an event within or affecting a process that causes a fire, explosion or release of a highly hazardous material has the potential to result in death or serious physical harm (as defined in Labor Code Section 6432(e)), or which results in a shelter-in-place, or an evacuation order.

"Feasible" means capable of being accomplished in a successful manner within a reasonable period of time, taking into account health, safety, economic, environmental, legal, social, and technological factors.

"Major change" means any of the following: (1) introduction of a new process, new process equipment, or new regulated substance; (2) any operational change outside of established safe operating limits; or (3) any that introduces a new process safety hazard or worsens an existing process safety hazard.

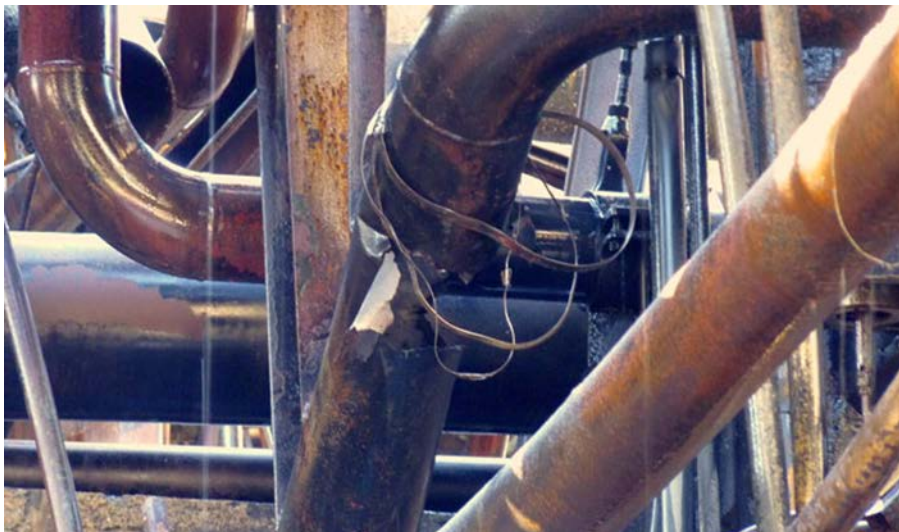
Additional Definitions

- "Highly hazardous material" means a substance possessing a toxic, reactive, flammable, explosive, or other dangerous property, exposure to which could result in death or serious physical harm as defined by Labor Code 6432 (e). Highly hazardous material includes all regulated substances listed in Appendix A.
- "Process" for purposes of this Article, means petroleum refining activities involving a highly hazardous material, including use, storage, manufacturing, handling, piping, or on-site movement. Utilities and safety related devices may be considered part of the process if, in the event of an unmitigated failure or malfunction, they could potentially contribute to a major incident.



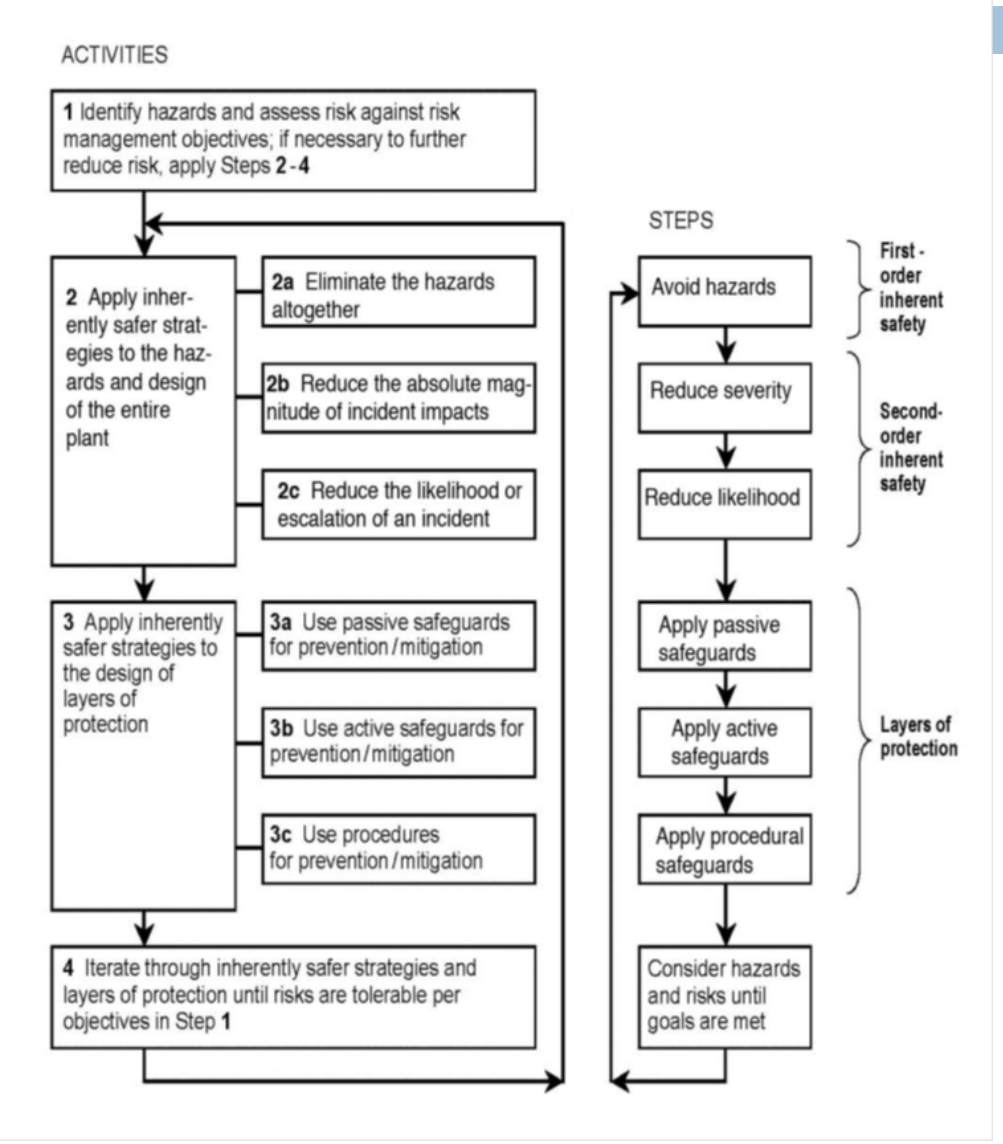
Damage Mechanism Review (DMR)

- Scope: “each process for which a damage mechanism exists”;
- Initial DMR within 5 years (50% within 3 yrs);
- Revalidated every 5 years or prior to a major change;
- Reviewed as part of an incident investigation;
- Team must include experts and employees;
- Feeds into the Process Hazard Analysis.

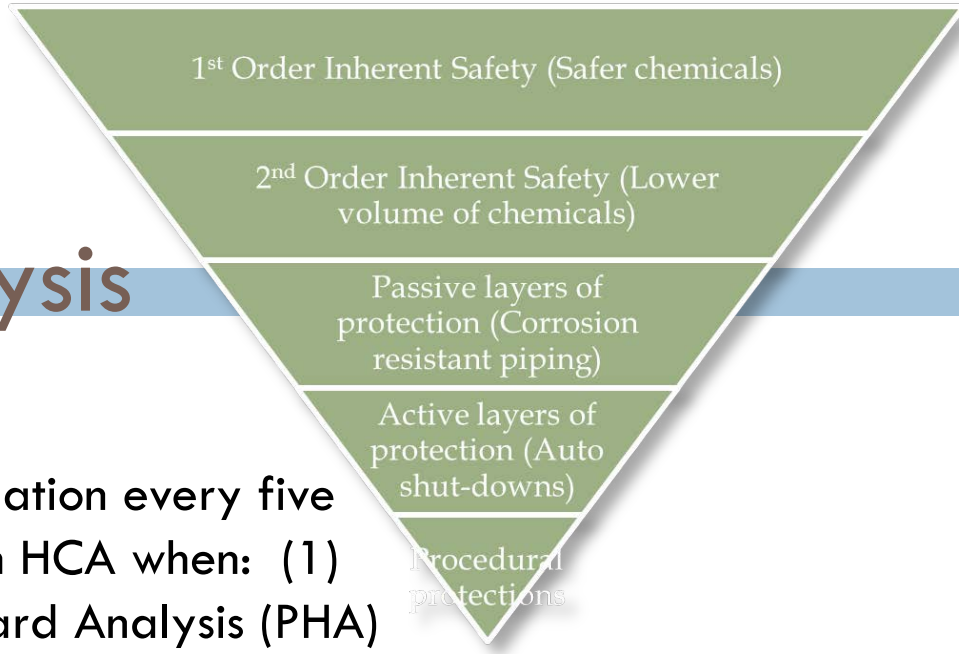


Hierarchy of Hazard Control

Hierarchy of Hazard Control; A system used to minimize or eliminate exposure to a hazard or to reduce the risk presented by a hazard. Control measures listed from most effective control measure to least effective control measure are: (1) eliminating the hazards altogether (first order inherent safety), (2) reducing severity of hazard or likelihood of release (second order inherent safety), or (3) applying layers of protection, including passive, active, or procedural safeguards (layers of protection).



Hierarchy of Hazard Control Analysis



- Initial HCA for all processes, & revalidation every five years. Refineries also must conduct an HCA when: (1) recommendations from a Process Hazard Analysis (PHA) show a potential for a major incident, (2) a major change is proposed, or (3) a major incident occurs.
- Also during the design of any new process, process unit, or facility. *An HCA done for this purpose must be made available to the public, with appropriate protections for trade secret information.*

- HCAs are conducted by a team with expertise in inherent safety and safeguards, with employee representation.
- Refineries must select the highest order safety measure unless it is not feasible. Any finding of infeasibility must be documented.

Safeguard Protection Analysis (SPA)

- "Safeguard" means a device, system, or action that interrupts the chain of events following an initiating cause, or that mitigates the impacts of an incident. [Passive/Active/Procedural Safeguards]
- Conduct and update within 6 months of finalizing a Process Hazard Analysis (PHA), to ensure the effectiveness of the individual and combined safeguards for each failure scenario identified in the PHA, and to assure that the safeguards are independent of each other.
- Team with expertise in engineering and process operations, the methodology, and the safeguards being evaluated; at least one employee representative.

Management of Organizational Change (MOOC)

- An analysis of impacts of any staffing changes or reorganization of operations, including reducing staffing levels, changing experience levels of employees, changing shift duration, or making changes in employee responsibilities.
- Analysis of change by a team; documentation of analysis, decision, and basis.
- Certification by the refinery manager that the proposed change(s) will not increase the likelihood of a major incident.
- Workers and their representatives must be involved in these processes.

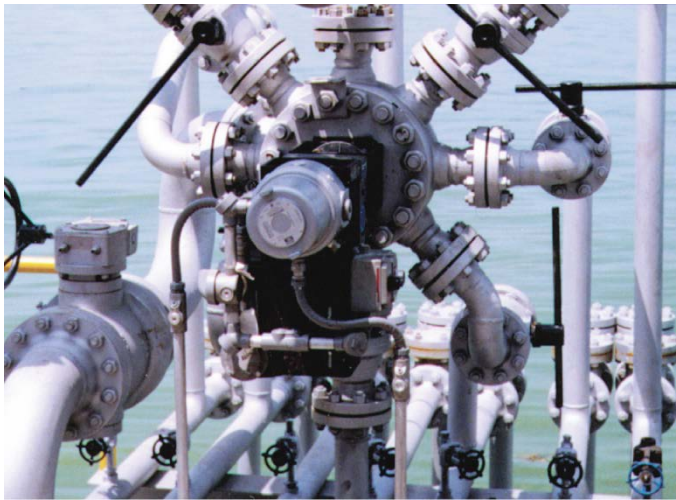
Incident Investigation

- Investigate incidents using effective methods that identify root causes to determine the underlying safety management system causes of the incident, which if corrected would prevent or significantly reduce the likelihood of the problem's recurrence.
- Investigate all incidents that resulted in, or could reasonably have resulted in, a major incident.
- Incident investigations are conducted by a team, including experts and employees.
- Investigation must begin within 48 hours; an initial report within 90 days of the incident; final report in 5 months.
- Interim and final recommendations to prevent recurrence and reduce the risk of future incidents.
- *For major incidents, reports will be made publicly available by the CUPA.*

Human Factors

- A discipline concerned with designing machines, operations, and work environments so that they match human capabilities, limitations, and needs. Human factors can be further referred to as environmental, organizational, and job factors, and human and individual characteristics, such as fatigue, that influence behavior at work in a way that can affect health and safety.
- Human factors program shall take into account staffing levels, complexity of tasks, time needed to complete tasks, level of training and expertise, human-machine interface, fatigue, communication systems, and other factors.

- Human factors must be assessed and included in all PHAs, incident investigations, written operating and maintenance procedures, and in management of change processes for major changes and organizational changes.
- Written program must include:
  - Training, operating, and maintenance procedures.
  - Staffing, shiftwork, overtime, and fatigue.

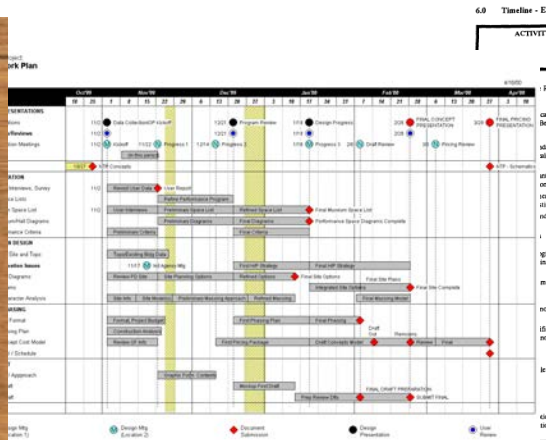


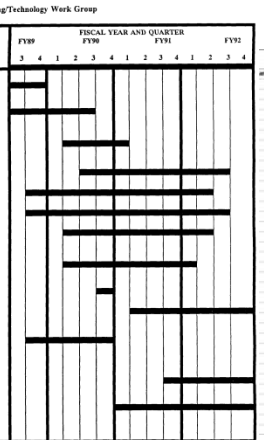
Process Safety Culture Assessment

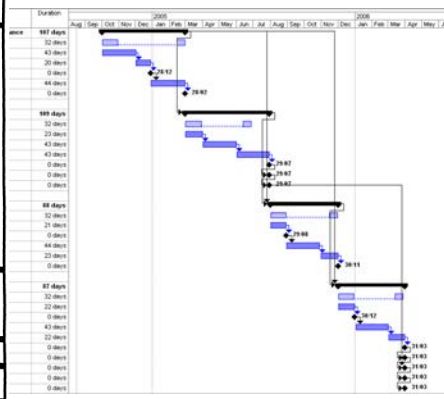
- Assessment of the core values and behaviors resulting from a collective commitment by leaders and individuals to emphasize safety over competing goals in order to ensure protection of people and the environment.
- Shall be done every 5 years, with a mid-term check on progress to:
  - Ensure that reporting of safety concerns is encouraged;
  - Ensure that reward or incentive programs do not deter reporting of concerns or incidents;
  - Ensure that safety is not compromised by production pressures;
  - Promote effective process safety leadership at all levels of the organization.
- Employees and their representatives shall participate in all phases of the safety culture assessment.
- The refinery manager, or his or her designee, must sign off on all process safety culture assessment reports and corrective action plans.

Program Management

- Written management system to ensure that all program elements are developed, implemented, modified when needed, communicated, and roles and responsibilities are assigned.
- Compliance audit every 3 years.
- Review all recommendations from team reports against defined rejection criteria; generate corrective actions; and implement corrective actions according to a specified timeline. Communicate reasons for all delays in the corrective action work process to employees and the CUPA. Document close-out of all recommendations and corrective actions.







Process Safety Performance Indicators

- Annual reporting of specifically defined performance indicators.
- Indicators will be reported to OES and the UPA.
- *OES will post the indicators on its website.*
- Indicators to be publicly reported:
  - Past due inspections for piping and pressure vessels;
  - Past due PHA recommended actions and seismic recommended actions;
  - Past due recommended actions from the investigation of major incidents;
  - The number of major incidents; and
  - The number of leak seal repairs, date installed, total days in place.
- Site-specific indicators: each refinery shall develop a list of site-specific activities and other events that it shall measure and report over time in order to evaluate the performance of its process safety systems. (These are not publicly reported)

Employee Participation (PSM only)

- Participation by affected operating and maintenance employees and employee representatives, throughout all phases, at the earliest possible point, in performing PHAs, DMRs, HCAs, MOCs, Management of Organizational Change (MOOCs), Process Safety Culture Assessment (PSCAs), Incident Investigations, SPAs and PSSRs

Why is EE Participation Important?

- Tosco refinery- workers expressed concern about cutting into piping that had not been effectively isolated or drained - when the pipe was cut it released hot flammable liquid leading to deaths and serious injuries
- Motiva Delaware City refinery - workers had repeatedly warned the company and issued a hazardous equipment report over holes in the spent sulfuric acid tank that contained carry-over flammables that were ignited during hot work near the tank. Several hundred thousand gallons of acid was released into the Delaware River - one workers body was never recovered.
- BP Texas City - workers expressed concern to management about the placement of the trailers near the Isom unit and warned the company about previous blowdown drum/stack release into the process units - both key issues that led to the 15 fatalities.

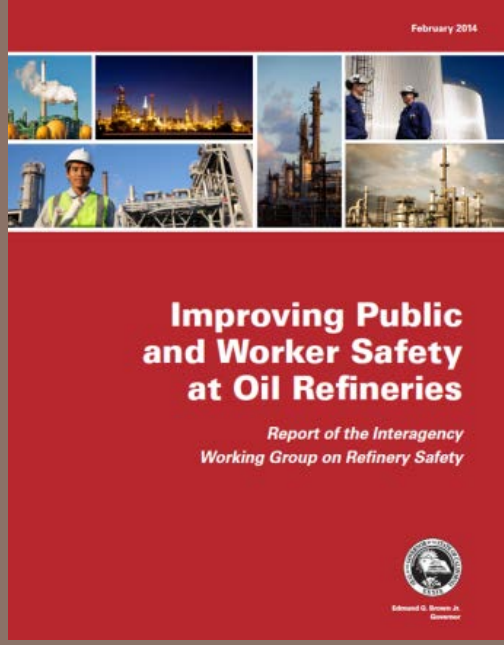
Why is EE Participation Important?

- Tesoro Anacortes - workers expressed concern about a history of leaks and releases from flanges on the heat exchanger that catastrophically failed. Rather than fixing the leaks the company installed a steam station for hoses to be placed on the leaks. The hazardous leaks brought many more workers into the area during the night of the incident to address the problems increasing the number of fatalities.
- DuPont LaPorte - workers warned management concerning the hazards of draining potentially toxic liquid inside a confined building and recommended the liquid be drained to a closed system. On the night of the incident workers and a supervisor drained toxic liquid into the confined area as was the accepted practice.

Thanks to Don Holstrom

Emergency Preparedness and Response

CALIFORNIA INTERAGENCY REFINERY TASK FORCE



- Emergency management and response
- Safety and prevention
- Public education and outreach
- Enforcement Coordination
- Improved agency coordination through the establishment of an Interagency Refinery Task Force

- Communication between Response Officials
- Coordinating Command during any event
- Plans and Protocols to Protect Persons Outside of a Refinery
- Drills and Exercises
- Coordination with the Air Quality Management Districts

www.calepa.ca.gov/refinery

Note: Not in the formal rulemaking process yet

CALARP REGULATION DRAFT PROPOSED AMENDMENTS- APPLICABLE TO PETROLEUM REFINERIES

EMERGENCY RESPONSE PROGRAM

Key Points

- The proposed requirements:
  - Are already being conducted to a large extent by the refineries
  - Are "reasonable and appropriate" for the hazards presented
  - Help refineries meet the intent of the "Report of the Interagency Working Group on Refinery Safety- Protecting Public and Worker Safety at Refineries," (February, 2014) Spanish)
  - Are intentionally broadly performance based with the intent of encouraging:
    - Partnerships among Public/Private/NGOs
    - Innovative solutions
  - To be accompanied by a guidance document developed after adoption, assisted by interested parties

§ 2765.1 Emergency Response Applicability.

Currently under review by counsel

- Except as provided in section (b), the owner or operator of a stationary source with Program 2 and Program 3 processes, with the exception of stationary sources subject to Program 4 of the California Accidental Release Prevention program, shall comply with the requirements of Section 2765.2. The Program 4 [petroleum refinery] stationary source owner or operator shall comply with the requirements of Section 2765.3.

* (tt) "Petroleum refinery" means a stationary source engaged in activities set forth in North American Industry Classification System (NAICS) code 324110. (proposed, TITLE 19. PUBLIC SAFETY DIVISION 2. CHAPTER 4.5)

(a) General

- The owner or operator shall submit to the Unified Program Agency (UPA) the California Refinery Emergency Management Specifications (CREMS) that documents all elements of Section 2765.3 within 12 months of the effective date of this section.

(a)(5)

- Actions and Activities in the CREMS such as community outreach, notification, training, drills and exercises, and emergency air monitoring, that are the responsibility of the owner or operator may, with the concurrence of the UPA, be conducted by a third party such as government entity, a non-profit organization, or a contractor.

(a)(6)

- (6) The owner or operator shall coordinate at least annually with local emergency response agencies to determine how the source is addressed in the community emergency response plan and to ensure that local response organizations are aware of the regulated substances at the source, their quantities, the risks presented by covered processes, and the resources and capabilities at the facility to respond to an accidental release of a regulated substance.

Zones

- The owner or operator shall establish and submit to the UPA a draft map showing a primary geographic area (primary zone) that may be impacted in the event of a potentially hazardous release based on the Alternative Release Scenario Analysis under Article 4, section 2750.4 and a secondary geographic area (secondary zone) based on the Worst-Case Scenario under Article 4, Section 2750.3.

Zones

- Primary Zone-
  - Monitoring, outreach, notification
- Secondary Zone
  - Outreach

Outreach and Notification

- The use of multiple languages;
- The use of multiple and varying communication techniques;
- Communication and recommendations for people with access and functional needs;
- Communication with emergency response agencies and organizations, the community and institutions including, but not limited to, local medical facilities, schools, transit agencies, railroads, utilities, employers who may have workers in the field and areas where populations congregate, such as sporting, shopping, religious, and cultural venues;
- Regular testing and maintenance schedule of existing physical and technological communications; including coordination with the UPA;
- Gap analysis and plans to minimize or eliminate potential gaps.

Monitoring

- Immediately detect, predict the offsite consequences, measure, and communicate the impacts of unplanned air releases to local response agencies and a reasonable and informed surrounding public as soon as the refinery becomes aware of the offsite consequences.
- A process in which data from the emergency air monitoring following a release or threatened release of a chemical(s) are immediately provided to emergency response agencies and the ICS or Unified Command responding to the incident.

Incident Management

- Unified Command
- Sufficient Resources
  - Identification of mutual aid providers;
  - Identification of external response organizations;
  - Materiel and trained personnel, based on the expected emergency management, response, support job functions and type of release;
  - Interoperable communications between the petroleum refinery and the local emergency responding agencies and other private and non-governmental organizations that will support emergency response activities;
  - Types and amounts of response equipment;
  - Availability of medical and emergency medical services, including decontamination of contaminated victims; and
  - Resources needed for demobilization.

Training

- Training and competencies for personnel relevant to their expected job functions regarding emergency management, response and support, including, but not limited to:
  - The Standardized Emergency Management System;
  - The National Incident Management System; and
  - Applicable worker safety standards [e.g., Respiratory Protection, HAZWOPER, PPE, Fire Brigade standards]

Exercises

- A master schedule and procedures for conducting annual drills and exercises to maximize the safe and effective response to a release or threatened release. Drills and exercises shall:
  - Be modeled after drills, tabletop, functional, and full scale exercises… the Homeland Security Exercise Evaluation Program, MARSEC, or other recognized program;
  - Assess plans, materiel, and training competencies for … responding, and supporting organizations … emergency management, response, recovery, and support functions;
  - Involve worker and community safety elements
  - Test organizational capabilities and capacities, including notification systems and procedures;
  - At least once triennially, conduct a full scale exercise…,
  - Evaluate the effectiveness of drills and exercises; and an improvement plan.

OK, So How Do I Know What Might be Emitted and How Do I Monitor?

Items of Interest (cont.)

- ARB/CAPCOA Refinery Emergency Air Monitoring Project
  - Inventory, Evaluate, Guidance, Improvements
- OEHHA Emergency Refinery Air Monitoring Project: Analysis of Refinery Chemical Emissions and Health Effects

REFINERY EMERGENCY AIR MONITORING

Monitoring and Laboratory Division
Office of Emergency Response

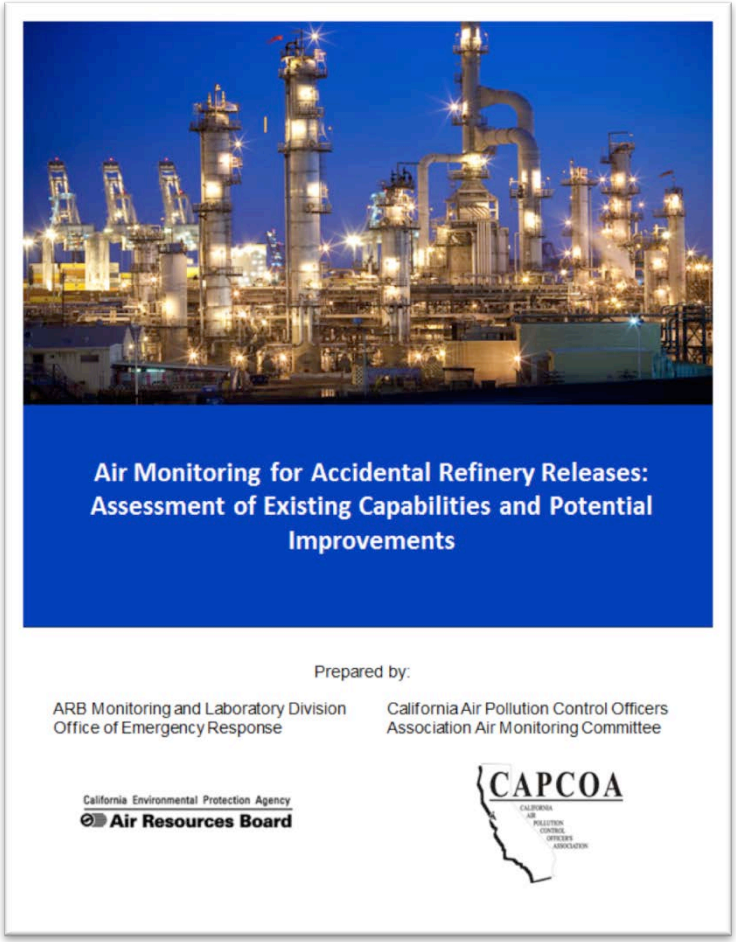
Coordination with Air Districts

BAY AREA AIR QUALITY MANAGEMENT DISTRICT

San Joaquin Valley
AIR POLLUTION CONTROL DISTRICT

Refinery Assessment Plan

- Inventory existing assets and resources: Completed
- Evaluate capabilities and propose enhancements
- Develop statewide guidance on best practices
- Improve coordination, training, and preparedness



Air Monitoring Methods

Air Monitoring Stations

Personal and Handheld Monitors

Hazmat Vehicles and Mobile Labs

Process Unit Monitors

Community Monitors

Fenceline Monitors

Delineate Existing Assets and Resources

- Air districts, local responders, refineries, State and federal support agencies, institutions, etc.
- Air monitoring instruments, equipment, and analytical support
- Trained personnel
- Protocols and procedures
- Accessibility of information

Evaluate Capabilities and Propose Enhancements

Assess:

- Suitability of protocols and procedures
- Existing and emerging technology
- Modeling and forecasting
- Notification and communication of air quality conditions
- Needs and critical gaps

Currently in IRTF agency review

Develop Statewide Guidance

- Document statewide best practices for emergency air monitoring
- Recommend enhancements to instrumentation, procedures, training, public education
- Recommend resources for filling unmet needs
- Incorporate in State Emergency Plan

Improve Coordination, Training, and Preparedness

- Provide and support ongoing collaboration, training, and preparedness for emergency air monitoring
- Participate in CAPCOA, Interagency Refinery Task Force, and CUPA Forum continuous improvement programs

EMERGENCY REFINERY AIR MONITORING PROJECT: ANALYSIS OF REFINERY CHEMICAL EMISSIONS AND HEALTH EFFECTS

Karen Riveles and Alyssa Nagai
Office of Environmental Health Hazard Assessment
California Environmental Protection Agency

Contact: Karen.Riveles@oehha.ca.gov

OEHHA
SCIENCE FOR A HEALTHY CALIFORNIA

Introduction

- Chemical health effects
  - Acute, chronic
  - Emergency guidelines
- California refinery incident history
- California refinery process units and emission points
- Routine Toxic Air Contaminant (TAC) emissions from California refineries
- Routine and nonroutine chemical emissions self-reported by California refineries

What's in the Smoke?

VOCs
Ammonia
PM10
NOx
Xylenes
Benzene
PM2.5
Sulfur Dioxide
Formaldehyde
Hydrogen Sulfide
Toluene
PAHs
Metals
Carbon Monoxide

Inhalation

California Refinery Incident History

- **Most commonly reported chemical releases:**
  - Sulfur dioxide, hydrogen sulfide, hydrocarbons

- **Health effects accompanying chemical releases specified in cases involving sulfur compounds:**
  - Nausea; dizziness; irritation of the eyes, nose, throat, and skin; and unconsciousness

OEHHA and US EPA Guidance Health Values and Descriptions

Reference Exposure Level (REL) ($\mu g/m^3$ inhalation, $\mu g/kg$-day oral)	OEHHA	Acute: Airborne concentration level at or below which no adverse health effects are anticipated for an exposure lasting ≤24 hours. Eight-hour: Airborne concentration level at or below which no adverse health effects are anticipated for a daily eight-hour exposure. Chronic: Airborne concentration level at or below which no adverse health effects are anticipated for an exposure lasting ≥12% of an individual's lifetime.
Reference Concentration (RfC) (mg/m^3)	US EPA	Estimate of continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

Refinery Chemicals with Highest Annual Emissions that have RELs and/or RfCs

Health Values of Refinery Chemicals	
Ammonia **A**,**C**	Hydrogen sulfide **A**,**C**
Benzene **A**,**8**,**C**	Methanol **A**,**C**
Butane **C**	Nitrogen dioxide **A**
Carbon Monoxide **A**	Propylene **C**
Formaldehyde **A**,**8**,**C**	Sulfur dioxide **A**
Hexane **C**	Toluene **A**,**C**
Hydrogen chloride **A**,**C**	Xylenes (mixed) **A**,**C**

OEHHA REL Type: Acute (**A**), 8-Hour (**8**), Chronic (**C**), Oral (**O**)
Highlighted chemicals also have US EPA RfC

Health Values of Refinery Chemicals

Acetaldehyde A,8,C
Acrolein A,8,C
Beryllium C,O
1,3-Butadiene A,8,C
Carbon disulfide A,C
Carbon tetrachloride A,C
Chromium (hexavalent) C,O
Chloroethane C
1,2-Dibromoethane C
1,4-Dichlorobenzene C
1,1-Dichloroethylene C
Diesel engine exhaust C
1,4-Dioxane A,C
Ethylbenzene C
Hydrogen cyanide A,C
Manganese 8,C

Mercury A,8,C,O
Methyl bromide A,C
Methyl ethyl ketone A
Methyl tert-butyl ether C
Methylene chloride A,C
Naphthalene C
Perchloroethylene A,C
Phosphoric acid C
Propylene glycol monomethyl ether C
Propylene oxide A,C
Styrene A,C
Toluene A,C
1,1,1-Trichloroethane A,C
Trichloroethylene C
Triethylamine A,C
Vinyl chloride A

Arsenic A,8,C,O
Cadmium C,O
Chlorine A,C
Chlorobenzene C
Chloroform A,C
Copper A
Cresols (mixtures of) C
Dibenzofurans (chlorinated) C,O
Dibenzo-p-dioxins (chlorinated) C,O
1,2-Dichloroethane C
Diethanolamine C
Ethylene glycol monoethyl ether A,C
Ethylene glycol monoethyl ether acetate A,C
Glutaraldehyde C
Hydrogen fluoride A,C,O
Isopropanol A,C
Nickel A,8
Phenol A,C
Selenium C,O
1,2,4-Trimethylbenzene C

OEHHA REL Type: Acute (A), 8-Hour (8), Chronic (C), Oral (O)
Highlighted chemicals (Left) also have US EPA RfC

OEHHA and US EPA Guidance Health Values and Descriptions

Cancer Slope Factor (CSF) $(mg/kg\text{-}day)^{-1}$	OEHHA, US EPA	Upper bound probability of developing cancer assuming continuous lifetime exposure to a substance at a dose of one milligram per kilogram of body weight.
Unit Risk $(\mu g/m^3)^{-1}$	OEHHA, US EPA	Upper bound probability of developing cancer assuming continuous lifetime exposure to a substance at a concentration of one microgram per cubic meter of air.

Cancer, Developmental, or Reproductive Effects

Acetaldehyde C	1,3-Butadiene C,D,R	Dibenzofurans (chlorinated) C
Aniline C	Cadmium C,D,R	Dibenzo-p-dioxins (chlorinated) C
Arsenic C	Carbon disulfide D,R	1,2-Dibromoethane C
Asbestos C	Carbon monoxide D	1,4-Dichlorobenzene C
Benz(a)anthracene C	Carbon tetrachloride C	1,1-Dichloroethane C
Benzene C,D,R	Chloroethane C	1,2-Dichloroethane C
Benzo(a)pyrene C	Chloroform C,D	1,2-Dichloropropane C
Benzo(b)fluoranthene C	Chromium (hexavalent) C,D,R	1,3-Dichloropropene C
Benzo(j)fluoranthene C	Chrysene C	Diesel engine exhaust C
Benzo(k)fluoranthene C	Cumene C	Diethanolamine C
Beryllium C	Dibenz(a,h)anthracene C	7,12-Dimethylbenz(a)anthracene C

Listed for: Carcinogenicity (C), Developmental toxicity (D), Reproductive toxicity (R)

Red Boxes represent high average annual emissions

US EPA and NIOSH Emergency Exposure Levels and Descriptions

Acute Exposure Guideline Level (AEGL) (mg/m^3)	U.S. EPA (NAC/AEGL Committee)	1: Airborne concentration above which the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects after an exposure duration of 10-minutes, 30-minutes, 1-hour, 4-hours, or 8-hours. Effects are not disabling and are transient and reversible upon cessation of exposure. 2: Airborne concentration above which the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or impaired ability to escape after an exposure duration of 10-minutes, 30-minutes, 1-hour, 4-hours, or 8-hours.
Immediately Dangerous to Life and Health (IDLH) (mg/m^3)	NIOSH	Airborne concentration likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment as a consequence of a 30-minute exposure.

Refinery Chemicals with Emergency Exposure Levels

Acetaldehyde 1,2,D	1,1-Biphenyl 2	Chlorobenzene 1,2,D
Acetone 1,2,D	1,3-Butadiene 1,2,D	Chloroethane D
Acrolein 1,2,D	Butane 1,2	Chloroform 2,D
Ammonia 1,2,D	Cadmium 1,2,D	Chromium (hexavalent) D
Aniline 1,2,D	Carbon disulfide 1,2,D	Chromium III D
Antimony D	Carbon monoxide 2,D	Cobalt D
Arsenic D	Carbon tetrachloride 2,D	Copper D
Barium D	Carbonyl sulfide 2	Cresols (mixtures of) D
Benzene 1,2,D	Chlorinated fluorocarbon D	Cumene 1, 2, D
Beryllium D	Chlorine 1,2,D	Cyclohexane D

Chemical has AEGL-$1_{10\ min}$ (1), AEGL-$2_{10\ min}$ (2), IDLH (D)

Red Boxes represent high average annual emissions

Common Process Units and Emission Points Self-Reported by CA Refineries (2010)[1]

Release Type		
Fugitive	**Point**	**Fugitive and Point**
Hydrogen plant	Boiler	Alkylation unit
Product loading	Flare	Cogeneration unit
Wastewater treatment	Heater	Coker
	Hydrotreater	Cooling tower
	Thermal oxidizer	Crude unit
	Vent	Fluid catalytic cracking unit
		Hydrocracker
		Incinerator
		Stack
		Storage tank

[1] The process units listed above represent those most commonly found in OEHHA's research of California refineries based on U.S. EPA (2012a, 2012b) data for 2010. Note that the processes listed above do not reflect all refinery processes at California refineries.

California Refinery Incident History

Process Units Reported to be Associated with California Refinery Incidents (2001-2012)[1]

Flares	FCCU	Diesel unit
Storage tank	Crude unit	Jet fuel unit
Heater/furnace	Cogeneration unit	Oxidizer
Coker	Hydrogen plant	Sonic meter system
Boiler	Hydrotreater	Vacuum distillation unit
Sulfur recovery unit	Ammonia recovery unit	Vapor recovery unit
Gas compressor	Cooling unit	

[1] Processes reported to be associated with refinery incidents are listed in descending order based on California data for 2001-2012 (CSB, 2013; BAAQMD, 2015; CCHS, 2015). Note that the processes listed above may not constitute all refinery incidents in the state.

Top 10 Routine TAC Emissions from California Refineries as Reported in CEIDARS (2009-2012)[1]

Chemical	Emissions (lb/year)
Ammonia	2,085,824
Formaldehyde	288,412
Methanol	122,611
Sulfuric acid	104,573
Hydrogen sulfide	103,385
Toluene	87,945
Xylenes	79,177
Benzene	43,308
Hexane	39,646
Hydrogen chloride	21,450

[1] Average annual routine Toxic Air Contaminant (TAC) emissions from California refineries based on data from the California Emission Inventory Development and Reporting System (CEIDARS) for 2009-2012 (ARB, 2014).

Top 10 Routine Chemical Emissions as Self-Reported by California Refineries (2010)[1]

Chemical	Emissions (lb)
Sulfur dioxide	21,158,748
Carbon monoxide	16,972,733
Nitrogen oxides	16,415,674
VOCs	13,562,963
PM_{10}	6,617,952
Butane	5,881,551
PM_{10} (filterable)	2,805,076
$PM_{2.5}$	2,004,663
Nitrogen dioxide	1,971,085
PM (condensable)	1,677,433

[1] Annual routine chemical emissions from California refineries based on available data for 2010 (U.S. EPA, 2012a; U.S. EPA, 2012b).

Top 10 Nonroutine Chemical Emissions as Self-Reported to by California Refineries (2010)[1-2]

Chemical	Emissions (lb)
VOCs	1,123,158
Sulfur dioxide	553,834
Carbon monoxide	418,331
Nitrogen oxides	223,792
PM_{10}	89,572
$PM_{2.5}$	26,306
PM_{10} (filterable)	22,802
Nitrogen dioxide	12,397
Propylene	7,799
Hexane	7,625

[1] Annual nonroutine chemical emissions from California refineries based on available data for 2010 (U.S. EPA, 2012a; U.S. EPA, 2012b).

[2] Highlighted chemicals also among top 10 routine chemical emissions from ICR

Almost the End.

Take Aways

- Major activity regarding refinery safety & prevention and preparedness & response
- Proposed regulations and tools are innovative, reasonable, and appropriate
- Can be used by all industries to improve overall safety, reliability, resiliency, and long term profitability
- Stay tuned because “can” may become “shall.”

Thanks

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The End