

Safety in the Refinery Sector: California's New Prevention Framework

California Industrial Hygiene Council Annual Meeting

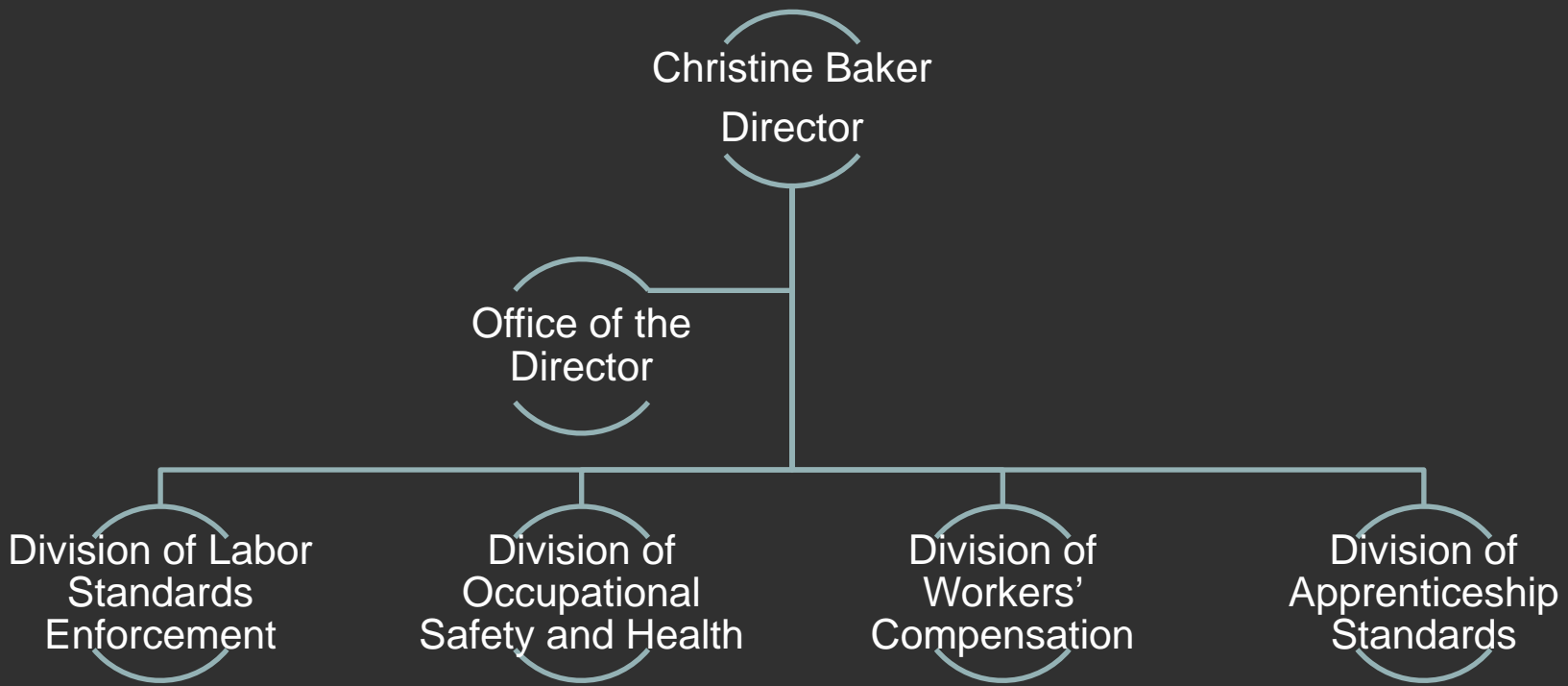
San Diego

December 4, 2014

Christine Baker, Director, California Department of Industrial Relations

Mike Wilson, PhD, MPH, Chief Scientist, Office of the Director





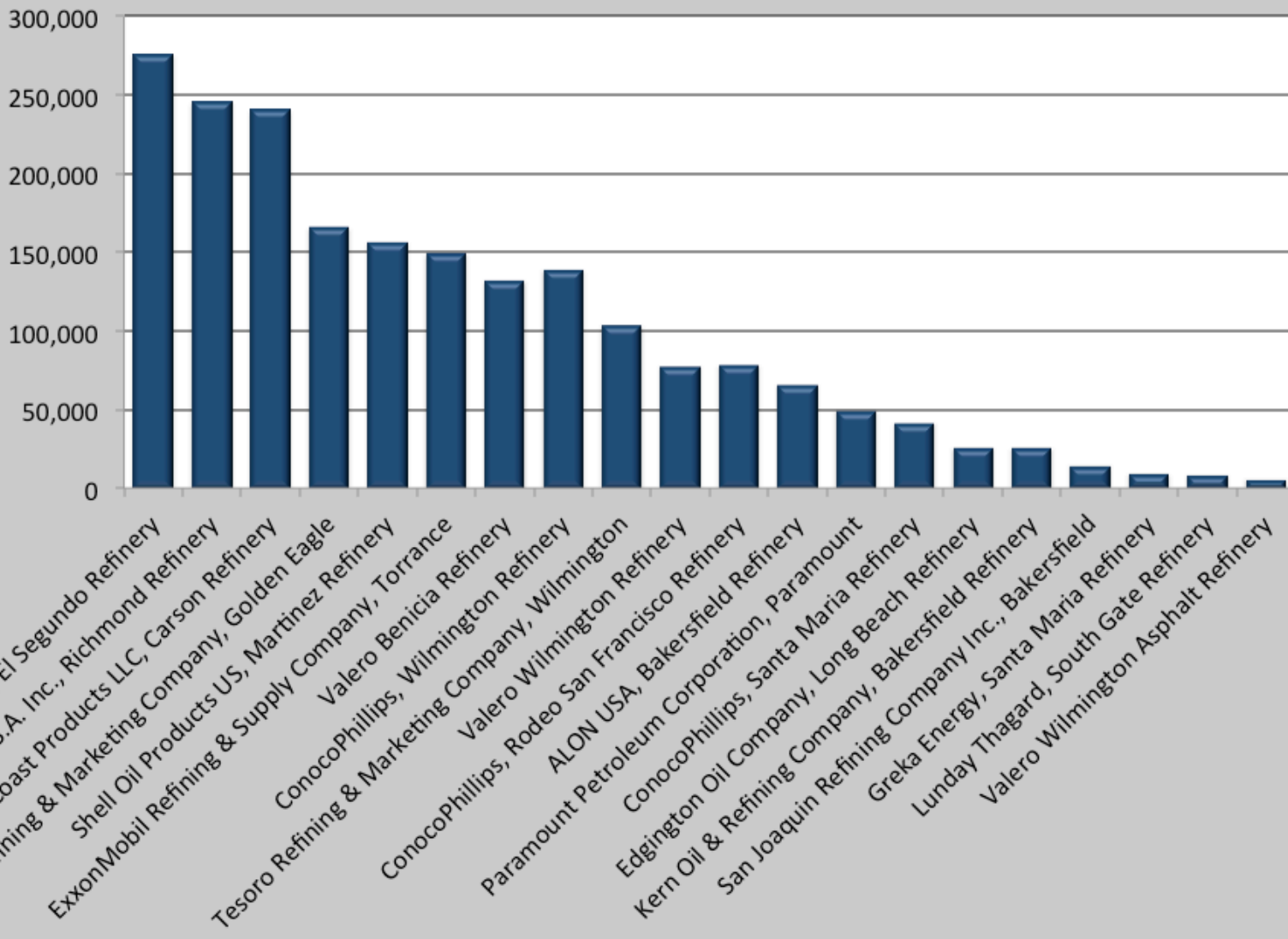
Major Divisions of the California Department of Industrial Relations (DIR)





- Number of major refineries: 14
- Crude oil refined per day: 2 million barrels
- Daily gasoline production: 45 million gallons (5,600 tanker trucks)
- Daily diesel production: 14 million gallons
- After Texas, California is nation's 2nd largest oil refining state.

Barrels/day

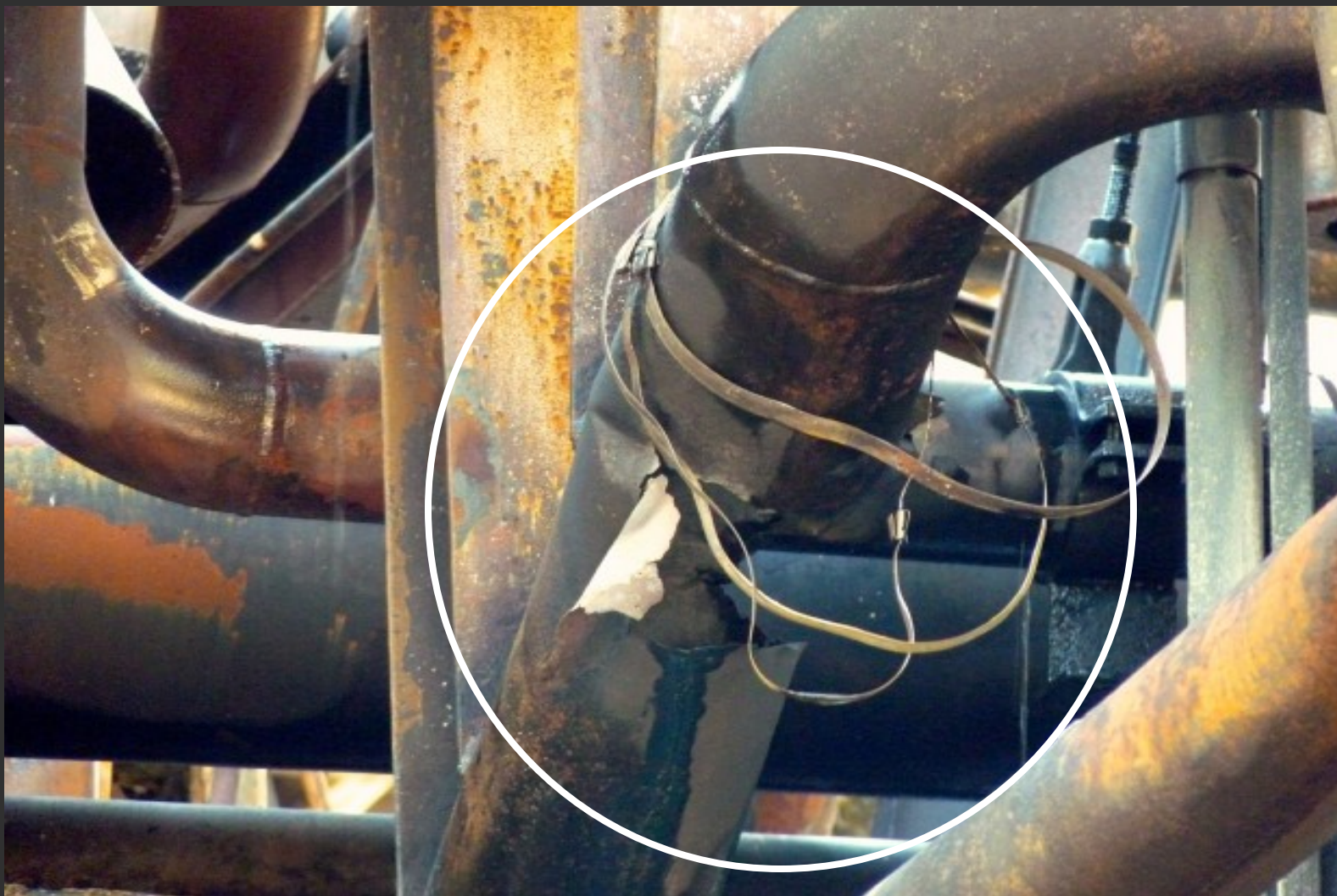


Of the largest 6 refineries, 3 are in the Bay Area, 3 in the LA area. Chevron Richmond (#2) produces 250,000 barrels of gasoline & diesel fuel per day.



First step in refining: Crude oil is cleaned and heated in the crude unit before entering a distillation tower, where it is boiled, producing jet fuels, diesel and fuel oil that are sent through “side-cut” pipes to other sections of the refinery.

August 6, 2012: At Chevron, Richmond, a small hole in an 8" side-cut pipe on distillation tower #4 in the crude unit developed into a catastrophic failure. The pipe contained fuel oil at 640 degrees F.



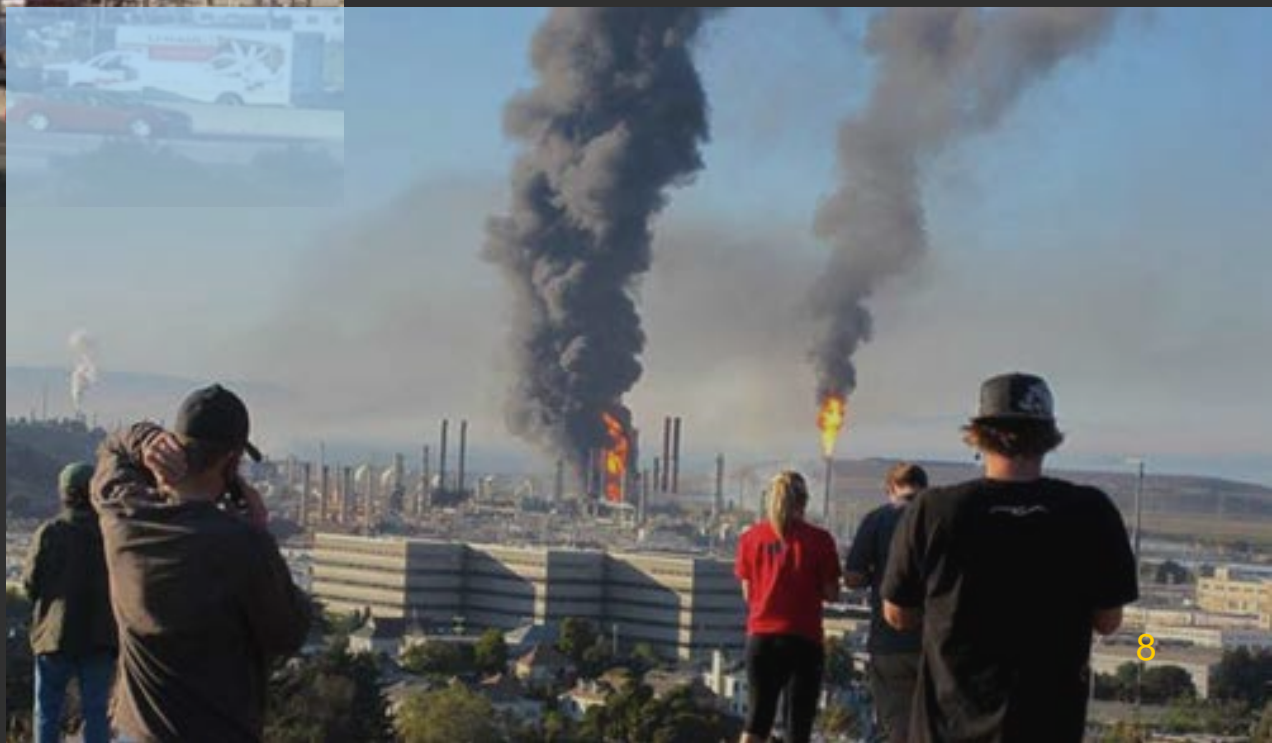
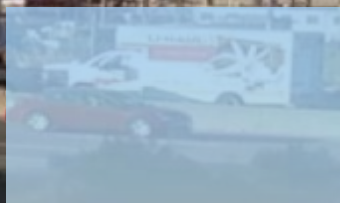
The pipe failure produced a large hydrocarbon and steam vapor cloud, which ignited after about 90 secs.

Hydrocarbon and steam cloud



Ignition







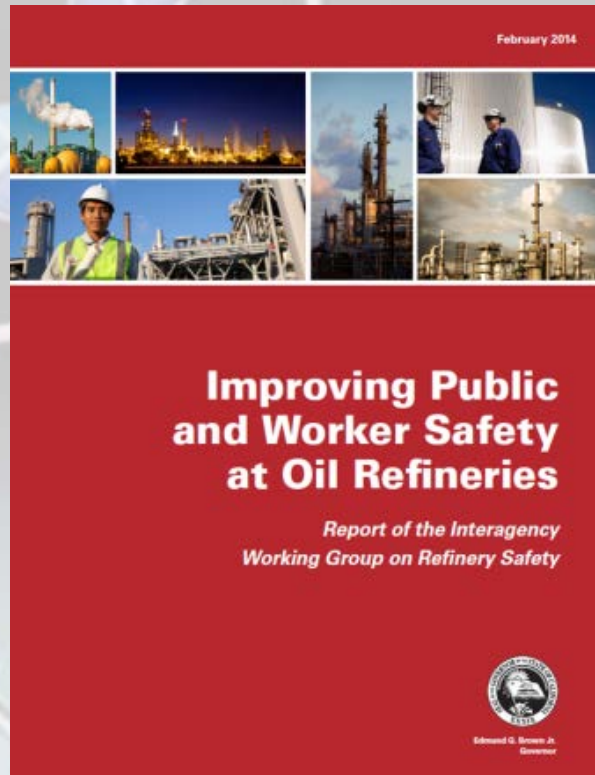


- Technical cause: Sulfidation corrosion
- Workers: 19 escaped vapor cloud by ~45 seconds
- Community: ~15,000 local residents sought medical attention
- Public expenses: Fire, police, public health services
- Public transit: BART shut down all trains to Richmond station
- Incident command: Various problems in communications to the public, health care providers, mutual aid responders.

Governor's Interagency Working Group on Refinery Safety

- Established immediately following the Aug 2012 Chevron, Richmond fire
- Participating agencies and departments:
 - DIR/DOSH
 - Cal/EPA Secretary's Office
 - Air Resources Board (ARB)
 - Governor's Office of Emergency Services (OES)
 - Department of Toxic Substances Control (DTSC)
 - State Water Resources Control Board (SWRCB)/
 - California Energy Commission (CEC)
 - California Technology Agency (CTA)
 - Department of Finance (DOF)
 - Department of Public Health (DPH)
 - Office of the State Fire Marshal (OSFM)

Governor's Interagency Working Group on Refinery Safety



Governor's Office released Final Report of findings and recommendations in February 2014 (dir.ca.gov)



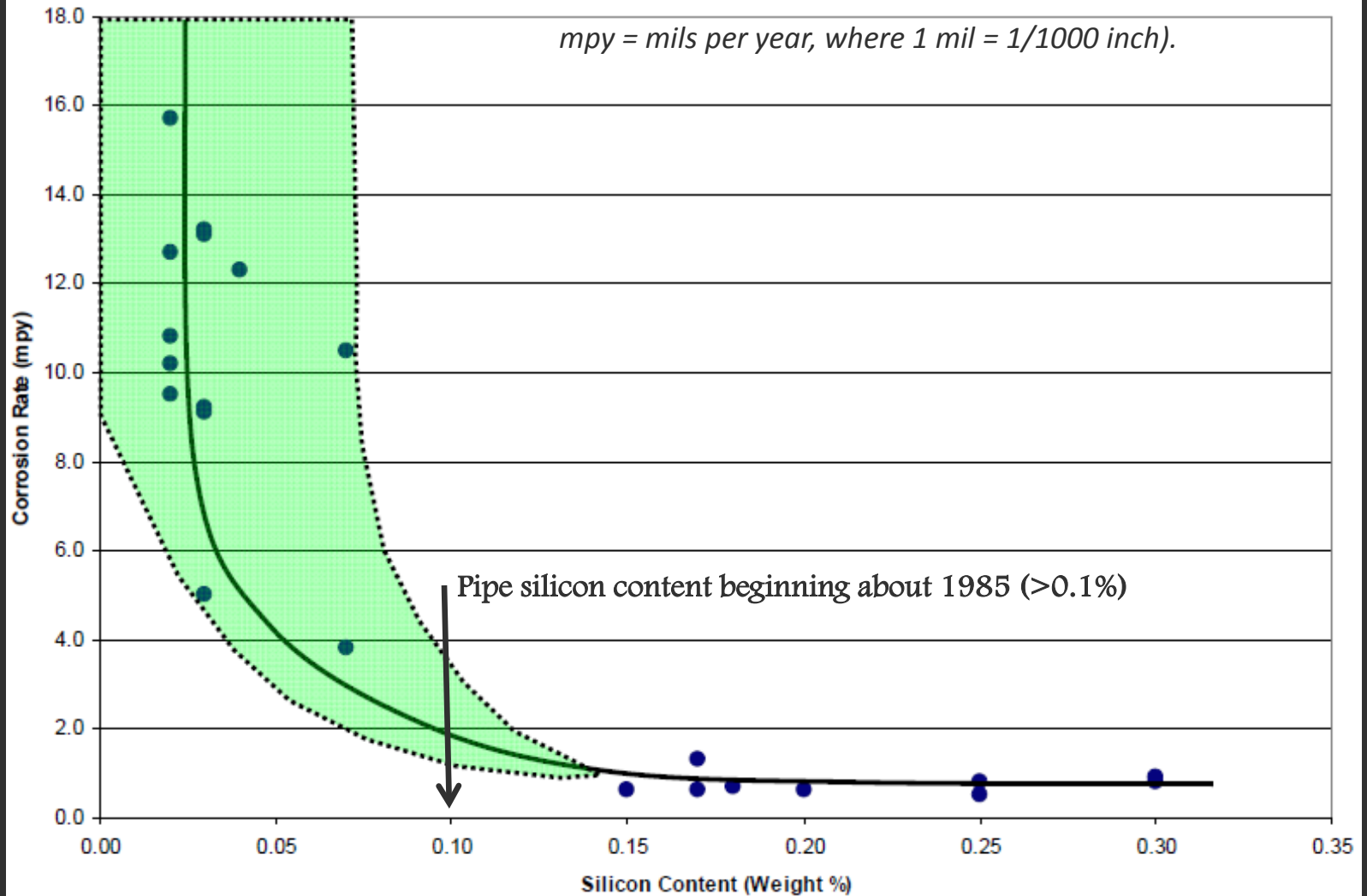
Most refineries in California are co-located with neighborhoods, schools and businesses. Chevron, Richmond refinery.

Photo Courtesy of Earl Dotter



Refinery workers and contractors face a range of workplace health and safety risks, including entry into tanks, vessels and other hazardous confined spaces.

Corrosion Rate vs Silicon Content



West Coast (PADD 5) Sulfur Content (Weighted Average) of Crude Oil Input to Refineries

Percent

2.0

1.5

1.0

0.5

0.0

1985 1990 1995 2000 2005 2010

— West Coast (PADD 5) Sulfur Content (Weighted Average) of Crude Oil Input to Refineries



Source: U.S. Energy Information Administration

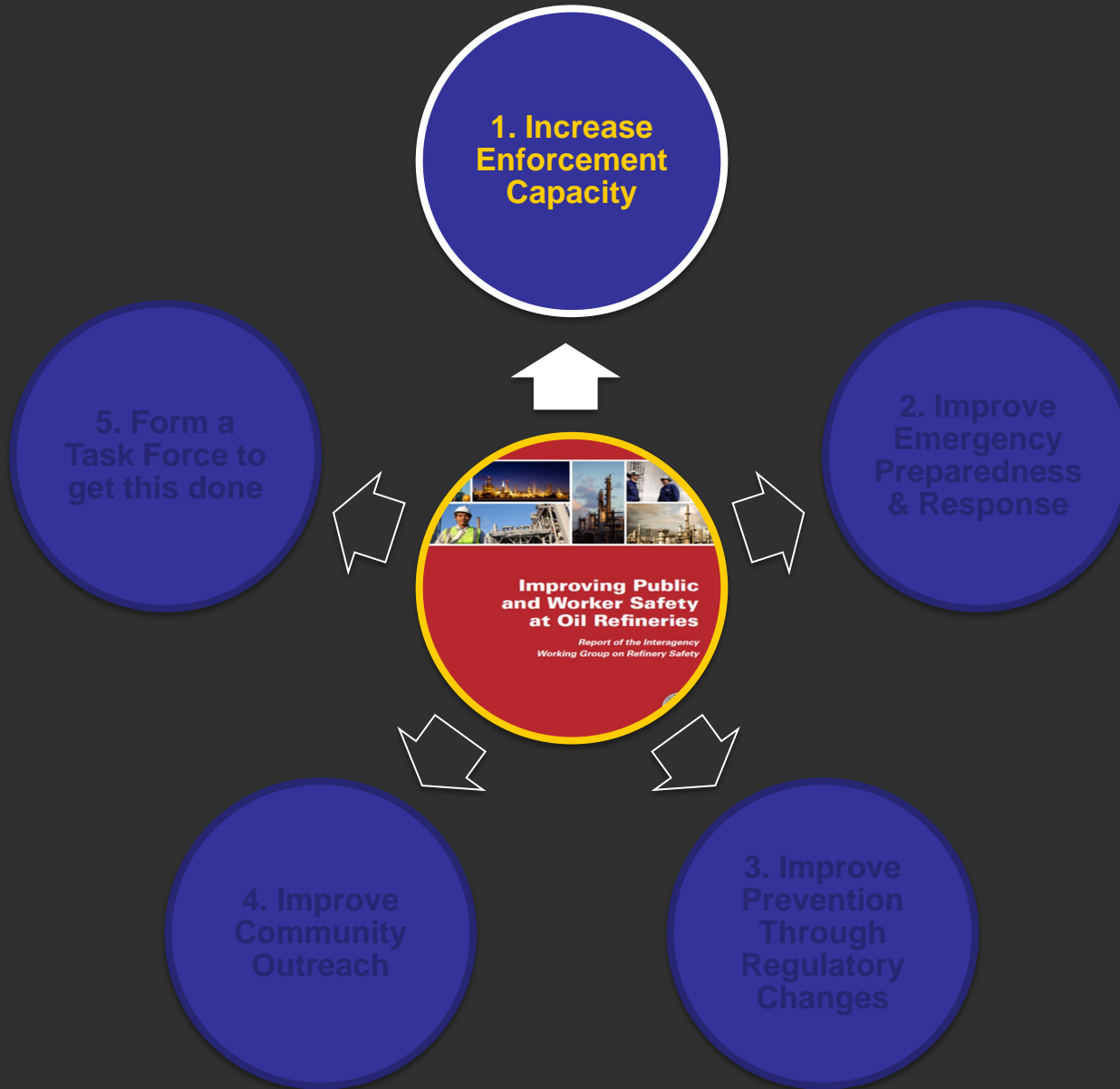


Sources: U.S. Energy Information Administration, 2013; CSB Richmond Refinery Report, Appendix D-31; CSB personal communication (6/23/14); and Hucínska (June 2006) *Advances in Materials Science*, Vol 6, No. 1(9)

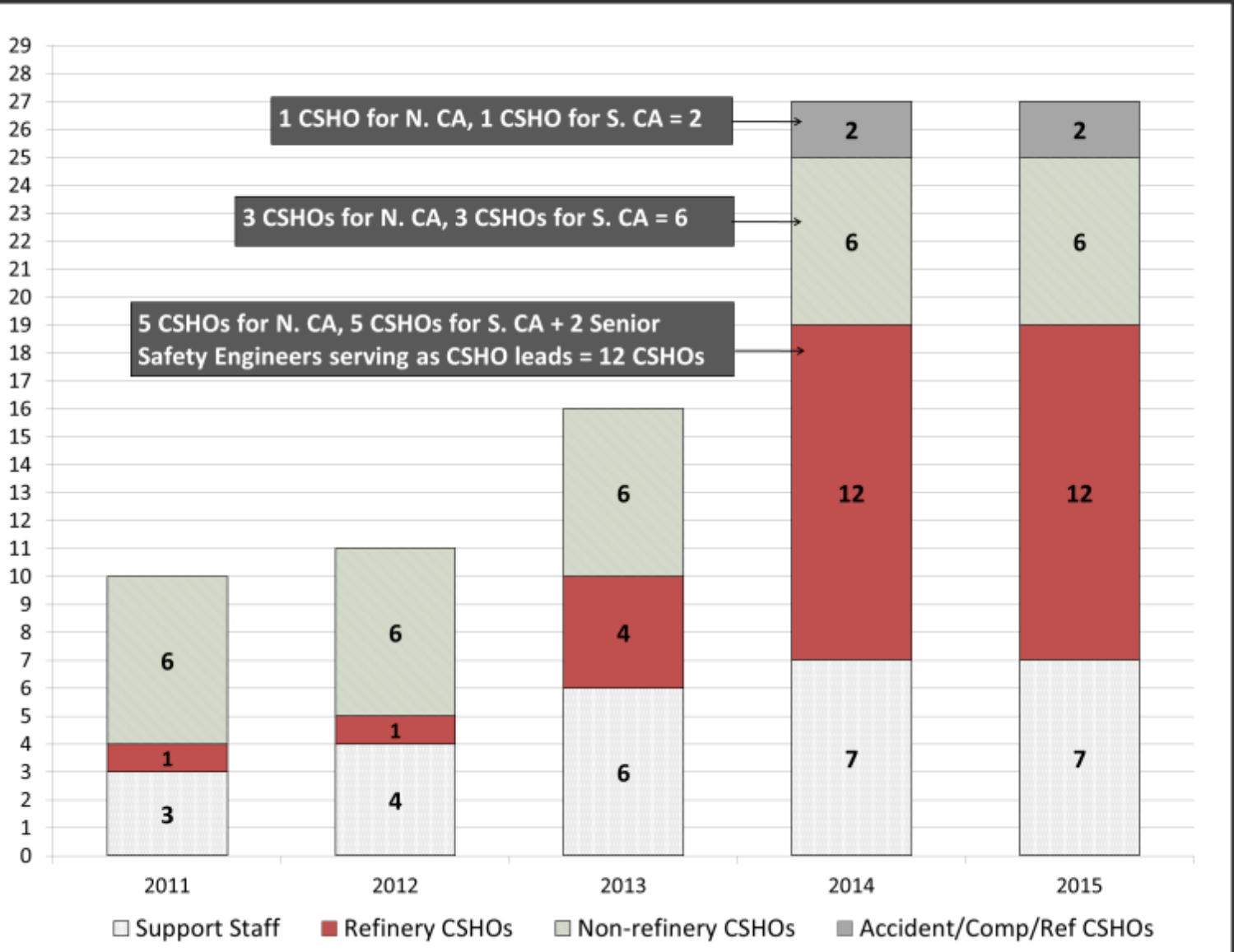
Serious sulfidation corrosion incidents in the U.S. refinery sector:

- Chevron El Paso, Texas 1988
- Chevron Pascagoula, Mississippi 1988
- Chevron Pascagoula, Mississippi 1993
- Chevron Salt Lake City, Utah 2002
- Chevron Richmond, California 2007
- Silver Eagle, Woods Cross, Utah 2009
- Regina, Saskatchewan, Canada 2011
- BP Cherry Point, Washington 2012
- Chevron Richmond, California 2012





1. Increase Enforcement Capacity



Staffing in the Cal/OSHA PSM unit has increased from 11 in 2012 to 27 today.



2014 Cal/OSHA Advanced Refinery PSM Course, Sept 30, Valero Refinery, Benicia, attended by compliance officers from Cal/OSHA, U.S. EPA, & county CUPAs from N and S California.



1. Increase
Enforcement
Capacity

Cal/OSHA Field Operations Refinery Inspections

Previously, in July 2013:

- One Cal/OSHA CSHO per inspection
- A single planned inspection per year, per refinery
- 72 hours per inspection, over about 2 weeks
- Focused on a single PSM issue

Beginning November 2014 and forward:

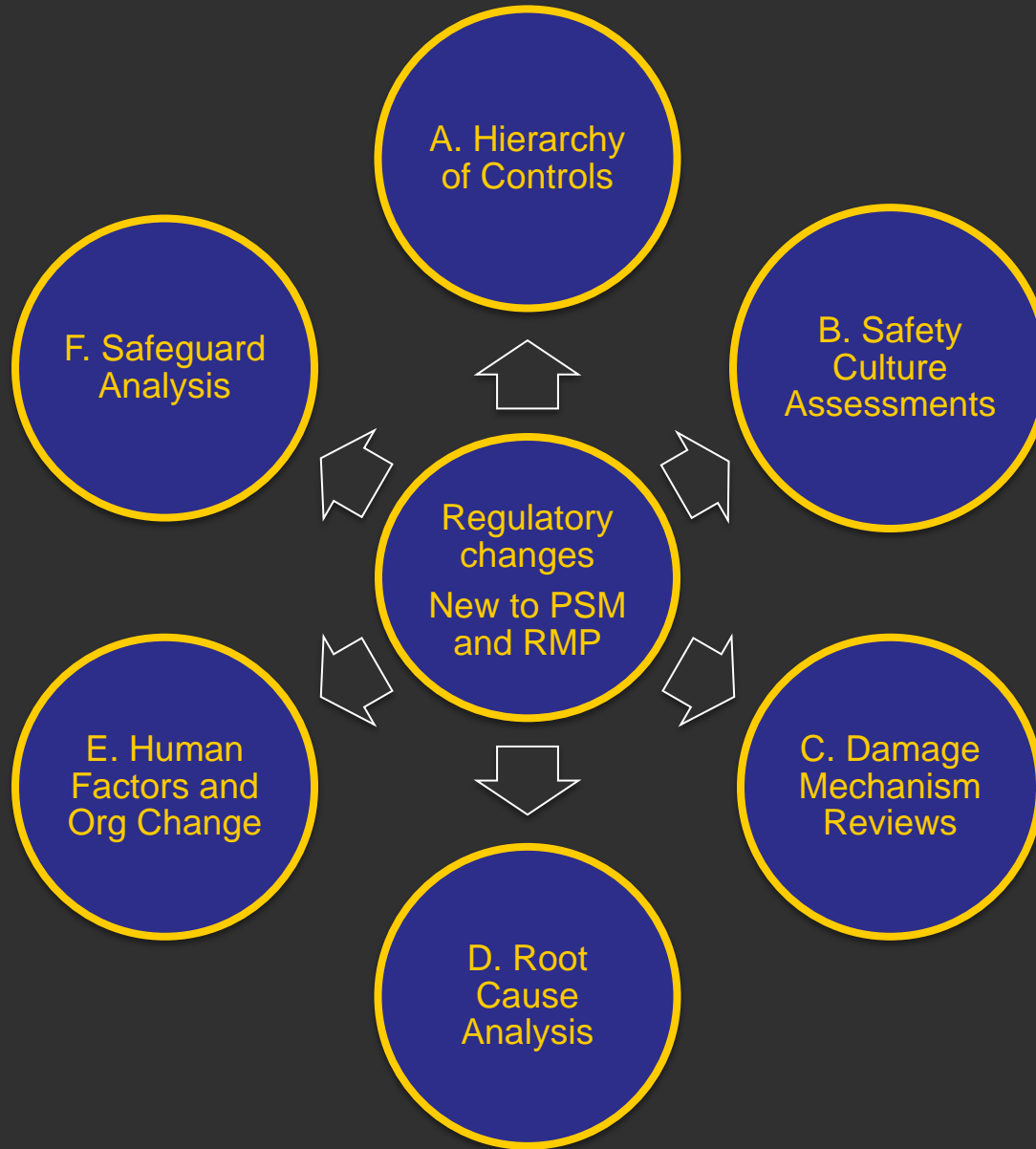
- PSM training completed by October
- Four planned refinery inspections per year
- Four to five CSHOs per inspection
- 1,000 to 1,200 hours per inspection, over 4 months
- Focused on wall-to-wall operation of a unit
- Coordinated with officers from U.S. EPA, Air District, local CUPA
- Total complement of 7 to 8 Compliance Officers per inspection



CCPS 2007 Subcommittee Findings

- “Process safety management is widely credited for reductions in major accident risk and improved process industry performance.”
- “Over the past 20 years, government mandates for formal process safety management systems in Europe, the U.S. and elsewhere have prompted widespread implementation of a management systems approach to process safety management.”
- “However, after an initial surge of activity, process safety management activities appear to have stagnated within many organizations.”
- “Incident investigations continue to identify inadequate management system performance as a key contributor to the incident.”
- “Audits reveal a history of repeat findings indicating chronic problems whose symptoms are fixed again and again without effectively addressing the technical and cultural root causes.”

2. Improve
Prevention
Through
Regulatory
Changes



2. Improve Prevention Through Regulatory Changes

Human Factors & Org Change: *What are the human & org elements involved?*

Safety Culture & PSM Management System

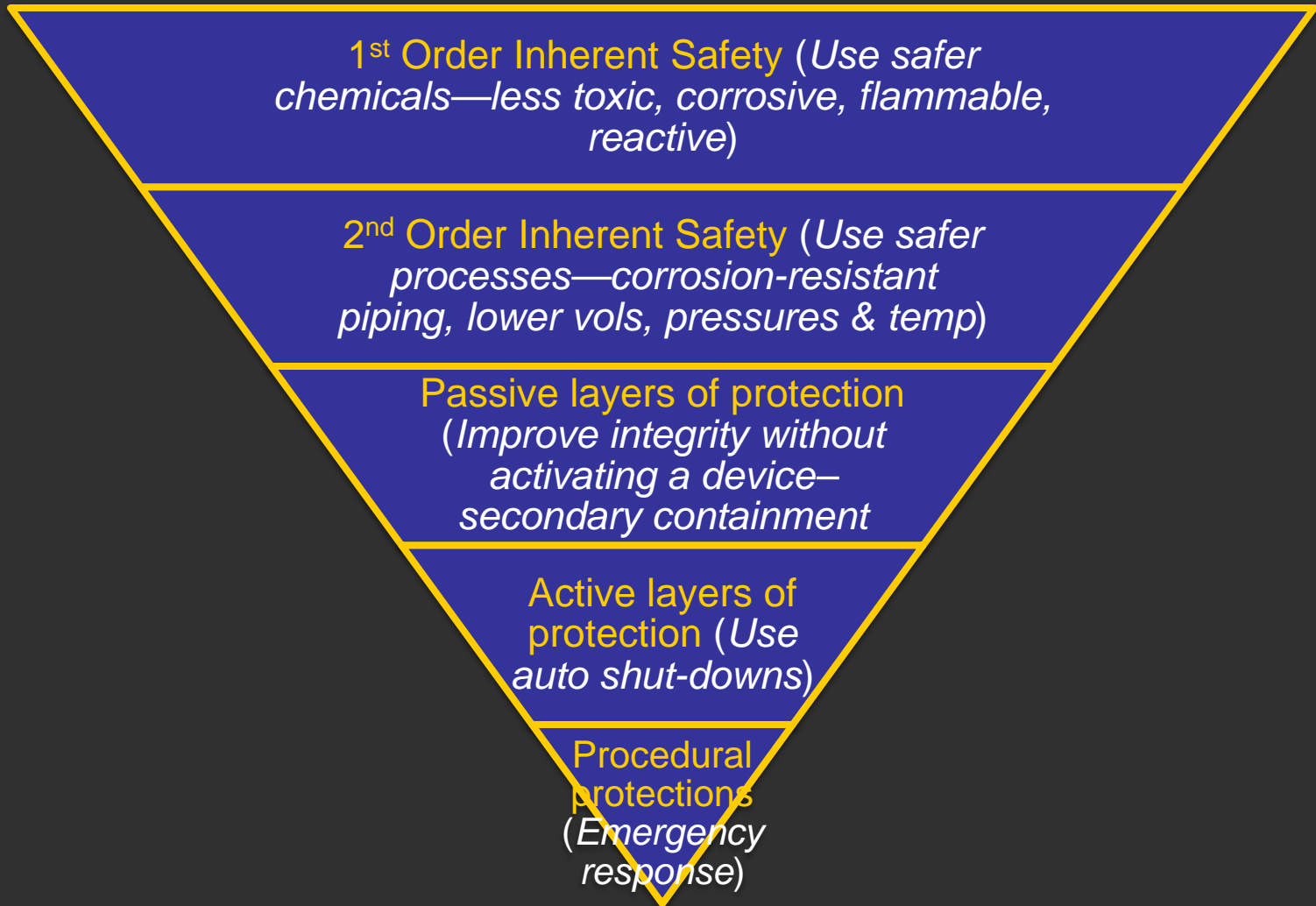
Damage Mechanism Reviews: *What are the physical hazards?*

Hierarchy of Controls: *What are the most effective & feasible solutions?*

Process Hazard Analysis: *What actions do we need to take to prevent a failure?*

Safeguard Analysis: *Is safety ensured by the set of solutions we put in place?*

Root Cause Analysis: *What have previous incidents taught us about this problem?*



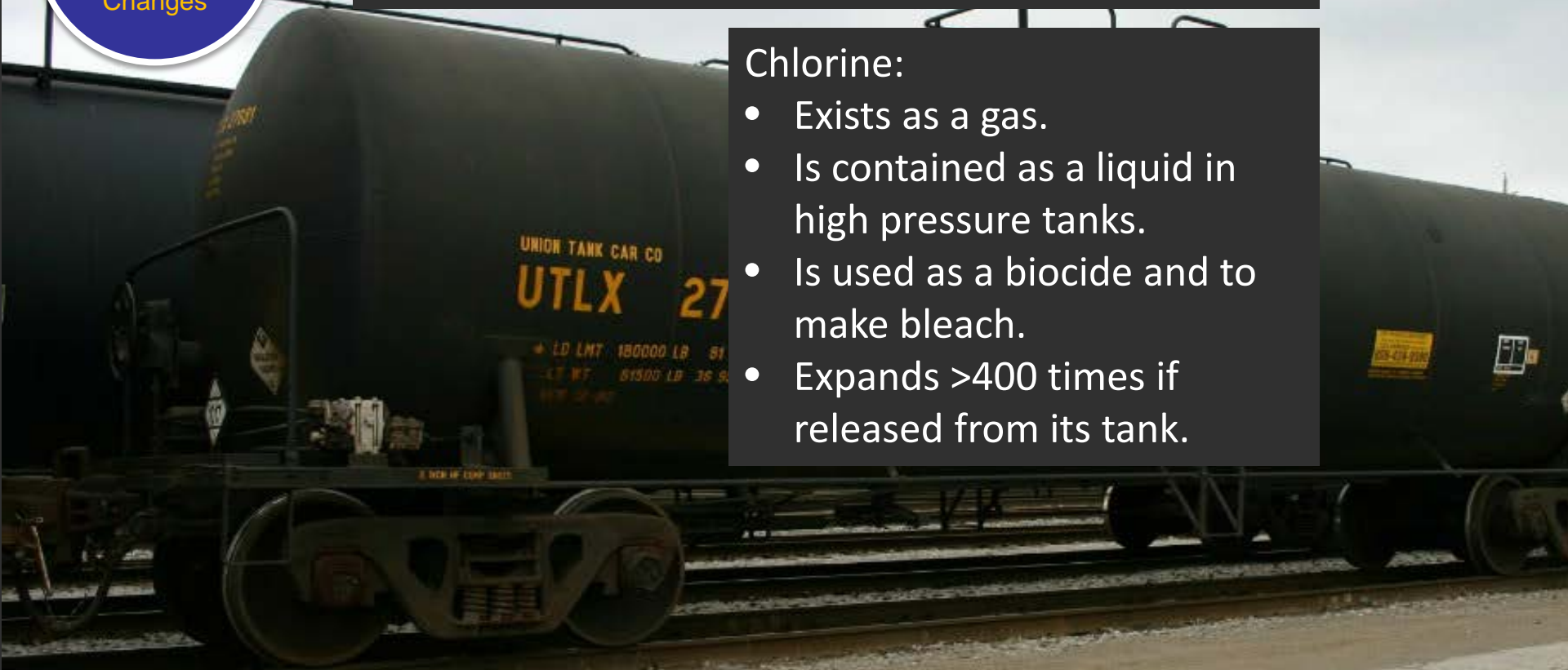
- *Governor's Report*: Employ hierarchy of controls analysis in regulation.
- Goal: Prevent incidents to the greatest extent feasible.
- Key issue: Costs required versus risks reduced.

2. Improve
Prevention
Through
Regulatory
Changes

Existing versus proposed PSM standard: Example using chlorine gas

Chlorine:

- Exists as a gas.
- Is contained as a liquid in high pressure tanks.
- Is used as a biocide and to make bleach.
- Expands >400 times if released from its tank.



2. Improve
Prevention
Through
Regulatory
Changes



- Vapors are 3-4 times heavier than air, produce acid in contact with water.
- 30 ppm: chest pain and shortness of breath
- 50 ppm: pulmonary edema
- 400 ppm: fatal in 30 mins
- Children more vulnerable due to smaller airways.

August 14, 2002: DPC Enterprises facility at Festus, Missouri, failure of a 1-inch transfer line from 90-ton chlorine railcar.



Previous and Proposed PSM standards: Example using Chlorine Gas

Previous PSM regulations: Use of chlorine is assumed	New PSM regulations: Use of chlorine is subject to question
Is the integrity of the chlorine tank itself sound?	Is the process requiring use of chlorine necessary?
Are all fittings and piping systems sound?	Are there safer alternatives to chlorine?
Have workers been trained in handling chlorine?	Are there new hazards associated with the alternatives?
Does the employer have written handling procedures?	Can those hazards be mitigated?
Have employees been provided with information on the health hazards of chlorine?	What have other facilities done? What is industry best practice?
Are there emergency procedures in place?	Are there emergency procedures in place?

Next Steps

PSM Regulations (GISO 5189.1)

- Labor-Management Advisory Committee
- Standards Board Process
- Regulation promulgation and implementation

Cal/OSHA

- New PSM teams now being deployed

Enforcement

- Cal/OSHA inspections conducted with 4-5 CSHOs.
- Joint inspections with sister agencies of Task Force.
- U.S. EPA RMP data to target 130 of 1,500 non-refinery PSM facilities

Discussion

