UNIVERSITY of WASHINGTON

How many lives does it take to change a light bulb?

A prevention based approach to reduce operational and maintenance accidents involving lighting

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THE PROBLEM

2006-2016

48 accidents, of which 28 fatal, occurred to workers **changing light bulbs** in construction or maintenance operations.

(Source: OSHA Accident Report)

Relevant precedent

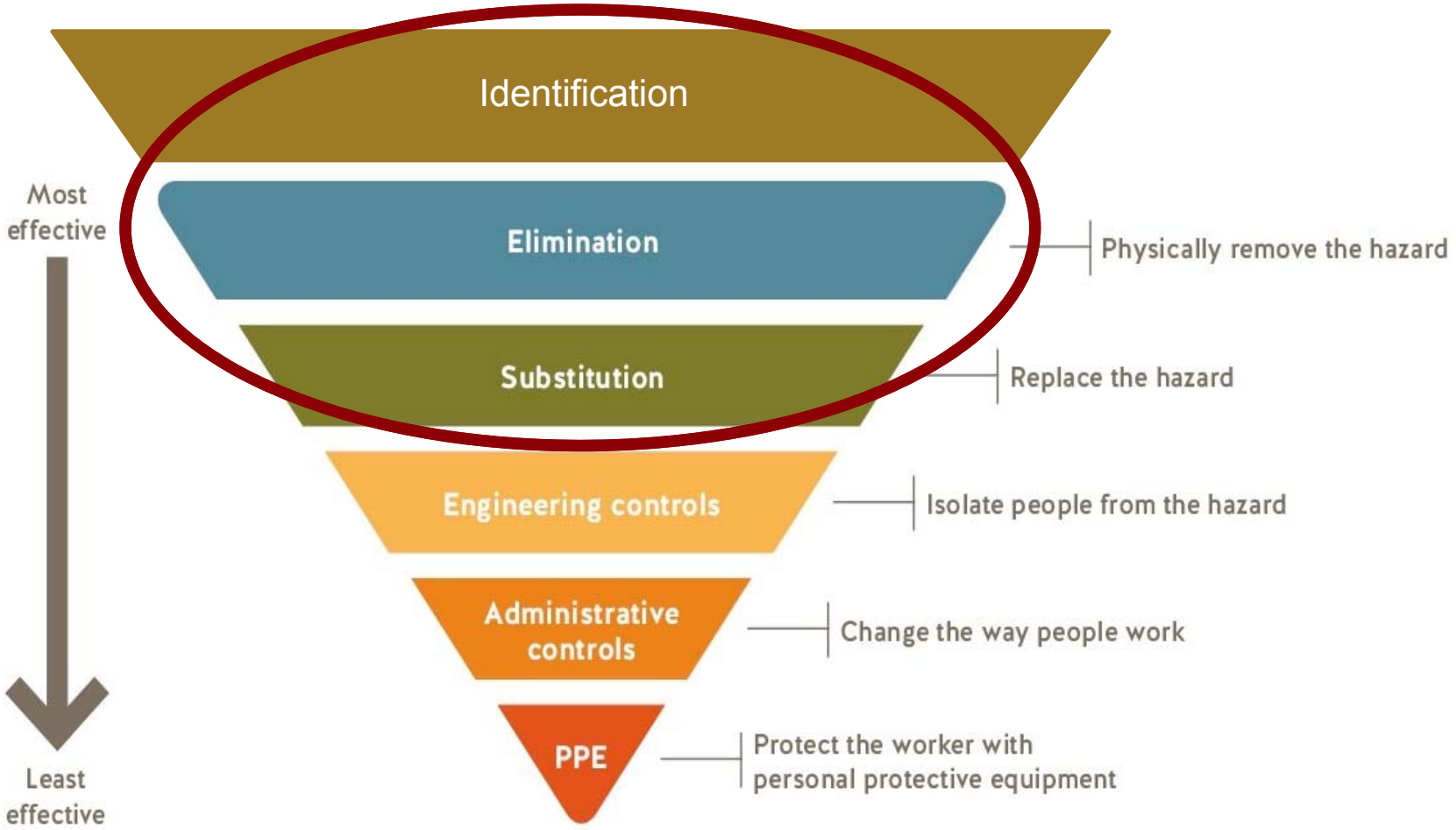
US mining industry 2002-2006 data: 140 accident records associated with maintenance or repair of work lighting.

(Yenchek and Sammarco, 2010)

THE QUESTIONS

- What is the associated hazard/risk?
- Who is impacted?
- What is the frequency of exposure?
- What are the most effective and "technologically and economically feasible" controls?

MOST EFFECTIVE CONTROLS



WHAT ~~IS~~ ARE THE RISKS/HAZARDS?

- Electric shock or electrocution
  - Fall from height as a result of shock
- Fall from ladder
- Struck by objects, vehicles, or cave-in
- Heart attack or unspecified ‘natural causes’
- Explosion / fire from flammable vapors
- Mercury vapor leaks

WHO IS IMPACTED?

Construction Phase

- Electricians
- Any other worker tasked to replace a bulb
- Anyone in proximity of the worker
- The site
- The operations

Lifecycle

- Facility maintenance operators
- Building occupants
- Renovation / demolition workers

FREQUENCY OF EXPOSURE

Fluorescent lights

Replacing I: Normal lifespan of approx. 8,000 hours ➔ ~333 days, or 0.9 years.

> At the very least 3 times/bulb throughout the duration of an average construction project: installation+1 replacement+ removal

Replacing II: Fragile, sensitive to voltage fluctuations and frequent on/off.

> At any time at during and after construction operations

Toxic exposure: Potential Mercury vapor leaks. Special handling and recycling required.

> At any time at during and after construction operations

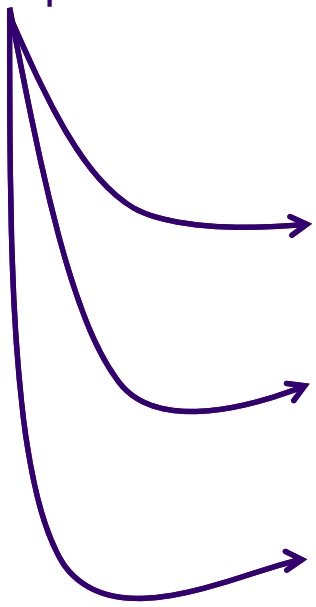
Poor visibility: Takes a few minutes to reach peak output. Flickers.

> At any time at during and after construction operations

PtD APPROACH

Main NORA Goal

13.0 Increase the use of Prevention through Design (PtD) approaches to prevent or reduce safety and health hazards in construction



Intersections

1.0 Reduce Construction Worker fatalities and serious injuries caused by falls to a lower level

2.0 Reduce fatal and nonfatal injuries from contact with electricity among construction workers

3.0 Reduce fatal and serious injuries associated with struck-by incidents associated with objects, vehicles, and collapsing materials and structures

PtD APPROACH

PtD aims at **eliminating hazards and minimizing risks** in work premises, tools, equipment, machinery, materials, and processes, including their construction, manufacture, use, maintenance, and ultimate disposal or reuse. (NIOSH)

Fall / Struck-by

> Reduce the need to work at heights

> Eliminate strain and risks of working in poorly lit spaces

Shock / Electrocution / Burns / Cuts

> Eliminate or reduce the need to replace bulbs

Toxic Substances

> Eliminate the exposure to mercury

SUBSTITUTION

Industrial and commercial lights: available alternatives

LED

A LED contains electrons that recombine with electron holes releasing energy in the form of photons and illuminating the bulb.

CFL

Halogen

Incandescent

An incandescent light bulb produces light by heating a filament wire to a high temperature until it glows

Fluorescent

CFL & fluorescent lights contain a mix of argon and mercury gases that produces UV light when the gas is excited by electricity.

SUBSTITUTION

"LEDs have the potential to significantly reduce the frequency of accidents related to the maintenance and repair of lighting systems. The **long life** of LEDs would enable an **exposure reduction to the associated hazards**. Consequently, risks would be reduced."

(Yenchek and Sammarco, 2010)

RELEVANT FEATURES

	LED	CFL	Incandescent
Life Expectancy	50,000 hours	8,000 hours	1,200 hours
Lifetime Cost to Operate for 50,000 hours*	$73	$140	$723
Heat Output	Low	Low	High
Affected by Low Temperatures	None	Yes	High
Affected by Humidity	None	Yes	Some
Instant On	Yes	No	Yes
Contains Mercury	No	Yes	No
Degradation from On/Off Cycling	None	Yes	Some
Wattage Used for 450 Lumens	5	9-13	40

* at $.14669 / KWH

PtD APPROACH

Has safety improved?

Fall / Struck-by

> Reduce the need to work at heights **–yes**

> Eliminate strain and risks of working in poorly lit spaces **–maybe?**

Shock / Electrocution / Burns / Cuts

> Eliminate or reduce the need to replace bulbs **–yes**

Toxic Substances

> Eliminate the exposure to mercury **–yes**

THE BIGGER PICTURE

Prevention Criteria

- Is it safer? **–yes**
- Is it technically feasible? **–yes**
- Is it economically feasible? **–depends**

By-products

- Is it more sustainable? **–yes**
- Does it improve worker productivity or comfort? **–maybe?**
- Is it an investment with long term returns? **–maybe?**

WOULD YOU WANT LED LIGHTS?

As an OWNER: in the project specifications

As a MANAGER: in your construction company

As a WORKER: for your daily tasks

THANK YOU