

# *Wastewater Collection Systems Workshop*

## *Pump Station Safety*

*Presenter*

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# Construction's "Fatal Four"

Of the 4175 worker fatalities in private industry in calendar year 2012, 806 or 19.3% were in construction.

The leading causes of worker deaths on construction sites were

- Falls – 279 out of 806 total deaths in construction in CY 2012 (34.6%)
- Struck by Object – 79 (9.8%)
- Electrocutions – 66 (8.1%)
- Caught-in/between – 13 (1.6%)

These "Fatal Four" were responsible for more than half (54.2%) the construction worker deaths in 2012 BLS reports.

**Eliminating the Fatal Four would save 437 workers' lives in America every year.**



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# *Main topics*

Confined Space

Fall Protection

Arc flash

NFPA 820

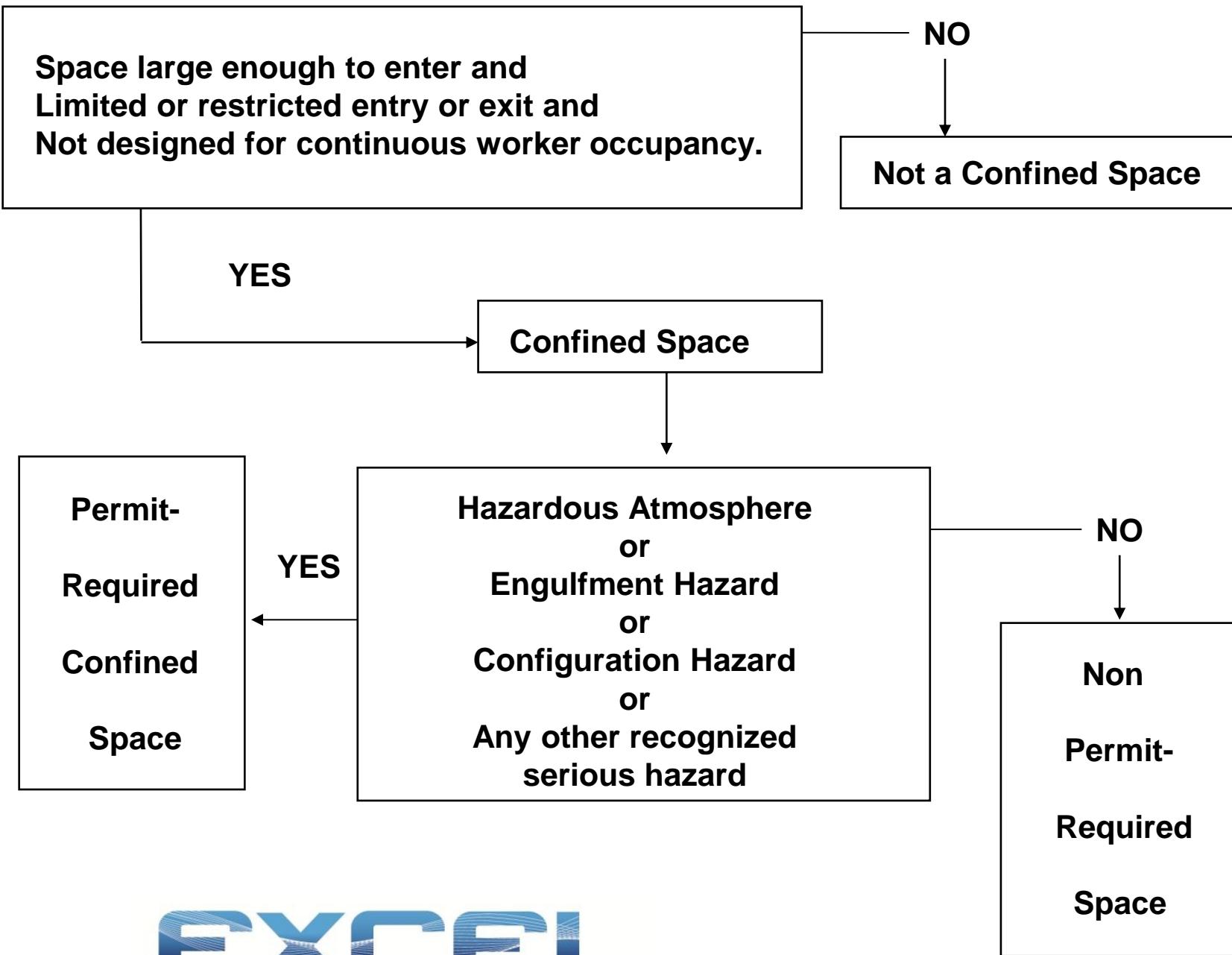


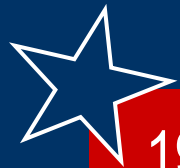


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1910.146

# Permit-Required Confined Spaces





# Applicable regulations

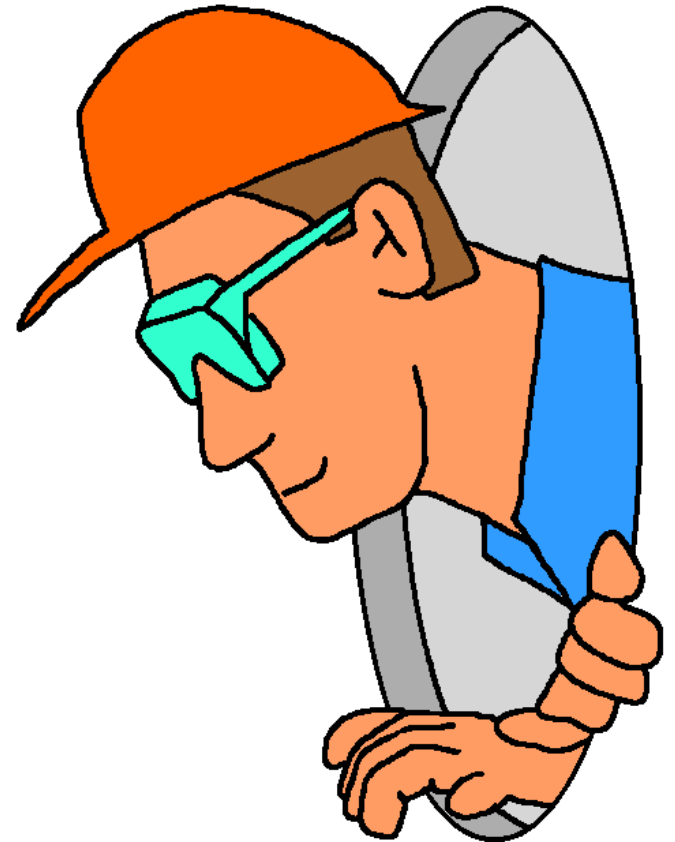
- 29 CFR 1910.146
  - General industry only – does not apply to construction operations



## (b) Definitions

### Entry

- Passing through opening (any part of entrant's body breaks its plane)
- Includes ensuing work activities





# (b) Definitions







# Hazards of Confined Spaces

- Oxygen Deficient Atmospheres
- Oxygen Enriched Atmospheres
- Flammable Atmospheres
- Toxic Atmospheres
- Temperature Extremes
- Engulfment Hazards
- Equipment (machinery, electrical)



# Other Hazards

- Noise
  - Amplified due to acoustics within the space
  - Damages hearing; affect communication
- Slick / Wet Surfaces
  - Slips and falls
  - Increased chance of electric shock
- Falling Objects
  - Topside openings expose workers inside confined space to falling objects

# Other Hazards









## (b) Definitions

### **Hazardous Atmosphere**

1. Flammable gas, vapor, or mist in excess of 10% of its LFL (lower flammable limit )
2. Airborne dust at a concentration that meets or exceeds its LFL (Rule of thumb: vision at <5')
3. Oxygen <19.5% or >23.5%
4. Atmospheric concentrations of substances above PEL (Permissible Exposure Level)
5. Other atmospheric conditions: IDLH.  
(immediately dangerous to life and health.)



# Engulfment Hazards

- Loose, granular materials stored in bins and hoppers - grain, sand, coal, etc.
- Crusting and bridging below a worker
- Flooding of confined space
- Water or sewage flow



29 CFR 1910.146(c)

# General Requirements



# 1910.146(c) General Requirements

1. Employer shall evaluate workplace
2. If workplace contains permit spaces, signs shall be posted
  - Give notice of
  - Existence
  - Location
  - Danger
3. Effective measures shall be taken to prevent entry if not allowed





# 1910.146(c) General Requirements

4. If entry is allowed, a permit space program must be:
  - Written
  - Implemented
  - Made available to employees/representatives

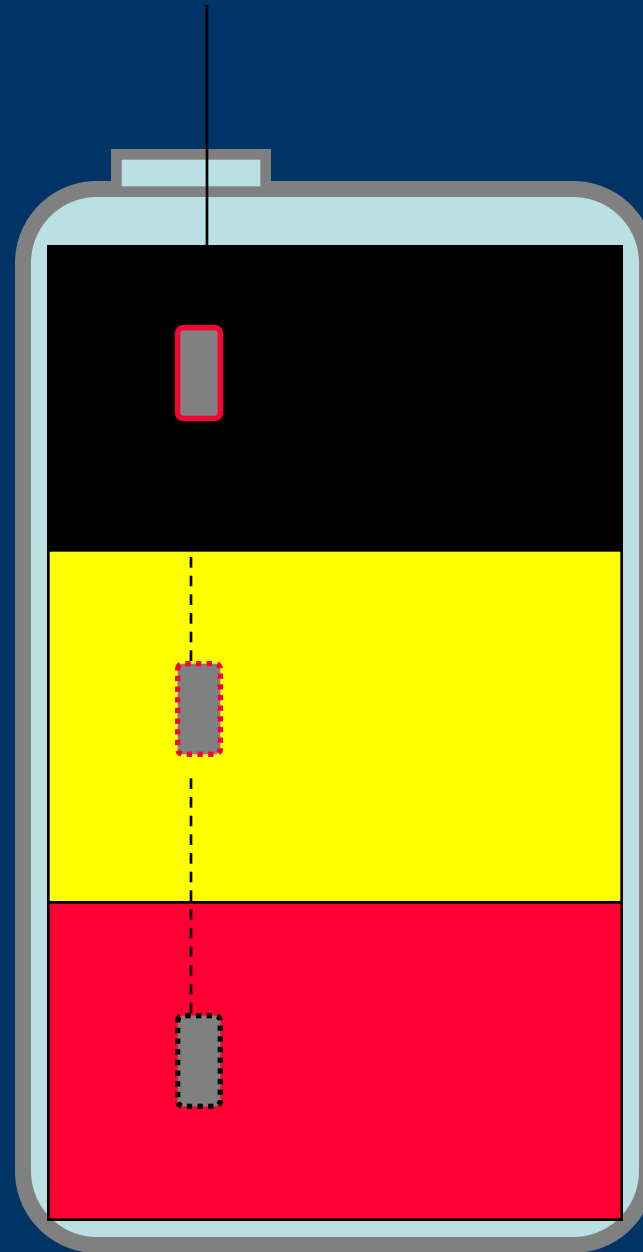


# 1910.146(c)(5) Alternate procedures

- Compliance may be simplified (paragraphs (d)-(f) and (h)-(k) exempted) if:
  - Can demonstrate that the only hazard is atmospheric
  - Can demonstrate that continuous forced air ventilation can control the hazard
  - Supportive monitoring & inspection data is developed

**Always test the air at various levels to be sure that the entire space is safe.**

**Good air near the opening does NOT mean there is good air at the bottom!**



**Good Air**

**Poor Air**

**Deadly Air**



# Order of Testing

- First---Oxygen Presence And Amounts
- Second---Flammables
- Third---Toxics
- Others





# Common Air Monitoring Errors

- No correlation between O2 and LEL
- Test it and forget it
- Lack of training
- Misinterpretation of readings and data
- Weak internal standards







# 1910.146(h) Duties of Authorized Entrants

- Know hazards and symptoms
- Use equipment properly
- Communicate with attendant
- Alert attendants of symptoms or prohibited condition
- Exit as quickly as possible after:
  - Attendant or supervisor give order to evacuate
  - Recognizing sign or symptom of exposure
  - Detecting prohibited condition
  - Evacuation alarm is activated

# Questions or Comments?



# Fall Protection



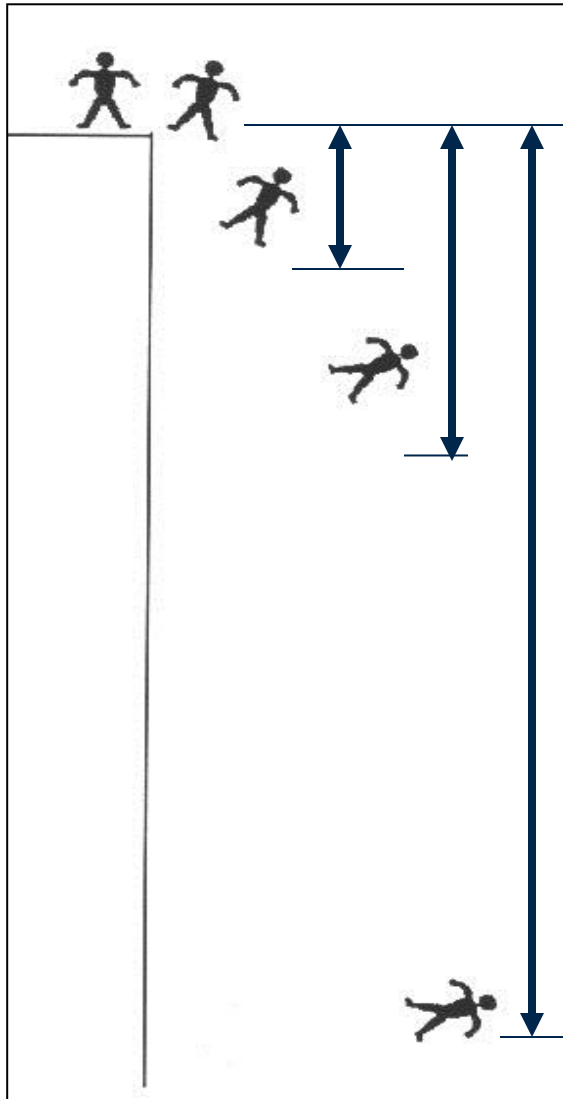
"You weren't listening. I said, 'Don't fall.'"

# What is Fall Protection?

- A series of reasonable steps taken to cause the **elimination** or **control** of the injurious effects of an unintentional fall while accessing or working at height



# Anatomy of a Fall



**.33sec./2 feet**

**.67 sec./7 feet**

**1 sec./16 feet**

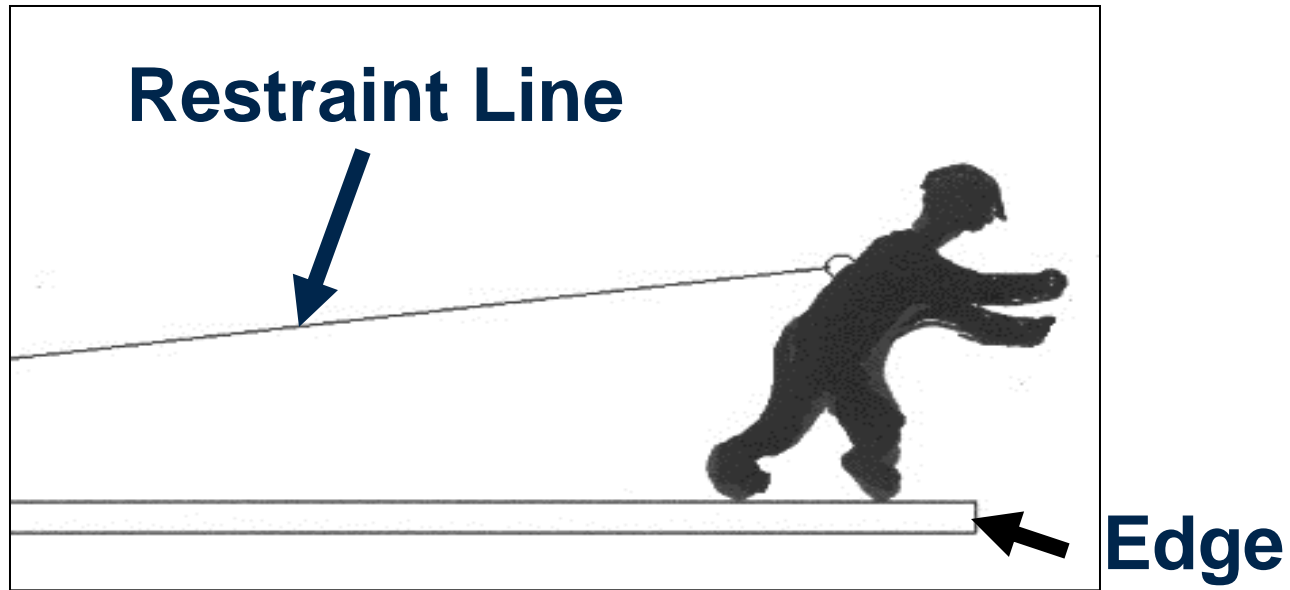
**2 sec./64 feet**

- It takes most people about 1/3 of a second to become aware.
- It takes another 1/3 of a second for the body to react.
- A body can fall up to 7 feet in 2/3 of a second.

# Fall Protection Methods

- Fall Prevention- A system that will prevent a person from falling to a lower level.  
Example: Railings
- Work Positioning or Fall Restraint- A system that will allow the worker to approach a fall hazard and work but will not allow the worker to fall to a lower level.
- Fall Arrest- A system that will protect a person from crashing on to a lower level after a fall.  
Example: Fall Arrest Harness/lanyard

# Fall Restraint



- Fall restraint assumes the employee cannot reach the edge, they are basically on a short leash.
- If the employee can fall over the edge, then a personal fall arrest system must be used.

# Anchorage

- Fall arrest anchor points must support 5000 lbs per employee attached
- Fall restraint anchor points must support at least 1000 lbs per employee attached
- Ask your supervisor, Senior Safety Officer, if you need assistance in determining an adequate anchorage point



# Anchorage

When certified, an equipment lifting bail can be an effective fall restraint tie off point





# Fall Prevention



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# Fall Prevention



# Personal Fall Arrest Systems

- Anchorage
- Body
- Connector

**Harnesses**



**Carabiners**



**Rope Grabs**



**Beam Wraps**



**Positioning**



**Lanyards**



# Questions or Comments?





# Arc Flash



- What is Arc Flash?
  - Arc flash results from an arcing fault, where the electric arcs and resulting radiation and shrapnel cause severe skin burns, hearing damage, and eye injuries.



## Why are we so interested in Arc Flash now?

- Numerous workers are injured and/or killed each year while working on energized equipment. Many of these casualties are a result of arc flash.
- Working on energized equipment has become commonplace in many industries.

## Important Temperatures

Skin temperature for curable burn	176°F
Skin temperature causing cell death	205°F
Ignition of clothing	752°-1472°F
Burning clothing	1472°F
Metal droplets from arcing	1832°F
Surface of sun	9000°F
Arc terminals	35,000°F

# Revisions To The NFPA 70E

1. Only qualified persons shall be permitted to work on electrical conductors or circuit parts that have not been put into an electrically safe work condition. (reference: NFPA 70E-2004 Section 110.8(A)(2) ©NFPA).
2. A flash hazard analysis shall be done in order to protect personnel from the possibility of being injured by an arc flash. (reference: NFPA 70E-2004 Section 130.3 ©NFPA).

# Energized Electrical Work Permit

When live parts over 50 volts are not placed in an electrically safe work condition it is considered energized electrical work and must be down under a written permit.

Permit gives conditions and work practices needed to protect employee from arc flash or contact with live parts.

# Typical NEC Labels

**⚠ DANGER**

## ELECTRIC ARC FLASH HAZARD



**Will cause severe injury or death.**

**Turn OFF ALL power before opening. Follow ALL requirements in NFPA 70E for safe work practices and for Personal Protective Equipment.**

69B1003H01 REV 1



# ⚠ WARNING

## Arc Flash and Shock Hazard Appropriate PPE Required

<b>24 inch</b>	<b>Flash Hazard Boundary</b>
<b>3</b>	<b>cal/cm<sup>2</sup> Flash Hazard at 18 inches</b>
<b>1DF</b>	<b>PPE Level, 1 Layer 6 oz Nomex®, Leather Gloves, Faceshield</b>
<b>480 VAC</b>	<b>Shock Hazard when Cover is removed</b>
<b>36 inch</b>	<b>Limited Approach</b>
<b>12 inch</b>	<b>Restricted Approach - 500 V Class 00 Gloves</b>
<b>1 inch</b>	<b>Prohibited Approach - 500 V Class 00 Gloves</b>

Equipment Name: **Slurry Pump Starter**

# Good safety practices minimize risk:

Switch remotely if possible.

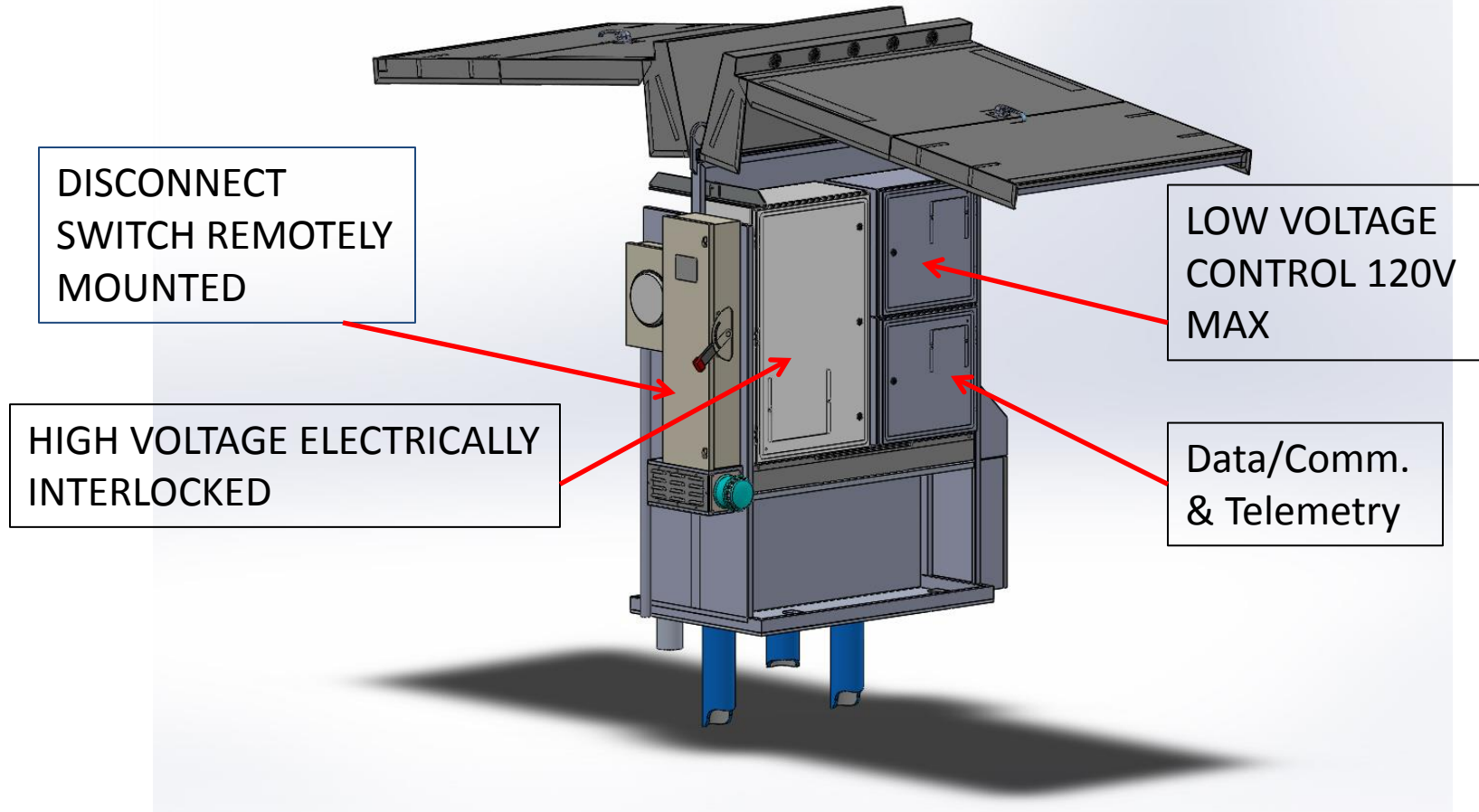
Standing aside and away as much as possible during switching.

Avoid leaning on or touching switchgear and metallic surfaces.

Use proper tools and PPE.



# Better Designs minimize the risk



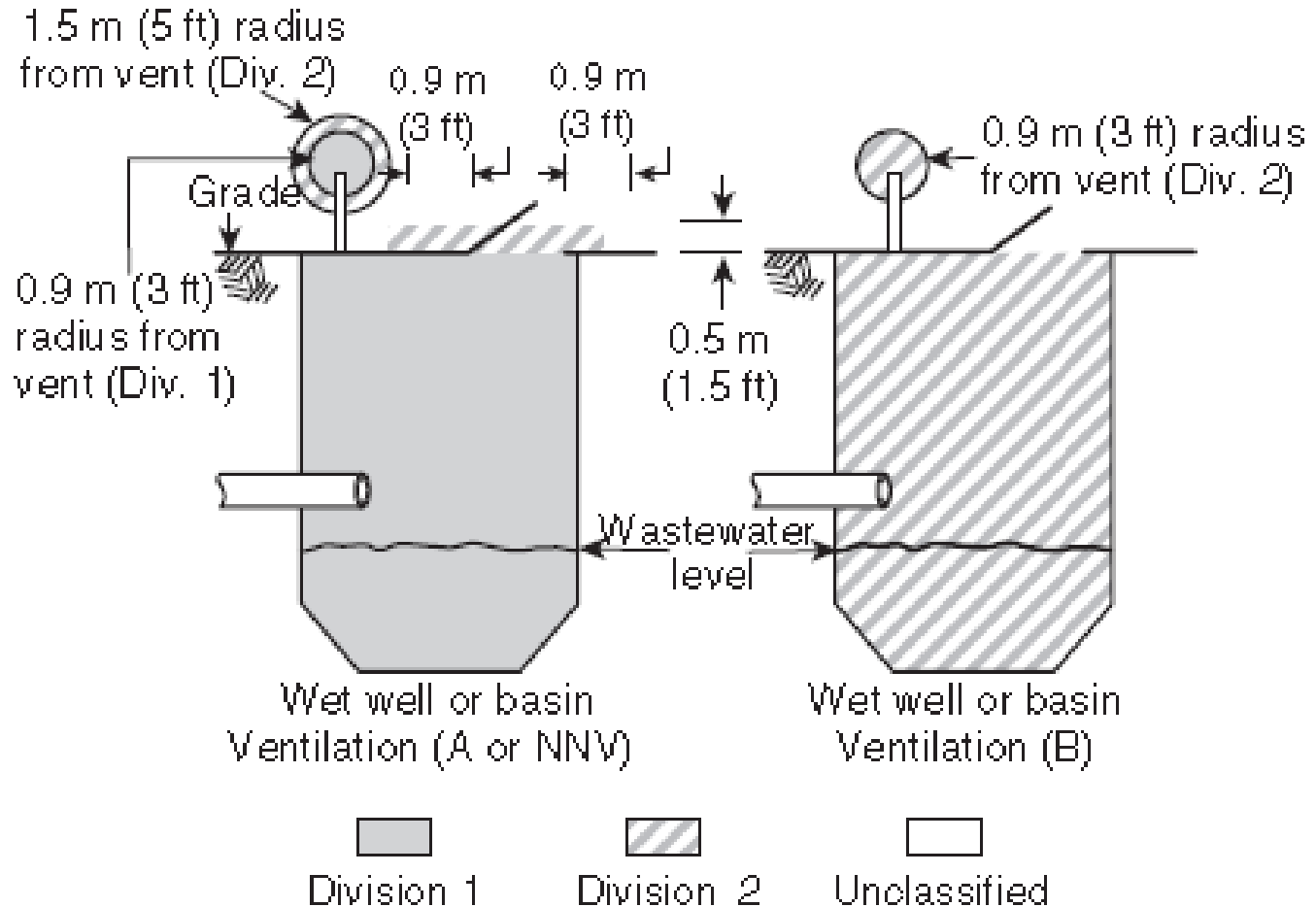
# Questions or Comments?



# NFPA<sup>®</sup> 820

## Standard for Fire Protection in Wastewater Treatment and Collection Facilities

# Wet well classification



# NEMA 7 Explosion Proof Control panel

**Explosion Proof Panels** may be installed in Class I, II or III, Division 1 Hazardous Locations according to appropriate National Electrical Code (NEC) installation practices



# NFPA 820

Table 4.2 *Continued*

Row	Line	Location and Function	Fire and Explosion Hazard	Ventilation	Extent of Classified Area	NEC Area Electrical Classification (All Class I, Group D)	Material of Construction for Buildings or Structures	Fire Protection Measures
16	a	WASTEWATER PUMPING STATION WET WELLS Liquid side of a pumping station serving a sanitary sewer or combined system	Possible ignition of flammable gases and floating flammable liquids	A	Entire room or space	Division 1	NC, LC, or LFS	CGD
	B			Division 2				

(3) The following codes are used in this table:

A: No ventilation or ventilated at less than 12 air changes per hour.

B: Continuously ventilated at 12 changes per hour or in accordance with Chapter 9.

C: Continuously ventilated at six air changes per hour or in accordance with Chapter 9.



# Traditional Pump Station



# Traditional Pump Station



Electric Powered Exhaust Vent:  
Inline bathroom fan duct booster  
All the foul air goes through the fan

***Not Recommended !***

Intake

Exhaust



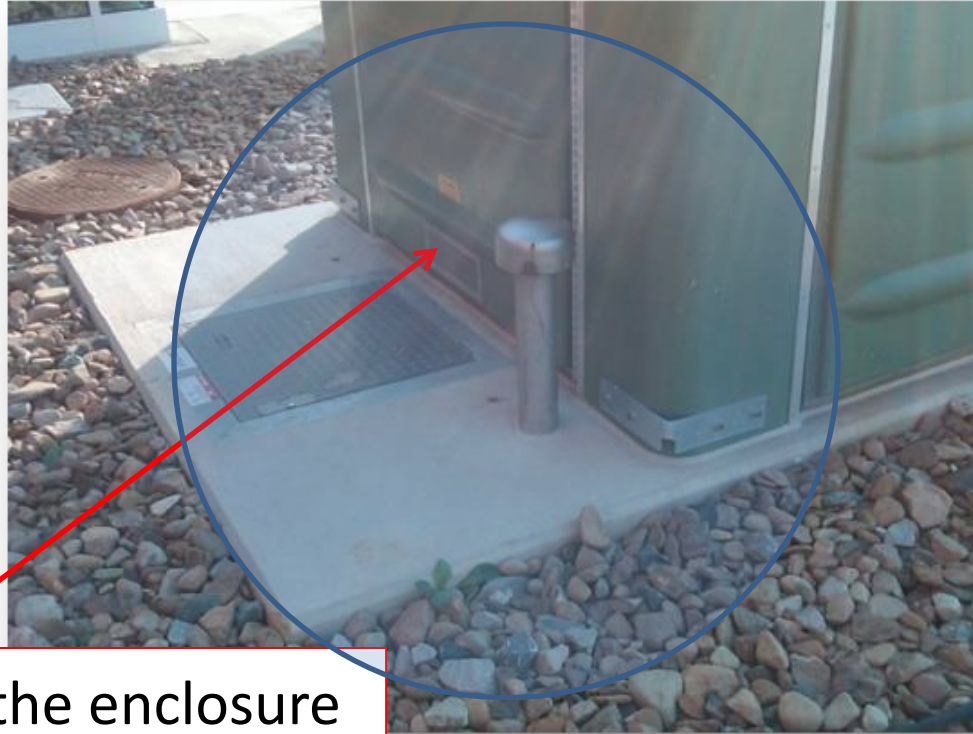




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Air intake to the enclosure  
Draws in sewer gas directly  
from the wet-well vent



Air intake to the enclosure



# Conclusion

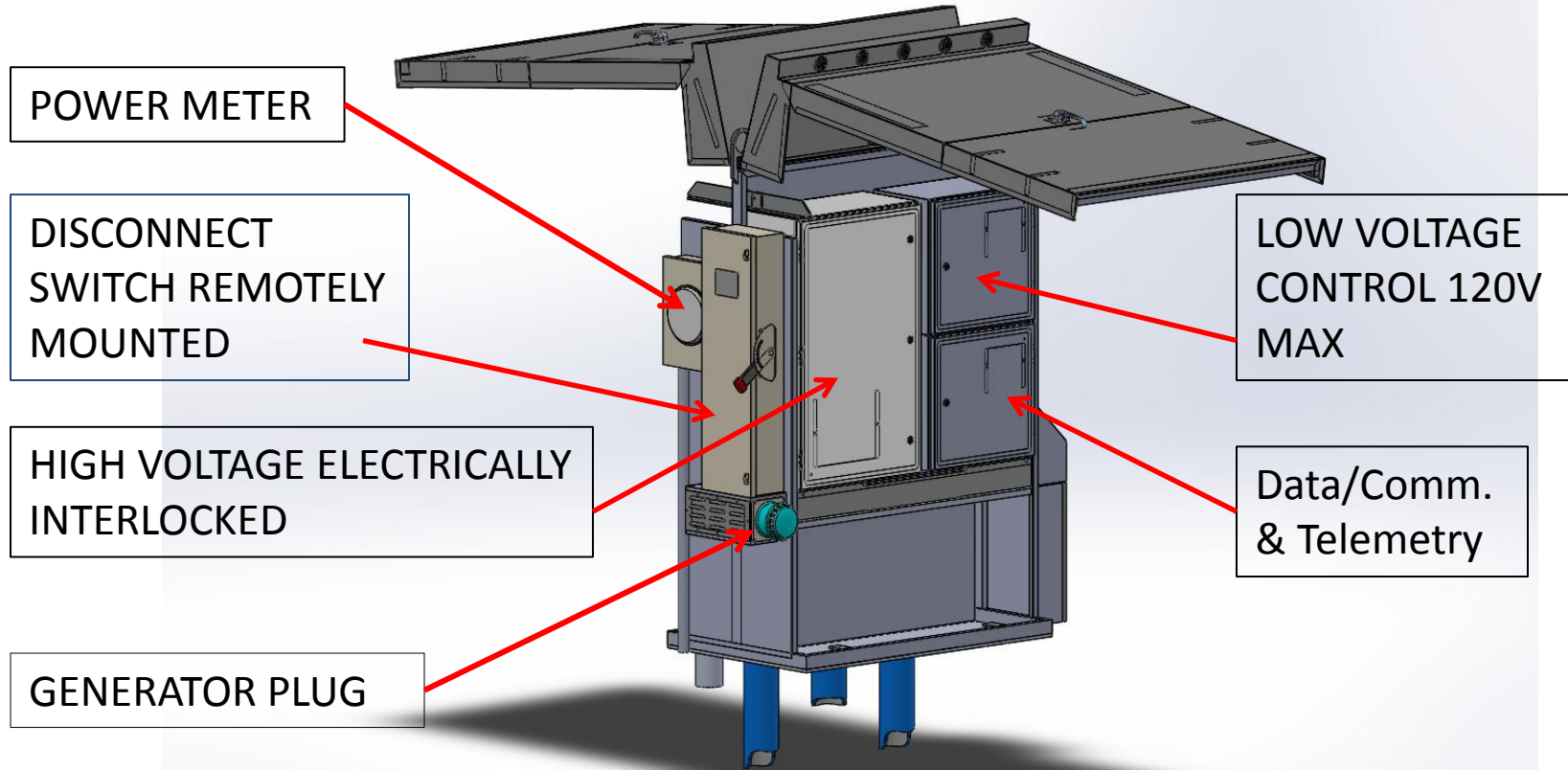
Do it ***Right***....Do it ***Safe***

Accept only products that offer practical solutions ***applied***

***SAFE*** can be ***by design***



# Practical Solutions Applied *by Design*



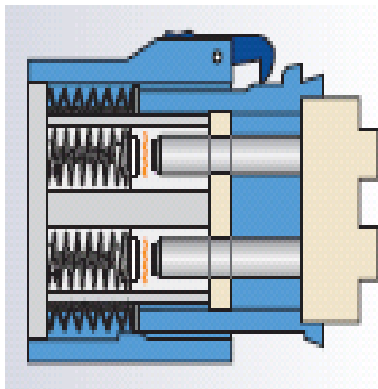
# Practical Solutions Applied by Design

Safe Means of disconnect using Meltric or equal “Deconnectors”

Push Button circuit Disconnection



Enclosed arc chambers



Arcing which normally occurs during the making and breaking of the contacts is contained inside the device.



# Practical Solutions Applied *by Design*



Air intake under the roof overhang  
60" above grade

Air Exhaust at  
ground level





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Thank You