



# From Calibration to Combustion

MANAGING RISK DURING METER PROVING

NCWM Interim Meeting, Mobile AL

January 14th, 2026



# Session Overview



Uses a real fuel truck fire during routine meter proving as a case study



Examines how changes to normal fuel handling introduce ignition risk



Focuses on splash loading, vapor hazards, and static electricity,



Reviews practical controls and standards to prevent recurrence

# Why Meter Proving Is Safety-Critical

Outside of  
“normal”  
operations

Introduces vapor  
space and free-  
fall conditions

Involves non-  
routine  
personnel

Changes system  
risk state

# Why This Matters to NCWM



Meter proving is often viewed primarily through the lens of measurement accuracy.



Safety risks created by proving activities may fall outside traditional oversight focus



Standards and procedures may exist but are not always integrated across disciplines



NCWM professionals are uniquely positioned to see where technical, procedural, and safety domains intersect



# The Incident



# Incident Summary

Meter proving completed

Fuel returned via splash loading

Fuel vapors within flammability range

Improper bonding

Ignition and fire occurred

# Splash Loading



Fuel was returned to the Avgas truck by being splash loaded through the tanks dome cover

# Static Electricity – The Ignition Source

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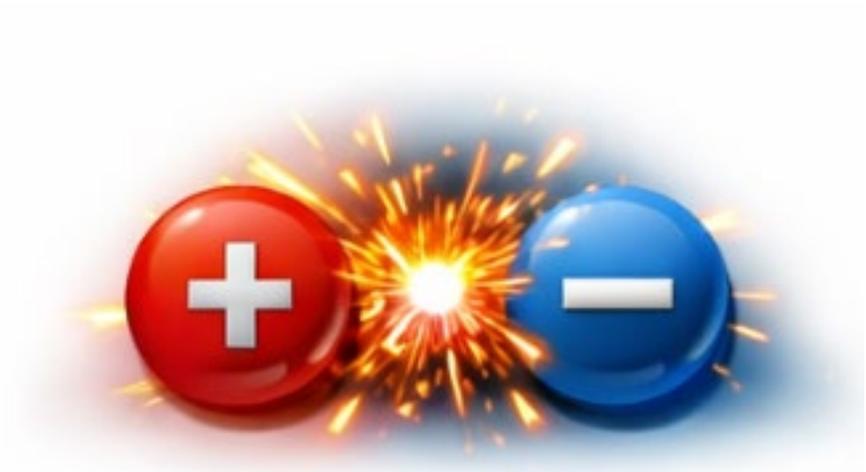
Generated by fuel movement

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Different charges can accumulate

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Sparks occur when charges equalize



# Flammability Range – When Fuel Becomes Ignitable

- The percentage of fuel in the air that will allow ignition to occur
- Too little vapor → mixture is too lean to burn
- Too much vapor → mixture is too rich to burn



# Risk Pathway – Control State Model





# Hazard Mechanisms



# Where Static Sparks Form

- Fuel movement builds static
- Free-fall streams and nozzles are high-risk points
- Sparks occur when charges equalize

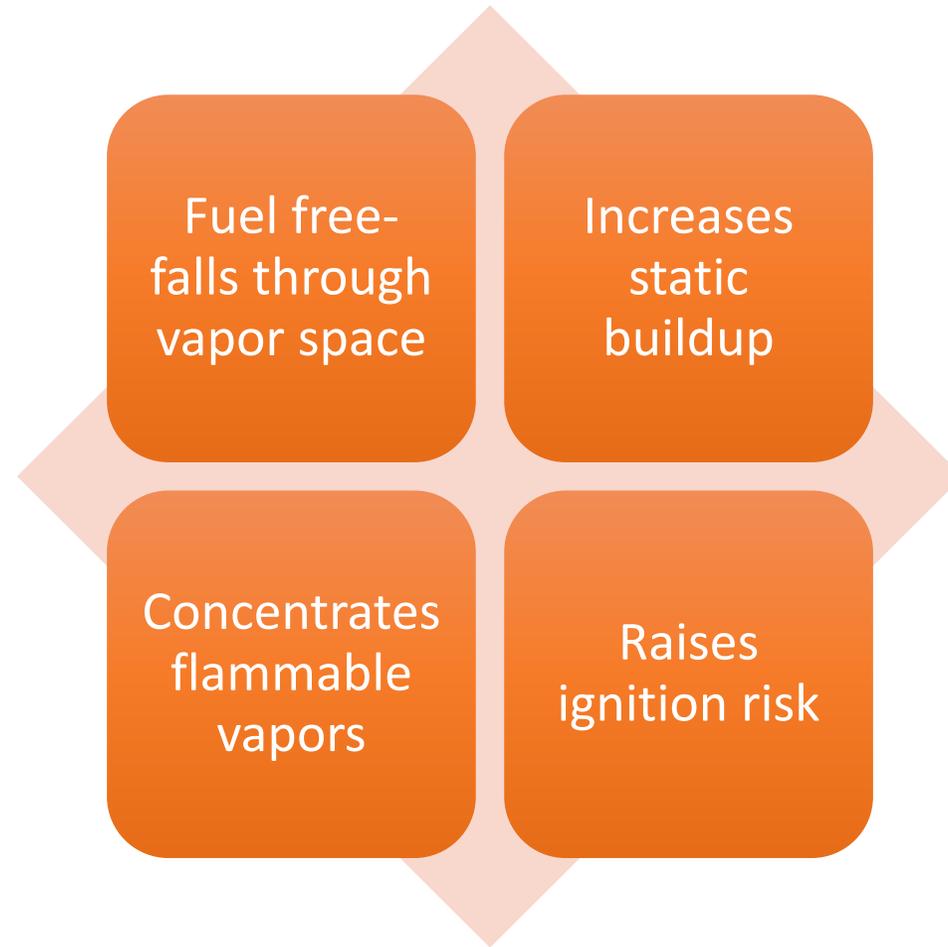


# Bonding: Why it works

- Connects parts to prevent charge buildup
- Prevents electrical differences
- Eliminates spark conditions



# Splash Loading: Why It Is Hazardous



# Why Ignition Occurred

- Vapor within flammability range
- Accumulation of static charges (splash loading, fuel free falling through vapor space)
- A static discharge occurred within a flammable mixture

**Key Point: The fire was not caused by one failure — it was caused by alignment of hazards and energy.**





# Controls and Standards



# Controls: Engineering



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Bottom loading  
preferred

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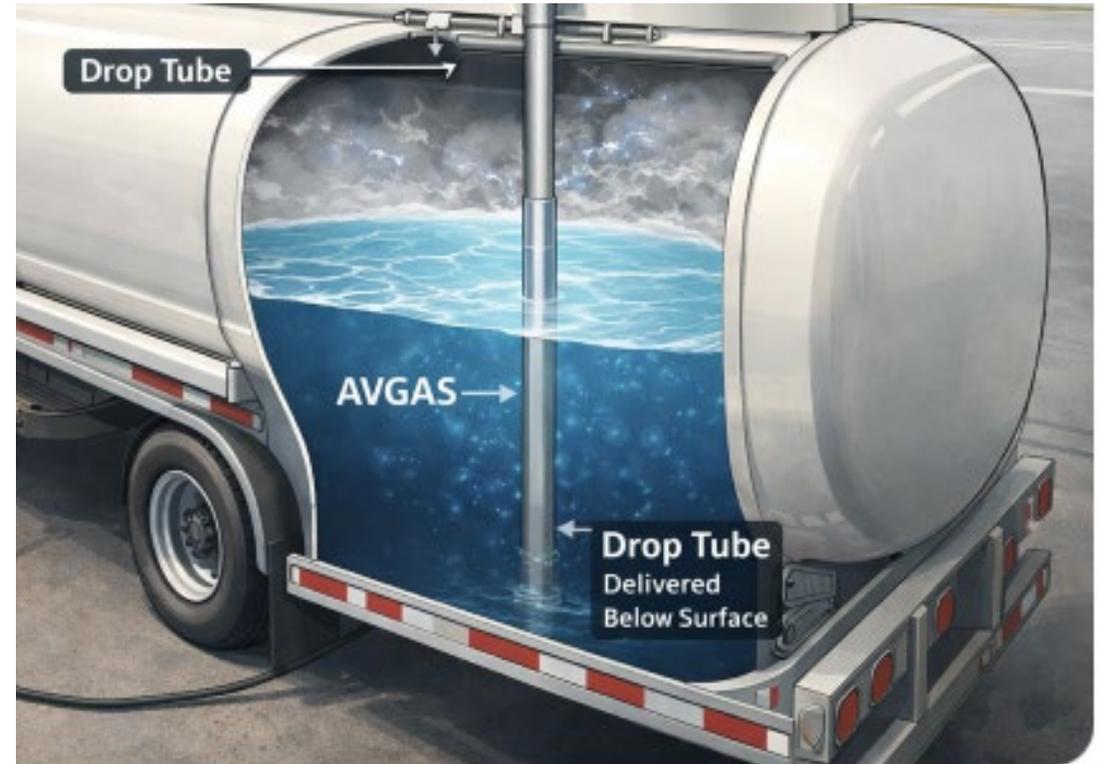
Drop tubes for  
submerged loading

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Bonding required

# Drop Tubes: Why and How They Reduce Risk

- Deliver fuel below the surface
- Prevent splash and excess static
- Must reach the bottom and stay in place



# Elimination Beats Mitigation

Top loading  
creates risk

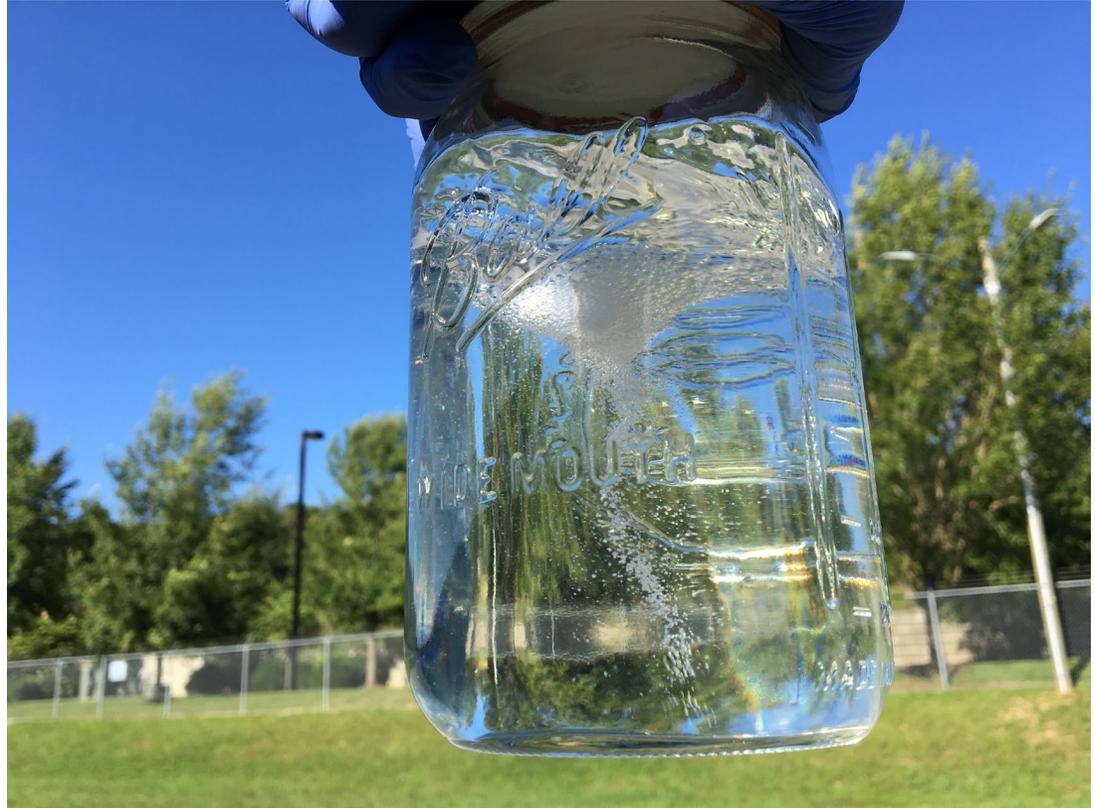
Bottom  
loading  
avoids it

Fewer  
controls  
required

# Safety Is Also Fuel Quality

(aircraft can't pull off to the side of the road....)

- Meter proving temporarily disrupts normal fuel quality controls
- Fuel may be moved outside normal filtration and sampling paths
- Cross-contamination and off-spec fuel risk increase during proving



# Quality Control



Flush proving equipment between grades



Prove Avgas before Jet-A



API gravity checks



Qualified refueling personnel (preferably supervisory)

# Controls: Standards and Best Practices



NFPA<sup>®</sup>

# 407

Standard for  
Aircraft Fuel Servicing

2022



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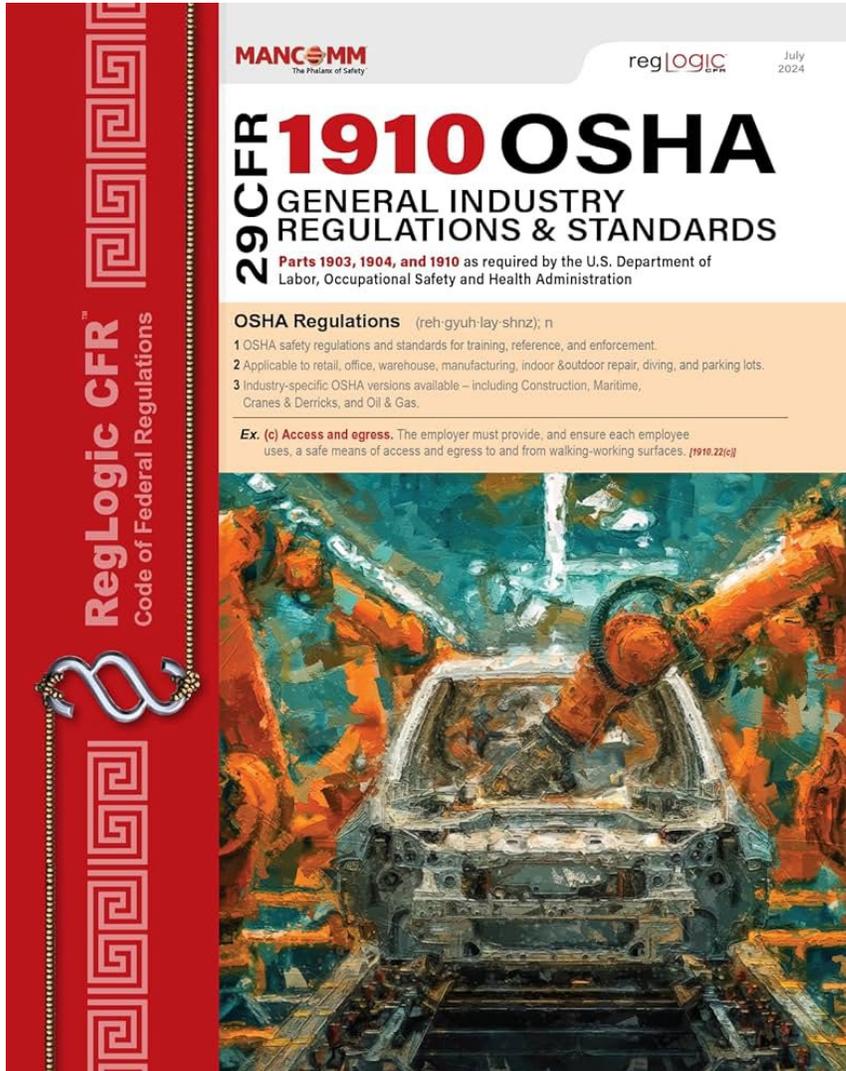
6.2.11.10.1 Where loading tank trucks through open domes, a bond shall be established between the loading piping and the cargo tank to equalize potentials

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iii. 6.2.11.10.3 Drop tubes attached to loading assemblies extending into the vehicle tank shall extend to the bottom of the tank and shall be maintained in that position until the tank is loaded to provide submerged loading

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iv. 6.2.11.10.4 Splash filling shall be prohibited



OSHA's General Fall Protection Requirements defined in 29 CFR 1910 which requires fall protection where employees are exposed to a fall risk of four feet or more

[Home](#) / [News](#) / [Safety 1st Alert \(SFA\): 2025.3 Fuel Truck Fire Highlights Hazards and Underscores Critical Considerations for Annual Meter Proving](#)

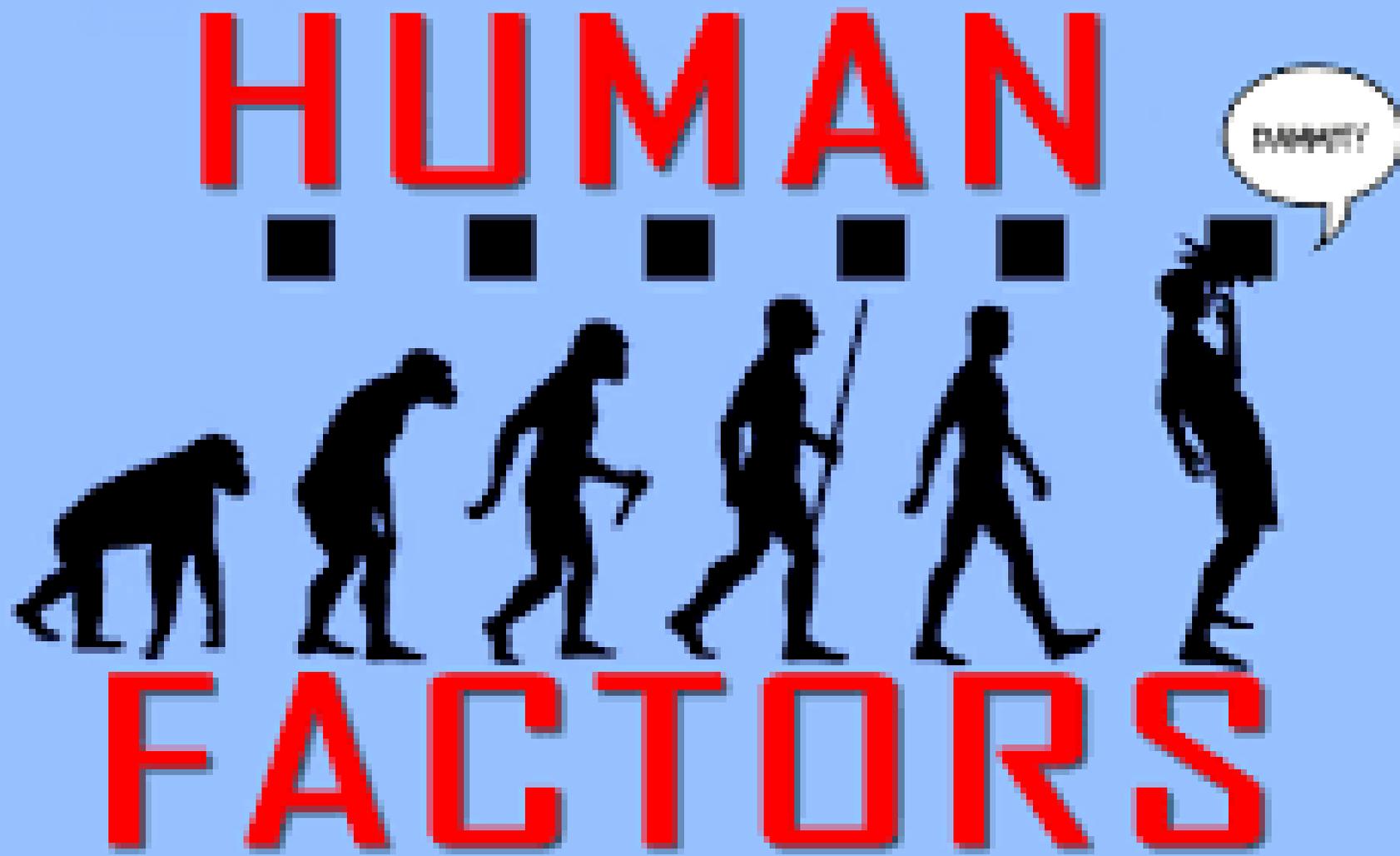
# Safety 1st Alert (SFA): 2025.3 Fuel Truck Fire Highlights Hazards and Underscores Critical Considerations for Annual Meter Proving





# Human and System Factors





# Why Controls Degrade

- Controls rely on people and organizations to apply them consistently
- Over time, work adapts to pressure, convenience, and routine
- Formal procedures slowly give way to informal practice
- That “practical drift” weakens the reliability of controls

## **Key Point:**

Controls rarely fail suddenly — they weaken gradually.

# Types of Errors

Unintentional v. Intentional

Latent v. Active



# Intentional Errors (malicious acts)



# Unintentional Errors (accidents)

# The Latent Errors (Hidden System Conditions)

The pre-conditions that contributed to the outcome

Where Latent Errors Commonly Occur:



# Procedures

How work is defined and normalized.

- ✗ Acceptance of splash loading as a routine practice.
- ✗ No clear boundary between “normal” and “non-standard” fuel handling.
- ✗ Lack of explicit prohibition reinforced by habit.

## **Key Idea:**

What was considered  
“normal” no longer  
matched what was safe.

# Equipment

What the system physically allowed.

- ✗ Ineffective or missing bonding connections.
- ✗ No drop tube available for submerged loading.
- ✗ Equipment did not prevent unsafe configurations.

## **Key Idea:**

The system did not physically enforce safe behavior.

## Training

What people were prepared to recognize and respond to.



- ✘ Fuel handling scenarios outside normal operations were not emphasized.
- ✘ Focus remained on routine fueling, not considering annual proving
- ✘ Splash loading risk taught. Dismissed because “not done here”?

These were the latent  
errors...

# The Active Error



# The Dirty Dozen

Lack of  
Knowledge

Lack of  
Resources

Norms

Lack of  
Awareness

Lack of  
Assertiveness

Pressure

Complacency

Lack of  
Teamwork

Distraction

Lack of  
Communication

Fatigue

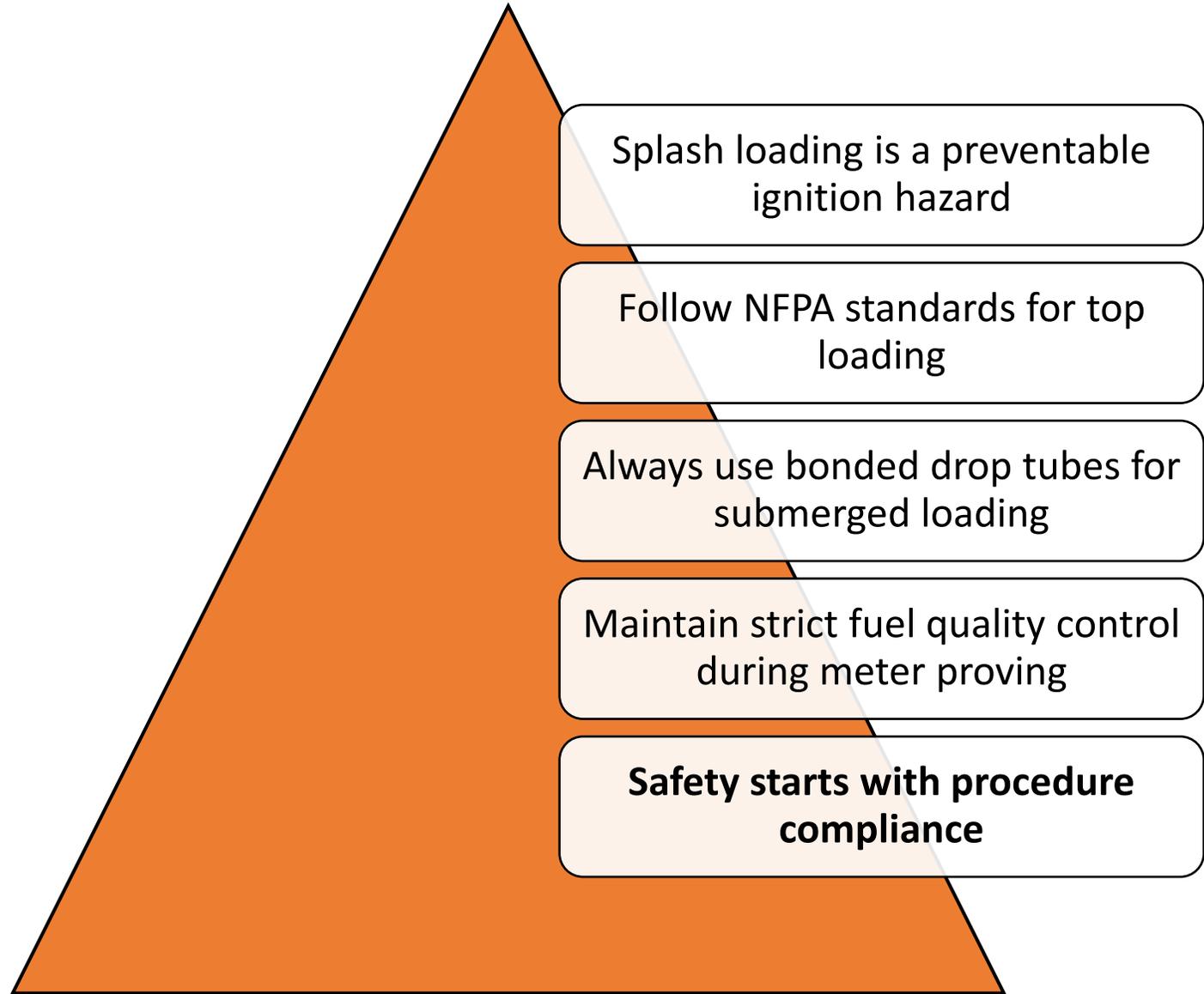
Stress



# Application and Close



# Key Takeaways from SFA 2025.3



# Resources & Next Steps



Download SFA 2025.3: [www.nata.aero](http://www.nata.aero)



Develop procedures in compliance with SFA 2025.3 and NFPA 407



Conduct training refreshers for all meter proving staff



Contact NATA for guidance



# Thank You!

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