Static Electricity Hazards and Controls

Dirk Smith, President
Ionix Gas Technologies

Who is Ionix Gas Technologies and why am I here?

- IGT has developed a suite of products to eliminate static inside and outside PE pipe.
- Because we are called in when static incidents occur, we have industry anecdotal history to draw upon.

Goals of this session

1. Gain working understanding of static electricity in PE gas pipe.
2. Learn to recognize static ignition risks in your field operations.
3. Provide basis for development/evaluation of your own static suppression procedures based upon how static operates and the known risks in gas O&M operations.
4. Basics apply from wellhead to delivery.

3 Threats caused by static

1. Ignition
2. Shock
3. Electrostatic leaks

The basics of static electricity

What is static electricity?

Static electricity is so called because it is an electrical charge at rest because it resides on an electrical insulator.

How static electricity is created

Friction of one electrical insulator against another displaces electrons which accumulate on one of the surfaces.

Mother nature doesn't like electrical imbalances.

The physical world is intended to be at electrical neutrality. Mother Nature will remedy the problem if you don't.

Arcing can ignite a gaseous mixture, shock the worker or create a leak

The 4 Basics of Static Electricity in PE pipe

As determined by research done by the Gas Research Institute

#1 – Static starts INSIDE pipe

The movement of gas inside pipe creates static on the inside walls of the pipe.

Why? That's where the friction is!

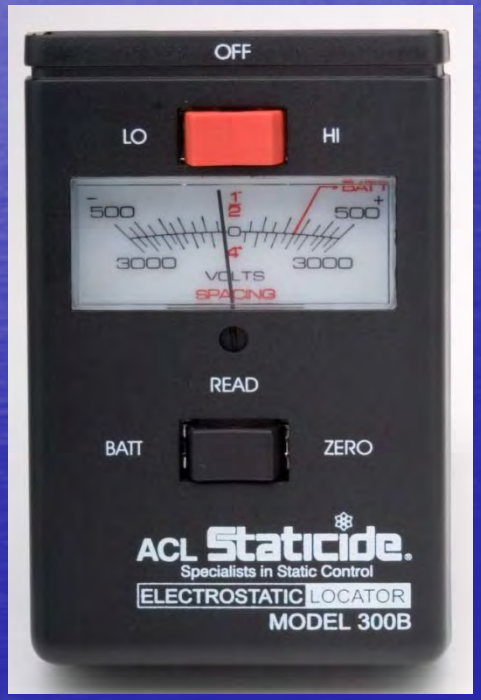
This is the most important takeaway today because this is the root cause of ALL static issues you encounter.

"When PE pipe is charged by dust or particulate flowing in the gas (triboelectrification), charge is generated initially in the interior of the pipe."

Gas Research Institute report 92-0460

-Technical Perspective, page iv, line 3

Measuring static



#2 - Once static is created, it just doesn't "go away..."

It will not conduct away ***since it is sitting on a non conducting material***. That is why it is called "static" electricity. It must be deliberately dissipated.

"Charges imparted to the interior PE pipe surfaces act as point sources and are immobile because of the inherent high resistivity of PE."

Gas Research Institute report 92-0460

Introduction, page 1 line 4.

#3 - Static is induced on the outside of pipe

This is why you have a wet rag procedure.

"The electric field resulting from the interior charge induces exterior charge on the pipe."

Gas Research Institute report 92-0460

Technical Perspective, page iv, line 3

#4 - Static WILL arc

Static charges WILL arc and ignite a gaseous mixture if the interior static charge is exposed to ground.

"The interior charge problem is still evident after gas flow has been cut off, and a defective section of pipe is cut for repairs by using a saw or circular cutter. When a metal object penetrates the inner wall of a charged pipe, a spark discharge is inevitable."

Gas Research Institute report 92-0460
Charge Removal Procedures, pg 1 line 5

The unique problem of distributing gas in PE pipe

It creates its own ignition source

Static Electricity

Here is summary of how GRI says static ignitions actually occur:

If there is an ignition of leaked/leaking gas, in the absence of a known ignition source, given that the passage of natural gas inside a pipe creates static, the most probable cause of the ignition is that static electricity has arced to ground in the presence of a gaseous mixture.

Suppressing static electricity as an ignition source is as important as preventing leaks because of static creation inside PE pipe.

Ignitions not leaks are your enemy!

Static Ignitions

The 5 Most Dangerous Static Ignition Gas Operations

What makes a situation a potential static ignition risk

1. Interior pipe surface static exposed
2. Gaseous mixture
3. Proximity to electrical ground (tool/worker/dirt)

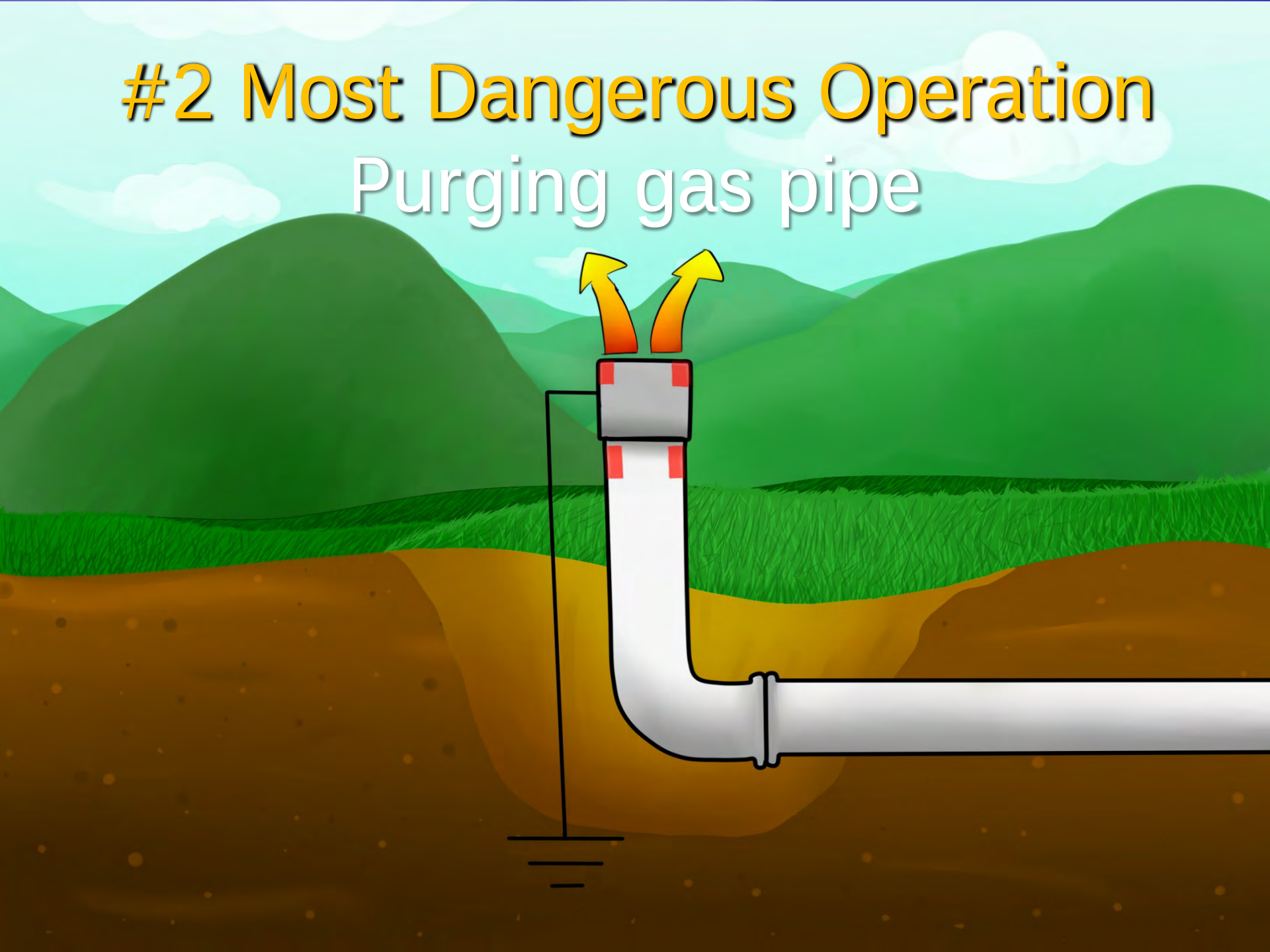
In all these 5 operations you must remember that there is both **exterior static** and **interior static** that must be addressed

#1 Most Dangerous Operation

3rd party damage repairs
or O&M operations

#2 Most Dangerous Operation

Purging gas pipe



#3 Most Dangerous Operation

Plastic pipe squeeze off.

This is a SHOCK danger rather than IGNITION danger

#4 Most Dangerous Operation

Hot taps

#5 Most Dangerous Operation

Plastic pipe previously under pressure removed from service opened up, cut into or reached into.

Evaluating your company's SOPS for static suppression
<u>focusing on eliminating static where research has determined it resides</u>
in these 5 O&M operations will drastically reduce the risk of an unintended ignition.

Won't guarantee you will never have a static ignition – no one can guarantee that.

This will reduce the possibly of a static ignition

1. It is risk based.
2. It is selective.
3. It is cost effective since it directs resources only to the operations your experience has shown a risk exists.

How to evaluate your company's static ignition risk reduction SOPS

1. Management buyin – prevention is cheaper than remediation. (Increased Workers Comp/liability) Alagasco
2. Using the 5 most dangerous as a starting point, add, delete or re-prioritize tasks based upon your operations. (i.e. pig launcher)
3. Make sure the MEANS used to eliminate the identified static risk is EFFECTIVE. ("Bucket Man")
4. Be *RUTHLESS* in your enforcement of the procedures you develop. Consistent and comprehensive.
5. Make procedures easy to use and redundant ("cowboy resistant")

Metal pipe considerations

1. Don’t automatically assume because a pipe is metal there is no static ignition risk.
2. Coatings, corrosion or electrical isolation can allow friction of passing gas to create patches of static on those electrically isolated patches.
3. In those spots all the basics of static apply.
4. Static in metal pipe theoretically can accelerate the depletion of buried anodes.

Feb 10 2011 Hanoverton OH 10:30PM - AP photo used by permission

Electrostatic Leaks

Static creates leaks in PE pipe

Basics of static in PE pipe

1. Static originates inside the pipe.
2. Static charges don't "go away".
3. Mother Nature will seek electrical neutrality.

So what happens when static builds up inside a BURIED PE pipe?

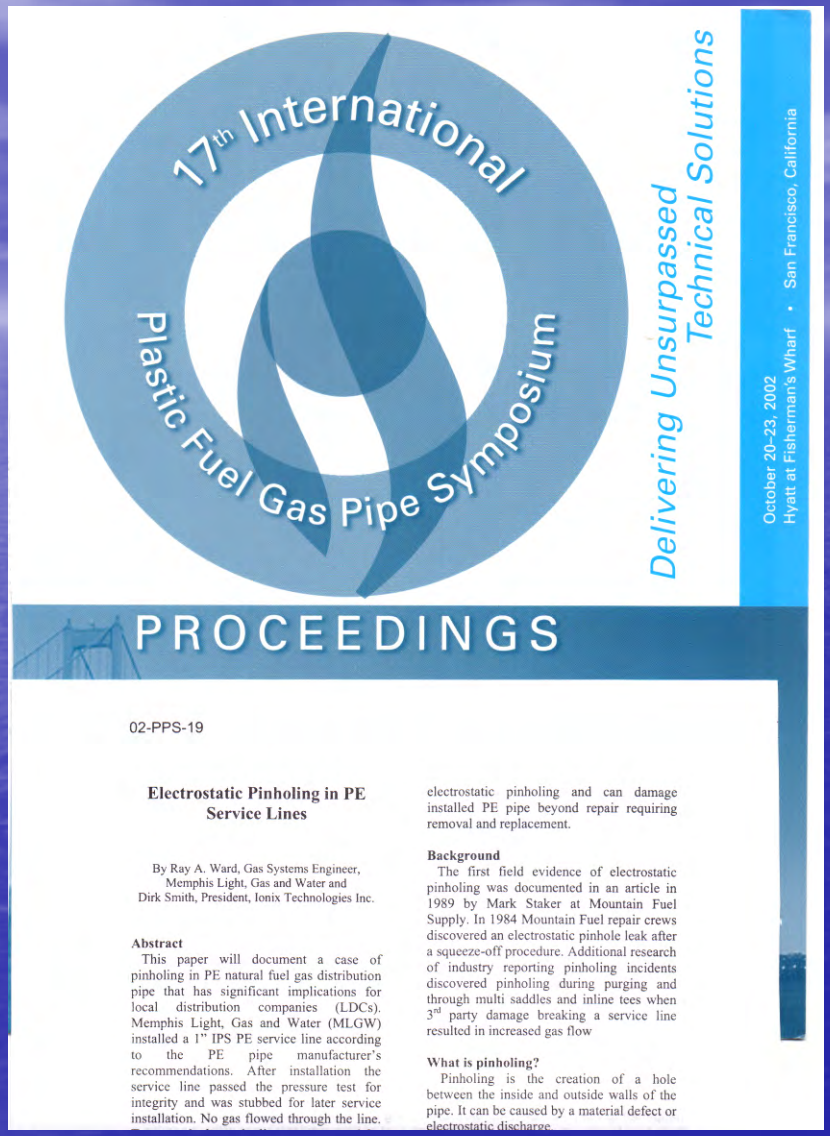
Section view of electrostatic pinhole

What is an electrostatic pinhole?

"The charge conditions across the pipe wall can increase high enough to exceed material breakdown. This breakdown phenomenon produces a small burned hole (about the size of a pinhole) through the pipe wall that can leak minute quantities of gas."

Gas Research Institute report 92-0460

Introduction page 1, 2nd paragraph.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Delivering Unsurpassed Technical Solutions
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PROCEEDINGS
02-PPS-19
Electrostatic Pinholing in PE Service Lines
By Ray A. Ward, Gas Systems Engineer, Memphis Light, Gas and Water and Dirk Smith, President, Ionix Technologies Inc.
Abstract
This paper will document a case of pinholing in PE natural fuel gas distribution pipe that has significant implications for local distribution companies (LDCs). Memphis Light, Gas and Water (MLGW) installed a 1" IPS PE service line according to the PE pipe manufacturer's recommendations. After installation the service line passed the pressure test for integrity and was stubbed for later service installation. No gas flowed through the line.
electrostatic pinholing and can damage installed PE pipe beyond repair requiring removal and replacement.
Background
The first field evidence of electrostatic pinholing was documented in an article in 1989 by Mark Staker at Mountain Fuel Supply. In 1984 Mountain Fuel repair crews discovered an electrostatic pinhole leak after a squeeze-off procedure. Additional research of industry reporting pinholing incidents discovered pinholing during purging and through multi saddles and inline tees when 3rd party damage breaking a service line resulted in increased gas flow
What is pinholing?
Pinholing is the creation of a hole between the inside and outside walls of the pipe. It can be caused by a material defect or electrostatic discharge.

Pinholes can be created during the normal operation of gas distribution

"Even under apparently normal operations when the pipe is not being squeezed, pinholing is observable because of high-turbulent flow conditions occurring near tees, elbows, etc."

Gas Research Institute report 92-0460

Introduction page 1, 2nd paragraph.

Pinholes are not due to pipe manufacturing defects

In all our field experience, when gas companies sent pinholed pipe samples to independent labs to determine the cause of the pinholes in their sample, 100% of the time the lab identified the cause as static and NOT manufacturing defects.

Repeated replacement of pinholed pipe will NOT stop pinholes!

The problem is electrostatic pinholes will accumulate.

Common characteristics of electrostatic pinholes

- Most pinholes occur in 1” or smaller plastic service lines.
- There seems no pattern for number of pinholes in pipe. I've seen 1 hole, 2, 3, 5 holes in pipe.
- Only observed in PE pipe - no PVC yet.
- It is not limited to one pipe brand.
- Pinholes cluster in groups of lines in geographical areas.
- They will continue and increase in number over time.

Since static creating pinholes originates INSIDE the PE pipe:

Pinholes can only be eliminated by system wide INTERIOR static suppression installed upstream of the pinholeing.

If you are repeatedly replacing pinholed pipe in the same areas, you should determine if interior static suppression is a more economical solution than replacing pipe.

Static Mitigation Technologies

External static suppression

- Wet rags (1984)
- Topical antistat (2010)

Internal static suppression

- Ionix Static Suppression Cartridges

Static Mitigation Technologies

External static suppression - grounding

Grounding – wet rags/film

Problem of using wet rags or plastic film to dissipate static on external surfaces

- In order to apply the rags/film to eliminate static, you have to come in contact with the very surfaces you're concerned could ignite from static.
- You can't visually confirm there is a good electrical connection.

Static Mitigation Technologies

External static suppression – topical antistat

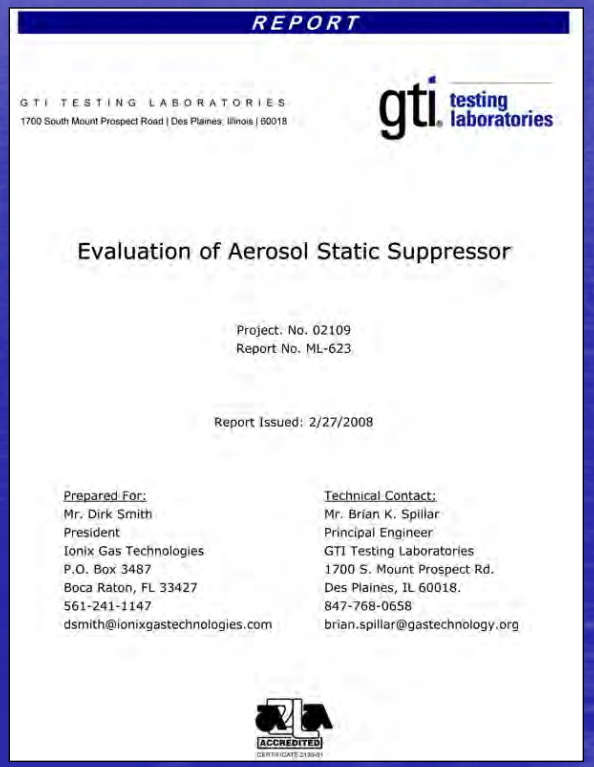
Dissipates static chemically on a molecular level.

Instantaneous – Reliable – Versatile

Overcomes wet rags inherent limitations

IGT Aerosol Lab tested by Gas Technology Institute Testing Lab

- Doesn't affect PE
- Doesn't affect fusing
- Non flammable
- As effective as wet burlap in eliminating static



REPORT

GTI TESTING LABORATORIES
1700 South Mount Prospect Road | Des Plaines, Illinois | 60018

gti testing laboratories

Evaluation of Aerosol Static Suppressor

Project. No. 02109
Report No. ML-623

Report Issued: 2/27/2008

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ACCREDITED

ANY external static mitigation DOES NOT eliminate the internal source of static!

"Prior to this project, standard safety procedures involved wrapping the pipe with wet soapy burlap. This procedure is effective for neutralizing exterior charge accumulation but does not affect the interior charge."
Gas Research Institute report 92-0460
Technical Perspectives page iv, line 7.

Static Mitigation Technologies

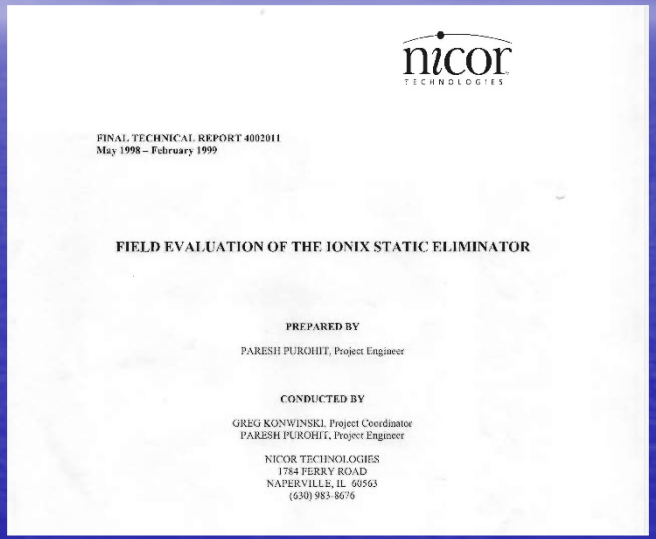
Internal static suppression

Ionix Static Suppression Cartridges

IGT Aerosol Purging Kit for temporary internal static mitigation

Ionix Interior Static suppression Lab tested by NICOR Labs

- Installed in actual system
- Were able to dissipate static in system
- When removed static returned.
- One city saw 90% reduction in PE leaks



nicor TECHNOLOGIES

FINAL TECHNICAL REPORT 4002011
May 1998 – February 1999

FIELD EVALUATION OF THE IONIX STATIC ELIMINATOR

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Final review of main points

- Static is normal in distribution systems.
- Static is an ignition AND integrity issue.
- ***ALL*** static issues can be traced to static originating INSIDE pipe which is caused by the flow of gas through the pipe.
- Current external static suppression procedures will only prevent ignitions caused by *external* static.
- Current external static suppression procedures are ineffective in eliminating ignitions caused by *internal* pipe static.
- Pinholes can only be stopped by internal static suppression.
- To prevent the three threats of static in PE pipe, internal static suppression is necessary.

Main Final Point

"IGNITIONS are your enemy – not LEAKS…"

Suppress the primary ignition source – static electricity – and all you have is a leak.

Leaks do not kill or harm people or property.

Ignitions do.

Final exam

1.Static in gas distribution systems originates _____ the gas pipe.

a. outside b. inside c. Washington DC

2.Exterior static dissipation does _____ to eliminate the source of static inside gas pipes.

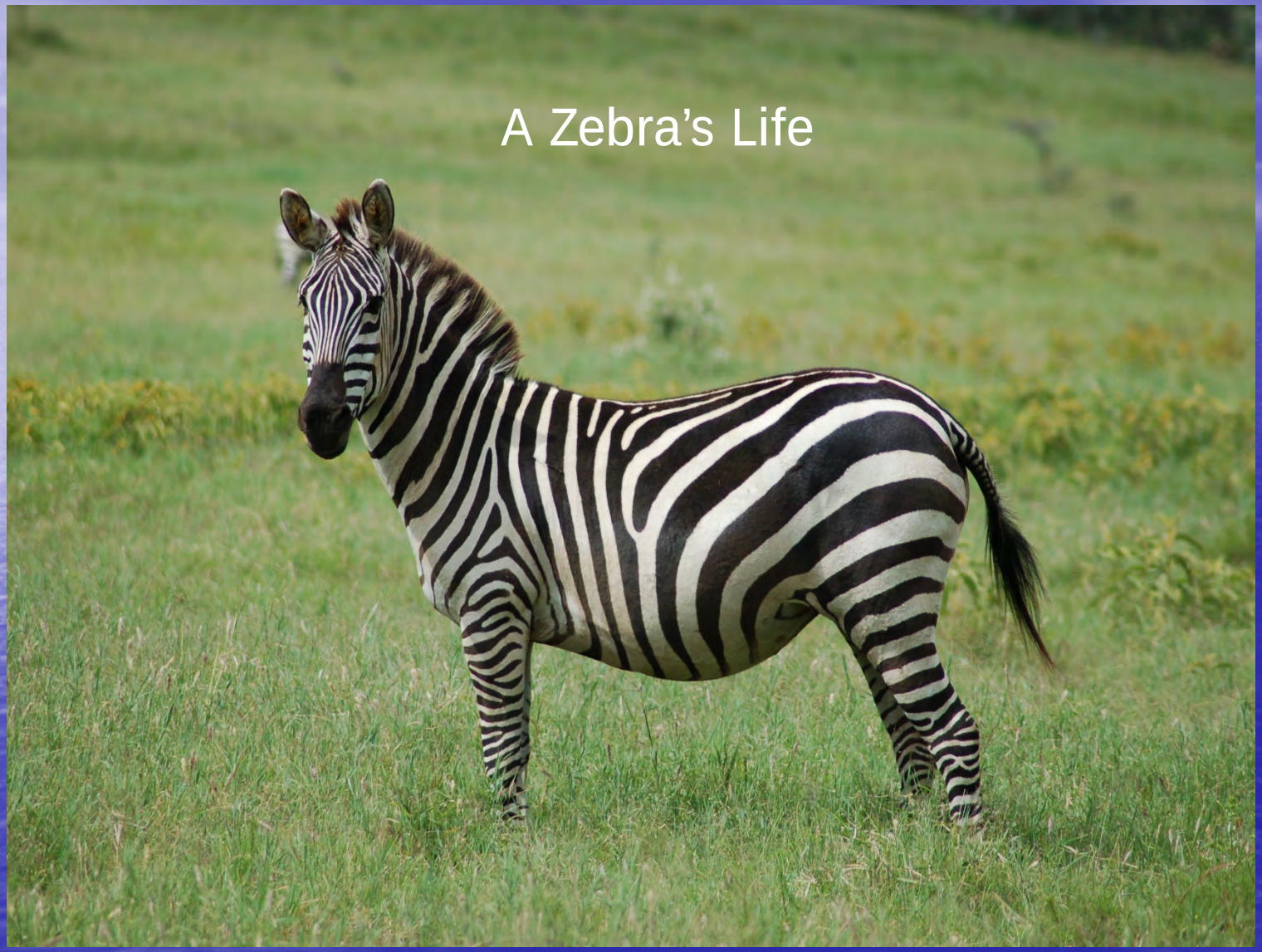
a. everything necessary

b. nothing

3. In the event of a gas ignition, in the absence of an identifiable ignition source, the Gas Research Institute says the probable cause of the ignition is _____ _____ inside the exposed pipe arcing to ground in a gaseous environment.

a. static electricity b. falling debris

A Zebra's Life



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