

Failure Investigations

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Main Purpose of investigations

The **primary purpose** of an accident or failure investigation is to **PREVENT REOCCURRENCE**.

The participation of all parties involved assures a thorough and unbiased investigation. These parties include the operator, regulators, manufactures, and witnesses.

Why do we investigate failures?

Federal code requires operators to perform an investigation on accidents and failures.

§192.617 - Each operator shall establish procedures for analyzing accidents and failures, including the selection of samples of the failed facility or equipment for laboratory examination, where appropriate, for the purpose of determining the causes of the failure and minimizing the possibility of a recurrence.

Why do we investigate failures?

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§192.605(e) - Surveillance, emergency response, and accident investigation. The procedures required by §192.613(a), §192.615, and §192.617 must be included in the manual required by paragraph (a) of this section.

Why do we investigate failures?

Federal code requires operators to perform an investigation after an emergency.

§192.615(a) - Each operator shall establish written procedures to minimize the hazard resulting from a gas pipeline emergency. At a minimum, the procedures must provide for the following:

§192.615(a)(10) - Beginning action under §192.617, if applicable, as soon after the end of the emergency as possible.

WHO MUST CONDUCT A FAILURE INVESTIGATION?

Federal code requires the operator to perform an investigation on accidents and failures.

When the Nebraska State Fire Marshal, Law Enforcement, Fire Departments, Insurance Companies, NTSB, PHMSA performs an investigation, this does not relieve the operator of the burden to complete an investigation.

OTHER AGENCIES POTENTIALLY INVOLVED

- Local Emergency Responders
- Nebraska State Fire Marshal
- PHMSA
- NTSB
- EPA
- Insurance Companies

What is an accident

An accident is defined as:

- An unplanned occurrence that results in a release of oil or natural gas from the pipeline.
- An event occurring by chance or arising from unknown causes
- An unfortunate event resulting from carelessness, unawareness, ignorance, or a combination of causes.

What is A FAILURE

A failure is defined as:

- (1) Omission of occurrence or performance
i.e., – failing to perform duty or expected action
- (2) Inability to perform a normal function
- (3) A falling short or deficiency

So what do we need to investigate?

- Incidents (§191.3)
- Excavation Damages
- Corrosion / Leaks
- Incorrect Operations
- Procedure Failures
- OQ / Training Failures
- THE UNKNOWN

So what do we need to investigate?



Typical operator response to failure?

- Correct Unsafe Condition
- Restore Service
- Document New Installation

...Oh, and maybe determine cause of failure

- Failure investigation is often secondary to the top three goals.

Roles of pipeline operators

- Making safe any actual or potential hazard to life or property (§192.615(a)(7) and Emergency Plan)
- Repair and restore service (Per O&M Procedures)
- Investigate failure or accident to identify root cause
- Create a plan to minimize reoccurrence
- Document the failure or accident, as well as actions taken or to be taken to prevent or minimize reoccurrence
- **AND KEEP DOCUMENTING FOLLOW-UP ACTIONS**

What is an investigation

An investigation is a process to collect and analyze data, determine root cause(s), and to document the facts.

A basic investigation has 4 phases:

- Phase 1 – Preparation
- Phase 2 – Data Collection
- Phase 3 – Analysis
- Phase 4 – Report

Phase 1 - Preparation

- Procedures in place before the need?
- Do you have the required equipment?
 - Personal Safety Equipment
 - Investigation Forms
 - Camera (Memory Cards, Extra Film, Batteries)
 - Notepads, pens, markers
 - Sample / Evidence collection supplies
 - Measuring equipment, scene markers
- Training or other resources?

Phase 2 – Data Collection

- What information (Data) must you collect?

YOU MUST COLLECT ALL THE FACTS!

- How will you preserve or capture the data?
 - How do you take and preserve photos?
 - How do you collect samples for lab testing?
 - How do you handle evidence for preservation?

DO YOUR PROCEDURES COVER THESE ACTIONS?

Phase 2 – Data Collection

Can you answer the **WHO, WHAT, WHEN, WHERE, WHY, and HOW?**

Document only the facts, **NEVER OPINIONS.**

- Don't jump to conclusions
- Allow the evidence to direct the investigation and findings

Use an investigation form to prompt and remind you what to collect (PHMSA Form 11 is a great start)

Phase 2 – Data Collection

- Construct a timeline of the events
- Document surface conditions at point of failure
- Document weather and environmental conditions
 - At Time of Failure
 - 24 hours before and after as available
- Apparent cause of failure

Phase 2 – Data Collection

- Material Make-up
 - Steel, PE, PVC, Copper, Cast Iron, Bare, Coating type, Coating Condition
- Installation Information
 - Date Installed, Pressure Test Records, MAOP, Actual Operating Pressure, Maps, Construction Standards
- Repair and Maintenance History

Phase 2 – Data Collection

- Pressure Testing
 - Pressure test only to the operating pressure at the time of the failure
 - Ensure that the test equipment is calibrated
 - Ensure test is done in accordance with O&M Procedures

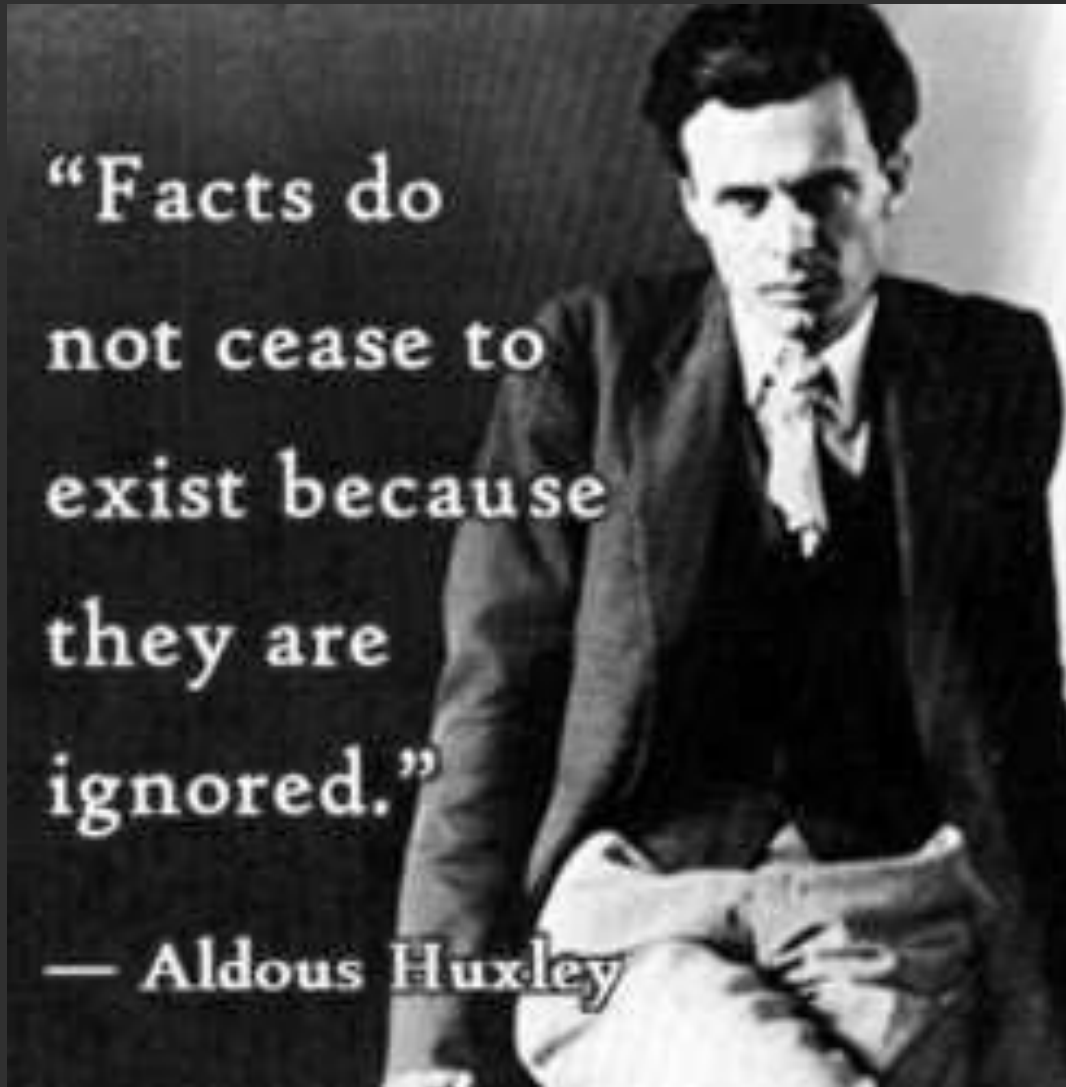
Phase 2 – Data Collection

- Cathodic Protection Records
 - CP History, Current CP Readings, Anodes, Rectifiers
- Samples for laboratory analysis
 - Soil, water, coatings, gas, pipe material, other materials
- Was the facility located above or below ground
- Failure characteristics
- Employee, Contractor/Excavator, and Witness statements

Phase 2 – Data Collection

- Photography
 - Photograph from the outside (MACRO) to the damage (MICRO)
 - Take multiple photographs, from as many angles as possible. Think of a clock as your directions
 - Keep a photo log of each photo taken
 - Take photos during the entire process.

Phase 2 – Data Collection



IF IT'S A FACT,
COLLECT IT AND
DOCUMENT IT!

Phase 3 – Analysis

Once you have collected all the information, its time to analyze the data and determine the cause and effect. This step is crucial before you can determine the root cause, or contributing causes to the failure.

The root, or contributing causes, will be needed later to evaluate actions to be taken to minimize potential reoccurrence.

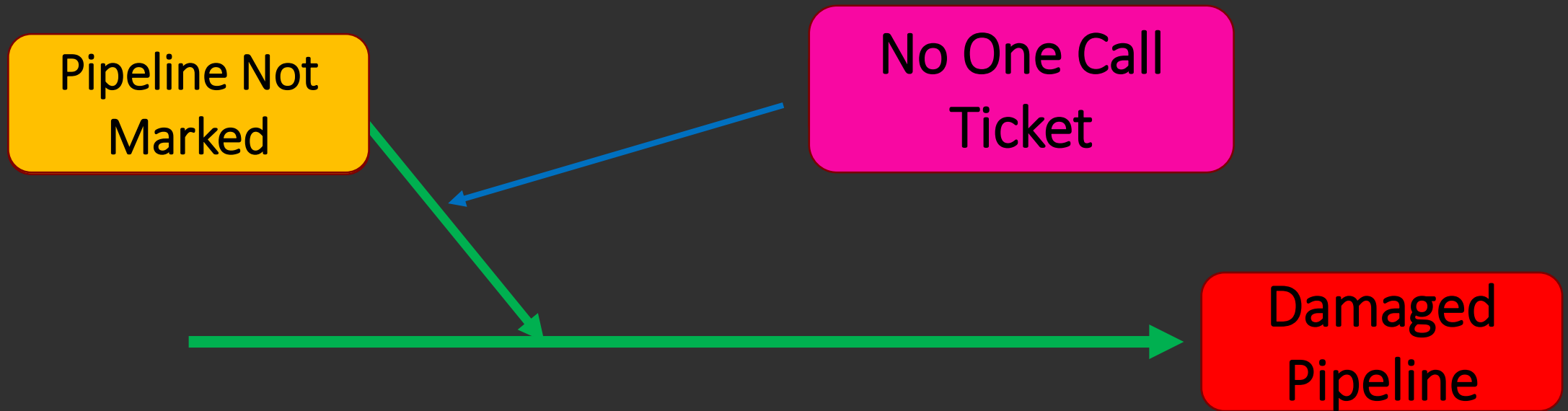
Phase 3 – Analysis

Cause & Effect Analysis

The Cause & Effect diagram should always be utilized during the Problem Identification phase of an investigation to determine all potential root causes.

Phase 3 – Analysis

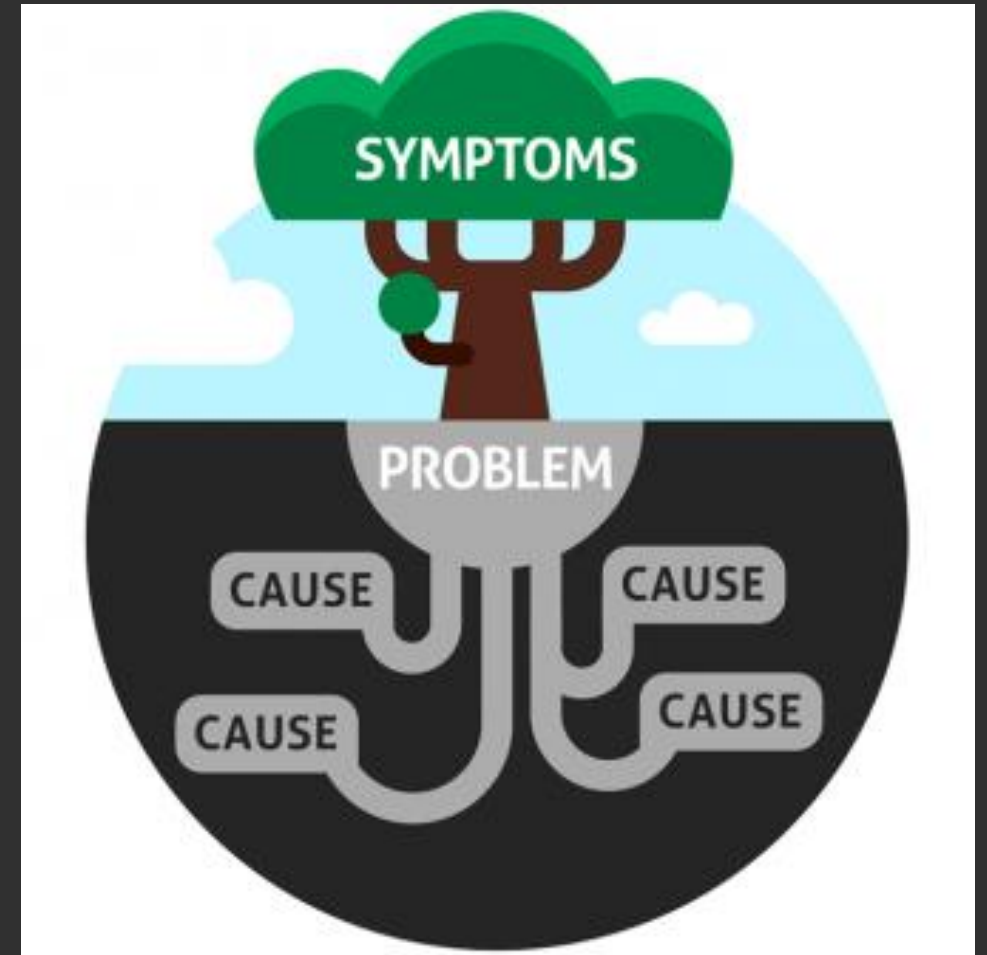
Cause & Effect Analysis (Fishbone Diagram)



Phase 3 – Analysis

Root Cause

The Root Cause(s) are the individual, or combination, of contributing causes of an event that lead to the apparent (obvious) problem.



Phase 3 – Analysis

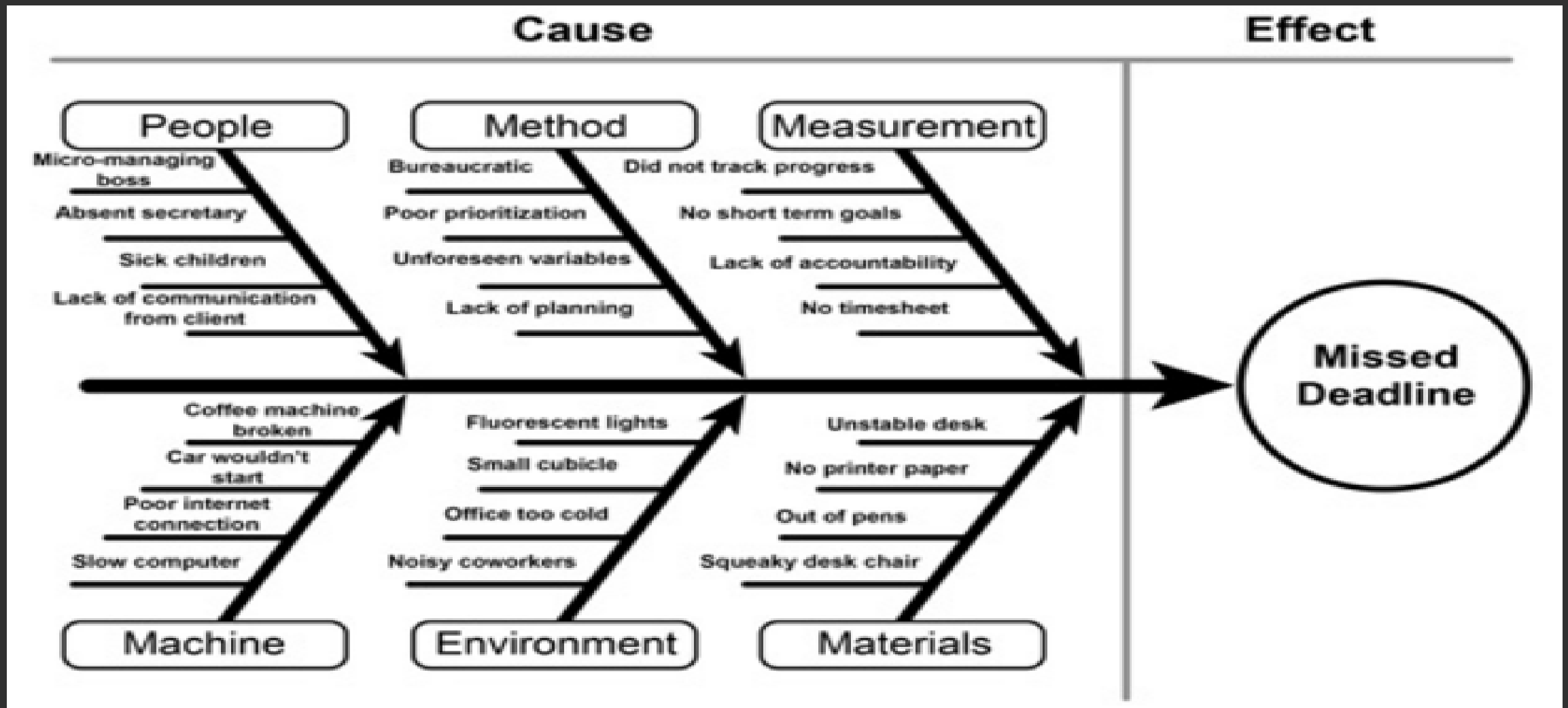
Root Cause are typically categorized under;

Human - Procedures, Mentality, Experience, Training

Machine – Materials, Components, Design, Limits

Environment – Weather, Soil, Workplace

Phase 3 – Analysis



Phase 3 – Analysis

There are many types of root cause analysis programs, training, and tools available to operators:

Conger Elsa – MORT (Management Oversight and Risk Tree)

Apollo – Root Cause Analysis

Taproot – Root Cause Analysis

DIRT – Damage Information Reporting Tool

Phase 3 – Analysis

Another part of the analysis stage, is to develop and initiate a method to minimize the potential for recurrence.

A simple method to test your theory is using the

HAZARD – BARRIER – TARGET Analysis

Phase 3 – Analysis

HAZARD – BARRIER – TARGET Analysis



HAZARD



BARRIER

TARGET

Phase 3 – Analysis

HAZARD: EXCAVATION DAMAGE

TARGET: Underground Pipeline

BARRIERS: 811 One Call Law Continuing Surveillance
Pipeline Markers NSFM – Pipeline Safety
Public Awareness

Phase 4 – REPORTING

After everything we just talked about, now its time to document.

Keep your report factual. Do not include opinions.

Be able to reference your facts to evidence

Do not use jargon

Your report should be understandable by someone that does not work in the pipeline industry.

Phase 4 – REPORTING

Attachments to include:

- Timelines
- Scene Diagrams or Maps
- Pictures and Picture Log
- Laboratory Reports
- Witness Statements
- Documents referenced in your report
- Chain of custody for evidence

If its not reported or documented, **IT NEVER HAPPENED!**

Failure Investigations

Anyone can look at a failure and provide a guess as to what happened. Training and experience is necessary for any good investigator to determine the root cause as to WHY and HOW a failure occurred. Without the factual WHY and HOW, developing a plan to minimize or prevent reoccurrence will fail.

This course provides the very first building blocks. Its up to you and your company to build on your investigation procedures and training.

Failure Investigations

QUESTIONS, COMMENTS,
CONCERNS?