



Underground Natural Gas Storage

**A Pragmatic Approach to PHMSA's IFR and
Risk Assessment**

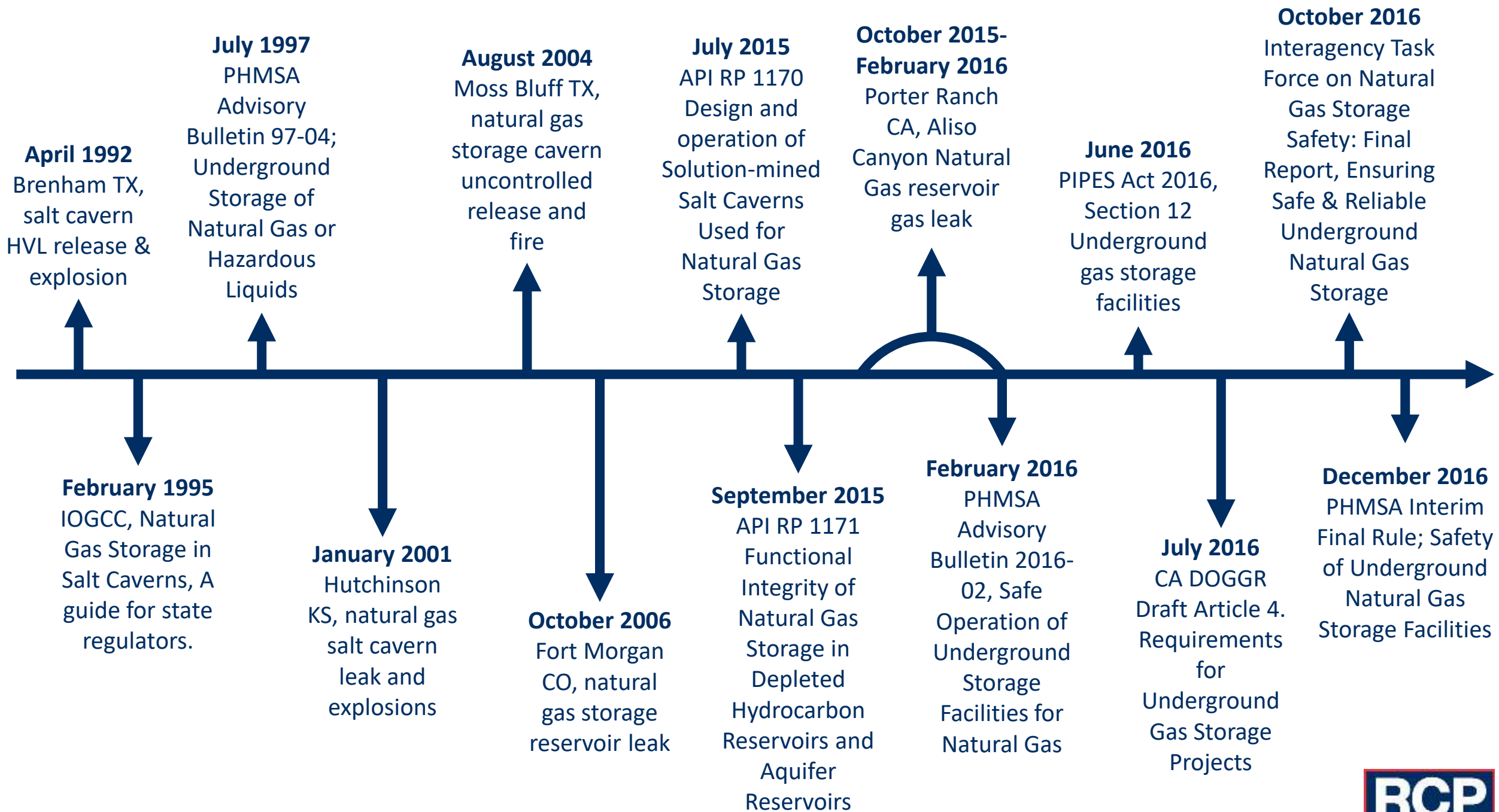
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Overview

1. Historical Perspective of Storage Incidents
2. New PHMSA IFR Requirements
3. Risk Analysis Potential Pit Falls
4. Building Blocks For Compliance With IFR
 - Gap Analysis
 - Process Development and Improvement
 - Risk Analysis
 - Integrity Assessment/Tracking
 - Remediation



Potential Pitfalls

1. Can't See the Forest For The Trees Syndrome -

- you might not realize that a branch of separate trees go together to make a forest

2. Draining the Swamp Syndrome –

- drain the swamp means to exterminate something that is harmful (in this case risk)

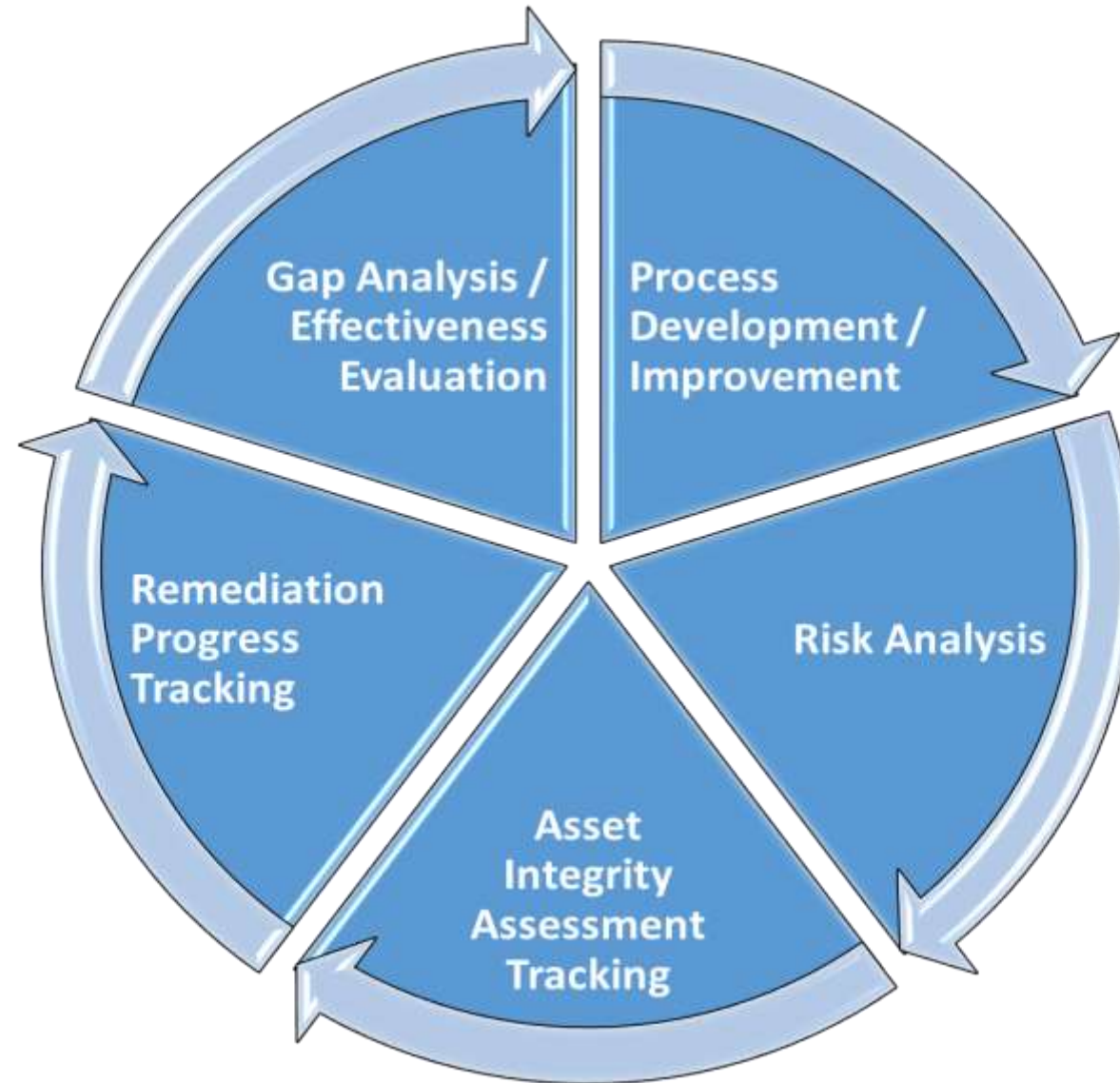
3. Trust But Verify Syndrome –

- extensive verification procedures that would enable both sides to monitor compliance with the treaty

Building a Risk Model – What's the Objective?

1. Types of Models
2. Critical Issues and Drivers
3. How much do we know and how well do we know it?
4. Feeding the beast

PHMSA IFR – Building Blocks for Compliance



Gap Analysis

1. Standards or Procedures

- Shall – (125)
- Should – (250+)
- May – (50+)

2. Storage Integrity Plan

- Overarching Plan – focus on “how to”

3. Risk Management Plan

- Describes how you will assess and manage risk

Process Development and Improvement

- Storage Risk Management Plan
- Site-Specific Operations & Integrity Standards



Risk Model Category Elements

1. Wells (subsurface)

- Challenging to Assess Integrity but well Developed Technology is Available

2. Reservoir (facility)

- Most Challenging to Assess Integrity but Combination of Technology and Industry Accepted Methods

3. Surface (Wellhead and near wellhead piping)

- Relatively easy to assess – can see, touch, and measure directly

Threats and Consequences

1. Threats

- Grouped According to Elements listed in Table 1 of API 1171
- Include concerns which can be assessed with existing methods, tools, and technology
- Site-specific issues

2. Consequences

- Comprehensive list outlined in API 1171
- Challenge is how to characterize continuum of outcomes

3. Threats and Consequences

- Should be weighted to differentiate potential impacts

Output Yields a Risk Score

1. Relative Ranking

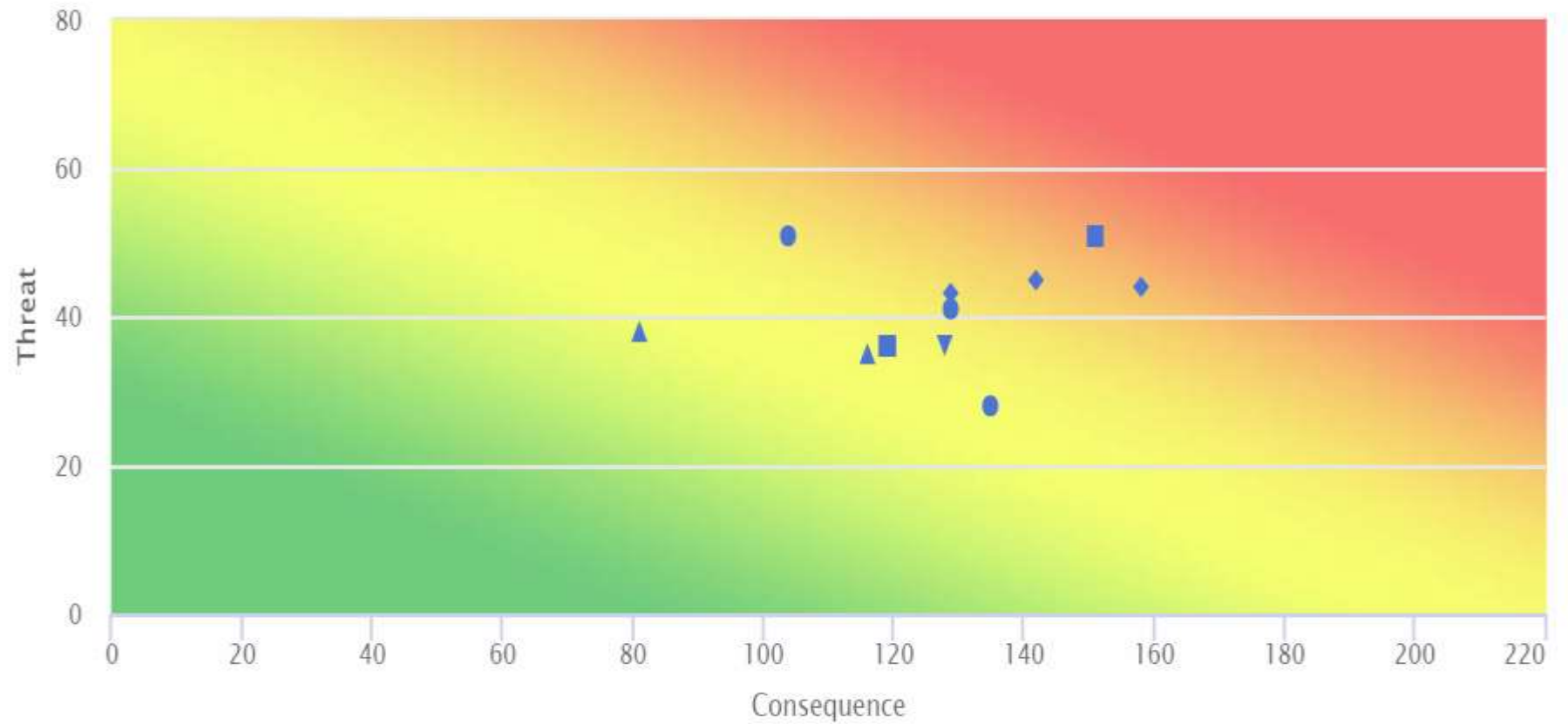
- Allows Prioritization of P&M Measures
- Wells – Well Specific
- Reservoir – Facility Basis
- Surface – Well Specific

2. Consequences

- Comprehensive list outlined in API 1171
 - Challenge is how to characterize continuum of outcomes

Graphical Output

Risk Matrix



- Well 1
- Well 2
- Well 3
- Well 4
- Well 5
- Well 6
- Well 7
- Well 8
- Well 9
- Well 10
- Well 11
- Well 12

Integrity Assessment and Tracking

1. 3-8 Years to Complete Process

- Baseline Assessments – Size Dependent
- Existing Baseline Assessments May be Used*
- Periodic Review and Update of Risk Assessment
- Ongoing Review of Standards

2. Plan will likely Evolve

- New Information will alter initial priorities

Remediation Progress Tracking

1. 3-8 Years to Complete Process

- Baseline Assessments – Size Dependent
- Existing Baseline Assessments May be Used*
- Periodic Review and Update of Risk Assessment
- Ongoing Review of Standards

2. Auditable Process

- Close Out of Remediation Efforts
- Record Keeping
- Training



Questions?

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