CMBG
2009

Failure Analysis & Fitness-for-Service - Impact to CM

Paul Bruck
(pbruck@luciuspitkin.com)
Tom Esselman
(tesselman@luciuspitkin.com)

Lucius Pitkin, Inc. (LPI)

July 1, 2009

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Configuration Management and Margin Management

- CM includes determining, controlling, and managing margins.
- Margins are used to define the region between where you operate and where a component or structure will “fail to operate”.

INPO's Approach to Margin

(from: "Margin Management", INPO presentation at 2008 CMBG)

- Encourages more systematic consideration
- Looks for margin contributors to performance
- Promotes identification and resolution of "latent problems"
- Promotes site-wide approach to MM

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Failure of a Component or Structure

- When a failure occurs, any margin that you thought was there is gone.
- This is a failure of engineering, operations, maintenance, etc. and also a failure of CM.
- The margin has been consumed allowing an unacceptable event to occur.

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How to Respond to a Failure?

- Three activities need to be followed in sequence:
  - Define the mechanism of failure.
  - Define the conditions that contributed to the failure.
  - Define the events or activities (Root Cause) that caused or allowed the conditions to exist.

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Mechanism of Failure

- The mechanism of failure is the metallurgical, mechanical, chemical or thermal cause of the failure.
- This is the mechanism, not the conditions that caused the mechanism.
- Examples are fatigue, corrosion, embrittlement, or some other related mechanism.

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Contributors to the Failure

- The contributors to the failure are the “stressors”.
- These are the high loads, the corrosive environment, the cycling load, the high temperature, the thinned wall, etc. that provided the basis for the mechanism of failure to occur.

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The "Root Cause"

- This is what allowed the stressors to exist.
- Examples are design, maintenance, operation, training, testing, or other event or activity.
- This has to include "Configuration Management."
- What happened to the margin?" What did we do (or not do) that allowed this to occur? Why didn't we recognize the degraded margin earlier?

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Understanding the Margin Can Help Avoid Failures

- Understand the operating envelope relative to the design boundary or component failure limit.
- CM contributes to understanding these envelopes and boundaries.
- Plant programs and fitness-for-service assessments can establish or re-affirm these boundaries.

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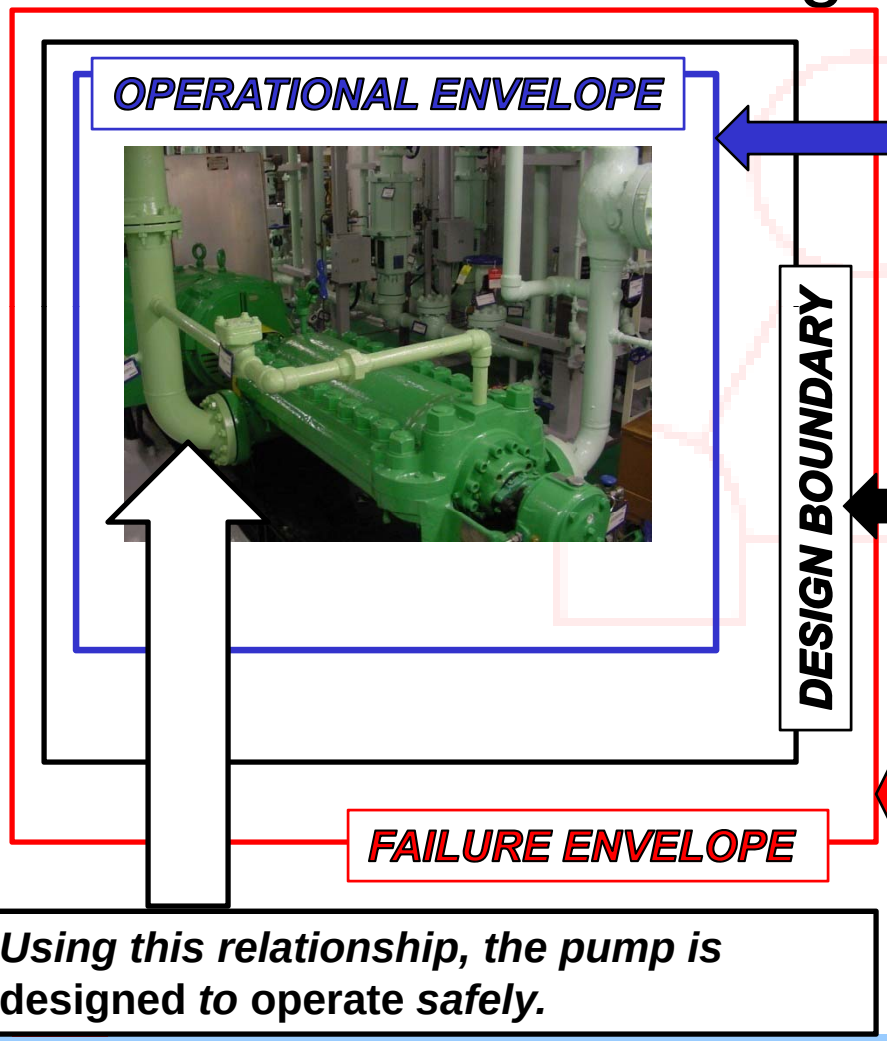
Establishment of a Component Protection Boundary

- Consider the design of a pump:



Operational Envelop

- Based on required pump performance: *Pump Head, Flow Capacity, Operating Duty, etc*

Design Boundary

- Established by Design Codes & Standards: *Provides Established limits to operate component*

Failure Envelop

- Limit at which component fails: *Material Failure, Performance Failure, etc*

Using this relationship, the pump is* designed *to* operate *safely.

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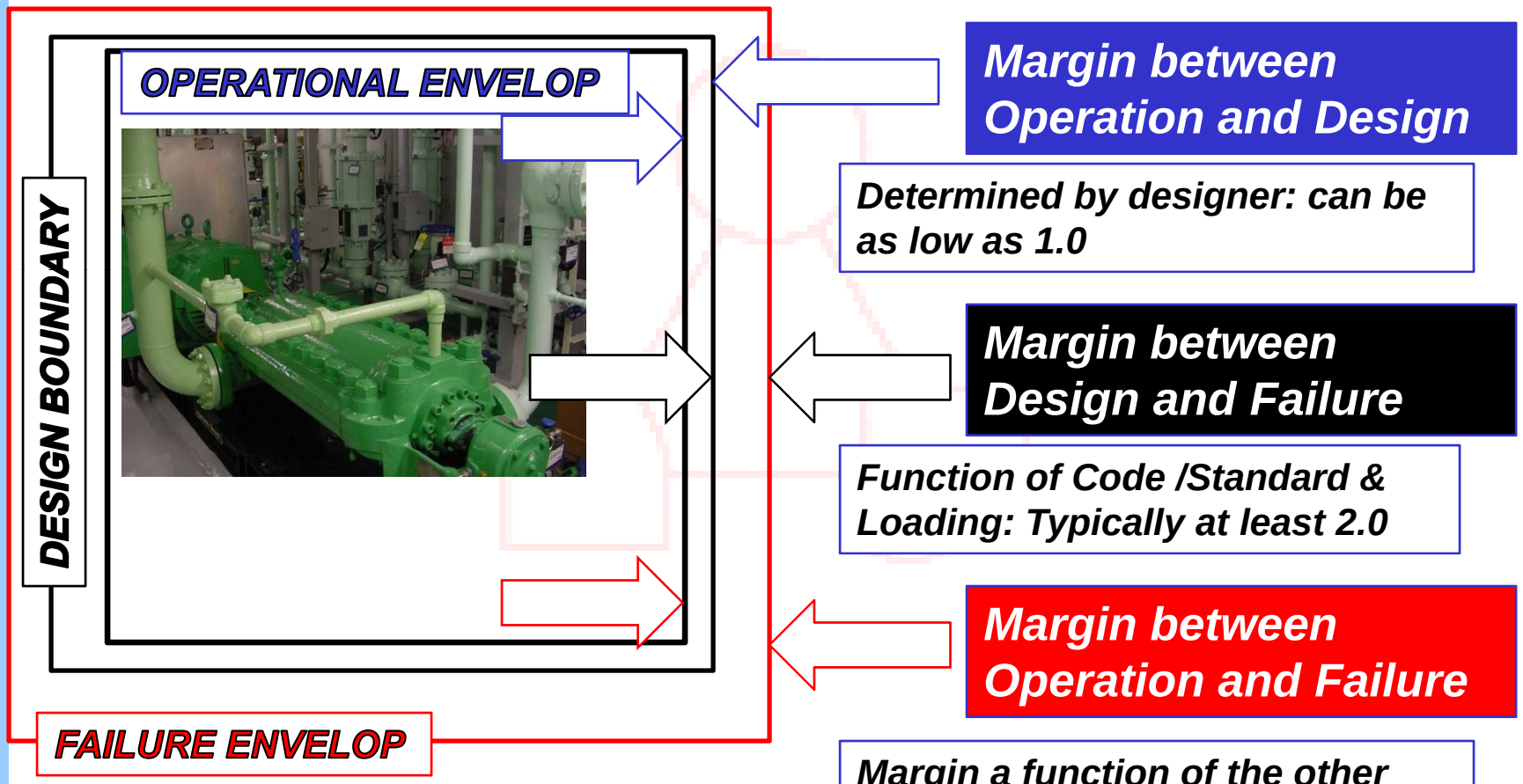
The Boundaries Result in Determination of Margin



Over Time These Margins May Change

- The Operational Envelope may stretch due to increased performance requirements, power up-rate, etc.
- The Design Basis generally remains static, however some SSC design bases are “cloudy” when evaluated 20 to 30 years later.
- The Failure Envelope tends to shrink: aging, corrosion, maintenance, external events, etc.

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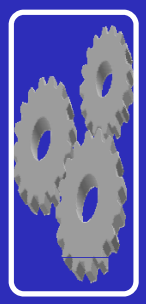
Consider a Recent Event Example of an Air Bound Pump

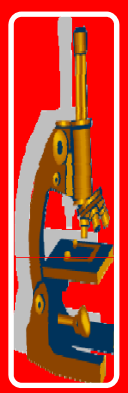


Operational Envelop

- Piping Subject to air pockets

Design Boundary

- Remains per Design

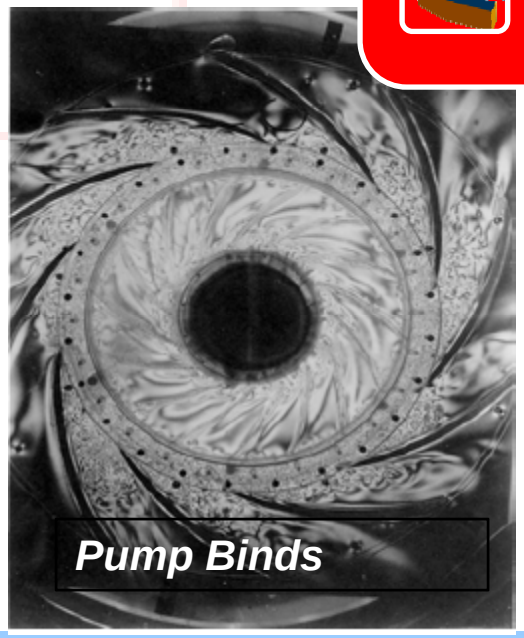


Failure Envelop

- Remains Constant – pump designed to operate with mininimal air in flow

Stretching Operational Envelope

Conditions result in an Event



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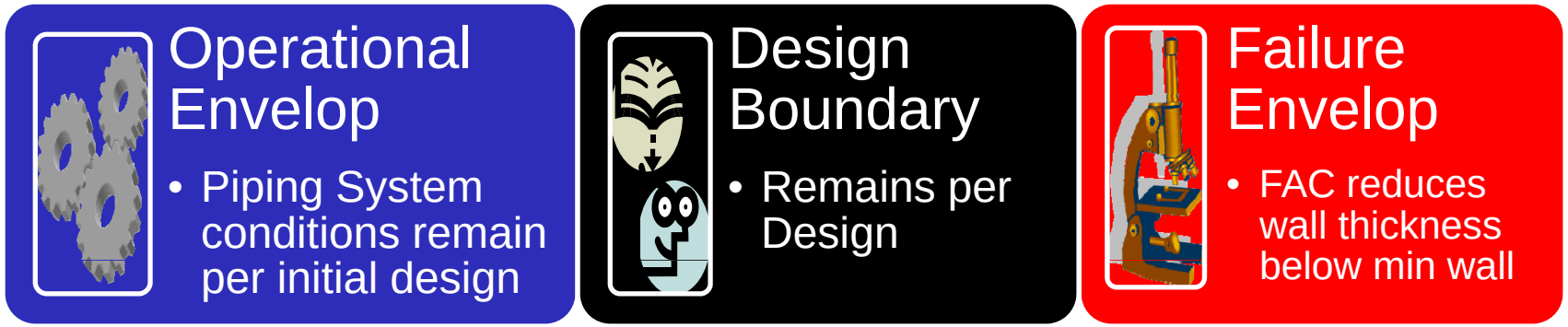
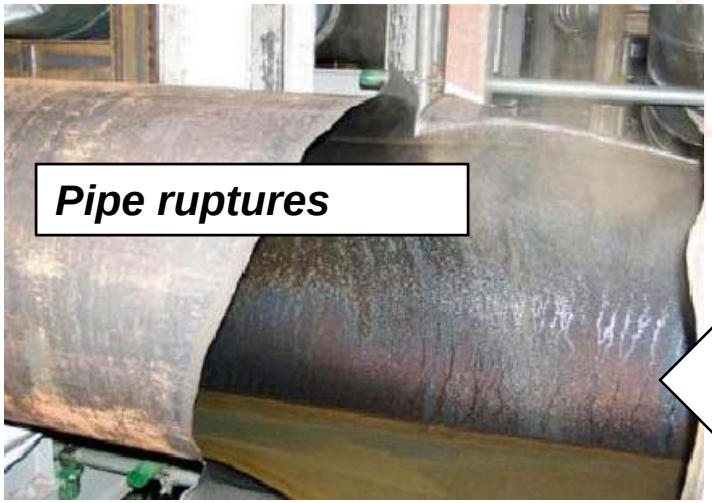
Consider a Recent Event Example of an FAC Pipe Rupture





Conditions result in an Event

Effectively Reduces Failure Envelop

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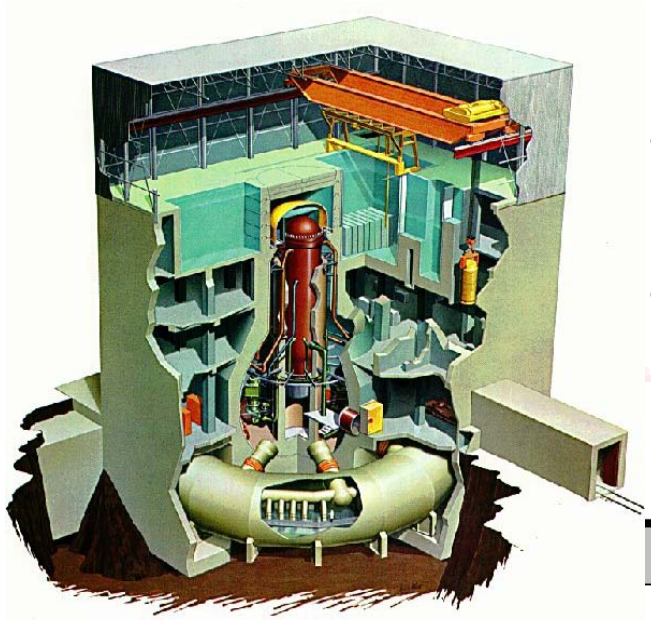
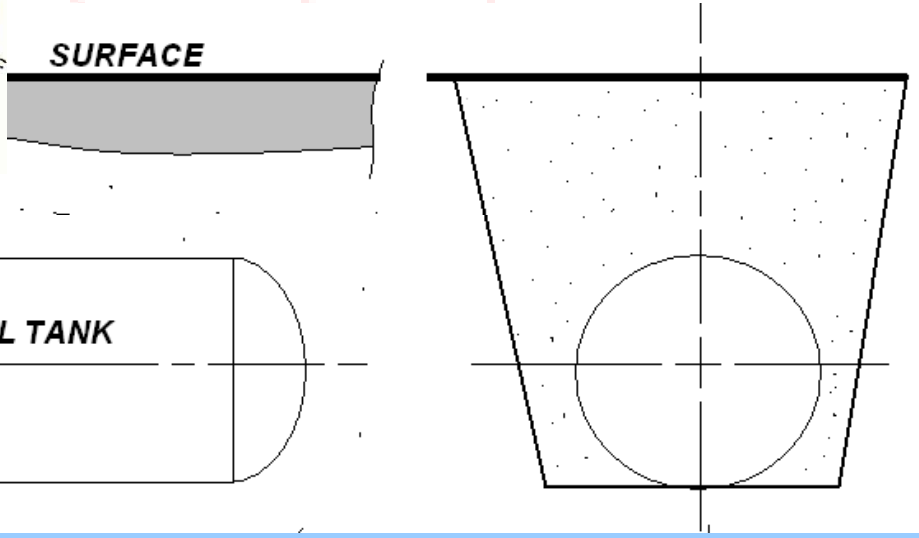
Consider Establishment of More Specifity for Component CM



- **Nuclear Plant undergoing life extension**
- **Buried Commodity – oil tank**
- ***QUESTION: is it O.K. for another 20 years?***



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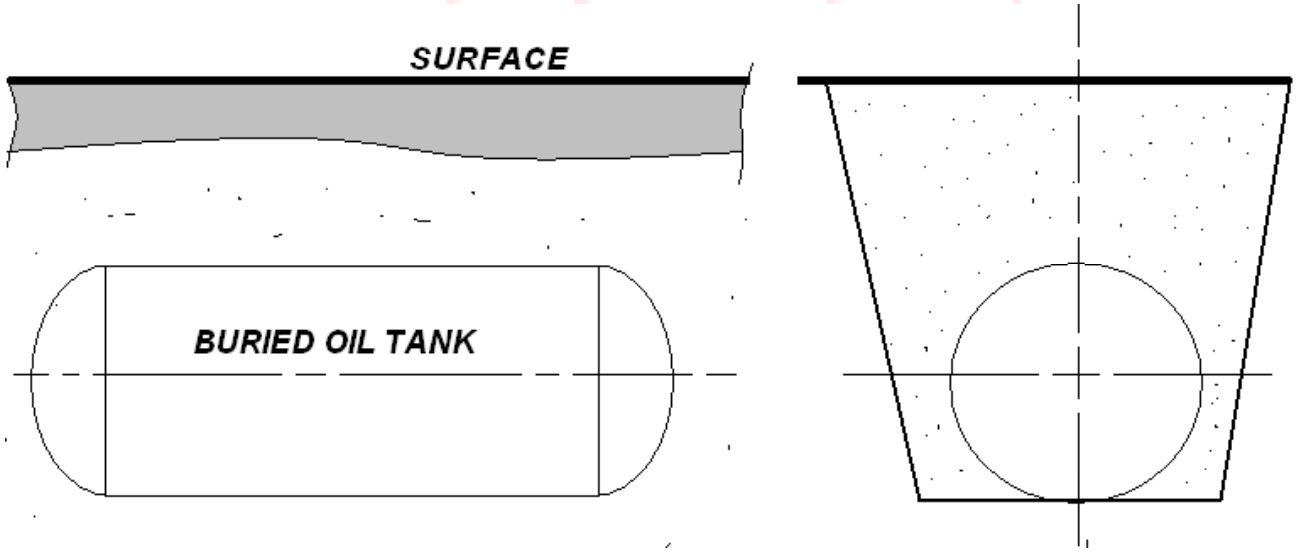
What is the Design Requirement?

- Tank installed 40 years ago
- Configuration Management Basis:
  - Tank drawing provides configuration, wall thickness, and material
- Tank identified in FSAR
  – important to safety FO for DG's



Fitness-for-Service

- **Is it Fit-for-Service?**
  – *Today, 20 years from now?*
- ***Is it corroding? How much corrosion is acceptable?***
- ***What was original Code?***
  – *What were the original loads that were considered.*
- ***How might it fail?***
  - *Chronic undetectable leak*
    – *contamination issue*
  - *Acute rupture (overload, external event)*
    - *loss of function*

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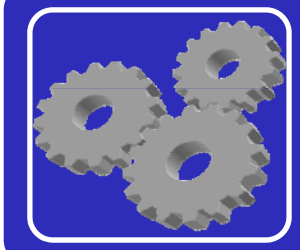
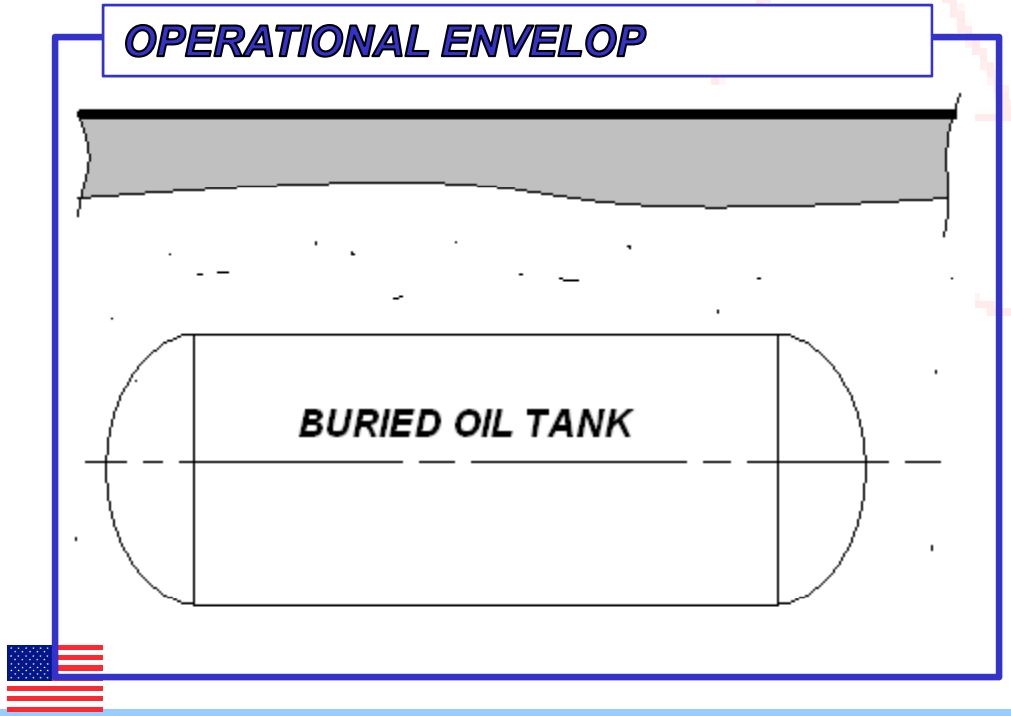
Operational Requirement Established



Operational Envelop

- Tank Operating Requirements Identified:
  - *Internal Pressure, Overburden, Seismic, Live-load at ground*



Original "Design requirements" are "cloudy"

Re-affirmed Operational Envelop becomes the DESIGN and is controlled through CM

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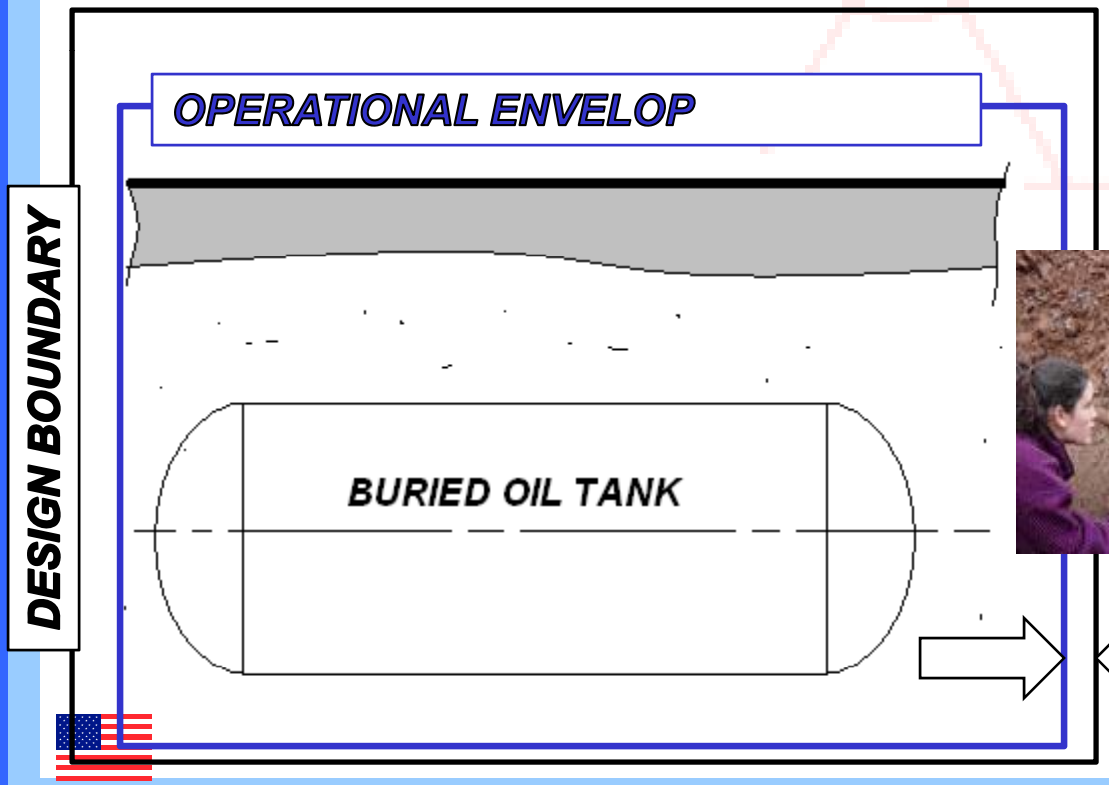
Operational Requirement Established

Design Boundary

- Established by Design Codes & Standards: *Provides Established limits to Operate Tank*

This is t-min

Once t-min established the tank can be inspected to determine t-actual



& Available margin

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Understanding of Component CM Relative to Margin

- Can help reduce the likelihood of component failures.
- Can be re-established through fitness-for-service programs.
- Is important throughout the life of the component.

What are "Key Elements" for Margin Management?

- Understand concepts of margin
- Identify margin concerns
- Evaluate potential changes in margin
- Prioritize margin issues
- Resolve selected margin issues
- Define roles and responsibilities
- Periodically assess and communicate.

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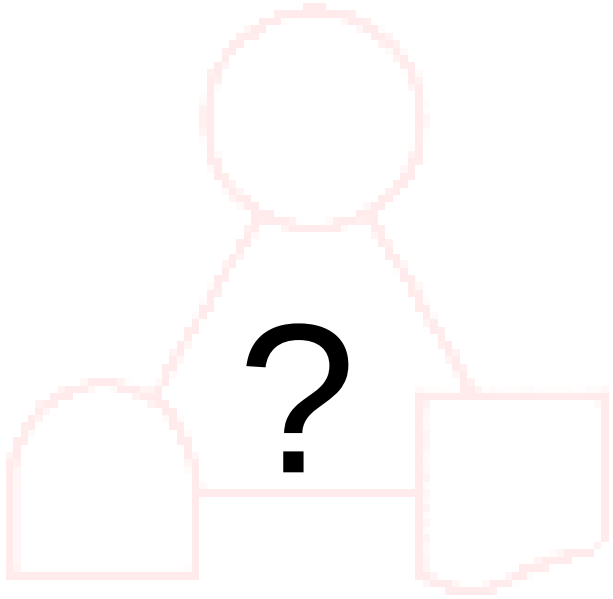
Questions



About LPI (Lucius Pitkin, Inc.)

Fitness-For-Service
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