Roadmap to Greater Capacity

# Moving from Today's Designs to Higher Pressures

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Roadmap to Greater Capacity

# Moving from Today's Designs to Higher Pressures

## Benefits

- Maximum Allowable Operating Pressure (MAOP) increases for new and existing pipelines provides
  - Increased volume or throughput
  - Increase fuel savings through more efficient transportation of product
  - Increased line pack
  - Peak-day excursion in pressure and volume to keep markets on-line during extreme product demand

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# Moving from Today's Designs to Higher Pressures

## Premise

- Options exist for maintaining current safety factors while employing alternatives to design, construction, operation and maintenance
  - Greater test levels or more rigorous design
- Options exist for decreasing safety factors while employing better controls and more rigorous specifications
  - Greater test levels and more integrity assessments
- Any changes will require understanding and utilization of life cycle management

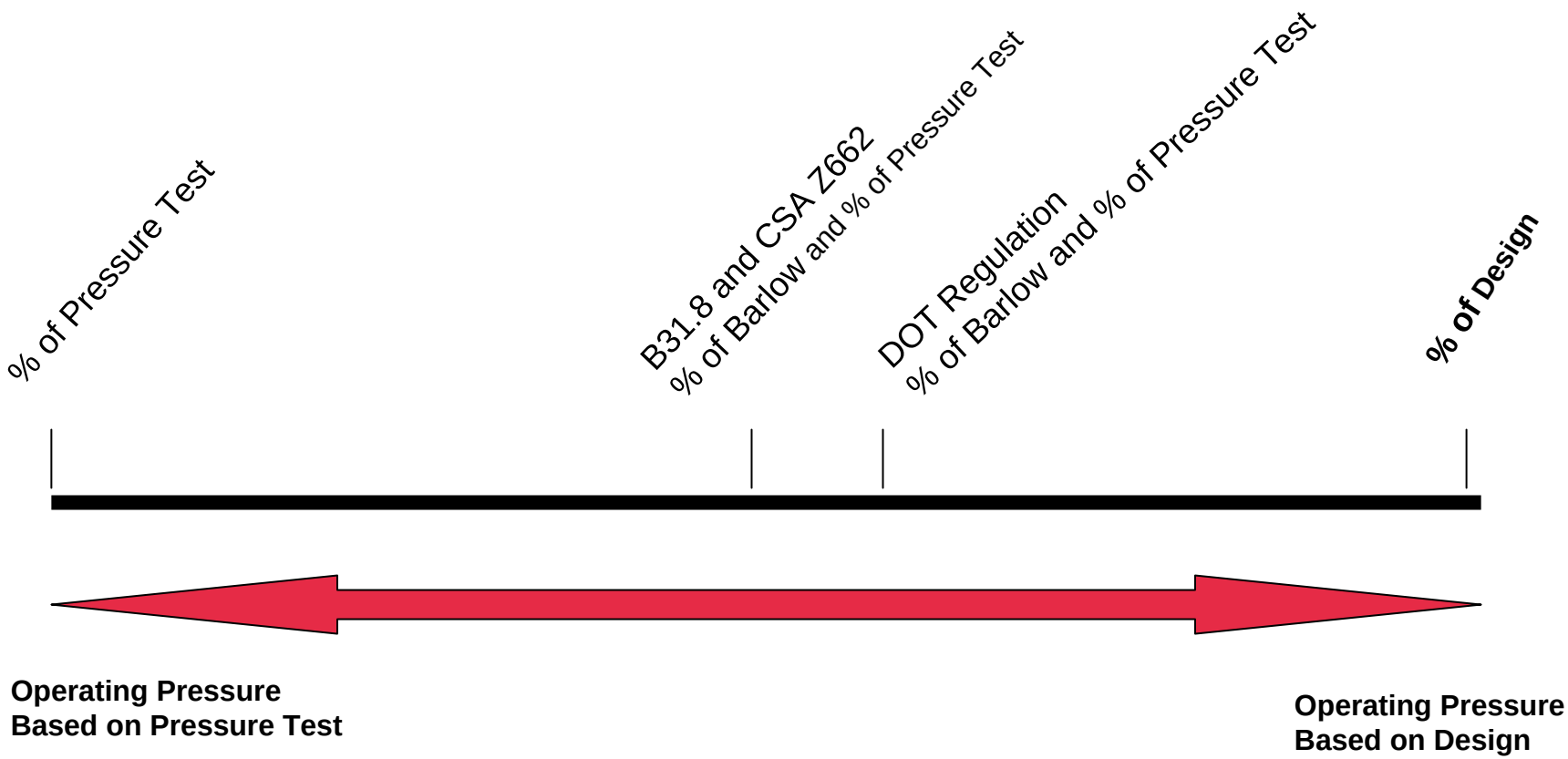
Roadmap to Greater Capacity

# Moving from Today's Designs to Higher Pressures

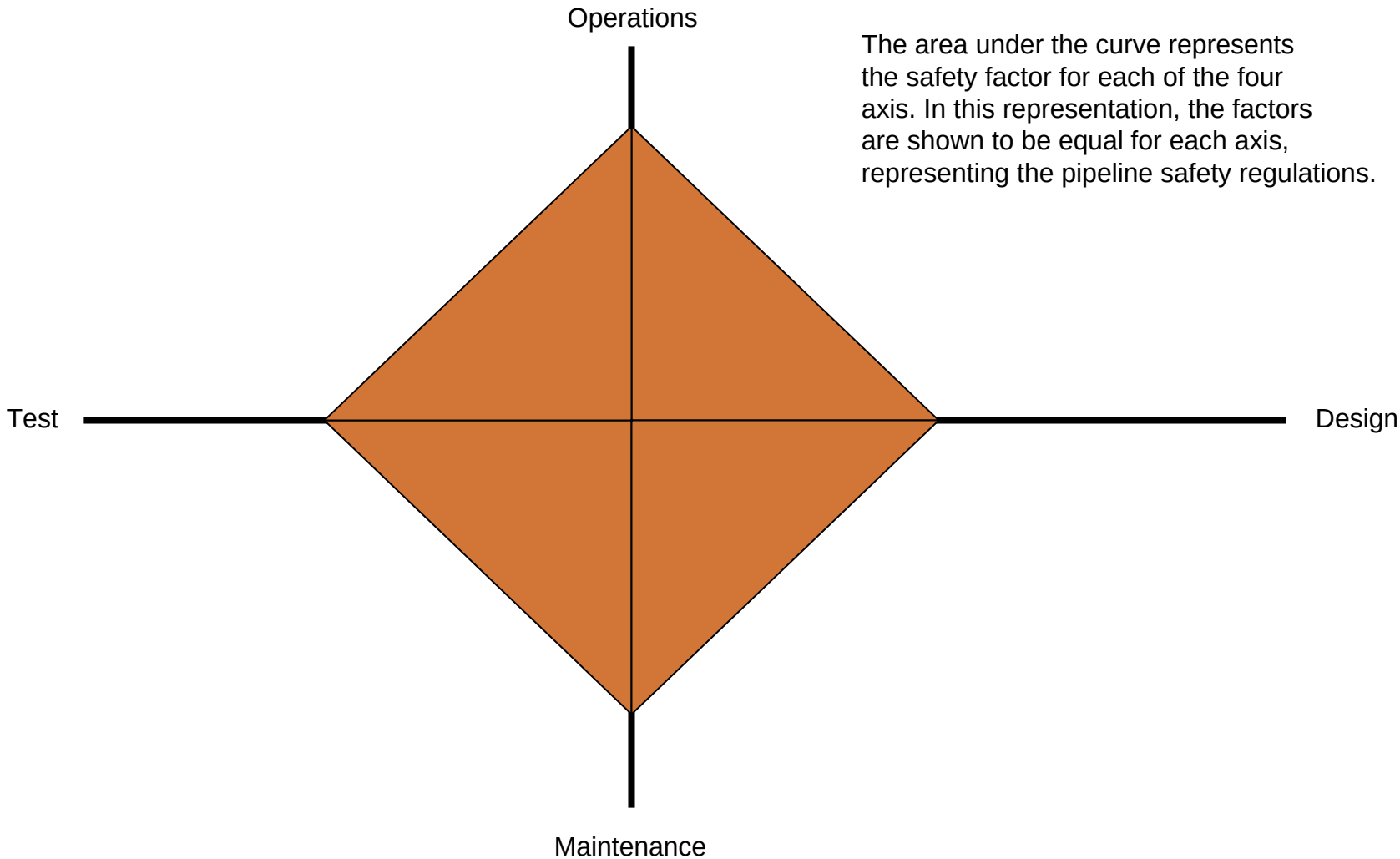
## Conclusions

- Certain codes and standards allow for operation above 72% SMYS
- Concept applicable to all class location areas
- Application in U.S. is limited by Pipeline Safety Regulations
- Standards for pipe and rated components presently set limitations
- Life cycle management will most likely need to be developed to take advantage of operation at higher pressures
- There does not appear to be any technical hurdles for full employment of life cycle management

# Maximum Allowable Operating Pressure Continuum

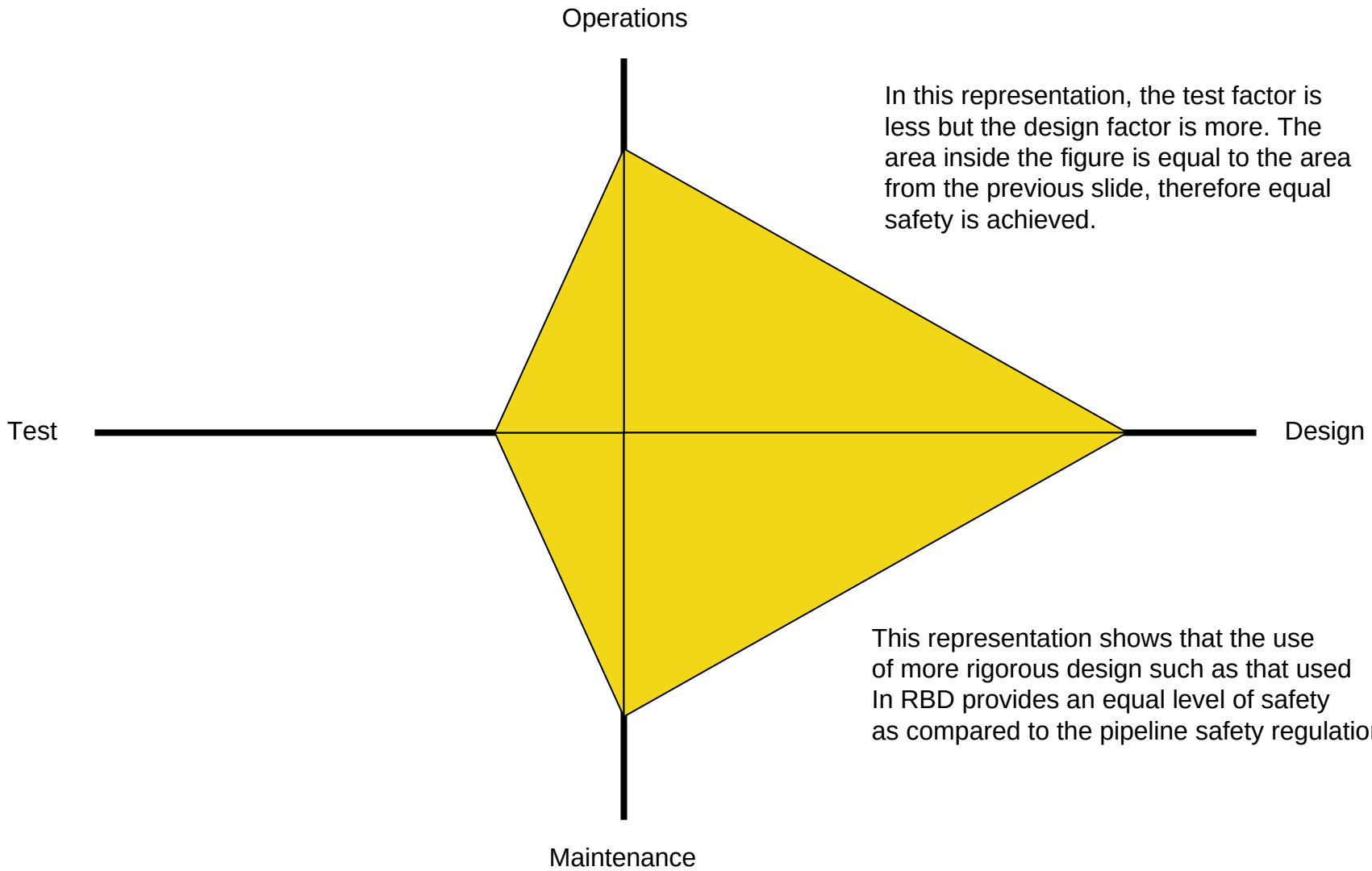


# Safety Factor for Current Scenario




The area under the curve represents the safety factor for each of the four axis. In this representation, the factors are shown to be equal for each axis, representing the pipeline safety regulations.

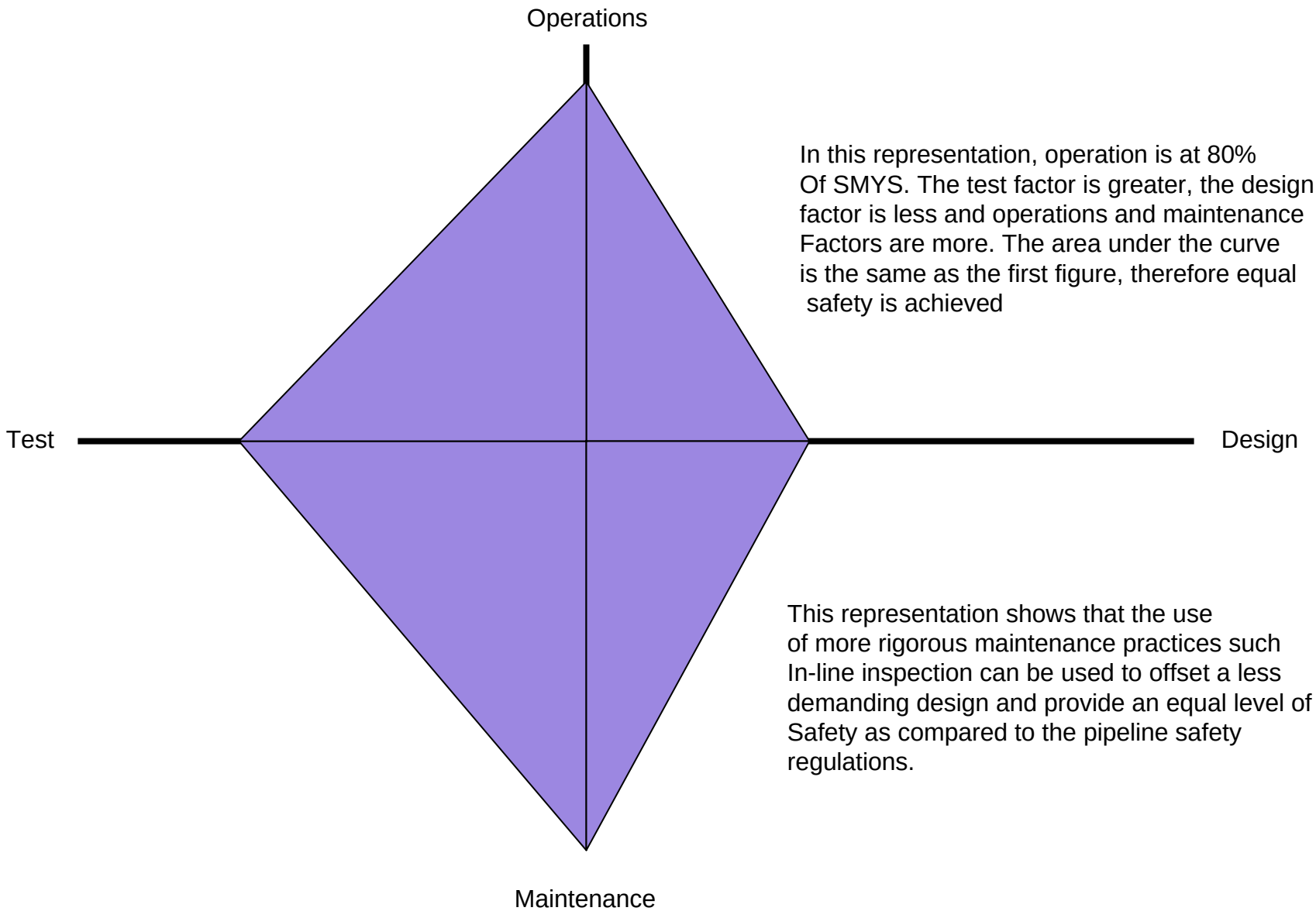
# Safety Factor for Alternate Design




In this representation, the test factor is less but the design factor is more. The area inside the figure is equal to the area from the previous slide, therefore equal safety is achieved.

This representation shows that the use of more rigorous design such as that used In RBD provides an equal level of safety as compared to the pipeline safety regulations

# Safety Factor for Alternate Integrity Management




In this representation, operation is at 80% Of SMYS. The test factor is greater, the design factor is less and operations and maintenance Factors are more. The area under the curve is the same as the first figure, therefore equal safety is achieved

This representation shows that the use of more rigorous maintenance practices such In-line inspection can be used to offset a less demanding design and provide an equal level of Safety as compared to the pipeline safety regulations.

# Solutions for Differing Scenarios

- The 4% solution shows modest increases in operating pressures limited by vintage pipeline history and past performance as verified through design and construction review and operation and maintenance practices
- The 11% solution shows greater increases in operating pressures limited by specific requirements in all phases of life cycle management

***Changes to consensus codes and standards may be required to fully implement programs for specific facilities***

# Example: Alternate Pressure Operation at 4%

| The 4% Solution | | | | |
|---|---|---|---|---|
| **System** | **Pressure** | **Present** | **Future** | **Comments** |
| **Mainline Piping** | **MAOP** | 72% | 75% | Justification is Through an Integrity Assessment |
| | **OPP** | 75% | 78% | |
| **Compressor Piping** | **MAOP** | 50% | 52% | Justification is based on not using the thin wall |
| | **OPP** | 55% | 55% | approximation for hoop stress |
| **Vessels** | **MAOP** | 45% | 47% | Limitation in present case based on OPP not |
| | **OPP** | 50% | 50% | MAOP |
| **Compressors** | **MAOP** | 50% | 52% | Requires review of operating parameters for each |
| | **OPP** | 55% | 55% | compressor unit |
| In this scenario, raising the operating pressure by 3% of the SMYS results in a pressure increase of 4%. | | | | |
| The 4% pressure increase will result in a corresponding volume increase of approximately 4% | | | | |

# Example: Alternate Pressure Operation at 11%

| The 11% Solution | | | | |
|---|---|---|---|---|
| **System** | **Pressure** | **Present** | **Future** | **Comments** |
| **Mainline Piping** | **MAOP** | 72% | 80% | Justification is Through an Integrity Assessment |
| | **OPP** | 75% | 83% | |
| **Compressor Piping** | **MAOP** | 50% | 55% | Justification is based on not using the thin wall |
| | **OPP** | 55% | 57% | approximation and load analysis and minimizatio |
| **Vessels** | **MAOP** | 45% | 50% | Limitation in present case based on OPP and on |
| | **OPP** | 50% | 54% | vessel dsign, requires analysis. |
| **Compressors** | **MAOP** | 50% | 55% | Requires review of operating parameters for each |
| | **OPP** | 55% | 57% | compressor unit |
| In this scenario, raising the operating pressure by 10% of the SMYS results in a pressure increase of 11%. | | | | |
| The 11% pressure increase will result in a corresponding volume increase of approximately 11% | | | | |

# Codes and Standards Review Necessary for Alternate Design and Operation

| Codes and Standards | | | |
|---|---|---|---|
| **Code/Standard** | **Present** | **4% Solution** | **11% Solution** |
| **Pipeline Safety Regs** | Limits MAOP to 50/72 % SMYS | Requires Waiver for Pipeline | Requires Waiver for all systems |
| **ASME B31.8** | Allows 80% in Class 1 | Requires Changes for Station | Requires changes for station systems |
| **ASME BPVC** | OPP limited to MAOP + 3# | Within Design limits | May be a limitng factor |
| **API 5L** | No limits | Should not be a limiting factor | May be limited by Company Spec. |
| **API 6D** | Rated Component | Should not be a limiting factor | May require replacement |
| **ASME B16.34** | Rated Component | Should not be a limiting factor | May require replacement |
| **Compressors** | Designed for Location | Requires review of parameters | Requires review of parameters |

# Codes and Regulations will Require Changes for Permanent Incorporation of Life Cycle Management

- Waivers from the regulations may be necessary in the interim
- ASME B31.8 will require modifications or a supplement will need to be developed to codify minimum requirements for life cycle management
- U.S. Pipeline Safety Regulations will require modifications for consistent implementation of life cycle management

# Integrity Assessment Table for Class Location Areas

| Class Designation | Design Factor | | | |
|---|---|---|---|---|
| | 0.5 | 0.6 | 0.72 | 0.8 |
| Class 1 | | | Grandfather with actual high or 1.1 times MAOP pressure test | Grandfather with actual high or<br>1.25 times MAOP pressure tes and one other assessment |
| Class 2 | | 1.25 times MAOP pressure tes | 1.25 times MAOP pressure tes or<br>1.1 times MAOP pressure test and one other assessment | 1.25 times MAOP pressure tes and two other assessments<br>( Duke Waiver) |
| Class 3 | 1.5 times MAOP pressure test | 1.5 times MAOP pressure test<br>1.25 times MAOP pressure tes and one other assessment | 1.40 times MAOP pressure test and one other assessment, or<br>1.25 times MAOP pressure test and two other assessments | Not under consideration |

Current Regulation

The 0.72 column is the same as the regulations for Liquid pipelines.

# Table of Threat Analysis with Practices Matrix

| | Mechanical Damage | | Weather and Outside Force | | Incorrect Operations | |
|---|---|---|---|---|---|---|
| | **Current Regulations** | **Operation Under MAOP Waiver** | **Current Regulations** | **Operation Under MAOP Waiver** | **Current Regulations** | **Operation Under MAOP Waiver** |
| **Primary** | Damage Prevention Program | Monitoring of Excavations on Entire System within Waiver | Design to Consider Load and Environment | Design to Consider Load and Environment | Operator Qualification | Operator Qualification Using ASME B31Q |
| **Secondary** | Marking and Patrolling | Puncture Resistivity: Min D/t - 90; M&N - 70 | | Montioring of Areas Prone to Washout | Policies and Procedures | Policies and Procedures |
| **Tertiary** | Public Education | Fracture Control Plan: 100% Ductile Pipe; Charpy: Greater Than 50 in Class 1; Duke: 99%>60; 90%>80 | | Mitigation of Areas Experiencing to Washout | QA/QC under IMP in HCAs | QA/QC on Entire System Within Waiver |
| **Quaternary** | Monitoring of Excavations in HCAs | Damage Prevention Program; Marking and Patroling | | Integrity Management Program Applied to Entire System Within waiver | Internal Audits under IMP in HCAS | Internal Audits on Entire System Within Waiver |
| **Quintinary** | | Integrity Management Program Applied to Entire System Within Waiver | | | | Integrity Management Program Applied to Entire System Within Waiver |
| **Hexinary** | | Public Education | | | | |

# B31.8 Table for Divisions of Alternate Design

**New Table 841.114 B: Design Factors for Steel Pipe Construction**

| Facility | Class 1 Div 1 | Class 1 Div 2 | Class 1 Div 3 | Class 2 Div 1 | Class 2 Div 2 | Class 2 Div 3 | Class 3 Div 1 | Class 3 Div 2 | Class 3 Div 3 | Class 4 |
|---|---|---|---|---|---|---|---|---|---|---|
| Pipelines and Mains | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Uncased Crossings | | | | | | | | | | |
| Private Roads | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Unimproved Public | * | 0.60 | * | * | 0.60 | * | * | 0.50 | * | 0.40 |
| Highways | * | 0.60 | * | * | 0.50 | * | * | 0.50 | * | 0.40 |
| Cased Crossings | | | | | | | | | | |
| Private Roads | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Unimproved Public | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Highways | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Parallel Crossings | | | | | | | | | | |
| Private Roads | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Uniproved Roads | 0.80 | 0.72 | 0.80 | 0.72 | 0.60 | 0.72 | 0.60 | 0.50 | 0.60 | 0.40 |
| Highways | * | 0.60 | * | * | 0.60 | * | * | 0.50 | * | 0.40 |
| Fabricated Assemblies | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.50 | 0.50 | 0.60 | 0.40 |
| Pipelines on Bridges | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.50 | 0.50 | 0.60 | 0.40 |
| M&R Facilites | 0.60 | 0.60** | 0.60 | 0.60 | 0.60 | 0.60 | 0.50 | 0.50 | 0.60 | 0.40 |
| Compressor Station | 0.60 | 0.50 | 0.60** | 0.60 | 0.50 | 0.60 | 0.50 | 0.50 | 0.50 | 0.40 |
| Concentrations of People | 0.60 | 0.50** | 0.60 | 0.60 | 0.50 | 0.60 | 0.50 | 0.50 | 0.50 | 0.40 |
| Test Pressure | 1.25xMOP | 1.10xMOP | 1.10xMOP | 1.40xMOP | 1.25xMOP | 1.25xMOP | 1.50xMOP | 1.40xMOP | 1.40xMOP | 1.50xMOP |
| Integrity Assessment | No | No | Yes | No | No | Yes | No | No | Yes | No |

* Denotes Engineering Critical Analysis using API 1102 or GRI 91/0284

** Denotes a difference between DOT 192 and ASME B31.8

Current DOT 192 and ASME B31.8

Proposed Change for Pressure Test

Current ASME B31.8

Proposed Change for Integrity Assessment

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## Summary

- Change is Achievable
- Life Cycle Management Practices will need to be further incorporated into Codes, Standards and Regulations
- Complete understanding of the affects of these changes to practices on other aspects of the cycle need to be fully understood and communicated
- Experience gained in the Integrity Management Program allows for a systematic, integrated and comprehensive approach