

Threat Analyses:
Comprehensive and Systematic Assessment
of Impact of Operation
at Higher Stress Levels

U.S. DOT-PHMSA Public Meeting
Natural Gas Pipeline Maximum Allowable Operating Pressure
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Why Use A Threat Based Approach?

- Post-Bellingham - Sought comprehensive and systematic approach to addressing threats to integrity
- Built upon historical development of B31.4 and B31.8
- Integrated into B31.8S - Integrity Management Supplement
- Applicable to any change in operation - high-level change management process

Development of Threat Matrix

Threat	Outcome	Management and Mitigation under Stress Levels Provided for in Current Regulations	Impact of Operation at Higher Stress Levels	Foundation for Operation at Higher Stress Levels	Additional Measures and Special Technical Studies
Time Dependent					
External Corrosion	<ul style="list-style-type: none"> • Wall Loss 				
Internal Corrosion	<ul style="list-style-type: none"> • Wall Loss 				
Stress Corrosion Cracking	<ul style="list-style-type: none"> • Localized cracking 				

Time Dependent Threats

Current Requirements and Impacts

Threat	Outcome	Management and Mitigation under Stress Levels Provided for in Current Regulations	Impact of Operation at Higher Stress Levels	Foundation for Operation at Higher Stress Levels	Additional Measures and Special Technical Studies
Time Dependent					
External Corrosion	<ul style="list-style-type: none"> • Wall Loss 	<ul style="list-style-type: none"> • FBE coated pipe • Cathodic protection and monitoring of system • In-line inspection • Electrical isolation • Interference testing • Atmospheric corrosion prevention 	<ul style="list-style-type: none"> • Reduces allowable defect size • Changes the repair thresholds • Reduces response time for repairs • Reduces re-inspection interval for active corrosion 		
Internal Corrosion	<ul style="list-style-type: none"> • Wall Loss 	<ul style="list-style-type: none"> • Monitor and ensure conformance with gas quality • Inspect internal surface when pipe is cut • In-line inspection 	<ul style="list-style-type: none"> • Reduces allowable defect size • Changes the repair threshold • Reduces response time for repairs • Reduces re-inspection interval for active corrosion 		
Stress Corrosion Cracking	<ul style="list-style-type: none"> • Localized cracking 	<ul style="list-style-type: none"> • Pre-service hydro test • FBE coated pipe with surface pretreatment 	<ul style="list-style-type: none"> • Ensure that coating is not susceptible to creating environment conducive to SCC • Potentially higher compressor station discharge temperatures 		

Time Dependent Threats

Threat	Outcome	Management and Mitigation under Stress Levels Provided for in Current Regulations	Impact of Operation at Higher Stress Levels	Foundation for Operation at Higher Stress Levels	Additional Measures and Special Technical Studies
Time Dependent					
External Corrosion	<ul style="list-style-type: none"> • Wall Loss 	<ul style="list-style-type: none"> • FBE coated pipe • Cathodic protection and monitoring of system • In-line inspection • Electrical isolation • Interference testing • Atmospheric corrosion prevention 	<ul style="list-style-type: none"> • Reduces allowable defect size • Changes the repair thresholds • Reduces response time for repairs • Reduces re-inspection interval for active corrosion 	<ul style="list-style-type: none"> • Completed Baseline ILI • Post-construction hydro-test • CP verification at close intervals • Monitoring of rectifiers • Integrity Management Plan (IMP) 	<ul style="list-style-type: none"> • ILI Reassessment • Special Study (SS) – Reassessment Intervals • SS – External Corrosion Mitigation Plan
Internal Corrosion	<ul style="list-style-type: none"> • Wall Loss 	<ul style="list-style-type: none"> • Monitor and ensure conformance with gas quality • Inspect internal surface when pipe is cut • In-line inspection 	<ul style="list-style-type: none"> • Reduces allowable defect size • Changes the repair threshold • Reduces response time for repairs • Reduces re-inspection interval for active corrosion 	<ul style="list-style-type: none"> • Completed Baseline ILI • Coupons on delivery segment • Gas quality turn-back on receipts 	<ul style="list-style-type: none"> • ILI Reassessment • SS – Reassessment Intervals
Stress Corrosion Cracking	<ul style="list-style-type: none"> • Localized cracking 	<ul style="list-style-type: none"> • Pre-service hydro test • FBE coated pipe with surface pretreatment 	<ul style="list-style-type: none"> • Ensure that coating is not susceptible to creating environment conducive to SCC • Potentially higher compressor station discharge temperatures 	<ul style="list-style-type: none"> • External fusion bond epoxy coating on line pipe and external liquid epoxy coating on girth welds • Integrity Management Plan in segments under waiver 	<ul style="list-style-type: none"> • SS - Assessment of Overall Pipe Quality • Station discharge temperatures within historical levels – Station Assessment

Stable Threats

Threat	Outcome	Management and Mitigation under Stress Levels Provided for in Current Regulations	Impact of Operation at Higher Stress Levels	Foundation for Operation at Higher Stress Levels	Additional Measures and Special Technical Studies
Stable					
Manufacturing Related	<ul style="list-style-type: none"> • Defective pipe • Defective seam weld 	<ul style="list-style-type: none"> • Materials specification in procurement • Pre-service hydrostatic test 	<ul style="list-style-type: none"> • Smaller critical defect size tolerance 	<ul style="list-style-type: none"> • Pipe characteristics including pipe toughness • QA/QC in contracting and manufacturing • Pre-service burst tests 	<ul style="list-style-type: none"> • SS – Presentation of Hydrostatic Tests
Welding and Fabrication Related	<ul style="list-style-type: none"> • Defective girth weld • Defective fabrication weld • Wrinkle bend • Buckle 	<ul style="list-style-type: none"> • Welding procedures • Qualification of welders • Preparation for welding • Inspection and testing of welds • Pre-service hydrostatic test 	<ul style="list-style-type: none"> • Smaller critical defect size tolerance 	<ul style="list-style-type: none"> • 100% NDE of girth welds • Summary of construction practices 	<ul style="list-style-type: none"> • SS – Presentation of Hydrostatic Tests
Equipment and Fittings Related	<ul style="list-style-type: none"> • Gasket/O-ring failure • Control/relief equipment malfunction • Seal/pump packing failure • Station equipment, fittings or piping failure 	<ul style="list-style-type: none"> • Design to appropriate pressure rating • Purchasing and design specifications 	<ul style="list-style-type: none"> • Some components may not be suitable for higher stress operation • Potential for increased thermal stresses on station piping • Potential for increased mechanical stresses on station piping 	<ul style="list-style-type: none"> • 100% NDE of girth welds • Station re-commissioning plan 	<ul style="list-style-type: none"> • SS - Station Assessment

Time Independent Threats

Threat	Outcome	Management and Mitigation under Stress Levels Provided for in Current Regulations	Impact of Operation at Higher Stress Levels	Foundation for Operation at Higher Stress Levels	Additional Measures and Special Technical Studies
Time Independent					
Mechanical Damage, First, Second and Third Party	<ul style="list-style-type: none"> • Dents • Fatigue cracking 	<ul style="list-style-type: none"> • Monitoring of excavations as per 192.935(b)(i-iv) • Damage Prevention Program and Public Education as per 192.614 and .616 • Marking as per 192.707 • Aerial and foot patrols as per 192.705 	<ul style="list-style-type: none"> • Greater stresses on dents • Increased potential for fatigue 	<ul style="list-style-type: none"> • IMP - Mechanical Damage Prevention Program • ILI Baseline • Adoption of API 1166 – Excavation Monitoring • Fracture Control Plan 	<ul style="list-style-type: none"> • SS - Fatigue Analysis • SS - Pipe Robustness and Resistance to Excavation Damage
Weather Related and Outside Force	<ul style="list-style-type: none"> • Damage to pipe by inducing strains • Damage to pipe by external loads 	<ul style="list-style-type: none"> • Design to consider the load and the environment 	<ul style="list-style-type: none"> • Marginal impact 	<ul style="list-style-type: none"> • IMP – Weather and outside force 	<ul style="list-style-type: none"> • SS – Assessment of Vehicle Loading on Pipeline Stresses
Incorrect Operations	<ul style="list-style-type: none"> • Operator Error 	<ul style="list-style-type: none"> • Operator Qualification as per 192, Subpart N 	<ul style="list-style-type: none"> • No substantive impact 	<ul style="list-style-type: none"> • IMP - Policies and procedures • Internal audits of procedure use and work practices • QA/QC 	
Infrastructure Security	<ul style="list-style-type: none"> • Human intervention 	<ul style="list-style-type: none"> • OPS Advisory • Alliance Security Plan 	<ul style="list-style-type: none"> • No substantive impact 	<ul style="list-style-type: none"> • Automation and SCADA • Remotely operated block valves 	

Thank You.

Questions?