

UTC Training & Qualification Gas Regulations and Code Compliance Seminar

Gas Transmission Integrity Verification Process

MAOP Verification/Material Documentation

U.S. DOT / PHMSA
Leticia Santos Hernández
May 12-13, 2015



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Integrity Verification Process

- **Drivers**
 - Overview of Issues
 - Statutory Mandates and NTSB Rec.
- **Goals – Principles**
- **IVP Process**
 - MAOP Verification
 - IVP Chart
 - Definitions
 - Records
 - Material Documentation
- **Pipeline Mileage**

2



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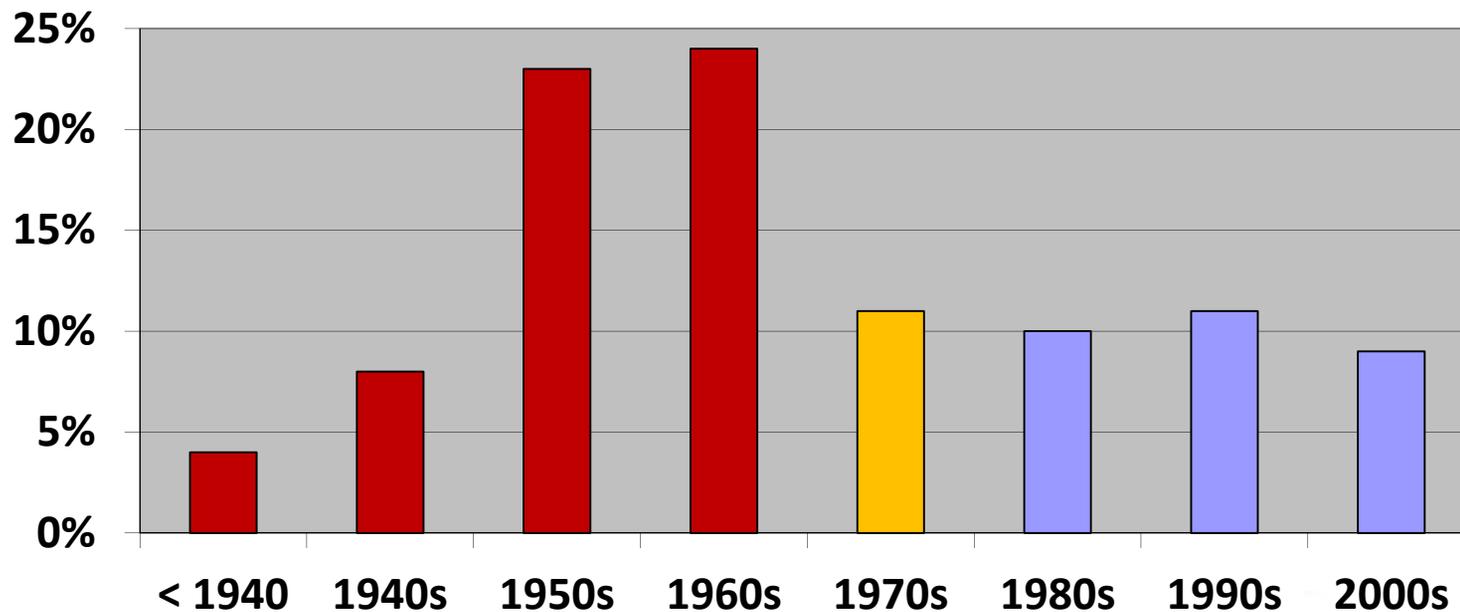


Pipeline Infrastructure

(% by Decade in USA)

Gas Transmission Pipeline Vintage

59% installed prior to 1970



3



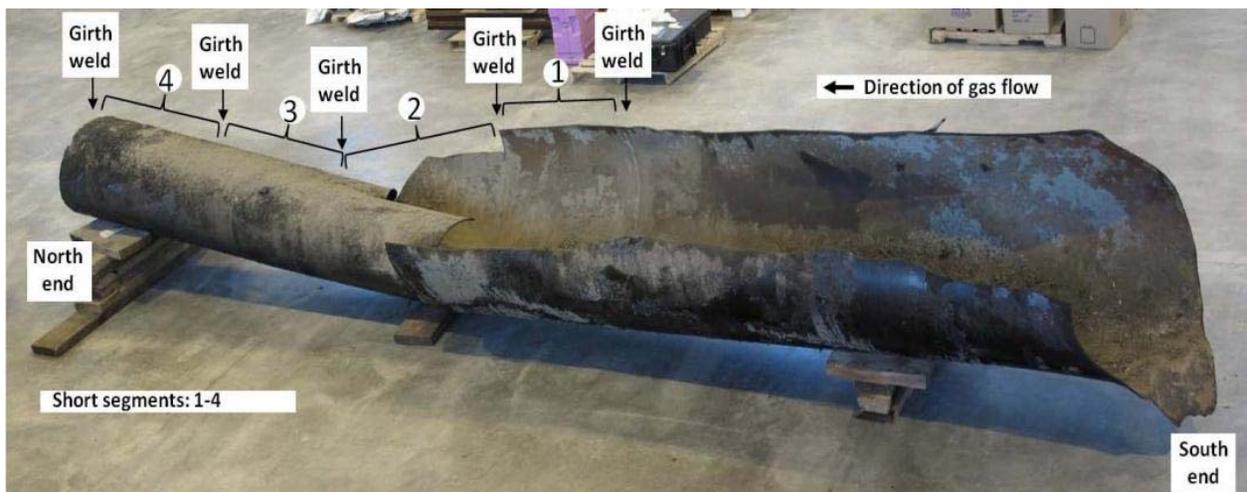
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3

Vintage Pipe Failures



Failure in San Bruno, CA

ERW Seam Failure in Carmichael, MS



Photograph of the 28-foot-long ruptured section of pipeline

Cross-section of defective SAW longitudinal seam - San Bruno (2010)



ERW Seam, Mayflower, AR



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Congressional Mandates

Pipeline Safety Act of 2011

- *PSA Section 23(a) §60139(a) & (b) – Verification of Records and Reporting –*
 - requires operators to identify **pipe segments for which they do not have records to substantiate MAOP for all Gas Transmission steel pipe (Class 3, 4 and all HCAs);**
 - exceedance of MAOP build-up allowed by pressure limiting device must be reported within 5-days.
- *PSA Section 23(a) §60139(c) – Determination of MAOP*
 - **reconfirm MAOP for pipeline segments with insufficient records.**

5



Congressional Mandates

- *PSA Section 23(a) §60139(d) - **“Testing Regulations”***
 - Requires **conducting tests** to confirm the material strength of previously untested gas transmission steel pipelines **in high consequence areas (HCAs) and operating at a pressure greater than 30 % SMYS that were not previously pressure tested;**
 - Tests can be either **pressure testing** or alternative equivalent means such as **ILI programs.**

6



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NTSB Recommendations

- **NTSB P-11-14 “Delete Grandfather Clause”**
 - recommends all grandfathered pipe be pressured tested, including a “spike” test;
- **NTSB P-11-15 “Seam Stability” –**
 - recommends pressure test to 1.25 x MAOP before treating latent manufacturing and construction defects as “stable.”
- **NTSB P-11-17 “Piggable Lines” -**
 - Configure all lines to accommodate smart pigs, with priority given to older lines

7



GOALS & IVP

8



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8

GT IVP

- Establishes MAOP verification options that are equivalent to pressure testing
- Addresses Class 1 and 2 pipe in higher risk locations to address related NTSB recommendations; these areas are called moderate consequence areas (MCAs)
- Strategy for addressing/correcting segments without adequate records;
- Process accommodates actions necessary commensurate with specific documentation shortcomings on a segment-specific basis

9



Basic Principles of IVP Approach

- **IVP is based on 4 principles**
 1. Apply to higher risk locations
 - High Consequence Areas (HCAs) and Moderate Consequence Areas (MCAs)
 2. Screen segments for categories of concern (e.g., “Grandfathered” segments)
 3. Assure adequate material and documentation
 4. Perform assessments to establish MAOP

10



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Principle #1

Apply to Higher Risk Locations

- High Consequence Areas (HCAs)
- **Moderate Consequence Area (MCA):**
 - an onshore area that is within a potential impact circle, containing one or more buildings intended for human occupancy, an occupied site, or a designated Federal interstate, expressway, or 4-lane highway right-of-way, and does not meet the definition of high consequence area, as defined in § 192.903.

11



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Principle #2

Screen for Categories of Concern

- **Apply process to pipeline segments with:**
 - Grandfathered Pipe
 - Lack of Records to Substantiate MAOP
 - Lack of Adequate Pressure Test
 - Operating pressures over 72% SMYS (pre-Code)
 - History of Failures Attributable to M&C Defects
 - Legacy materials and construction techniques

12



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Principle #3

Know & Document Pipe Material

- If Missing or Inadequate Validated Traceable Material Documentation, then Establish Material Properties by a new Part 192 process:
 - Cut out and Test Pipe Samples (Part 192 process)
 - *In Situ* Non-Destructive Testing (if validated and Part 192 process)
 - Field verification of code stamp for components such as valves, flanges, and fabrications
 - Other verifications

13



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Principle #4

Assessments to Establish MAOP

- Allow Operator to Select Best Option to Establish MAOP
- **Candidate IVP Options for Establishing MAOP**
 - Subpart J Test with Spike Test
 - Legacy pipe or pipe with history of seam failures
 - Derate pressure
 - Engineering Critical Assessment
 - Replace
 - **Other options to consider?**

14



MAOP Determination

- **Applicable Locations**

- Located in HCA, MCA, and meets any of the following:

- Experienced reportable in-service incident since last pressure test due...
- Legacy pipe or constructed with legacy construction techniques and has not had a PT of the greater of
 - 1.25 times MAOP or applicable Class location PT requirement
- Test pressure (TP) for modern pipe with MAOP \geq 20% SMYS & TP less than Code (such as below 1.1 times MAOP)
- No PT records
- MAOP established per Grandfather Clause

15



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15

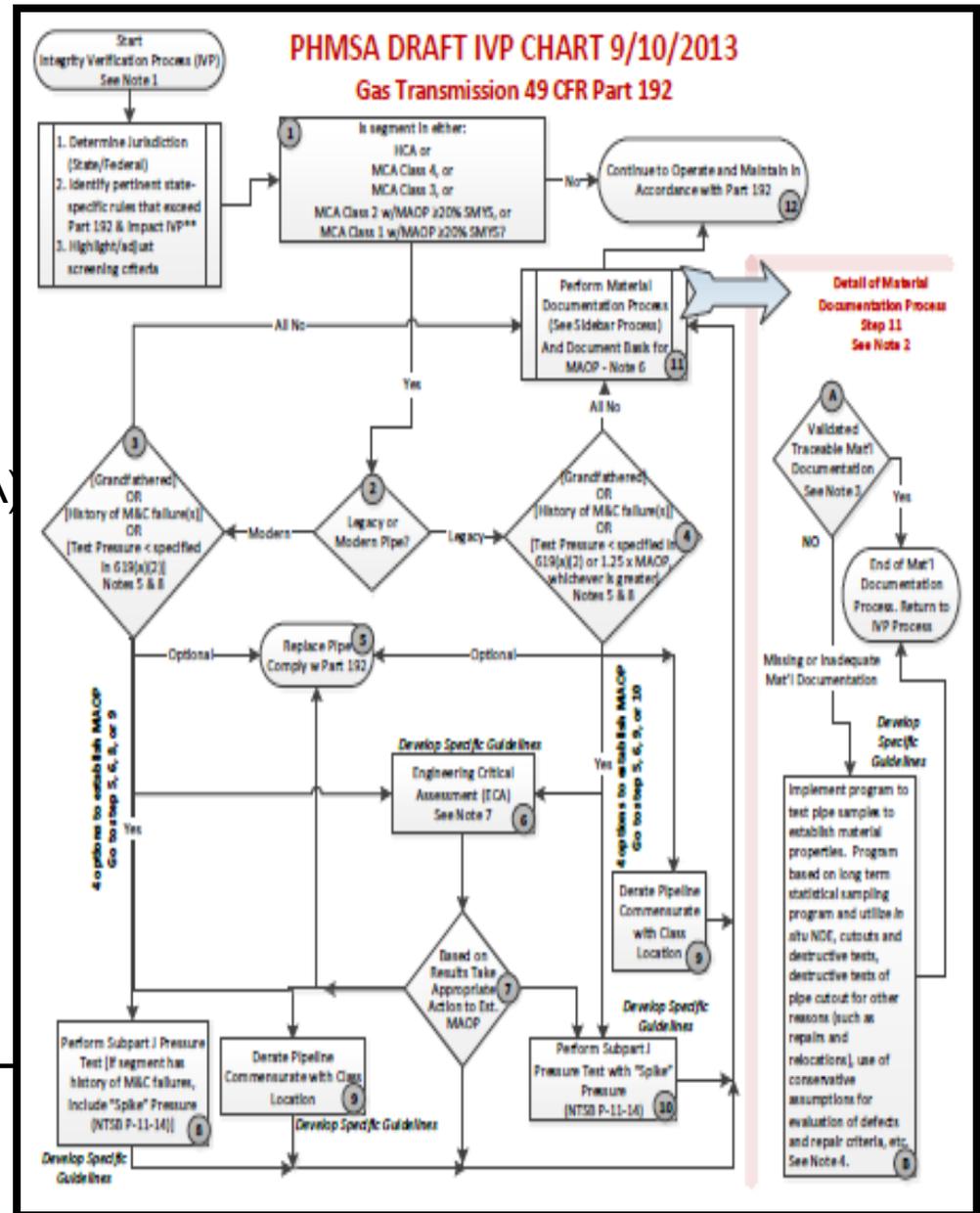
MAOP Determination

- Onshore, steel pipelines – possible criteria
 - Pressure Test (PT)
 - Pressure Reduction
 - Engineering Critical Assessment (ILI)
 - Pipe Replacement
 - Alternative Technology
 - Determine, if reassessment is necessary



• IVP Chart

- Applicable Segments
 - (Steps 1, 2, 3 and 4)
- MAOP Determination Methods (Steps 5 – 10)
 - Pressure Test
 - Pressure Reduction
 - Engineering Critical Assessment (ECA)
 - Pipe Replacement
 - Pressure Reduction for Segments w/Small PIR
 - Alternative Technology
- Materials Documentation (11)
 - Destructive
 - Non-destructive
- Continue Operations (12)
- **IVP Chart – on PHMSA web site**
- <http://primis.phmsa.dot.gov/meetings/MtgHme.mtg?mtg=91>



Definitions

- Hard Spot
- Legacy Construction Technique
- Legacy Pipe
- Moderate Consequence Area (MCA)
- Modern Pipe
- Occupied Site
- Significant Seam Cracking (SSC)
- Wrinkle Bend

18



Material Documentation Plan

- **Establishes Standards for:**
 - Pipe: strength and chemistry
 - Design pressure, MAOP, and anomaly remediation operating pressures
 - Valves, fittings, and fabrications
 - Integrity management:
 - HCAs and other locations



19



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19

Records – Why?



20



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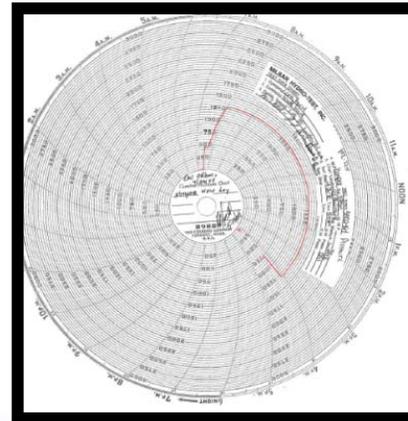
Why are pipeline material records needed?

- **§23 PSA of 2011 – Statute requires PHMSA to:**
 - Direct gas transmission Operators to provide verification their records accurately reflect MAOP of Class 3 and 4 locations and Class 1 and 2 HCAs
 - **Reconfirm MAOP for pipe with incomplete records**
 - Strength test all untested pipe in HCA operating at > 30% SMYS
- **PHMSA Advisory Bulletin – May 7, 2012**
 - **Verification of Records**



Why are pipeline material records needed?

- To establish design and maximum operating pressures (MAOP)
- For integrity management (IM)
- Anomaly evaluations for safe operating pressure



Metallurgical and Pipe Test Report MTR No.: 4000020382-4228
Sample No.: J06200474

SAW PIPES USA, Inc.
P.O. Box 2349
Baytown, TX 77622-2349
Phone: (281) 963-0300
Fax: (281) 924-0479

PO Number: 4000020382 PO Date: 11/04/05 Date: 05/15/06
Diameter (In): 42 Wall (In): 0.438 Grade: X70 PSL2 Heat No: 804825
Comments: LSAW MATERIAL AS-ROLLED 100% Weld seam inspection by ultrasonic testing method. Calibration standard: N6 notches and 1R" through drilled hole

Customer: CENTERPOINT ENERGY GAS TRANSMISSION COMPANY
P.O. BOX 1374 HOUSTON, TEXAS 77261
Ship To: CENTERPOINT ENERGY GAS TRANSMISSION COMPANY
LOUISIANA ARMY NATIONAL GUARD, CAMP MIREUX 100 LOUISIANA
MINORVILLE, LOUISIANA 71055

Physical Analysis:

Width (Inch)	Yield (PSI)	Tensile (PSI)	Elong (%)	YR Ratio	Weld Tensile Ratio	Fracture Location	HYDRO PSI	HYDRO TIME (sec)
TBT 1.50	78008	87007	36	0.88	Guided Band (WELD)	Root	1402	20
TWT 1.47		89203			Face	OK		

MINIMUM HYDRO TEST PRESSURE FOR THIS HEAT IS 1402 PSI @ 90% MACRO OK

Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Ti	Al	N	V	B	Nb	Ca	Zr	CE	Pom	V	HND	
Ladle	0.28	1.50	0.005	0.005	0.27	0.02	0.02	0.18	0.01	0.013	0.027	0.007	0.065	0.000	0.054	0.002	0.000	0.39	0.19	0.13		
Prod1	0.06	1.53	0.007	0.007	0.26	0.01	0.01	0.16	0.00	0.017	0.036	0.004	0.069	0.000	0.057	0.002	0.000	0.38	0.16	0.13		
Prod2	0.08	1.53	0.005	0.005	0.26	0.01	0.01	0.16	0.00	0.017	0.036	0.004	0.069	0.000	0.057	0.002	0.000	0.38	0.16	0.13		

CE MAX = 0.41%, PCM MAX = 0.21%

Hardness Analysis:

Temp	Shear	Shear	Shear	Avg
(F)	(%)	(%)	(%)	(%)
1: 188	6: 192	11: 185	16: 212	21: 184
2: 180	7: 180	12: 192	17: 200	22: 154
3: 192	8: 188	13: 218	18: 190	23: 190
4: 192	9: 184	14: 219	19: 188	24: 184
5: 206	10: 192	15: 206	20: 184	25: 164

Charpy Impact Analysis:

Dir/Notch	Spec Size	Temp	Ft lb1	Ft lb2	Ft lb3	Pt lb avg	Shear1 (%)	Shear2 (%)	Shear3 (%)	Shear Avg (%)
TBC	10x10 mm	32 F	126	133	173	145	100	100	100	100
THC	10x10 mm	32 F	110	115	112	112	100	100	100	100
TWC	10x10 mm	32 F	89	81	88	85	100	100	100	100

Fracture Toughness Criteria: As per API 5L, PSL2, BSA @ 32 F, B700 @ 30 F, S70 @ 32 F

The material has been manufactured, sampled, tested, and inspected in accordance with the spec/API and has been found to meet the requirements. We verify the above to be correct as contained in the records of the company.



Code Requirements

- **Code - Gas Pipeline**
 - **MAOP Determination**
 - 192.105 - DP
 - 192.619 & 192.620 - MAOP
 - Subpart J – Prs. Test –
192.501 thru 192.517
 - **Material Determination**
 - 192.105 – Design
 - 192.107 – Yield Strength
 - 192.109 – Wall thickness
 - 192.113 – Joint factor
 - Appendix B- Qual. of Pipe

23



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Records Management

- **Materials must be manufactured in accordance:**
 - DOT referenced standards
 - Able to maintain structural integrity of the pipeline:
 - Operating pressure, temperature, and environmental conditions including outside force loads
 - Fracture arrest for 80% SMYS pipelines
- **Pipe Design**
 - Withstand external pressures and anticipated loads
 - Designed for service and class location



Records Management

- **What type pipe records are needed?**
 - **For Design Formula and Maximum Operating Pressure**
 - Outside diameter
 - Pipe wall thickness
 - Yield strength
 - Weld joint/seam type
 - **API 5L – pipe mill test report**
 - Chemical properties
 - Tensile properties – yield and ultimate
 - Hydrostatic test pressure

2
5



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Applicable Segments for Material Documentation Plan

- **Verification of Pipeline Material (Step I I)**
 - Applicable Locations
 - HCAs
 - Class 3 and 4 locations
 - Class 1 and 2 locations in a MCA w/ $\geq 20\%$ SMYS
 - Material
 - Pipe and fittings – yield strength, composition, & seam type
 - Valves – pressure rating and weld end compatibility w/pipe
 - Components – pressure rating compatibility

26



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26

Records Management

- **Records! What type do we need?**
 - Material records – pipe, fittings & fabrications, etc.
 - QA and QC
 - Standards – API, ASME, ANSI, MSS, and ASTM
 - Tests – mechanical & chemical properties, welding, NDE, and hydrostatic test
 - Design and construction records – hydrostatic test
 - Operations and maintenance records
 - Integrity management records

27



Mill Test Reports

MTR – Pipe

Metallurgical and Pipe Test Report MTR No.: 4600020362-4625
Sample No.: M08206474

SAW PIPES USA, Inc.
P.O. Box 2349
Baytown, TX 77522-2349
Phone: (281) 353-3300
Fax: (281) 353-0473

PO Number: 4600020362 PO Date: 11/04/05 Date: 08/15/06
Diameter (In): 42 Wall (In): 0.438 Grade: X70 PSL2 Heat No: S04625
Comments: **AS-ROLLED** 100% Weld seam inspection by ultrasonic testing method;
Cust Spec: SPEC 101, REV 4, DATED 01-17-06 Calibration standard: NS notches and 1/8" through drilled hole
API 5L October 2004 43rd Ed LSAW MATERIAL

Customer
CENTERPOINT ENERGY GAS TRANSMISSION COMPANY
P.O. BOX 1374
HOUSTON, TEXAS 77251

Ship To
CENTERPOINT ENERGY GAS TRANSMISSION COMPANY
LOUISIANA ARMY NATIONAL GUARD, CAMP MINDEN 100 LOUISIANA
MINDEN, LOUISIANA 71055

Physical Analysis:

	Cwidth (Inch)	Yield (PSI)	Tensile (PSI)	Elong (%)	YT Ratio	Weld Tensile	Fracture Location
TBT	1.50	75006	87007	38	0.86	BASE METAL	
TWT	1.47		89203			Guided Bend (WELD)	
						Root	Face
						OK	OK

Hydrostatic Test
HYDRO PSI HYDRO TIME (sec)
1402 20
MINIMUM HYDROTEST PRESSURE FOR THIS HEAT IS 1402 PSI @ 95%
MACRO OK

Type	C	Mn	P	S	SI	Cu	NI	Cr	Mo	TI	Al	N	V	B	Nb	Ca	Zr	CE	Pcm	+Nb +Ti
Ladle	0.09	1.50	0.006	0.005	0.27	0.02	0.02	0.18	0.01	0.013	0.027	0.007	0.065	0.0005	0.054	0.002	0.000	0.39	0.19	0.13
Prod1	0.08	1.53	0.007	0.007	0.26	0.01	0.01	0.15	0.00	0.017	0.035	0.004	0.059	0.0002	0.057	0.002	0.000	0.38	0.18	0.13
Prod2	0.08	1.53	0.006	0.006	0.26	0.01	0.01	0.15	0.00	0.017	0.035	0.004	0.059	0.0001	0.057	0.002	0.000	0.38	0.18	0.13

CE MAX = 0.41%, PCM MAX = 0.21%

Hardness Analysis

Temp	Shear 1 (%)	Shear 2 (%)	Shear Avg (%)
32 F	100	97	99

1: 188 6: 19211: 18816: 21221: 184
2: 188 7: 18012: 19217: 20622: 184
3: 192 8: 18813: 21818: 18023: 188
4: 192 9: 18414: 21819: 18824: 184
5: 20610: 19215: 20620: 18425: 184
26: 180

(HV10 - Scale)

Charpy Impact Analysis

Dir/Notch	Spec Size	Temp	Ft lb1	Ft lb2	Ft lb3	Ft lb avg	Shear1 (%)	Shear2 (%)	Shear3 (%)	Shear Avg (%)
TBC	10x10 mm	32 F	128	133	173	145	100	100	100	100
THC	10x10 mm	32 F	110	115	112	112	100	100	100	100
TWC	10x10 mm	32 F	89	81	86	85	100	100	100	100

Fracture Toughness Criteria: As per API 5L, PSL2, SR5A @ 32 F, SR5B @ 30 F, SR6 @ 32 F
The material has been manufactured, sampled, tested, and inspected in accordance with this spec(API5L) and has been found to meet the requirements. I/We certify the above to be correct as contained in the records of the company.



Where are the gaps?

- Old Pipelines
- New Pipelines
- **What do we do?**
 - Keep records
 - Existing Pipeline
 - New Construction
 - Test – Destructive and Non-Destructive
 - Cut-outs
 - Relocations
 - Repairs

29



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Materials - New Technology

- **Needs to be developed for:**
 - Internal use in the pipeline
 - External use in the ditch
- **Must be tested**
 - Against destructive test coupons
 - Repeatable
- **Multiple test points**
 - Method must not use high values, without using low values
 - Must be repeatable
- **Must be technically verified**

30



New Tech – Benefits and Limits

- **Material Properties**
 - Yield, Tensile, and Elongation
 - Wall thickness
 - Seam Type
- **Chemistry**
- **May need to use multiple tools**
 - Destructive and Non-destructive

31



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How much pipeline mileage will these mandates and recommendations effect?

32



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Summary by HCA and Class Location

Location	Total GT Miles	% in HCA	GT HCA Miles	Non-HCA Miles
Class 1	237,756	0.7	1,660	236,096
Class 2	30,210	4.7	1,412	28,798
Class 3	32,613	48.6	15,854	16,759
Class 4	962	78.2	752	209
Total	301,540		19,678	281,862

33

data as of 7-1-2013 from Part Q

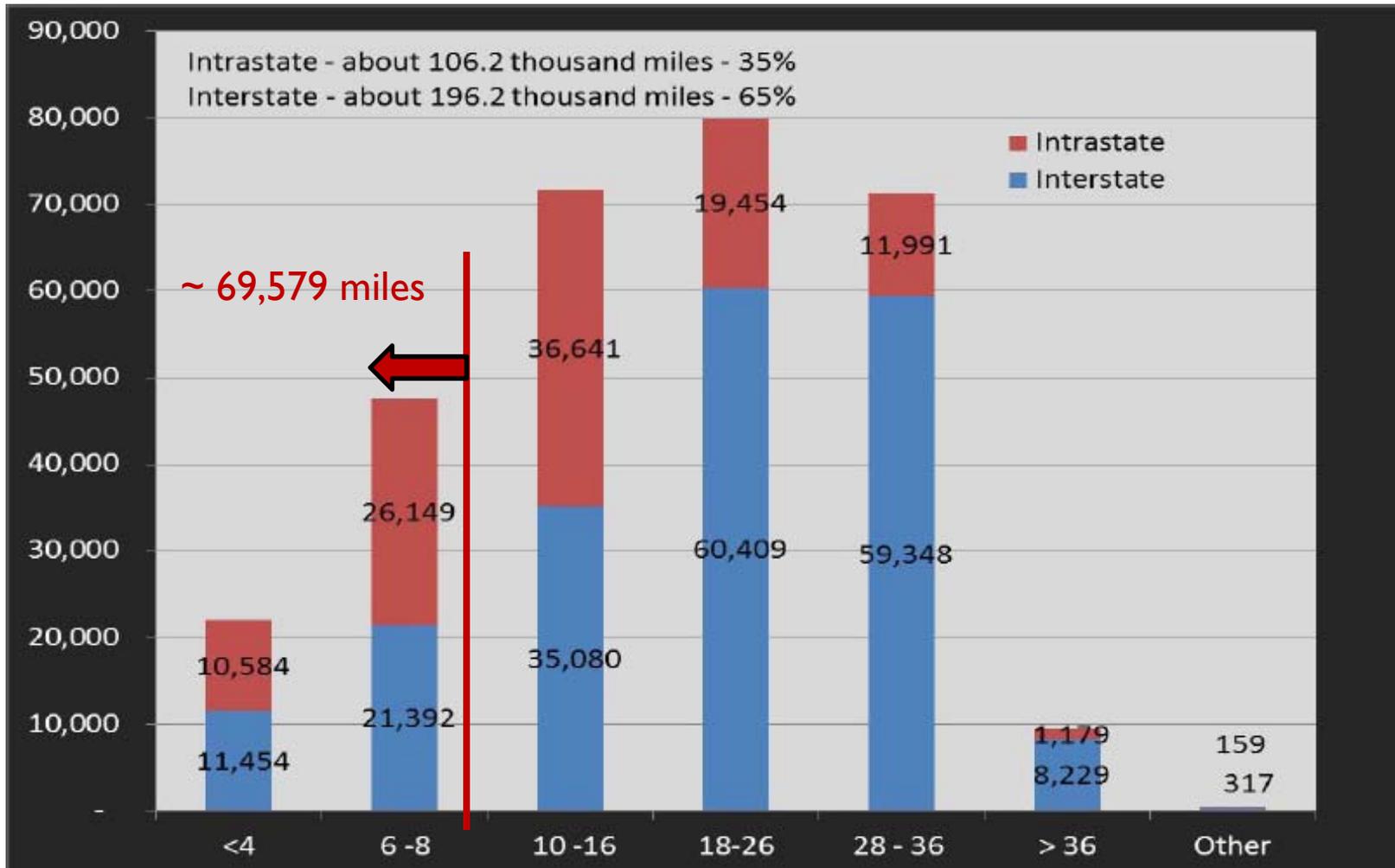


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Nominal Pipe Size



34

data as of 7-1-2013 from Part H

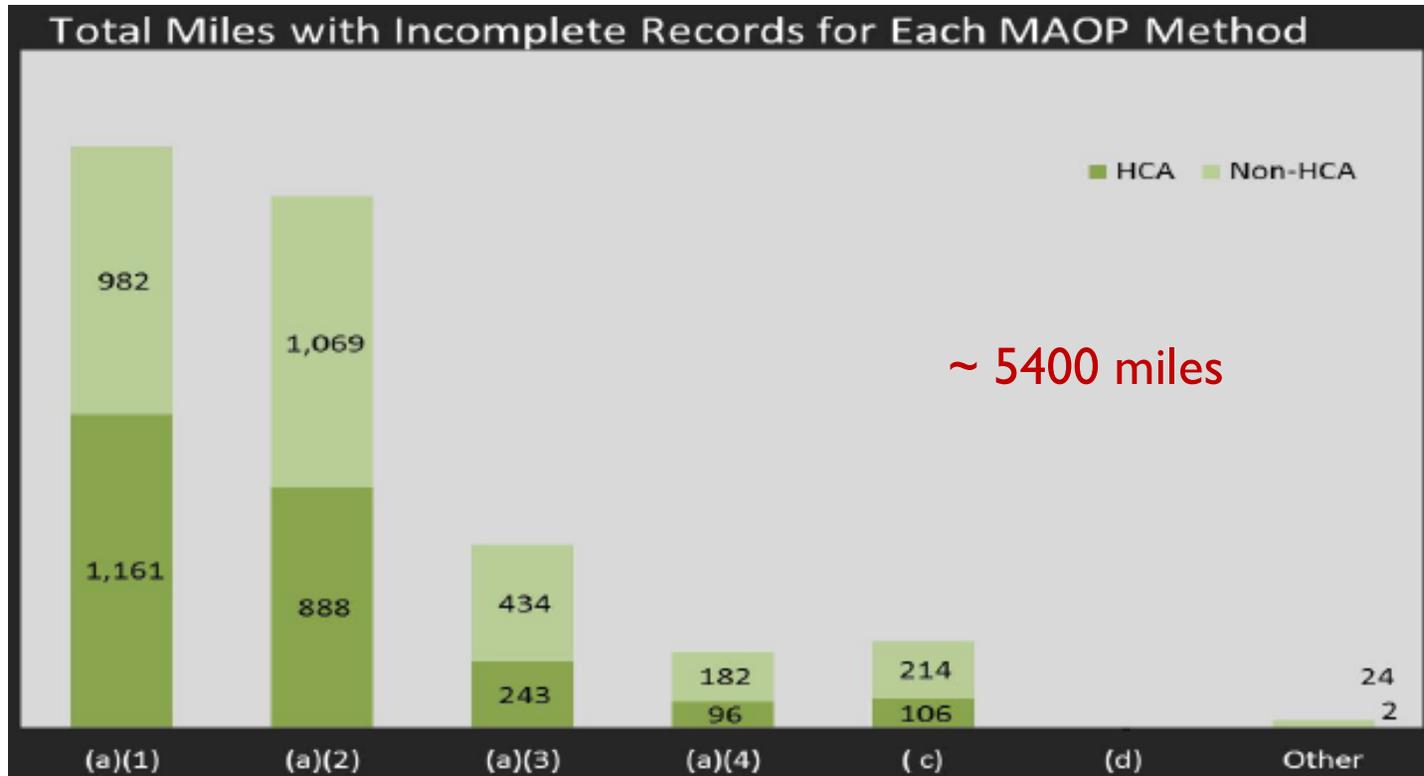


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Incomplete Records for MAOP in HCAs and Class 3 and 4



➤ Record status not collected for Class Locations 1 & 2 outside of HCAs
 data as of 7-1-2013 from Part Q

35



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Pressure Test Range – Part R

Pressure Test Range	Total Miles	% Total
PT < 1.1 MAOP or no PT	93,817	31%
1.25 MAOP > PT ≥ 1.1 MAOP	19,131	6%
PT ≥ 1.25 MAOP	187,628	62%



ILI Able vs Not Able

Part R	Total Miles	ILI Able	ILI Not Able
Class 1 - HCA	1,658	1,380	278
- non-HCA	234,851	146,035	88,816
Class 2 - HCA	1,409	1,152	257
- non-HCA	28,978	15,073	13,905
Class 3- HCA	15,850	10,469	5,381
- non-HCA	16,751	6,924	9,827
Class 4 - HCA	752	366	386
- non-HCA	209	112	97
TOTAL	300,458	181,511	118,947

Gas Transmission 2012 Annual Report data as-of 7-1-2013

37



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37

Operating Stress Levels over 72% SMYS & Unknown - Part K

% SMYS	Interstate	Intrastate	Total
> 72 to 80	11,665	231	11,895
> 80	978	321	1,299
Unknown	973	6,074	7,038

- Miles operating between 72 and 80% SMYS are either Grandfathered, Special Permit, or Alternative MAOP under 619(d)
- Miles with Unknown SMYS are Grandfathered



HCA and Est. MCA Mileage

- **Scope of Proposed IVP Process Estimated to Apply to approx. 73,000 Miles of GT Pipeline**

	HCA	MCA
Class 1	1,599	(est.) 20,411
Class 2	1,403	est.) 15,146
Class 3	15,886	(est.) 17,617
Class 4	744	(est.) 208
Total	19,633	(est.) 53,382

➤ **Total Estimated HCA + MCA Mileage = ~ 73,000 miles**

39



Thank You

For more information contact:

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40



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