Know what's below. Call before you dig.

PHMSA Your Safety Our Mission

Hazardous Liquid Pipeline Integrity Verification Process (HL-IVP)

US DOT/PHMSA Workshop

Arlington, Virginia

August 27, 2015

HL-IVP

- **What is HL-IVP?**
- **Where would HL-IVP be applicable?**
- **Drivers -** GT Statutory Mandates and NTSB Rec.
- **Goals - Principles**
- **HL-IVP Process**
  - HL-IVP Chart
  - Definitions
  - MOP Determination
  - Material Documentation
- **Other Part 195 Updates**
- **HL-IVP Impacts and Benefits**

HL-IVP

What is HL-IVP?

- Verification of Maximum Operating Pressure (MOP) and material records
- Pressure testing and material verification where adequate records do not exist
- Re-evaluation, where Risk-Based Alternative was used instead of Pressure Testing
- Fatigue analysis process used for determining reassessment intervals for cracking issues
- Other Part 195 Updates

HL IVP

Where should HL IVP be applicable?

- High consequence areas (HCA);
- Rural gathering lines (195.11) that could affect an HCA;
- "Could affect" right-of-ways of a designated interstate, freeway, expressway, and other principal 4-lane arterial roadways;
- Highly volatile liquid (HVL) pipelines; and
- Any other non-HCA hazardous liquid pipeline with an MOP of > 20% Specified Minimum Yield Strength (SMYS).

GT Drivers considered for HL Pipelines:
Pipe, MOP, and Material Documentation Issues

- **PSA §23(a) 60139(d) mandate for "Testing Regulations"**
  - requires either pressure testing or an alternative equivalent means such as an In-Line Inspection (ILI) program for pipe not previously tested;
- **PSA §23(a) 60139(a) & (b)**
  - requires operators to self-report that they do not have records to substantiate MOP and requires a strategy for addressing and correcting non-compliances that emerge from this reporting;
- **NTSB P-11-14 "Delete Grandfather Clause"**
  - recommended grandfathered pipelines be pressure tested, including a "spike" test. (This can be applied to HL's Risk-Based Alternative" pipe.); and
- **NTSB P-11-15 "Seam Stability"**
  - recommended pressure testing to 1.25 x MOP before treating latent manufacturing and construction defects as "stable."

Drivers for HL Pipelines

Since 2002:

Accident Cause	No Prior Pressure Test	With Some Type of Prior Pressure Test	*Totals*
Material Defect*	29	68	*97*
Construction Defect	18	39	*57*
Total	47	107	***154***

**52 LF ERW and Flash Welded; 8 Furnace Lap or Butt Welded pipe*

- Over 330,000 bbls. spilled → ~ 2,200 bbls./accident

Drivers for HL Pipelines:

HL Pipeline Accidents Material & Construction Defect Failures Since 2002

Volume (Barrels)	Accidents	%
≥ 10,000 bbls	9	6%
1,000 – 9,999	30	19%
100 – 999	40	26%
10 – 99	63	41%
< 10 bbls	12	8%
Totals	154	

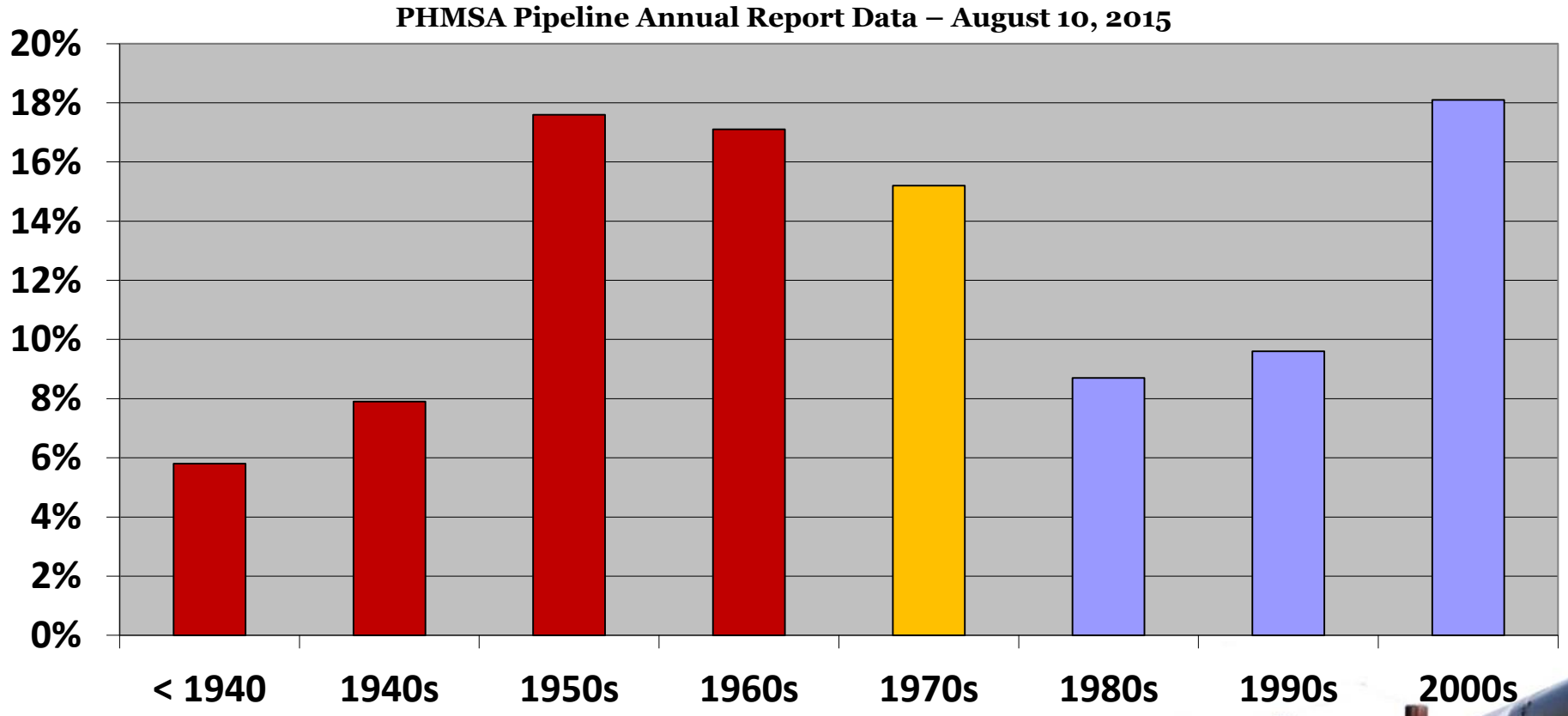
- 1 in 25 are over 20,000 bbls.
- 1 in 10 are over 5,000 bbls.
- 1 in 4 are over 1,000 bbls.
- One half are over 100 bbls.

U.S. HL Pipeline Infrastructure

Hazardous Liquid Pipeline Vintage

~48% installed prior to 1970

(~199K total miles total / 194K onshore/ 83K HF-ERW / 47K LF-ERW)



Basic Principles of HL-IVP Approach

HL IVP is based on 4 principles:

1. Apply to higher risk locations
2. Screen pipe segments for categories of concern
3. Assure adequate material and documentation
4. Perform tests and integrity assessments as needed to establish MOP

Principle # 1
Apply to Higher Risk Locations

- **HCAs - could affect segments**
- **Roadways**
- **Rural Gathering (195.11) that could affect an HCA**
- **HVL pipelines**
- **Non-HCA pipelines w/ MOP > 20% SMYS**
- **PHMSA Estimates ~ 194K miles of onshore HL mileage would need to be "screened" of which ~ 48% HL mileage is pre-1970 construction**

Principle # 2
Screen for Categories of Concern

- **Apply process to pipeline segments with:**
  - Pipe w/o a pressure test
    (i.e., MOP established per risk-based approach §195.303)
  - History of Failures Attributable to M&C Defects
  - Legacy pipe w/o valid **spike** pressure test
  - Lack of Records to Substantiate MOP
- **PHMSA Advisory Bulletin's (ADB) 11-01:**
  Docket No. PHMSA–2010–0381
  "Reliable, traceable, verifiable, and complete"

Principle # 3
Know & Document Pipe Material

- **If Missing or Inadequate Material Documentation*, then Establish Material Properties by an approved process:**
  - Test Pipe Samples (Code approved process)
  - *In Situ* Non-Destructive Testing
    - Must be validated and Code/PHMSA approved
  - Field verification of code stamp for components such as valves, flanges, and fabrications
  - Other verifications

* PHMSA ADB's (11-01)– *"Reliable, traceable, verifiable, and complete"*

Principle # 4
Tests & Integrity Assessments to Establish MOP

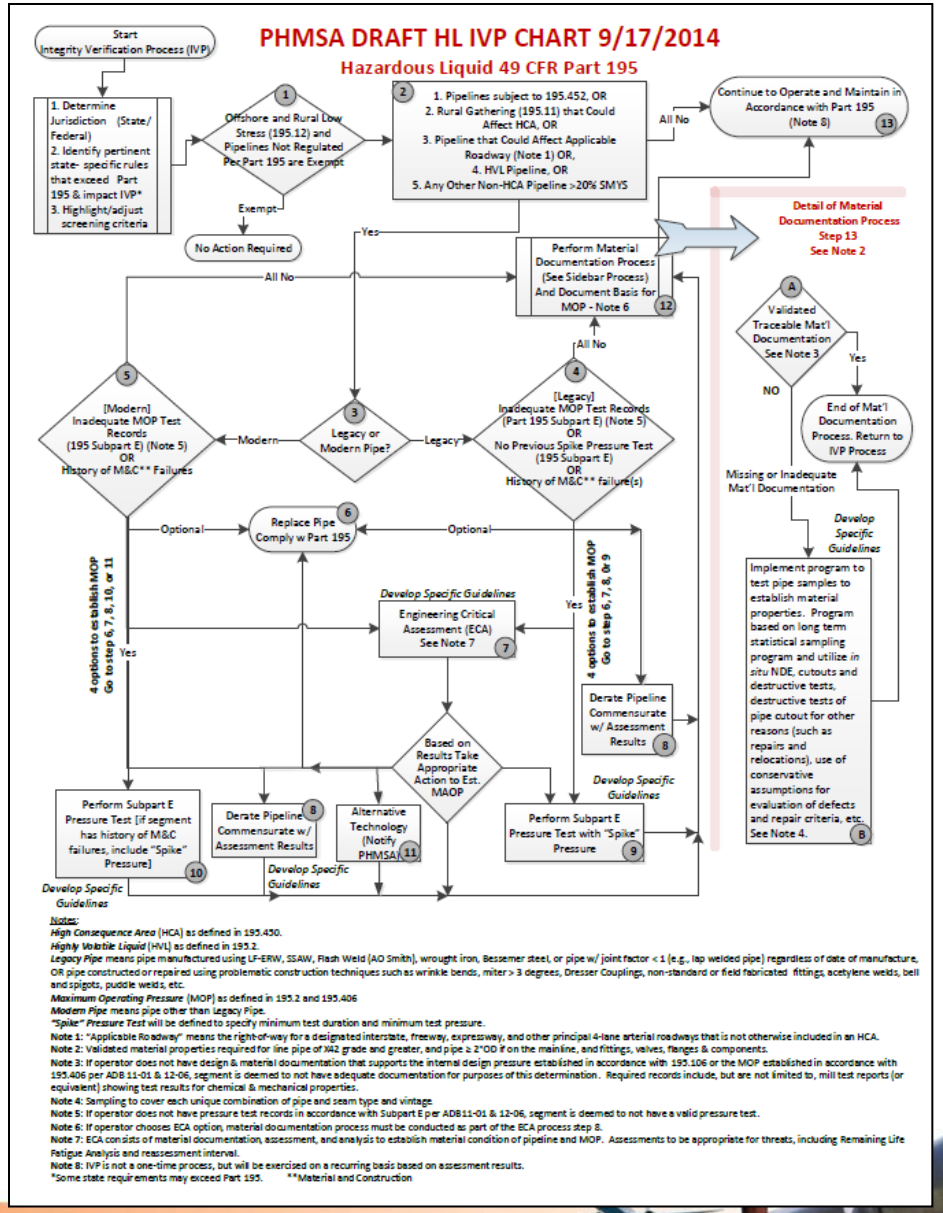
- **Allow Operator to Select Best Option to Establish MOP**
- **Candidate IVP Options for Establishing MOP**
  - Pressure Test (with Spike Test for Legacy Pipe or pipe with M&C failure history)
  - Derate pressure
  - Engineering Critical Assessment
  - Replace
  - Alternative technology (notification to PHMSA required)
  - **Any other options to consider?**

Draft – HL-IVP Process Steps

- **13 Step Process Embodies These 4 Principles**
  - **Screen for High Risk Pipe** – Process Steps 1 – 2
  - **Integrity Review** – Process Steps 3 – 5
  - **Assessment/MOP Determination** – Steps 6 – 11
  - **Material Documentation Review** – Process Step 12
  - **Continue Operations –** Process Step 13

HL-IVP Chart – Draft

- **Applicable Segments**
  (Steps 1 and 2)
- **Integrity Review** (Steps 3 – 5)
- **Assessment/MOP Determination** (Steps 6 – 11)
  - Pressure Test
  - Pressure Reduction
  - Engineering Critical Assessment
  - Pipe Replacement
  - Alternative Technology
- **Material Documentation** (12)
  - Destructive
  - Non-destructive
- **Continue Operations** (13)



Existing Part 195 HL Code Requirements

- **MOP Determination**
  - 195.106 – Design Pressure
  - 195.406 - MOP
  - Subpart E – Pressure Test
    - 195.300 thru 195.310
- **Material Documentation**
  - 195 Subpart C – Design
  - 195.106 – Yield Strength, Wall thickness, & Joint factor
  - 195.112 and .114 – Pipe Qual.

MOP Verification

Possible Definitions

- **Legacy Pipe**
  - LF-ERW, DC-ERW, SSAW, Flash Weld (AO Smith), wrought iron, Bessemer Steel, or pipe w/ joint factor <1 (e.g., lap welded pipe)
- **Modern Pipe**
  - Pipe not manufactured with any techniques listed under Legacy Pipe
- **Spike Hydrostatic Pressure Test**
  - Minimum pressure and duration
- **Legacy Construction Techniques**
  - Use of any historic, now-abandoned, construction practice to construct or repair pipe segments, including wrinkle bends, miter > 3 degrees, Dresser Couplings, non-standard fittings, arc welds, oxyacetylene welds, bell spigots, puddle weld repairs, etc.

Consideration of State-Specific Requirements

1. **Determine Jurisdiction (State/Federal)**
2. **Identify State-Specific Rules**
3. **Adjust Screening Criteria Accordingly**

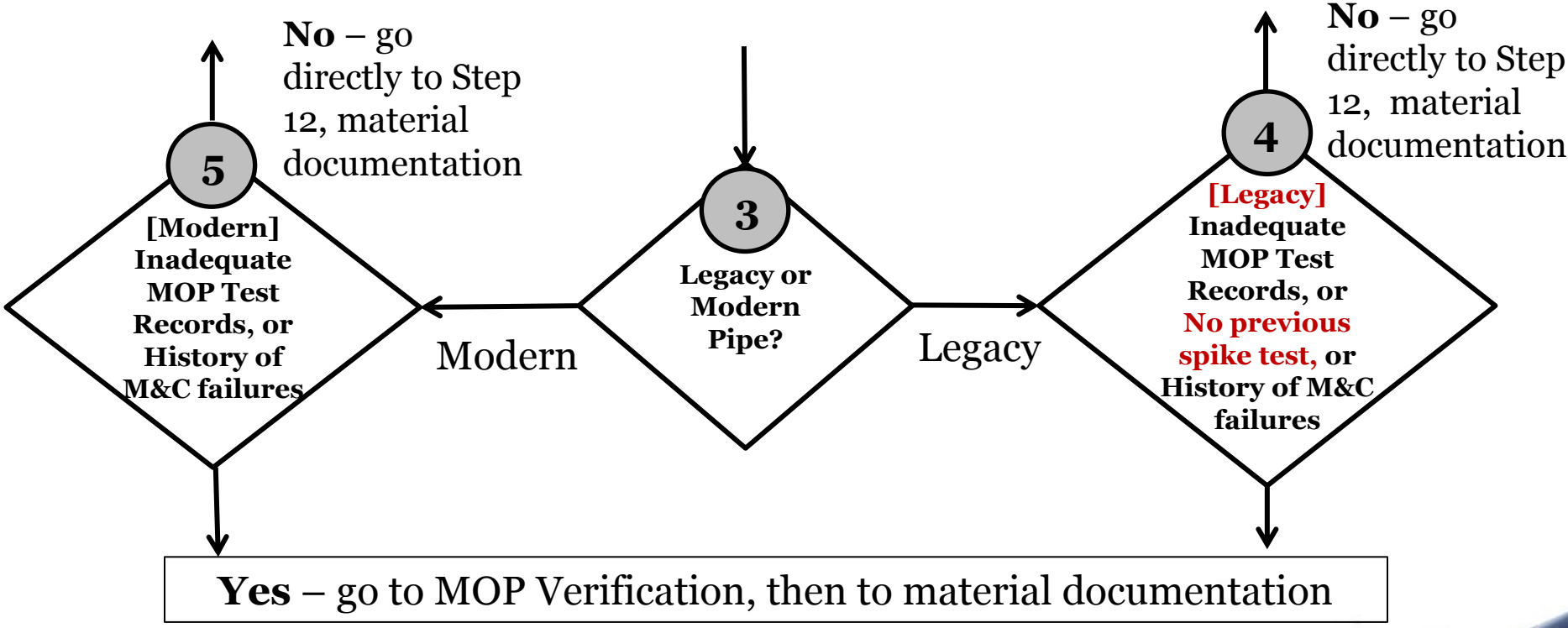
- **Some states have requirements that exceed federal regulations**
- Process must account for those differences

Draft Process Steps 1 and 2 Risk-Based Screening

- **Screening criteria based on pipeline type**
  - Offshore and rural low stress lines are exempt
- **Screening criteria based on operational risk**
  - HCA could affect segments ~ 83,000 miles
  - Segment ≤ 20% SMYS ~ 2,000 miles)
- **PHMSA High End Estimate**

  ~ XXX,000 miles; ~ XX% HL ??

Draft - Process Steps 3 - 5 Inadequate Records and Failure History Screen



Draft - Process Steps 3-5 Mileage that would Require MOP Verification

- HL operators did not have to report grandfathered pipe or inadequate records
- ~96K miles pre-1970 or unknown decade of installation
- ~1K miles of Low Frequency pipe installed after 1970
- **~ 97K Miles - is this a high end estimate for MOP Verification?**

Draft - Process Steps 6 through 11 MOP Determination Methods

- **Approaches based on case-specific considerations:**
  - Method 1: Pressure Test (PT)
  - Method 2: Pressure Reduction
  - Method 3: Engineering Critical Assessment (ECA)
  - Method 4: Pipe Replacement
  - Method 5: Alternative Technology
  - **Other Methods to Consider?**
  - **Should all of the above methods be considered?**

MOP Determination Methods

- **Method 1: Pressure Test**
  - 1.25 times MOP
  - Spike test segments w/ reportable in-service incident due to legacy pipe/construction, SCC, SSC, etc.
  - Estimate remaining life for segments w/ crack defects
- **Method 2: Pressure Reduction**
  - Reduce MOP by 1.xx factor (= xx% MOP)
  - Estimate remaining life for segments w/ crack defects

MOP Determination Methods

- **Method 3: Engineering Critical Assessment (ECA)**
  - **ECA analysis** - MOP based upon lowest predicted failure pressure (PFP)
    - Segment-specific technical and material documentation issues
    - Analyze cracks, metal loss, and interacting defects remaining in the pipe, or could remain in the pipe, to determine PFP
    - MOP established at the lowest PFP divided by a safety factor
    - Estimate remaining life for segments w/ crack defects
  - **ILI Tool Inspections** – to identify and evaluate threats per ECA

MOP Determination Methods

- **Method 4: Pipe Replacement**
- **Method 5: Alternative Technology**
  - May use an alternative technical evaluation process that provides a sound engineering basis for establishing MOP.
  - Notification to PHMSA in advance of use
- **Other Methods to Consider?**

MOP Determination Methods

- **Fracture mechanics modeling for failure stress and cyclic fatigue crack growth analysis**
  - Contains or susceptible to cracks or crack-like defects
  - Fatigue analysis techniques
  - Analyze microstructure(ductile/brittle or both), location and type of defect, and operating conditions, including pressure cycling
  - Is a 2nd re-evaluation needed? Pressure Test or ILI?
    - when before **XX%** of the remaining life has expired
  - Should the results confirmed by an independent expert?

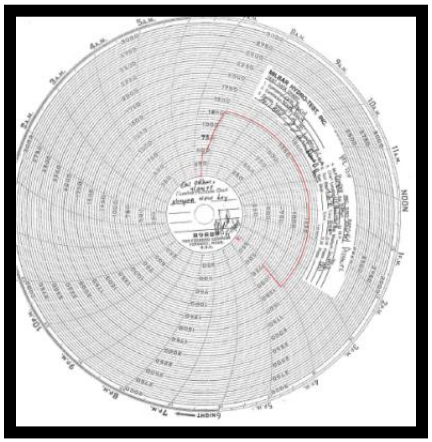
MOP Determination – Timing?

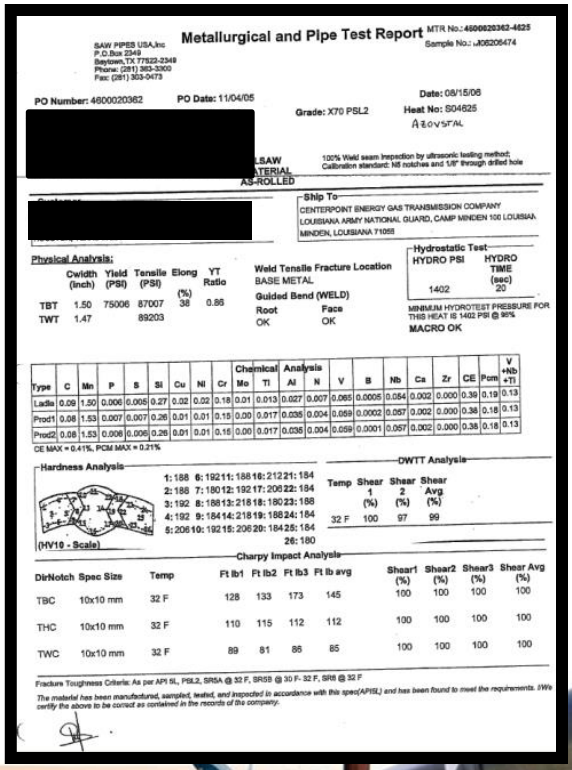
- Re-establishing MOP:
  - Require that existing HCA could affect segments of pipe be assessed within XX years and any needed reassessments every XX years thereafter
  - **Any suggestions?**

Material Documentation

Why are material records needed?

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





Metallurgical and Pipe Test Report

SAW PIPES USA,Inc
P.O.Box 2349
Baytown,TX 77522-2349
Phone: (281) 383-3300
Fax: (281) 383-0473

MTR No.: 4600020362-4625
Sample No.: J06205474

PO Number: 4600020362 PO Date: 11/04/05 Grade: X70 PSL2 Date: 08/15/06 Heat No: S04625

[redacted] LSAW MATERIAL AS-ROLLED

100% Weld seam inspection by ultrasonic testing method; Calibration standard: N8 notches and 1/8" through drilled hole

[redacted]

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
TBT	1.50	75006	87007	38	0.86
TWT	1.47		89203		

Weld Tensile Fracture Location: BASE METAL

Guided Bend (WELD): Root OK, Face OK

Hydrostatic Test: HYDRO PSI 1402, HYDRO TIME (sec) 20

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

									Chemical Analysis													
Type	C	Mn	P	S	Si	Cu	Ni	Cr	Mo	Ti	Al	N	V	B	Nb	Ca	Zr	CE	Pcm	V +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 (HV10 - Scale)

1: 188 2: 188 3: 192 4: 192 5: 206 6: 192 7: 180 8: 188 9: 184 10: 192 11: 188 12: 192 13: 218 14: 218 15: 206 16: 212 17: 206 18: 180 19: 188 20: 184 21: 184 22: 184 23: 188 24: 184 25: 184 26: 180

DWTT Analysis

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

Charpy Impact Analysis

DirNotch	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- 32 F, SR8 @ 32 F

The material has been manufactured, sampled, tested, and inspected in accordance with this spec(APISL) and has been found to meet the requirements. We certify the above to be correct as contained in the records of the company.

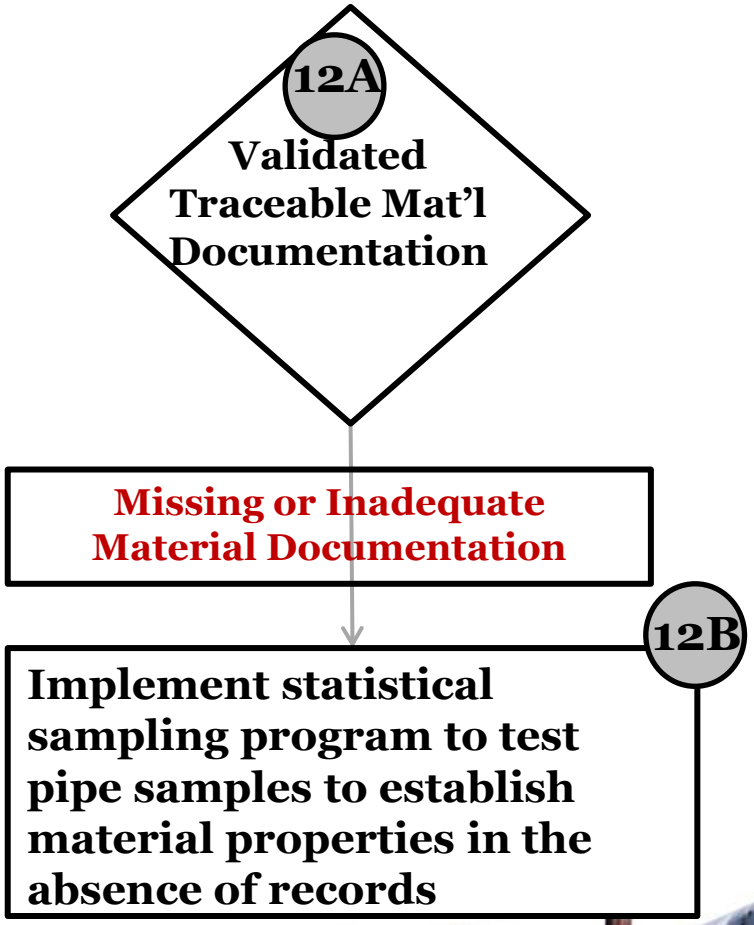
Material Records

- **Materials manufactured in accordance with:**
  - DOT referenced standards or other applicable standards
- **Able to maintain structural integrity of the pipeline:**
  - Operating pressure, temperature, and environmental conditions, including outside force loads
- **Pipe Design**
  - Withstand internaal/external pressures and anticipated loads
  - Designed for service type and with design factor
  - Must verify: diameter, wall thickness, grade and seam type
- **Integrity Management (IM)**
  - Predicted failure pressure of defects

Draft - Process Step 12 Material Documentation

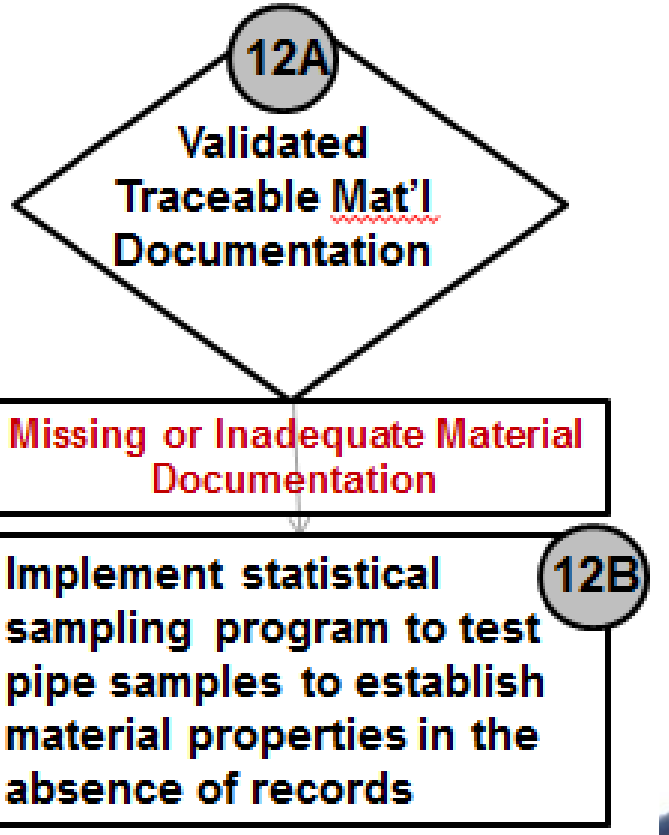
1. **Material Documentation also Required for Pipe, Valves, Flanges, Fittings, & Components**

2. **Validated material properties required for X-42 & greater, and pipe ≥ 2-inch OD, if on mainline (Should we consider these ranges?)**



Draft - Process Step 12 Material Documentation (cont.)

3. Valves and Components (ANSI Rating)
4. Cutouts each XX joints or XX miles
5. May use *in situ* NDE, if validated
6. May not be required for some short segments
7. Each Unique Combination of Pipe Type, Seam, Vintage

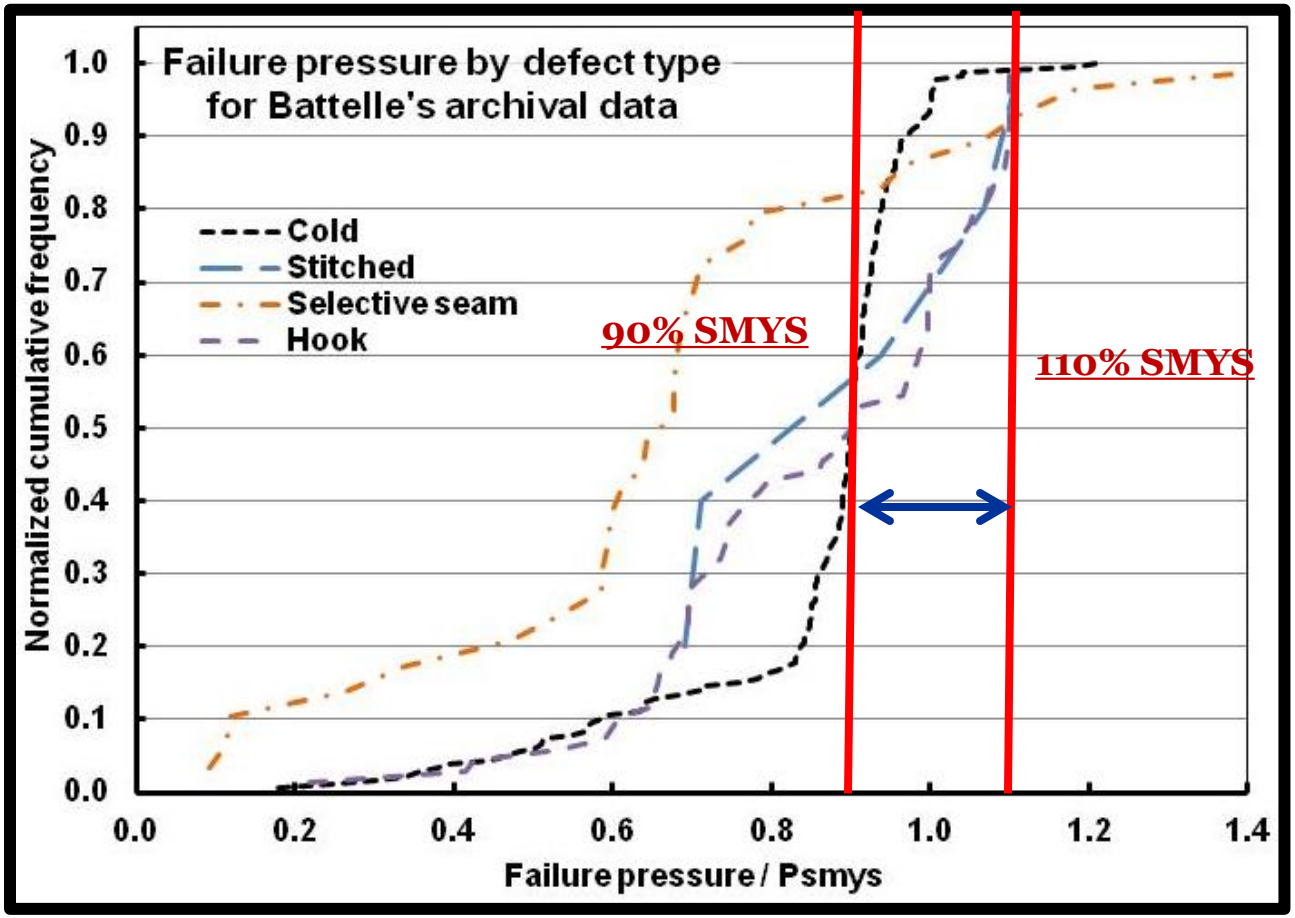


Possible Guidelines & Criteria

- **HL-IVP chart is high level concept**
- **Details and specifications to be developed**
- **For example:**
  - Spike pressure test specs (pressure, hold time, etc.)
  - De-rate criteria (amount of MOP reduction)
  - ILI program requirements and specifications
  - Material verification specs (# of cutouts, etc.)

Pipe and Seam Cracking

Long Seam ERW Failures Chart



What should be considered for spike pressure test for cracking issues?

- **90% SMYS**
- **100% SMYS**
- **105% SMYS**
- **110% SMYS**

  or

- **X times MOP**

Information from PHMSA Long Seam ERW R&D Program – over 600 failures

Other Possible Part 195 Updates

- **External Corrosion Assessment and Remediation**
  - Use of close interval surveys to find inadequate cathodic protection and ineffective coatings
  - AC/DC interference surveys in high voltage power line routings
- **New Construction**
  - Coating assessments (DCVG) after backfill for new construction;
  - Girth weld non-destructive examination (NDE) requirements for new construction (+95%)
  - Fracture mitigation plan requirements for CO2 pipelines
    - Address operating temperatures, pressures, product compositions, pipe grade and operating stress levels
    - Mitigation or arrest measures
- **GWUT Assessment Guidance in Part 195 Code**
  - For segments where ILI cannot be run

Other Part 195 Updates

- **Records Retention**
- **Appendix – Records for Life of Facility or X-years**
  - **Materials** – pipe, valves, fittings, flanges & components
  - **Design** – external loads and design pressures
  - **Construction** – inspection, welding procedures, and NDT
  - **Pressure Testing**
  - **Corrosion Control**
  - **Operations & Maintenance (O&M)** – measurement, patrols, surveys, repairs, manuals
    - Integrity Management (IM)
    - Operator Qualification (OQ) Plans
    - Control Room Management (CRM)

IVP IMPACTS & BENEFITS

What are Potential IVP Data Impacts?

- **Accurate data is needed to identify the extent of impacted pipe:**
  - **MOP records**
    - Material records – wall thickness, grade, and seam type
    - Use of "Risk-based Alternative to Hydrotest Rule"
    - Subpart E or spike pressure test Legacy Pipe and/or Legacy Construction issues
- **Determining the *impact* will require additional information**
- **Annual Report data may need to be expanded**

What are the Expected IVP Benefits?

- **IVP is for pipeline accidents caused by:**
  - Material- and Construction-related defects
  - Without pressure tests and material records
- **Proposed Rule: Costs vs Benefits**
  - **Both cost impacts and benefits are considered**
- **Impacts and Costs of Individual Accidents:**
  - Consequences and $$ reported to PHMSA
  - Sometimes other costs *not reported* are significant…$$$
    - Lost revenue and local supply disruptions
    - Long-term remediation
    - Legal costs and penalties

HL-IVP – Possible Impacted Pipelines

Pipe Dia	Decade of Constr	MOP	Seam Factor	Seam Type	Vintage	Risk Based or No Pressure Test	HCA Could Affect Segment	Could Impact Applicable Roadway	ILI-able
X	Unknown 19x0 – 19x9 20x0-20x9	MOP ≤ 20% SMYS MOP > 20% SMYS	1.0 0.8 0.6 Other	Seamless LF-ERW or HF-ERW Electric Flash Welded Electric Fusion Welded DSAW SAW Furnace Lap Welded Furnace Butt Welded Other, describe	Legacy Pipe Modern Pipe Legacy Constr Modern Constr	Y N	Y N	Y N	Yes With minor modifications With moderate modifications Not practicable – can only be accomplished with significant pipe and/or equipment replacement

Docket: PHMSA-2014-0150 Posted Comments to Consider

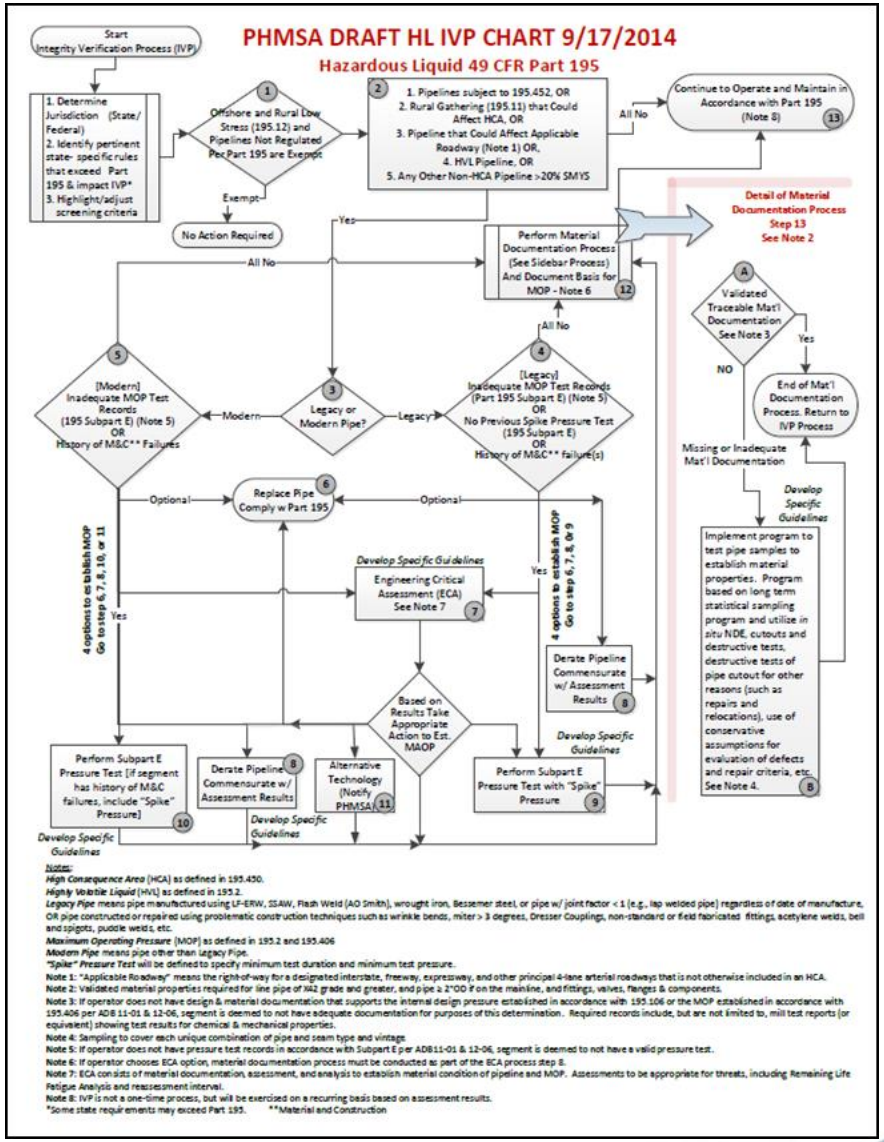
- Allow sufficient time for compliance
- “Legacy pipe” definition should be expanded to include certain early vintage HF ERW pipe
- Test pressures should be established as % of SMYS rather than MOP
- Pressure de-rating should not be a long-term solution if crack threats are present
- Crack threats related to “Legacy pipe”, including early vintage HF ERW pipe, need special consideration in ECA’s

Docket: PHMSA-2014-0150 Posted Comments to Consider

- HL IVP does not appear to effectively further “integrity verification” beyond what operators have already done
- Congressional mandates don’t apply – they pertain solely to confirming MAOP of "grandfathered"
- A “one-size-fits-all” spike test pressure is not appropriate
- ECA process needs more clarity – industry began working with PRCI to develop an industry-wide ECA process in 2015
- Some HL-IVP options are unrealistic: replacement, long-term de-rating, or alternative technology
- Consider 30% SMYS the appropriate threshold;
- apply RBA-like approach for non-HCAs

Questions?

Docket: PHMSA-2014-0150 on regulations.gov



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Thank you

US DOT / PHMSA

Steve Nanney

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