Gas Transmission Integrity Verification Process

Integrity Verification Workshop

August 7, 2013

Arlington, Virginia

Pipeline and Hazardous Materials Safety Administration (PHMSA)

Steve Nanney

811 Know what's below. Call before you dig.

PHMSA Your Safety Our Mission

Integrity Verification

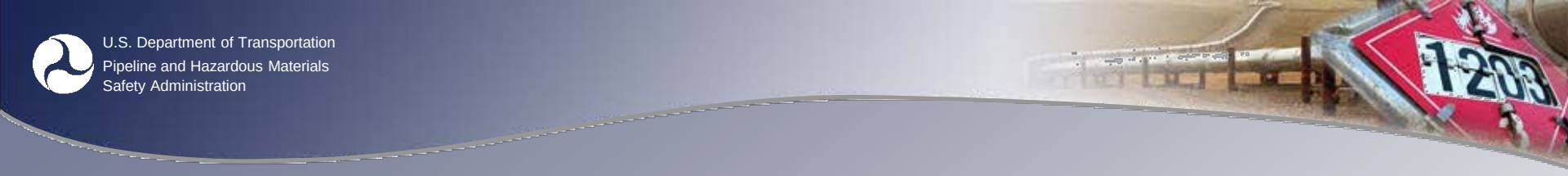
- Multi-disciplinary engineering approach has been defined to verify that steel gas transmission (GT) pipeline integrity is adequate for continued operation for some desired future period.
- Pipeline may contain flaws, have sustained damage, or have aged so that it can not be evaluated by use of the original construction codes.
- **GOAL: Establish a comprehensive program to effectively address a number of Congressional Mandates and NTSB Recommendations.**

Basic Principles of IVP Approach

- PHMSA's proposed **process 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

Principle #1
Apply to Higher Risk Locations

- High Consequence Areas (HCAs)
- Moderate Consequence Area (MCA):
  - Non-HCA pipe in Class 2, 3, and 4 locations
  - Non-HCA pipe Class 1 locations that are populated in PIR (proposed 1 house or occupied site) to align with INGAA commitment
  - House count and occupied site definition same as HCA, except for 1 house or 1 person at a site (instead of 20)
- PHMSA Estimates ~ 91,000 miles HCA/MCA (out of ~ 300,000 miles)



HCAs and Est. MCA Mileage

- **Scope of Proposed IVP Process Estimated to Apply to approx. 91,000 Miles of GT Pipeline**

	Total	HCA	Non-HCA	MCA
Class 1	237,756	1,660	236,096	(est.) 25,394
Class 2	30,210	1,412	28,798	28,798
Class 3	32,613	15,854	16,759	16,759
Class 4	962	752	209	209
Total	301,540	19,678	281,862	(est.) 71,160

➢ **Total Estimated HCA + MCA Mileage = ~ 91,000 miles**

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

Principle #3
Know & Document Pipe Material

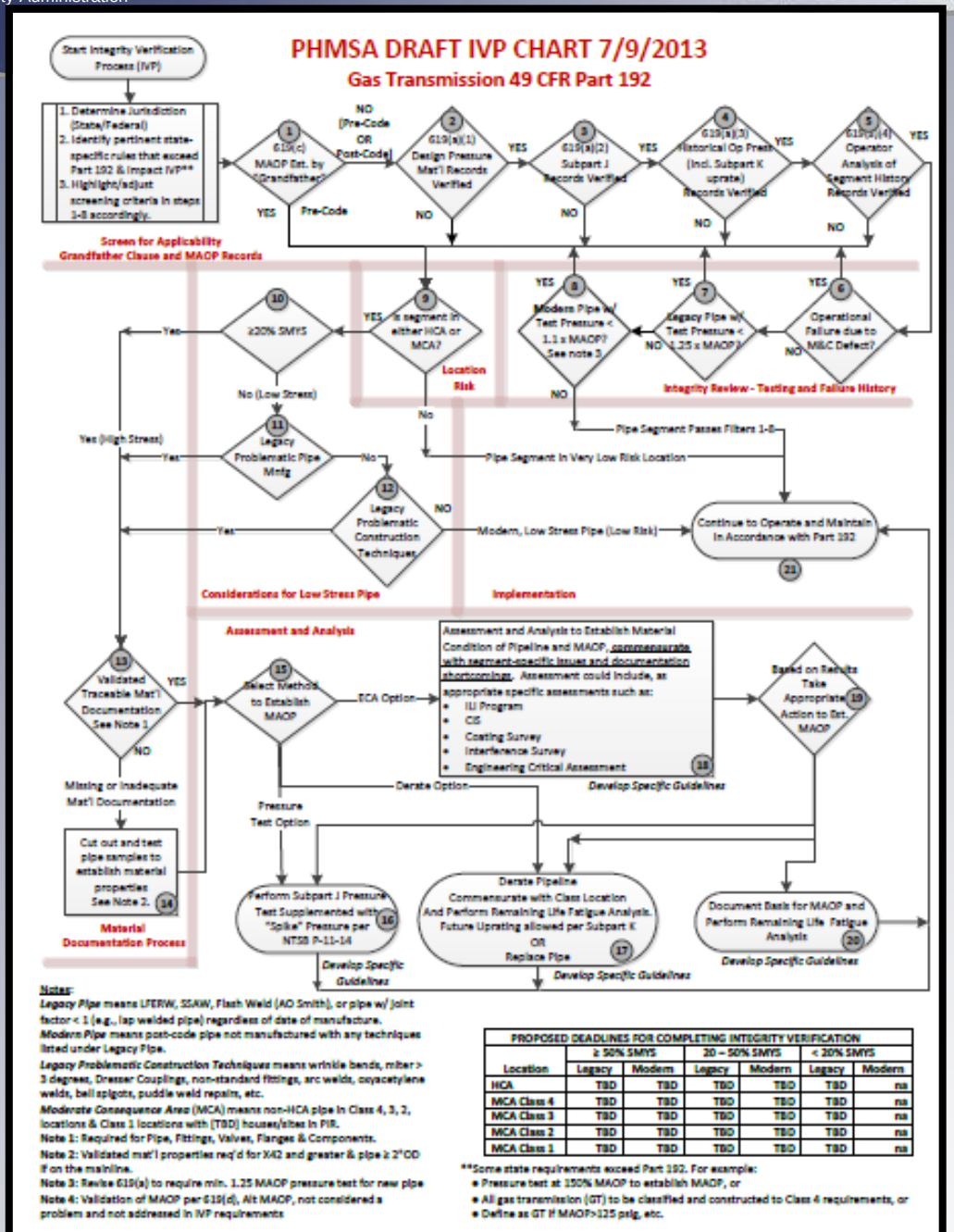
- If Missing or Inadequate Validated Traceable Material Documentation, then Establish Material Properties by an approved process:
  - Cut out and Test Pipe Samples (Code approved process)
  - *In Situ* Non-Destructive Testing (if validated and Code approved)
  - Field verification of code stamp for components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

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
  - Derate pressure
  - Engineering Critical Assessment
  - Replace
  - **Other options PHMSA should consider?**

Draft – IVP Process Steps

- **21 Step Process Embodies These 4 Principles**
  - **Grandfather Clause and MAOP Review** – Process Steps 1 – 4
  - **Integrity Review** – Process Steps 5 – 8
  - **Location Risk Review (HCA/MCA) – Process Step 9**
  - **Low Stress Review** – Process Steps 10 – 12
  - **Material Documentation Review** – Process Steps 13 – 15
  - **Assessment and Analysis Review** – Process Steps 16 – 20
  - **Implementation –** Process Step 21
  - **Deadlines for Implementation**



Notes:

Legacy Pipe means LFERW, SSAW, Flash Weld (AO Smith), or pipe w/ joint factor < 1 (e.g., lap welded pipe) regardless of date of manufacture.

Modern Pipe means post-code pipe not manufactured with any techniques listed under Legacy Pipe.

Legacy Problematic Construction Techniques means wrinkle bends, miter > 3 degrees, Dresser Couplings, non-standard fittings, arc welds, oxyacetylene welds, bell spigots, puddle weld repairs, etc.

Moderate Consequence Area (MCA) means non-HCA pipe in Class 4, 3, 2, locations & Class 1 locations with [TBD] houses/sites in PIR.

Note 1: Required for Pipe, Fittings, Valves, Flanges & Components.

Note 2: Validated mat'l properties req'd for X42 and greater & pipe ≥ 2"OD if on the mainline.

Note 3: Revise §19(a) to require min. 1.25 MAOP pressure test for new pipe

Note 4: Validation of MAOP per §19(d), Alt MAOP, not considered a problem and not addressed in IVP requirements

PROPOSED DEADLINES FOR COMPLETING INTEGRITY VERIFICATION						
	≥ 50% SMYS		20 – 50% SMYS		< 20% SMYS	
Location	Legacy	Modern	Legacy	Modern	Legacy	Modern
HCA	TBD	TBD	TBD	TBD	TBD	na
MCA Class 4	TBD	TBD	TBD	TBD	TBD	na
MCA Class 3	TBD	TBD	TBD	TBD	TBD	na
MCA Class 2	TBD	TBD	TBD	TBD	TBD	na
MCA Class 1	TBD	TBD	TBD	TBD	TBD	na

**Some state requirements exceed Part 192. For example:
- Pressure test at 150% MAOP to establish MAOP, or
- All gas transmission (GT) to be classified and constructed to Class 4 requirements, or
- Define as GT if MAOP>125 psig, etc.

Integrity Verification Process (IVP) Chart

Consideration of State-Specific Requirements

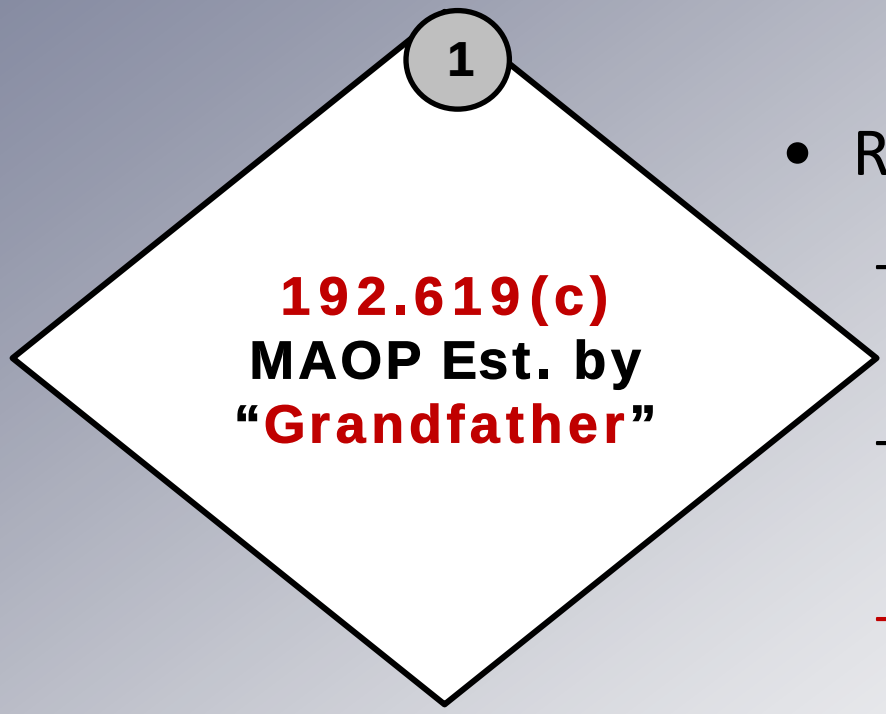
1. **Determine Jurisdiction (State/Federal)**
2. **Identify State-Specific Rules****
3. **Adjust Screening Criteria 1-8 Accordingly**

- ****Some states have requirements that exceed federal regulations, e.g.,**
  - Pressure Test (PT) at 1.5 times Maximum Allowable Operating Pressure (MAOP)
  - All GT to be classified as Class 4 location
  - GT pipeline if MAOP > 125 psig
- Process must account for those differences

Draft Process Step 9 HCA/MCA Screen

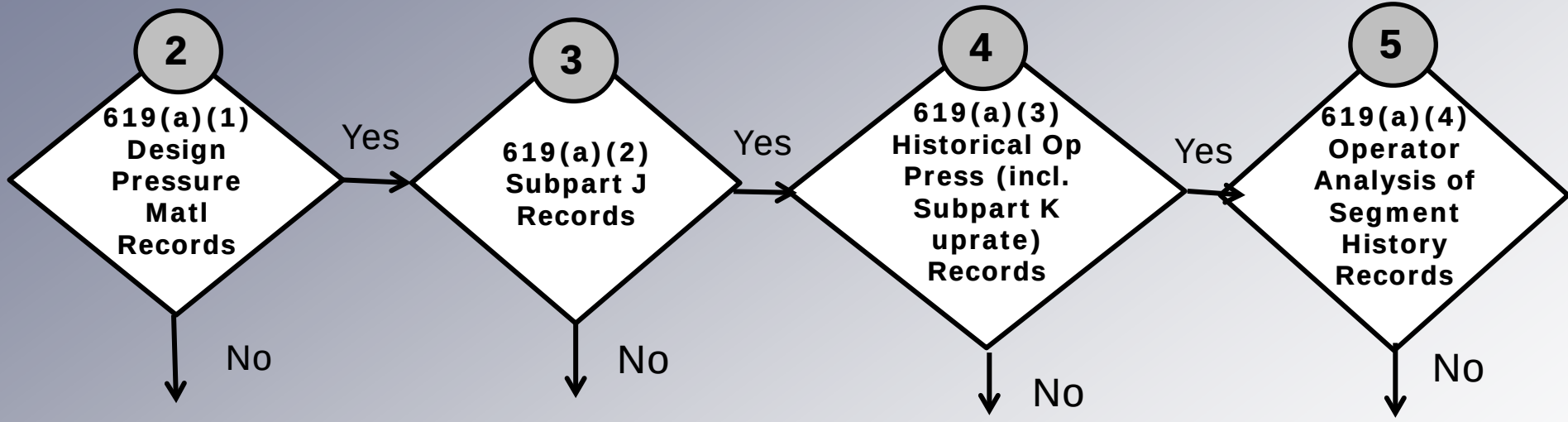
- A major screening criterion is location risk (HCA or MCA)
- Even though listed on the draft flow chart as **Step 9, the HCA/MCA screening step may be accomplished first.**
- HCA/MCA screen should be done first to avoid exhaustive and expensive documentation review for segments that are screened out by virtue of low location risk
- PHMSA Estimates **~ 91,000 miles HCA/MCA miles (out of ~ 300,000)**

Draft Process Step 1
Grandfather Clause Screen

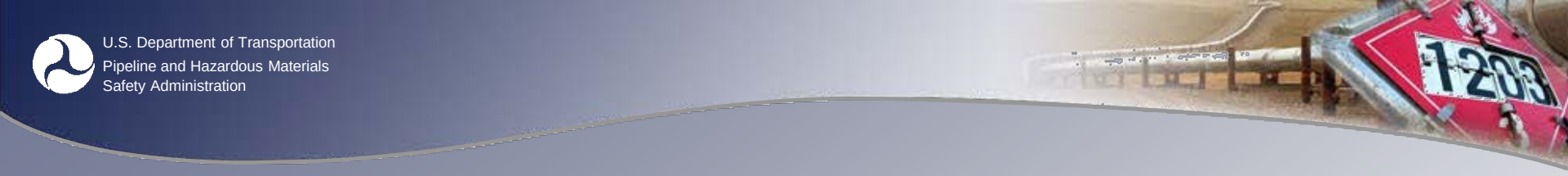


- Related Mileage
  - 22,717 miles reported as Grandfathered MAOP (192.619(c))
  - 32,403 miles reported for MAOP (192.619(a)(3))
  - Estimated **14,000 HCA/MCA Miles** for 192.619(a)(3) and 192.619(c) MAOP

Draft Process Steps 2-5 Inadequate Records Screen



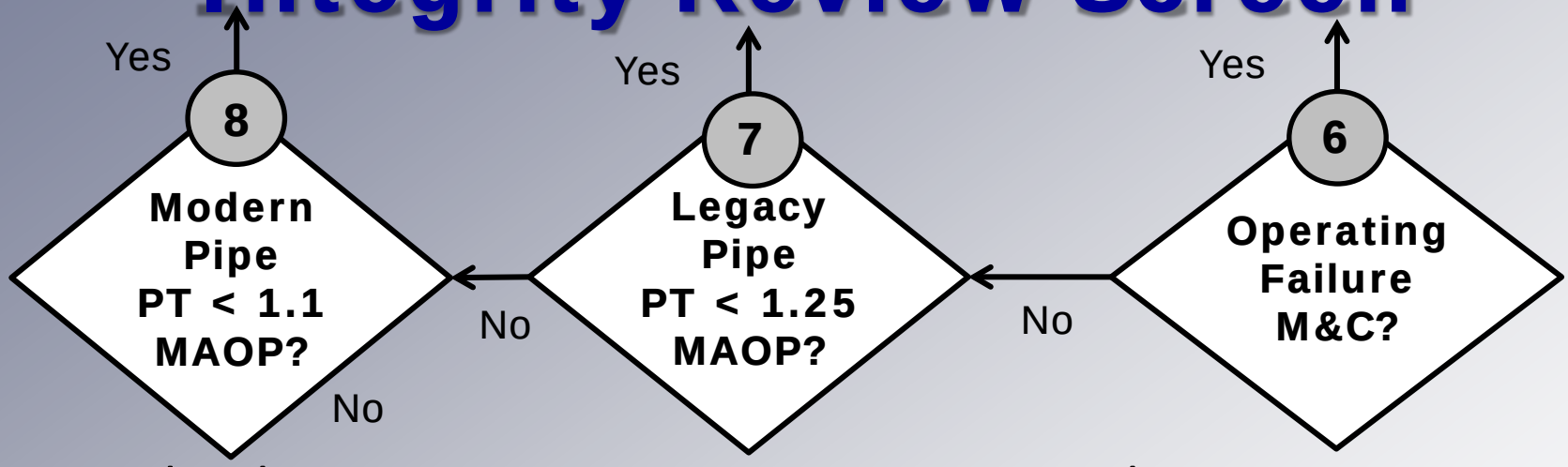
- Historical Operating Pressure (a)(3) and Analysis of Other Factors (a)(4) were needed when code first established
- IVP process - Design Records (a)(1) and Pressure Test (a)(2) are the most important



Process Steps 2-5 Related Mileage

- 5,400 Miles Reported with Incomplete Records (HCA, Class 3, Class 4 Only)
- 7,700 Estimated Class 1 and 2 MCA Miles with Incomplete Records
- 13,100 Estimated Total HCA/MCA Miles with Incomplete Records

Draft Process Steps 6-8 Integrity Review Screen

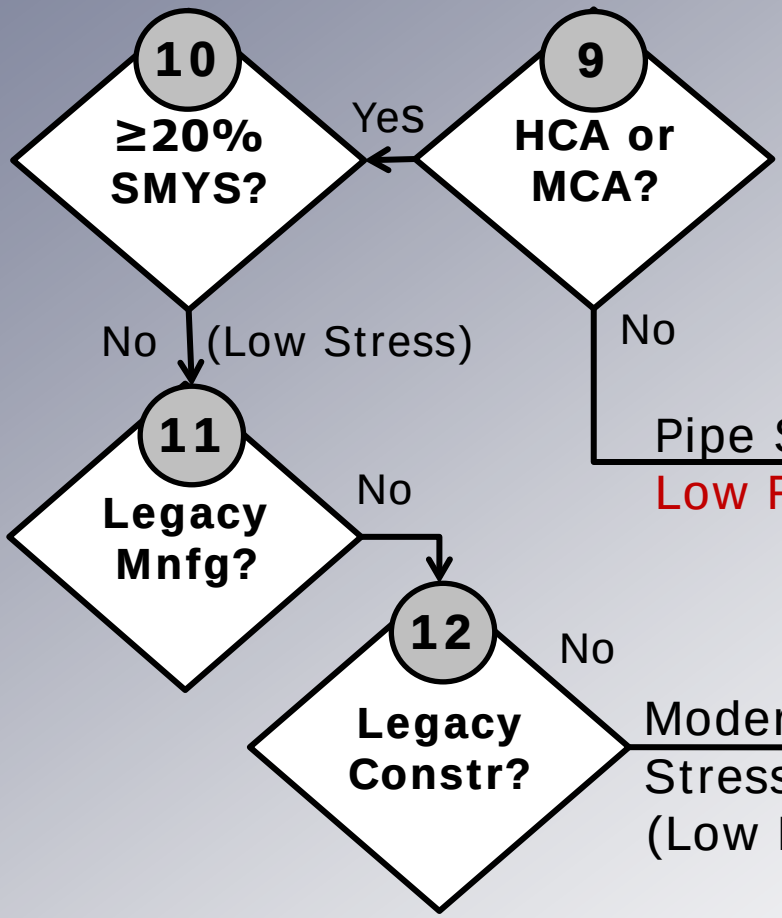


- Total Mileage PT < 1.25 MAOP ~ 113,000 miles
  PHMSA estimates ~ 27,000 miles in HCA/MCA
- Pipe mill pressure test not allowed
- Historical Manufacturing & Construction (M&C) failures of the segment.
- Propose to revise 619(a) to require min. 1.25 x MAOP pressure test for new pipe (to address NTSB issue for new pipe)

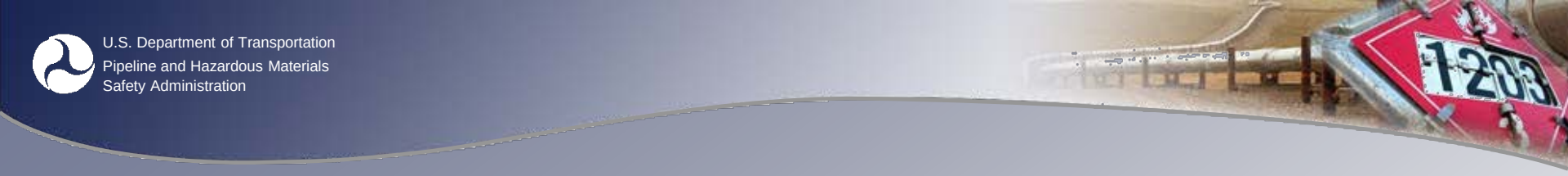
Definitions

- ***Legacy Pipe*** means LFERW, SSAW, Flash Weld (AO Smith), or pipe w/ joint factor < 1 (e.g., lap welded pipe)
- ***Modern Pipe*** means pipe not manufactured with any techniques listed under Legacy Pipe
- ***Legacy Problematic Construction Techniques*** means wrinkle bends, miter > 3 degrees, Dresser Couplings, non-standard fittings, arc welds, oxyacetylene welds, bell spigots, puddle weld repairs, etc.
- ***Transmission line*** means a pipeline, other than a gathering line, that: (1) Transports gas from a gathering line or storage facility to a distribution center, storage facility, or large volume customer that is not down-stream from a distribution center; (2) operates at a hoop stress of 20 percent or more of SMYS; or (3) transports gas within a storage field.

Draft Process Steps 9-12 Location and Low Stress Screen



- Previously Discussed HCA/MCA
- 20% SMYS consistent with Part 192 definition of GT



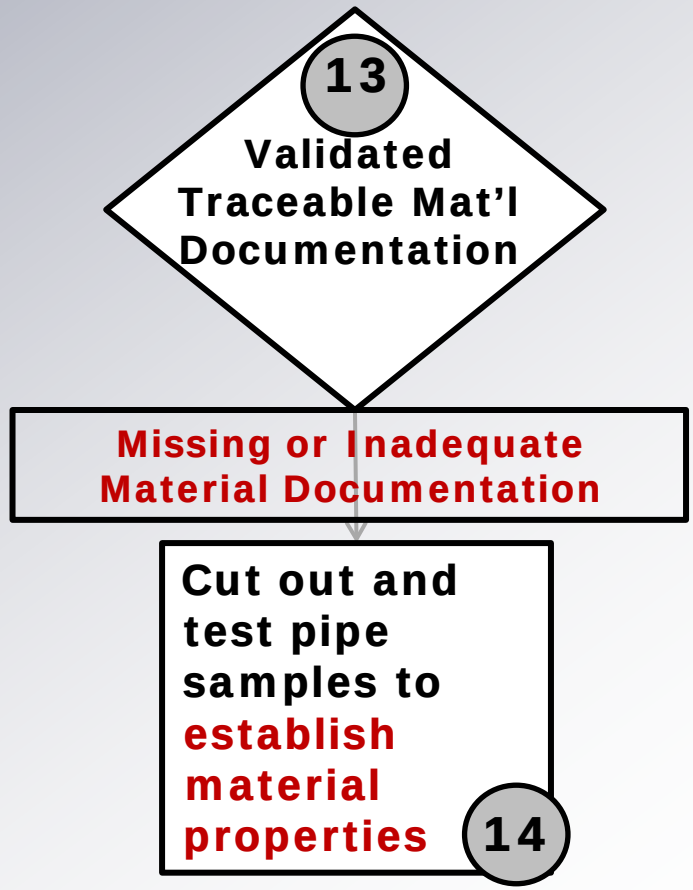
Draft Process Steps 1-12 Anticipated Scope Based on 2012 Annual Report Data

- PHMSA estimates approximately 33,000 miles of GT pipe (approximately 11% of total GT mileage) would meet screening criteria & require IVP assessment to establish MAOP

Draft Process Steps 13-14 Material Documentation

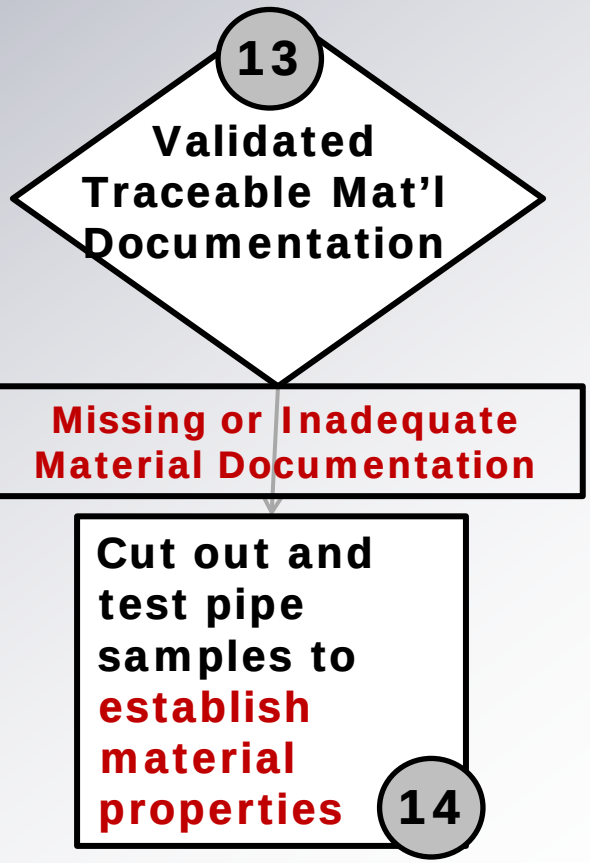
Notes:

1. Material Documentation Required for Pipe, Valves, Flanges, Fittings, & Components
2. Validated material properties required for X42 and greater & pipe ≥ 2“ OD if on mainline



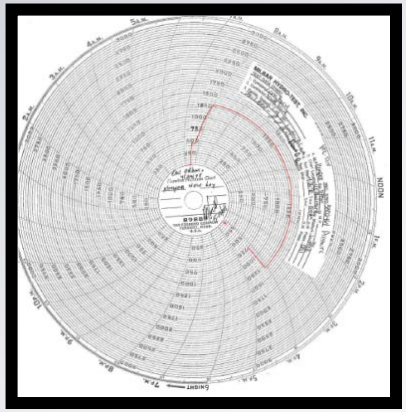
Draft Process Steps 13-14 Material Documentation (cont.)

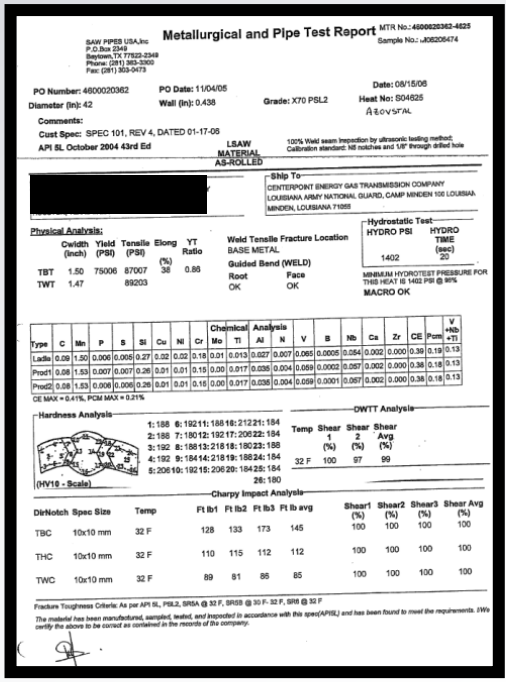
3. Valves and Components (ANSI Rating)
4. Cutouts each XX joints or X miles
5. Use *in situ* NDE, if validated
6. Not required for short segments
7. Each Unique Combination of Pipe Type, Seam, Vintage



Why are pipeline material records needed?

- To establish design and maximum operating pressures (MAOP)
- For integrity management (IM) programs
- 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) 303-0473

MTR No.: 4600020362-4625
Sample No.: J05206474

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: Removal
Cust Spec: SPEC 101, REV 4, DATED 01-17-06
API 5L October 2004 43rd Ed LSAW MATERIAL AS-ROLLED
100% Weld seam inspection by ultrasonic testing method; Calibration standard: N5 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

Type	C	Mn	P	S	Si	Cu	Ni	Cr	Chemical Analysis 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: 186 9: 188 10: 192 11: 188 12: 192 13: 218 14: 218 15: 219 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(APR5L) and has been found to meet the requirements. I/We certify the above to be correct as contained in the records of the company.

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

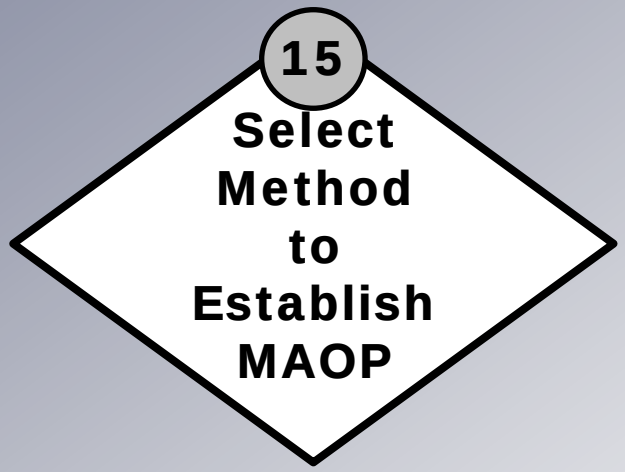
Code Requirements - MAOP

- **Code - Gas Pipeline**
  - **MAOP Determination**
    - 192.105 – Design Pressure
    - 192.619 & 192.620 - MAOP
    - Subpart J – Pressure 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

Material Documentation Records Management

- **Materials manufactured in accordance:**
  - 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 external pressures and anticipated loads
  - Designed for service and class location
  - Must be able to verify: diameter, wall thickness, grade and seam type
- **Integrity Management (IM)**
  - Predicted failure pressure of defects
  - Risk analysis

Draft Process Step 15
Select Method to Establish MAOP



- PHMSA proposes four approaches that operators could select based on case-specific considerations:
  - Pressure Test, with Spike Test
  - Derate Pipeline MAOP (commensurate with margin obtained from PT)
  - Replace pipe
  - ILI/ECA Program (equivalent to PT)

Draft Process Step 16 Pressure Test Option

Perform Subpart J Pressure Test Supplemented with "Spike" Pressure per NTSB P-11-14

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- **Pressure Test with "Spike Test"**
  - NTSB Recommendation P-11-14
  - Spike test to clear cracks and crack-like defects, including M&C defects
  - Spike test parameters, TBD
    - Spike pressure as a % of SMYS (e.g., 100% SMYS, 105% SMYS)
    - Spike hold time (min. 30 min. to 1-hour)

Draft Process Step 17
De-rate Option

MAOP De-Rate Option

- De-rate option treats recent operating pressure as pressure test alternative.
- Set MAOP at least 20% below recent operating pressure
- Specific parameters - TBD
  - Look back period
  - Continual pressure period
- Future Uprate per Subpart K Allowed

De-rate Pipeline Commensurate with Class Location and Perform Remaining Life Fatigue Analysis. Future Uprating allowed per Subpart K
OR
Replace Pipe

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Draft Process Step 17 Replace Option

Replacement Option

- Most costly
- Ultimate solution
- Could also address other issues based on case-specific circumstances

Derate Pipeline Commensurate with Class Location and Perform Remaining Life Fatigue Analysis. Future Uprating allowed per Subpart K
OR
Replace Pipe

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Draft Process Steps 18-19 Engr. Critical Assessment Option

Assessment and Analysis to Establish Material Condition of Pipeline and MAOP, commensurate with segment-specific issues and documentation shortcomings.
Assessment could include, as appropriate, specific assessments such as:

- **ILI Program**
- **CIS**
- **Coating Survey**
- **Interference Survey**
- **Engineering Critical Assessment**

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Based on Results Take Appropriate Action to Est. MAOP

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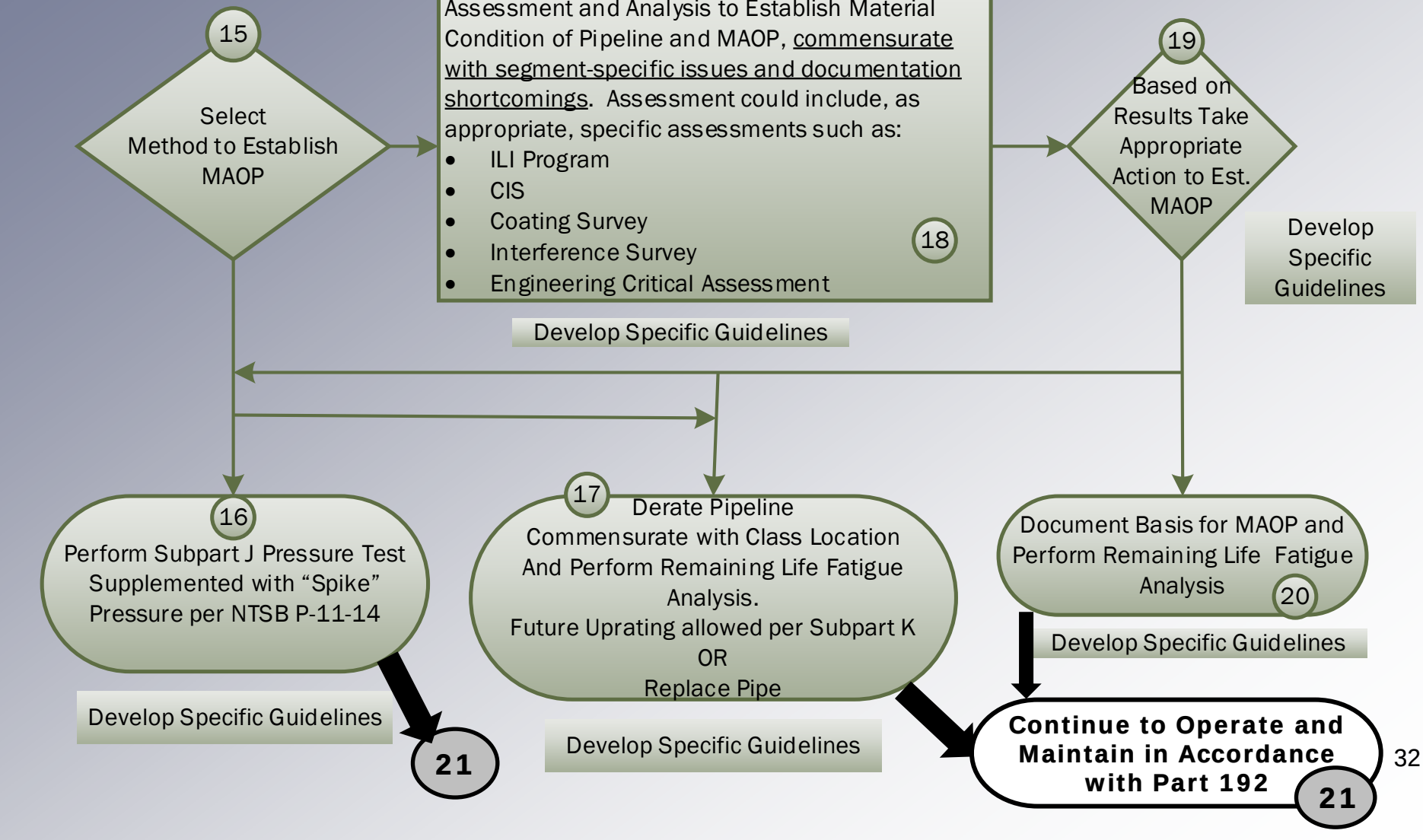
- Key point is assessment and analysis **commensurate** with segment specific issues and documentation shortcomings.
- E.G., segment with good PT but is missing some design records, might need only material documentation (ILI or other assessments might not be needed in this case).

Draft Process Steps 18-19 Engr. Critical Assessment (cont.)

- PHMSA developing specific ILI, assessment, and analysis reqts.
- Maximize technology to provide highest practical level of assurance given the state-of-the-art
- Comprehensive ILI program required in most cases absent a valid, documented pressure test
  - ILI program supplemented by other assessments, analysis, or revised repair criteria to demonstrate equivalency to pressure testing with respect to mitigating latent Materials & Construction defects.
  - Appropriate ILI crack tools, or combination of tools, required in addition to typical MFL/deformation tools
    - Needed to identify seam defects, girth weld defects, and tight cracks,
    - e.g., UT, TFI, or EMAT Tools

Assessment & Analysis - Steps 15-21



Approach Issues: Limitations of Pressure Testing

- Technical (Conventional Industry Issues)
  - produces little information about pipe condition
  - could grow or destabilize defects
  - could result in “pressure reversal” (adding spike pressure could mitigate)
- Technical (R&D)
  - ongoing R&D suggests that above issues might be less valid than previously believed
- Operational
  - requires service disruptions in many/most cases

Approach Issues: Limitations of ILI

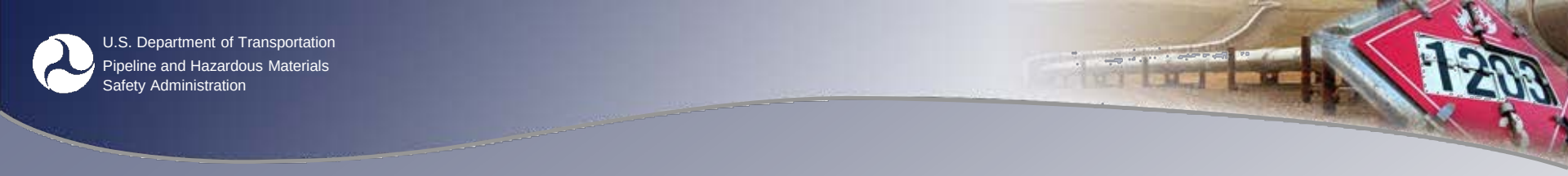
- Technical
  - provide much more detailed information about potentially injurious latent defects. *However…*
  - state-of-the-art limits assurance that all such defects will be detected and that detected defects will be accurately characterized (especially for cracks and seam defects).
- Operational
  - Cannot be accomplished for some lines that are not piggable

Specific Guidelines & Criteria

- IVP Chart is high level concept
- Details and specifications under development
  - Will use knowledge from workshop and comments on web site to develop details
- For Example:
  - Spike pressure test specs (pressure, hold time, etc.)
  - De-rate criteria (amount of MAOP reduction)
  - ILI program requirements and specifications
  - Material verification specs (# of cutouts, etc.)

Target Completion Timeframes

- Implementation Timeframe
  - Multi-Year Effort
  - Graduated timeframes with priority to:
    - Legacy pipe segments
    - HCAs
    - High Stress segments
- Proposed deadlines under development
  - Reasonableness in light of 2012 Annual Report data and estimated scope



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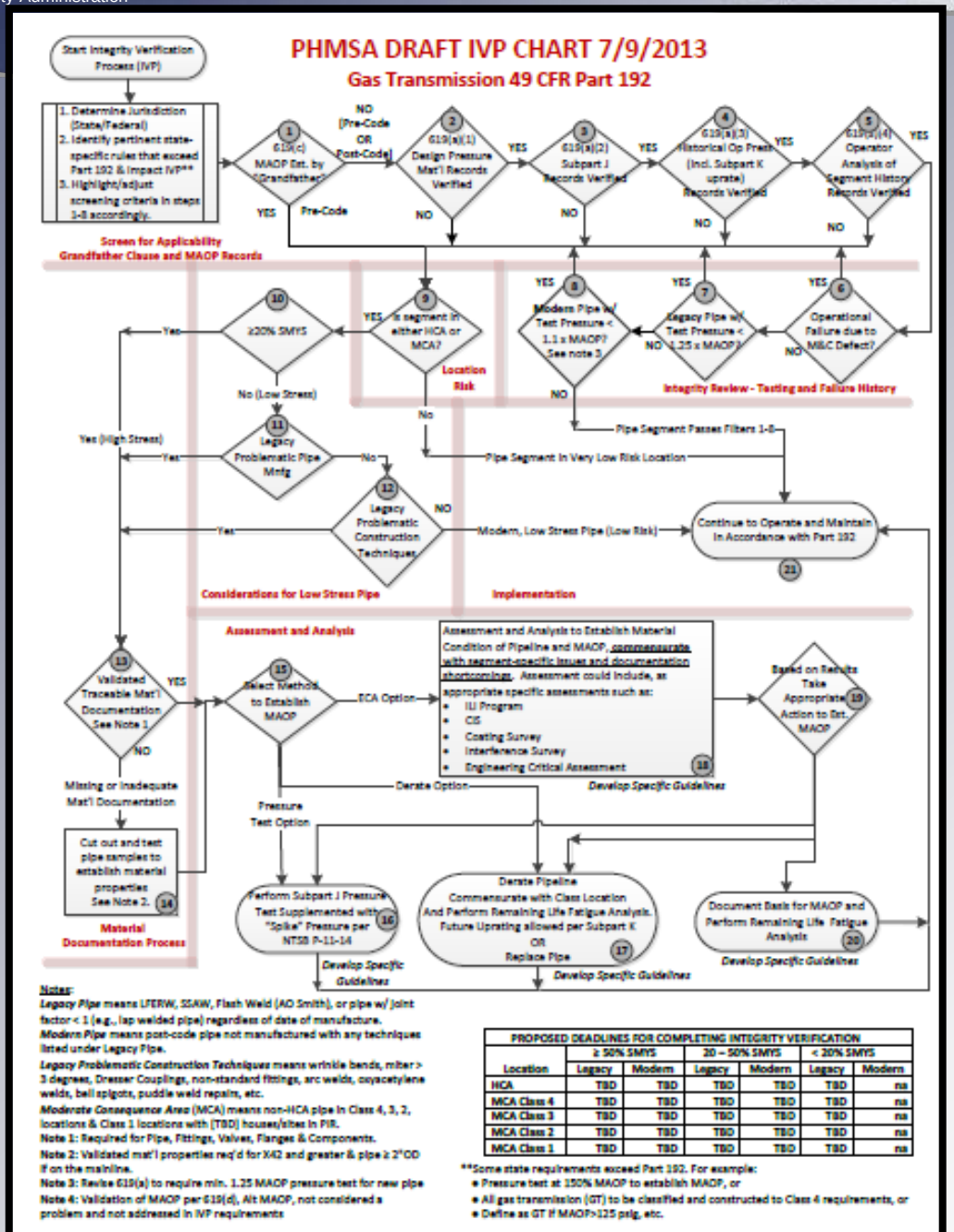
Note: Deadlines to be Reviewed after 2012 Annual Report data Received and affected pipe population known



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MCA Class 2	TBD	TBD	TBD	TBD	TBD	na
MCA Class 1	TBD	TBD	TBD	TBD	TBD	na

**Some state requirements exceed Part 192. For example:

- Pressure test at 150% MAOP to establish MAOP, or
- All gas transmission (GT) to be classified and constructed to Class 4 requirements, or
- Define as GT if MAOP>125 psig, etc.

Questions?

Thank you

Steve Nanney

US DOT / PHMSA

(713) 272-2855 office

steve.nanney@dot.gov

811 Know what's below. Call before you dig.

PHMSA Your Safety Our Mission