Data gaps in pipeline risk assessment and the role of ASME Codes and Standards

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Topics to discuss

- Role of ASME Codes & Standards support for PHMSA regulatory process
- Issues around data gaps in pipeline risk assessment:
  - Defining data quality
  - Effect of data gaps on risk assessment
- Potential for ASME contribution to solutions
  - Handling uncertainty
  - Reducing uncertainty
  - Preventing uncertainty

How the ASME process works

- Accredited by American National Standards Institute (ANSI)
- Standards committees must have balanced membership
- Committee membership is individual, not corporate
- Committee meetings are open to the public
- All standards development and revisions by consensus ballot process
- All technical objections on ballots must be resolved
- Must respond to public inquiry or comment
- Standards must be periodically revised

Standards and regulations

ASME B31.4/B31.8

- Technical standards
- Written by engineers for engineers and designers
- Concerned with safety

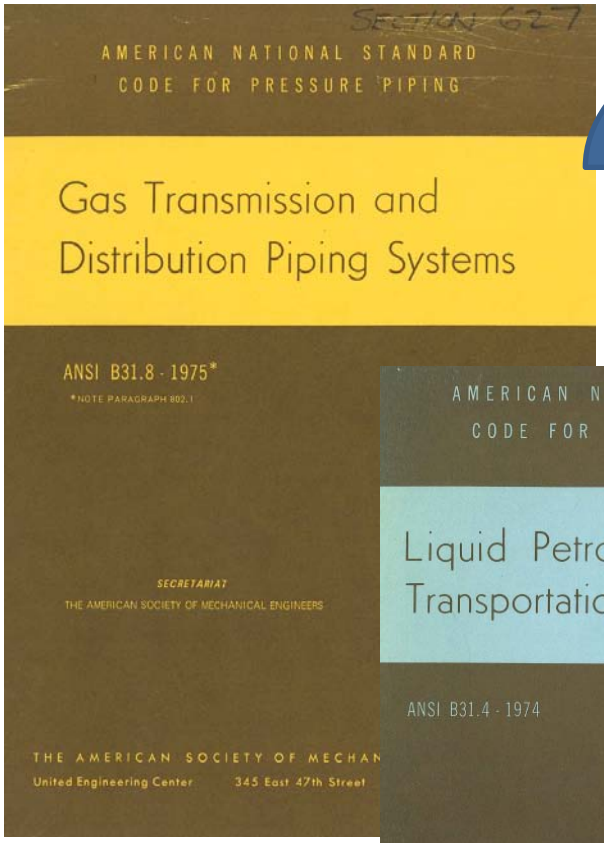
Part 192/195

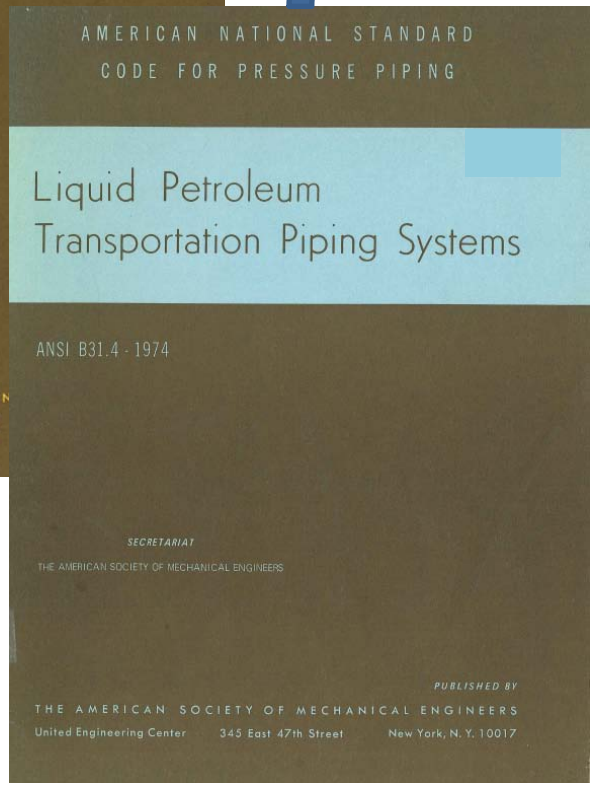
- Regulations
- Written by regulators for inspectors and enforcement
- Concerned with safety

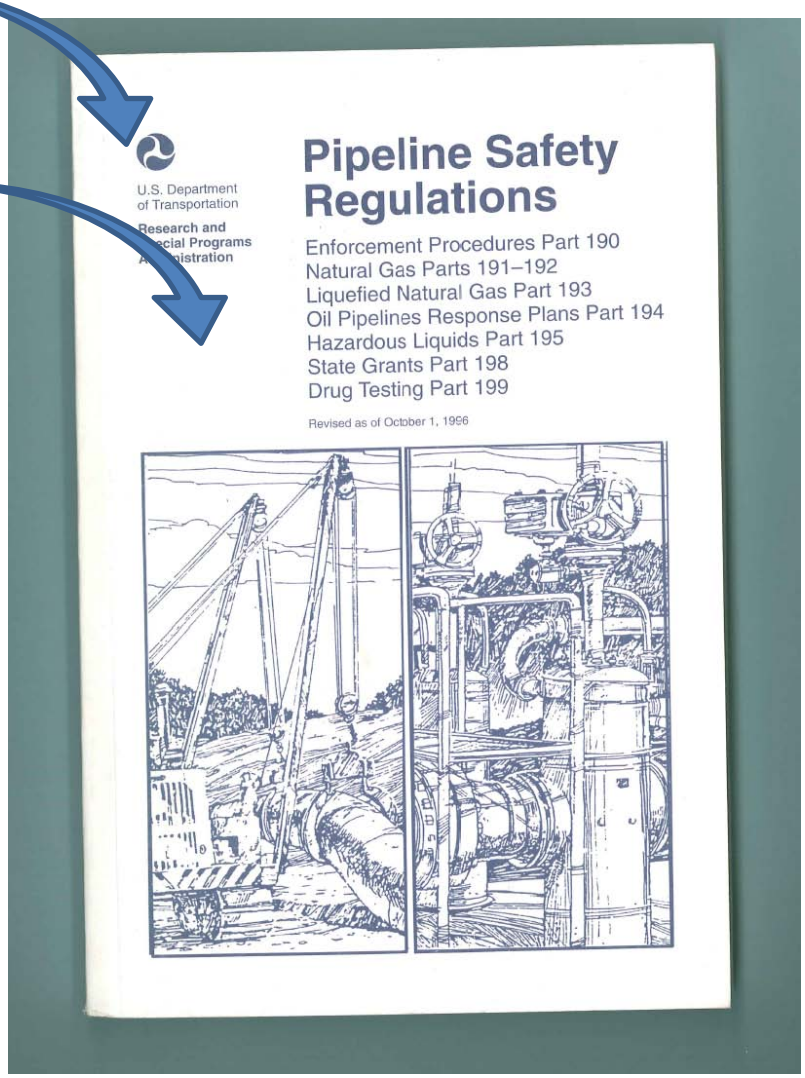
Roles of Codes and Standards with respect to pipeline regulations

- Technical content for incorporation into regulation by reference
- Technical tools for compliance with nontechnical regulatory requirements
- Technical guidance where regulations are silent
- Point the way for regulatory evolution

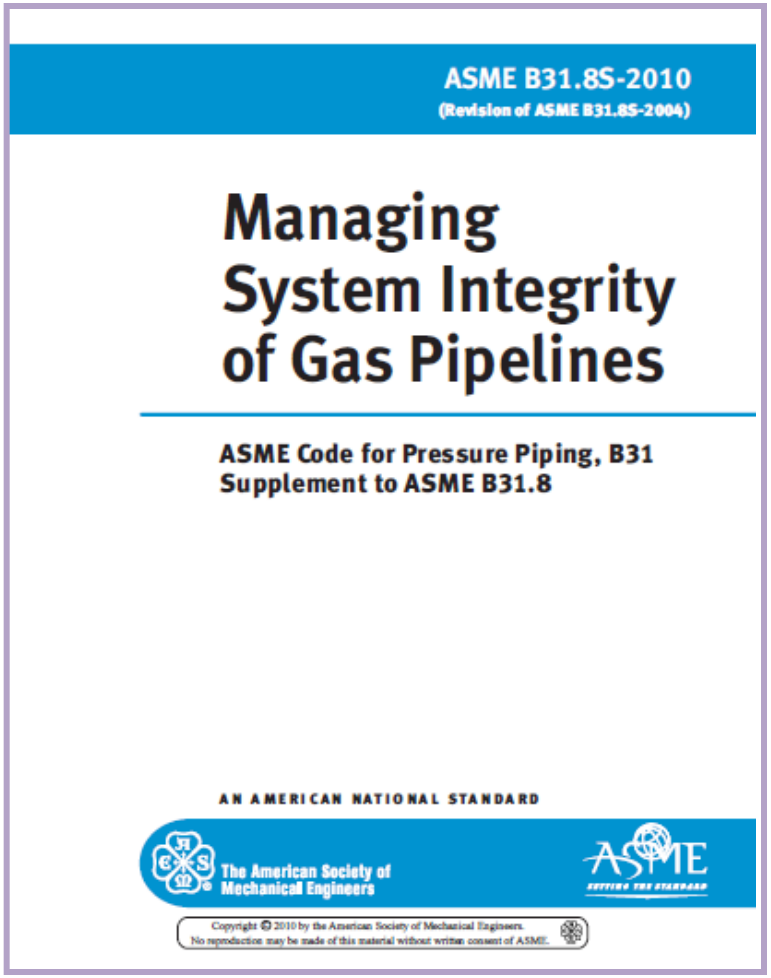
A history of contribution

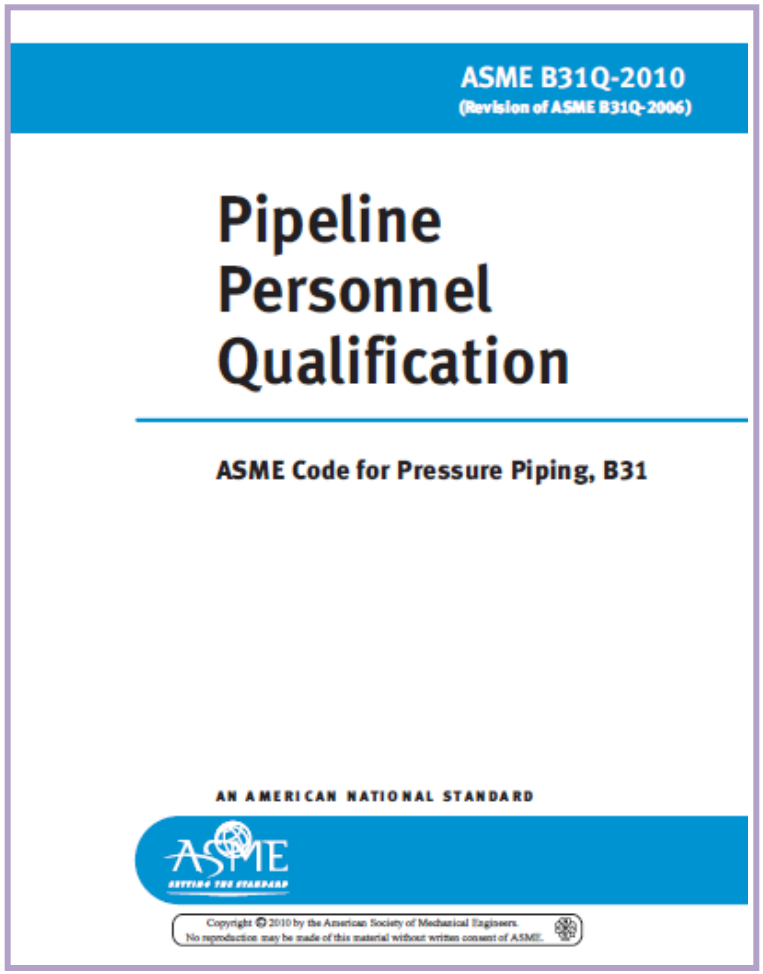






Recent examples





- Not to mention B31G and B16 standards

What is a risk assessment

- Per B31.8-S, §2.3.3, "…the risk assessment process identifies the location-specific events and/or conditions that could lead to a pipeline failure, and provides and understanding of the likelihood and consequences of an event."
- Risk assessment is required in 49 CFR 192.917(c) and 195.452(i)
- The purpose is to focus and prioritize integrity management activities

Data and Risk Assessment

- A key reason for the failure of a risk assessment to lead to appropriate decisions is poor data quality.
- No risk assessment model can compensate for “bad” data (i.e. wrong data, missing data, or inappropriate defaults)
- B31.8-S, §5.6.2: “Inaccurate data will produce a less accurate risk result.”

Evaluating data quality

- Prior to pipeline regulations, there was no mandated level for acceptable records.
- Then DOT allowed not much more than operating history (grandfathered lines).
- Now that may not be good enough. Data QA systems adequate for today's data needs are inadequate in the future as we identify data that previously was thought unimportant.
- B31.8-S §4.4 discusses data quality, but gives no specific guidance.
- Can pipeline data quality be evaluated using consistent measures? Is that useful, or burdensome?

Data quality attributes

Accuracy	Agreement with correct values
Completeness	Values are present where needed
Consistency	Logical coherence with facts, without contradiction
Precision	Exact within bounds of what is needed
Reliability	Permits correlation or comparison with other data
Temporality	Recognize changes in meaning/applicability over time
Uniqueness	Each value is the same wherever it is used
Validity	Data presents a low probability of error

Ref: Paprani & Ernst, "A Model for Data Quality Assessment"

Evaluating data quality

- Other industries rely on data for risk assessment:
  - Environmental sciences
  - Aviation
  - Process and offshore
  - Economics and banking
- What do those industries do about
  - Handling uncertainty?
  - Reducing uncertainty?
  - Minimizing uncertainty?

Compensating for data gaps

- B31.8-S, §5.6.2:
  - “The operator should choose default values that conservatively reflect the values of other similar segments on the pipeline or in the operator’s system. These conservative values may elevate the risk of the pipeline…”
- Excessively “conservative” default assumptions
  - populates risk input data and risk results with unrepresentative values;
  - overestimates the real risk;
  - could misdirect attention to false threats and away from a real threats.

Eastern Airlines Flight 401

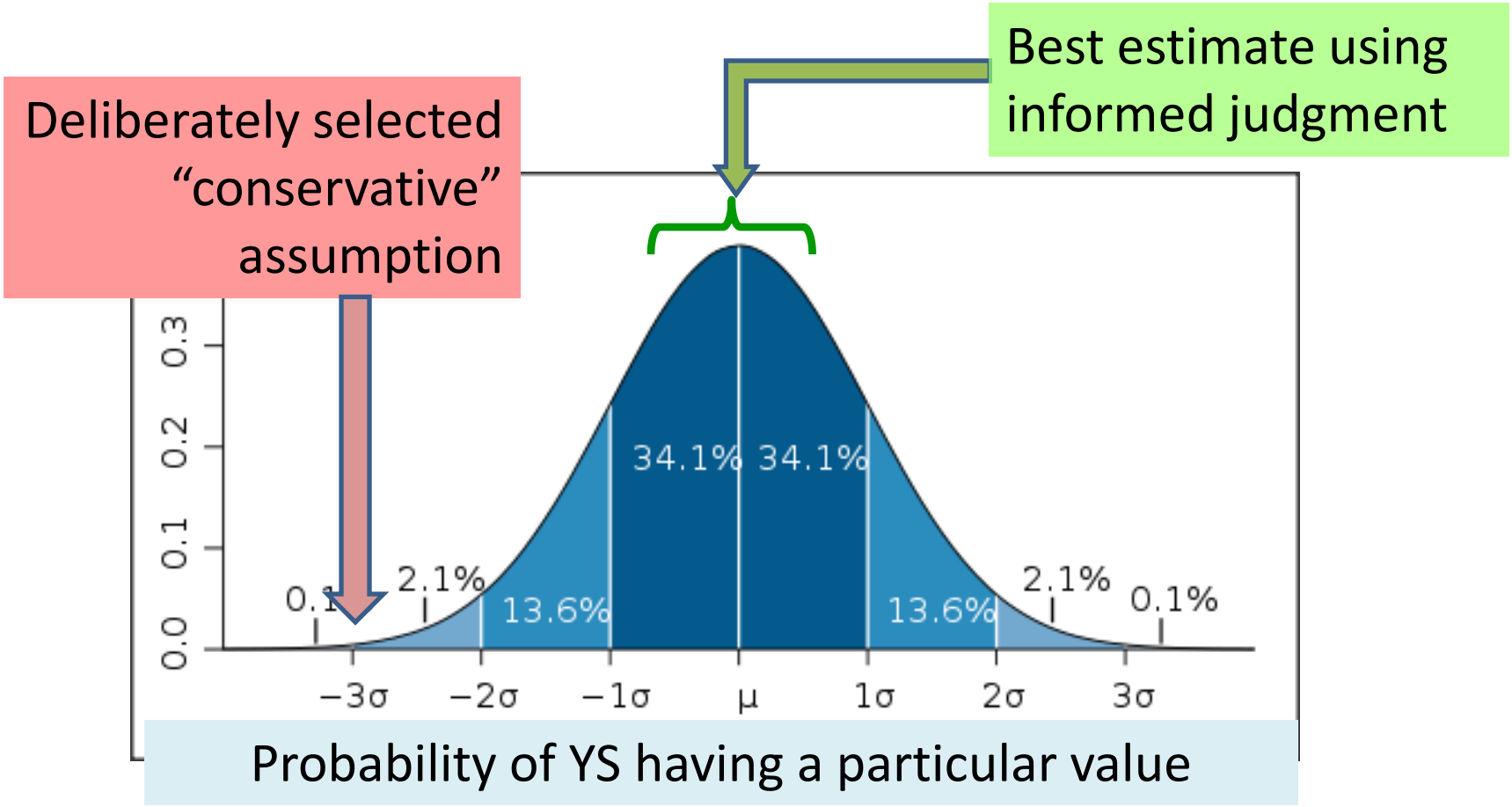
- 12/29/72, EA401 L-1011 crashed in Everglades swamp 19 miles short of Miami Int’l Airport
- From NTSB report: “Preoccupation with a malfunction of the nose landing gear position indicating system distracted the crew's attention from the instruments and allowed the descent to go unnoticed.”
- In other words, crew was distracted by a false threat and failed to recognized the real threat.

Pipeline example

- The yield strength (YS) of a pipeline segment is not documented. The pipe is 12.75” OD installed in 1950. The operator selects a worst-case YS of 24 ksi for the unknown pipe.
- YS=24 ksi corresponds to wrought iron pipe. It is implausible that pipe is actually wrought iron, and highly unlikely to be less than Grade B or better.
- Operating stress taken as 1.5 to 2.2 times higher %SMYS than it actually is, falsely elevating calculated risk for corrosion, SCC, seams.

Data gaps

- Cannot accurately assess risk with missing data
- Cannot accurately assess risk with wrong data



Handling uncertainty

- In a rigorous statistical risk assessment where data is not known a best guess value would be used with a higher value for uncertainty.

- With relative risk assessment models the uncertainty might be dealt with by evaluating sensitivity of results to a *reasonable* range of variations reflecting the uncertainty.

Reducing uncertainty

- Confidence can be increased, or uncertainty reduced, by enhanced data mining such as:
  - In-situ hardness testing to estimate YS & TS
  - In-situ spot checks of wall thickness (WT), or in-line inspection (ILI) to verify WT or changes in WT
  - In-situ spot checks to determine or confirm seam type
  - ILI to confirm seam condition by detecting important defects
- Sampling rate could reflect goal (determine a probable unknown vs confirm what is expected)
- Codes and regulations currently discourage in-situ sampling with infeasible requirements

Minimizing uncertainty

- Future uncertainty can be minimized by enhanced recordkeeping going forward
- Precedents exist in other ASME standards:
  - ASME B&PV Section III (Nuclear Power Plant Components), Subsection NCA, General Requirements, Article NCA-4134.17 “QA Records”
  - ASME B&PV Section XI (In-Service Inspection of Nuclear Power Plant Components), Article IWA-6000 “Records and Reports”
- Some uncertainty will always exist

Enhanced recordkeeping

- BPV III, NCA-4134.17 (1 page)
  - Table of Lifetime QA records
  - Table of Nonpermanent QA records
- BPV XI, IWA-6000 (2 pages)
  - Owner and contractor responsibilities
  - Maintenance of records
  - Reproduction, digitizing, microfilming
  - Construction records per NCA-4134.17
  - In-service inspection records
  - Repair/replacement activity records

Possible role for ASME

- Develop *processes* and *criteria* for
  - Evaluating data quality and accepting data
  - Handling uncertainty through appropriate defaults and risk analysis techniques
  - Reducing uncertainty through data mining
  - Minimizing future uncertainty through enhanced records retention requirements
- Revise B31.4, B31.8, and B31.8-S accordingly using language that can be referenced by Parts 192 and 195.

What will be required

- Communication of regulatory needs with respect to standards content
- Improve cooperation and engagement between regulator and standards-writing body in setting goals and developing content
- Build consensus within the standards body and the regulator
- Execute ASME/ANSI standards process
- Execute the rulemaking process

End of presentation.
Thank you.