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Comparison for Assessment of Pipeline Integrity with ASME B31.8 and ASME B31.G

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Abstract

Integrity assessment is a critical process in the oil and gas industry to prevent pipeline failures such as leaks or ruptures. This study evaluates a gas pipeline's integrity using two assessment methodologies: the conventional design code (ASME B31.8) and the defect-specific method (ASME B31G). An in-line inspection (ILI) conducted in June 2024 revealed the maximum corrosion depth with a depth-to-thickness ratio (d/t) of 0.35. The design code assessment classified the pipeline as potentially unsafe due to wall thickness falling below the minimum requirement. In contrast, the ASME B31G assessment showed the pipeline could safely withstand the design pressure. The comparison highlights the conservative nature of design codes and underscores the importance of defect-specific assessment in accurately determining residual life and optimizing maintenance strategies.

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Abstrak

Penilaian integritas merupakan proses penting dalam industri minyak dan gas untuk mencegah kegagalan pipa seperti kebocoran atau ruptur. Studi ini mengevaluasi integritas pipa gas menggunakan dua metode penilaian: kode desain konvensional (ASME B31.8) dan metode berbasis cacat spesifik (ASME B31G). Inspeksi internal (ILI) yang dilakukan pada Juni 2024 mengidentifikasi korosi maksimum dengan rasio kedalaman terhadap ketebalan (d/t) sebesar 0,35. Penilaian menggunakan kode desain menyatakan pipa dalam kondisi berpotensi tidak aman karena ketebalan dinding berada di bawah batas minimum yang dipersyaratkan. Sebaliknya, penilaian dengan ASME B31G menunjukkan bahwa pipa masih mampu menahan tekanan desain dengan aman. Perbandingan ini menunjukkan sifat konservatif dari kode desain dan menekankan pentingnya penggunaan metode penilaian berbasis cacat spesifik untuk menentukan sisa umur layanan secara lebih akurat dan mengoptimalkan strategi pemeliharaan.

1. BACKGROUND

In the oil and gas sector, conducting integrity assessments is essential for evaluating the structural health of pipelines and preventing catastrophic failures.The repair of corroded pipelines is essential for the transportation of fluids under high pressure (Abtahi *et al*, 2024). These assessments often rely on non-destructive testing (NDT), such as ultrasonic testing (UT), to obtain actual wall thickness data.The combination of several NDT methods can enhance the accuracy of detection and the reliability of inspection (Alwahidi *et al*, 2025) The collected inspection data may be analyzed using design codes (e.g., ASME B31.8),

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Fitness-for-Service (FFS) s.tandards (e.g., ASME B31G or API 579), or risk-based inspection (RBI) methodologies.ASME B31G provides the most basic and widespread method in assessing the remaining strength of corroded pipelines (Ma *et al*., 2011).

According to Indonesian regulation (Permen ESDM No. 32 Tahun 2021), residual life estimation may utilize fitness-for-service analysis or other methods depending on equipment type. Process calculation and analysis by using the remaining life assessment and fitness for services method according to API 579-1/ASME FFS-1 for the process piping area (Purwidyasari *et al*., 2023). While design code checks provide conservative results by assuming uniform corrosion along the entire length, this approach may underestimate the actual residual life. Conversely, ASME B31G considers localized corrosion defects, offering a more precise and often less conservative estimate. In the opinion of Husen *et al*., (2024), A high corrosion rate causes the service life of the pipe to become shorter.The occurrence of corrosion will cause a material to experience a decrease in quality (Zulfri *et al.*, 2023).

This paper presents a comparative analysis of a gas pipeline segment's integrity using the ASME B31.8 design code and ASME B31G methodology.

2. METHODOLOGY

A gas transmission pipeline transporting sales gas was assessed. The key specifications are:

- Design Pressure: 1,150 psi
- Operating Temperature: 20–40°C
- Material: API 5L PSL 2 X52
- Outer Diameter: 12.75 in
- Nominal Wall Thickness: 0.5 in (12.7 mm)
- Location Class: 2 and 3
- Commissioned: April 2021
- Inspection Method: ILI-MFL (June 2024)

The inspection revealed a maximum corrosion depth with a d/t ratio of 0.35 and longitudinal length (L) of 48 mm, corresponding to a minimum remaining wall thickness of 8.25 mm. Figure below shows the reported corrosion anomaly from ILI.

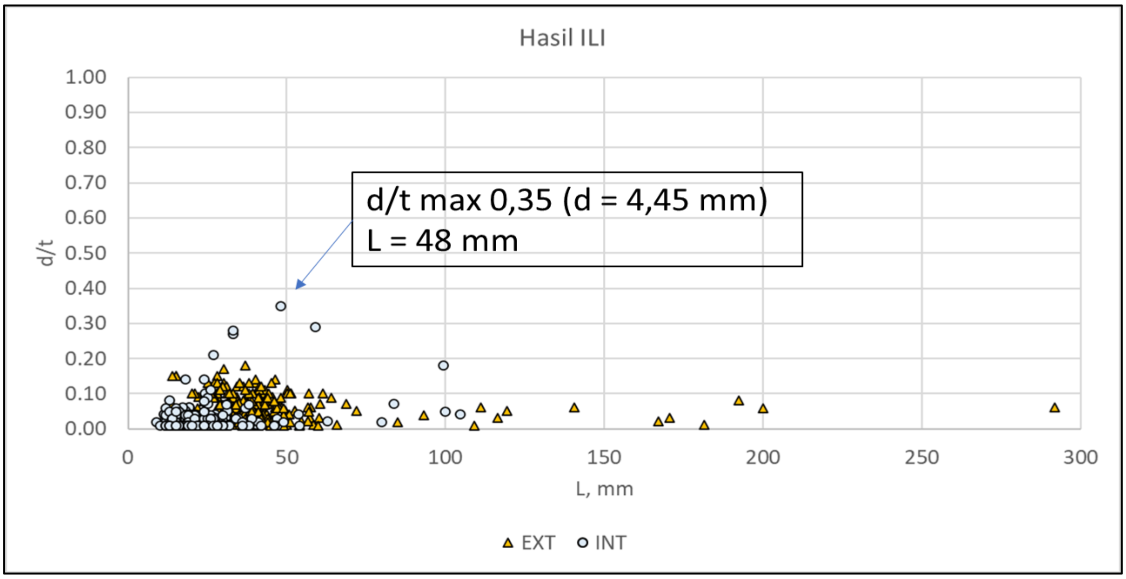

Figure 1.
Reported anomaly from inspection

2.1 Design Code: Asme B31.8

Minimum thickness as per design code ASME B31.8, t_{min}, is calculate with equation below.

$$t_{min} = \frac{P \cdot D}{2 \cdot S \cdot F \cdot E \cdot T} \quad \text{.....} \quad (1)$$

Where:

- S = 52,200 psi (SMYS)
- F = 0.5 (design factor for Location Class 3)
- E = 1 (joint efficiency)
- T = 1 (temperature derating)

This results in a required minimum thickness of 9.02 mm.

2.2 Asme B31.G Assessment

ASME B31G evaluates individual corrosion defects using remaining strength calculations. Both the Original and Modified B31G formulas were applied. The failure pressure (Ps) and safe operating pressure are calculated based on defect geometry (depth and length), material strength, and pipeline dimensions.

Figure 2 presents the allowable defect size envelope. If the corrosion defect falls within this envelope, it is considered acceptable.

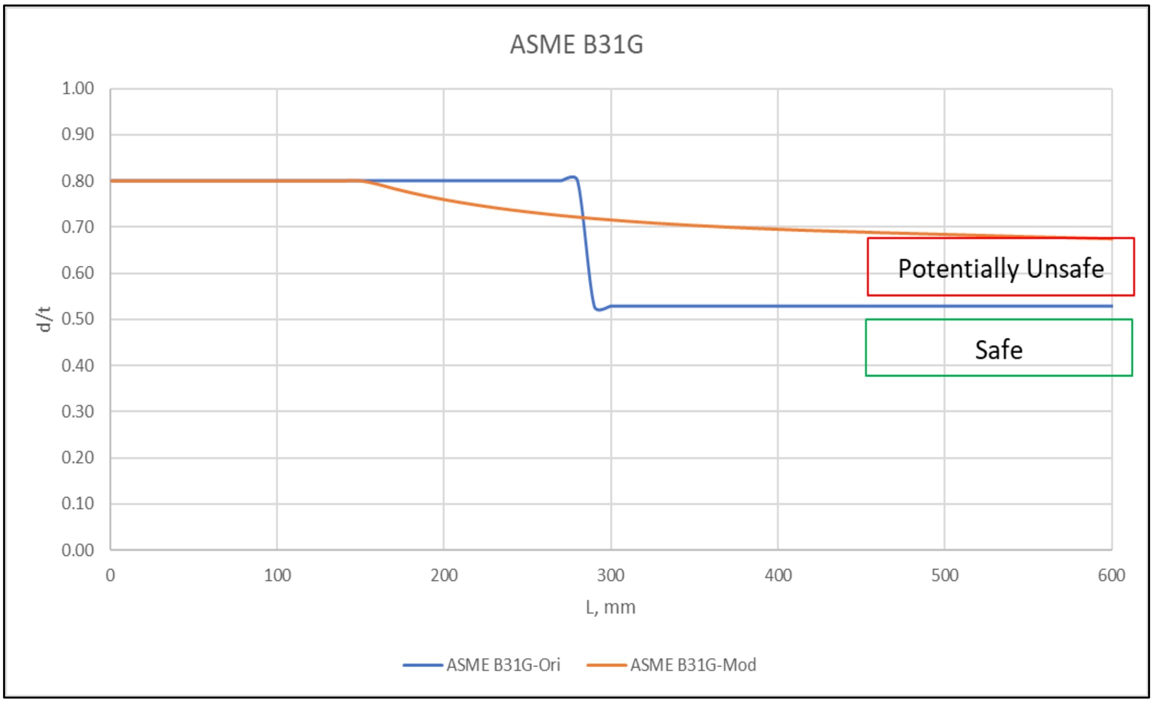

Figure 2.
Allowable anomaly size as per ASME B31.G

3. RESULT AND DISCUSSION

Table 1 below shows result of design code check.

Table 1.
Result of design code check

t_{min}, mm	t_{mm}, mm	Criteria	Result
9.02	8.25	IF(t_{mm} > t_{min}; "Safe"; else "Potentially Unsafe")	Potentially unsafe

Error! Reference source not found. below shows result of ASME B31G.

Table 2.
Result of ASME B31G assessment

Type of Assessment	Ps, psi	Criteria	Result
Original	2,320	IF(min [$P_{S\text{-}ori}$; $P_{S\text{-}mod}$] > P_{design} ; "Safe" else ; "Potentially Unsafe")	**Safe**
Modified	2,303		

Figure 3 below shows the defect plotted on the acceptability chart.

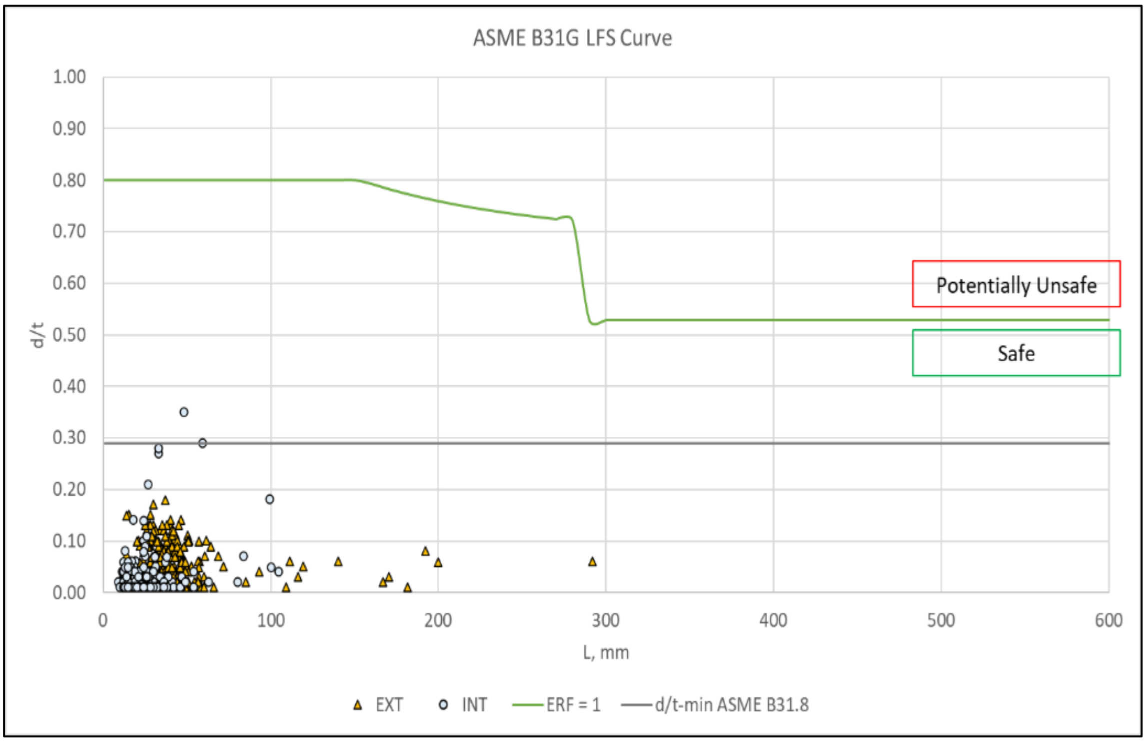

Figure 3.
Assessment result

According to ASME B31G, the defect is acceptable, indicating that the pipeline can safely continue operation at the design pressure.

This finding demonstrates that design code assessments may be overly conservative for localized corrosion, potentially leading to premature repair or replacement recommendations. In contrast, ASME B31G offers a more realistic assessment when reliable defect data is available.

4. CONCLUSION AND RECOMMENDATION

This study highlights the importance of selecting an appropriate integrity assessment method. The gas pipeline segment examined failed to meet minimum thickness requirements under the ASME B31.8 design code, rendering it potentially unsafe. However, when evaluated using ASME B31G, the same defect was found to be acceptable, with a calculated failure pressure exceeding the design pressure.

This discrepancy illustrates the conservative nature of design code evaluations and the benefit of using defect-specific assessments like ASME B31G for more accurate residual life estimation.

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