User Guide

Congratulations on downloading Penspen's PDAT Lite mB31G software, which is intended for the assessment of corrosion defects in oil and gas pipelines.

Installation

1. Extract all files from software.zip.
2. Navigate to the directory where extracted files are located.
3. Double click software icon 

4. Follow onscreen instructions.

User Instructions

1. Select appropriate units either 'imperial' or 'metric' from the [Units] icon at the top of the page.
2. Input required data (green boxes):
   Diameter – Pipeline external diameter, although please note for small diameter pipelines this may not always be the nominal diameter.
   Specified Minimum Wall Thickness (t) – As defined by design/manufacturer.
   Material – Pipeline material, select appropriate grade from the drop down menu.
   Pipeline Design Factor – As defined by the design code (e.g. ASME B31.4). Typically a design factor of 0.72 is used in remote areas or 0.3 in built up or sensitive areas. Design factor = Hoop Stress/SMYS.
   Maximum Depth (d) – Maximum depth of defect.
   Maximum Length – Maximum length of defect.

3. The following optional fields may be input (white boxes):
   User – Name of user carrying out the assessment.
   Date – Date of assessment.
   Pipeline Identifier – Unique name or number of pipeline.
   Measured Local Wall Thickness- Measured wall thickness of undamaged pipe near to the defect. This will be used in the assessment in place of the minimum specified thickness.
   Hydrotest Pressure – Pressure pipeline tested to during pre-commissioning hydrotest, dependant on design code.
   Design Pressure – As obtained from national or international design codes.
   Maximum Allowable Operating Pressure – A rating indicating the maximum pressure at which a pipeline or segment of a pipeline may be operated based on the pre-commissioning hydrotest and any other restrictions.
   Toughness – The minimum pipe material charpy test energy, full size.

Tolerance on depth measurement – Error margin on depth measurement. This will depend on the measurement method and conditions, typically for an MFL pig +/- 10% of wt.
Tolerance on length measurement – Error margin on length measurement.
Corrosion Depth growth rate – Corrosion depth growth rate if known.
Corrosion Length growth rate – Corrosion length growth rate if known.
Years of Growth – Number of years of corrosion growth.

Please note the following parameters are calculated by the software:
Final Defect Depth – Based upon maximum depth, tolerance on depth measurement, corrosion growth rate and number of years of corrosion growth.
Final Defect Length – Based upon maximum length and tolerance on length measurement, corrosion growth rate and number of years of corrosion growth.

4. Upon entry of all mandatory fields the calculated failure pressure for the defect is displayed within the [Calculated Failure Pressure] box at the bottom of the page. In addition the defect is plotted on the right hand-side of the page.
5. Units can be changed from imperial to metric by selecting [Units] icon at top of page and then clicking the appropriate measurement unit.
6. All input parameters can be cleared by clicking [Clear Data] button or by selecting [File] then 'New'.
7. Software includes save, open, and print functionality which can be selected from the [File] icon.

Modified B31G

The modified B31G method for assessing corrosion is a semi-empirical method[1] based on the Battelle part-wall failure criterion (also referred to as the part-wall NG-18 equations). The NG-18 flow-stress dependent part-wall failure criterion was developed from elastic-plastic fracture mechanics and burst tests of machined, V-shaped notches. The underlying NG-18 part-wall relationship is cast in terms of the defect area, a flow stress equal to the yield stress plus 10 ksi and a three-term Folias (bulging correction) factor is used.

The modified B31G method assumes an arbitrary geometric defect profile in which the defect area is assumed to be 0.85dL, thus corrosion typically represents 85 percent of the area of a rectangle bounded by the maximum length and depth of the defect. It defines simple approximations to the exact corroded area, based on the maximum length and the maximum depth of the defect, giving recognition to the irregular shape typical of most corrosion.

Modified B31G is ideal for assessing corrosion defects in lower toughness, older line pipe. However it should be noted that this method is not applicable if the line pipe steel is operating below its transition temperature.

The definition of the modified B31G acceptance criterion, which calculates the safe maximum pressure of a corroded area, is: - all acceptable corrosion is predicted to fail at a stress in excess of 100 percent SMYS and the factor between the safe working pressure and the burst pressure is at least 1.39. This method is thus intrinsically conservative.

The modified B31G criterion is the assessment criterion based on a simple geometric idealisation of the shape of the corroded area, suitable for simple hand calculations. It is given by the following equations:

$$\sigma_f = \overline{\sigma}\left[\frac{1-0.85\frac{d}{t}}{1-0.85\frac{d}{t}\frac{1}{M}}\right]$$

where

$$\overline{\sigma} = SMYS + 10\ \text{ksi}\ \left(68.95\ \text{Nmm}^{-2}\right)$$

$$M = \begin{cases} \sqrt{1+0.6275\left(\frac{L}{\sqrt{Dt}}\right)^2 - 0.003375\left(\frac{L}{\sqrt{Dt}}\right)^4} & \text{for } \left(\frac{L}{\sqrt{Dt}}\right)^2 \le 50.0 \\ 0.032\left(\frac{L}{\sqrt{Dt}}\right)^2 + 3.3 & \text{for } \left(\frac{L}{\sqrt{Dt}}\right)^2 > 50.0 \end{cases}$$

Where M is the Folias ‘bulging factor’.

For corrosion in low toughness, older line pipe, modified B31G is recommended for assessing a single defect based on the overall dimensions.

The analysis does not take account of any significant bending or other external loading at the defect location, and if this is known to be the case then more detailed analysis is required.

Other types of defect, such as cracks, should be assessed by appropriate methods such as BS7910[2]. Guidance on the choice and use of such methods is given by the Pipeline Defect Assessment Manual (PDAM)[3].

References

1. Kiefner, J.F., and Vieth, P.H., "Evaluating Pipe: New Method Corrects Criterion for Evaluating Corroded Pipe", *Oil and Gas Journal*, August 6, 1990.
2. Anon, BS7910, “Guide on methods for assessing the acceptability of flaws in metallic structures”, BSI, 1999.
3. Anon, “The Pipeline Defect Assessment Manual (PDAM)”, Release 1.05, Penspen Integrity, 2005.

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