A Basis for Changing the Stress-Based Design Factor for Pipelines

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Analysis Method

- Defined the inherent "safety factor" in stress based design.

- Determined Y/T effects

- Established basis for "Level 1" type assessment for elevating the design factor

Defining a Safety Factor

- What is the inherent "safety factor" in the code?

- Define safety factor= P_b/P_o

- P_o for ASME B31.8 is given by the Barlow equation:
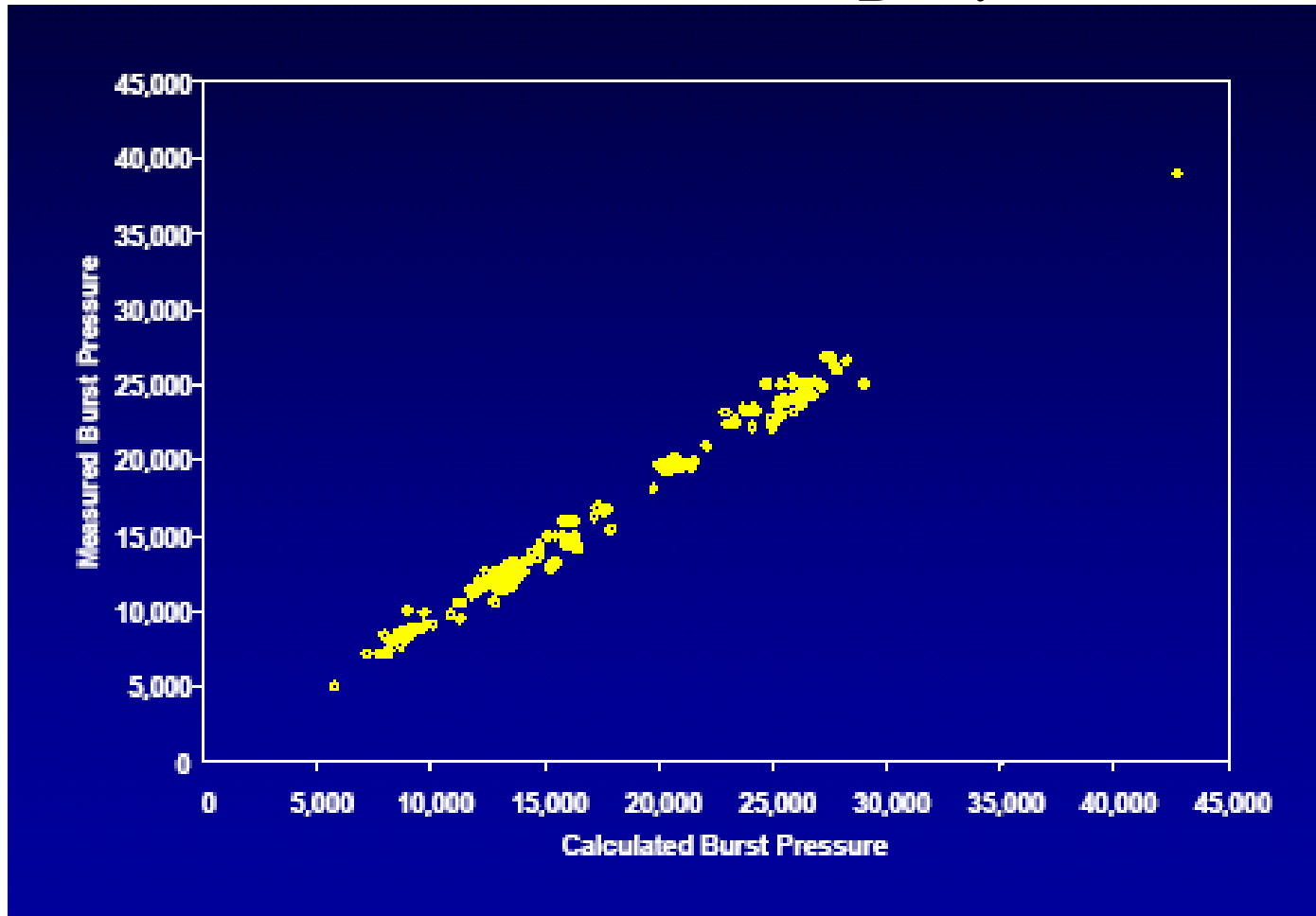
$$P_o = F\, Y_m\, \frac{2\,t}{D}$$

- P_b can be modeled using the API 1111 committee calibration of their proposed burst equation vs. burst test data.

Calibration of the API 1111 Burst Equation

- 267 burst tests
- Diameters: 2.65" – 20"
- D/t: 6 – 32
- Yield Strengths: 40 – 138 ksi
- Burst Pressures: 6 – 43 ksi

API 1111 Burst Equation

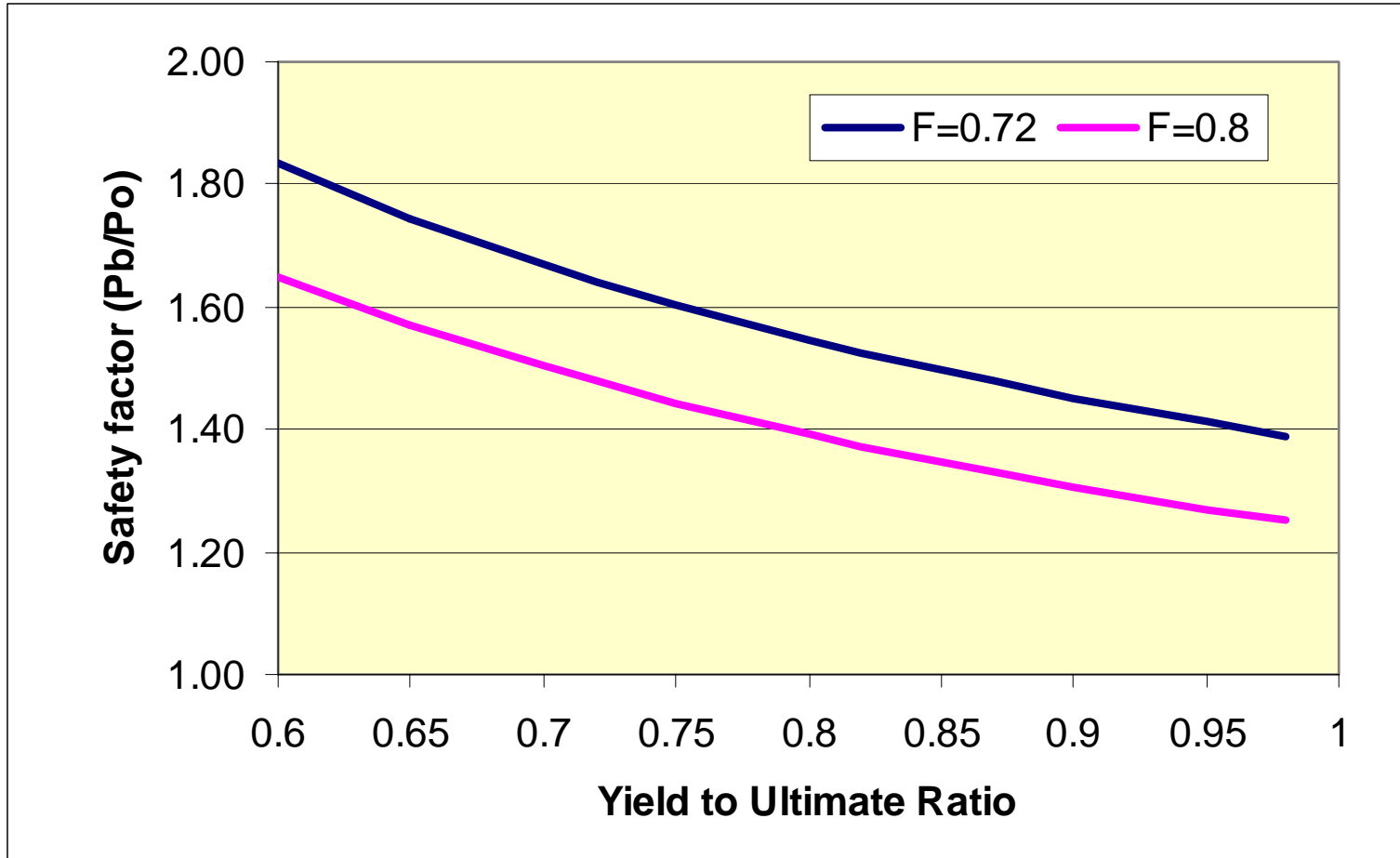$$P_b = 0.45 \left(Y_a + T_a \right) \frac{2t}{D - t}$$

Defining a Safety Factor

$$SF = \frac{P_b}{P_o} = 0.45 \frac{g}{F} \left(1 + \frac{1}{q} \right)$$
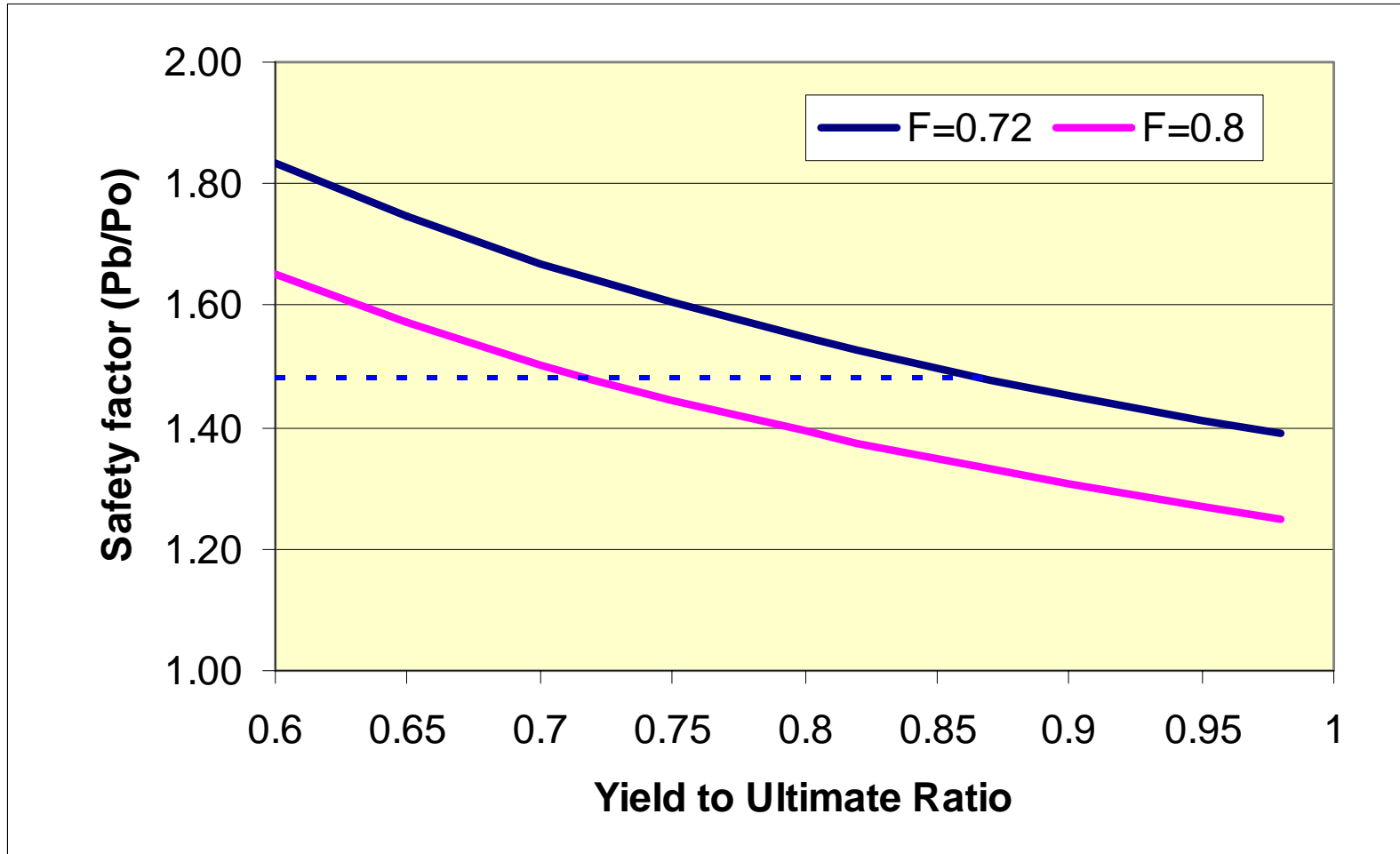
- Where
  - g is the actual yield strength/SMYS
  - q is the actual Y/T ratio
- Assumed D-t = D (for larger pipelines)

Effect of Y/T
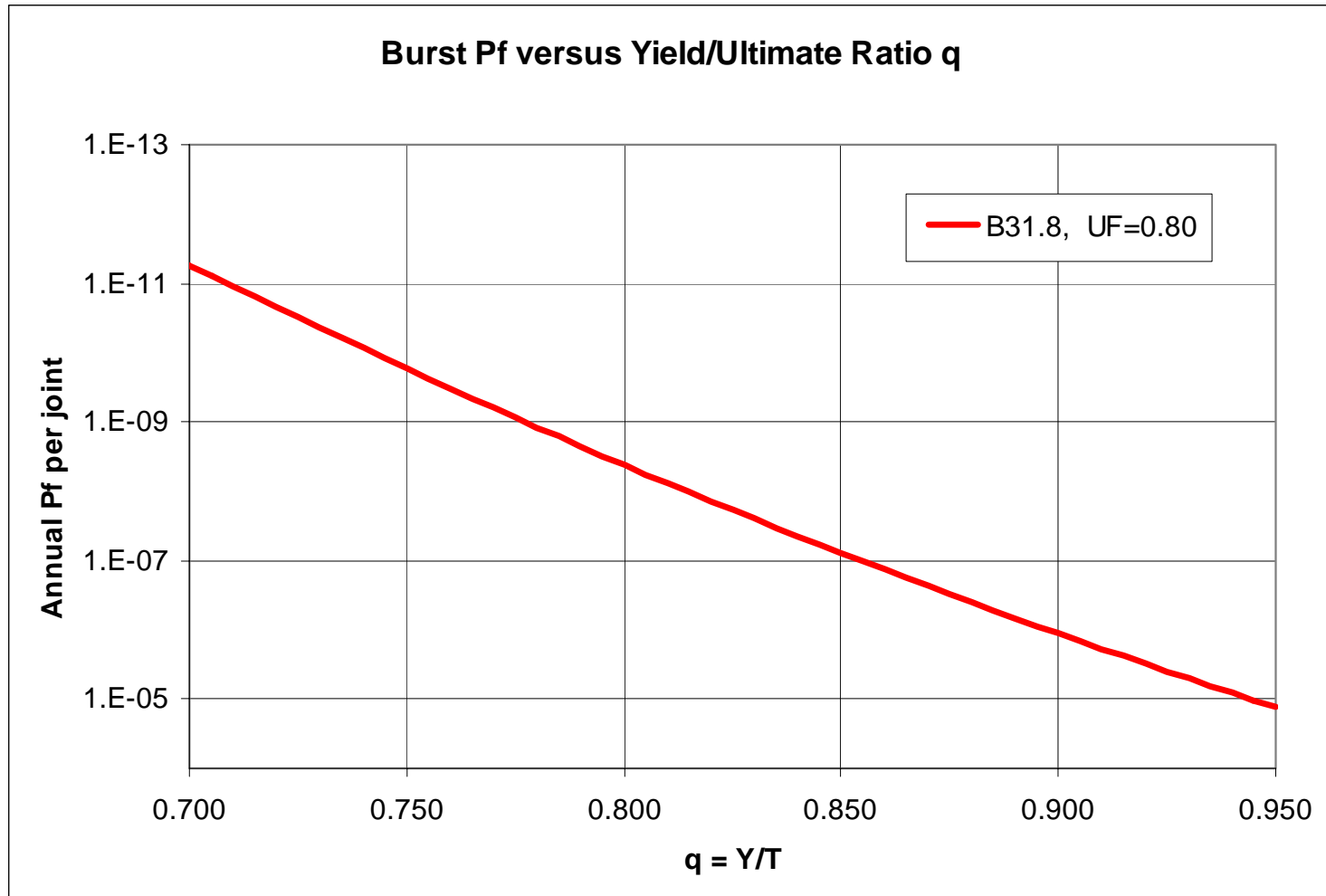

Note: g is assumed to be 1.1

Utilization

Validation using Reliability Analysis
(Ref. Maes, et al, OMAE'06)

Burst UFs for Barlow Eq.
(Ref. Maes, et al, OMAE'06)

Pf per km per year	Y/T = 0.77	Y/T = 0.89
1.0 E-04	0.91	0.83
1.0E-05	0.87	0.8
1.0E-06	0.83	0.77
1.0E-07	0.8	0.74

Questions?