Engineering the Risk out of HDD

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APGA Convention 2021

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HDD Threats

HDD Threats - Pipeline

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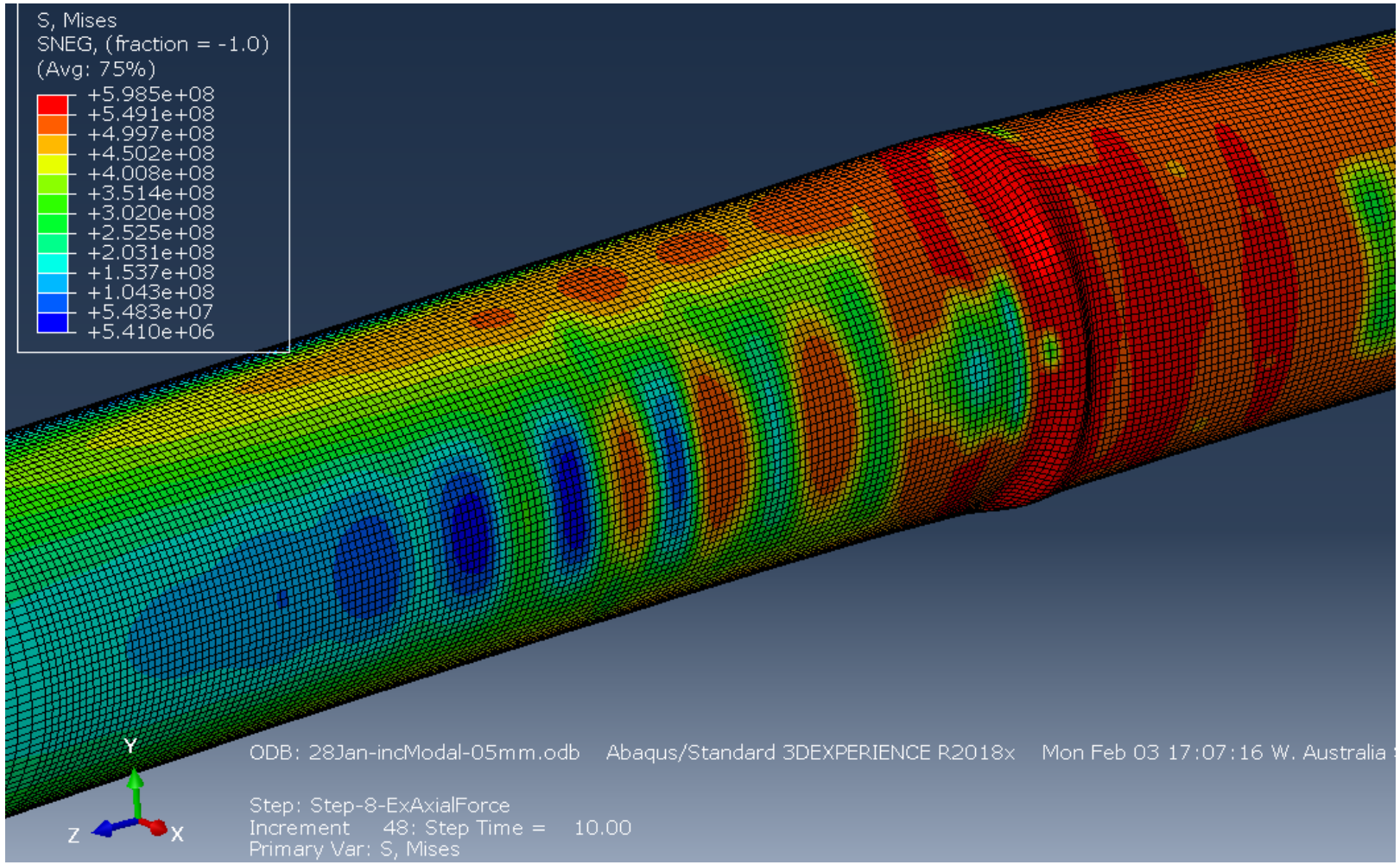
PIPELINE

Pipeline material overstress



HDD Threats - Pipeline

PIPELINE

Coating damage

Drilling Fluid

Unplanned release

Drilling Fluid

Critical Infrastructure

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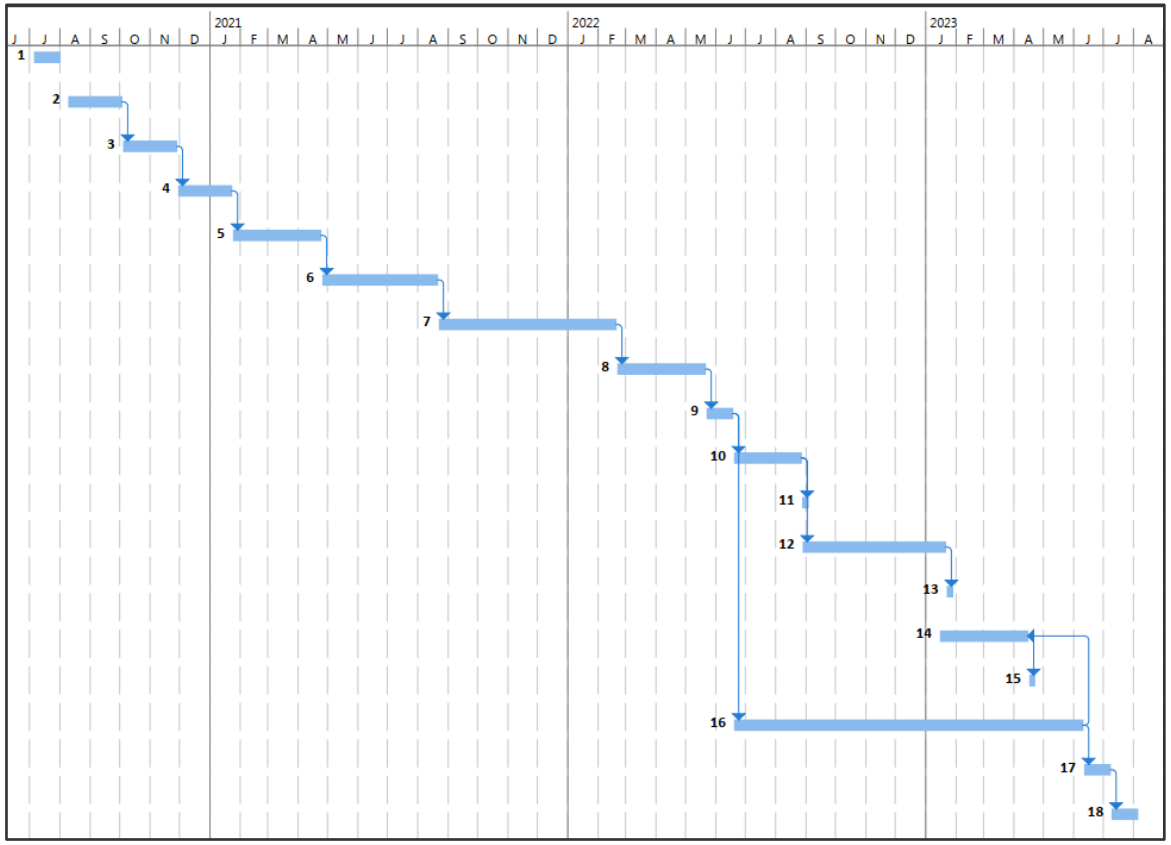


Schedule Risk

Who owns the risk?

I mean *really?*

Installation Stress Analysis

- Pull Forces ➔ installation stresses
- PRCI Guideline:

Combined stress analysis may begin with a check of axial tension and bending according to the following limiting criterion. The criterion is taken from practices established for design of tubular members in off-shore structures with an increase in the allowable tensile proportion to make it consistent with established practice in the HDD industry. [1, p. 42]

$$f_t/0.9F_y+f_b/F_b \leq 1$$

Where:

f_t = tensile stress in pounds per square inch

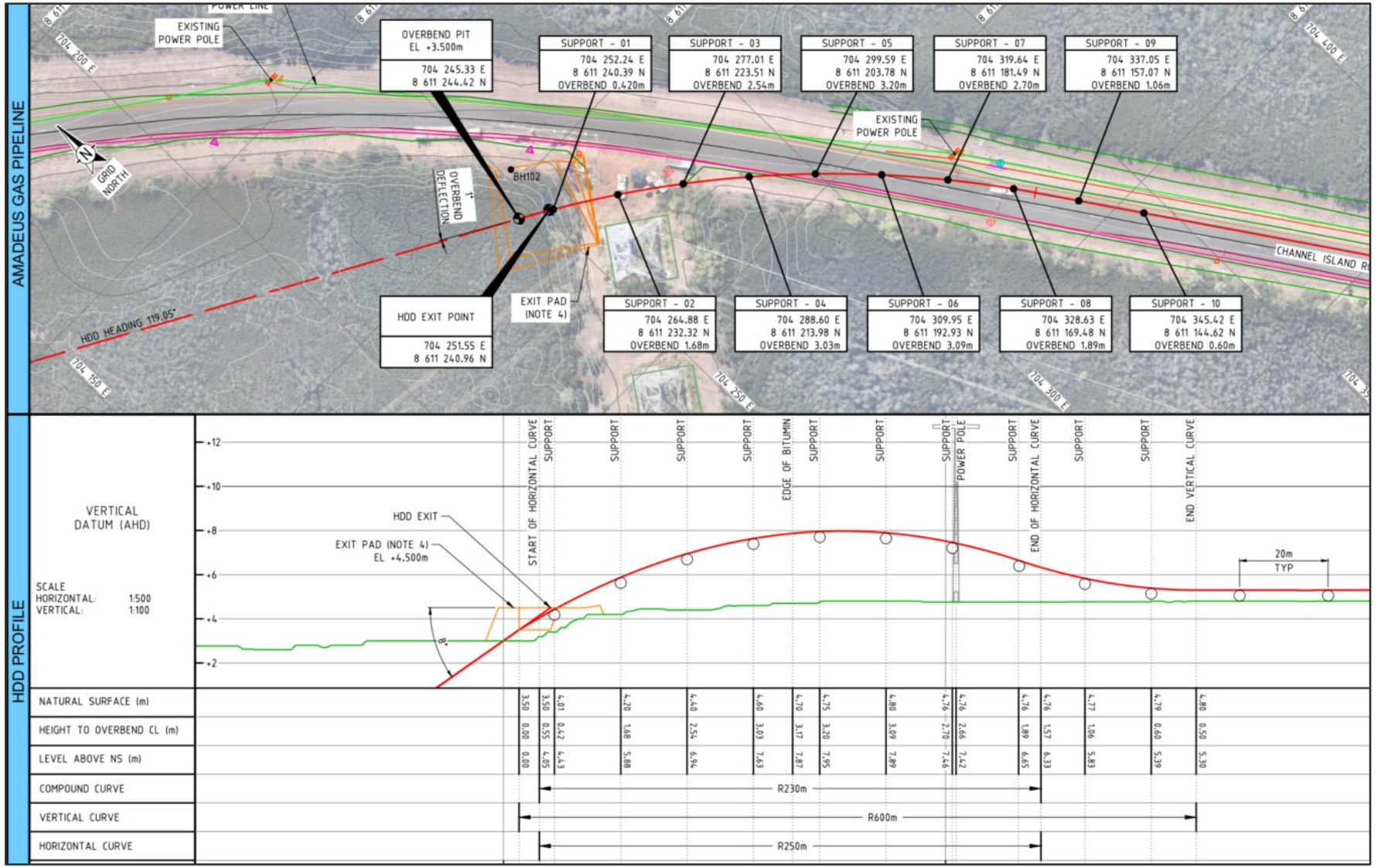
The full interaction of axial tension, bending and external pressure stresses should be limited according to the following criteria. [1, pp. 43-44]

$$A^2+B^2+2\nu|A|B \leq 1$$

Where:

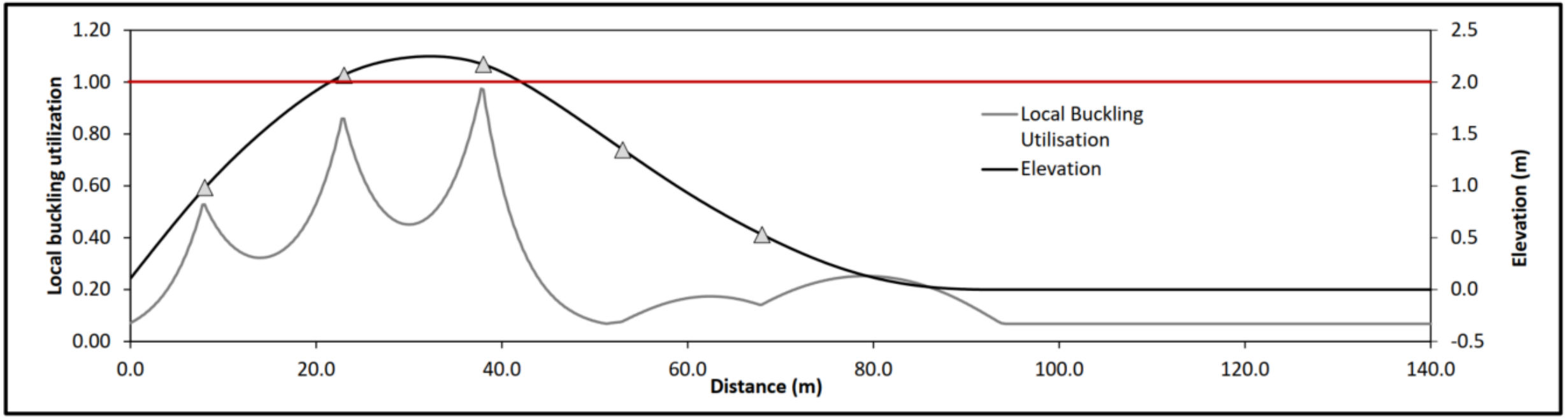
$A = ((f_t+f_b-0.5f_h)1.25)/F_y$
$B = 1.5f_h/F_{hc}$
ν = Poisson's ratio, 0.3 for steel [3, p. 25]

Overbend Stress Analysis



Overbend Stress Analysis

Tension, bending, and free-spanning



Overbend Stress Analysis

Engineering for Coatings

What Damages a Coating?

- Gouging
- Abrasion
- Doglegs

GEOTECH

Pipeline Route

Coating Selection

National Facility for Pipeline Coating Assessment

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DEAKIN UNIVERSITY

Buoyancy Control

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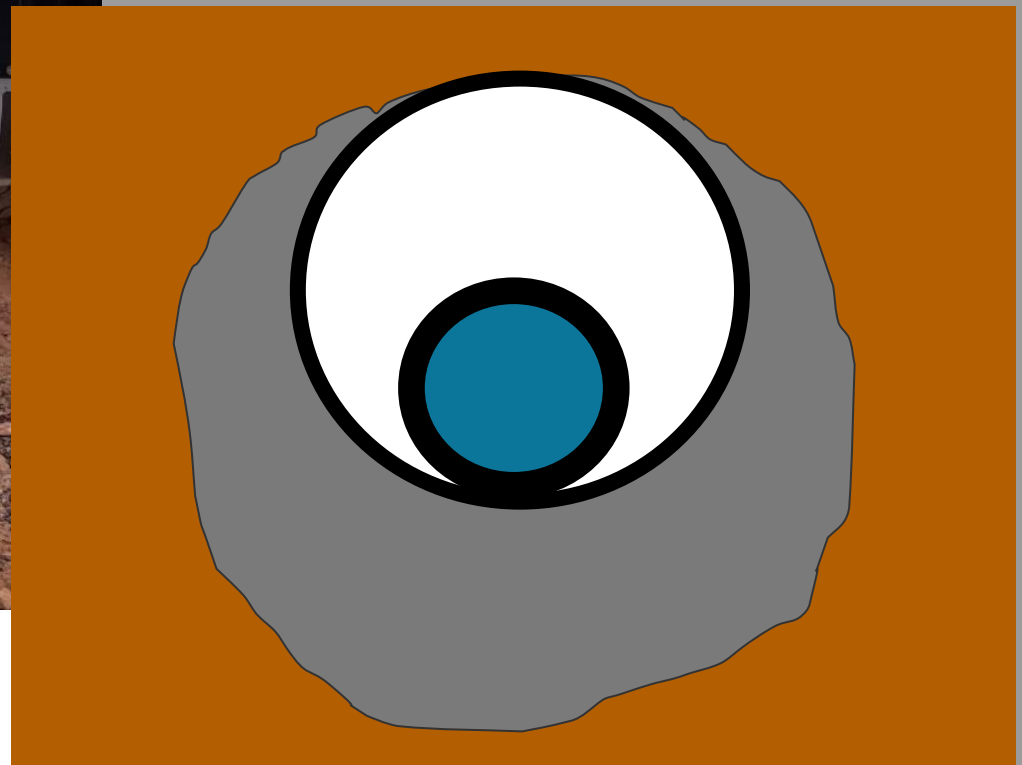
Buoyancy Control



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Buoyancy Control

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Buoyancy Control

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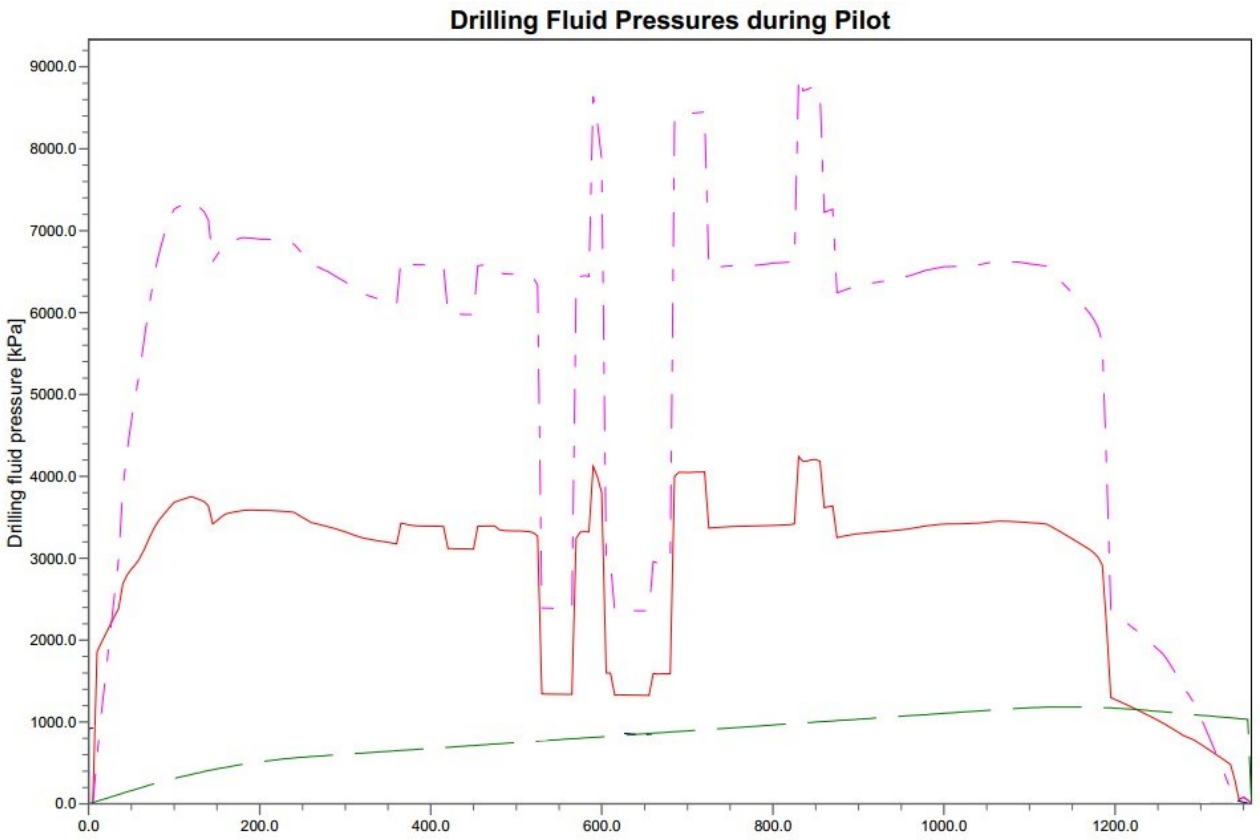
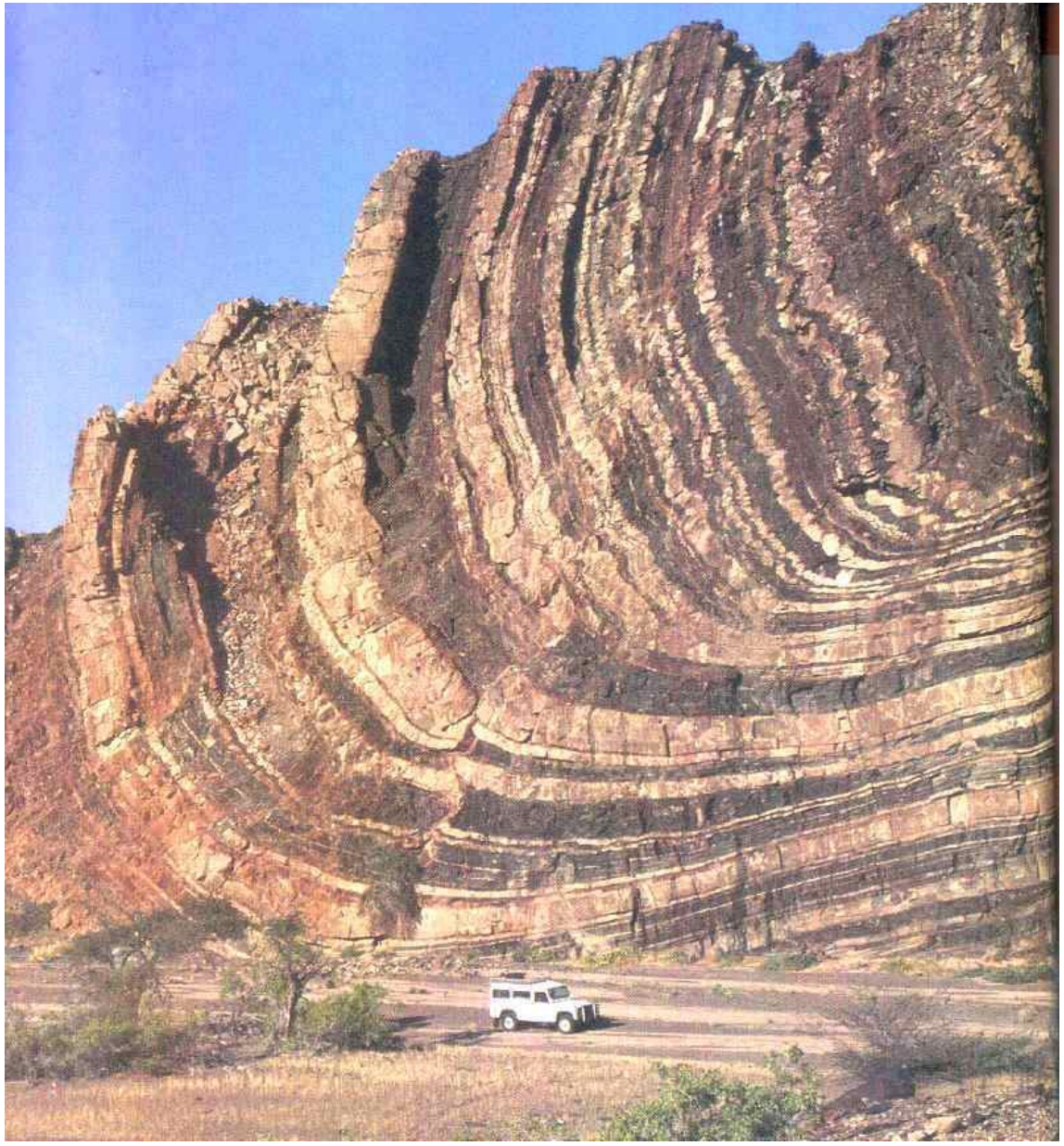
Drilling Fluid Pressure Assessment

Failure Modes

- Borehole Deformation
- Depth of Cover
- Existing Leak Path



Drilling Fluid Pressure Assessment



Drilling Fluid Pressure Assessment

Inputs

- Unit Weight
- Youngs Modulus
- Cohesion

2.3 Material Types

Name	Gamma unsat [kN/m³]	Gamma sat [kN/m³]	Cohesion [kN/m²]	Phi [degrees]	Cu top [kN/m²]	Cu bottom [kN/m²]	Emod top [kN/m²]	Emod bottom [kN/m²]
1	22.00	24.00	0.00	40.00	0.00	0.00	100000	120000
2	16.00	18.00	0.00	0.00	20.00	25.00	5000	5000
3	20.00	22.00	0.00	36.00	0.00	0.00	60000	80000
3A	18.00	20.00	0.00	34.00	0.00	0.00	35000	50000
4	24.00	25.00	150.00	30.00	0.00	0.00	10000...	1000000
4A	22.00	24.00	25.00	30.00	0.00	0.00	150000	150000
4B	25.00	26.00	200.00	30.00	0.00	0.00	10000...	1000000
5	24.00	25.00	200.00	32.00	0.00	0.00	10000...	1000000
5A	22.00	24.00	25.00	32.00	0.00	0.00	250000	250000
5B	25.00	26.00	300.00	34.00	0.00	0.00	10000...	1000000

Drilling Fluid Pressure Assessment

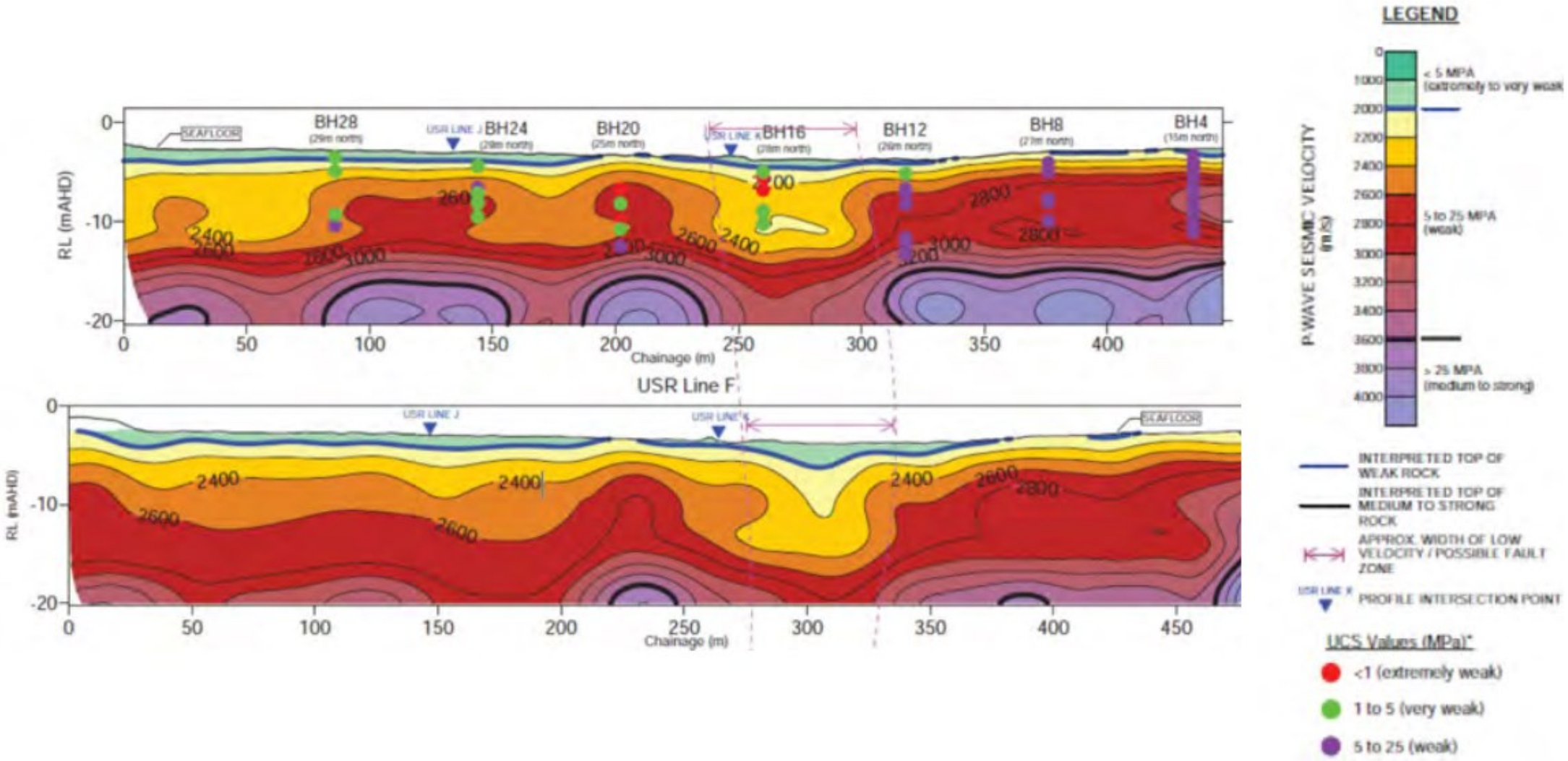
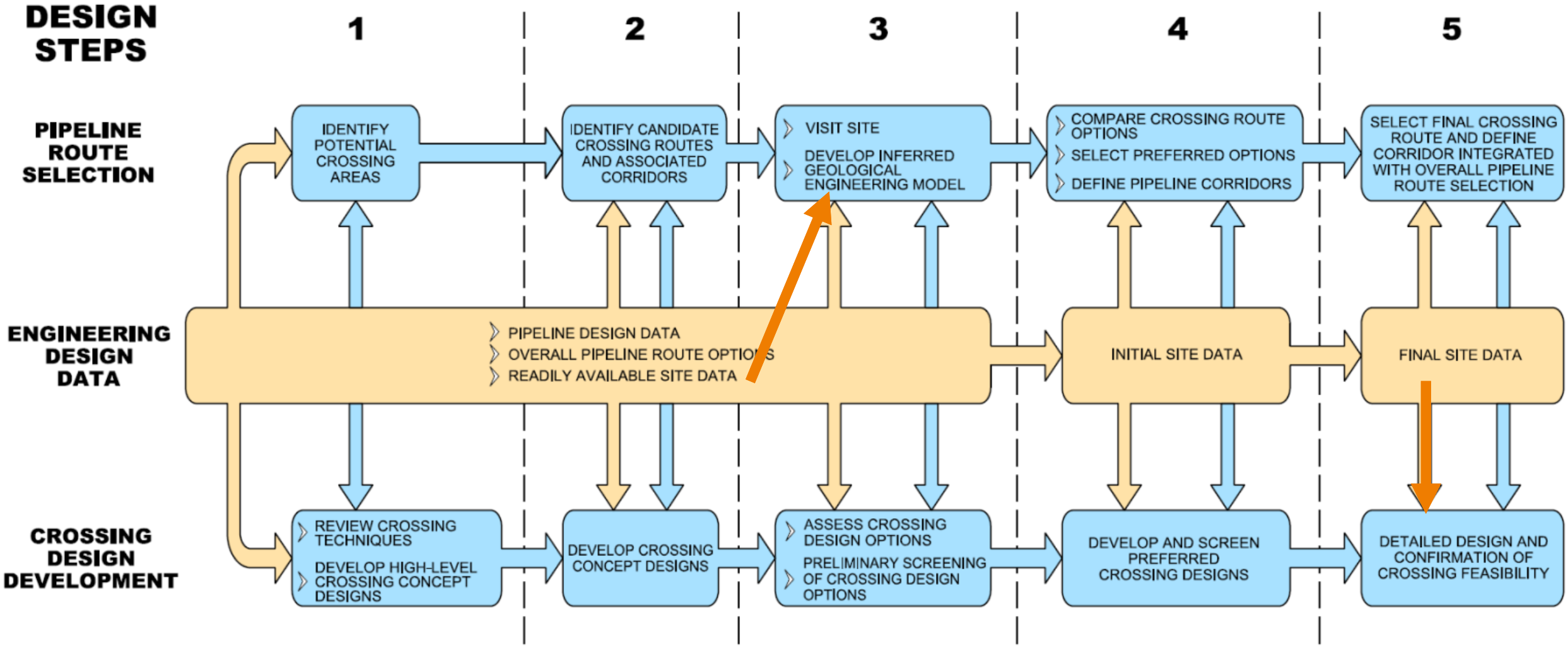


Figure 2.4. USR Velocity Profiles (Ref. 5).

Drilling Fluid Pressure Assessment



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Thank You