Late life management of onshore and offshore pipelines

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SUT Engineering Solutions for Mature Subsea & Pipeline Assets, July 2016

Safety & Assurance Relationships Social Responsibility People Innovation Financial Responsibility Integrity

Introduction

Australia's first oil & gas boom: 1960's & 70's.

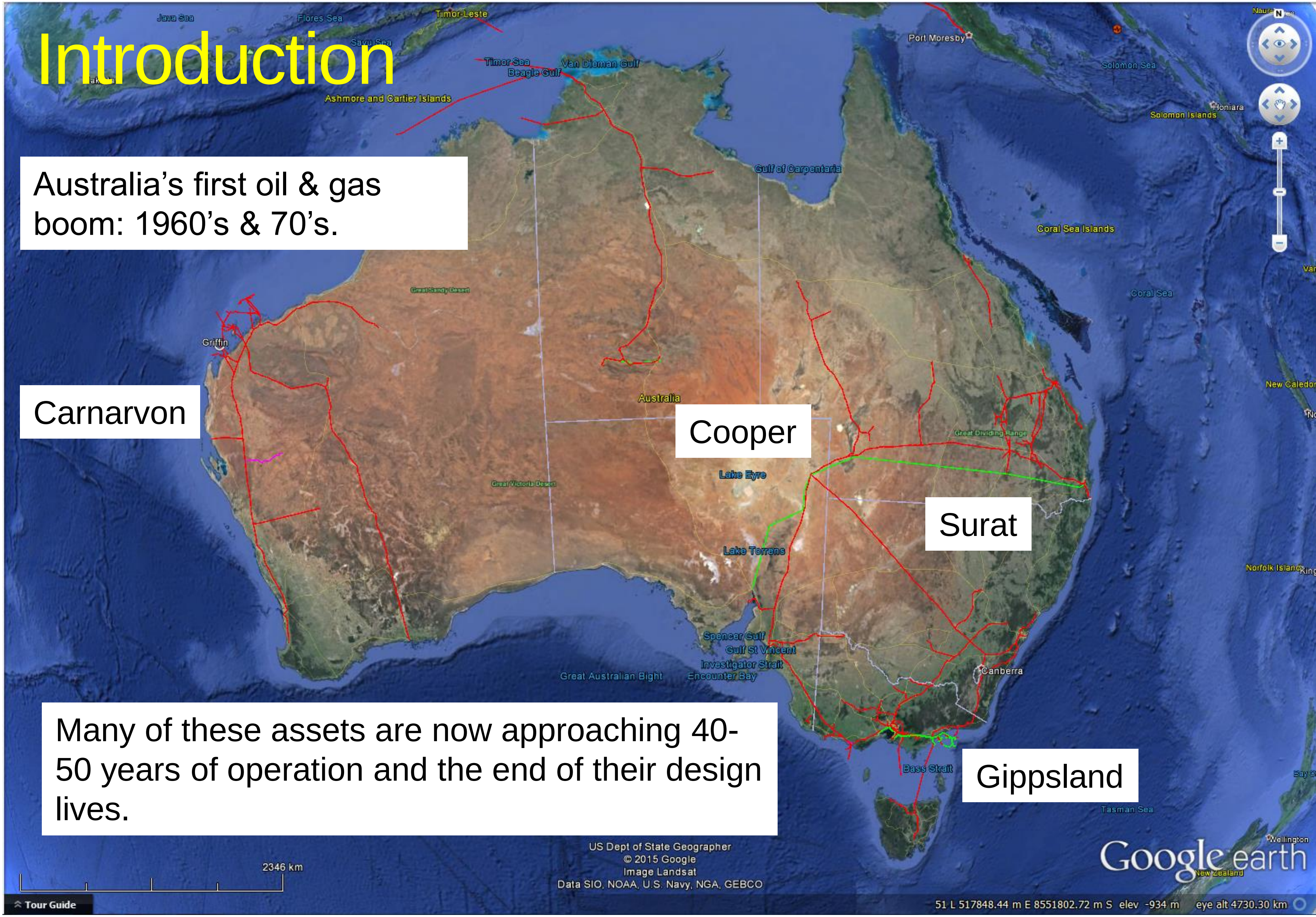
Carnarvon

Cooper

Surat

Gippsland

Many of these assets are now approaching 40-50 years of operation and the end of their design lives.



Life Extensions Process

Onshore vs offshore: different standards, similar approaches

Onshore: Remaining Life Review (AS2885.3)

Offshore: Design Requalification (DNV-OS-F101 / ISO TS 12747)

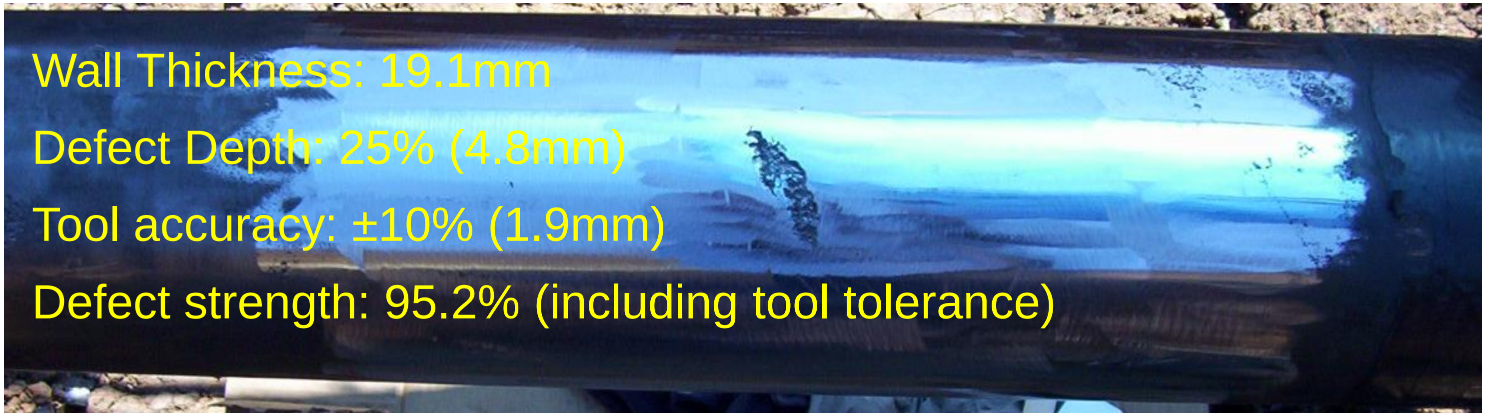
General steps in onshore and offshore life extension processes:

1. Data gathering
2. Review and assessment of risks
3. Review pipeline integrity management plan
4. Assessment of current integrity
5. Design validation, standard compliance
6. Prediction of future integrity / remaining life
7. Update pipeline integrity management plan

Characteristic Wall Thickness

Used to validate pipeline calculations at current pipeline condition for a section

- Need to balance conservatism with realism
- Need to take into account the accuracy of the inspection tools



Existing approach: use the min. WT of worst defect – 65%, 12.4mm, too conservative

New approach: use the calculated remaining strength – 95%, 18.2mm, realistic

use average WT used for large areas of corrosion like splash zones.

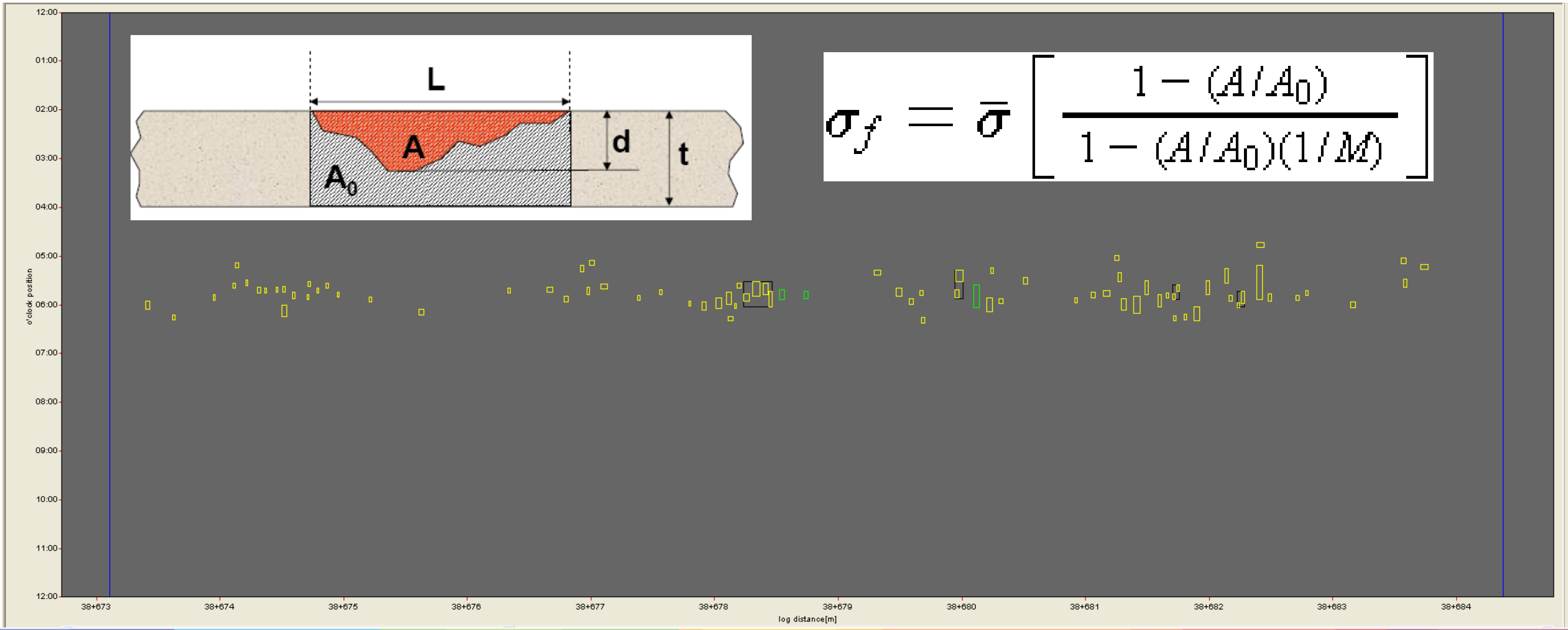
Corrosion Growth Rates

Comparing multiple ILI difficult due to detection thresholds and tolerances

- Detection threshold causes defects to “appear” and “disappear”
- Tolerances causes positive and negative corrosion growth

Most FFP reviewed only considered depth as part of corrosion growth

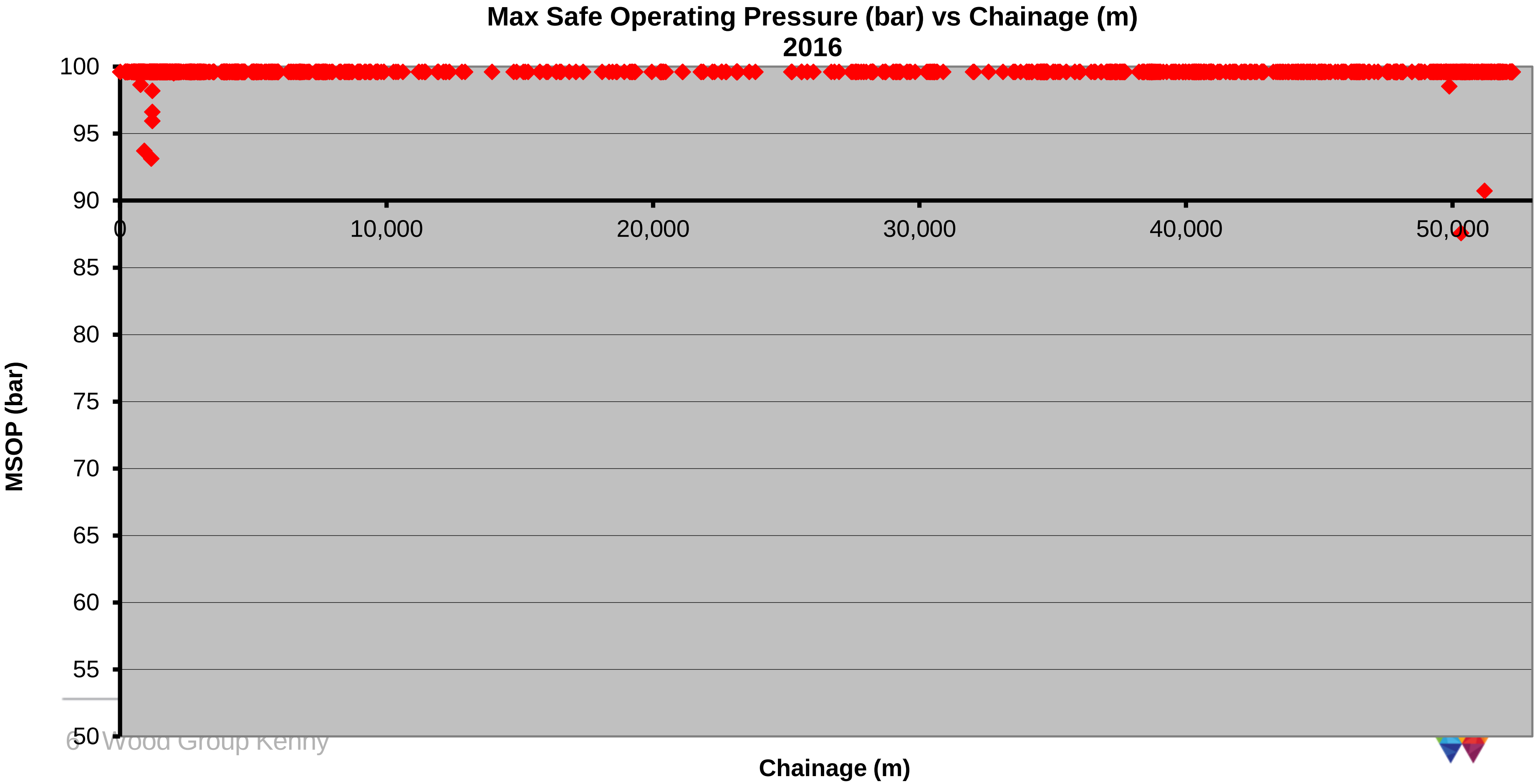
- Need to consider length growth & defect interaction, particularly in channel corrosion



Corrosion Growth Rates

Corrosion growth calculations MUST consider depth and length

- Approach taken was to calculate future defect failure pressures from depth & length
- Plot defect failure pressure decline (or MSOP) to assess future integrity



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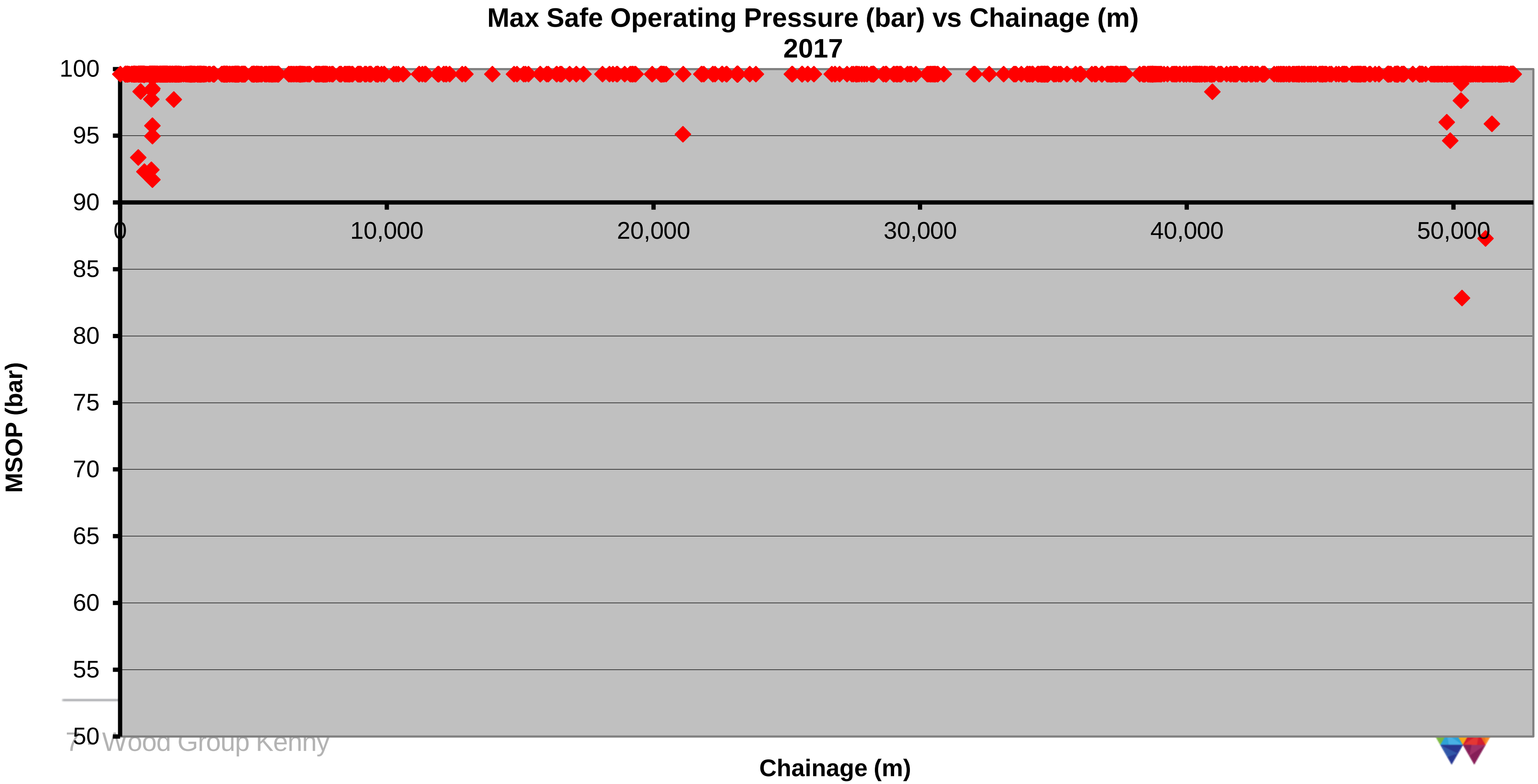

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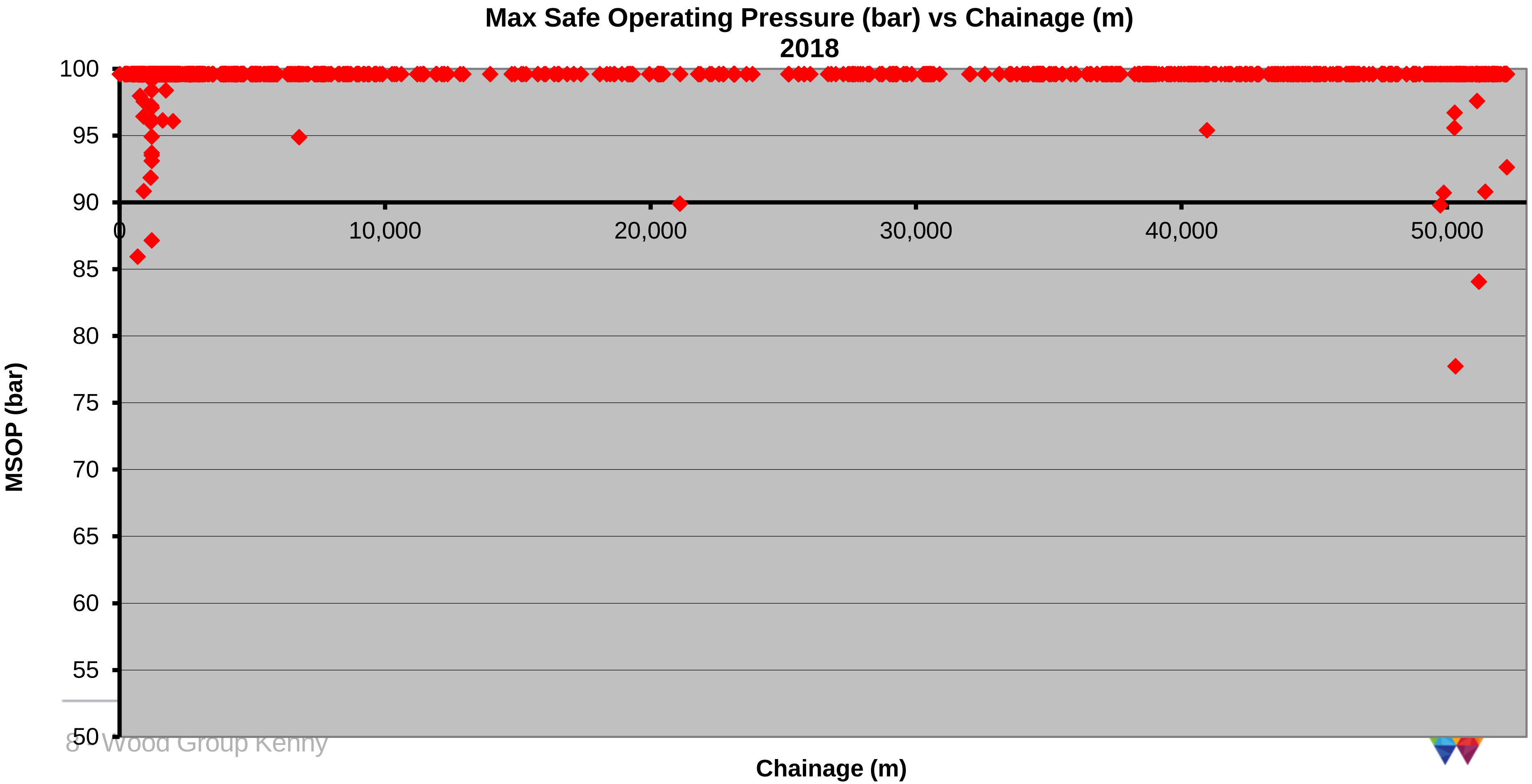

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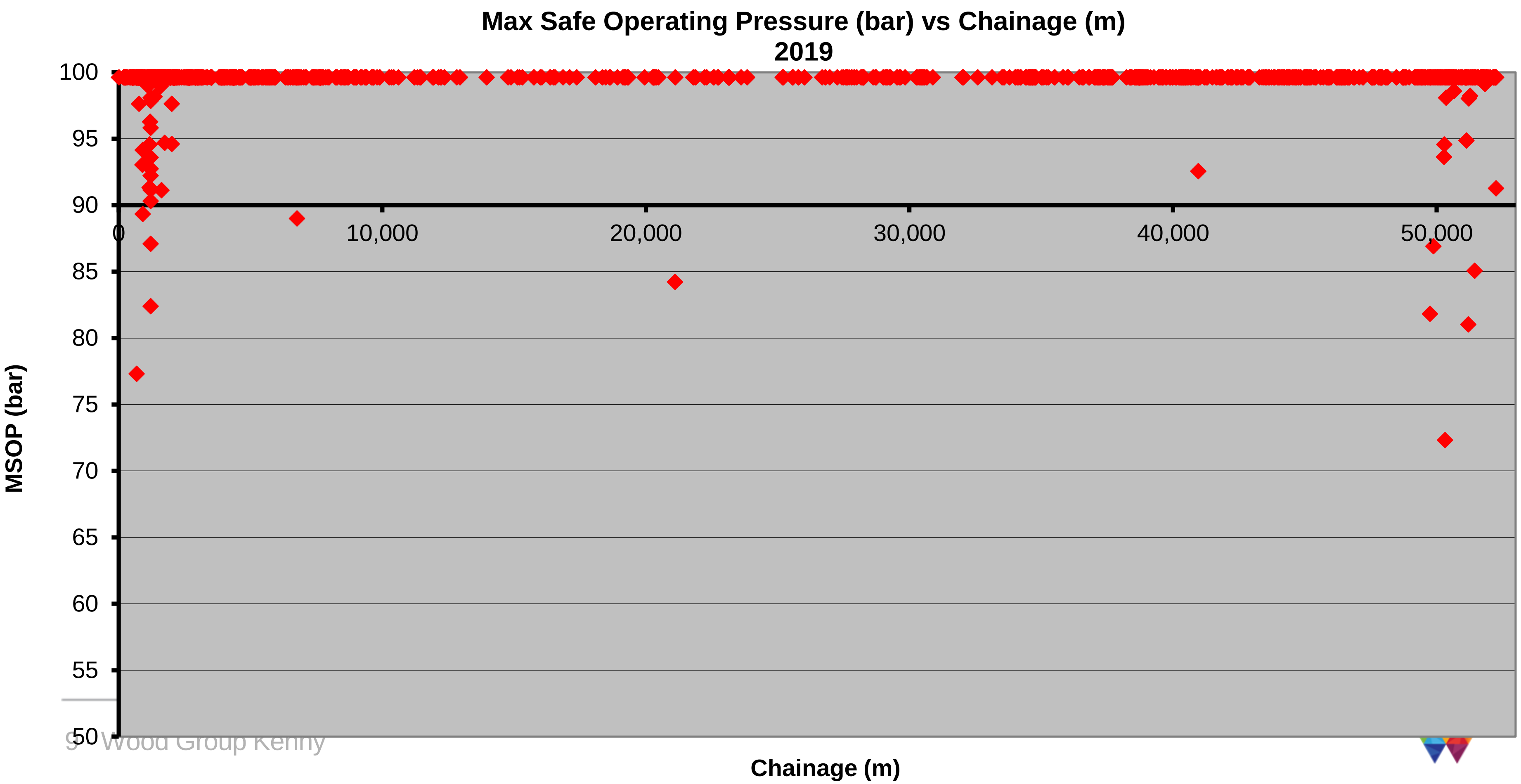

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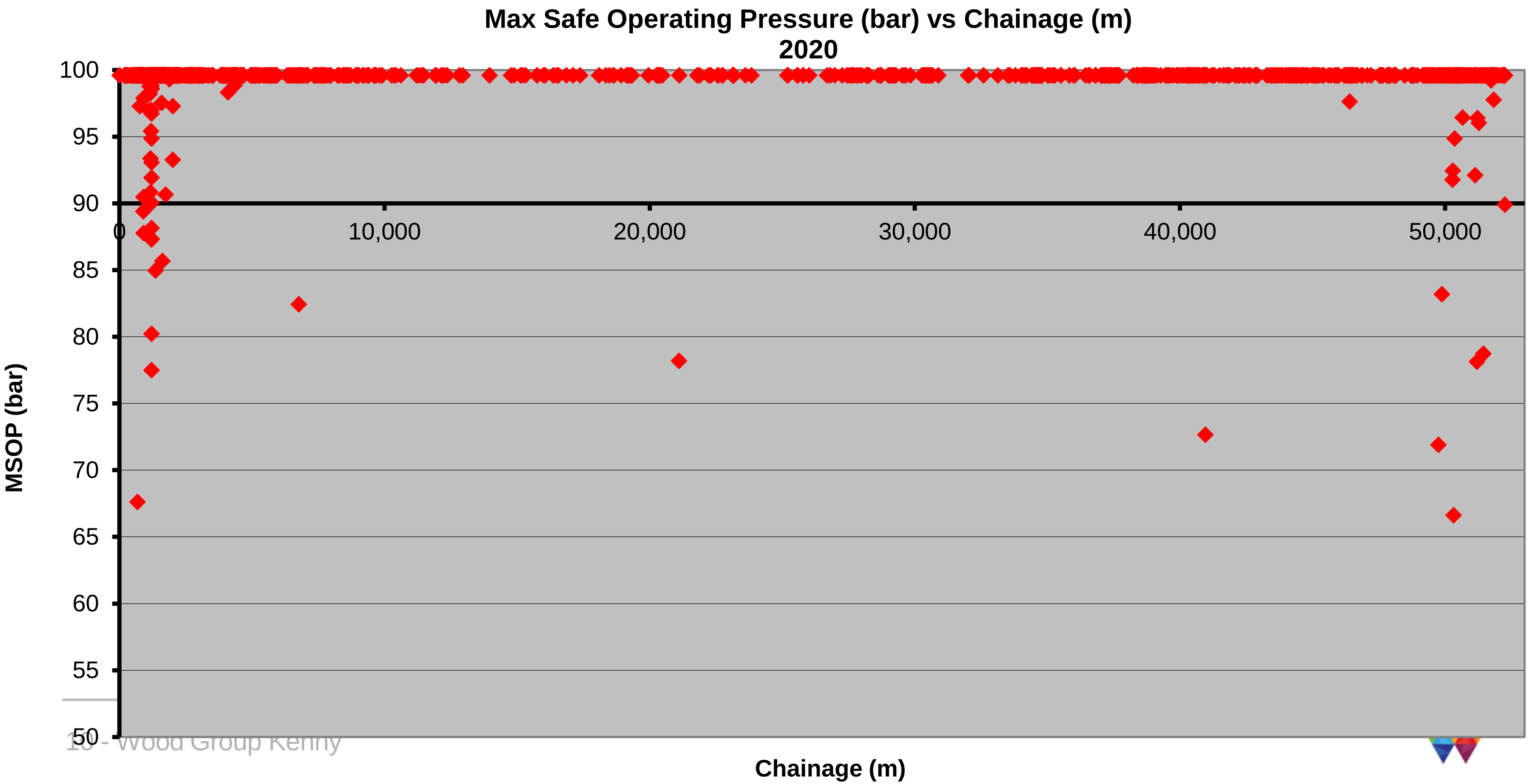

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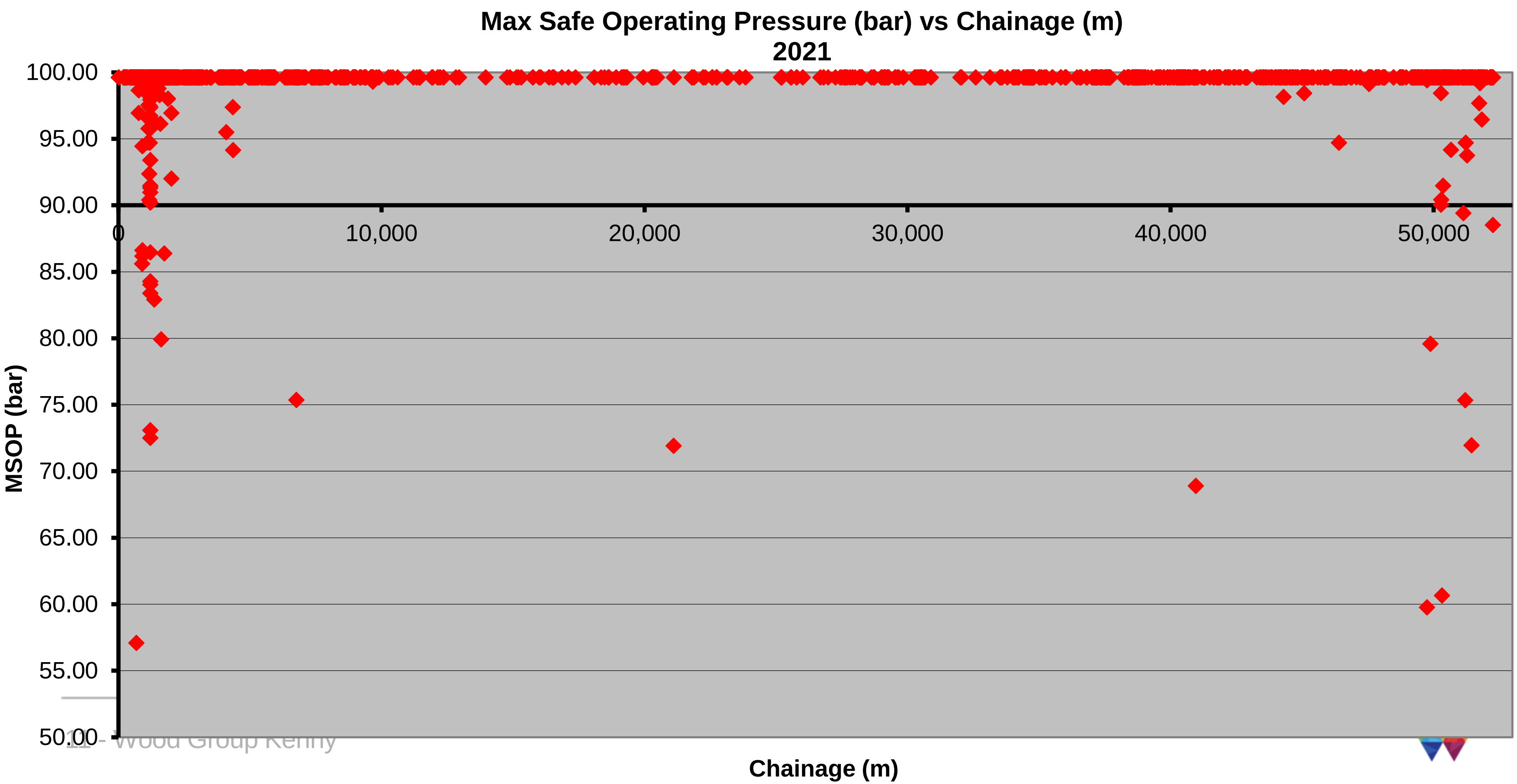


Lessons Learned

"That men do not learn very much from the lessons of history is the most important of all the lessons of history.“ ***Aldous Huxley***

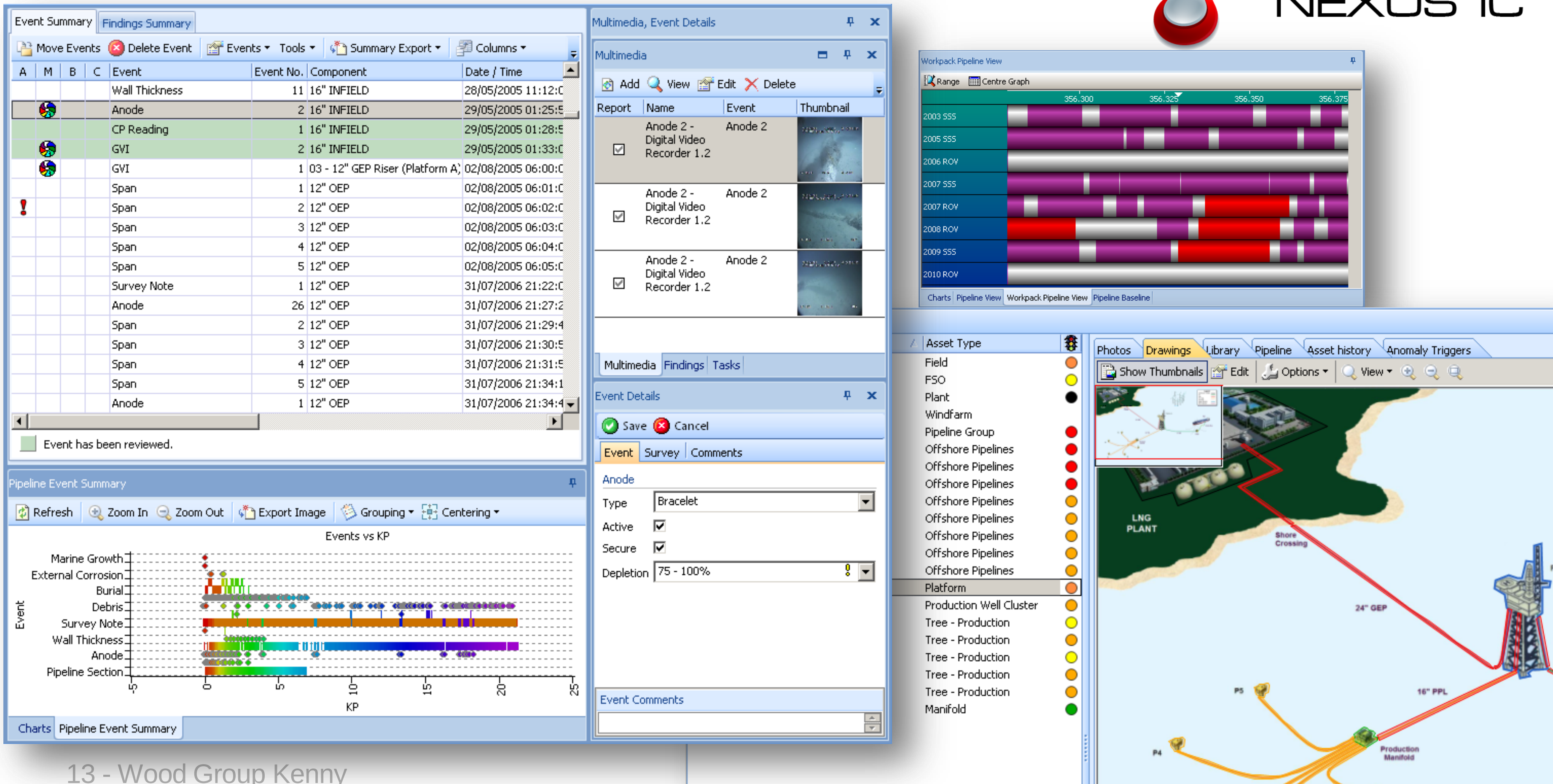
WGK have completed life extensions studies on 30 offshore and 20 onshore pipeline in the last 2 years, from which many key lessons have been learned.

Key lessons learned:

1. Allow sufficient time for data gathering
2. Prepare a Basis of Re-qualification document
3. Pay attention to pipeline interfaces such as shore crossings and splash zones
4. Always critically review theoretical predictions against reality
5. Carefully consider how to apply modern standards to old pipelines

Data Gathering

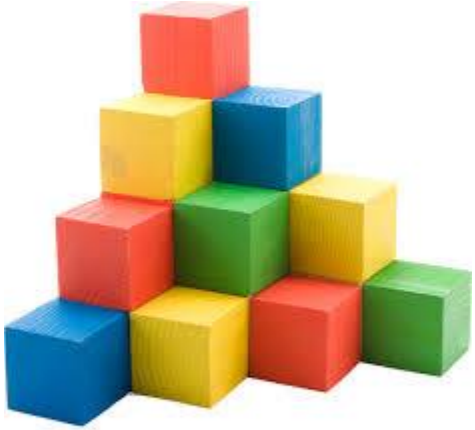
- At least 4 weeks required, can take up to 12 weeks for archive searches
- Additional time taken in data collection will be pay for itself later in the project
- Use of integrity data management software like Nexus IC



Basis of Re-qualification

Like a good foundation, a Basis document is vital

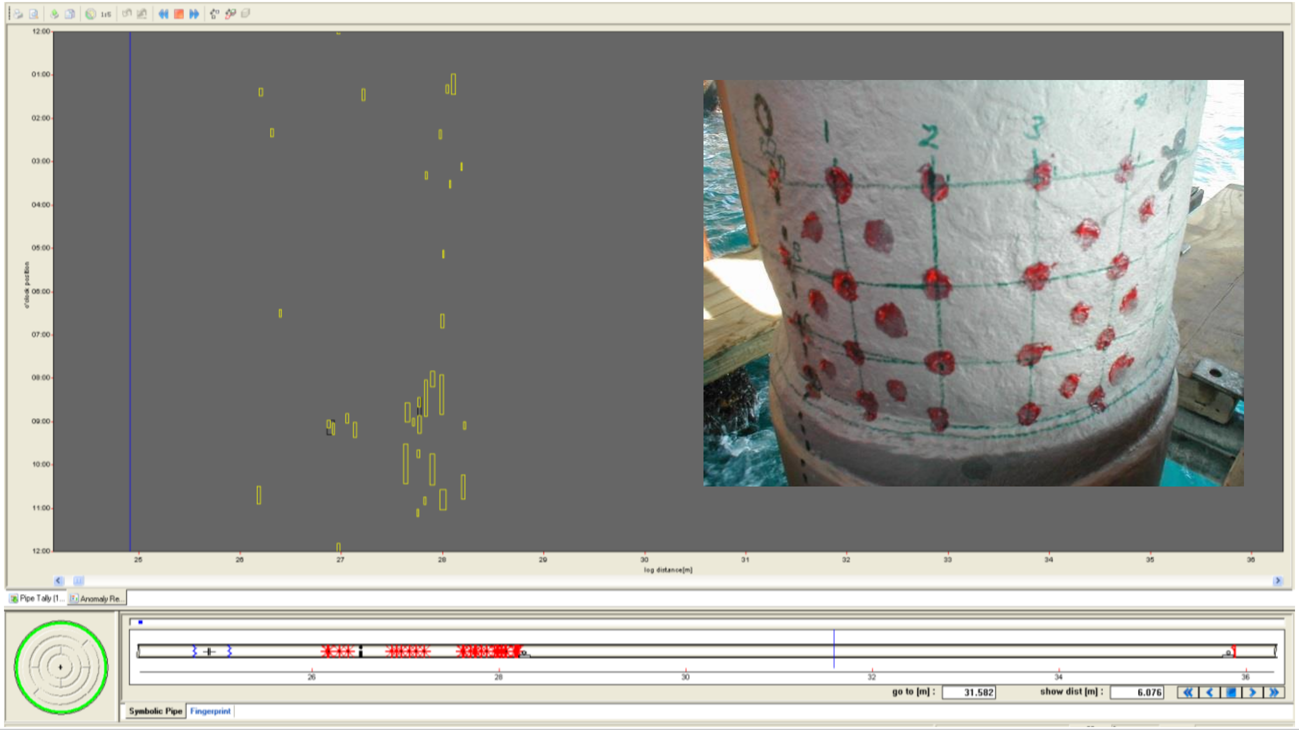
- Provides a framework for completing the life extension work
- Clearly identify missing & contradictory data from data gathering
- Document assumptions made to complete missing data
- Document resolution to data conflicts
- Minimises the likelihood of rework being required



Pipeline interfaces

High risk areas that require greater vigilance

- Riser splash zones are highly susceptible to external corrosion
- ILI data is often unreliable due to increased wall thickness and high tool speed
- Additional data such a UT results required to support ILI data



Theory vs Reality

Critical review of theoretical predictions against reality

For example, fatigue calculations (riser VIV or onshore compressor stations)

- Predicted fatigue life of 6 months compared to actual life to date of 50 years

FATIGUE LIFE	
In-line (Response Model)	4.76E-01 yrs
Cross-Flow	7.05E+01 yrs
In-line (Force Model)	8.50E+04 yrs
In-line (Combined)	4.76E-01 yrs

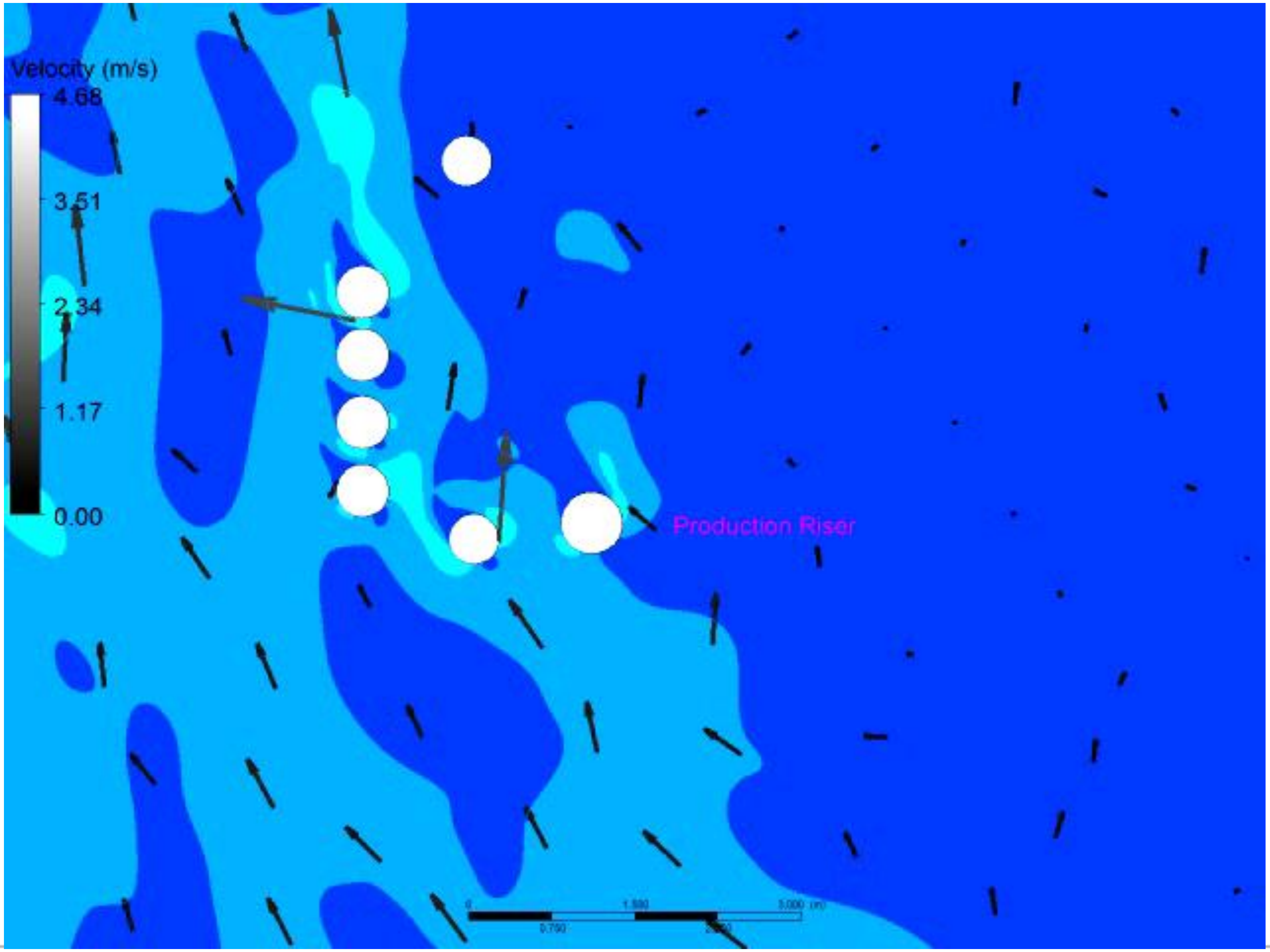
Riser Elevation (metres)	Damage (Y / N)		Clamp Elevation (m)	Clamp Damage (Y / N)
	Riser	Coating		
MSL	-	-	MSL	-
(-) 5.7M	N	N	N/A	N/A
(-) 17.3M	N	Y	(-) 16.5	N
(-) 30.4M	N	Y	(-) 29.7	N
(-) 45.7M	N	Y	(-) 45.0	N
(-) 61.8M	N	Y	N/A	N/A

Generally caused by:

- Lack of accurate and detailed operational history and conservative assumptions
- Compounded by conservative design calculations and simplistic modelling
- Requires detailed analysis and explanation

Theory vs Reality

Direct vs shielded wave action



New standards, old pipelines

Need to take a pragmatic approach

These assets were built well before AS2885 and DNV-OS-F101 existed.

- Getting a 50 year pipeline to fully comply with current standards is very difficult
- AS2885 and DNV-OS-F101 are risk based standards and exceptions can be made;
- Where issues of compliance arise;
    - Don’t be afraid to challenge them,
    - Assess the risk, engineer an alternative solution.
- AS2885 is not well suited to liquids or upstream pipeline, use international standards such as ASME B31.4 where they provide better guidance

Conclusions

Not just a tick in the box

Life extensions processes under AS2885 and DNV-OS-F101 provide a rigorous framework under which to assess current and future integrity

- Design, construction and operations is collated in one place, often for the first time in many decades

They provide asset managers with:

- A sound basis to make decisions of life extensions
- Provide clear direction for ongoing pipeline integrity activities
- Allow for efficient allocation of OPEX resources based on condition and risk