



PULSE

Real Time Monitoring to Support
Workover and Intervention
Operations on Ageing Conductors

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an **ACTEON** company

Agenda

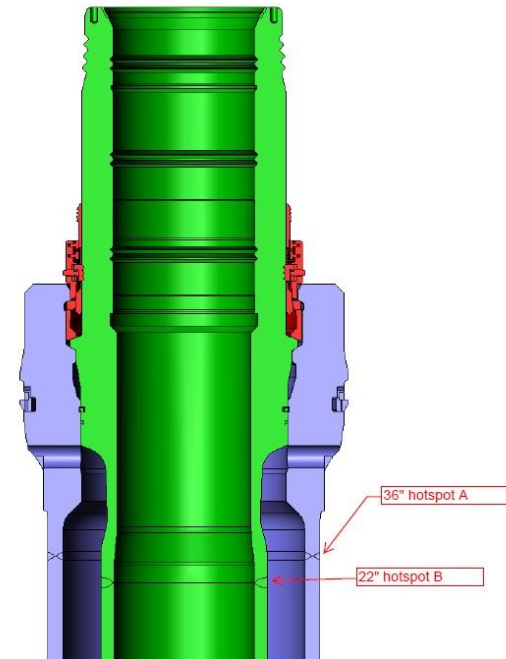


- Wellhead & Conductor Fatigue
- Workover & Intervention
- Real time monitoring
- Case Study
 - Summary
 - System overview
 - Data loggers
 - Environmental monitoring
 - Cable installation
 - Data management
 - Software
- Summary
- Questions

Wellhead & Conductor fatigue

Industry Issues

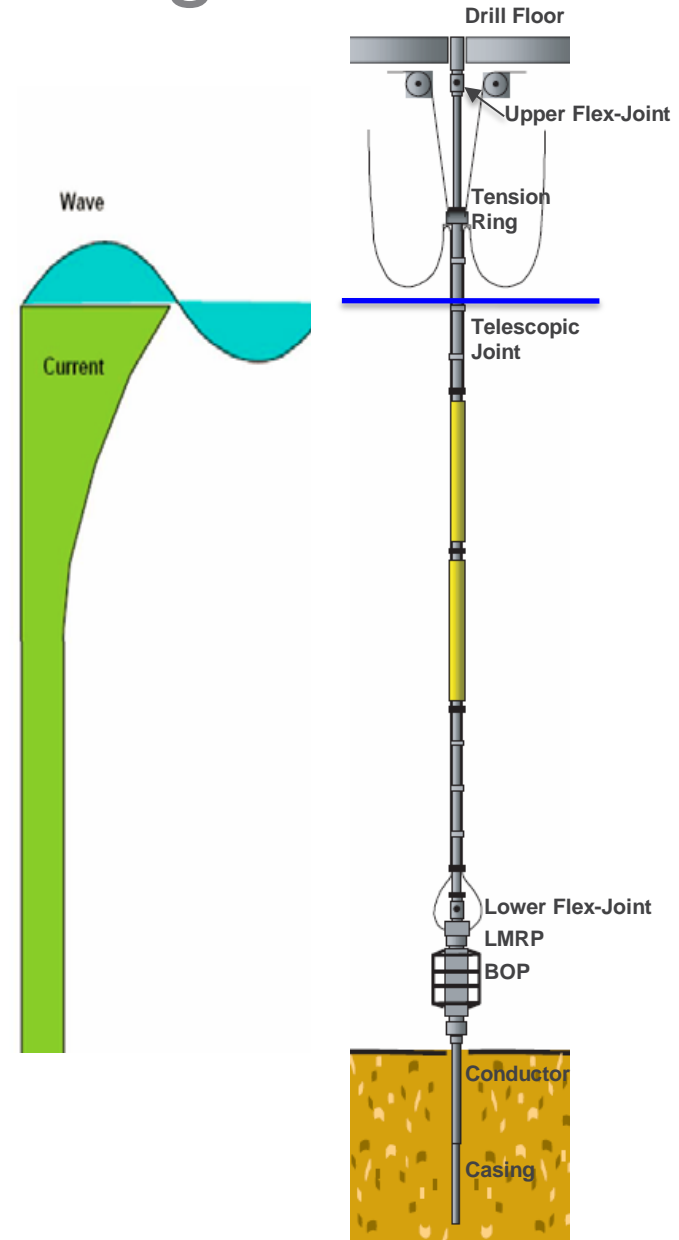
- Significant loading from:
 - Environmental interaction
 - Axial loads associated with hang-off of internal casings
- 'Fatigue hotspots'
- Analytical fatigue response conservative
- Safe operations require understanding of strength & durability



Wellhead & Conductor fatigue

Environmental Loading

- 2 primary causes of environmental loading:
 - VIV
 - Wave induced loading



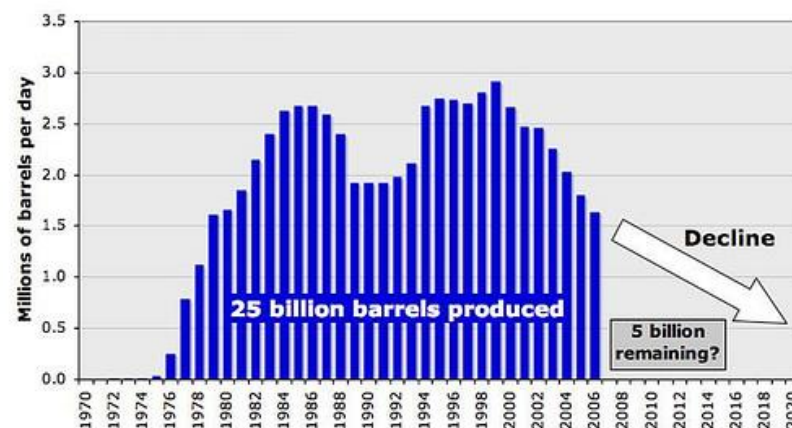
Workover & Intervention

Introduction

- Critical for future profitability of brownfield assets
- Extending field life & maximising recovery rates
- Europe- biggest market for intervention activity (32%)



UK North Sea Oil Production



Workover & Intervention

Specific challenges



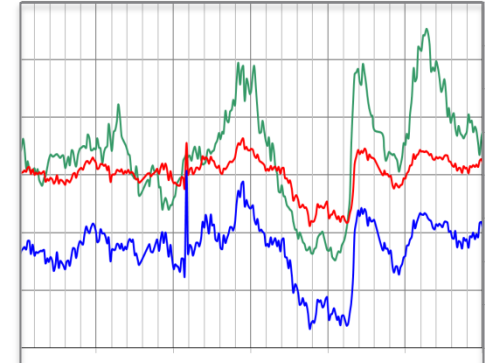
Taller & Heavier Stacks

- Xmas tree, BOP, LMRP, EDP
- Total stack taller & heavier than during drilling
- Enhanced lever arm effect



Old Wells

- Returning to old wells
- Often not designed for size of modern equipment (e.g. 5 ram BOP)



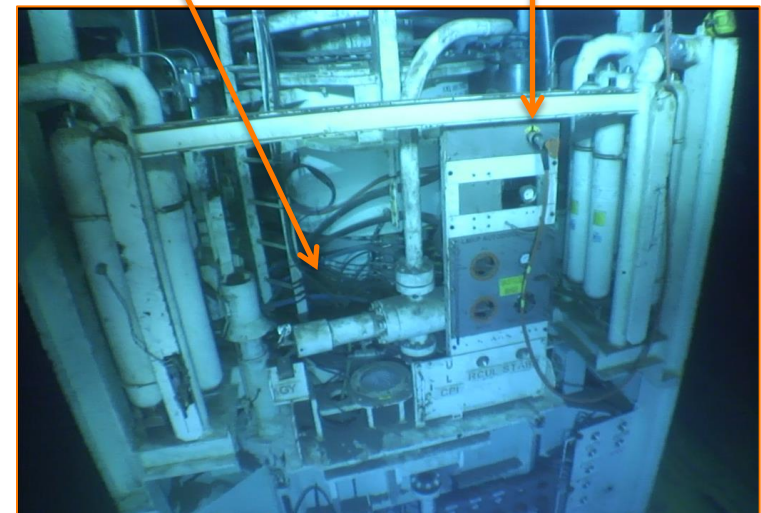
Limited Fatigue Data

- Often very little data on accumulated well fatigue damage
- Causes inaccuracies in analytical model

Real Time Monitoring

Introduction

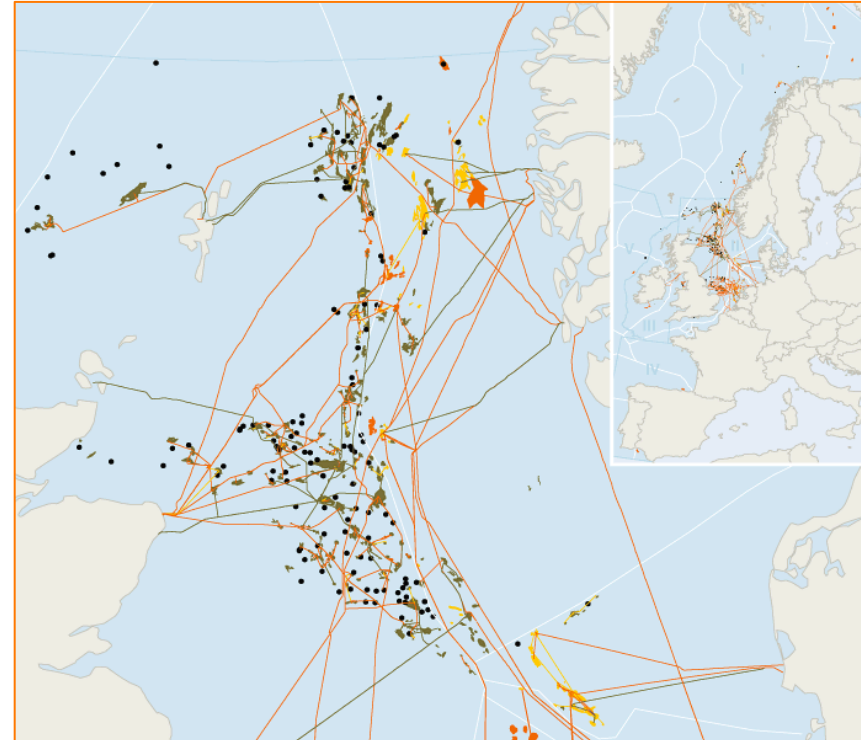
- Simple & rapidly deployable system
- ROV installable & retrievable
- Provides early warning of excessive BOP motion
- Calculates wellhead fatigue in real time
 - Improves confidence
 - Reduces uncertainty



Case Study: UK North Sea

Project Background

- UKCS
- Workover & intervention
- Semisub
- Issues:
 - Old well
 - Big BOP
 - Limited fatigue history



Fields/pipelines

- Natural gas
- Oil/condensate
- Mixed

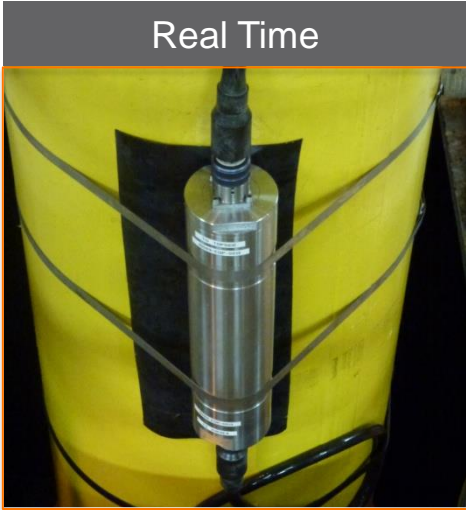
● New discoveries of oil and gas fields since 2000 (not yet in production)

Case Study: UK North Sea Wellhead & conductor monitoring System



Case Study: UK North Sea

Data loggers



Location	Centre of vessel	Lower riser, Tree & LMRP	LMRP
Measuring	Vessel motions	Tree vs LMRP motion	LMRP displacement
Installation	Bolted topside	Riser-strapped Tree/LMRP- magnetic	Logger installed while LMRP on deck
Logging Period	Real time	15 minutes every hour	Real time
Battery	N/A	60 days	N/A

Case Study: UK North Sea

Standalone logger installation

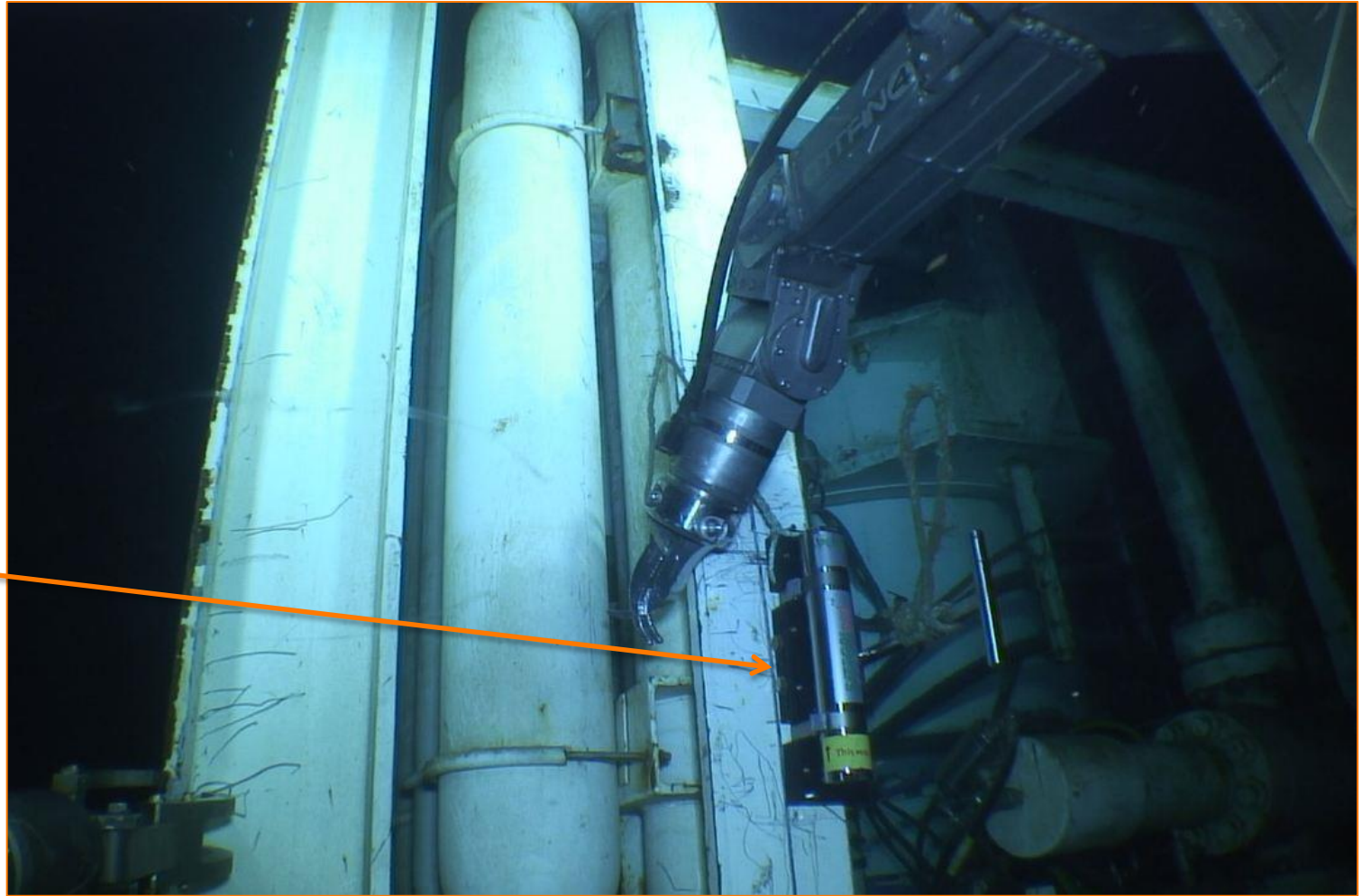


Loggers strapped to lower riser



Case Study: UK North Sea

Standalone logger installation



ROV deployable loggers on LMRP & Tree

Case Study: UK North Sea

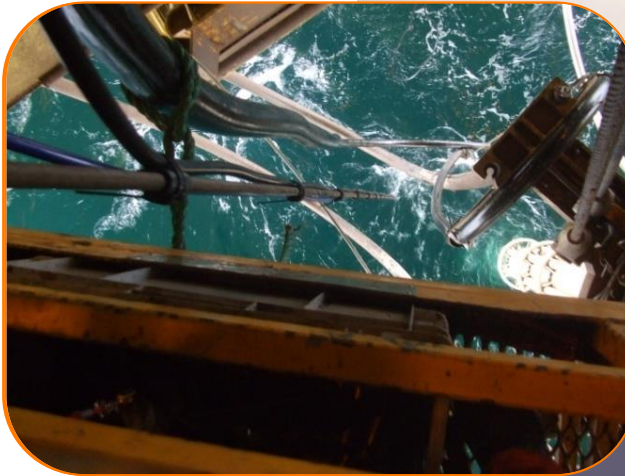
Environmental monitoring

- ADCP
 - Current strength
 - Current speed
- Identify any correlation with LMRP motion
- Wave height & direction data from 3rd party



Case Study: UK North Sea

Cable Installation



Case Study – Drilling Monitoring Online Integrity Management

Pre-Job

Consultant

Integrity Management

- KPI determination
- Traffic light levels
- Communication protocol

Riser Analysis

- Hotspot location
- Fatigue damage accumulation
- Monitoring requirement

Operator

Operational Requirements

- Potential issues
- Data frequency
- Details of campaign length

During operations

Offshore

Data Acquisition Sensors

- BOP motion
- Riser motion
- Metocean (wave, current)

Online Software Interface

- BOP displacement
- Fatigue damage at defined locations
- Green/amber/red warnings defined

Offshore -Operator

Offshore Action Taken

- Change operational parameters
 - Tension
 - Vessel position
 -
- Stop operations

Onshore–Consultant

Onshore Analysis

- Medium priority warnings (orange traffic lights) analysed within defined operational timeframe
- Report analysis and conclusions to client
- Decision whether to escalate

Onshore -Operator

Online Decision Making

- Review of escalated issues and risk assessment carried out:
- Operational action taken
- or
- KPI's reviewed and/or refined

Data Processing, Visualisation & Management

Use of KPIs to Simplify and Visualise

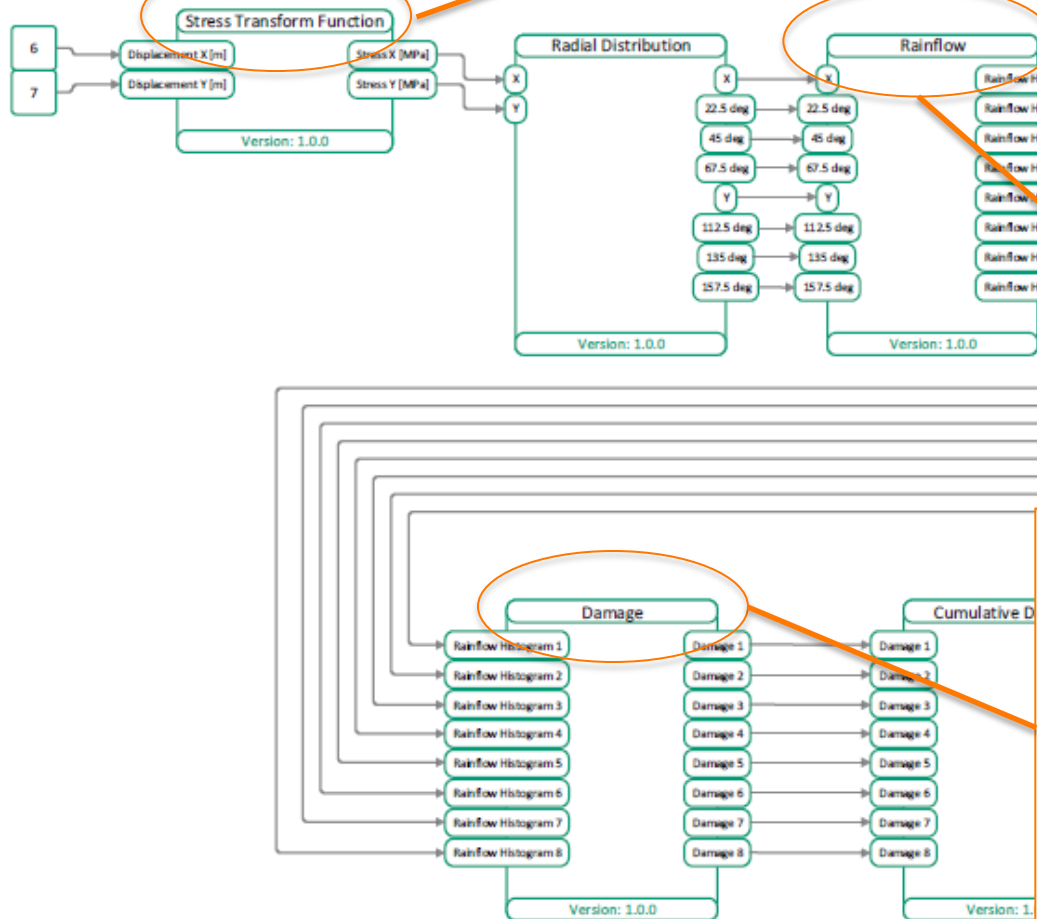
Key Performance Indicator	Measurement Method	Quantity	Units	Green	Orange	Red
Wellhead bending	BOP Motion Sensor	Angular Rate	deg	below orange	1	3
Wellhead tension	Tension Strain Measurement	Inferred Tension Variation	Te		±10%	±25%
Fatigue accumulation	BOP Motion Sensor	Inferred Accumulated Fatigue Damage	-		5% of fatigue life in 24 hour period	10% of fatigue life in 3 hour period
		Inferred Accumulated Fatigue Damage	-		50%	90%
VIV warning	BOP Motion Sensor	Response Frequency	Hz		±20% of natural frequency	±20% of natural frequency
		Amplitude at Response Frequency	m		A/D = 0.25	A/D=0.5
Wave	Wave Radar	Wave Height	m		normal operating limit	extreme operating limit
Current	ACDP	Speed	m/s		normal operating limit	extreme operating limit

Figure 2.2.2 – KPI Parameters & Actions (example)

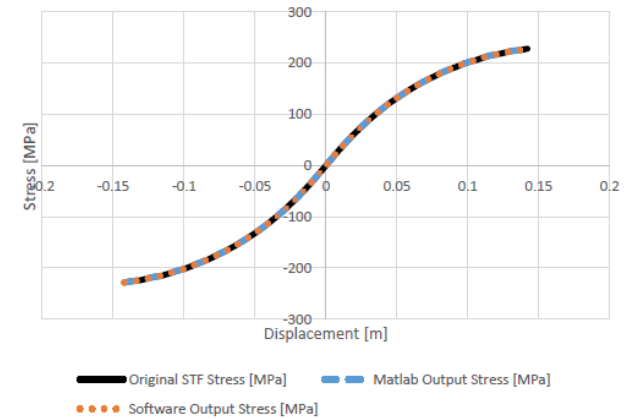


Data Processing, Visualisation & Management

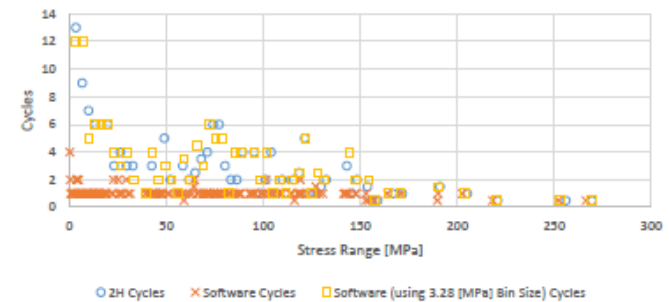
IP integrated into software with extensive



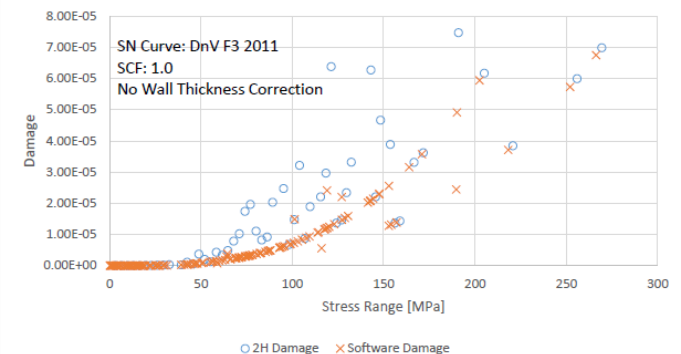
Stress Transfer Comparison



Stress Histogram Comparison



Damage Histogram Comparison



Data Processing, Visualisation & Management

Sample screenshot





- Continuing to see requirement for 'immediate knowledge'
- Hardwired- provides maximum speed and power of data
- Data available for analysis in minutes
- Trade off between data availability vs cost/ risk



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Thank You

Questions?

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