CoilData™

Coiled Tubing Online

Online Analysis of Weight and Pressure History aids Pipe Failure Investigations

ICoTA-Canada Roundtable

October 2015

- An online archive of data from CT operations (CoilData)
- Analyzing outcomes for ‘retired’ CT strings
- Online implementation of a basic CT limits calculation
- Interpreting weight and pressure data over the life of a string
- Case studies

CoilData (formerly Aradia)

- Web-based pipe management and job analysis system
- 3,452 strings and 99,374 jobs covering 5 year period
- Linked to Cerberus™ modeling software (NOV-CTES)
- Used by 26 service companies worldwide (7 in Canada)
- Includes controlled access for pipe manufacturers and operators
- Data confidential to each company – no combined analysis

D1

WELLSITE

Data Acquisition
(e.g. Orion™)

Job log data
- time
- depth
- speed
- pump pressure
- wellhead pressure
- surface weight
- *other*

WELLSITE or OFFICE

Modeling
(Cerberus™)

String properties
- geometry, material
- fatigue, diameter
- job history
- maintenance

Job information
- well
- client
- personnel
- equipment

CDU

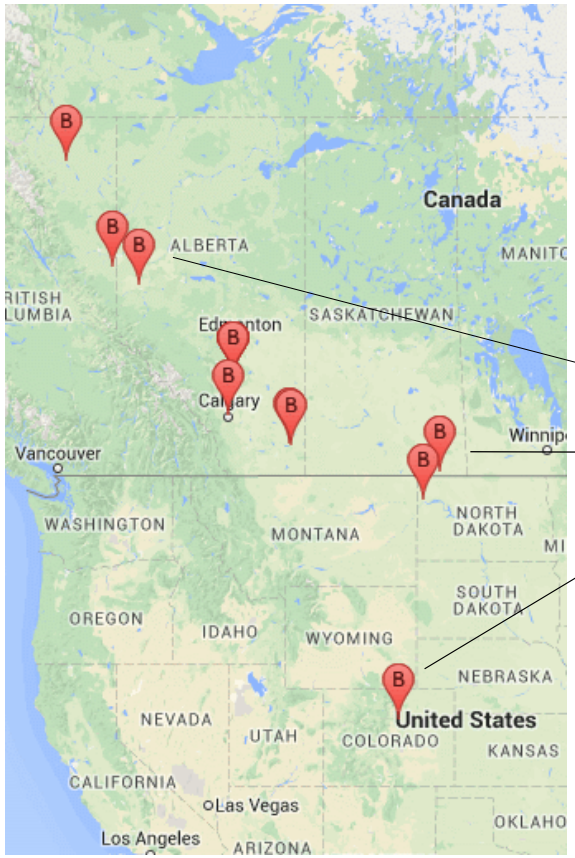
WEB SERVER

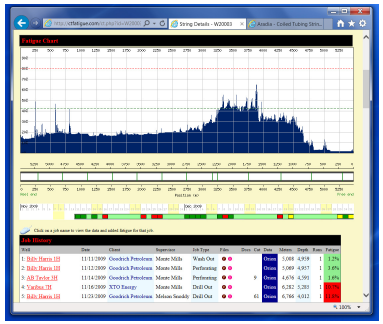
CoilData

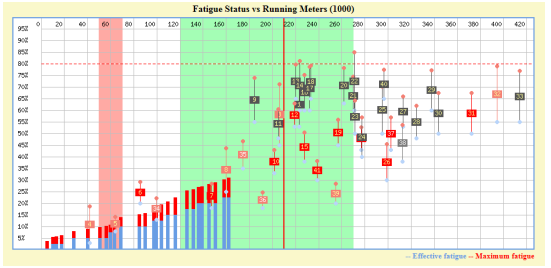
+ user edits
+ documentation
+ inspections
+ pressure tests
+ maintenance records
+ treatment reports
+ failure analyses
+ 3rd party data

Slide 4

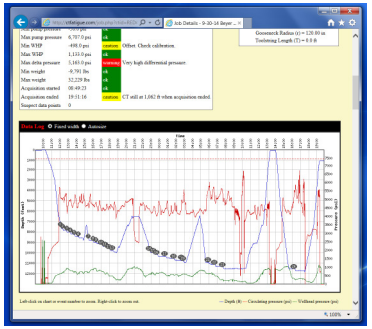
D1 Doug, 10/22/2014

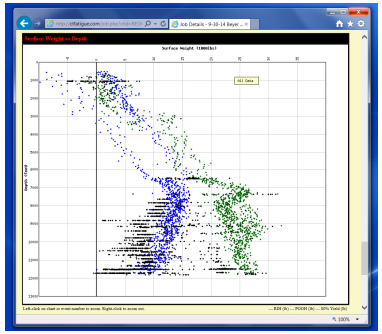


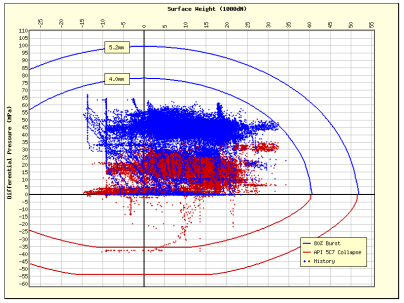




www.CoilData.com



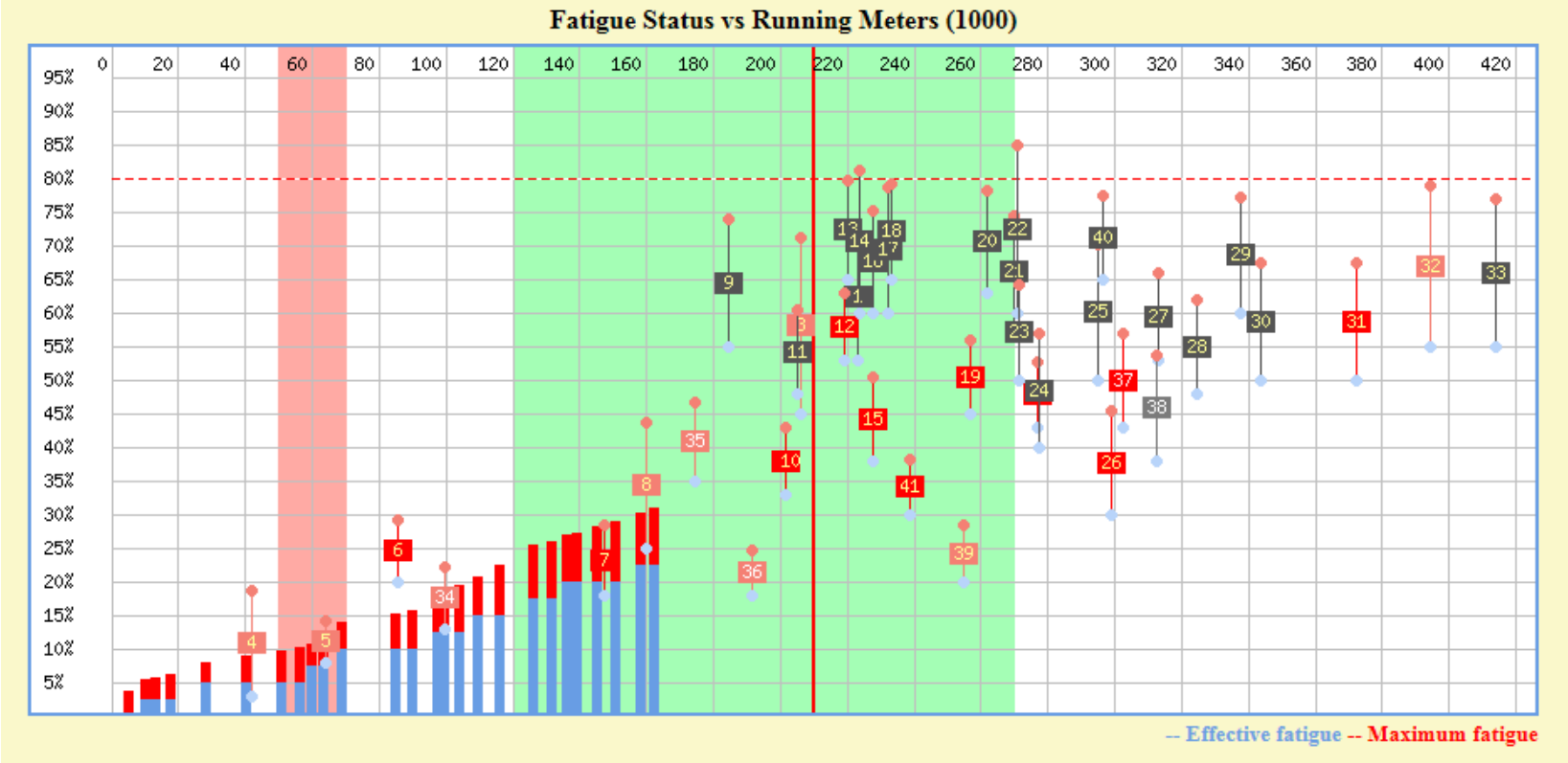




33 Retired

32 Damaged

26 Pinholed or Parted



Fatigue (%) vs Running Meters (1,000m)

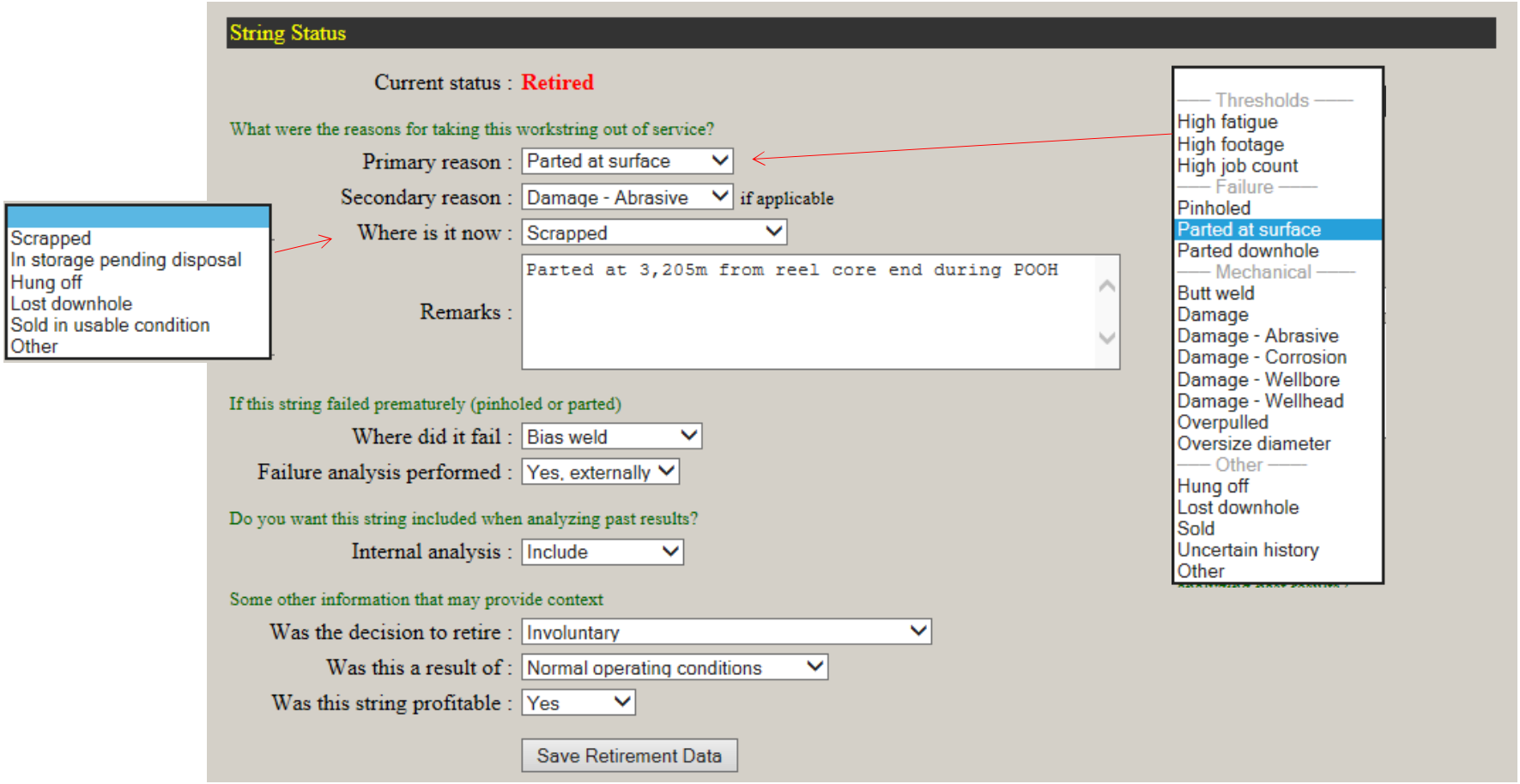
showing outcomes for 41 retired 50mm (2") 100-Kpsi strings

Reason String Retired Raw data		
High fatigue	19	24.7%
Normal	12	15.6%
Parted	9	11.7%
Pinholed	7	9.1%
Major damage	6	7.8%
Butt weld	6	7.8%
Other	5	6.5%
Oversize	5	6.5%
Minor damage	3	3.9%
Hung off	2	2.6%
Lost downhole	2	2.6%
Scrapped	1	1.3%

Reason String Retired Interpreted data		
High fatigue	23	33.8%
Parted	9	13.2%
Pinholed	7	10.3%
Major damage	6	8.8%
Butt weld	6	8.8%
Oversize	5	7.4%
Other	5	7.4%
Minor damage	3	4.4%
Hung off	2	2.9%
Lost downhole	2	2.9%
Expended		36.8%
Damage related		22.1%
Fatigue failures		23.5%
Fatigue related		64.7%

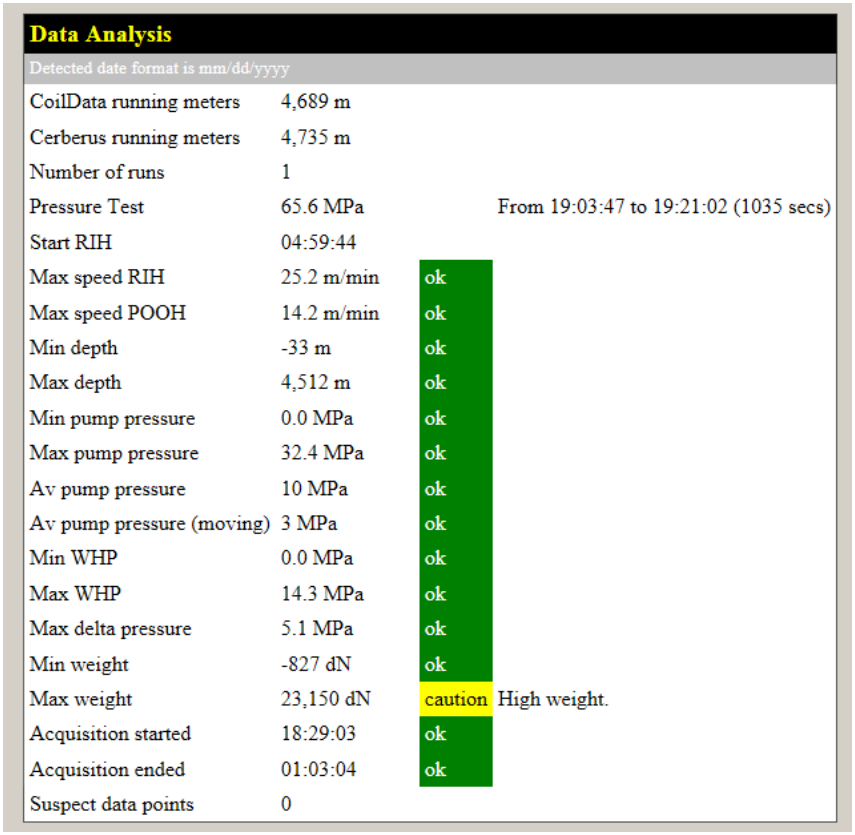
Pipe Failure Analysis

- Detailed information is needed about each failure to draw appropriate conclusions, e.g. was there an investigation, if so who by, was there a material defect, did it fail at a weld, etc…


String Status
Current status : Retired
What were the reasons for taking this workstring out of service?
Primary reason : Parted at surface
Secondary reason : Damage - Abrasive if applicable
Where is it now : Scrapped
Remarks : Parted at 3,205m from reel core end during POOH
If this string failed prematurely (pinholed or parted)
Where did it fail : Bias weld
Failure analysis performed : Yes, externally
Do you want this string included when analyzing past results?
Internal analysis : Include
Some other information that may provide context
Was the decision to retire : Involuntary
Was this a result of : Normal operating conditions
Was this string profitable : Yes
Save Retirement Data
Scrapped
In storage pending disposal
Hung off
Lost downhole
Sold in usable condition
Other
Thresholds
High fatigue
High footage
High job count
Failure
Pinholed
Parted at surface
Parted downhole
Mechanical
Butt weld
Damage
Damage - Abrasive
Damage - Corrosion
Damage - Wellbore
Damage - Wellhead
Overpulled
Oversize diameter
Other
Hung off
Lost downhole
Sold
Uncertain history
Other

Pipe Failure Analysis

- Detailed information is needed about each failure to draw appropriate conclusions, e.g. was there an investigation, if so who by, was there a material defect, did it fail at a weld, etc…
- What pressure and tension/compression conditions was the pipe subjected to over its working life? (were the limits exceeded at some point prior to the final failure?)

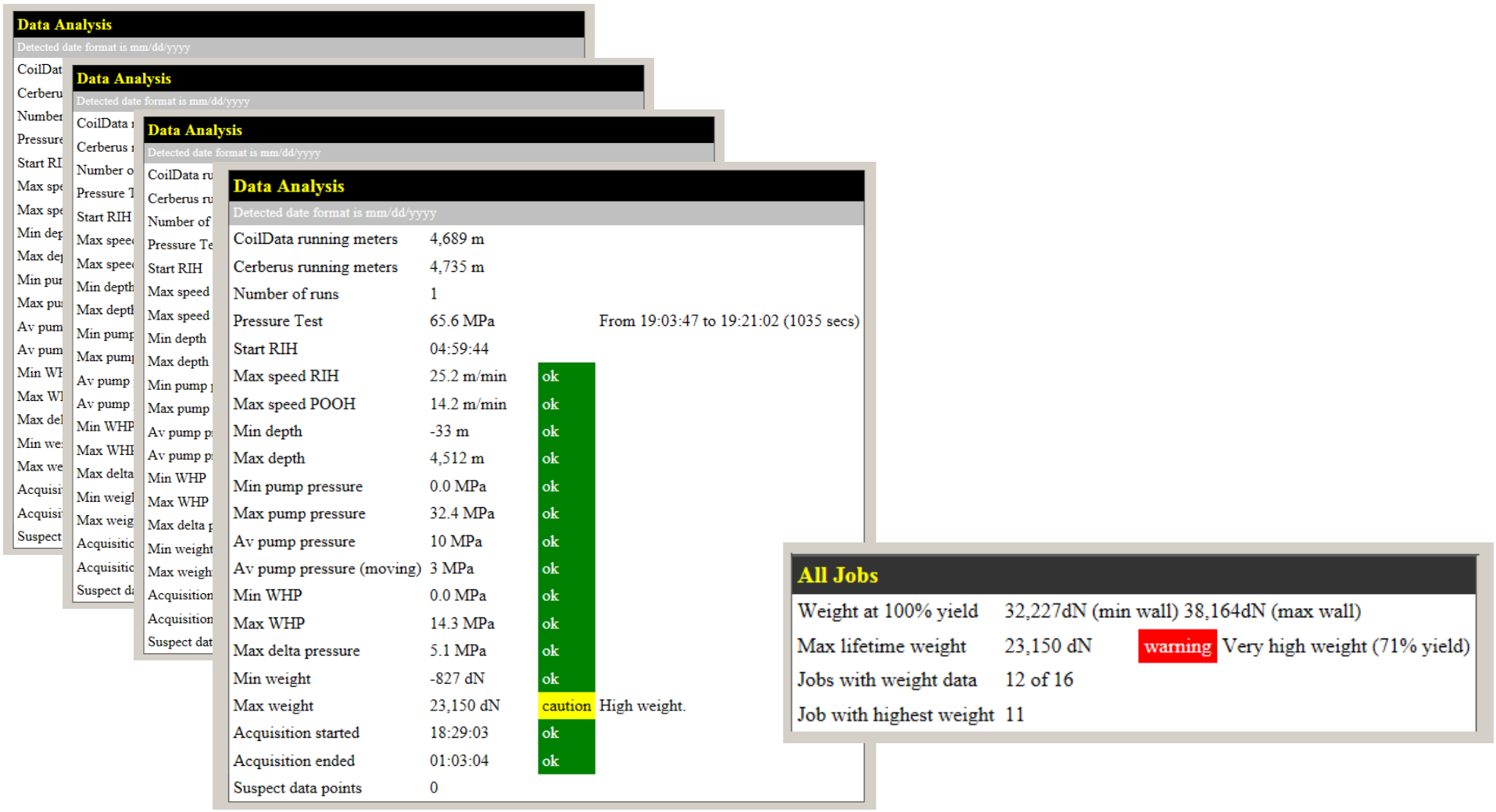


Data Analysis

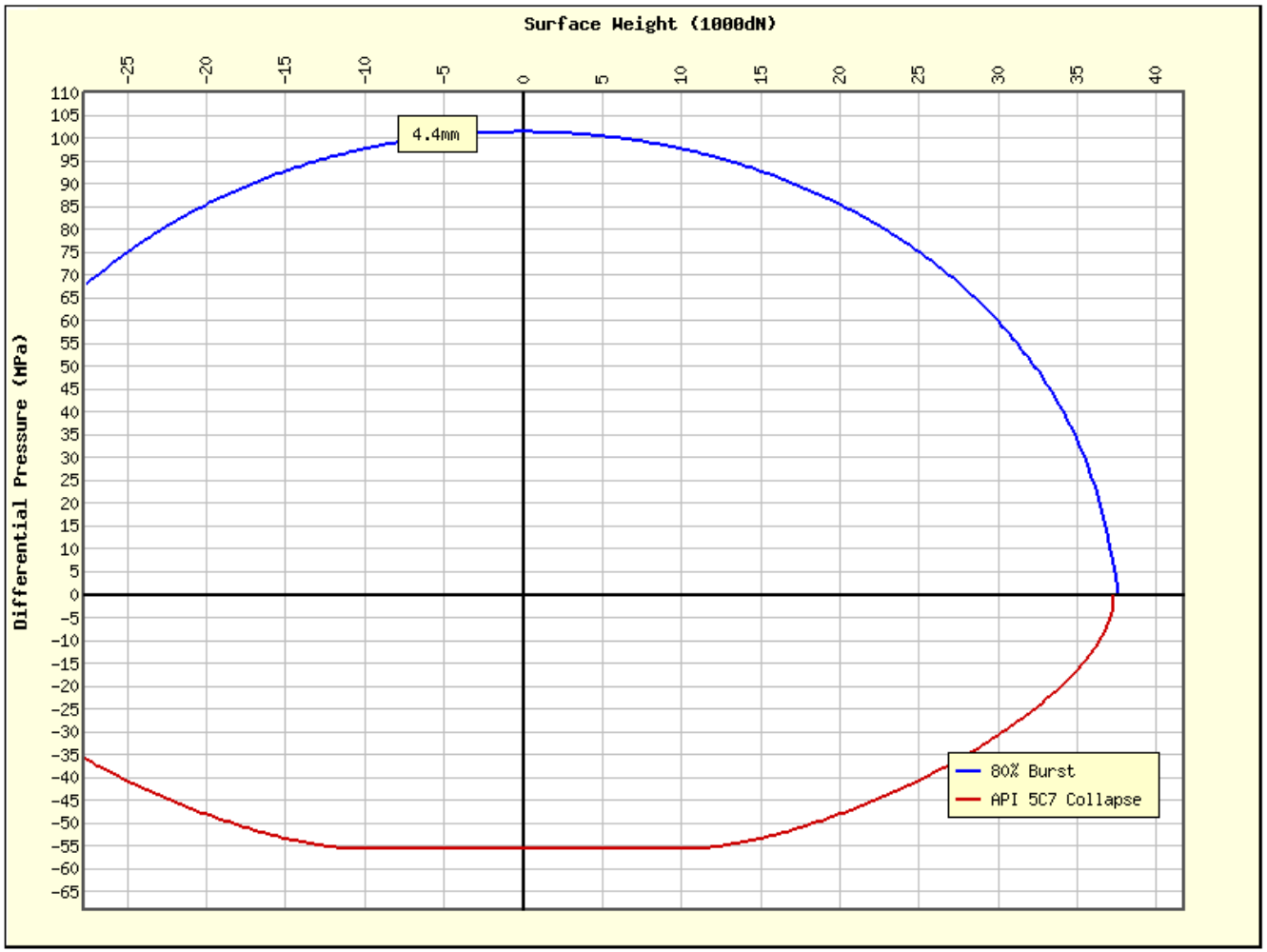
Detected date format is mm/dd/yyyy

CoilData running meters	4,689 m		
Cerberus running meters	4,735 m		
Number of runs	1		
Pressure Test	65.6 MPa		From 19:03:47 to 19:21:02 (1035 secs)
Start RIH	04:59:44		
Max speed RIH	25.2 m/min	ok	
Max speed POOH	14.2 m/min	ok	
Min depth	-33 m	ok	
Max depth	4,512 m	ok	
Min pump pressure	0.0 MPa	ok	
Max pump pressure	32.4 MPa	ok	
Av pump pressure	10 MPa	ok	
Av pump pressure (moving)	3 MPa	ok	
Min WHP	0.0 MPa	ok	
Max WHP	14.3 MPa	ok	
Max delta pressure	5.1 MPa	ok	
Min weight	-827 dN	ok	
Max weight	23,150 dN	caution	High weight.
Acquisition started	18:29:03	ok	
Acquisition ended	01:03:04	ok	
Suspect data points	0		

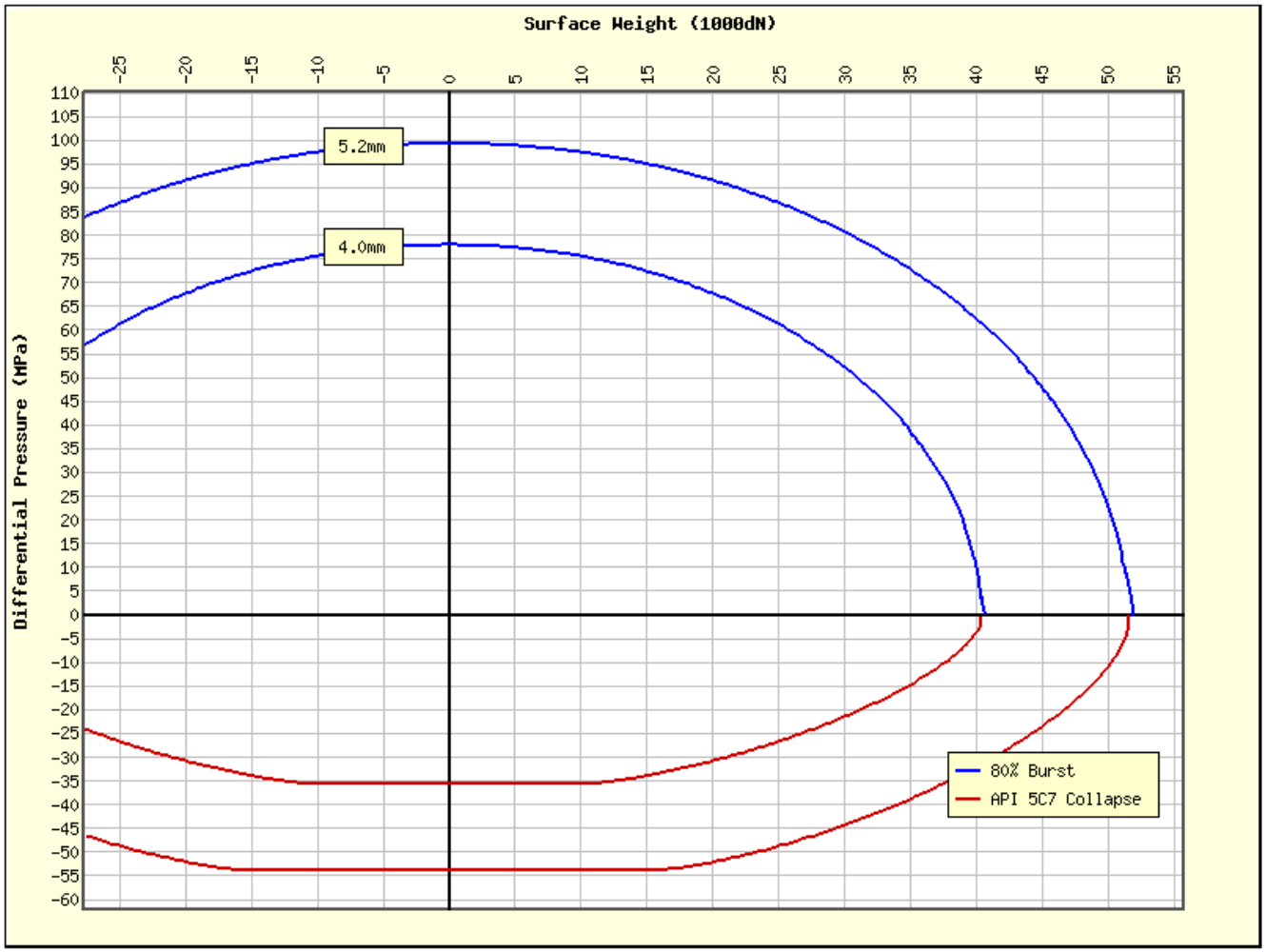
Data Analysis – One Job



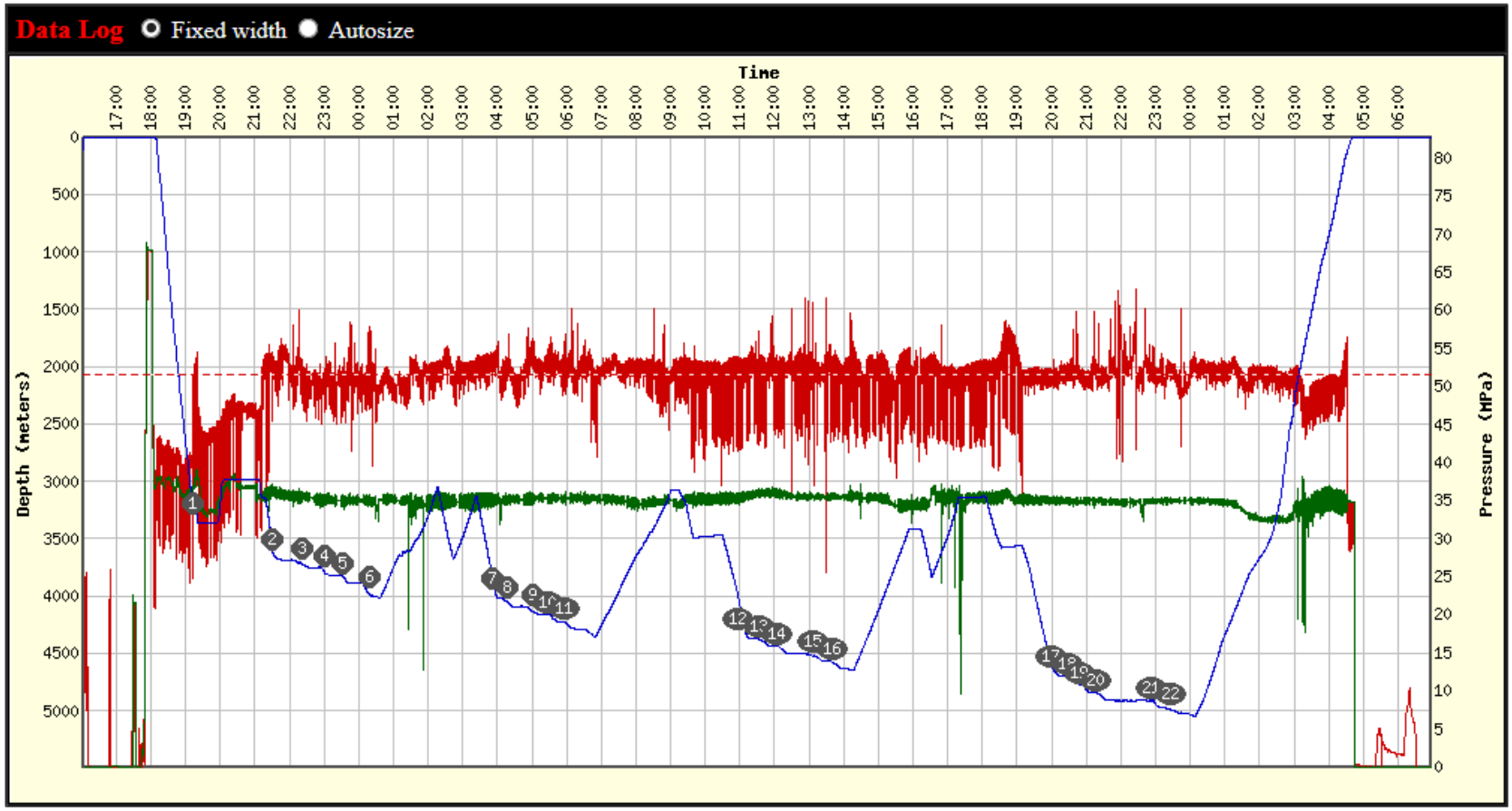
Data Analysis – All Jobs



Tubing Limits Online – Straight Wall

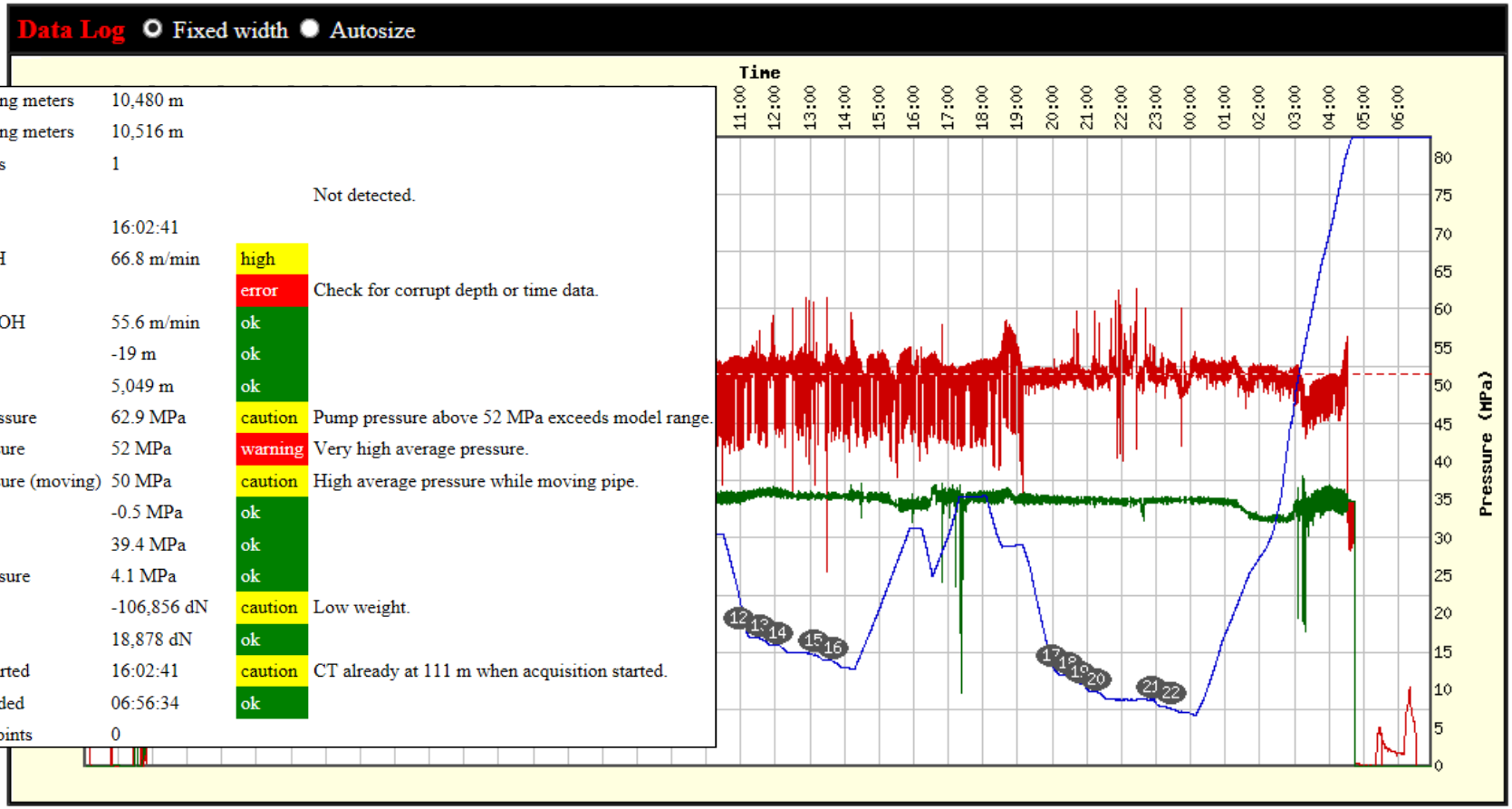


Tubing Limits Online – Tapered Wall


Data Log
Fixed width
Autosize
Time
Depth (meters)
Pressure (MPa)
Depth (m)
Pump Pressure (MPa)
Wellhead Pressure (MPa)

Data Log ○ Fixed width ● Autosize

CoilData running meters	10,480 m		
Cerberus running meters	10,516 m		
Number of runs	1		
Pressure Test			Not detected.
Start RIH	16:02:41		
Max speed RIH	66.8 m/min	high	
Depth channel		error	Check for corrupt depth or time data.
Max speed POOH	55.6 m/min	ok	
Min depth	-19 m	ok	
Max depth	5,049 m	ok	
Max pump pressure	62.9 MPa	caution	Pump pressure above 52 MPa exceeds model range.
Av pump pressure	52 MPa	warning	Very high average pressure.
Av pump pressure (moving)	50 MPa	caution	High average pressure while moving pipe.
Min WHP	-0.5 MPa	ok	
Max WHP	39.4 MPa	ok	
Max delta pressure	4.1 MPa	ok	
Min weight	-106,856 dN	caution	Low weight.
Max weight	18,878 dN	ok	
Acquisition started	16:02:41	caution	CT already at 111 m when acquisition started.
Acquisition ended	06:56:34	ok	
Suspect data points	0		



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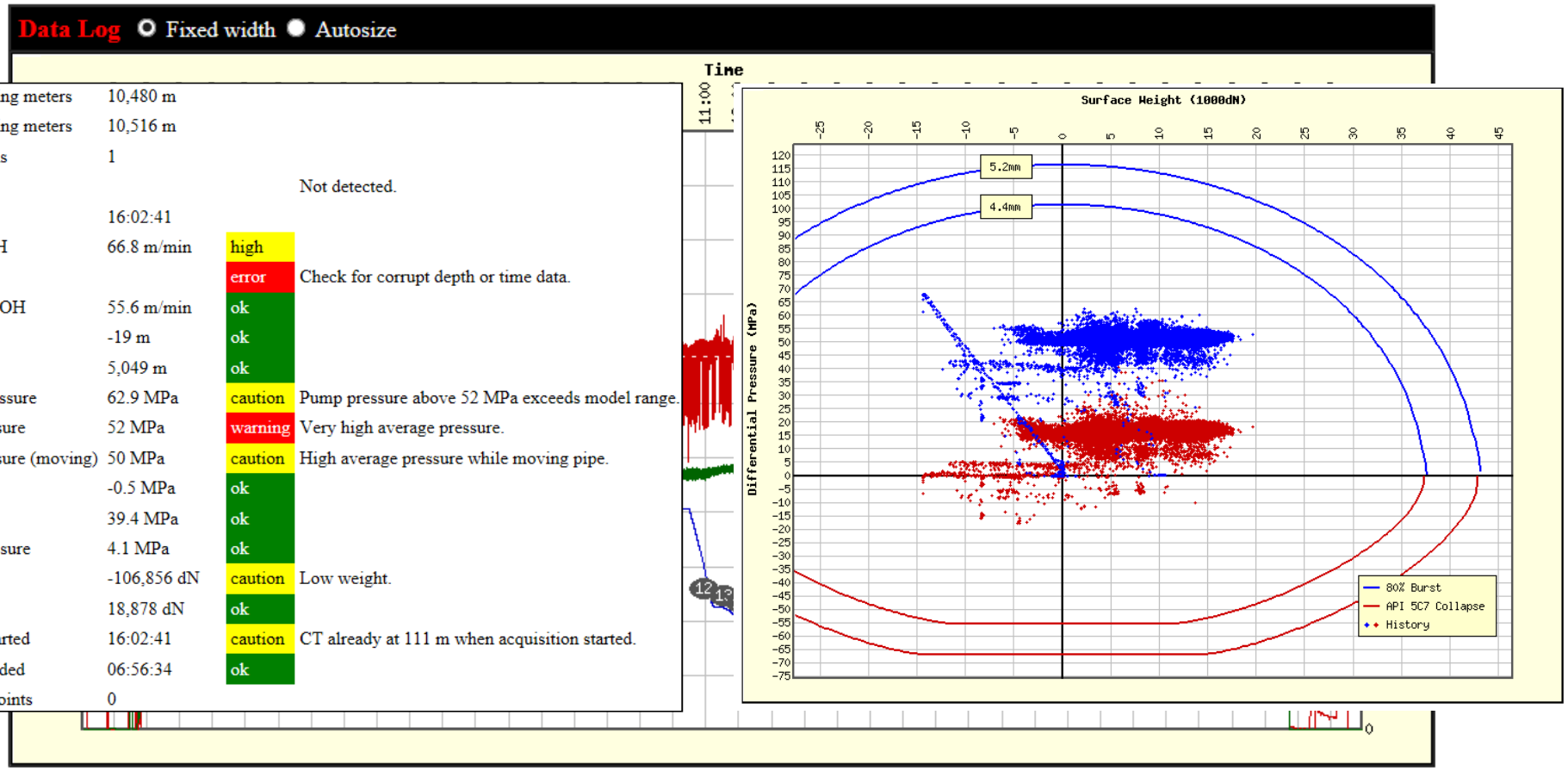

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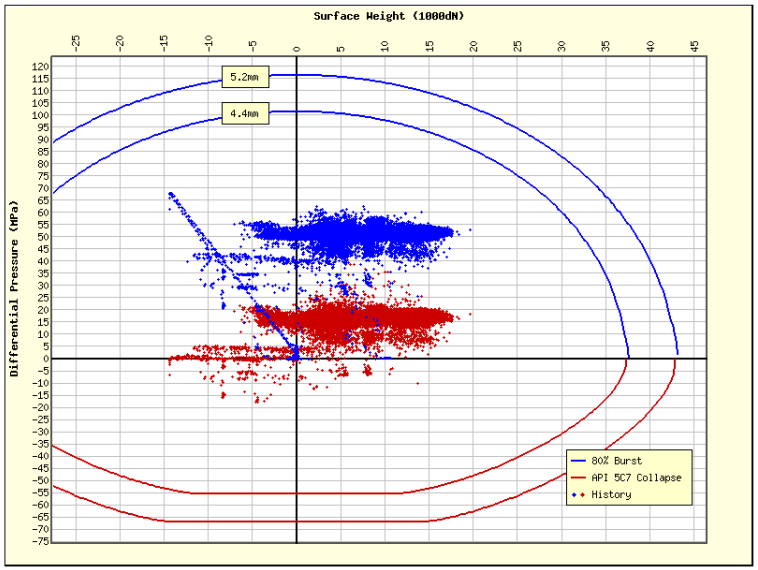

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Pressure Test	Not detected.
Start RIH	
Max speed	
Depth char	
Max speed	
Min depth	
Max depth	
Max pump	
Av pump p	
Av pump p	
Min WHP	
Max WHP	
Max delta	
Min weigh	
Max weigh	
Acquisitio	
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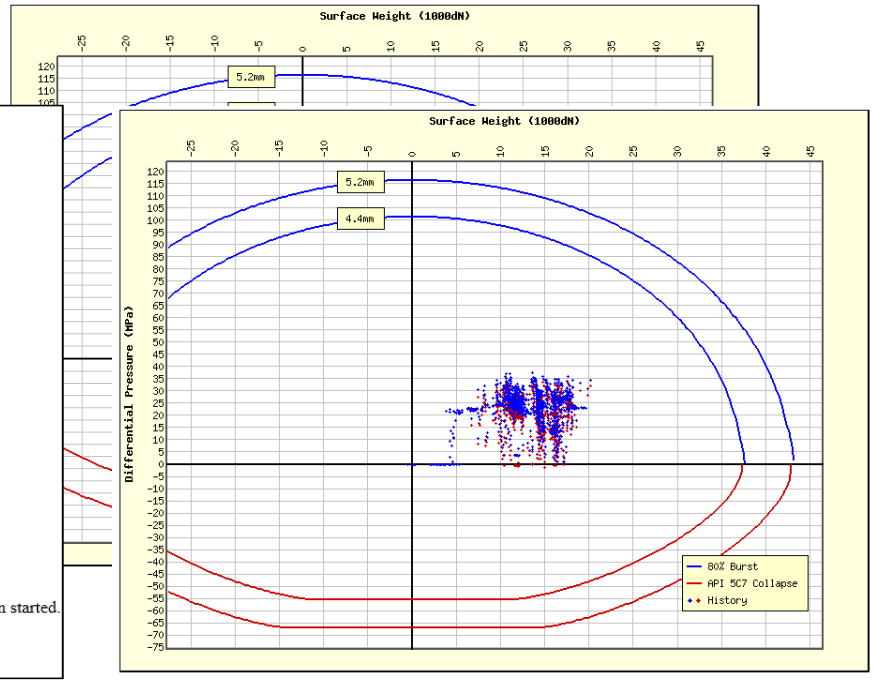
Suspect da	

CoilData running meters	583 m		
Cerberus running meters	588 m		
Number of runs	0		
Pressure Test		Not detected.	
Start RIH	07:28:23		
Max speed RIH	17.3 m/min	ok	
Max speed POOH	59.2 m/min	ok	
Min depth	-3 m	ok	
Max depth	3,330 m	ok	
Max pump pressure	37.6 MPa	ok	
Av pump pressure	24 MPa	ok	
Av pump pressure (moving)	23 MPa	ok	
Min WHP	-0.2 MPa	ok	
Max WHP	6.5 MPa	ok	
Max delta pressure	24.5 MPa	caution	High differential pressure.
Min weight	2,703 dN	ok	
Max weight	19,356 dN	ok	
Acquisition started	07:28:23	caution	CT already at 2,950 m when acquisition started.
Acquisition ended	12:11:19	ok	
Suspect data points	0		



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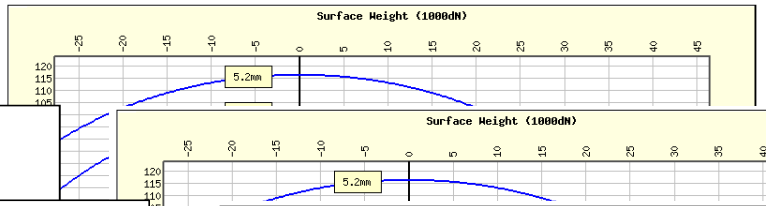
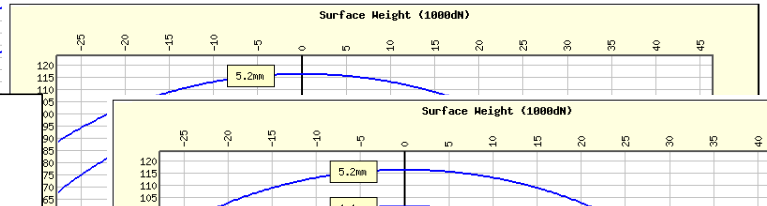
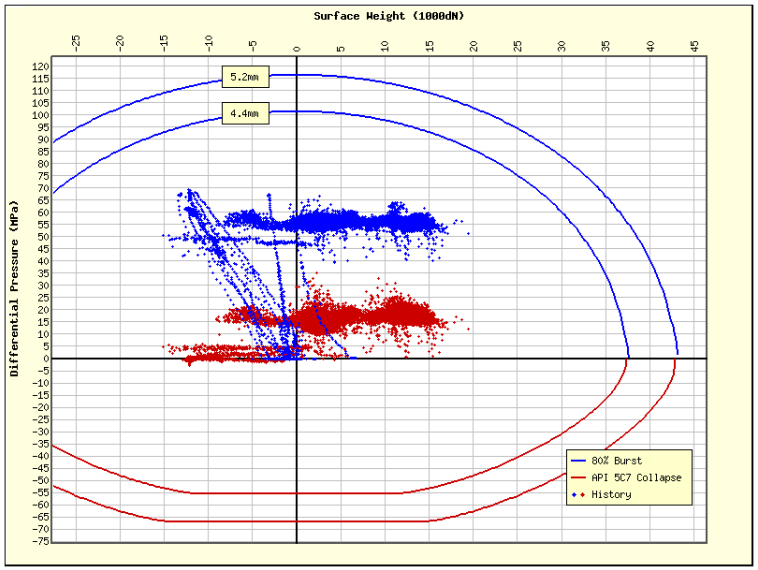
Pressure Test	Not detected.



CoilData running meters	583 m
Cerberus running meters	588 m
Number of runs	0



CoilData running meters	10,199 m		
Cerberus running meters	10,267 m		
Number of runs	1		
Pressure Test	Not detected.		
Start RIH	16:42:00		
Max speed RIH	63.1 m/min	high	
Max speed POOH	67.6 m/min	ok	
Min depth	-23 m	ok	
Max depth	5,352 m	ok	
Min pump pressure	-0.3 MPa	ok	
Max pump pressure	67.0 MPa	caution	Pump pressure above 52 MPa exceeds model range.
Av pump pressure	56 MPa	warning	Very high average pressure.
Av pump pressure (moving)	54 MPa	warning	Very high average pressure while moving pipe.
Min WHP	-0.8 MPa	ok	
Max WHP	46.3 MPa	ok	
Max delta pressure	18.1 MPa	ok	
Min weight	-14,613 dN	caution	Low weight.
Max weight	18,650 dN	ok	
Acquisition started	07:51:07	ok	
Acquisition ended	07:40:47	ok	
Suspect data points	0		



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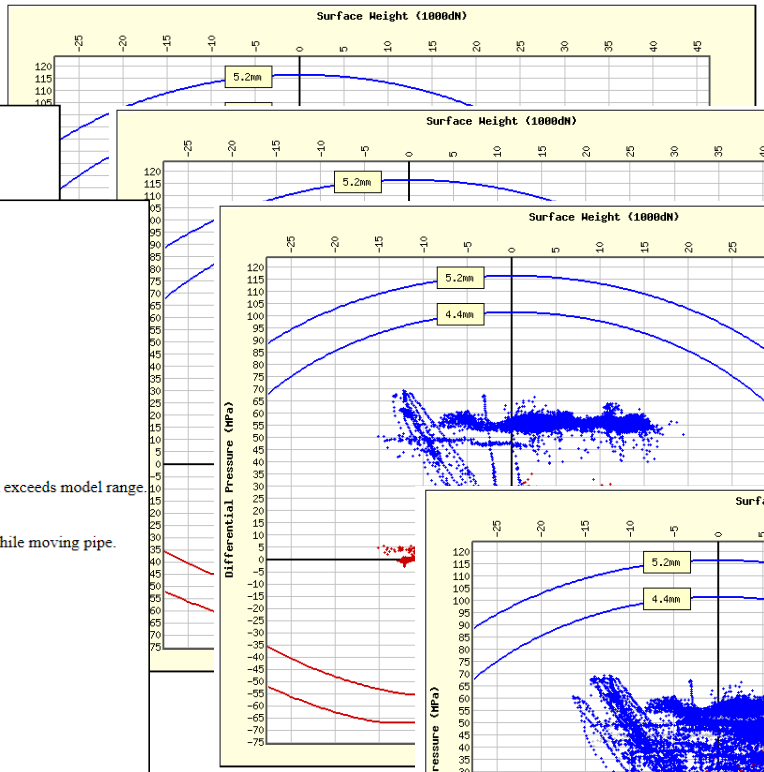
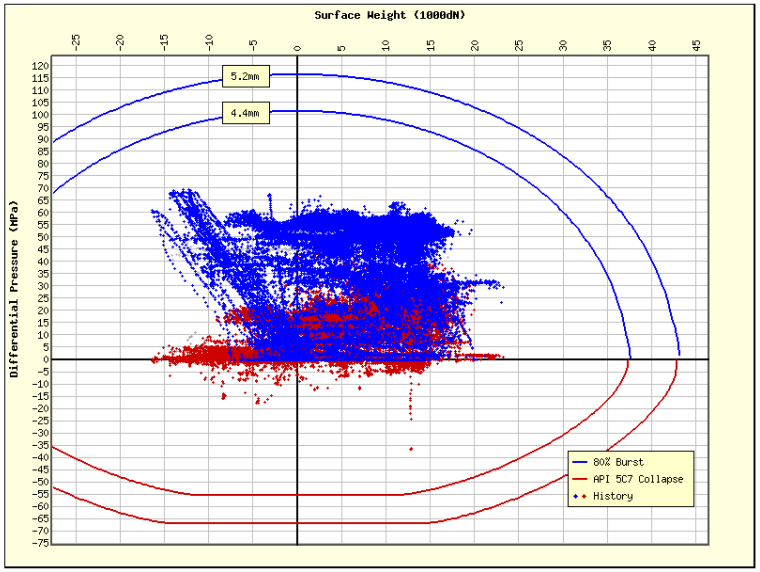
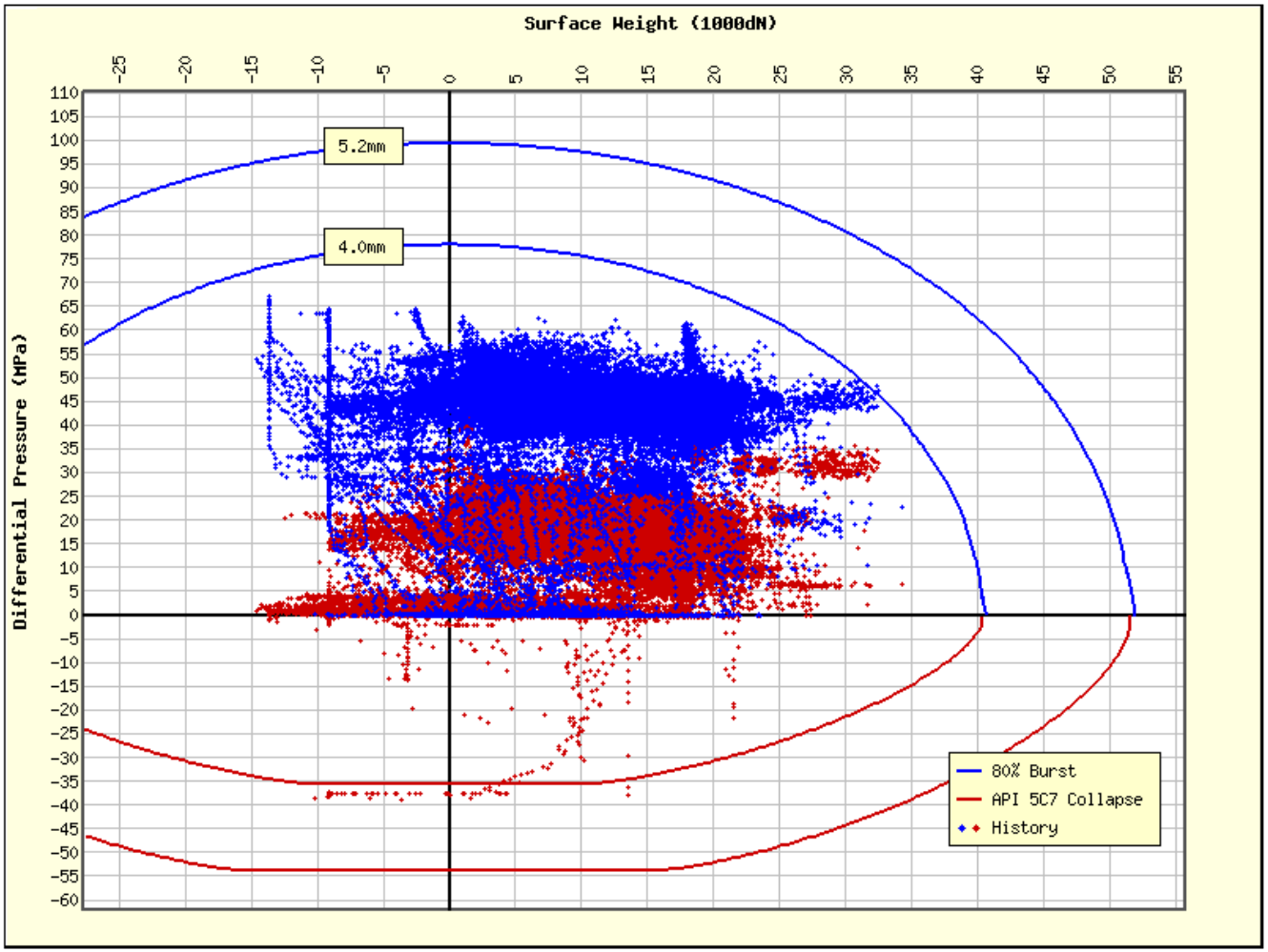


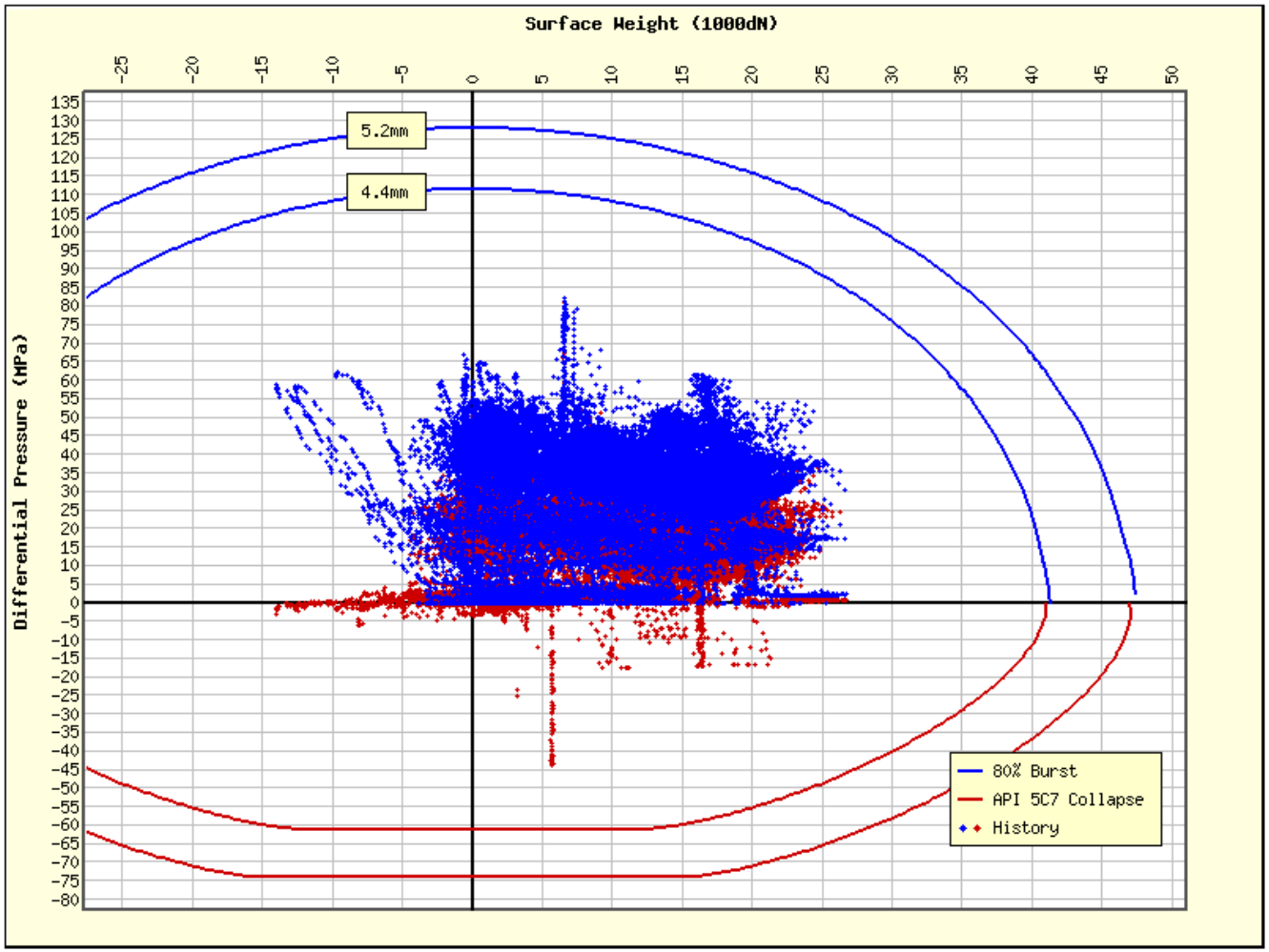


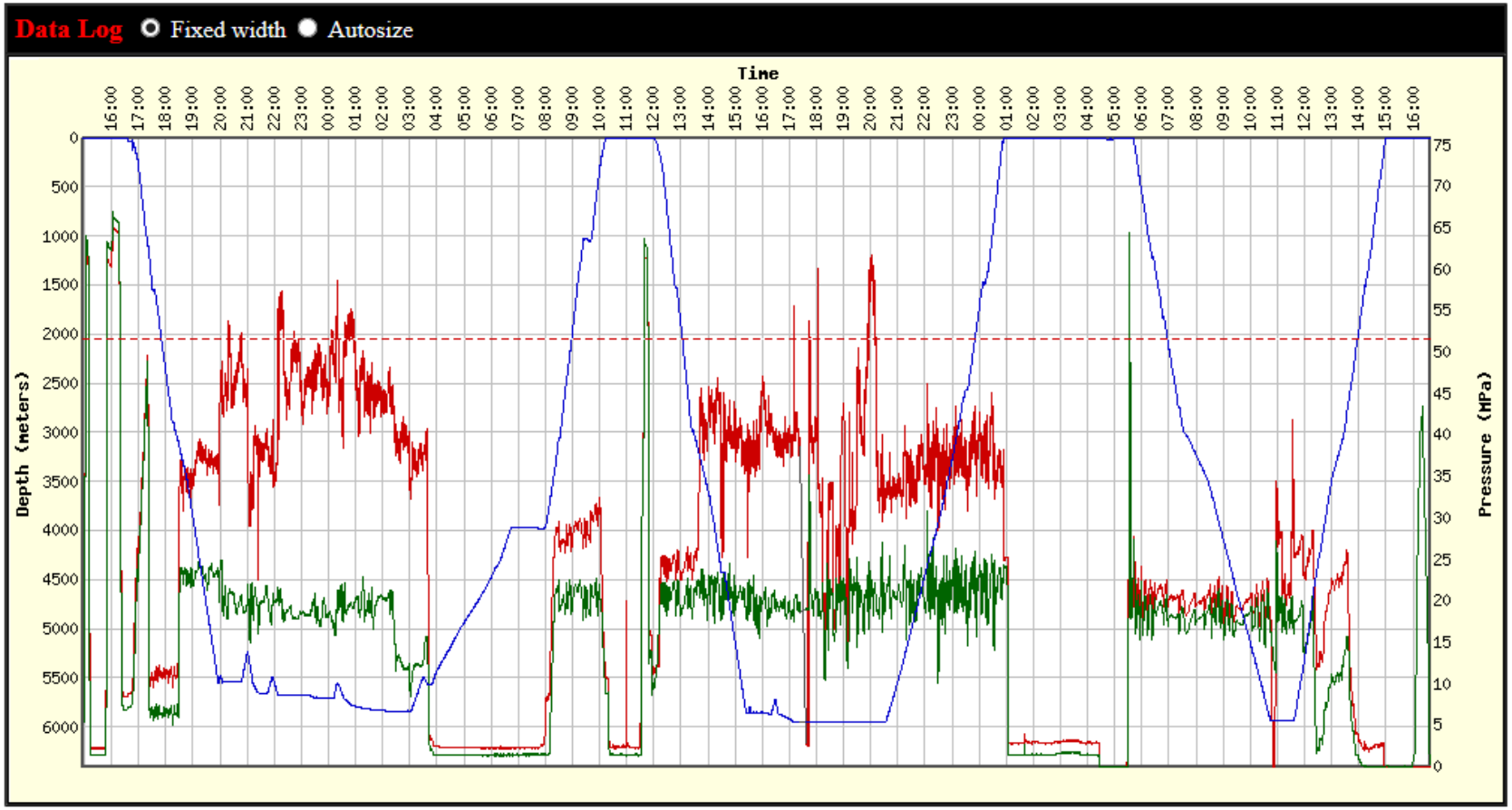
All Jobs

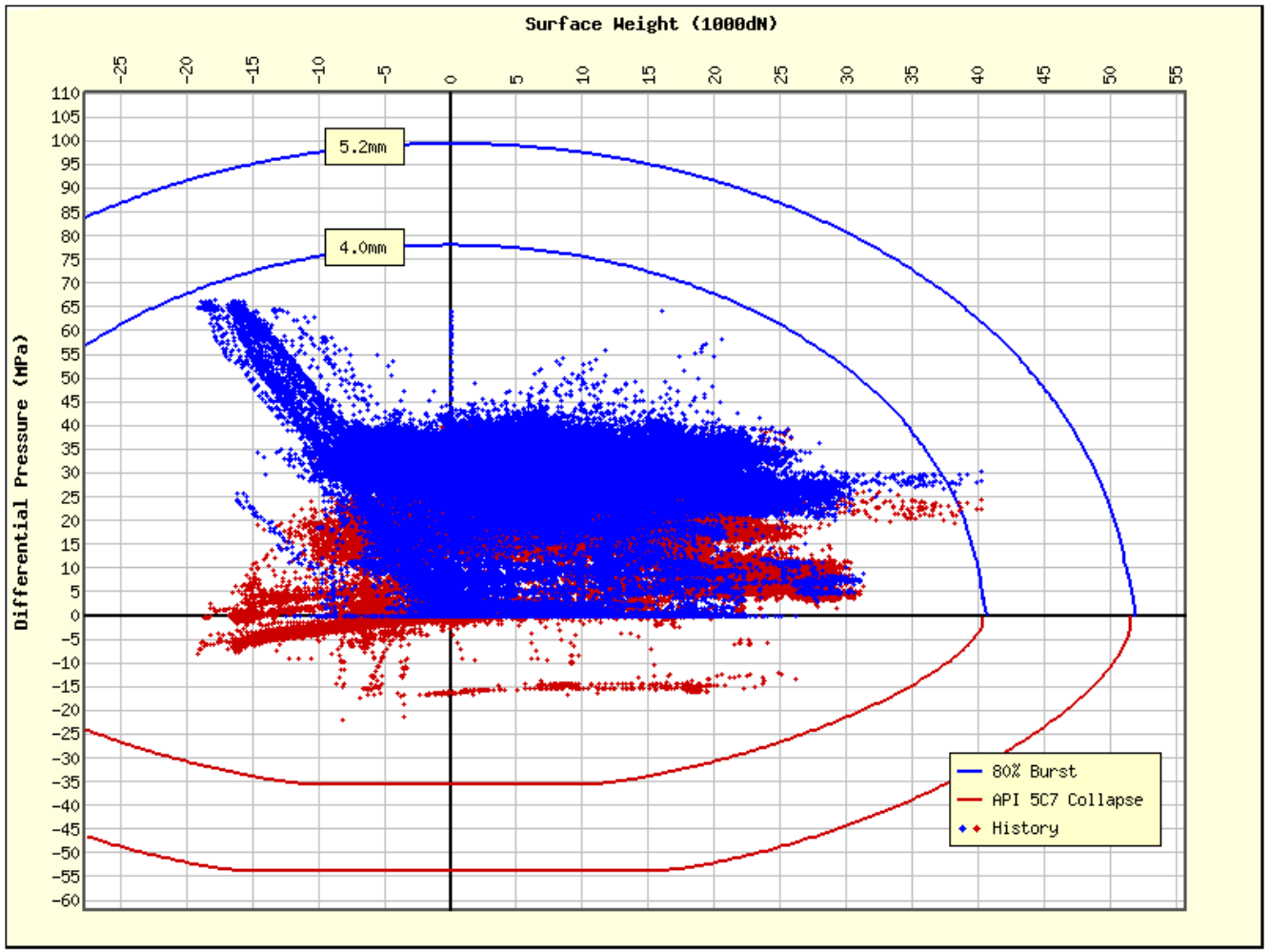
Weight at 100% yield	44,725dN (min wall) 51,308dN (max wall)		
Max lifetime weight	22,302 dN	ok	(49% yield)
Jobs with weight data	13 of 14		
Job with highest weight	3		



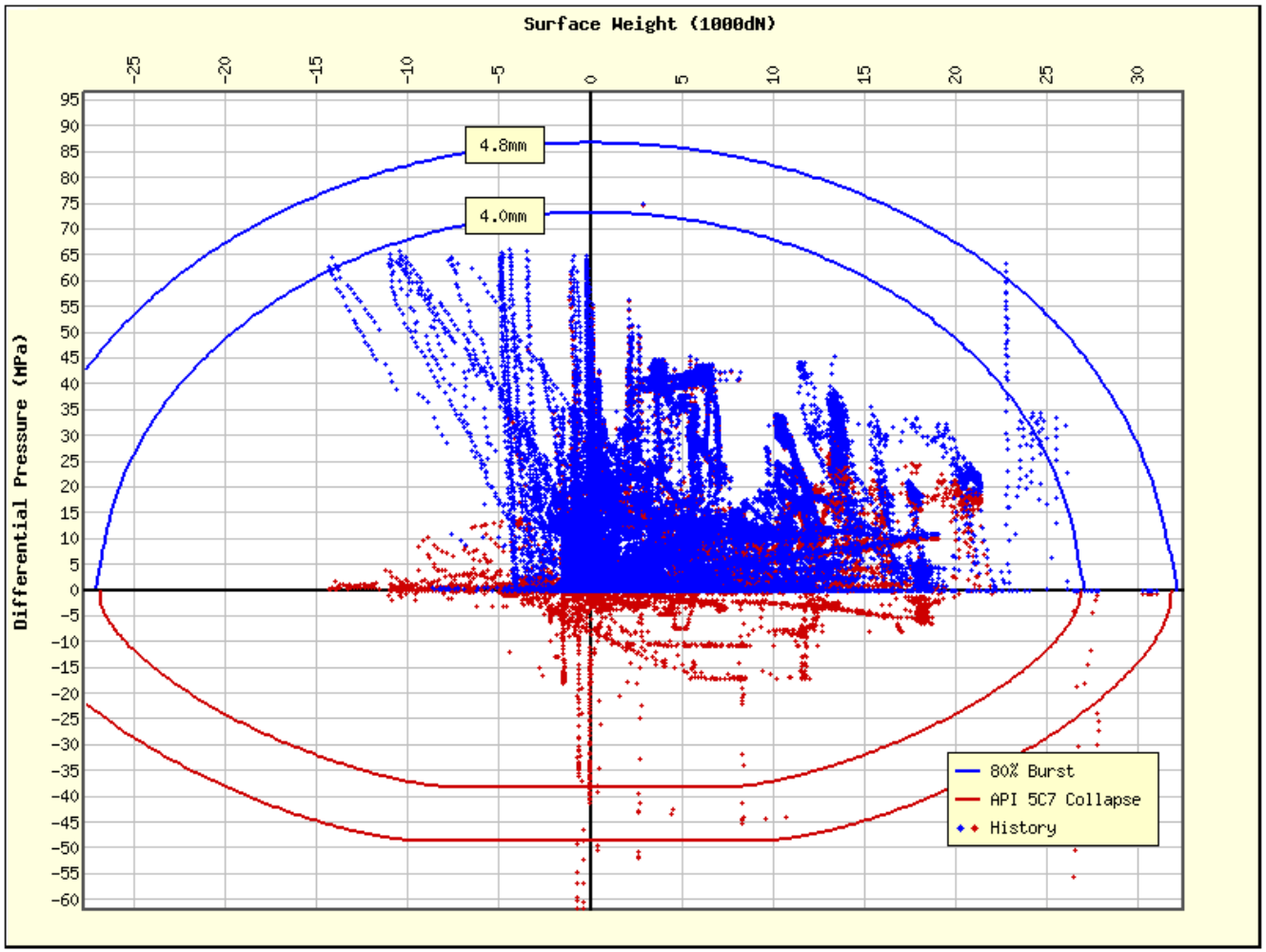
All Jobs Combined


Surface Weight (1000dN)
Differential Pressure (MPa)
5.2mm
4.4mm
80% Burst
API 5C7 Collapse
History

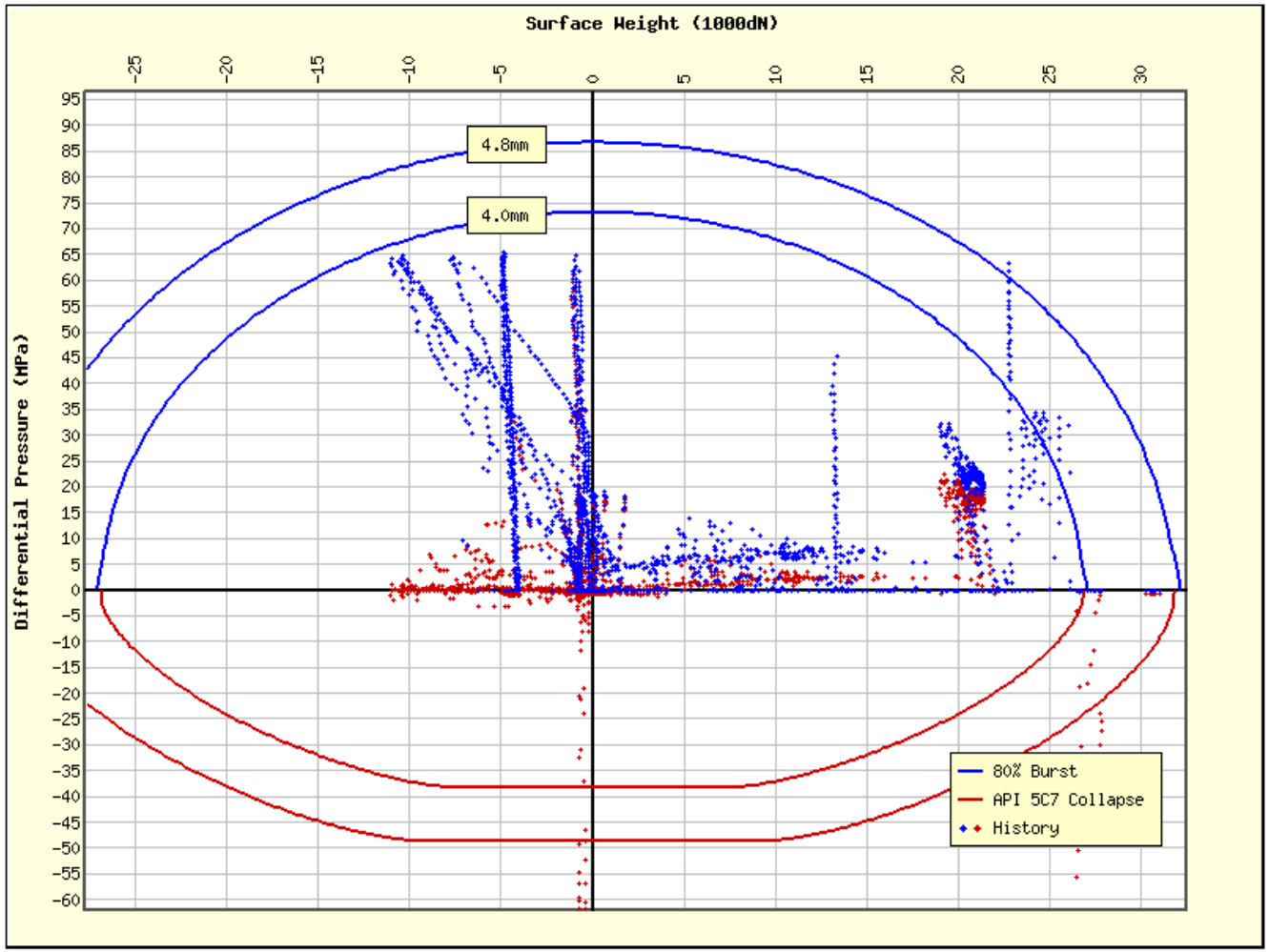

Data Log
Fixed width
Autosize
Time
Depth (meters)
Pressure (MPa)
Depth (m)
Pump Pressure (MPa)
Wellhead Pressure (MPa)



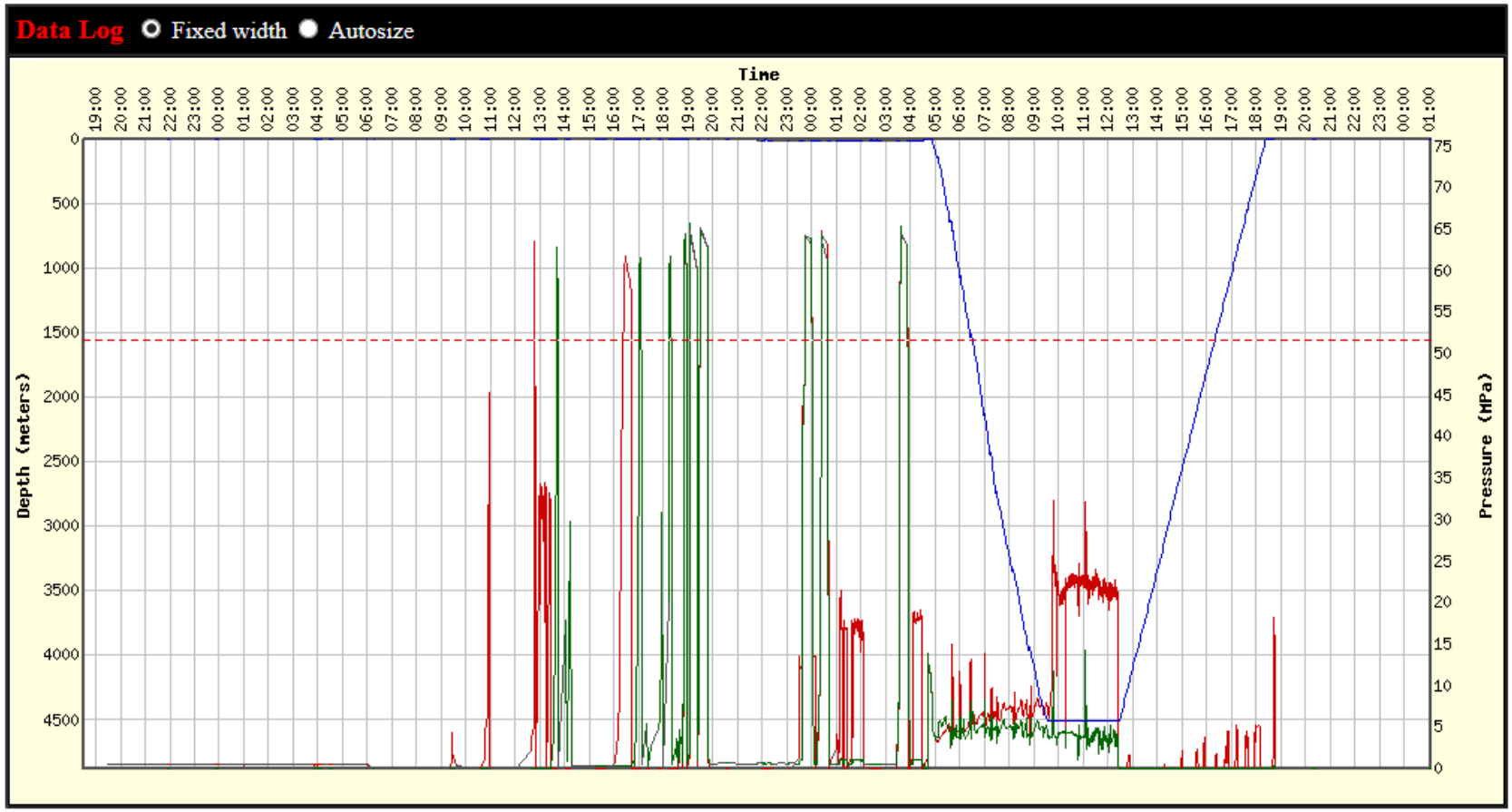
Example string showing all jobs and all data



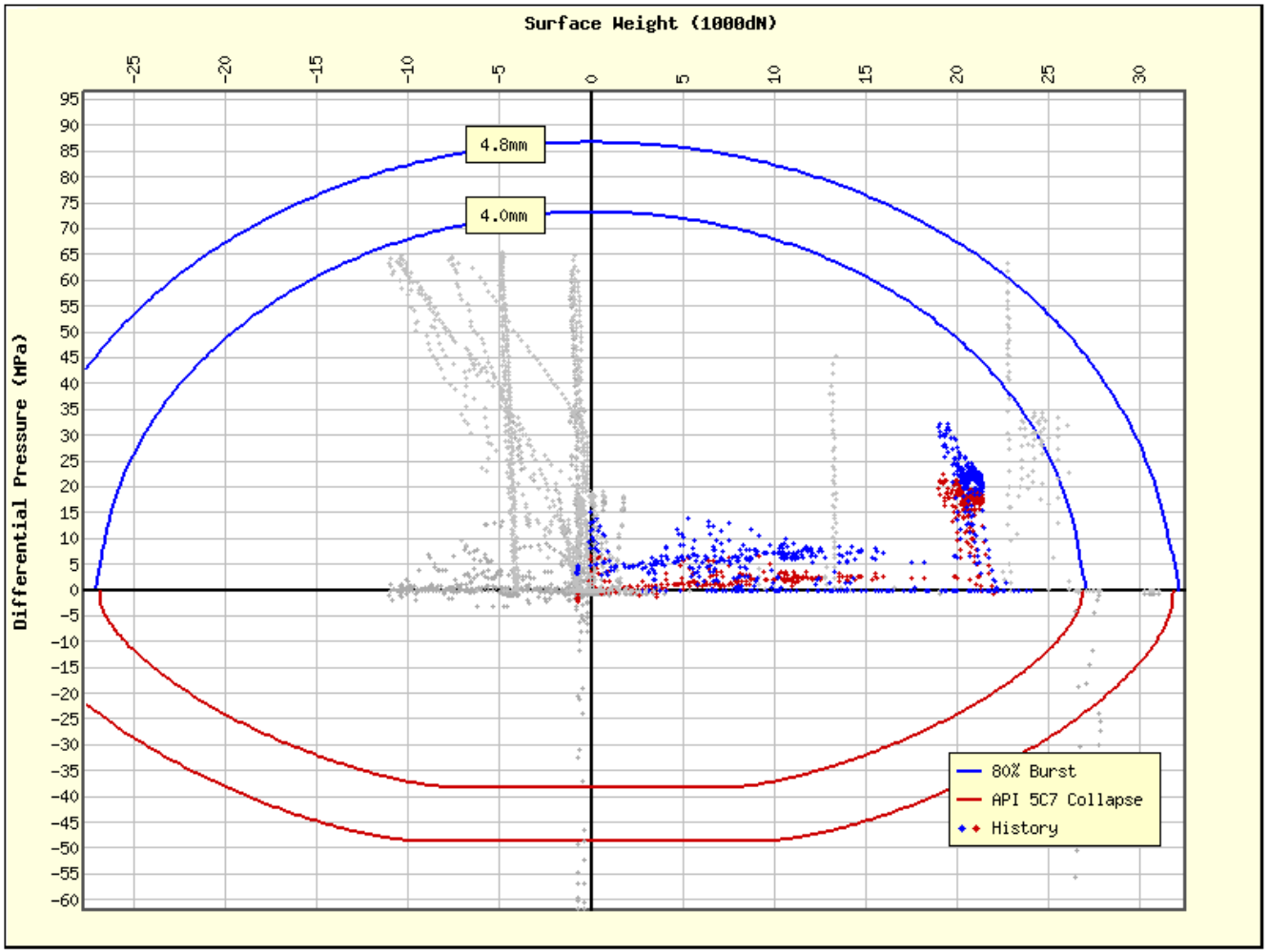
Example string showing possible overpressure and overpull



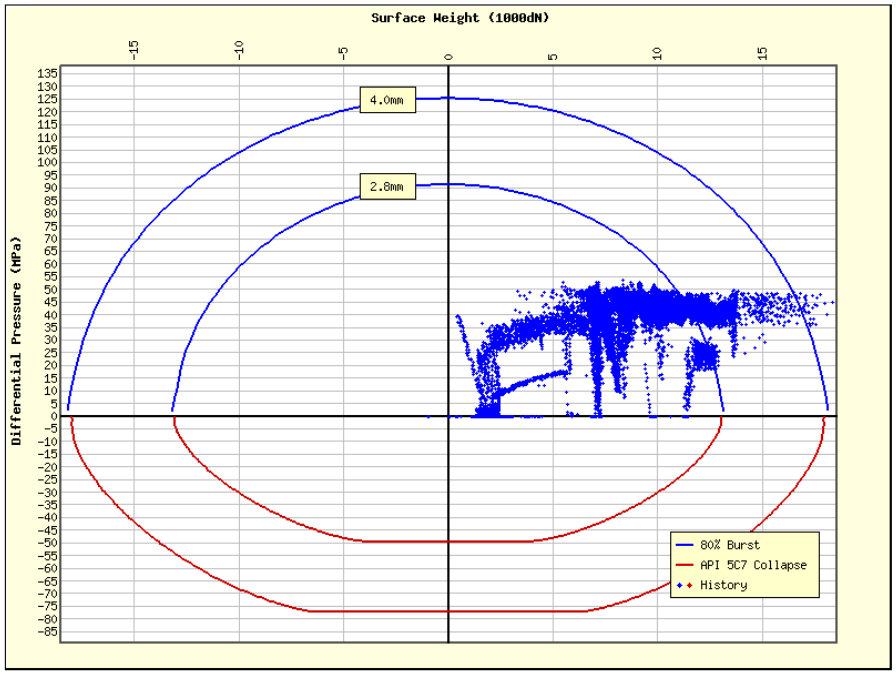
Identifying the job with possible overpressure



Job Log Data, revealing multiple pressure tests

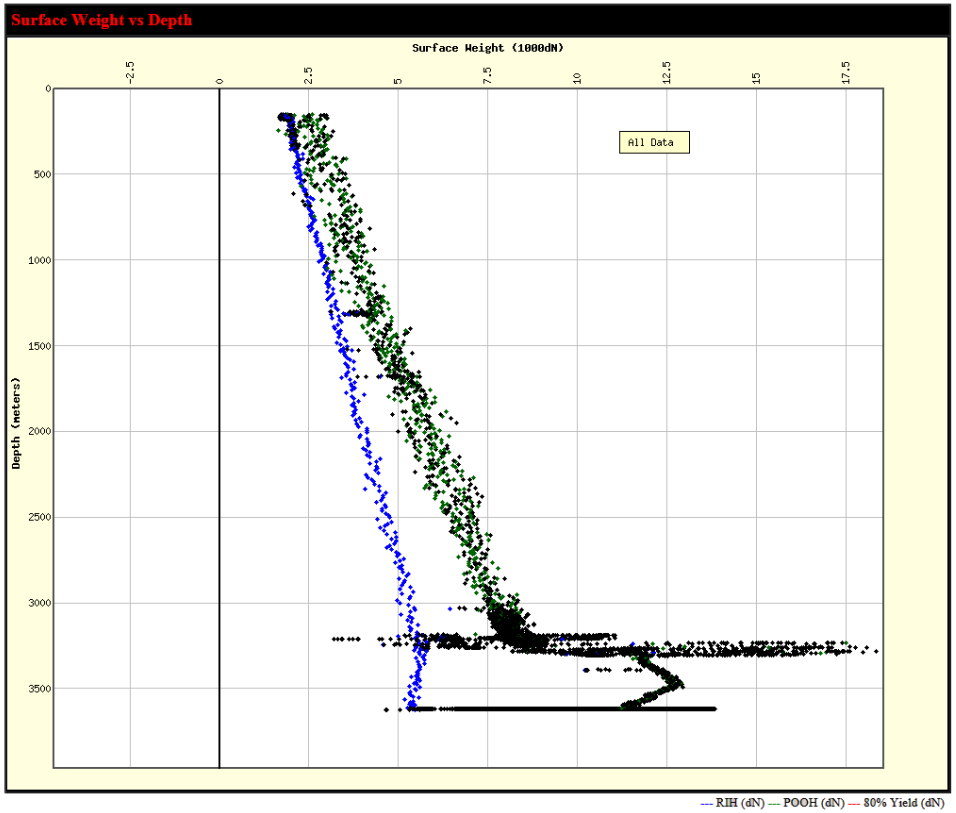


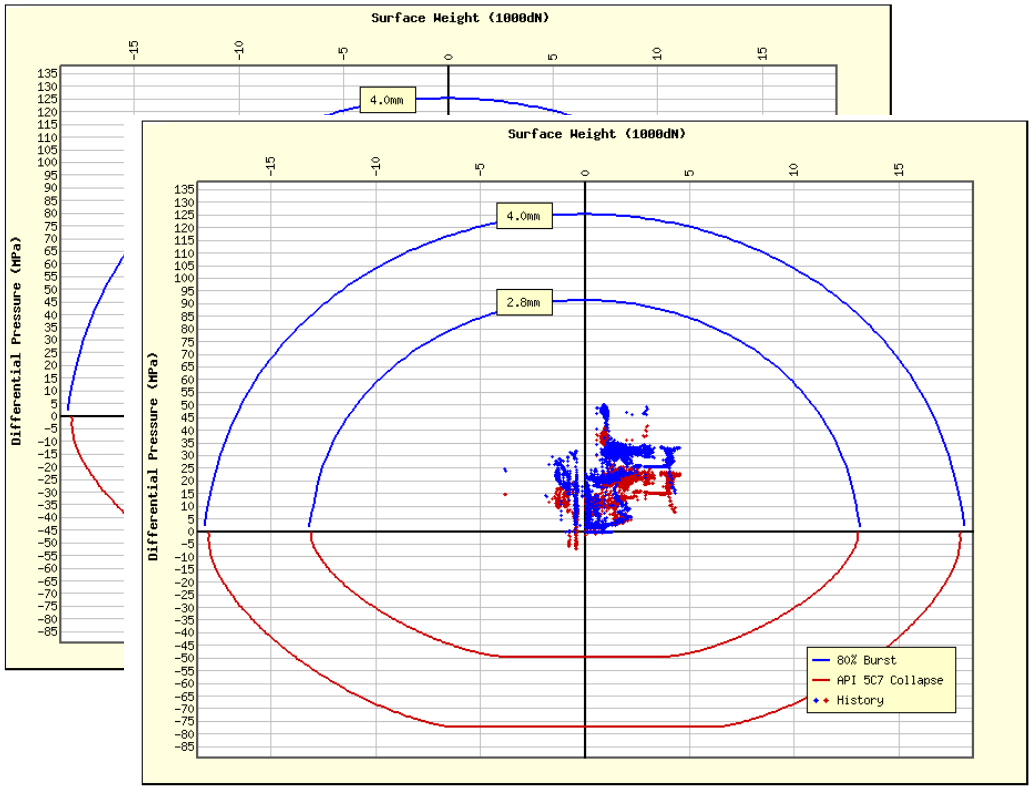
The same job, with pressure tests in grey



Case study: overpulled string

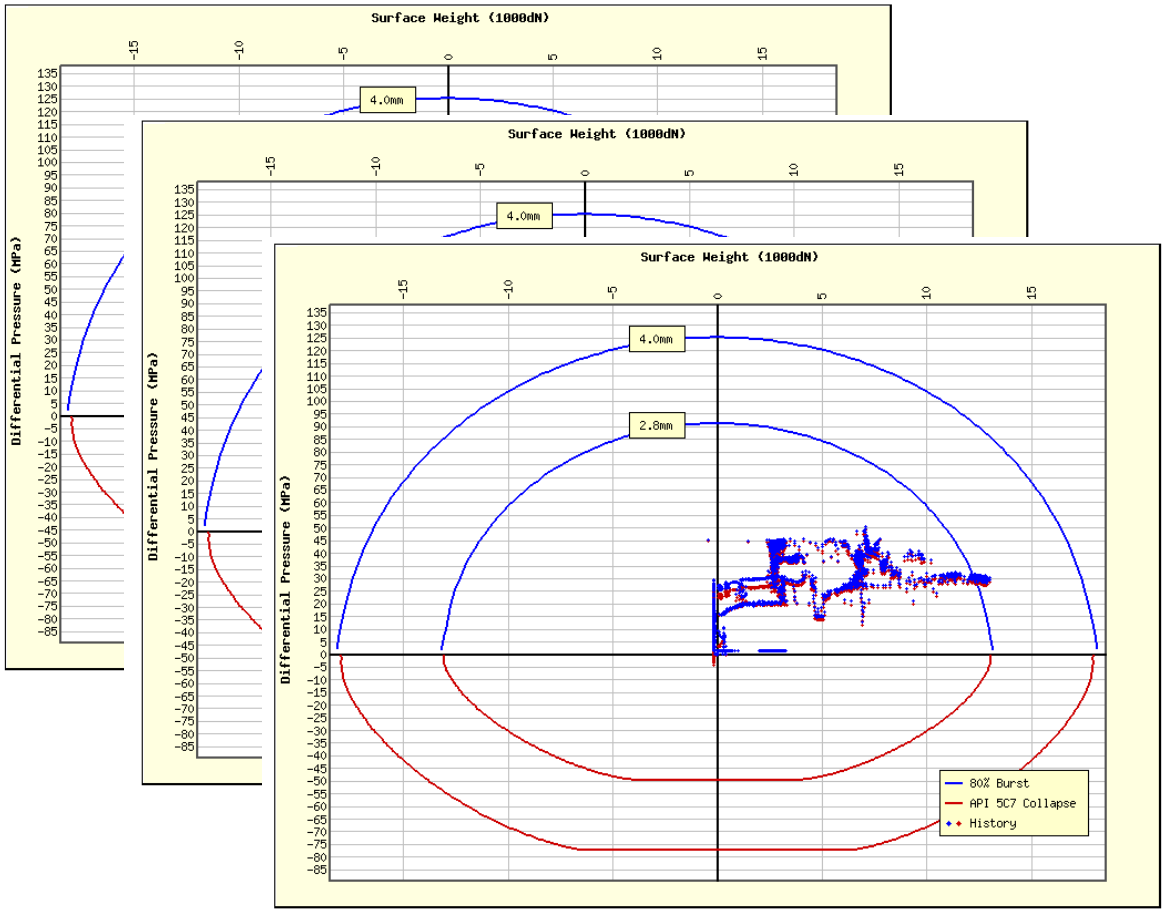
Job 7 (milling)





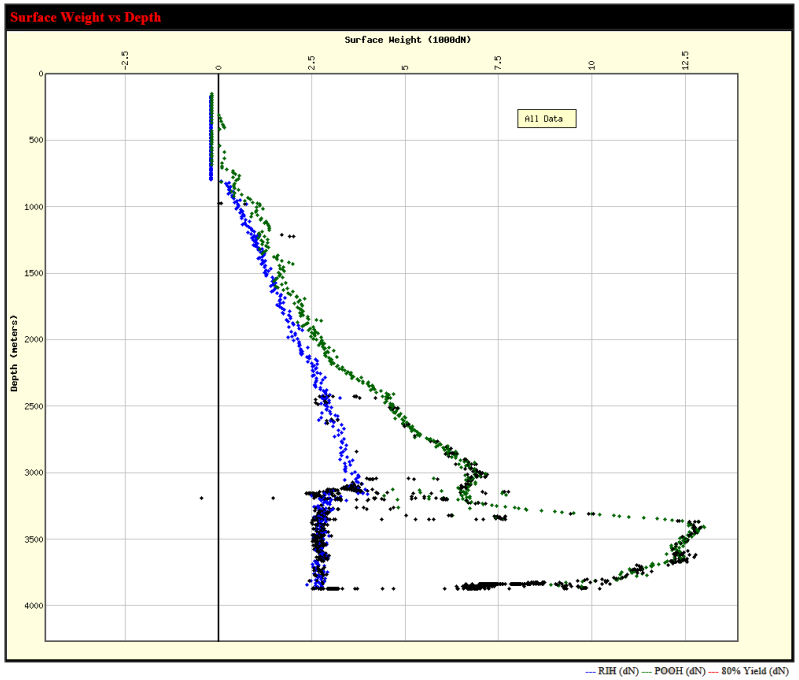
Case study: overpulled string

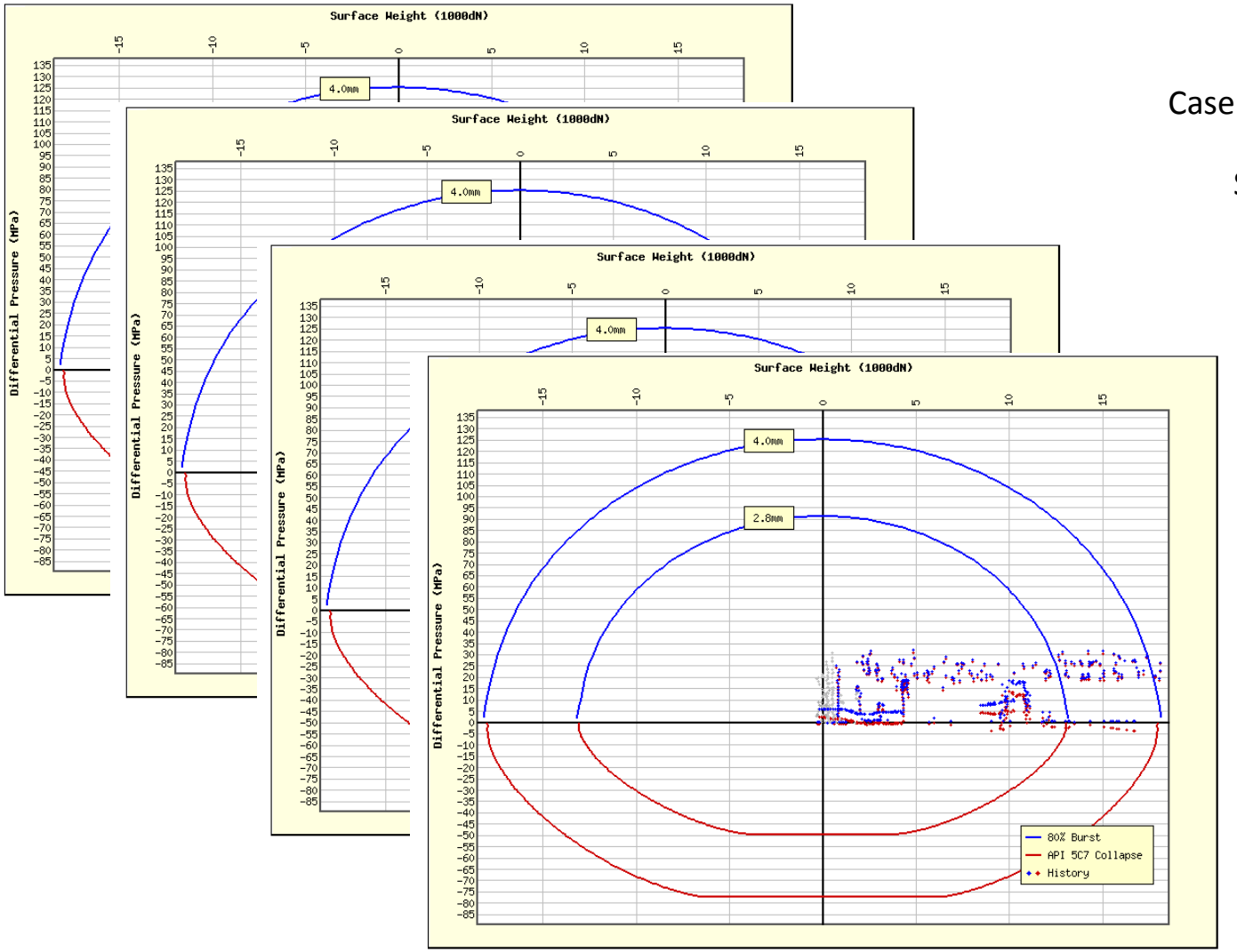
Job 17 (cleanout)



Case study: overpulled string

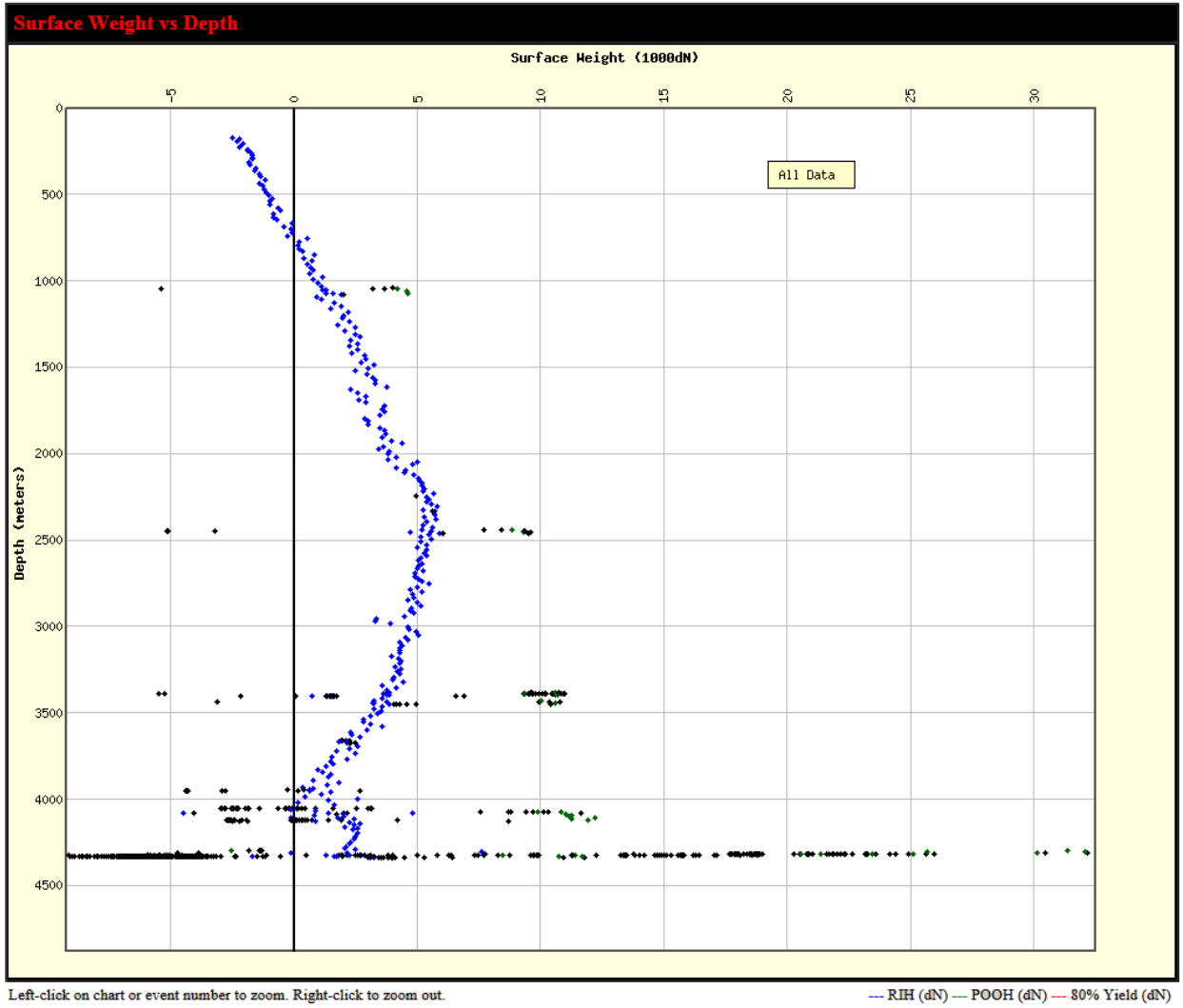
Job 20 (cleanout)



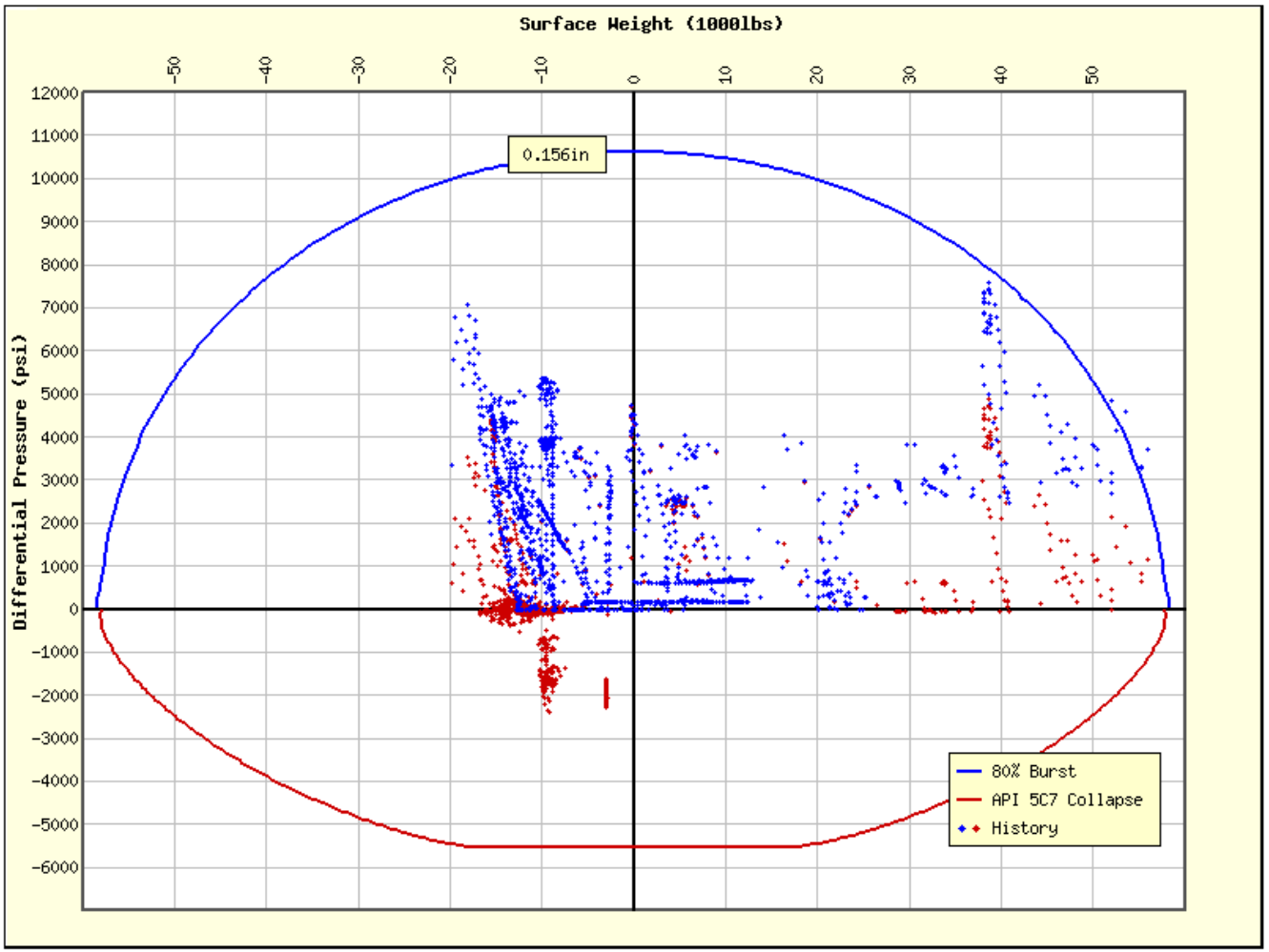


Case study: overpulled string

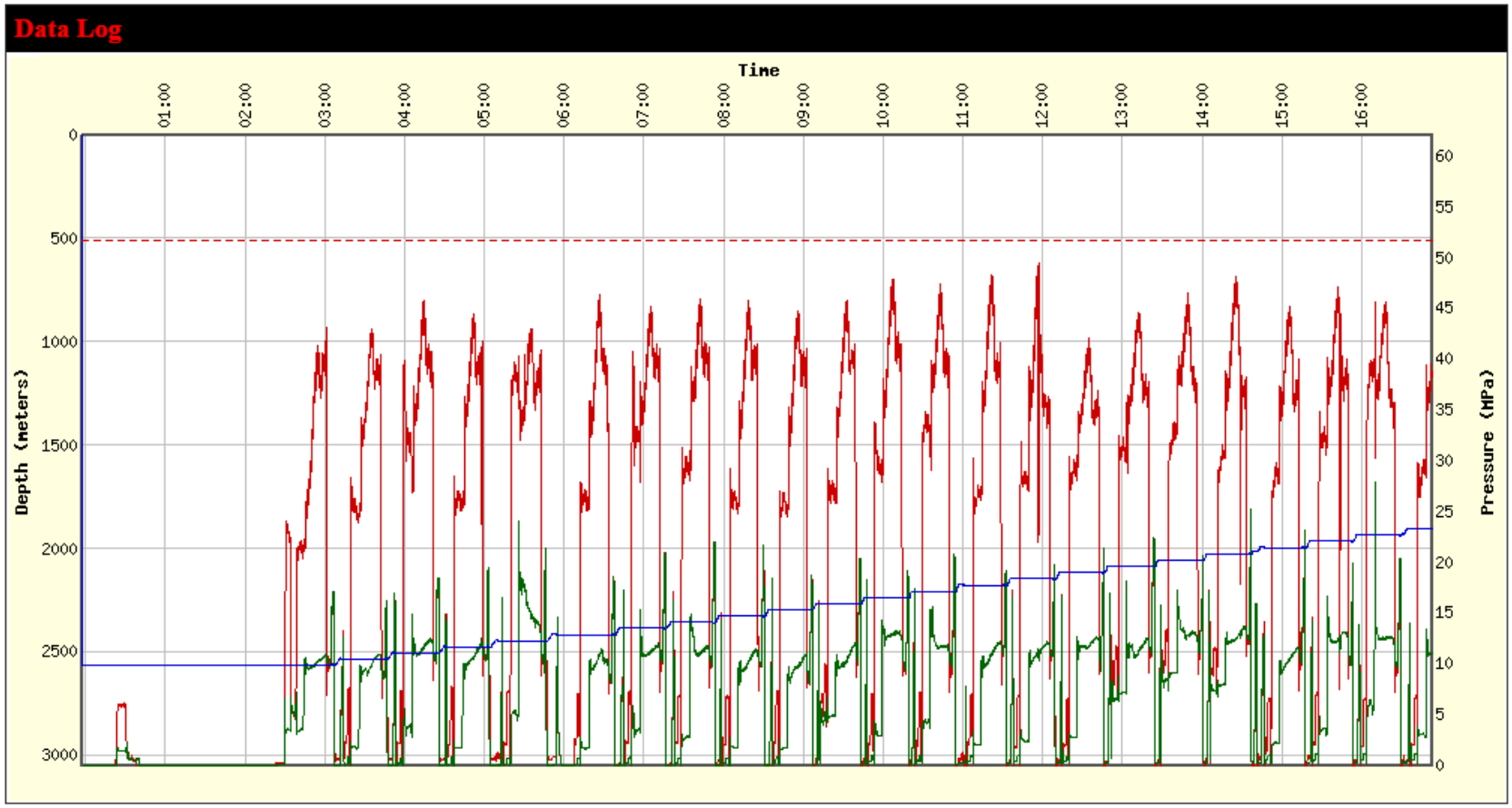
String parted on job 23



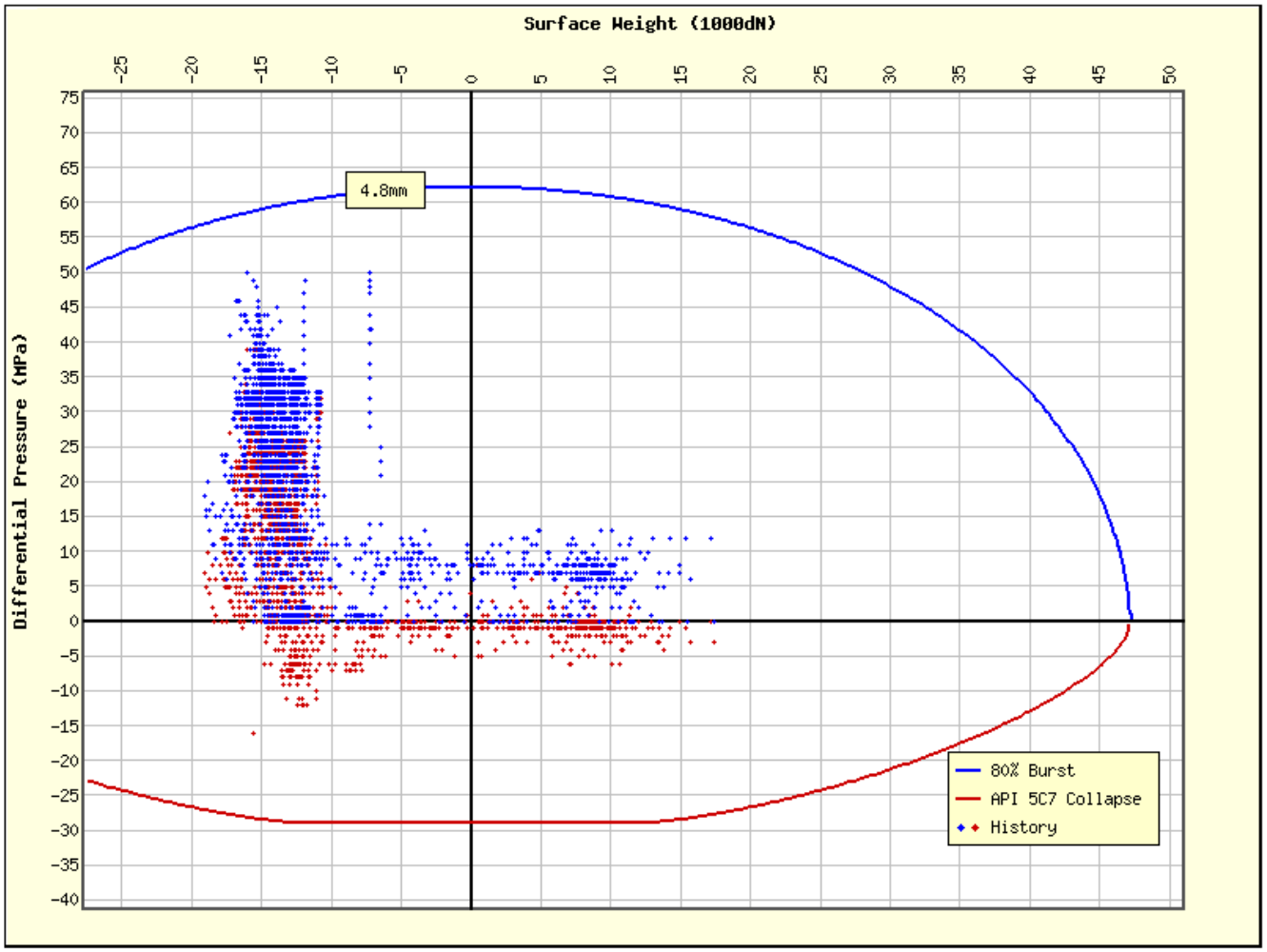
Case Study: Parted at surface during frac (job 25 of 25)



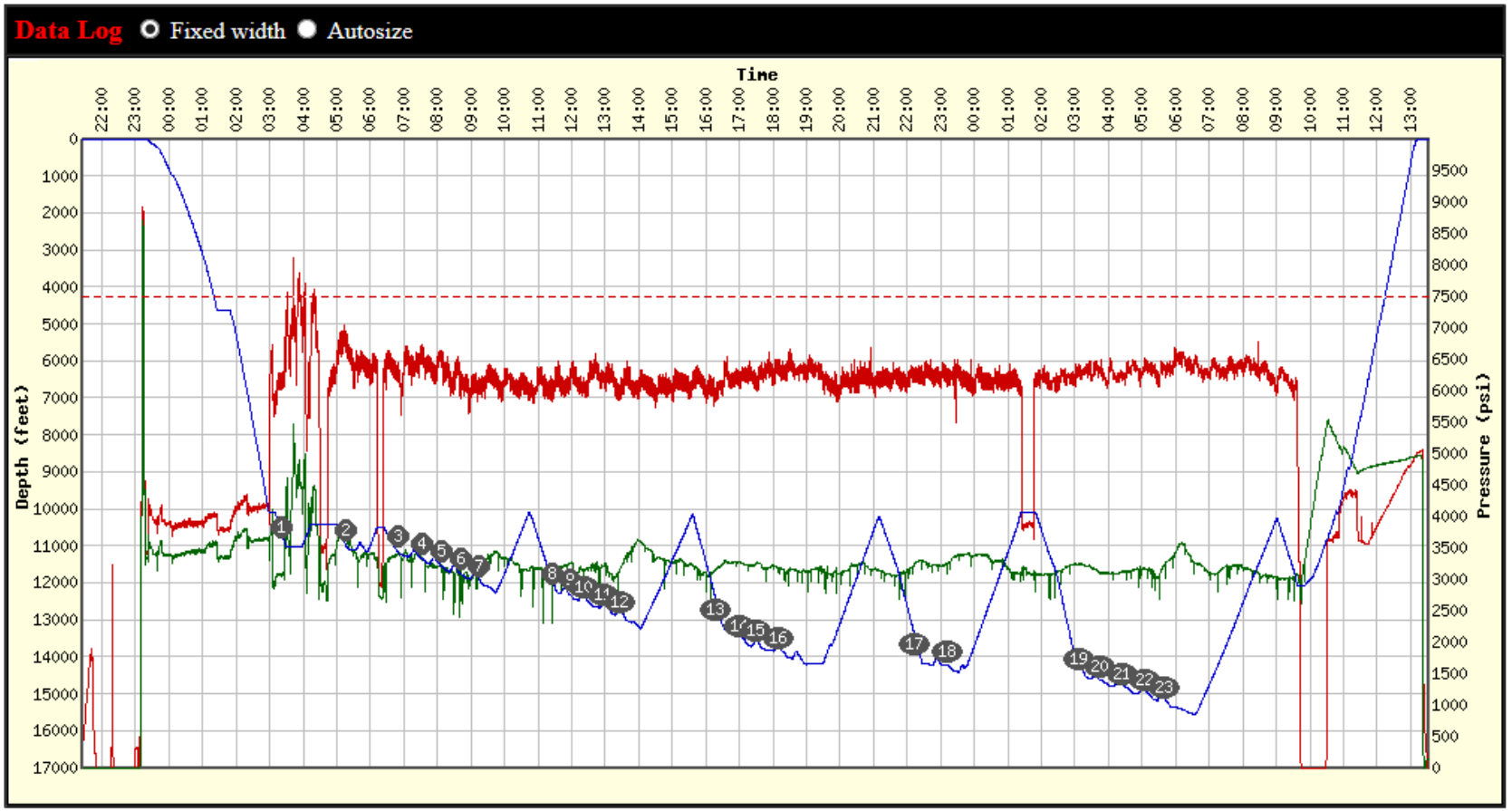
Case Study: Parted at Surface During Frac (job 25 of 25)



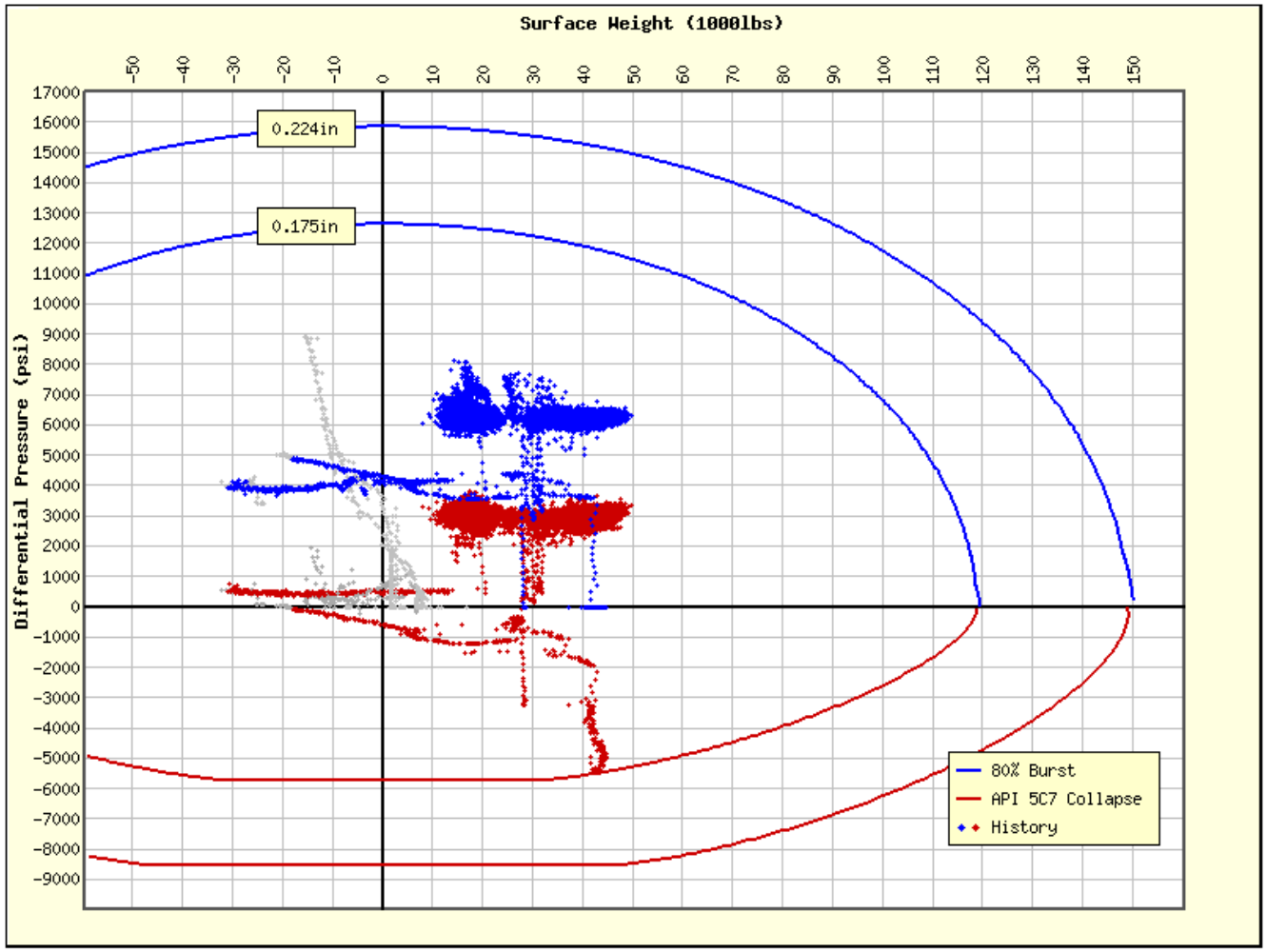
Annular Fracturing Example



Annular Fracturing Example



Case Study: Potential Collapse Scenario



Case Study: Potential Collapse Scenario

Summary

- Analyzing weight and pressure for all jobs performed by a string can quickly reveal events which might have contributed to a later failure.
- Care is needed to eliminate any recorded data which does not directly impact the pipe.
- An overpull or overpressure in the string history does not necessarily mean the string is compromised, and in most cases studied there was no clear correlation between early events and subsequent failures.
- More study is needed, in particular for collapsed strings, for which there is little data.