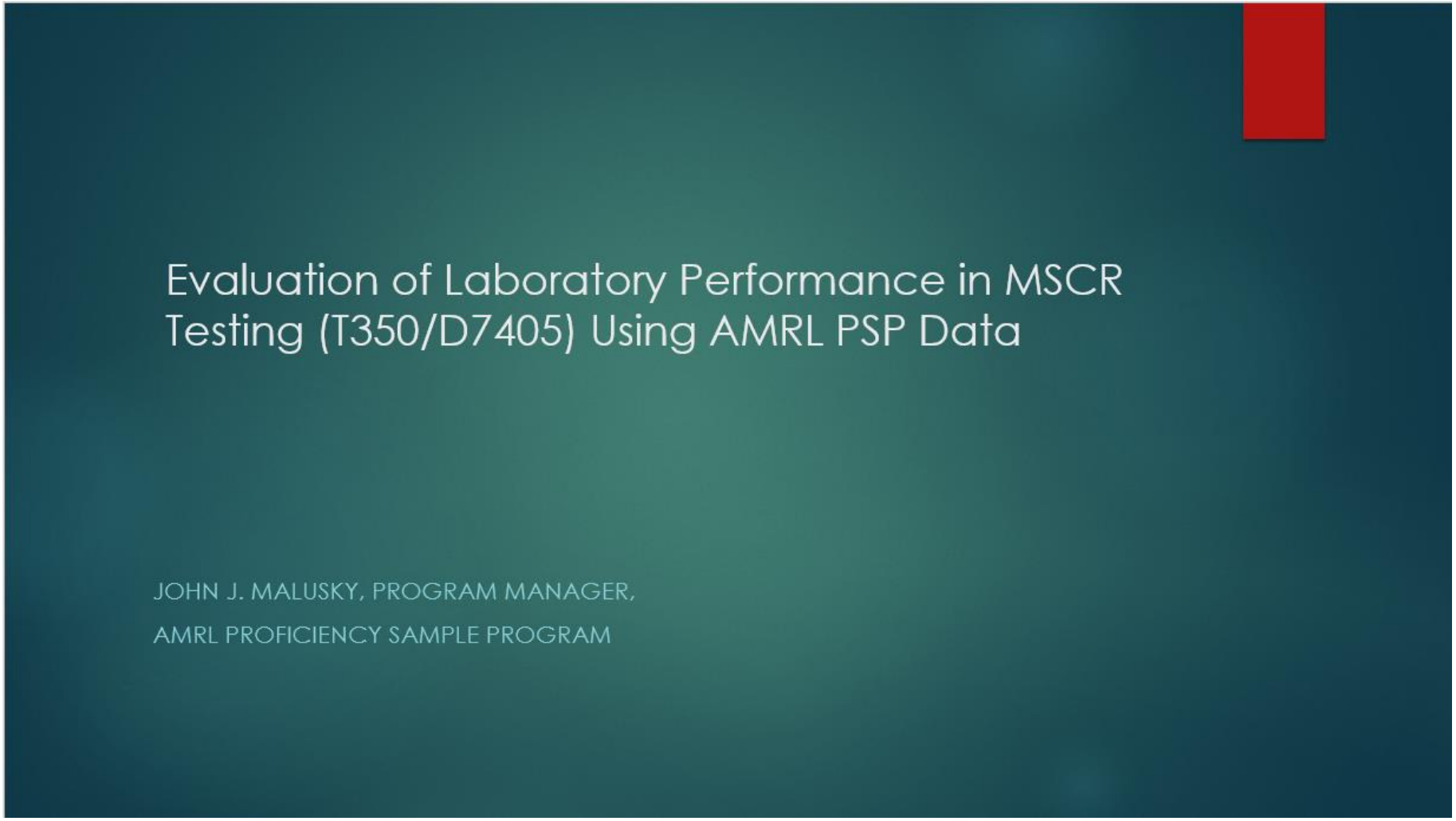
MSCR Demistified & re:Source (AMRL) Concerns Revisited

Prepared for the PCCAS

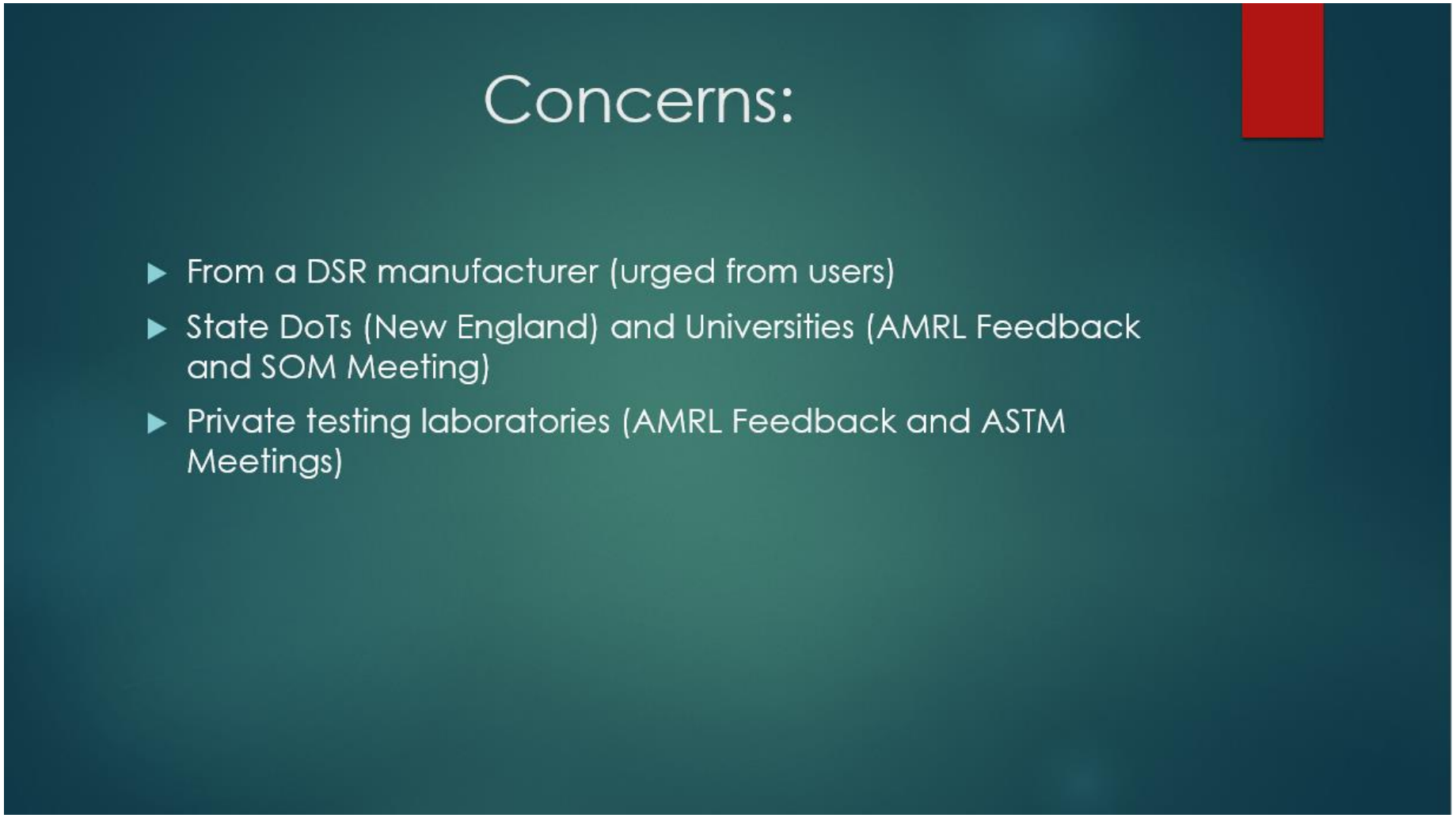
John Casola

27 April 2017

Excerpts from ETG 2017 Meeting; Salt Lake City



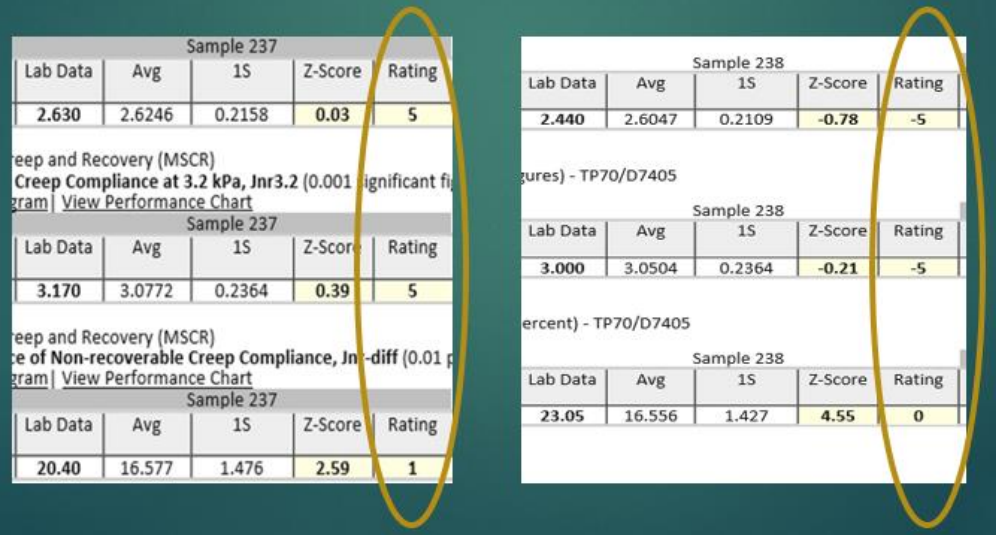
Excerpts from ETG 2017 Meeting; Salt Lake City



Excerpts from ETG 2017 Meeting; Salt Lake City

AMRL's Evaluation of the Issue:

- From the initial feedback and comments we determined that this was an isolated event happening in one PSP round. Caused by the difference in values between the "+5s and the -5s".
- Not the case:



Sample 237

Lab Data	Avg	1S	Z-Score	Rating
2.630	2.6246	0.2158	0.03	5

eep and Recovery (MSCR)
Creep Compliance at 3.2 kPa, Jnr3.2 (0.001 ignificant fi
gram | View Performance Chart

Sample 237

Lab Data	Avg	1S	Z-Score	Rating
3.170	3.0772	0.2364	0.39	5

eep and Recovery (MSCR)
e of Non-recoverable Creep Compliance, Jn -diff (0.01 p
gram | View Performance Chart

Sample 237

Lab Data	Avg	1S	Z-Score	Rating
20.40	16.577	1.476	2.59	1

Sample 238

Lab Data	Avg	1S	Z-Score	Rating
2.440	2.6047	0.2109	-0.78	-5

gures) - TP70/D7405

Sample 238

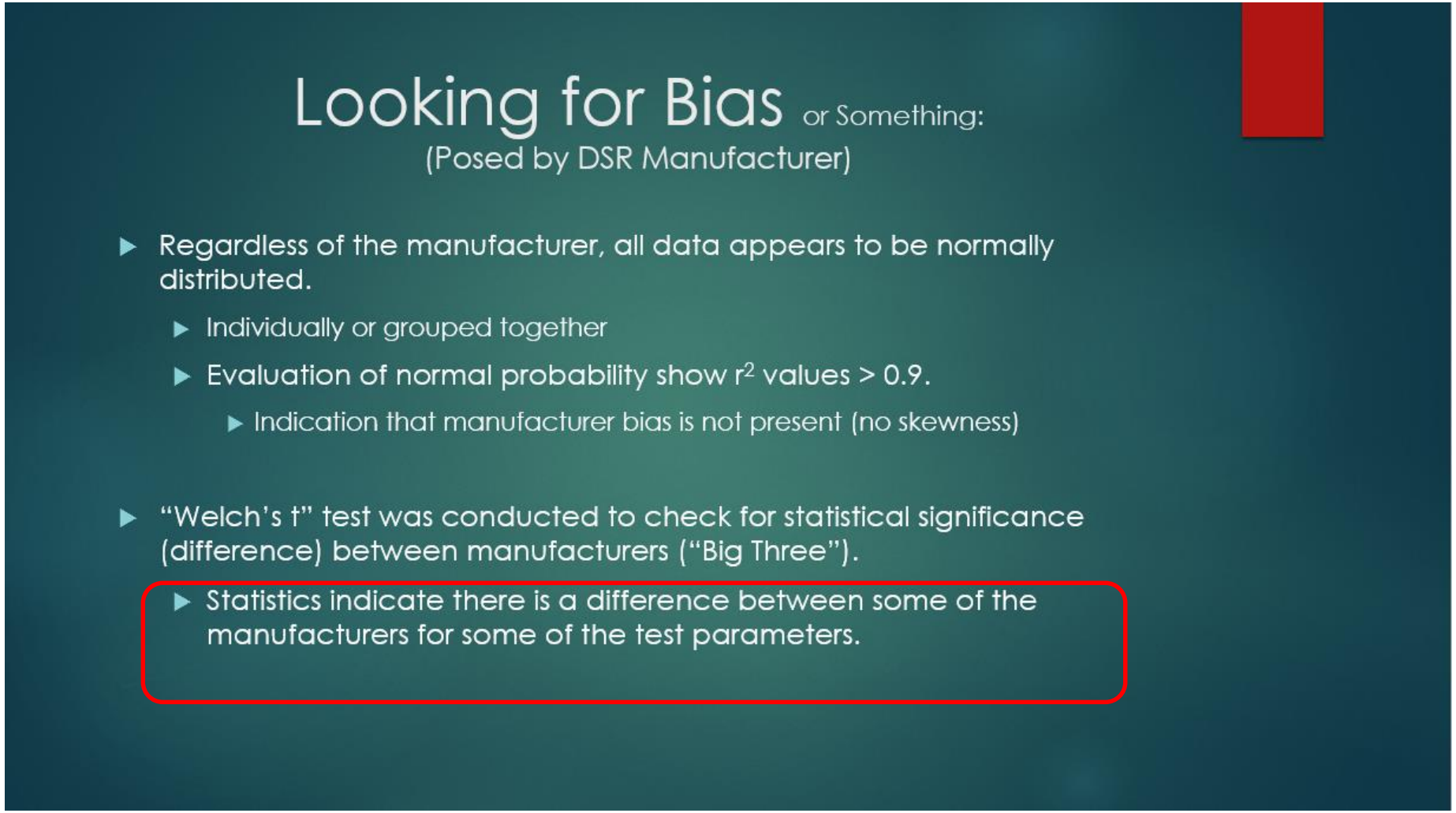
Lab Data	Avg	1S	Z-Score	Rating
3.000	3.0504	0.2364	-0.21	-5

ercent) - TP70/D7405

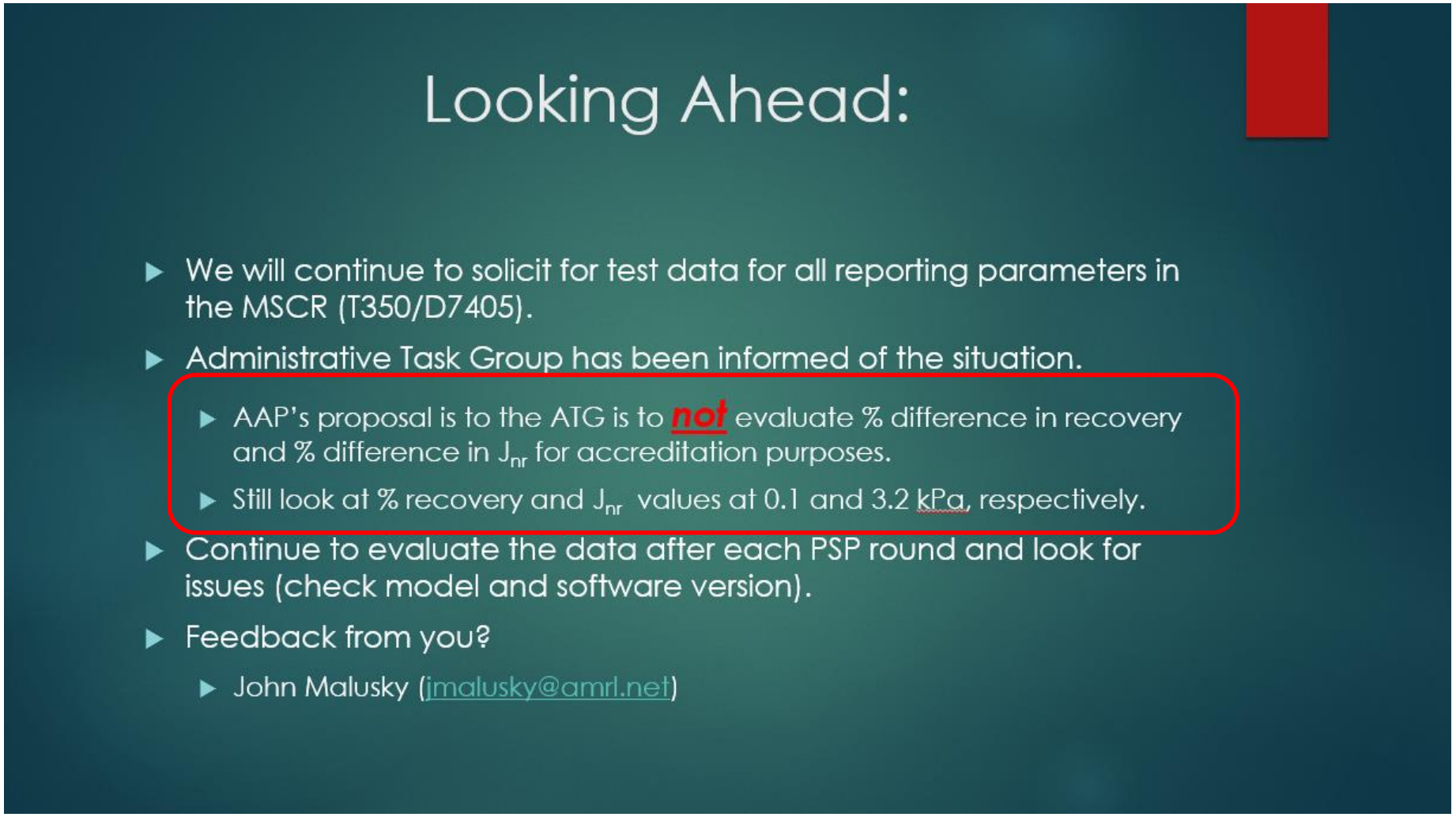
Sample 238

Lab Data	Avg	1S	Z-Score	Rating
23.05	16.556	1.427	4.55	0

Excerpts from ETG 2017 Meeting; Salt Lake City

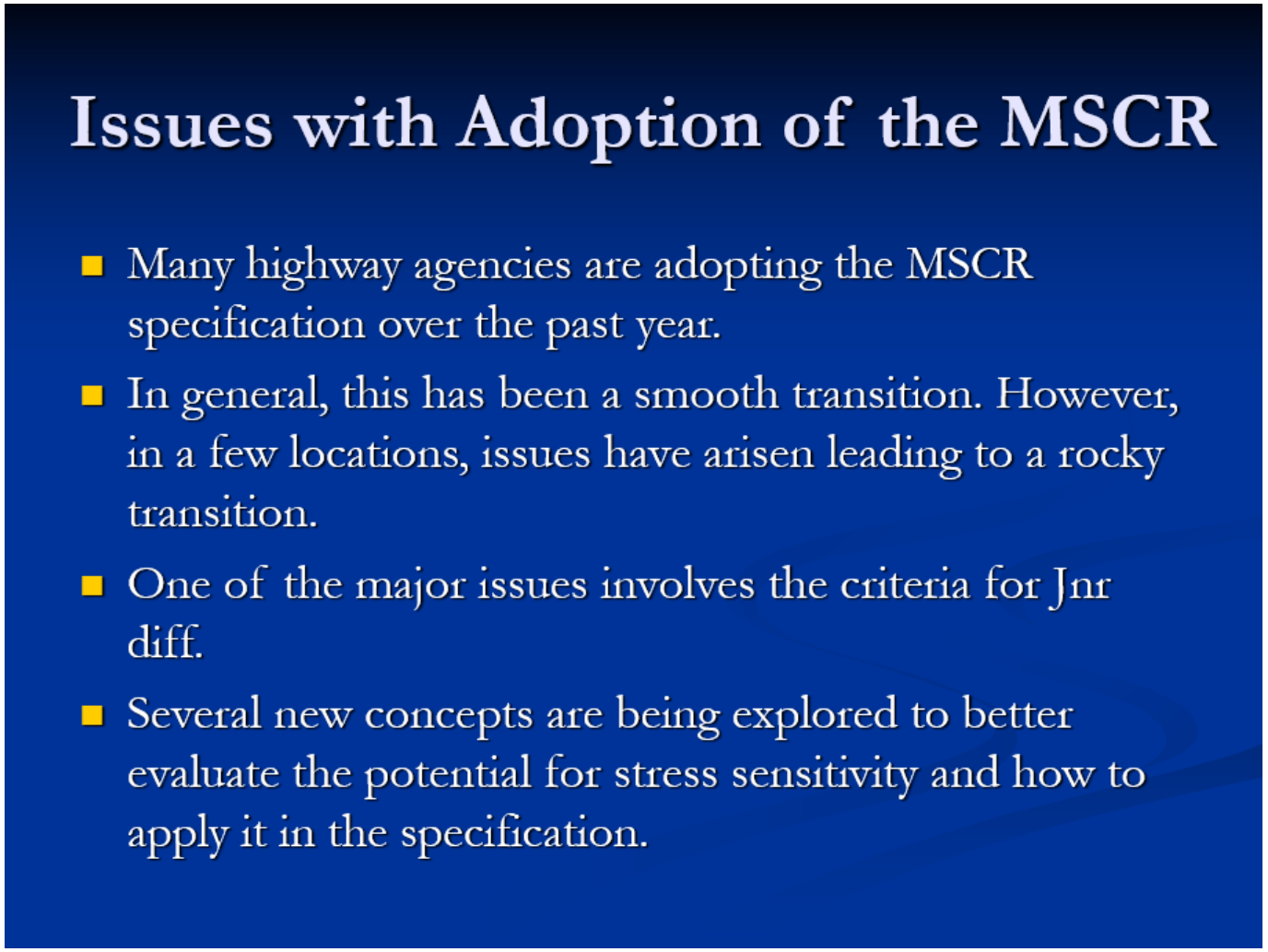


Excerpts from ETG 2017 Meeting; Salt Lake City

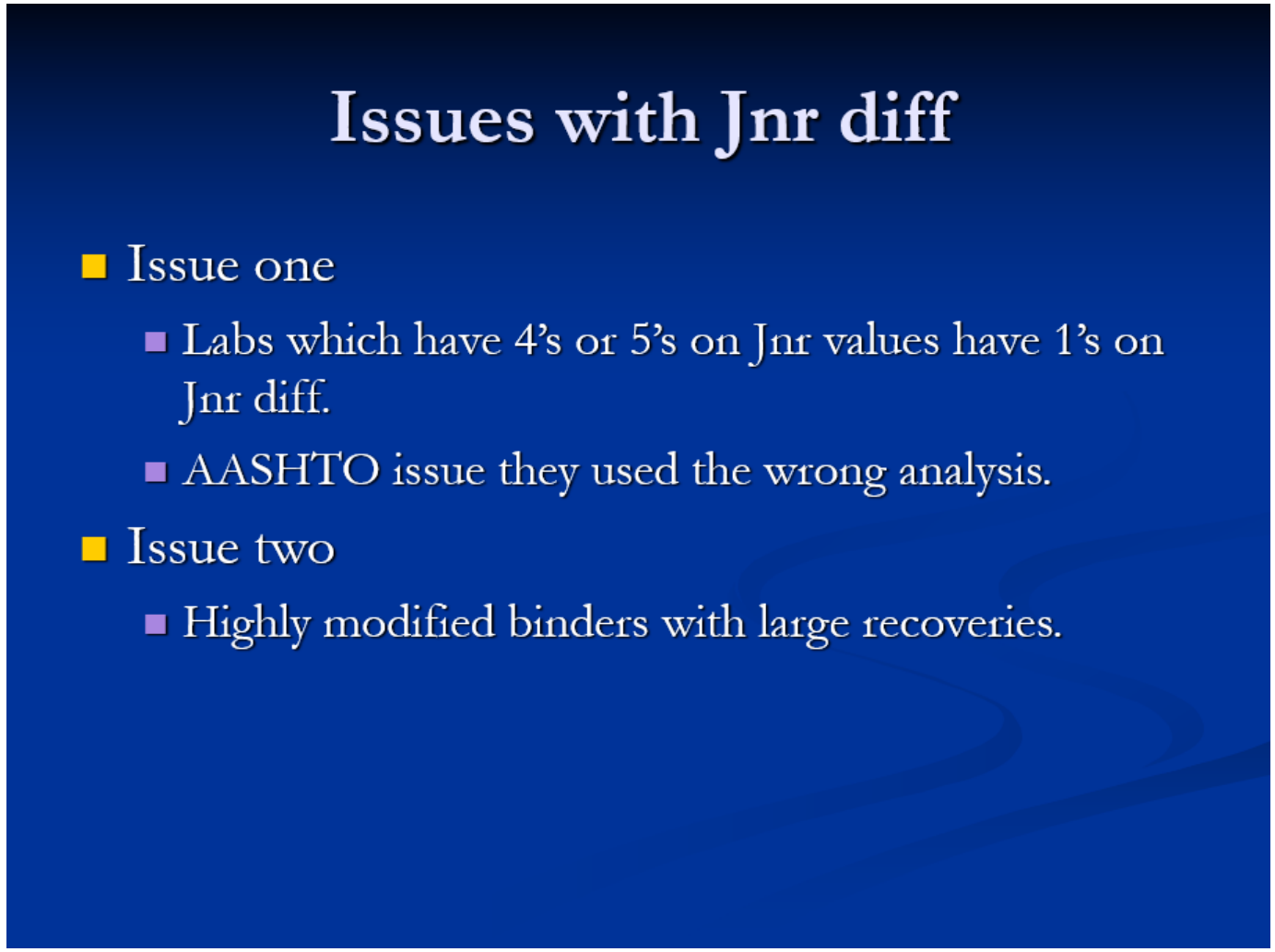


Excerpts from AMAP 2017 Meeting

Excerpts from AMAP 2017 Meeting



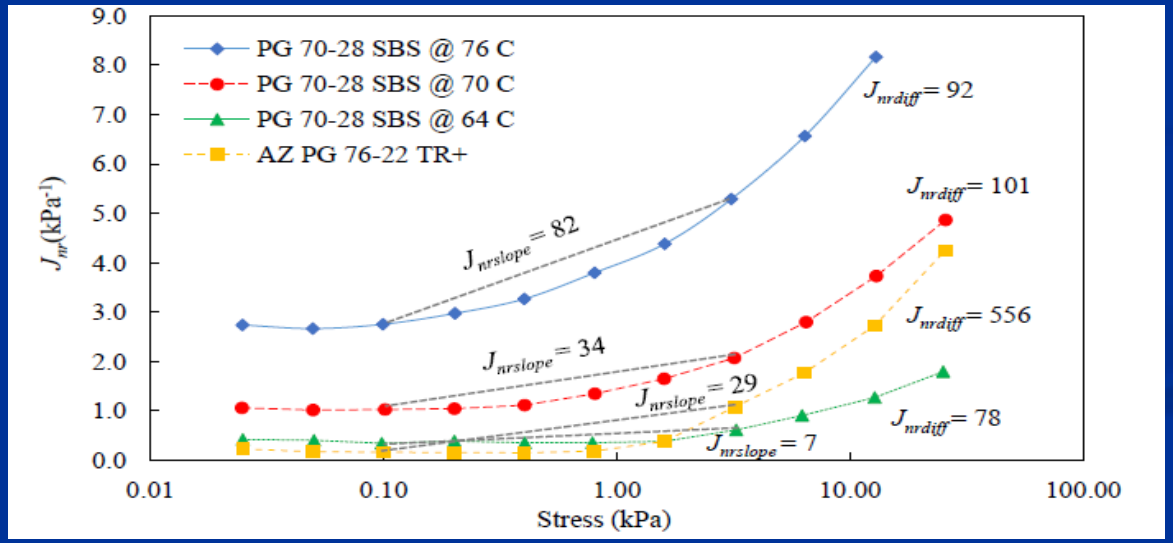
Excerpts from AMAP 2017 Meeting



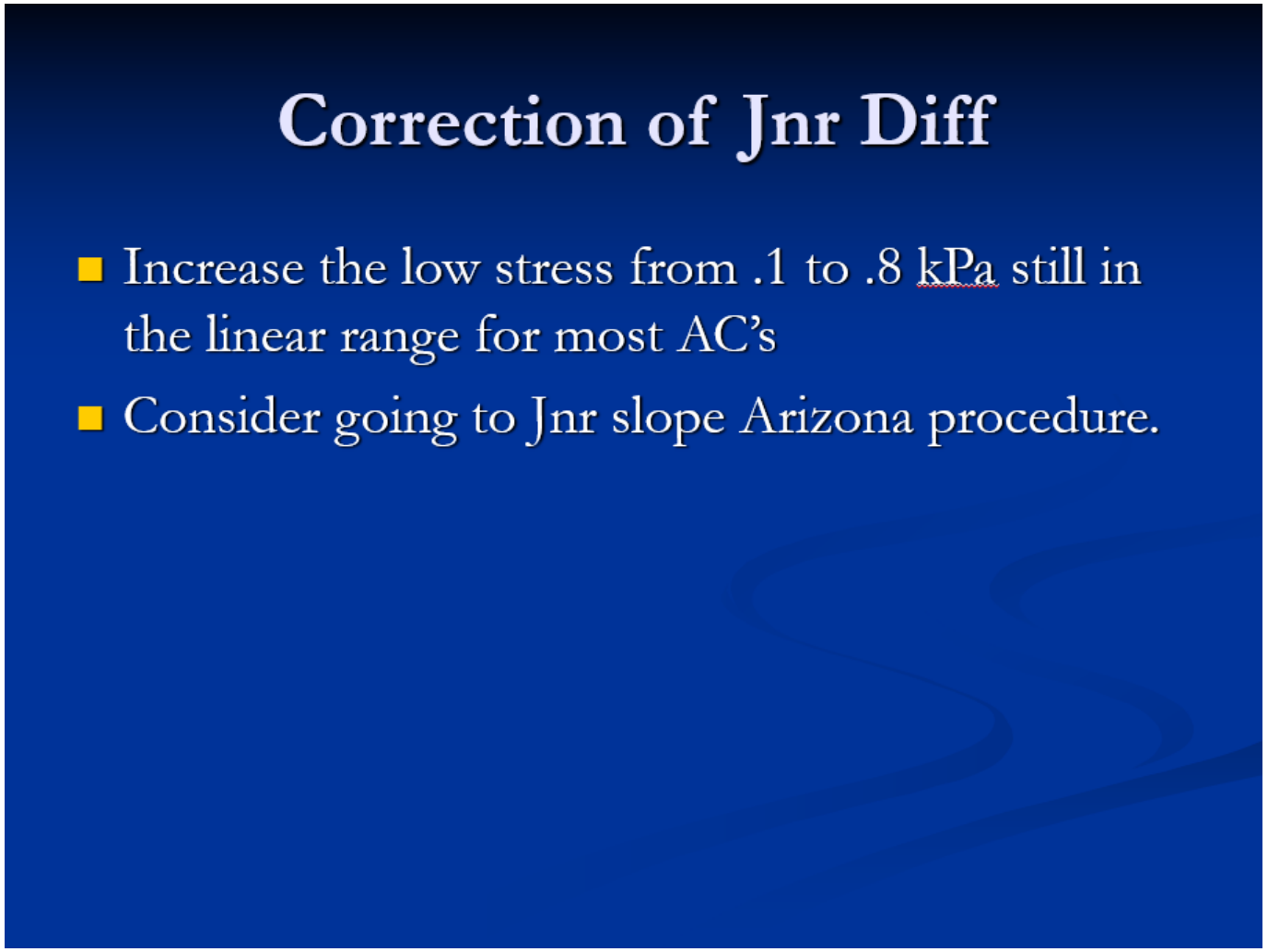
Excerpts from AMAP 2017 Meeting

New Arizona State Procedure

- Slope is less affected by small number.
- (Jnr high – Jnr low)/(stress high – stress low)



Excerpts from AMAP 2017 Meeting



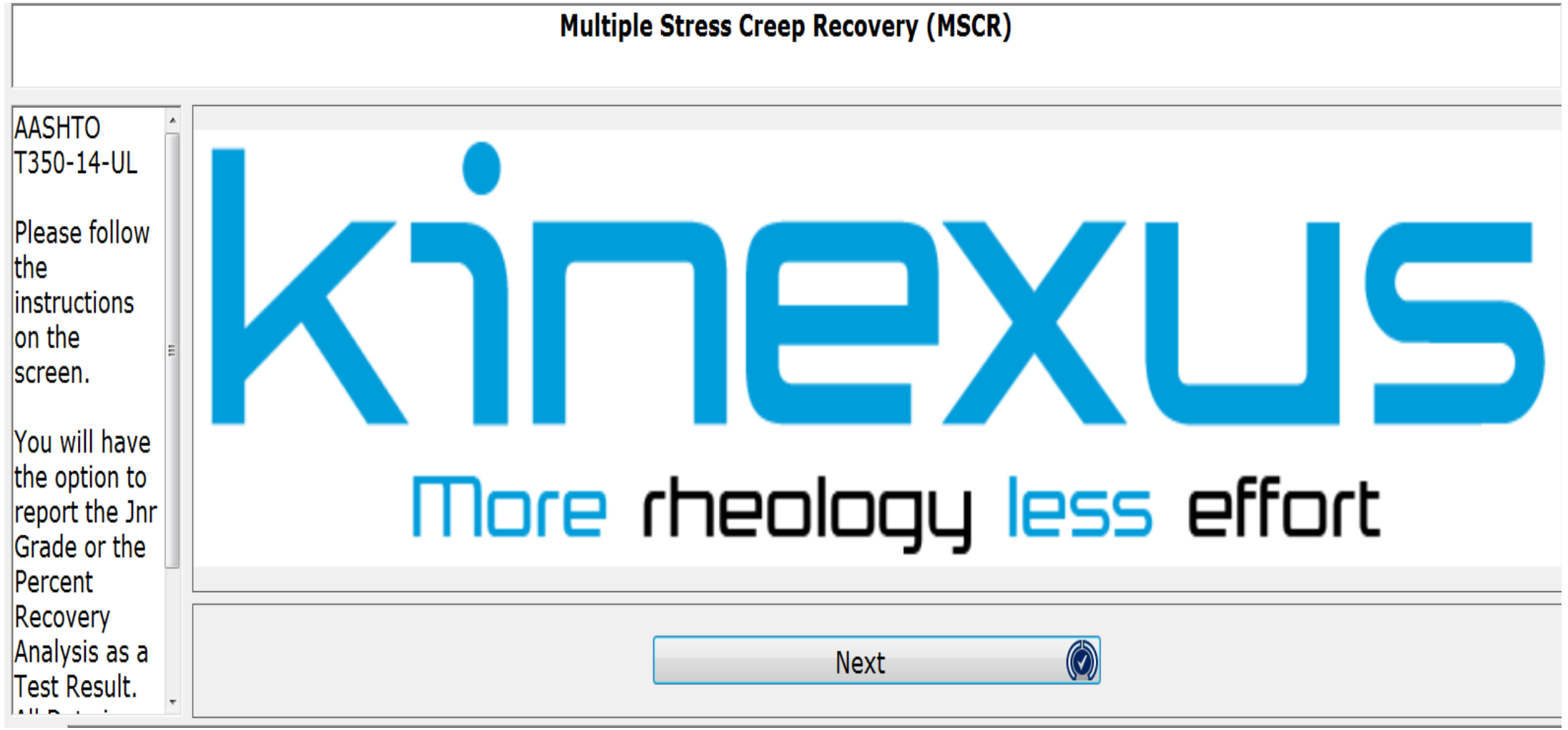
What's All This Mean?

- **These concerns with %diff recovery and %diff Jnr have been raised to the Binder ETG**
- **A task group is working with AMRL to make some language changes in T350 to provide a formal solution**
- **FHWA is working with the Asphalt Institute, as well**
- **AMRL accreditation will not be in jeopardy based on these results**

- **Overall goal is to get M332 implemented across all regions**
  - *"Just because the cup's chipped doesn't mean we can't drink from it"* *Matt Corrigan*

The PCCAS Regional Survey

- **DSR Software; AASHTO tests to T315, TP70 & T350**
  - Kinexus rSpace version 1.7X (1.70 & 1.72) are current and acceptable data collection and analysis for reporting
  - Bohlin 6.5X (6.50 & 6.51) are current and acceptable data collection
    - **For MSCR Analysis & Reporting use rSpace v1.7X**
- **Data for all raw & processed results are easily accessible**
  - Review in subsequent slides
- **Access for user edits or modifications is available**
- **Malvern reviews & revises its AASHTO sequences yearly**
- **Software updates are free for the life of the instrument**
- **Service updates software at yearly calibration visits**



Malvern MSCR Sequence; Inside the Sequence

Properties | Live Display | Start Sequence | Save options | Results | Perform MCSR Data Collection | Find Points for Analysis | Perform Analysis AASHTO TP-70 | MSCR elastic response and grade | Sample loading | change temperature | unload sample | Determine Jnr Grade | Full Report | Brief Report

Drag an action from the **Palette** list on the left to its appropriate position below. Then modify its **Properties**, if needed.

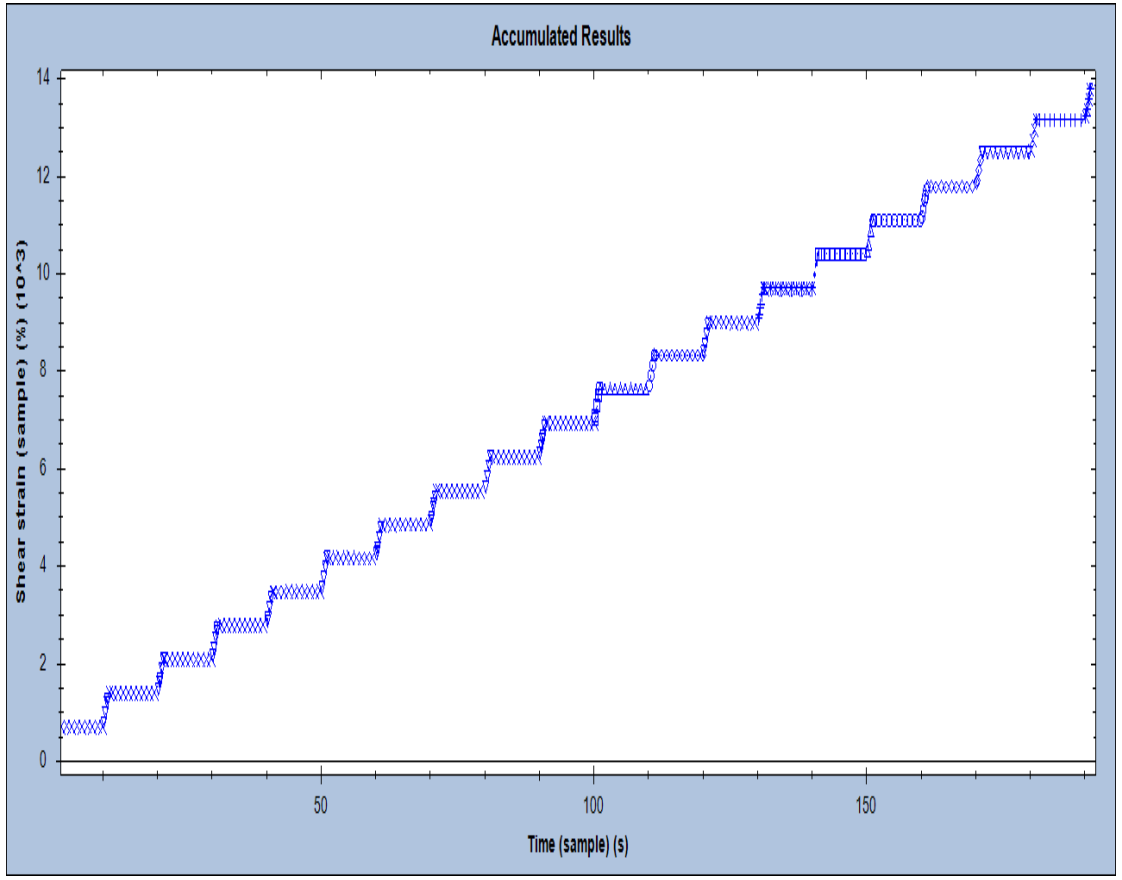
Action	Enabled	Type	Comment
Start of sequence prompt	☑	Prompt	Sequence prompt
Clear Test Result	☑	Modify Value	Set Test Result to Not Tested
Clear Test Result in Notes	☑	Modify Value	Set Test Result to Not Tested
Clear Passing Point	☑	Modify Value	Set Test Result to Not Tested
Log Plate Diameter	☑	Modify Value	Plate diameter
Reset test counter	☑	Modify Value	User 18 - to monitor number of retesting
Enter Sample Details	☑	Enter Sample Details	
Check if Sample Loaded	☑	Test True/ False	
False	☑	Test True/ False	
Is Hood Open	☑	Test True/ False	Check to see if oven open
Run Sample Loading	☑	Run Subsequence	
Run test	☑	Run Subsequence	
True	☑	Test True/ False	
Run again choice	☑	Choose Question	
Run test (at current temperature with no time for thermal equilibrium)	☑	Choose Question	
Run test (change temperature parameters)	☑	Choose Question	
Clean up and Exit	☑	Choose Question	
Prompt clean up and data deletion	☑	Prompt	
Run Clean Up	☑	Run Subsequence	
Sequence completed	☑	Prompt	Informs the user that the sequence has finished...

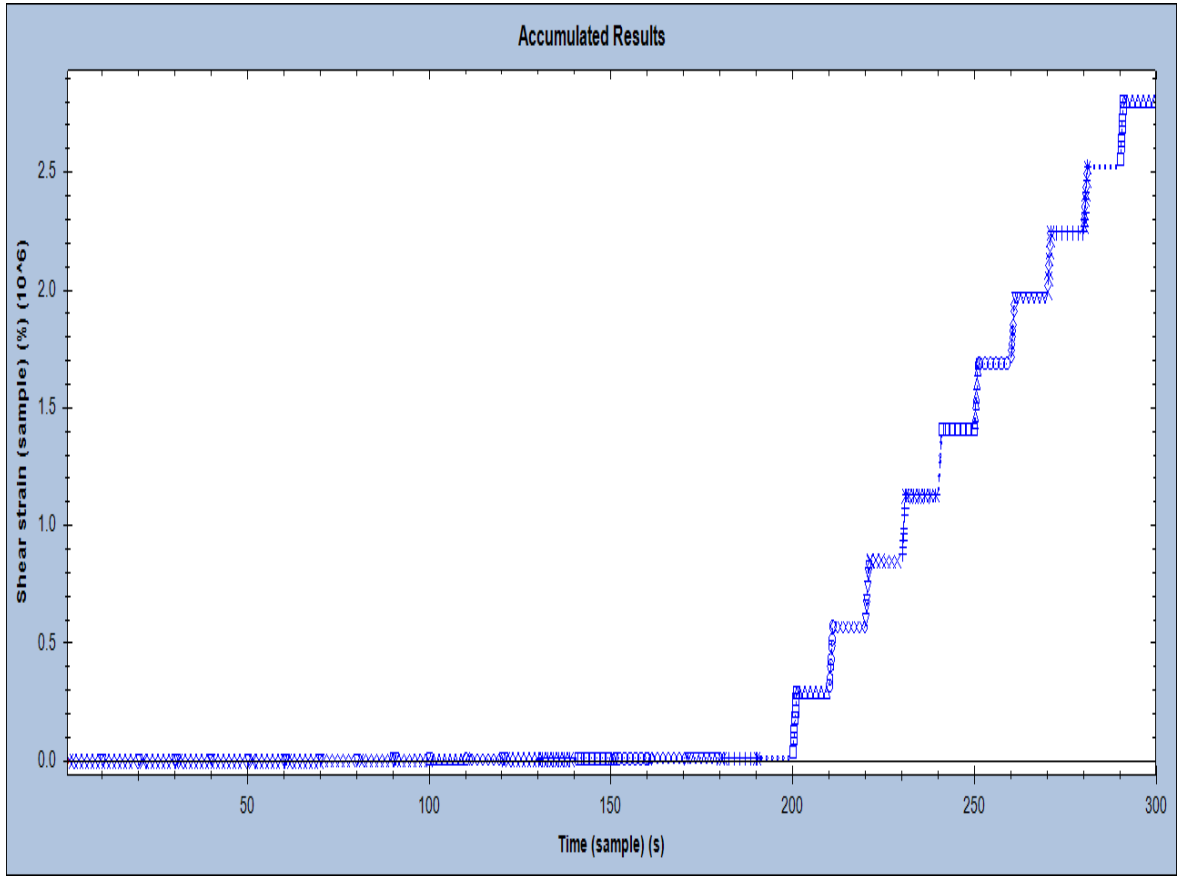
Perform the Data Collection

Applied Values		
Use engineering units	No	
Target shear stress	100.0	Pa
Perform recovery	Yes	
Sampling		
Linear Sampling	Yes	
Maximum sampling interval	0.00:00:00.100	
Raw data		
Raw data rate	50	
Integration time	0.00:00:00.500	
Use minimum displacement	No	
Store raw data?	Yes	
Store live data?	Yes	
Creep equilibrium settings		
Use creep equilibrium	No	
Creep end conditions		
Use maximum creep time	Yes	
Maximum creep time	0.00:00:01	
Recovery end conditions		
Use maximum recovery time	Yes	
Maximum recovery time	0.00:00:09	
Use creep dependant end time	No	

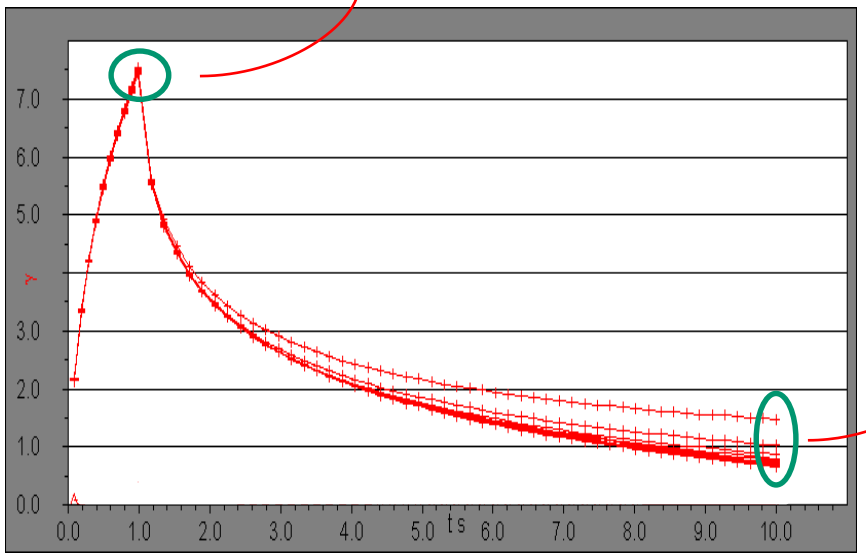
Action	Enabled	Type	Comment
Reset sample time	☑	Reset sample time	
Loop preconditioning 10 cycles	☑	Loop	Disable to perform AASHTO TP-70
0.1kPa precondition cycle	☑	Creep and Recovery	
0.1kPa creep (1)	☑	Creep and Recovery	
0.1kPa creep (2)	☑	Creep and Recovery	
0.1kPa creep (3)	☑	Creep and Recovery	
0.1kPa creep (4)	☑	Creep and Recovery	
0.1kPa creep (5)	☑	Creep and Recovery	
0.1kPa creep (6)	☑	Creep and Recovery	
0.1kPa creep (7)	☑	Creep and Recovery	
0.1kPa creep (8)	☑	Creep and Recovery	
0.1kPa creep (9)	☑	Creep and Recovery	
0.1kPa creep (10)	☑	Creep and Recovery	
3.2kPa creep (1)	☑	Creep and Recovery	
3.2kPa creep (2)	☑	Creep and Recovery	
3.2kPa creep (3)	☑	Creep and Recovery	
3.2kPa creep (4)	☑	Creep and Recovery	
3.2kPa creep (5)	☑	Creep and Recovery	
3.2kPa creep (6)	☑	Creep and Recovery	
3.2kPa creep (7)	☑	Creep and Recovery	
3.2kPa creep (8)	☑	Creep and Recovery	
3.2kPa creep (9)	☑	Creep and Recovery	
3.2kPa creep (10)	☑	Creep and Recovery	
Run Find points for analysis	☑	Run Subsequence	

Live Feedback Display of the Results



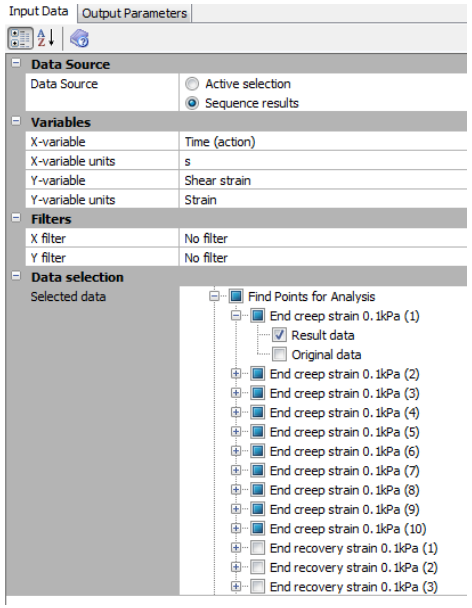


Find Points for Analysis



Action	Enabled	Type	Comment
End creep strain 0.1kPa (1)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (2)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (3)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (4)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (5)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (6)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (7)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (8)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (9)	☑	Peak and Valley Analysis	
End creep strain 0.1kPa (10)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (1)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (2)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (3)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (4)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (5)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (6)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (7)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (8)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (9)	☑	Peak and Valley Analysis	
End recovery strain 0.1kPa (10)	☑	Peak and Valley Analysis	
End creep strain 3.2kPa (11)	☑	Peak and Valley Analysis	
End creep strain 3.2kPa (12)	☑	Peak and Valley Analysis	
End creep strain 3.2kPa (13)	☑	Peak and Valley Analysis	
End creep strain 3.2kPa (14)	☑	Peak and Valley Analysis	

Perform the Analysis



Equation

([Instrument].[Sample].[User Numeric 5]-[Instrument].[Sample].[User Numeric 11])/([Instrument].[Sample].[User Numeric 5])*100)

Equation

([Instrument].[Sample].[User Numeric 10]-[Instrument].[Sample].[User Numeric 4])/[Instrument].[Sample].[User Numeric 4])*100

Action	Enabled	Type	Comment
Average creep strain at 0.1kPa in strain	☑	Point Statistics	Stats for User 1
Average end strain at 0.1kPa in strain	☑	Point Statistics	Stats for User 2
Average creep compliance at 0.1kPa in Pa-1	☑	Point Statistics	Jc
Average end compliance at 0.1kPa in Pa-1	☑	Point Statistics	Jr
Average Jnr	☑	Calculate Value	User 4 Jnr
Average creep strain at 0.1kPa output	☑	Calculate Value	User 1 E1 From point stats
Average end strain at 0.1kPa output	☑	Calculate Value	User 2 E10 From point stats
Average recoverable strain 0.1kPa R0.1	☑	Calculate Value	User 3 (E1 - E10) R0.1 or [user1-user2]
% recoverable strain	☑	Calculate Value	User 5 ((E1 - E10) / E1) *100
% non recoverable strain	☑	Calculate Value	User 6 (E10 / E1) *100
		cs	Stats for User 7
		cs	Stats for User 8
		cs	Jc
		cs	Jr
Average creep strain at 3.2kPa output	☑	Calculate Value	User 7 E1 From point stats
Average end strain at 3.2kPa output	☑	Calculate Value	User 8 E10 From point stats
Average recoverable strain 3.2kPa (1) R3.2	☑	Calculate Value	User 9 (E1 - E10) R3.2 or [user7-user8]
Average Jnr 3.2k (1)	☑	Calculate Value	User 10 Jnr
% recoverable strain 3.2k (1)	☑	Calculate Value	User 11 ((E1 - E10) / E1) / *100
% non recoverable strain 3.2k (1)	☑	Calculate Value	User 12 (E10 / E1) *100
% Difference in recovery	☑	Calculate Value	User 13 ((%R0.1 - %R3.2) / %R0.1) *100 or [((user5-user11)/user5)*100]
% Difference of Jnr	☑	Calculate Value	User 14 ((Jnr3.2 - Jnr0.1) / Jnr0.1) *100 or [((user10-user4)/user4)*100

Equation

([Instrument].[Sample].[User Numeric 10]-[Instrument].[Sample].[User Numeric 4])/[Instrument].[Sample].[User Numeric 4])*100

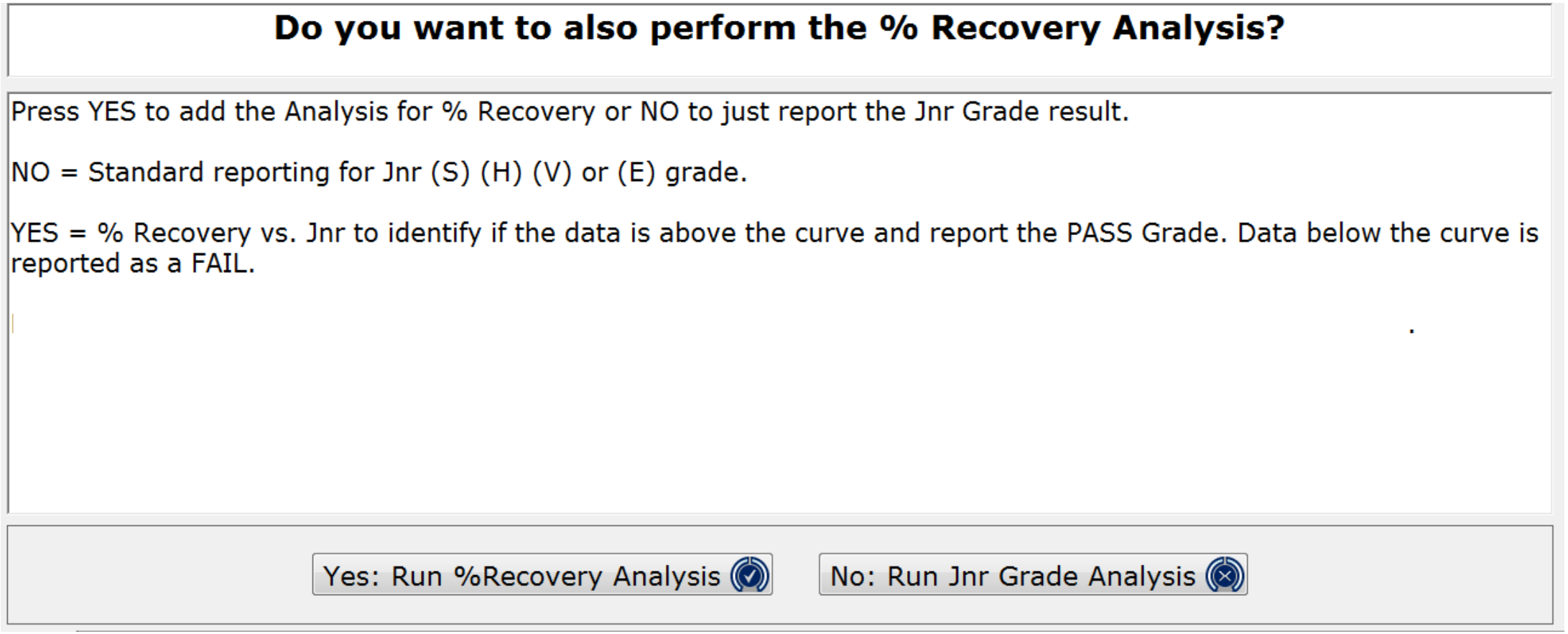
Comprehensive Reporting (*easily changed*)

Company name
Experiment Name
Material name
Sample Description
Sample ID
Batch number
Operator name
Plate diameter
Temperature control method
Temperature(°C)
Non-recoverable creep compliance at 0.1kPa (kPa-1)
Non-recoverable creep compliance at 3.2kPa (kPa-1)
Percent difference between non-recoverable creep compliance (%)
Percent recoverable strain at 0.1kPa (%)
Percent recoverable strain at 3.2kPa (%)
Percent difference between average percent recovery (%)
Average creep strain at 0.1kPa (Strain)
Average creep strain at 3.2kPa (Strain)
Average end strain at 0.1kPa (Strain)
Average end strain at 3.2kPa (Strain)
Average recoverable strain at 0.1kPa (Strain)
Average recoverable strain at 3.2kPa (Strain)
Percent non-recoverable strain at 0.1kPa (% Strain)
Percent non-recoverable strain at 3.2kPa (% Strain)
Test result
% Recoverable Strain 3.2kPa Passing Point
Notes

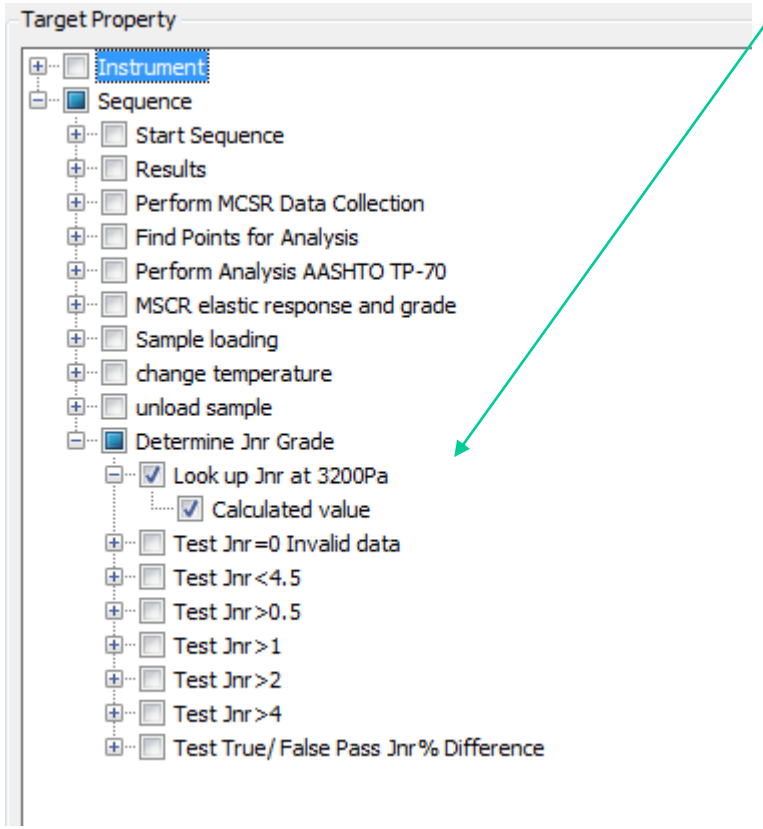
Co.	Malvern Instruments Ltd
Exp.	AASHTO_0007 TP-70 Multiple Stress Creep Recovery
Material	RTFO
Samp.	MSCR test with pdms
Sample id	
Batch No.	
Op.	
Dplate	25.00
Tcontroller	Peltier Dry Chamber
T(°C)	25.00
Jnr (0.1)	0.02676
Jnr (3.2)	0.04052
% Jnr diff	51.4
% R (0.1)	41.3
% R (3.2)	17.4
% Rdiff	57.8
Av E1 (0.1)	4.557E-003
Av E1 (3.2)	0.1570
Av E10 (0.1)	2.676E-003
Av E10 (3.2)	0.1297
(E1 - E10) 0.1kPa	1.881E-003
(E1 - E10) 3.2kPa	0.02736
% Enr (0.1)	58.7
% Enr (3.2)	82.6
Result	FAIL - The result fell below the comparison line at 25.0°C
PassPoint	68.9
Notes	

Co.	Malvern Instruments Ltd
Exp.	AASHTO_0007 TP-70 Multiple Stress Creep Recovery
Material	RTFO
Samp.	MSCR test with pdms
Dplate	25.00
Tcontroller	Peltier Dry Chamber
T(°C)	25.00
Jnr (3.2)	0.04052
% R (3.2)	17.4
% Jnr diff	51.4
Result	FAIL - The result fell below the comparison line at 25.0°C

Automated Analysis

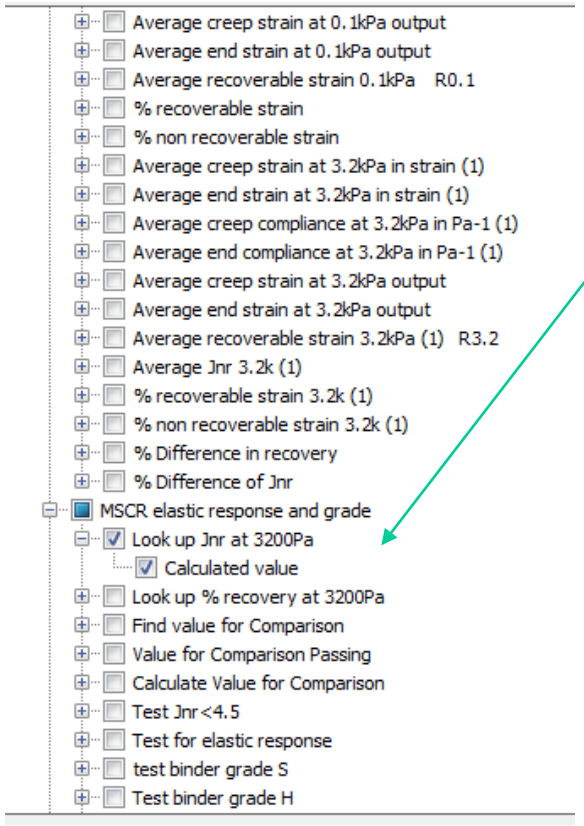


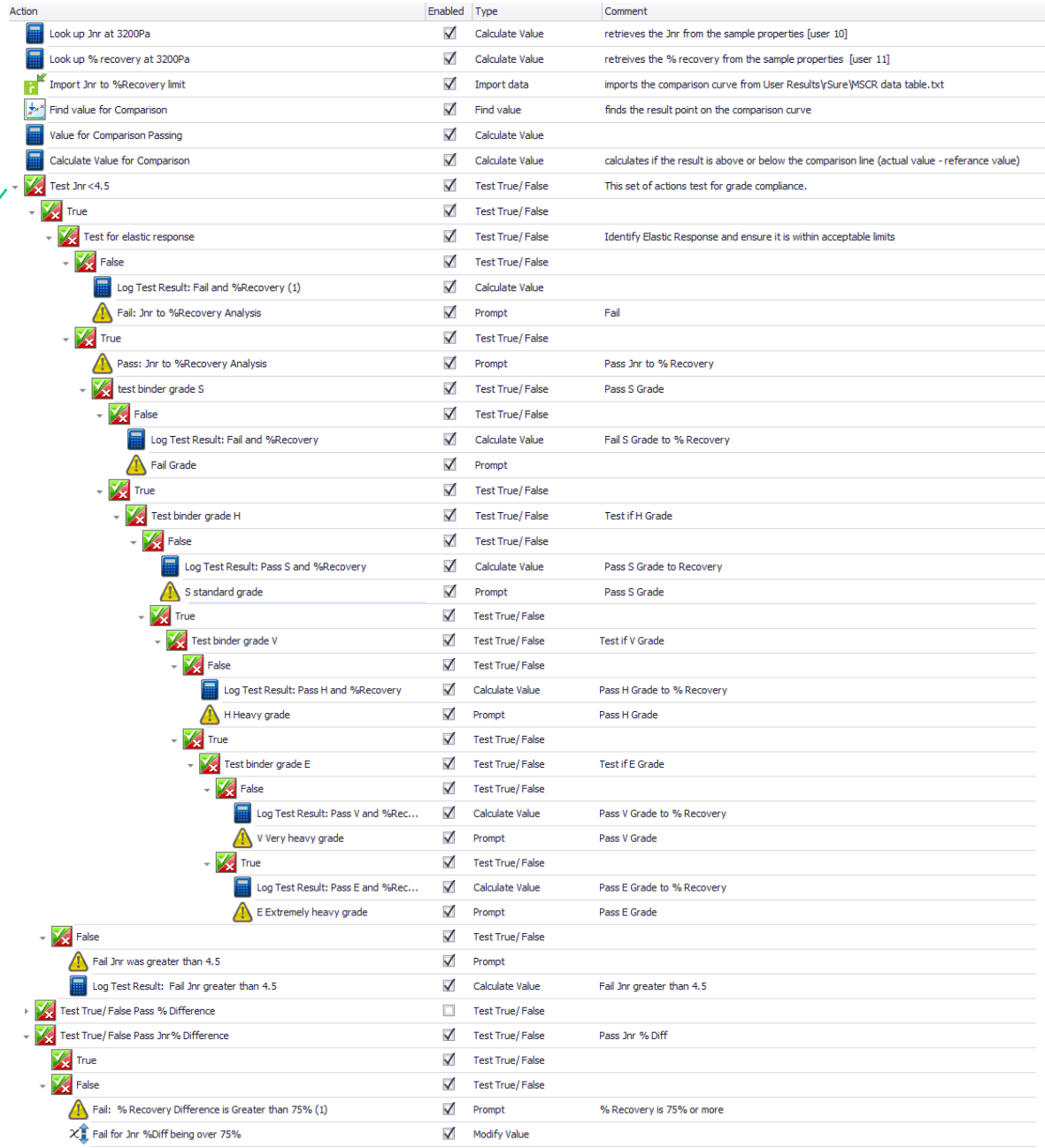
Logical Sieve to Determine Jnr Grade



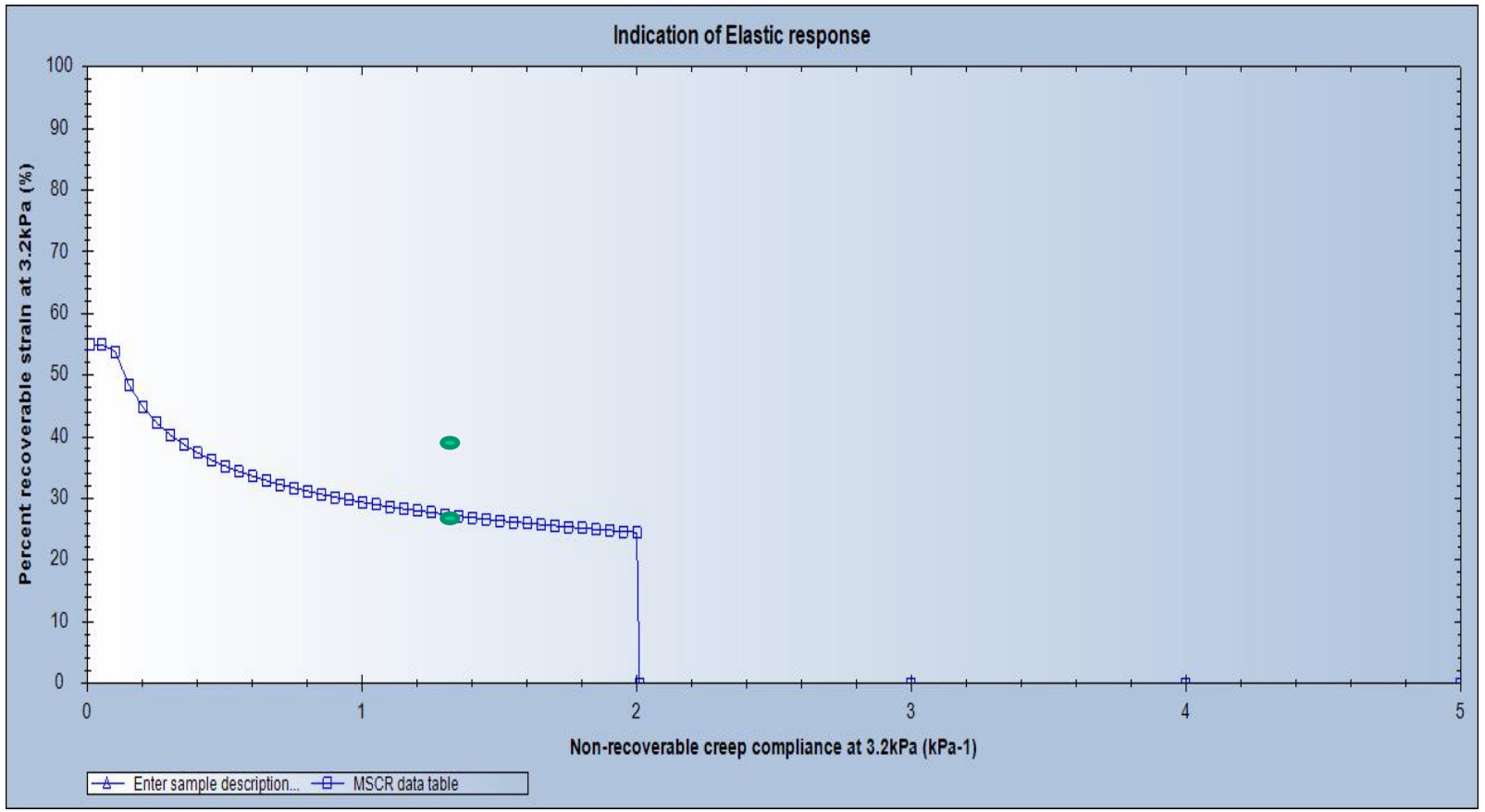
Action	Enabled	Type	Comment
Look up Jnr at 3200Pa	☑	Calculate V...	retrieves the Jnr from the sample properties [User 10]
Test Jnr=0 Invalid data	☑	Test True/ ...	
False 1 Run Analysis	☑	Test True/ ...	
Test Jnr<4.5	☑	Test True/ ...	This set of actions test for grade compliance.
False 2 Data outside range	☑	Test True/ ...	
Log Test Result FAIL	☑	Calculate V...	
Fail Jnr values outside the acceptable range of 4.5	☑	Prompt	
True 2 Data in range	☑	Test True/ ...	
Test Jnr>0.5	☑	Test True/ ...	
False 3	☑	Test True/ ...	
Test Jnr>1	☑	Test True/ ...	
False 4	☑	Test True/ ...	
Test Jnr>2	☑	Test True/ ...	
False 5	☑	Test True/ ...	
Test Jnr>4	☑	Test True/ ...	
False 6	☑	Test True/ ...	
True 6	☑	Test True/ ...	
Log Test Result Standard Grade	☑	Calculate V...	
Pass Standard Grade	☑	Prompt	
True 5	☑	Test True/ ...	
Log Test Result Heavy Grade	☑	Calculate V...	
Pass Heavy Grade	☑	Prompt	
True 4	☑	Test True/ ...	
Log Test Result Pass V	☑	Calculate V...	
Pass Very Heavy Grade	☑	Prompt	
True 3	☑	Test True/ ...	
Log Test Result Pass E	☑	Calculate V...	
Pass Extremely Heavy Grade	☑	Prompt	
True 1	☑	Test True/ ...	
Log Test Result Fail No Grade zero results	☑	Calculate V...	
Fail No Grade Determined results were zero	☑	Prompt	
Test True/ False Pass Jnr% Difference	☑	Test True/ ...	
True	☑	Test True/ ...	
False	☑	Test True/ ...	
Fail: % Recovery Difference is Greater than 75%	☑	Prompt	Passing is 75% or less.
Fail for Jnr %Diff being over 75%	☑	Modify Value	

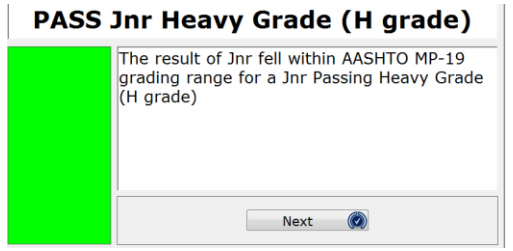
Logical Sieve to Determine both Grade & Elastic Response

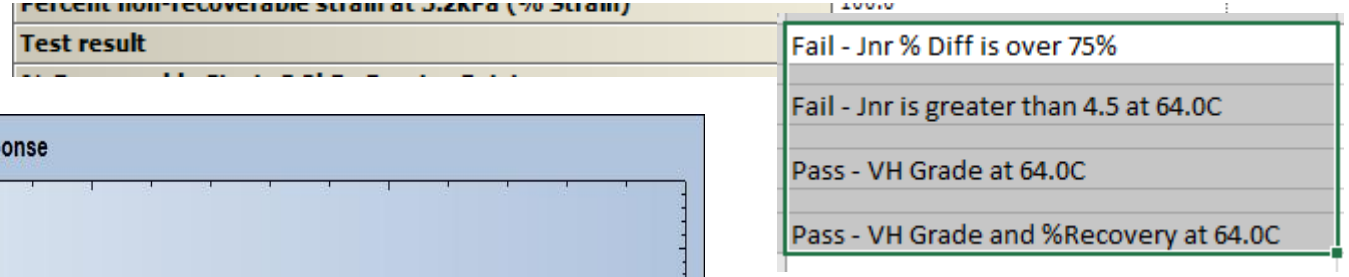


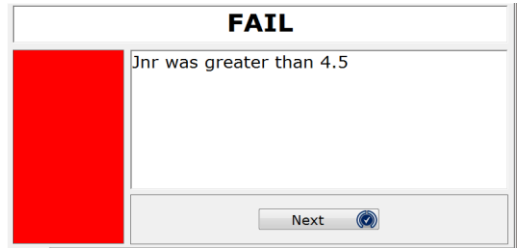


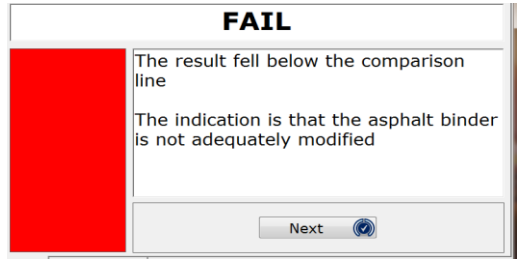
Feedback of Test Results

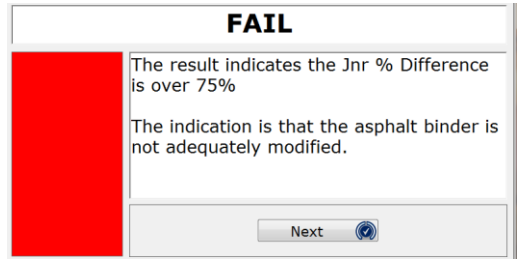






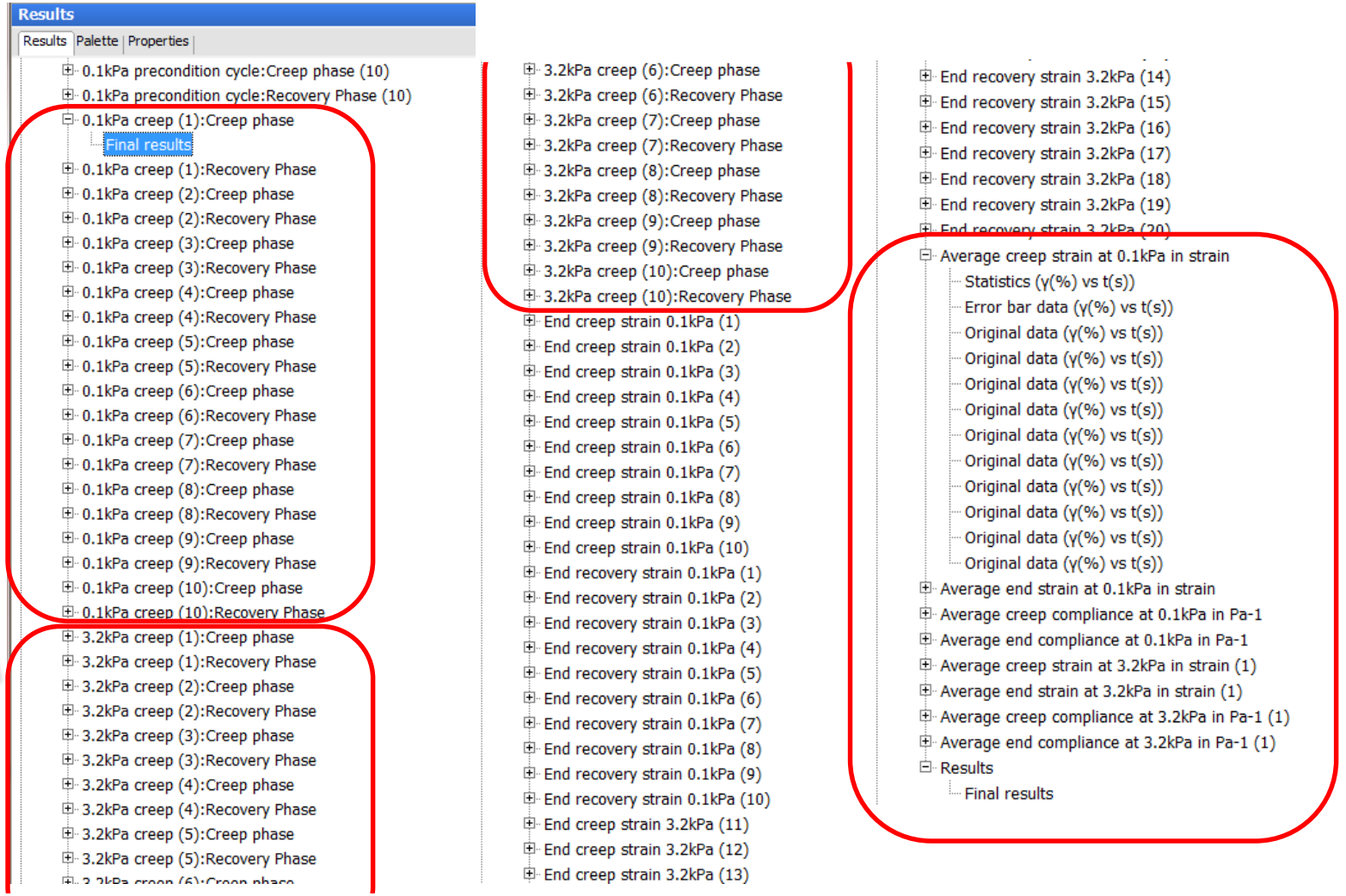






Access to all raw and processed results

RAW Data



Analysis & Results

Questions?