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# **Test Monitoring Center**

<http://astmtmc.cmu.edu>

## **ASTM D02.B1 Semiannual Report Passenger Car Reference Oil Testing**

April 2019

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# Passenger Car Engine Oil Testing Executive Summary

- ▶ Seq. IVB
  - Monitoring of the Fe wear parameter began this period.
- ▶ Seq. IIIF and VG
  - Only one test reported this period
- ▶ Seq. IIIG/A/B
  - No reference activity this report period. Test results and status from previous report period.
- ▶ Seq. IIIH
  - Targets generated for reblend of 434, blend 434-3. LTMS changes were needed to address MRV. Batch Code 6 rings introduced
- ▶ BOI-VGRA
  - Testing is complete for Sequence IIIH, IVB, VH, VIE, VIF, IX, and X

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# Calibrated Labs and Stands\*

Test	Labs	Stands
IIIF	1	1
IIIG/A/B	0	0
IIIH/A/B	5	17
IVA	2	4
IVB	4	10
VG	1	1

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\*As of 9/30/2018

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# Calibrated Labs and Stands\*

Test	Labs	Stands
VH	5	11
VIE	5	16
VIF	3	7
VIII	2	3
IX	3	6
X	4	8

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\*As of 3/31/2019

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# Sequence III F

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# Sequence IIF Activity

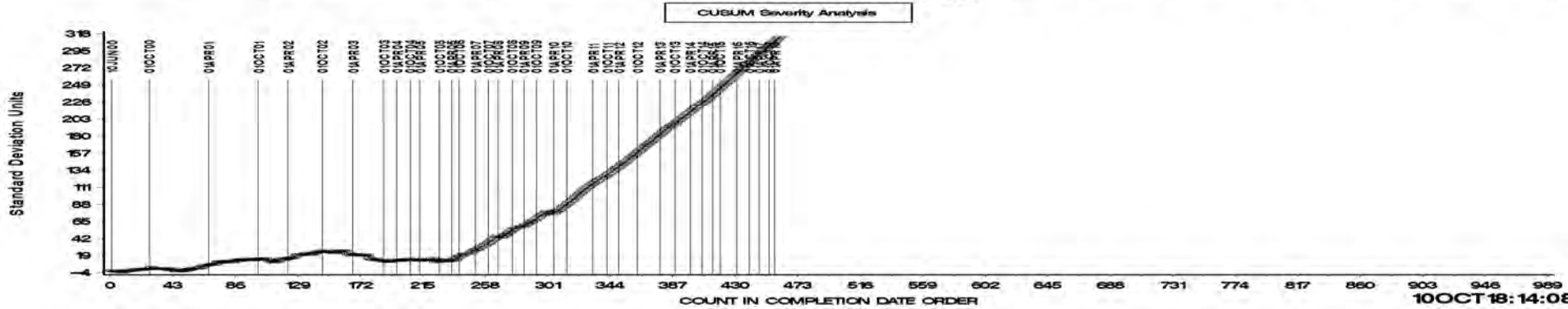
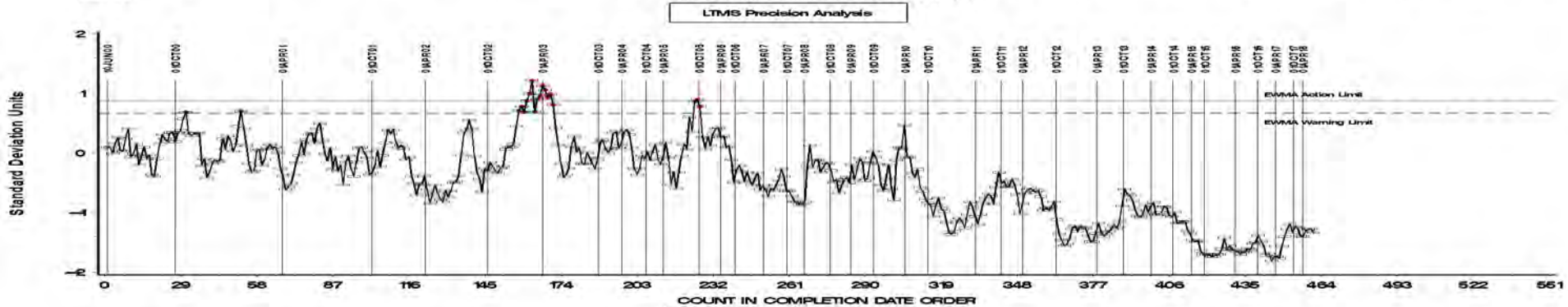
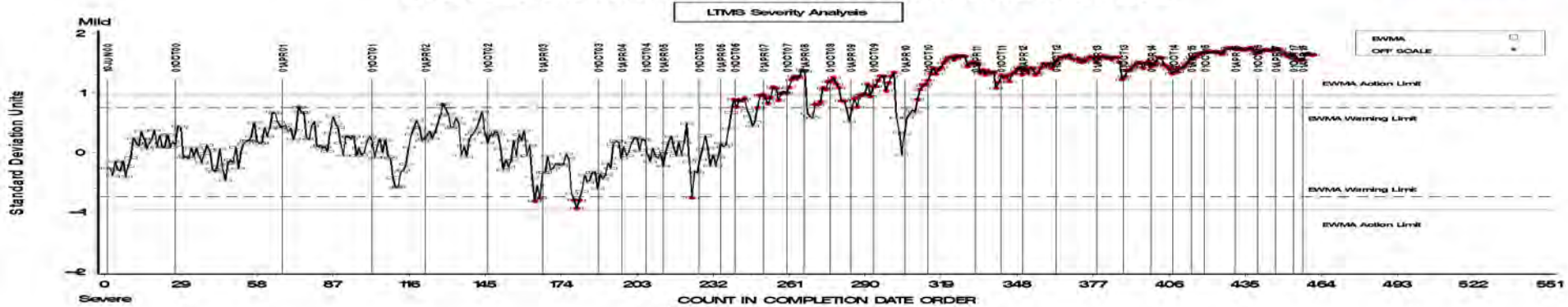
Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
<b>Total</b>		<b>1</b>

# Sequence IIF Test Severity

- APV
  - In severity action alarm, mild
  - Long-term mild trend continuing (Since April 2006)
- Hours to 275% Vis Increase
  - In control
- WPD
  - In severity warning alarm (severe)
- PV60
  - In severity action alarm (severe)

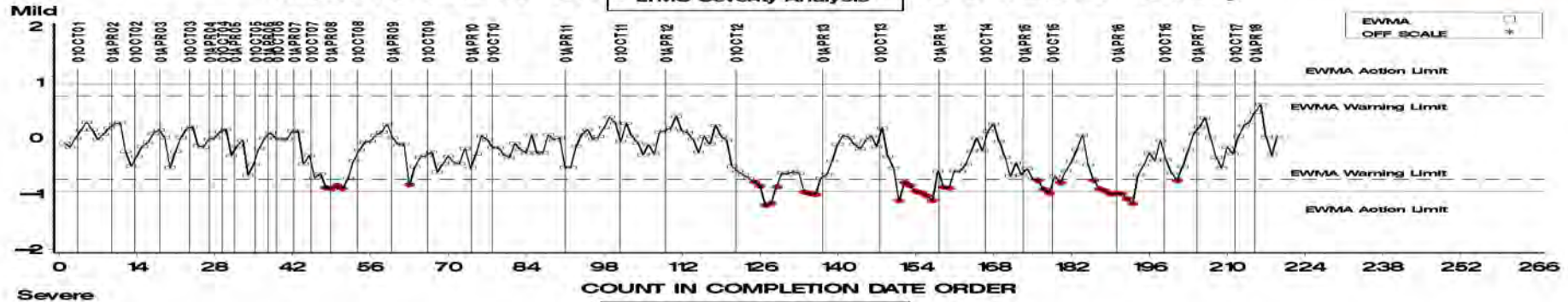
# SEQUENCE IIIF INDUSTRY OPERATIONALY VALID DATA

## AVERAGE PISTON SKIRT VARNISH FINAL ORIG UNIT RES

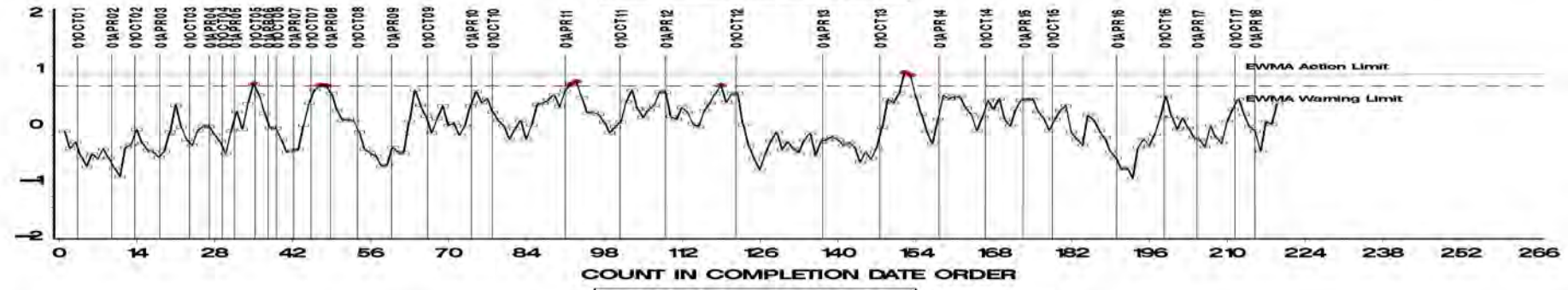


## HOURS FINAL ORIG RES (REFERENCE TESTS ONLY)

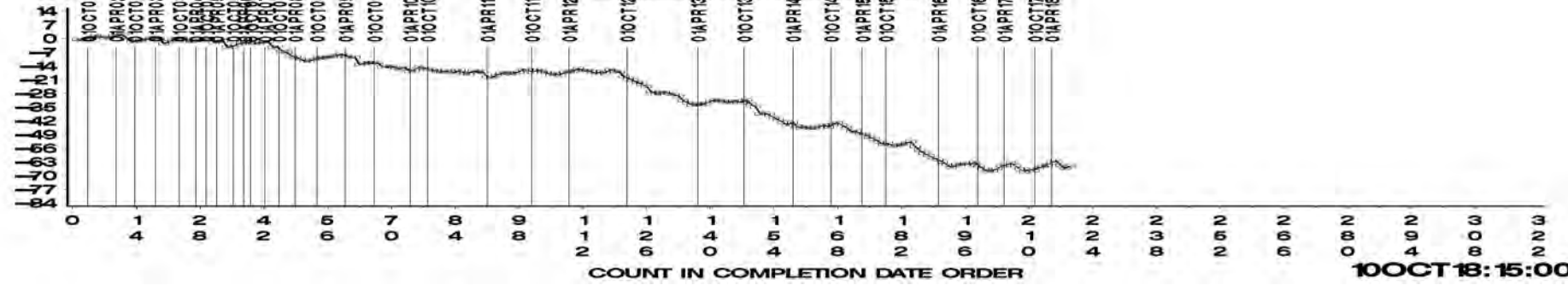
LTMS Severity Analysis



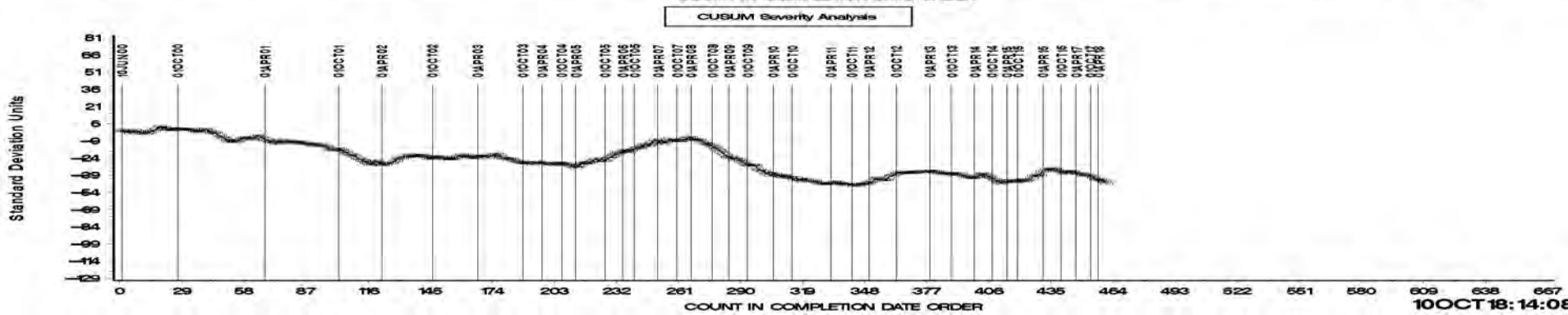
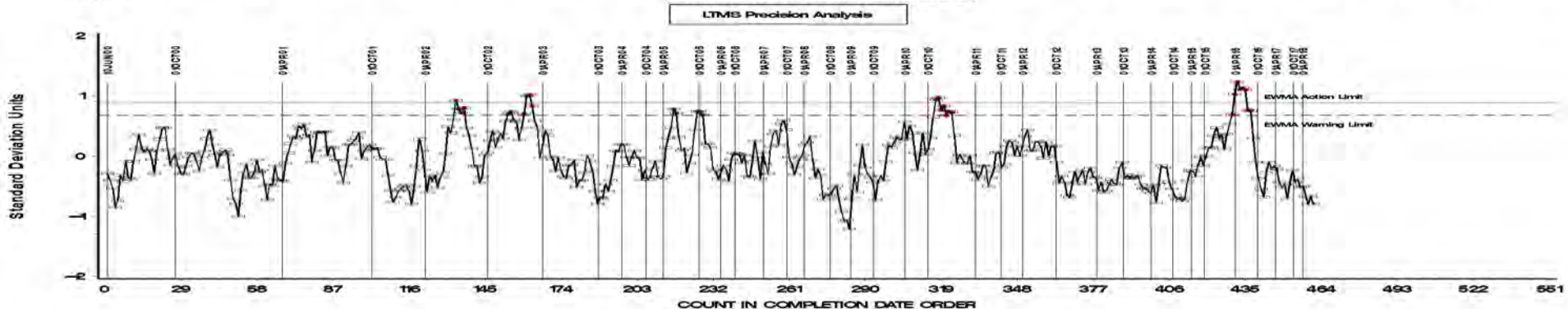
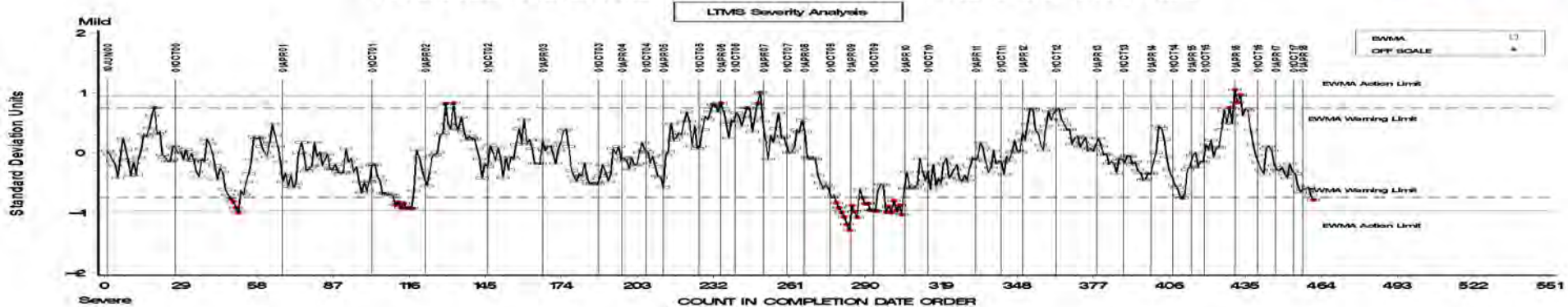
LTMS Precision Analysis



CUSUM Severity Analysis



AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG UNIT RES



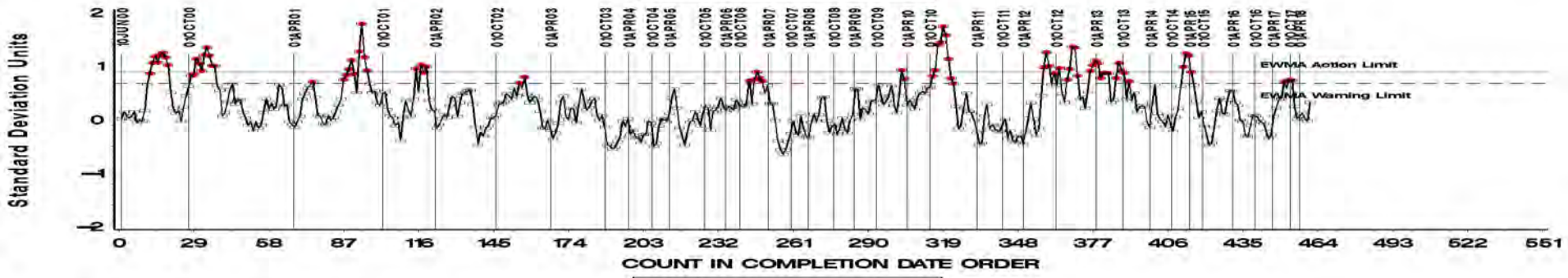
10OCT18: 14:08

## % VISCOSITY INCREASE @ 060 HOURS

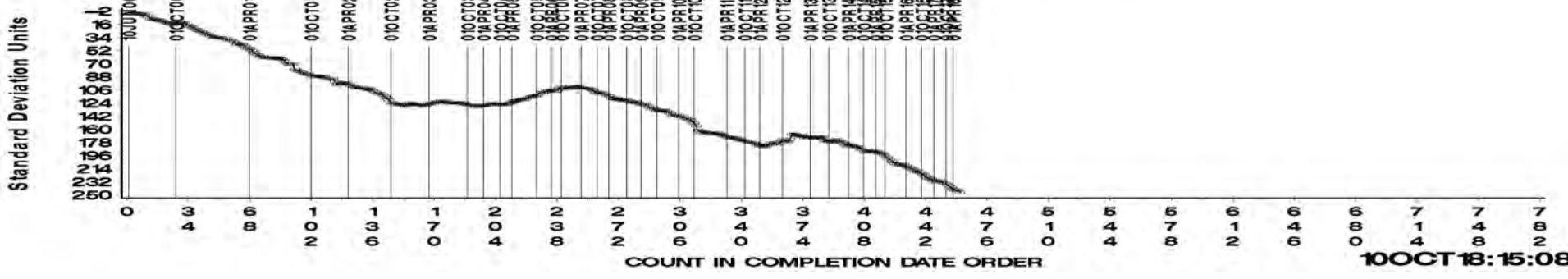
LIMS Severity Analysis



LIMS Precision Analysis



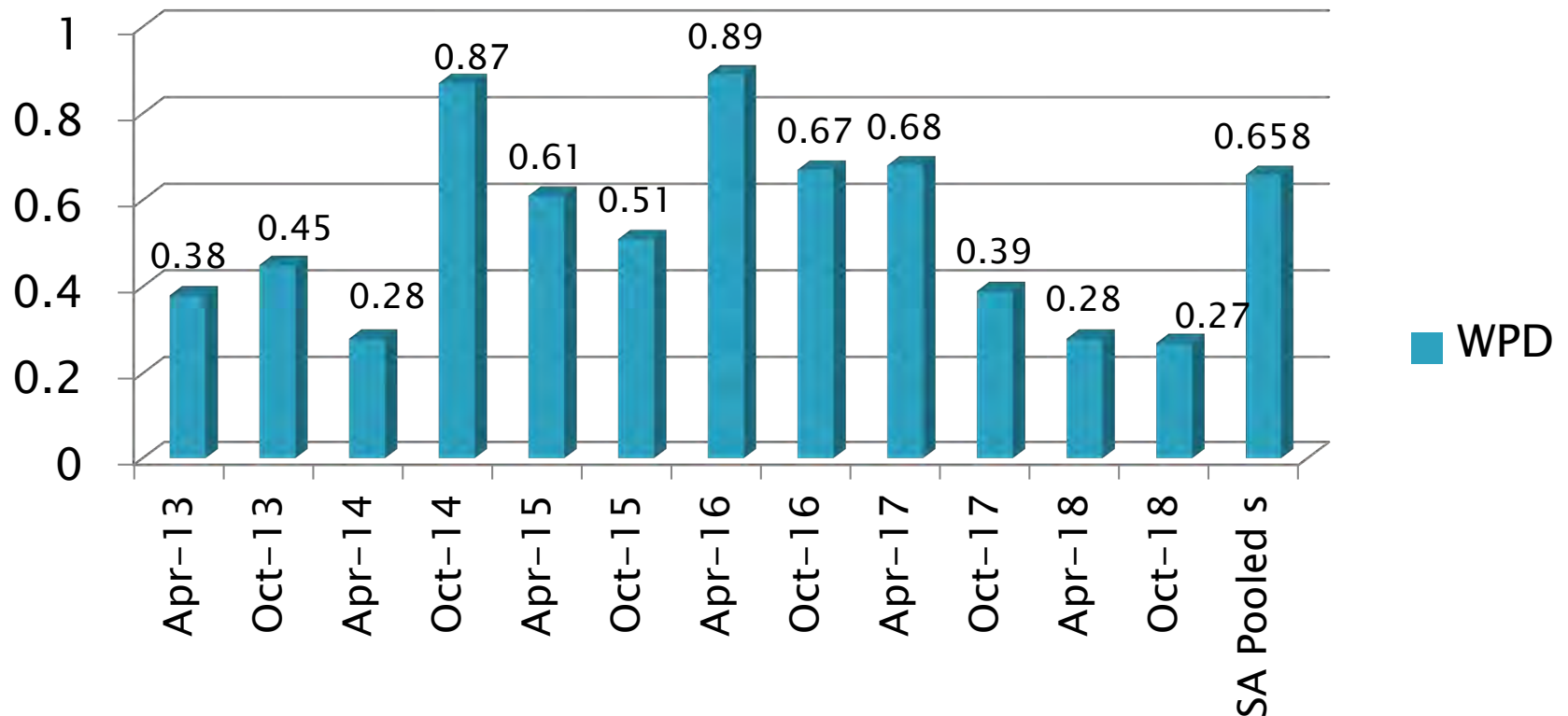
CUSUM Severity Analysis



10OCT18:15:08

# IIIF Precision Estimates

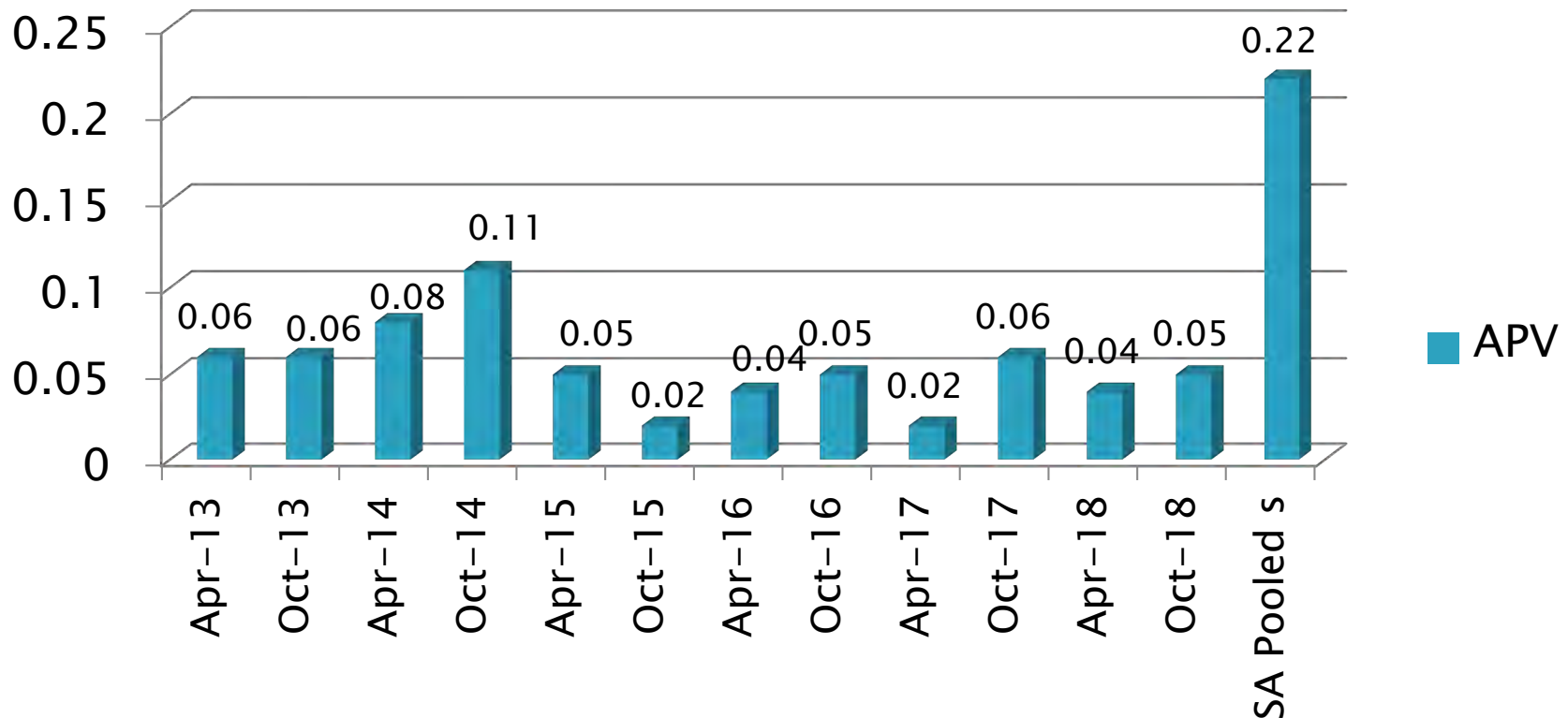
## WPD



Precision estimates for Apr-19 not calculated as only one test reported this period

# IIIF Precision Estimates

## APV

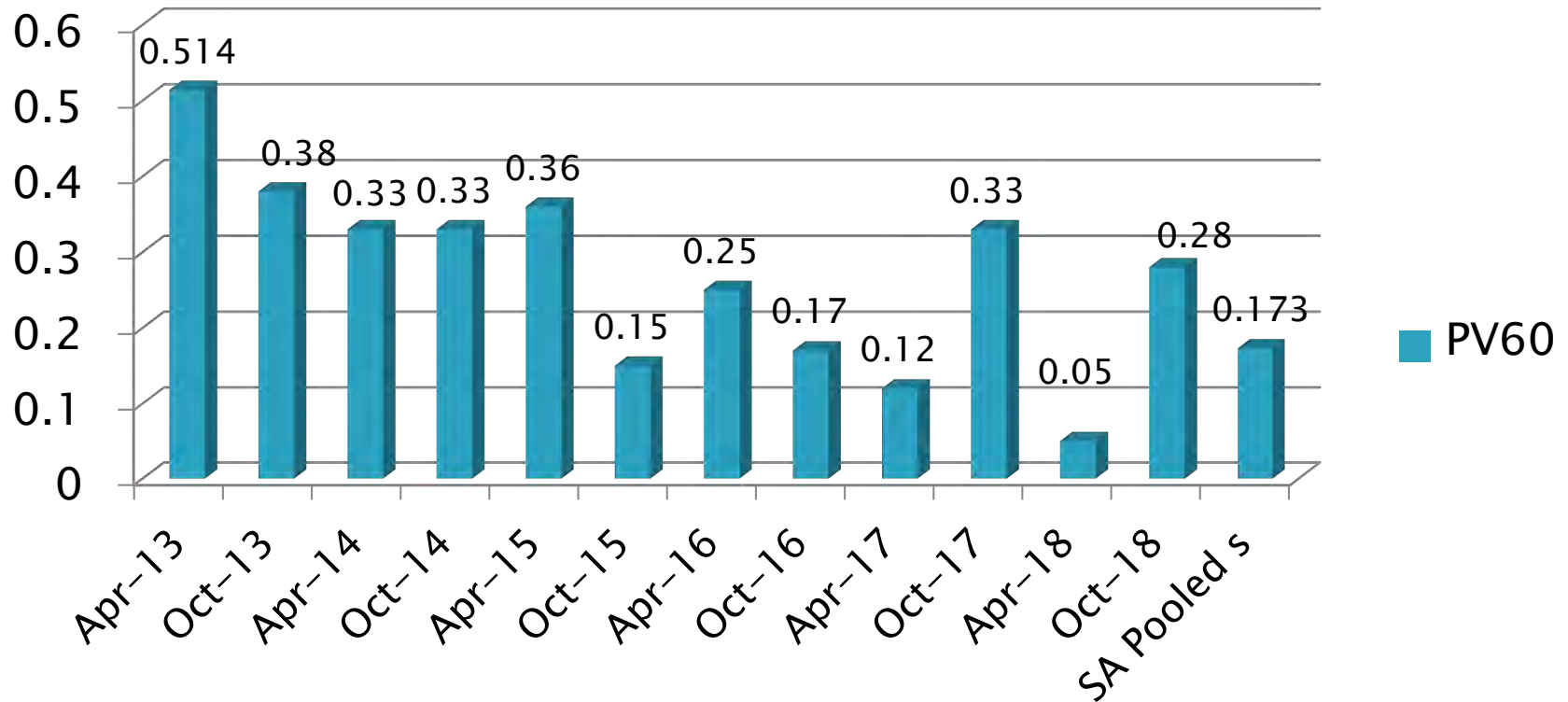


Precision estimates for Apr-19 not calculated as only one test reported this period



# IIIF Precision Estimates

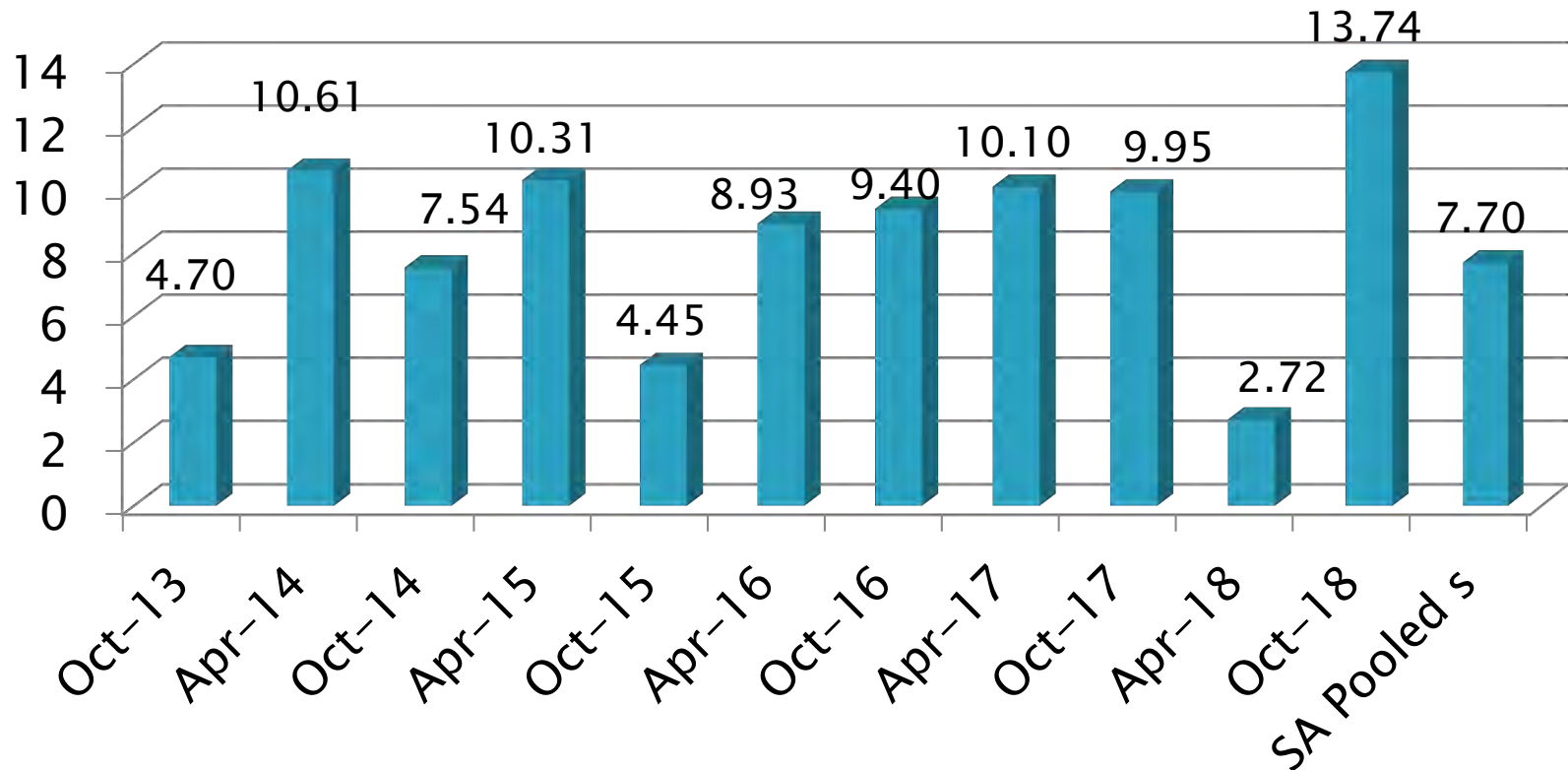
## PV60



Precision estimates for Apr-19 not calculated as only one test reported this period

# IIIF Precision Estimates

## Hours to 275%



Precision estimates for Apr-19 not calculated as only one test reported this period

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# Sequence IIIG/A/B

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# Sequence IIIG Activity

No activity this report period. April 2018 data shown for informational purposes only.

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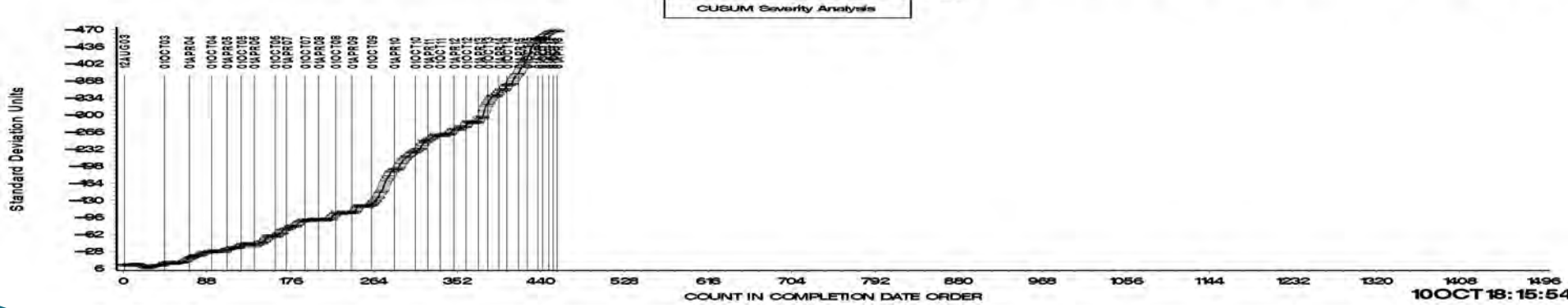
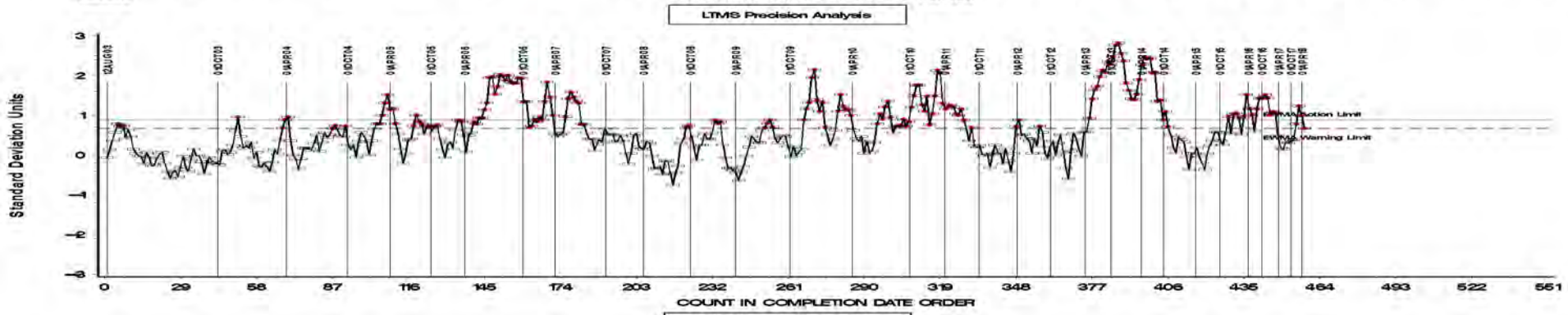
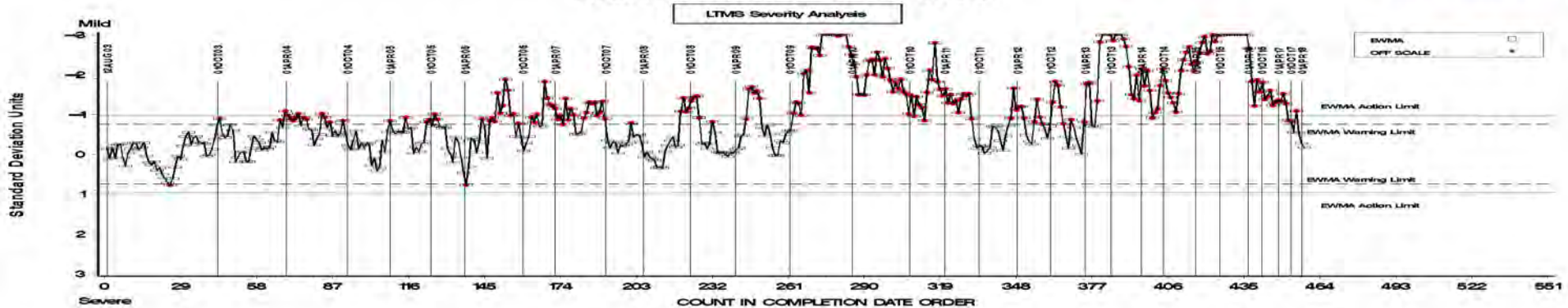
# Sequence IIIG Test Severity

- **ACLW** in precision warning alarm
  - Long-term mild trend
- **PVIS**
  - Precision action alarm
  - Severity action alarm (severe)
- **WPD** in severity warning alarm
  - Long-term severe trend continuing
- **MRV** is in severity action alarm (severe)
  - Long-term severe trend continuing
- **PHOS** in control
- Precision plots not updated, only 1 test reported

# SEQUENCE IIIG INDUSTRY OPERATIONAL VALID DATA



## AVERAGE CAM + LIFTER WEAR



10OCT18:15:54

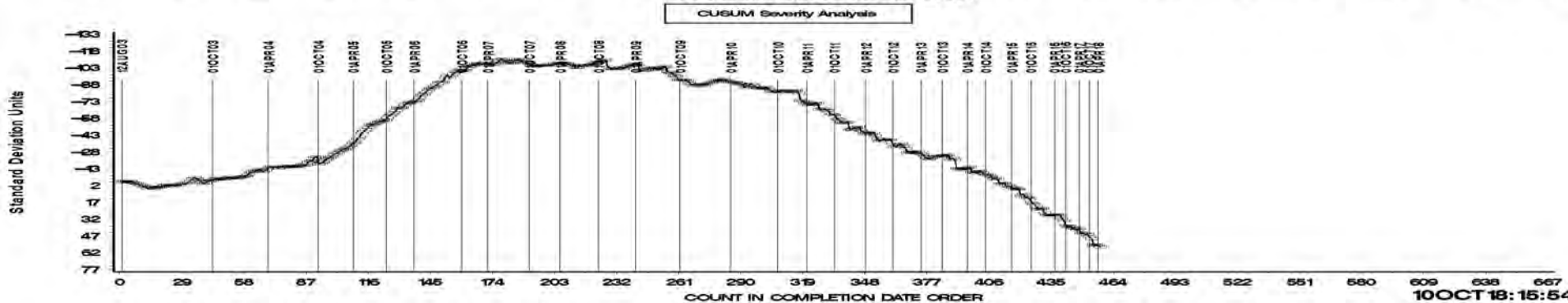
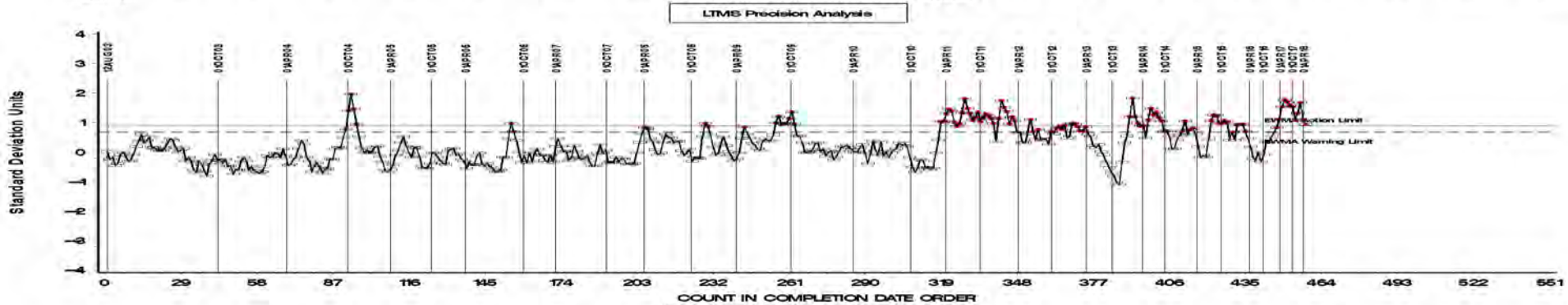
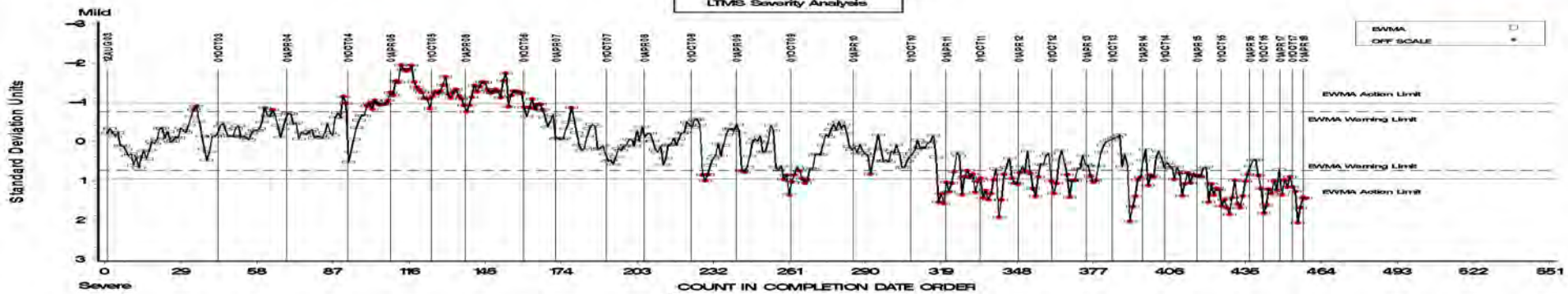
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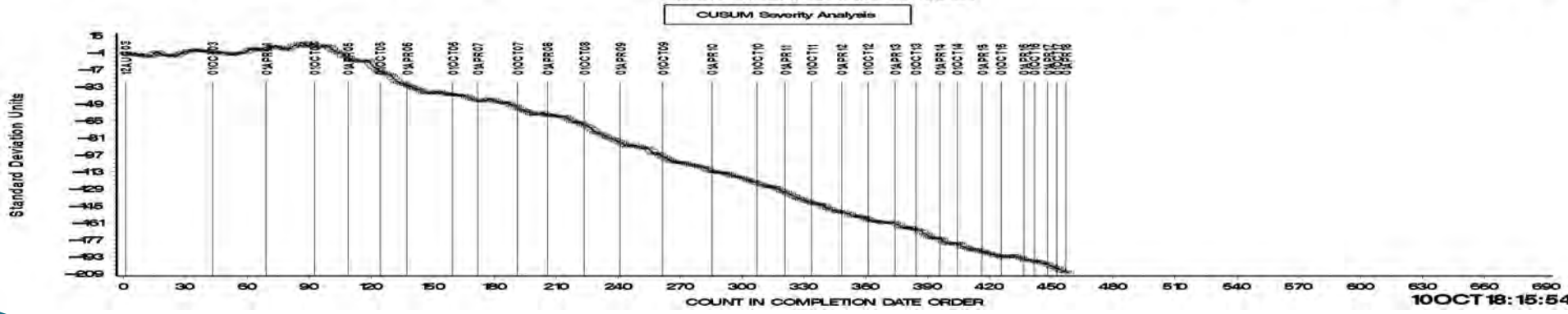
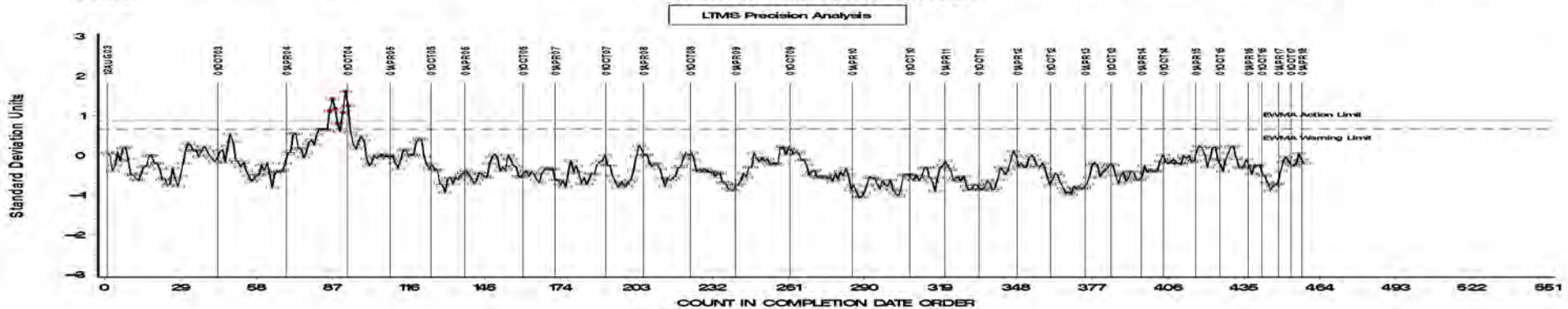
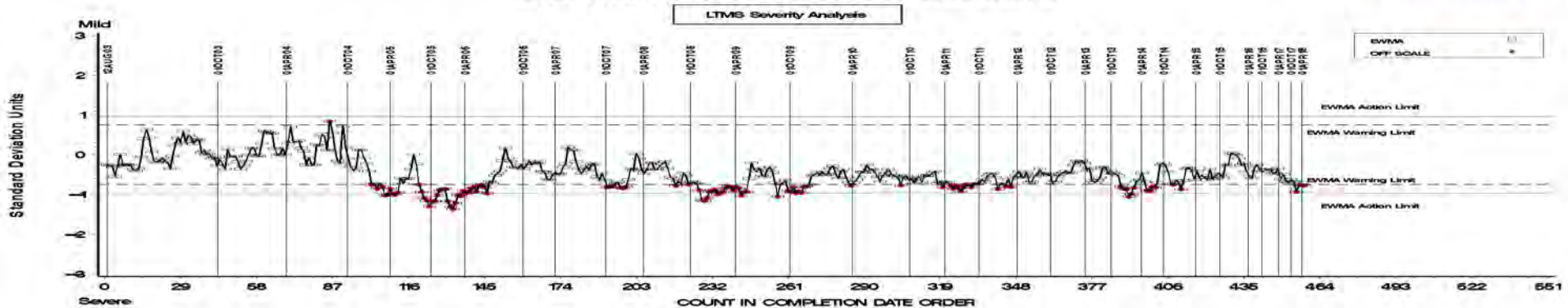


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## VISCOSITY INCREASE



## AVERAGE WEIGHTED PISTON DEPOSITS

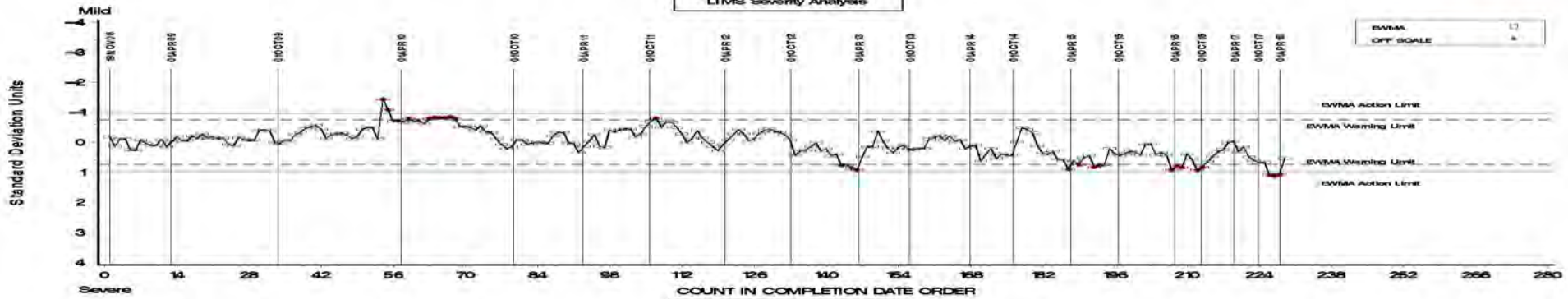


10OCT18:15:54

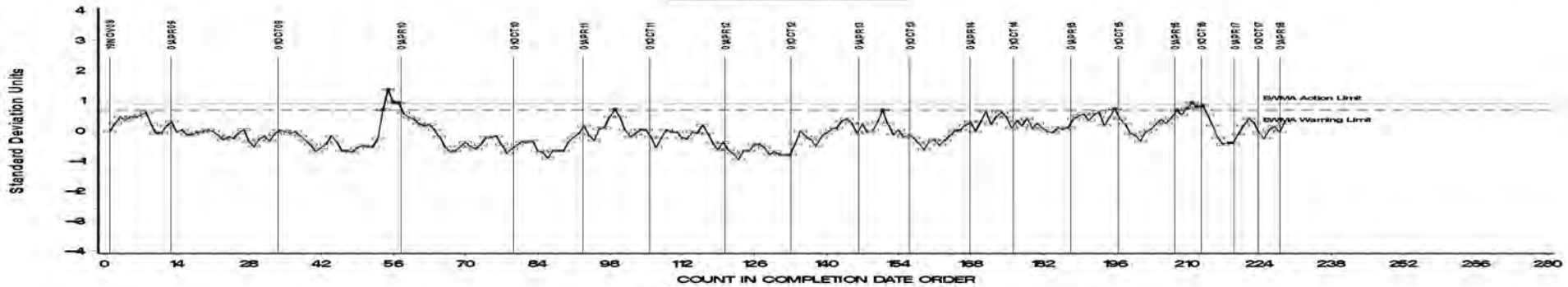


## PHOS RETENTION

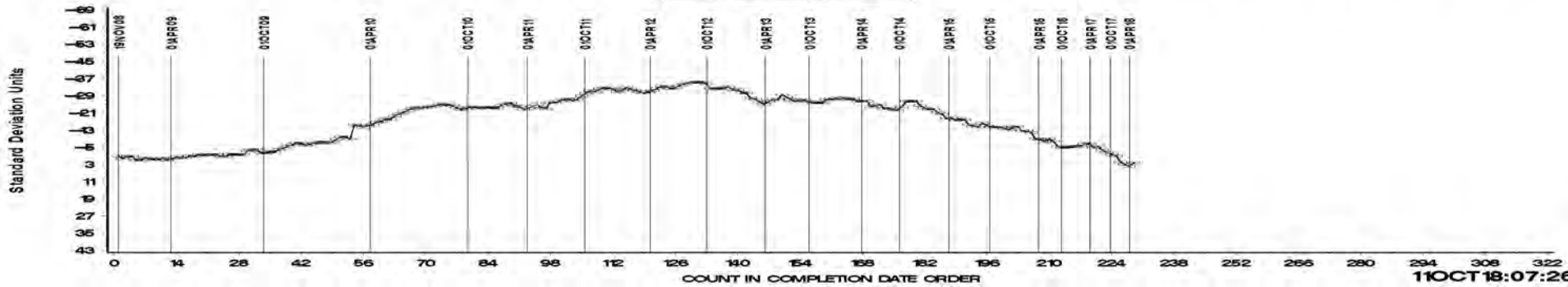
LTMS Severity Analysis



LTMS Precision Analysis

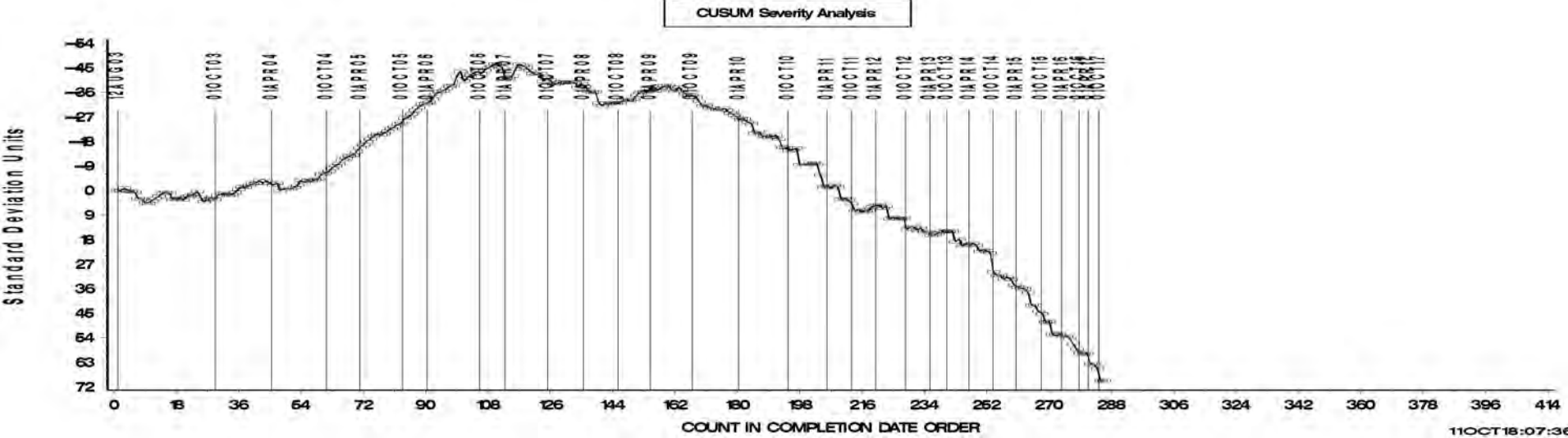
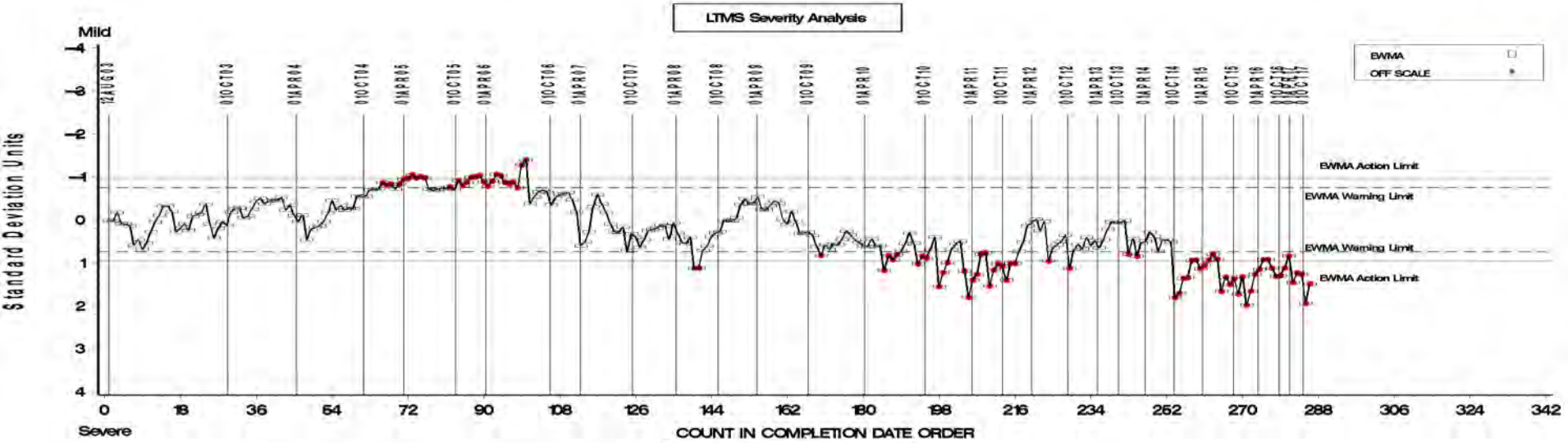


CUSUM Severity Analysis



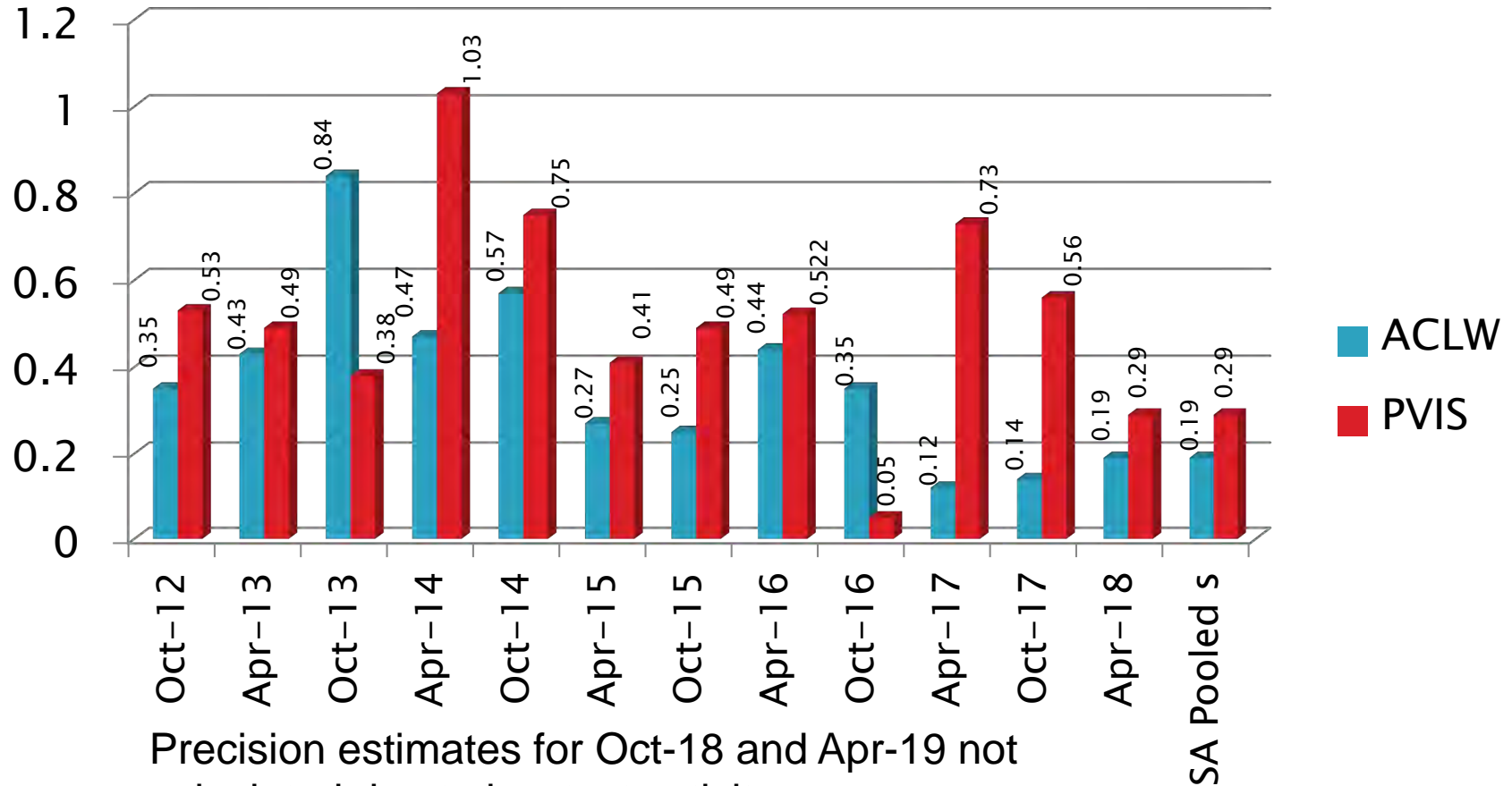
11OCT18:07:26

MRV VISCOSITY RESULT



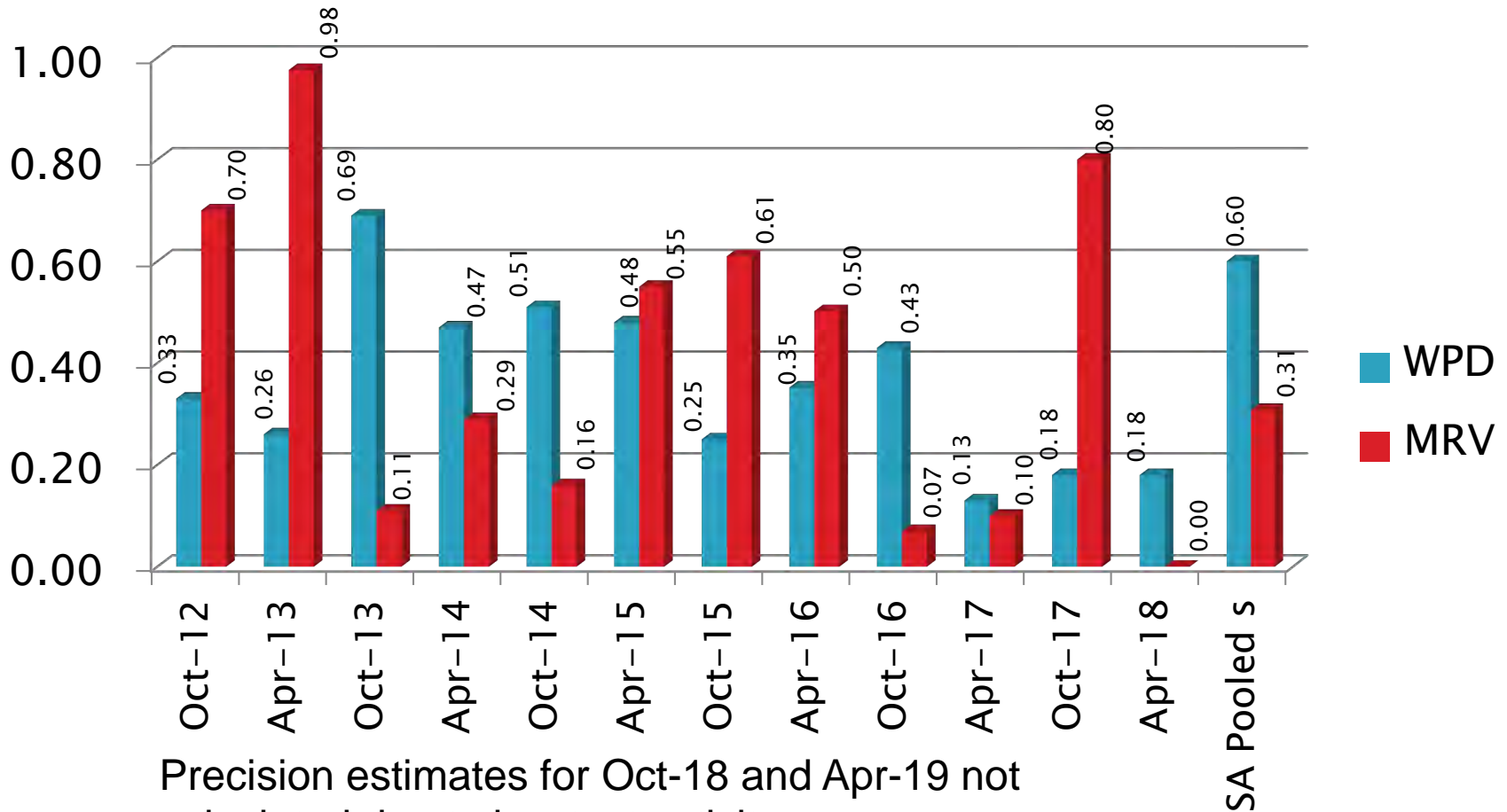
11OCT18:07:36

# IIIG Precision Estimates



Precision estimates for Oct-18 and Apr-19 not calculated due to low test activity

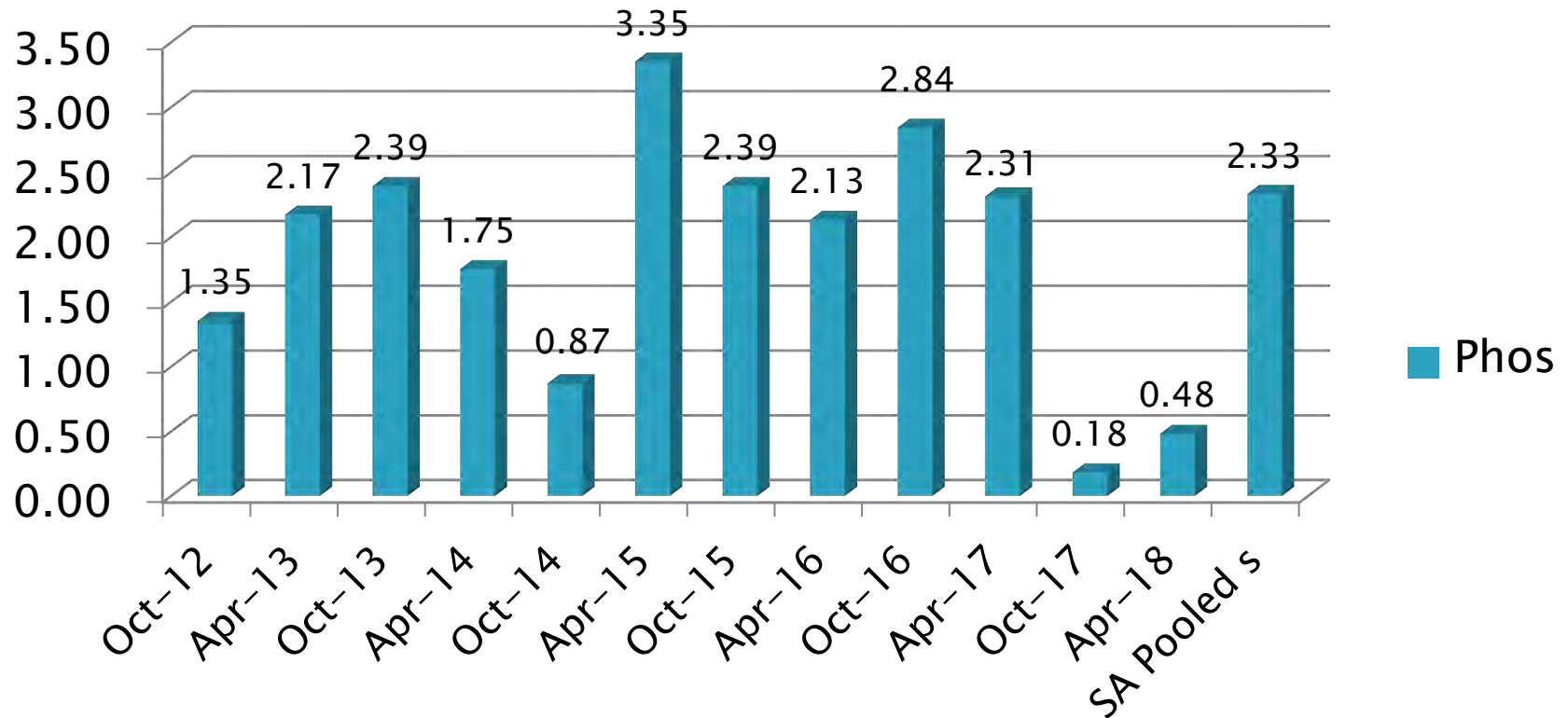
# IIIG Precision Estimates



Precision estimates for Oct-18 and Apr-19 not calculated due to low test activity

# IIIG Precision Estimates

## Phos



Precision estimates for Oct-18 and Apr-19 not calculated due to low test activity

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# Sequence IIIH/A/B

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# Sequence IIIH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	24
Statistically Unacceptable Calibration Test	OC	1
Aborted Industry Support Test ( 70 Hour IIIH)	XI	1
Industry Support Test, 70 hour IIIH Test	NI	1
<b>Total</b>		<b>27</b>

# Sequence IIIH – Failed Tests

Test Status	#
Level 3 Ei Alarm PVIS	1
<b>Totals</b>	<b>1</b>



# Sequence IIIH – Lost Tests\*

Test Status	Cause	#
Aborted	Unable to maintain oil pressure	1
<b>Totals</b>		<b>1</b>

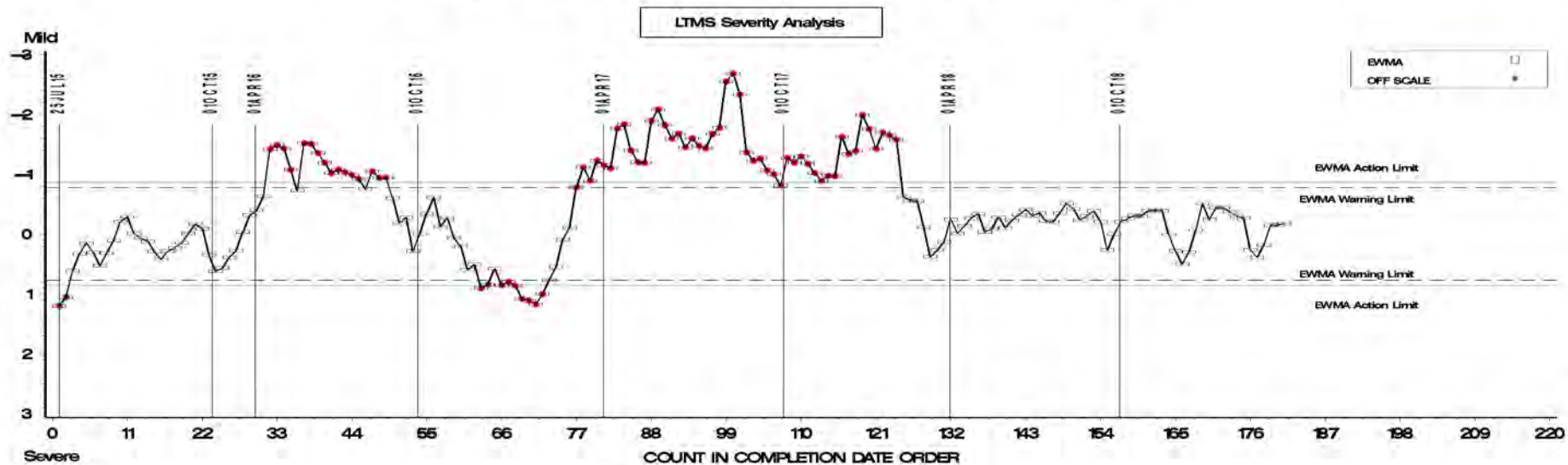
\*Invalid and aborted tests

# Sequence IIIH Test Severity

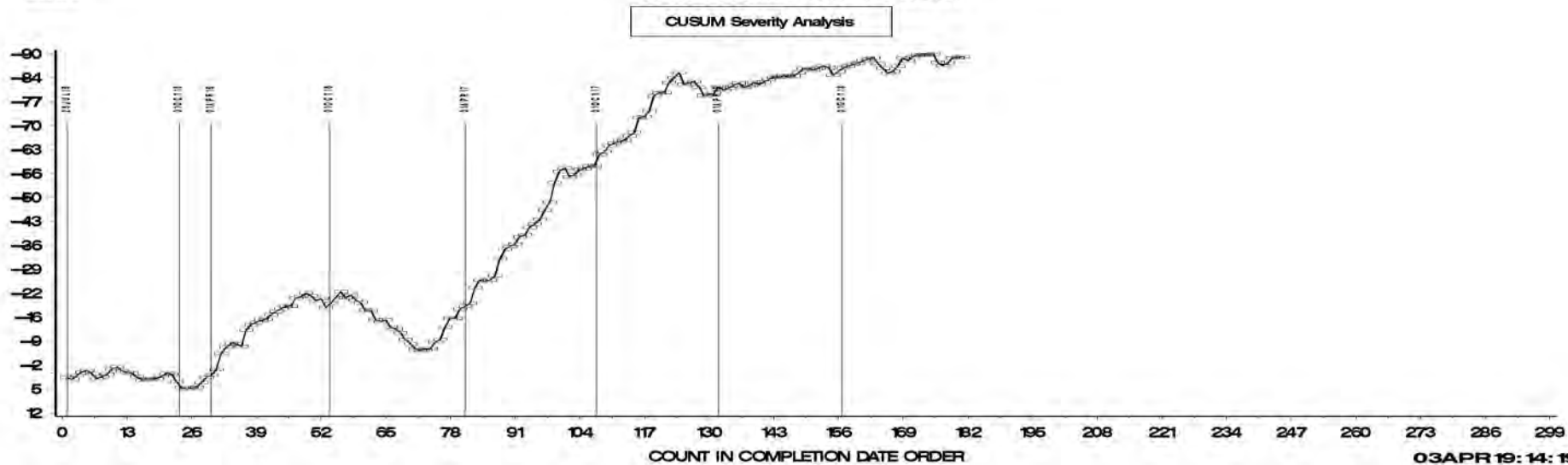
- All parameters are in control

VISCOSITY INCREASE FINAL ORIG UNIT RES

Standard Deviation Units

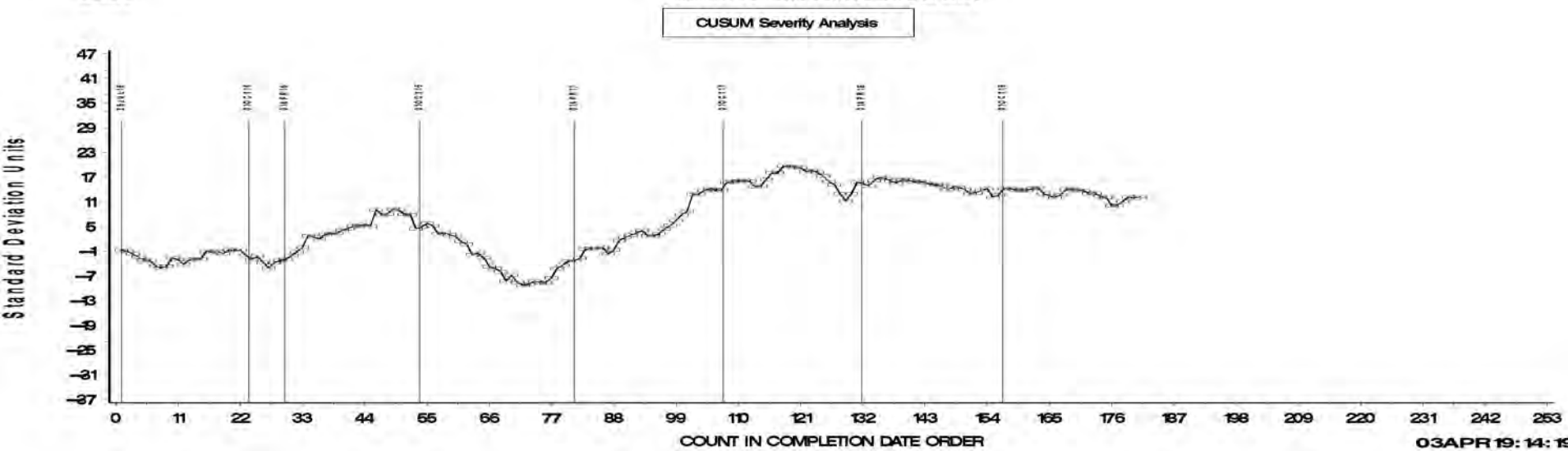
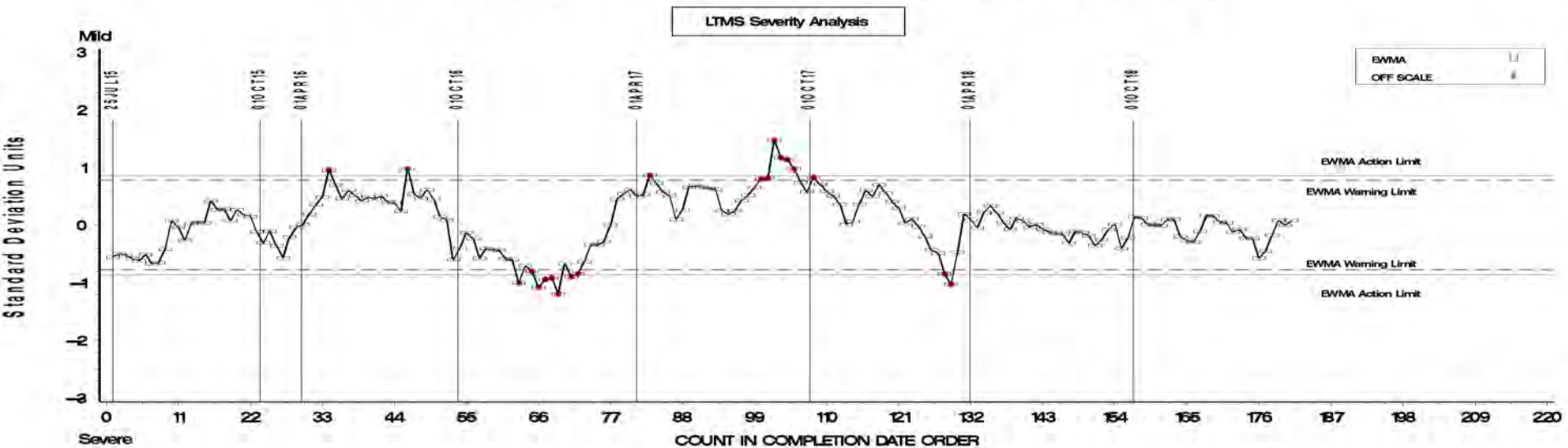


Standard Deviation Units



03APR19: 14:19

AVERAGE WEIGHTED PISTON DEPOSITS FNL ORIG U



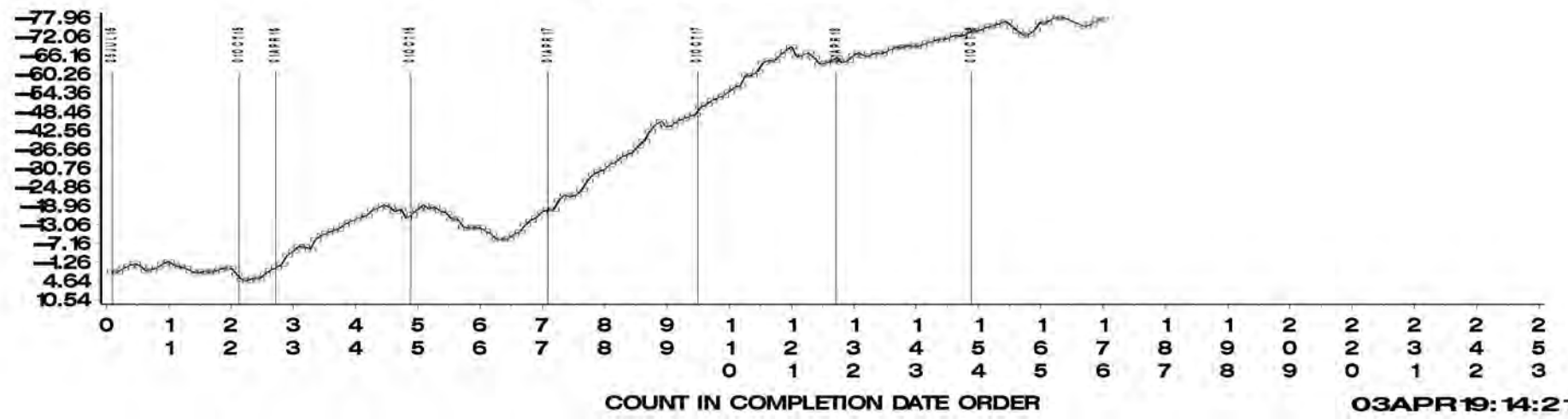
03APR 19: 14: 19

MRV FINAL ORIG UNIT RES [NM, FROZEN, SOLID]

LTMS Severity Analysis



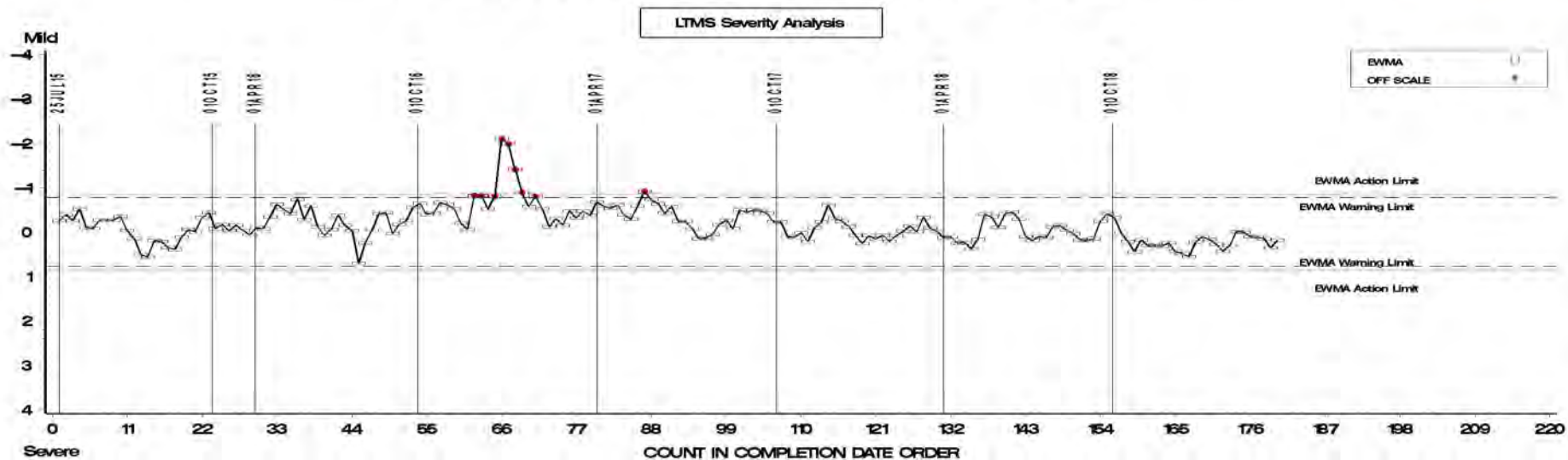
CUSUM Severity Analysis



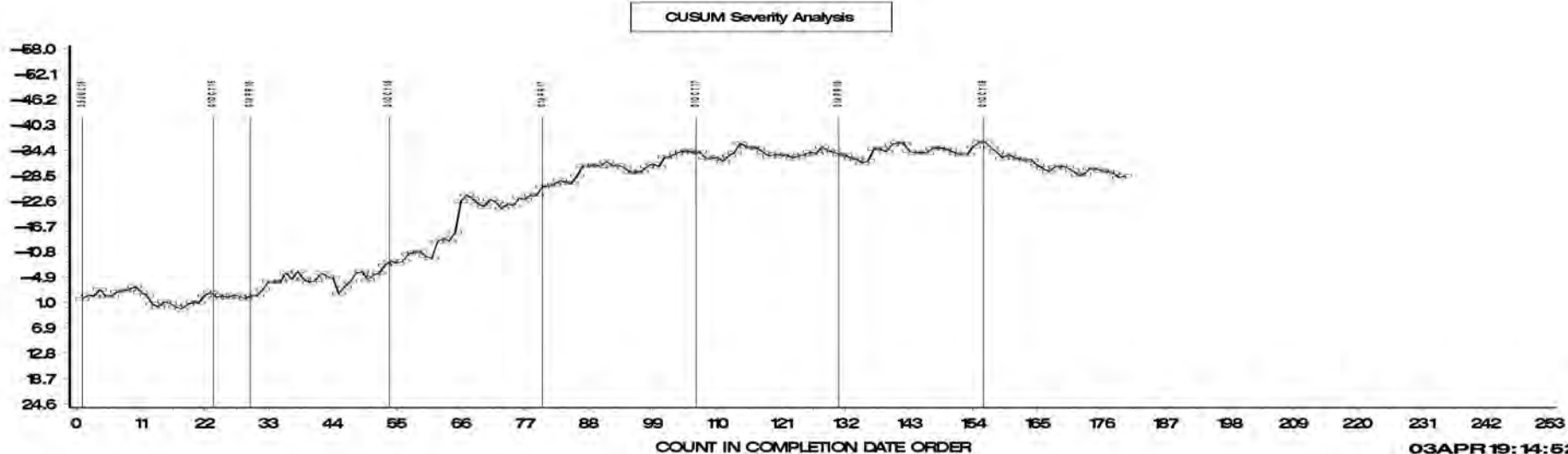
03APR19: 14:21

PHOSPHORUS RETENTION, FINAL RESULT

Standard Deviation Units

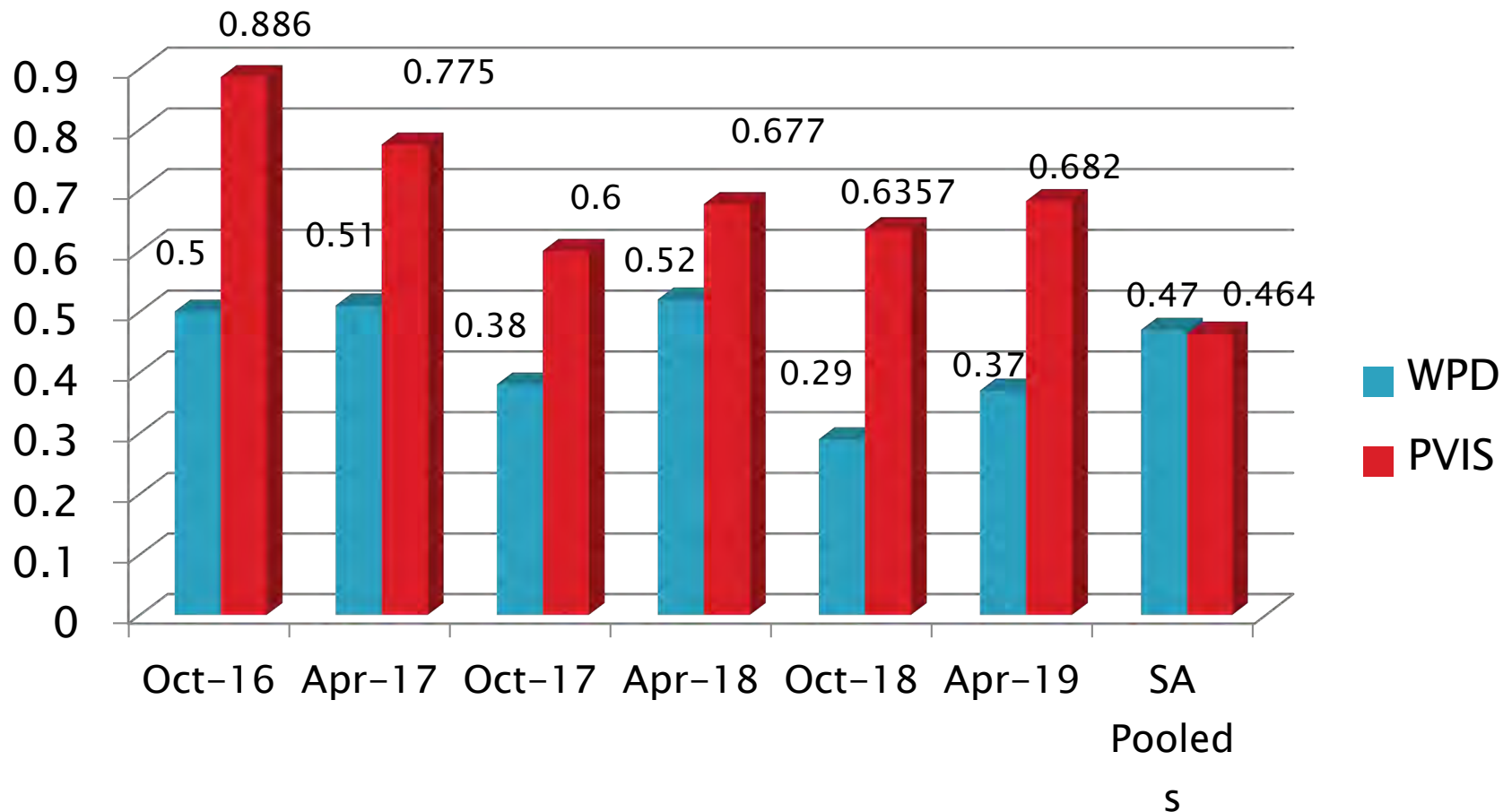


Standard Deviation Units

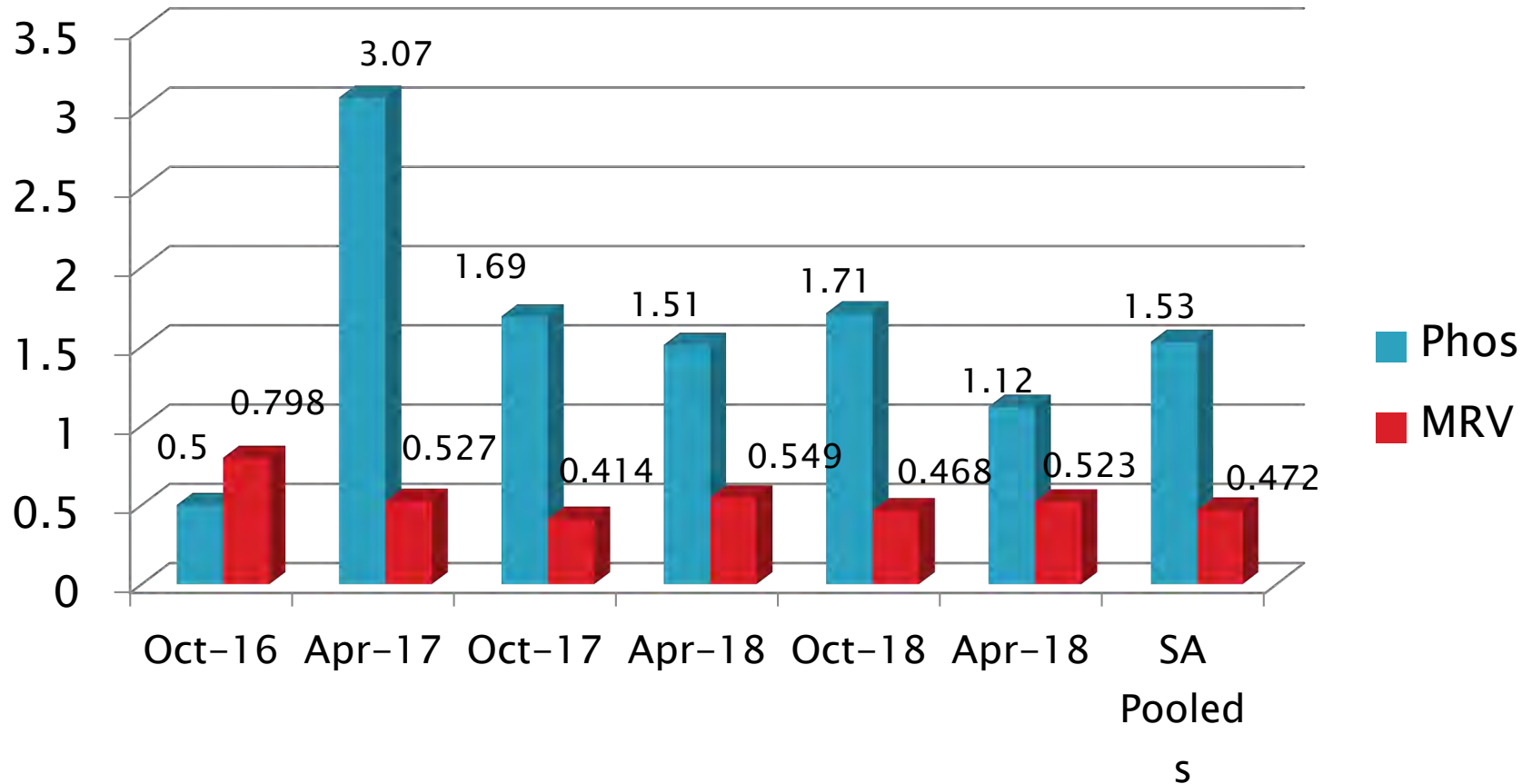


03APR19: 14:52

# IIH Precision Estimates



# IIIHA/B Precision Estimates



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# Sequence IVA

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# Sequence IVA Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	5
Statistically Unacceptable Calibration Test	OC	1
<b>Total</b>		<b>6</b>

# Sequence IVA – Failed Tests

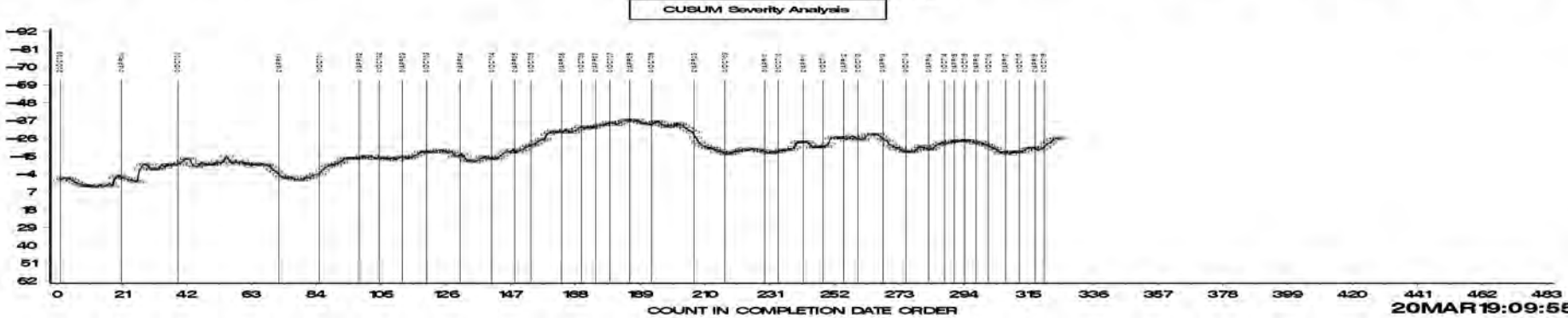
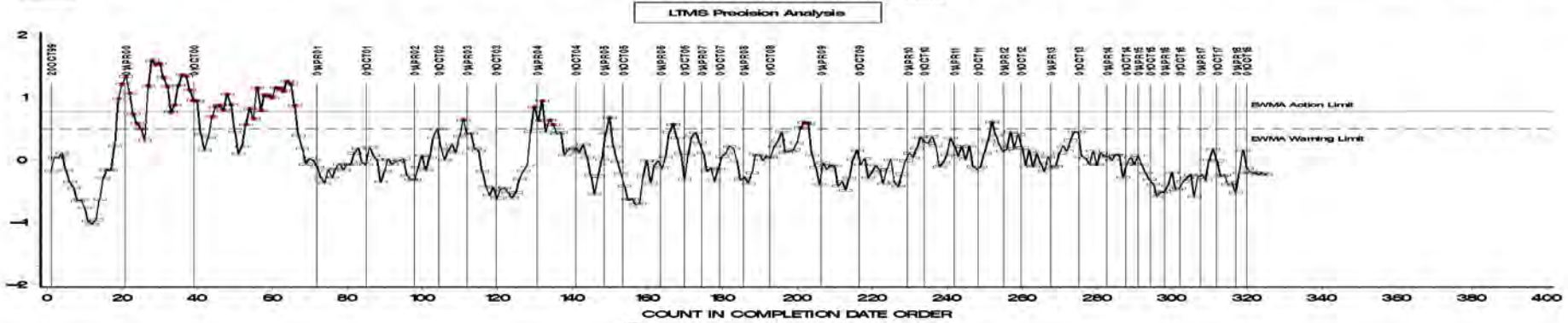
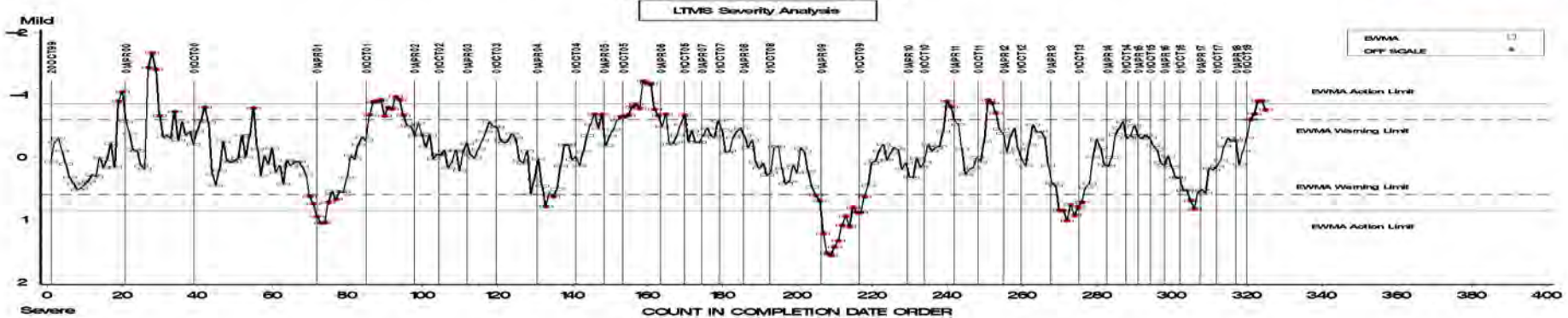
Test Status	#
Precision Shewhart Alarm	1
Totals	1

\*Invalid and aborted tests

# Sequence IVA Test Severity

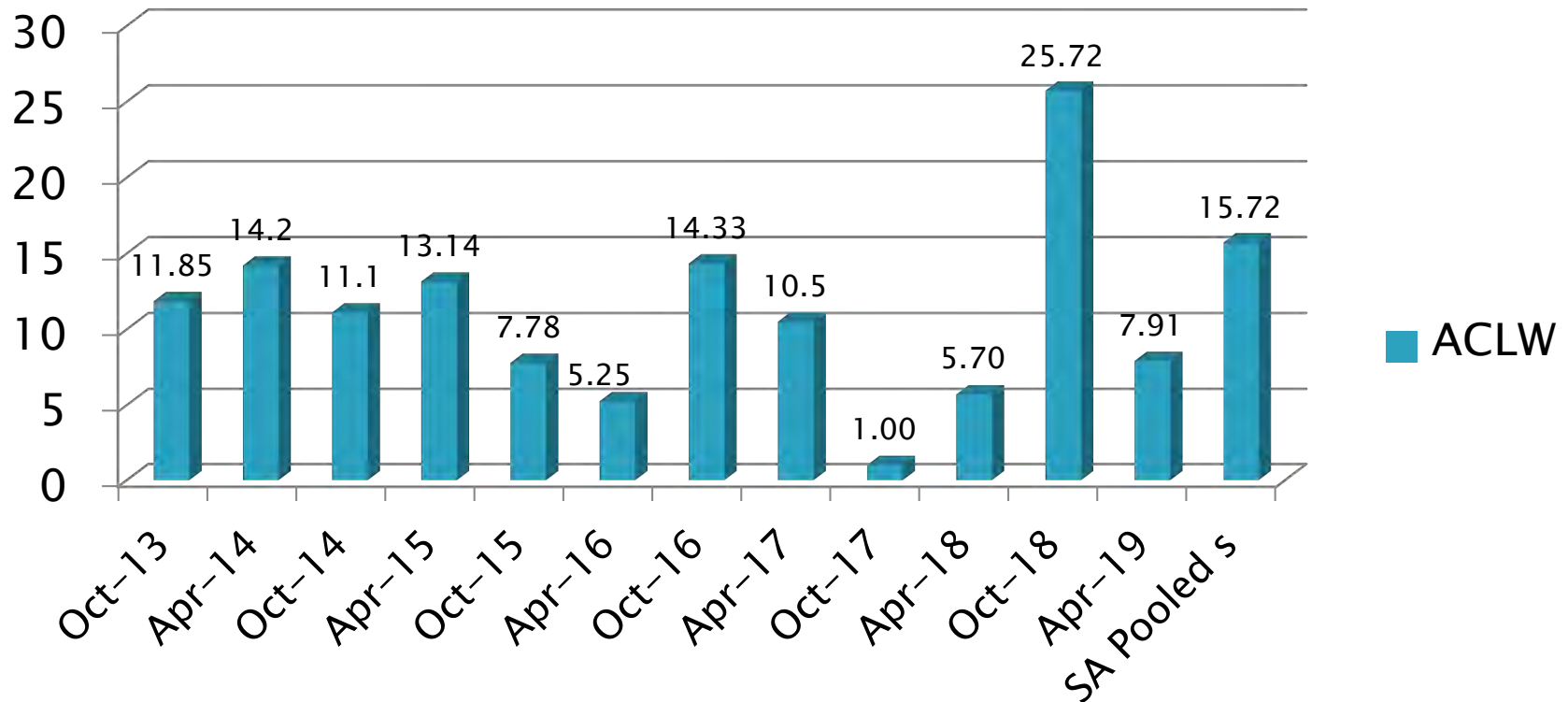
- ACW in severity warning alarm (mild direction)

## AVERAGE CAM WEAR



# Sequence IVA Precision Estimates

## ACW



Precision estimates for Oct -18 based on two test results

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# Sequence IVB

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# Sequence IVB Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	11
Statistically Unacceptable Calibration Test	OC	1
Industry Support Test (BOI-VGRA)	NI	17
Operationally Invalid Industry Support Test (lab judgement)	LI	1
<b>Total</b>		<b>30</b>



# Sequence IVB – Failed Tests

Test Status	#
Ei Level 3 Alarm	1
Totals	1

\*Invalid and aborted tests

# Sequence IVB – Lost Tests

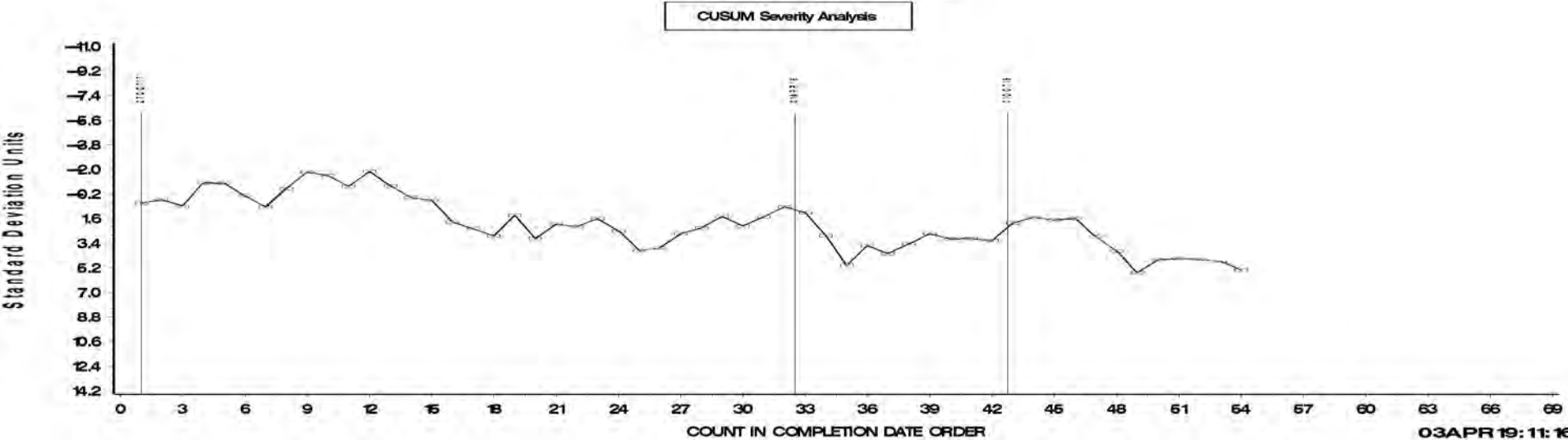
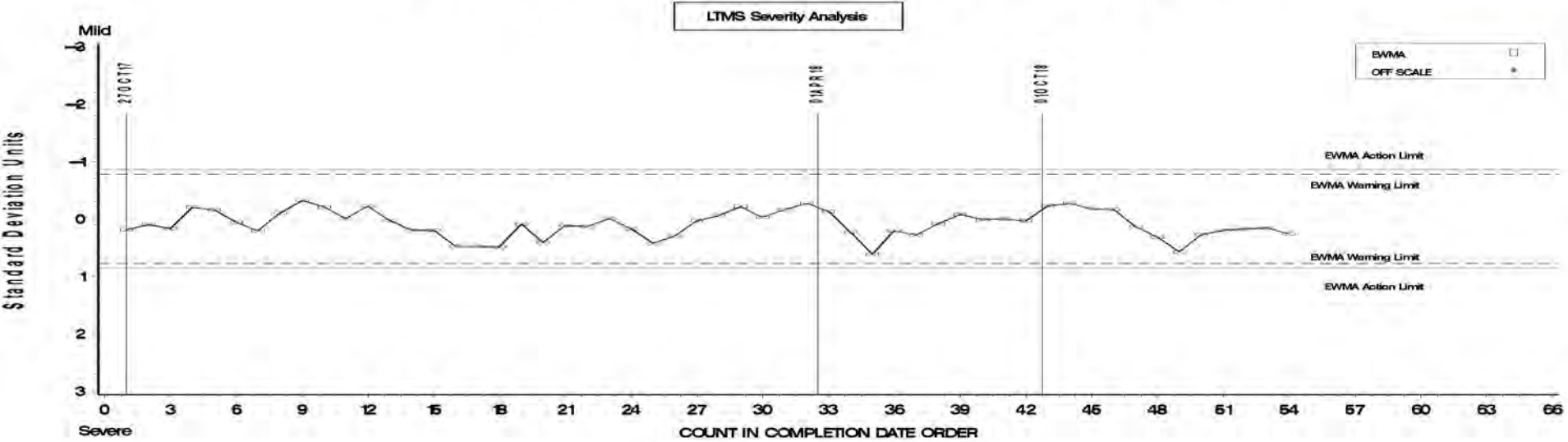
Test Status	Cause	#
Invalid	Lobe failure	1
Totals		1

\*Invalid and aborted tests

# Sequence IVB Test Severity

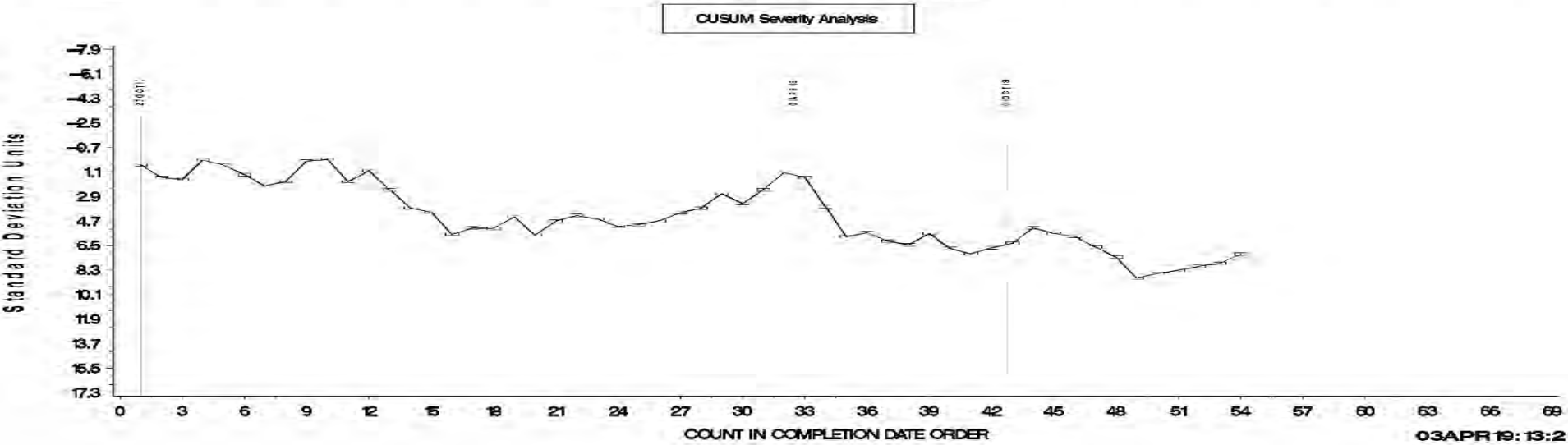
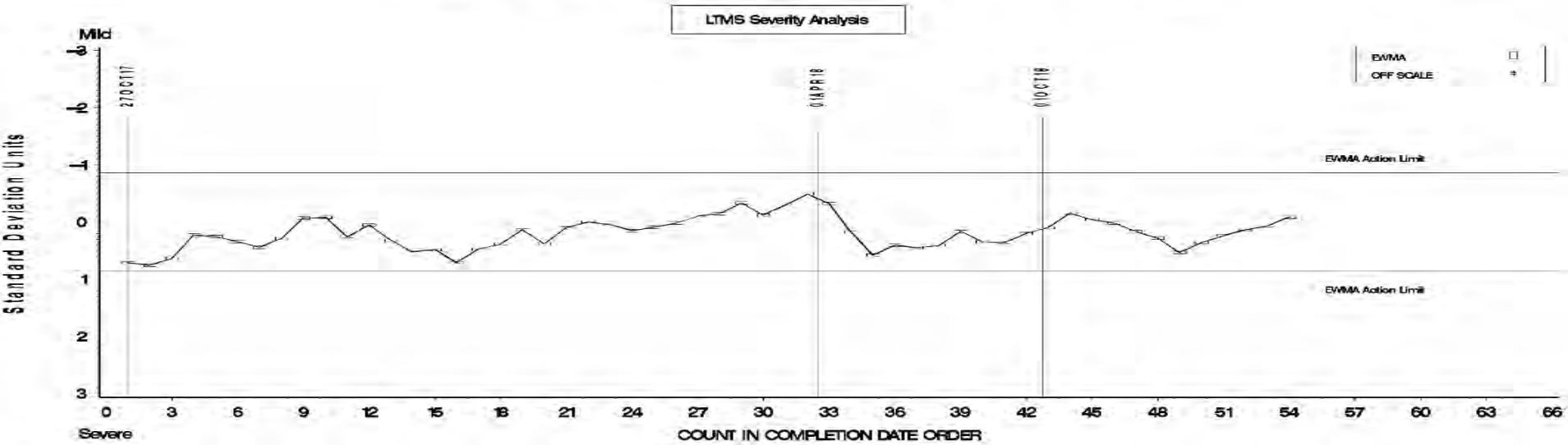
- AVLI and Fe in control.

AVERAGE VOLUME LOSS BY KEYENCE INTAKE Final



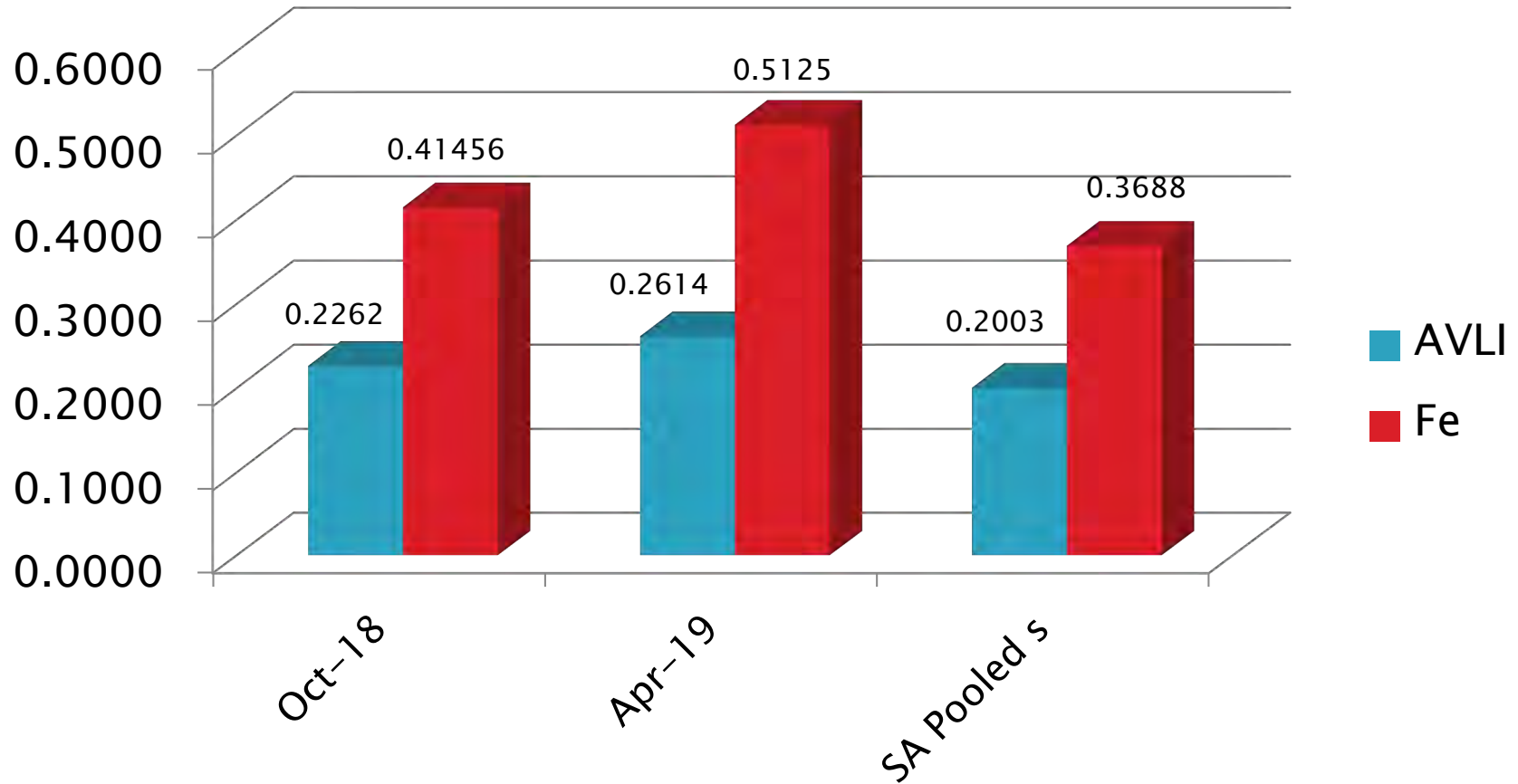
03 APR 19: 11: 16

END OF TEST FE FINAL Severity Adjusted RESULT



03 APR 19: 13:21

# Sequence IVB Precision Estimates



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# Sequence VG

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# Sequence VG Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
<b>Total</b>		<b>1</b>

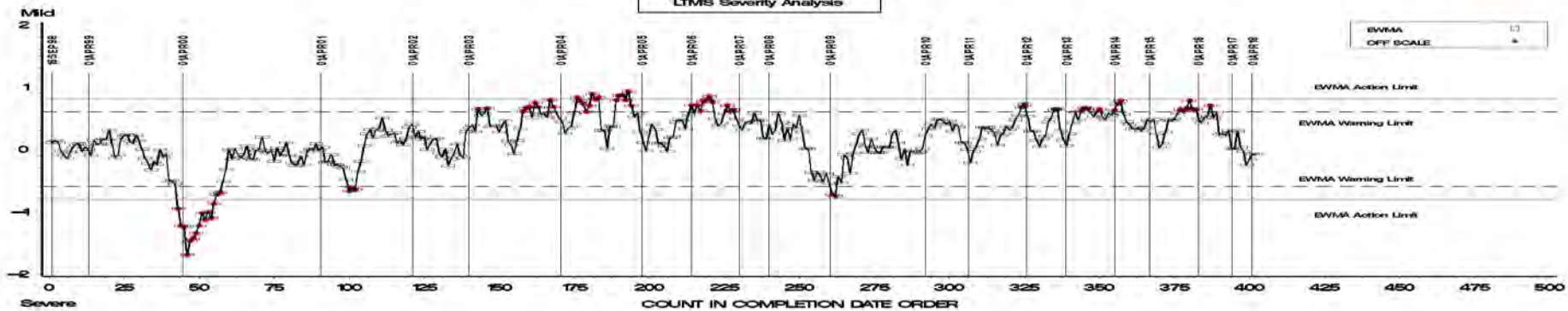


# Sequence VG Test Severity

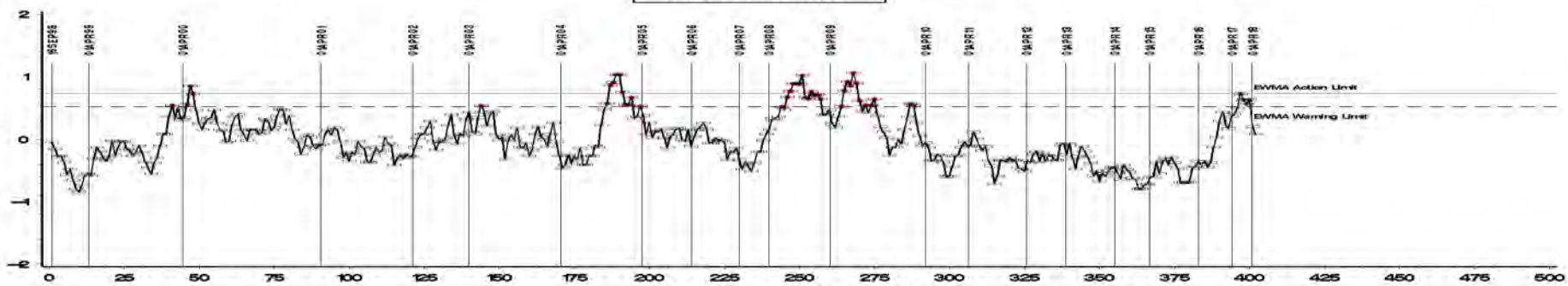
- All parameters in control
- Precision estimates not calculated for this and previous period as only 1 test was reported each period.
- Plots show every year rather than 6 months as only one test reported in each of the previous two periods

## AVERAGE ENGINE SLUDGE

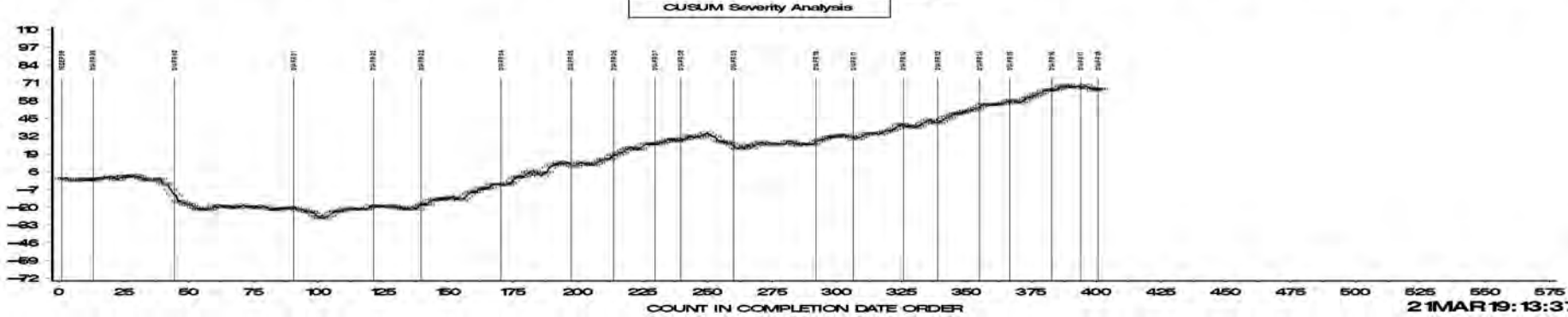
LTMS Severity Analysis



LTMS Precision Analysis



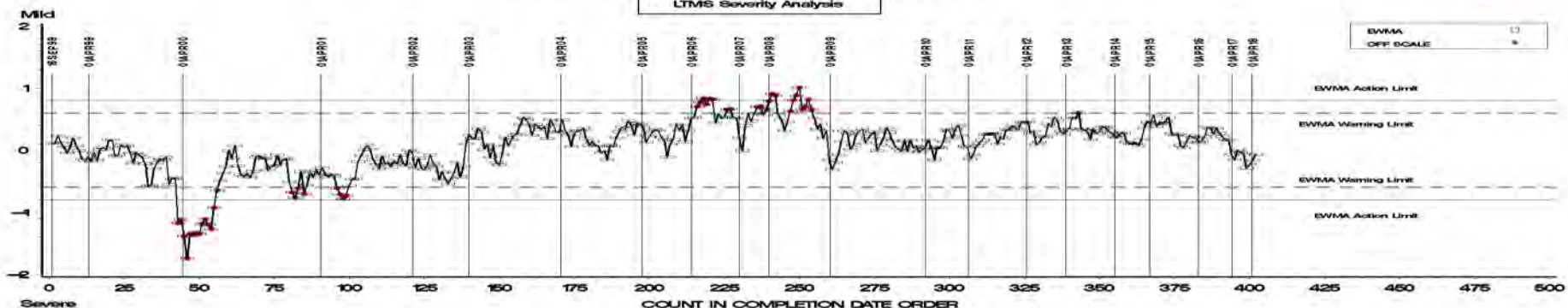
CUSUM Severity Analysis



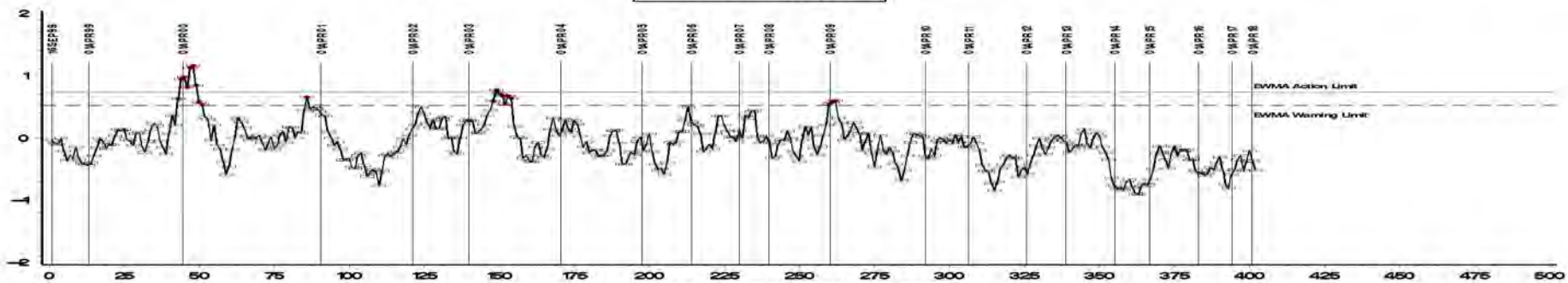
21 MAR 19: 13:37

## AVERAGE ROCKER COVER SLUDGE

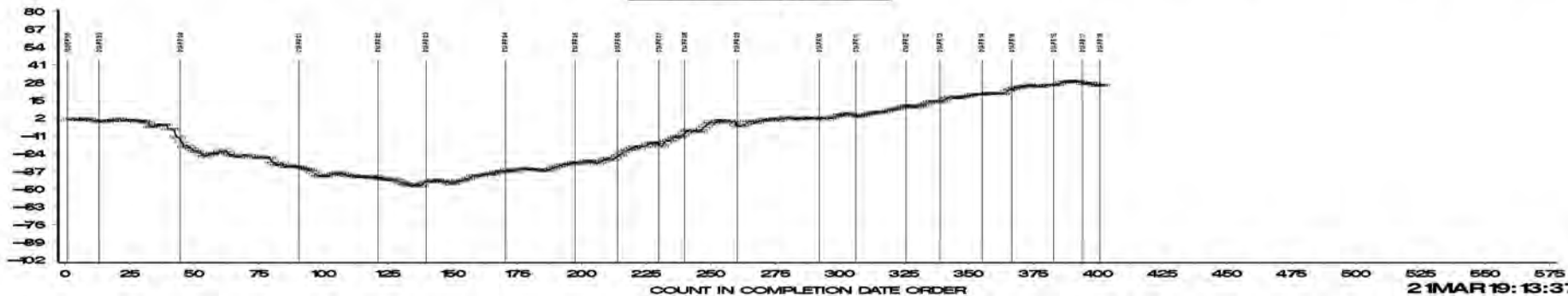
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

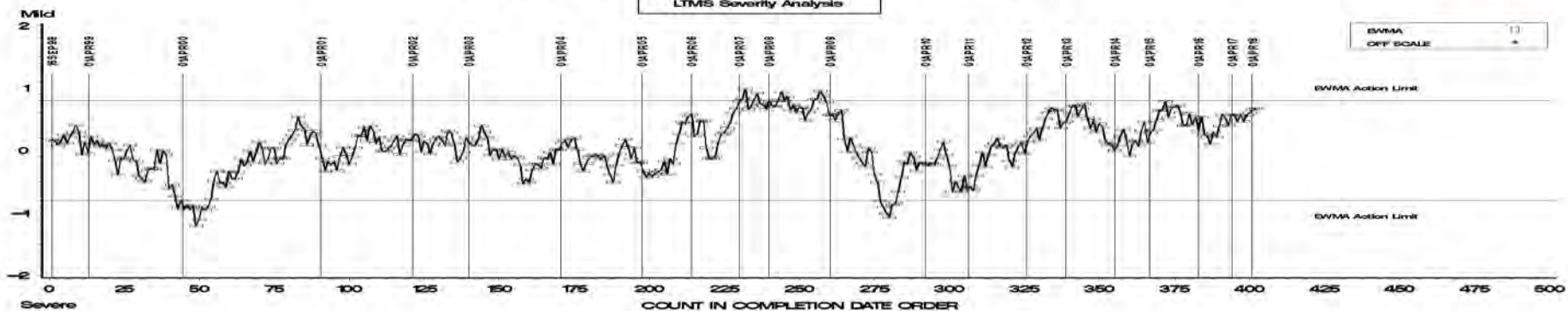


21 MAR 19: 13:37

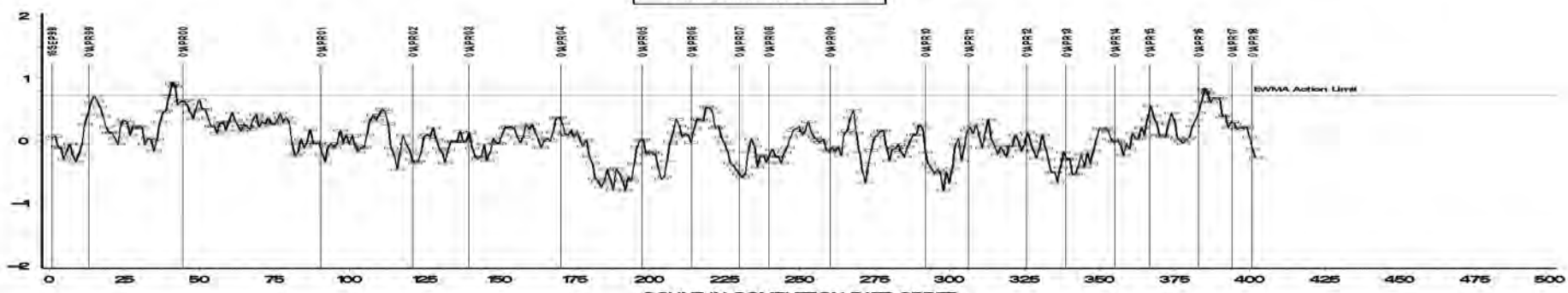
# SEQUENCE VG INDUSTRY OPERATIONAL VALID DATA

## AVG. ENG. VARN. 3 - PART APV + BAFFLES

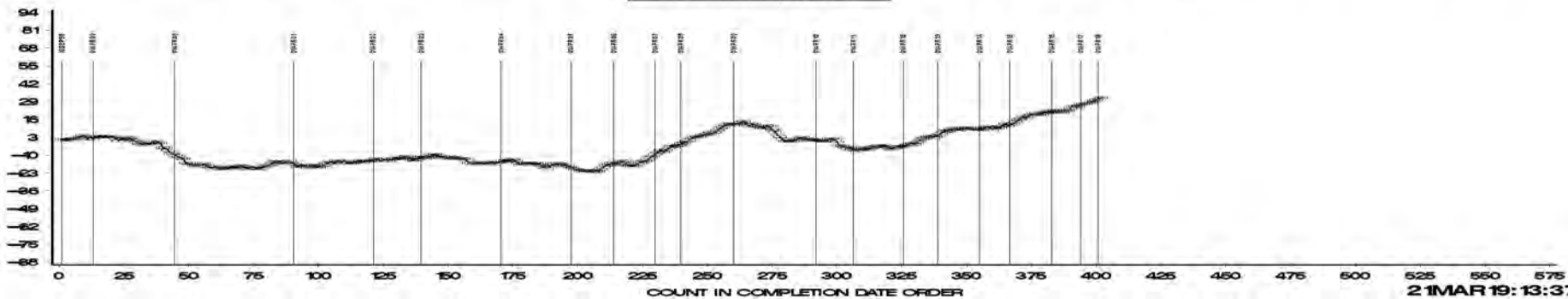
LTMS Severity Analysis



LTMS Precision Analysis



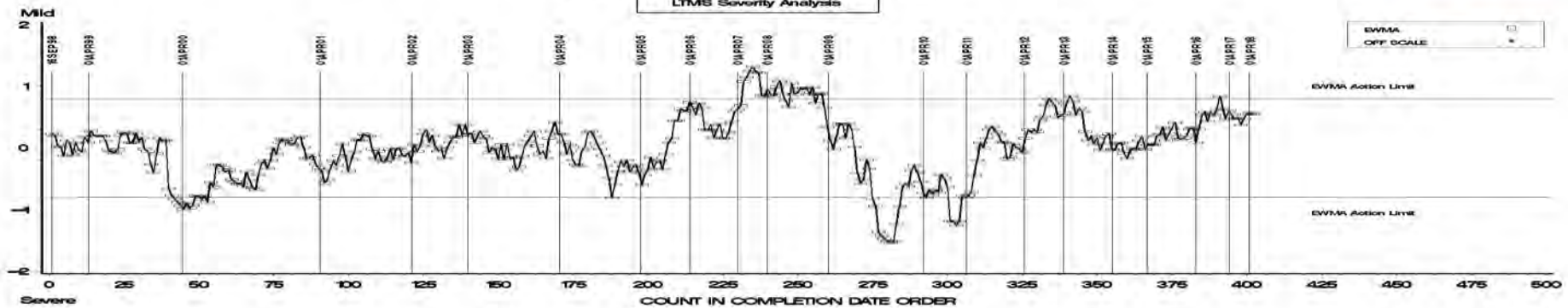
CUSUM Severity Analysis



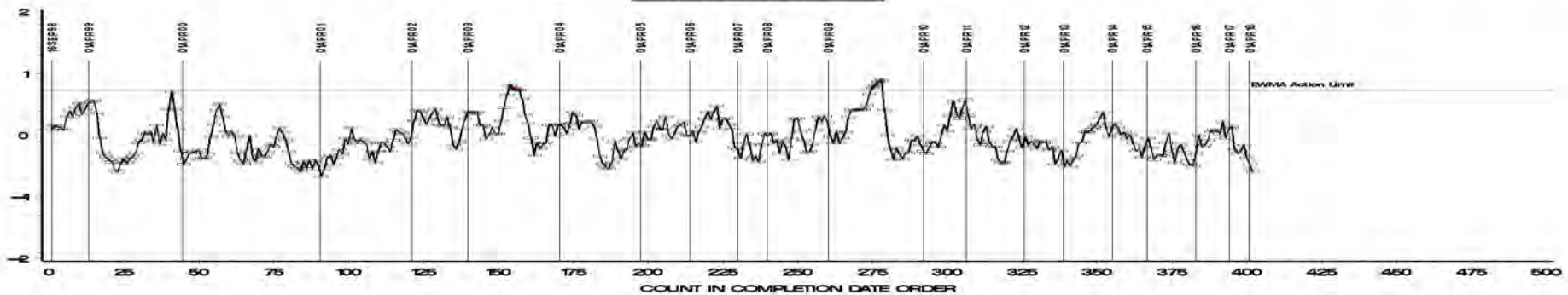
21 MAR 19: 13:37

## AVG PISTON SKIRT RATING

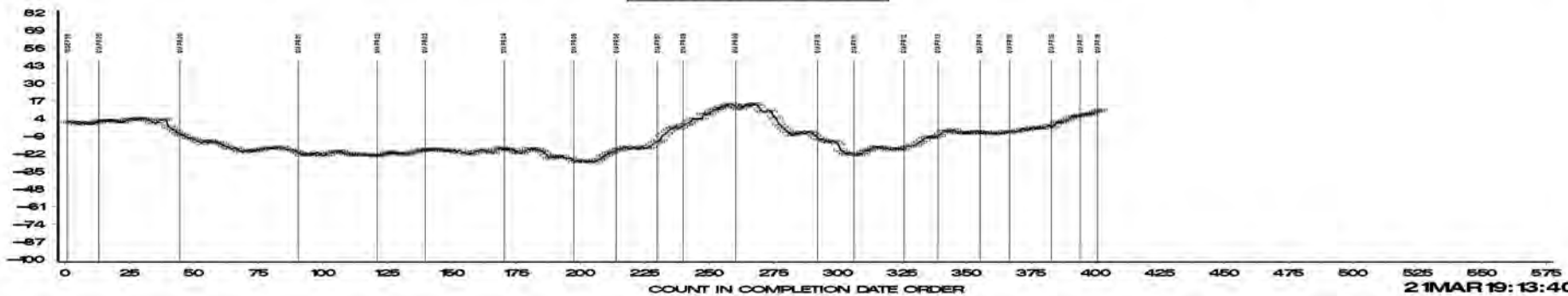
LTMS Severity Analysis



LTMS Precision Analysis

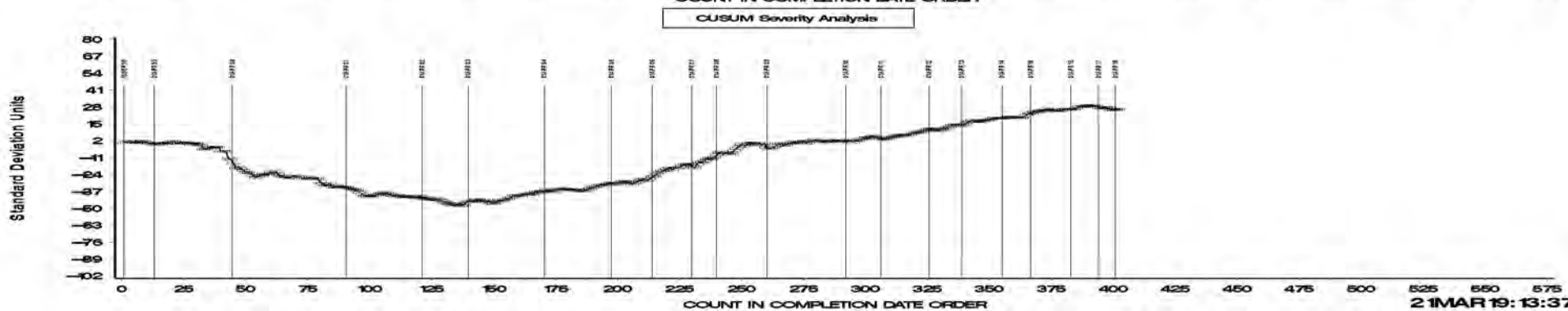
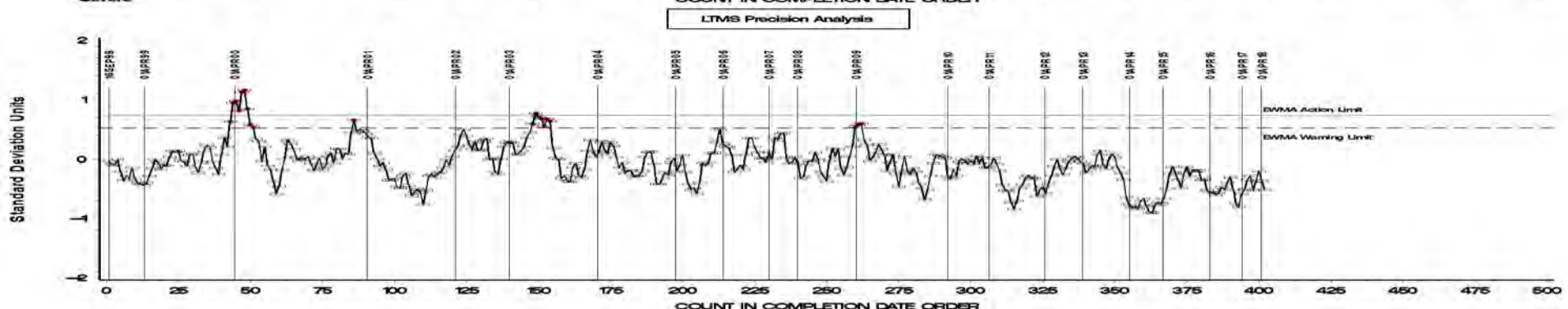
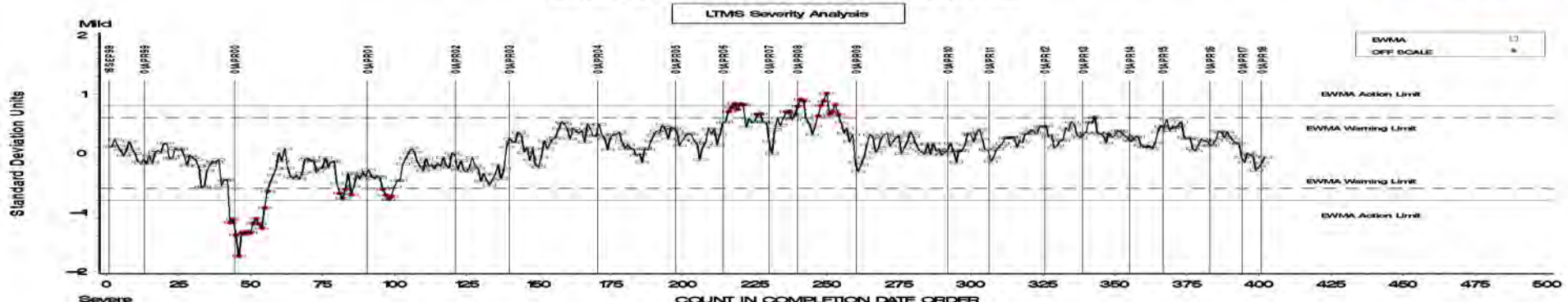


CUSUM Severity Analysis



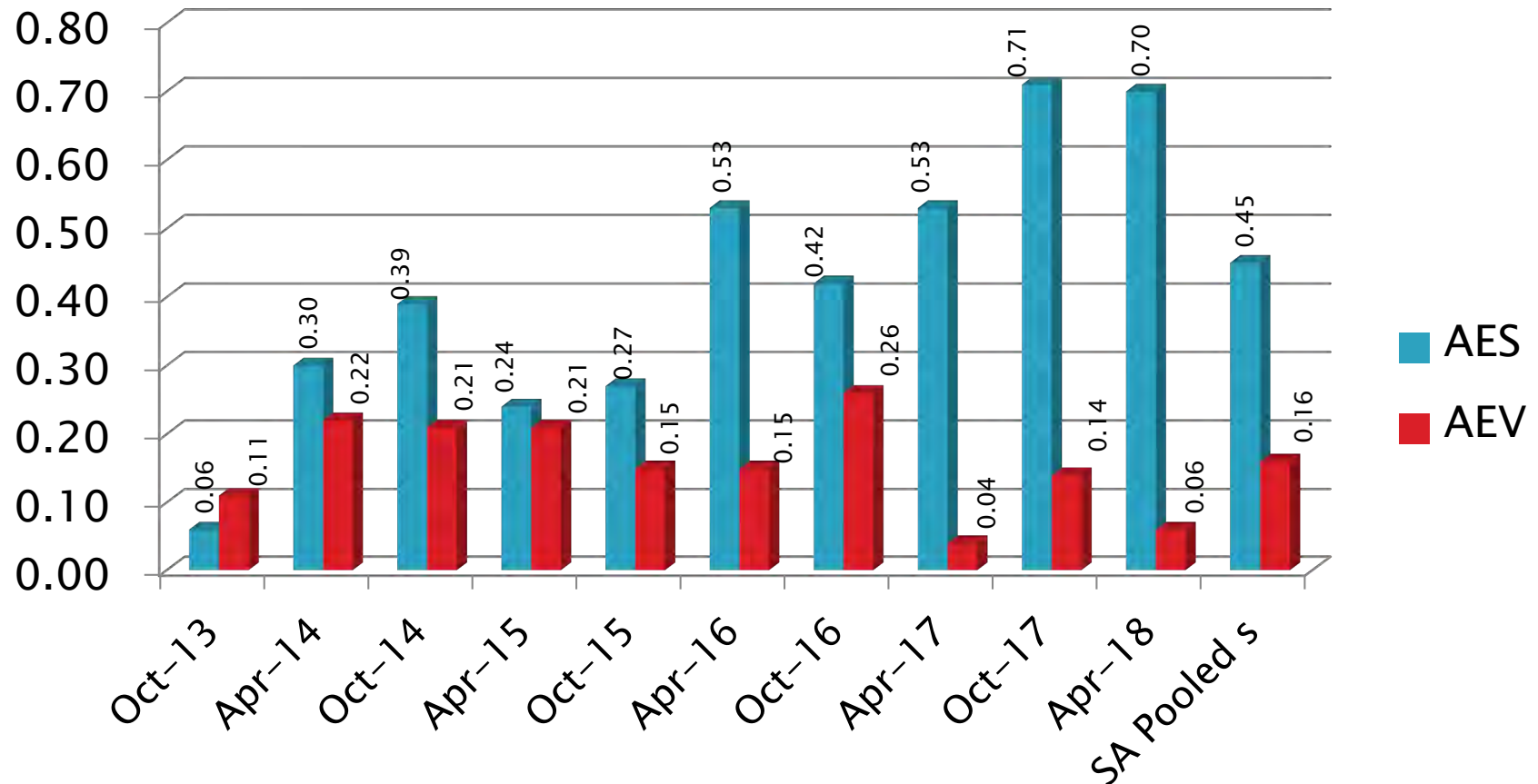
21 MAR 19: 13:40

## AVERAGE ROCKER COVER SLUDGE



21 MAR 19: 13:37

# Sequence VG Precision Estimates



Precision estimates for Oct -18 and Apr-19 not calculated  
as only one test reported these periods

Test Monitoring Center

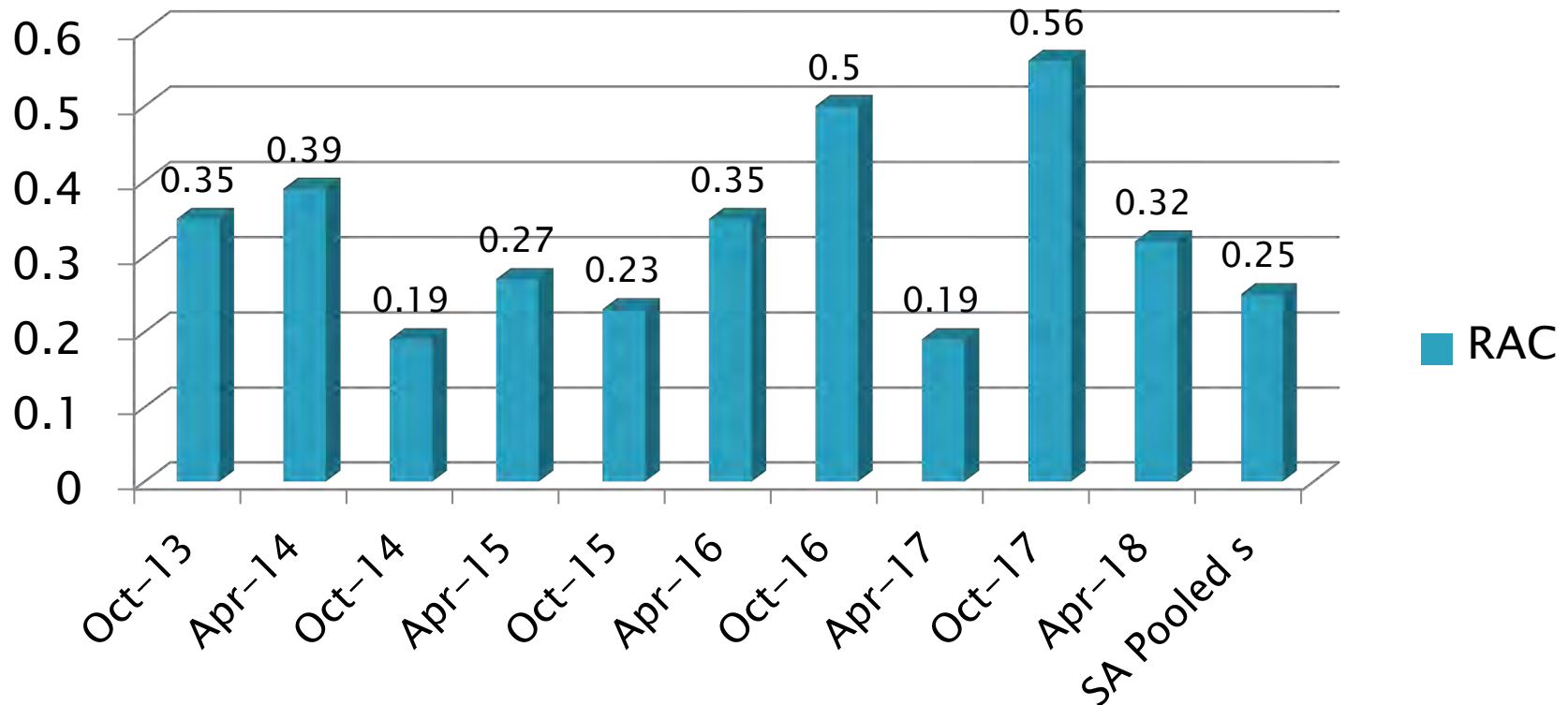
<http://astmtmc.cmu.edu>



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# Sequence VG Precision Estimates

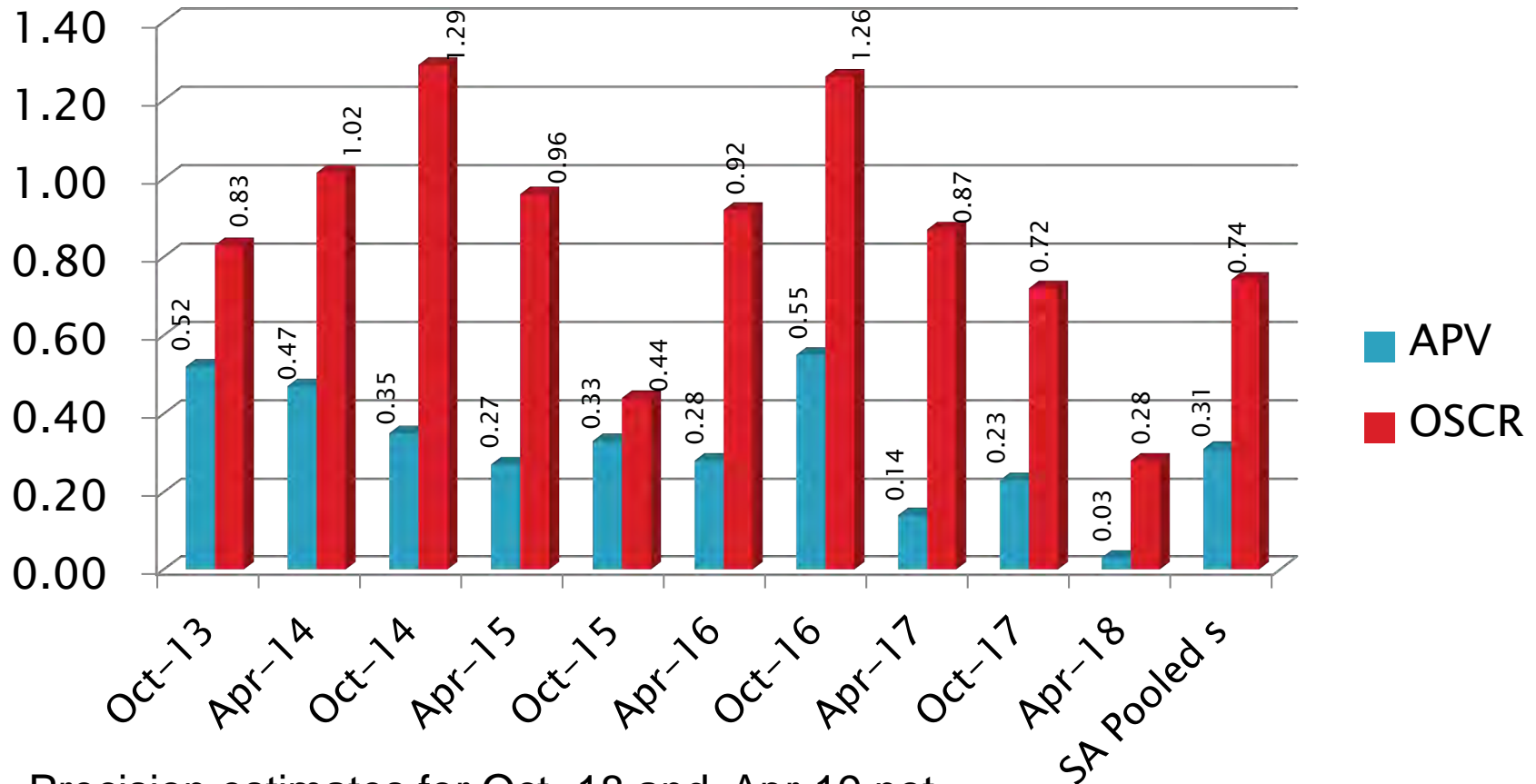
## RAC



Precision estimates for Oct -18 and Apr-19 not calculated as only one test reported these periods



# Sequence VG Precision Estimates



Precision estimates for Oct -18 and Apr-19 not calculated as only one test reported these periods

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# Sequence VH

»» April 2019

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# Sequence VH Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	12
Statistically Unacceptable Calibration	OC	1
BOI-VGRA Matrix Test	NI	2
Operationally Invalid, Lab Determination	LC	2
<b>Total</b>		<b>17</b>

# Sequence VH – Failing Tests

Test Status	#
Level 3 Ei Alarm AES	1
<b>Totals</b>	<b>1</b>

# Sequence VH – Lost Tests\*

Test Status	Cause	#
Invalid	Stage transitions not in spec	1
Invalid	Cam Position Sensor Failure	1
<b>Totals</b>		<b>2</b>

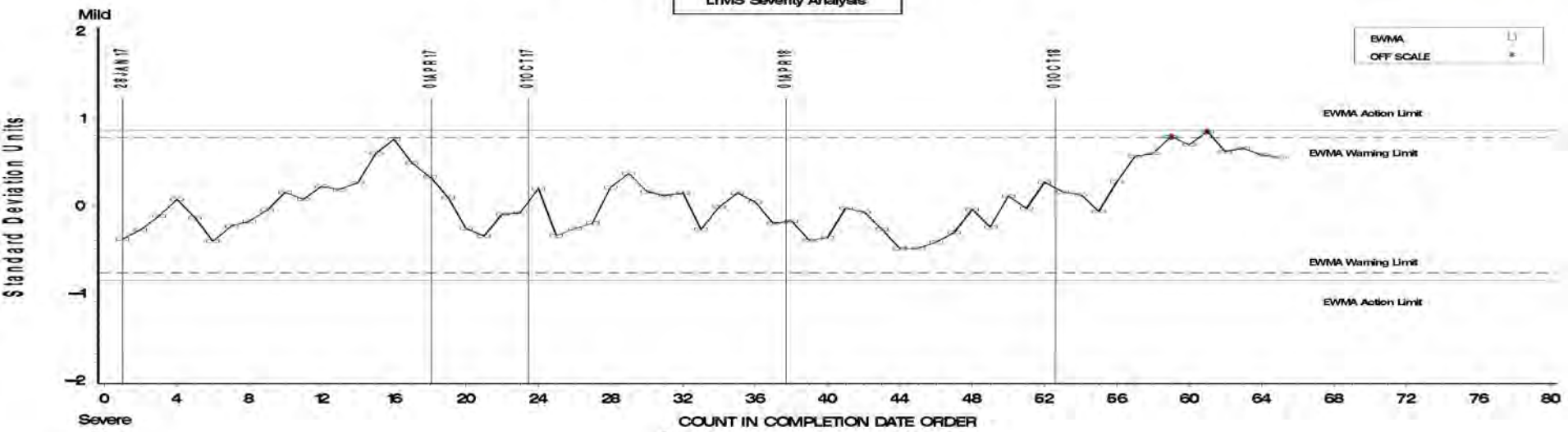
\*Invalid and aborted tests

# Sequence VH Test Severity

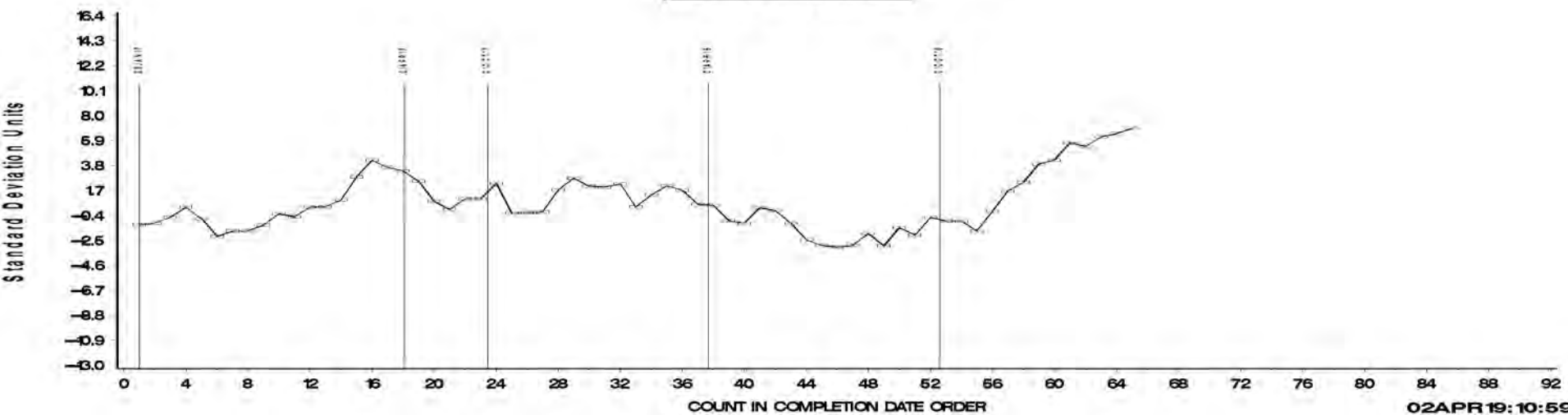
- All parameters in control

**AVERAGE ENGINE SLUDGE**

LTMS Severity Analysis



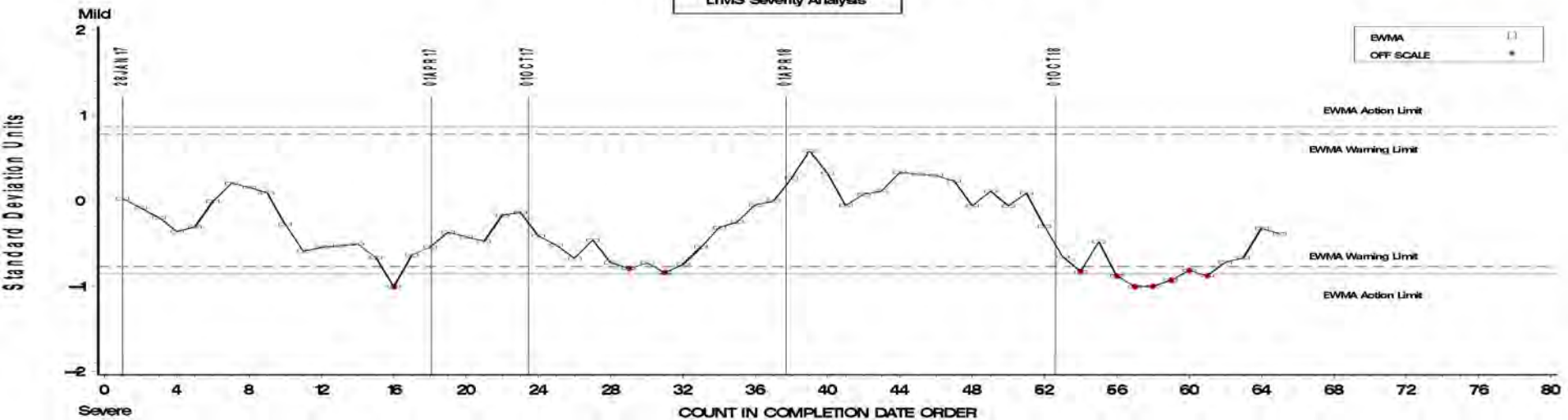
CUSUM Severity Analysis



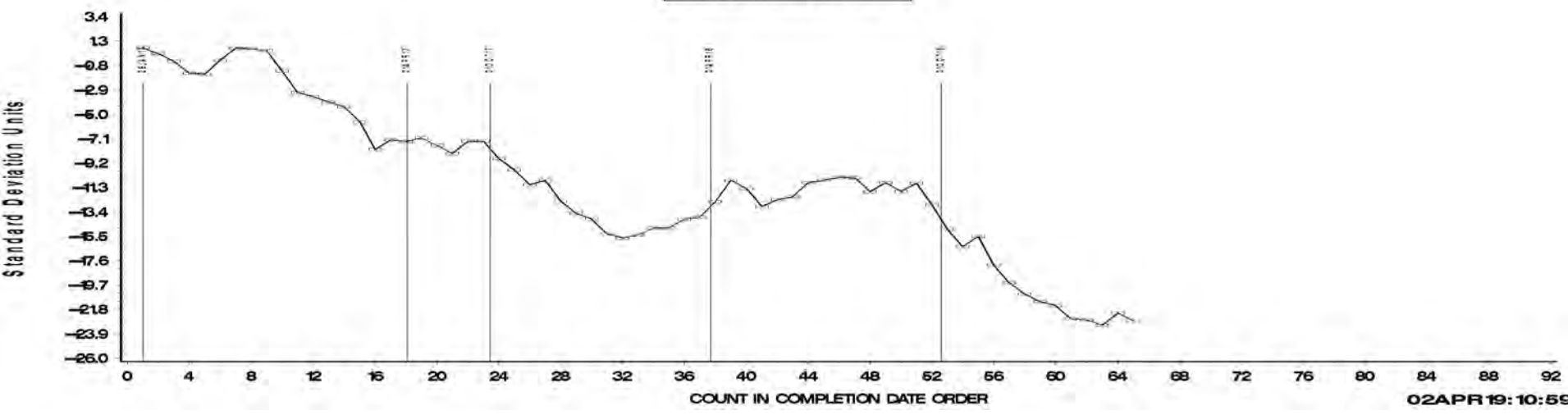
02 APR 19: 10:59

AVERAGE ROCKER COVER SLUDGE

LTMS Severity Analysis



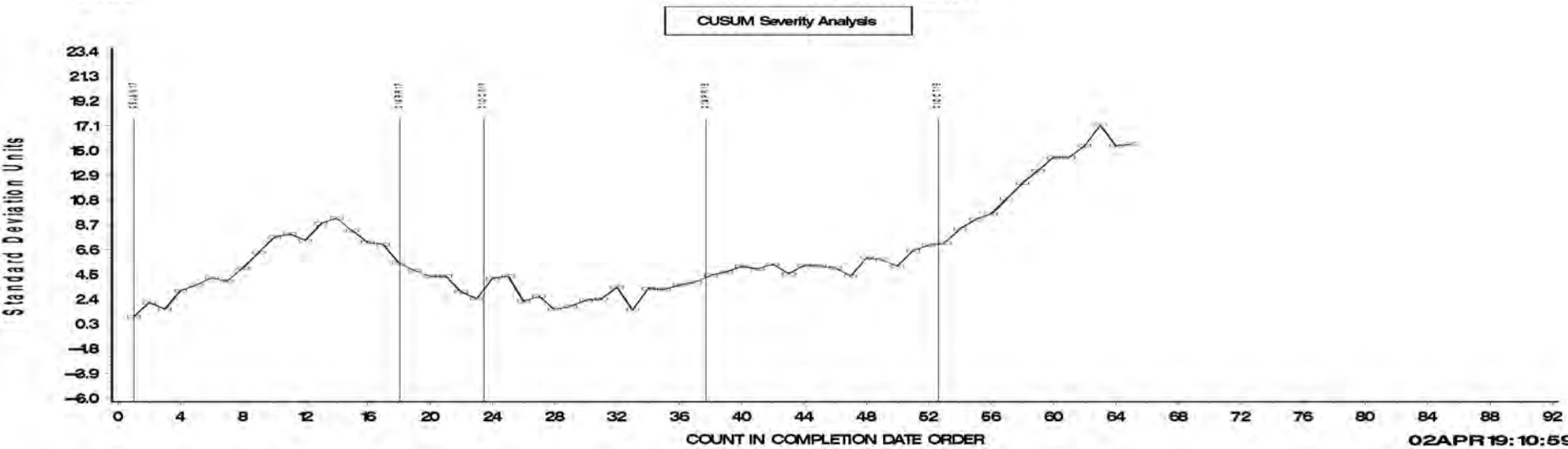
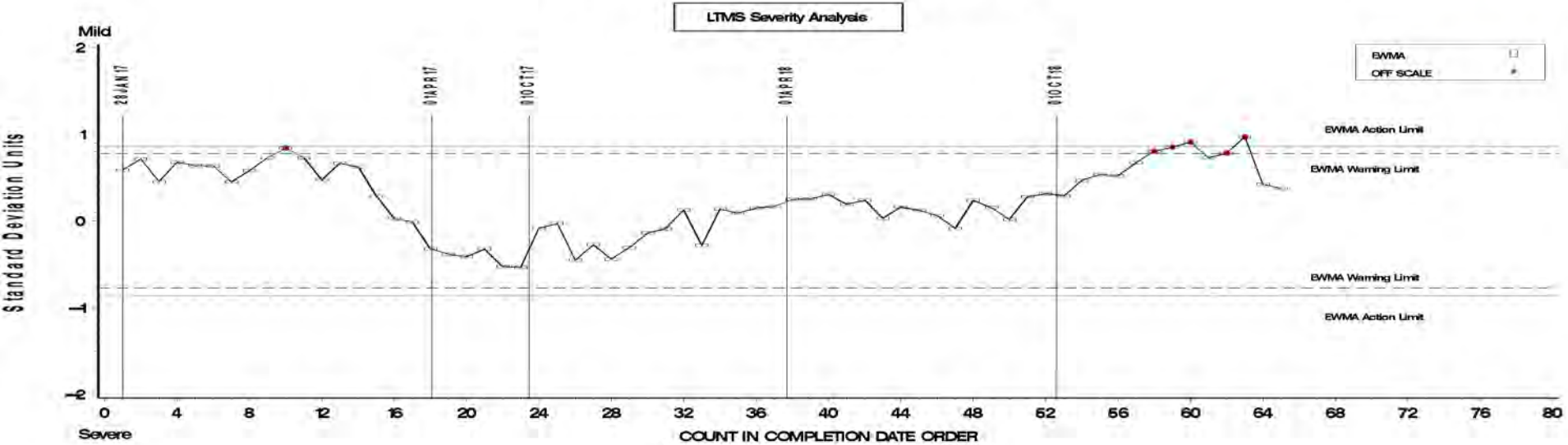
CUSUM Severity Analysis



02 APR 19: 10:59



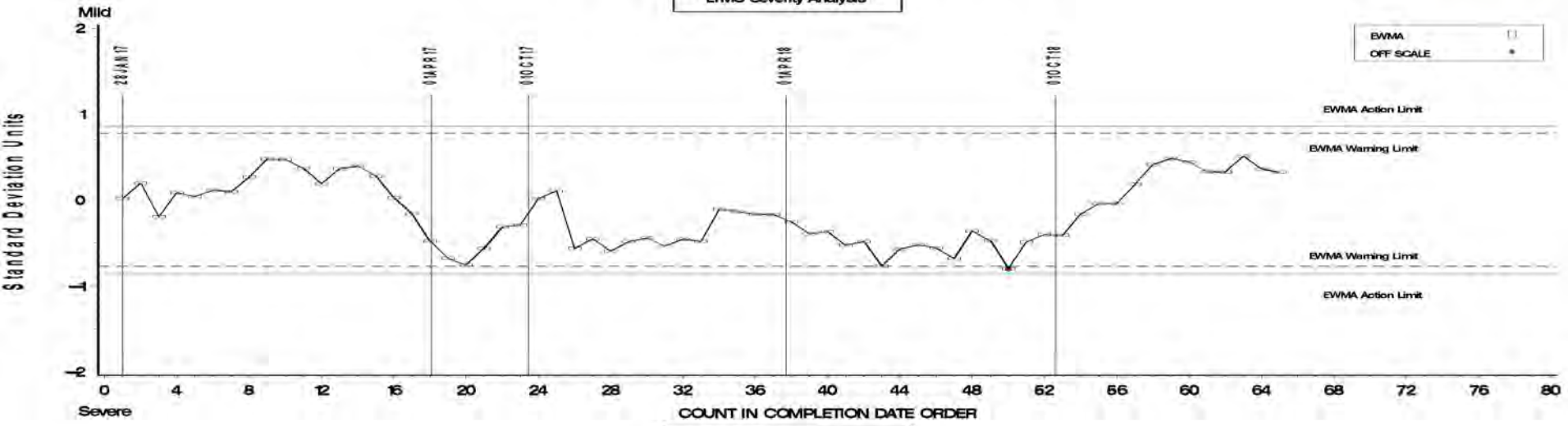
**AVG. ENG. VARN. 50% RATING**



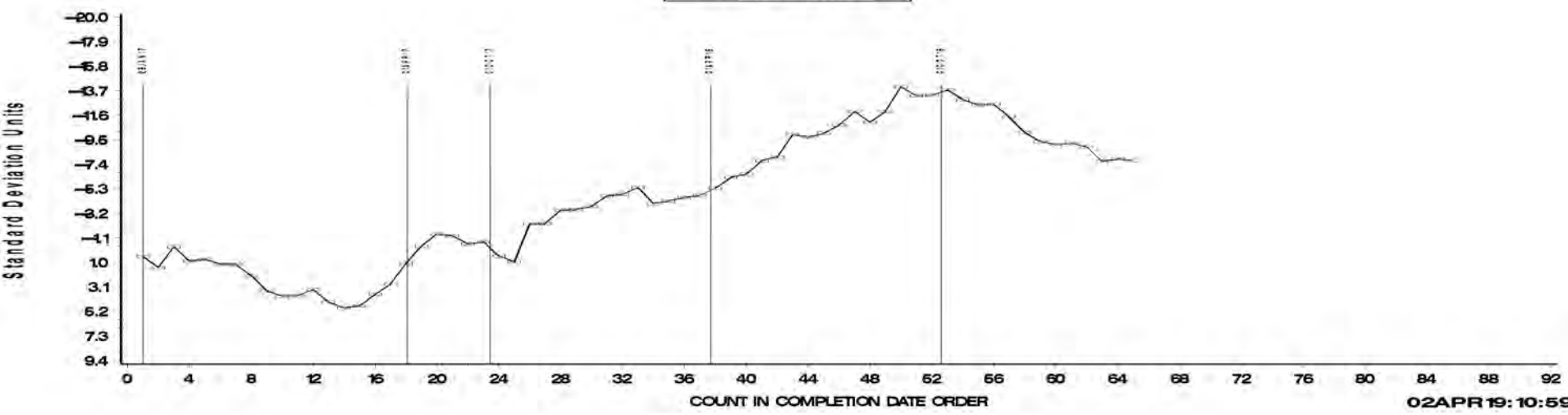
02 APR 19: 10:59

AVG PISTON SKIRT 50% RATING

LTMS Severity Analysis

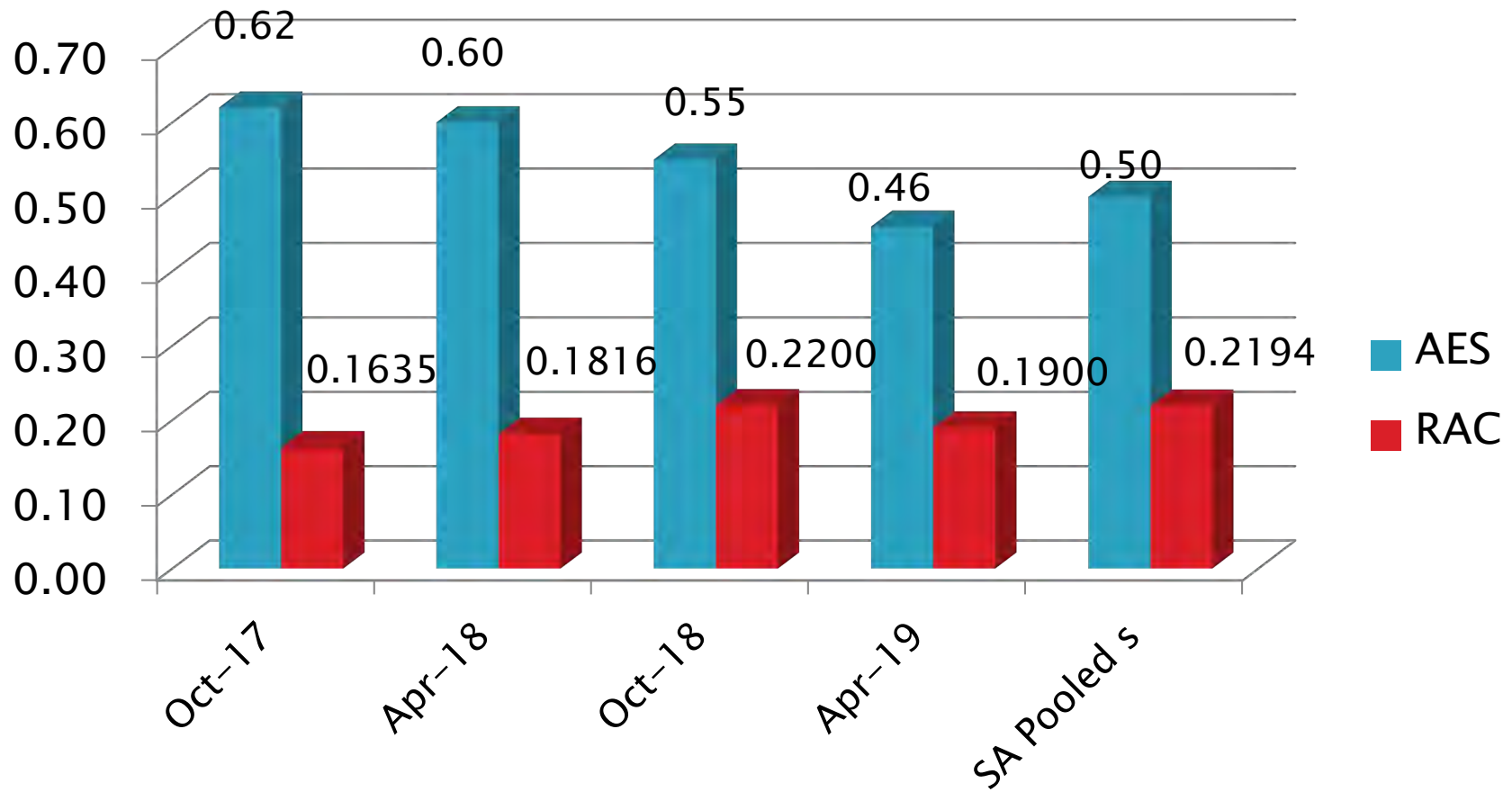


CUSUM Severity Analysis

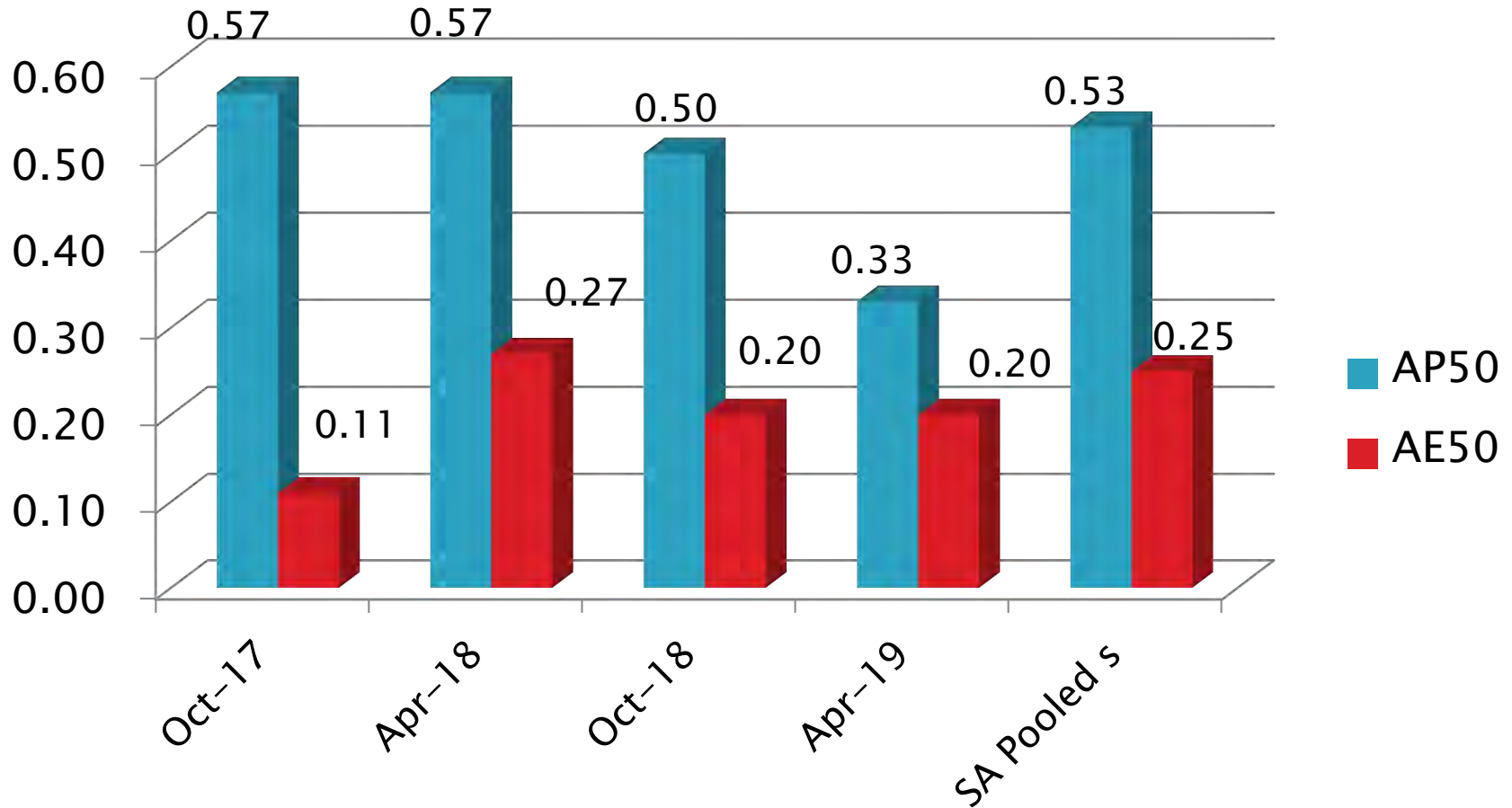


02 APR 19: 10:59

# Sequence VH Precision Estimates



# Sequence VH Precision Estimates



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# Sequence VIE

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# Sequence VIE Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	48
Operationally Invalid Calibration Test, Lab Judgement	LC	1
Abandoned engine	MC	1
<b>Total</b>		<b>50</b>

# Sequence VIE – Lost Tests\*

Test Status	Cause	#
Invalid	Fuel leak downstream of flow meter	1
<b>Totals</b>		<b>1</b>

\*Invalid and aborted tests

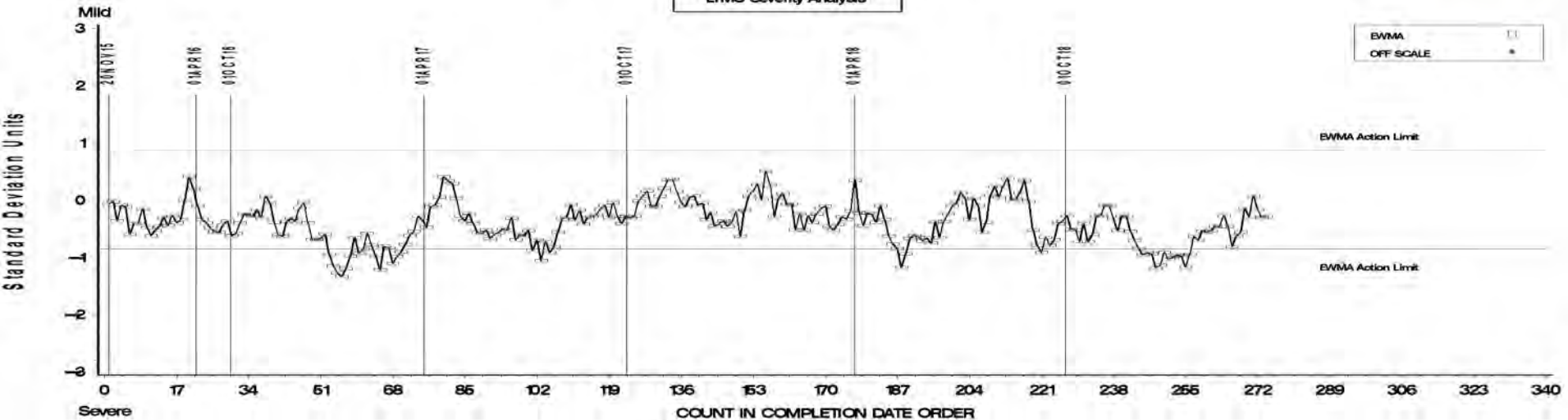
# Sequence VIE Test Severity

- FEI1 and FEI2 are in control

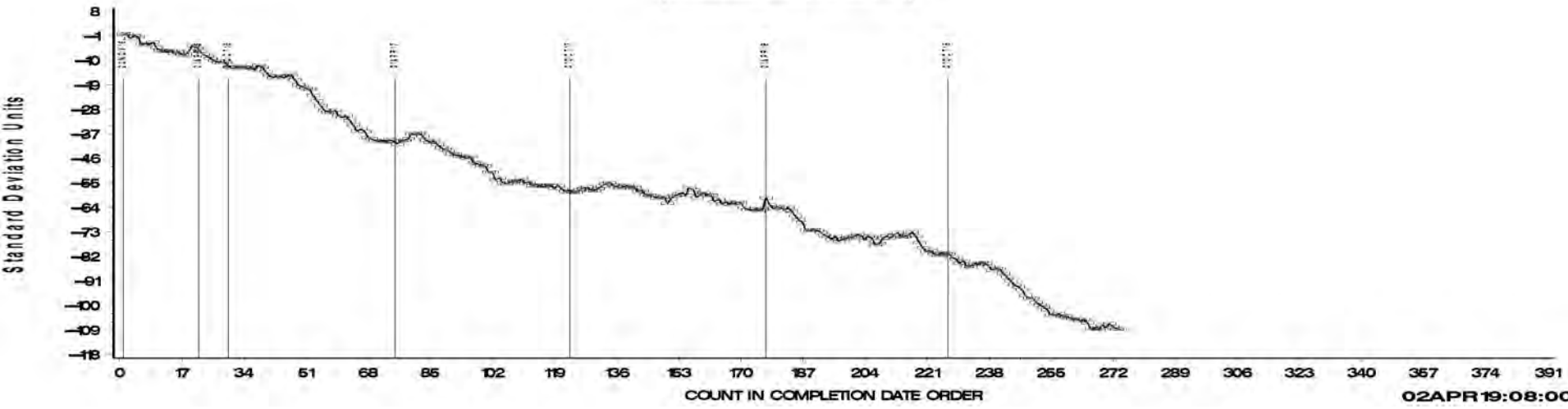


FEI FINAL RESULT PHASE I

LTMS Severity Analysis



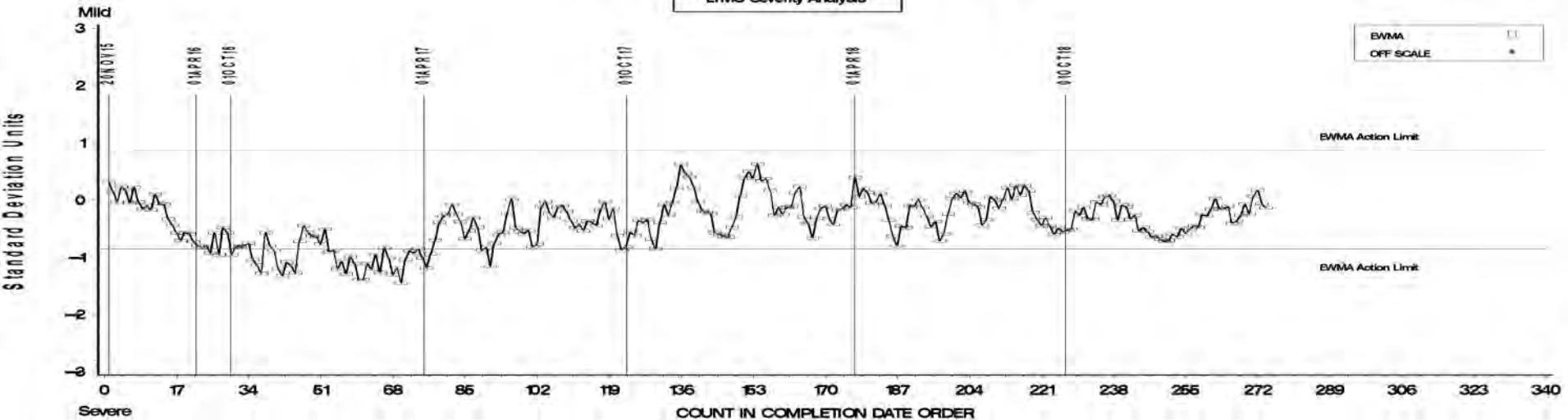
CUSUM Severity Analysis



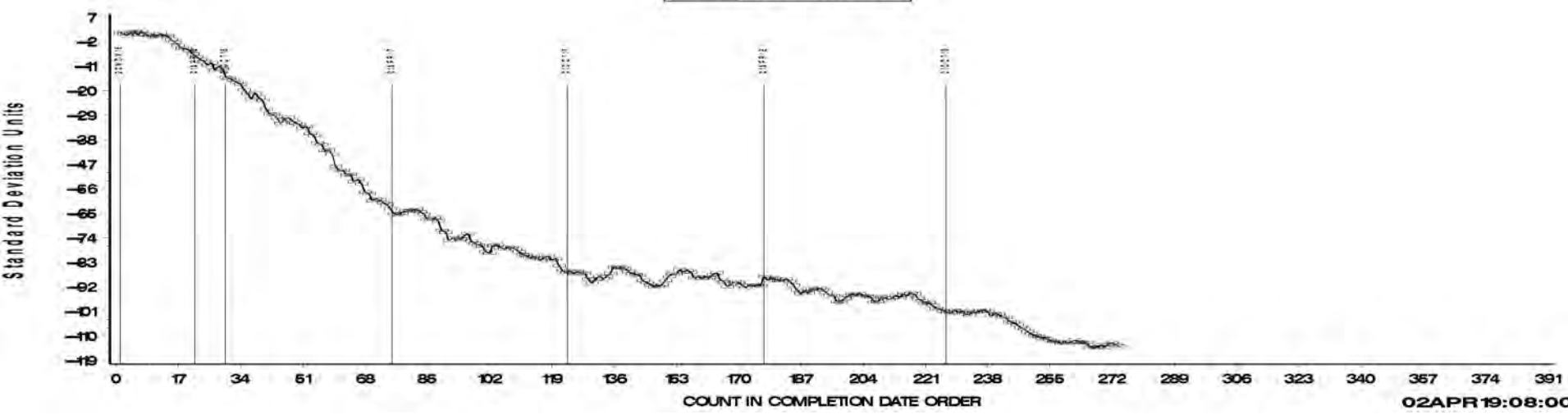
02APR19:08:00

FEI FINAL RESULT PHASE II

LTMS Severity Analysis

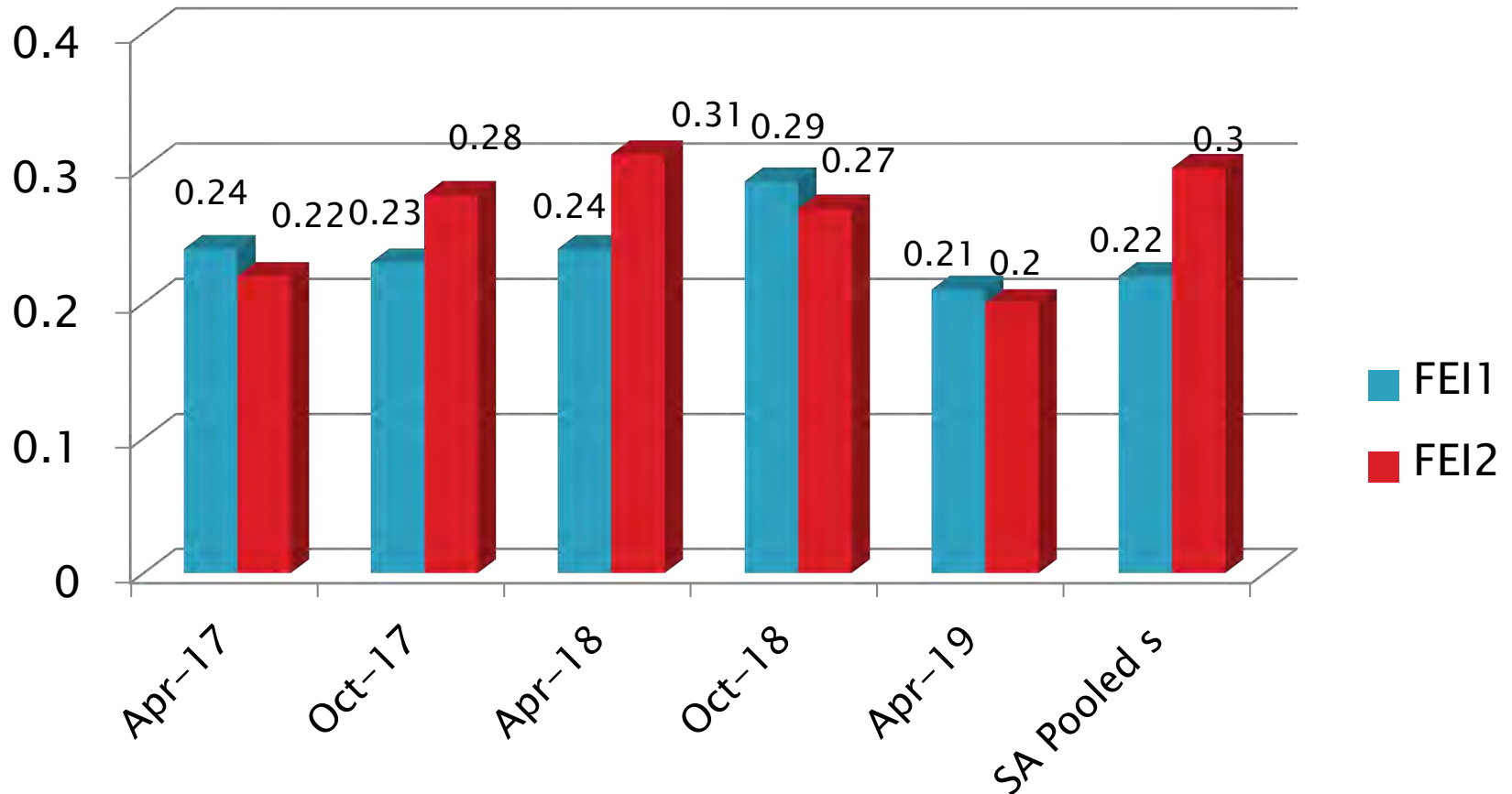


CUSUM Severity Analysis



02APR19:08:00

# Sequence VIE Precision Estimates



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# Sequence VIF

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# Sequence VIF Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	44
Failed Statistically	OC	7
Aborted	XC	1
Invalid by Lab	LC	2
<b>Total</b>		<b>54</b>

# Sequence VIF – Failed Tests

Test Status	Number of Tests
Mild FEI1	1
Severe FEI1	2
Vi Alarm FEI1	1
Vi Alarm FEI2	3
<b>Total</b>	<b>7</b>

# Sequence VIF – Lost Tests\*

Test Status	Cause	#
Aborted	Ran BL Before under VIE conditions	1
Invalid	Repeated a stage more than once	1
Invalid	Fuel Flow calibration error	1
Totals		3

\*Invalid and aborted tests

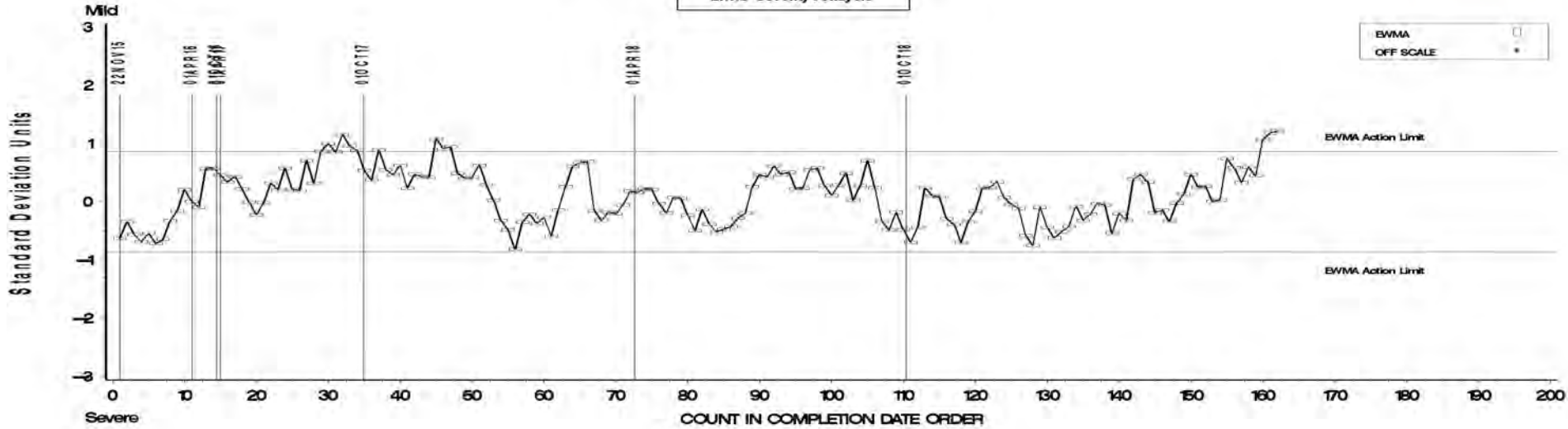
# Sequence VIF Test Severity

- FEI1 in severity action alarm
- FEI2 is in control

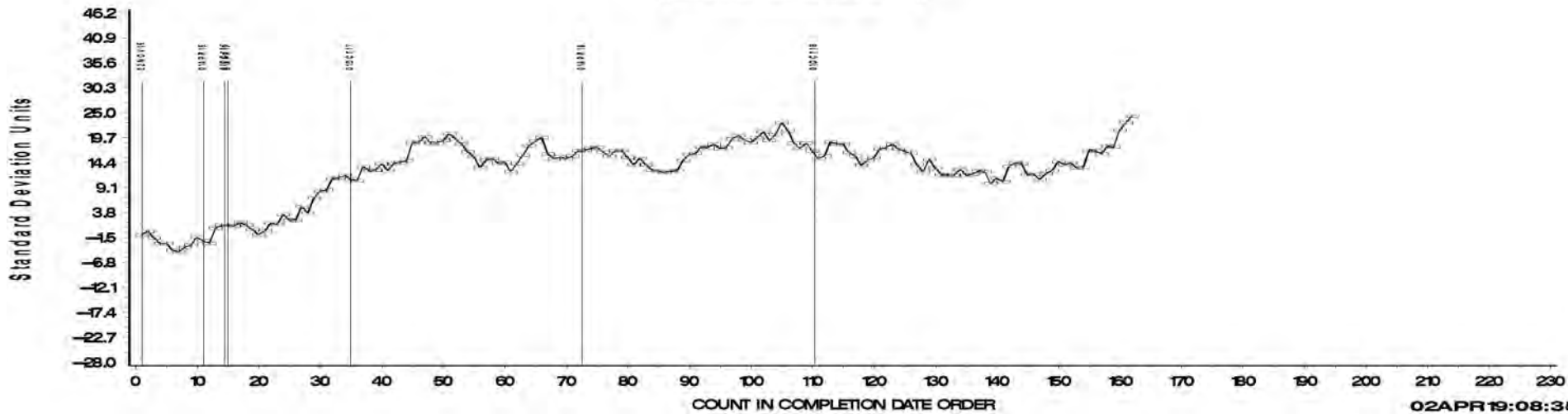


FEI FINAL RESULT PHASE I

LTMS Severity Analysis



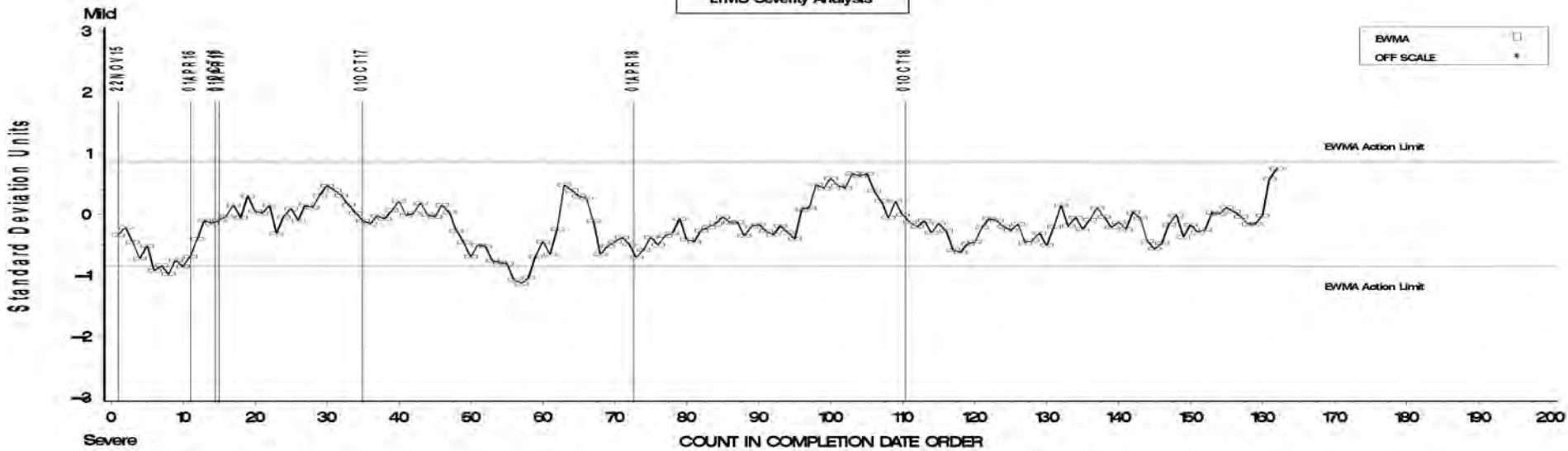
CUSUM Severity Analysis



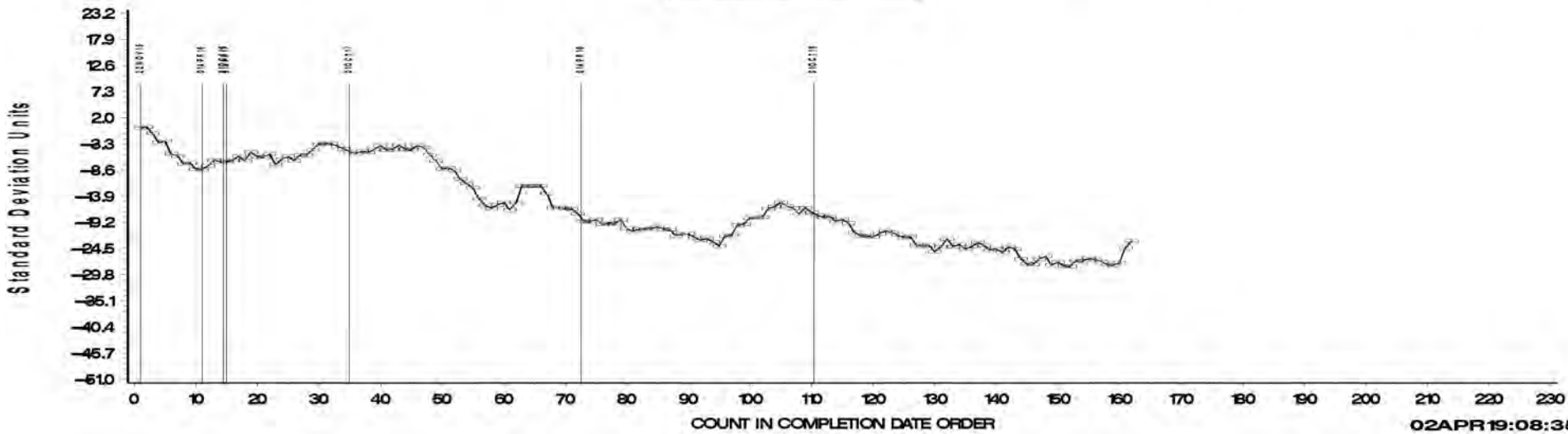
02APR19:08:35

# FEI FINAL RESULT PHASE II

LTMS Severity Analysis



CUSUM Severity Analysis



02APR19:08:35

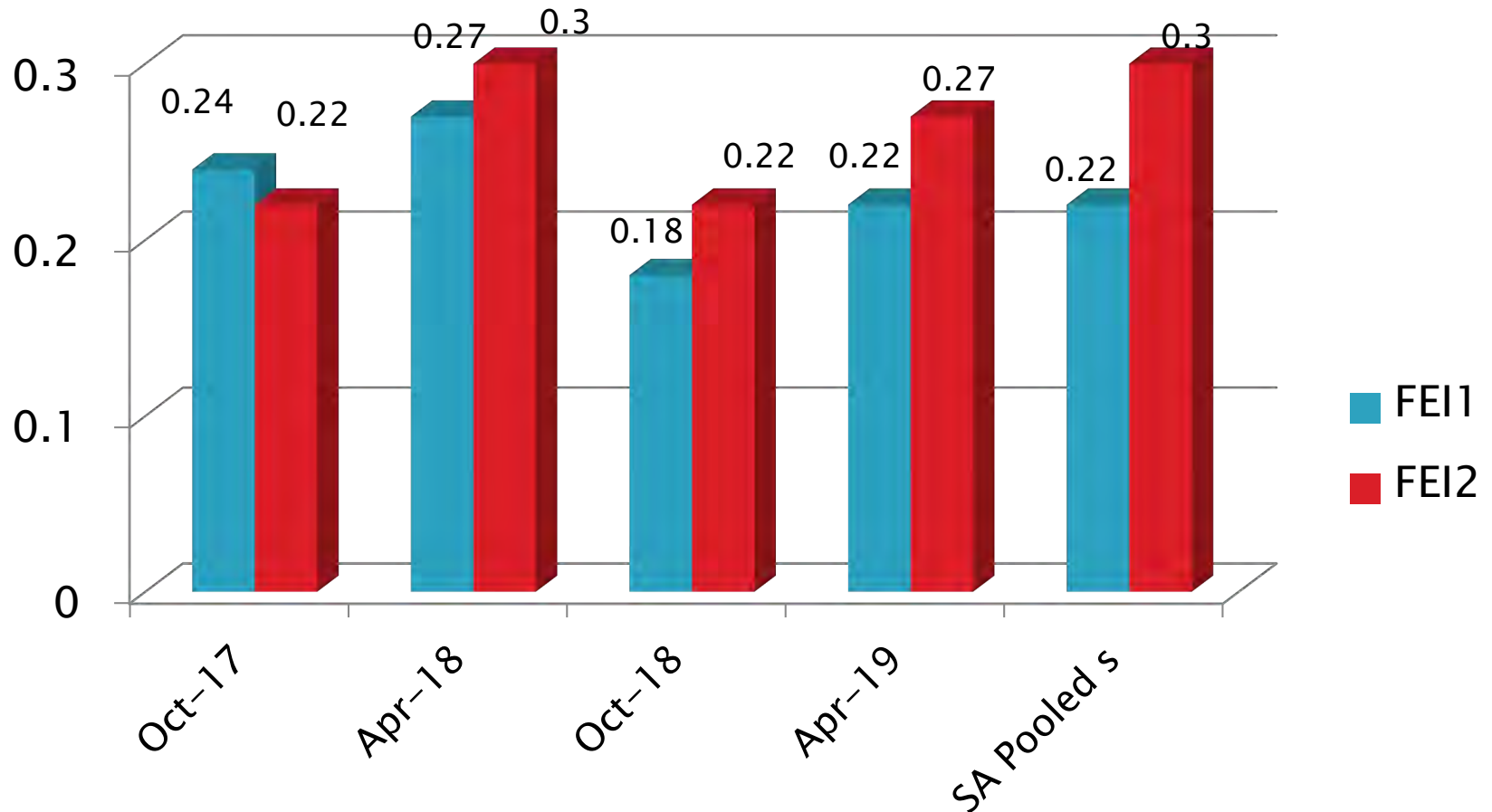
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# Sequence VIF Precision Estimates



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# Sequence VIII

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# Sequence VIII Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	4
Total		4

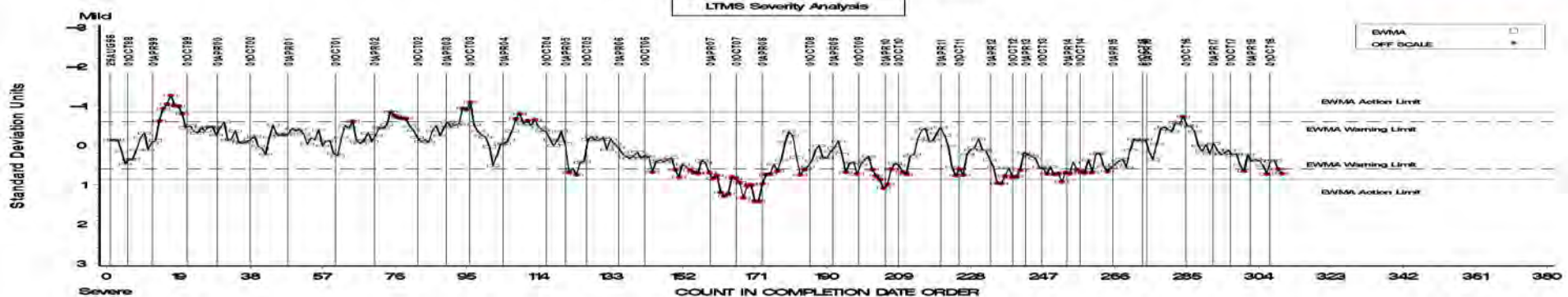
# Sequence VIII Test Severity

- Bearing Weight Loss is in severity warning alarm (severe direction)
- Stripped Viscosity is in control

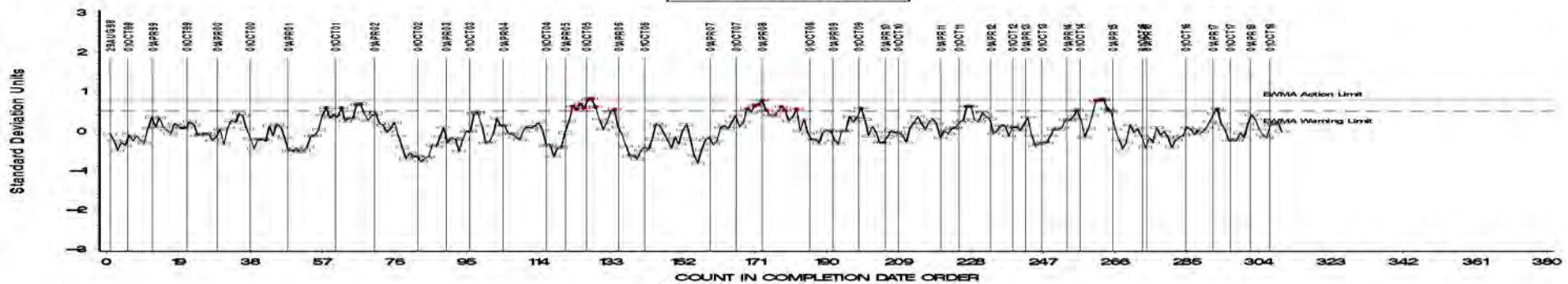
# SEQUENCE VIII INDUSTRY OPERATIONAL VALID DATA

## FINAL BEARING WEIGHT LOSS

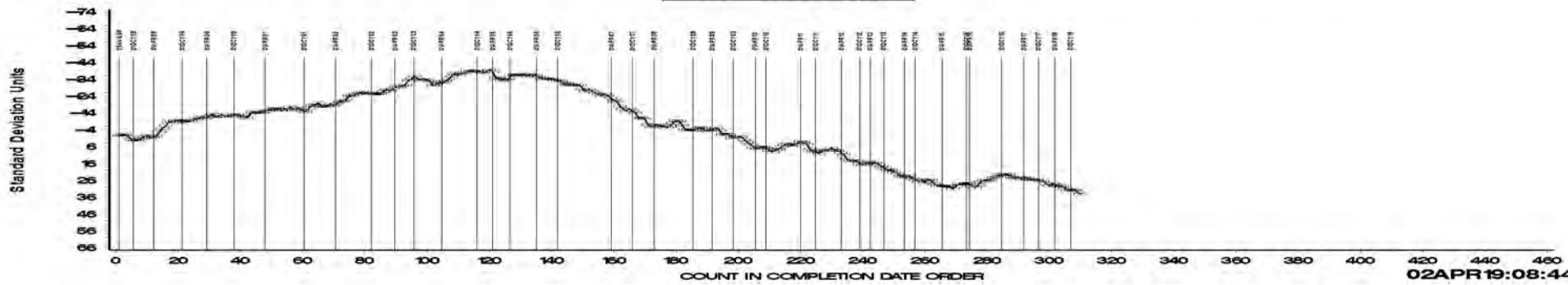
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

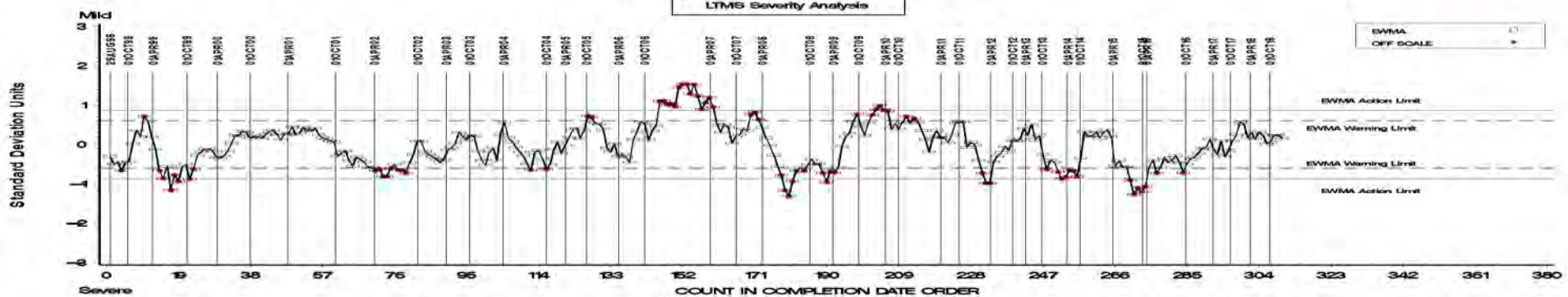


02APR19:08:44

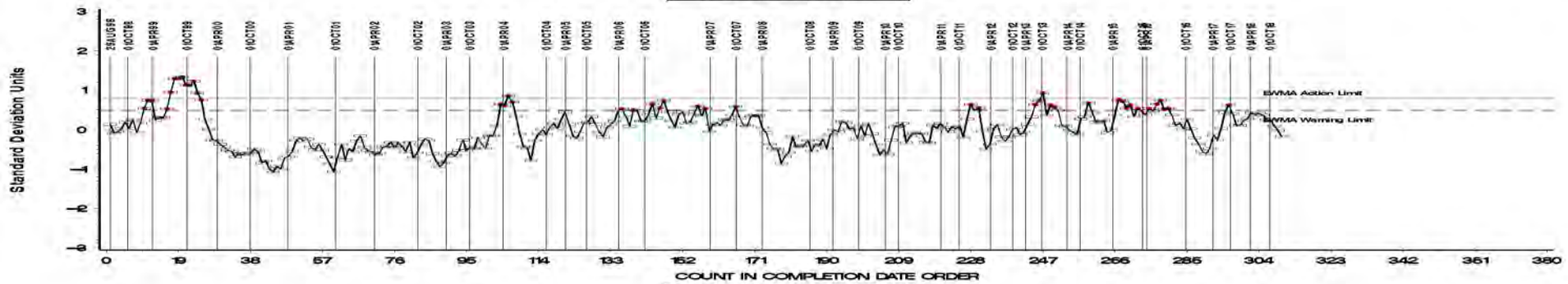
# SEQUENCE VIII INDUSTRY OPERATIONAL VALID DATA

## STRIPPED VIS. @ 100 DEG C

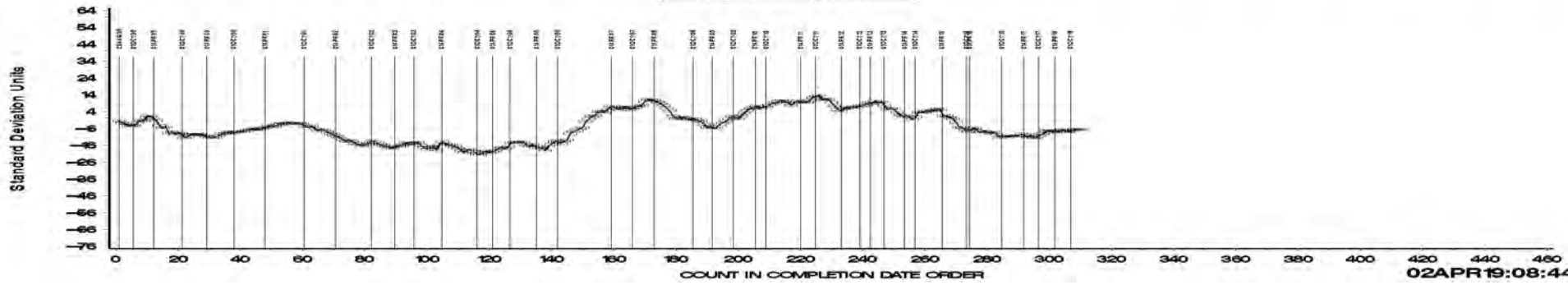
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

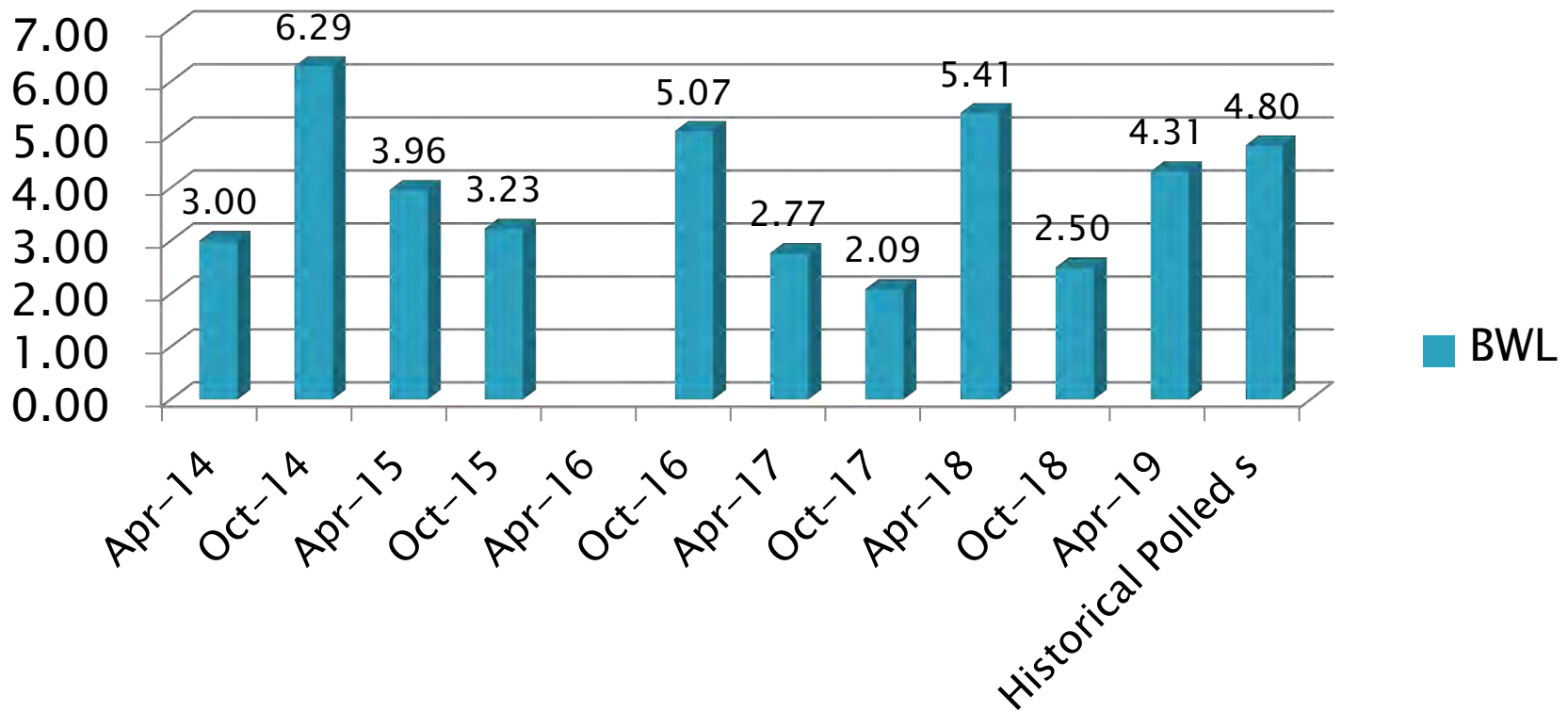


02APR19:08:44



# Sequence VIII Precision Estimates

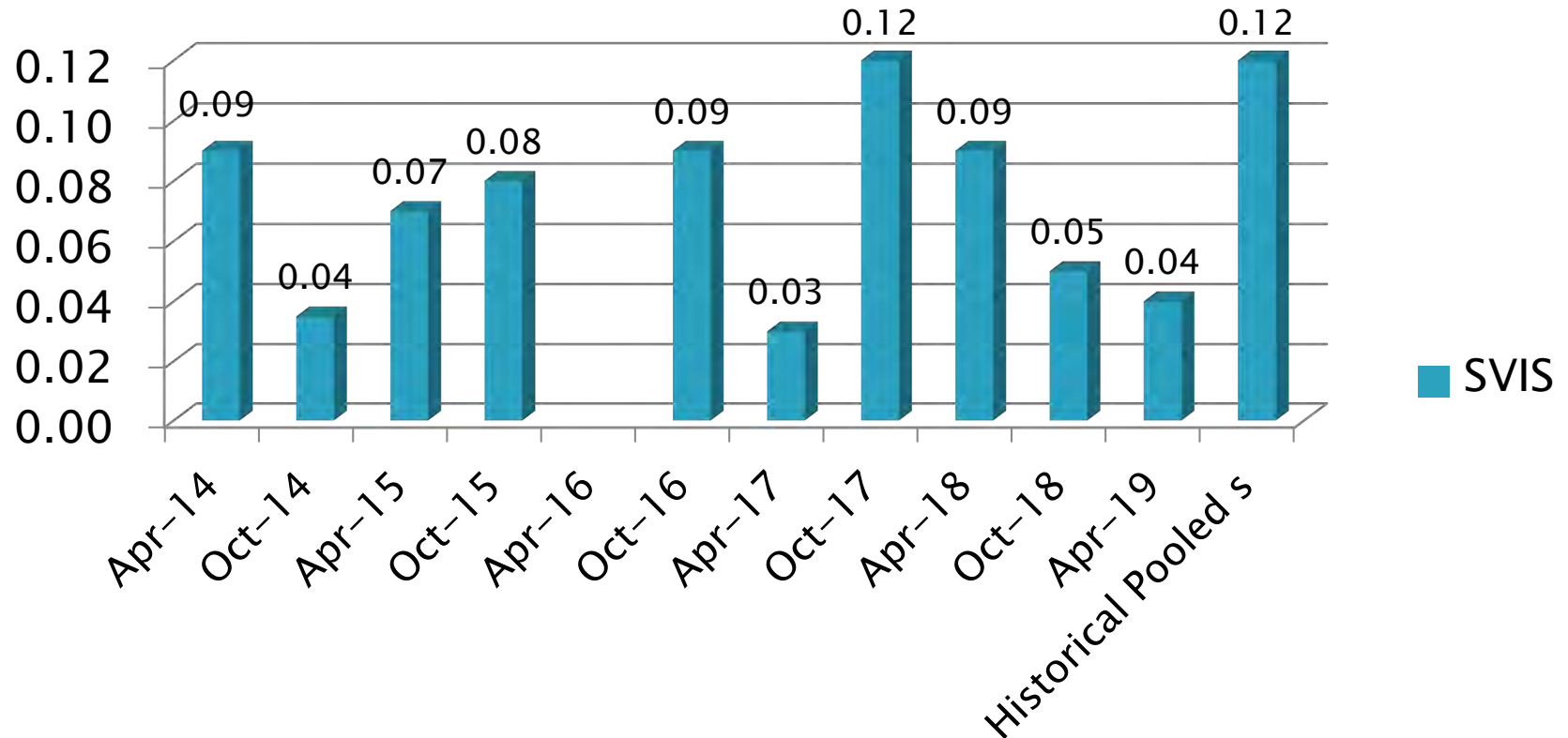
## BWL



# Sequence VIII Precision Estimates

## SVIS

Historical Pooled s used for comparison purposes, parameter is not severity adjusted.



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# Sequence IX

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# Sequence IX Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	39
Invalid Donated test, Reference oil 224	LG	1
Operationally Invalid, Laboratory Judgement	LC	6
Statistically Unacceptable Calibration Test	OC	21
Acceptable Donated Test, Reference oil 224	AG	10
Aborted Calibration Test	XC	3
<b>Total</b>		<b>80</b>

# Sequence IX – Failed Tests

Test Status	Number of Tests
Severe Average Pre-ignitions	4
Ei Level 3 alarm	11
Ei Level 3, Zi level 2	3
Zi Level 2 Alarm	3
<b>Total</b>	<b>21</b>

# Sequence IX – Lost Tests\*

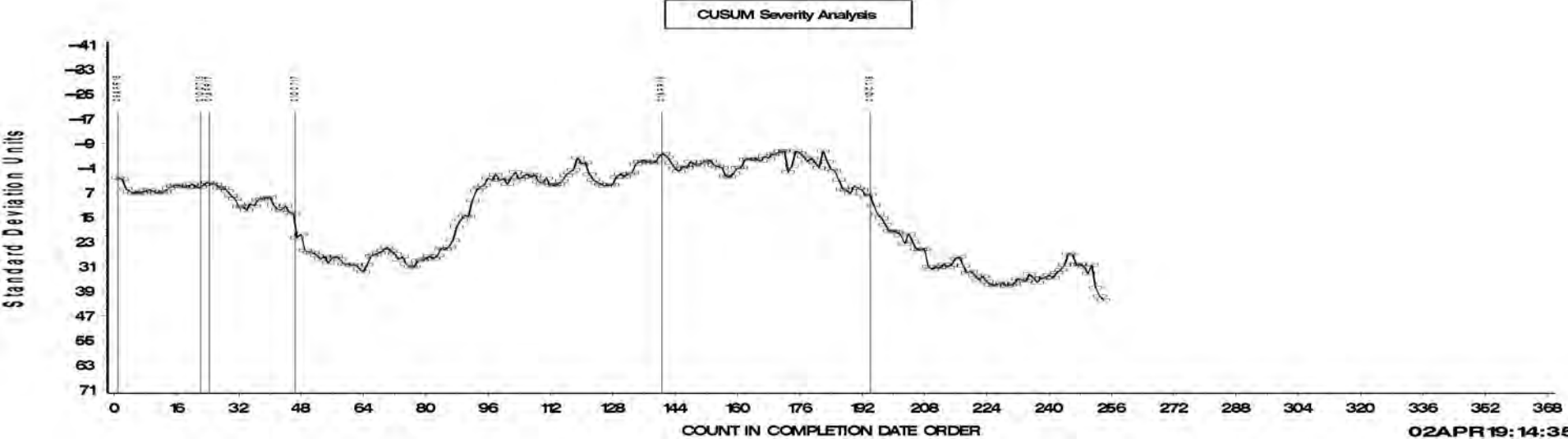
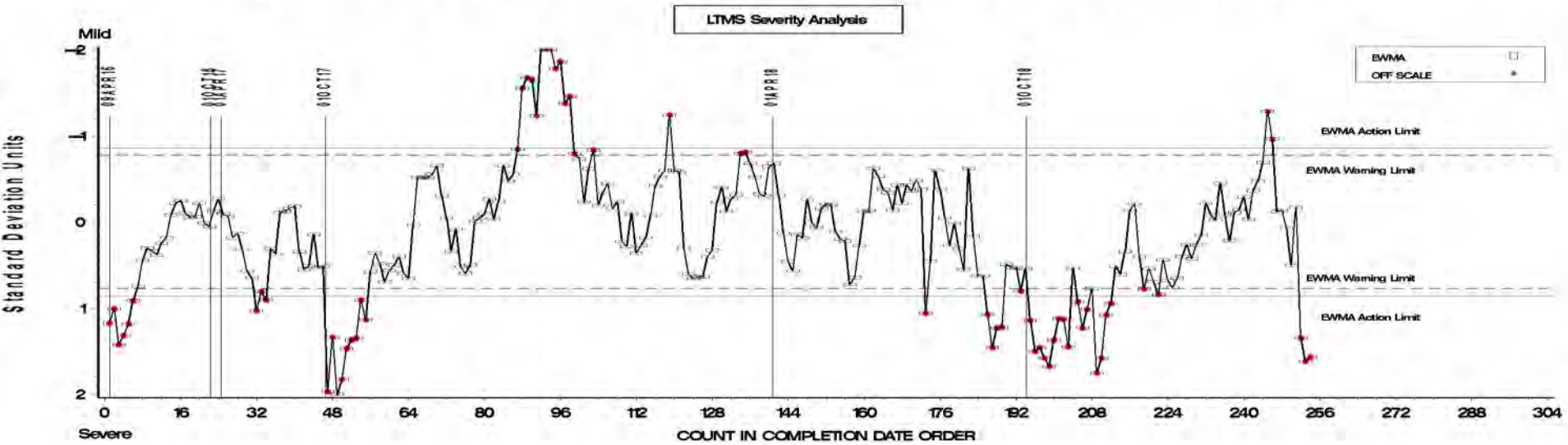
Test Status	Cause	#
Invalid	Broken Piston	1
Invalid	Exceeded Downtime Limits	4
Invalid	Unable to obtain 4 valid iterations	2
Aborted	Exceeded Downtime Limits	1
Aborted	Unable to Maintain Engine Power in Spec	1
Aborted	Unable to Maintain Engine Coolant Flow in Spec	1
<b>Totals</b>		<b>10</b>

\*Invalid and aborted tests

# Sequence IX Test Severity

- Average number of Pre-ignitions in severity action alarm.

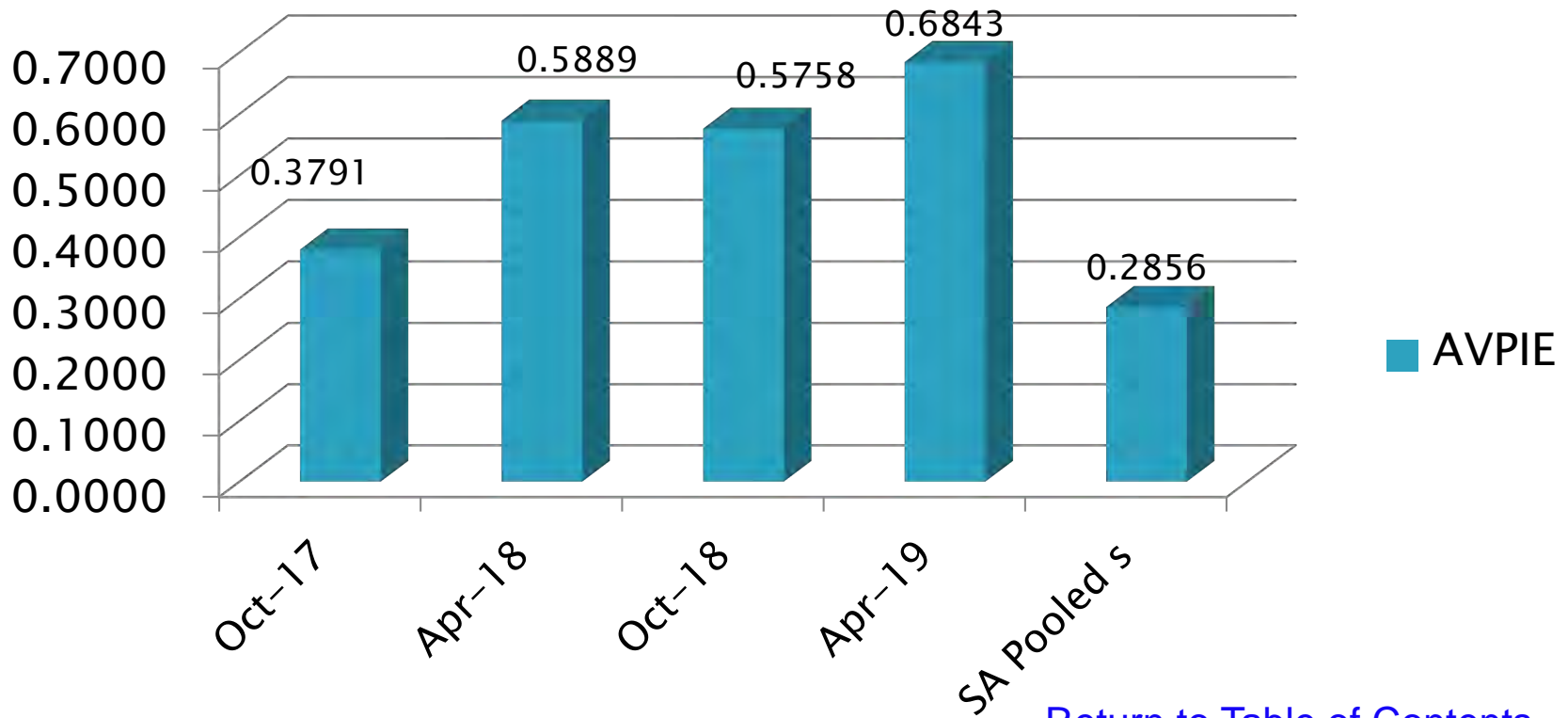
AVERAGE NUMBER OF PREIGNITIONS FROM VALID ITERATIONS





# Sequence IX Precision Estimates

## AVPIE



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# Sequence X

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# Sequence X Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	8
Aborted Calibration Test	XC	1
Operationally Invalid Calibration Test	LC	1
<b>Total Number of Tests</b>		<b>10</b>

# Sequence X – Lost Tests\*

Test Status	Cause	#
Invalid	Blowby temperature control, other operational issues	1
Aborted	Oil loss during break-in	1
Totals		2

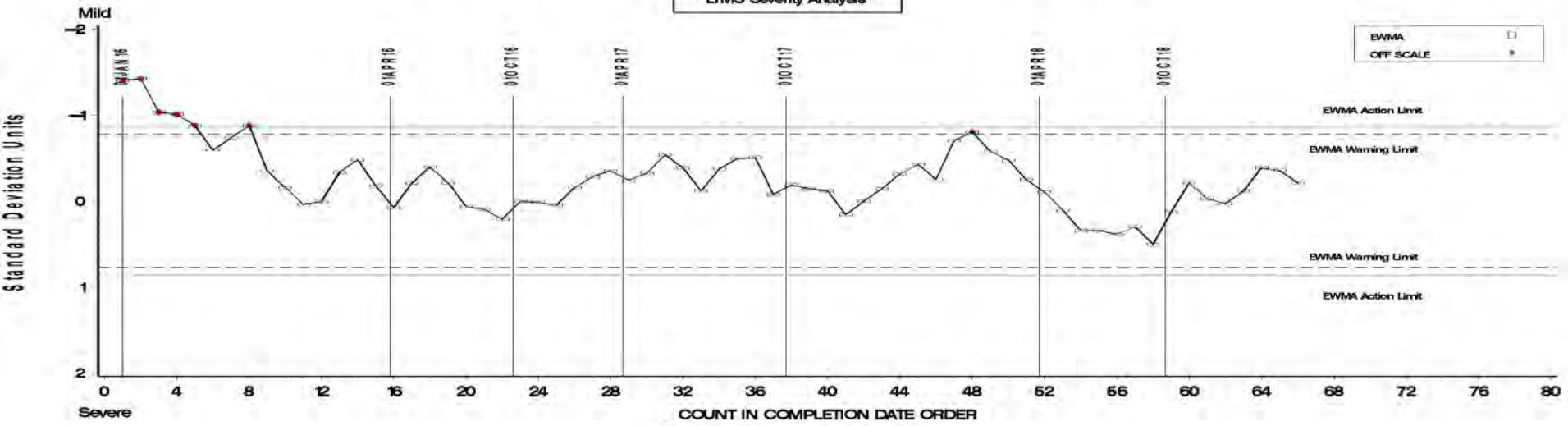
\*Invalid and aborted tests

# Sequence X Test Severity

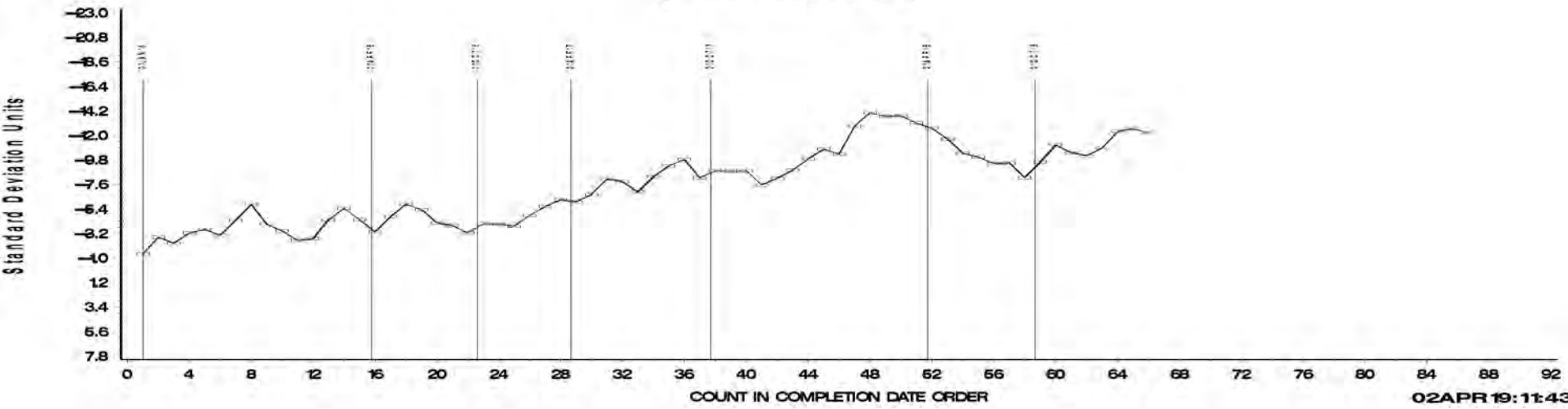
- Average Chain Stretch % in control.

END OF TEST CHAIN WEAR FINAL RESULT

LTMS Severity Analysis



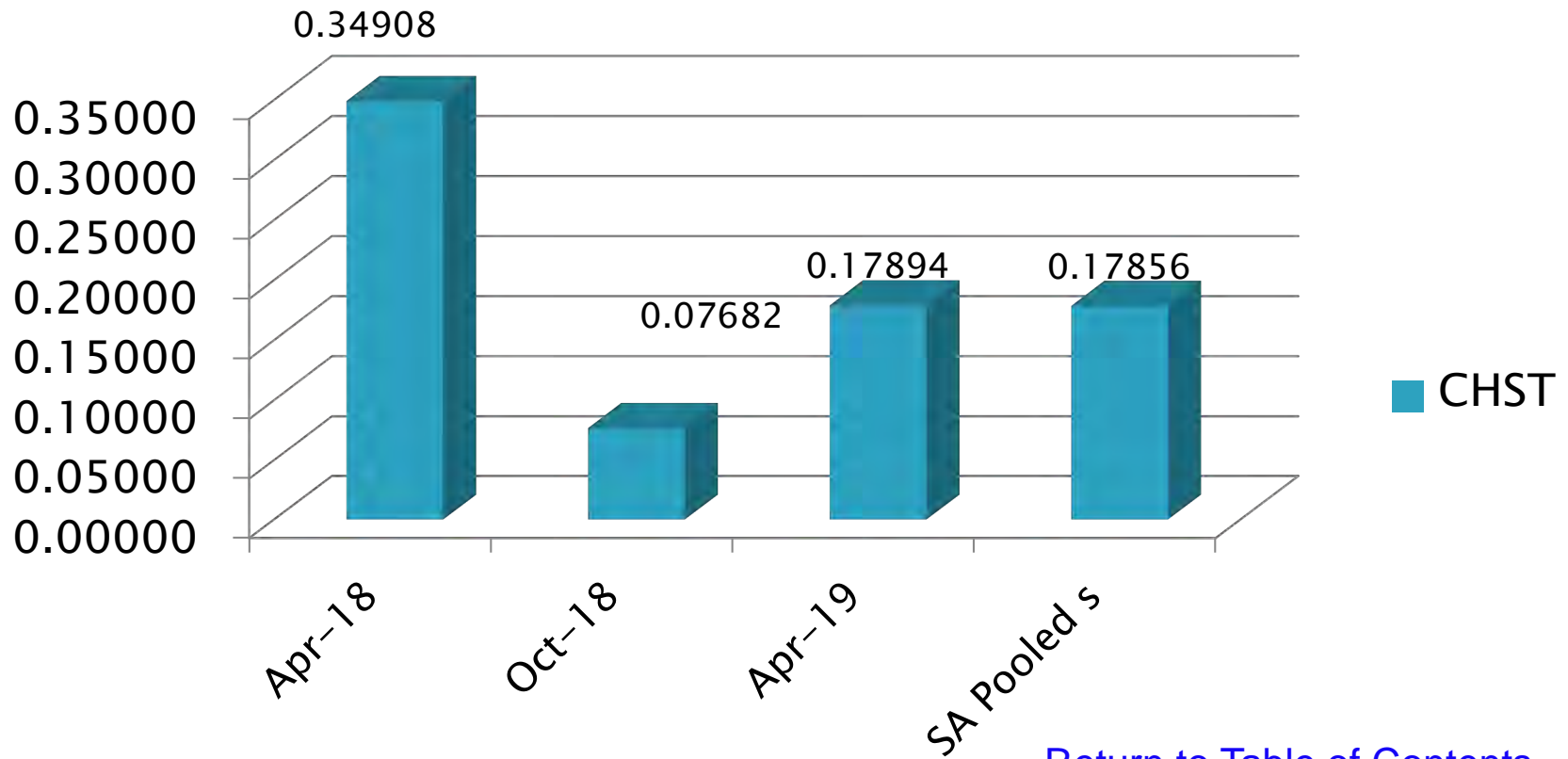
CUSUM Severity Analysis



02APR19:11:43

# Sequence X Precision Estimates

## CHST



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# Information Letters

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# Information Letters\*

Test	Date	IL	Topic
IIIH	20181015	18-4	Updated part numbers in table 2, added reference for DACA II document fir QI calculations and editorial changes to Appendix X2
IIIH	20181116	18-5	Update ultrasonic cleaning fluid supplier, additional clarifications to QI calculations and identified the transformation applied to MRV results
IVB	20181206	18-1	Added transformation and severity adjustments to end-of-test Iron parameter.
VIE	20181119	18-4	Added fuel flow measurement device and oil circulation pump and updated pump motor specifications
VIE	20190107	19-1	Added alternate oil level measurement technique
VIF	20190110	19-1	Added alternate oil level measurement technique

\*Available from TMC Website

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# Reference Oil Inventory

»» Actions, Re-blends, Inventories  
and Estimated Life

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# Reference Oil Re-blends

## ➤ TMC 222 and 224

- Reference oil 222 has been depleted and supplier can not re-blend. Panel is generating data for Reference oil 224 targets as a replacement oil.

## ➤ TMC 434-3

- Targets generated and being applied to reference tests. Shipment quantities reduced from 4 gallons to 2.5 gallons for Sequence IIIH reference tests.

# Reference Oil Re-blends (cont)

## ➤ TMC 438-2

- This re-blend is available, not yet introduced.

## ➤ TMC 542-3

- Little over a year supply remaining, reblend (542-4) is available for introduction.

## ➤ TMC 1009-1

- This re-blend is available, not introduced yet.

# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount (gallons)	Quantity Shipped in last 6 months	TMC Inventory (gallons)	Lab Inventory (gallons)	Estimated Life
220	IX	1100	50	390	50	3 years
221	IX	2120	300	106	60	2.5+ years
222	IX	1040	60	0	35	<1 year
224	IX	1026	80	847	105	4+ years
270	X	1100	15	848	30	5 years
271	X	980	25	779	35	5 years
300-1	IVB	378	5	342	24	5 years
433-1	IIIF	1045	0	0	8	<1 year
433-2	IIIF	500	0	146	28	2+ years
434	IIIG	550	0	<1	12	<1 year

# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount (gallons)	Quantity Shipped in last 6 months	TMC Inventory (gallons)	Lab Inventory (gallons)	Estimated Life
434-1	IIIG	660	0	4	20	1.5 years
434-2	IIIG, IIIH	495	0	0	12	<1 year
434-3	IIIG, IIIH	980	45	840	30	5+ years
435	IIIG	550	0	2	4	<1 year
435-2	IIIG	550	18	139	32	3+ years
436	IIIH	1100	10.5	761.5	23.5	5+ years
438	IIIG	990	0	16	28	1.5 years
438-1	IIIH	605	13	13.5	14.5	<1 year
438-2	IIIH	540	0	540	0	5 years
542-2	VIE	1000	0	0	6	<1 year
542-3	VIE	997	252	87	132	<1 Year

# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount (gallons)	Quantity Shipped in last 6 months	TMC Inventory (gallons)	Lab Inventory (gallons)	Estimated Life
542-4	VIE/VIF	1100	105	657	8	3+ Years
543	VIF	1100	126	530	60	2.5 Years
544	VIE	897	12	265	84	2+ years
704-1	VIII	897	14	75	14	5+ years
940	VG, VH	560	21	136	18	2+ years
1006-2	IVA, VG, VIII	5500	352	672	67	1-2 years
1009	VG, VH, VIII	1100	0	0	3	<1 year
1009-1	VG, VH, VIII	1100	0	1094	15	5 years
1010-1	VIE	1760	102	478	84	2 years
1011	IVB/VH/VIF/X	1100	100	392	141	2 years
1012	IVB	2200	134	1867	45	5+ years

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# LTMS Deviations

»» October 1, 2018 –  
March 31, 2019

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# LTMS Deviations

- No LTMS Deviations this period

# LTMS Deviations

## Historical Count of PCEO LTMS Deviations

Test	LTMS Deviations
IIIF	6
IIIG	6
IIIH	0
IVA	7
VG	8
VID	3
VIE	0
VIF	0
VIII	3
IX	0
X	0

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# Quality Index Deviations

»» October 1, 2018 –  
March 31, 2019

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# Quality Index Deviations

- Three Quality Index Deviations this Report Period.
  - VH – Oil inlet temperature (Lab G)
  - VH – Intake air pressure (Lab A)
  - VH – Intake air pressure (Lab A) Different stand

# Quality Index Deviations

## Historical Count of PCEO Quality Index Deviations

Test	Quality Index Deviations
IIIF	28
IIIG	16
IIIH	5
IVA	30
VG	46
VH	5
IX	1
X	2

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# TMC Laboratory Visits

»» October 1, 2018 –

March 31, 2019

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# TMC Lab Visits

Test	Number of Labs Visited
IIIH	1
IVA	1
VH	2
VIE/VIF	2
VIII	2
IX	1
X	1

# Lab Visit Issues

- IIIH
  - Unapproved bore measurement gauge used.
- VH
  - Main bearing caps not torqued properly.
- VIE
  - Pressure at fuel flow sensor not located within 5 meters.
  - Unapproved fuel flow sensor.
- IX
  - Exhaust backpressure probe not located properly.
- X
  - Exhaust backpressure and temperature probes not located properly.

Labs have notified the TMC that these items were corrected or were corrected during the visit.

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# Test Area Timelines

»» October 1, 2018 –  
March 31, 2019

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# Test Area Timeline Additions\*

Test	Date	Topic	IL
IIIH	20180107	Added reference to DACA II document in calculating Quality Index and added note to Table 7 to show the transformation applied to MRV.	19-1
IIIH	20181113	Updated targets for reference oil 434-3	
IIIH	20181115	Additional Brulin solution for ultrasonic cleaner and corrected table 7 to show transformation applied to MRV	18-5
IIIH	20181226	First occurrence of Batch code 6 rings	
IVB	20181025	Added Fe as wear parameter to LTMS	18-1

\*As of 03/31/2019

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# Test Area Timeline Additions\*

Test	Date	Topic	IL
VIE	20181119	Added fuel flow measurement device, oil circulation pump and updated oil circulation pump motor specification	18-4
VIE	20190107	Added alternate method for establishing oil level marks for determining oil consumption.	19-1
VIF	20190107	Added alternate method for establishing oil level marks for determining oil consumption and added fuel flow measurement device, oil circulation pump and updated oil circulation pump motor specification	19-1

\*As of 03/31/2019

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# Rating Workshop Data

»» 2018 Light Duty Workshop

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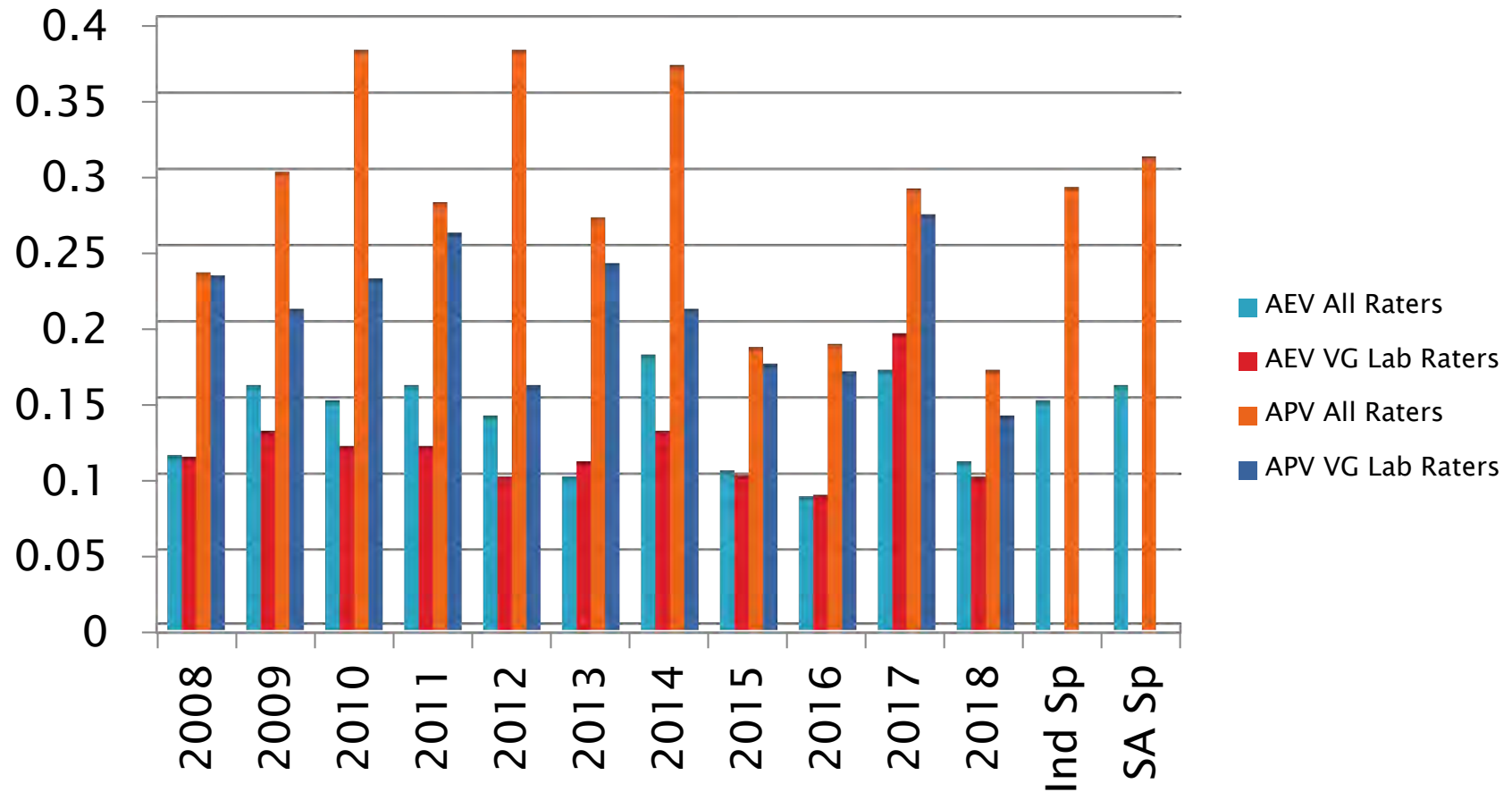
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# Rating Workshop Data

- ▶ Summary of Precision Data From Light Duty Rating workshops:
  - VG Average Piston and Average Engine Varnish.
  - IIIIG WPD
  - IIIH WPD

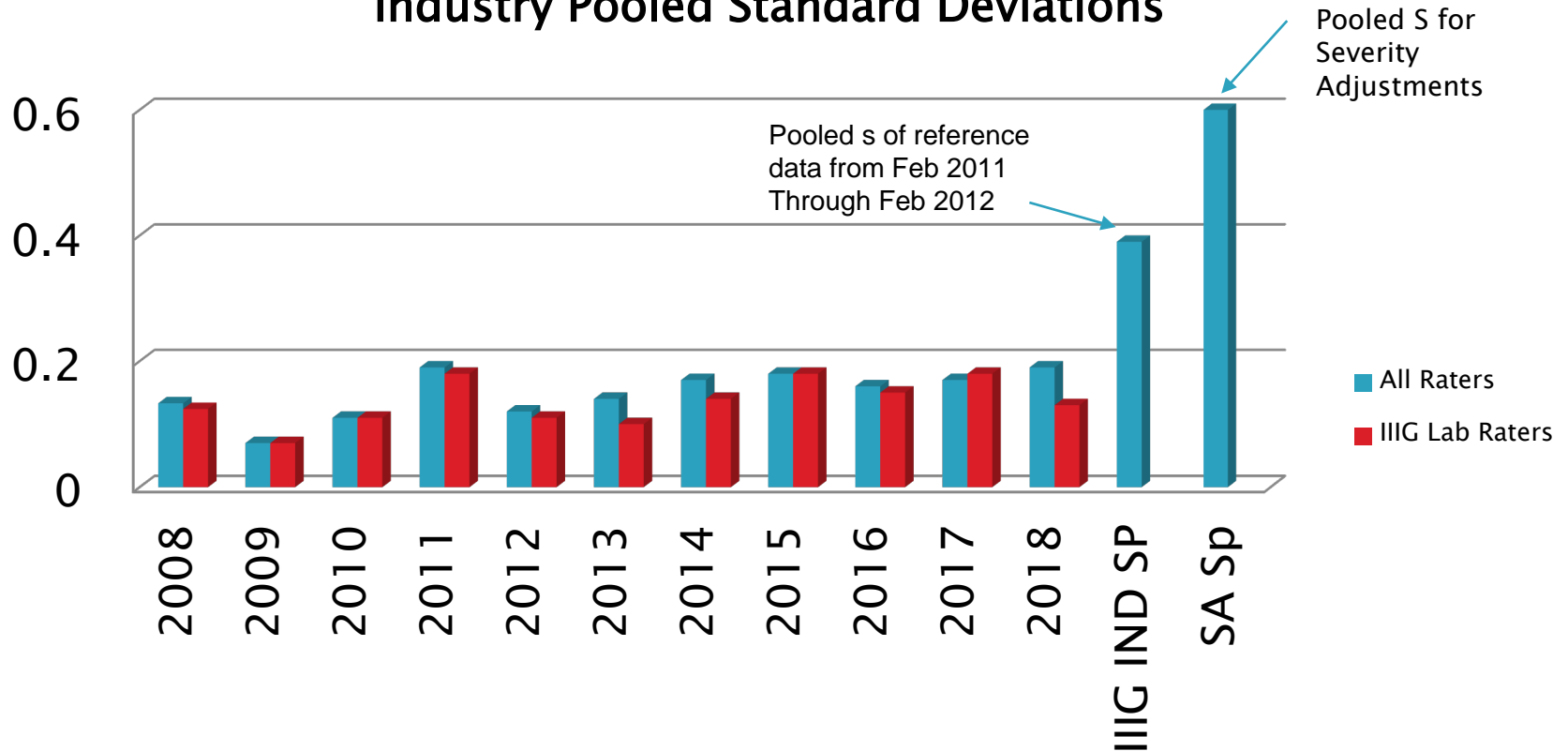
# Sequence VG Precision–Rating Workshop Data

## Workshop Data for VG/VH Varnish



# Sequence IIIG Precision – Rating Workshop Data

## Comparison of Workshop Pooled Standard Deviations with Industry Pooled Standard Deviations



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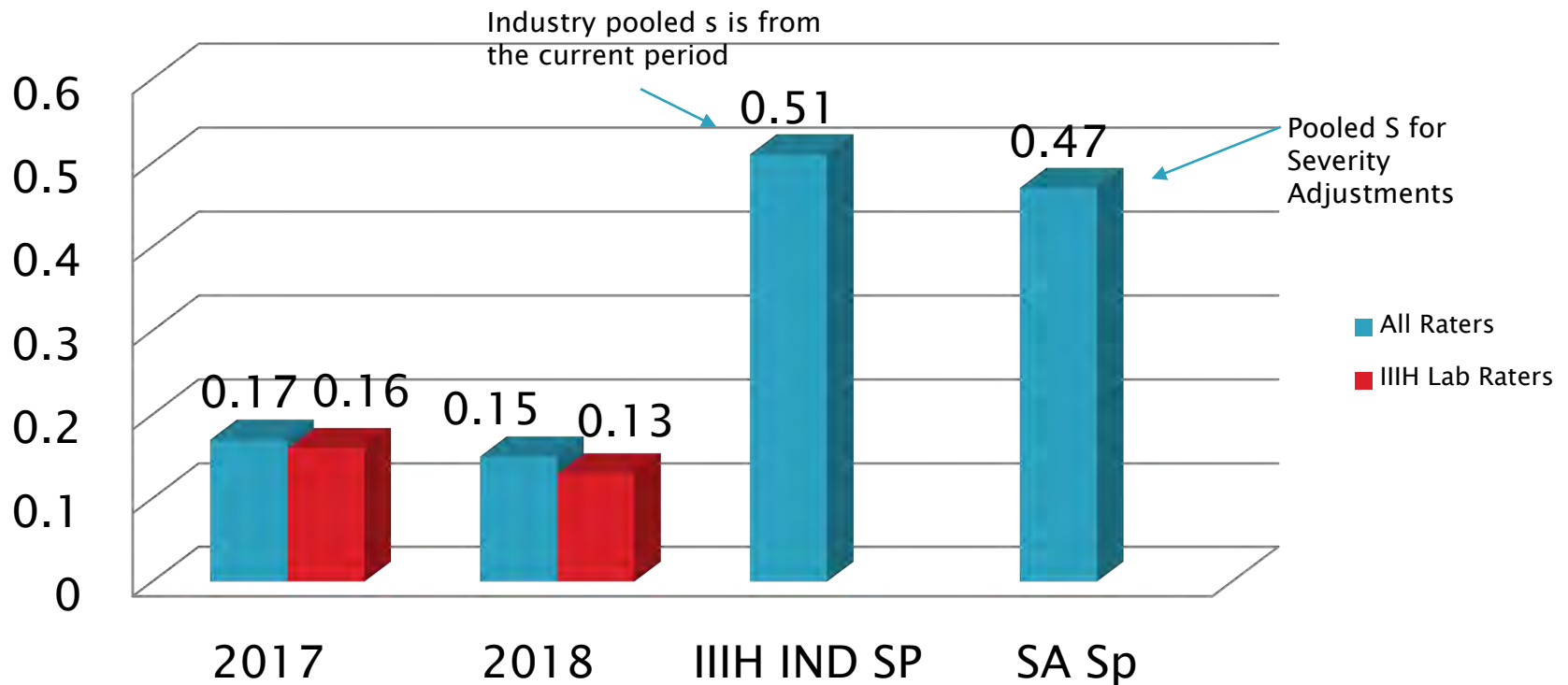
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# Sequence IIH Precision – Rating Workshop Data

## Comparison of Workshop Pooled Standard Deviations with Industry Pooled Standard Deviations



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# Miscellaneous Information

- ▶ Available on TMC Website:
  - Live Reference Test Data Bases
  - Surveillance Panel Meeting Minutes
  - Test Area Alarm Logs
  - Complete Test Area Timelines
  - LTMS Manual
  
- ▶ [www.astmtmc.cmu.edu](http://www.astmtmc.cmu.edu)

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