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# ***Test Monitoring Center***

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## **ASTM D02.B2 Semi-Annual Report Heavy Duty Reference Oil Testing**

October 2015

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# Heavy Duty Testing

## Executive Summary

### ▶ Reference Oils

- 823
    - T13 Reference Oil is available for testing.
  - 832 & 833
    - C13 Oil Aeration Test Reference oils are available for testing.
- ▶ PC11 Tests COAT and T13 included in this report.

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# Calibrated Labs and Stands\*

Test	Labs	Stands
1K	3	3
1N	4	8
1M-PC	1	1
1P	2	2
1R	1	1
C13	2	5
ISB	3	9
ISM	4	7
EOAT	1	1
RFWT	2	2
T-8/E	2	4
T-11	4	7
T-12/T-12A	4/4	11/11
T-13	5	13
COAT	3	3

\*As of 03/31/2015

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# SCOTE 1K

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# 1 K Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	1
<b>Total</b>		<b>2</b>



# 1 K Failed Tests

Failed Parameter	Number of Tests
No failed tests	
Total	0

# 1 K Lost Tests\*

Status	Cause	#
Aborted	Broken exhaust valve keeper	1
<b>Total</b>		<b>1</b>

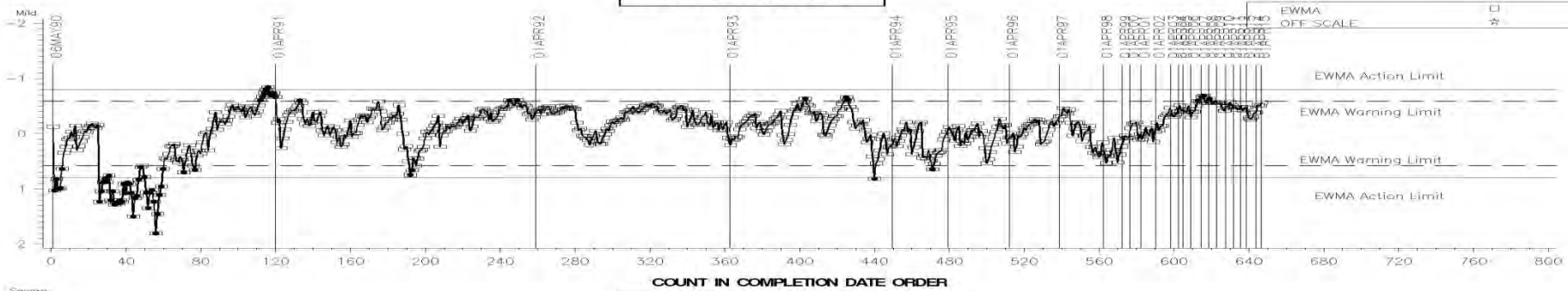
\*Invalid and aborted tests

# 1 K Test Severity

- ▶ WDK, TGF, TLHC, ETOC are in control. WDK near warning limit.
- ▶ TGF and TLHC
  - Within Chart Limits but near warning limit.
  - Long-term mild trend continuing
- ▶ BSOC in Warning Limit in the mild direction
  - Long-term mild trend continuing
  - Nearing Action Limit

FINAL TGF

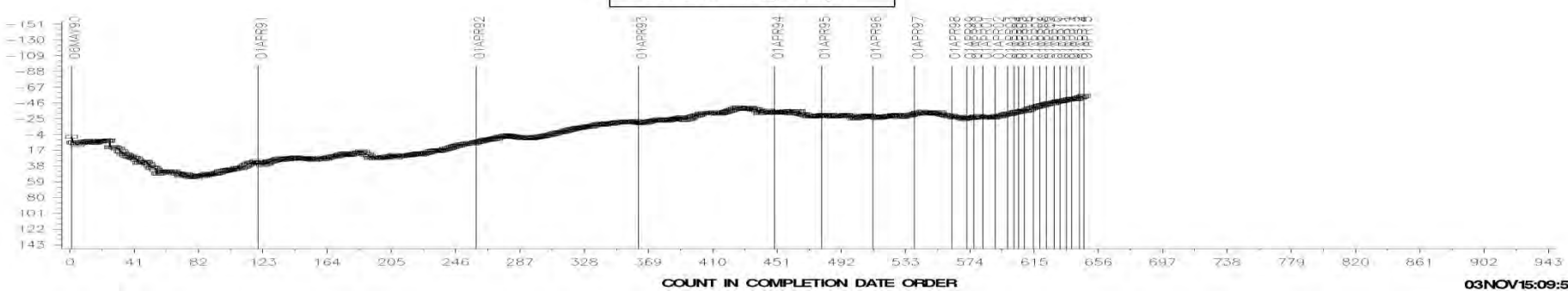
LTMS Severity Analysis



LTMS Precision Analysis



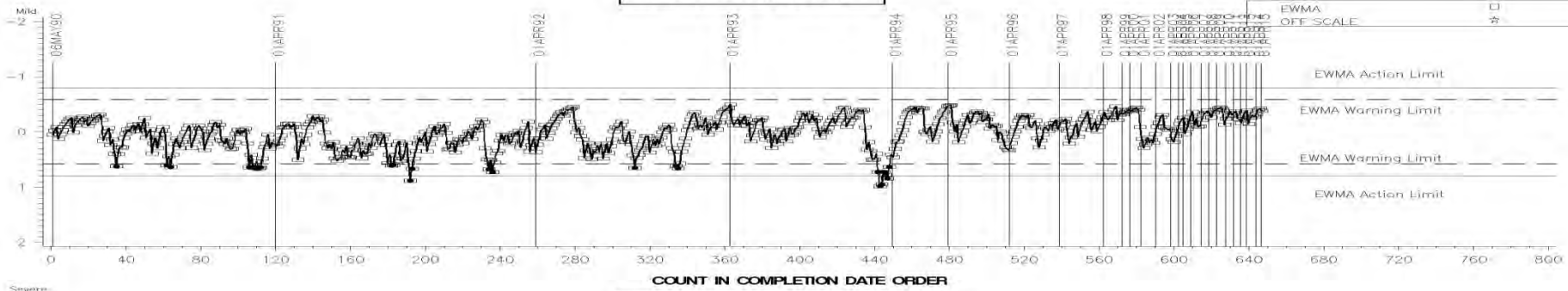
CUSUM Severity Analysis



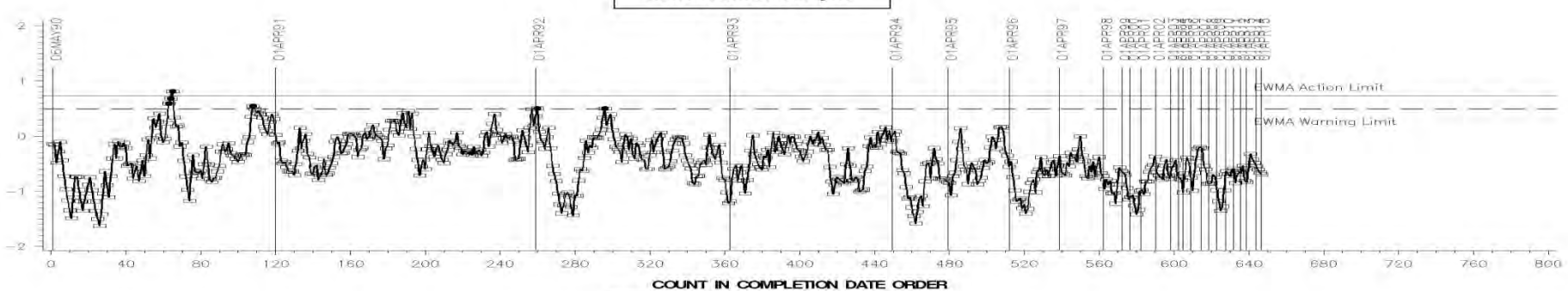
03NOV15:09:51

FINAL TLHC

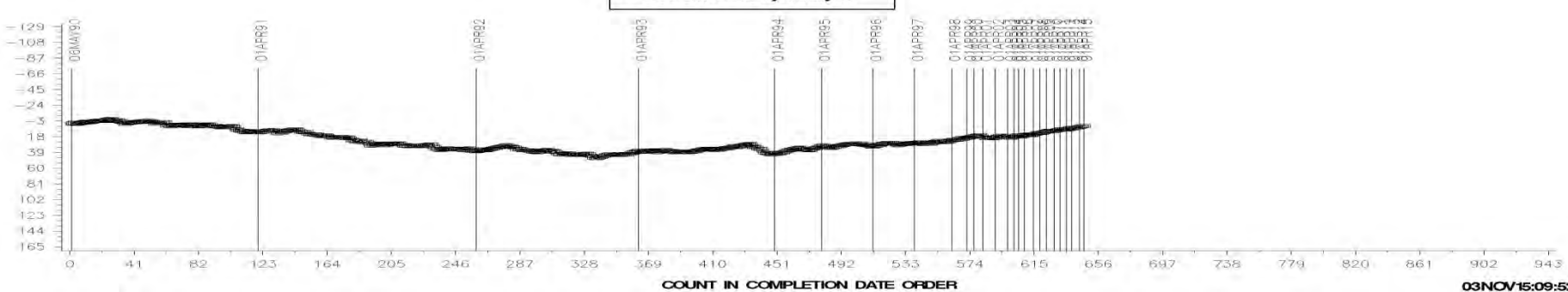
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

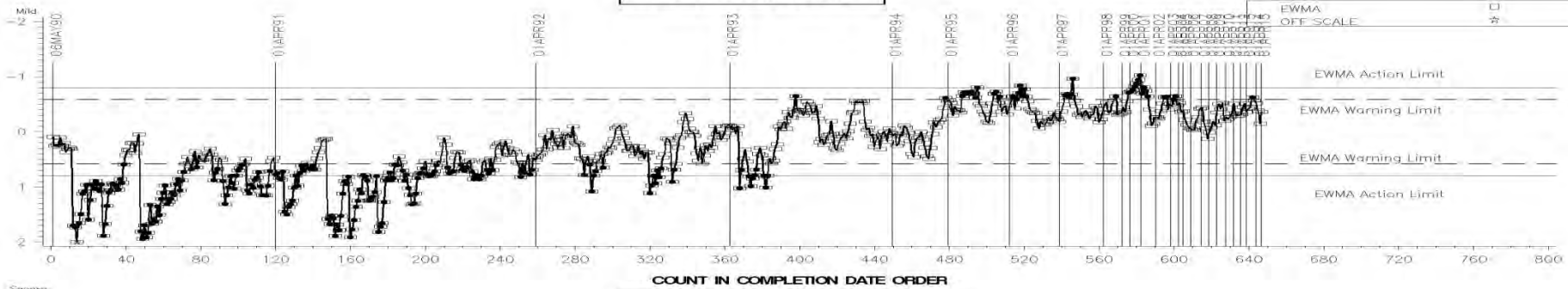


03NOV15:09:52



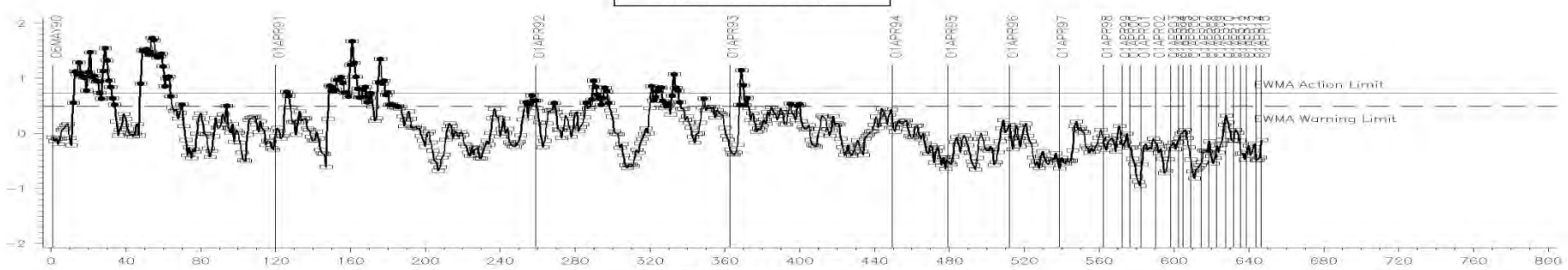
FINAL Weighted Total Demerits

LTMS Severity Analysis



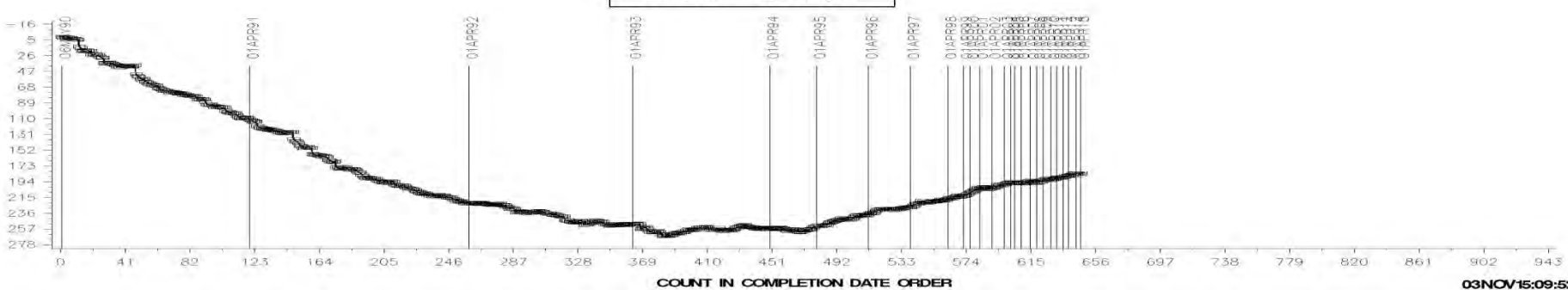
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

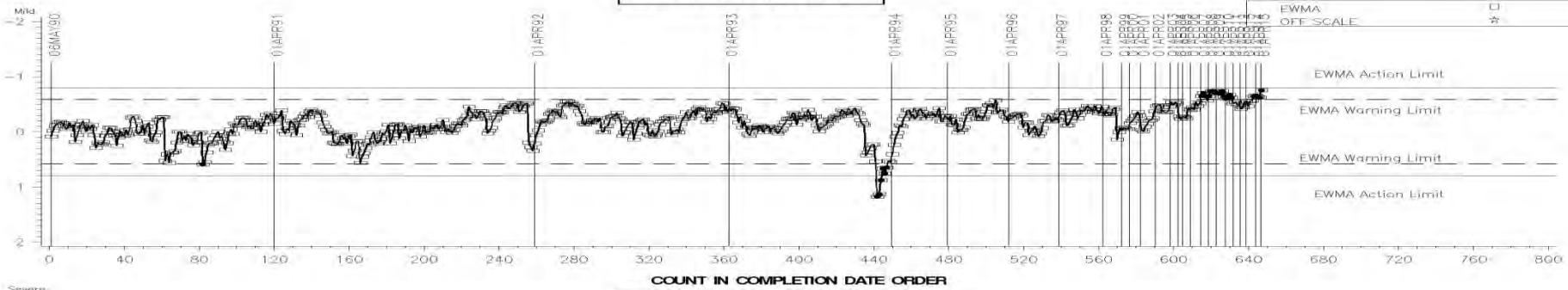


COUNT IN COMPLETION DATE ORDER

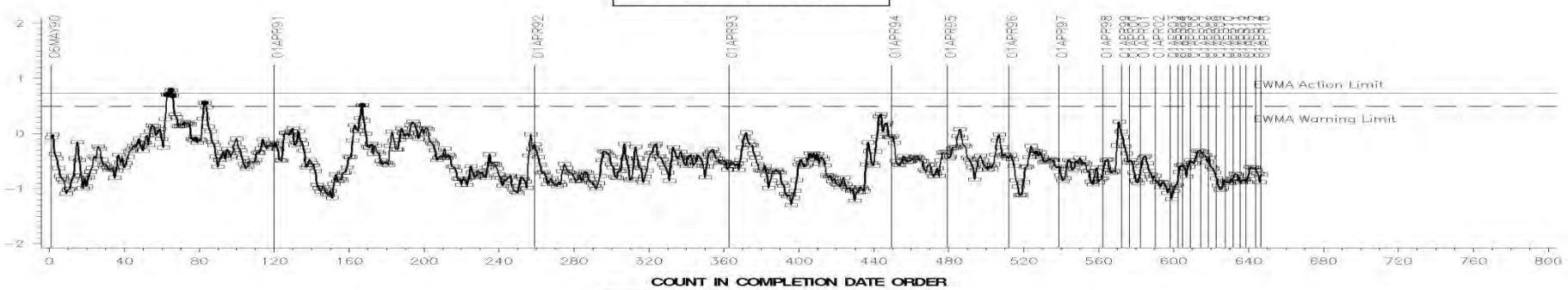
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FINAL BSOC

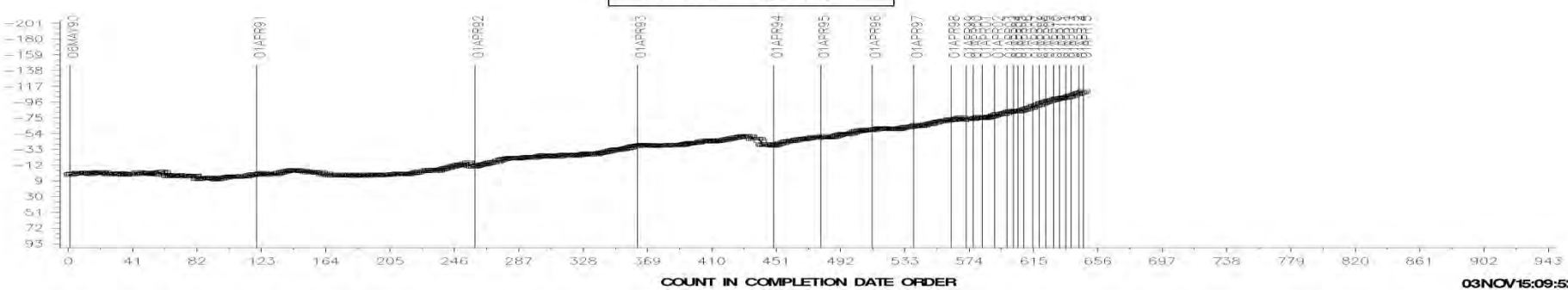
LTMS Severity Analysis



LTMS Precision Analysis



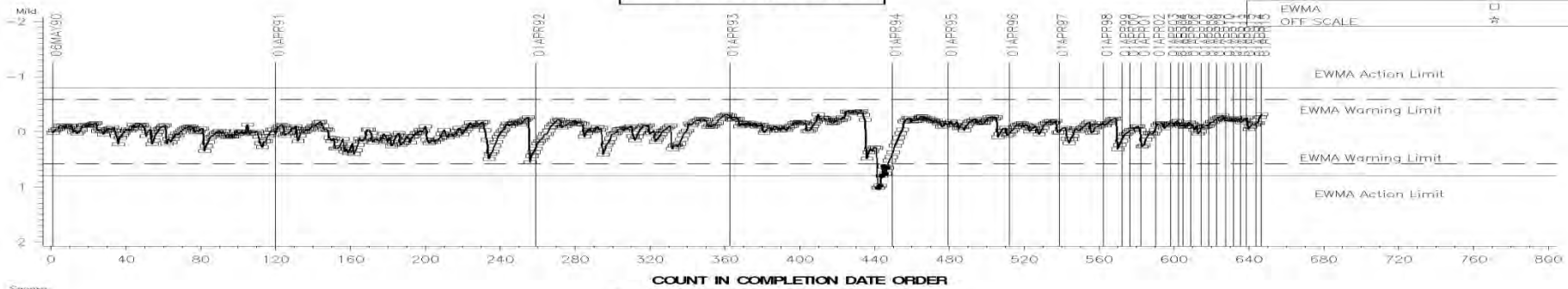
CUSUM Severity Analysis



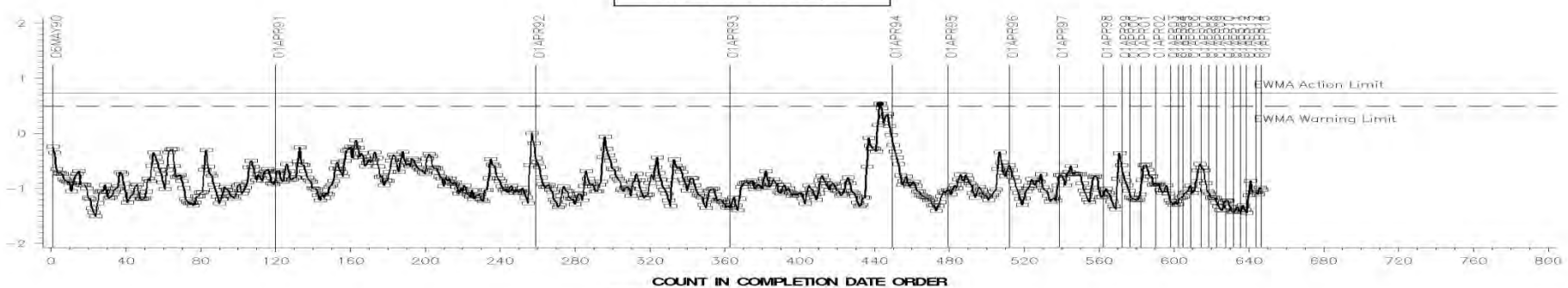
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FINAL EOTC

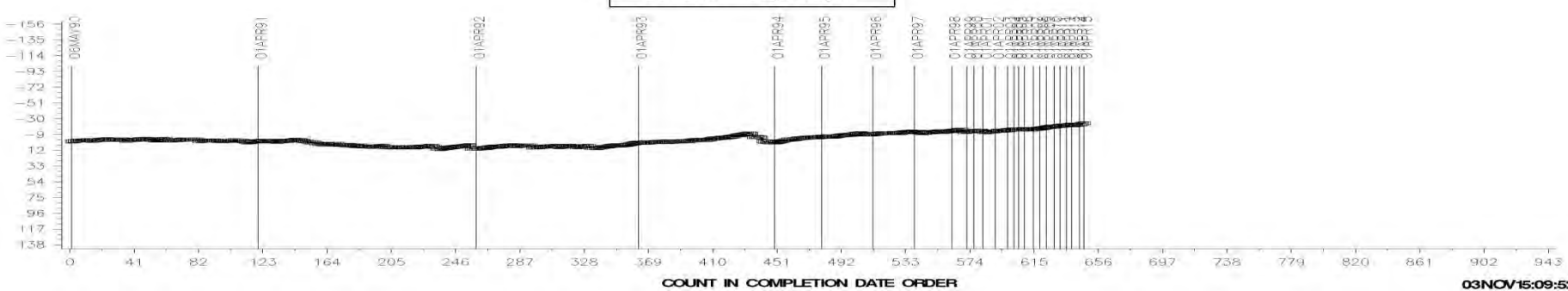
LTMS Severity Analysis



LTMS Precision Analysis



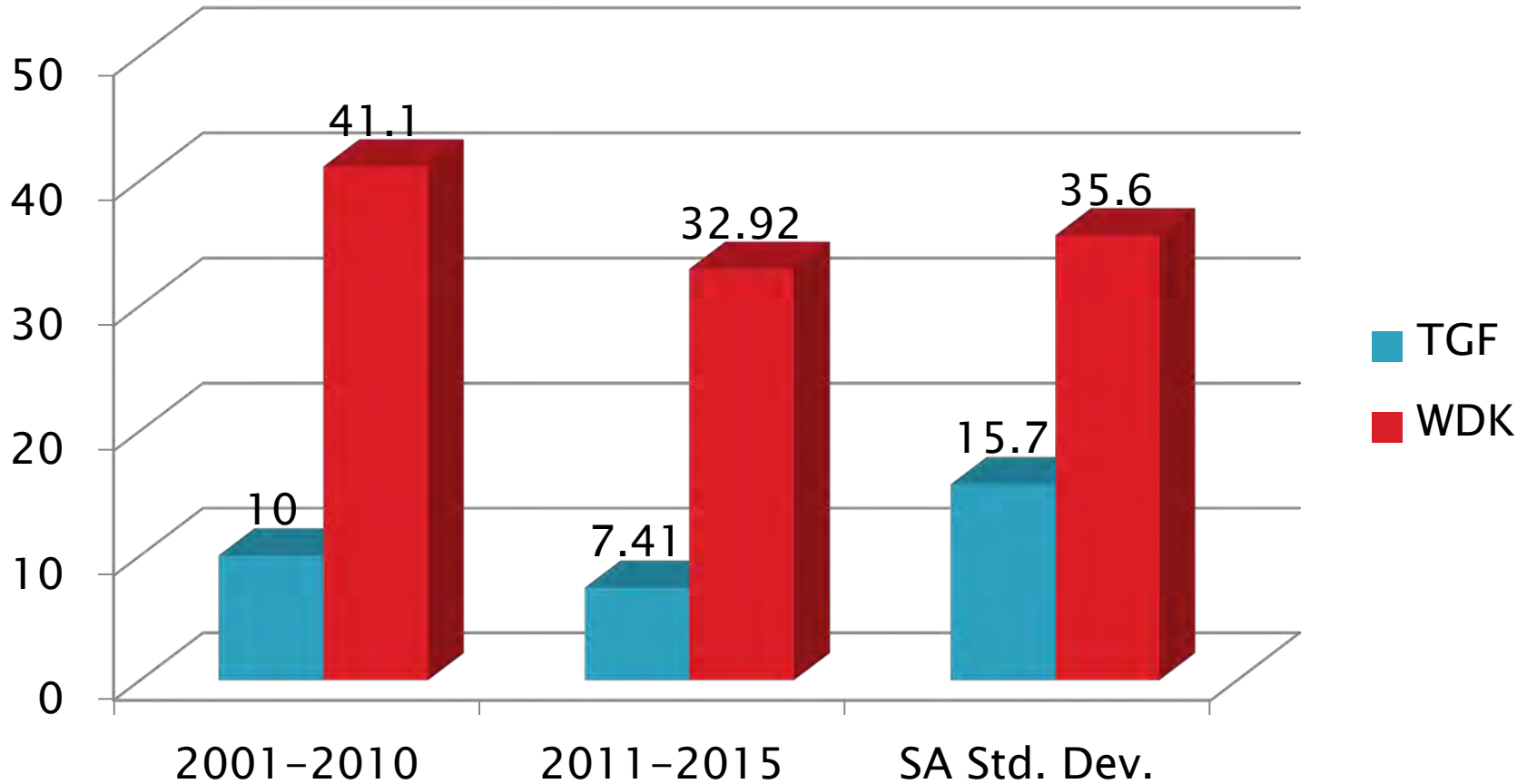
CUSUM Severity Analysis



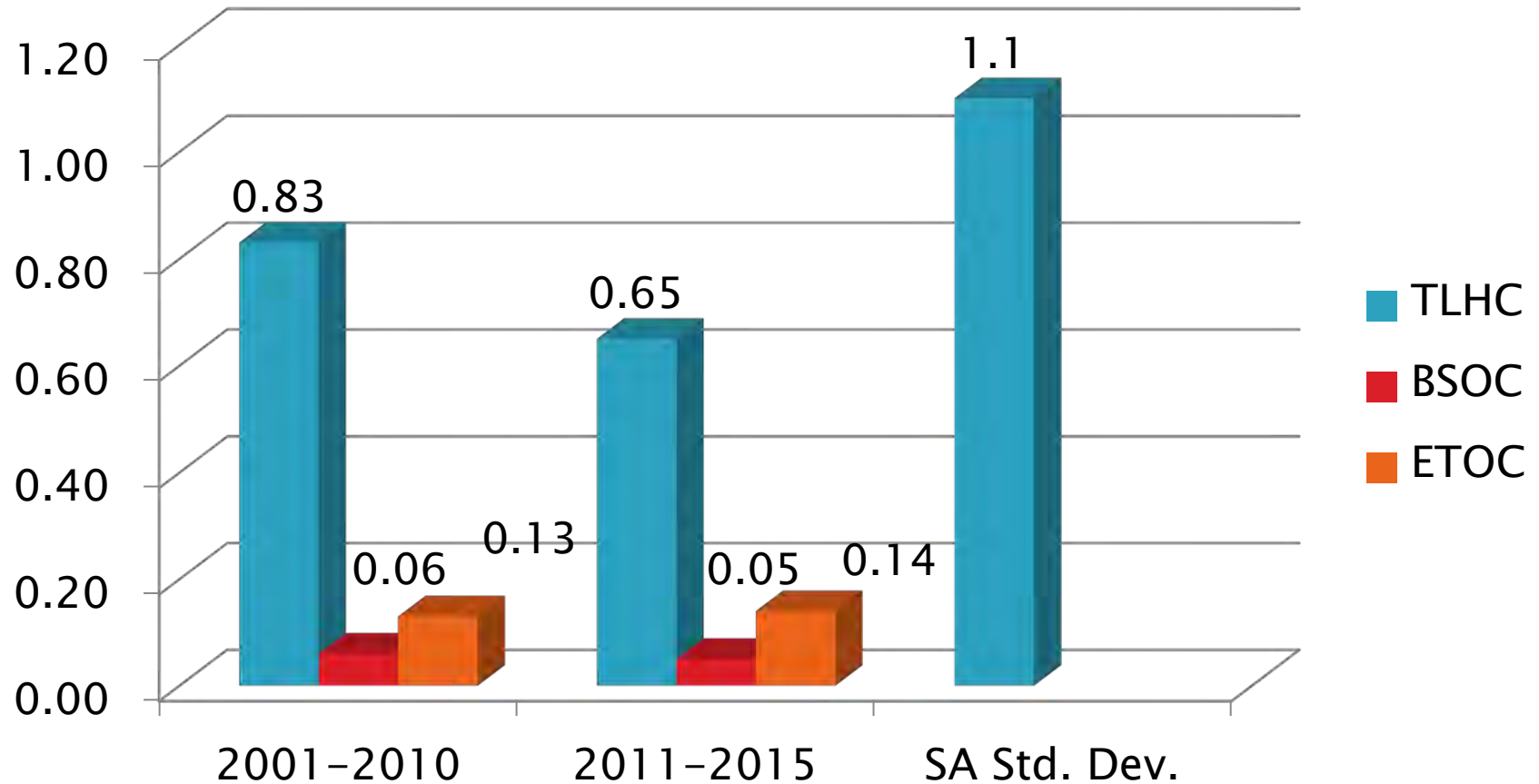
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# 1 K Precision Estimates



# 1K Precision Estimates



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# SCOTE 1N

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# 1 N Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	5
Failed Calibration Test	OC	1
Operationally Invalid	LC	0
Aborted	XC	2
<b>Total</b>		<b>8</b>

# 1 N Failed Tests

Failed Parameter	Number of Tests
Severe Top Groove Fill	1
<b>Total</b>	<b>1</b>

# 1 N Lost Tests\*

Status	Cause	#
Aborted	High Oil Consumption	1
Aborted	Loss of Oil Charge	1
<b>Total</b>		<b>2</b>

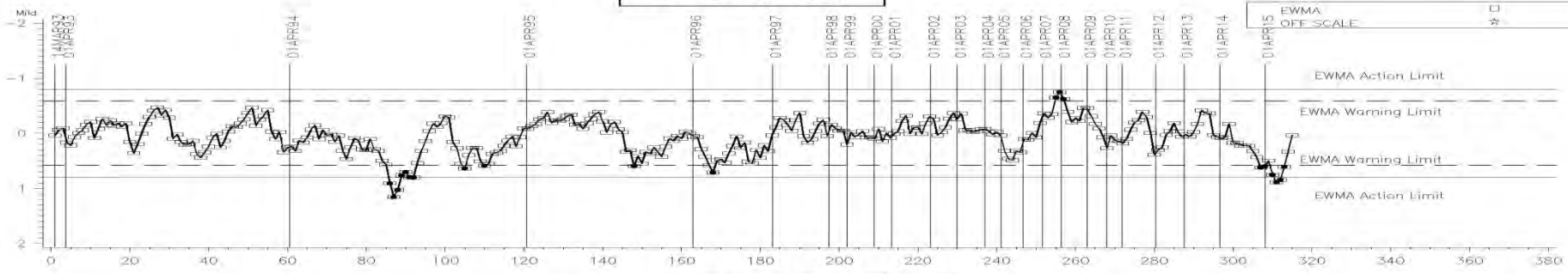
\*Invalid and aborted tests

# 1 N Test Severity

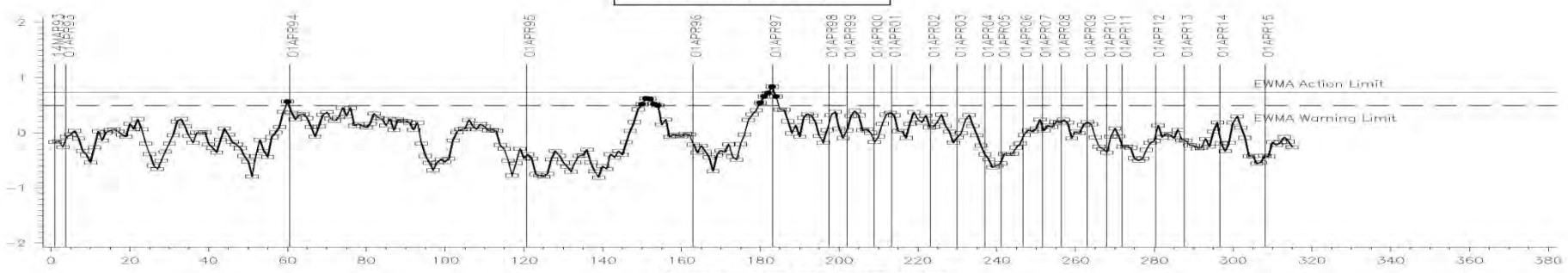
- ▶ BSOC in action alarm mild direction
- ▶ WDN in warning alarm mild direction
- ▶ TGF and TLHC in control
- ▶ WDN, TLHC, and BSOC trending mild
- ▶ Severity trends are being evaluated by surveillance panel

FINAL CORRECTED TGF

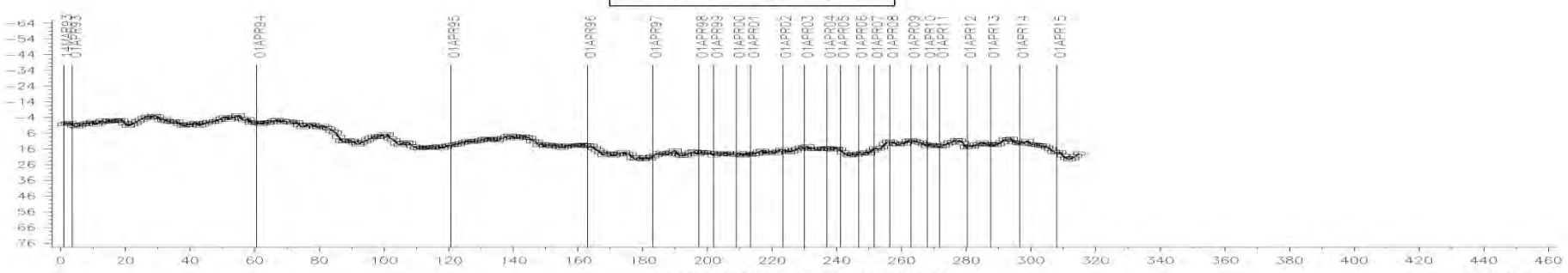
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

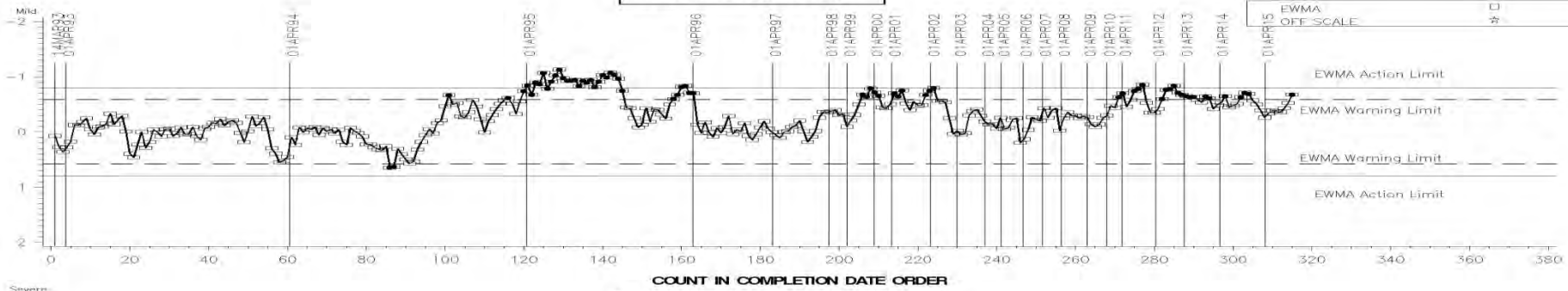


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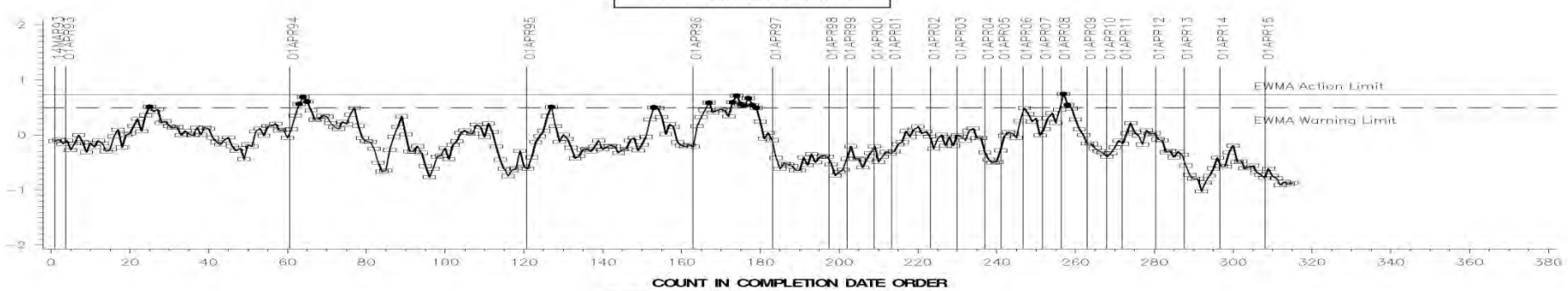


Weighted Total Demerits

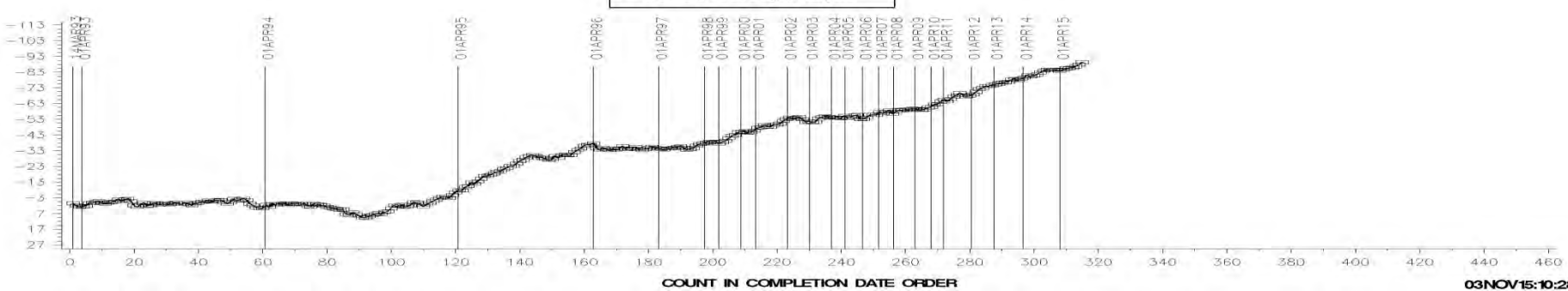
LTMS Severity Analysis



LTMS Precision Analysis



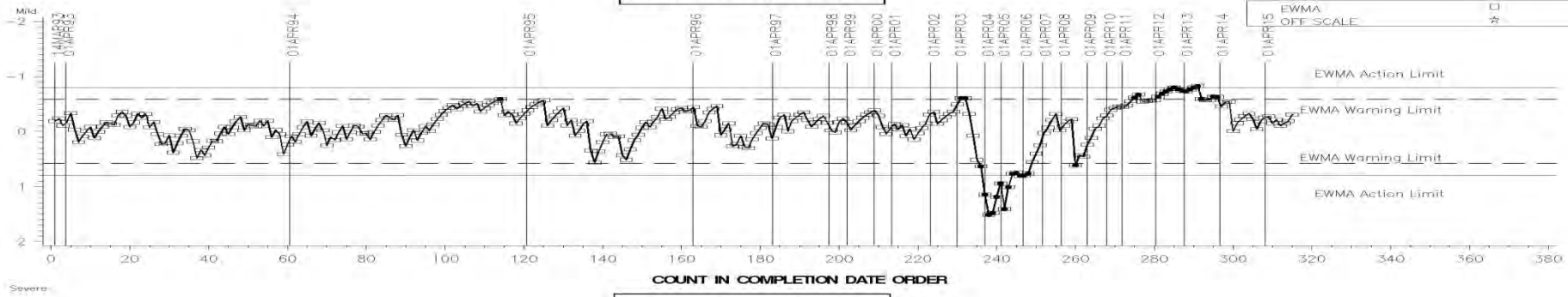
CUSUM Severity Analysis



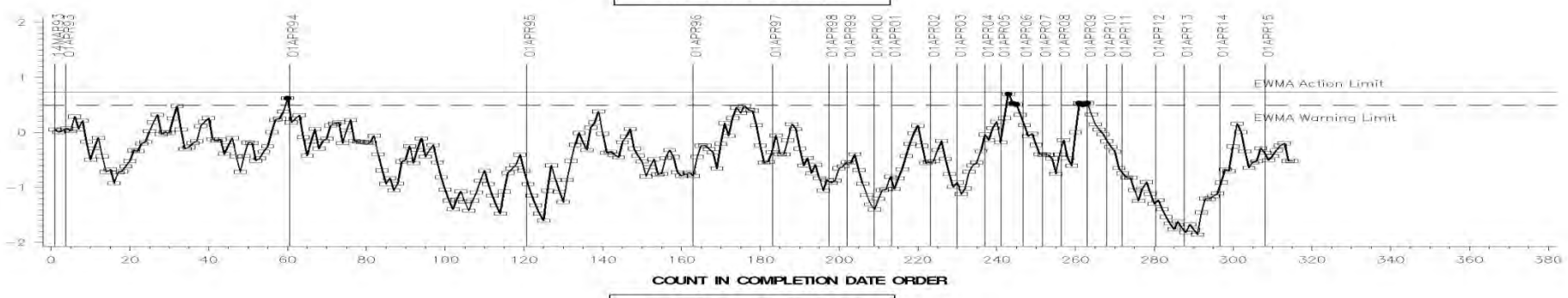
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Top Land Heavy Carbon

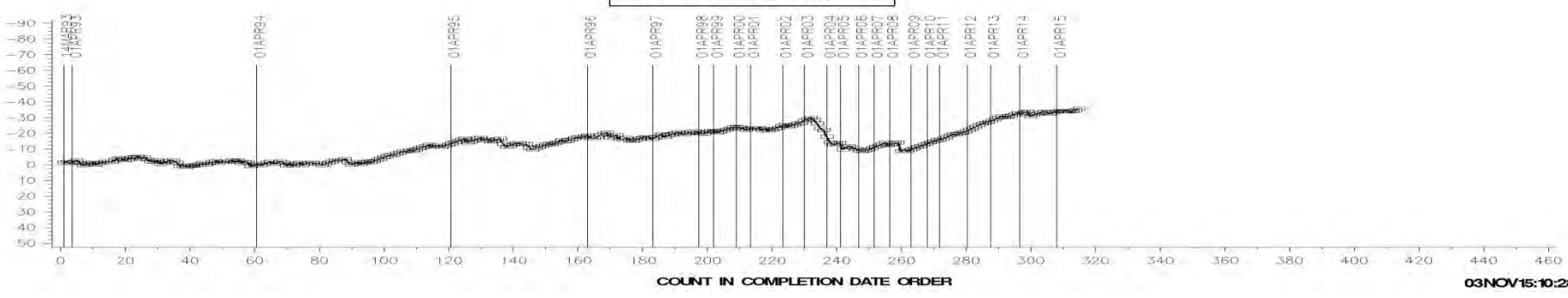
LTMS Severity Analysis



LTMS Precision Analysis



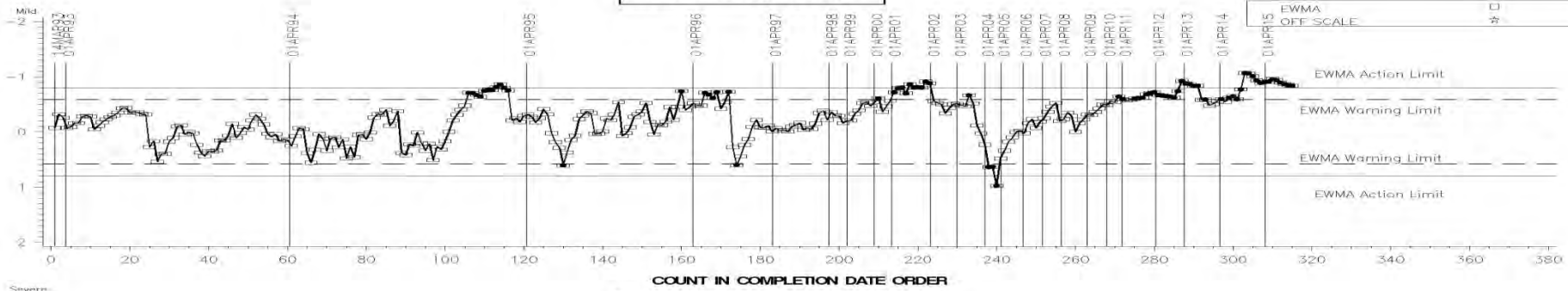
CUSUM Severity Analysis



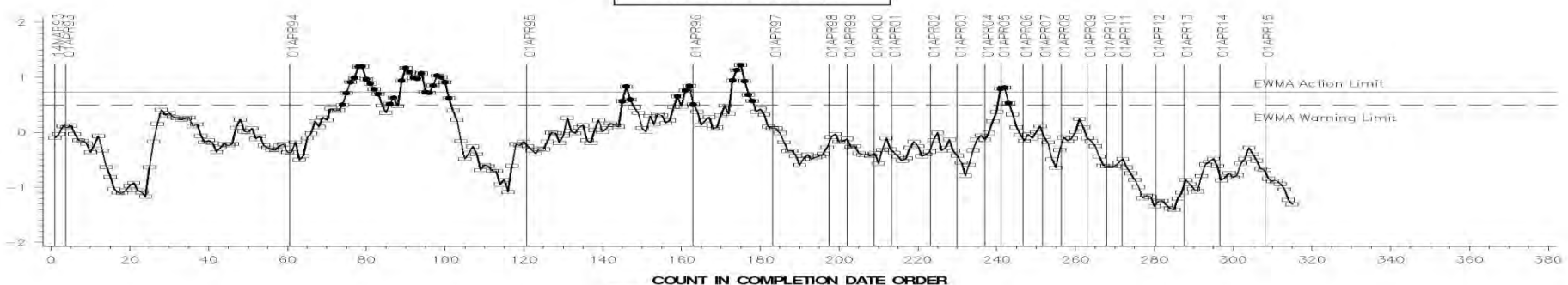
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BSOC

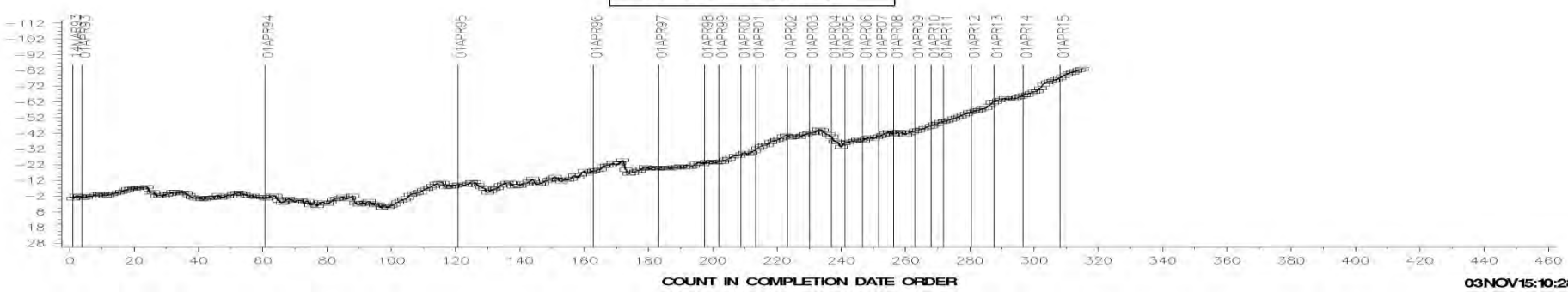
LTMS Severity Analysis



LTMS Precision Analysis



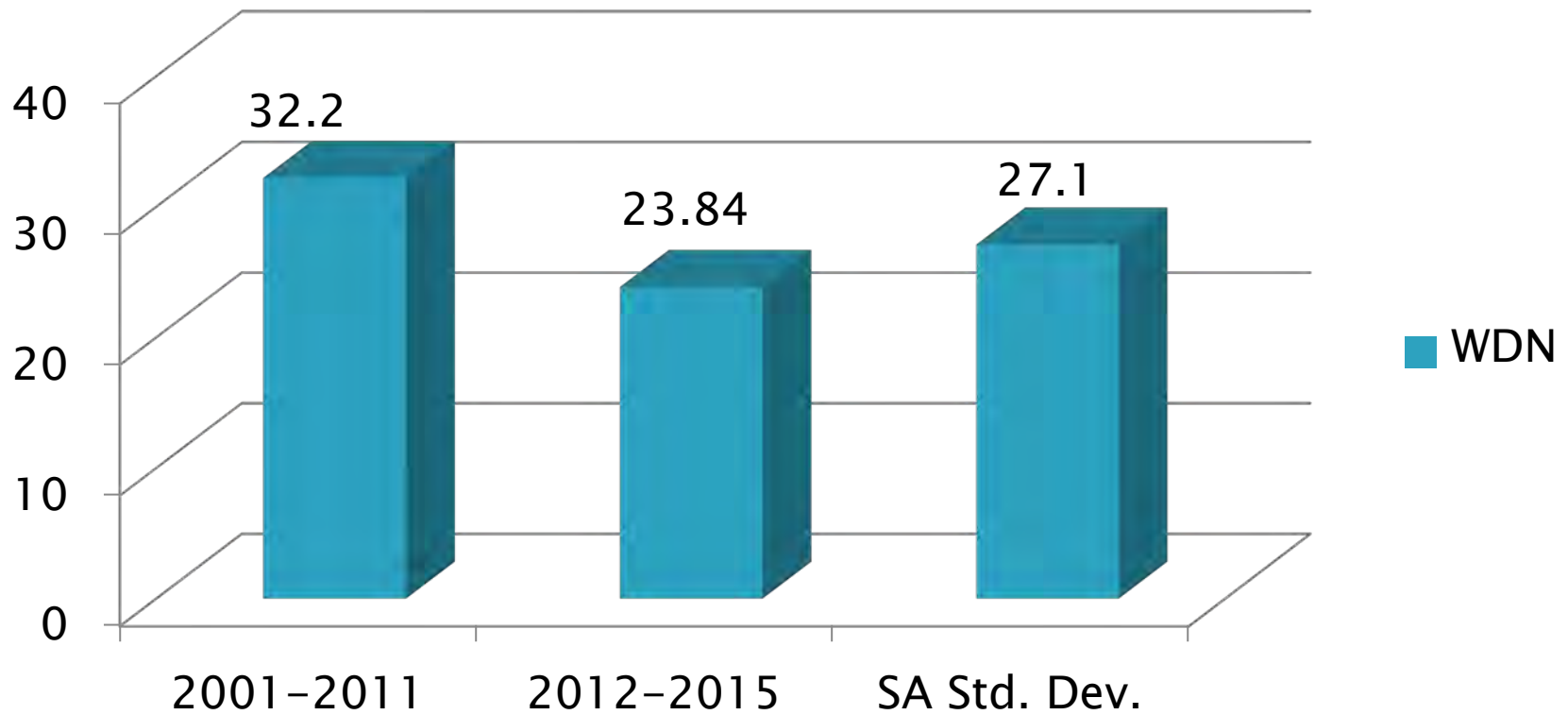
CUSUM Severity Analysis



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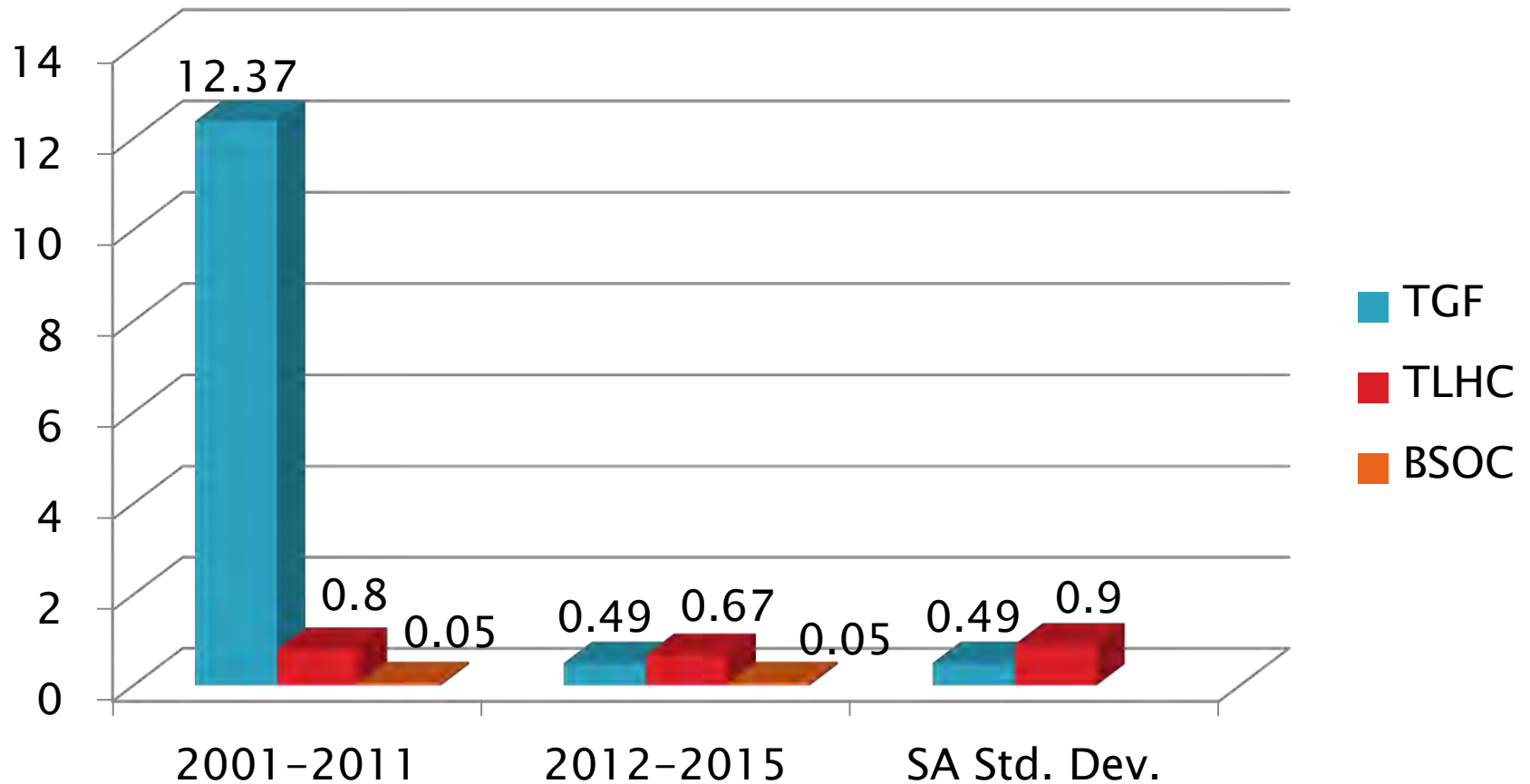
# 1 N Precision Estimates

WDN





# 1N Precision Estimates



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# SCOTE 1M-PC

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# 1 M-PC Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	1
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>2</b>

# 1 M-PC Failed Tests

Failed Parameter	Number of Tests
Mild Top Groove Fill	1
<b>Total</b>	<b>1</b>



# 1 M-PC Lost Tests\*

Status	Cause	#
Invalid	No Invalid Tests	0
Aborted	No Aborted Tests	0
<b>Total</b>		<b>0</b>

\*Invalid and aborted tests

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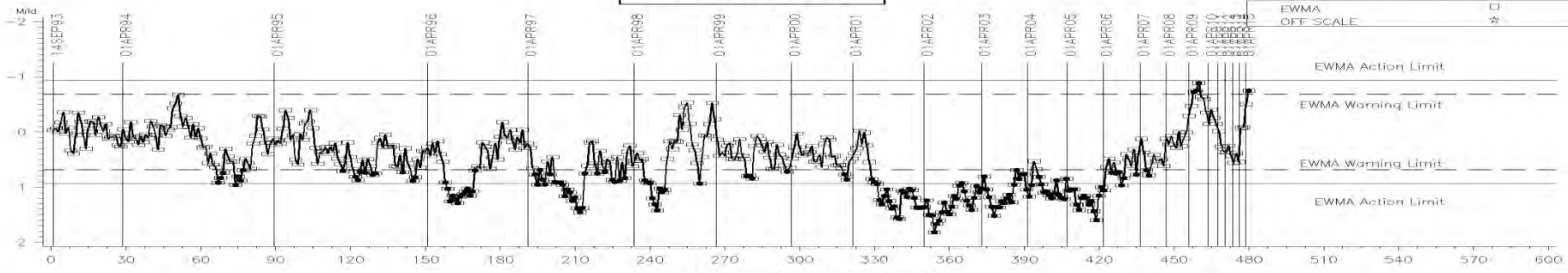
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# 1 M-PC Test Severity

- ▶ TGF in warning alarm mild direction.
- ▶ TGF in precision warning alarm.
- ▶ WTD in control.

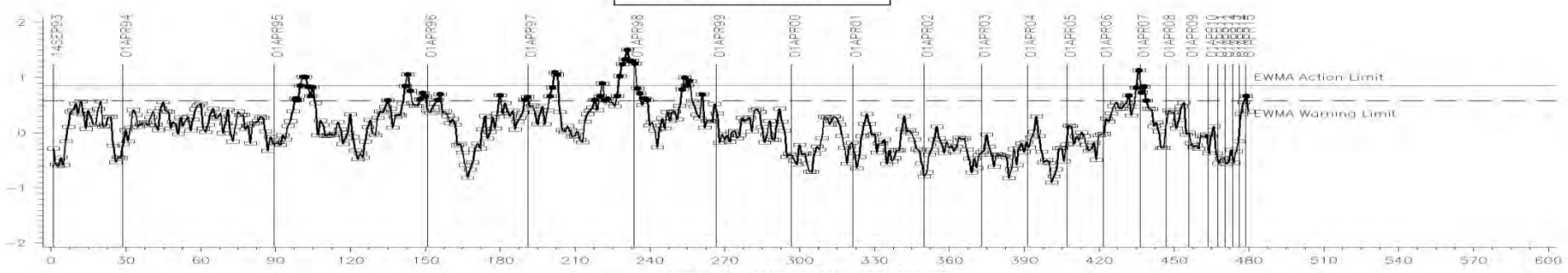
FINAL TOP GROOVE FILLING

LTMS Severity Analysis



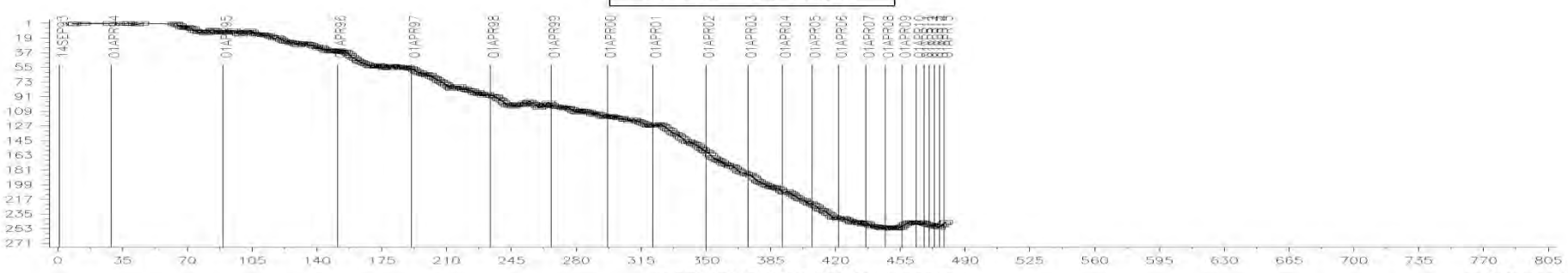
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

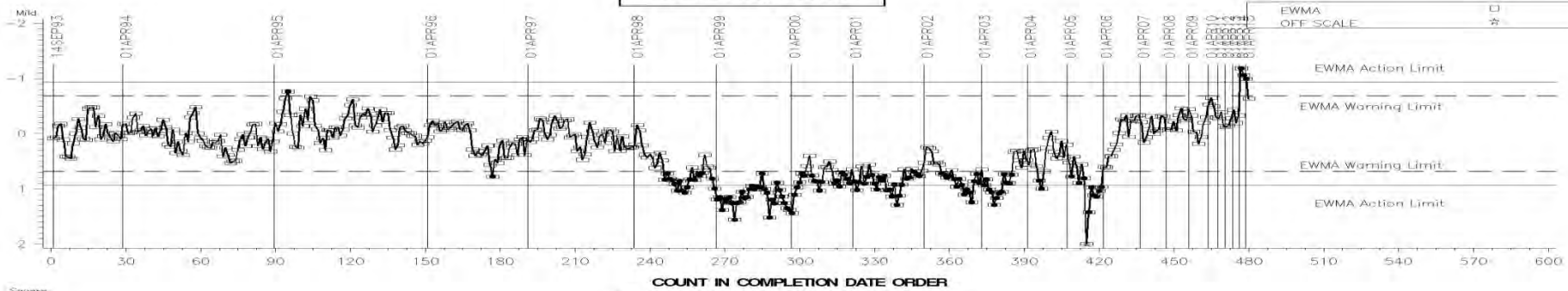


COUNT IN COMPLETION DATE ORDER

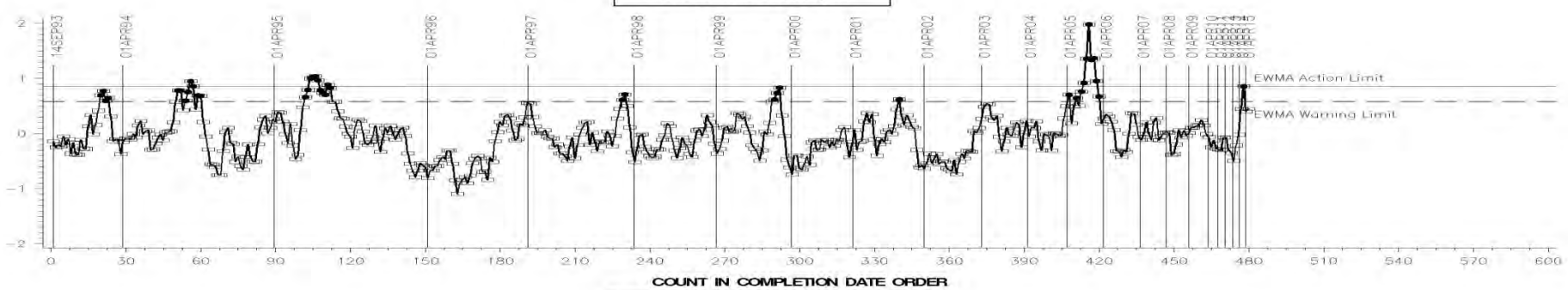
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Weighted Total Demerits

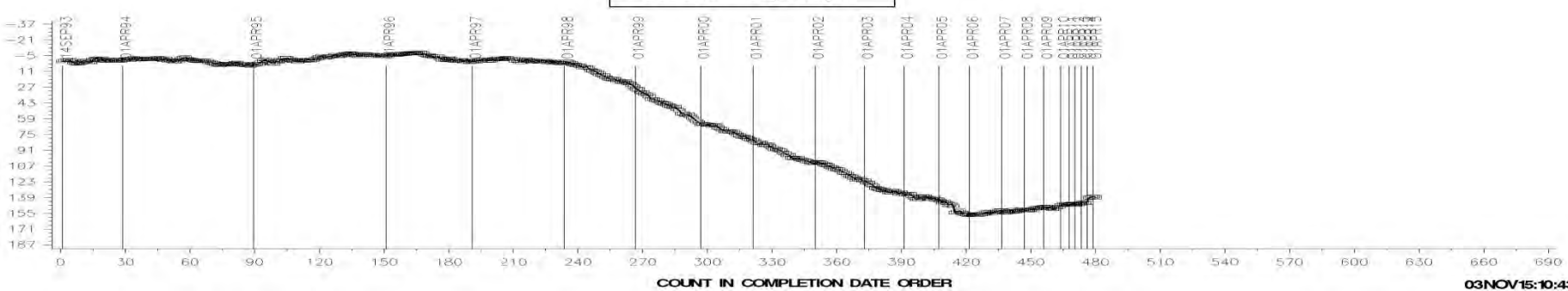
LTMS Severity Analysis



LTMS Precision Analysis

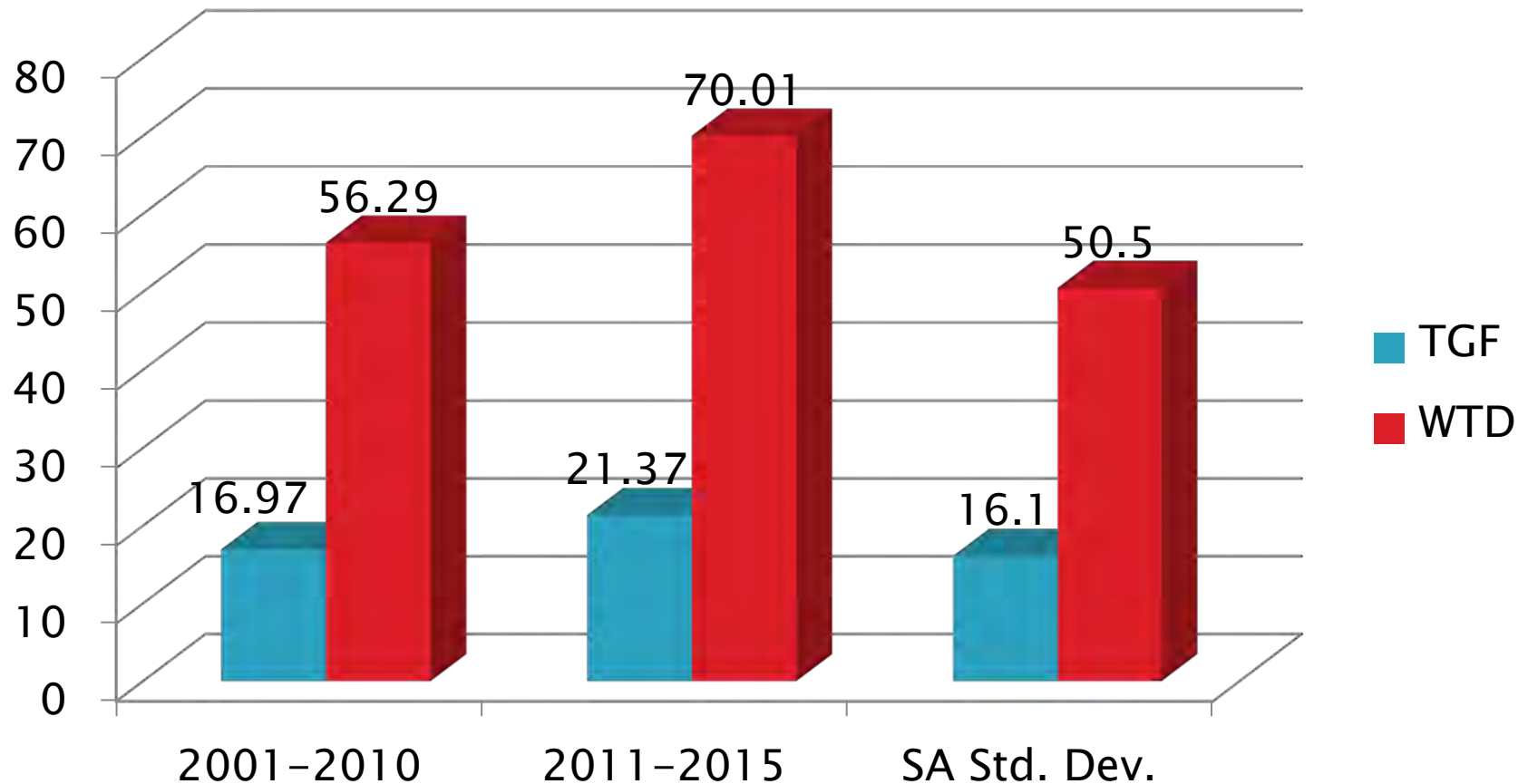


CUSUM Severity Analysis



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# 1 MPC Precision Estimates



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# SCOTE 1 P

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# 1P Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	3
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
Donated	AG	1
<b>Total</b>		<b>4</b>

# 1 P Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
<b>Total</b>	<b>0</b>



# 1P Lost Tests\*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
<b>Total</b>		<b>0</b>

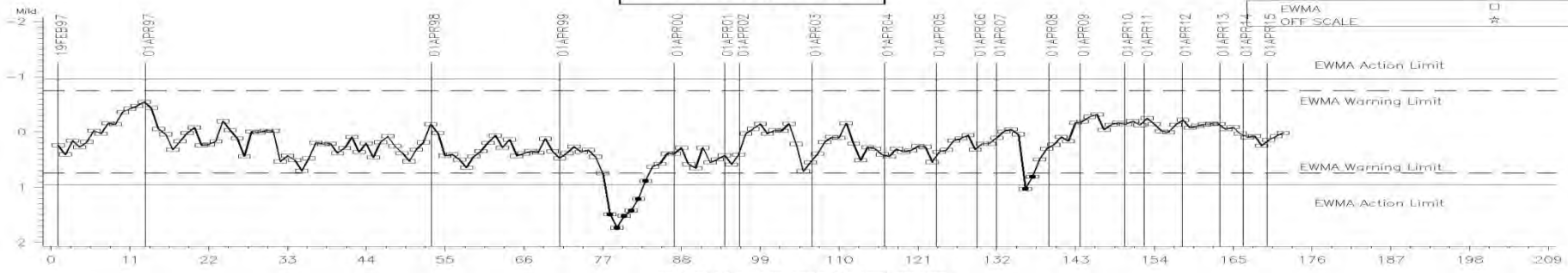
\*Invalid and aborted tests

# 1 P Test Severity

- ▶ EOTOC is in action alarm severe direction.
- ▶ OC in warning alarm severe direction.
- ▶ TGC, TLC and WD are in control.

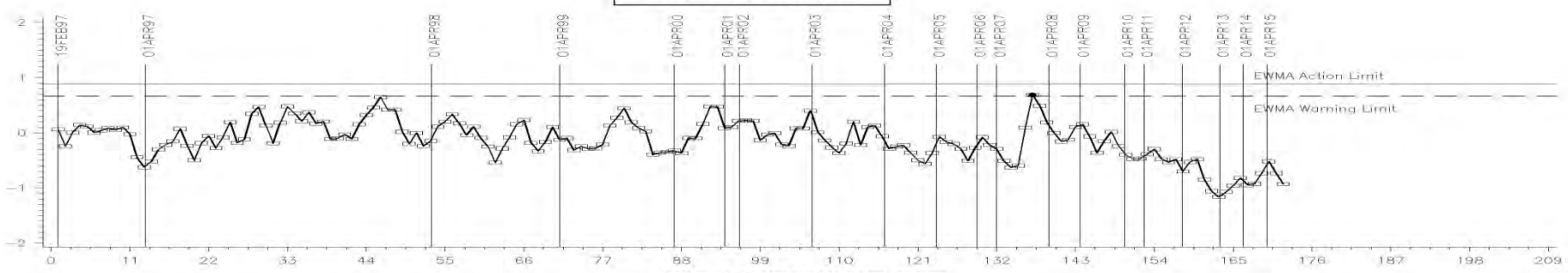
TOP GROOVE CARBON

LTMS Severity Analysis



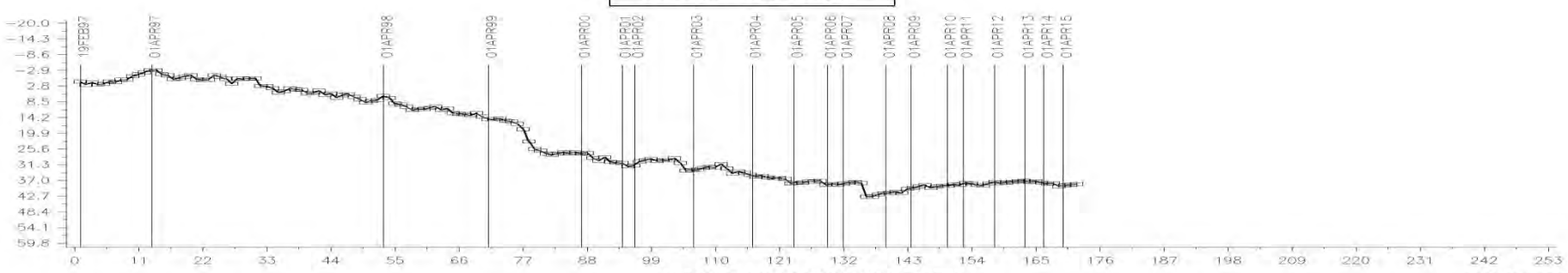
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

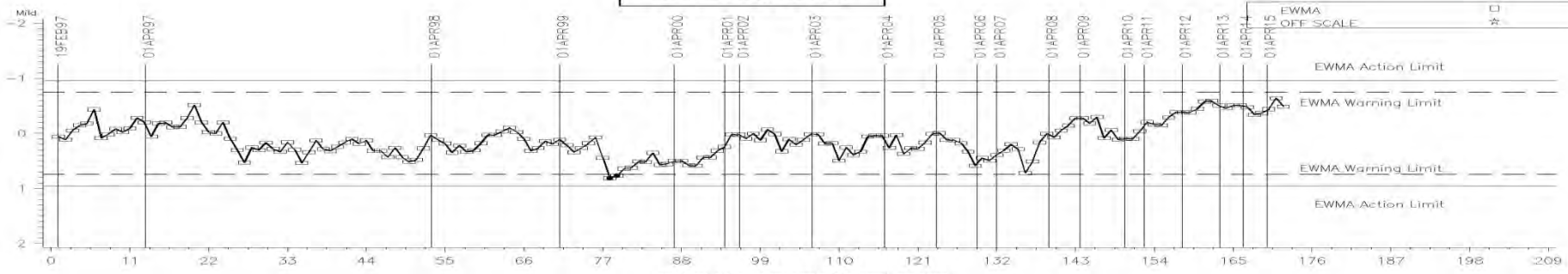


COUNT IN COMPLETION DATE ORDER

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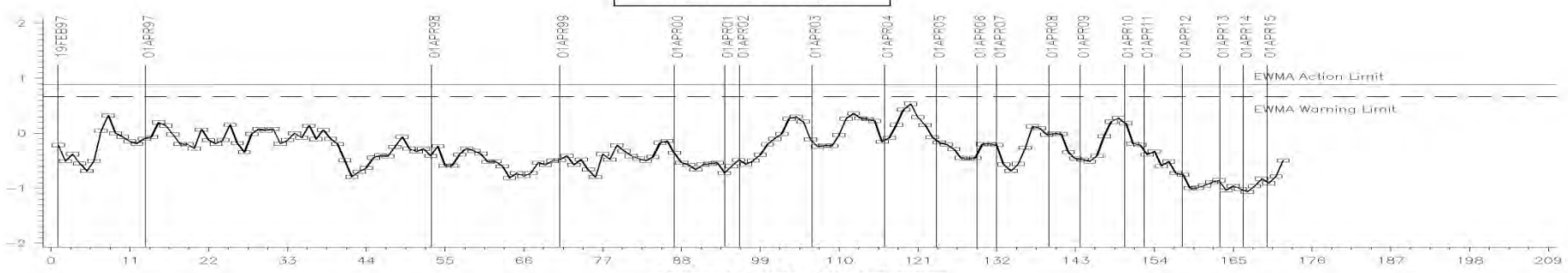
TOP LAND CARBON

LTMS Severity Analysis



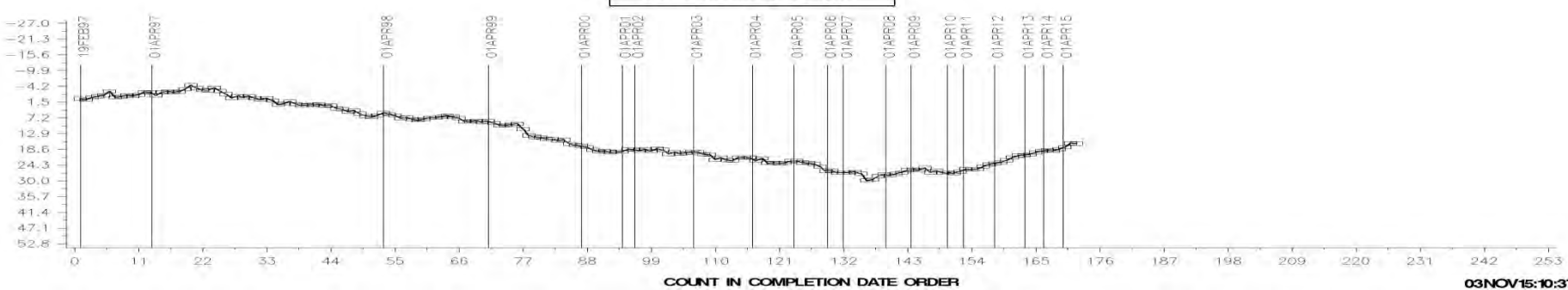
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

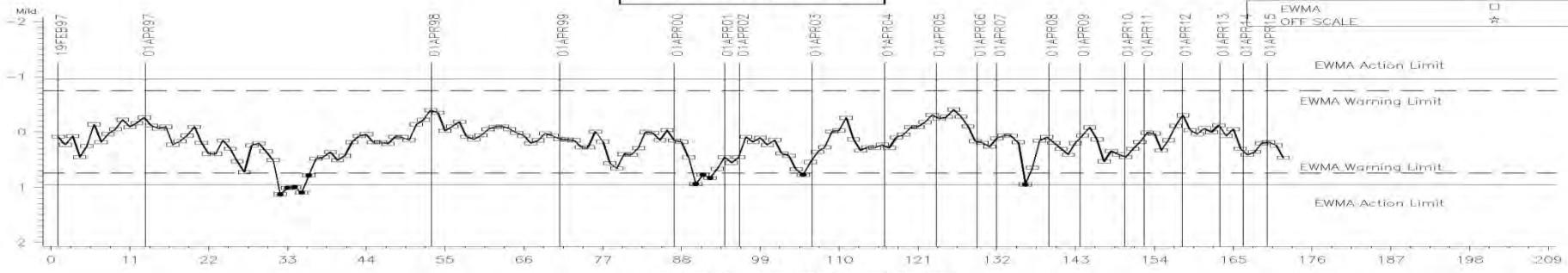
CUSUM Severity Analysis



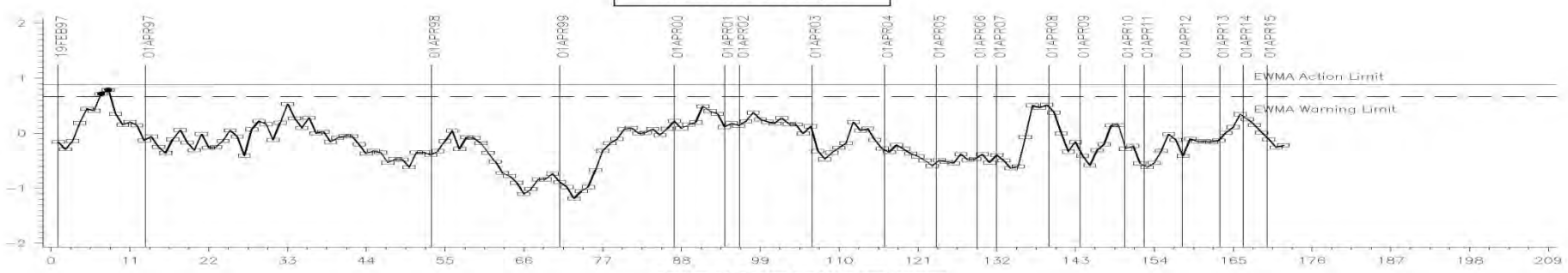
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WEIGHTED TOTAL DEMERITS

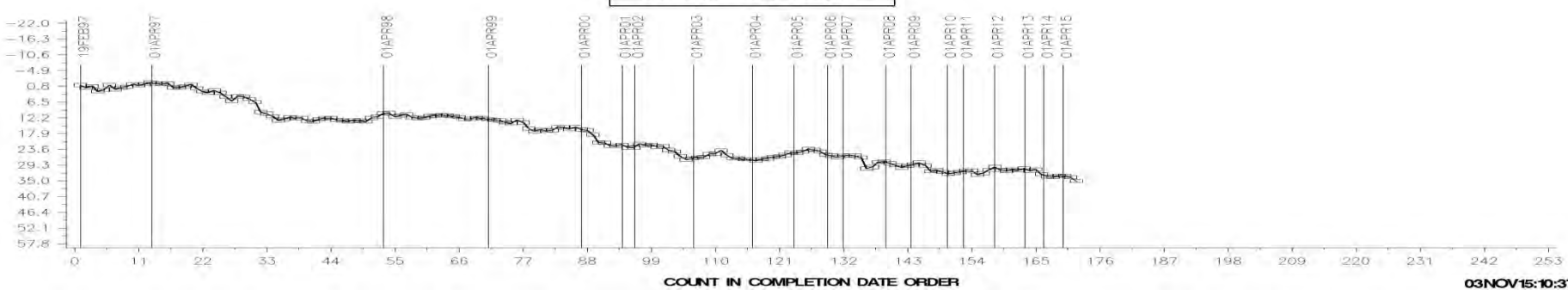
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

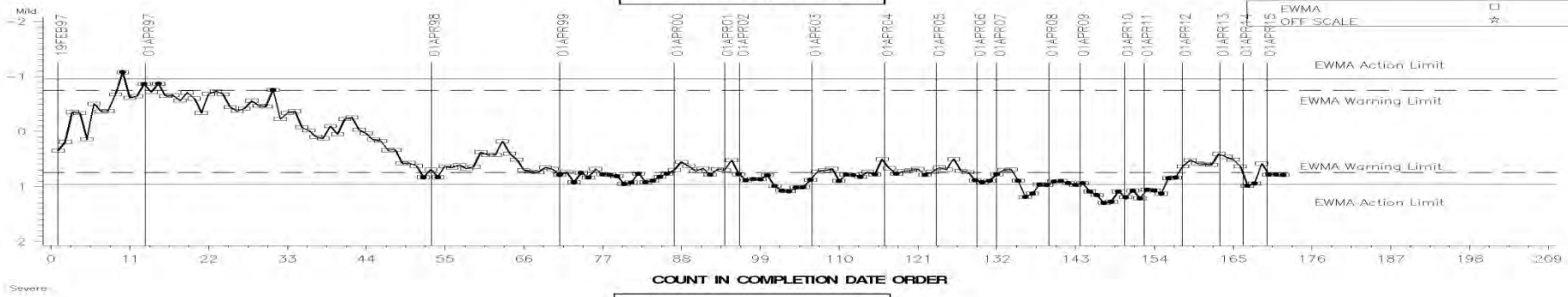


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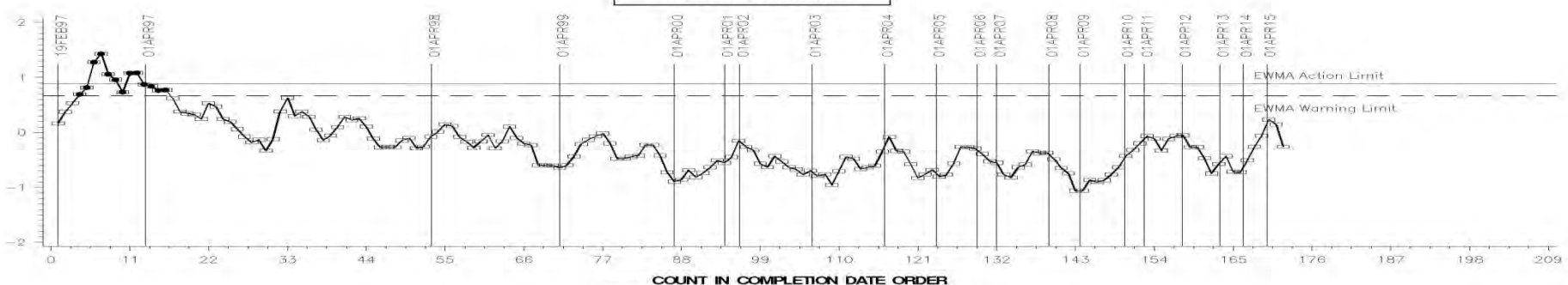


OIL CONSUMPTION

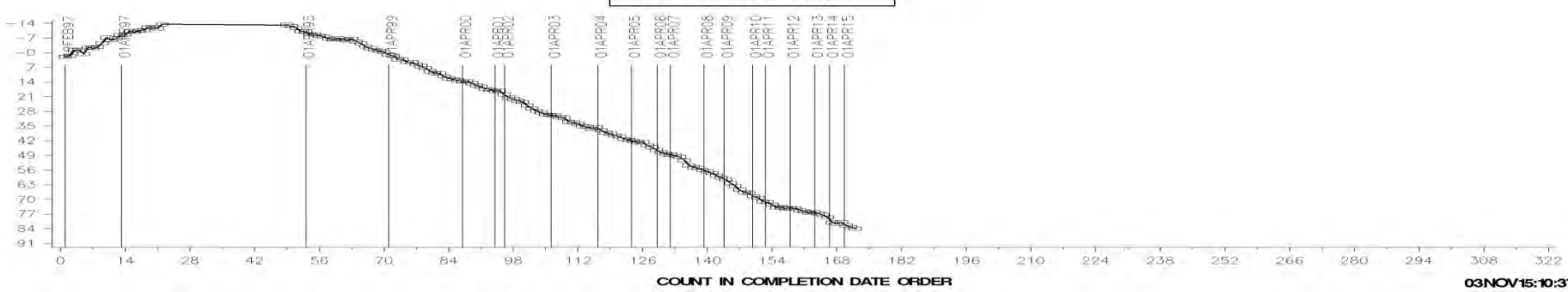
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

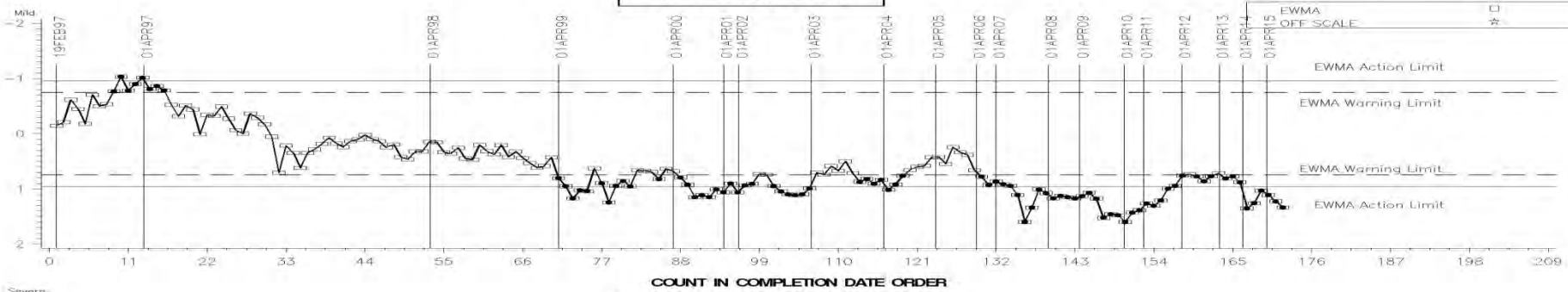


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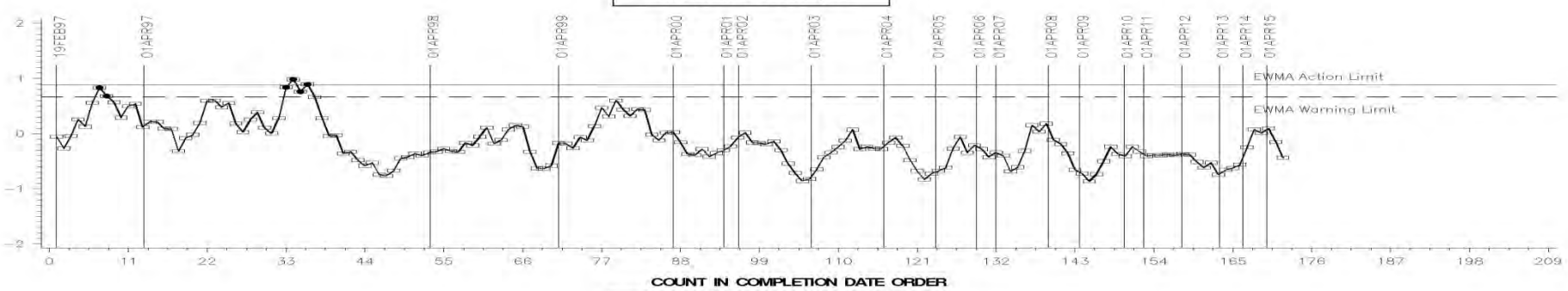


EOTOC

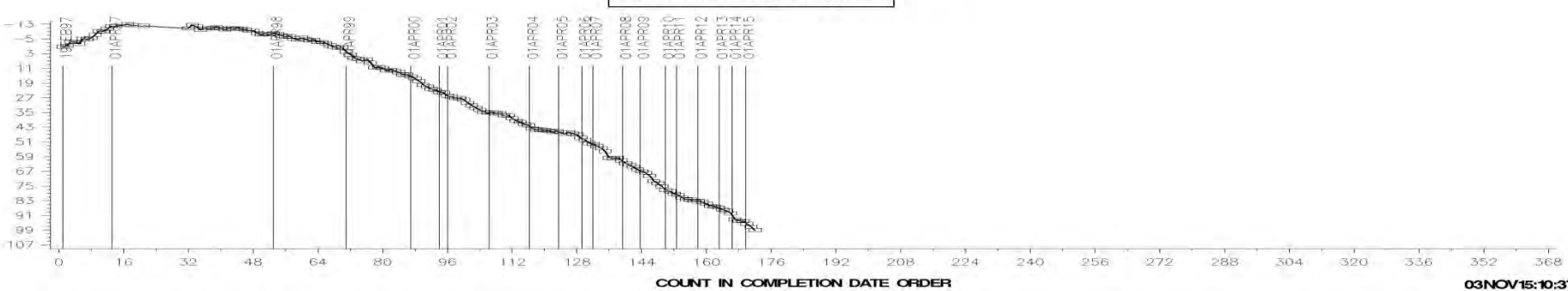
LTMS Severity Analysis



LTMS Precision Analysis

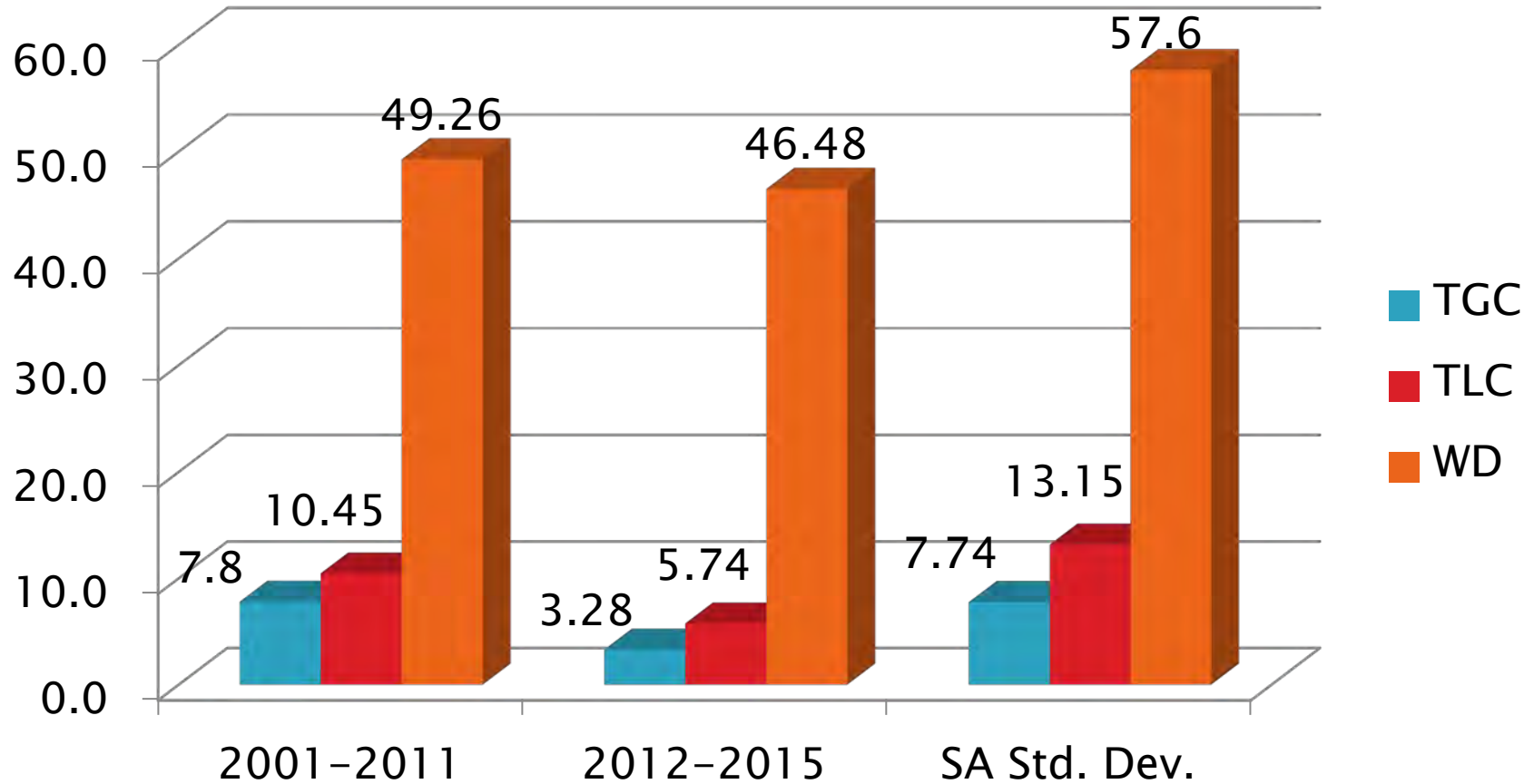


CUSUM Severity Analysis

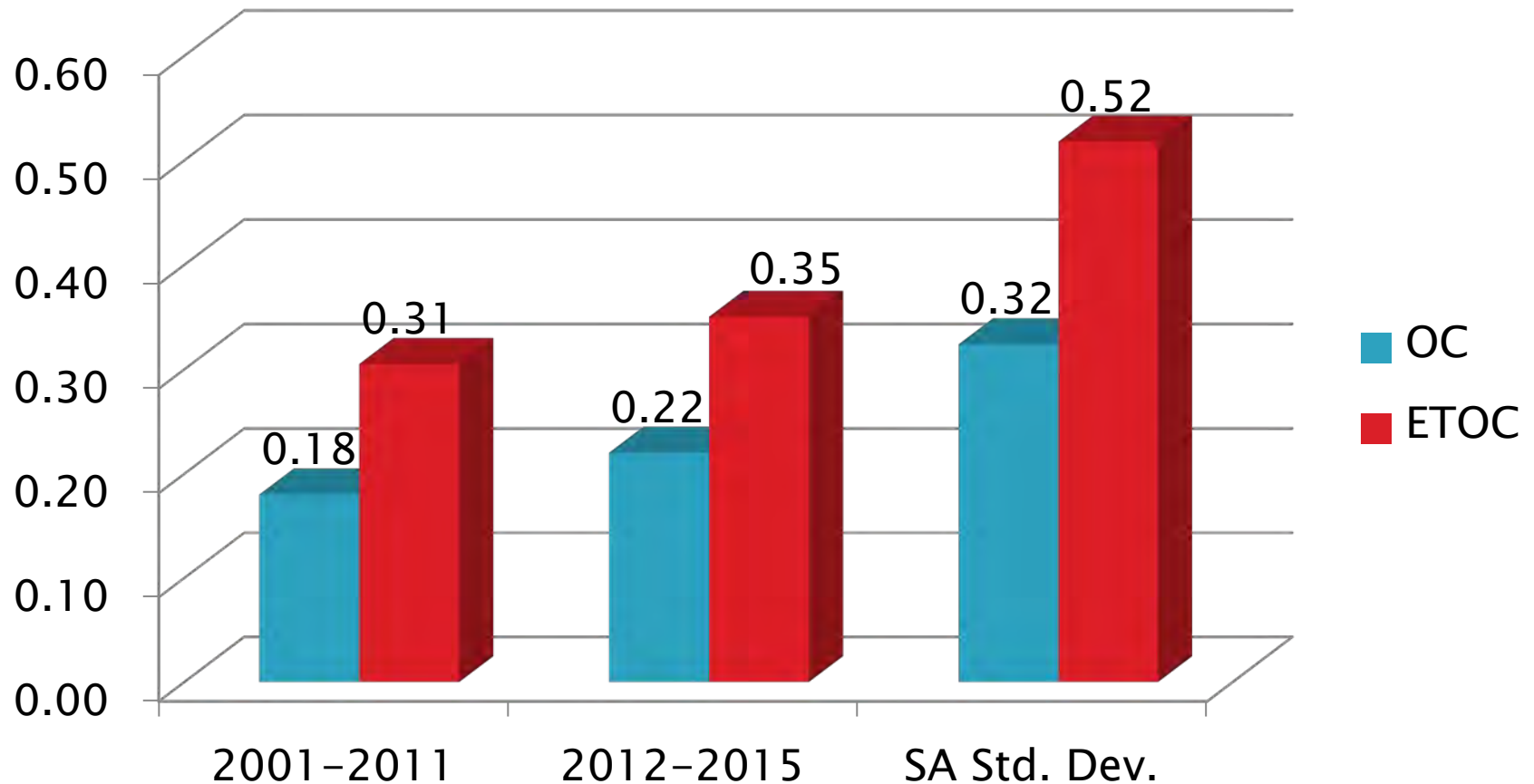


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# 1P Precision Estimates



# 1P Precision Estimates



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# SCOTE 1 R

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# 1 R Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	0
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>0</b>

# 1 R Failed Tests

Failed Parameter	Number of Tests
No Failed Tests	0
Total	0



# 1 R Lost Tests\*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
<b>Total</b>		<b>0</b>

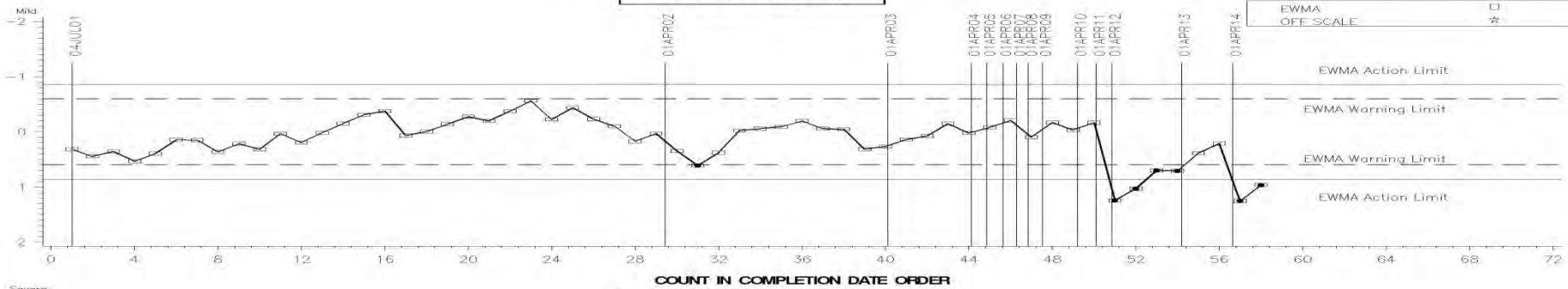
\*Invalid and aborted tests

# 1 R Test Severity

- ▶ As no 1R tests were reported this period no statement about test severity or precision can be made.

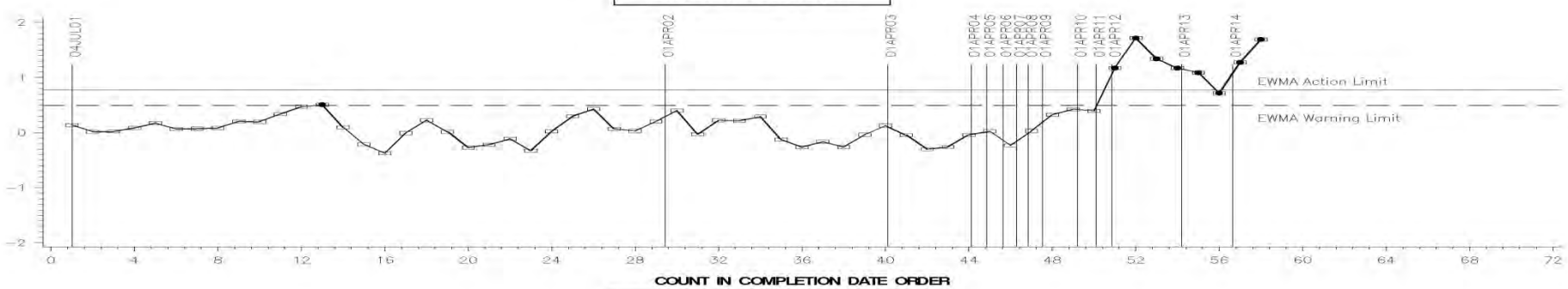
FINAL WEIGHTED TOTAL DEMERITS (DEMERITS)

LTMS Severity Analysis



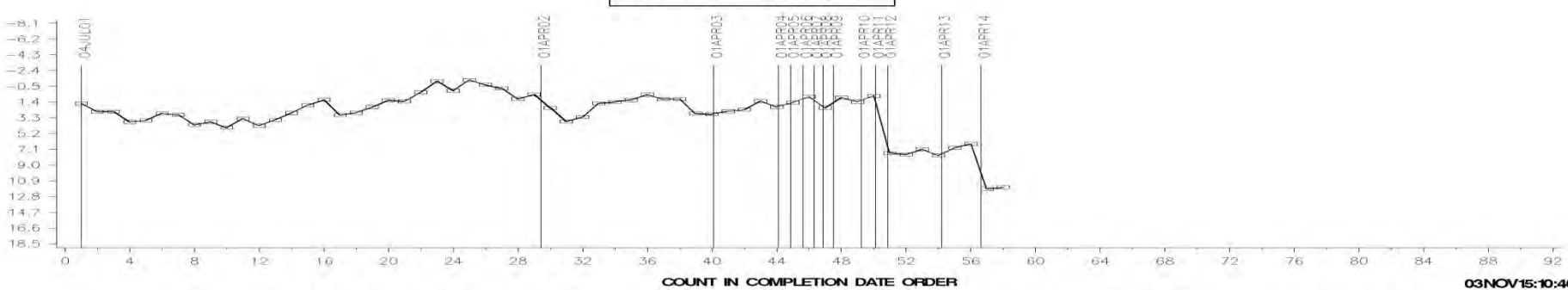
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

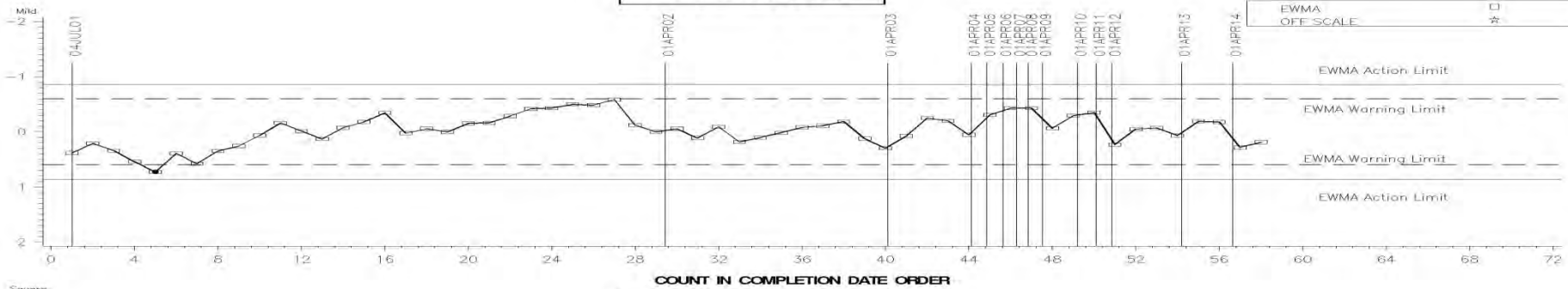


COUNT IN COMPLETION DATE ORDER

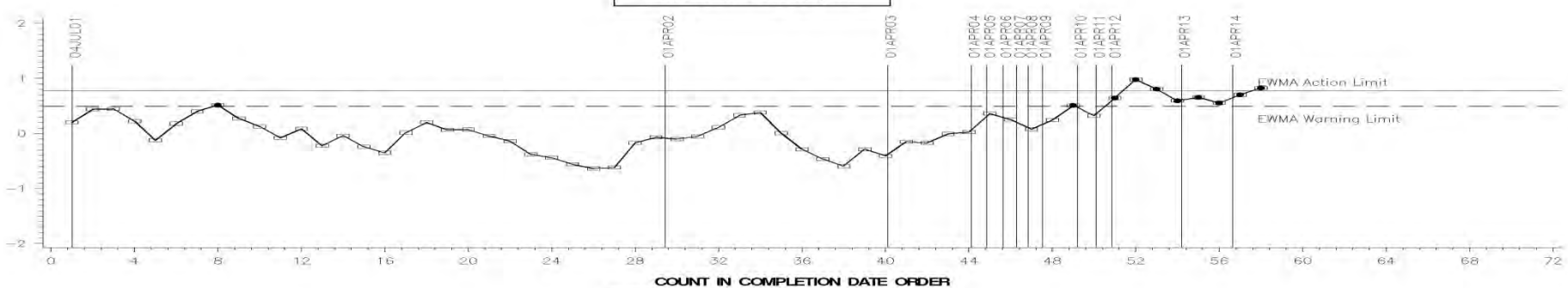
03NOV15:10:40

FINAL TOP GROOVE CARBON (DEMERITS)

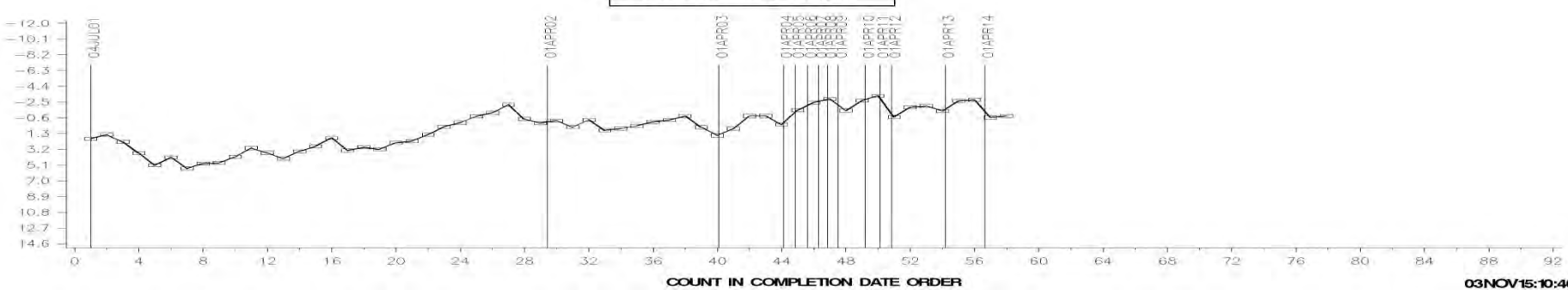
LTMS Severity Analysis



LTMS Precision Analysis



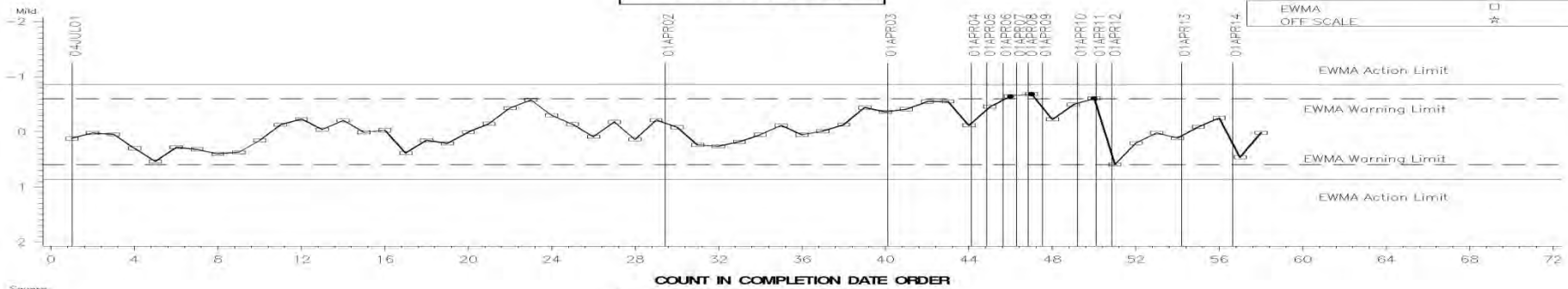
CUSUM Severity Analysis



03NOV15:10:40

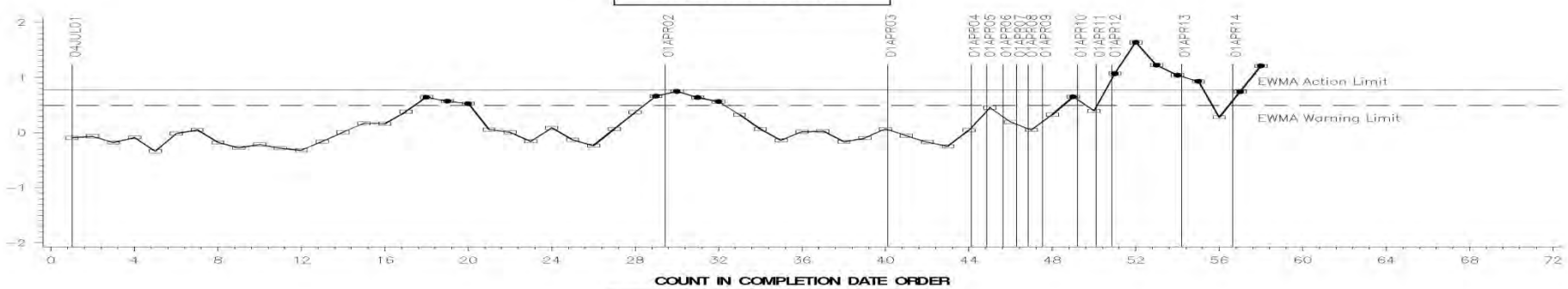
FINAL TOP LAND CARBON (DEMERITS)

LTMS Severity Analysis



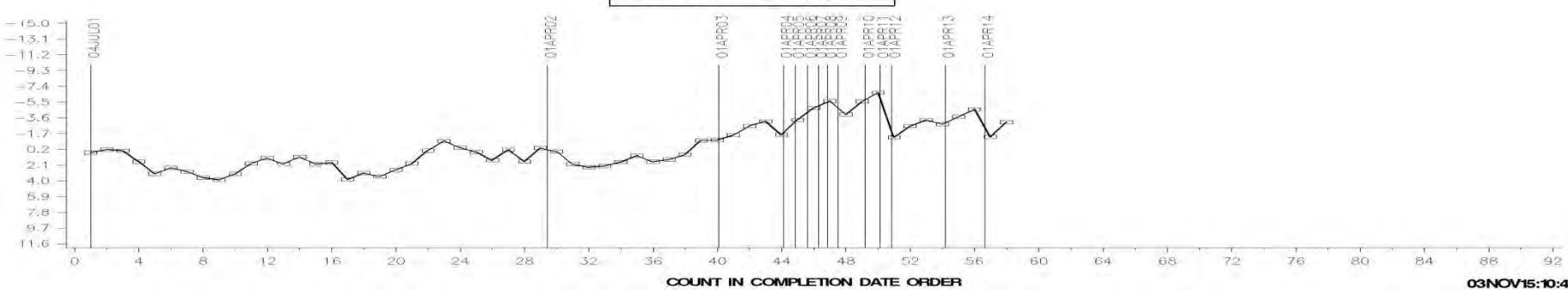
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



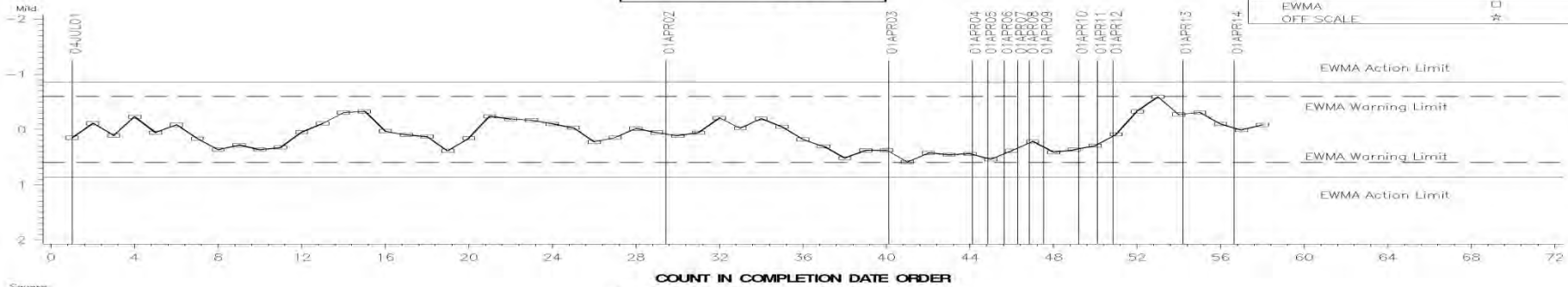
COUNT IN COMPLETION DATE ORDER

03NOV15:10:41



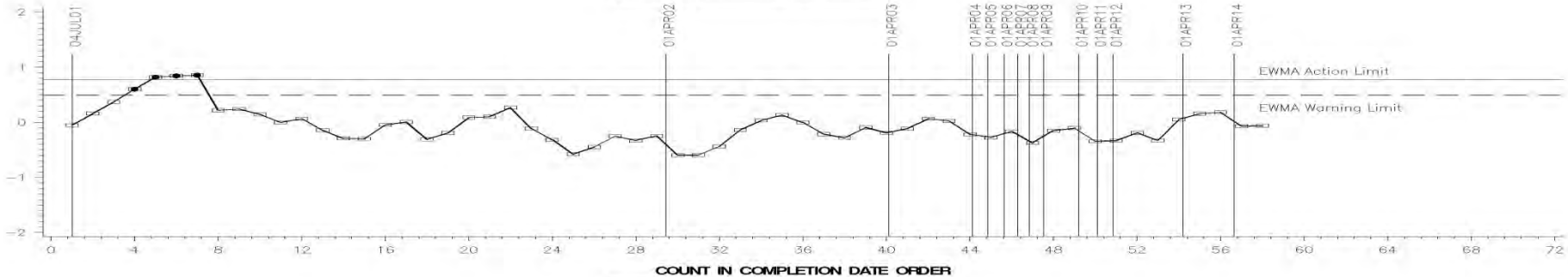
FINAL BOTOC

LTMS Severity Analysis



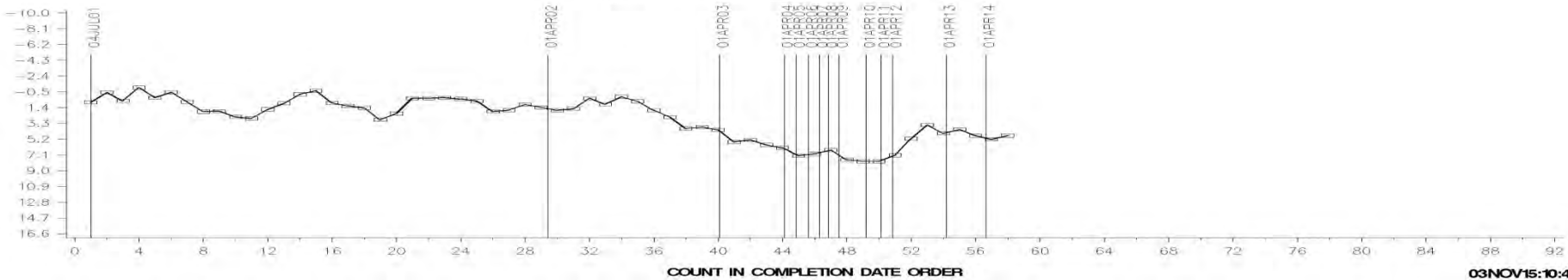
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis



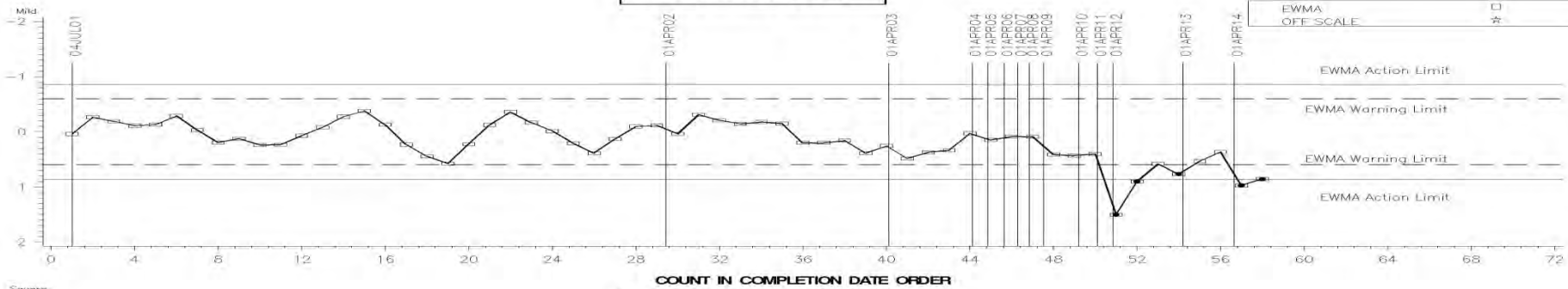
COUNT IN COMPLETION DATE ORDER

03NOV15:10:41



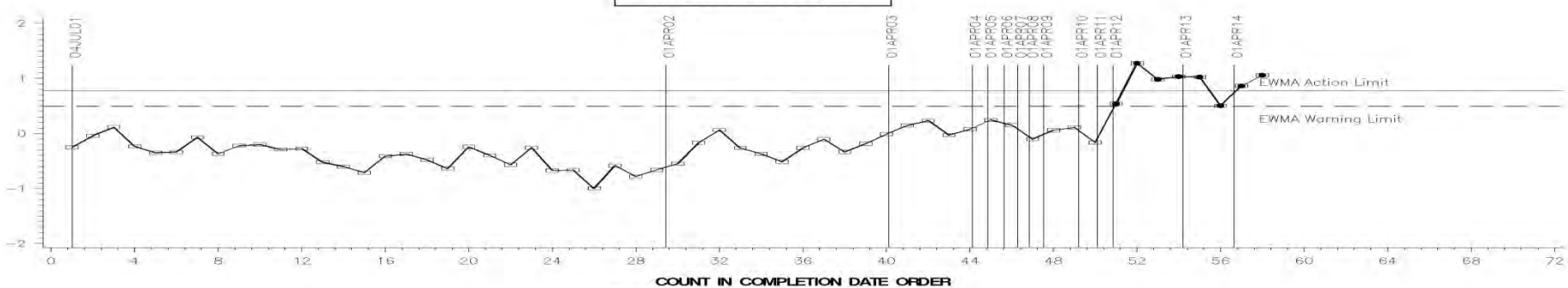
FINAL EOTC (g/h)

LTMS Severity Analysis



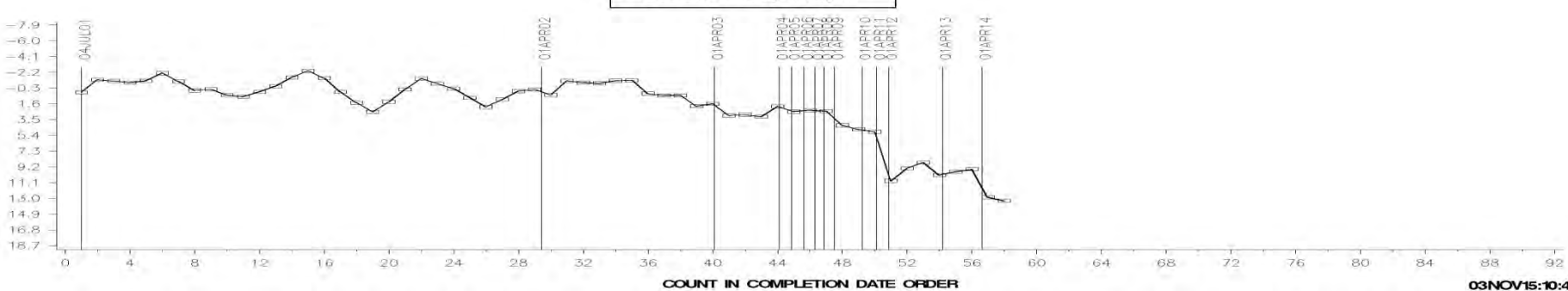
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

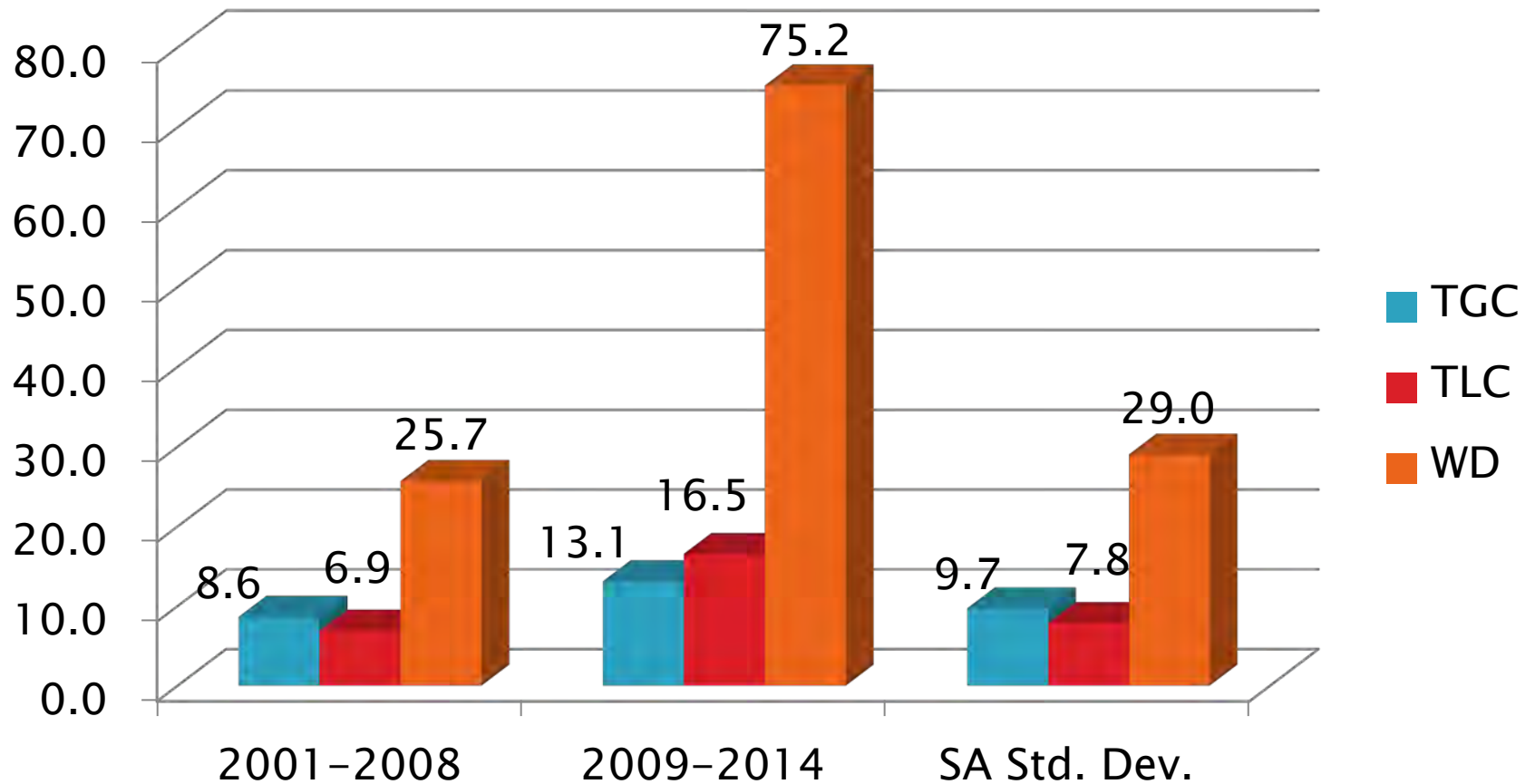
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

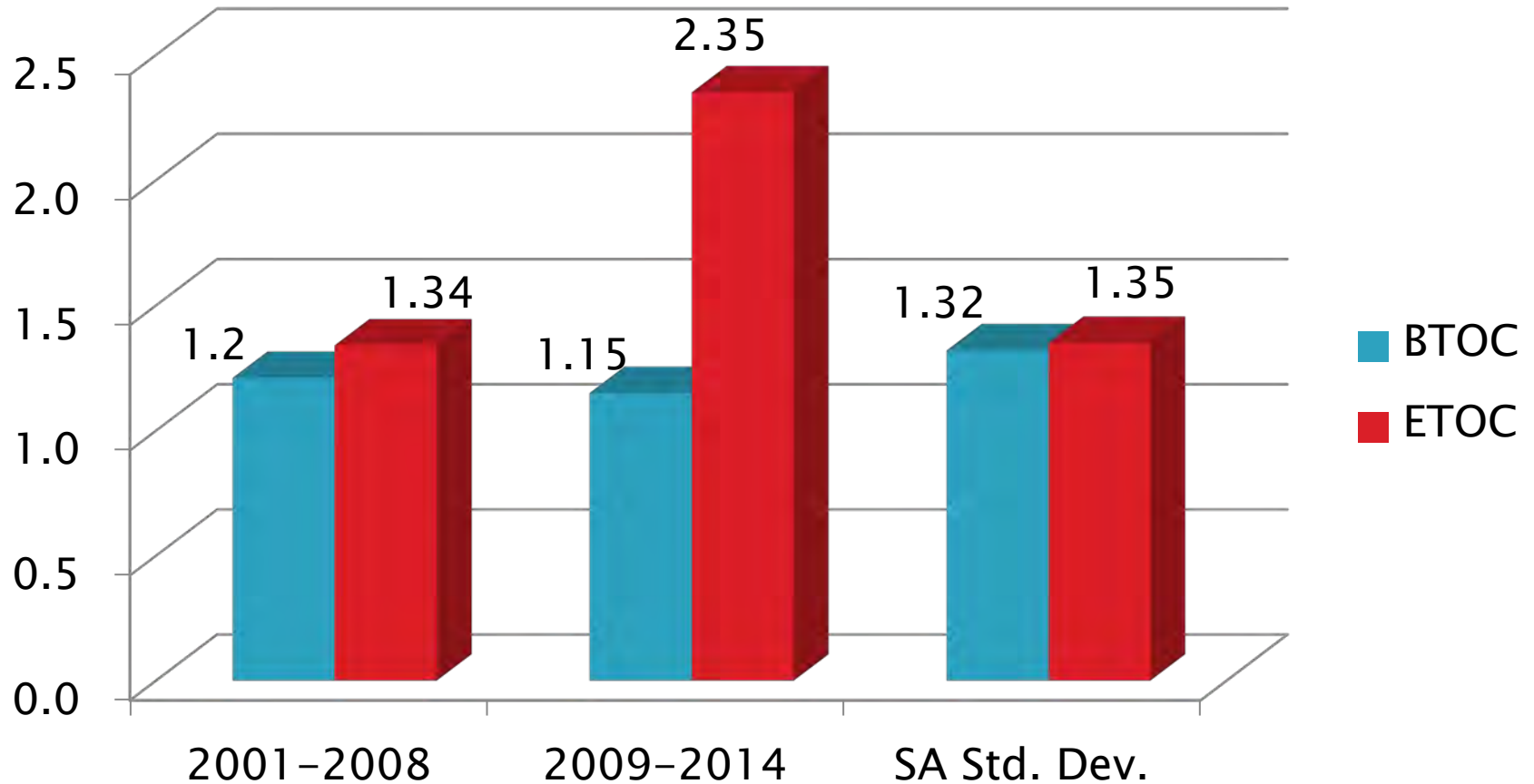
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# 1R Precision Estimates



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# 1 R Precision Estimates



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# CAT C13

»» October 2015

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# C13 Test Activity

Test Status	Validity Code	C13
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	2
Operationally Invalid	LC	0
Aborted	XC	1
<b>Total</b>		<b>5</b>

# C13 Failed Tests

Failed Parameter	Number of Tests
Mild Top Groove Carbon	1
Severe Oil Consumption	1
<b>Total</b>	<b>2</b>



# C13 Lost Tests\*

Status	Cause	#
Aborted	Coolant contamination	1
<b>Total</b>		<b>1</b>

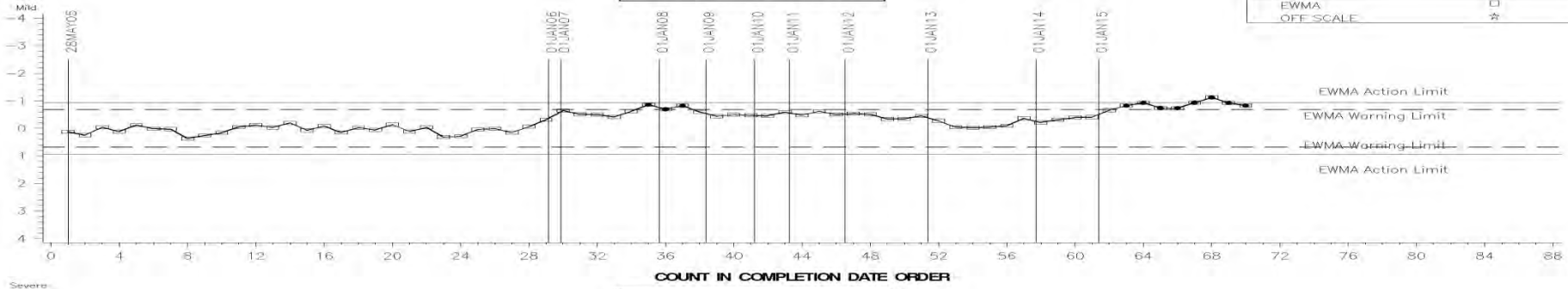
\*Invalid and aborted tests

# C13 Test Severity

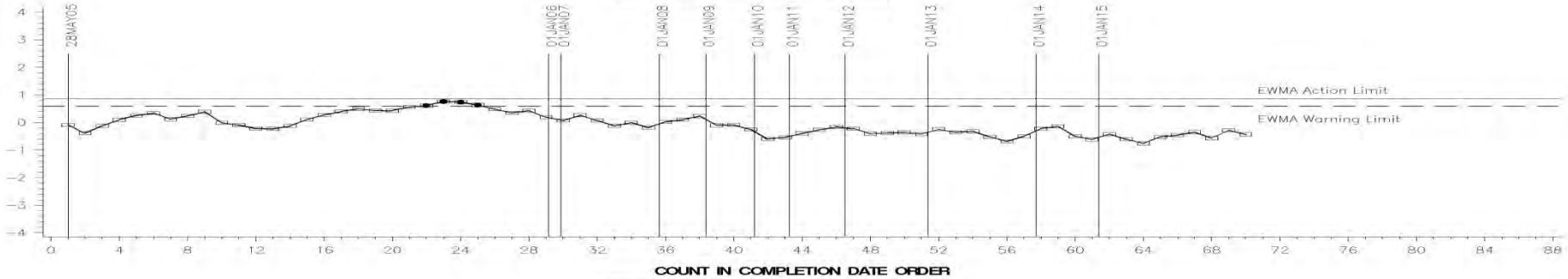
- ▶ TGC, R2TC and OC are in control.
- ▶ OC in precision warning alarm.
- ▶ TLC in severity warning alarm mild direction.

TOP LAND CARBON AVG. - FINAL RESULT

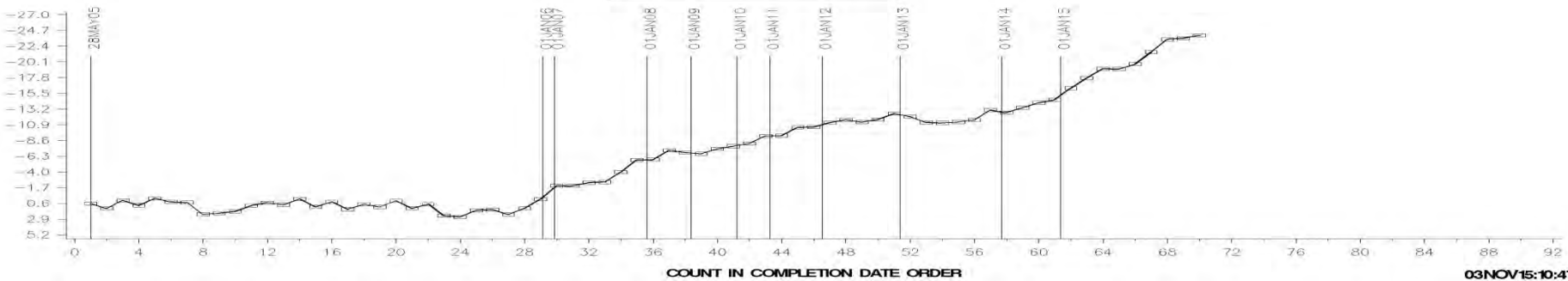
LTMS Severity Analysis



LTMS Precision Analysis



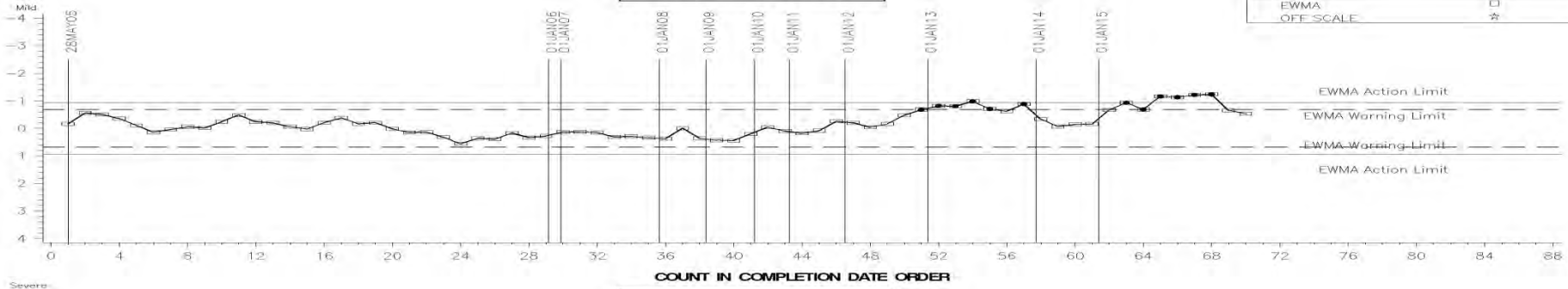
CUSUM Severity Analysis



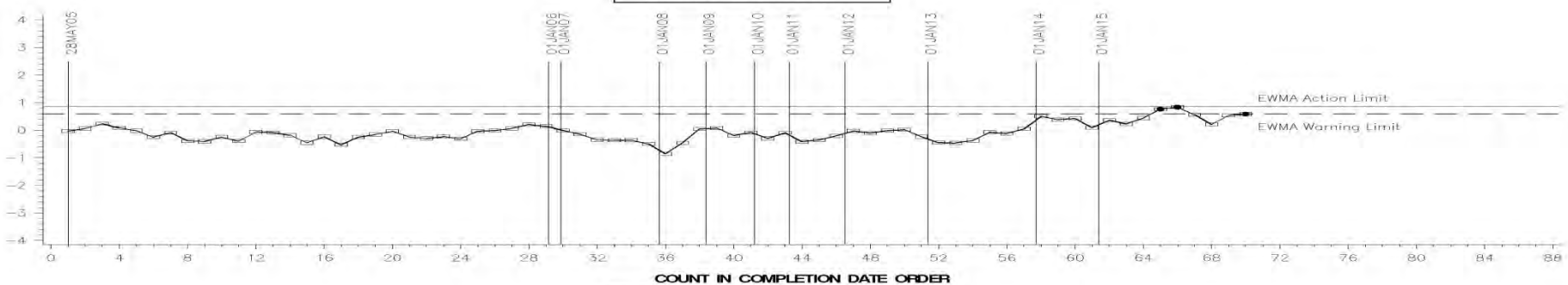
03NOV15:10:47

TOP GROOVE CARBON AVG - FINAL RESULT

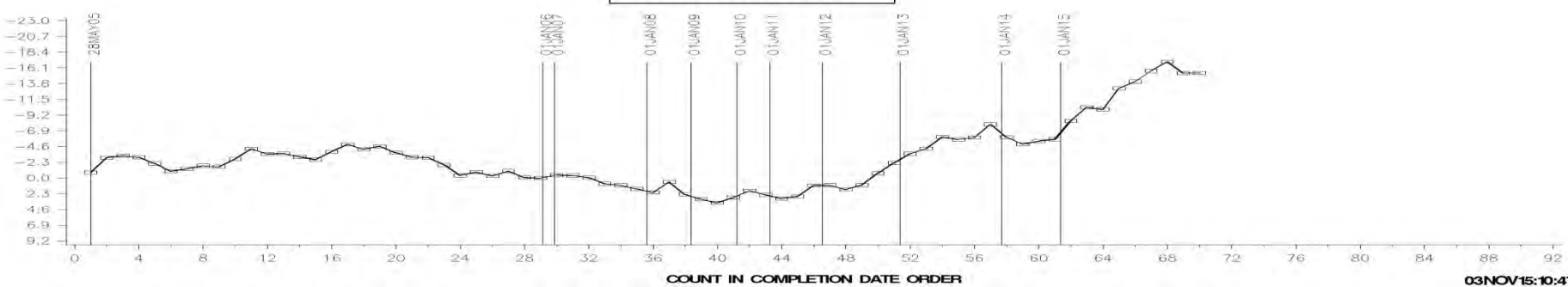
LTMS Severity Analysis



LTMS Precision Analysis



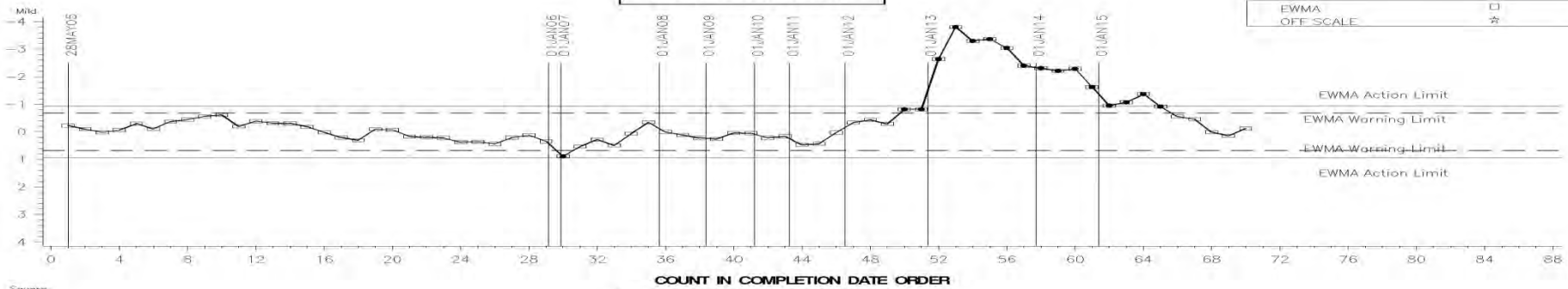
CUSUM Severity Analysis



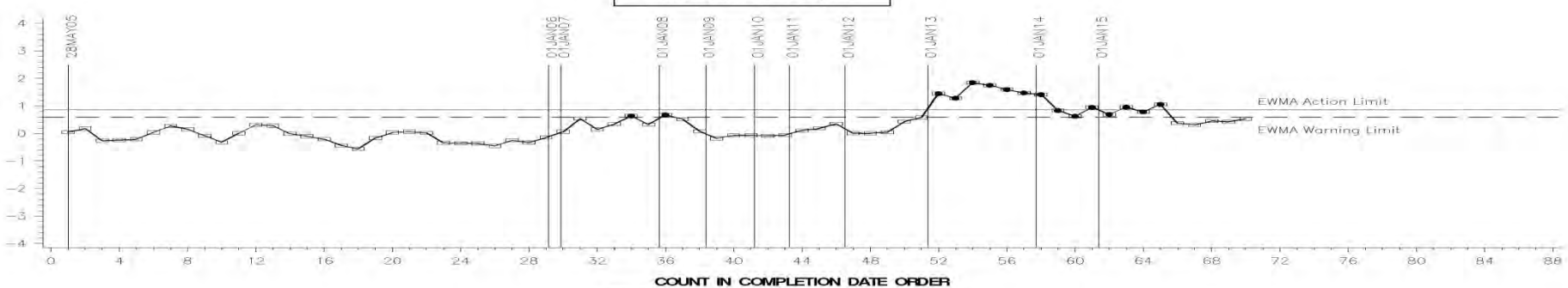
03NOV15:10:47

2ND RING TOP CARBON AVG. — FINAL RESULT

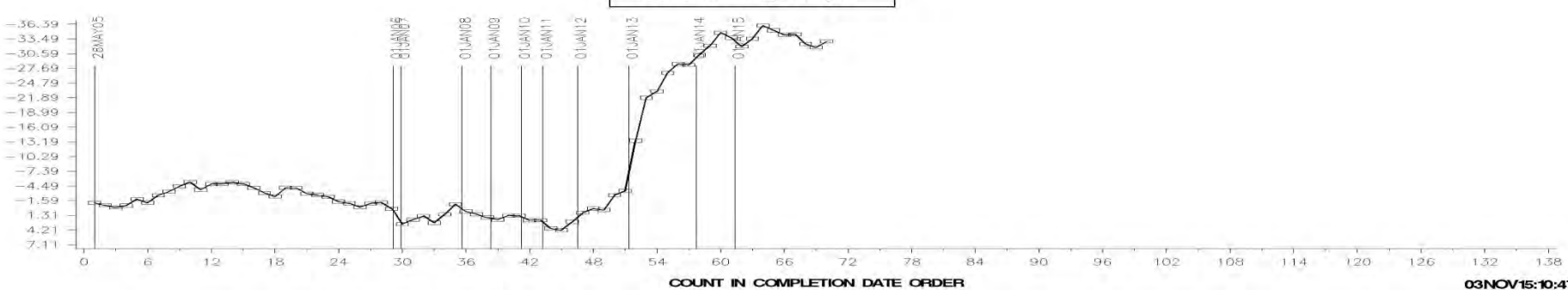
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

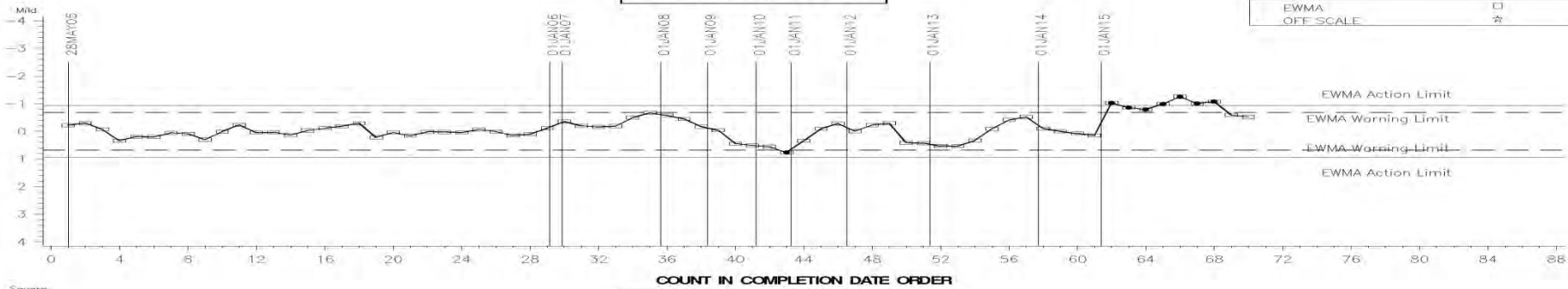


03NOV15:10:47

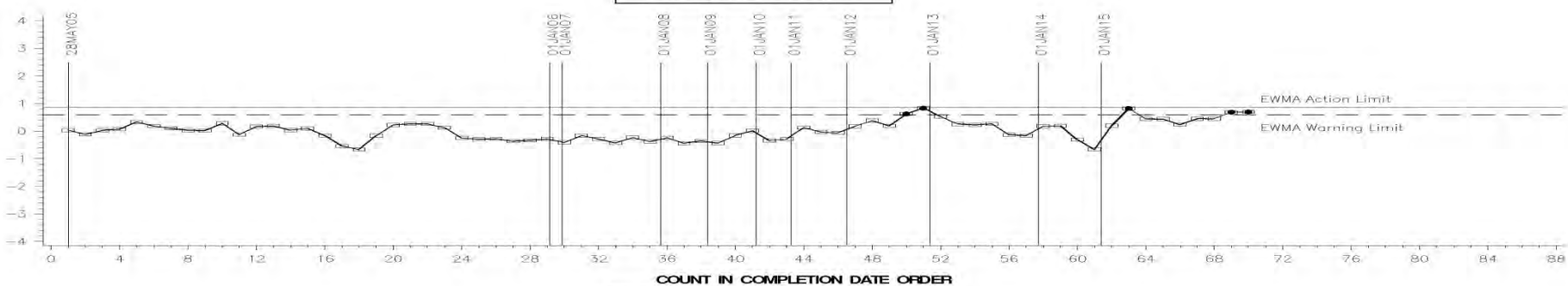


OIL CONS. DELTA - FINAL RESULT

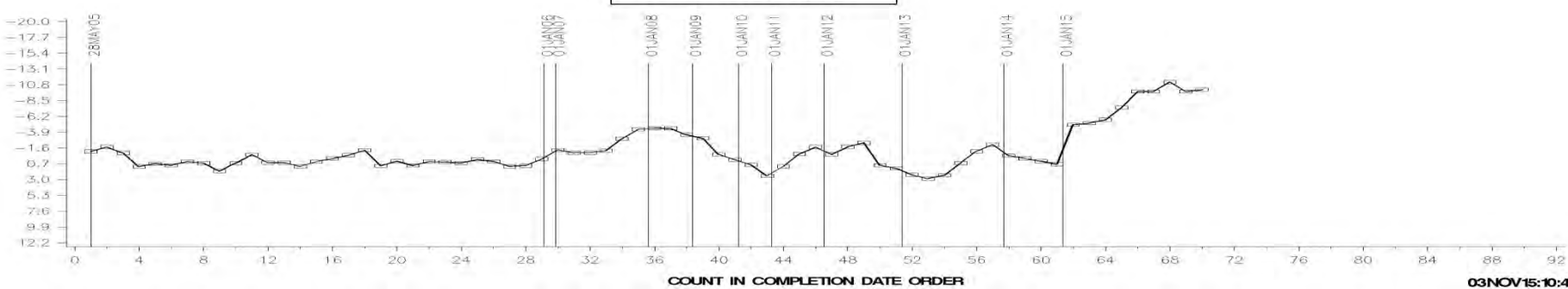
LTMS Severity Analysis



LTMS Precision Analysis



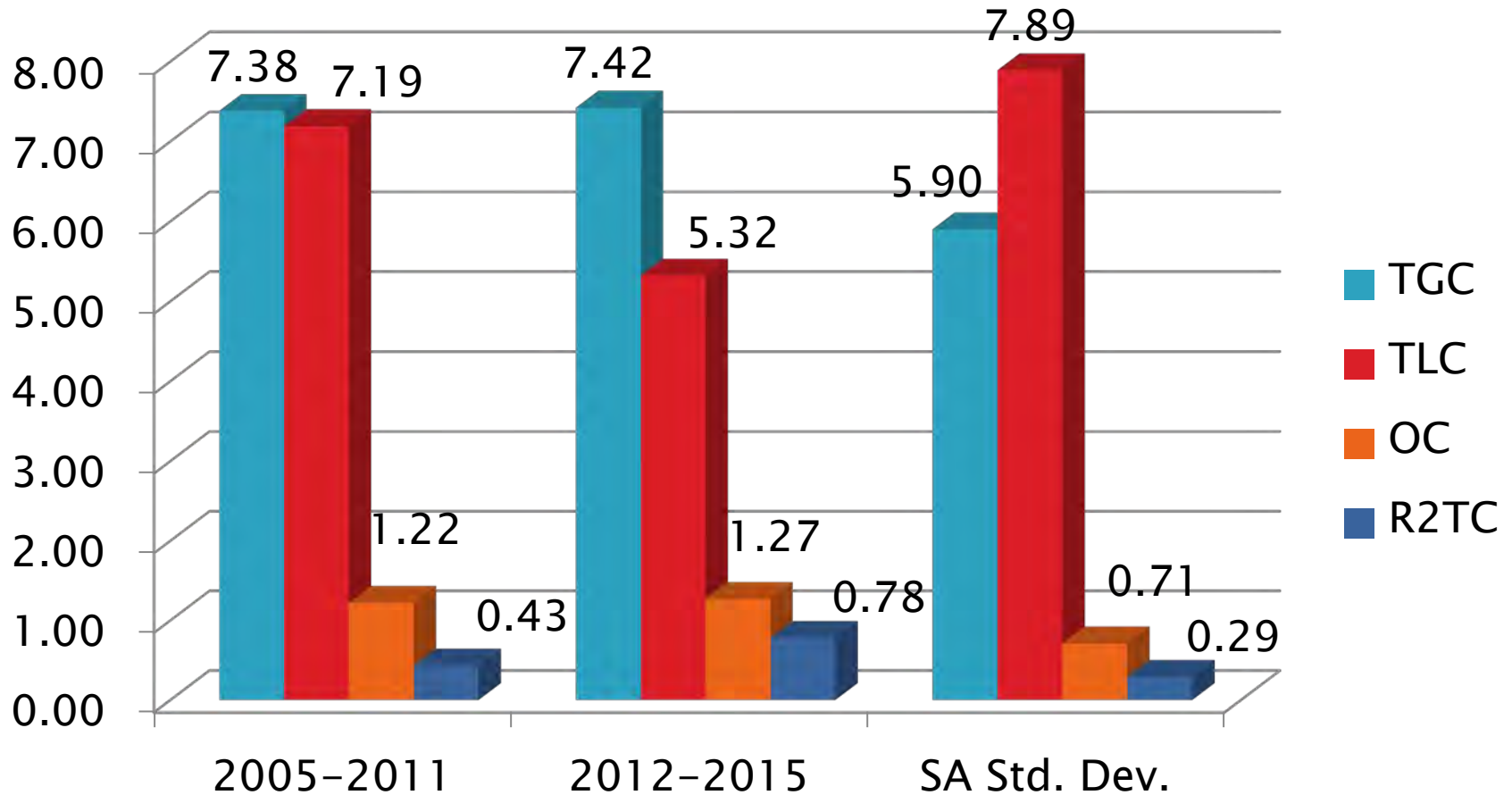
CUSUM Severity Analysis



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# C13 Precision Estimates



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# C13 Oil Aeration (COAT)

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# COAT Test Activity

Test Status	Validity Code	COAT
Acceptable Calibration Test	AC	5
Failed Calibration Test	OC	1
Operationally Invalid	LC	3
Aborted	XC	0
Donated	AG	3
<b>Total</b>		<b>12</b>

# COAT Failed Tests

Failed Parameter	Number of Tests
Severe Average Aeration	1
Total	1

# COAT Lost Tests\*

Status	Cause	#
Invalid	Faulty Flow Density Meter	1
Invalid	Misplaced FDM inlet pressure sensor	1
Invalid	Loose sample FDM sample pressure connection	1
<b>Total</b>		<b>3</b>

\*Invalid and aborted tests

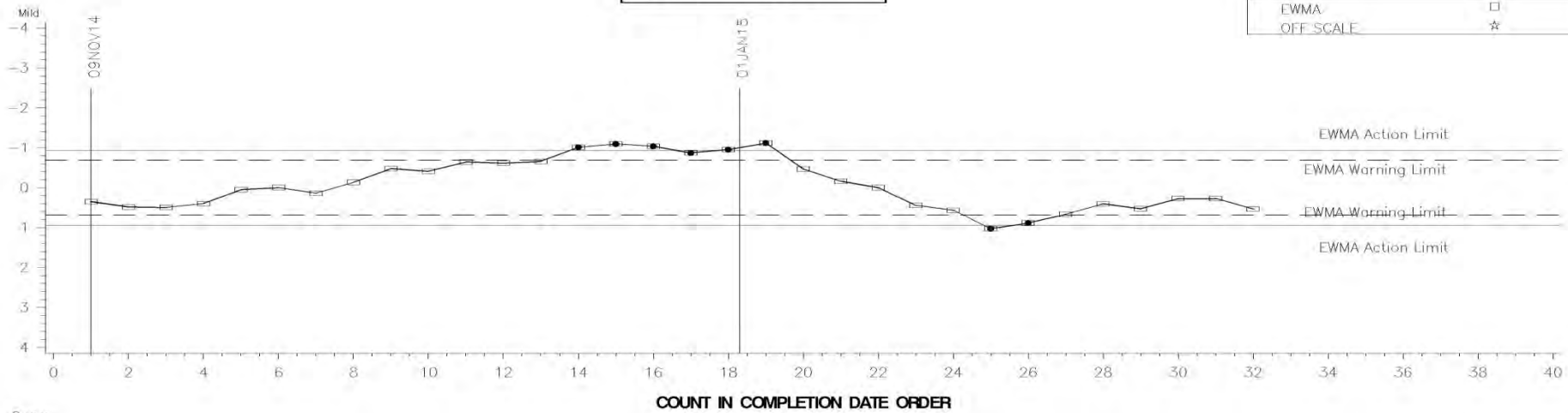
# COAT Test Severity

- ▶ AAVE is in control.

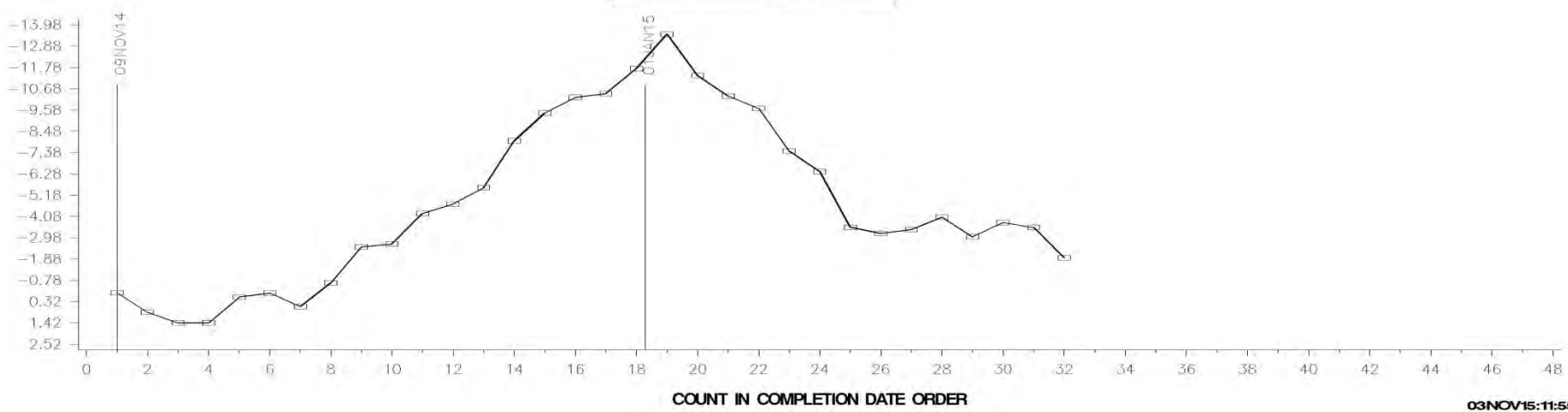


AVERAGE AERATION HOURS 40 — 50

LTMS Severity Analysis



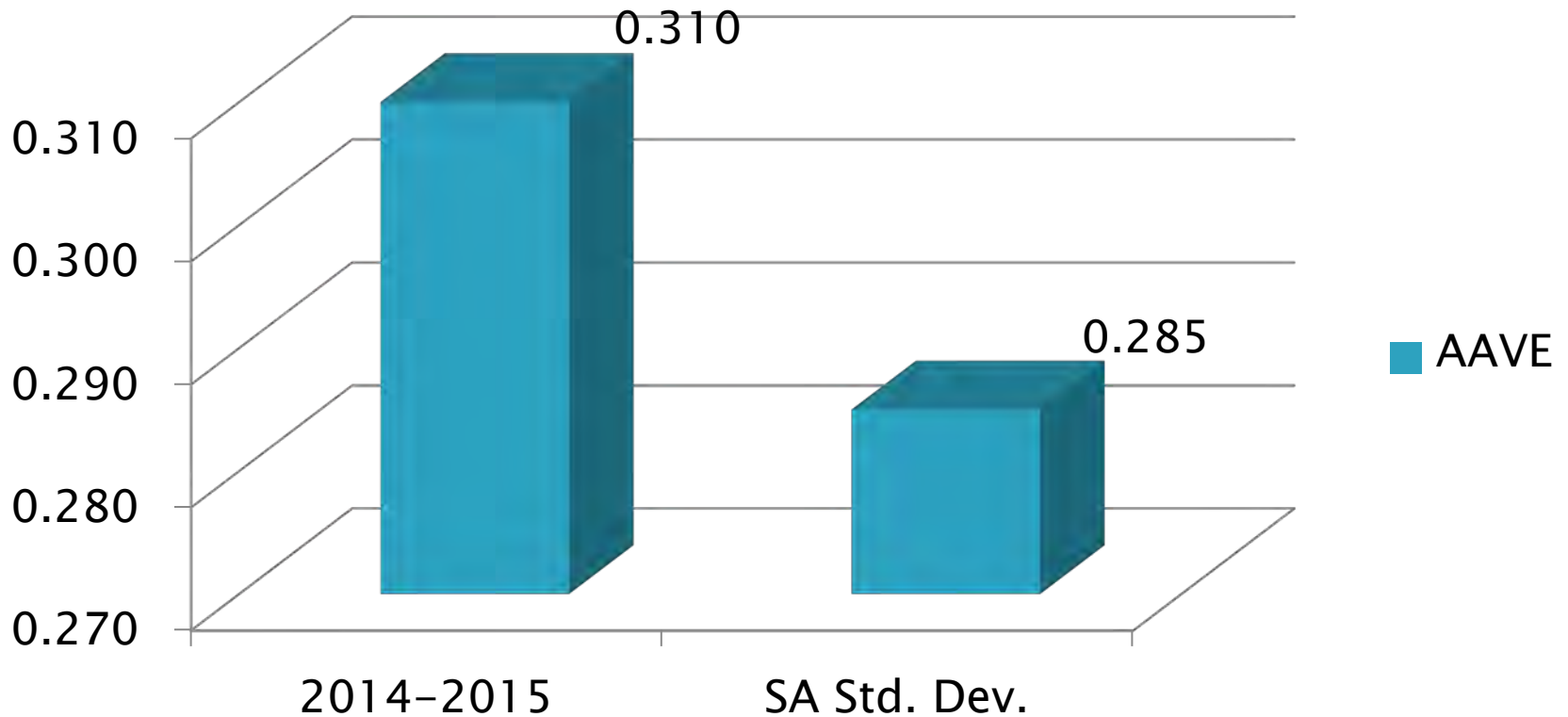
CUSUM Severity Analysis



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# COAT Precision Estimates

## AAVE



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# Cummins ISB

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# ISB Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	1
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>2</b>

# ISB Failed Tests

Failed Parameter	Number of Tests
Mild ACSW	1
<b>Total</b>	<b>1</b>

# ISB Lost Tests\*

Status	Cause	#
Invalid	No Invalid Tests	0
Aborted	No Aborted Tests	0
<b>Total</b>		<b>0</b>

\*Invalid and aborted tests

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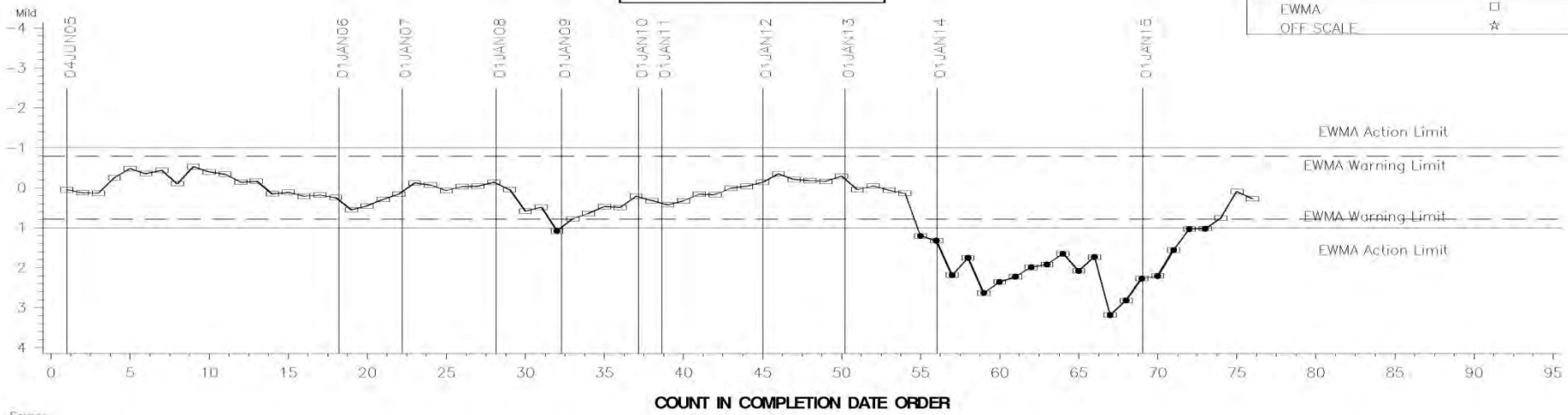


# ISB Test Severity

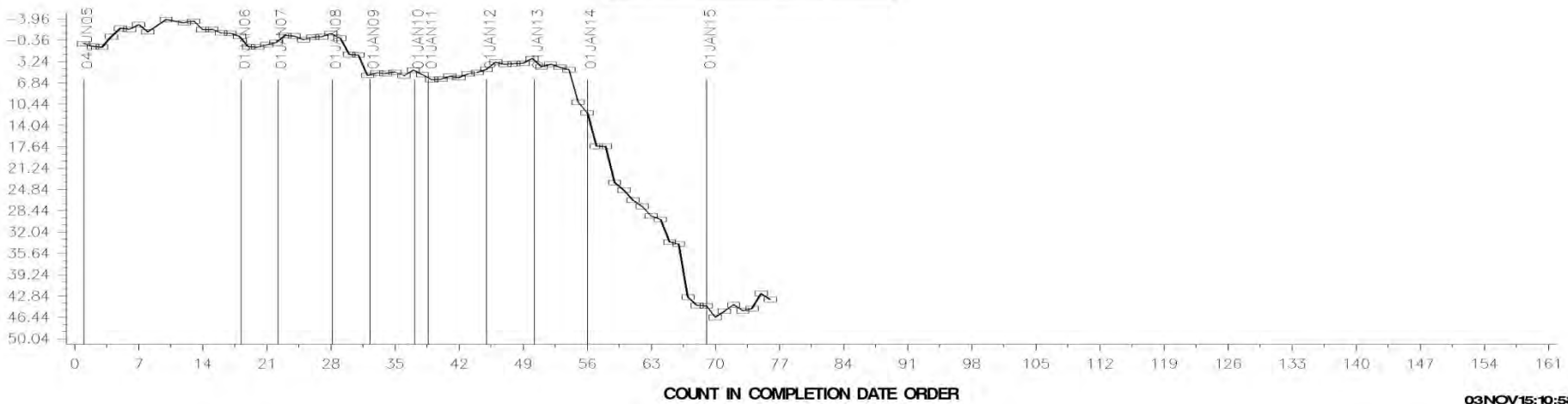
- ▶ ACSW is in control.
- ▶ ATWL in action alarm in the mild direction

AVERAGE CAMSHAFT WEAR

LTMS Severity Analysis



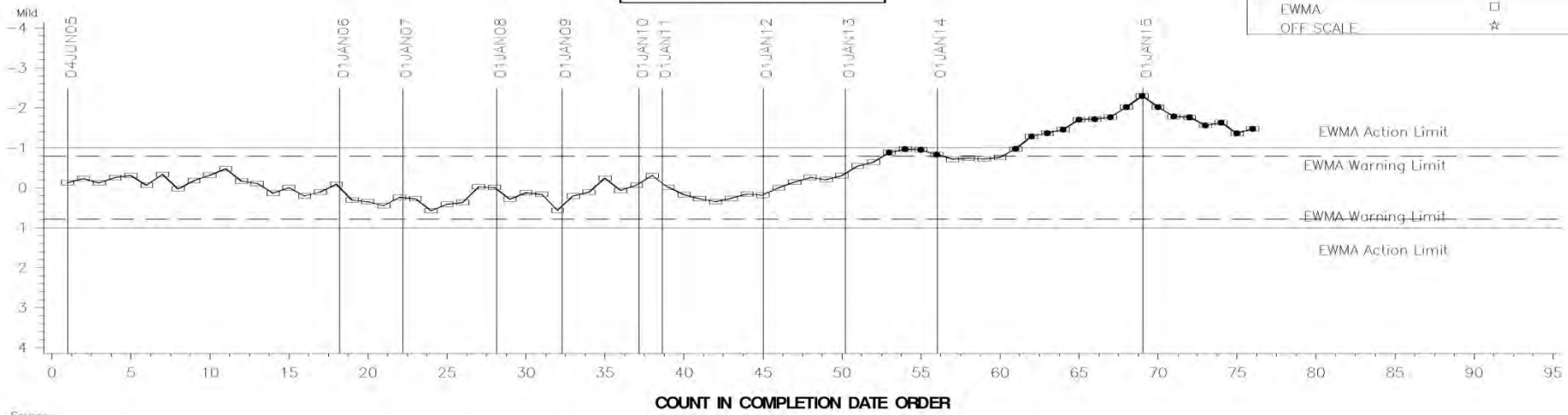
CUSUM Severity Analysis



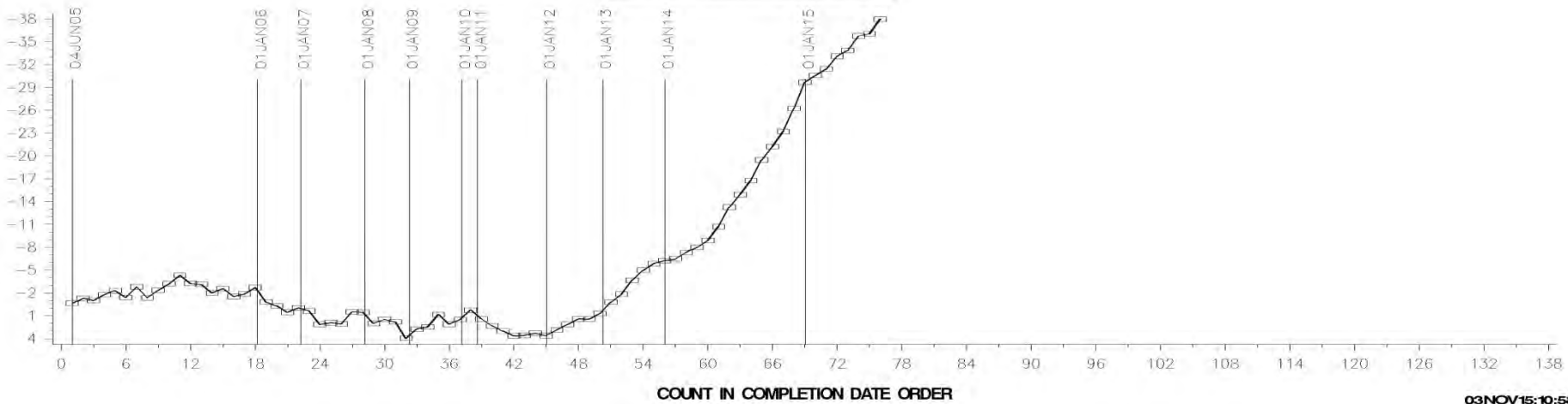
03 NOV 15: 10:58

AVERAGE TAPPET WEIGHT LOSS

LTMS Severity Analysis

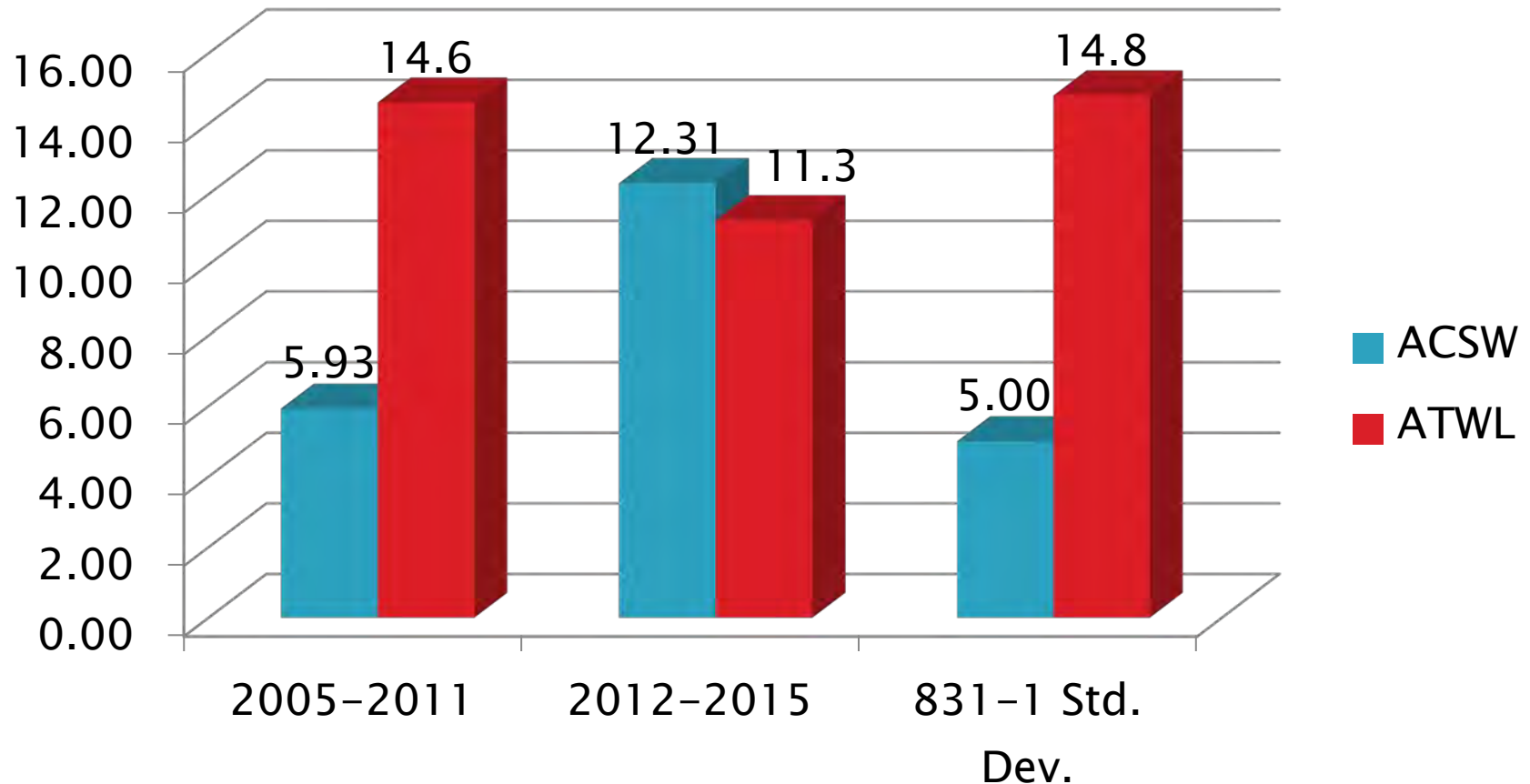


CUSUM Severity Analysis



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# ISB Precision Estimates



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# Cummins ISM

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# ISM Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>2</b>



# ISM Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
<b>Total</b>	<b>0</b>

# ISM Lost Tests\*

Status	Cause	#
Invalid	No Invalid Tests	0
Aborted	No Aborted Tests	0
<b>Total</b>		<b>0</b>

\*Invalid and aborted tests

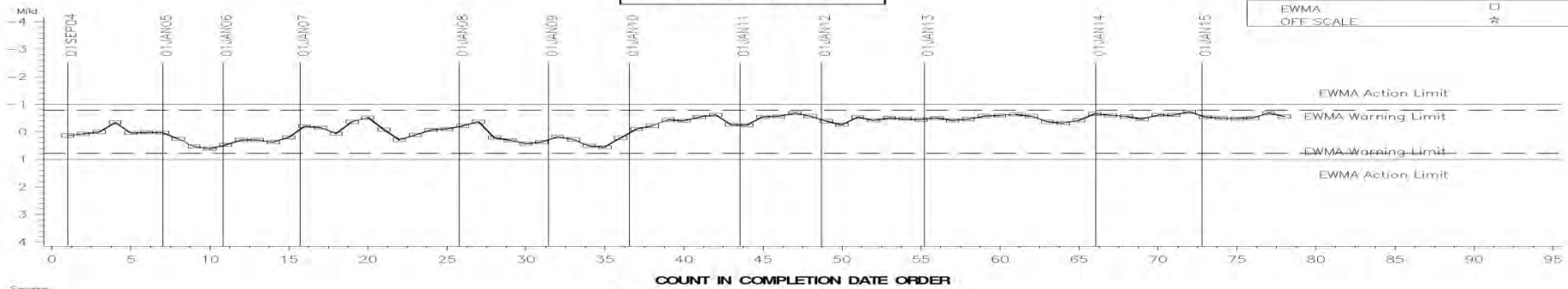
# ISM Test Severity

- ▶ ASR in near severity warning action alarm mild direction as well as precision warning alarm.
- ▶ IAS in precision action alarm.
- ▶ CWL, FPD are in control.
  - CWL trending mild and near warning alarm.
  - FPD trending mild and near warning alarm.

CROSSHEAD WEIGHT LOSS ADJUSTED TO 3.9 % SOOT

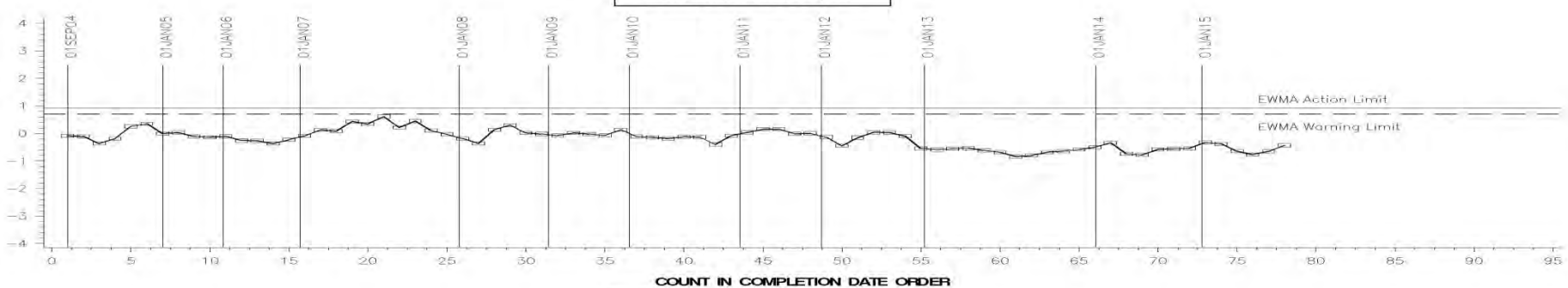
LTMS Severity Analysis

Standard Deviation Units



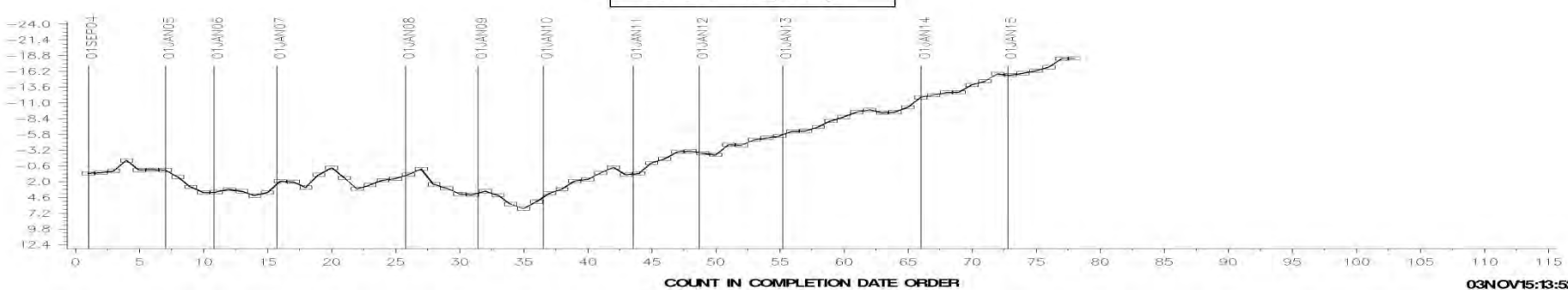
LTMS Precision Analysis

Standard Deviation Units



CUSUM Severity Analysis

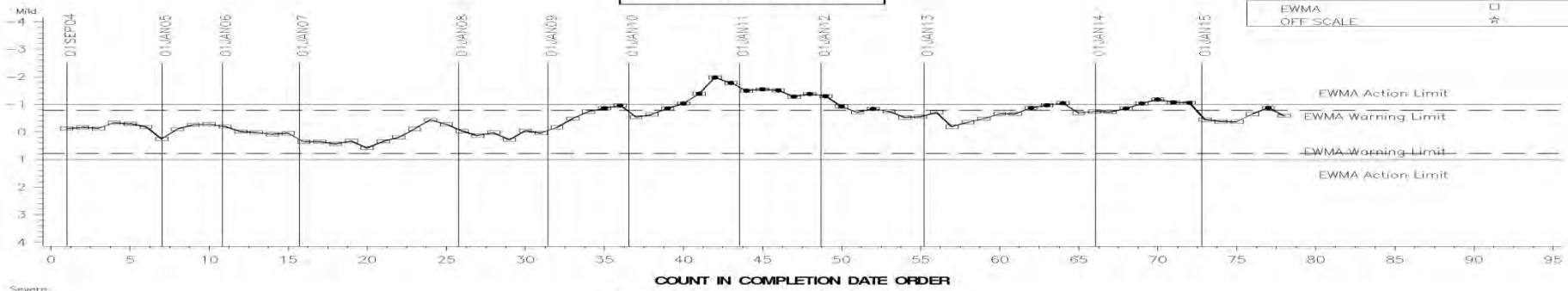
Standard Deviation Units



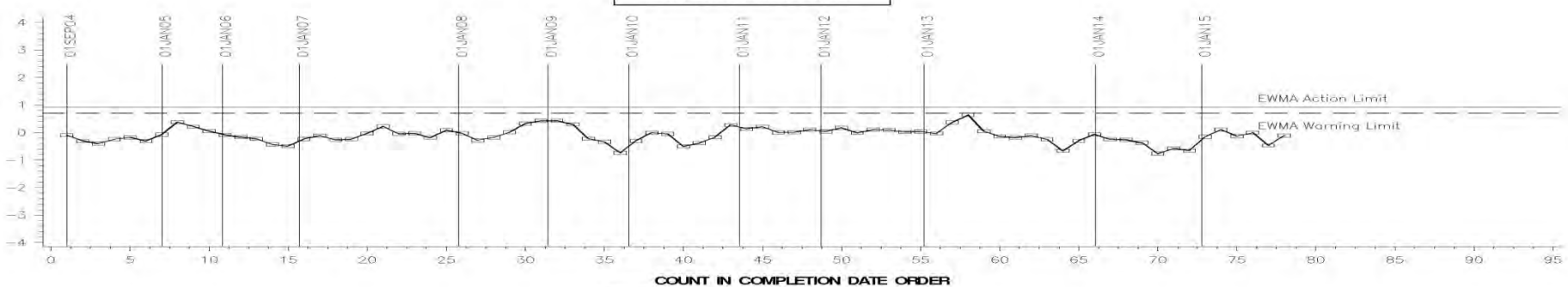
03NOV15:13:52

FILTER PLUGGING DELTA P

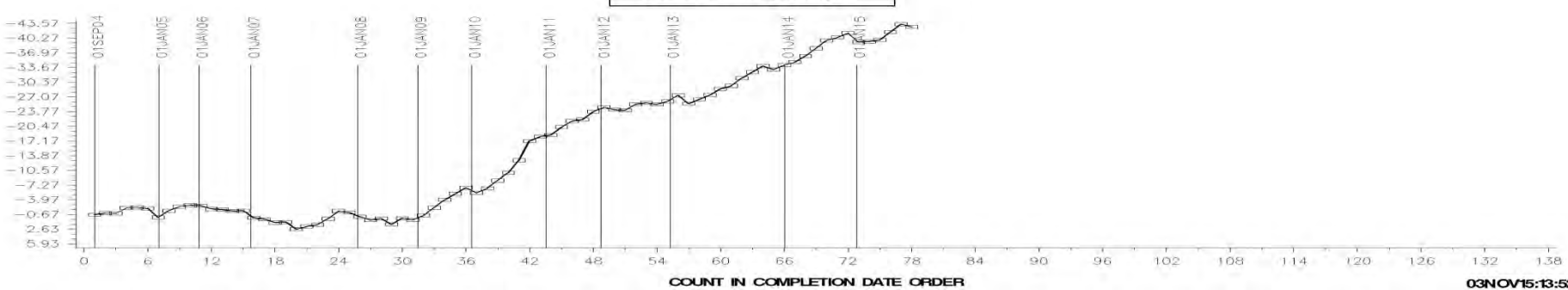
LTMS Severity Analysis



LTMS Precision Analysis



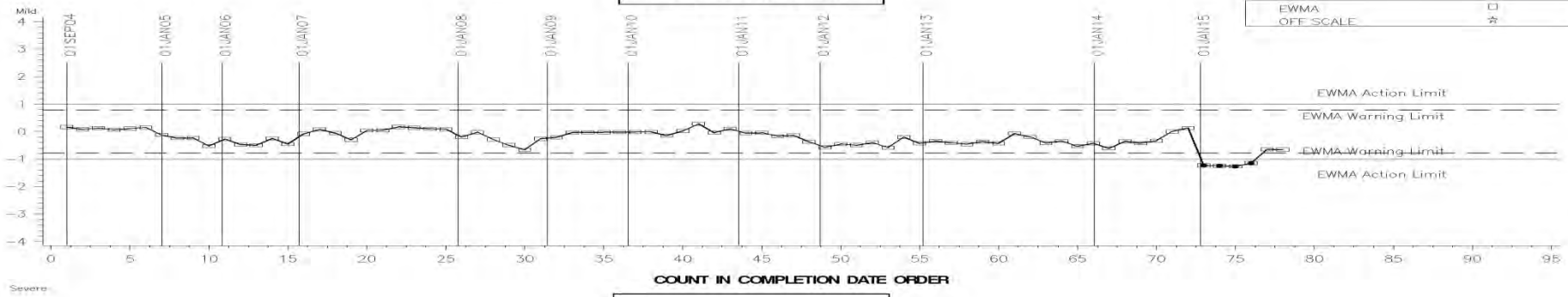
CUSUM Severity Analysis



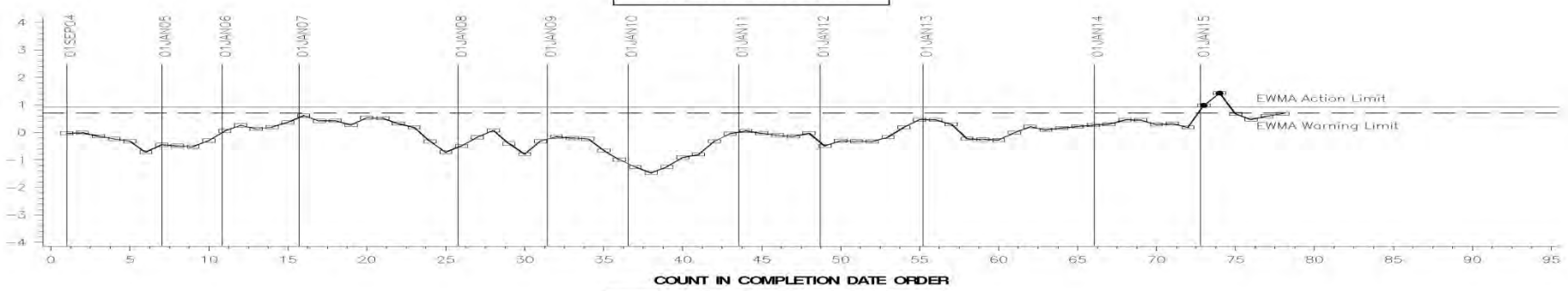
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AVERAGE SLUDGE RATING

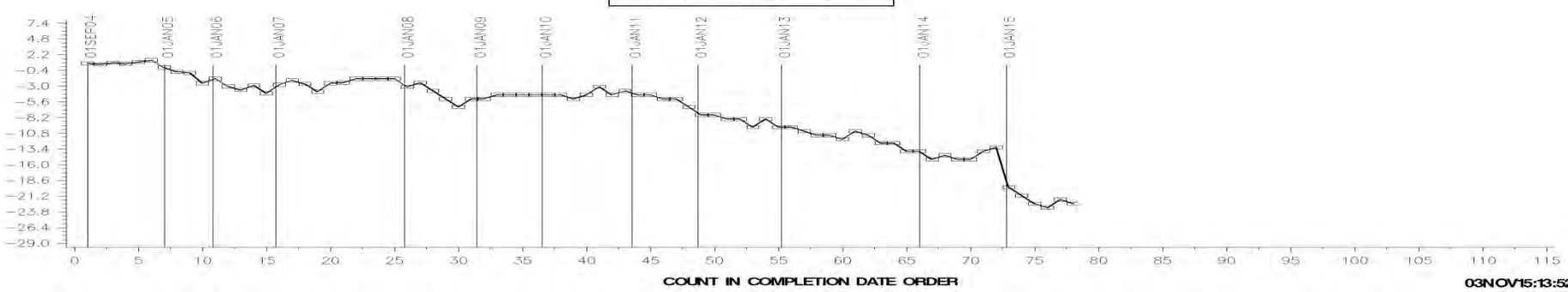
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

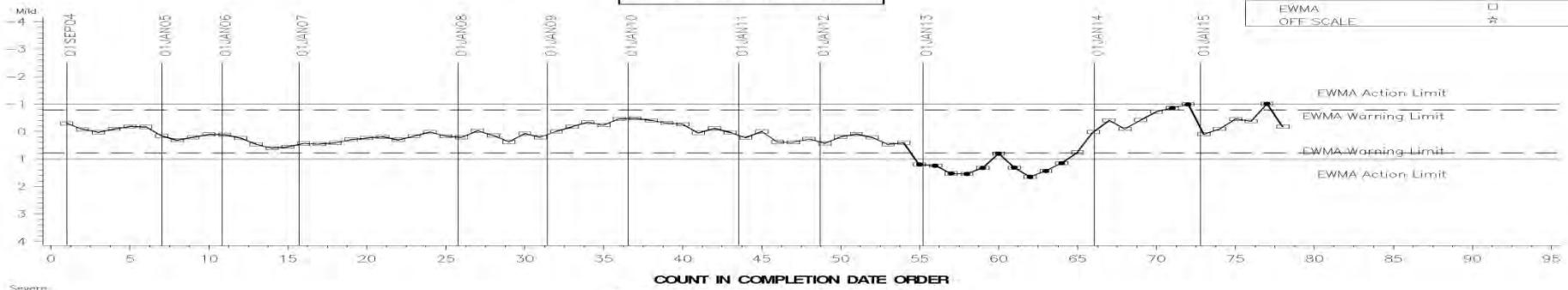


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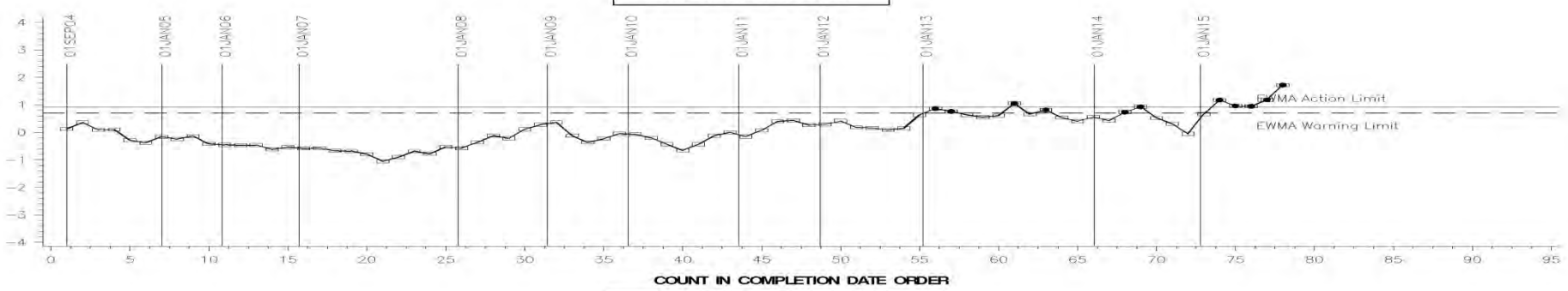


INJECTOR SCREW WEIGHT LOSS ADJUSTED TO 3.9% SOOT

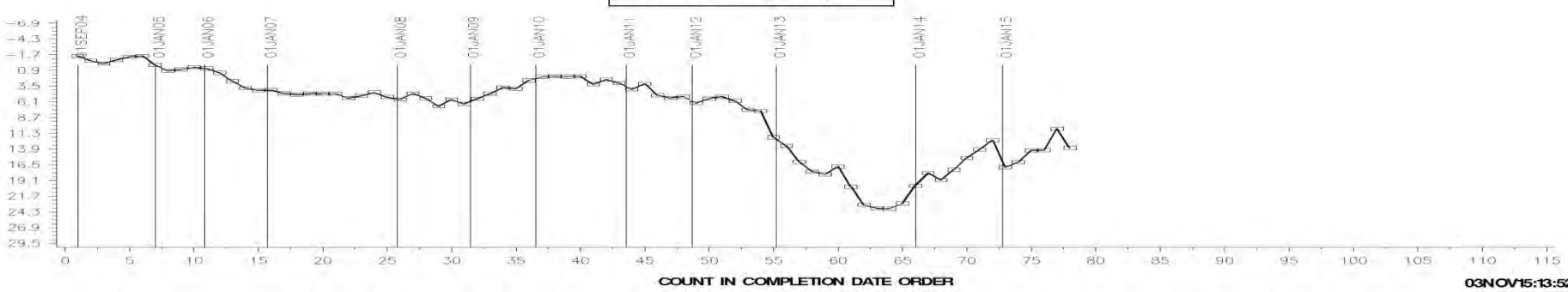
LTMS Severity Analysis



LTMS Precision Analysis

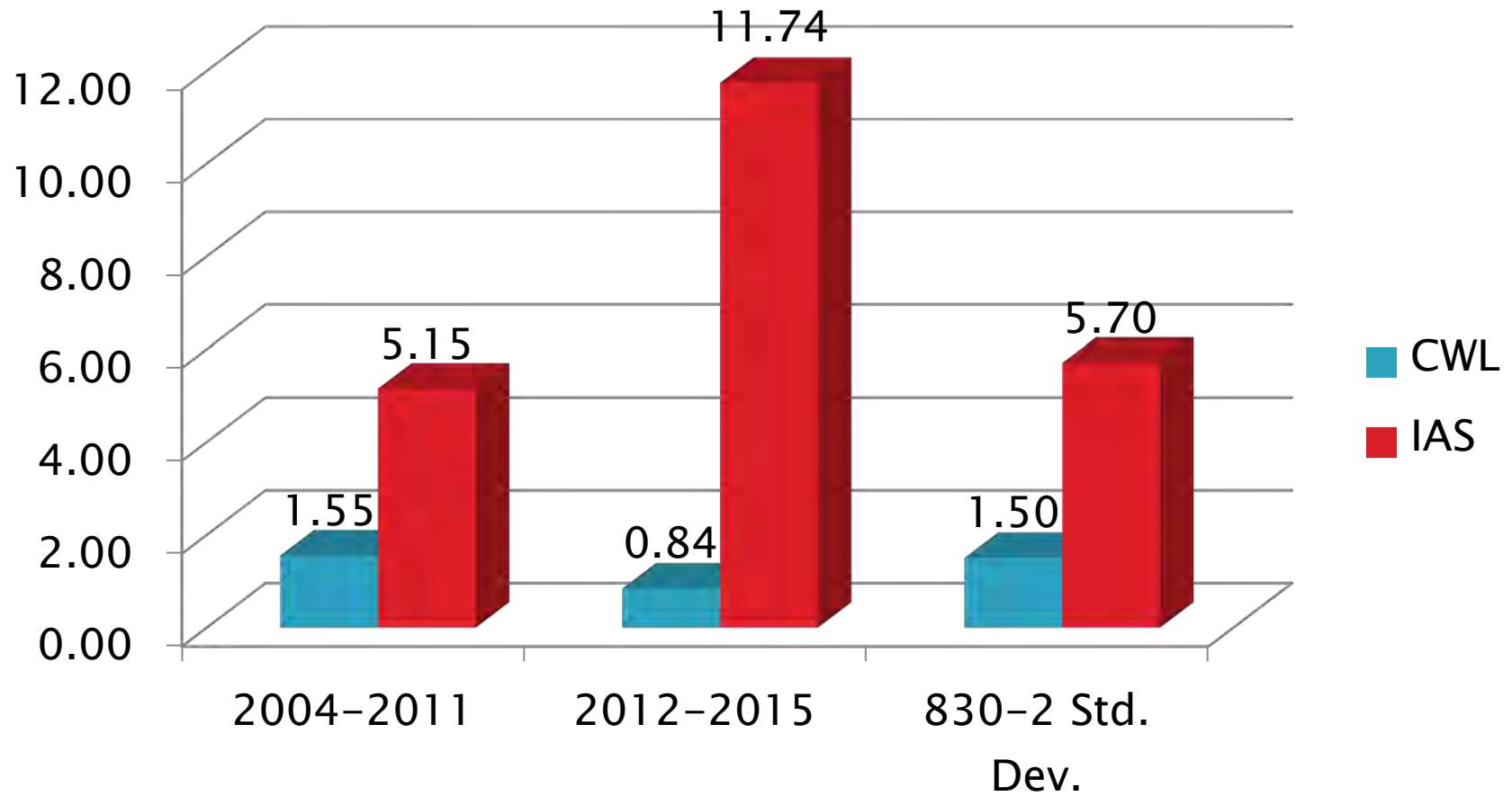


CUSUM Severity Analysis

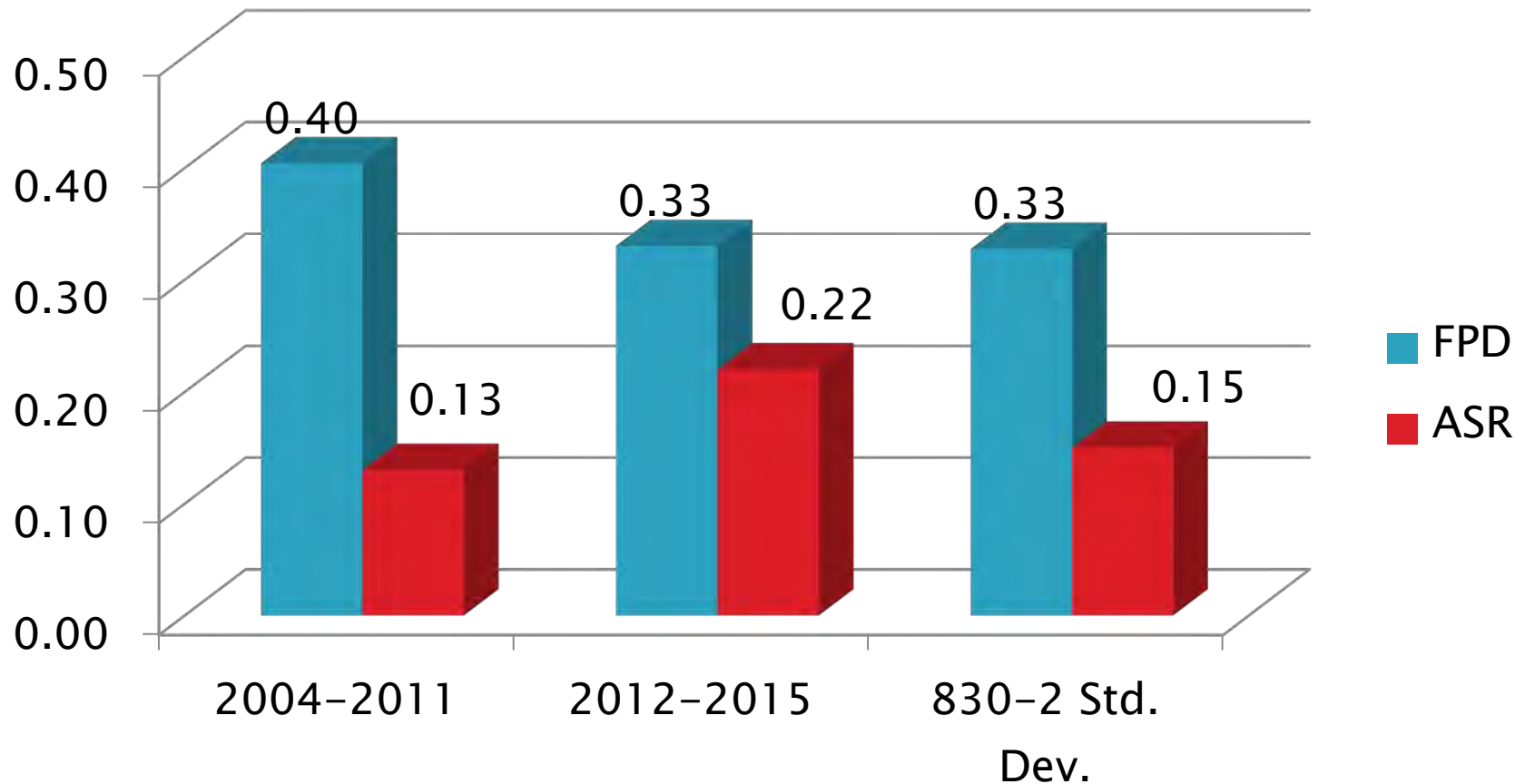


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# ISM Precision Estimates



# ISM Precision Estimates



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# EOAT

»» October 2015

# EOAT Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	1
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>1</b>

# EOAT Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
<b>Total</b>	<b>0</b>



# EOAT Lost Tests\*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
<b>Total</b>		<b>0</b>

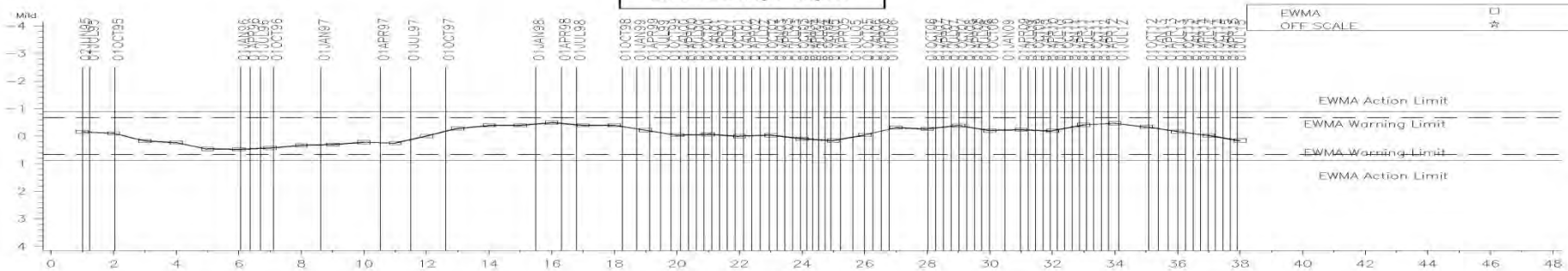
\*Invalid and aborted tests

# EOAT Test Severity

- ▶ AEOA in control.

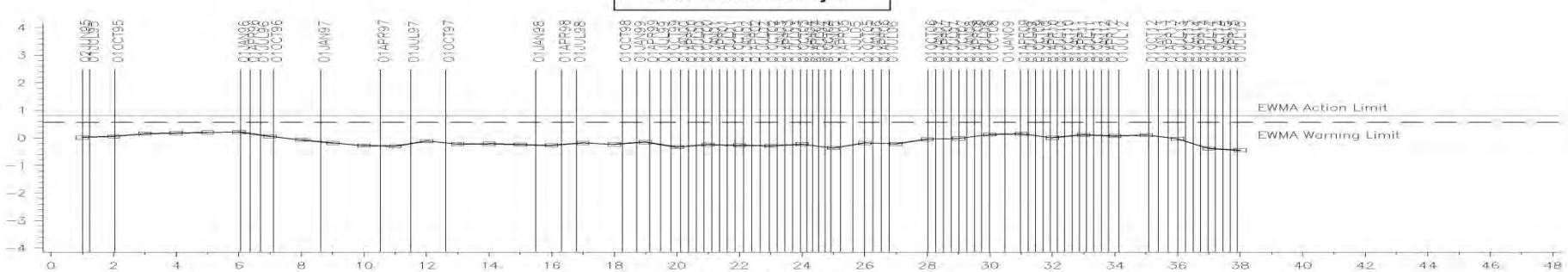
ENGINE OIL AERATION

LTMS Severity Analysis



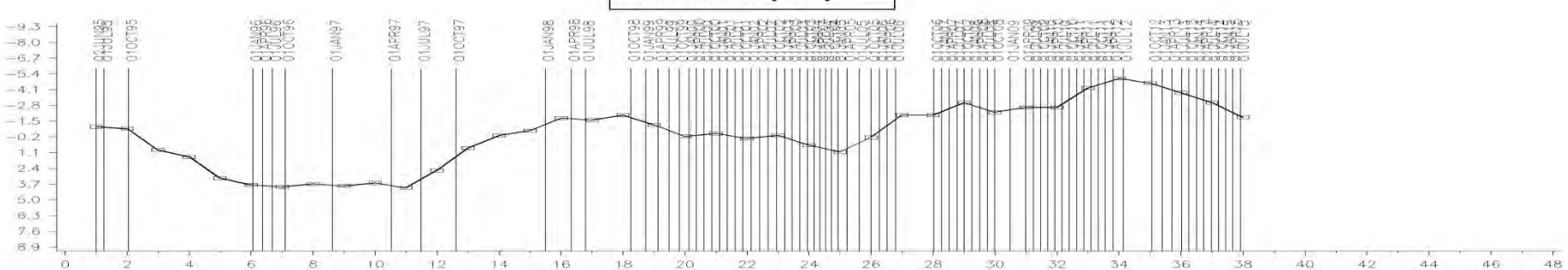
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

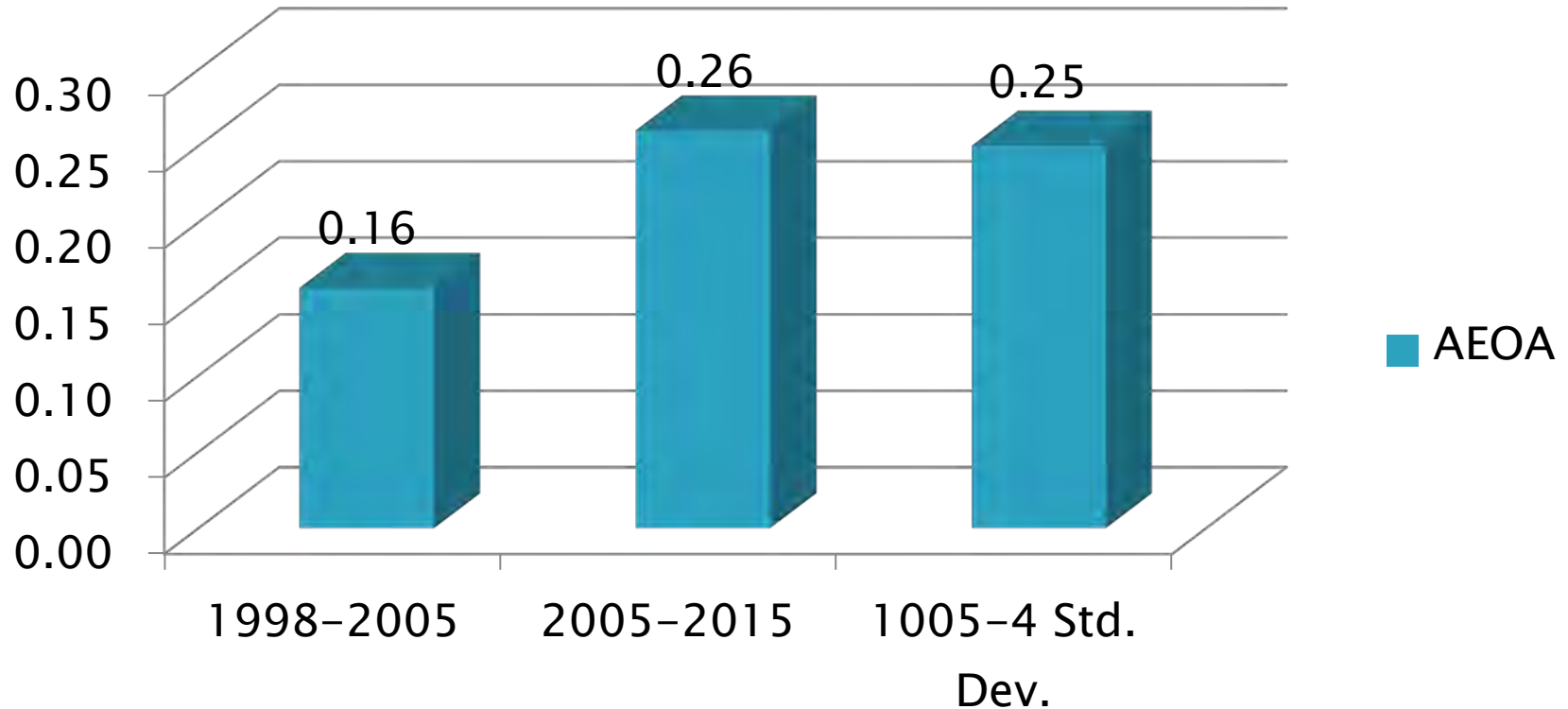


COUNT IN COMPLETION DATE ORDER

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# EOAT Precision Estimates

## AEOA



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# RFWT

»» October 2015

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# RFWT Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>2</b>

# RFWT Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0



# RFWT Lost Tests\*

Status	Cause	#
Invalid	No invalid tests	0
Aborted	No aborted tests	0
<b>Total</b>		<b>0</b>

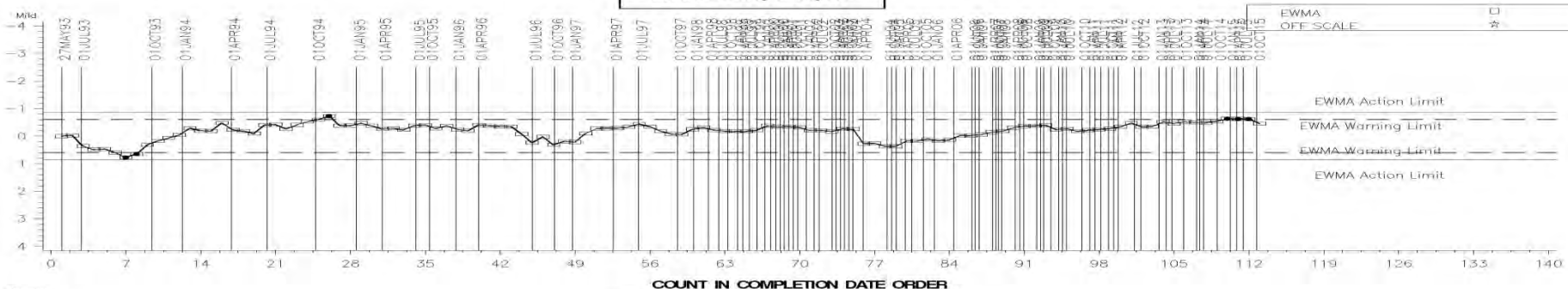
\*Invalid and aborted tests

# RFWT Test Severity

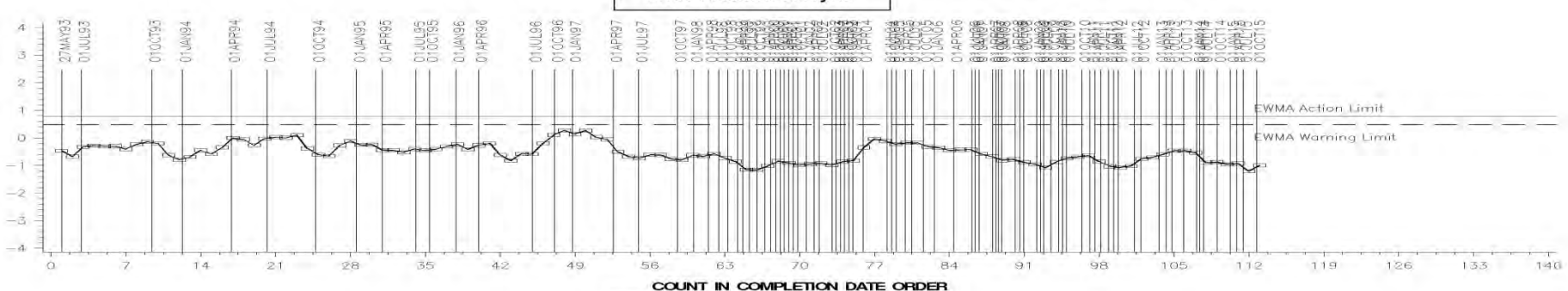
- ▶ AFW is in control but near severity warning alarm in mild direction.

Average Follower Wear

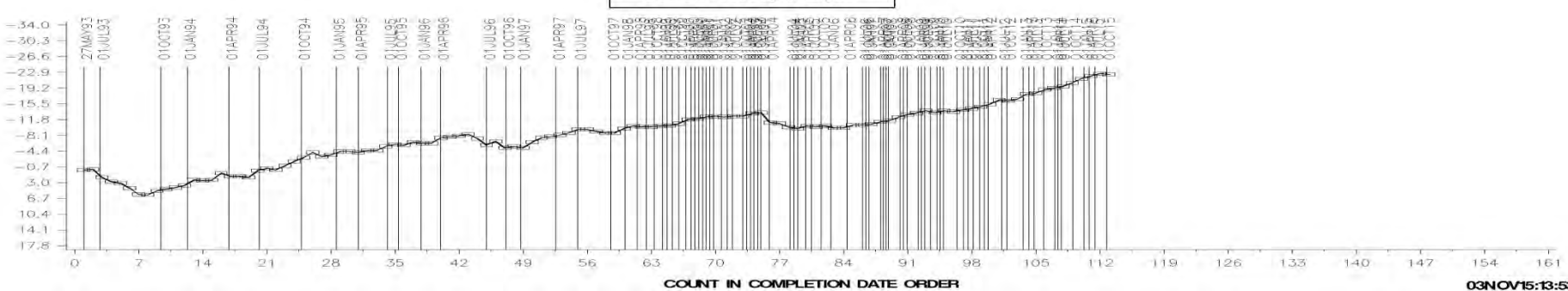
LTMS Severity Analysis



LTMS Precision Analysis



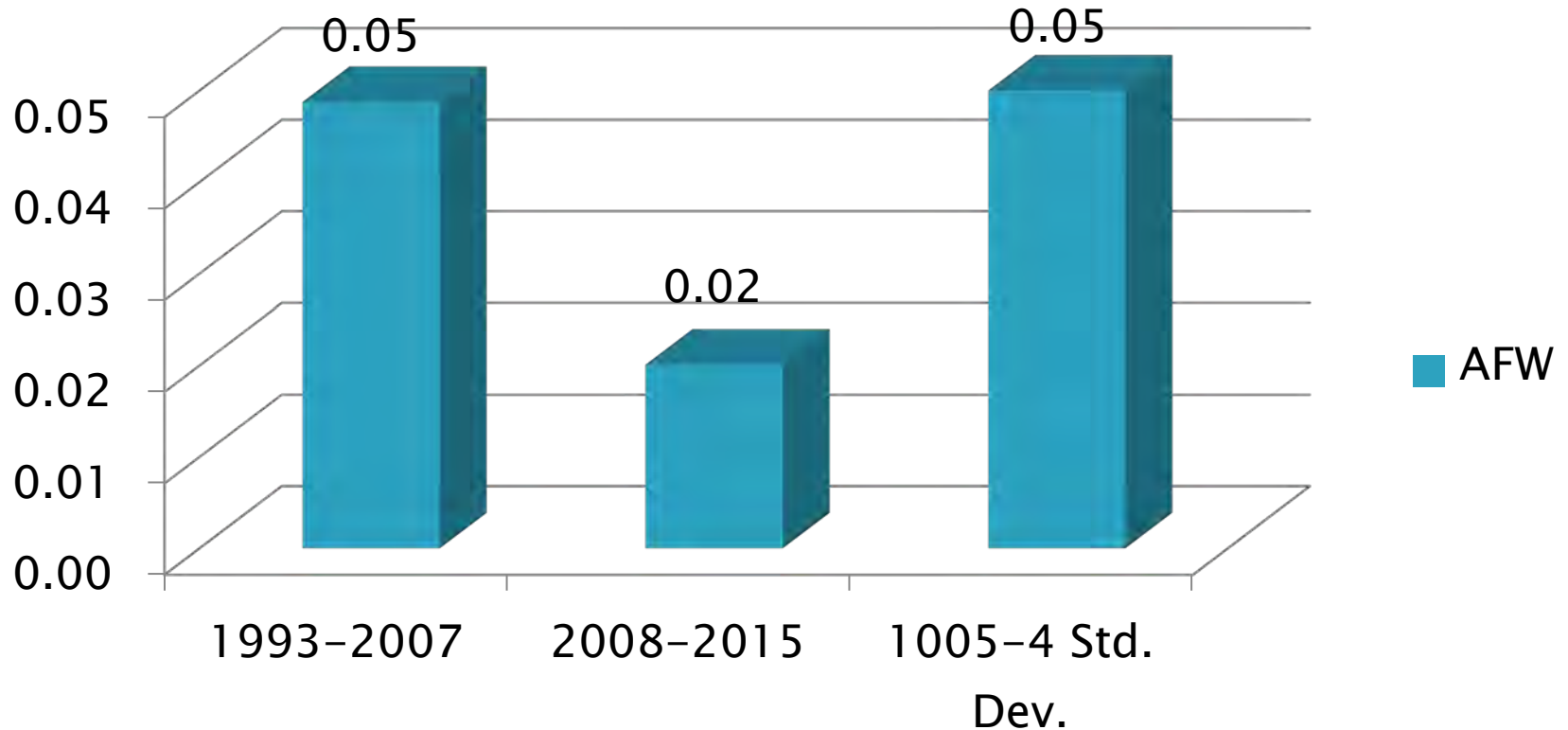
CUSUM Severity Analysis



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# RFWT Precision Estimates

AFW



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# Mack T-8/T-8E

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Test Monitoring Center

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# T-8/T-8E Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	2
Failed Calibration Test	OC	3
Operationally Invalid	LC	0
Aborted	XC	2
<b>Total</b>		<b>7</b>

# T-8/T8-E Failed Tests

Failed Parameter	Number of Tests
Mild VI38	3
Total	3



# T-8/T8-E Lost Tests\*

Status	Cause	#
Aborted	Missed soot window	2
<b>Total</b>		<b>2</b>

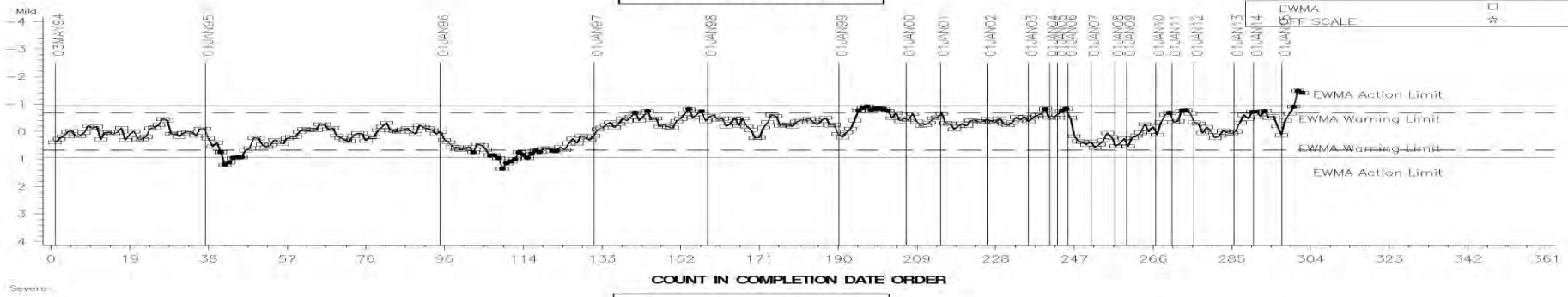
\*Invalid and aborted tests

# T-8/T-8E Test Severity

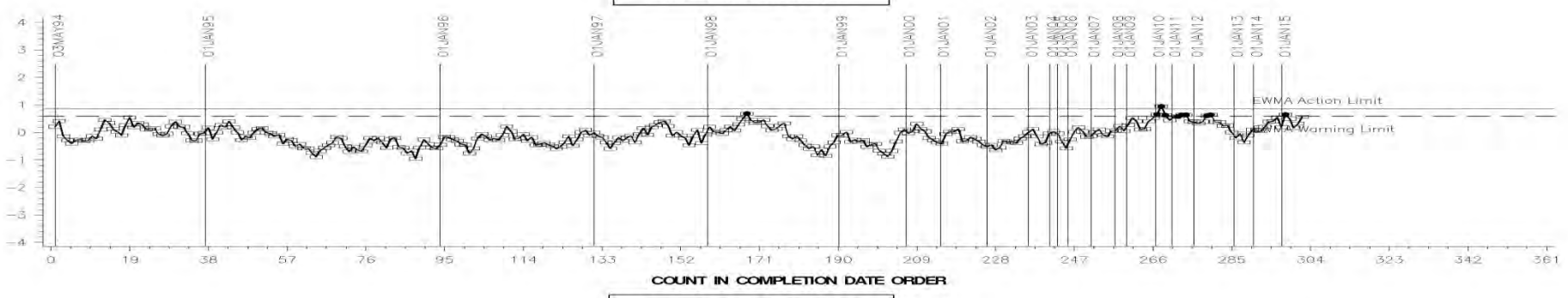
- ▶ VI38, RV48 and RV2 are in in severity action alarm in mild direction.
- ▶ VI38, RV48 and RV2 near precision warning alarm.

FINAL REFERENCE VISCOSITY AT 3.8% TGA SOOT LEVEL

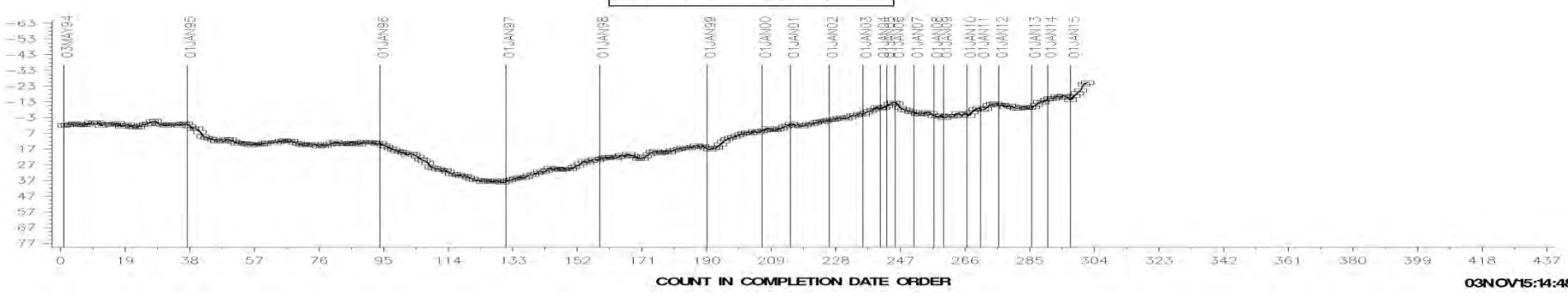
LTMS Severity Analysis



LTMS Precision Analysis



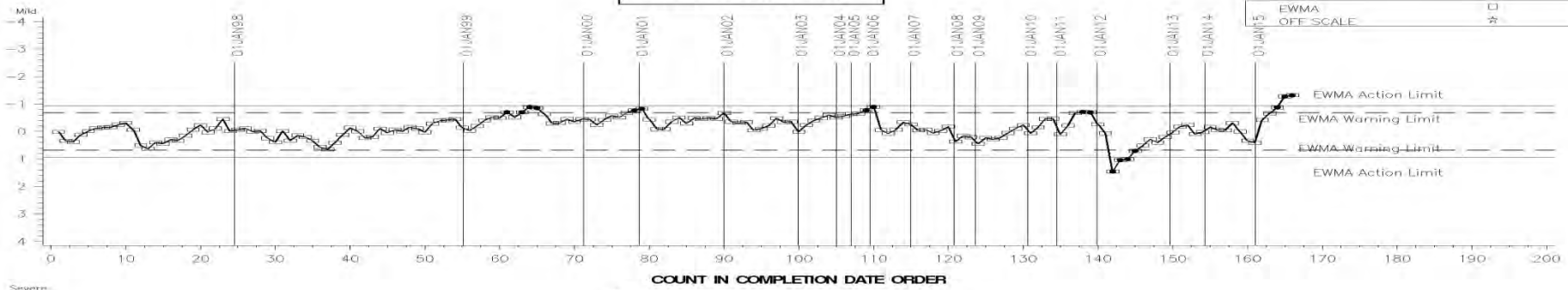
CUSUM Severity Analysis



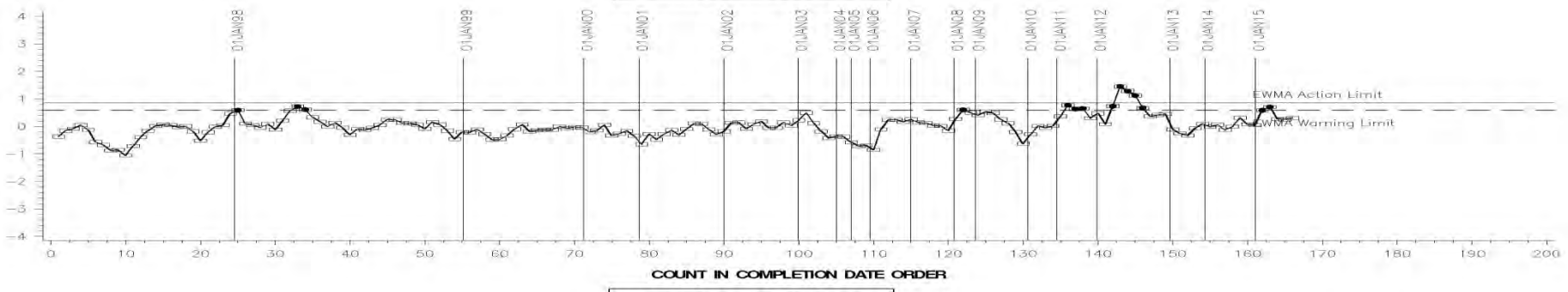
03NOV15:14:48

FINAL RELATIVE VISCOSITY (50% LOSS)

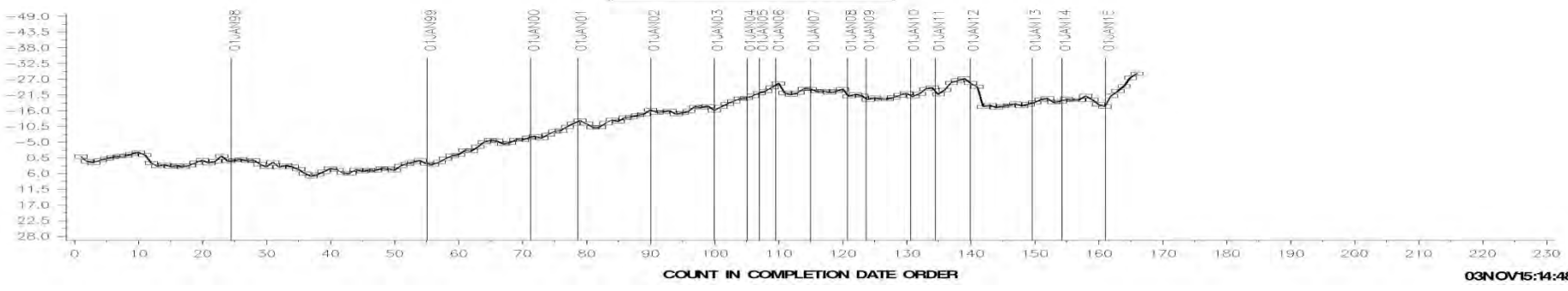
LTMS Severity Analysis



LTMS Precision Analysis



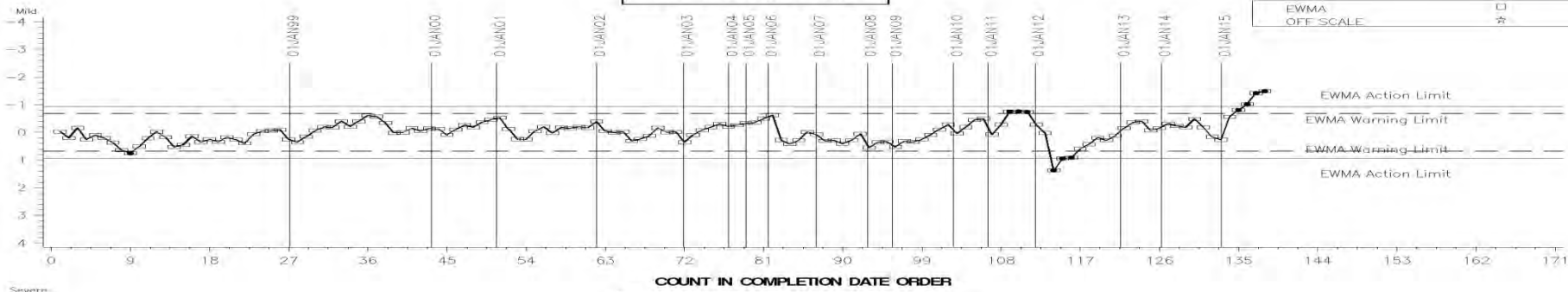
CUSUM Severity Analysis



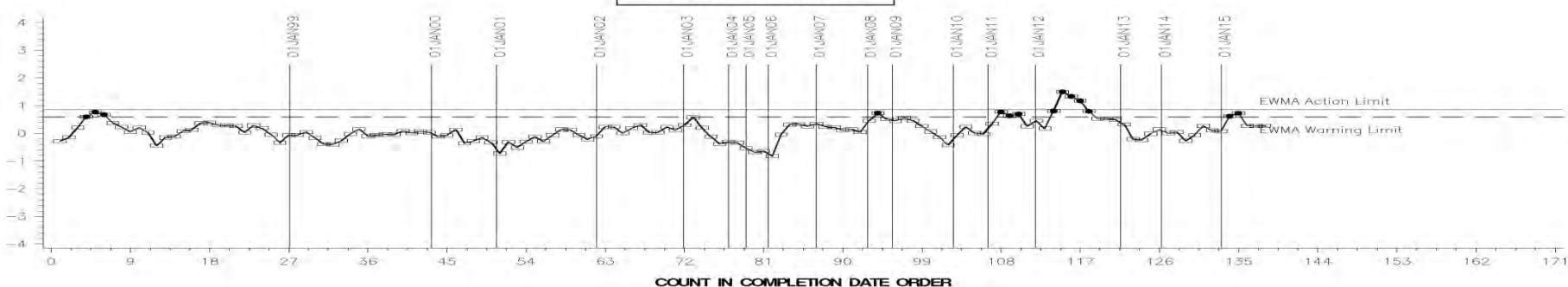
03NOV15:14:48

FINAL RELATIVE VISCOSITY (100% LOSS)

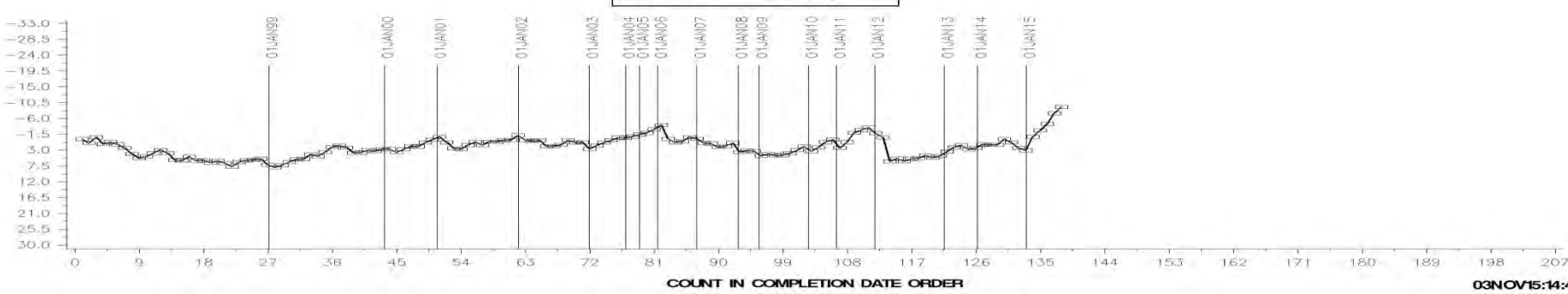
LTMS Severity Analysis



LTMS Precision Analysis



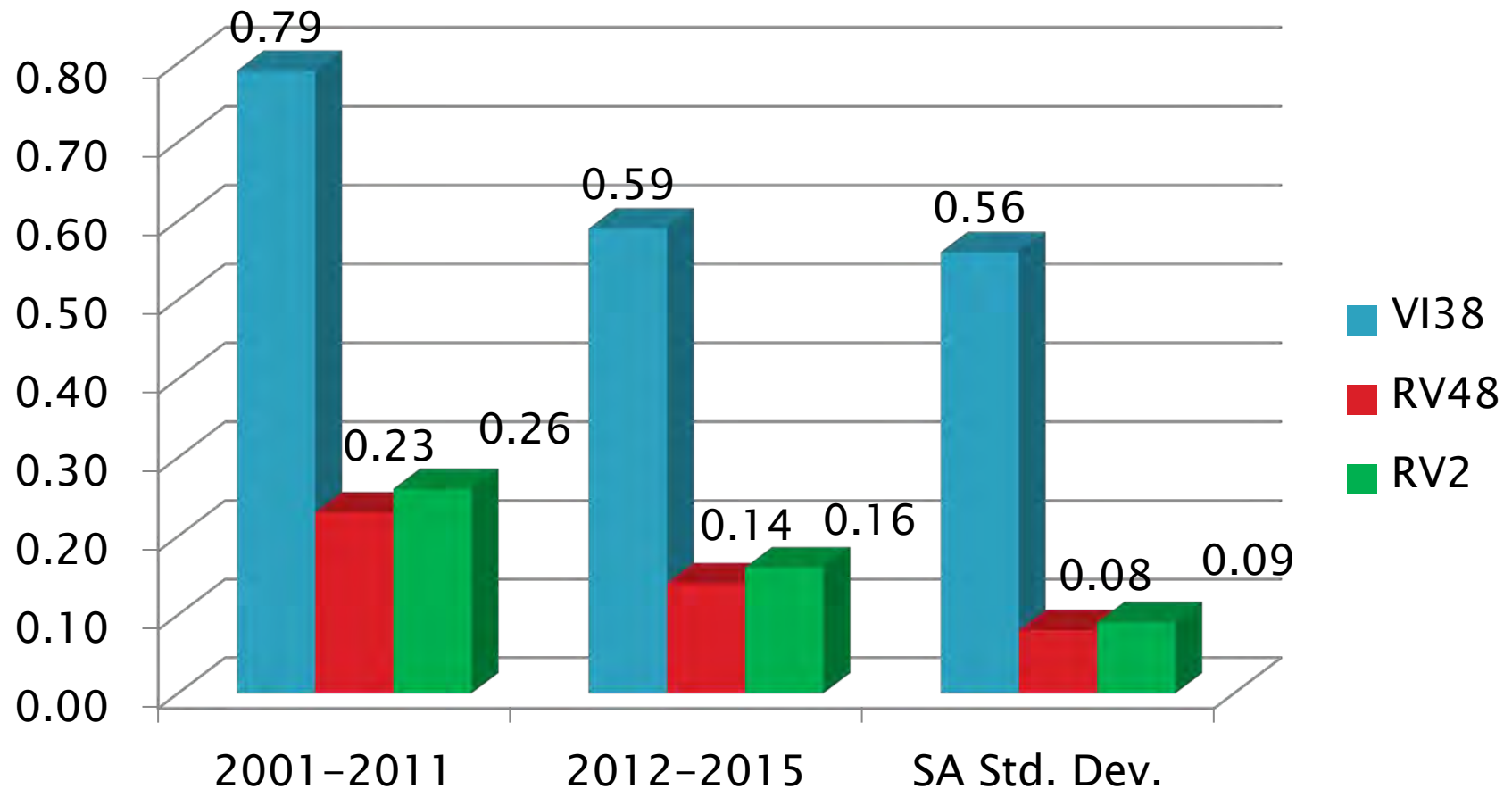
CUSUM Severity Analysis



03NOV15:14:48



# T-8/E Precision Estimates



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# Mack T-11

»» October 2015

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# T-11 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	7
Failed Calibration Test	OC	0
Operationally Invalid	LC	0
Aborted	XC	0
<b>Total</b>		<b>7</b>

# T-11 Failed Tests

Failed Parameter	Number of Tests
No failed tests	0
Total	0

# T-11 Lost Tests\*

Status	Cause	#
Invalid	No Invalid Tests	0
Aborted	No Aborted Tests	0
<b>Total</b>		<b>0</b>

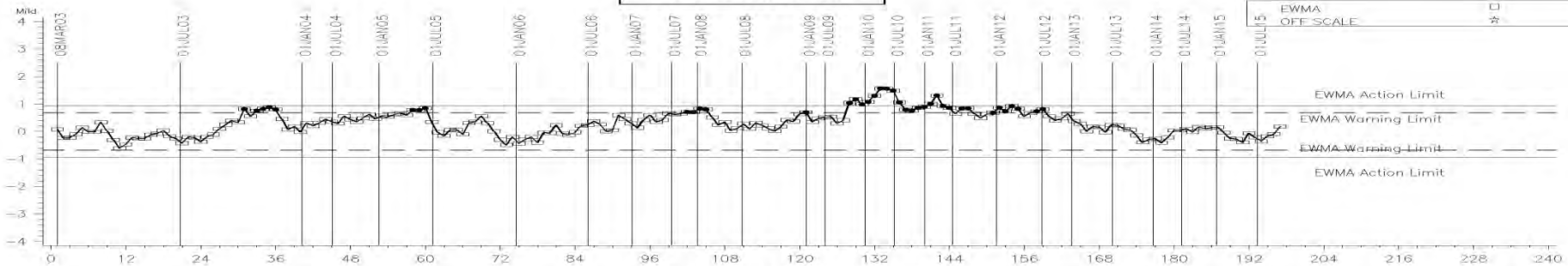
\*Invalid and aborted tests

# T-11 Test Severity

- ▶ SOOT and SOOT5 in control.
- ▶ SOOT4 in severity action alarm severe direction and near precision warning alarm.
- ▶ MRV in precision warning alarm.

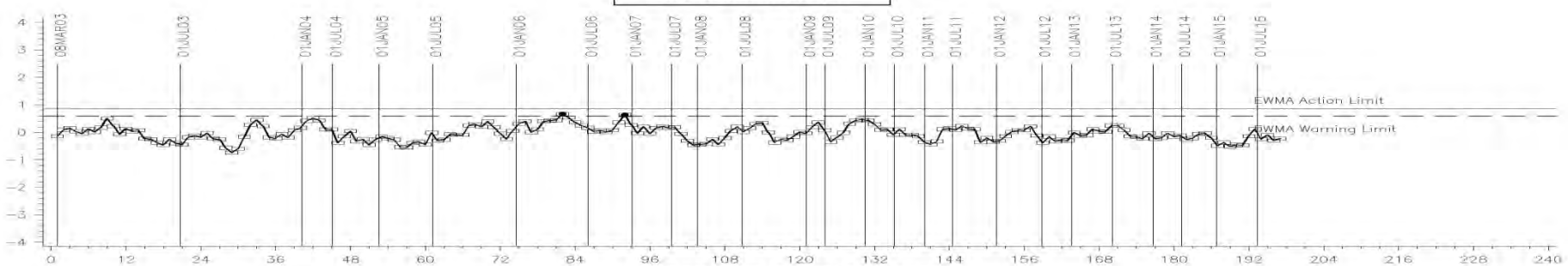
SOOT AT 12 cSt

LTMS Severity Analysis



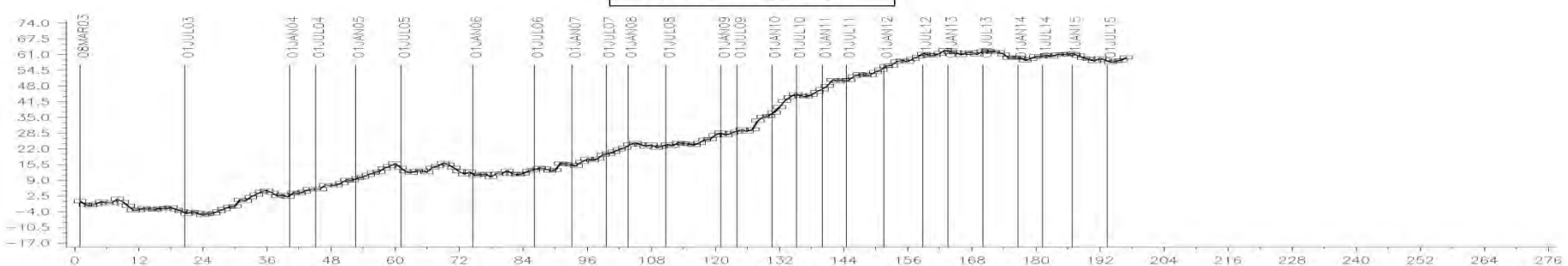
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

CUSUM Severity Analysis

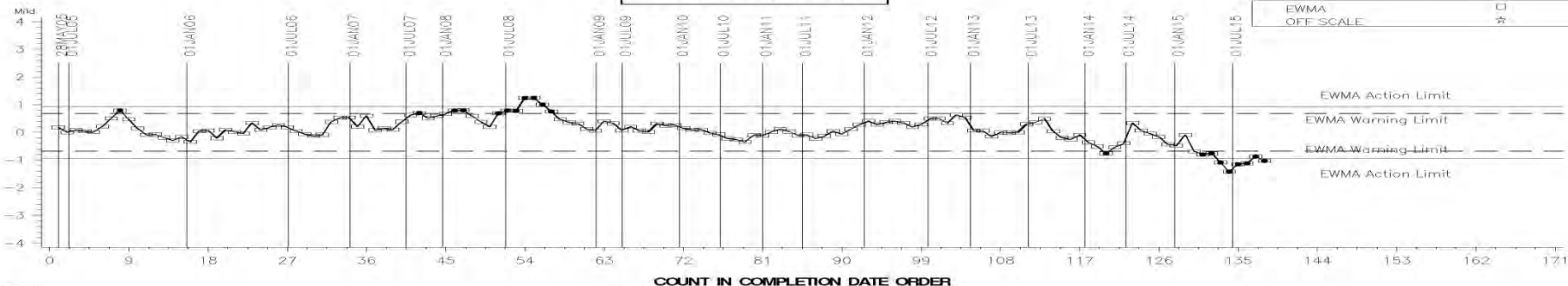


COUNT IN COMPLETION DATE ORDER

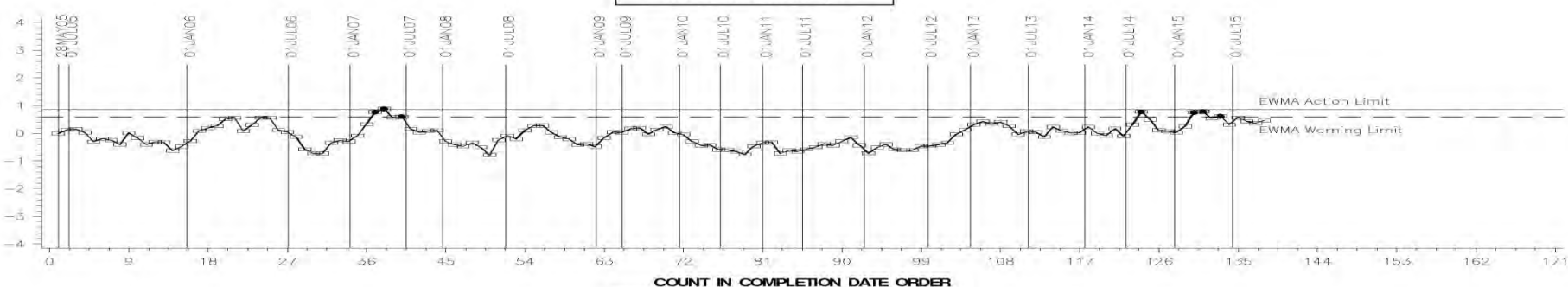
03NOV15:14:19

SOOT @ 4 cSt - FINAL RESULT

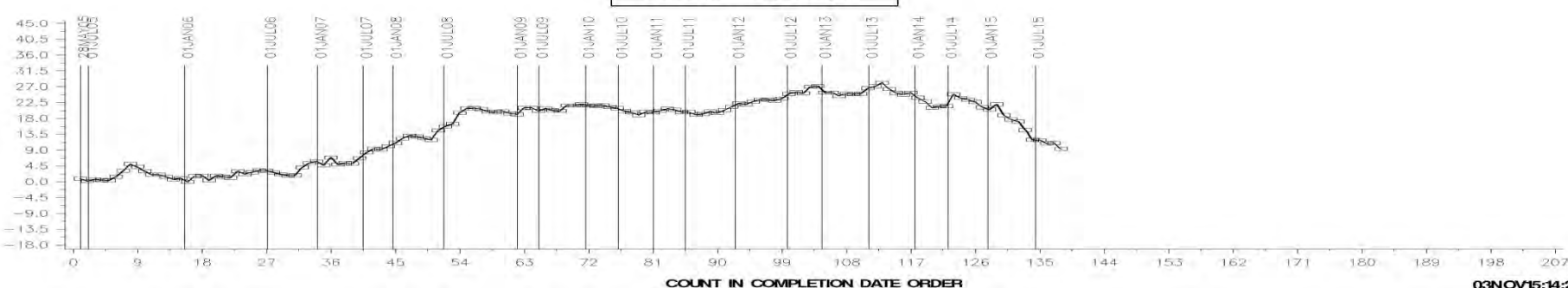
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

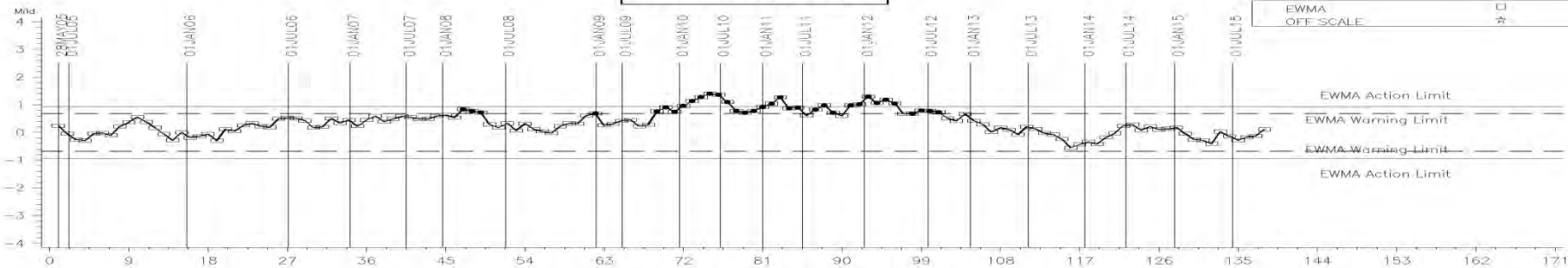


03NOV15:14:25

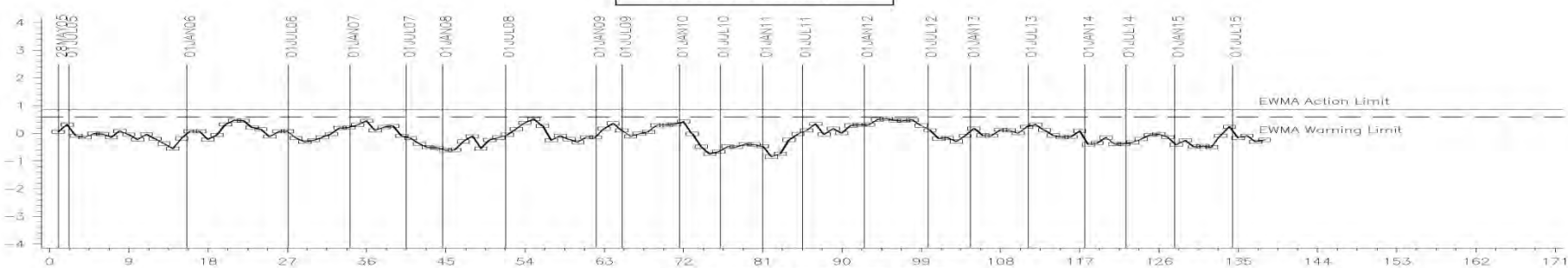


SOOT @ 15 cSt - FINAL RESULT

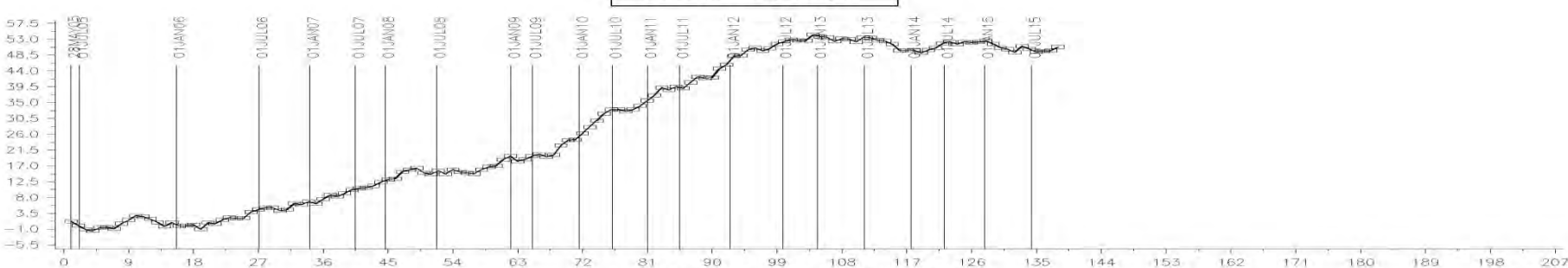
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

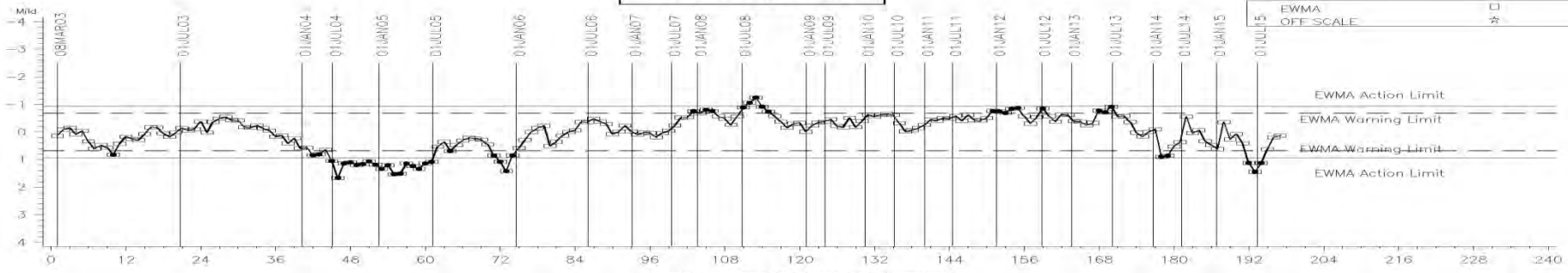


03NOV15:14:25



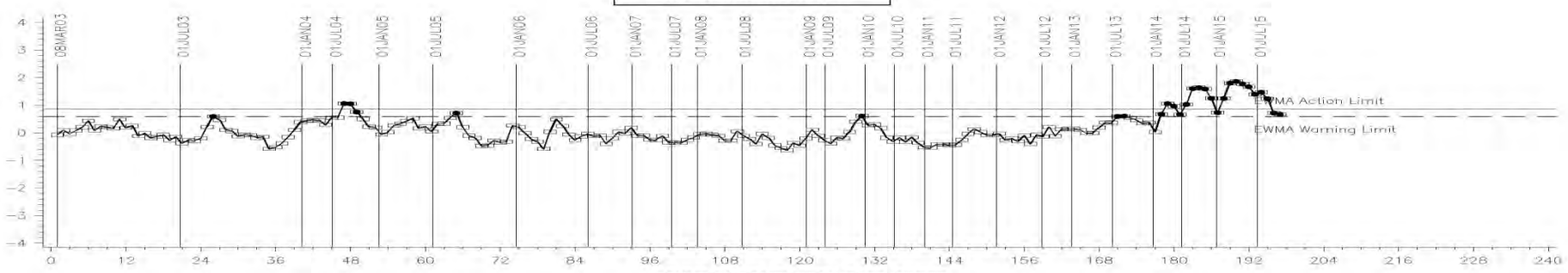
MRV VISCOSITY

LTMS Severity Analysis



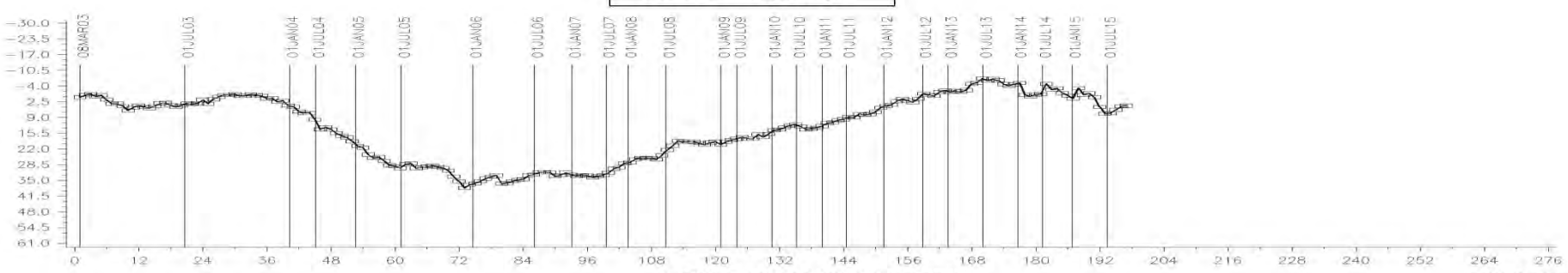
COUNT IN COMPLETION DATE ORDER

LTMS Precision Analysis



COUNT IN COMPLETION DATE ORDER

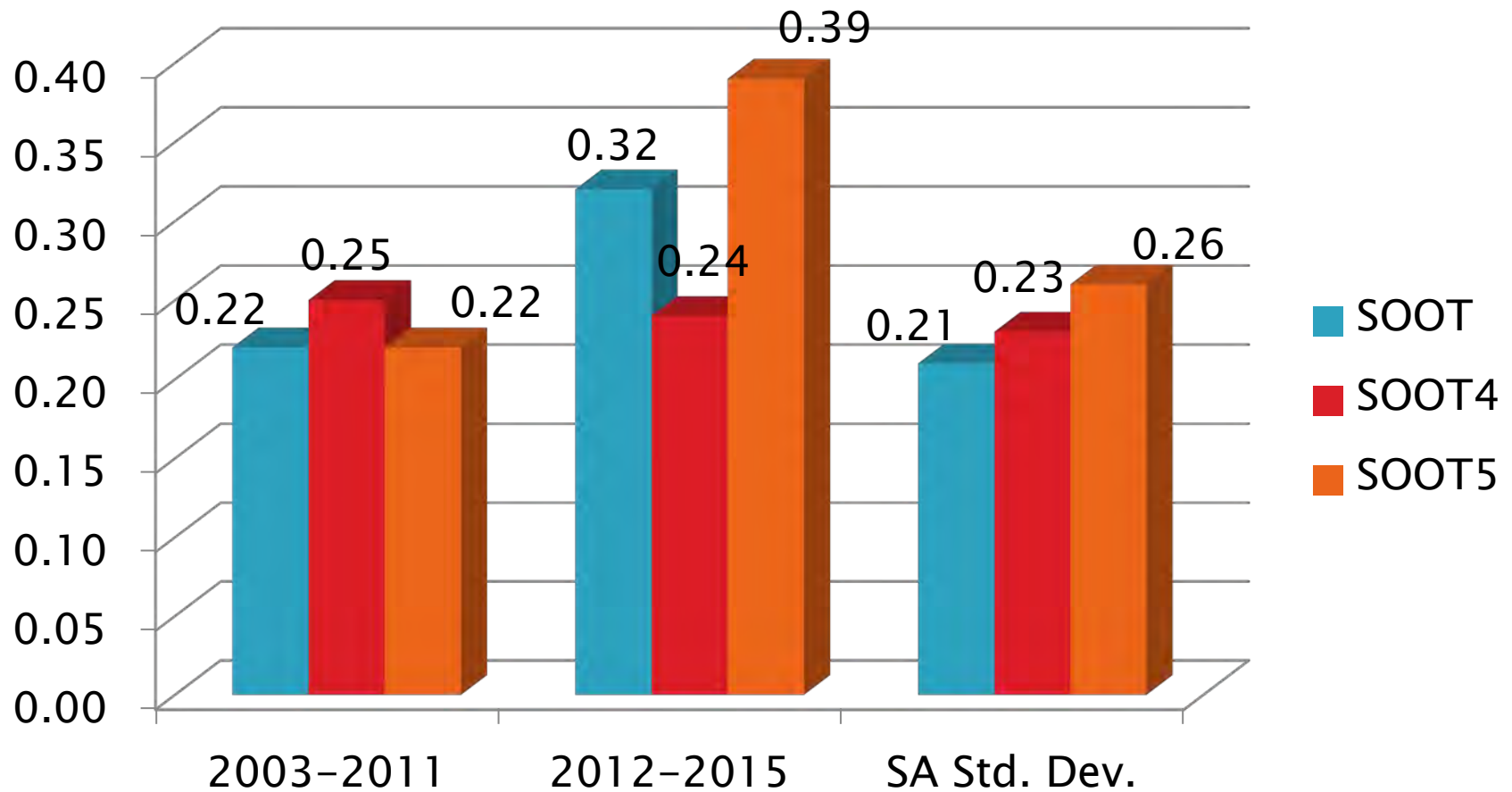
CUSUM Severity Analysis



COUNT IN COMPLETION DATE ORDER

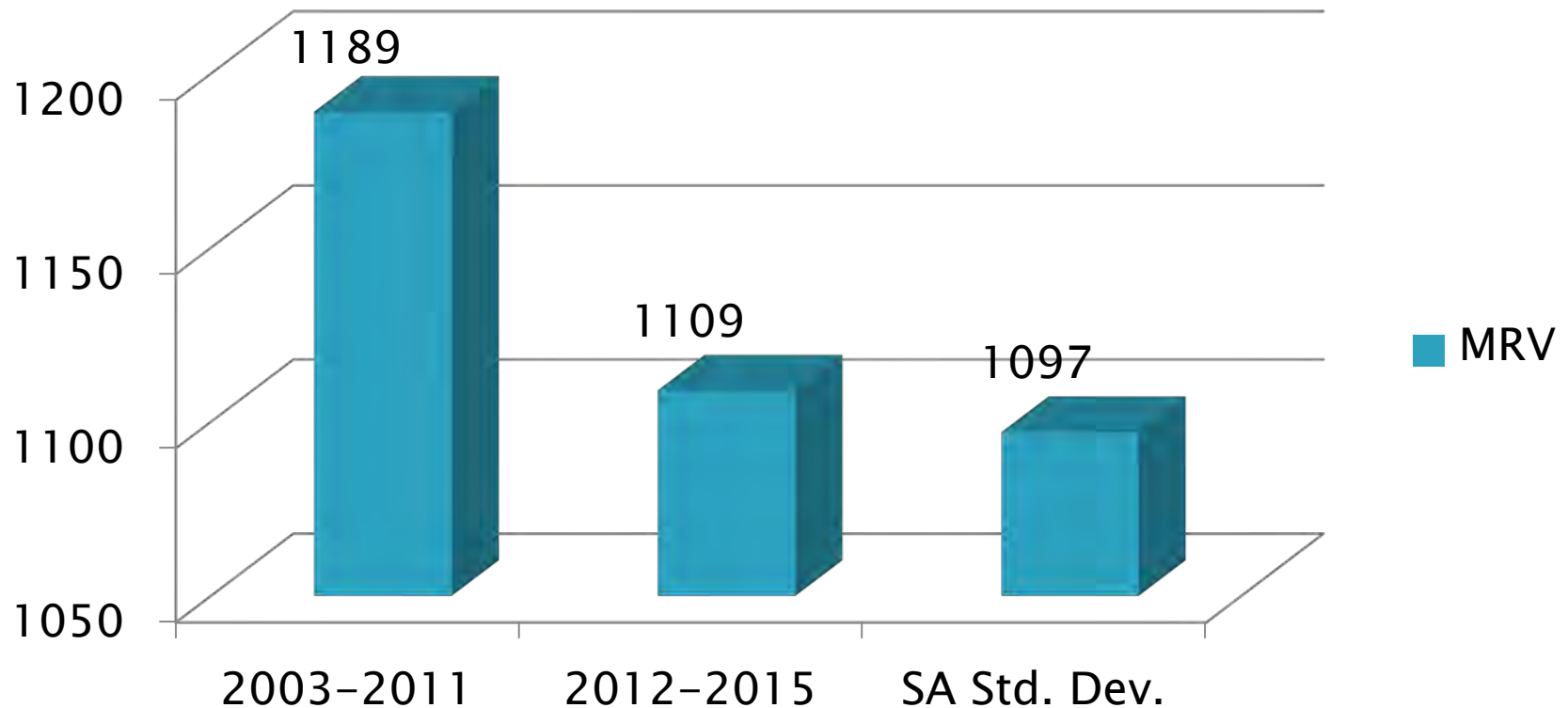
03NOV15:14:19

# T-11 Precision Estimates



# T-11 Precision Estimates

## MRV



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# Mack T-12

»» October 2015

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# T-12 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	6
Failed Calibration Test	OC	1
Operationally Invalid	LC	0
Aborted	XC	5
<b>Total</b>		<b>12</b>

# T-12 Failed Tests

Failed Parameter	Number of Tests
Severe Liner Wear	1
<b>Total</b>	<b>1</b>

# T-12 Lost Tests\*

Status	Cause	#
Aborted	EGR failure High soot	1
Aborted	Scuffing during break-in	1
Aborted	Mechanical Failure	1
Aborted	Engine failure during break-in	1
Aborted	Missed 100 Hour soot window	1
<b>Total</b>		<b>5</b>

\*Invalid and aborted tests

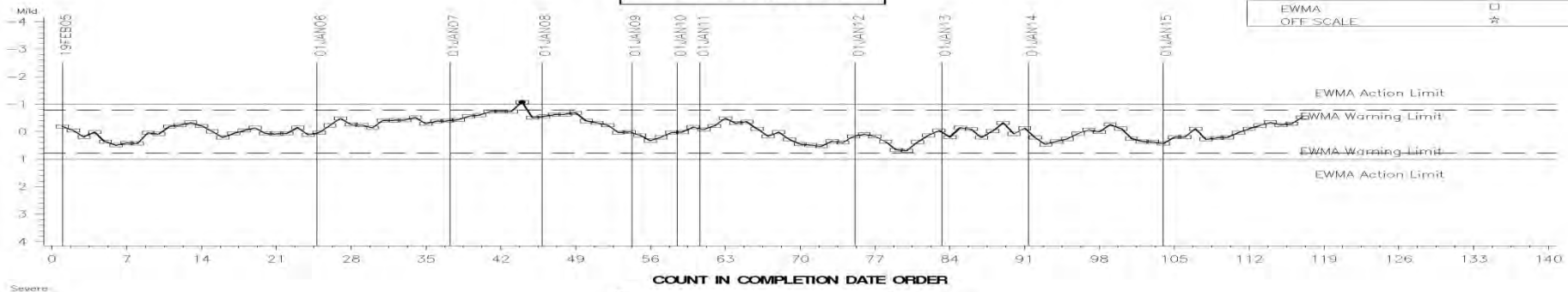


# T-12 Test Severity

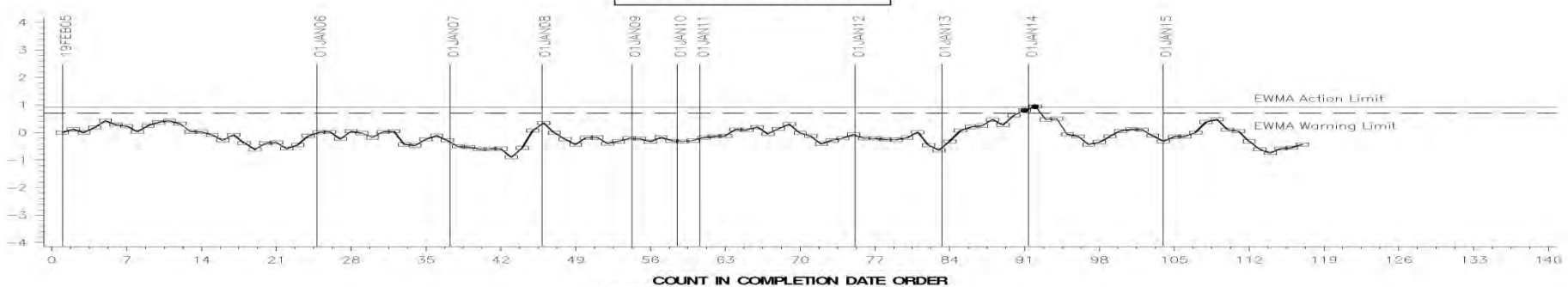
- ▶ All parameters are in control.

FINAL TRANS. RES. DELTA PB @ EOT

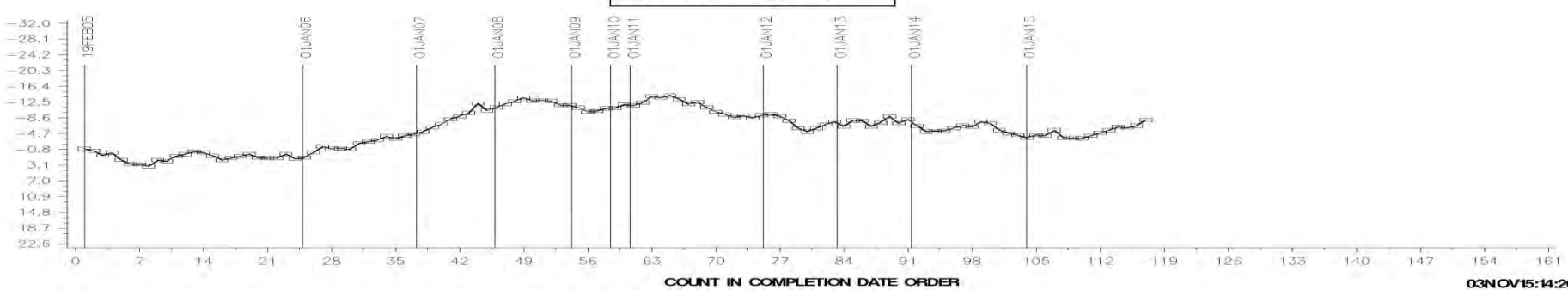
LTMS Severity Analysis



LTMS Precision Analysis

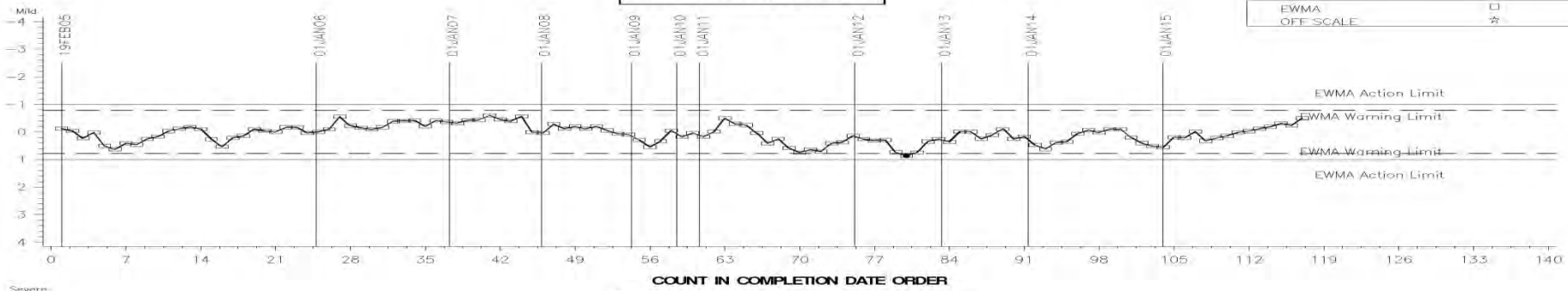


CUSUM Severity Analysis

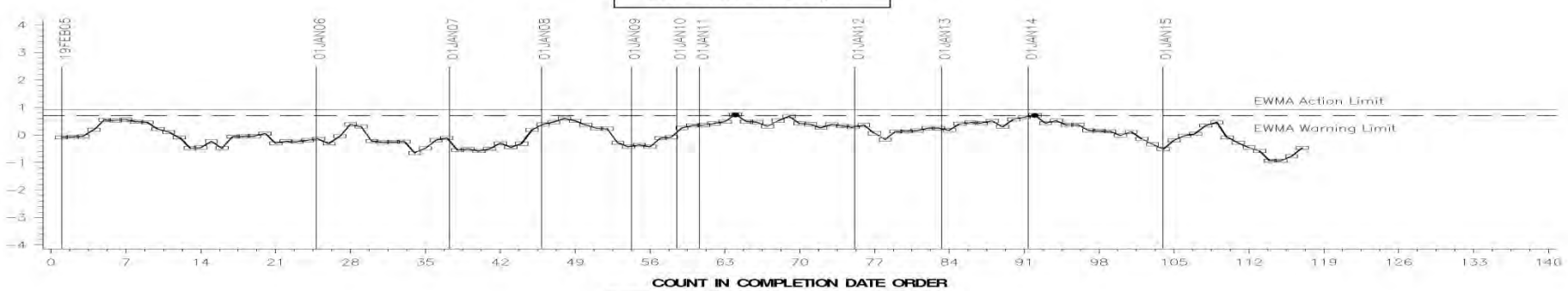


03NOV15:14:26

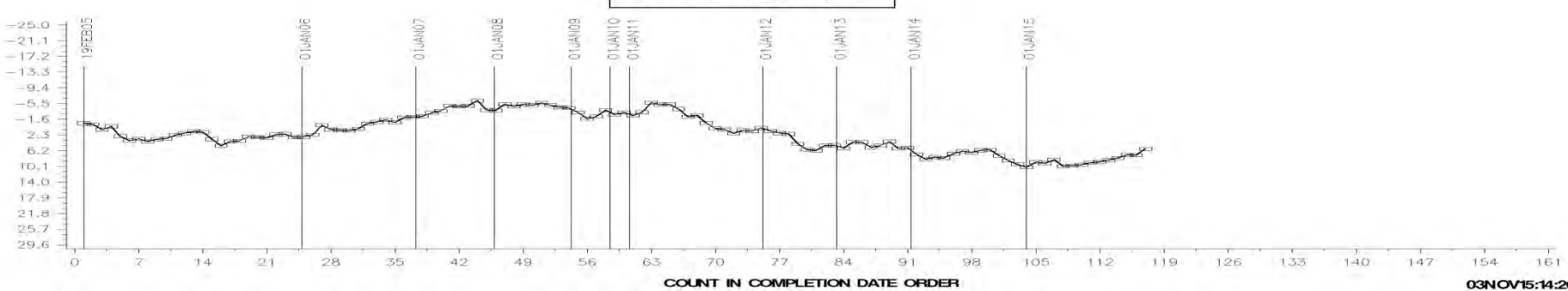
LTMS Severity Analysis



LTMS Precision Analysis



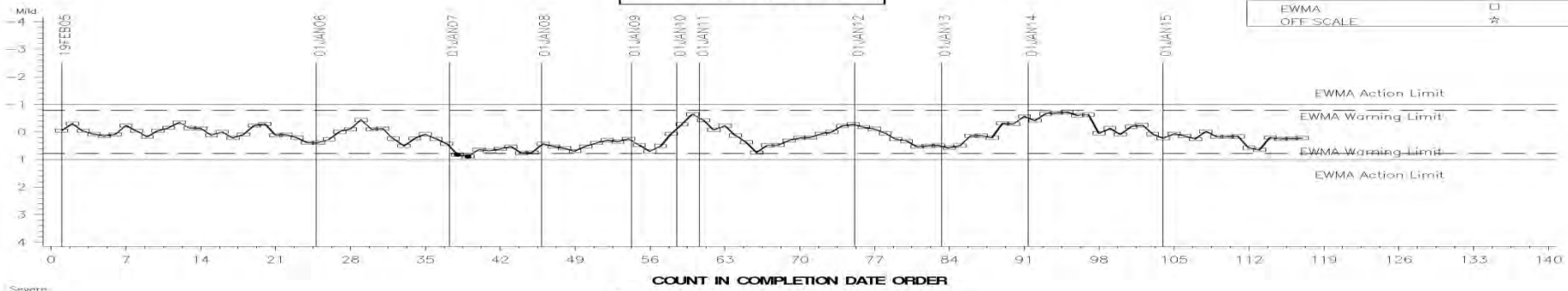
CUSUM Severity Analysis



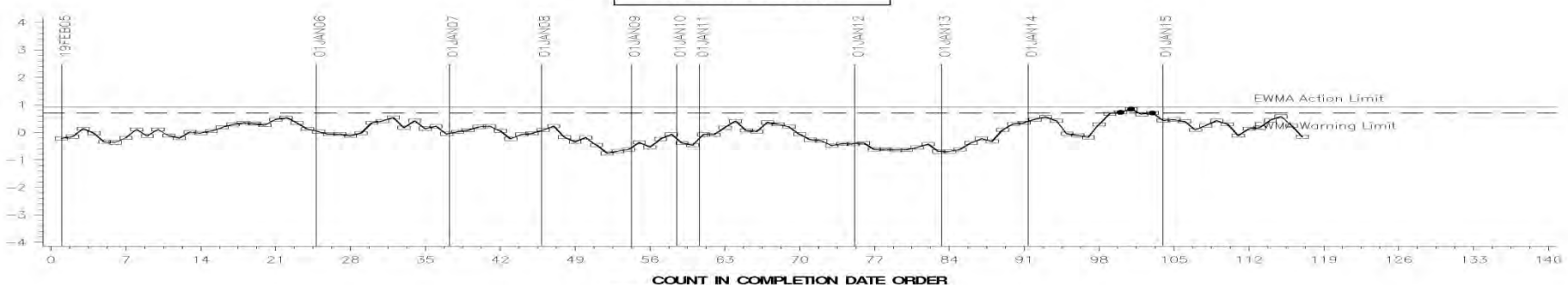
03NOV15:14:26

AVG. CYLINDER LINER WEAR (CLW)

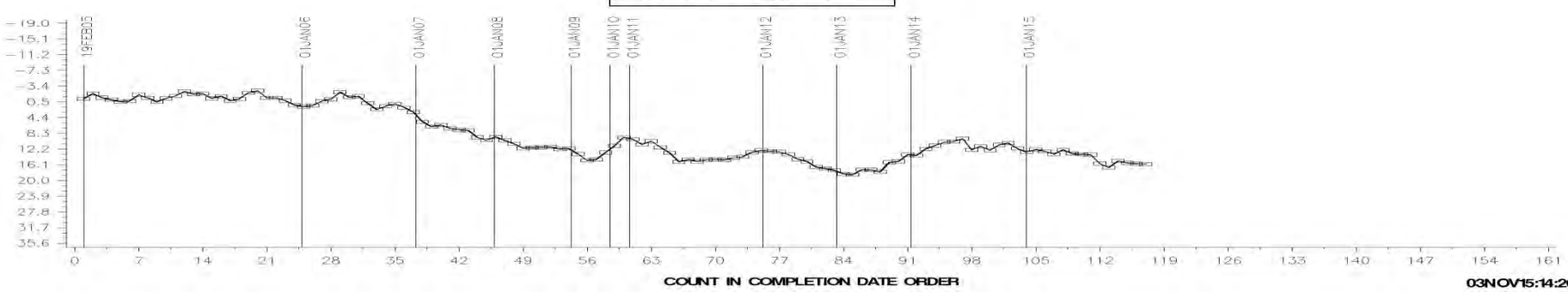
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

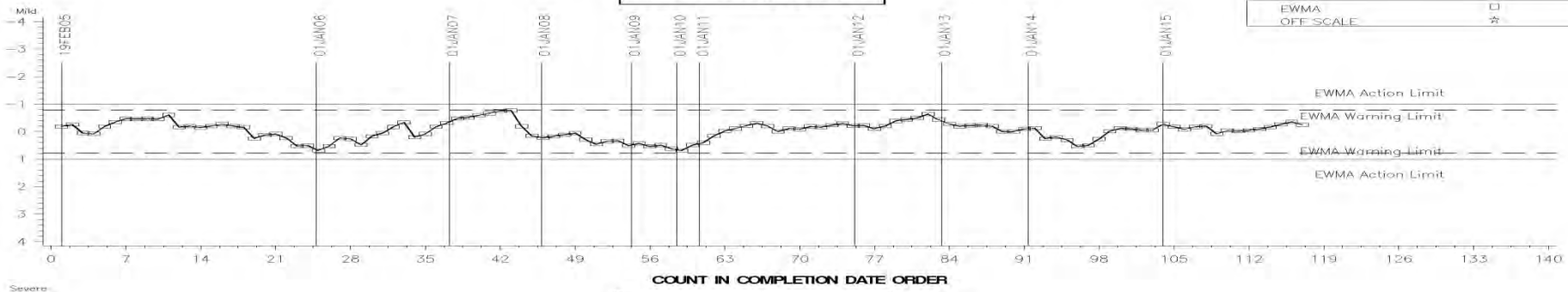


03NOV15:14:26

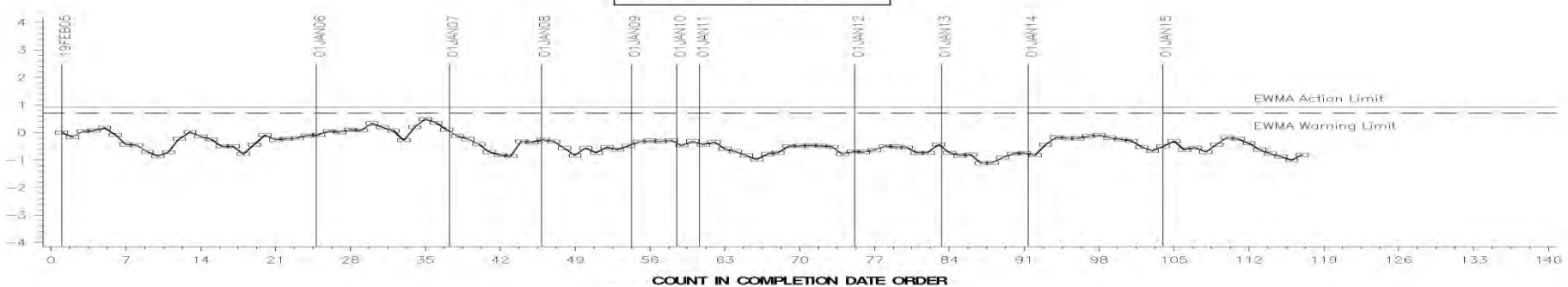


AVG. TOP RING WEIGHT LOSS (TRWL)

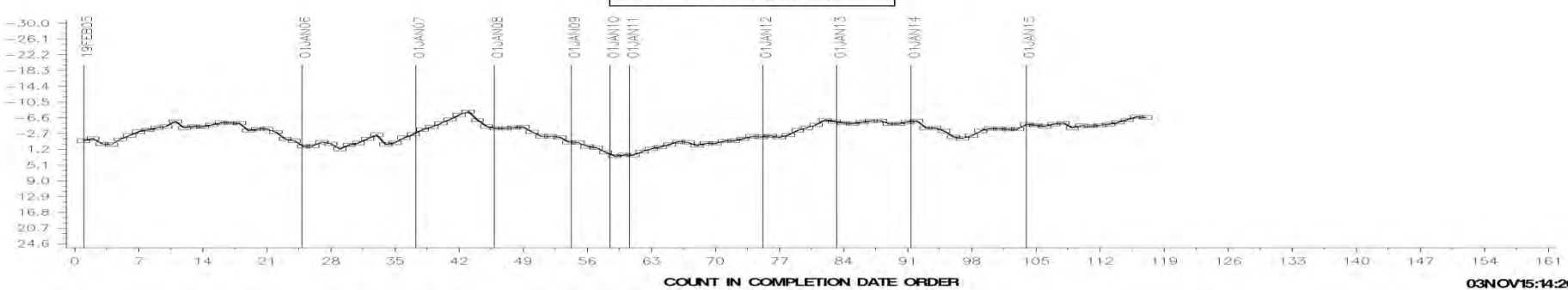
LTMS Severity Analysis



LTMS Precision Analysis



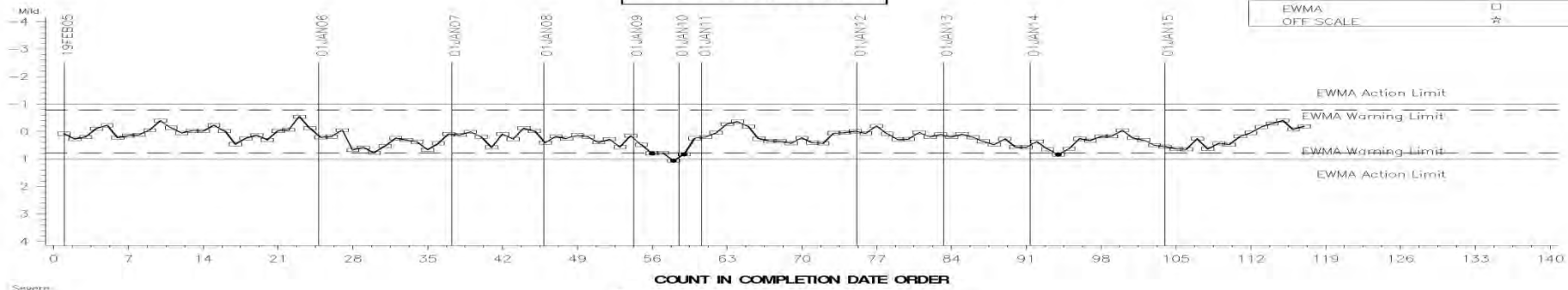
CUSUM Severity Analysis



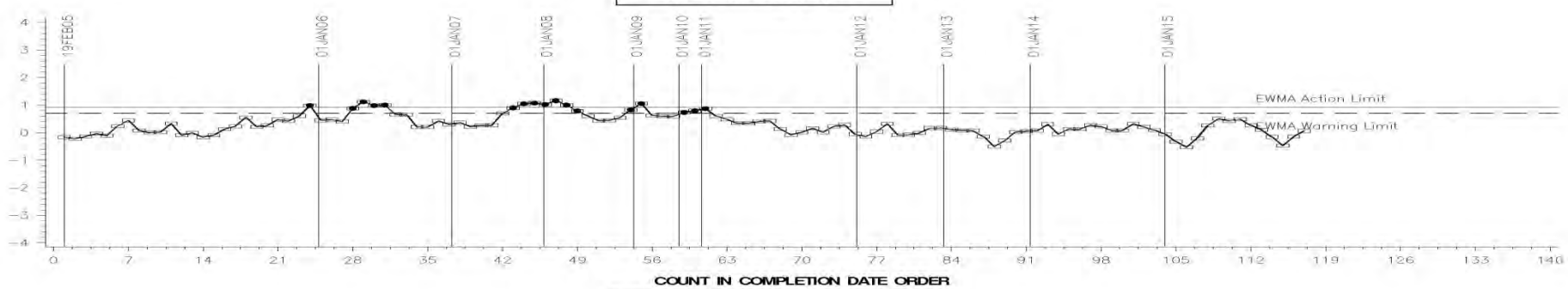
03NOV15:14:26

FINAL TRANS. RES. OIL CONSUMPTION

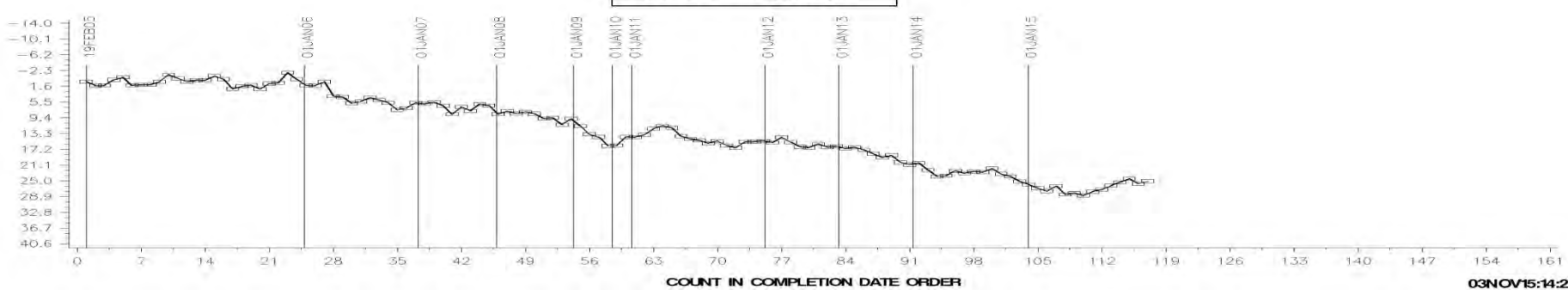
LTMS Severity Analysis



LTMS Precision Analysis

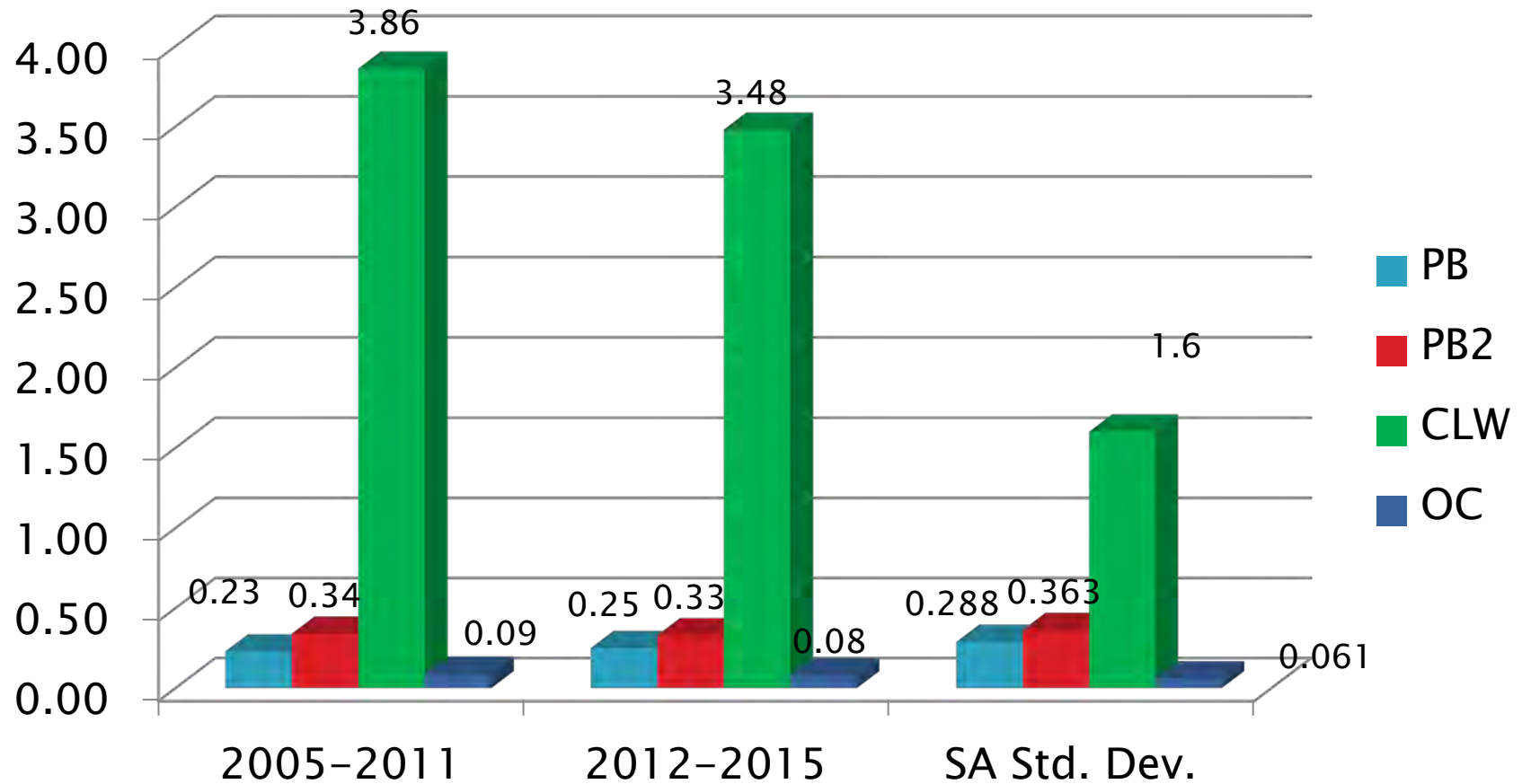


CUSUM Severity Analysis



03NOV15:14:27

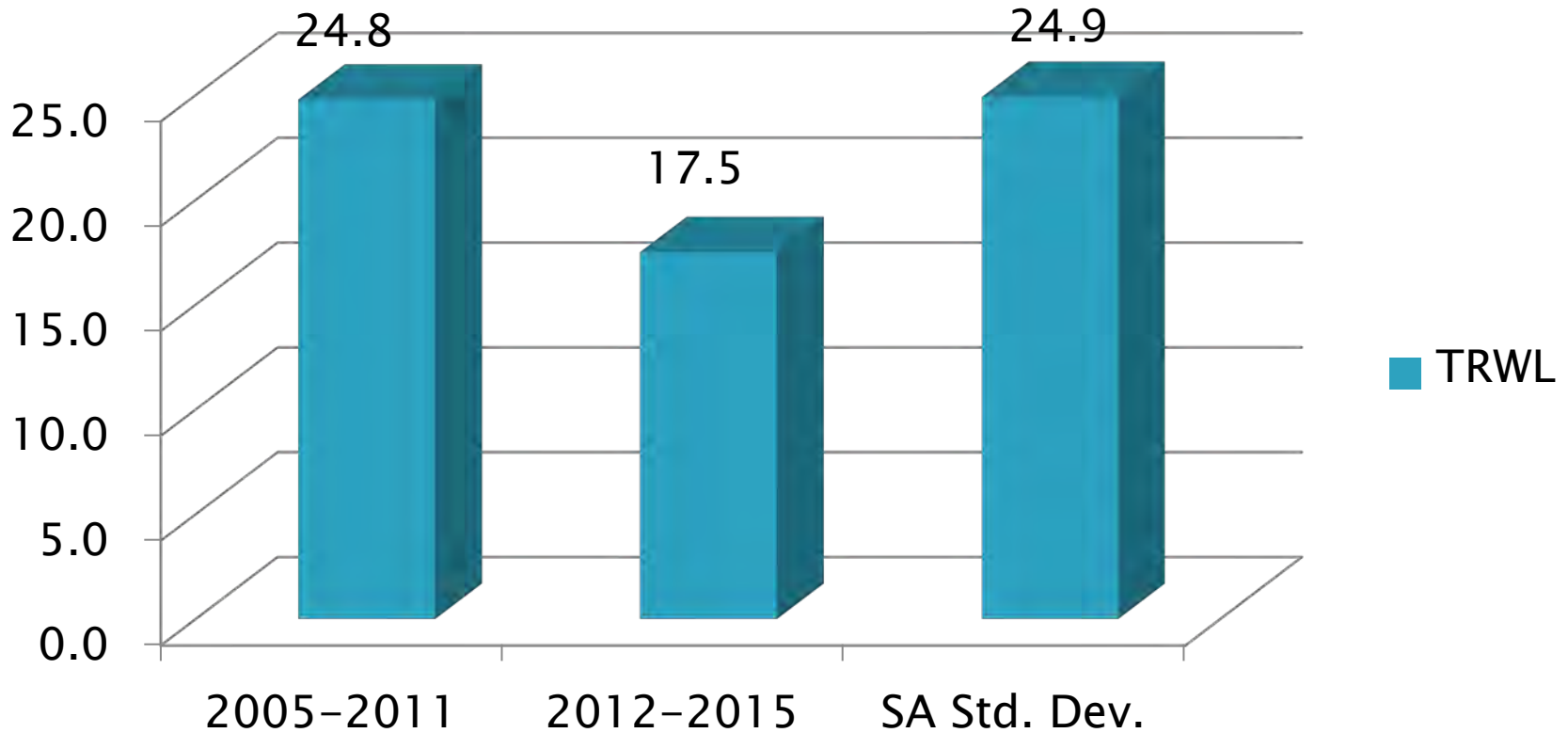
# T-12 Precision Estimates





# T-12 Precision Estimates

## TRWL



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# Mack T-12A

»» October 2015

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# T-12A Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	8
Failed Calibration Test	OC	0
Operationally Invalid	LC	3
Aborted	XC	2
<b>Total</b>		<b>13</b>

# T-12A Failed Tests

Failed Parameter	Number of Tests
No failed tests	
Total	0

# T-12A Lost Tests\*

Status	Cause	#
Aborted	High oil consumption -Safety issue	1
Aborted	Missed oil add @ 120 Hrs	1
Invalid	Incorrect oil sample	1
Invalid	Missed soot window	2
<b>Total</b>		<b>5</b>

\*Invalid and aborted tests

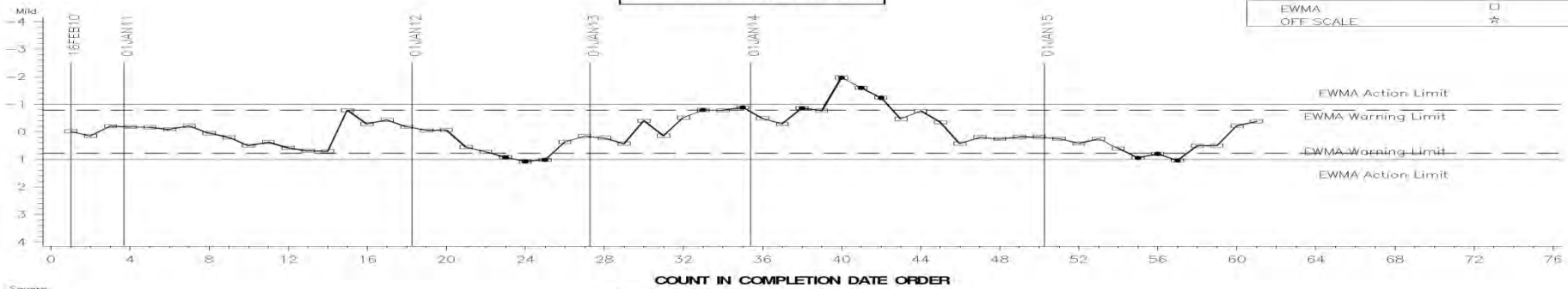
# T-12A Test Severity

- ▶ MRV is in a precision action alarm.

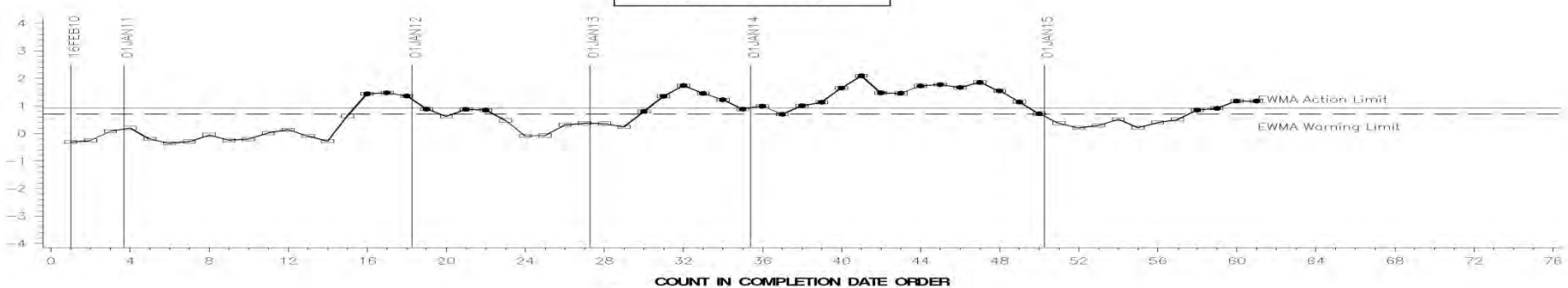
MACK T-12A INDUSTRY OPERATIONAL VALID DATA

FINAL ORIGINAL UNIT MRV VISCOSITY [NM, SOLID, FROZEN, <, > ]

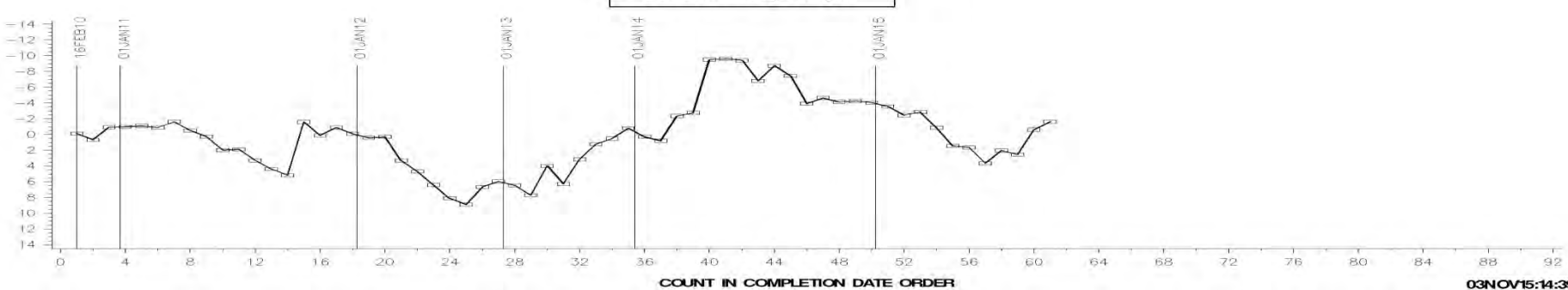
LTMS Severity Analysis



LTMS Precision Analysis



CUSUM Severity Analysis

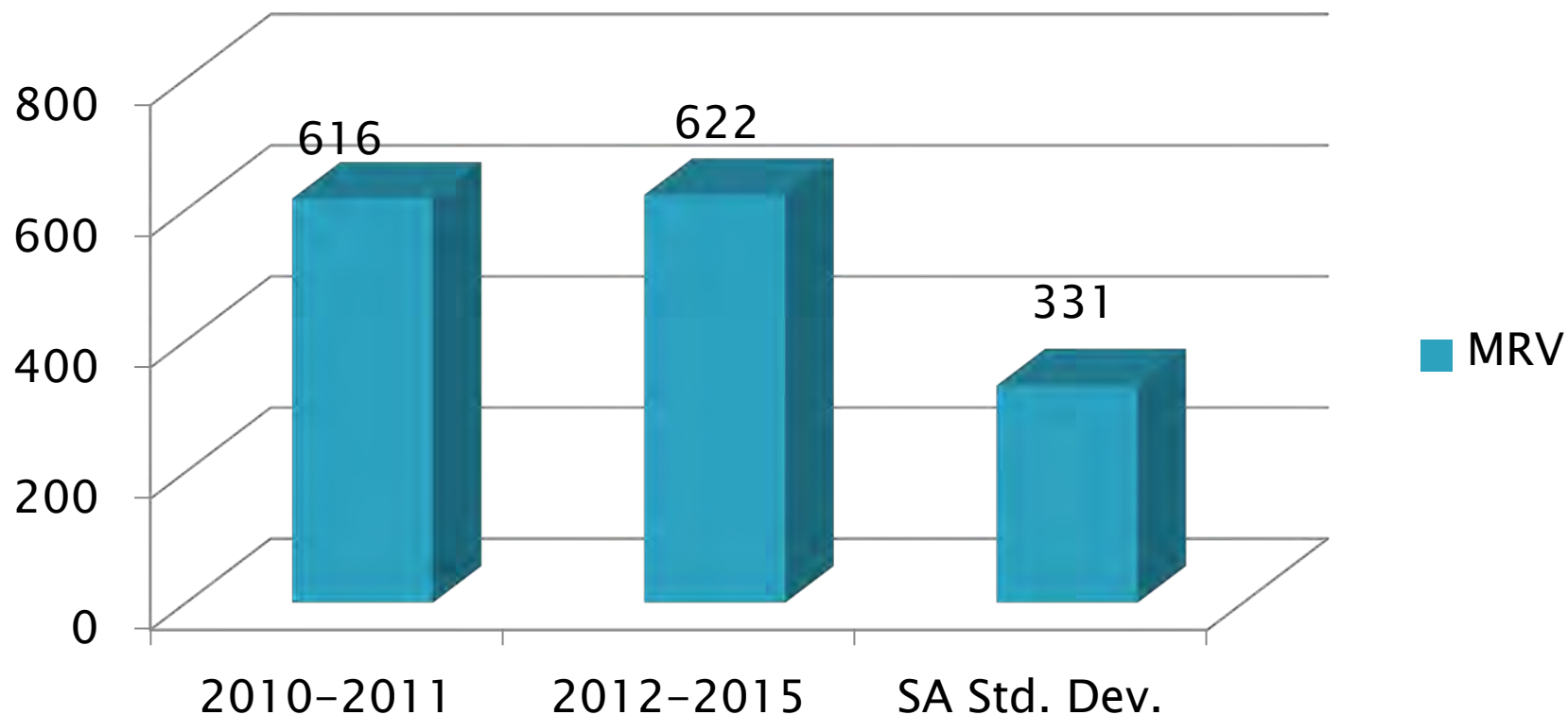


03NOV15:14:39



# T-12A Precision Estimates

## MRV



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# Mack T-13

»» October 2015

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# T-13 Test Activity

Test Status	Validity Code	#
Acceptable Calibration Test	AC	14
Failed Calibration Test	OC	0
Operationally Invalid	LC	2
Aborted	XC	1
<b>Total</b>		<b>17</b>

# T-13 Failed Tests

Failed Parameter	Number of Tests
No Failed Tests	0
Total	0

# T-13 Lost Tests\*

Status	Cause	#
Invalid	Bad Exhaust back pressure configuration	1
Invalid	Bad coolant out thermocouple	1
Aborted	High fuel dilution	1
<b>Total</b>		<b>3</b>

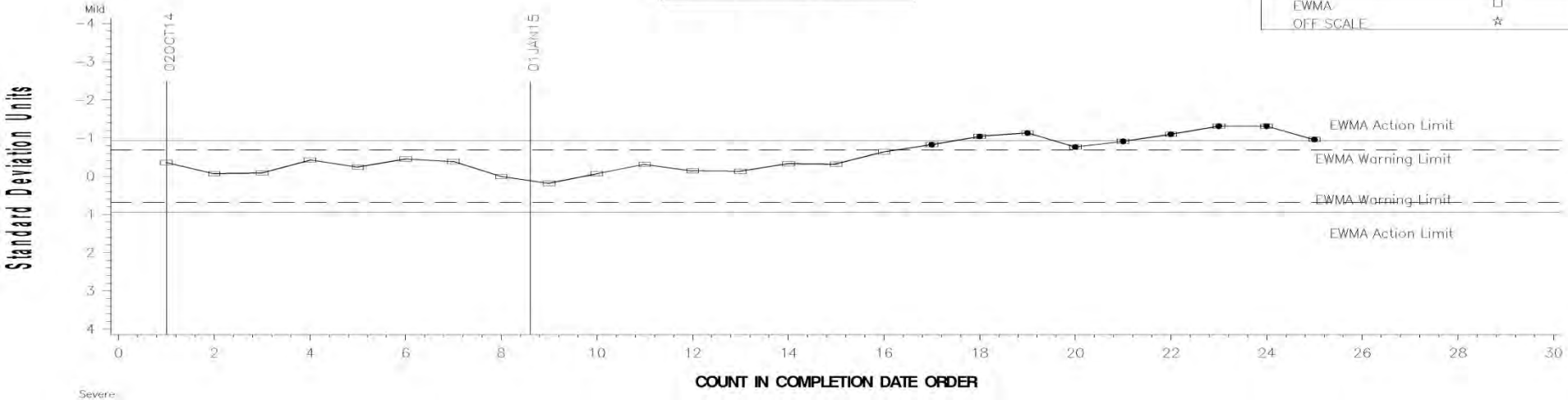
\*Invalid and aborted tests

# T-13 Test Severity

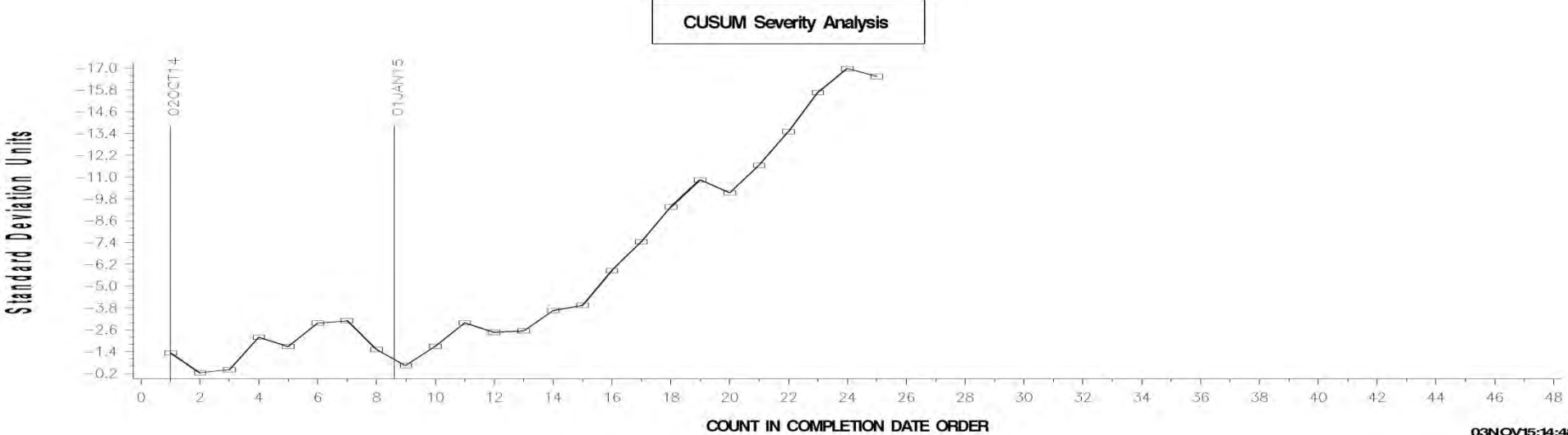
- ▶ IRPH in severity action alarm mild direction.
- ▶ KV40PC in control but near severity warning limit.

FINAL ORIGINAL PEAK HEIGHT IR AT EOT

LTMS Severity Analysis



CUSUM Severity Analysis

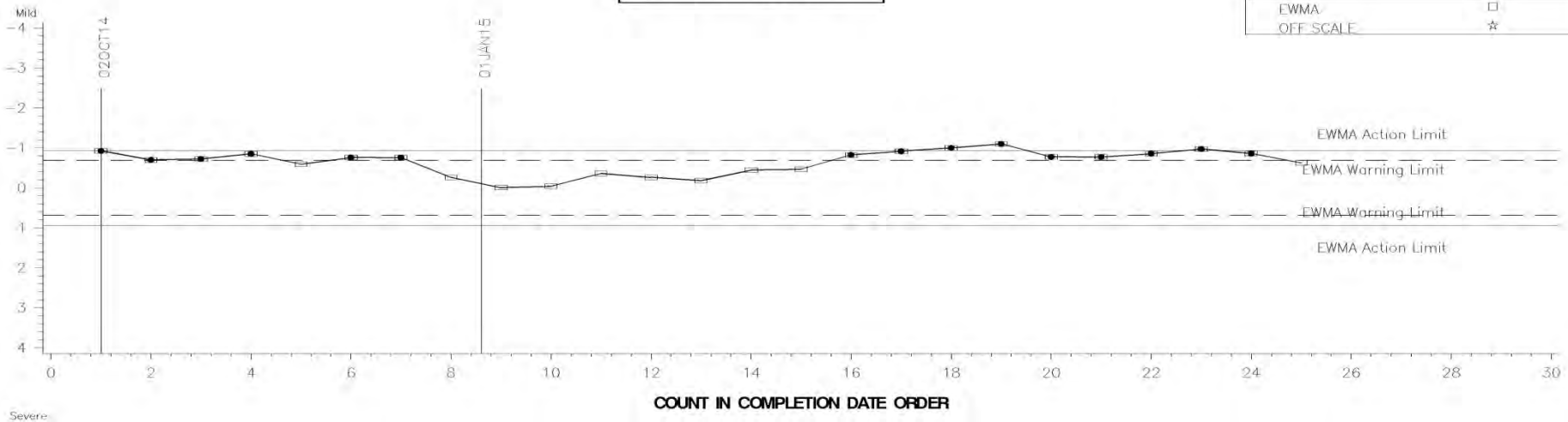


03 NOV 15:14:48

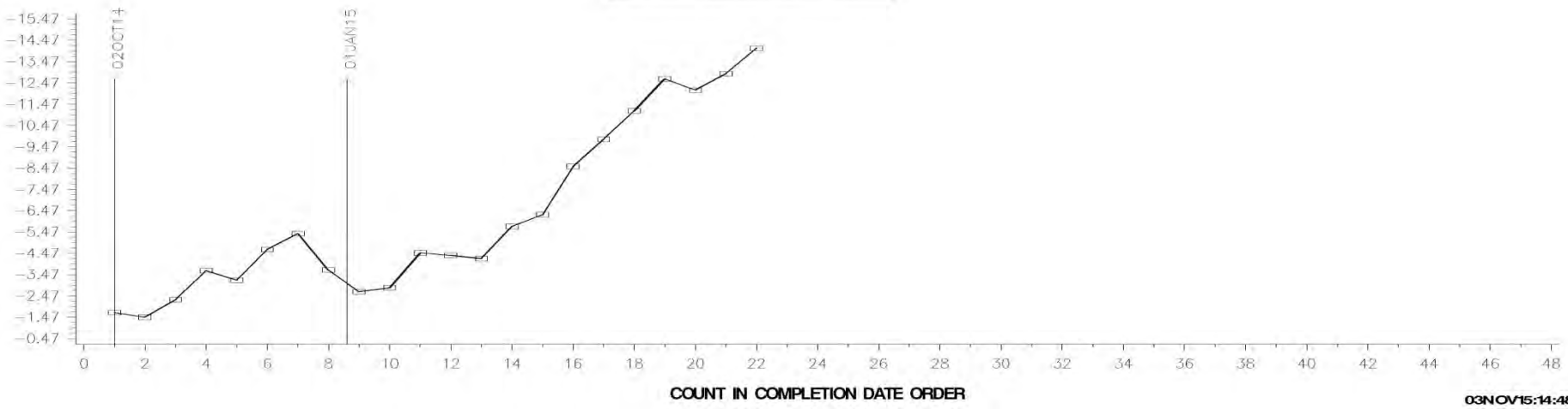


FNL. ORIG. UNIT KINEMATIC VISCOSITY AT 40 DEG C % CHANGE 300-360 HRS

LTMS Severity Analysis

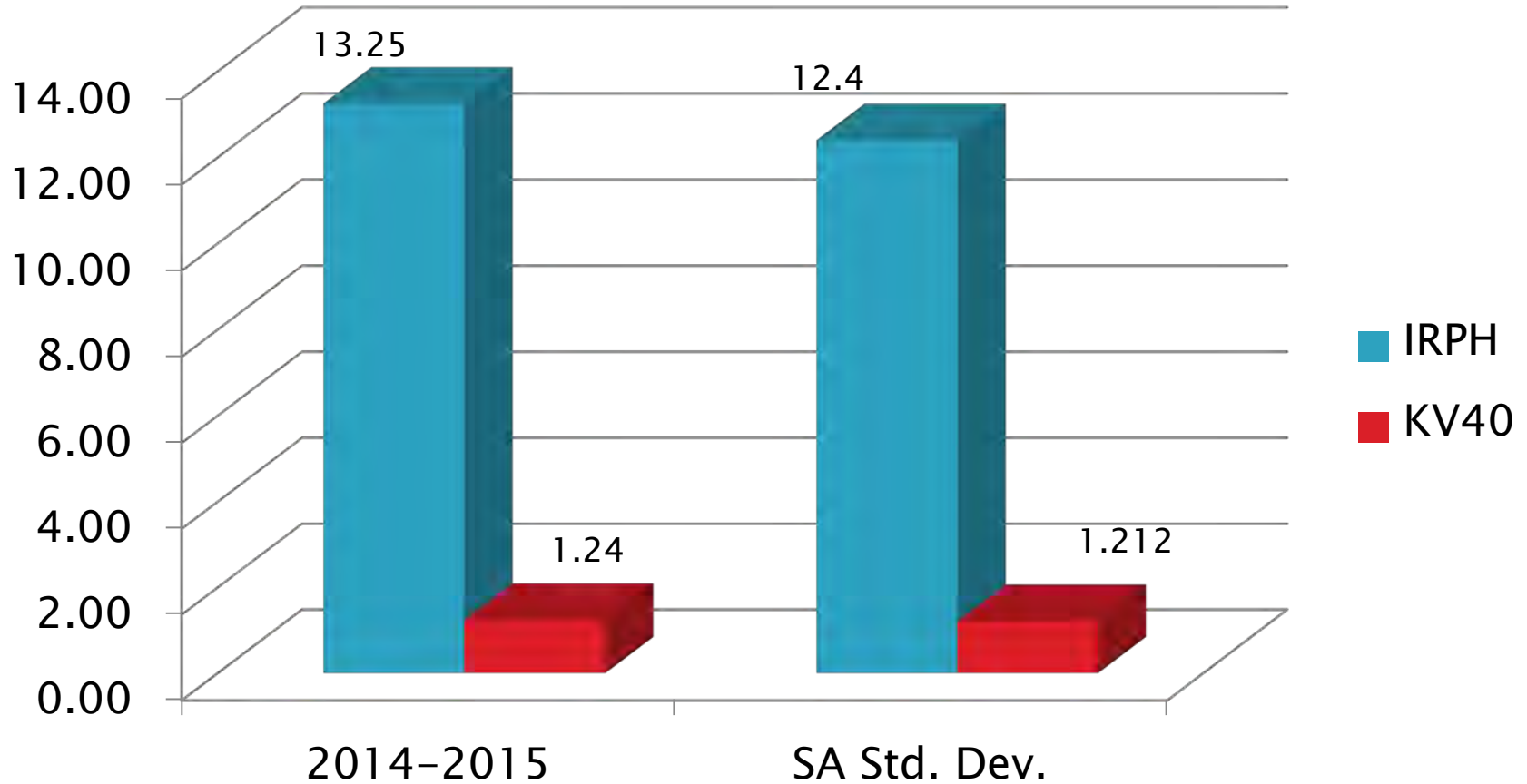


CUSUM Severity Analysis



03NOV15:14:48

# T-13 Precision Estimates



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# Information Letters

»» April 1, 2015 –

September 30, 2015

*Test Monitoring Center*

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# Information Letters\*

Test	Date	IL	Topic
1N	4/6/2015	15-2	Changes to 1N Top Groove Fill and Top Land Heavy Carbon Reporting
ISB	4/6/2015	15-1	ISB ATWL & ACSW Correction Factors for Batch K cams and Batch D tappets
C13	7/24/2015	15-2	New Lab and New Stand Definition
T12	8/3/2015	15-2	Updated VUXO Hardware Correction Factors
1P	9/14/2015	15-1	Revision to 1P Procedure to Remove 7 Day Test Report Validity Criteria
1MPC	9/14/2015	15-1	Revision to 1MPC Procedure to Remove 7 Day Test Report Validity Criteria

\*Available from TMC Website

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# Reference Oil Inventory

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

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# Reference Oil Reblends

- ▶ T13 and COAT reference oils released for testing

# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
809-1	1K, 1N	9134	60	2239	126	5+ years
811-2	1K, 1N	1732	50	1194	50	5+ years
822-1	1R, T-10A, T-11	560	0	16	56	~.25 years
822-2	1R, T-10A, T-11	4386	308	3516	252	5+ years
821-3	T-12	1500	0	94	100	~.75 years
821-4	T-12	4495	375	3335	250	2.75 years
823	T-13	1796	360	1359	268	5+ years



# Reference Oil Inventory Estimated Life

Oil	Tests	Original Blend Amount	Quantity Shipped in last 6 months	TMC Inventory	Lab Inventory	Estimated Life
830-2	ISM	3786	0	367	276	1.5 years
831-3	C13, ISB	972	90	478	325	5+ years
873-2	1M-PC	1650	10	107	40	5+ years
1005-4	1P, 1R, EOAT, RFWT, T-8/E	2000	112	74	125	< 0.5 years
1005-5	1P, 1R, EOAT, RFWT, T-8/E	3826	220	3588	130	5+ years
832	COAT	1166	364	782	224	5+ years
833	COAT	1152	364	757	196	4.25 years

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# LTMS Deviations

»» April 1, 2015 –  
September 30, 2015

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# LTMS Deviations

- No LTMS Deviations in Current Period

Historical Count of HD LTMS Deviations

Test	LTMS Deviations
1M-PC	2
1N	2
T-8/E	2
T-10A	1
T-12	1

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# Quality Index Deviations

»» April 1, 2015 –

September 30, 2015

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# Quality Index Deviations

- ▶ 1 P Qi Deviation
  - Inlet air pressure Qi Negative due to lab power outage and abrupt shutdown of test on same inlet air system.
- ▶ T12 Qi Deviation
  - Intake manifold temperature negative Qi due to engine shutdowns and slow controller response.

# Quality Index Deviations

## Historical Count of HD Quality Index Deviations

Test	Qi Deviations
1P	13
1R	1
ISM	3
C13	1
T-10A	1
T-11	3
T-12	6

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# TMC Laboratory Visits

»» April 1, 2015 –

September 30, 2015

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# TMC Lab Visits

- ▶ C13, ISM and ISB lab visit this period
  - C13 coolant pressure not measured at top of tank.
  - ISM coolant pressure not measured at top of tank.
  - ISM intake manifold temperature thermocouple located in wrong place.
  - ISM turbo inlet piping too short.

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# Test Area Timelines

»» April 1, 2015 –  
September 30, 2015

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# Test Area Timeline Additions\*

Test	Date	Topic	IL/Memo
ISB	4-2-2015	Changes ISB ATWL & ACSW Correction Factors for Batch K cams and Batch D tappets	15-1
T12	7-31-2015	Updated VUXO Hardware Correction Factors	15-2

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\*As of 9/30/2015

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# Rating Workshop Data

»» 2015 Heavy Duty Workshop

Test Monitoring Center

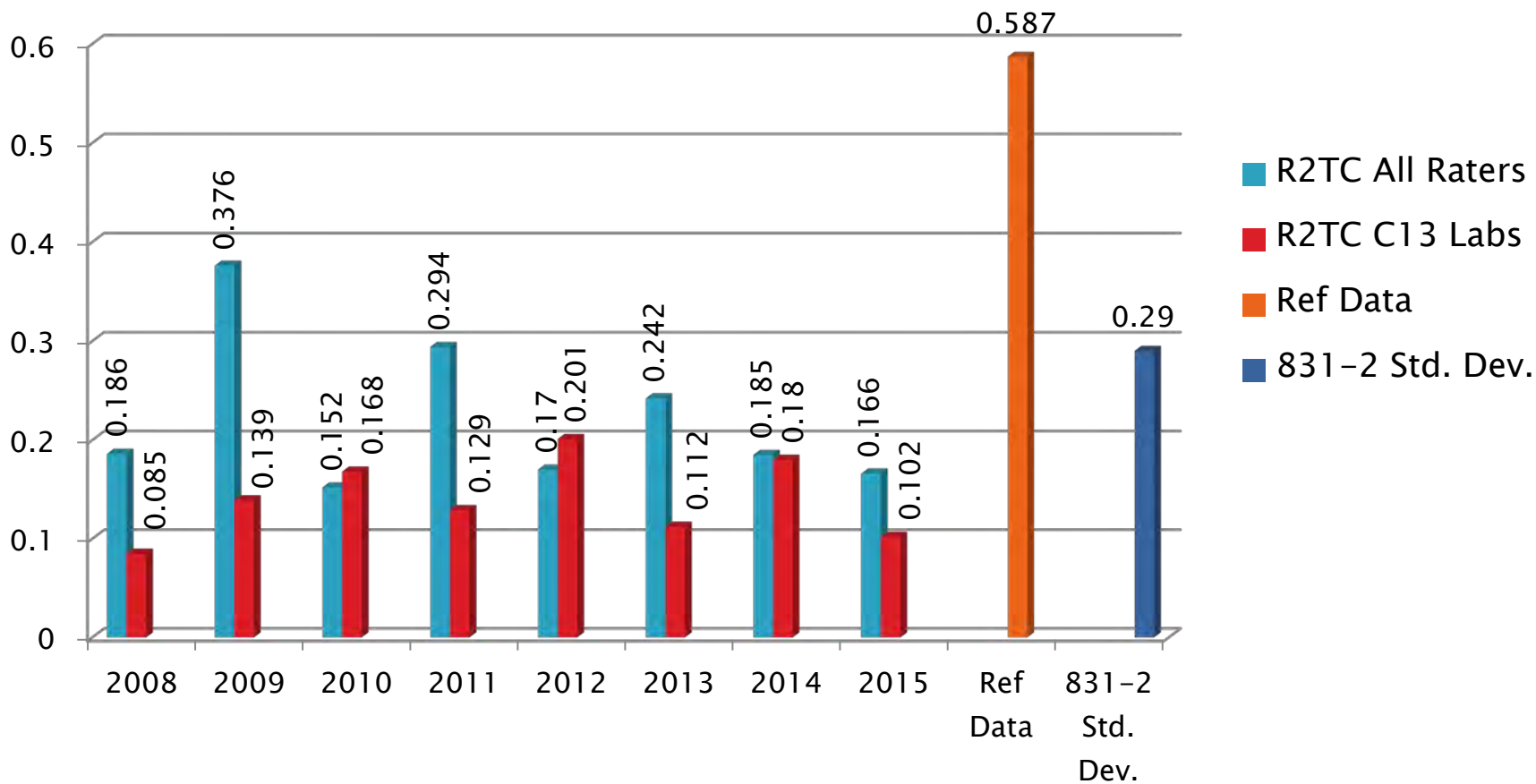
<http://astmtmc.cmu.edu>



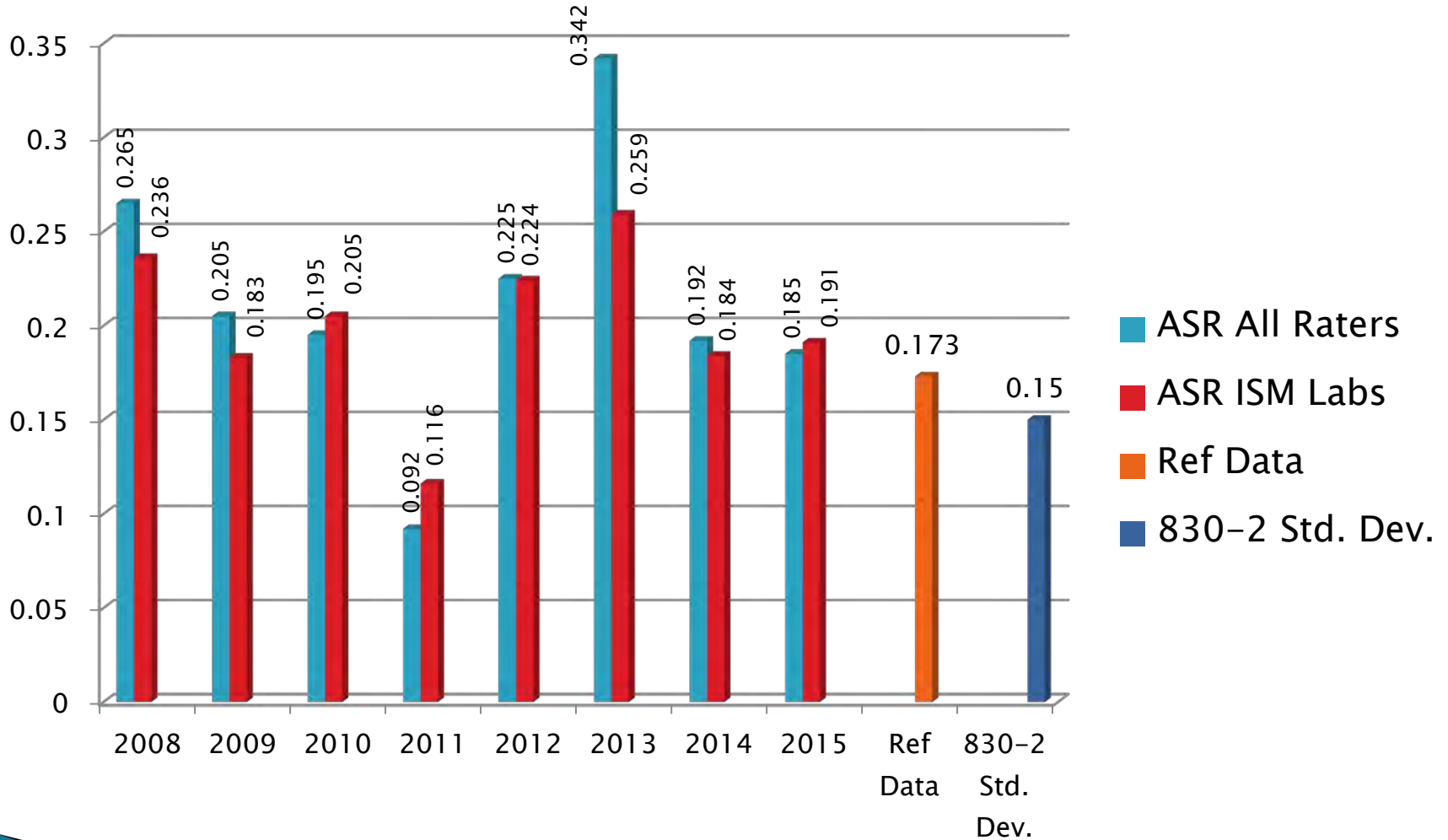
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# C13 2<sup>nd</sup> Ring Carbon Precision – Rating Workshop Data

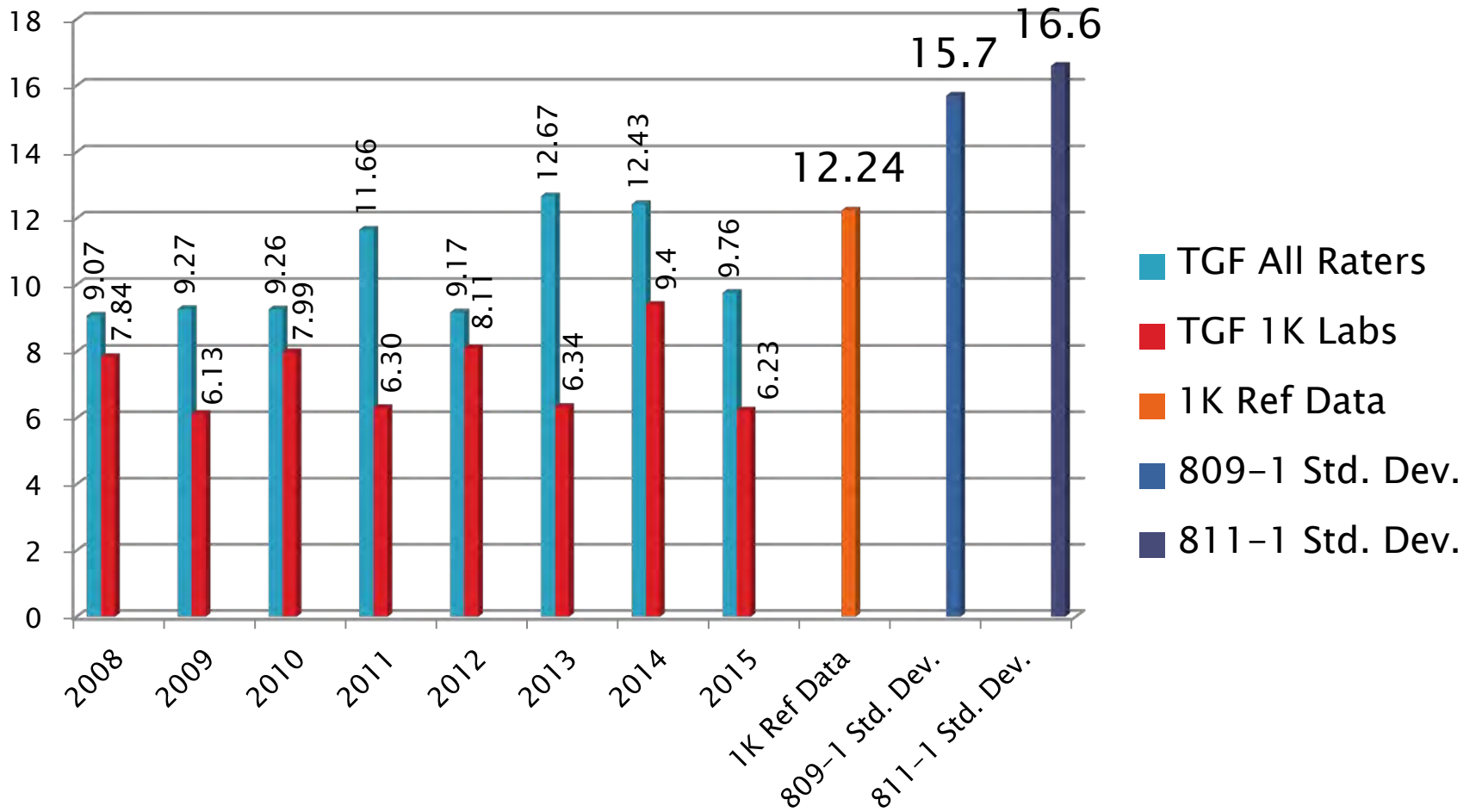
## R2TC



# ISM Sludge Rating Precision - Rating Workshop Data

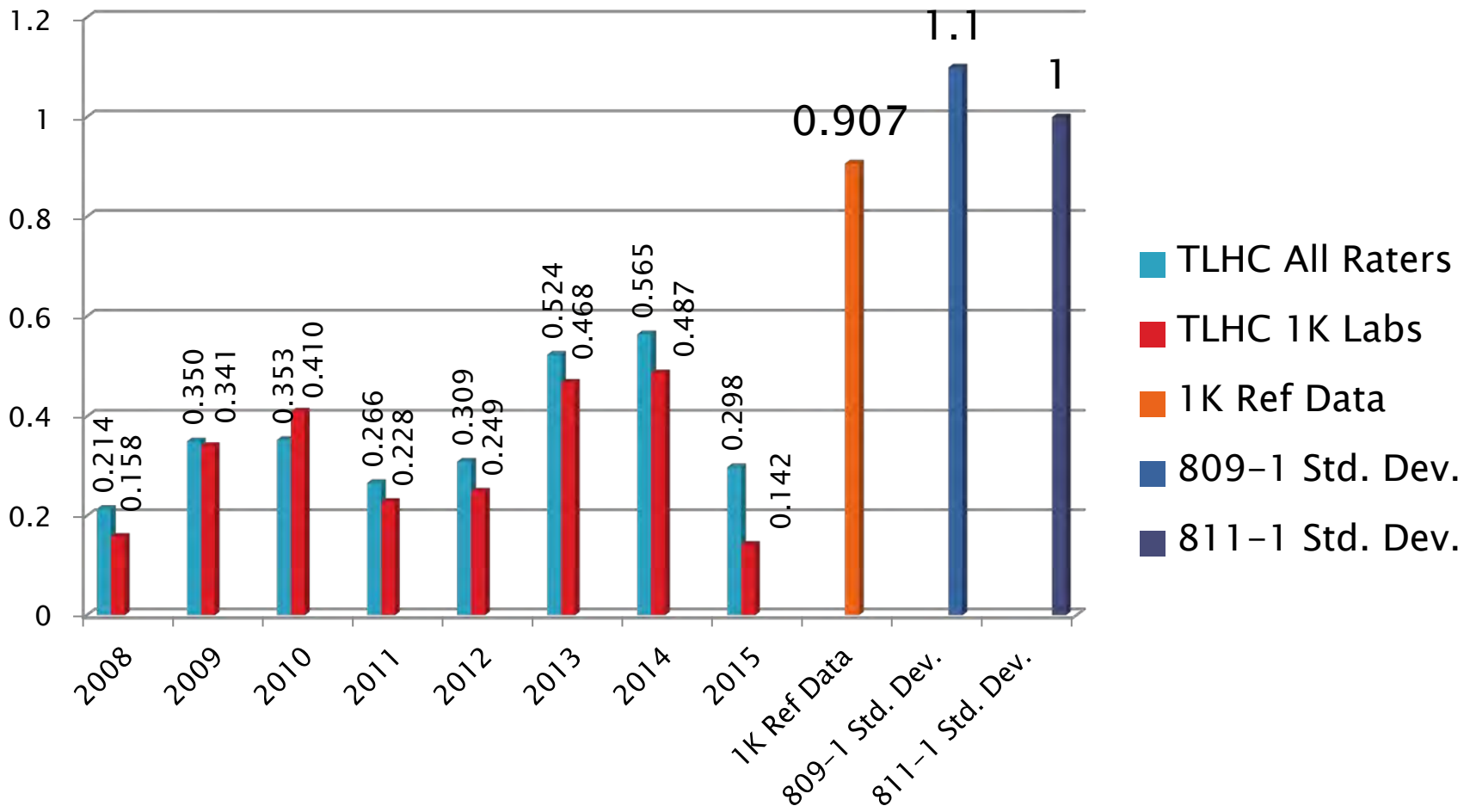


# Deposit Rating Precision - Rating Workshop Data





# Deposit Rating Precision - Rating Workshop Data



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# Miscellaneous Information

- ▶ Available on TMC Website:
  - Oil Assignment Request and Test File Upload
  - 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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