Sequence V Surveillance Panel Meeting
January 11th, 2021 10 AM EST

Roll Call:

Afton:	B. Maddock, B. Campbell
Ford:	M. Deegan
General Motors:	B. Cosgrove
Haltermann:	P. Tumati
HCS Group:	T. King, I. Gabrel
Infineum:	D. Boese, C. Laufer, A. Ritchie (Chair)
Intertek:	A. Lopez
Lubrizol:	J. Brys, J. Gingerich
OHT:	J. Bowden
Oronite:	R. Stockwell
Shell:	J. Hsu
SwRI:	T. Kostan, P. Lang, M. Lochte, D. Engstrom
TMC:	R. Grundza
Valvoline:	A. Savant
Willis Advanced Consulting:	A. Willis

Meeting Summary:

The Surveillance Panel met to review the existing and new fuel batch situation. Given that 278,000 gal of the current batch of fuel remain (including the heel), the matter was recognized to be not as urgent as previously thought. The date when the contract team is to have an answer back to the panel has been revised to March 15th, which is a more realistic timeframe for demonstration tests to be run. The panel also reviewed AES and RACS plots prepared by TMC and agreed that the next step to further investigate the mild shift is to request for analysis by the statisticians. The group is waiting for the 6th data point for 931 for targets calculations and introduction.

Actions:

1. **SwRI** to complete 931 test.
2. **Statisticians** to analyze the database for potential causes of the mild shift.
3. Open action from June 24th meeting: **Haltermann** to look at fuel data from Sec 8.2.6 requirement and report back to panel.

Next meeting: Monday, January 25th, 2021 @ 10 AM EST

Meeting was adjourned at 11:14 AM EST

Meeting Details:

Minutes from the Dec 21st meeting were unanimously approved (J. Bowden - OHT, A. Lopez – IAR).

The Surveillance Panel reconvened to:

1) Review of existing and new fuel batch situation.
2) Review of operational and/or hardware causes for the recent RACS and AES mild shifts which triggered a number of VH test key alarms.

Prasad Tumati (Haltermann) updated that the current batch of fuel is 278,000 gal, including the heel. Chair Ritchie commented that the group is not in a desperate hurry as it previously thought when the heel amount was unknown. Going forward, the group will expect a monthly update on remaining fuel.

Mike Lochte (SwRI) and Chair Ritchie spoke the first week of January re: the Feb 15th target and would like to revise the date to March 15th. This is a more realistic timeframe for tests to be run and for the contract team to have an answer back to the Surveillance Panel. The group agreed and Mike Deegan (Ford) approved this revision.

Re: the mild shifts, Rich Grundza (TMC) investigated the individual sludge parameters. The group was reminded that AES is the average of 9 individually rated parts (rocker arm covers left and right, camshaft baffles left and right, timing chain, oil pan baffle, oil pan, valve deck left and right) and RACS is the average of the 2 rocker covers. (See TMC plots appended). Rich explained that the significance of the first plot “CUSUM Severity Analysis” is that the 45 degree angle equates to about 1 standard deviation shift.

In the second set of plots “Rocker Cover Sludge” left and right, Rich noted that the right Rocker Cover is more or less on target whereas the left one is shifting mild. Caroline Laufer (Infineum) questioned if there’s an engine hardware / operations reason why the left side seems milder (example if the hotter exhaust is on the right side). Rich remarked that it’s hard to say as the exhaust temps are low around the engine. J. Brys offered that there’s a theory about how the cam shafts spin (the right side spins toward the drains whereas the left side spins toward the top of the head), but it doesn’t quite explain why RACS was ok before. Charlie Leverett (Infineum) added that since all of these engines are built from the same kit, this shift should not be hardware related. Amol Savant (Valvoline) confirmed with Rich that the “summation deltas” are CUSUM values.

Chair Ritchie asked to what extent do we dismiss that the fuel could be milder than the group thought and if we are sure that this trend started before the new batch of fuel came in. Rich replied that this is difficult to confirm. Angela Willis (Willis Advanced Consulting) suggested to place a line when all of the labs moved over to the new batch of fuel, as a way to see a transition point. The Chair proposed to also look at each lab separately. Rich added that all the labs switched to the new fuel batch at around the same time.

Bob Campbell (Afton) asked if the goal was to hand this over to the statistician group as they can break down the dataset quicker. The Chair commented that although Ron Romano (Ford) was firm on giving this panel instruction to investigate this issue, the group should be mindful that this can be very resource intensive with high chances that there might not be any firm answers. The Chair asked the group how best to address this / if the feeling is that it’s more than likely the fuel, we could stop the investigation as we would not find much more.

- Ben Maddock (Afton) suggested that the group could ask the statisticians to help answer the question if it's likely the fuel or something else. This could help determine the path the group takes.
- Rich Grundza (TMC) added that if the data is modeled, the fuel batch will be a significant factor. He explained he had done some multivariate analysis, in excel, using the CoAs of the fuel batches.
- Jerry Brys (Lubrizol) also looked into the data. He noted that every reference test run after Dec 8th, 2018 was run on the current batch. So there could definitely be a line drawn as Angela Willis suggested.

The Chair requested for views from the lab engineers:

- Jerry Brys (Lubrizol) stated that it appears the data is trending mild. However, addressing this is not an emergency as each lab is still currently able to qualify. He likened the task to looking for a needle in a haystack. Although difficult, it does not mean that we should not go ahead with the investigation.
- Dan Engstrom (SwRI) agreed with Jerry. There's not an immediate need since we can all calibrate. But the group should look at the data incase it accelerates.
- Al Lopez (IAR) recommend to keep in mind that the labs are still running tests for 931 and we are seeing a mixed bag of results. IAR's last result for 940 was severe on AES but was on the mild side for RACS. He recalled that another lab was very mild on 1009 and that some of these mild results are so mild, they may be over-influencing the CUSUM plots. Fuel could be an issue but we're still getting results that are on target or severe. Al suggested that analysis by lab could potentially show something.
- Ben Maddock (Afton) believed the group caught this as the right time and can ask the statisticians to look at this and if the analysis points to fuel batch or a different compounding factor.
- Amol Savant (Valvoline) agreed with Al's suggestion to see these plots individually per lab. It would be interesting to see if some labs are milder than other labs.

Re: Al's comment about 931 testing, the Chair summarized that we currently have 5 test results and asked what the status was to obtain the 6th data point.

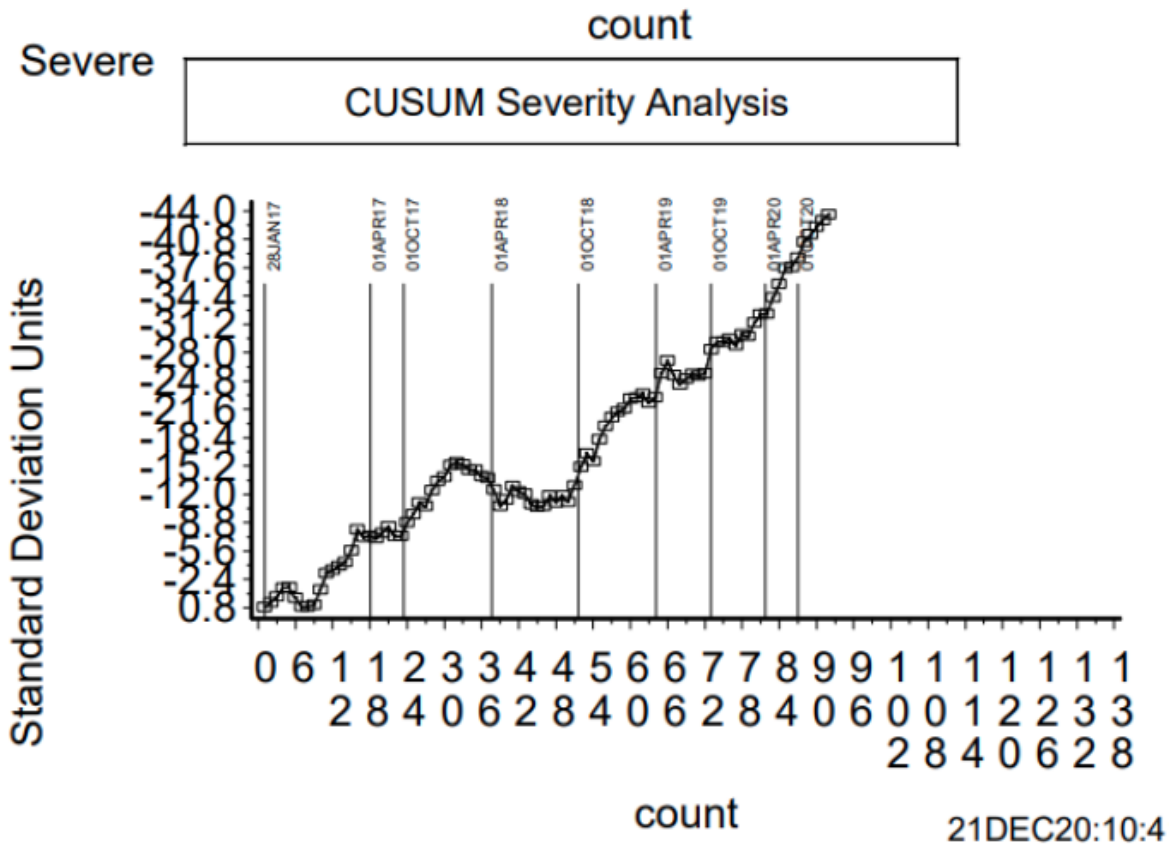
- Rich Grundza (TMC) said he has extended some stands a full calibration period to try to at least address that we do not have a 6th data point. He explained that we are moving references around to facilitate the targets.
- Jerry Brys (Lubrizol) asked if something changed as he recalls that 6 tests were promised. Al Lopez (IAR) said there was a gentleman's agreement to run all 6 and that one is outstanding. Jerry asked if the group could work with only 5 and if it was essential to get all 6 data points.
    - Doyle Boese (Infineum) informed the group that the 5 data points were looked at. Had everything looked stable, although it's a risk, we could go with 5 data points and set the targets early. However, there were a couple of results that did not look like the rest and the desire then is to dilute that by adding 1 result, for a total of 6 data points.
- Bob Campbell (Afton) asked if the minutes reflect what the agreement was. 3rd page of the July 22nd minutes were then referenced, which reminded the group of the agreement. The 6th data point will be obtained.

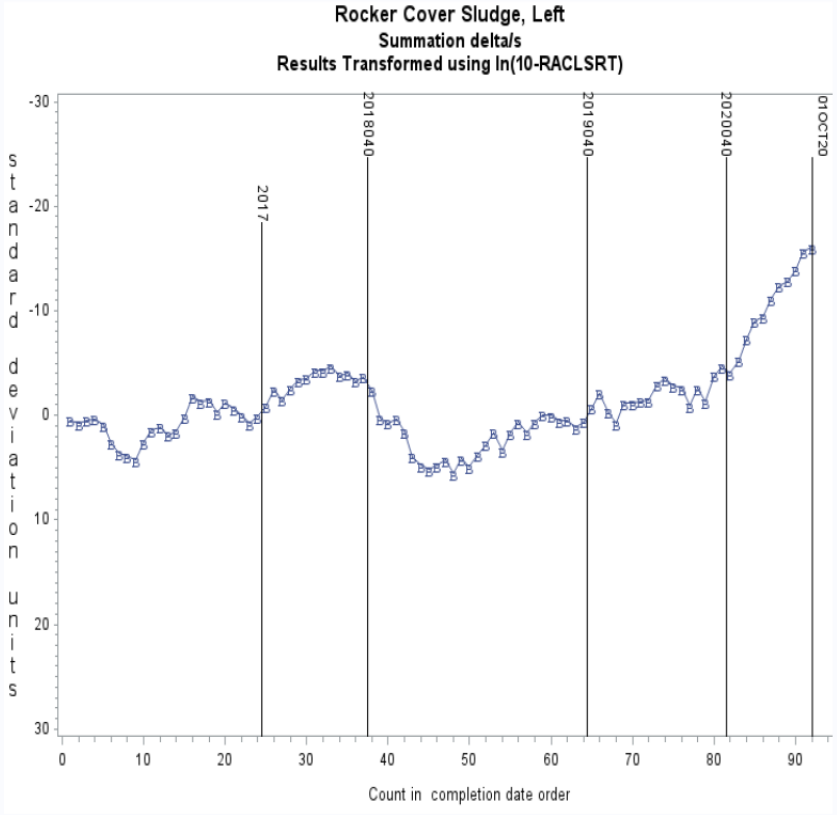
Given the discussion, the Chair asked if the statisticians can take a look at the data to investigate the mild shift. Doyle Boese (Infineum) happy to take the lead and will pass on to the other statisticians. Travis Kostan (SwRI) also happy to meet with Doyle to help with this

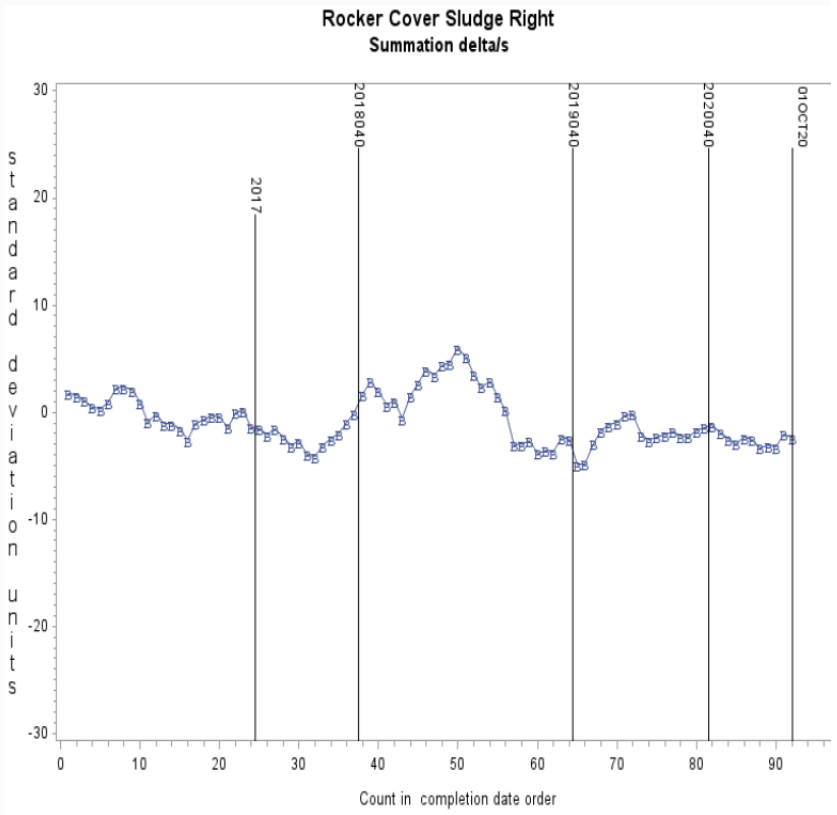
analysis. Doyle offered that they will look for things in the database that might show change but noted that a lot of things that happened are not listed in the database. But looking at plots could help us come up with some potential factors that might be driving the mild shift. 2 weeks to conduct the analysis was requested. The group agreed with this plan; Mike Deegan (Ford) approved of the direction and request that anyone can reach out to him if there's anything he can do to help.

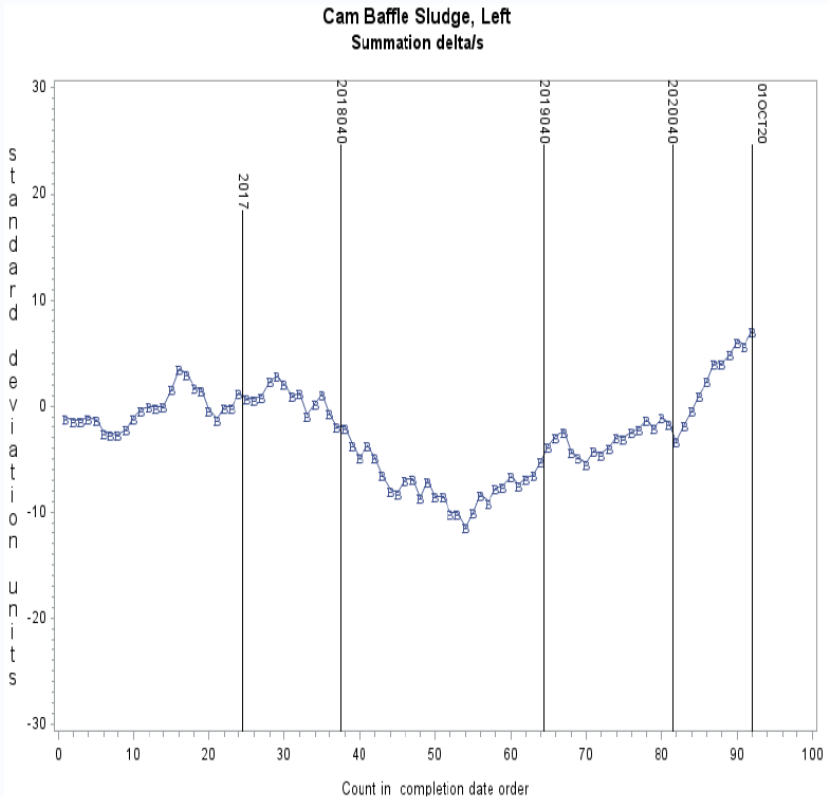
Meeting adjourned at 11:14 AM EST.

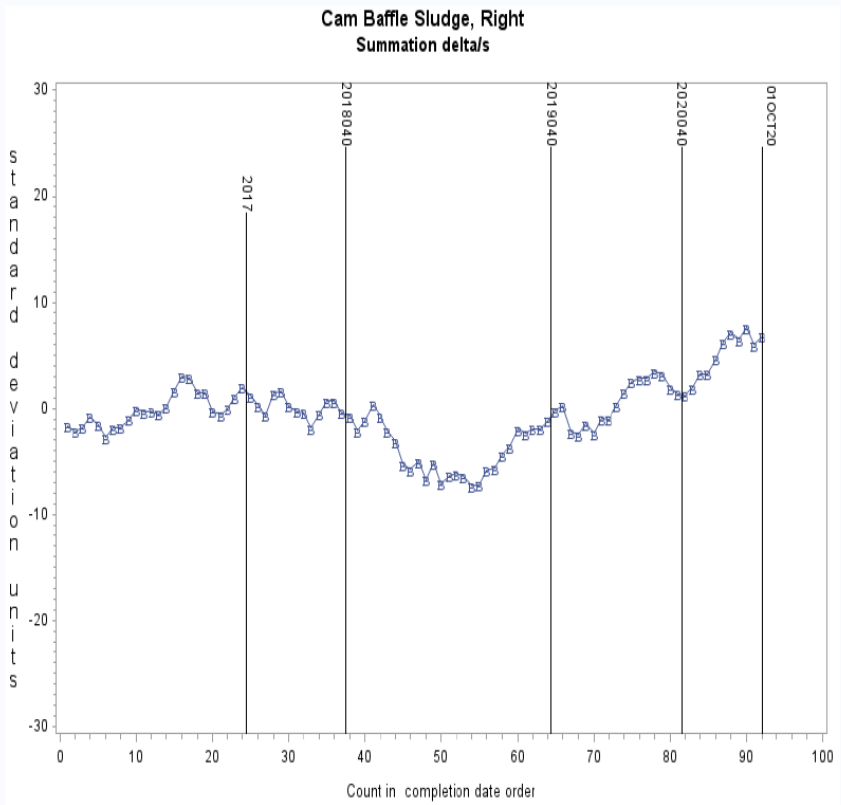
TMC charts below:

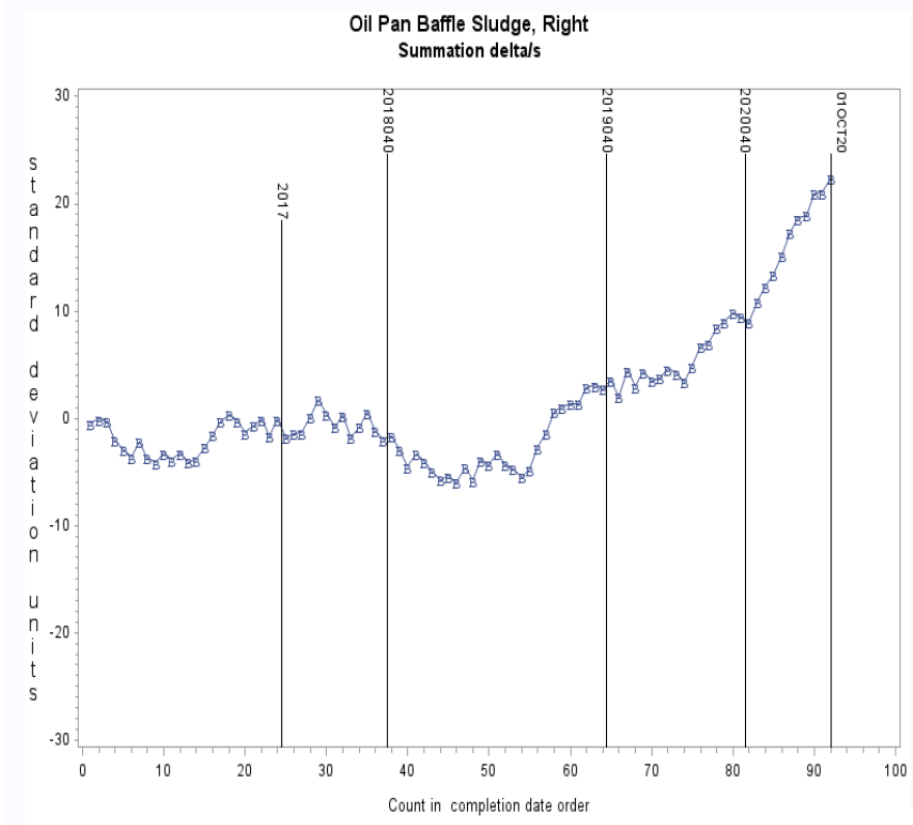


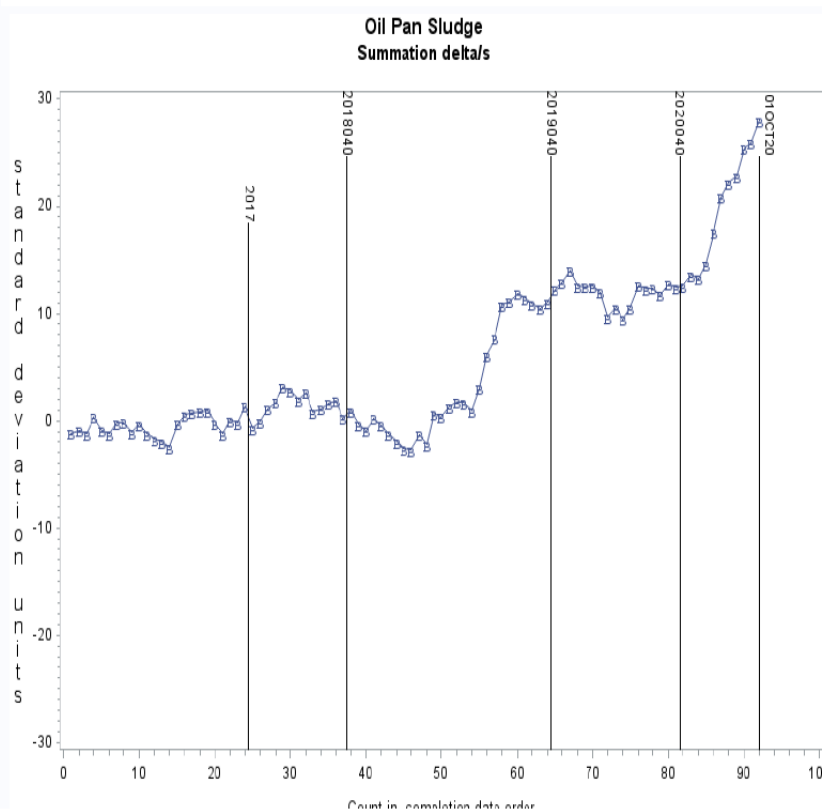

Rocker Cover Sludge, Left
Summation delta/s
Results Transformed using ln(10-RACLSRT)
standard deviation units
-30
-20
-10
0
10
20
30
2017
2018040
2019040
2020040
01OCT20
0
10
20
30
40
50
60
70
80
90
Count in completion date order

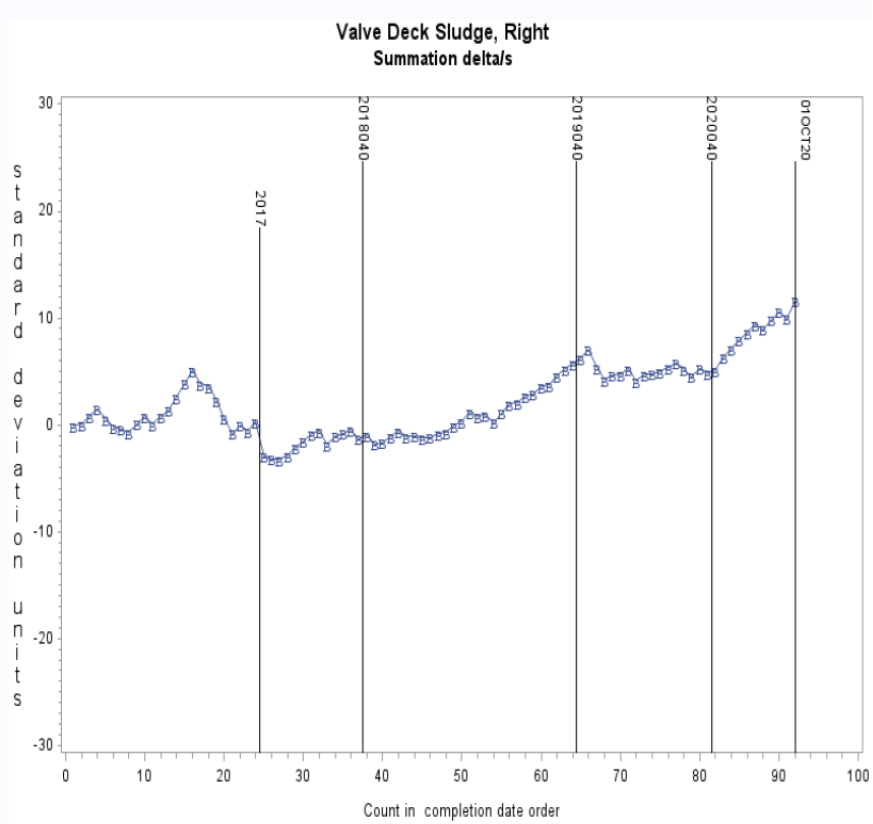

Rocker Cover Sludge Right
Summation delta/s
standard deviation units
30
20
10
0
-10
-20
-30
2017
2018040
2019040
2020040
01OCT20
0
10
20
30
40
50
60
70
80
90
Count in completion date order

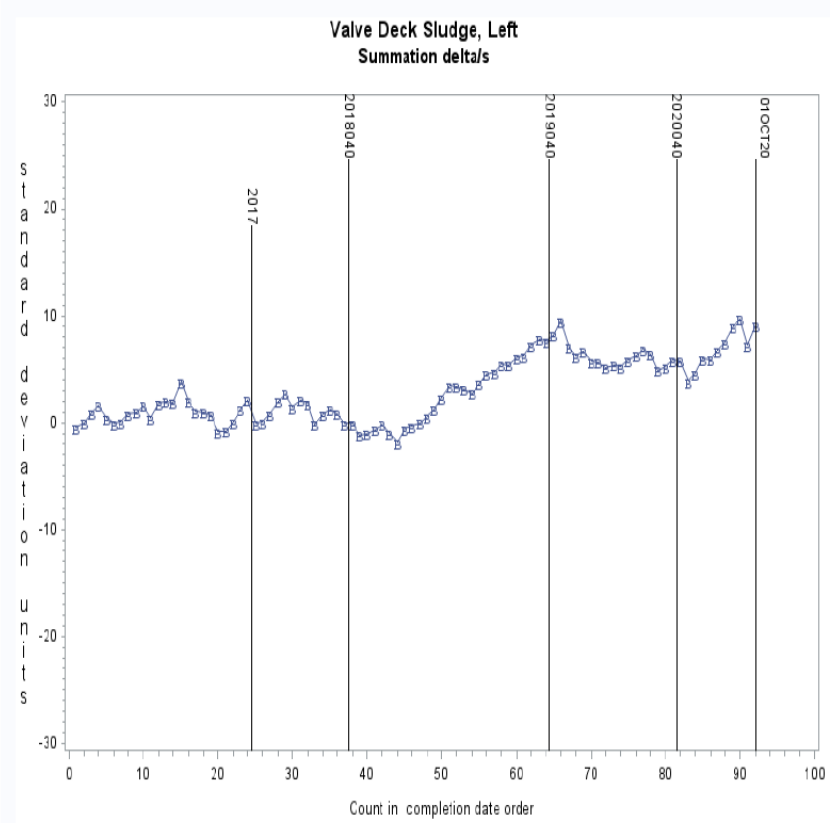

Cam Baffle Sludge, Left
Summation delta/s
standard deviation units
2017
2018040
2019040
2020040
01OCT20
Count in completion date order

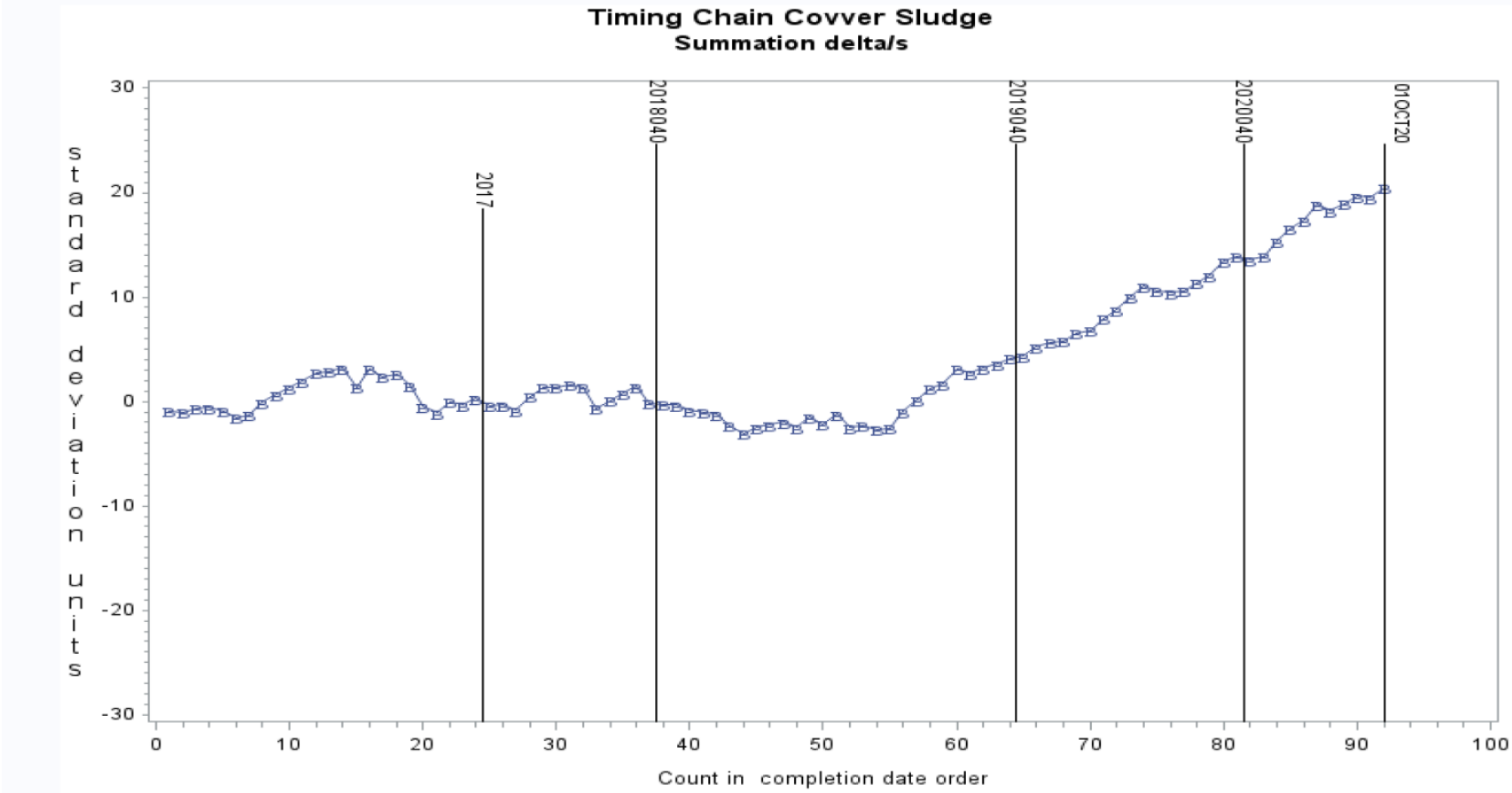

Cam Baffle Sludge, Right
Summation delta/s
standard deviation units
2017
2018040
2019040
2020040
01OCT20
Count in completion date order

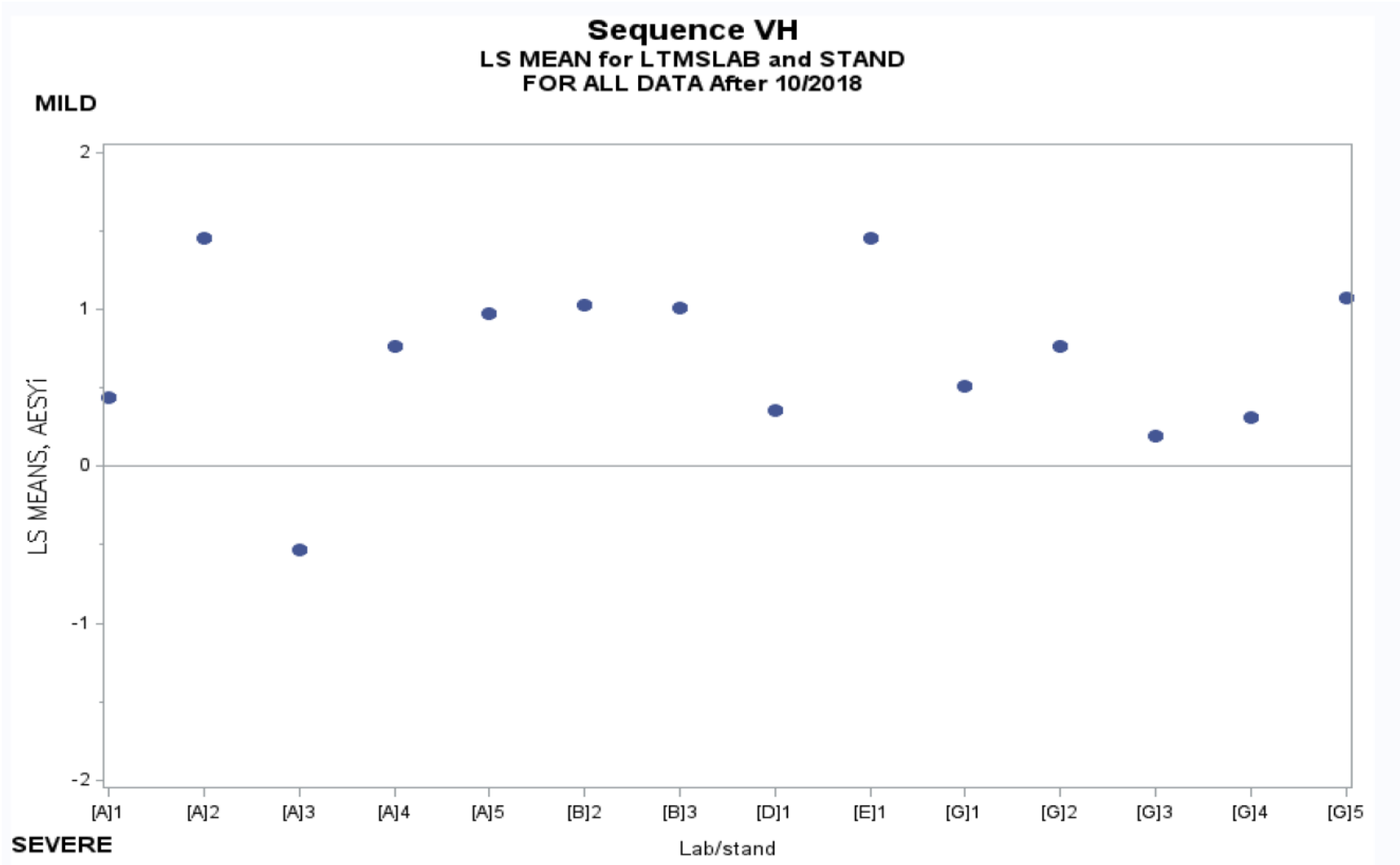

Oil Pan Baffle Sludge, Right
Summation delta/s
standard deviation units
Count in completion date order
2017
2018040
2019040
2020040
01OCT20

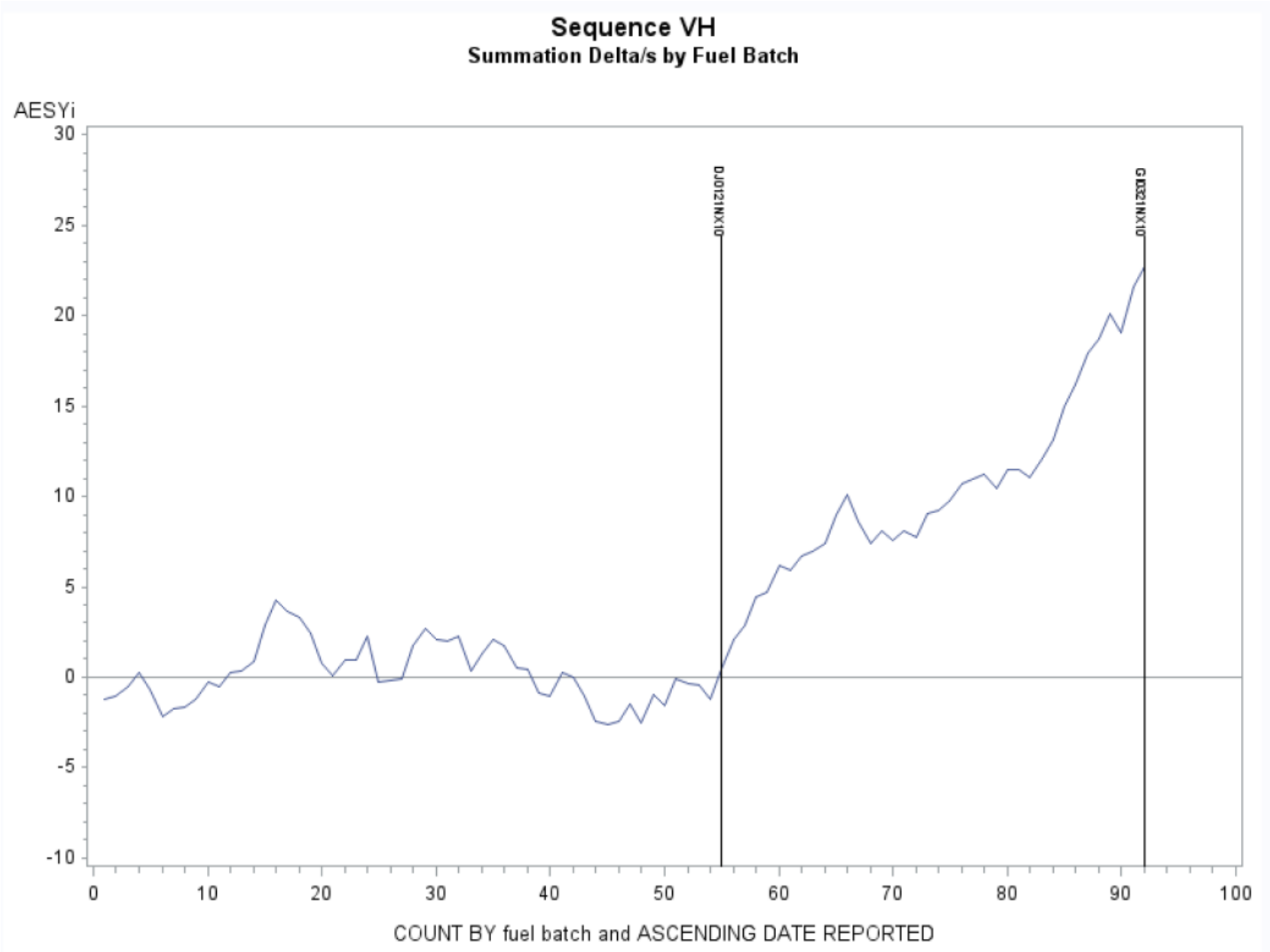

Oil Pan Sludge
Summation delta/s
standard deviation units
2017
2018040
2019040
2020040
01OCT20

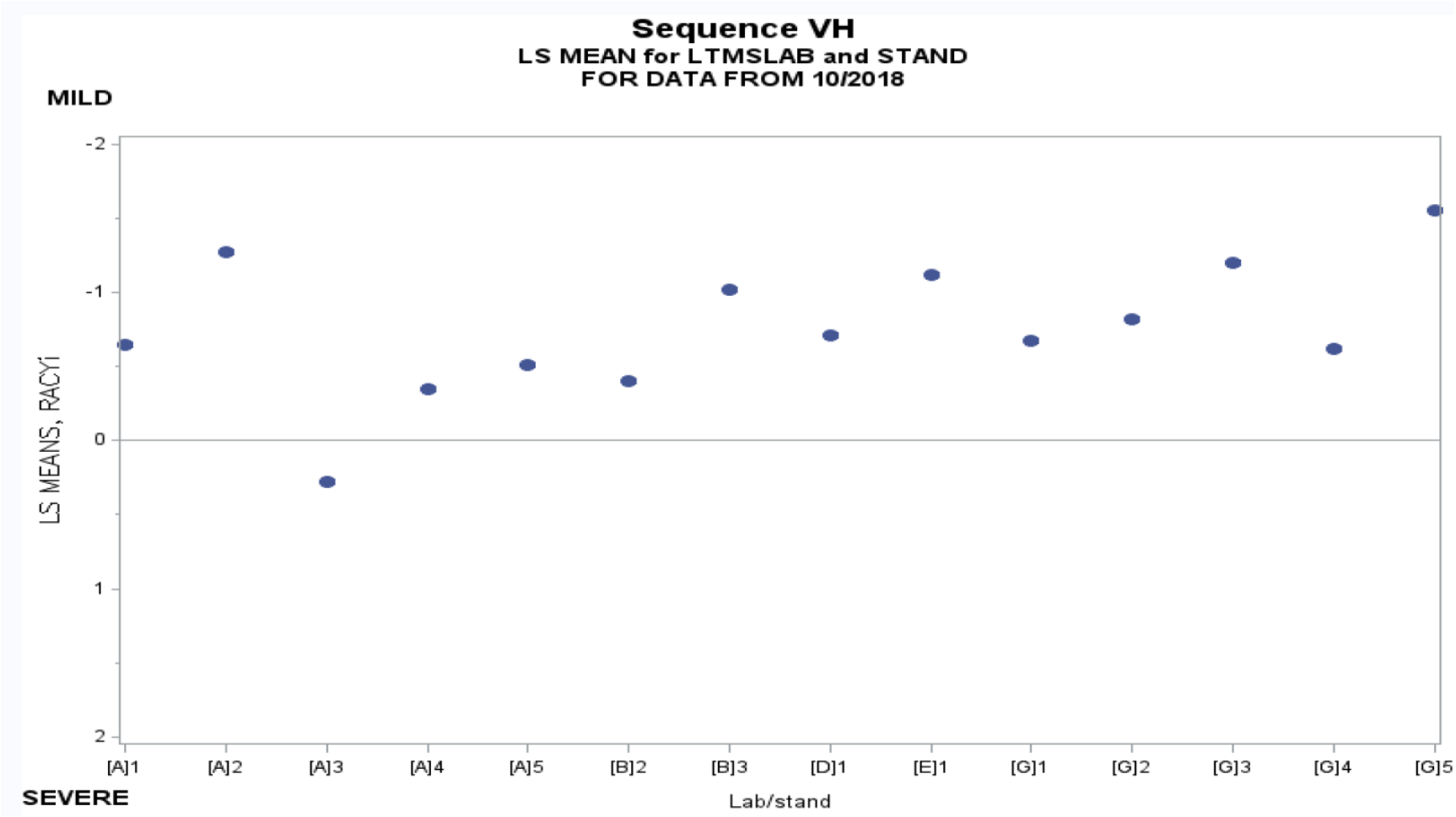

Valve Deck Sludge, Right
Summation delta/s
standard deviation units
Count in completion date order
2017
2018040
2019040
2020040
01OCT20

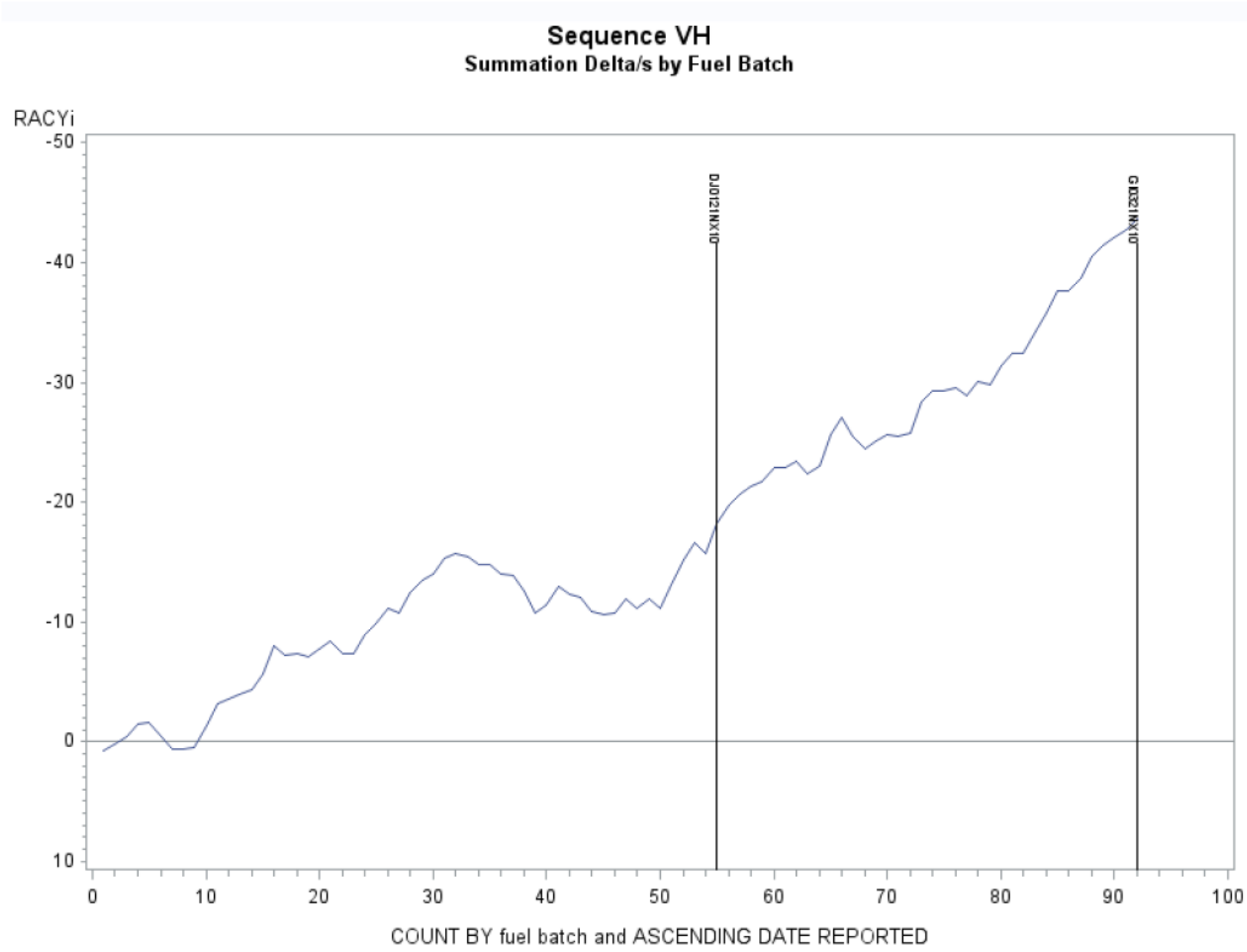

Valve Deck Sludge, Left
Summation delta/s
standard deviation units
Count in completion date order
2017
2018040
2019040
2020040
01OCT20


Timing Chain Covver Sludge
Summation delta/s
standard deviation units
30
20
10
0
-10
-20
-30
2017
2018040
2019040
2020040
010CT20
0
10
20
30
40
50
60
70
80
90
100
Count in completion date order


Sequence VH
LS MEAN for LTMSLAB and STAND
FOR ALL DATA After 10/2018
MILD
SEVERE
LS MEANS, AESYI
2
1
0
-1
-2
[A]1
[A]2
[A]3
[A]4
[A]5
[B]2
[B]3
[D]1
[E]1
[G]1
[G]2
[G]3
[G]4
[G]5
Lab/stand


Sequence VH
Summation Delta/s by Fuel Batch
AESYi
30
25
20
15
10
5
0
-5
-10
DJ0121NX10
GB321NX10
0
10
20
30
40
50
60
70
80
90
100
COUNT BY fuel batch and ASCENDING DATE REPORTED


Sequence VH
LS MEAN for LTMSLAB and STAND
FOR DATA FROM 10/2018
MILD
SEVERE
LS MEANS, RACYI
-2
-1
0
1
2
[A]1
[A]2
[A]3
[A]4
[A]5
[B]2
[B]3
[D]1
[E]1
[G]1
[G]2
[G]3
[G]4
[G]5
Lab/stand


Sequence VH
Summation Delta/s by Fuel Batch
RACYi
-50
-40
-30
-20
-10
0
10
0
10
20
30
40
50
60
70
80
90
100
DJ012INX10
GD32INX10
COUNT BY fuel batch and ASCENDING DATE REPORTED