Sequence V Surveillance Panel Meeting
May 16th, 2022 2 PM EST, via Webex

Roll Call:

Afton:	B. Campbell
BP:	J. Agudelo
ExxonMobil:	A. Meier, A. Montufar
Ford:	M. Deegan, R. Zdrodowski
General Motors:	M. Hopp, N. Siebert, N. Tyrer
Haltermann:	P. Tumati
HCS Group:	I. Gabrel
Infineum:	C. Laufer, A. Ritchie (Chair)
Intertek:	A. Lopez
Lubrizol:	J. Gingerich
OHT:	J. Bowden
Oronite:	J. Martinez, R. Stockwell
PSL Services:	C. Taylor
Shell:	J. Hsu
SwRI:	D. Engstrom, T. Kostan, P. Lang
TMC:	F. Farber, R. Grundza
TOTAL:	A. Willis
Valvoline:	A. Savant

Meeting Summary:

The Surveillance Panel convened to review a summary of the current fuel batch and of the new fuel batch, currently being prepared by Haltermann. Haltermann provided an update and estimated that the new fuel batch would be ready for testing at the 3 labs by the 1st week of June. There are approximately 3-4 months' worth of the current fuel batch remaining. A deep analysis showed that the RAC target may have been set too low (or too severe) and the group agreed to have TMC generate new RAC target using more data that came in after the precision matrix using the same fuel. The group will reconvene in 1 week to see its impact on the industry control charts.

Open Actions:

1. From March 26th, 2021 meeting: **Lab engineers** to meet to investigate severity shifts (share operational data, build data, ratings, etc.). The TF has been productive and meeting frequently.
2. From Sept 9th, 2021meeting: **Statisticians Group** led by Doyle Boese (Infineum) to provide update around potential ways to improve current lab-based system. Interim recommendation is to not adopt a stand-based system.
3. From Sept 9th, 2021 meeting: **Haltermann** to report monthly inventory via email to V SP. Monthly updates are being provided.
4. From Nov 29th, 2021 meeting: **Haltermann** to include extra column in fuels data to indicate which fuel goes with which test.
5. From February 10th, 2022 meeting: **The VH Task Force** to assess number of parts remaining as it relates to the life of the test.
6. From February 10th, 2022 meeting: **Haltermann** to report average time it takes for them to respond back to the labs with RVP data.

7. From [February 10th, 2022 meeting](#): The **VH Task Force** to discuss the lab responsibility to measure the fuel parameters as received (section 8.2) vs the use of the CoA.
8. From **May 16th, 2022 meeting**: **Bob Campbell** and **Andrew Stevens** to consider if their labs, Afton and Lubrizol respectively, would be willing to participate in helping Angela come up with a more realistic forecast number for the VH.
9. From **May 16th, 2022 meeting**: **TMC** to generate new RAC target using the 7 valid, chartable RO 940 data points plus the 14 additional RO 940 results run on the same DJ fuel batch.

Next call: May 23rd, 2022 at 2 PM EST via Webex

Meeting Details:

Agenda:
- Current/New fuel batch situation
- PCEOCP request for parts inventory for life of GF-6 / SP / SP PLUS
- RAC presentation

The Chair summarized the current and new fuel batch information as well as the planned precision matrix with the new fuel:

New Fuel Batch

- <u>400,000</u> gallons target of new fuel batch, expect to last <u>~3 years</u>. Final volume expected in few weeks.
- Date ready for testing at 3 labs: <u>1st week of June</u>
- Remaining inventory of <u>4 ISO tanks (~25,000 gallons)</u>
- Estimate of enough GI0321NX10 to run ____ tests to last <u>about 4 months</u>.
- Previous fuel batch transitions have allowed <10% of old fuel batch to be mixed with new fuel batch to transition lab tanks to new fuel.
- Previous fuel batch matrix consisted of 15 tests, 3 labs, 5 stands.
  - Labs A and G ran 6 tests each and Lab D 3 tests.
  - 6 1009 tests were included last time – presumably 931 would now replace 1009

After asking each lab (except for Lubrizol who did not have a lab representative on the call) about the inventory of the current fuel, the Chair determined there is about 3-4 months of the current fuel batch remaining.

- Al Lopez (Intertek) stated they have about 3-4 months left of fuel
- Dan Engstrom (SwRI) reported they have about 4 months' worth
- Bob Campbell (Afton) will report back on the amount
- Amol Savant (Valvoline) does not have any fuel of the current batch remaining

The Chair presented the following precision matrix (PM) plan (copied from the last matrix) but after some discussion about which oils are best to test, the plan will be confirmed against what's stated in the fuel contract. (Bob Campbell's (Afton) comment was that the goal of the PM is to know that the fuel can make sludge and answer what the fuel severity is, close to the pass fail which is 931 or 1011, and asked if the split of the oils was correct. Amol Savant (Valvoline), who is on the fuel contract team, confirmed that what is shown below is not the same as the one listed in the fuel contract so the topic of which oils are the right ones to test may have already been discussed and incorporated into the plan).

Fuel Matrix – Same Starting Point as Last Matrix?

LAB	Run 1 A		Run 1 G		Run 1 D	Run 2 A		Run 2 G		Run 2 D	Run 3 A		Run 3 G		Run 3 D
Rating	940	1011	940	1011	940	940	940	1011	1011	1011	1011	931	931	940	931
AES															
RCS															
AEV															
PSV															
OSC															
HSR															
SA Applied															

PM plan to be confirmed

CONFIRMED LATER: Fuel contract matrix comprises 931:6 tests, 940:6 tests 1011:3 tests

Prasad stated that the new batch should have a similar certificate of analysis and expects it to not be different to the current batch.

Amol Savant (Valvoline) suggested to the group to consider selecting stands which are performing closer to target to increase the confidence in the targets for the upcoming PM. The Chair recommended that we discuss with the 3 labs participating in the PM re: the options for running these tests. Bob Campbell (Afton) wasn't sure of Amol's comment as all the stands would be calibrated, well enough behaved to run candidates. Amol said there are some stands that are more well behaved than others and perhaps it would be better to select the stands that are more centered around the target to increase our confidence in the target setting process.

Al Lopez (Intertek) asked if the PM results will have severity adjustments. Rich Grundza (TMC) replied that as the fuel has a significant effect on this test, we do not adjust for the fuel. Amol Savant (Valvoline) commented this supports the need to use stands more centered around the target. Rich mentioned that that may be difficult to be within half a standard deviation on all 4 parameters.

The Chair announced that Charlie Leverett is no longer on an Infineum contract and Al Lopez (Intertek) has stepped in as Chair of the Task Force group. Al updated the group that the TF will meet again soon to review the hardware, conduct lab visits, and review the RAC issue. After a deeper review, Angela Willis (TOTAL) explained that the fact that engines are rebuilt a number of times to get a certain number of tests through was not accounted for in her calculations which may be the reason why her estimate may be inaccurate. Al offered to work with Angela to go through the details and calculations. Angela confirmed that the calculations do not include the dependent labs because they were not open to sharing their testing capacity. The Chair asked Amol, Bob, and Andrew to consider if their labs would be willing to participate with the independent labs to help Angela come up with a more realistic number. Amol Savant (Valvoline) replied yes but asked to recognize that the testing rate can be erratic at his lab, which Angela acknowledged. Mike Deegan (Ford) requested that Al, Angela, and Andy keep him in the loop re: the forecast as he is working on replacing the VH.

Before discussing the RAC topic, the Chair checked if there are any new or old business items. None were raised.

The Chair recognized many people spent a lot of time on this RAC issue and in particular, Doyle Boese (Infineum) worked hard on this analysis and brought it forward to the VH Task Force who appreciated his efforts. The Chair let the group know that he has spoken with many people about this: Pat Lang as TGC Chair, Frank Farber, Rich Grundza, and Jeff Clark though the TMC protocols, etc. He highlighted that this is a good example to learn and improve from. The slide deck, "VH RACS Assessment for May 16th SP Call Edit.ppt" was shared (see Appendix for ppt file).

The Chair reviewed the background to the issue:

- 24 test Precision Matrix (PM) and the analysis from the statisticians reported out in June 2017.
  - 4 labs (A,G,D and E) and 3 oils (940,1009,1011)
  - 22 of the 24 tests were reported and confirmed as valid
- Since 2017 approximately 140 calibration test oil results have been reported.
  - Current fuel batch applies a correction factor to average engine sludge (AES) but not to Rocker Arm Cover (RAC) sludge.
- Recent analysis as part of the VH Severity Task Force activities, suggest the original PM targets for RAC may have been set too low.
- Case for action on the 940 RAC targets, should be addressed by the VH Surveillance Panel.
- Discussion is needed within the Technical Guidance Committee (TGC) for the analysis approach for future Precision Matrices.

Note: original file says the "RAC targets may have been set too mild". That was a mistake and has been corrected above to reflect "too low" (or too severe).

Pat Lang (SwRI) commented that he would get this, as a bigger picture item, on the TGC agenda to discuss if there are better ways of doing things in the future. The next TGC meeting will be in Seattle at the end of June.

The original 24 test precision matrix from 2017 was shown, with 2 invalid tests with RO 940 from Lab E shaded in pink:

Lab Stand	D1	E1	G1	G2	A1	A2
1	1011✓ 119162-VH	1009✓ 100682-VH	940✓ 119150-VH	940✓ 119151-VH	1009✓ 117777-VH	1011✓ 122929-VH
2	1011✓ 121400-VH	940 120502-VH 940 122931-VH	940✓ 123887-VH	1011✓ 122926-VH	1009✓ 119143-VH	1009✓ 119141-VH
3	940✓ 121398-VH	1011 120503-VH	1009✓ 118693-VH	1009✓ 118692-VH	1011✓ 119147-VH	940✓ 108997-VH
4	1009✓ 119160-VH	1011	1011✓ 122927-VH	1009✓ 119155-VH	940✓ 118698-VH	940✓ 108998-VH

✓ Indicates surveillance panel has reviewed the operational data and found the test to be operationally valid.

| Reported | Invalid |

- 4 labs,3 oils: 8 G(IAR), 8 A (SwRI), 4 D (Afton), 4 E (Valvoline)

The following plot shows the RAC results for the 22 valid tests. Lab E (green data) had 2 valid results, one on 1009 and one on 1011, both of which were the lowest (tied for lowest on 1011) for each RO. The model predicted that Lab E would yield a mean RAC of 6.67 for RO 940, which in hindsight, is lower than it probably should have been.
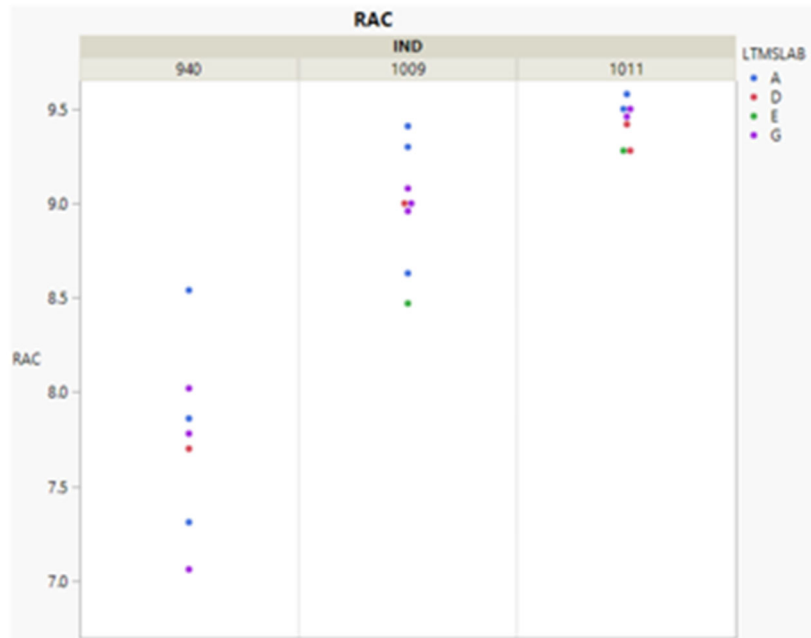
The Chair explained that for precision matrices for at least the last 2 categories, equal weighting across the labs is applied to set the targets. So in the case of the VH precision matrix in 2017, since there were 4 labs participating, a weighting of 25% of applied to each lab for the calculation of targets. But the LTMS average EWMA is weighted by lab test frequency. So there are 2 conflicting items: principle of fairness and the disconnect going forward on how to determine a test is on target.

For setting the calibration oil targets equal weightings were applied to each lab.
– This approach is the standard one applied to all PM analyses.
– In this case 25% A, 25% G, 25% D, 25% E
– Equal weighting provides an equal weight for each participating lab to the calculation of the targets, but LTMS averages (EWMAs) are weighted by lab test frequency.
  • Principle of fairness to all labs creates a disconnect with how a test is determined to be on target.
A model was developed which included an intercept and estimated coefficients for each of the labs and oils based on all PM data giving each lab equal weight regardless of the number of tests it provided.
The model yields a least square mean estimate of the Oil 940 for Lab E based on E's 1009 and 1011, the other lab's 940 results and the estimated lab severity differences.

The following chart shows approximately 140 RO test results for RAC, noting that Lab E's lowest 940 result is 7.5 which is significantly higher than the modeled 6.67 result.

RAC vs. IND
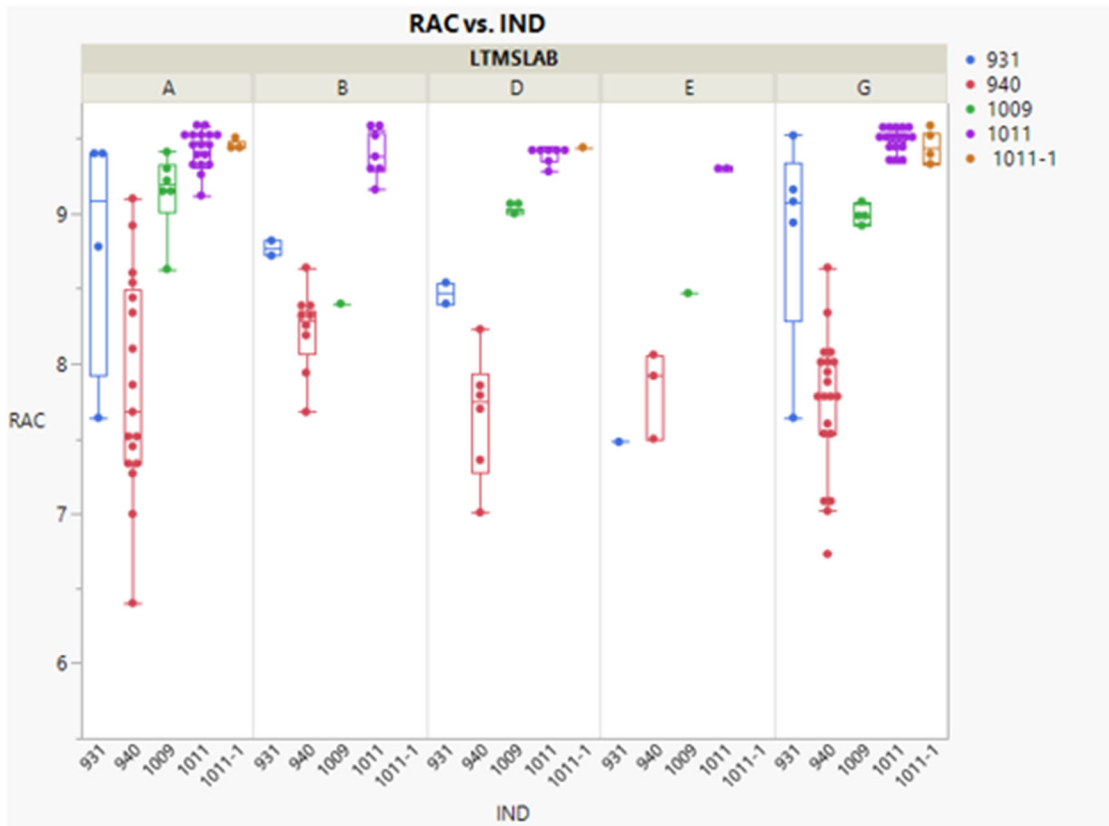
- Lab E's lowest 940 result is 7.50, substantially higher than the 6.67 projected via the Precision Matrix model.
- Lab E has the, or among the, lowest RAC for 931, 1009 and 1011 but is mid-range for 940. (Note, this does not appear to be a transformation issue because E's 931 is in the lower region of its 940 results.)
- The 2 lowest RACs are 6.40 (Lab A) and 6.73 (Lab G). The rest are 7.00 or higher.

The analysis shows that the RAC target may have been set too low (or too severe). As can be seen in the RAC EWMA and CUSUM charts, RAC has been mild for most of the VH test's life:

SEQUENCE VH INDUSTRY OPERATIONALLY VALID DATA

AVERAGE ROCKER COVER SLUDGE
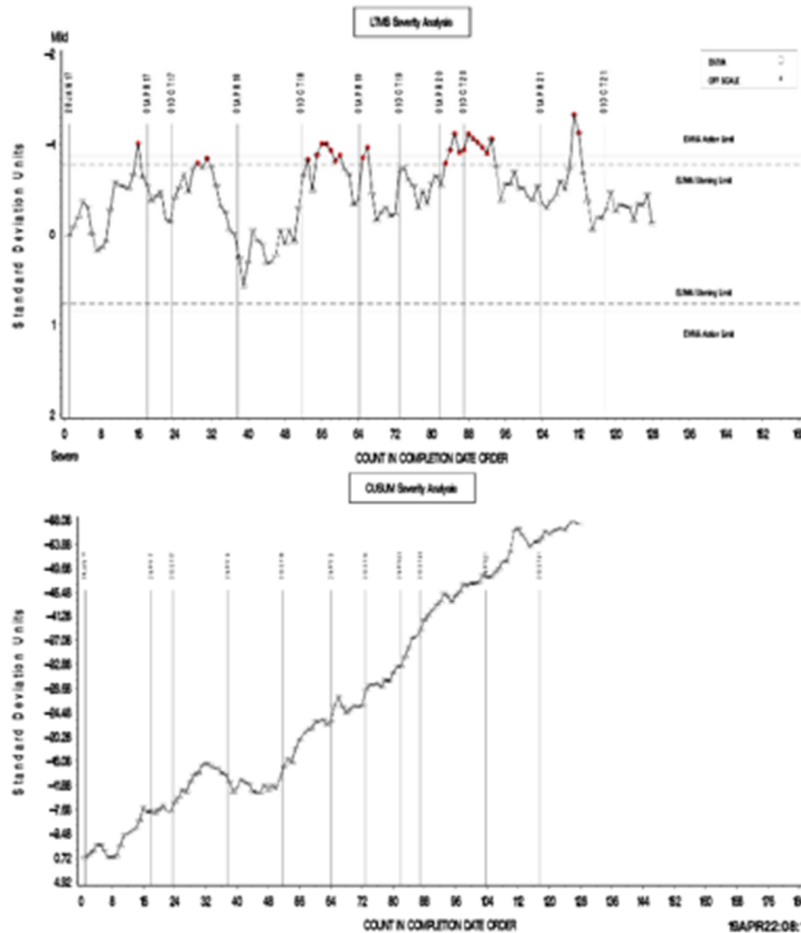
Rich Grundza commented that the 45 degree angle of the CUSUM plot translates to roughly a 1 standard deviation shift. The Chair explained that this indicates that the RAC target should be reset, noting all the alarms and CUSUM trend, both of which were brought up by Nathan Siebert (General Motors) many times during the fuel correction factor process. The Chair will bring this topic to TGC and ask to consider setting the targets after 10, 20, 30 tests. He also commented that other tests' CUSUM plots look similar; this is not isolated to just the Seq VH. Examples are IIIH and VIE.

Slide 8 shows all the industry alarms for the Seq VH, with the majority (28) of them for RAC. The Chair commented that a rough calculation was done to show that if the RAC target were set higher, the number of alarms would reduce from 28 to 6. The number of alarms on RAC is another indication that something wasn't right.

The Chair explained that when Doyle Boese (Infineum) conducted this analysis, he looked at a number of different options, summarized in the following slide:

RAC LS Means from Various Subsets

Infineum

Untransformed RAC LS Means

Source		All Labs			Exclude Lab E			Exclude Lab E - RAC Not Trans		
Subset	Target	All	Excl 3 A Hi 940	DI Fuel	All	Excl 3 A Hi 940	DI Fuel	All	Excl 3 A Hi 940	DI Fuel
n		143	140	54	136	133	50	136	133	50
931	8.74	8.78	8.79		8.89	8.89		8.78	8.78	
940	7.50	7.83	7.75	7.76	7.91	7.83	7.76	7.86	7.79	7.73
1009	8.95	8.98	8.99	9.03	9.04	9.05	9.03	9.03	9.04	9.00
1011	9.41	9.40	9.40	9.43	9.43	9.43	9.43	9.43	9.44	9.42
1011-1	9.41	9.41	9.42		9.44	9.44		9.47	9.48	

- If we are to recalculate the RAC targets what subset would we use and which ROs should be revised?
  1. Original PM without Lab E
  2. Calibration oil test data on the original fuel batch
  3. All of the calibration oil test data covering 2 fuel batches
- TMC has been working on different options – they advise Option 2.
  - Question about need to recalculate all the parameters for 940 or just RAC.
  - Option 3 does not seem viable.
    - Would need to factor in the effect of the current fuel batch over the original fuel batch.
    - Current fuel batch has a Correction Factor applied for AES.

The Chair asked for direction from the panel to instruct the TMC on the options and to raise any objections or other thoughts:
- Amol Savant (Valvoline) asked what the difference is between the middle column ("Exclude Lab E") and the last column ("Exclude Lab E – RAC not Trans"). Bob Campbell (Afton) said the middle column is the averages or LS means calculated in transformed space and then back-transformed in engineering space. Frank Farber (TMC) and Jo Martinez (Oronite) concurred. Rich Grundza (TMC) clarified that option 2 is not shown in the table.
- Option 2 is advised by TMC because it includes a larger data set on the original DJ fuel batch. (7 valid, chartable 940 results from the PM plus 14 more 940 results on the same DJ fuel batch).
- Al Lopez (Intertek) asked about removing the weighting factor and if Rich's calculations included weighting. Rich Grundza (TMC) confirmed that the numbers he generated have no weighting.
- Frank Farber (TMC) questioned whether the group is comfortable using a data set that is not made up of operationally valid test results. The targets for 940 were based on 9 data points and there are only 7 operationally valid data points. Bob Campbell (Afton) answered no and that the data set should only include valid tests.
- Nathan Siebert (General Motors) asked if the AES has a correction factor with the new fuel batch, why wouldn't we set the same correction factor on the RAC on the same fuel batch. Al Lopez (Intertek) agreed because RAC is a part of the overall sludge rating.

Rich Grundza (TMC) recalled that it was determined by the statisticians group that RAC was not statistically significant and that there was recognition that applying the correction factor to AES and not to RAC was not consistent (see notes starting at the bottom of page 2 from [Feb 15th, 2021 meeting minutes](#)). Bob Campbell (Afton) added that once we fix the targets, we need to assess if there was a fuel bias.

- No objection to TMC preparing for Option 2. TMC to generate new RAC targets using the 21 data points (7 valid tests from PM and 14 additional data points using RO 940 on the same DJ fuel batch). Al Lopez (Intertek) requested new industry charts be generated as well to see if the alarms are reduced and if we bounce around the mean. He asked in the context of the VH Task Force and wondered if a math issue, not an engineering issue, caused the alarms.

Meeting adjourned at 3:24 PM EST.

Appendix: VH RACS Assessment for May 16th SP Call Edit.ppt

VH RACS
Assessment for May