Sequence V Surveillance Panel Meeting
March 11th and 15th, 2021 10 AM EST

Roll Call:

	March 11th	March 15th
Afton:	T. Dvorak, B. Maddock	B. Maddock
BP:		J. Agudelo
ExxonMobil:	A. Montufar	
Ford:	M. Deegan	same
Gage Products:	J. Carter	
General Motors:	B. Cosgrove, T. Cushing	same
Haltermann:	P. Tumati	same
HCS Group:	I. Gabrel, T. King	
Infineum:	D.Boese, C.Laufer, C.Leverett, A.Ritchie (Chair)	same
Intertek:	A. Lopez	same
Lubrizol:	J. Brys, P. Scinto	same
OHT:	J. Bowden	same
Oronite:	J. Martinez	J. Martinez, R. Stockwell
PSL Services:	C. Taylor	
Shell:	J. Hsu	same
SwRI:	A. Chaudhry, D. Engstrom, T. Kostan, P. Lang, M. Lochte	A. Chaudhry, P. Lang, M. Lochte
TEI:	D. Lanctot	same
TMC:	R. Grundza	same
Valvoline:	A. Savant	same
Willis Advanced Consulting:	A. Willis	same

<u>Meeting Summary</u>:
Over the course of 2 teleconferences, the Surveillance Panel approved the 931 targets and, for AES, an ICF, and a TSA (Top Scale Adjustment). The approved motions are listed:

1) **Approval of reference oil 931 targets presented during February 25, 2021 and March 11, 2021 Conference calls. Reference oil standard deviations will be reviewed when 30 tests are obtained on this oil.**
   Motion voting results: 8 approve, 4 waive, 0 negative.

For AES:

2) **We accept ICF of -0.32 to be applied to all reference tests and candidates when on current fuel batches GI0321NX10 and GI0321NX10-1, effective date to be March 16th, 2021.**
   Motion voting results: 8 approve, 0 negative, 8 waive.

3) **Move that we accept TSA (Top Scale Adjustment) as noted below and apply them to candidates starting on or after March 16th, 2021. Final report forms will follow.**

- For candidates, apply the following adjustment:
  - Factor = 1 - (Original Result – 8.7), 0 ≤ Factor ≤ 1
  - New ICF = Factor x ICF
  - New SA = Factor x SA
  - Adjusted Result = Original Result + New ICF + New SA

Motion voting results: 10 approve, 0 negative, 5 waive.

Actions:

1. Open action from Feb 25th meeting: **Robert Stockwell (Oronite)** to lead task force on obtaining clarity around test validity, QIs, 2 hours of no data, etc.
2. Open action from June 24th meeting: **Haltermann** to look at fuel data from Sec 8.2.6 requirement and report back to panel.

Next call: Friday, March 19th @ 11 AM EST

March 11th Meeting Details:

Minutes from the Feb 25th SP call unanimously approved (motion by Angela Willis – Willis Advanced Consulting, second by Al Lopez – Intertek).

Prasad Tumati (Haltermann) provided an update on the fuel inventory: as of March 10th, we have 250,000 gal left in the tank (including the heel). Although the depletion is slower than it was toward the end of 2020, Chair Ritchie stated that we will still plan to need a new batch by year end. No objections to moving the contract date discussion to commence April 1st.

The Chair announced the agenda: 1) recommendation of the 931 targets and 2) presentation from the stats group. These items are a direct follow-up from the Feb 25th meeting, where the panel agreed that more time was needed to digest the 931 targets document from TMC and to allow more time for the statisticians to investigate lab stand bias impact on ICF and SA.

With slide 3 ("Summary of Severity Adjusted Test Results" of 931) being shared, Rich Grundza (TMC) started the discussion by motioning to approve the 931 targets. Caroline Laufer (Infineum) seconded the motion. With the motion on the table, the Chair prompted the discussion.

- Brad Cosgrove (GM) asked are we taking the mean for the targets? Rich affirmed yes, as well as the standard deviation.
- Al Lopez (Intertek) asked why we display RAC in transformed units instead of untransformed (merits)? Because we calculate Yi, Rich explained. The merits are on slide 4 in the bar charts.

- The Chair noted that the results are in between 940 and 1011 values and appears to perform the intended task of 931 being a borderline oil with the type of variability expected of such an oil.
- Al Lopez (Intertek) asked if we would revise the targets as more data comes in? Rich replied that historically, the recommendation from the stats group has been to adjust only the standard deviation when necessary. We would not adjust the mean unless there's a very compelling reason to. Al commented that this was fair and agreed.
- Angela Willis (Willis Advanced Consulting) asked if we could include in the motion that we would revisit the targets after a certain number of tests? Rich agreed that this would be wordsmithed in.
- Brad Cosgrove (GM) asked if this would be for each lab? Rich confirmed that this is based on the industry as a whole, not based on lab.

Motion is as follows: **Approval of reference oil 931 targets presented during February 25, 2021 and March 11, 2021 Conference calls. Reference oil standard deviations will be reviewed when 30 tests are obtained on this oil.**

Motion passed with the following results: 8 approve, 4 waive, 0 negative.

Intertek	Al Lopez	Approve
SwRI	Ankit Chaudry	Approve
Afton	Ben Maddock	Approve
Lubrizol	Jerry Brys	Approve
Valvoline	Amol Savant	None recorded
Ford	Mike Deegan	Approve
GM	Brad Cosgrove	Approve
OHT	Jason Bowden	Waive
TEI	Dan Lanctot	Waive
HCS Group	Izabela Gabrel	None recorded
Haltermann	Prasad Tumati	None recorded
Gage Products	Jim Carter	Waive
ExxonMobil	Ashley Montufar	Waive
Infineum	Caroline Laufer	Approve
TMC	Rich Grundza	Approve
PSL Services	Chris Taylor	None recorded

Rich Grundza (TMC) would like to circle back at the end of the call to discuss effective date as the subsequent discussion on the statisticians may impact putting these targets in.

Jo Martinez (Oronite) and Phil Scinto (Lubrizol) guided the panel through each of the slides in the statisticians report ("VH LTMS Review 031021.pdf" appended at the end of this document). Highlighted comments from Jo and Phil are as follows:

- Jo explained that the differences in stand as shown in Slides 10 and 11 for AES and RAC led her to think of a stand-based system.
- Phil explained that with the mild fuel batch, there are top of the scale issues. Since sludge is limited, you can't get over a 9.6 and we're limited at the top of the scale. Sludge across the scale is not linear; flat at the top and at the bottom. For VH, all the reference oils weren't at the top, rather in the linear part of the s-curve, and 7.6 was in the middle. He continued that when we started seeing the severity shifts with the fuel shift, we started getting pushed into the upper part of the curve. This wasn't a big deal

because reference oils weren't at the top. But when we start talking about pass limits that aren't there and more at the top of the scale, combined with the fuel batch severity, you start to have issues that need to be corrected.

- Slide 16 shows that the non-linearity is skewed for 1011. Phil explained that no matter how mild the test gets, 1011 can only go so high. Normally, there would be a transformation (as there was in VE) but at this stage, we don't want to disrupt the system and he recommended to avoid transforming the data. This segued into an alternative fix: multiply the adjustment by a factor.
- This factor, Phil explained, is a number between 0 and 1. The closer you are to 8.7, the closer the factor is to 1.
- Slide 18 hits home on the point that this factor only affects test results above 8.7 AES. Slide 19 shows it works in the opposite direction. Phil commented that if we had a reference oil in the high 8s or in the 9s, we would have had a transformation from the beginning.
- Jo summarized the recommendations:

Recommendation

- Adopt Oil 931 Targets as calculated by the TMC
- Continue with a Lab Based SA System at this time
- Do not add an AES transformation at this time
- For candidates, apply the following adjustment:
  - Factor = 1 - (Original Result – 8.7), $0 \leq$ Factor ≤ 1
  - New ICF = Factor x ICF
  - New SA = Factor x SA
  - Adjusted Result = Original Result + New ICF + New SA
- Consider an ICF for AES (we are neutral)
  - This is a Surveillance Panel issue that affects test labs
  - An ICF will not impact final adjustments for candidates
  - An ICF will impact the calibration status of some labs

Discussion from the panel followed the statisticians' report presentation:

- Bob Campbell (Afton) asked about lab bias, stand being the lowest common denominator, and wondered if transforming the data is 'more right' than a stand based system as the stands do appear different. Travis Kostan (SwRI) explained that when they took a deeper look at the stands that seemed different (ex: A1 and A3 for AES), it was found that the stands did not have a chance to run any tests with the mild fuel. Travis said that there may be a confounding factor of time. Bob asked if the same holds true for RAC. Rich Grundza (TMC) replied that B1 no longer exists and when he ran models, nothing was significant.
- Angela Willis (Willis Advanced Consulting) complimented Phil and team. She likes the top of the scale concept and believes it's a very smart way of approaching this. But she agreed with Bob. She pointed out that unfortunately, data given are snapshots in time. She said that there could be a point in time where you do have a stand variation for one reason or another. Could be for a short period of time. But these factors can have a serious effect. Angela continued that a stand based system would be more relevant going forward for the Seq VH.
- Angela also asked if we instituted the adjustment factor, would the equation or conditions for the equation have to be reevaluated when we change the fuel batch? Also asked about the 8.7 and if this would be evaluated again. Phil said that the 8.7 is just a best guess. He answered that we would not have to reevaluate because this is

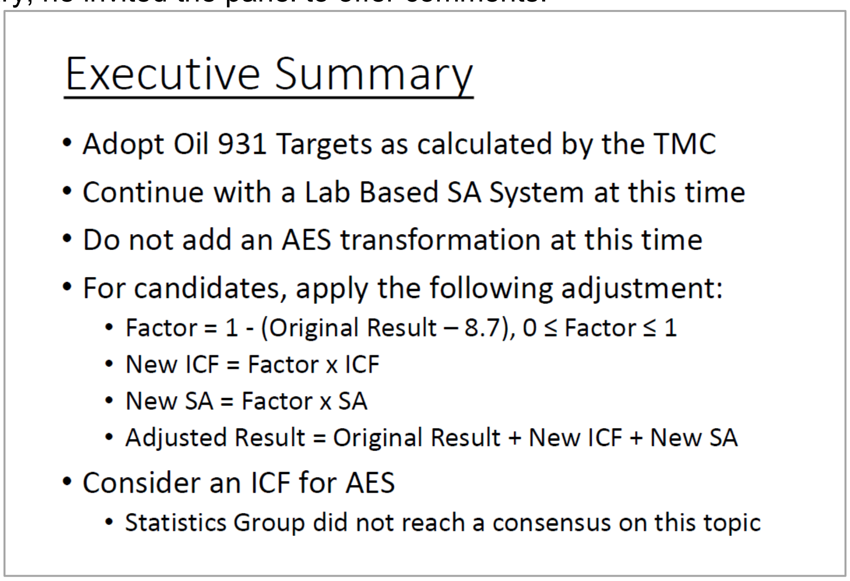
the top of the scale. He said that if we get a fuel batch that moves us away, it wouldn't matter.

The March 11th call had to be ended early to the many members needing to attend another industry call. The Chair said this conversation continues the following Monday, March 15th.

Meeting was adjourned at 10:57 AM EST.

<u>March 15th Meeting Details</u>:

The Chair opened by reminding the panel that we passed the motion to approve the 931 targets but did not yet agree to a date to introduce the targets. As Jo Martinez (Oronite) reshared the summary, he invited the panel to offer comments.



- Jo Martinez (Oronite) said she thinks the ICF will benefit the references but not the candidates.
- Angela Willis (Willis Advanced Consulting) said she would support the top of the scale concept as it can address some of the issues that have been occurring. She also supports the stand based LTMS but ok to hold on that allow time for a deep dive and to obtain more data with the new fuel batch.
- Since we adopted the targets at the last meeting, Bob Campbell (Afton) asked if they should be live now and back applied to 931? Rich Grundza (TMC) explained that we didn't pick a date yet because he wanted to see if the panel made changes to the system.
- Bob Campbell (Afton) asked where 8.7 came from and why not set a ceiling like we do for PVIS which can't go below zero. Phil Scinto (Lubrizol) answered that capping AES does not address the issue. The issue is the top of the scale.
- Bob asked how we landed at the equation. Phil answered that we cannot implement a transformation because it would disrupt the system for oils performing around the much lower AES limits for the API minimum standards and is not the right answer. He referenced Appendix II, clarifying that rather than have 2 levels of adjustment, we

simplified it between 8.6 and 8.8 and started with 1 equation at 8.7. The differences are very tiny.

- Angela commented that many of the members on this call might not be working on formulating for meeting specifications. If we're working on API, this would have no bearing because API limit is right at the middle of the s-curve. However, there are other specs out there that are very influential; Angela furthered that there are a lot of companies working on formulations where the upper part of the s-curve heavily impacts whether you pass or fail. She said that that's why it's important to look into remedying this, to make sure we're getting the appropriate results for these high end oils. Phil Scinto (Lubrizol) agreed and said this doesn't matter for a limit at 7.6. Bob appreciated Angela's comments but said supporting this could be challenging and asked where's the data that says this is the right correction. Also asked if the data needs to be transformed, why not look at that. Phil answered that transformation is the wrong thing to do because it does not change the landscape for oils around AES values of 7.6. He added that everything is an estimate and that it's better to do something than nothing. Doyle Boese (Infineum) pointed out that if we went with a transformation, it would affect the full range of AES, not just the upper range.
- The Chair asked what's the highest AES in the calibration oil database? Rich answered 9.41, on the current fuel batch. We saw 9.3/9.1 on the previous fuel batch. The Chair followed that if an oil is designed to be an 8.7, and just for illustration a lab SA of -0.9, they would have to get a 9.6 uncorrected result which appears to be almost impossible. With the new categories, Phil said formulators are not designing the oils to be 8.7, but rather the 9s.
- Al Lopez (Intertek) remarked that we should really be dealing the reference data, not candidates. Bob agreed that we have this backwards and we should start with the ICF. Chair Ritchie recalled that the ICF was discussed but dismissed because its implementation was not expected to make much difference to candidate results. He asked Rich Grundza (TMC) to brief us on ICF and implications.
    - Rich explained that when you apply an ICF, it will affect the SA. But the difference is that the overall candidates would be adjusted by the same amount. Al noted the good input, but asked to refocus on the reference data set as the labs' reference efforts are under threat with the mild fuel batch. Travis Kostan (SwRI) clarified that although no one among the stats group was strongly one way or another, there was more support than against for introducing an ICF. Rich agreed that he himself does not have a strong opinion on the ICF.

Chair Ritchie invited others to share their ICF position:

- Al Lopez (Intertek), referencing the analysis from the statisticians, is in favor of an ICF.
- Ankit Chaudhry (SwRI) is in favor of ICF. He asked TMC: if we continue to see mild results, will there be a point when we cannot calibrate if we do not apply an ICF? Rich Grundza (TMC) answered that if one continues to get above 1.8 standard deviations mild, their EWMA will catch up and they will fail on Zi. If you apply an ICF, it's roughly a 0.5 standard deviation downward.
- Amol Savant (Valvoline) is <u>not</u> in favor of ICF. He explained that he would be in favor if the following 2 conditions were met: 1) all 3 reference oils show similar digression from their targets and 2) all labs which have contributed data recently show mild trend. He then asked if criteria 1 was true. Rich replied yes, within the average. Amol offered an intermediate approach: have a lab correction factor. Rich countered that this is why we have SAs. Referring back to Al's point, Amol said this had nothing to do with the targets of the reference oil. Rich explained that it does because we're adjusting the individual result before it's judged.

- Ben Maddock (Afton) is not in favor of ICF as no one is failing their references. He commented that it's good to be ahead of the curve but we're not near failing our references. He noted some interest in a stand-based system.
- Jerry Brys (Lubrizol) is in favor of ICF. He recognizes that no one is having trouble referencing their stands but see the potential for the need of an ICF.
- Mike Deegan (Ford) is in favor of ICF to support the industry.
- Angela Willis (Willis Advanced Consulting) is not in favor of ICF, but understands the concerns due to the mild batch. She would like to look more into the top of the scale adjustment.
- After hearing a few negatives, Chair Ritchie asked TMC what the process would be if the motion to introduce an ICF was not unanimous. Rich explained that the negative vote would have to go to B for adjudication. Chair Ritchie asked if this would be the same process if a motion to accept the curving correction, to which Rich affirmed. Chair Ritchie prompted the panel to put the motion forward.

Ankit Chaudhry (SwRI) motioned to introduce the correction factor, seconded by Al Lopez (Intertek). Motion is as follows for AES: **Move that we accept ICF of -0.32 to be applied to all reference tests and candidates when on current fuel batches GI0321NX10 and GI0321NX10-1, effective date to be March 16th, 2021.**

Before a vote was called, a few comments and questions came up:

- Angela Willis (Willis Advanced Consulting) asked: If ICF motion is approved, and we decide to implement it when we're in the middle of a fuel batch, Rich indicated that the SA would have the recalculated. So how does that work for the candidate data? Rich stated that there is no retroactivity in ASTM. He said that we don't go back and change what's been done. Rich clarified that the reason to do this for the reference data is to get the SAs correct.
- Angela asked: if the ICF is implemented, is there a way to go back through the data, and replot to see if the s-curve still exists? Phil Scinto (Lubrizol) confirmed that nothing would change; whether we apply all the ICFs, the SA will be different, but the end result will be the same level of severity for each reference oil test.
- Angela would like everyone to be aware that with an ICF implemented, we still have an issue with extreme cases in terms of candidate oil performance on this test.
- Bob Campbell (Afton) asked: Do ICF and SA arithmetically get us to the same place? Rich answered that Jo Martinez (Oronite) and one lab did the analysis and got the same number. They went back and adjusted all the GJ batch data and subtracted 0.32 and redid their lab charts and saw the same number.

Motion was voted on and had the following final results: 8 approve, 0 negative, 8 waive.

TMC	Rich Grundza	Approve
Oronite	Robert Stockwell	Approve
Intertek	Al Lopez	Approve
Valvoline	Amol Savant	~~Negative~~ → Waive
Willis Advanced Consulting	Angela Willis	Waive
SwRI	Ankit Chaudry	Approve

Afton	Ben Maddock	Approve
TEI	Dan Lanctot	Waive
OHT	Jason Bowden	Waive
Shell	Jeff Hsu	Waive
Lubrizol	Jerry Brys	Approve
Ford	Mike Deegan	Approve
GM	Tim Cushing	Waive
Haltermann	Prasad Tumati	Waive
BP	Jorge Agudelo	Waive
Infineum	Caroline Laufer	Approve

Amol Savant (Valvoline) explained that ICF has sometimes backfired to the labs and he has yet to see how the top of the scale adjustment would play with ICF. Travis Kostan (SwRI) said that the stats group looked at some of the concerns that Amol voiced. He noted that the group looked at fuel-oil interaction and didn't see an impact. They also looked across all reference oils and saw that 3 out of the 4 labs were mild vs target, but noted that one lab has not run much tests so there could be a time confounding. After further clarification, especially around the point that the top of the scale adjustment only applied to candidates and not references, Amol restated his vote, changing it to abstain.

With the passing vote, Rich Grundza (TMC) explained that he will proceed with prearing the info letter. Labs will have to upload all their reference data that's been conducted on this fuel batch and apply an ICF of -0.32. Rich will put the 931 results in the charts today and will determine reference periods. Al Lopez (Intertek) asked if we apply ICF for the fuel, to which Rich affirmed that it is treated the same way.

Ankit Chaudhry (SwRI) made the next motion to accept the top of the scale adjustment factor, seconded by Angela Willis (Willis Advanced Consulting). Motion is as follows for AES: **Move that we accept TSA (Top Scale Adjustment) as noted below and apply them to candidates starting on or after March 16th, 2021. Final report forms will follow.**

- For candidates, apply the following adjustment:
  - Factor = 1 - (Original Result – 8.7), 0 ≤ Factor ≤ 1
  - New ICF = Factor x ICF
  - New SA = Factor x SA
  - Adjusted Result = Original Result + New ICF + New SA

Motion was voted on with the following results: 10 approve, 0 negative, 5 waive.

Oronite	Robert Stockwell	Approve
Intertek	Al Lopez	Approve
Valvoline	Amol Savant	Approve
Willis Advanced Consulting	Angela Willis	Approve
SwRI	Ankit Chaudhry	Approve
Afton	Ben Maddock	Approve
TEI	Dan Lanctot	Waive
OHT	Jason Bowden	Waive
Shell	Jeff Hsu	Waive

Lubrizol	Jerry Brys	Approve
Ford	Mike Deegan	Approve
Haltermann	Prasad Tumati	Waive
GM	Tim Cushing	Approve
Infineum	Caroline Laufer	Approve
TMC	Rich Grundza	Waive

Chair Ritchie summarized that the panel has just passed both ICF and TSA motions. Although discussion ensued about the effective date after the votes were cast, the panel adjusted the dates in the motions together on a shared screen and the final motions are already represented above.

Meeting was adjourned at 12:29 PM EST.

New 931 targets.pptx

VH LTMS Review 031021.pdf

Original documents above can also be found attached to the March 11th meeting request.

VH LTMS Review 031921.pdf

On March 19th, VH LTMS Review document was updated (VH LTMS Review 031921.pdf) to reflect TSA naming and legend for fuel approval matrix in the charts. The updated 031921 document is copied in the appendix.

Appended: TMC document “New 931 targets.ppt”

Slide 1:

Test Monitoring Center

http://astmtmc.cmu.edu

A Program of ASTM International

Reference Oil 931 Targets

All Reference data reported through 2/22/21

Slide 2:

Summary of Review

- Reference Oil 931 is to replace Reference Oil 1009
  - Targets adjusted using lab SA from previous reference test in lab. Reference oil 931 means for RAC and AEV compare reasonably well with 1009, while AES and APV appear to be somewhat milder.
  - Standard deviations appear to be more variable for AES and RAC, while APV and AEV show some improvement when compared to 1009.
  - Summary of all results included at the end of the presentation.

Slide 3:

Summary of Severity Adjusted Test Results

	RAC Corrected	AES Corrected	AEV Corrected	APV Corrected
	-0.4271	8.9	8.42	9.37
	1.0709	7.48	9.23	8.59
	0.4941	7.59	9.24	8.37
	0.1886	7.99	8.53	8.03
	0.4314	7.49	9.22	8.13
	-0.3881	8.56	8.82	7.6
Mean	0.2283	8.00	8.97	8.35
s	0.5715	0.60	0.30	0.60

RAC in transformed (ln(10-RAC)) Units

Test Monitoring Center
http://astmtmc.cmu.edu
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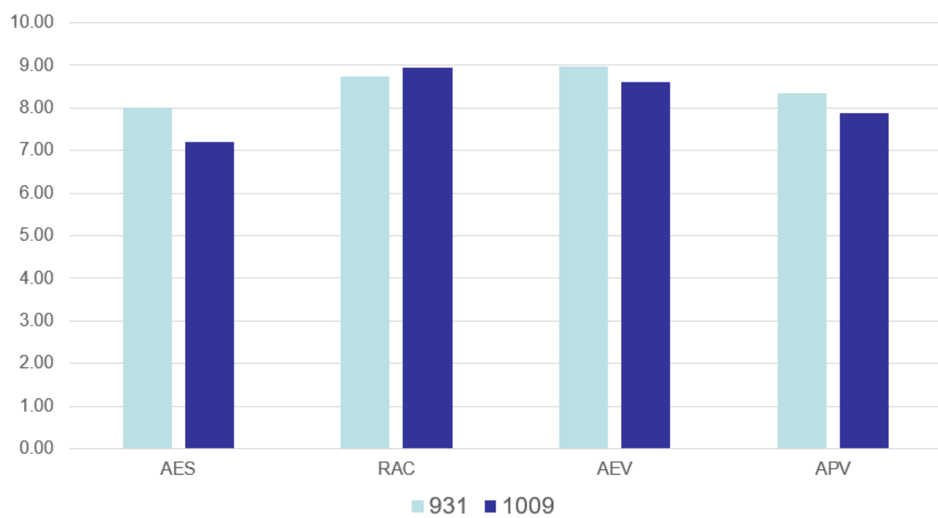
Slide 4:

Comparison of Reference oil Means



RAC means calculated in transformed units (10-RAC) and converted back to original units

Test Monitoring Center
http://astmtmc.cmu.edu
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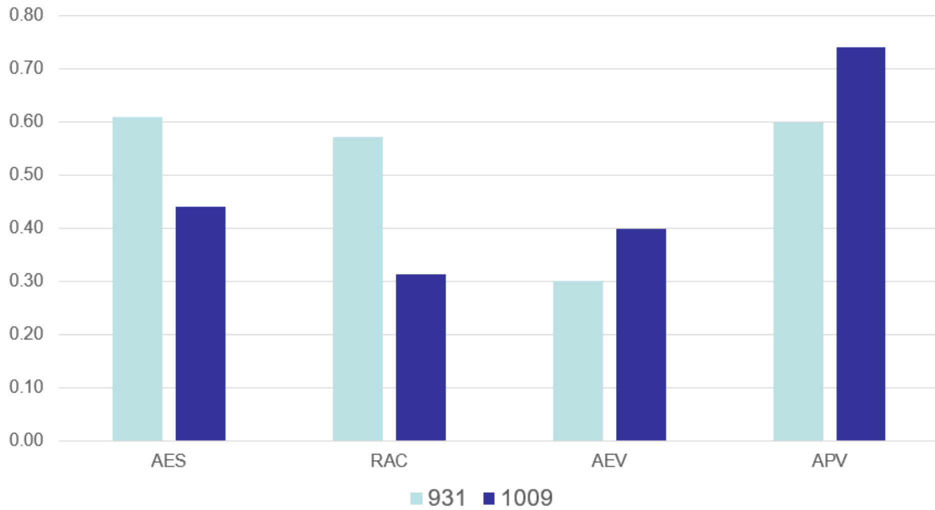
Slide 5:

Comparison of Reference oil Standard Deviations



Standard deviations not adjusted for lab

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Slide 6:

Summary of Test Results, SA's and Corrected Results

ind	RAC	AES	AP50	AE50	RACti	RAC SA	AES Sa	APV Sa	AEV Sa	RAC Cor	AES Cor	AEV Cor	APV Cor
931	9.4	9.15	9.12	8.67	-0.5108	0.0837	-0.25	0.25	0.13	-0.4271	8.9	8.80	9.37
931	7.64	7.66	8.55	9.34	0.8587	0.2122	-0.18	0.04	-0.11	1.0709	7.48	9.23	8.59
931	8.54	7.77	8.2	9.16	0.3784	0.1157	-0.18	0.17	0.08	0.4941	7.59	9.24	8.37
931	9.08	8.37	8.2	8.64	-0.0834	0.272	-0.38	-0.17	-0.11	0.1886	7.99	8.53	8.03
931	8.72	7.99	7.7	9.07	0.2469	0.1845	-0.50	0.43	0.15	0.4314	7.49	9.22	8.13
931	9.4	9.2	7.64	8.88	-0.5108	0.1227	-0.64	-0.04	-0.06	-0.3881	8.56	8.82	7.6

Test Monitoring Center
http://astmtmc.cmu.edu
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Appended: Statisticians Report “VH LTMS Review 031921.pdf” (UPDATED VERSION)

Updated Slide 1:

VH LTMS Review

Statistics Group

March 19, 2021

Updated Slide 2:

Statistics Group

- Todd Dvorak, Afton
- Jo Martinez, Chevron Oronite
- Doyle Boese, Infineum
- Martin Chadwick, Intertek
- Phil Scinto, Lubrizol
- Travis Kostan, SwRI
- Richard Grundza, TMC

Updated Slide 3:

Executive Summary

- Adopt Oil 931 Targets as calculated by the TMC
- Continue with a Lab Based SA System at this time
- Do not add an AES transformation at this time
- For candidates, apply the Top of Scale Adjustment (TSA):
  - Factor = 1 - (Original Result – 8.7), 0 ≤ Factor ≤ 1
  - New ICF = Factor x ICF
  - New SA = Factor x SA
  - Adjusted Result = Original Result + New ICF + New SA
- Consider an ICF for AES
  - Statistics Group did not reach a consensus on this topic

Updated Slide 4:

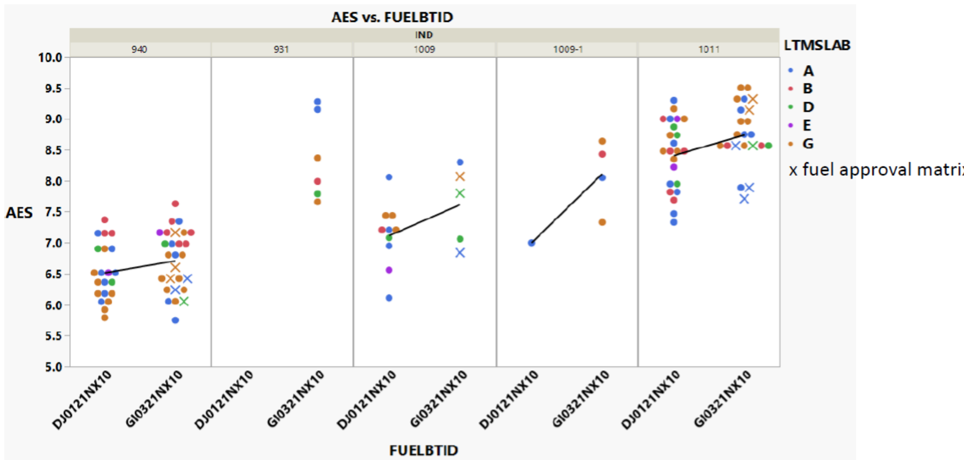
Outline

- Fuel Batch
- Stand Differences
- Top of the Scale Issues
- Recommendation

Updated Slide 5:

Fuel Batch

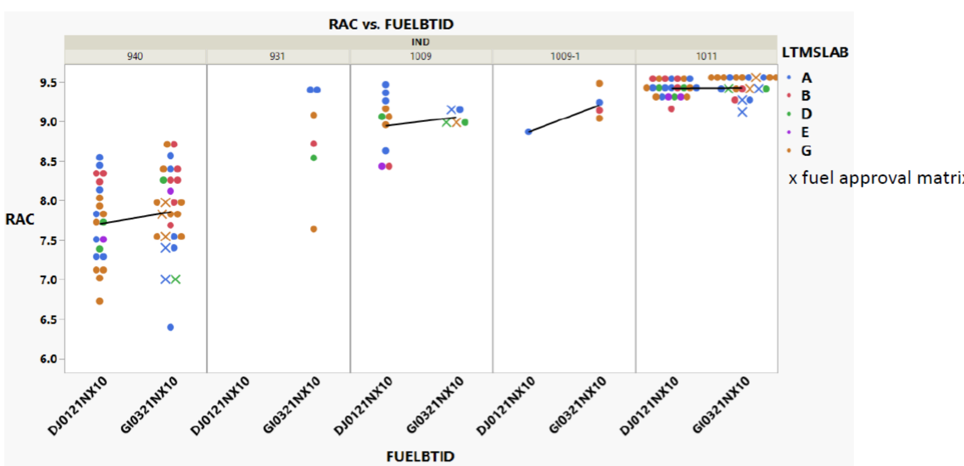
Significant fuel batch difference for AES



Updated Slide 6:

Fuel Batch

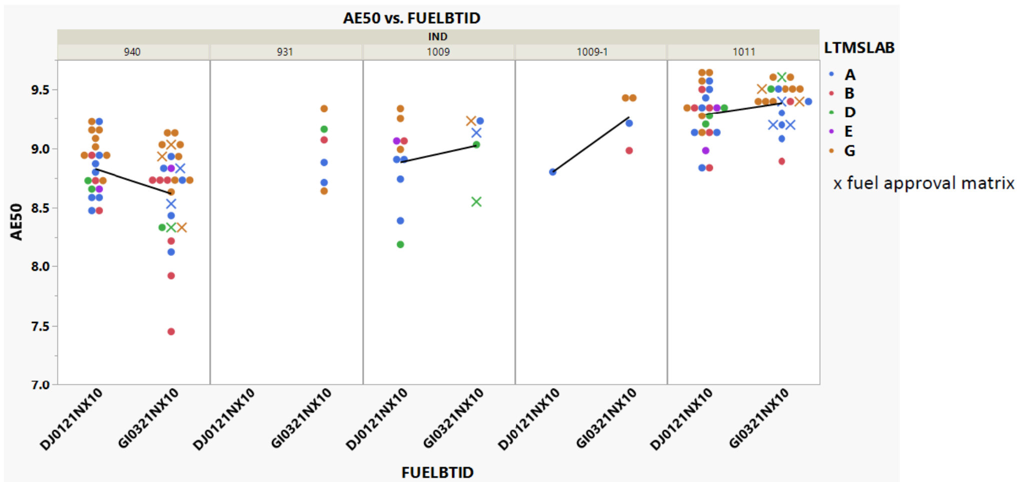
No significant fuel batch difference for RAC



Updated Slide 7:

Fuel Batch

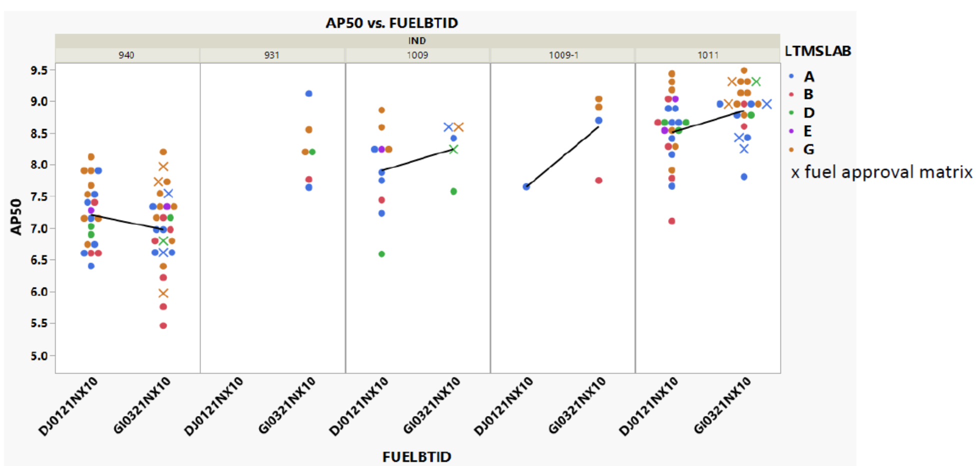
No significant fuel batch difference for AEV50



Updated Slide 8:

Fuel Batch

No significant fuel batch difference for APV50



Updated Slide 9:

Fuel Correction Factor

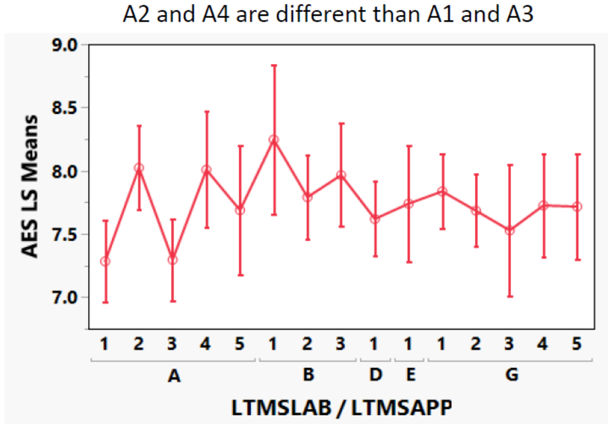
- Estimated ICFs for AES are
  - Lab system ICF = -0.32
  - Stand system ICF = -0.34
- Applying an ICF in the middle of the life of a fuel batch may not serve the system well
- RAC, AEV50 and APV50 do not need an ICF

Updated Slide 10:

Stand

There may be stand effects for AES within a lab

A2 and A4 are different than A1 and A3

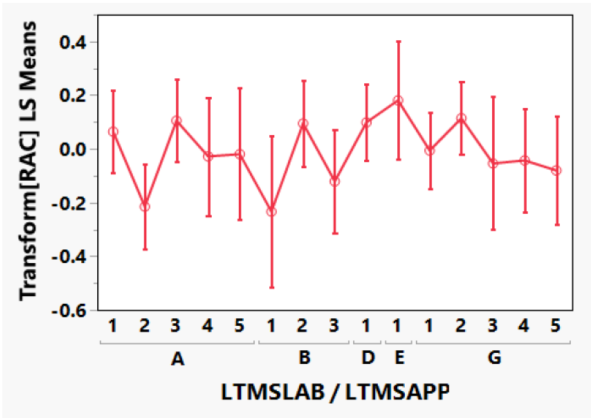


Updated Slide 11:

Stand

There may be stand effects for RAC within a lab

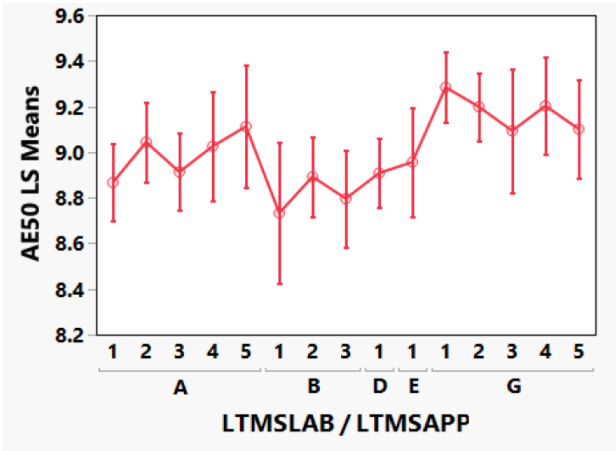
A2 is different than A1 and A3, B1 is different than B2



Updated Slide 12:

Stand

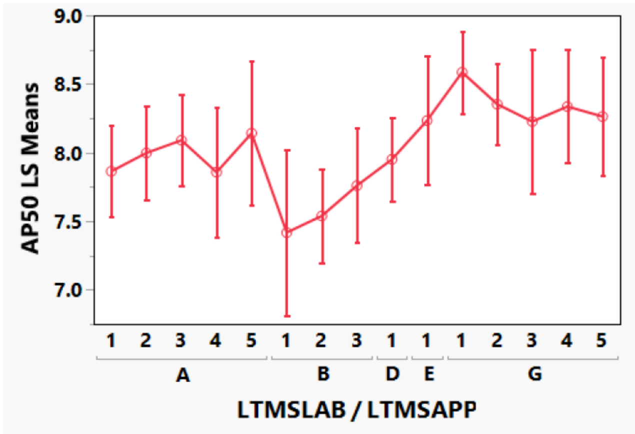
No significant stand differences within a lab for AEV50



Updated Slide 13:

Stand

No significant stand differences within a lab for APV50



Updated Slide 14:

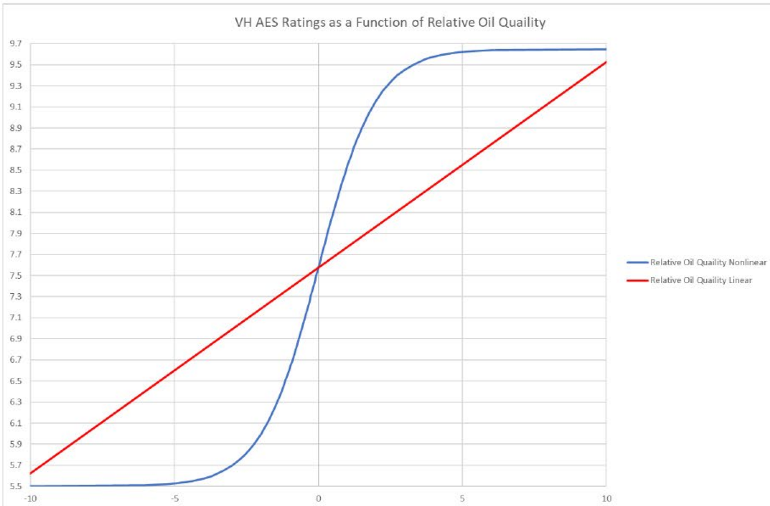
Stand-based Severity Adjustment System

- AES and RAC could benefit from a stand-based system
- Severity adjustment from a lab-based system may not accurately account for the severity of some of the stands in the system
  - A severe result would be adjusted with a –SA for some of the severe stands from a lab that is trending mild
- However
  - The stand effects observed may be confounded with other covariates such as time, runs on the engine head and fuel dilution
  - Converting to a stand-based system in the middle of the life of a fuel batch may not serve the system well

Updated Slide 15:

Top of the Scale Issues

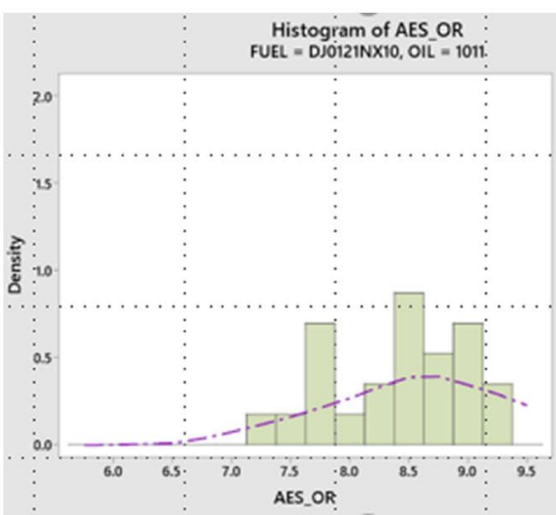
The sludge scale is not linear for high or low tier oils

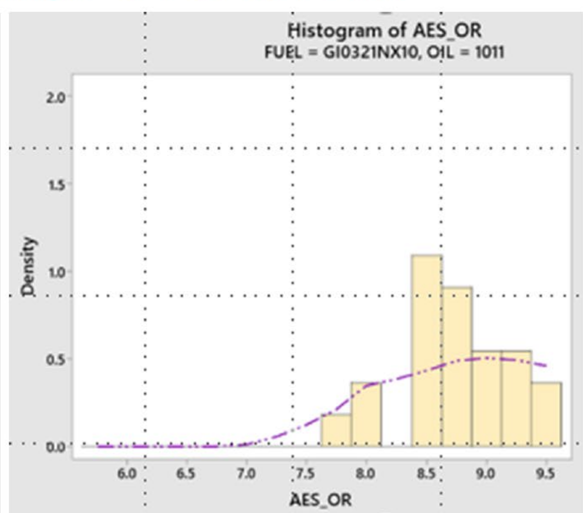


Updated Slide 16:

Top of the Scale Issues

The scale is not linear for high or low tier oils





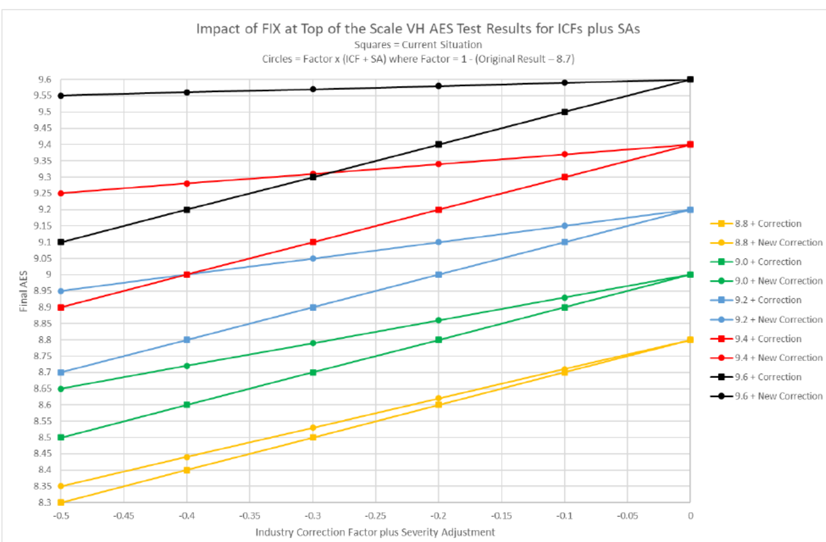
Updated Slide 17:

Top of the Scale Issues

- Oil 1011, possible future high performance reference oils, and candidate high-tier oils are not normally or uniformly distributed
  - Applying full (- or +) ICF and SA for these types of oils, based upon reference oils with performance in the 6.0 to 8.5 range, would be incorrect
    - A result of 9.5 should not be pushed to 10.3 or down to 8.7
  - AES could benefit from a logistic transformation, however
    - Converting in the middle of the life of a fuel batch may not serve the system well
- An alternative fix in place of a transformation
  - For candidates, apply the Top of Scale Adjustment (TSA):
    - Factor = 1 - (Original Result – 8.7), 0 ≤ Factor ≤ 1
    - New ICF = Factor x ICF
    - New SA = Factor x SA
    - Adjusted Result = Original Result + New ICF + New SA

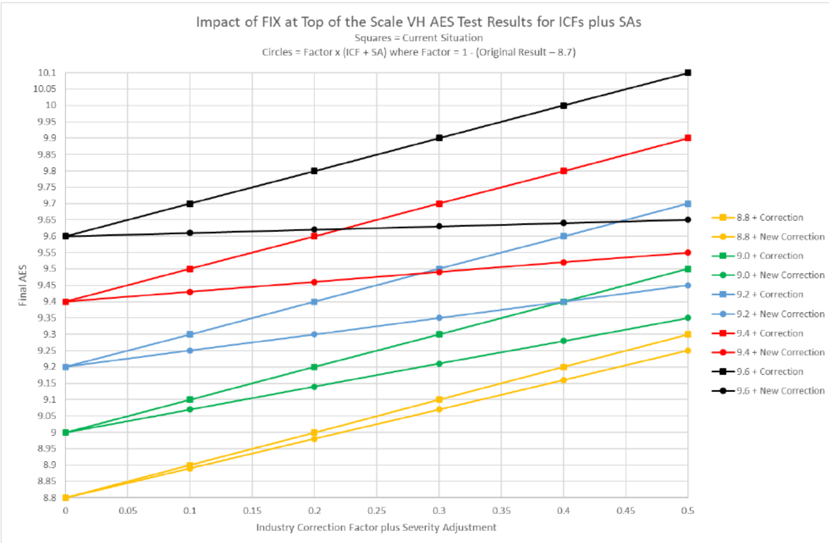
Updated Slide 18:

Top of the Scale Issues



Updated Slide 19:

Top of the Scale Issues



Updated Slide 20:

Recommendation

- Adopt Oil 931 Targets as calculated by the TMC
- Continue with a Lab Based SA System at this time
- Do not add an AES transformation at this time
- For candidates, apply Top of Scale Adjustment (TSA):
  - Factor = 1 - (Original Result – 8.7), 0 ≤ Factor ≤ 1
  - New ICF = Factor x ICF
  - New SA = Factor x SA
  - Adjusted Result = Original Result + New ICF + New SA
- Consider an ICF for AES (we are neutral)
  - This is a Surveillance Panel issue that affects test labs
  - An ICF will not impact final adjustments for candidates
  - An ICF will impact the calibration status of some labs

Updated Slide 21:

Appendix I

Regression Models

Updated Slide 22:

AES

Summary of Fit

RSquare	0.768462
RSquare Adj	0.749345
Root Mean Square Error	0.519579
Mean of Response	7.582605
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	7.7213898	0.085267	90.56	<.0001*
IND[940]	-1.114628	0.093017	-11.98	<.0001*
IND[931]	0.4985964	0.183117	2.72	0.0075*
IND[1009]	-0.33454	0.131241	-2.55	0.0122*
IND[1009-1]	0.0805907	0.19537	0.41	0.6808
LTMSLAB[A]	-0.127924	0.09102	-1.41	0.1627
LTMSLAB[B]	0.2037862	0.113336	1.80	0.0749
LTMSLAB[D]	-0.096402	0.129914	-0.74	0.4597
LTMSLAB[E]	0.0126547	0.193007	0.07	0.9478
FUELBTID[DJ0121NX10]	-0.158796	0.050391	-3.15	0.0021*

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	94.415225	87.4338	<.0001*
LTMSLAB	4	4	1.489031	1.3789	0.2460
FUELBTID	1	1	2.680892	9.9306	0.0021*

Summary of Fit

RSquare	0.809986
RSquare Adj	0.773519
Root Mean Square Error	0.493889
Mean of Response	7.582605
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	7.7432189	0.085812	90.23	<.0001*
IND[940]	-1.119497	0.091933	-12.18	<.0001*
IND[931]	0.493534	0.178145	2.77	0.0067*
IND[1009]	-0.301793	0.127622	-2.36	0.0200*
IND[1009-1]	0.0589726	0.189186	0.31	0.7559
LTMSLAB[A]	-0.083682	0.09145	-0.92	0.3624
LTMSLAB[B]	0.2572468	0.117018	2.20	0.0303*
LTMSLAB[D]	-0.124695	0.124617	-1.00	0.3194
LTMSLAB[E]	-0.003509	0.184053	-0.02	0.9848
LTMSLAB[A]:LTMSAPP[1]	-0.376329	0.146048	-2.58	0.0114*
LTMSLAB[A]:LTMSAPP[2]	0.3634119	0.155863	2.33	0.0217*
LTMSLAB[A]:LTMSAPP[3]	-0.363488	0.15013	-2.42	0.0173*
LTMSLAB[A]:LTMSAPP[4]	0.3480853	0.192346	1.81	0.0734
LTMSLAB[B]:LTMSAPP[1]	0.2452884	0.212374	1.15	0.2509
LTMSLAB[B]:LTMSAPP[2]	-0.209764	0.160655	-1.31	0.1947
LTMSLAB[G]:LTMSAPP[1]	0.138532	0.13666	1.01	0.3132
LTMSLAB[G]:LTMSAPP[2]	-0.014141	0.136865	-0.10	0.9179
LTMSLAB[G]:LTMSAPP[3]	-0.170056	0.209813	-0.81	0.4196
LTMSLAB[G]:LTMSAPP[4]	0.0273287	0.168074	0.16	0.8712
FUELBTID[DJ0121NX10]	-0.17511	0.049637	-3.53	0.0006*

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	92.641414	94.9483	<.0001*
LTMSLAB	4	4	1.442837	1.4788	0.2144
LTMSAPP[LTMSLAB]	10	10	5.277192	2.1634	0.0262*
FUELBTID	1	1	3.035744	12.4453	0.0006*

Updated Slide 23:

RAC

Summary of Fit

RSquare	0.863999
RSquare Adj	0.85277
Root Mean Square Error	0.246544
Mean of Response	0.088154
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0574289	0.04046	1.42	0.1586
IND[940]	0.7490941	0.044137	16.97	<.0001*
IND[931]	0.0674119	0.086891	0.78	0.4395
IND[1009]	-0.061218	0.062275	-0.98	0.3278
IND[1009-1]	-0.167517	0.092705	-1.81	0.0735
LTMSLAB[A]	-0.05999	0.04319	-1.39	0.1677
LTMSLAB[B]	-0.082542	0.053779	-1.53	0.1277
LTMSLAB[D]	0.0466401	0.061645	0.76	0.4509
LTMSLAB[E]	0.134624	0.091583	1.47	0.1445
FUELBTID[DJ0121NX10]	0.0227956	0.023911	0.95	0.3425

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	41.726583	171.6180	<.0001*
LTMSLAB	4	4	0.291510	1.1990	0.3155
FUELBTID	1	1	0.055246	0.9089	0.3425

Summary of Fit

RSquare	0.886592
RSquare Adj	0.864827
Root Mean Square Error	0.236234
Mean of Response	0.088154
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0319443	0.041045	0.78	0.4383
IND[940]	0.7665089	0.043973	17.43	<.0001*
IND[931]	0.0717538	0.085209	0.84	0.4018
IND[1009]	-0.083119	0.061043	-1.36	0.1764
IND[1009-1]	-0.181463	0.09049	-2.01	0.0477*
LTMSLAB[A]	-0.050662	0.043742	-1.16	0.2496
LTMSLAB[B]	-0.118614	0.055972	-2.12	0.0366*
LTMSLAB[D]	0.0664735	0.059606	1.12	0.2675
LTMSLAB[E]	0.1487158	0.088035	1.69	0.0943
LTMSLAB[A]:LTMSAPP[1]	0.0827319	0.069857	1.18	0.2391
LTMSLAB[A]:LTMSAPP[2]	-0.196289	0.074551	-2.63	0.0098*
LTMSLAB[A]:LTMSAPP[3]	0.1237341	0.071809	1.72	0.0880
LTMSLAB[A]:LTMSAPP[4]	-0.009266	0.092002	-0.10	0.9200
LTMSLAB[B]:LTMSAPP[1]	-0.147018	0.101581	-1.45	0.1510
LTMSLAB[B]:LTMSAPP[2]	0.1814634	0.076844	2.36	0.0202*
LTMSLAB[G]:LTMSAPP[1]	0.007841	0.065367	0.12	0.9048
LTMSLAB[G]:LTMSAPP[2]	0.1280365	0.065464	1.96	0.0533
LTMSLAB[G]:LTMSAPP[3]	-0.040335	0.100357	-0.40	0.6886
LTMSLAB[G]:LTMSAPP[4]	-0.029108	0.080392	-0.36	0.7181
FUELBTID[DJ0121NX10]	0.0280804	0.023742	1.18	0.2398

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	41.195382	184.5457	<.0001*
LTMSLAB	4	4	0.411000	1.8412	0.1269
LTMSAPP[LTMSLAB]	10	10	1.100626	1.9722	0.0443*
FUELBTID	1	1	0.078064	1.3988	0.2398

Updated Slide 24:

AEV50

Summary of Fit

RSquare	0.623251
RSquare Adj	0.592144
Root Mean Square Error	0.255489
Mean of Response	9.005714
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	8.9790245	0.041928	214.16	<.0001*
IND[940]	-0.323222	0.045739	-7.07	<.0001*
IND[931]	-0.035906	0.090043	-0.40	0.6908
IND[1009]	-0.093144	0.064534	-1.44	0.1518
IND[1009-1]	0.1444916	0.096068	1.50	0.1355
LTMSLAB[A]	-0.008188	0.044757	-0.18	0.8552
LTMSLAB[B]	-0.14157	0.05573	-2.54	0.0125*
LTMSLAB[D]	-0.063496	0.063882	-0.99	0.3224
LTMSLAB[E]	-0.015746	0.094906	-0.17	0.8685
FUELBTID[DJ0121NX10]	0.0225449	0.024778	0.91	0.3649

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	9.4274933	36.1070	<.0001*
LTMSLAB	4	4	2.3726306	9.0871	<.0001*
FUELBTID	1	1	0.0540379	0.8279	0.3649

Summary of Fit

RSquare	0.65274
RSquare Adj	0.586094
Root Mean Square Error	0.257377
Mean of Response	9.005714
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	8.9682964	0.044719	200.55	<.0001*
IND[940]	-0.316199	0.047908	-6.60	<.0001*
IND[931]	-0.028124	0.092835	-0.30	0.7626
IND[1009]	-0.087691	0.066507	-1.32	0.1904
IND[1009-1]	0.1162153	0.098589	1.18	0.2413
LTMSLAB[A]	0.024407	0.047657	0.51	0.6097
LTMSLAB[B]	-0.160956	0.060981	-2.64	0.0096*
LTMSLAB[D]	-0.059934	0.064941	-0.92	0.3583
LTMSLAB[E]	-0.011623	0.095914	-0.12	0.9038
LTMSLAB[A]:LTMSAPP[1]	-0.125653	0.076109	-1.65	0.1019
LTMSLAB[A]:LTMSAPP[2]	0.0516402	0.081224	0.64	0.5264
LTMSLAB[A]:LTMSAPP[3]	-0.07932	0.078236	-1.01	0.3131
LTMSLAB[A]:LTMSAPP[4]	0.0333366	0.100236	0.33	0.7402
LTMSLAB[B]:LTMSAPP[1]	-0.074181	0.110673	-0.67	0.5042
LTMSLAB[B]:LTMSAPP[2]	0.085161	0.083721	1.02	0.3115
LTMSLAB[G]:LTMSAPP[1]	0.1084332	0.071217	1.52	0.1311
LTMSLAB[G]:LTMSAPP[2]	0.0225812	0.071323	0.32	0.7522
LTMSLAB[G]:LTMSAPP[3]	-0.082849	0.109339	-0.76	0.4504
LTMSLAB[G]:LTMSAPP[4]	0.0268145	0.087588	0.31	0.7601
FUELBTID[DJ0121NX10]	0.0217086	0.025867	0.84	0.4034

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	9.2385275	34.8661	<.0001*
LTMSLAB	4	4	1.7091404	6.4503	0.0001*
LTMSAPP[LTMSLAB]	10	10	0.5568983	0.8407	0.5908
FUELBTID	1	1	0.0466557	0.7043	0.4034

Updated Slide 25:

APV50

Summary of Fit

RSquare	0.727849
RSquare Adj	0.705377
Root Mean Square Error	0.494802
Mean of Response	7.914958
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	8.035007	0.081201	98.95	<.0001*
IND[940]	-1.01012	0.088582	-11.40	<.0001*
IND[931]	0.1445738	0.174385	0.83	0.4089
IND[1009]	-0.046726	0.124983	-0.37	0.7092
IND[1009-1]	0.3137422	0.186054	1.69	0.0946
LTMSLAB[A]	-0.052983	0.08668	-0.61	0.5423
LTMSLAB[B]	-0.434413	0.107932	-4.02	0.0001*
LTMSLAB[D]	-0.079243	0.123719	-0.64	0.5232
LTMSLAB[E]	0.206075	0.183803	1.12	0.2647
FUELBTID[DJ0121NX10]	-0.038501	0.047988	-0.80	0.4241

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	62.019181	63.3290	<.0001*
LTMSLAB	4	4	9.317389	9.5142	<.0001*
FUELBTID	1	1	0.157600	0.6437	0.4241

Summary of Fit

RSquare	0.74291
RSquare Adj	0.69357
Root Mean Square Error	0.50462
Mean of Response	7.914958
Observations (or Sum Wgts)	119

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	8.0200287	0.087676	91.47	<.0001*
IND[940]	-1.016542	0.09393	-10.82	<.0001*
IND[931]	0.1722312	0.182015	0.95	0.3463
IND[1009]	-0.039973	0.130395	-0.31	0.7598
IND[1009-1]	0.2766445	0.193296	1.43	0.1555
LTMSLAB[A]	-0.029797	0.093437	-0.32	0.7505
LTMSLAB[B]	-0.448186	0.119561	-3.75	0.0003*
LTMSLAB[D]	-0.068851	0.127324	-0.54	0.5899
LTMSLAB[E]	0.2137363	0.188052	1.14	0.2585
LTMSLAB[A]:LTMSAPP[1]	-0.126378	0.149222	-0.85	0.3991
LTMSLAB[A]:LTMSAPP[2]	0.0073408	0.15925	0.05	0.9633
LTMSLAB[A]:LTMSAPP[3]	0.1000633	0.153392	0.65	0.5157
LTMSLAB[A]:LTMSAPP[4]	-0.132746	0.196525	-0.68	0.5010
LTMSLAB[B]:LTMSAPP[1]	-0.154405	0.216988	-0.71	0.4784
LTMSLAB[B]:LTMSAPP[2]	-0.033236	0.164146	-0.20	0.8400
LTMSLAB[G]:LTMSAPP[1]	0.2328324	0.13963	1.67	0.0986
LTMSLAB[G]:LTMSAPP[2]	0.0001714	0.139838	0.00	0.9990
LTMSLAB[G]:LTMSAPP[3]	-0.12635	0.214372	-0.59	0.5569
LTMSLAB[G]:LTMSAPP[4]	-0.017097	0.171726	-0.10	0.9209
FUELBTID[DJ0121NX10]	-0.030349	0.050716	-0.60	0.5509

Effect Tests

Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
IND	4	4	61.619291	60.4962	<.0001*
LTMSLAB	4	4	7.017810	6.8899	<.0001*
LTMSAPP[LTMSLAB]	10	10	1.476912	0.5800	0.8268
FUELBTID	1	1	0.091185	0.3581	0.5509

Updated Slide 26:

Appendix II

Estimating the Overall Average Multiplier to SAs and ICFs at the Top of the AES Scale

Updated Slide 27:

Appendix II