

Sequence VIE/F Severity Review Task Force

Scope:

The ASTM Sequence VI Surveillance Panel requested a Task Force be formed to review/explore the observed severity bias of the of the CUSUM chart for the Seq. VIE/F FEI2 parameter and potentially identify the factor(s) contributing to the FEI2 severity.

Objectives:

The Task Force will:

- Review available calibration data to determine a timeline of the severity bias.
- Review existing calibration data to identify individual factors that could influence the severity of the test:
 - Review conclusions/results from the FEI2 Severity TF formed in 2017
 - Research individual labs severity
 - Research individual engine/stand influence on the overall dataset
 - If there is significant difference in labs performance, should group lab audits be completed with reps from each lab visiting all the labs?
 - Influence of calibration oils on labs severity
 - Are all labs performing similar with the same RO?
 - Have there been a bias from one batch of RO to the next?
 - Potential bias due to fuel batch changes
 - Potential bias due to hardware changes

Below is the agenda for this meeting, if you have any additions, please send them to me and Cc this distribution.

- Roll Call and membership changes
 - Attendance updated on the last page (attendance sheet)
- Chairman's opening comments
- Open Discussion on Scope and Objective. Scope accepted as is. Objective to be revised to change the word shift with bias, this will better represent the goal of this TF of determining if there is a factor truly influencing the performance of the tests or introducing bias.
- Discussion of the objectives
 - In 2017-2018 a TF investigated the same thing and extensive work was completed
 - An observation on the conclusions of the previous TF is that at the time the labs were still acquiring fuel from various locations. Revisiting the fuel lab interaction might be of interest for current TF.
 - The industry correction factors introduced might not have been appropriate.
 - Angela Willis suggested a brainstorming session to effectively develop a path for the TF to follow.

- Four engines at one lab and possibly 2 or 3 more at another lab have experience cylinder failures caused by collapsed follower. At one lab the collapsed follower has always been the same cylinder (#3, last cylinder on the copilot side). 543 right heads were purchased/imported from Australia to complete the short block kits. Are the failing right heads from Australia or USA?
- Meetings Time and frequency
 - Tuesdays are not an option. Meetings will likely be on Wed-Fri. times date and times for the next meeting will be determined at every meeting.
- **Review of action items**
 - Angela Willis: Create a template for the Brainstorm/RedX meeting.
 - Rich Grundza: Check the meeting minutes from the previous task force to find the final presentation of the findings.
 - Adrian Alfonso: send TF dist. List to Rich G.
- Schedule for next conference call.
 - Next call will be on 10 August 2022.

Attendance Sheet

REPRESENTATIVE	COMPANY	VOTING MEMBER (x)	ATTENDED (Y/N)
Ben Maddock	AFTON	x	y
Rich Grundza	TMC	x	y
Doyle Boese	INFINEUM	x	y
Andrew Stevens	LUBRIZOL	x	y
George Szappanos	LUBRIZOL		y
Robert Stockwell	ORONITE	x	y
Paul Rubas	EXXONMOBIL	x	y
Michael Deegan	FORD	x	n
Angela Willis	Willis Advanced Consulting	x	y
Adrian Alfonso	INTERTEK	x	y
Bill Buscher	INTERTEK		y
Izabela Gabrel	HALTERMANN CARLESS	x	y
Prasad Tumati	HALTERMANN SOLUTIONS	x	y

Sequence VIE FEI 2 Response Shift Task Force

SOUTHWEST RESEARCH INSTITUTE®

WINTER 2017



Task Force Members

Adrian Alfonso

Jerry Brys

Bill Buscher

Todd Dvorak

Rich Grundza

Charlie Leverett

Katerina Pecinovsky

Cliff Salvesen

Andrew Stevens

Amol Savant

Dan Worcester

Intertek

Lubrizol

Intertek

Afton

TMC

Infineum

Afton

ExxonMobil

Lubrizol

Valvoline

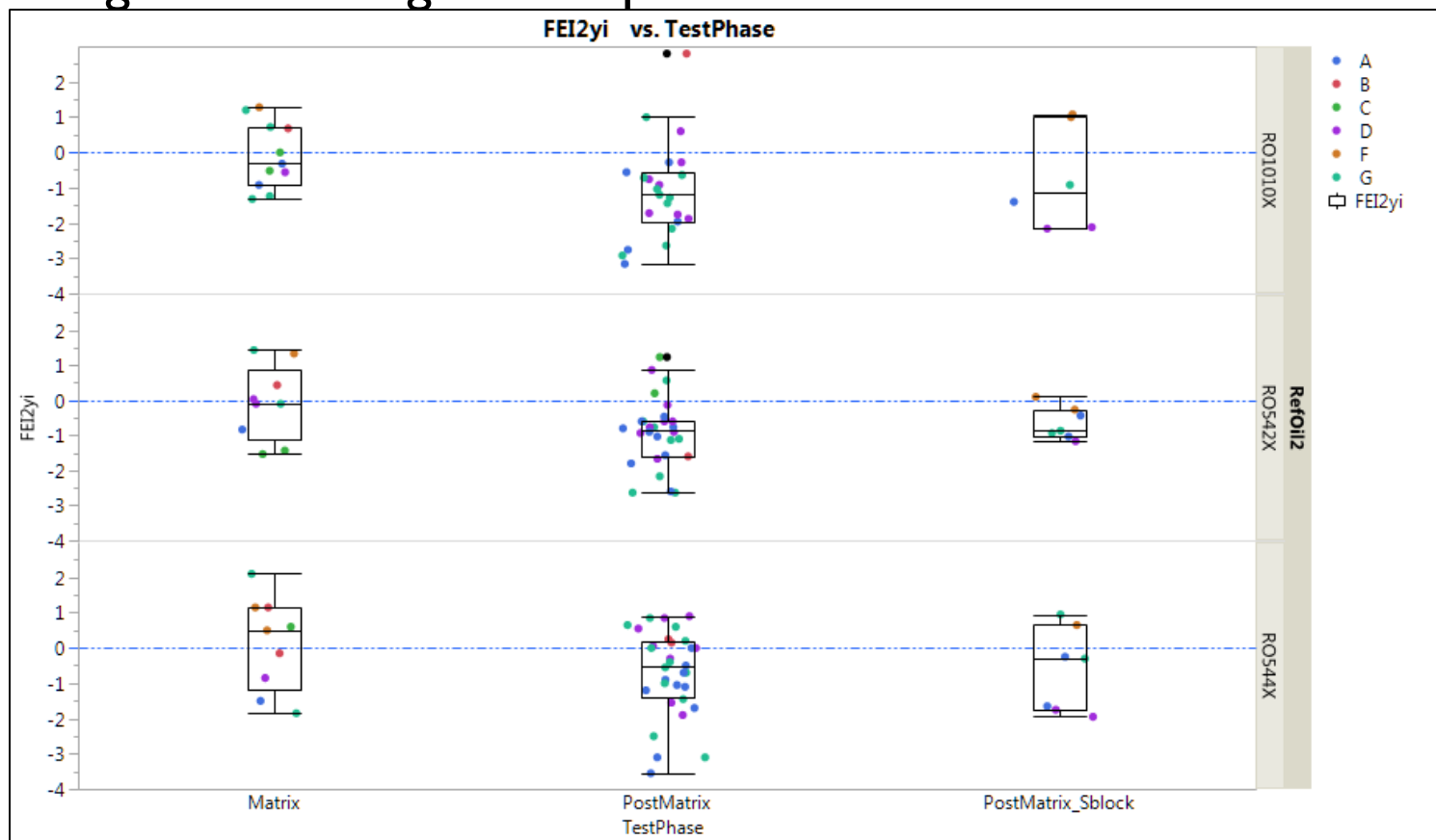
SwRI

Task Force Scope

The Task Force will review data, chemical analysis for the 109 hour aging, and other factors for the VIE test looking for a root cause for a response shift affecting FEI 2.

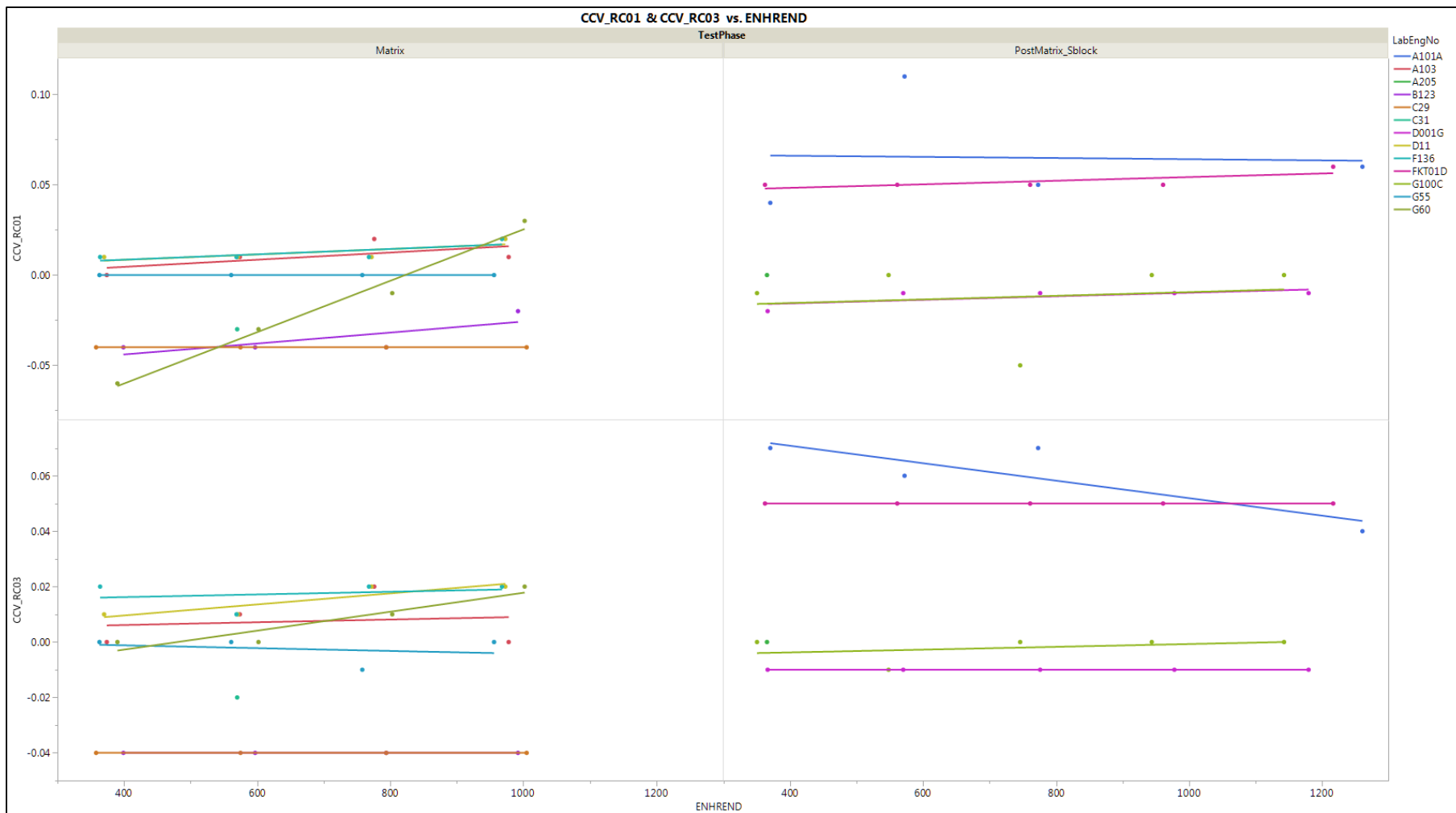
Review of VIE Data

- Plot of VIE FEI2Y_i; Chart provided by Todd Dvorak
 - Data suggests that the FEI2Y_i performance has shifted severe of target - following the VIE precision matrix.



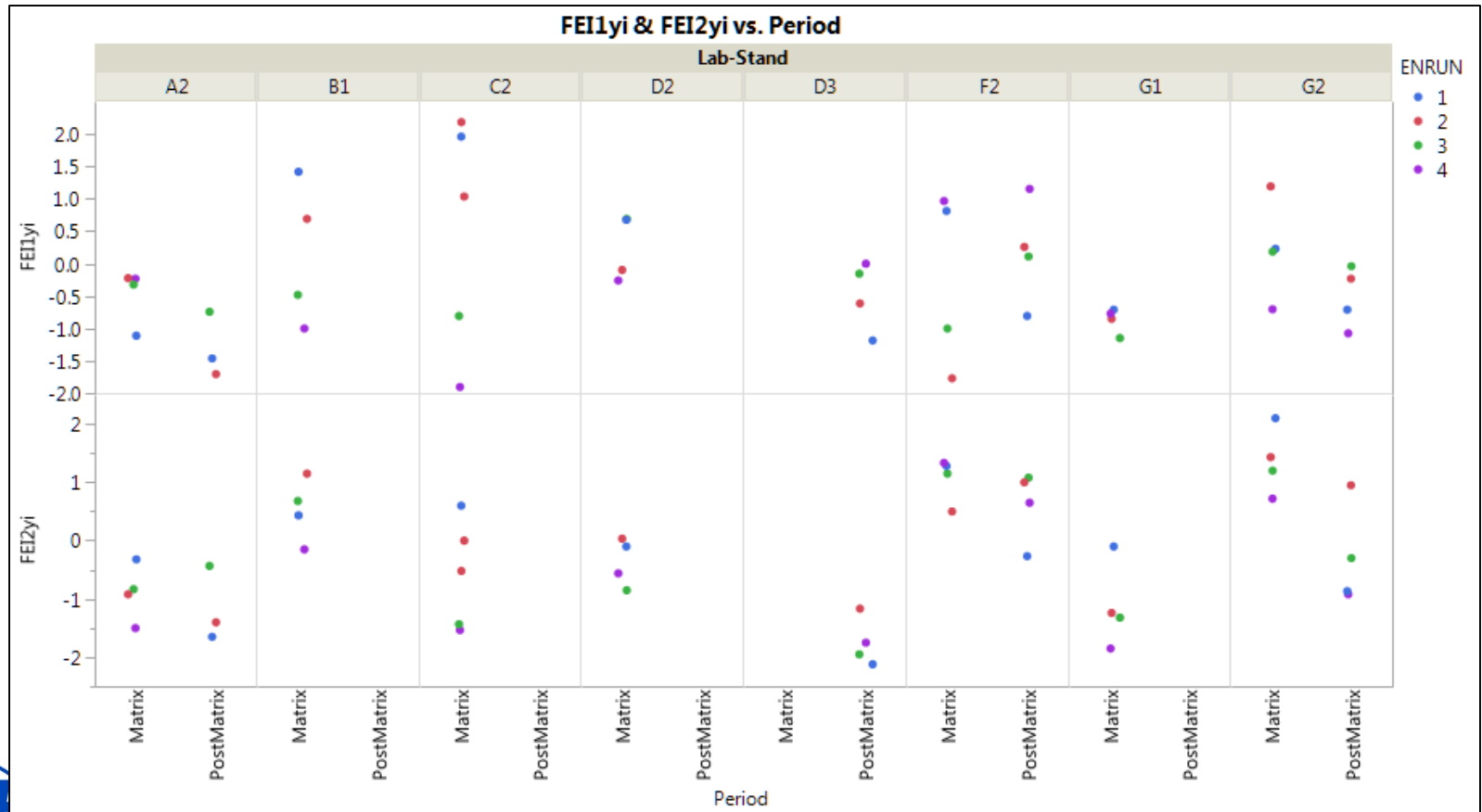
Review of VIE Data

Crankcase pressure is higher with PostMatrix SBEngines



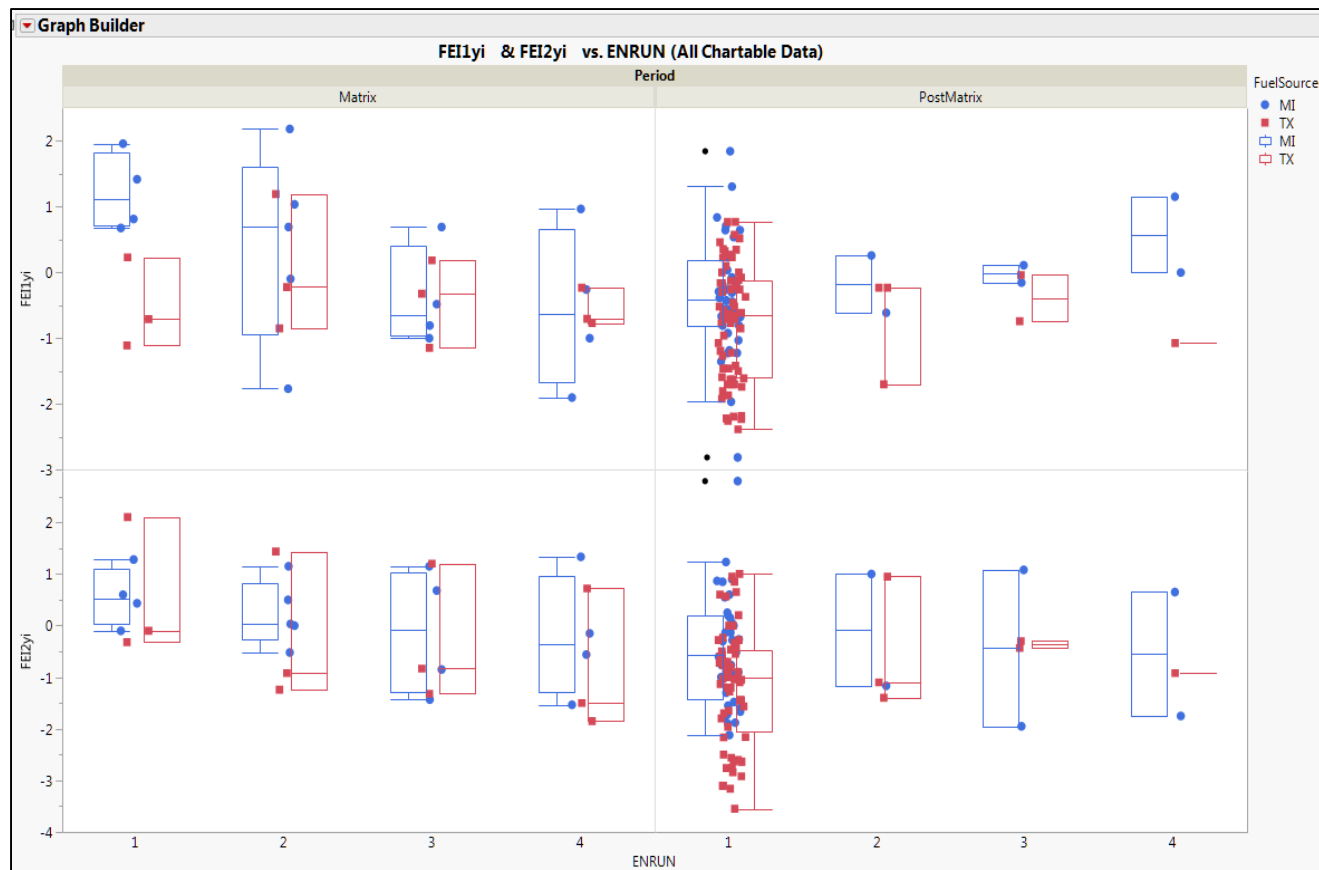
Lab-Stand Comparison of PM and PPM Test Severity

- Plot of Precision Matrix and Short Block Post Matrix data by Lab-Stand combination
 - General trend of test being more severe during PostMatrix



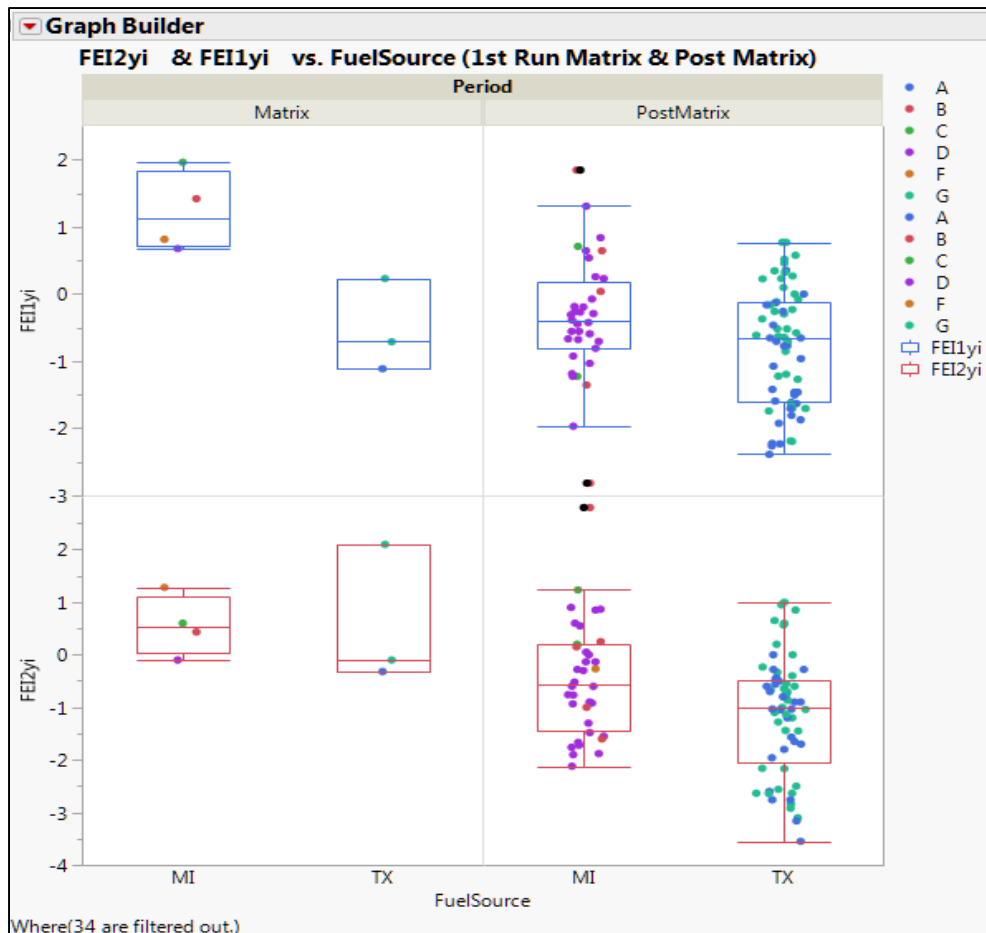
VIE Analysis of Fuel Source Analysis

- Plot of all chartable FEI_Yi data by test run, period (Matrix vs. PostMatrix) and fuel source (Texas vs. Michigan)
 - Plot may suggest difference in FEI2_Yi during PostMatrix)



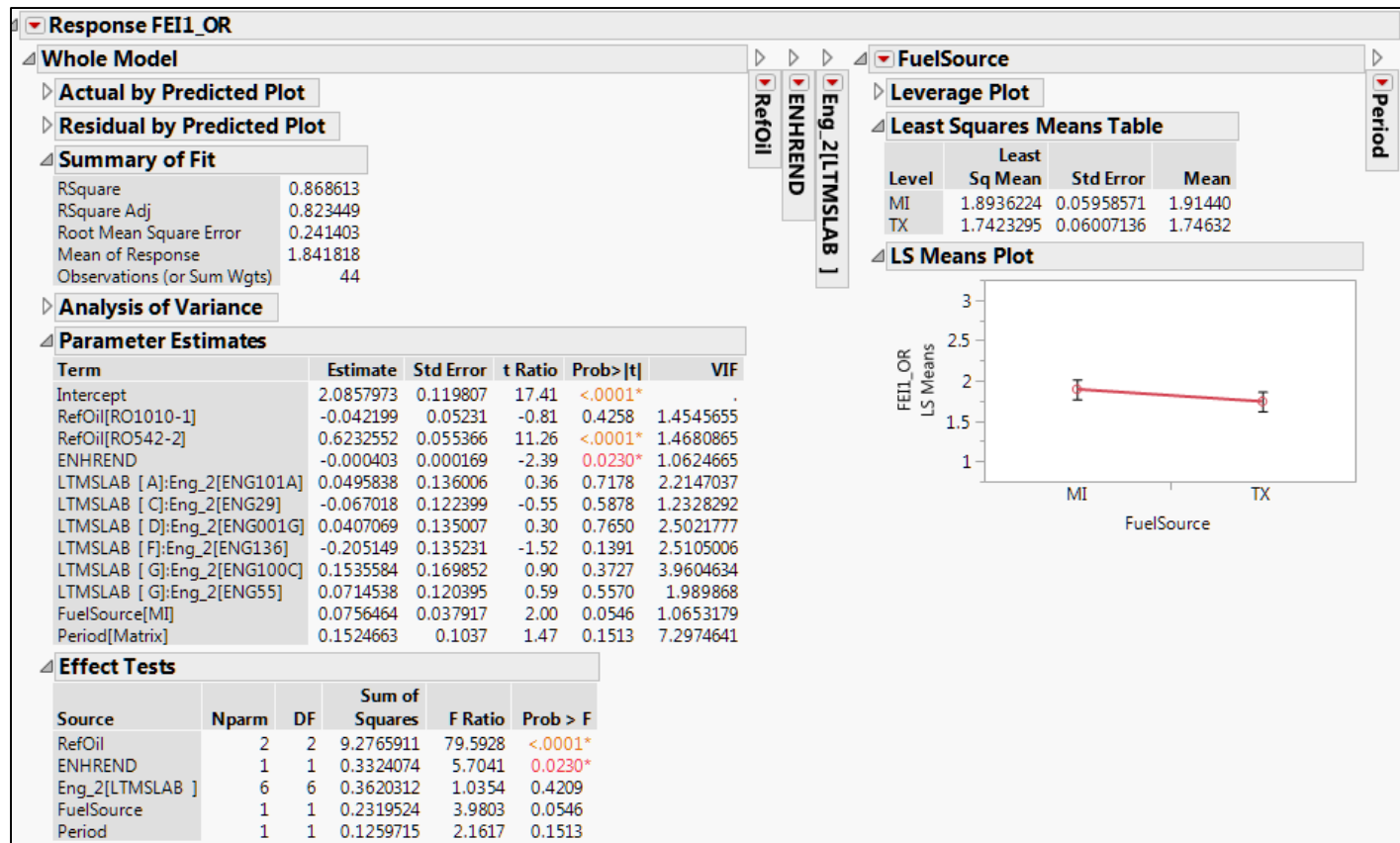
VIE Analysis of Fuel Source Analysis

- Plot of all chartable FEI_Yi 1st run data by Fuel Source and Period



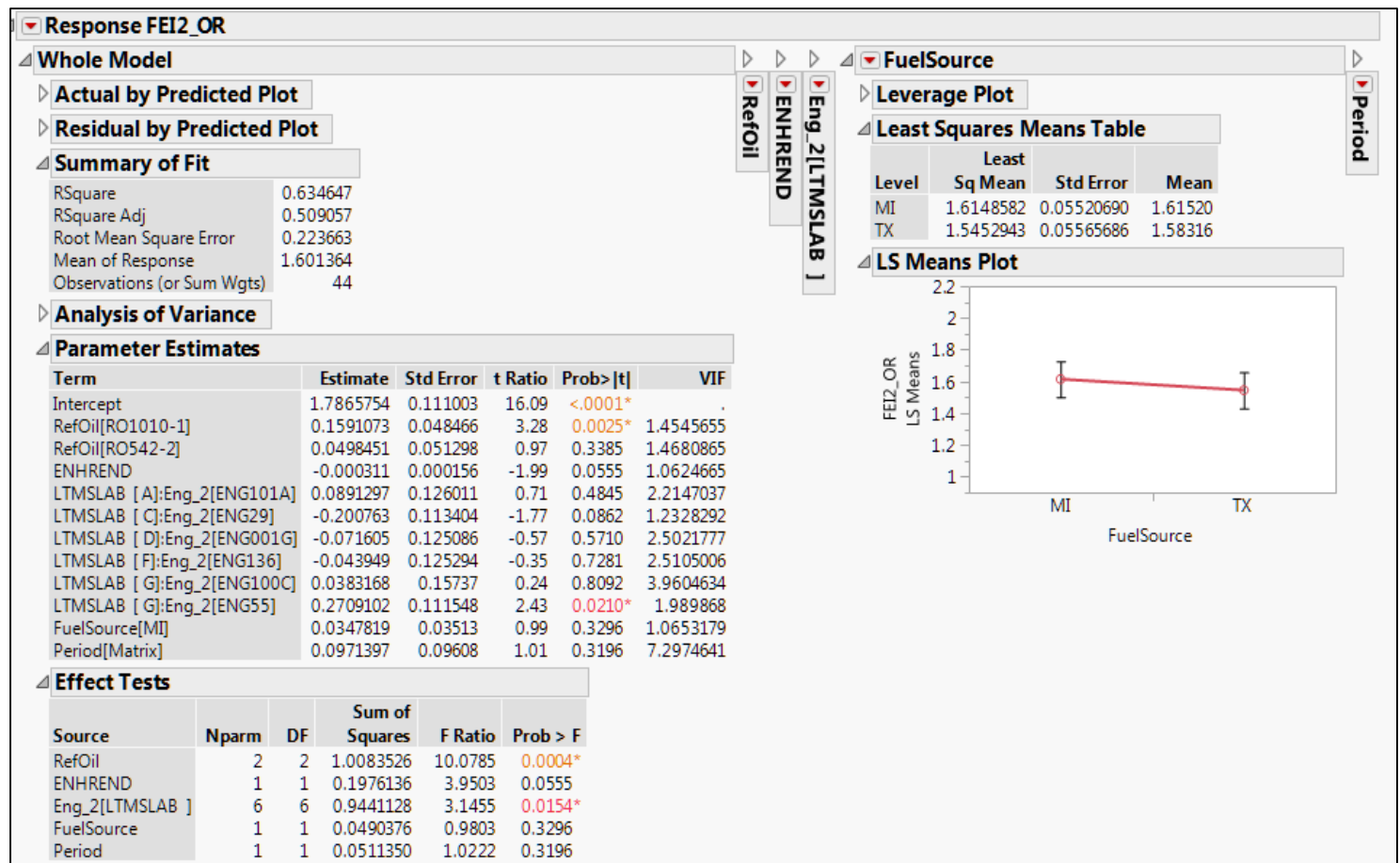
VIE Analysis of Fuel Source Analysis

- Analysis of FEI1 chartable PM and SBM data
 - Analysis suggests fuel source is significant.
 - Fuel source confounded with test laboratory



VIE Analysis of Fuel Source Analysis

- Analysis of FEI2 chartable PM and SBM data
 - Analysis suggests fuel source is not significant.



Review of VIE Data

Analysis of VIE Reference Oil Viscosity Data

KV40 EOT Oil Analysis (PM n = 28¹ & n = 16 SBM)

- Analysis suggests significant increase in KV40 EOT viscosity between the 2 test phases (PM-EOT-KV40 < SBM-EOT-KV40)

Response V40EOT

Whole Model

Actual by Predicted Plot

Effect Summary

Residual by Predicted Plot

Summary of Fit

R Square	0.922023
R Square Adj	0.902523
Root Mean Square Error	1.008013
Mean of Response	46.99793
Observations (for Sum Wgts)	44

Analysis of Variance

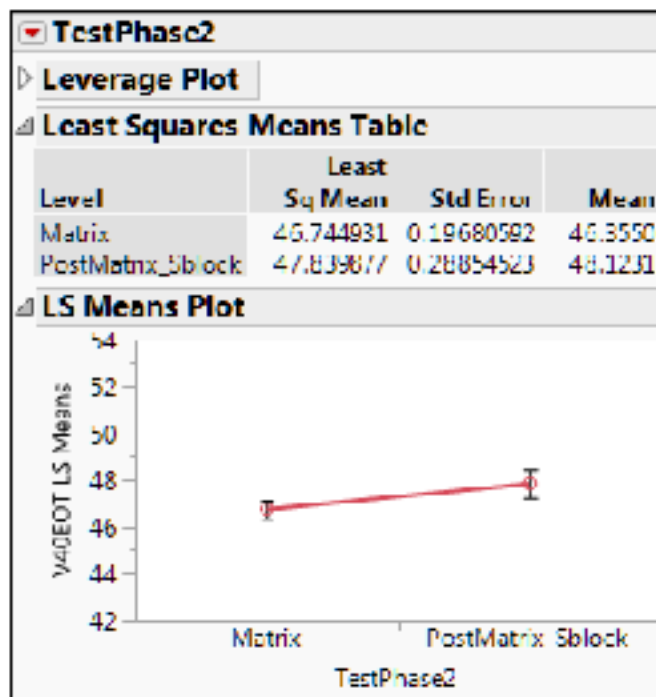
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Model	9	412.67364	45.8444	45.2266	<.0001*
Error	34	34.54704	1.0161		
C. Total	43	448.22072			<.0001*

Parameter Estimates

Term	Estimate	Std Error	T Ratio	Prob > t
Intercept	45.813073	0.481718	95.10	<.0001*
ITMS:AB(C)	3.0196939	0.340631	8.85	<.0001*
ITMS:AB(E)	-0.506295	0.461872	-0.47	0.6377
ITMS:AB(I)	-0.057277	0.416035	-0.14	0.8919
ITMS:AB(J)	-0.857543	0.340631	-2.52	0.0155*
ITMS:AB(K)	-0.14023	0.361151	-0.39	0.4738
TestPhase2(Matrix)	-0.561723	0.175953	-3.19	0.0017*
BA(B)(AC0100-1)	-0.12665	0.211111	-0.60	0.5497*
BA(B)(AC0100-2)	-0.414017	0.220954	-1.87	0.0661
BA(B)(ND)	0.029295	0.21067	0.14	0.8873*

Effect Tests

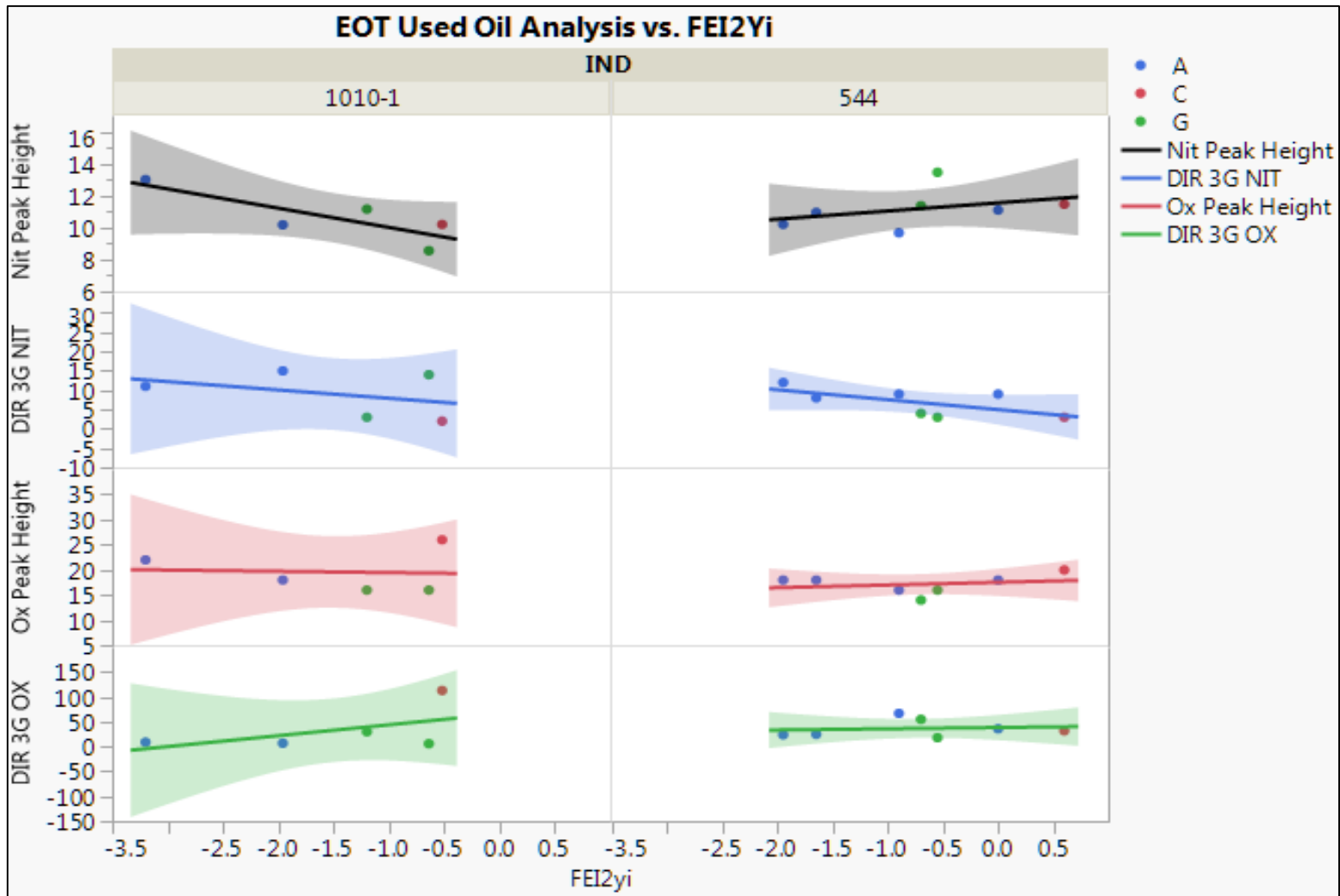
Source	Nparm	DF	Sum of Squares	F Ratio	Prob > F
ITMS:AB	5	5	41.88179	8.2473	<.0001*
TestPhase2	1	1	9.84027	9.7371	0.0037*
BA(B)	2	2	316.66619	155.5109	<.0001*
BA(B)(ND)	1	1	11.67211	10.6476	0.0029*



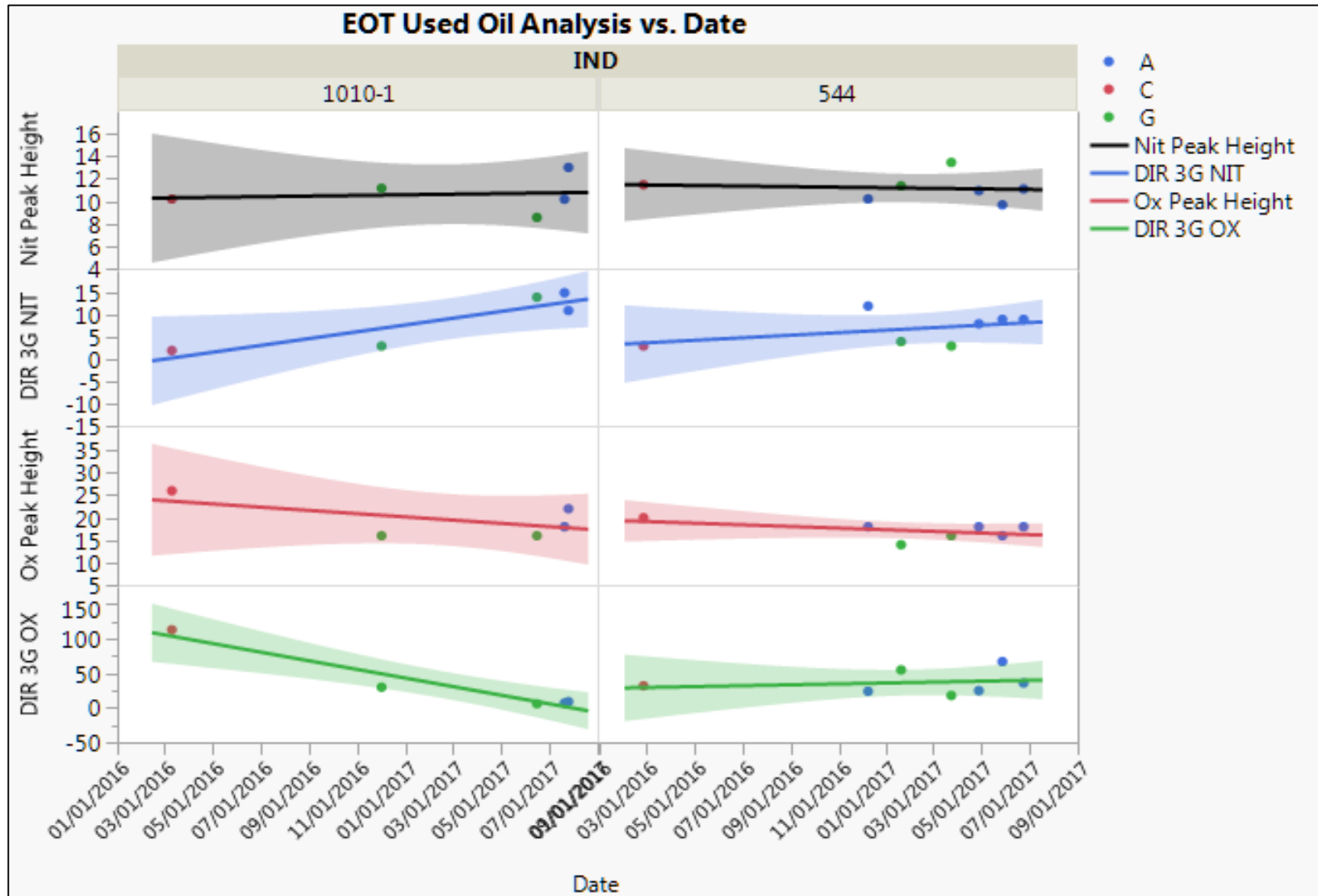
Note 1: One observation missing PM EOT viscosity data

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FEI 2 Yi CHEM DATA



EOT CHEM DATA by OIL



Engines

- OHT-1 engines were used for the Precision Matrix.
- Labs moved to OHT-2 engines in 2016.
- GM Short Block Kit engines are approved, and labs are running.
- All Labs will switch over this Fall.

Fuel Batches

- Haltermann to report to the Sequence VI surveillance panel the process for building the Texas and Michigan Lube Cert EEE fuel batches and for additizing the SEQ VI-E + DCA fuel. Include details on component sourcing for the Texas and Michigan locations (i.e. are the components for both locations obtained from the same source and from the same component batches, etc.). Include details on the additizing process for the Texas and Michigan locations (i.e. are the additives for both locations obtained from the same source and from the same batches, when is the Lube Cert EEE additized, etc.).

Fuel Batches

EEE Lube Cert blending

The components used in the EEE Lube Cert blending process (at both the Nixon and Sterling locations) are sourced from the same suppliers. This has been our standard practice since we place the Nixon tanks into service.

Seq.VI DCA additive

Original MOC for this additive was created on 09/03/2013. HS purchased 2 drums of this material in 2013 to start the project. HS purchased an additional 7 drums in 2014 and four more drums in 2016.

The additive used when producing the Seq.VI fuel, HF-2003, has been and continues to be sourced from the same supplier.

The HF-2003 is additized at the rack at both locations.

Action

- Amol has created Power Points comparing a pass and a fail engine.
- Those are posted at:
 - <http://www.astmtmc.cmu.edu/ftp/refdata/gas/VIE/plots/>