

## **AB679 Diesel Fuel Comparison Study Meeting – March 26, 2010**

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**Panel Members Present:** Dean Simeroth/CARB, Ken Kimura/WSPA, Michael Tunnell/ATA, Thomas Durbin/UCR CE-CERT, Eric Sauer/CTA (for Matthew Schrap), Paul Wuebben/SCAQMD

**Teleconference:** Roger Gault/EMA, Fred Cornforth/ConocoPhillips, Charles Schleyer/ExxonMobil

**Air Resources Board (ARB) Present:** Richard Corey, Dean Simeroth, Floyd Vergara, Jim Guthrie, Aubrey Sideco, Stephen d'Esterhazy

**Public Present:** Nick Economides/Chevron, Kim Waggoner/AIAM

**Teleconference:** Rasto Brezny/MECA, Jim Halloran/Caterpillar, Rich Hawkins/Chevron

### **Handouts**

- Federal Diesel Research Study Presentation – Tom Durbin, March 26, 2010
- Draft Test Fuel Plan Chassis Dynamometer Testing

### **Meeting and Presentation**

Meeting began at 10:08 a.m.

Simeroth opened the meeting and announced a time limitation. He informed the group that Gault had to leave the phone by 11:00 am. The agenda was adjusted to accommodate discussion and vote on the test plan before Gault left. Vergara conducted the roll call of the Panel and a quorum was present.

The Panel reviewed the draft minutes from the previous meeting on February 4, 2010. Tunnell noted his name was misspelled a few instances. There were no other changes. Tunnell motioned for the minutes to be approved. Seconded (Gault). Voted 7-0. Minutes approved.

Eric Sauer entered the meeting room (participating on behalf of Matthew Schrap).

Durbin began his presentation. He stated that the results from the 91 DDC engine would be presented at the end of his presentation. He started with the test plan to accommodate Gault's request.

Durbin presented the chassis dyno testing status on slide 2. The test plan was ready for final approval. Installation of the dynamometer is complete and the chassis is in the ground. Commissioning and training will be conducted during the week of April 6.

Durbin's test plan calls for 10 vehicles. Four vehicles have been identified. MBE 4000, 2006 ISM Cummins, 2000 Cat (C15 tested) which are under the concurrent biodiesel program. The fourth vehicle is a Cummins ISX engine that belongs to UCR.

Kimura and Corey arrived at 10:13 a.m.

Durbin said it would be a good vehicle to add to the program. Additional vehicles were solicited over Craigslist; a more in-depth discussion will be covered later in the presentation.

Durbin presented the updated test plan on slide 3. Based on the prior meeting's discussion, he was asked to go back, address a few concerns, and provide additional information. The first issue was the test sequence, more specifically the sequence of A and B fuels being tested in the same order. The second issue was the possibility of regeneration throughout the test schedule. Durbin's solution was to alternate between A and B fuels between each vehicle. This sequence would allow preservation of randomization. Regeneration would also be conducted each day during a CARB fuel run, which is important for 2007 and newer engines. More discussion would be conducted after slide 4 has been discussed. Finally, if a 2010 engine cannot be found, a second 07-10 engine will be sought.

Durbin presented the chassis dyno test matrix on slide 4. The most significant revision was that regeneration events for post 2007 will be denoted with a /R notation after each new test fuel used. This approach seemed appropriate to ensure regeneration does not occur in the middle of a test. The second revision was that for five out of the ten vehicles, fuels A and B would be switched to avoid bias in the matrix. This problem may arise because test fuel B follows test fuel A throughout the schedule. The bias seemed to be alleviated if five vehicles are tested on one fuel pattern and the other five on the alternate. Vehicles may want to be separated into two groups based on their engine technology.

Economides asked to know where the reversal of the fuel matrix was located on the slides. Durbin responded that it was explicitly stated in the test plan but not presented in the slides. Other options were considered to further randomize the test plan but time constraints limited what could be done. The regeneration step at the beginning of each new fuel reduced the number of fuel data points but other options would have required additional time that was not available. For testing that includes regeneration, CARB fuel shall have nine data points while Fed A and B shall have 10.

Wuebben asked if there was a possibility of reporting the regeneration measurements as the data may be useful. Durbin stated he could research it but currently they were not being reported and the test plan could not be updated to accommodate the request. Gault asked what data would be logged as regeneration occurs under stationary type conditions. He was curious to know how the data obtained would be equated as there is no test cycle present.

Gault believed it was outside the scope of work. Numerous regeneration cycles would be needed for comparison and that would add significant complexity to the testing. Simeroth added that the data might be valuable to MSCD or MSOD, which has done studies on regeneration. Gault added that the test program was time sensitive.

Simeroth responded that if MSCD finds value in the data, it can be collected, but if not, time will not be expended as it can possibly be incorporated into the next test program.

Gault felt that there should be some order to the alternating of sequence A and B since some categories had only one vehicle while others had two or three and therefore, not being able to test on both matrices. Durbin stated they would break them up evenly so that one category would not all test on the same cycle. Gault stated that following the vehicle matrix sequentially to determine which vehicle would be tested on each cycle would be sufficient. Durbin agreed and explained that it would be incorporated to obtain a sufficient alternating sequence. Durbin also stated the vehicles would be tested as they arrive and therefore the order would need to be determined prior to testing to ensure an equal split rather than alternating tests for each new vehicle.

Economides made two comments. First, he recognized the difficulty in building a test matrix with time constraints because of limited test days. However, he wanted to remind everyone that the goal of the program was to test the differences between Federal A and B fuels versus CARB diesel. Therefore, the test matrix should focus on testing A and C and B and C on the same days and that testing A and B on the same day is not as valuable. By doing ACCA and BCCB, test day variability is removed.

Gault asked to have the test matrix read once more and then stated that all three fuels were being tested on each day. Economides responded that was the problem and in no day was there a straight comparison of A and C in the morning and afternoon. Durbin clarified further that there was a sequential reversal in the certification process. Simeroth replied that the test program was also not doing 20 replications, which is a part of the certification process. Economides stated that it would be a self-contained pattern with back-to-back runs. Cornforth thought they had discussed this all before and that there would be too many fuel changes if they had to alternate between CA, AC, CB, and BC. Tunnell added that the new idea seems to suggest that everything would need to be tested in one day to address the ambient variation. Durbin agreed that was a factor in determining to keep the current matrix. He explained over the three-day period each fuel would be tested in each morning and afternoon session. Durbin spoke with an ARB statistician regarding the biodiesel program. He stated that the matrix was preferred because it gives the best baseline out of all the options and CARB fuel is tested each day.

Economides explained that the test program was broken into 12 runs. He clarified that he was not trying to have different back-to-back runs each day but that Fed A should be tested against CARB in both the morning and afternoon of the same day, likewise with Fed B. Gault was concerned that not all fuels would be seen in the same day. Economides believed this was not a concern as the comparison to CARB fuel was the most important factor. Simeroth believed it was time to move on and they could return to the issue after the presentation.

Durbin continued to slide 6. He presented the initial vehicle recruitment and identified how many of each vehicle would be required per category. Durbin stated that four

vehicles had already been obtained, three through the biodiesel program and another one because it is an in-house vehicle for CE-CERT.

Durbin presented the recruitment contingencies on slide 7. The contingencies included shifting the 2010 engine to a 07-10 if one cannot be found. The second was moving either the 92-94 or 94-97 up to the 98-02 if one cannot be found. Lastly, if both the pre 94 and 94-97 could not be obtained, allocate one to the 98-02 and the other to the 02-06 categories.

Durbin presented the test weights in slide 8. They planned to use test weights from the biodiesel program for those three vehicles. All other vehicles would use the MEL trailer, which is approximately 65,000 lbs. A provision was added to the test matrix that if the MEL trailer were being used in another test, a trailer with equivalent weight would be used. Durbin concluded the first half of his presentation and stated that they could return to discussing concerns about testing.

Economides stated he would like to finish their discussion on the trucks. Simeroth noted that Gault had five minutes left before he would have to leave. Gault asked if all the listed trucks in the matrix had been obtained. Durbin responded that they have received initial offers but testing has not started as safety inspections of the vehicles still need to occur.

Wuebben asked what the protocol would be for an unintended regeneration. Durbin answered that a new test would be conducted for unintended regeneration. However, most regenerations are active and with the forced regeneration at the beginning, there should be no need. If there is, the sequence will resume from the same spot.

Guthrie stated that he looked over what Economides had proposed earlier and that it was possible but one additional regeneration and fuel change would be required. Durbin stated he thought the possible sequence would be doable in a day's time. Economides suggested the group return to the truck testing protocol. Wuebben asked if unintended regenerations would be noted. Durbin affirmed.

Kimura asked the purpose of the retrofit. He did not see their value and that they would just add complexity to the testing if they failed because of the regeneration issues. Durbin noted that was a valid point as the retrofits utilize passive regeneration and would be occurring throughout testing. Kimura stated that the 2007 and 2010 did not need to be retrofitted.

Simeroth announced that Gault was out of time and asked if there were more changes to discuss. He asked the panel for their recommendations for approval or modifications. Tunnell stated that two modifications would be alternate vehicle testing while also sequencing it based on engine technology. His preference was to plan ahead of time to note which vehicle would fall into each sequence. Simeroth asked if there were further modifications.

Kimura suggested that Economides had a pertinent point and that the goal of this study was to compare CARB versus EPA fuel and that Fed A versus B was less important. Kimura believed in the merit behind the change and that he would go along with the modification. Simeroth did not object to the change in the sequence but was concerned with the amount of fuel available and time constraints. Durbin believed there was enough fuel to complete that sequence and while the difficulty would be raised, the time constraints were not impossible. He wanted to ensure that a test plan would be approved in the next few weeks so testing could begin.

Simeroth outlined the modifications that were to occur. First, generate the alternating sequence for incoming vehicles. Second, redesign the fuel test sequence to have day 1 be CAAC and day 2 be CBBC. There had been numerous discussions on the issue and both could be accommodated. Durbin questioned what was occurring with the retrofits. Tunnell stated it was important to include them, as trucks from now on will have a trap. Kimura was still unsure of including retrofits because of their nature and the possibility of having two engines that were not valid. Economides thought that one of the retrofits could be shifted from the 98-02 category into 02-06 category to have a side-by-side comparison bringing more value to their data. This would make the 02-06 category have four trucks while the 98-02 category to have one. Simeroth asked if the test protocol modifications were acceptable. Gault's connection ceased.

The Panel decided to take more time in discussing the issue, as they no longer had a time constraint. Tunnell asked if doing away with the retrofit would guarantee getting through the test program. Kimura believed that having the retrofits would lead to the possibility of dropping two vehicles. Simeroth restated the two vehicles would be in the 02-06 category and if they failed, it would not effect the vehicle distribution negatively.

Simeroth asked for the motion to be repeated. The first modification would be to ensure the ten vehicles were equally distributed over the two fuel test sequences by engine technology. The second change was that day 1 and day 2 sequences would be modified to focus on CARB versus Fed A or Fed B each day. Finally, there would be the change for the retrofits, which would move the retrofit assigned in the 98-02 to the 02-06. Therefore, the number in each would be one pre-94, one 94-97, one 98-02, four 02-06, two 07-10, and one post-2010.

Tunnell agreed with this layout, as most vehicles before 2002 would not have EGR so there would not be much retrofit technology available. There was some confusion still on the vehicles per category; however, a reevaluation suggested the matrix could remain constant. If there were a failure in the retrofit, it would not matter if it were in either category. The current matrix would allow for a better vehicle distribution. Wuebben agreed with this analysis and Guthrie noted that there was going to be no change.

Kimura resonated once more that he was concerned about losing any vehicles because of regeneration but Simeroth reassured him stating the group would reconvene if there were an issue.

Vergara asked if there was a motion to approve the change. Guthrie listed out the changes to the test plan as follows:

1. Alternate test sequence within each model year category.
2. Evaluate the test of the first retrofit, if there is issue that complicating the study report to the group and possibly revise test strategy.
3. Finally, the fuel test sequence of: Day 1: CAAC, Day 2: CBBC and Day 3: ACCB. A and B are switched for five vehicles.

Simeroth asked if that proposal would be put forward. Wuebben added that he would like to have the regeneration results evaluated if MSCD or MSOD find value in the data. Durbin also stated that day 3 for the fuel sequence would not need to be alternated for A and B.

Simeroth asked for a roll call with the previously stated modifications. Kimura motioned to take a vote. (Wuebben seconded). Voted 7-0. One abstention. Motion passed to modify test plan.

Simeroth stated they could now continue on to the rest of Durbin's presentation.

Durbin presented the engine testing status. He hoped to have something posted on the website for the panel to read. Cornforth wanted to know if it was going to be open to public review. Guthrie stated it would be posted on the website and emailed to the Panel. Simeroth asked if there was concern in posting before the Panel looked over the document. Cornforth believed it would be better to review before posting to the public. Simeroth suggested that the report be e-mailed to the Panel and be given adequate time before posting to the website. Simeroth asked to have a phone survey if there were any issues and to make it available to the Panel prior to the release of the document.

Durbin motioned to send the report to the Panel and have a follow up phone survey. Seconded (Kimura). Voted 7-0. One abstention. Motion passed to send report and have follow up phone survey.

Durbin presented the 1991 NOx results on slide 10. There is both an increase for Fed A and B fuels.

Durbin presented the statistical NOx results. In most cases, the data was statistically significant. Further details will follow in the report.

Economides wanted to know what the CERT limit was of the 50 mph cruise cycle. He asked if it similar to that of the FTP. Durbin stated that it was similar to what they tested for the CARB fuel. Economides followed up that the Fed B is right at the top level.

Cornforth wanted to know if the Panel was still waiting for the Fed A fuel for the MBE 4000 engine. Durbin restated his answer from prior meetings that they were not and that because of earlier time constraints in finding the Fed A fuel that the MBE 4000 had to be moved to MTA for the biodiesel study.

Durbin presented the 91 PM data and statistical results on slides 12 and 13. The only significance was with the Fed A fuel on the 50 mph Cruise cycle. Durbin was slightly surprised that there were some PM differences on the Cummins but not on the 91 Detroit Diesel.

Durbin continued onto the THC levels for the 91 DDC and the statistical THC results on slides 14 and 15. Consistent decreases were seen in the FTP cycle but most were not significant and Economides suggested that the values be taken with a grain of salt.

Durbin presented the 91 CO data and statistical results on slides 16 and 17. All the results were significant and were at very low levels when compared to the CERT standard. Durbin stated he would have comparisons for the Fed A to B fuels in the report.

Durbin presented the 91 CO<sub>2</sub> data and statistical results on slides 18 and 19. All data showed statistical differences. Economides and Wuebben questioned why there appeared to be a decrease from CARB to Fed B. Durbin answered that Fed B has a higher fuel density because there are more CC bonds than CH bonds and that it can be explained further in the BSFC.

Durbin presented the 91 BSFC data and statistical results on slide 20 and 21. He explained once again how the density of the Fed B fuel led to lower fuel consumption. However, if the fuel were adjusted to reflect the carbon weight fractions then it would be closer to those results seen in CO<sub>2</sub>.

Simeroth asked if there were any additional questions or topics to be raised as the presentation was completed. Economides asked how long it would take for testing to be completed. Durbin stated it has to be completed by June 30. He stated his team would be aggressive in writing the report. Simeroth stated if the panel had test questions to refer them to Durbin or Guthrie. Durbin added that the results would be evaluated throughout the testing so it is not rushed at the end.

Simeroth announced that the next meeting would occur at the end of the test program. Durbin affirmed but suggested it be before the end of June as his travel expenses may not be budgeted past that time.

Meeting adjourned at 11:48 a.m.