AAFEX-II Status Report #4 – 24 March 2011

Primary Activities: Continue instrument setup; modify rake stands; perform calibrations; install rakes and probes; conduct leak checks and line losses

Weather: 39 F at 0700, partly cloudy with strong, unrelenting southerly winds. 51 F with broken clouds and blustery winds at 1600.

Summary: Lots of new participants arrived today including Carl Ma (FAA), Edwin Corporan and Matt DeWitt (AFRL), Berk Knighton, Scott Herndon and Ed Fortner (Aerodyne); Greg Smallwood (National Research Council, Canada); and Chung (Penn State). These folks sprang into action right away to help team members address a variety of issues, some of which are described below.

- Installing the 1-m rakes, rake stands and inlet probes is a massive job and the AAFEX-II configuration is particularly complex and difficult because it includes two traversing tables, 4 rakes and about 30 separate probes of various design and mounting requirements (Figure 1) Because AEDC did not officially receive funding until after March 7, much of the hardware was machined within the last two weeks and could not be test fitted prior to deployment. This created the necessity of doing a lot on-the-spot redesign and modifications including re-drilling holes (Figure 2) and spot-welding joints rather than using roll pins or threaded holes. Despite these challenges, Robert and his team of crack mechanics have made great progress and are only about a half-day behind schedule in getting all the near-field sampling equipment mounted and plumbed.
- With the arrival of Carl and Greg, the E-31 crew doubled their manpower and were able to make significant headway toward completing their sampling system and instrument setup. Achievements include: completing and leak checking the Annex 16, E-31, and Reference sample lines; plumbing the mass and number measurement manifold; setting up/testing the data acquisition systems (Figure 3); installing the number instruments; troubleshooting sources of high particle counts; replacing contaminated sampling line; and repairing problems in the sample dilution box. Moreover, the team in converging on being ready for the Saturday engine test runs, but still has significant work remaining to determine the flow and particle transport characteristics of the complicated sampling system.
- A number of participants spent the day setting up equipment to evaluate sampling system transport efficiency. Eddie calibrated CPCs, readied the tube furnace particle generator and hooked up an SMPS on the source output line to measure particle size distributions. Max set up the MST high volume DMA particle size selector while Don worked up the mathematics to correct for multiple charging effects (Figure 4). And Bruce and Dave ran tubing to transport monodisperse particles from the MST trailer to the various sample lines of interest. Actual testing began in mid-afternoon, but, unfortunately, a faulty valve caused the sample lines to over-pressurize, which blew butanol into the optics of the upstream CPC. Eddie

spent the remainder of the afternoon cleaning and re-calibrating the CPC—testing will resume Friday morning.

- Berk (Montana State/Aerodyne) arrived around noon and was soon busy installing his GC/MS and PTRMS systems into the LaRC van, happy home to a half-dozen eager researchers (Figure 5). After replace a detector in the PTRMS, Berk had his kit up and operational by the end of the day.
- The AFRL group continued to lead the pack in terms mission preparedness. They report having all sample lines, valves, instruments, etc. installed and ready for action. With the arrival of group lead, Edwin, and combustion scientist extraordinaire, Matt, the team is at full strength and itching to take data.
- After many phone calls and much hand-wringing, Changlie's equipment finally arrived on site in early afternoon (Figure 6). It was apparent that the equipment was badly mishandled, however, as a wheel was broken off one rack and a set of very valuable and delicate aerosol instruments were simply strapped down to a wooden pallet without any protective cover or cushioning (Figure 7). Despite the new dings and abrasions, all instruments appeared to be operational and Changlie was happily installing them in the aft section of the AEDC trailer at day's end.
- AESO continued installing instruments within the 1-m coffin boxes (Figure 8) and DB2.0. The instruments will be controlled from computers locating in the groups Sea-Container via long lengths of Ethernet cables (Figure 9). Xu (Figure 10) expects that all work will be completed and the group will be ready to take data by COB Friday.

<u>Main Activities for Friday</u>

-Complete 1-m rake and probe installations
-Secure all lines and cables to the concrete pad in preparation for engine runs
-Complete line-loss experiments
-Conduct CO2 instrument intercomparison
-Evaluate functionality of sample distribution and dilution systems
-Hold mission readiness review

Figure 1. Rakes behind the left inboard engine supporting gas, particle, temperature, pressure and the special “E-31” test inlet probes.

Figure 2. Brad deploys a portable drill-press to drill new holes through the 1-inch thick base plate to support the AESO inlet rake.

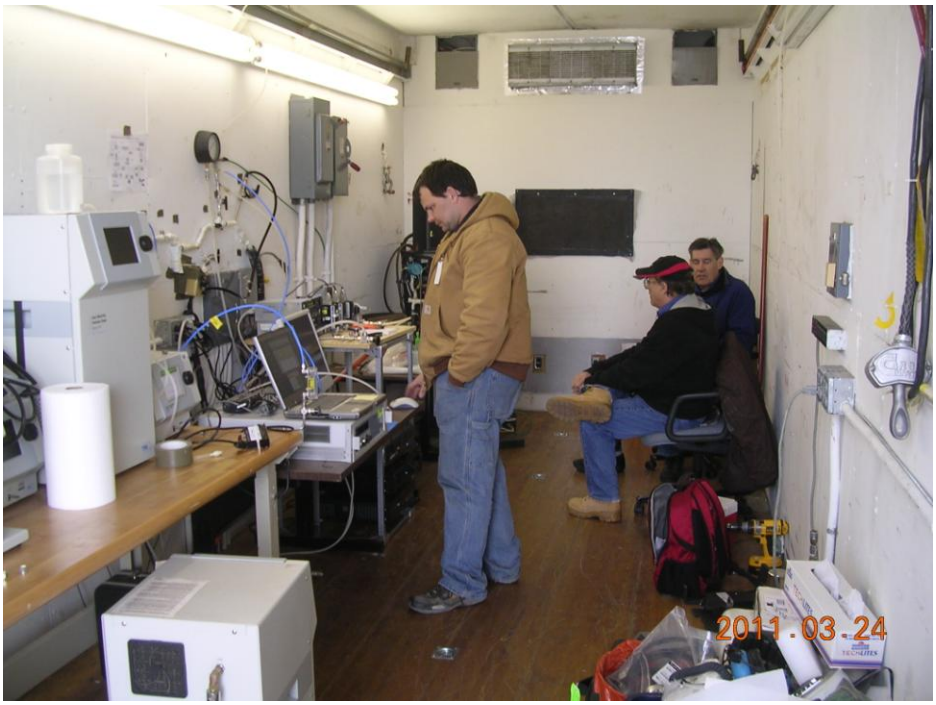

Figure 3. The ever-present and multi-talented Steve helps John and Dave get computer equipment running in the E-31 trailer.

Figure 4. Professor Hagen delivers a lecture on methods of correcting particle size distribution inversions for multiple charge effects to a mesmerized Dave Liscinsky.

Figure 5. The NASA EM-50 buzzes with activity as LaRC and Aerodyne scientists prepare instruments for the upcoming tests.

Figure 6. Changlie dances with joy as his long-awaited equipment finally arrives at the test site…

Figure 7. …but he is also less than pleased with NASA GRC shipping's packing job on his $160K set of fragile particle instruments.

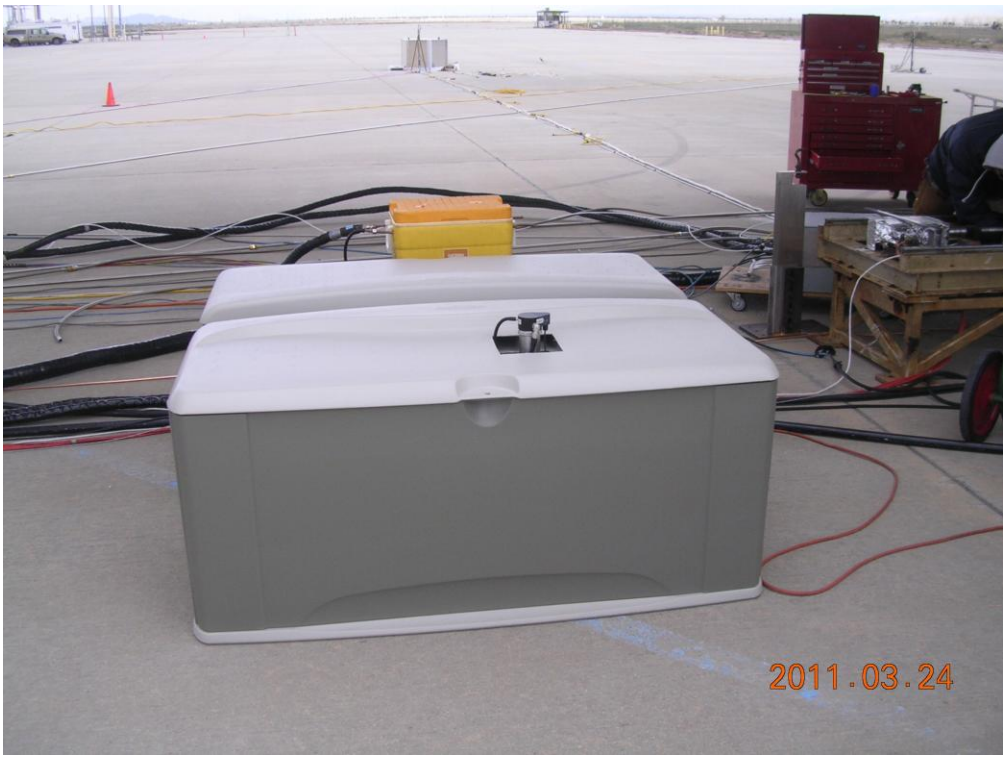

Figure 8. AESO instrument coffins with Death-Box 2.0 in background. The configuration will be used to study sample line effects on particle size distributions and volatile aerosol formation.

Figure 9. AESO researchers prepare one of the two sets of Ethernet cables that are used to collect data from the coffin and DB2.0 instruments.

Figure 10. Xu is a blur of activity as she interfaces cables from the coffin and DB2.0 instruments to AESO computer data-acquisition system.