AAFEX Status Report #4 – 23 January 2009

Primary Activities: Rake and inlet plumbing; 30-m box construction; 200-m trailer instrumentation; instrument setup/test/calibration

Weather: The temperature was 50 F at 7 am; conditions were foggy in the morning with drizzle and overcast skies through mid-afternoon. Clouds were broken and the temperature was 58 F at sunset. Winds were calm throughout the day.

Summary: Participants hurried through the security gate at 7 am, with determined looks and a laundry list of tasks to accomplish for the day. For the most part, progress was not slowed by security or transportation hassles as a majority of AAFEX investigators now have picture badges and many have flight-line driver's licenses which allow them use of the two vehicles at their disposal: a 10 passenger min-van and 4-seat, golf-cart-like electric vehicle. With the initial confusion and search for boxes, parts and facility support behind us, the pace of work has settled into a steady march toward being ready for engine runs next Monday. Friday's significant advancements and impediments in reaching this goal are described below.

To satisfy a Dryden safety review panel request, Palmdale fire and rescue squads were invited to the site to familiarize themselves with the AAFEX installation and to develop a plan for addressing any emergency situation that might arise. Firefighters and EMTs arrived in an impressive fleet of vehicles as shown in Figure 1.

Steady progress was made in plumbing/wiring the 1-m sampling rakes. Late Friday, Gary (AEDC) reported that most of the connections were complete to the #2 engine rake and that the remaining work could easily be finished on Saturday. Brad (AEDC), working on the much more complex #3 engine rake (Figure 3 and 4), assessed that the plumbing and leak checking would be completed on Saturday, but expressed doubt that the difficult task of installing the rake's rear, water-cooled cover could be accomplished any sooner than Sunday. Robert (AEDC) was more optimistic and thought that the rake could potentially be used without the rear cover if it proved too difficult to install.

After reviewing photographs, drawings and load calculations submitted by Robert, the Dryden structural engineer approved installation of the 30-m equipment box, which will house fast response aerosol counting and sizing instruments and a CO2 analyzer that will sample exhaust using a very short inlet tube. By contrasting these measurements with those provided by similar instruments in the much more distant equipment trailers, we'll be able to evaluate the extent to which transmission-line chemistry effects our observations of volatile aerosols. News of the approval sent Dave (UTRC), lead scientist for the 30-m sampling effort, into a flurry of activity (Figure 5).

AAFEX science (Anderson) and aircraft operations (Cutler, Bereda) met after the daily 1 pm brief to resolve a number of open issues regarding the engine and APU test matrices and aircraft

fueling plan. The need to establish N1 values corresponding the desired % thrust settings for test card development was quickly dispensed by supplying AO with Will Dodd's engine run memo (see most recent experiment plan). A more lengthy discussion focused on how to run FT fuel through the APU and on how the APU load/EGT could be varied to simulate run modes that would typically be encountered in commercial aircraft operations. The fueling problem stems from the fact that the APU can only draw fuel from the #2 main tank on the left wing, while the FT fuels for the engine runs will be stored in the #3 main. Mike Bereda (DC-8 crew chief) suggested that JP-8 stored in the #1 and #4 alt tanks on the left and right wingtips, respectively, be burned in the initial exhaust mapping and base-line fuel emission tests. Subsequently, fuel remaining in #3 main after the two FT fuel tests could be transferred to the alt tanks for later transfer to a drained and cleaned #2 main for use in the APU emissions tests. Mike further explained APU operation and noted that the units EGT could be varied from about 300 C to a maximum of 670 C by increasing the aircraft's use of bleed air and electrical power. It was agreed that 4 run modes which span the range of EGT would be employed in the APU emission tests: 1) minimum which corresponds to use of generator power only; 2) minimum cabin service, which is generator + some circulation of cabin air; 3) moderate cabin services; and 4) maximum cabin services and/or engine spin-up. Mike noted that the engine could be spun for 5 minutes followed by a 10 minute cooling off period. After the second spin, the starters have to rest for 30 minutes. Armed with this information, Anderson promised to confer with AAFEX investigators and supply a test matrix within a few days.

With rake/probe installation left in the capable hands of the AEDC/MST team, a majority of investigators focused on testing and calibrating instruments. ARI reported that their gas phase and aerosol instruments were all in good working order (Figures 5 and 6) and that they would be ready for the instrument comparison tests to be held on Sunday. MST is also in good shape as their team was able to focus largely on calibration and analysis routine development (Figures 7 and 8). The EPA completed leak checking their 30-m sampling system and reported that their instrument suite was in good working order (Figure 9). AFRL arrived on site pretty much ready to take data and certainly take the prize for the most well-organized equipment trailer (Figure 10). NASA GRC (Figure 11) reported that the CGA and MGA instruments were working well, but the LII was experiencing problems due to "dirty" or intermittent line power. Changlie planned to address the problem by acquiring an un-interruptible power supply to filter the unit's AC power line. The LaRC/UTC group is still awaiting a power supply for the CCN unit, but report that all other primary instruments are operating within spec. They spent Friday night developing plans to attack the 30-m box and 200-m aerosol instrument installations.

Figure 1. Enforcing tough California air quality standards, airport emergency vehicles respond to rumors of flagrant cigarette smoking at the AAFEX experiment site.

Figure 2. A neatnik by nature, Gary (AEDC) gravitates to the most complete and orderly portion of the 1-m sampling apparatus, the #2 engine inlet rake.

Figure 3. Roy (foreground, AEDC) fights the second law of thermodynamics in trying to constrain entropy in the #3 engine sampling system.

Figure 4. Dave (UTRC) enthusiastically resumes work on the 30-m instrument enclosure.

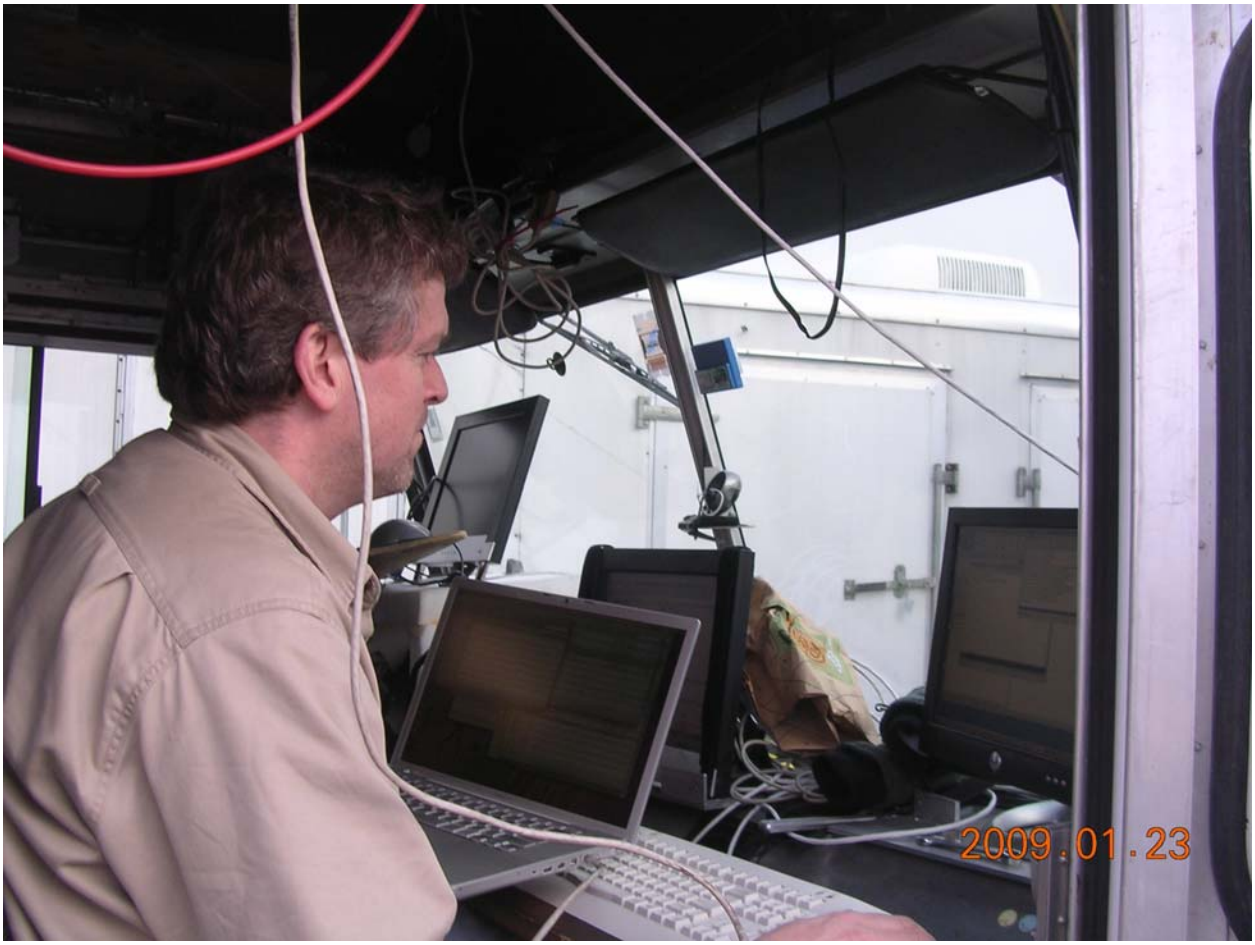

Figure 5. Scott expertly tends the computer display farm within the ARI van.

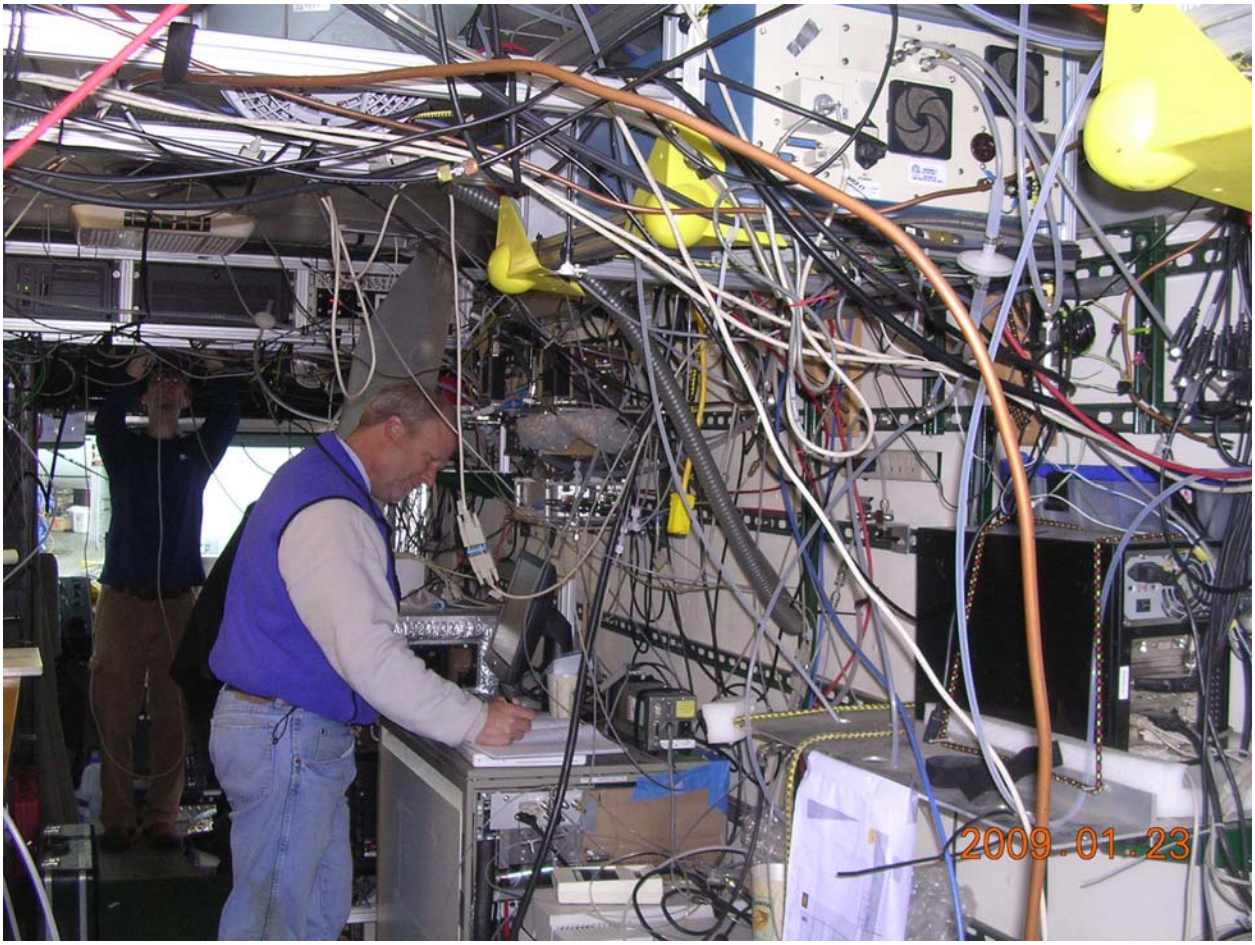

Figure 6. Having recently returned from a trout fishing expedition in the wilds of Patagonia, Dr. Knighton and his GC/PTRMS instrument now stalk big hydrocarbon data in the deep, dark, wiring/plumbing jungle of the ARI equipment van.

Figure 7. Professor Hagen resonates with a bank of data loggers and aerosol instruments within the MST trailer.

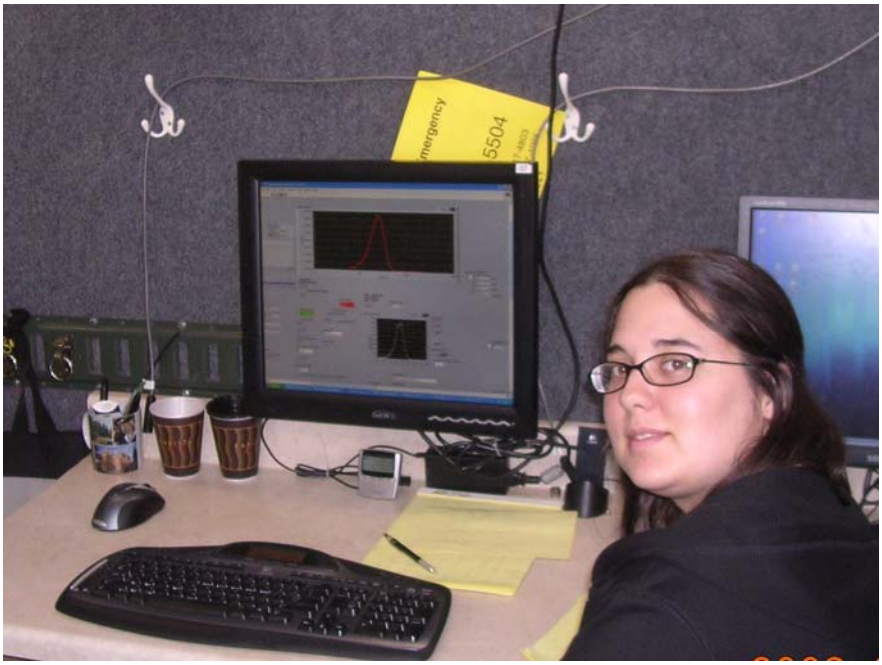

Figure 8. Sensing impending disaster, new MST graduate student, Elizabeth Black, reviews aerosol instrument calibration data while keeping DAOF emergency contact information close at hand.

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Figure 9. Bill watches nervously as John adjusts EPA sensor operating parameters.

Figure 10. Chris evaluates instrument performance in the comfortable confines of the AFRL Turbine Engine Research Transportable Emissions Lab (TERTEL), of which all the other investigators are quite envious.

Figure 11. Changlie (GRC) gets eye-to-eye with his instruments.

Figure 12. The LaRC/UTRC team holds a planning meeting Friday night at BJ's while anxiously awaiting the start of work early Saturday morning.