ARM
CLIMATE RESEARCH FACILITY

FACT SHEET

U.S. Department of Energy

ARM Aerial Facility G-1 Research Aircraft

The Gulfstream-159 (G-1) twin turboprop aircraft, owned by Battelle Memorial Institute since 1988 and operated by the Pacific Northwest National Laboratory for the Department of Energy (DOE), serves as an airborne atmospheric research facility for DOE and other users. The aircraft can measure a wide range of aerosol and cloud properties, as well as collect gas-phase measurements. It is capable of taking measurements at altitudes approaching 25,000 feet (7.5 kilometers) over ranges of up to 1,500 nautical miles (2,800 kilometers). The G-1 operates at a wide range of air speeds that enables both relatively slow sampling and rapid deployment to field sites throughout the world.

Instrumentation and Measurements

The aircraft can accommodate external probes to measure aerosol and cloud properties, zenith and nadir pointing radiometers, and internal sampling devices that cover a wide range of measurement needs. The G-1 has sufficient cabin volume, electrical power, and payload capacities, and possesses flight characteristics to accommodate a large variety of instrument systems and equipment configurations. Many instruments are provided by the ARM Aerial Facility (AAF), but other organizations may contribute instrumentation for campaigns.

A sample of the available instrumentation and measurement capabilities is as follows; see the AAF website, ***www.arm.gov/sites/aaf***, for a complete list:

Aerosol

- Ultra-High Sensitivity Aerosol Spectrometer (UHSAS): Size distribution 0.055 to 1 microns
- Scanning Mobility Particle Sizer (SMPS): Size distribution 0.015 to 0.450 microns
- Single Particle Soot Photometer (SP2): Soot spectrometry
- Photo-Acoustic Soot Spectrometer, 3 wavelengths (PASS-3): Light absorption and scattering
- Dual-Column Cloud Condensation Nuclei Counter (Dual-CCNC): CCN concentration at two specified supersaturations
- Condensation Particle Counter (CPC): Total aerosol concentration (>0.007 microns)
- Ultrafine CPC (UCPC): Total aerosol concentration (>0.003 microns).

Gas Phase

- Trace Gas System: Concentration of SO_2, CO, O_3, NO, NO_2, and NO_y
- Cavity Ring Down (CRD): Concentration of CO_2, CH_4, and H_2O.

Cloud Properties

- Cloud Droplet Probe (CDP): Size distribution 2 to 50 microns
- 2-Dimensional Stereo Probe (2D-S): Size distribution 10 to 3,000 microns
- High Volume Precipitation Spectrometer version 3 (HVPS-3): Size distribution 400 to 50,000 microns
- Cloud Particle Imager (CPI) Version 2: Images of cloud droplets and ice crystals.

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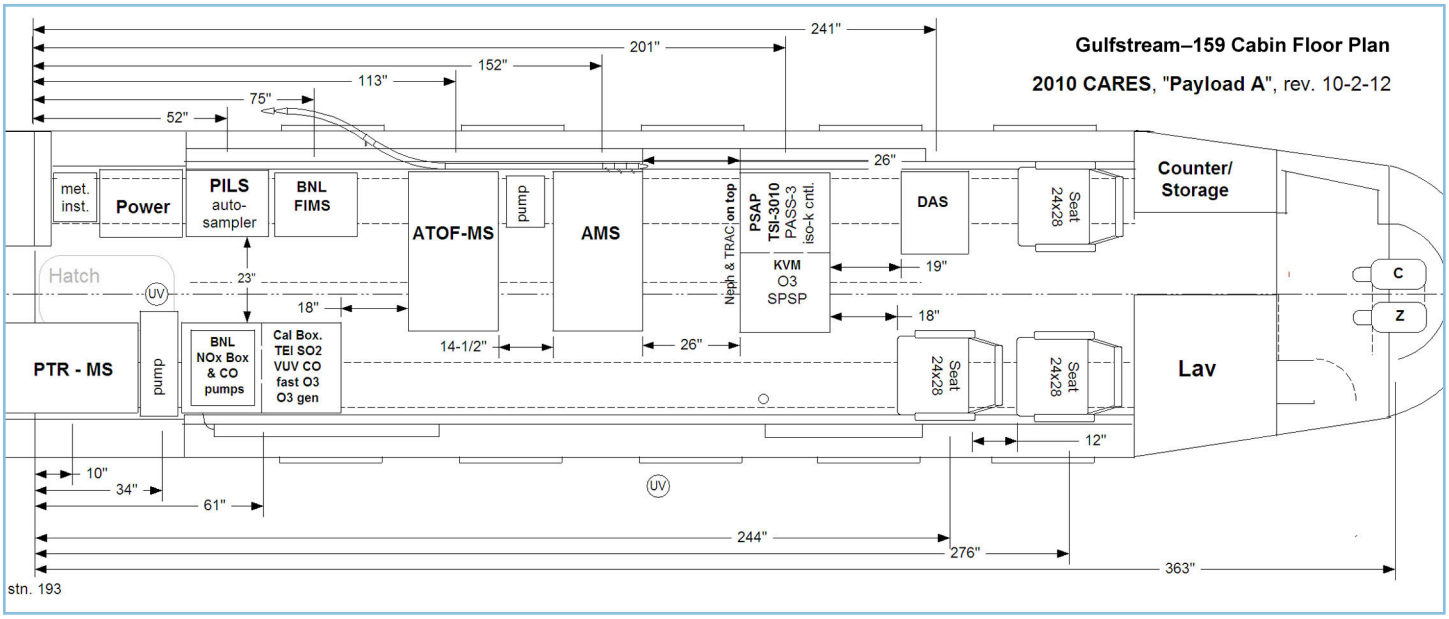

Cabin Configuration

The aircraft's 165 square feet of interior space is configured for maximum utility. Internal removable instrumentation racks enable rapid reconfiguration for customized deployments. Inlets and sensors are mounted on aluminum inserts that replace selected windows, as well as on pylons and other fuselage locations. An onboard data acquisition system, recently upgraded with funding from the American Recovery and Reinvestment Act of 2009, accommodates a wide range of analog and digital inputs. Acquired data are processed for in-flight display. The cabin graphic (above) illustrates the cabin configuration for the Carbonaceous Aerosols and Radiative Effects Study (CARES) field campaign. For this campaign, the G-1 is configured to accommodate 13 aerosol and gas-phase instruments within the cabin and 4 onboard scientists. Two additional aerosol instruments are mounted externally.

Recovery Act Enhancements

Funding from the Recovery Act has enhanced the G-1 with an onboard gigabit local area network (LAN) system capable of data transfers up to 125 megabytes per second. The updated data acquisition system uses virtual networking clients that allow scientists to remain safely seated during flight operations while monitoring data from the onboard instruments. Small, low-power fanless brick computers (six units can fit in the space of one old unit) operate the onboard instruments and are networked together. In addition, scientists located on the ground can monitor real-time data during flight operations and coordinate with onboard scientists as needed using instant messaging to the netbooks now available at each seat. Mission flight patterns may also be monitored remotely through Google Earth™.

Battelle capital equipment funding was also used to increase the research power from 400A to 500A volts of direct current (VDC) and to upgrade the aircraft power inverters. This increased the available 110-volt power to 77A, allowing more instrumentation to be operated. Pylons have been installed on the G-1 wingspan, increasing its capacity to three probes per wing and increasing the number of available external probes for a field campaign from two to eight.

This configuration is currently undergoing Federal Aviation Administration (FAA) certification for the wing-mounted pylons. Each probe will have its own computer inside the aircraft and be ready to connect to the onboard LAN for deployment in late 2010.

Aircraft Technical Information

- Length: 63.75 feet (19.44 meters)
- Wingspan: 78.33 feet (23.88 meters)
- Height: 23.33 feet (7.11 meters)
- Cabin space: 165 square feet (15.33 square meters)
- Maximum altitude: 25,000 feet (7.5 kilometers)
- Maximum gross weight: 36,000 pounds (16,330 kilograms)
- Endurance with typical payload fuel: 4 hours
- Crew capacity: 2 pilots, 1–4 scientists
- Cabin payload: 4,200 pounds (1,905 kilograms)
- Research Power: 500A @ 28 VDC; 77A @ 110 VAC, 60 Hz, 1-phase.

For more information, contact:

http://www.arm.gov/sites/aaf

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