Atmospheric Science Program:

DOE Research Aircraft Facility
Gulfstream 159 Aircraft for
Airborne Atmospheric Research

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ASPS Facility: Gulfstream 159

DOE Research Aircraft Facility

Grumman Gulfstream 159 (G-1) twin turboprop aircraft
DOE Research Aircraft Facility

- A DOE/OBER/ESD resource for atmospheric chemistry & aerosol research
- Instrument development, testing, and application; field study deployment
- Requests for access reviewed and recommended by Advisory Panel
- Priority given to DOE/OBER/ESD projects
- Contact W. R. Barchet for more information or application for flight hours:
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Attributes of the G-1 Aircraft

- Dimensions: Length 20 m, Wingspan 24 m, Height 21 m, Weight 16,330 kg max
- Nominal operation: Altitude 0.5-7.5 km, Speed 80-150 m/s, Sampling speed 100 m/s, Climb 160-330 m/min
- Endurance with maximum fuel: 6 hr
- Electrical Power: 4,000 VA @ 110&220 VAC, 28 VDC
- Crew: 2 pilots, 1-4 scientists
- Cabin payload: 1,300 kg
Research Electrical Power

- Independent generator on left engine
  - 300 A @ 28VDC
- Inverters transform 28 VDC to AC voltage
  - 4000 VA @ 110 VAC, 60 Hz, 1-_  
  - 4000 VA @ 220 VAC, 60 Hz, 1-_  
- Belly plugs provide 110 & 220 VAC shore power
- Distribution panel divides into circuits
  - circuit breaker protected
  - multi-voltage receptacle boxes
- Pilot can “kill” research power in an emergency
  - 2000 VA @ 110 VAC available from aircraft system
- Electrical power is the most limiting resource
Instrumentation on G-1

- PNNL and collaborative
  - ANL, BNL, Battelle Columbus
  - Other research organizations
- Meteorological sensors
  - Temperature, pressure, dew point temperature
  - Gust probe vector winds
- Chemical sensors
  - Real-time: O$_3$, CO, SO$_2$, NO/NO$_2$/NO$_y$, H$_2$O, H$_2$O$_2$; VOCs via PTR-MS; H$_2$SO$_4$, HNO$_3$, HONO via API-MS
  - Integrating: NO$_2$, PAN, HCHO, VOC
Instrumentation on G-1
(continued)

- Cloud & Aerosol Microphysics
  - PCASP, FSSP, 2D aerosol/cloud size spectra
  - Total scatter/back scatter nephelometers
  - Condensation particle counters
  - Ultrafine particle counter
  - Liquid water content probe

- Radiation
  - UV/solar/IR radiometers
  - Up/down-looking IR thermometers
Instrumentation on G-1
(continued)

• External instrumentation collaboration
  – BNL: NO$_x$/NO$_y$, H$_2$O$_2$, HCHO,
    Aerosol chemistry, Ultrafine sizing
  – BCO: API-MS, PAN-GC, VOC
  – ANL: VOC, VOC-GC, NO$_2$/PAN
  – U-WA: CFVI, CCN, B$_{scat}$
  – U-NV/DRI: CCN spectrometer
  – PNNL: PTR-MS, TRAC

BCO API 365 MS/MS
Instrumentation on G-1
(continued)

View forward

View aft
Inlets and Exhausts for Research Instruments

- Inlets need to be
  - chemically inert (Teflon, SS)
  - insensitive to angle of attack
  - isokinetic for particles
- Exhausts are needed to
  - remove excess heat
  - vent sensor trace gases
- Venturis needed to draw sample air through some instruments
Instrumentation Racks

- Racks fastened to floor tracks
  - two on left
  - three on right
- Racks come in different sizes
  - Single-wide: 22”Wx19”Dx42”H
  - Double-wide: 42”Wx24”Dx42”H
- Racks protect
  - instruments from mechanical shock & accidental jolts
  - flight crew from injury
- Racks withstand high g-forces
  - turbulence
  - landings
**Data Acquisition System**

- Science & Engineering Associates M200
- 64 channels of analog (±5 VDC) input
  - space available for another 32 channels
- Special interface cards for
  - FSSP, PCASP aerosol probes
  - TANS/Vector attitude GPS
- Output to 8 mm tape or save on hard disk
- Flat panel display for real-time monitoring
  - Aircraft position superimposed on map
  - Strip-chart trace of selected parameters
  - Parameter versus Altitude for profiles
Cabin Configuration for FY02 Field Studies

- 2700 lb equipment
- 4 scientific crew
- 5000 VA @ 110 VAC
- 2900 VA @ 220 VAC
ASP Facility: Gulfstream 159

Locations of ACP Projects Using the DOE RAF G-1

Locations:
- PNW 2001
- ITEX 98
- CCOS 00
- PHOENIX 98+01
- SALT RIVER NGS 91
- ARM IOPs 97+98
- TX2000
- SOS 95+99
- FBS 89 88+90
- EPA ACID-MODES 88+90
- AMS/NEAQS/NAOPEX 02
- NARSTO-NE 95+96
- NEOPS 99
- KUWAIT 91
- PNNL

Symbols:
- ★ Home Base
- Previous
- Future