ARM

CLIMATE RESEARCH FACILITY

The ARM Aerial Facility in the Biomass Burn Observation Project (BBOP)

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Pacific Northwest National Laboratory

Richland, WA

U.S. DEPARTMENT OF ENERGY | Office of Science

G-1 (BMI owned, ARM base funded, PNNL based and managed, for the science community)

Aircraft Technical Information

Length: 19.4 m

Wingspan: 23.9 m

Height: 7.1 m

Cabin space: 15.3 m^2

External probes (PMS cans): 8

Maximum gross weight: 16,330 kg

Maximum Endurance: 9.5 hours

Maximum Range: 4000 km

Endurance with full payload: 4-5 hours

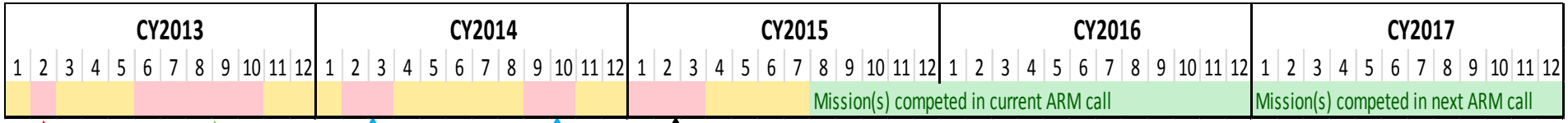
Crew capacity: 7 max**,** 2 pilots + 3-5 scientists

Cabin payload: 1,900 kg

Research Power: 700A @ 28 VDC (incl. 85A @ 115 VAC, 60 Hz)

Ceiling: 7.6 km

AAF G-1 Plan 2013-17



Twin Column Aerosol Project (TCAP II)
Cape Cod, MA
PI: Larry Berg (PNNL)

Biomass Burns in the US
Pasco WA & Little Rock, AR
PI: L. Kleinman & A. Sedlacek (BNL)

Intensive Airborne Research in Amazonia (IARA)
Manaus, Brazil
PI: Scot Martin (Harvard)

ARM Cloud Aerosol Precipitation Experiment (ACAPEX)
California
PI: Ruby Leung (PNNL)

	G-1 Available
	G-1 Not Available (Deployment)
	G-1 Not Available (Transition, Test Flights, Maintenance, etc)

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AAF BBOP Deployment

Table 1: Proposed Field Campaign Timeline and Requested Flight hours for DOE G-1

Activity	June	July	August	Sept.	Oct.
Instrument Staging & G-1 Test Flights	5-hrs				
Deployment at Pasco (WA)		15-hrs	35-hrs	15-hrs	
3-week IOP at Little Rock (AR)					35-hrs
Round trip Ferry Little Rock to-Pasco					15-hrs

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G-1 TCAP Payload
(High Level Summary)

- Aircraft and Atmospheric State Parameters
- Trace Gases
  - H_2O, CO, CO_2, CH_4, N_2O,NO, NO_2, NO_y, O_3, SO_2
- Aerosol Properties
  - Total Concentration
  - Size Distribution (30 nm – 50 μm)
  - Cloud Condensation Nuclei Concentration
  - Optical Properties (absorption, scattering, extinction)
  - Physico-chemical composition
- Radiation
  - SW, Upwelling hemispheric, spectral
  - SW, Upwelling hemispheric, broadband
  - IR. Surface Temperature
  - SW, Down-welling hemispheric, broadband, global and diffuse
  - SW, Down-welling hemispheric, broadband, diffuse

G-1 BBOP Payload (v1.1)

Aircraft and Atmospheric State Parameters


TDL

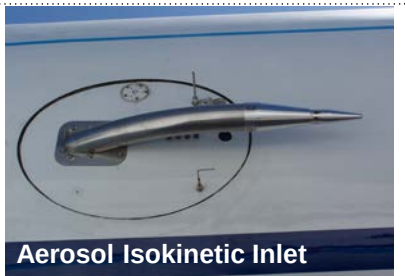
Instrument	Measurement
Platform Pos/Vel/Attitude	
DSM 232 GPS	Position and velocity
TANS Vector GPS	Position, velocity, attitude
Atmospheric State	
Rosemount 102	Temperature
Rosemount 1201F1	Pressure
Chilled Mirror Hygrometer – General Eastern 1011B	Dew-point temperature
Tunable Diode Laser Hygrometer	Absolute Humidity
Gust Probe	5-Port air motion sensing: true airspeed, angle-of-attack, side-slip
Aircraft Integrated Meteorological Measurement System - 20 (AIMMS-20)	5-Port air motion sensing: true airspeed, angle-of-attack, side-slip Meteorology: temperature, and relative humidity. INS/GPS: position, velocity, attitude
Inlet	
Aerosol Isokinetic Inlet	sample stream of dry aerosol, sizes < 5 microns


Rosemount 102


GE-1011B


Gust Probe

AIMMS-20

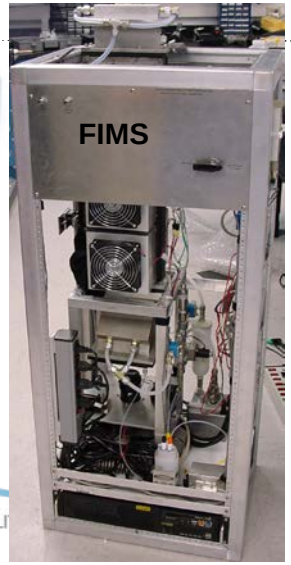

Aerosol Isokinetic Inlet

G-1 BBOP Payload (v1.1)
(Detail)

Aerosol Concentration and Size Distribution

Instrument	Measurement
Aerosol	
UCPC TSI 3025	total particle concentration (> 3 nm)
CPC TSI 3010	total particle concentration (> 10 nm)
FIMS	aerosol size distribution (30-100 nm)
UHSAS-A	aerosol size distribution (60-1000 nm)
PCASP	aerosol size distribution (100-3000 nm)
CAS	aerosol size distribution (500-50,000 nm)

CPCs



PCASP

UHSAS-A

CAS

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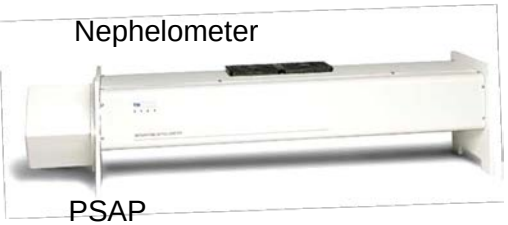
G-1 BBOP Payload (v1.1)
(Detail)

Aerosol Optical Properties

Instrument	Measurement
Aerosol	
Nephelometer (TSI 3563)	Aerosol scattering, 3λ
Particle/Soot Absorption Photometer (PSAP)	Aerosol absorption, 3λ
DMT SP-2 Single Particle Soot Photometer	Soot mass, number and size distribution UPGRADE
Photothermal Interferometer (PTI)	Aerosol absorption 532 nm UPGRADE
Photoacoustic Spectrometer (Arnott)	Aerosol light absorption and scattering 355 nm NEW
CAPS PMex Particle Extinction Monitor	Aerosol extinction NEW

Nephelometer

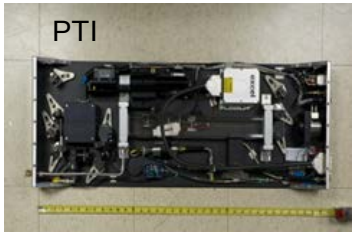


PSAP

SP2 Rev C

SP2 Rev D

PTI



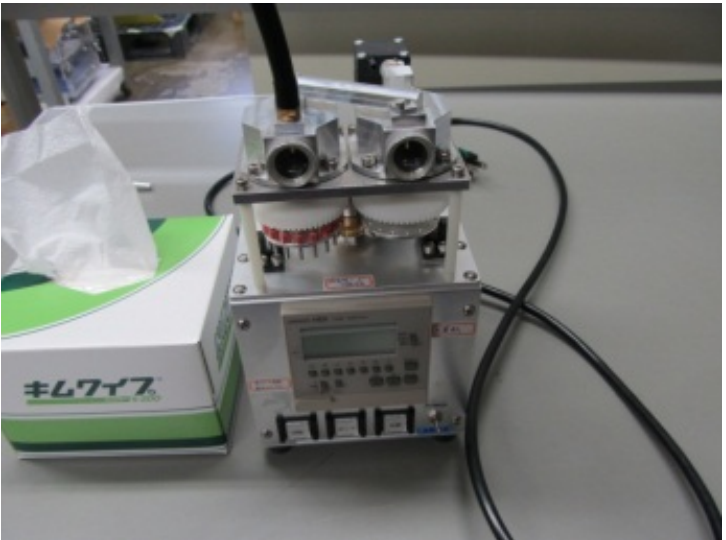
Arnott PAS

CAPS

G-1 BBOP Payload (v1.1)
(Detail)

Aerosol Composition and Make-Up

Instrument	Measurement
Aerosol	
Aerosol Sampler	Samples for off-line microscopy and spectroscopy NEW
Soot Particle Aerosol Mass Spectrometer (SP-HR-ToF-AMS)	Size-resolved aerosol composition UPGRADE
Cloud Condensation Nuclei (CCN) Counter	CCN concentration at 2 super-saturations



G-1 BBOP Payload (v1.1)
(Detail)

Gases

Instrument	Measurement
Gases	
Quadrupole Ionicon PTR-MS	real-time Volatile Organic Compounds
Los Gatos Research N2O/CO -23r	Concentration of CO, N2O, and H2O
Oxides of Nitrogen Instrument	NO, NO2 and total NOy
Thermo Environmental Model 49i	O3 NEW
Thermo Environmental Model 43i - LTE	SO2 NEW
Picarro CRD System - Model G2301-m	CO2, CH4, H2O NEW

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G-1 BBOP Payload (v1.1)
(Detail)

Radiation

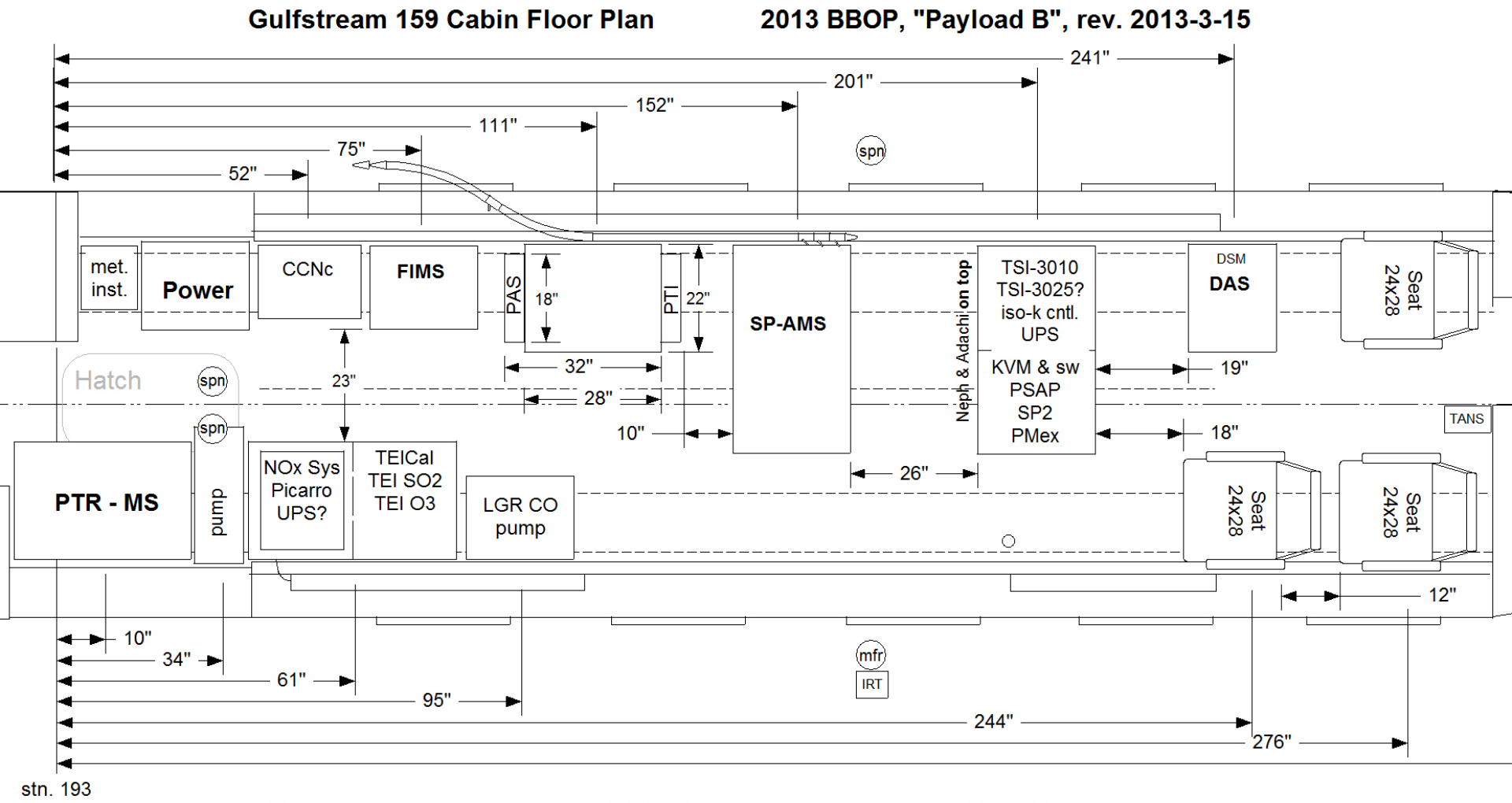
Instrument	Measurement
SPN-1 unshaded NEW	Down-welling shortwave radiation global and diffuse, broadband
SPN-1 shaded NEW	Down-welling shortwave radiation global, broadband
MFR	Upwelling shortwave radiation global, 415, 500, 615, 673, 870 ,940,1625 nm spectral channels
SPN-1 unshaded	Upwelling shortwave radiation global, broadband
Heitronics NEW	Surface radiating temperature

G-1 BBOP (v1.1)
(Detail)

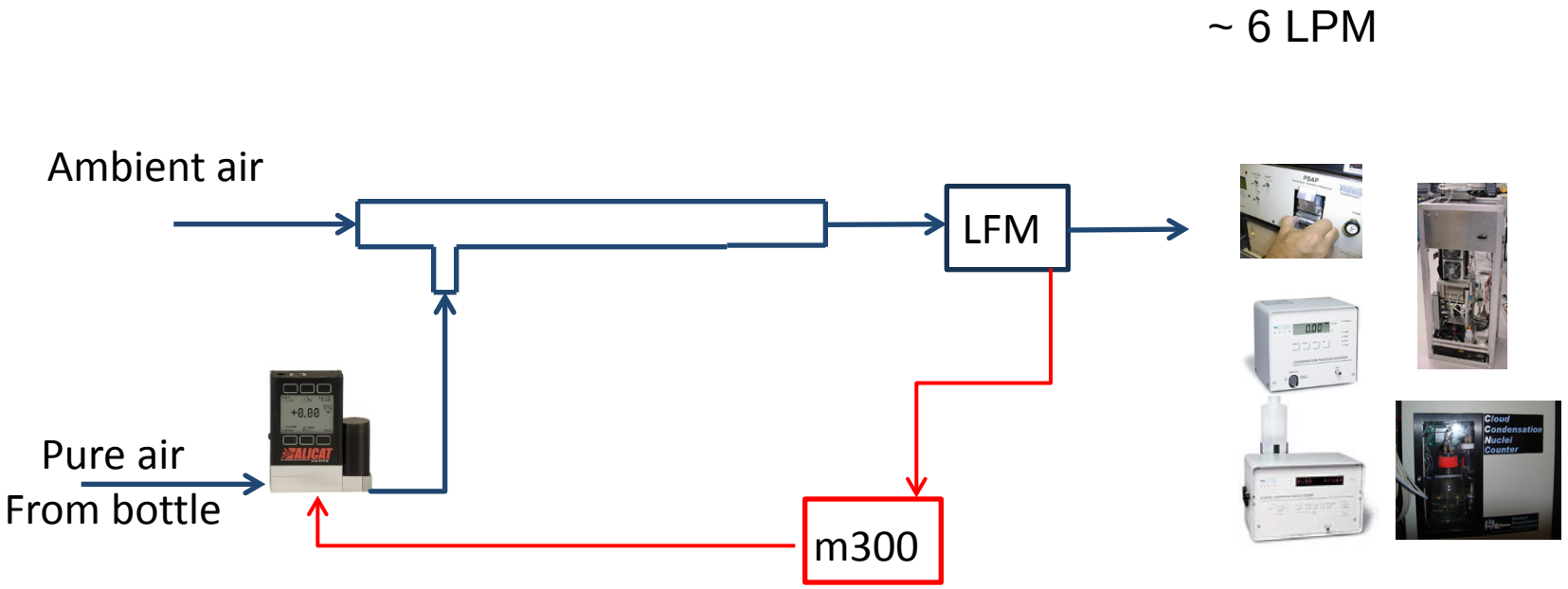
Other

Instrument	Measurement
Other	
Dilution System	Diluted sample flow for some instruments
Cockpit Video Camera	Movies 1 frame/sec (adjustable)
Weather radar	Cockpit display of precipitation returns
SEA Data System	Central Data System
Iridium Satellite Modem	Limited data link to ground station
Radar Altimeter	Altitude above surface
Honeywell 67A ACAS III	Traffic Collision and Avoidance System
TAWS Landmark TAWS8000	Terrain Awareness and Warning System
Stormscope WX500	Lightning Detector

G-1 BBOP Draft Floor Plan (v1.1)



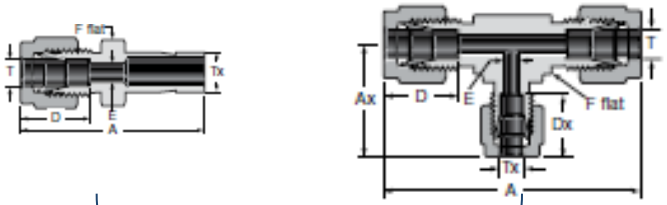
Dilution system diagram 10:1

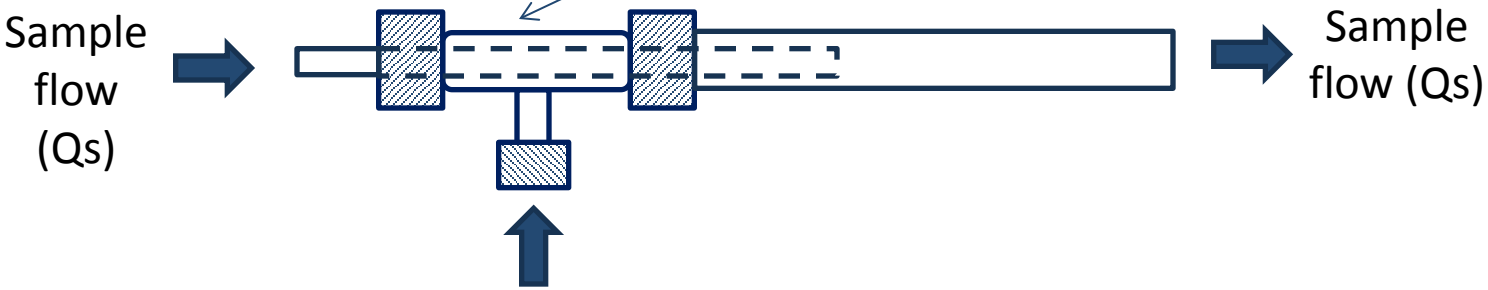


Mixing/sampling Tee diagram

Swagelok 1/2”-1/4” (SS-400-R-8)

Swagelok 1/2”-1/2”-1/4” Reducing union Tee (SS-810-3-8-4)





Dilution flow (Qd)

Dilution air option:

- Pure air
- Filtered ambient air