F&J SPECIALTY PRODUCTS, INC.

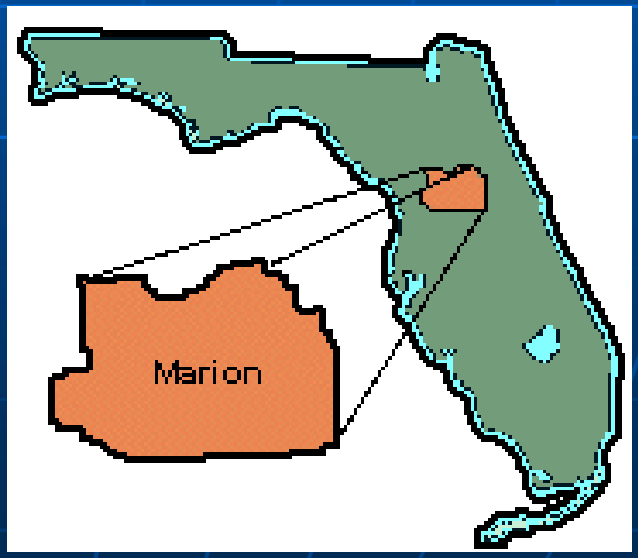
Air Monitoring User's Group

Las Vega, Nevada

1-3 May 2007

Corporate Facilities

Founded in 1979, F&J SPECIALTY PRODUCTS, INC. is a manufacturing and services company located in the beautiful horse country of Ocala in Marion County, Florida



Corporate Facilities (cont.)

F&J's facilities consist of 23,000 square feet in three buildings on a 2.3 acres

F&J Calibration Services

Calibration Services
(NIST Traceable)

- Airflow Calibrators
- Air Monitoring Systems

Calibrations to four different reference temperatures

Classical Standard T and P (STP)	0°C (32°F)
Normal T and P (NTP)	20°C (68°F)
USA Modified Normal T and P (MNTP)	21.1°C (70°F)
Standard Ambient T and P (SATP)	25°C (77°F)
Reference P (for all the above)	1 atmosphere, 760 torr, 101.325 kPa

F&J Electrical Safety Product Certifications

F&J has the following certifications for ~ 360 products

- IEC 61010-1:2001 2nd Edition
- EN6010-1:2001 2nd Edition

- ANSI/UL 61010-1:2001
- CAN/CSA-C22.2 No.61010-1; 2nd Edition

F&J Air Sampler Systems Compliant with ANSI/UL Electrical Safety Standards

Digital Flowmeter Low Volume Air Samplers

DF-1

DF-14M

DF-22

DF-2234

DFM-100 Series (15 models)

DF-34M

DF-134

DFM-10034 (10 models)

F&J Air Sampler Systems Compliant with ANSI/UL Electrical Safety Standards (cont.)

Digital Flowmeter High Volume Air Samplers

DFHV-1	DFHV-1S
DF-604	DF60810
DF-804	DF-804-30

Homeland Security Focus

- Self-contained emergency air sampling systems which include air samplers, consumables, calibration instrument(s), adaptors, tools and a storage/ transportation case
  - Instrumentation for extreme operating conditions
  - Lightweight, portable air sampling instruments operating on long life batteries, DC voltage or conventional line power.

F&J Air Sampler Systems Compliant with ANSI/UL Electrical Safety Standards (cont.)

Digital Flowmeter AC/DC Air Samplers

Nominal 40 LPM Capacity

DF-40L-8

NiMH Batteries
~ 8 lbs.
AC/DC/Battery

DF-40L-12

Lead Acid Battery
~ 17 lbs.
AC/DC/Battery

DF-AB-40L

NiMH Batteries
~ 12 lbs.
AC/DC/Battery

F&J Air Sampler Systems

Nominal 75 LPM Capacity

DF-75L-AC

~ 13 lbs.
AC/DC

DF-AB-75L-AC

~ 13 lbs.
AC/DC

DF-AB-75L

Lead Acid Battery
~ 31 lbs.
AC/DC/Battery

Digital Flowmeter Technology

Key Features

- Greater accuracy, reliability and simplicity of operation
- Auto shut off on time or volume
- Automatic flow control (High Volume and DC motor systems)
- RS232 communications port
- Flow and volume correction to a reference temperature and pressure
- Bright LED display with dimming feature
- Display of flowrate, elapsed time and accumulated sample volume
- Multiple engineering units available for flowrate/volume display

Emergency Response Air Sampler Systems Portable Beta-Gamma CAM

RMDF-30L

Nominal 30 LPM Capacity

RMDF-60L

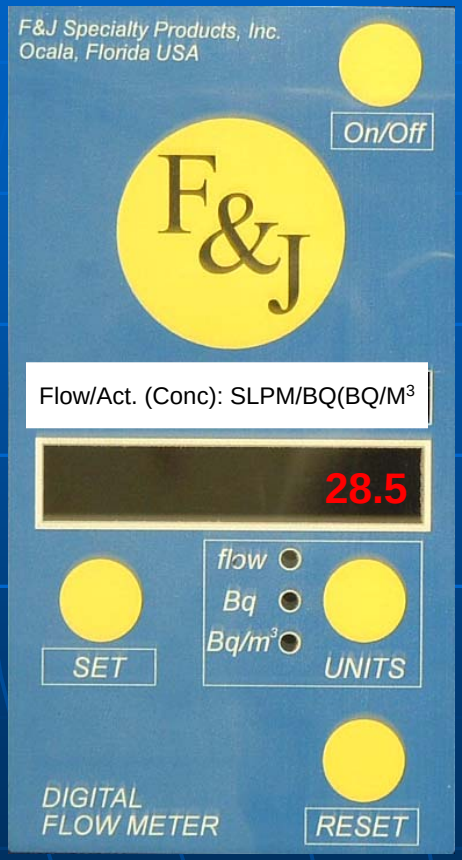
Nominal 60 LPM Capacity

Key Features

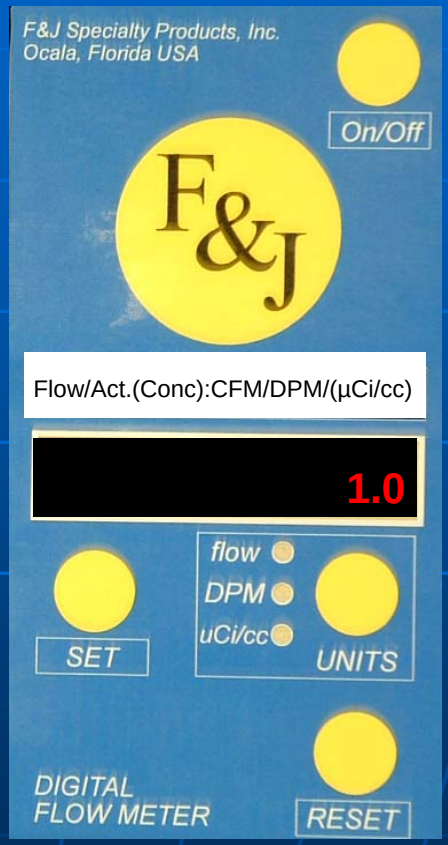
- Background Correction
- North American or International Units
- Automatic Flow Control
- Calibration based on CS-137
- Visual Alarm and Audible Alarm
- Audible Alarm Reset Button

- Correction of flowrate and volume to a reference T and P
- Auto shut off on time or volume
- RS232 communications port with user selectable data export rate

KeyPad Options



International Units



North American Units

Development of a Real-Time Beta Air Monitor

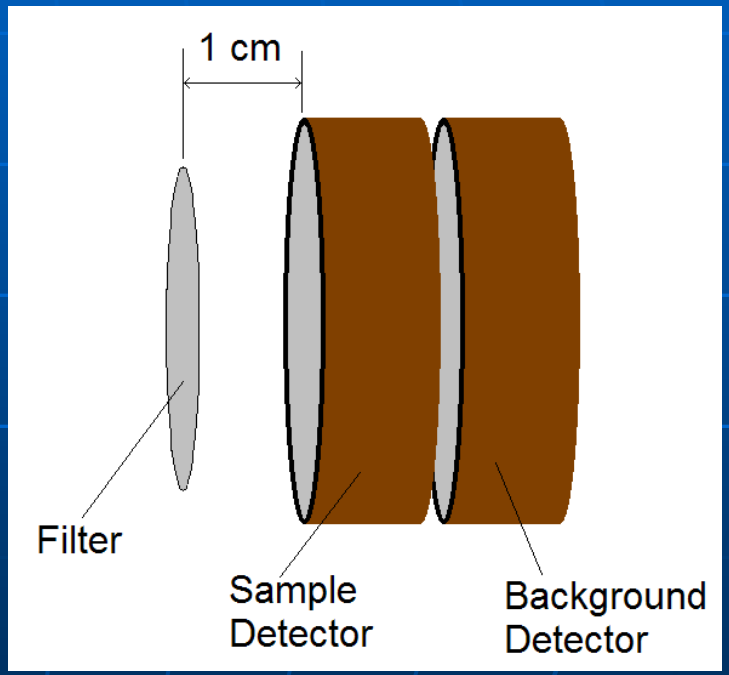
Paul R. Steinmeyer
Radiation Safety Associates, Inc.

Beta Detector Design Goals

- Reliable
- Accurate and sensitive
- Inexpensive (relatively…)
- Interface w. F&J's existing DFM
- Integrated alarm
  - Activity Concentration (µCi/cc or Bq/m³)
  - Total Activity (dpm or Bq)

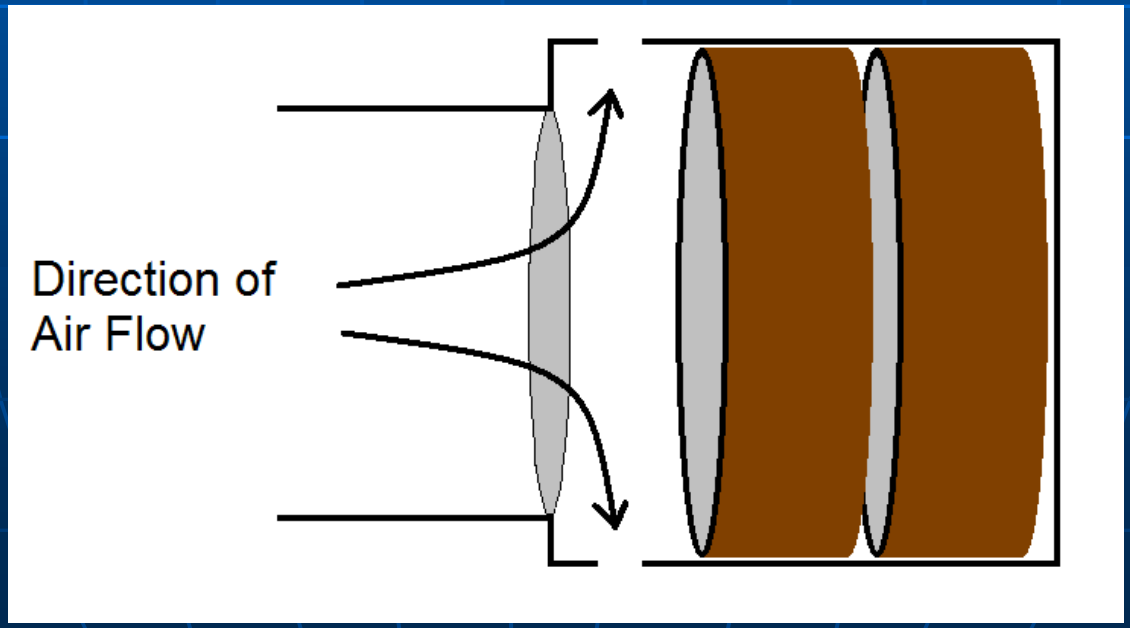
As-Designed Detector Assembly (1 of 2)

- Two G-M “Pancake” Detectors
- One for sample
- One for background
- Front-to-back
- Thin window of background detector shielded by back wall of sample detector



As-Designed Detector Assembly (2 of 2)

- Minimize risk of detector contamination
- Back of filter faces detector
- Minimal effect on beta efficiency
- Eliminates alpha response



Detector Electronics (1 of 2)

- Based on existing “CRD” Design
- Reliable and efficient HV (~200 µA)
- Microcontroller-based

Detector Electronics (2 of 2)

- Flexible power requirements
  - 6 to 20 VDC input
- Custom data interface to DFM
- Parallel RS232 I/O for setup and cal
- Also controls audible and visual alarms, plus alarm reset

Overall Logic Flow (1 of 2)

- Accumulate counts from both tubes for two seconds
- Correct both count rates for dead time
- Subtract background from sample
  - If difference is negative, use zero
- Combine with seven previous counts
- Calculate average rate (16 sec total)
- Calculate ^{137}Cs activity and transmit to DFM
- DFM adjusts for efficiency of selected isotope

Overall Logic Flow (2 of 2)

- DFM unit:
  - Converts to appropriate units
  - Calculates concentration
  - Displays current measurement
  - Transmits alarm state back to detector electronics board
- Detector electronics board controls audio and visual alarms, responds to silence and reset

Minimum Detectable Activity (1 of 2)

- What to use as background?
  - Background is subtracted automatically
  - Slight conservative bias caused by substituting zero for negative numbers
  - End Result: Integral granularity of data is 1 cps so use 60 cpm as background

Minimum Detectable Activity (2 of 2)

$$\frac{2.71 + 3.29\sqrt{(R_b)(t_s)\left(1 + \frac{t_s}{t_b}\right)}}{(t_s)(E)}$$

R_b = 60 cpm
T_s = 0.267 (16 seconds)
T_b = 0.267 (16 seconds)
E = 0.10 c/d (Cs-137)

MDA = 800 dpm (3.6E-4 µCi, 13.3 Bq)

Lower Limit of Detection

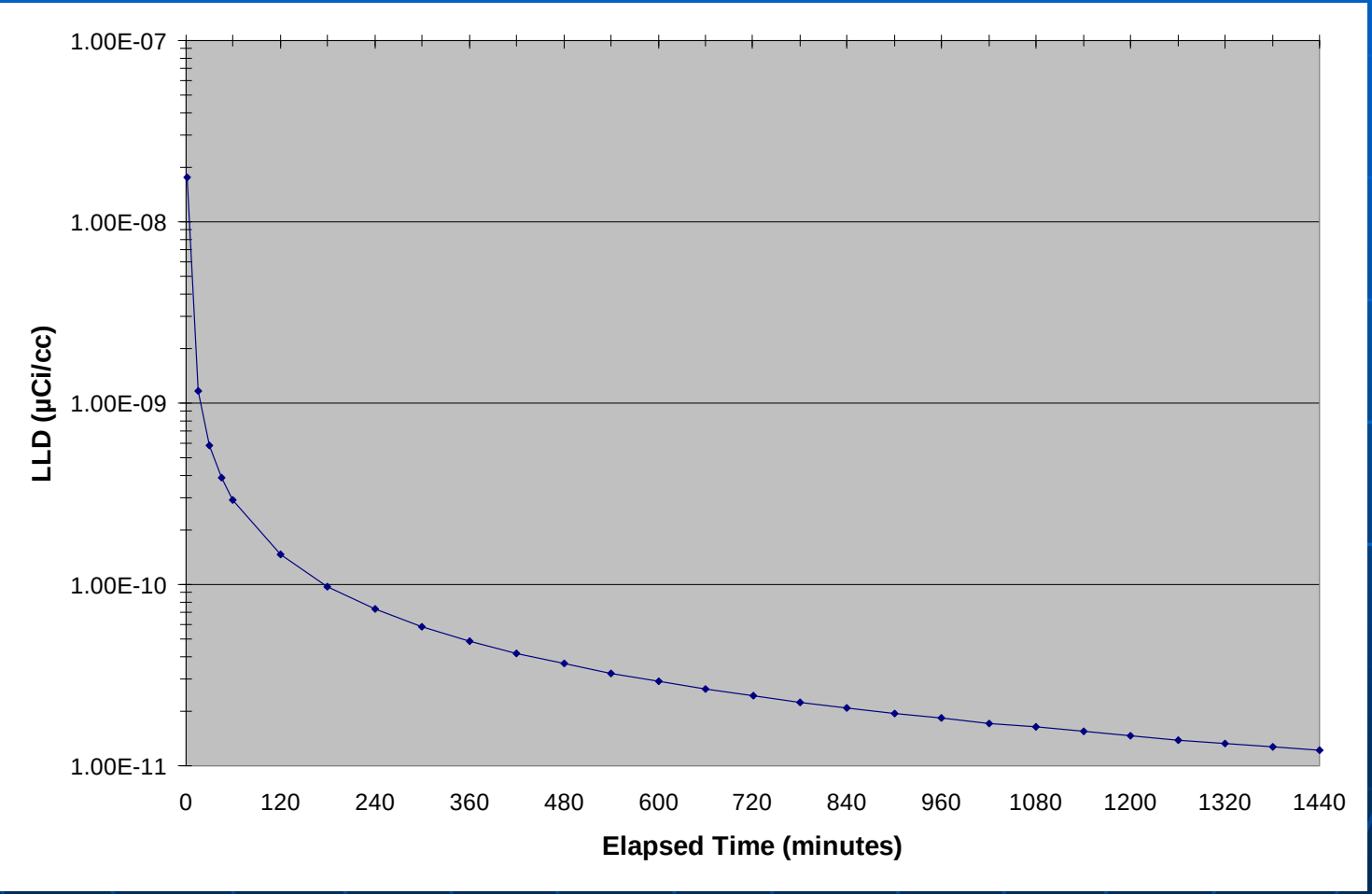
- LLD is MDA with sample-specific parameters applied
- Only other parameter of significance here is total volume
- Total volume changes continuously

Lower Limit of Detection

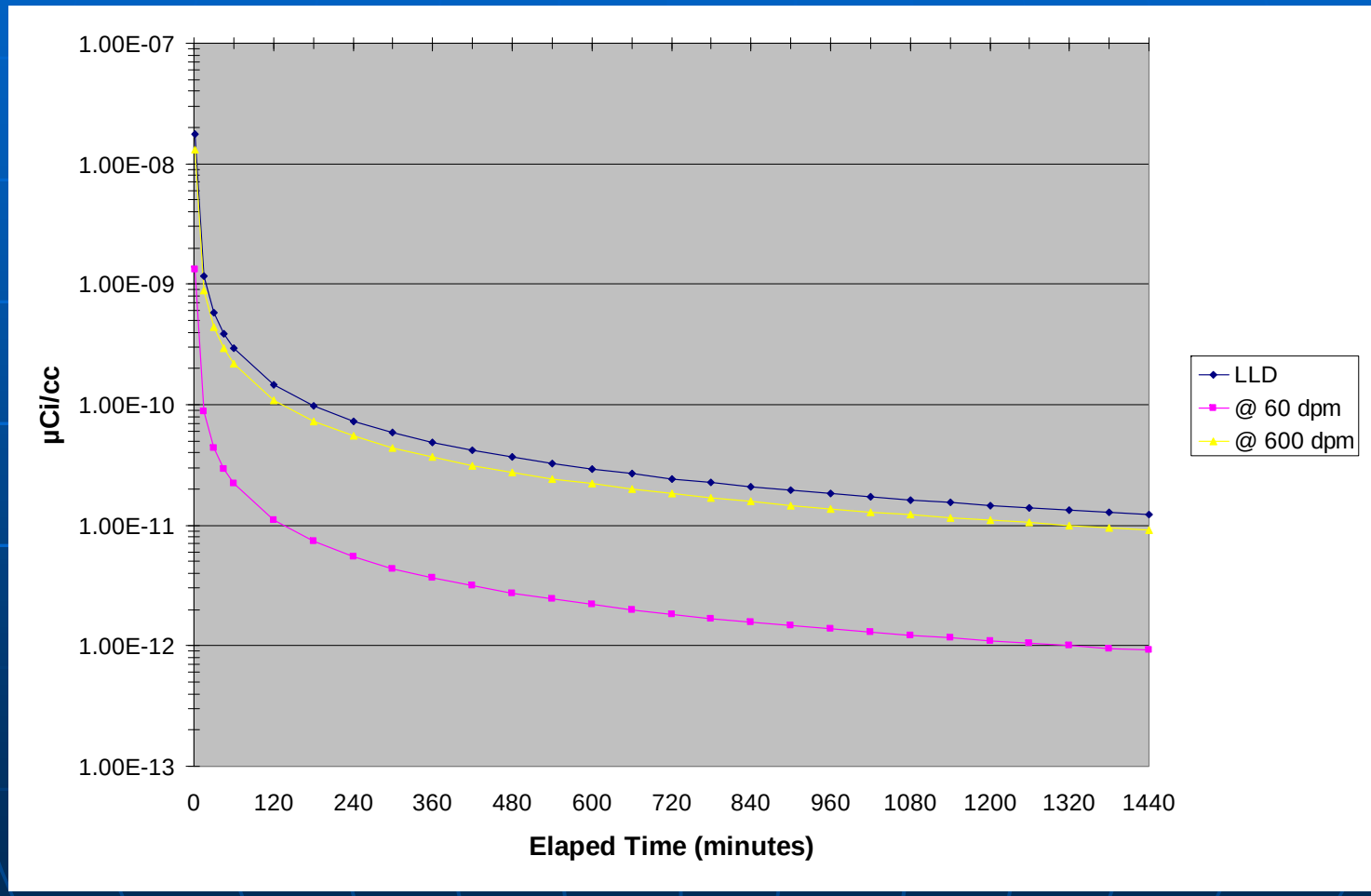
$$\frac{2.71+3.29\sqrt{R_b T_s\left(1+\frac{T_s}{T_b}\right)}}{(T_s)(E)(E_f)(FF)(SAF)(C)(Vol)}$$

R_b = 60 cpm
T_s = 0.267 (16 seconds)
T_b = 0.267 (16 seconds)
E = 0.10 c/d (Cs-137)
E_f = 0.9987
FF = 1
SAF = 1
Vol = TAKE YOUR PICK

Elapsed Time vs. LLD at 20.5 lpm



Elapsed Time vs. Activity Concentration at 20.5 lpm



Alarm Options

- Alarms for
  - Total Activity or
  - Activity Concentration
- Only one alarm at a time can be utilized
- Loud (and annoying) piezo, xenon strobe light
- “Silence” button
- Strobe remains on until < alarm level

Total Activity Alarm

- Either dpm or Bq
- Fastest response to change
  - Less than 16 seconds
- Radon progeny WILL accumulate over time.
  - I got up to 2400 dpm

Activity Concentration Alarm

- Either µCi/cc or Bq/m³
- Alarm not active for initial 15 minutes of sample!
  - Prevents continuous “statistical” alarms
  - Total flow volume is very small during first minutes of operation

Radiological Calibration (1 of 2)

- Special cable connects CRD board to PC RS232 serial port (9600,8,N,1)
  - Only special in that it contains circuitry to convert 5V logic to ±12V RS232 levels
  - Will make schematic available, or can purchase pre-made, or send in for calibration.
- Simple ASCII commands

Radiological Calibration (2 of 2)

- Entering Calibration Mode sends additional data every two seconds
  - instantaneous DTC cps for main tube
  - instantaneous DTC cps for bkgd tube
  - net cps, averaged over 16 seconds
  - current activity in Bq, in hexadecimal
- Expose detector to field near the upper maximum and adjust DT until proper value is achieved
- Use NIST-traceable sources to determine efficiency

Field Operation Notes

- Source check to confirm operation
  - Air pump does not need to be on for this
- Use to get reasonably accurate real-time results
- Total volume is known with accuracy, so filter can also be analyzed by traditional means

Suggested Uses

- Re-fuel floor
- High potential-airborne areas
- Work Area Monitoring
- Emergency Response
- Plume Boundary Definition