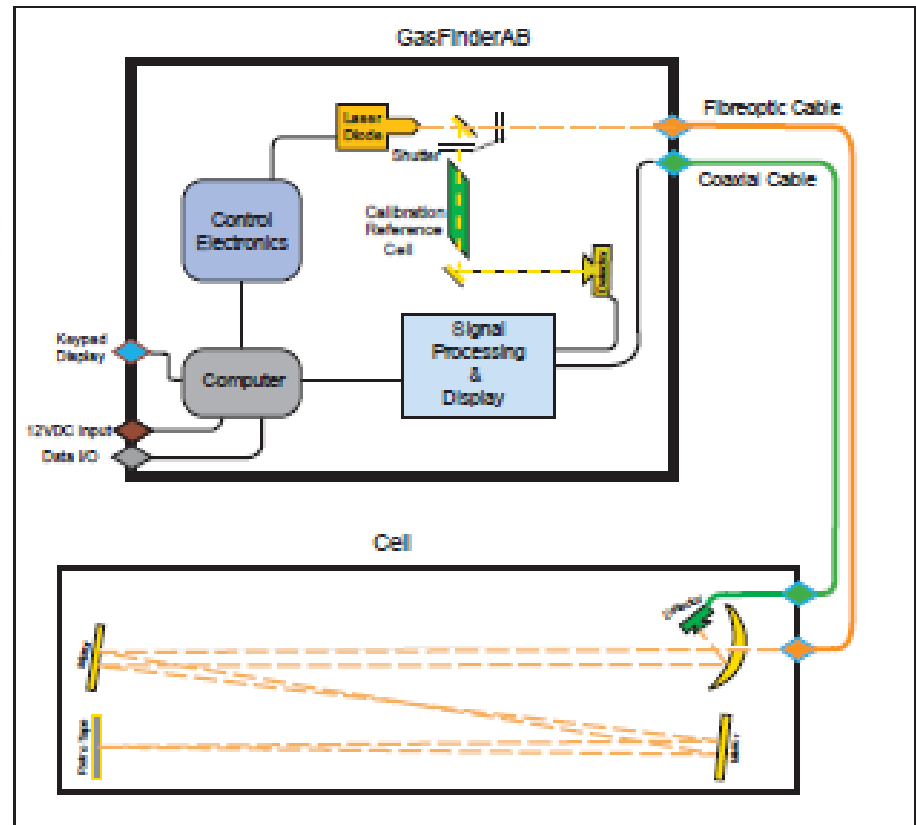




Airborne pipeline leak detection - an evolving success story

GasFinderAB schematic and components



Typical GFAB installation



GasFinderAB mounted in helicopter cabin (left) and multiple pass cell mounted under cabin (right).

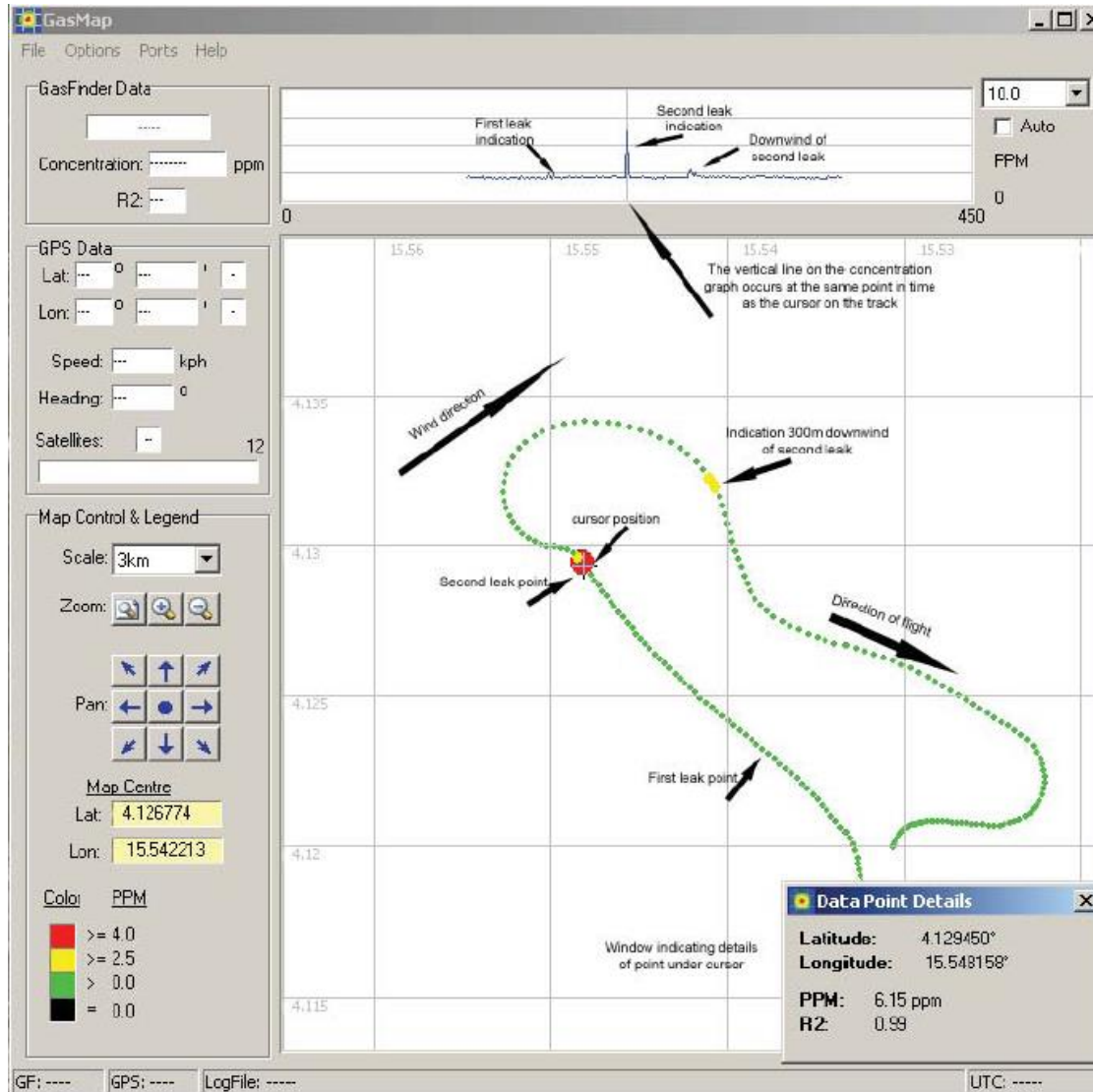
Detection Limit & Accuracy	<1 ppm (CH ₄)
Range	0 to 100 ppm (CH ₄)
Alarm settings	Default 10 ppm
Data rate	3 readings per second
Recommended speed	60 – 100 knots
Recommended altitude	50 – 65 m (150 – 200 feet)

Airborne system schematic



Helicopter mounted GasFinderAB detects elevated levels of CH₄ in plumes resulting from leaks in high pressure natural gas pipelines

On-board data display



Concentration on Track

☐ CH4 & GPS data recorded

☐ 3-D plot shows

- < 5 ppm in green

- 5 –10 ppm in yellow

- >10 ppm in red

☐ Real time alarm at 10 ppm

Concentr:

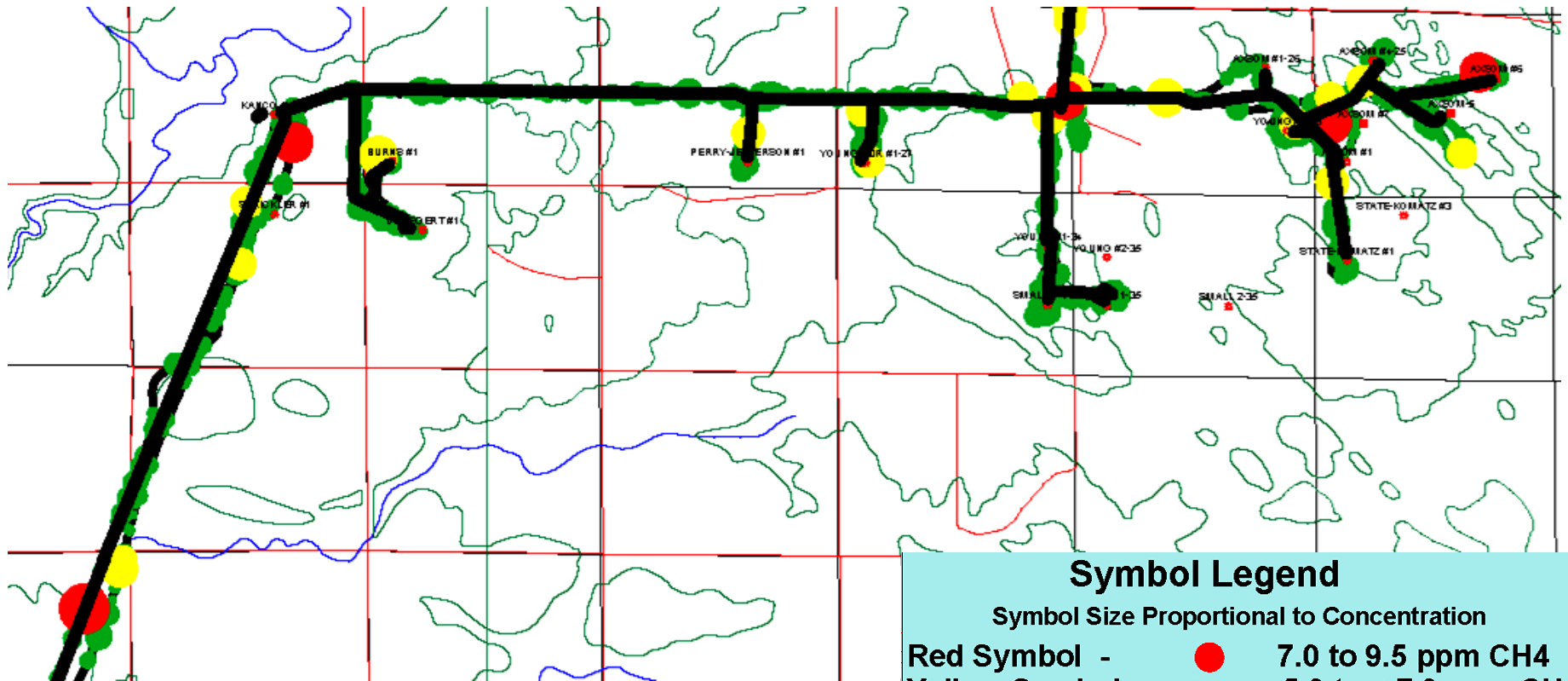
50
45
40
35
30
25
20
15
10
5
0



A significant leak was discovered, the alarm activated, the pilot went back and circled the source of the leak a few times to confirm the initial reading.




Latitude

Post-processed results - detail



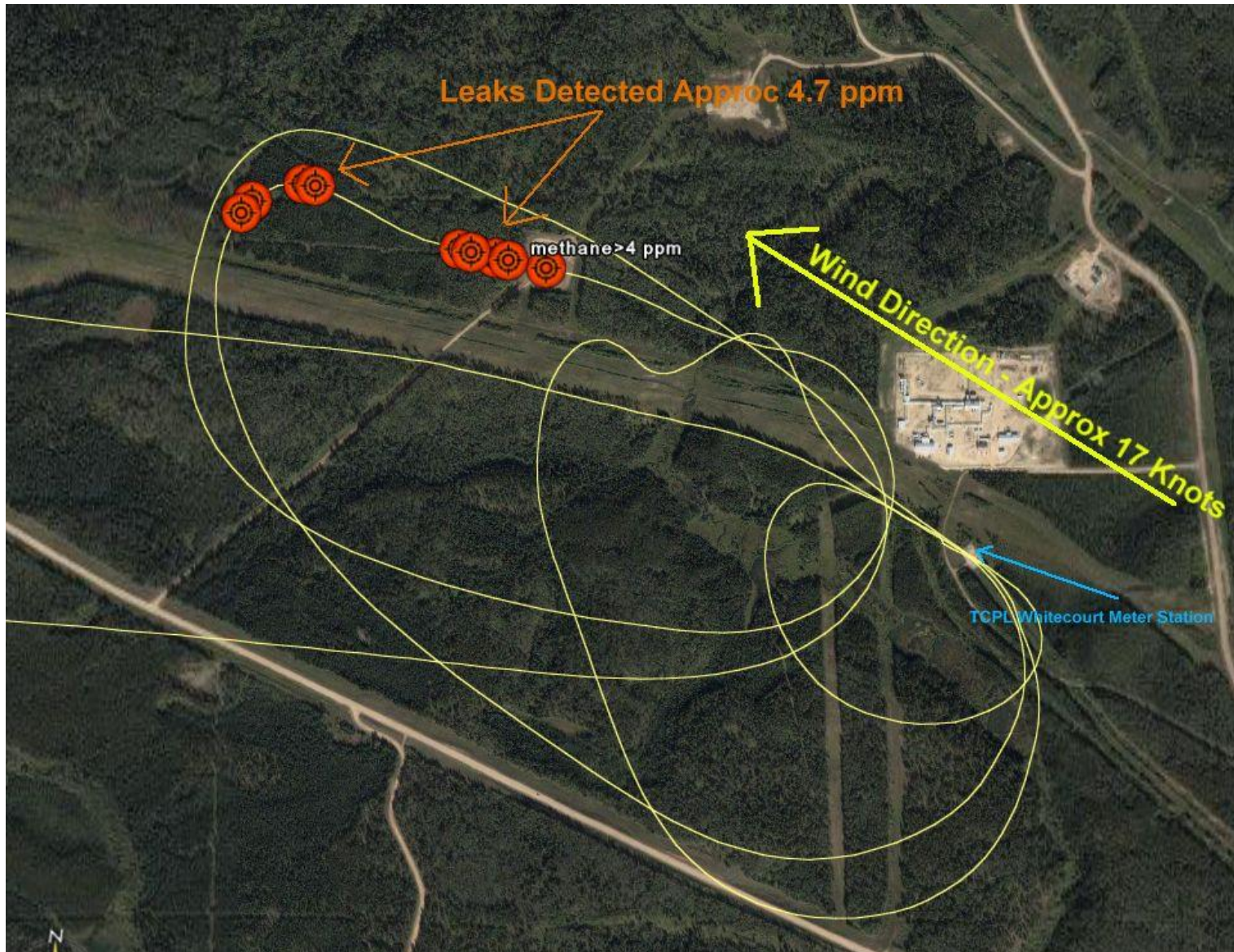
Symbol Legend

Symbol Size Proportional to Concentration

Red Symbol -		7.0 to 9.5 ppm CH4
Yellow Symbol -		5.0 to < 7.0 ppm CH4
Green Symbol -		> 0 to < 5.0 ppm CH4
Black Symbol -	.	0 ppm CH4

Aviation Technology Services, LLC
February 3, 2005 Pipeline Inspection

Airborne leak detection in Alberta



Mobile GHG Monitoring with GasFinderAB

CH₄ pipeline leak detection
CH₄ emissions from landfills and other area sources
CO₂ emissions in volcanic areas
CH₄ and CO₂ Background surveys
CO₂ emissions from EOR and CO₂ sequestration (CCS) projects

Spatial & Temporal resolution

- CH₄ sensitivity of 0.2 ppm
- CO₂ sensitivity of 5 ppm
- Response time < 1 second

Airborne monitoring

Helicopter based system
Long range (500 km/day)



Road gas detection

Medium range (400 km/day)
Urban pipelines



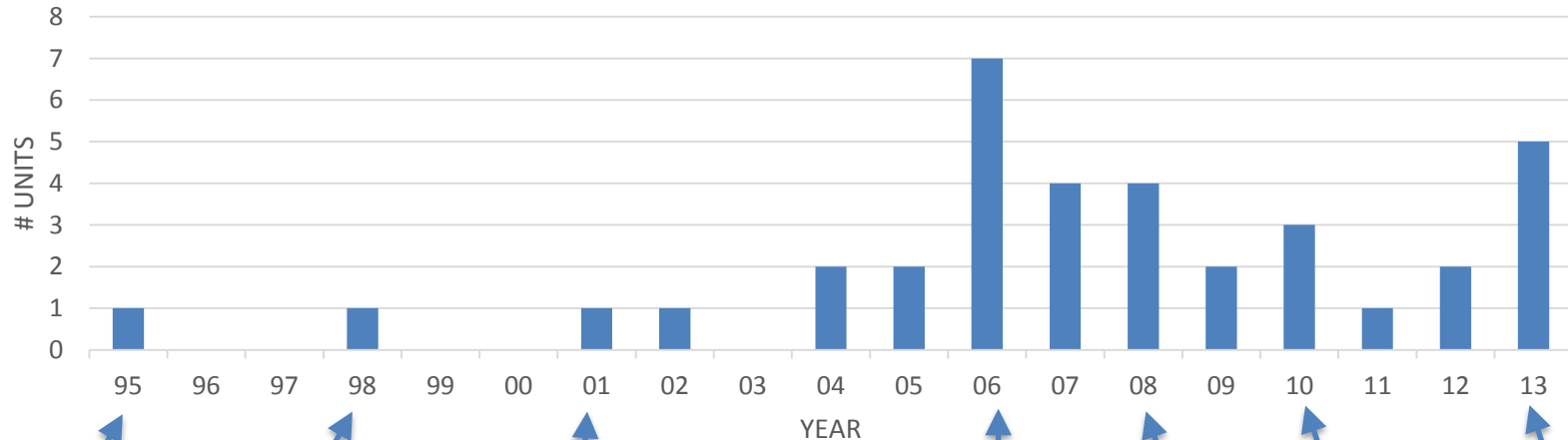
ATV gas detection

Short range (200 km/day)
Rural pipelines
Off road



GasFinderAB timeline

GFAB Units Sales by Year



G1 – unit
Low sens
Complex probe
NOVA Pipelines
interest and
support.
Surveys only in
AB.

TCPL-Nova
merger.
G2 config
Higher sens
Simpler probe
Regular
surveys across
Canada

Simpler and more
robust probe –
suitable for sale
rather than lease.
First sale to
independent
service provider.
First sale overseas.

Exclusive with
US service
provider.
Annual min
purchase
requirement

RMOTC
test
&
First
ground
based
unit

Upgraded
probe
design for
greater
sensitivity
and
stability

End of
exclusive
with US
partner

Increased
interest in
pipeline
integrity.
Sales to multiple
local service
providers.

35 units total - 30 in North America - 4 ground based

Leak tests at DOE RMOTC test site

http://www.rmotc.doe.gov/Pdfs/ATSheli_PipelineLeakDet.pdf is an official DOE report on results obtained by ATS with a Boreal GasFinderAB system in Sept 2006 at the DOE's Rocky Mountain Oilfield Testing Center , Wyoming.

The pipeline surveillance course at RMOTC is a simulated underground pipeline, 7.5 miles in length with 15 predetermined leak points. Leak points rates were blind to the testers and changed twice a day for the testing period.

Following are statements taken directly from this independent report:

“The ATS system consistently detected methane leak rates of 500, 100, 10-15, and 1.8 scfh. These leaks, including the 1.8 scfh leak, were detected an average of 75% of the time. The 75% translates to 90 % of all emitted gas volume. Few false positive and false negative leaks were identified. The system had no “down-time” and remained operational throughout the three-day test. Compared with the previous tests, the ATS airborne methane detection system produced substantial improvement in gas leak detection making it a viable system for gas leak detection in the field.”

“The *performance* of the system *substantially exceeded* prior evaluated detection systems at RMOTC. The test demonstrated the system's strengths in measuring minute levels of methane in the air. “

Lessons learned

- 1. Importance of Early Adopter / Technology advocate with a real need.**
 - In our case Nova Pipelines, with a need for faster, cheaper, more reliable pipeline leak detection.
- 2. Need to Decide / Understand what your product is from perspective of the end user.**
 - In our case it is NOT the GasFinder AB per se, but a superior leak detection service.
 - Which presented a challenge as Boreal Laser is a product company, not a service company.
 - Transpires that Boreal clients are rarely pipeline operators; more likely aerial service companies.
- 3. Understand and play to market dynamics.**
 - Few pipeline operators have their own flight operations.
 - Aerial service companies tend to be regional; personal relationships, history with clients is important - countrywide exclusivity restricted sales opportunities.
 - Nevertheless, still need to sell to both pipeline operators and service companies.
 - Integrated data mapping service providers are also valuable partners.
- 4. Independent product validation is critical.**
 - The DOE RMOTC test results are our best marketing tool!
- 5. Product robustness, reliability, ease of use with minimal training all essential**
 - But if and when something goes wrong, speed and quality of technical support can make or break reputation.
- 6. Don't put all your eggs in one basket! GFAB represents <10% Boreal's business.**

What does the future hold?

1. Inquiries and system sales at all-time high.

- Still predominantly North American

2. Strong interest in future development of technology for:

- UAV and ground based platforms
- Non-methane (e.g. liquid hydrocarbon) leak detection.
- Environmental monitoring

3. Boreal Laser next gen analyzer platform will make this possible

- Lighter, smaller, cheaper.
- Capability to measure gases in mid IR with new laser technologies. Examples:
 - Volatile Organic Compounds.
 - Polyaromatic Hydrocarbons.
 - Greenhouse Gases.
 - PerFluoroCarbons used as tracers in CCS
- **TECTERRA funding is supporting this initiative**

DRDC Suffield visit 10-June-13



Interests:

1. Detection methods for **organo-phosphates** (V series and G series nerve agents) and perhaps mustard gas.
2. QCL may be able to do.
3. Reflector based systems for camp protection may be acceptable.
4. Fixed detection systems for a training "arena" 50m by 50m. Could be scanner based.
5. Also interest in **UAV mounted sensors**.
6. Canadian military focusing on the **Aeryon Scout**

Defence R&D Canada – Suffield (DRDC) offers expertise in military engineering, **autonomous intelligent systems**, and **defence against chemical and biological (CB) agents**.

Key research areas include**CB detection and identification**.....CB hazard assessment, and physical protection against CB agents.

Aeryon Scout



Aeryon
Labs Inc.

Very neat device!

BUT, max payload < 500g!



Aeryon
Labs Inc.

Other topics

1. Suncor Edmonton Refinery / Worley Parsons visit Friday 14th:

- Apparently strong interest in HFPT
- Jacques Piche and others

2. New laser driver board for current tech:

- Performance of CO2OP-X008 seems much improved over previous units
- Plan for implementing in ALL current products?

3. GasFinder2012 production prototype.

- Original date was 17th June
- Latest projection is end August
- However, must have prototype available for deployment at Shell Quest 1st September.
- Do we build a field deployable prototype using engineering prototype boards as fall back?

Thanks for your attention!

Any Questions?



Contact following for more information :

Hamish Adam - hadam@boreal-laser.com

BOREAL
LASER