DEFENCE R&D DÉFENSE

Canadian vehicle protection program (EO considerations)

International Symposium for
Indirect Protection Systems

Dr Jean Fortin
DRDC Valcartier
9-12 October 2012

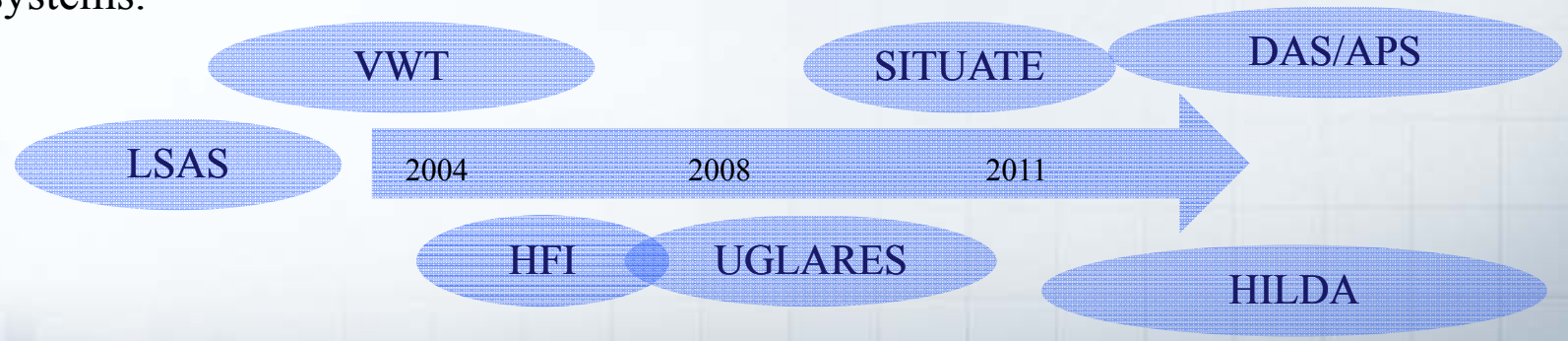
Background

- Since the war in Afghanistan, the CF have been deeply involved in the procurement of armored fighting vehicle, e.g.:
  - TAPV: Tactical Armored Patrol Vehicle
  - CCV: Close Combat Vehicle
  - LAV III upgrade
  - Leopard 2
- Protection of the vehicle and their occupants was always considered on top of the priority list.
- Currently, industry can provide partial solutions but the technology evolves rapidly…
- There is a need **to understand** the most recent developments, **to explore unforeseen avenues** and **to develop**, in collaboration with allied countries, standard methods to characterize system effectiveness.

Background

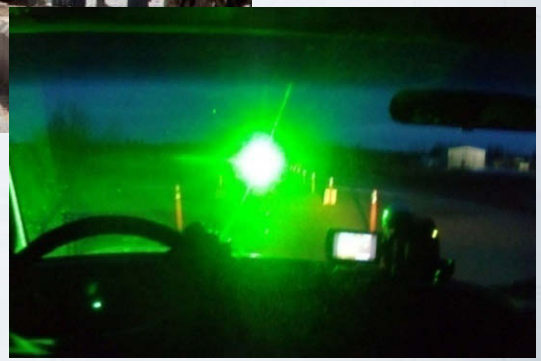
- Since the last 8-10 years, DRDC-Valcartier has been involved in numerous electro-optics (EO) projects related to vehicle protection.
  - Local Situational Awareness System (LSAS).
  - **Visual Warning Technology (VWT).**
  - **Defensive Aids Suites (DAS) & Active Protection Systems (APS).**
  - Hostile Fire Indication (HFI); EO and Acoustic Sensing.
  - Situational Awareness Technologies Evaluation (SITUATE).
  - Urban Gated Laser Retro-reflection Scanner (UGLARES).
  - **High Energy Lasers for Defense Applications (HILDA)** .
  - *Thermal protection & camouflage.*

- Our goal is to progress toward full understanding of capabilities and the **synergy** of systems.



Visual Warning Technology

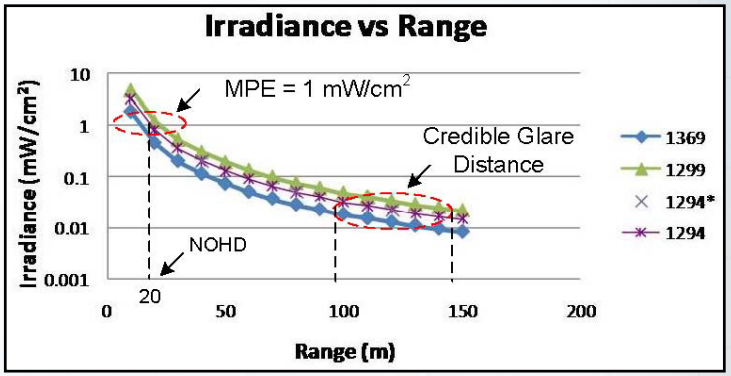
- VWT goal:
  - Warn and dissuade vehicles or persons from encroaching specific or delimited perimeters.
  - Effective: 100m (day) / Visible: 300m (day).
  - Safe and easy to operate.



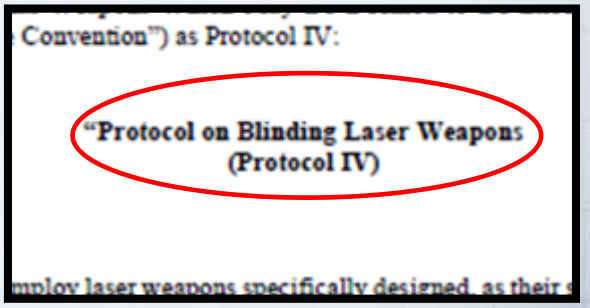
- What was provided to the CF:
  - 750 VWT devices and equipment
  - 21 000 protective lenses
  - 2 years of support
  - O&M training, training aids and/or simulation to support individual, collective and continuation training.

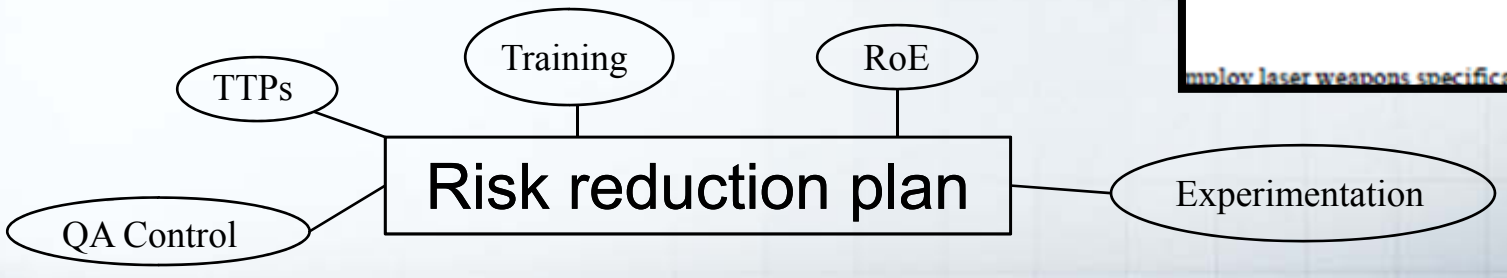
Visual Warning Technology

- CF requested scientific support to:
  - Help identifying key parameters in system **effectiveness** and potential **pitfalls**.
  - Collaborate to the definition of SOR.
  - Risk reduction plan.
    - Define TTPs.
    - Plan to address the press.
    - Help with reviews.
      - Laser Safety Office , Army Medical Advisor,
      - Judge Advocate General , ADM(Policy).



The Ottawa Citizen:
Army looks to lasers for convoy defence; High-tech 'dazzlers' temporarily blind drivers who ignore soldiers warnings.

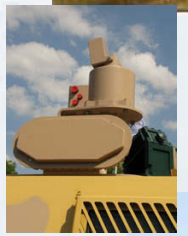




Toward DAS/APS Overall Performance

- Defensive aids suite are either semi-autonomous or autonomous systems that when integrated on Land Vehicles are capable of detecting, classifying and providing effective warning/cueing and countermeasures for defined imminent or incoming threats.
- Determining the performance of a DAS is a complex process that requires good understanding of:
  - Threat behavior,
  - Sensor performance,
  - Countermeasure performance, and
  - System integration.
- There are significant “paradigm shifts” associated with this defensive capability.

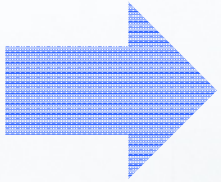





Paradigm Shifts

- Technical
  - Sensor requirement vs countermeasure performance/coverage
    - Pre-warning
    - Active/Passive
    - Effects and collateral



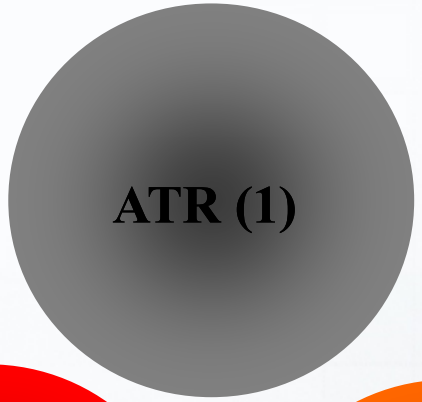
Detection
False alarms
Tracking (accuracy)
ID (speed, profile, etc)

  - Processing / Networking
    - Real-time requirement (chain)
    - HMI (Manual/Auto/Sector)
    - Situational awareness (real-time information management)
- Legal / Political
  - Field usage of autonomous / semi-autonomous systems involves new CONOPS/TTPs/RoE.

Aim and Scope

- Aim:
  - To foster Canadian expertise in the field of APS/DAS and **pave the way to the procurement** of a system tailored to Canadian requirements (context of operation, vehicle fleet, etc). **Anticipate** the issues related to safe use of this technology in the field to facilitate future procurement.
  - Entails significant pre-definition/definition work.
- Scope:
  - System technology.
    - TRL
  - System performance.
    - Test procedures
  - System procurement.
    - CONOPS/TTPs/RoE
  - Duration: ≈3 years

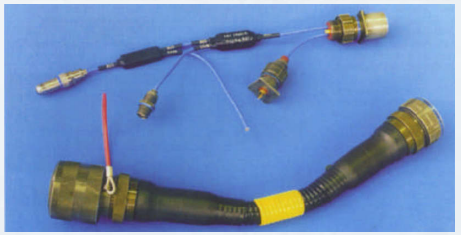
The Threat



Based on proliferation, operational experience and capability technical maturity.

System Technology

1. Assess the maturity of commercial systems and components.
   - Several concepts / Technology has evolved (high TRL achieved).
   - Interest from international community (NATO) in on the rise.
2. Determine the impact of DAS/APS integration on vehicle integrity, mobility & signature.
   - Space claim.
   - Vetronics, BMS, networking.
   - Non recurring engineering costs.
3. Perform a cost benefit analysis study.
   - Threat proliferation / kill probability.
   - Level of protection required.



Protection spectrum

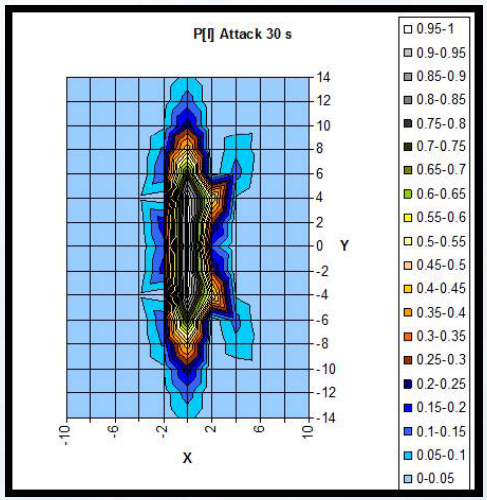
Training | Passive | Add-on | Active (SK/HK) | Hybrid solution

System Performance

1. Continue support STANAG 4686 (Performance levels of defensive aids suites (DAS) for armored vehicle).
2. Develop metric to determine overall system performance.
   - Meet national policies, legislation and safety standards.
   - False Alarms / Signature / ECM Vulnerability.
3. Adopt national procedure for testing.
   - Stress areas.
   - On-the-move.
   - Test vehicle (min integration).
4. Acquire test equipment and develop tools for data analysis and performance rating.
5. Develop infrastructures for testing.
6. Field trials to validate procedures.

System Procurement

1. Understand collateral effects (blast, fragments, heat, EO, EM, toxicity).
   - Experiment on methods to quantify collateral effects.
   - Develop / improve test procedures.
   - Develop safety template.
2. Determine the impact of using autonomous/semi-autonomous systems during operations.
   - Crew.
   - Dismounted soldiers.
   - Joint.
3. Work with Canadian Army to refine operational requirements.



Outcome

- Good understanding of latest technology trends.
  - Maturity of commercial and close-to-be commercial systems.
  - Timeline and strategy for procurement.
  - Refined requirements.

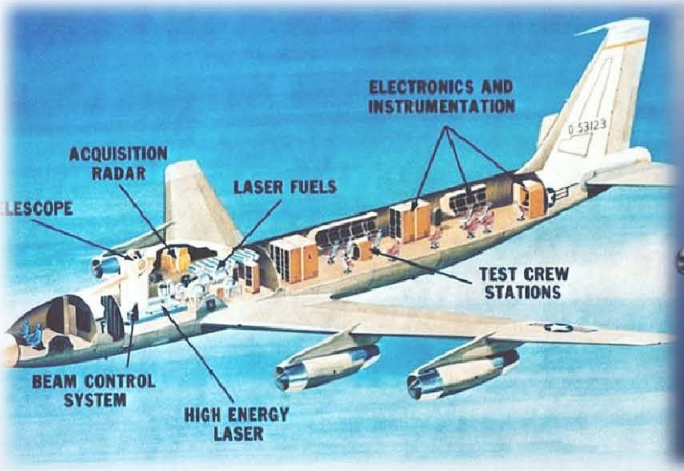
- CONOPS / TTPs.

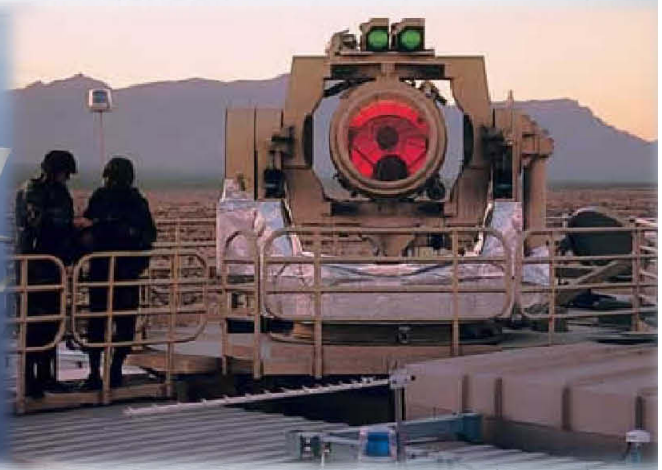
- National test procedures including test equipment and data processing capability.

- Not limited to “conventional” approaches.

High Intensity Laser for Defence Applications

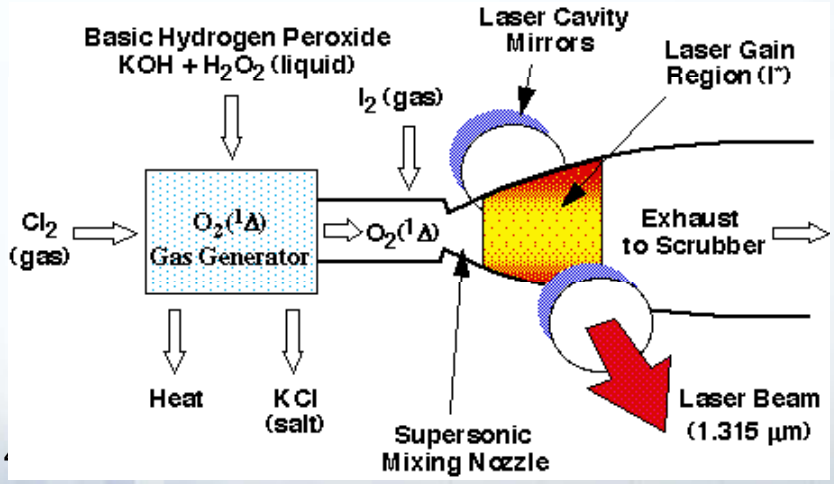
- Laser: May 16th,1960
- Invention of chemical lasers paved the way to MW powers
- High energy laser projects developed since 1962:
  - USAF 100 kW CO_2 laser used to shoot drone (1973)
  - USN shot an Army TOW missile (1978)
  - Airborne Laser Lab program launched (1976)
  - COIL laser appeared (1978)





Background

- Chemical lasers have inherent issues
  - Logistics nightmare
    - THEL: Ethylene, nitrogen trifluoride, helium, deuterium, hydrogen fluoride…
    - ABL: Chlorine, iodine, hydrogen peroxide, potassium hydroxide/chloride..
  - Low efficiency
  - Expensive
  - Heavy
  - Fragile



Background

Advantages

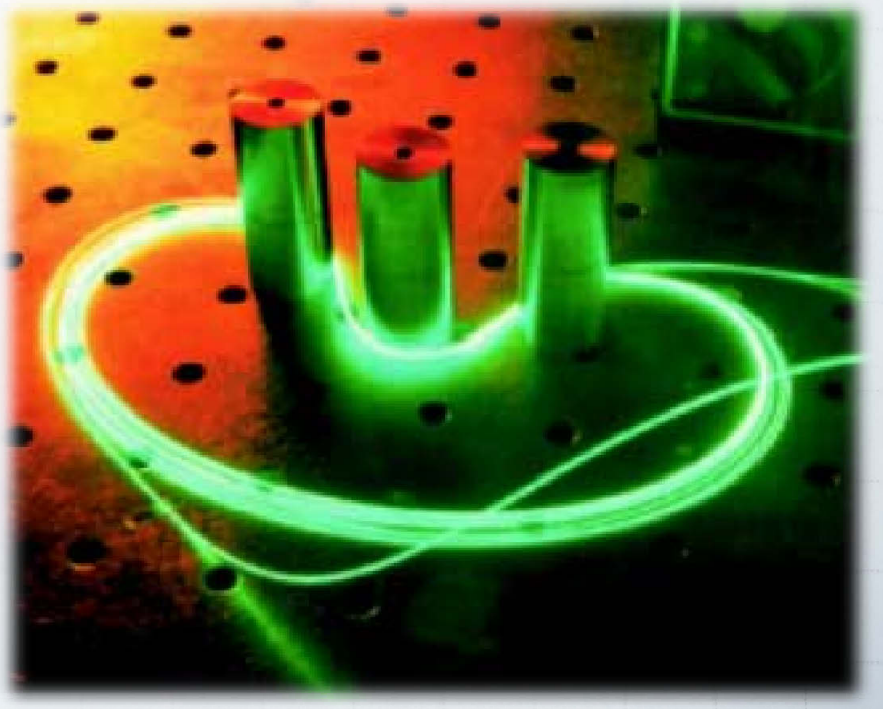
- Speed-of-light delivery
- Rapid retargeting
- Unlimited ammunition
- Low incremental cost per shot
- Exceptional accuracy and adjustability
- Flexibility
- Low collateral damages
- Quasi-stealth operation

Issues to consider

- Footprint / platform / application
- Laser-target interaction
- Line-of-sight operation
- Long range beam delivery
- Weather impact
- Maintenance and repair
- New standards
- **Acceptance**

Background

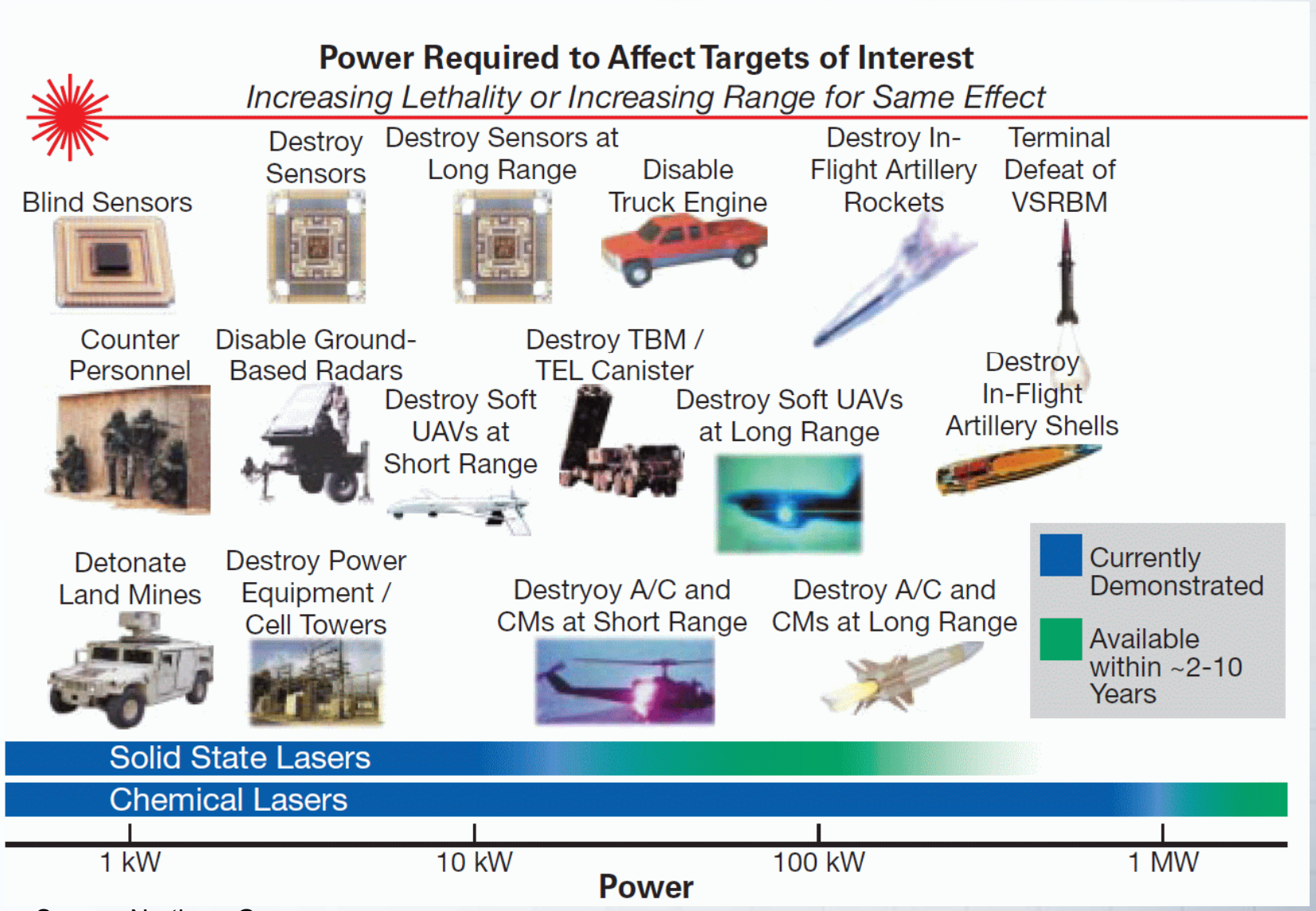
- Since the early 2000s, the development, and commercial availability of fiber lasers drastically changed the situation.
  - High efficiency (30%)
  - Robust
  - Electrically powered
  - Cheap



- Compact fibre lasers operate in the kW regime

- ~ M$ off-the-shelf equipment

Background



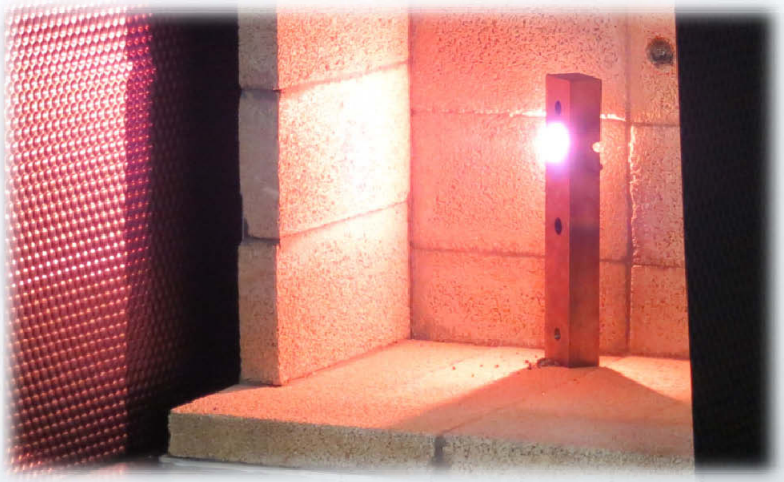
Source: Northrop Grumman

HILDA – Canadian Context

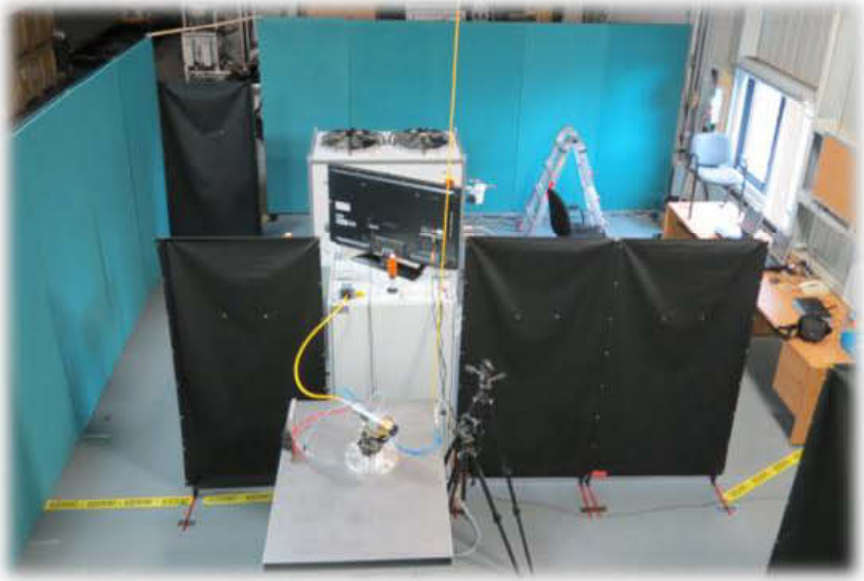
- Aim:
  - To develop a Canadian **expertise** and spearhead a capability on high power laser defence systems, with a focus on C-IED and-UXO operations, in order to assist the CF with their needs and requirements of directed energy systems.
- Scope:
  - Evaluate the performance and effects of a high power laser for a vast array of materials, ranges, and conditions.
  - Design and demonstrate optical components necessary to achieve the desired range.
  - Address laser safety issues.
  - Provide insights on vulnerabilities and protection.

High Power Laser Characterization Laboratory

- 10 kW laser
- Riedel chiller
- Standalone power generator
- IPG 2 cm collimator
- 3m firing range
- Brick / metal target containment zone
- Small (<30 cm) targets



High Power Laser Characterization Laboratory



Conclusion

- EO technologies are evolving extremely fast and cost/size/weight is going down.
- New protection concepts can be envisaged taking full advantage of the synergy between the systems.
- No silver bullet.
- The introduction of theses technologies in the field will require significant changes in:
  - Mind.
  - Operations.
- New vulnerabilities need to be analyzed.
- New protection means are required.


DEFENCE
R&D
DÉFENSE