



Ground Mobility Robotics Systems Integration Skunk Works

Inspiring Joint Robotic Programs

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SUPERIOR TECHNOLOGY FOR A SUPERIOR ARMY

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Robotics Skunk Works

Briefing Outline

- What's TARDEC Skunk Works?
- Historical Foundation – TATRC SBIR contract & collaboration
- Skunk Works work directive contract & collaborative opportunities
- 1st WD – ARDEC / TARDEC TAGS weapons integration
- FIRRE Spiral Technologies
- 2nd WD – NCDR / TARDEC TAGS mechanical arm integration
- MANSCEN / TARDEC chem / engineer robotics
- Summary of Collaborative Opportunities

Robotics Skunk Works



Problem: No formal process to evaluate ILIR & SBIR component technologies at system level prior to transitioning to ATO & PM programs

Schedule

	FY 2006				FY 2007				FY 2008			
Event	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
API Work Directive Contract												
WD-1 TAGS Weapon Robot												
Ft. Knox VTI Joint Operations			^									

Objective: Establish In-house quick reaction, ground mobility, robotics systems integration capability

Approach:

- Create a fleet of heterogeneous **lab robots**
 - JAUS compliant common controls,
 - Standard navigational sensors
 - **plug & play payload hardware & software interfaces.**
- Integrate, demonstrate and evaluate ground mobility robotic technologies.

Benefits:

- **Increase Collaborations**
 - ILIR/SBIR Tech Transition Teams
 - Externally with ARDEC, SPAWAR, JPO, OUSD, Academia (Vetronics Inst.)
- **Showcase Capabilities/Accomplishments**
 - Field Experiments / User Interface
 - Conference Displays / Demonstrations
- **Define Program Requirements**
- **Improve Tech Transition to ATO & PM**

Robotic Evacuation Vehicle (REV)

Applied Perception, Inc. SBIR Contract



High gain
wireless Ethernet
radio comms.

Color camera on
pan/tilt mast

Laser ranging
sensor for obstacle
detection



Dual patient bays



Integrated GPS / INS for
localization and
navigation



Life Support for Trauma
and Transport (LSTAT)
litters

Walking beam
suspension for
traversing rough
terrain

Designed for high-
speed, long range
patient transport

Vehicle based on
amphibious TAGS-DM
platform

Robotic Extraction Vehicle (REX)

Applied Perception, Inc. SBIR Contract



Color, thermal, RF, and UWB
Radar sensors for patient
detection



REX is transported in a
marsupial fashion to the
field by the REV



Manipulator for
patient grasping
and loading.



NATO stretcher for
patient transport

Designed for short
range patient
extraction



Integrated GPS / INS for
localization and
navigation



Vehicle based on
ANDROS Wolverine
platform

Robotics Skunk Works

Applied Perception, Inc. SBIR Contract

- Sole Source, 3 yr, Work Directive (WD) contract:
 - Acquire COTS or use GFE mobility platform
 - Modify platform to meet specified mission
 - Integrate JAUS compliant:
 - Standard auto-navigation sensors
 - Mission specific sensors & payloads
 - **Common controls and plug & play interfaces**
- First WD: Joint TARDEC/ARDEC program
 - TAGS-DM mobility platform
 - Non-lethal & lethal weapons integration



❖ Joint Funding-TARDEC & ARDEC

❖ API Systems Integrator

❖Leverage Remotec IRAD

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Robotics Skunk Works

TAGS Weapons Integration



Picatinny Lightweight Remote Weapon Station with M240 (7.62) MG



System Capabilities:

M240/M249 (7.62/5.56mm)

Weight goal: <150 lbs including gun and 200 rounds

Slew rates: 90 deg/sec in Az and El
2-Axis Stabilization, 5Hz, 20 Db goal

Continuous 360 Degree rotation

Elevation Range +45 to -15 degrees

Non-Lethal Integration:

❖ FN-303 Less-Lethal Launcher

❖ Acoustic round detection integrated with PLWRWS

Robotics Skunk Works FN-303 Less-Lethal Launcher



Technology

- Compressed air powered launcher designed to fire **0.58 caliber 8.5 g less-than-lethal projectiles**
- Allows for greater engagement range (100m), higher accuracy, and higher rates of fire than any currently fielded non-lethal capability
- Both stand-alone & under-barrel (M16/M4) versions are available.

Capabilities of Item

- Disperse a crowd between 10-20 meters
- Stop, confuse, disorient an individual from 20-100 meters
- Stop, confuse, disorient a crowd of individuals from 20-80 meters
- Deny an area to personnel
- Stand alone or under-barrel version

Status

- Rapid Equipment Fielding of 30 systems to CTF-180 (Bagram AB, Afghanistan)
- ONS expected for 600 systems for CFLCC – G3 Looking to approve 80
- Add-on Safety Testing Scheduled within next month (bullet impact testing).

Robotics Skunk Works PLWRWS with M240 & FN-303



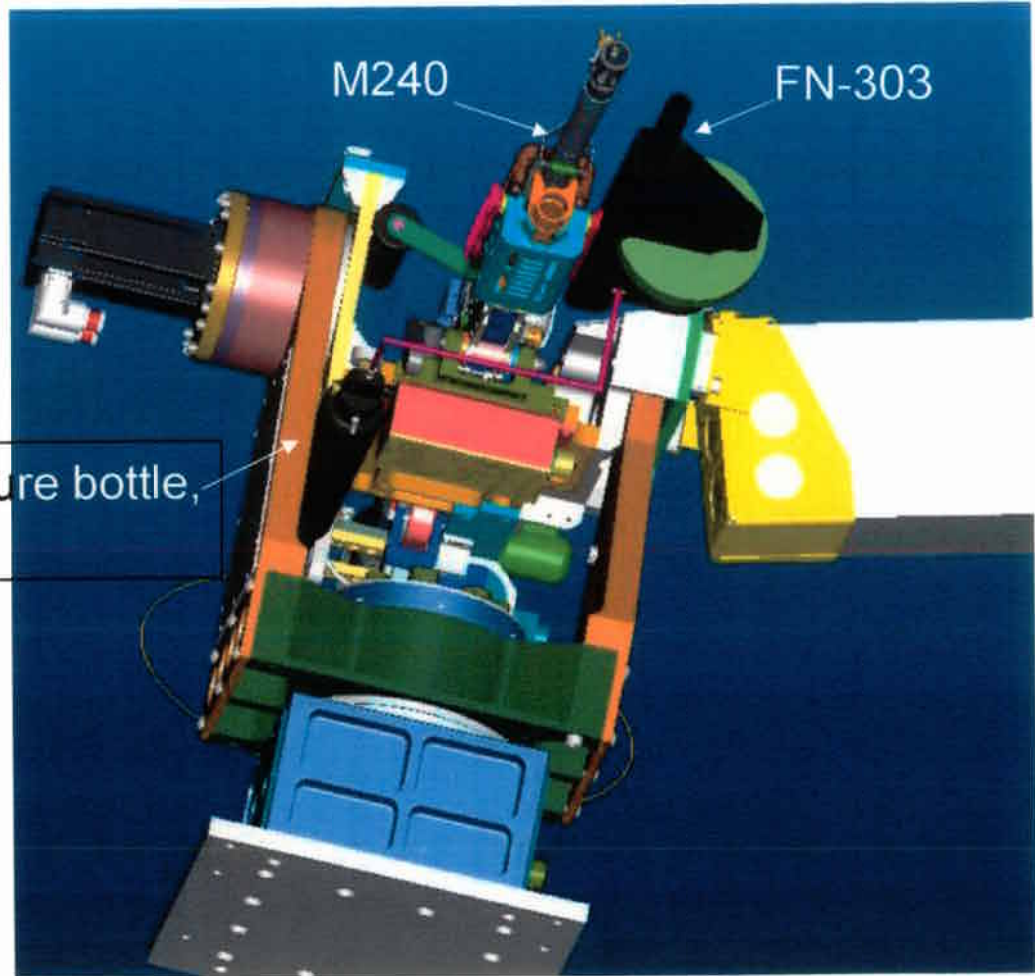
Picatinny CRADA with FN
HERSTAL to modify FN-303
with electric trigger



200 bar pressure bottle,
110 round



.68" projectiles, 8.5g weight,
polystyrene body & granular non-
toxic bismuth forward payload



Robotics Skunk Works

Applied Perception, Inc. SBIR Contract



TAGS-based Weapons Platform
JAUS compliant ARDEC
Weapons Integration

- **Std. Sensor Suite:** Scanline and scanning Sick, 6 radars (front, rear, 2 left/right), DGPS/Gyro positioning system, roll and pitch rate gyros, color omnicam, 35 lb capacity pan tilt, 3 color cameras, 1 320x240 FLIR, comms,
- **Operator Control Units (OCU) :** Hand Held PDU & Laptop Computer
- **JAUS Compliant Software**
- **Programmable Mission Scenarios** (e.g., come to me, GPS waypoint, OD/OA,...)

Technology Transition to FIRRE Phase III

Robotics Skunk Works

TAGS-DM modifications

- **Top surface:**
 - **Span full width of vehicle** to outside track edges
 - **Structural I-beam rail mounts** to allow weapons placement and operation in forward, rearward and central vehicle locations
- **Marsupial / Payload bay:**
 - **Electric / hydraulic access panels** (vertical surfaces in bay)
 - Widened to transport tracked wolverine-based robot.
 - Locking mechanisms to secure marsupial robot into the bay.
 - Loading ramp made of perforated/grate type material & flare open at base
 - Manual controls accessed through **password protected touchpad**.
- **Engine and hydrostatic drive systems** - moved forward.
- **Semi-active suspension & two speed Poclain wheel motors**
- **Fuel tank & filler** - sized & positioned for 200 km mission & safe easy access.
- **J AUS compliant GFE weapons integration**

Technology Transition to FIRRE Phase III

Robotics Skunk Works

- Status: Contract award 26 Sept., 2005
- Coordination: TARDEC/ARDEC meeting with MANSCEN to discuss robot & non-lethal/lethal requirements
- Initial WD Program Objectives:
 - (VTI) joint operations technology demonstration in July, 2006
 - Technology transition to ART ATO, FCS ARV & PM-FPS FIRRE
 - Obtain joint funding for Needs-Based Robotic Demonstrators (Expand Skunk Works Capabilities)



Robotics Skunk Works

MANSCEN / TARDEC Collaboration



Unmanned Systems Advanced Technology Assessments

- **Provide Prototype Experiment Support to the MANSCEN Futures Center, Military Police, Chemical, and Engineer Schools to Modernize the Current Force and Develop Future Force Requirements.**
- **Provide Prototype Experimentation Support to Joint Robotics Program (JRP) to Develop, Evaluate, and Support Unmanned Systems Throughout the Life Cycle.**



Robotics Skunk Works

Autonomous Robotic Decontamination



Teams of Robots Provide Collaborative Semi Autonomous Tactical Decontamination in Forward Combat Areas.

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NCDR / TARDEC Collaboration

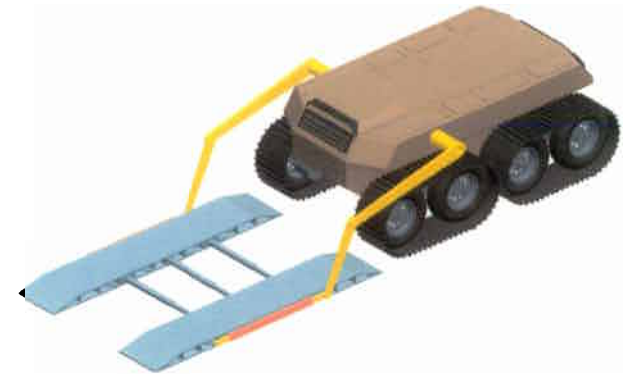
NCDR developed JAUS Compliant Hydraulic Arm to be Integrated with TARDEC TAGS Robotic Vehicle using Plug & Play I-Beam Rail System



Robotics Skunk Works

TAGS Robotic Bridger Demonstrator

- TARDEC Tech Director funds
 - TAGS Robotic base-platform
 - Funds required for
 - Robotic retrofit
 - GFE bridge integration
- Bridging Group in Engineering
 - Two BAA contracts for bridging demonstrators
 - GFE bridge for TAGS integration
- Advanced Concepts – TAGS Integration of either
 - Aluminum/Composite Expansion Bridge
 - Fascine Deployment Bridge



Robotics Skunk Works Funding Issues

- Skunk Works 1st Work Directive
 - Tech Director funds get tele-operated TAGS vehicle
 - OUSD JPO funds semi-autonomy & autonomous capabilities, as well as JAUS compliant weapons payload integration & support
- TAGS Robotic Bridger Demonstrator
 - Tech Director funds TAGS vehicle, with vehicle payload modifications & teleop / waypoint following capabilities
 - Funding required for OD/OA capabilities and Bridge Integration
 - **Interim capability demonstrator:** MANSCEN Anti-mine or Decontamination Robot payload integration support
- Decontamination effort might be co-funded by **National Center for Defense Robotics (NCDR)**



TARDEC Robotics Skunk Works

Inspiring Joint Robotic Programs



Description: TARDEC & ARDEC joint program to integrate lethal and non-lethal weapons onto the Tactical Amphibious Ground Support (TAGS) vehicle. Vehicle mission includes sentry perimeter security operations. Plug & play hardware and software concepts being applied to demonstrate vehicle mission reconfiguration. Alternate mission being considered under joint TARDEC & TATRC program for robotic combat casualty evacuation & extraction (RCCE&E), for which the TAGS would have removable patient bays.

Utility: Provide Customer Robot Mission Application Demonstrators

Sole Source, 3 yr, Work Directive contract to:

- ❖ Acquire COTS or use GFE platform
- ❖ Modify platform to meet specified mission
- ❖ Integrate JAUS compliant:



- Standard auto-navigation sensors
- Mission specific sensors & payloads
- Common controls and plug & play interfaces



- ❖ Integrate marsupial casualty extraction & modular patient bays for evacuation.

Customers: Customers include PM-Force Protection Systems and Maneuver Support Center

Partners: Armaments Research Development and Engineering Center (ARDEC) and Telemedicine and Advanced Technology Research Center (TATRC)



Schedule

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WD-1 TAGS Weapon Robot												
Ft. Knox VTI Joint Operations												

Funding:
FY05 = \$850K
FY06 = \$229K

Lethal / Non-Lethal Considered:

- ❖ Picatinny Lightweight Remote Weapon Station with M240/M249
- ❖ FN-303 Less-Lethal Launcher
- ❖ Acoustic round detection integrated with the PLWRWS